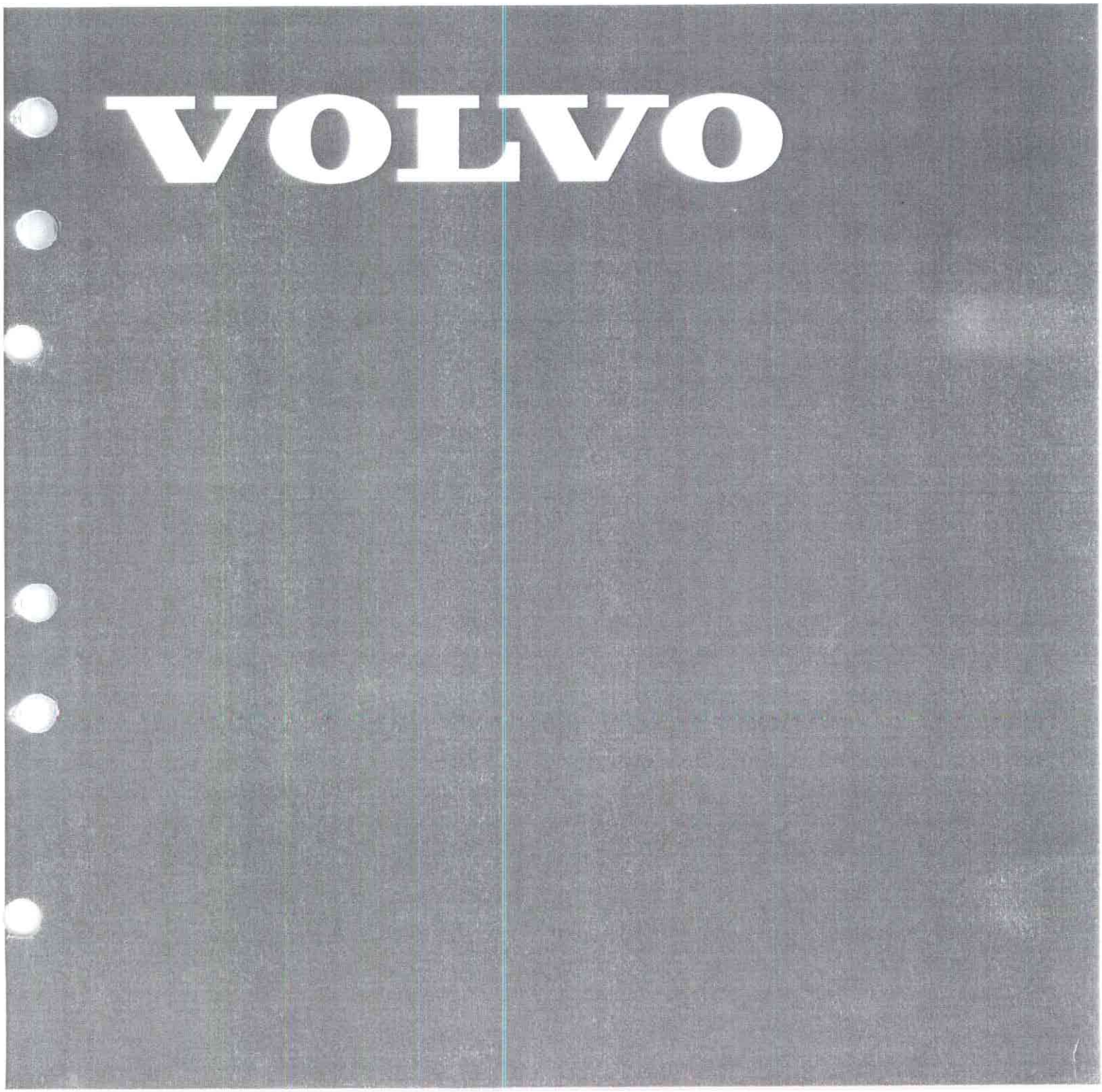
Service Manual

Section 0 (02)

TABLES

Trucks



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THE INTERNATIONAL SYSTEM OF UNITS (SI)

The SI-System is an international system of units established in 1960.

It differs from earlier systems in that the units can be used directly without conversion factors.

The SI-System has seven basic units and two supplement units from which all other units (derived units) are developed in a simple way. The SI-System is uniform, that is, each unit pertains *only* to one quantity.

For ex.: the kilogram (kg) in the SI-System concerns only mass – previously the kilogram could cover both mass and force.

Basic Units:

Unit	Quantity	Symbol
Metre	Length	m
Kilogram	Mass (weight)	kg
Second	Time	s
Ampere	Electric current	A
Kelvin	Thermal dynamic temperature	K
Candela	Luminous intensity	cd
Mole	Amount of substance	mol

Supplement units

Unit	Quantity	Symbol
Radian	Plane angle	rad
Steradian	Solid angle	sr

Example of derived units

Unit	Quantity	Symbol (Derivative)
Hertz	Frequency	1 HZ = 1 s^{-1}
Newton	Force	1 N = 1 kg.m/s^2
Pascal	Pressure and stress	1 Pa = 1 N/m^2
Joule	Work, Energy, Quantity of heat	1 J = 1 Nm
Watt	Power	1 W = 1 J/s

Multiples of SI units

The prefixes given in the table below are used from names and symbols of multiples (decimal multiples and sub-multiples) of the SI units. For ex., 1000 J = 1 **kilo**joule.

For practical application purposes, a prefix should be chosen so that the measured unit is greater than 0.1 and less than 1000, e.g. 100 kW instead of 100,000 W.

Factor by which the unit is multiplied		Prefix	
		Name	Symbol
10^{12}		Tera	(T)
10^{9}		Giga	(G)
10^{6}		Mega	(M)
10^{3}	(= 10 x 10 x 10)	Kilo	(k)
10^{2}	(=10 x 10)	Hecto	(h)
10^{1}	(= 10)	Deka	(da)
10^{-1}	$(= \frac{1}{10})$	Deci	(d)
10^{-2}	$(= \frac{1}{10 \times 10})$	Centi	(c)
10^{-3}	$(= \frac{1}{10 \times 10 \times 10})$	Milli	(m)
10^{-6}		Micro	(μ)
10^{-9}		Nano	(n)
10^{-12}		Pico	(p)

METRICAL AND IMPERIAL UNITS EXPRESSED

Quantity	Unit	Symbol
Length	millimetre	mm
	centimetre	cm
	metre	m
	kilometre	km
	inch	in
	foot	ft
	yard	yd
	mile	mile

Area	square millimetre	mm^2
	square centimetre	cm^2
	square metre	m^2
	square yard	yd^2
	hectare	ha
	square inch	in^2
	square foot	ft^2
	acre	ac

Quantity	Unit	Symbol
Volume	cubic millimetre	mm^3
	cubic metre	m^3
	cubic inch	in^3
	millilitre	ml
	litre	l
	pint	pt
	quart	qt
	gallon	gal
Mass	gramme	g
	kilogramme	kg
	tonne	t
	pound	lb
	hundredweight	cwt
	ton	ton
Time	second	s
	minute	min
	hour	h
Speed	metre per second	m/s
	kilometre per hour	km/h
	foot per minute	ft/min
	mile per hour	mile/h
	revolutions per minute	rev/min
Effect	watt	W
	kilowatt	kW
	horse-power	hp
	brake horse-power	bhp
Energy	kilowatt hour	kWh
Pressure	bar	bar
	pound per square inch	lbf/in^2
Torque	newtonmetre	Nm
	footpound-force	ft lbf
Electricity	ampere	A
	volt	V
	ampere hour	Ah

TABLES OF DECIMAL MULTIPLES AND SUB-MULTIPLES

The following tables give examples of decimal multiples and sub-multiples for a number of commonly used quantities. The purpose is to comparison and conversion of the various multiples of a certain unit. The first column in the table always contains the SI-unit.

Each line in a table contains the various multiples and sub-multiples of a unit. Figures underlined indicate exact comparisons. Some tables contain comparisons beyond that envisaged by the table.

The calculation procedure is similar in all the tables.

Example:
Converting 1 minute to seconds (see table next page).
Go straight from "Minute" column in the table to the reference value "1"
Then proceed from there to the "Second" column.

1 minute = 1 x 60 sec.

Converting two hours to weeks.
Go straight from the "Hr." column to the reference value "1".
Then go to the "Week" column to the right.
2 hours = $2 \times 5{,}952\ 38 \cdot 10^{-3}$ weeks = $11{,}9 \cdot 10^{-3}$ weeks ($11{,}9 \cdot 10^{-3} = 0{,}0119$).

$1^g = \underline{\pi/200}$ rad π(pi) $\approx 3{,}14$
$1^o = \underline{\pi/180}$ rad

1 newminute = $\underline{1/1009}$
1 newsecond = $\underline{1/100}$ newminute
1 stroke (1 Swedish Military stroke) = $\underline{\pi/3\ 150}$ rad

1 Å (1 Ångström) = $\underline{10^{-10}}$ m
1 mil (1 Swedish mile) = $\underline{10^4}$m = $\underline{10}$ km
1 AU (astronomic unit) = $0{,}149\ 600 \times 10^{12}$m
1 light-year = $9{,}460 \times 10^{15}$m
1 pc (parsec) = $30{,}86 \times 10^{15}$m

Second (s)	Minute (min)	Hour (h)	Day	Week
1	16,666 7 · 10^{-3}	0,277 778 · 10^{-3}	11,574 1 · 10^{-6}	1,653 44 · 10^{-6}
60	1	16,666 7 · 10^{-3}	0,694 444 · 10^{-3}	99,206 3 · 10^{-6}
3,6 · 10^3	60	1	41,666 7 · 10^{-3}	5,952 38 · 10^{-3}
86,4 · 10^3	1,44 · 10^3	24	1	0,142 857
604,8 · 10^3	10,08 · 10^3	168	7	1

Plane angle

Radian (rad)	Gon alt. Nygrad (.....^{g})	Degree (....^{o})	Minute (....')	Second (....'')	Stroke
1	63,662 0	57,295 8	3,437 75 · 10^3	0,206 265 · 10^6	1,002 68 · 10^3
15,708 0 · 10^{-3}	1	0,9	54	3,24 · 10^3	15,75
17,453 3 · 10^{-3}	1,111 11	1	60	3,6 · 10^3	17,5
0,290 888 · 10^{-3}	18,518 5 · 10^{-3}	16,666 7 · 10^{-3}	1	60	0,291 667
4,848 14 · 10^{-6}	0,308 642 · 10^{-3}	0,277 778 · 10^{-3}	16,666 7 · 10^{-3}	1	4,861 11 · 10^{-3}
0,997 331 · 10^{-3}	63,492 1 · 10^{-3}	57,142 9 · 10^{-3}	3,428 57	205,714	1

1^g = $\pi/200$ rad π (pi) ≈ 3,14

1^o = $\pi/180$ rad

1 newminute = $1/100^g$

1 newsecond = 1/100 newminute

1 stroke (1 Swedish military stroke) = $\pi/3\,150$ rad

Length

Meter (m)	Inch (in)	Foot (ft)	Yard (yd)	Mile	Nautical mile
1	39,370 1	3,280 84	1,093 61	0,621 371 · 10^{-3}	0,539 957 · 10^{-3}
25,4 · 10^{-3}	1	83,333 3 · 10^{-3}	27,777 8 · 10^{-3}	15,782 8 · 10^{-6}	13,714 9 · 10^{-6}
0,304 8	12	1	0,333 333	0,189 394 · 10^{-3}	0,164 579 · 10^{-3}
0,914 4	36	3	1	0,568 182 · 10^{-3}	0,493 737 · 10^{-3}
1,609 344 · 10^3	63,36 · 10^3	5,28 · 10^3	1,76 · 10^3	1	0,868 976
1,852 · 10^3	72,913 4 · 10^3	6,076 12 · 10^3	2,025 37 · 10^3	1,150 78	1

1 Å (1 Ångström) = 10^{-10}m

1 mile (1 Swedish mile) = 10^4 m = 10 km

1 astronomic unit = 0,149 600 · 10^{12}m

1 light-year = 9,460 5 · 10^{15}m

Area

Square metre (m^2)	Square inch (in^2)	Square foot (ft^2)	Square yard (yd^2)	Acre (ac)	Square mile
1	$1{,}550\,00 \cdot 10^3$	10,763 9	1, 195 99	$0{,}247\,105 \cdot 10^{-3}$	$0{,}386\,102 \cdot 10^{-6}$
$0{,}645\,16 \cdot 10^{-3}$	1	$6{,}944\,44 \cdot 10^{-3}$	$0{,}771\,605 \cdot 10^{-3}$	$0{,}159\,421 \cdot 10^{-6}$	$0{,}249\,098 \cdot 10^{-9}$
$92{,}903\,0 \cdot 10^{-3}$	144	1	0,111 111	$22{,}956\,9 \cdot 10^{-6}$	$35{,}870\,1 \cdot 10^{-9}$
0,836 127	$1{,}296 \cdot 10^3$	9	1	$0{,}206\,612 \cdot 10^{-3}$	$0{,}322\,831 \cdot 10^{-6}$
$4{,}046\,86 \cdot 10^3$	$6{,}272\,64 \cdot 10^3$	$43{,}56 \cdot 10^3$	$4{,}84 \cdot 10^3$	1	$1{,}562\,5 \cdot 10^{-3}$
$2{,}589\,99 \cdot 10^6$	$4{,}014\,49 \cdot 10^9$	$27{,}878\,4 \cdot 10^6$	$3{,}097\,6 \cdot 10^6$	640	1

1 a (1 are) = $100\ m^2$

1 acre = 4 936 m^2

1 barn = $10^{-28}\ m^2$

1 circular mile = $0{,}506\,707 \times 10^{-3}\ mm^2$ = area of a circle Ø 10^{-3} in

Volume

Cubic metre (m^3)	Cubic inch (in^3)	Cubic foot (ft^3)	Cubic yard (yd^3)	Gallon (eng)	Gallon (USA)
1	$61{,}023\,7 \cdot 10^3$	35,314 7	1,307 95	219,969	264,172
$16{,}387\,1 \cdot 10^{-6}$	1	$0{,}578\,704 \cdot 10^{-3}$	$21{,}433\,5 \cdot 10^{-6}$	$3{,}604\,65 \cdot 10^{-3}$	$4{,}329\,00 \cdot 10^{-3}$
$28{,}316\,8 \cdot 10^{-3}$	$1{,}728 \cdot 10^3$	1	$37{,}037\,0 \cdot 10^{-3}$	6,228 84	7,480 52
0,764 555	$46{,}656 \cdot 10^3$	27	1	168,178	201,974
$4{,}546\,09 \cdot 10^{-3}$	277,420	0,160 544	$5{,}946\,06 \cdot 10^{-3}$	1	1,200 95
$3{,}785\,41 \cdot 10^{-3}$	231	0,133 681	$4{,}951\,13 \cdot 10^{-3}$	0,832 675	1

1 l (litre) = $10^{-3}\ m^3$ = 1 dm^3
1 pint (USA) = 0.4732 l
1 pint (Eng) = 0.5682 l
1 quart (USA) = 0.9463 l
1 quart (Eng) = 1.1363 l

Time

Second (s)	Minute (min)	Hour (h)	Day	Week
1	$16{,}666\,7 \cdot 10^{-3}$	$0{,}277\,778 \cdot 10^{-3}$	$11{,}574\,1 \cdot 10^{-6}$	$1{,}653\,44 \cdot 10^{-6}$
60	1	$16{,}666\,7 \cdot 10^{-3}$	$0{,}694\,444 \cdot 10^{-3}$	$99{,}206\,3 \cdot 10^{-6}$
$3{,}6 \cdot 10^3$	60	1	$41{,}666\,7 \cdot 10^{-3}$	$5{,}952\,38 \cdot 10^{-3}$
$86{,}4 \cdot 10^3$	$1{,}44 \cdot 10^3$	24	1	0,142 857
$604{,}8 \cdot 10^3$	$10{,}08 \cdot 10^3$	168	7	1

Speed

Metre/second (m/s)	Kilometre/hour (km/h)	Foot/second (ft/s)	Mile/hour (mile/h)	Knot (kn)
1	3,6	3,280 84	2,236 94	1,943 84
0,277 778	1	0,911 344	0,621 371	0,539 957
0,304 8	1,097 28	1	0,681 818	0,592 484
0,447 04	1,609 344	1,466 67	1	0,868 976
0,514 444	1,852	1,687 81	1,150 78	1

1 kn = nautical mile/h

Normal acceleration with free fall

$g_n = 9{,}806\,65\ m/s^2 = 32{,}174\,0\ ft/s^2$

Mass

Kilogram (kg)	pound (lb)	slug	ounce (oz)	hundredweight (cwt)	Ton (Eng)	Short hundred-weight (USA) (sh cwt)	Short ton (USA) (USA) (sh tn)
1	2.203	$68{,}522 \cdot 10^{-3}$	35,274	$19{,}684 \cdot 10^{-3}$	$0{,}984 \cdot 10^{-3}$	$22{,}046 \cdot 10^{-3}$	$1{,}102 \cdot 10^{-3}$
0,454	1	$31{,}081 \cdot 10^{-3}$	16	$8{,}929 \cdot 10^{-3}$	$0{,}446 \cdot 10^{-3}$	$10 \cdot 10^{-3}$	$0{,}5 \cdot 10^{-3}$
14,594	32,174	1	$51{,}479 \cdot 10^{4}$	0,287	$14{,}363 \cdot 10^{-3}$	0,322	$16{,}087 \cdot 10^{-3}$
$28{,}350 \cdot 10^{-3}$	$62{,}5 \cdot 10^{-3}$	$1{,}946 \cdot 10^{-3}$	1	$0{,}558 \cdot 10^{-3}$	$27{,}902 \cdot 10^{-6}$	$0{,}625 \cdot 10^{-3}$	$31{,}25 \cdot 10^{-6}$
50,802	112	3,481	$1{,}792 \cdot 10^{3}$	1	$50 \cdot 10^{-3}$	1,12	$56 \cdot 10^{-3}$
$1{,}016 \cdot 10^{3}$	$2{,}24 \cdot 10^{3}$	69,621	$35{,}84 \cdot 10^{3}$	20	1	22,4	1,12
45,359	100	3,108	$1{,}6 \cdot 10^{3}$	0,893	$44{,}643 \cdot 10^{-3}$	1	$50 \cdot 10^{-3}$
907,185	$2 \cdot 10^{3}$	62,162	$32 \cdot 10^{3}$	17,857	0,893	20	1

1 ounce = 1 avoirdupois ounce (USA)
7680 oz avdp = 7000 troy ounce
1 hundredweight (Eng) = 1 long hundredweight (USA)
1 ton (Eng) = 1 long ton (USA)
1 ton (1 metric ton) = 10^3 kg

Mass-moment of inertia

$kg \cdot m^2$	$g \cdot cm^2$	$lb \cdot ft^2$	$lb \cdot in^2$	$slug \cdot ft^2$	$oz \cdot in^2$
1	$10 \cdot 10^{6}$	23,730 4	3,417 17 $\cdot 10^{3}$	0,737 565	54,675 0 $\cdot 10^{3}$
$0{,}1 \cdot 10^{-6}$	1	$2{,}373\,04 \cdot 10^{-6}$	$0{,}341\,717 \cdot 10^{-3}$	73,756 5 $\cdot 10^{-9}$	5,467 50 $\cdot 10^{-3}$
42,140 0 $\cdot 10^{-3}$	$421{,}4 \cdot 10^{3}$	1	144	31,081 0 $\cdot 10^{-3}$	$2{,}304 \cdot 10^{3}$
0,292 640 $\cdot 10^{-3}$	2,926 40 $\cdot 10^{3}$	6,944 40 $\cdot 10^{-3}$	1	0,215 839 $\cdot 10^{-3}$	16
1,355 73	13,557 3 $\cdot 10^{6}$	32,174 0	4,633 06 $\cdot 10^{3}$	1	74,128 9 $\cdot 10^{3}$
18,290 0 $\cdot 10^{-6}$	182,900	0,434 028 $\cdot 10^{-3}$	$62{,}5 \cdot 10^{-3}$	13,490 0 $\cdot 10^{-6}$	1

Density

kg/cm^3	g/cm^3	lb/in^3	lb/ft^3
1	10^{-3}	36,127 3 $\cdot 10^{-6}$	62,428 0 $\cdot 10^{-3}$
10^{3}	1	36,127 3 $\cdot 10^{-3}$	62,428 0
27,679 9 $\cdot 10^{3}$	27,679 9	1	$1{,}728 \cdot 10^{3}$
16,018 5	16,018 5 $\cdot 10^{-3}$	0,578 704 $\cdot 10^{-3}$	1

Force

Newton (N)	dyn	Kilopond (kp)	Pound-force (lbf)
1	$0{,}1 \cdot 10^{6}$	0,101 972	0,224 809
$10 \cdot 10^{-6}$	1	$1{,}019\,72 \cdot 10^{-6}$	$2{,}248\,09 \cdot 10^{-6}$
9,806 65	$0{,}980\,665 \cdot 10^{6}$	1	2,204 62
4,448 22	$0{,}444\,822 \cdot 10^{6}$	0,453 592	1

kp = kgf

Moment of a force

Nm	kpm	inchpound – force (in. lbf)	footpound–force (ft. lbf)
1	0,101 972	8,850 75	0,737 562
9,806 65	1	86,796 2	7,233 01
0,112 985	$11{,}521\,2 \cdot 10^{-3}$	1	$83{,}333\,3 \cdot 10^{-3}$
1,355 82	0,138 255	12	1

Pressure

Pascal = N/m^2 (pa)	kp/cm^2 vid at.	mm water guide of manometer (mm wg)	mm barometric column (mm hg alt.dry)	inch mercury column (inch hg)	Normal 1 atmosphere	pounds per square inch (lbf/in^2)
1	$10{,}197 \cdot 10^{-6}$	0,102	$75{,}007 \cdot 10^{-4}$	$29{,}531 \cdot 10^{-5}$	$98{,}692 \cdot 10^{-7}$	$14{,}504 \cdot 10^{-5}$
$98{,}068 \cdot 10^{3}$	1	$10 \cdot 10^{3}$	735,579	28,960	0,968	14,224
9,807	$10 \cdot 10^{-5}$	1	$73{,}560 \cdot 10^{-3}$	$28{,}961 \cdot 10^{-4}$	$96{,}787 \cdot 10^{-6}$	$14{,}224 \cdot 10^{-4}$
133,32	$13{,}595 \cdot 10^{-4}$	13,595	1	$39{,}371 \cdot 10^{-3}$	$13{,}158 \cdot 10^{-4}$	$19{,}337 \cdot 10^{-3}$
$33{,}863 \cdot 10^{2}$	$34{,}530 \cdot 10^{-3}$	345,4	25,4	1	$33{,}420 \cdot 10^{-3}$	0,491
$10{,}1325 \cdot 10^{4}$	1,033	$10{,}335 \cdot 10^{3}$	760	29,922	1	14,696
$68{,}945 \cdot 10^{2}$	$70{,}303 \cdot 10^{-3}$	703,239	51,714	2,036	$68{,}043 \cdot 10^{-3}$	1

1 bar = 10^5 pascal
1 lbf/in^2 = 1 psi
1 kp/cm^2 = 1,0197 bar

Energy work

Joule (Nm, Ws)	Erg	kilowatt hour (Kwh)	kilopond-metre (kpm)	kilo-calorie (kcal)	metric, horse power/hour (hkh)	foot pound-force (ft · lbf)	British thermal unit (Btu)
1	$10 \cdot 10^{6}$	$0{,}278 \cdot 10^{-6}$	0,102	$0{,}239 \cdot 10^{-3}$	$0{,}378 \cdot 10^{-6}$	0,738	$0{,}948 \cdot 10^{-3}$
$0{,}1 \cdot 10^{-6}$	1	$27{,}778 \cdot 10^{-15}$	$10{,}297 \cdot 10^{-9}$	$23{,}885 \cdot 10^{-12}$	$37{,}767 \cdot 10^{-15}$	$73{,}756 \cdot 10^{-9}$	$94{,}782 \cdot 10^{-12}$
$3{,}6 \cdot 10^{6}$	$36 \cdot 10^{12}$	1	$0{,}367 \cdot 10^{6}$	859,845	1,360	$2{,}655 \cdot 10^{6}$	$3{,}412 \cdot 10^{3}$
9,807	$98{,}067 \cdot 10^{6}$	$2{,}724 \cdot 10^{-6}$	1	$2{,}342 \cdot 10^{-3}$	$3{,}704 \cdot 10^{-6}$	7,233	$9{,}295 \cdot 10^{-3}$
$4{,}187 \cdot 10^{3}$	$41{,}868 \cdot 10^{9}$	$1{,}163 \cdot 10^{-3}$	426,935	1	$1{,}581 \cdot 10^{-3}$	$3{,}088 \cdot 10^{3}$	3,968
$2{,}648 \cdot 10^{6}$	$26{,}478 \cdot 10^{12}$	0,736	$0{,}27 \cdot 10^{6}$	632,415	1	$1{,}953 \cdot 10^{6}$	$2{,}510 \cdot 10^{3}$
1,356	$13{,}558 \cdot 10^{6}$	$0{,}377 \cdot 10^{-6}$	0,138	$0{,}324 \cdot 10^{-3}$	$0{,}512 \cdot 10^{-3}$	1	$1{,}285 \cdot 10^{-3}$
$1{,}055 \cdot 10^{3}$	$10{,}551 \cdot 10^{9}$	$0{,}293 \cdot 10^{-3}$	107,586	0,252	$0{,}399 \cdot 10^{-3}$	778,169	1

Effect

Watt (W) alt. Nm/s, J/s	kpm/s	kcal/s	kcal/h	metric horse (hk) power	Horsepower (hp) (Eng. USA)	Footpound-force/sec. (ft. lbf/s)	British thermal unit/hour (Btu/h)
1	0,102	$0{,}239 \cdot 10^{-3}$	0,860	$1{,}360 \cdot 10^{-3}$	$1{,}341 \cdot 10^{-3}$	0,738	3,412
9,807	1	$2{,}342 \cdot 10^{-3}$	8,432	$13{,}333 \cdot 10^{-3}$	$13{,}151 \cdot 10^{-3}$	7,233	33,462
$4{,}187 \cdot 10^{3}$	426,935	1	$3{,}6 \cdot 10^{3}$	5,693	5,615	$3{,}088 \cdot 10^{3}$	$14{,}286 \cdot 10^{3}$
1,163	0,119	$0{,}278 \cdot 10^{-3}$	1	$1{,}581 \cdot 10^{-3}$	$1{,}560 \cdot 10^{-3}$	0,858	3,968
735,499	75	0,176	632,415	1	0,986	542,476	$2{,}510 \cdot 10^{3}$
745,700	76,040	0,178	641,186	1,014	1	550	$2{,}544 \cdot 10^{3}$
1,356	0,138	$0{,}324 \cdot 10^{-3}$	1,166	$1{,}843 \cdot 10^{-3}$	$1{,}818 \cdot 10^{-3}$	1	4,626
0,293 2	$29{,}884 \cdot 10^{-3}$	$69{,}999 \cdot 10^{-6}$	0,252	$0{,}399 \cdot 10^{-3}$	$0{,}393 \cdot 10^{-3}$	0,216	1

Output/area

W/m^2	$kcal/m^2\ h$	$cal/cm^2\ s$	British thermal unit/$foot^2$. hour ($Btu/ft^2\ h$)
1	0,859 845	$23{,}884\,6 \cdot 10^{-6}$	0,316 998
1,163	1	$27{,}777\,8 \cdot 10^{-6}$	0,368 669
$41{,}868 \cdot 10^3$	$36 \cdot 10^3$	1	$13{,}272\,1 \cdot 10^3$
3,154 59	2,712 46	$75{,}346\,1 \cdot 10^{-6}$	1

Output/volume

W/m^3	$kcal/m^3\ h$	$cal/cm^3\ s$	British thermal unit/$foot^3$. hour ($Btu/ft^3\ h$)
1	0,859 848	$0{,}238\,846 \cdot 10^{-6}$	$96{,}621\,1 \cdot 10^{-3}$
1,163	1	$0{,}277\,778 \cdot 10^{-6}$	0,112 370
$4{,}186\,8 \cdot 10^6$	$3{,}6 \cdot 10^6$	1	$0{,}404\,533 \cdot 10^6$
10,349 7	8,899 15	$2{,}471\,99 \cdot 10^{-6}$	1

Temperature and temperature differences

Unit	Kelvin (K)	Celsius (C)	Rankine (R)	Fahrenheit (F)	Physical conditions
Related temperature	0 K	−273,15° C	0° R	−459,67°F	Absolute zero
	255,372 2 K	−17,777 8° C	459,67° R	0° F	
	273,15 K	0° C	491,67° R	32° F	Ice melt point 1)
	273,16 K	0,01° C	491,688° R	32,018°F	Water triple point
Related temperature differences	1 K 0,555 556 K	1° C 0,555 556° C	1,8° R 1° R	1,8° F 1° F	

1) Under accurately described conditions

CONVERSION TABLE INCHES TO MILLIMETER

Values rounded from 1/64" to 10"

Inch		0"	1"	2"	3"	4"	5"	6"	7"	8"	9"
		Millimeter									
0"	0"	–	25,400	50,800	76,200	101,600	127,000	152,400	177,800	203,200	228,600
1/64"	0,015625"	0,397	25,797	51,197	76,597	101,997	127,397	152,797	178,197	203,597	228,997
1/32"	0,03125"	0,794	26,194	51,594	76,994	102,394	127,794	153,194	178,594	203,994	229,394
3/64"	0,046875	1,191	26,591	51,991	77,391	102,791	128,191	153,591	178,991	204,391	229,791
1/16"	0,0625"	1,588	26,988	52,388	77,788	103,188	128,588	153,988	179,388	204,788	230,188
5/64"	0,078125"	1,984	27,384	52,784	78,184	103,584	128,984	154,384	179,784	205,184	230,584
3/32"	0,09375"	2,381	27,781	53,181	78,581	103,981	129,381	154,781	180,181	205,581	230,981
7/64"	0,109375"	2,778	28,178	53,578	78,978	104,378	129,778	155,178	180,578	205,978	231,378
1/8"	0,125"	3,175	28,575	53,975	79,375	104,775	130,175	155,575	180,975	206,375	231,775
9/64"	0,140625"	3,572	28,972	54,372	79,772	105,172	130,572	155,972	181,372	206,772	232,172
5/32"	0,15625"	3,969	29,369	54,769	80,169	105,569	130,969	156,369	181,769	207,169	232,569
11/64"	0,171875"	4,366	29,766	55,166	80,566	105,966	131,366	156,766	182,166	207,566	232,966
3/16"	0,1875"	4,762	30,162	55,562	80,962	106,362	131,762	157,162	182,562	207,962	233,362
13/64"	0,203125"	5,159	30,559	55,959	81,359	106,759	132,159	157,559	182,959	208,359	233,759
7/32"	0,21875"	5,556	30,956	56,356	81,756	107,156	132,556	157,956	183,356	208,756	234,156
15/64"	0,234375"	5,953	31,353	56,753	82,153	107,553	132,953	158,353	183,753	209,153	234,553
1/4"	0,25"	6,350	31,750	57,150	82,550	107,950	133,350	158,750	184,150	209,550	234,950
17/64"	0,265625"	6,747	32,147	57,547	82,947	108,347	133,747	159,147	184,547	209,947	235,347
9/32"	0,28125"	7,144	32,544	57,944	83,344	108,744	134,144	159,544	184,944	210,344	235,744
19/64"	0,296875"	7,541	32,941	58,341	83,741	109,141	134,541	159,941	185,341	210,741	236,141
5/16"	0,3125"	7,938	33,338	58,738	84,138	109,538	134,938	160,338	185,738	211,138	236,538
21/64"	0,328125"	8,334	33,734	59,134	84,534	109,934	135,334	160,734	186,134	211,534	236,934
11/32"	0,34375"	8,731	34,131	59,531	84,931	110,331	135,731	161,131	186,531	211,931	237,331
23/64"	0,359375"	9,128	34,528	59,928	85,328	110,728	136,128	161,528	186,928	212,328	237,728
3/8"	0,375"	9,525	34,925	60,325	85,725	111,125	136,525	161,925	187,325	212,725	238,125
25/64"	0,390625"	9,922	35,322	60,722	86,122	111,522	136,922	162,322	187,722	213,122	238,522
13/32"	0,40625"	10,319	35,719	61,119	86,519	111,919	137,319	162,719	188,119	213,519	238,919
27/64"	0,421875"	10,716	36,116	61,516	86,916	112,316	137,716	163,116	188,516	213,916	239,316
7/16"	0,4375"	11,112	36,512	61,912	87,312	112,712	138,112	163,512	188,912	214,312	239,712
29/64"	0,453125	11,509	36,909	62,309	87,709	113,109	138,509	163,909	189,309	214,709	240,109
15/32"	0,46875"	11,906	37,306	62,706	88,106	113,506	138,906	164,306	189,706	215,106	240,506
31/64"	0,484375"	12,303	37,703	63,103	88,503	113,903	139,303	164,703	190,103	215,503	240,903
1/2"	0,5"	12,700	38,100	63,500	88,900	114,300	139,700	165,100	190,500	215,900	241,300
33/64"	0,515625"	13,097	38,497	63,897	89,297	114,697	140,097	165,497	190,897	216,297	241,697
17/32"	0,53125"	13,494	38,894	64,294	89,694	115,094	140,494	165,894	191,294	216,694	242,094
35/64"	0,546875"	13,891	39,291	64,691	90,091	115,491	140,891	166,291	191,691	217,091	242,491
9/16"	0,5625"	14,288	39,688	65,088	90,488	115,888	141,288	166,688	192,088	217,488	242,888
37/64"	0,578125"	14,684	40,084	65,484	90,884	116,284	141,684	167,084	192,484	217,885	243,284
19/32"	0,59375"	15,081	40,481	65,881	91,281	116,681	142,081	167,481	192,881	218,281	243,681
39/64"	0,609375"	15,478	40,878	66,278	91,678	117,078	142,478	167,878	193,278	218,678	244,078
5/8"	0,625"	15,875	41,275	66,675	92,075	117,475	142,875	168,275	193,675	219,075	244,475
41/64"	0,640625"	16,272	41,672	67,072	92,472	117,872	143,272	168,672	194,072	219,472	244,872
21/32"	0,65625"	16,669	42,069	67,469	92,869	118,269	143,669	169,069	194,469	219,869	245,269
43/64"	0,671875"	17,066	42,466	67,866	93,266	118,666	144,066	169,466	194,866	220,266	245,666
11/16"	0,6875"	17,462	42,862	68,262	93,662	119,062	144,462	169,862	195,262	220,662	246,062
45/64"	0,703125"	17,859	43,259	68,659	94,059	119,459	144,859	170,259	195,659	221,059	246,459
23/32"	0,71875"	18,256	43,656	69,056	94,456	119,856	145,256	170,656	196,056	221,456	246,856
47/64"	0,734375"	18,653	44,053	69,453	94,853	120,253	145,653	171,053	196,453	221,853	247,253
3/4"	0,75"	19,050	44,450	69,850	95,250	120,650	146,050	171,450	196,850	222,250	247,650
49/64"	0,765625"	19,447	44,847	70,247	95,647	121,047	146,447	171,847	197,247	222,647	248,047
25/32"	0,78125"	19,844	45,244	70,644	96,044	121,444	146,844	172,244	197,644	223,044	248,444
51/64"	0,796875"	20,241	45,641	71,041	96,441	121,841	147,241	172,641	198,041	223,441	248,841
13/16"	0,8125"	20,638	46,038	71,438	96,838	122,238	147,638	173,038	198,438	223,838	249,238
53/64"	0,828125"	21,034	46,434	71,834	97,234	122,634	148,034	173,434	198,834	224,234	249,634
27/32"	0,84375"	21,431	46,831	72,231	97,631	123,031	148,431	173,831	199,231	224,631	250,031
55/64"	0,859375"	21,828	47,228	72,628	98,028	123,428	148,828	174,228	199,628	225,028	250,428
7/8"	0,875"	22,225	47,625	73,025	98,425	123,825	149,225	174,625	200,025	225,425	250,825
57/64"	0,890625"	22,622	48,022	73,422	98,822	124,222	149,622	175,022	200,422	225,822	251,222
29/32"	0,90625"	23,019	48,419	73,819	99,219	124,619	150,019	175,419	200,819	226,219	251,619
59/64"	0,921875"	23,416	48,816	74,216	99,616	125,016	150,416	175,816	201,216	226,616	252,016
15/16"	0,9375"	23,812	49,212	74,612	100,012	125,412	150,812	176,212	201,612	227,012	252,412
61/64"	0,953125"	24,209	49,609	75,009	100,409	125,809	151,209	176,609	202,009	227,409	252,809
31/32"	0,96875"	24,606	50,006	75,406	100,806	126,206	151,606	177,006	202,406	227,806	253,206
63/64"	0,984375"	25,003	50,403	75,803	101,203	126,603	152,003	177,403	202,803	228,203	253,603

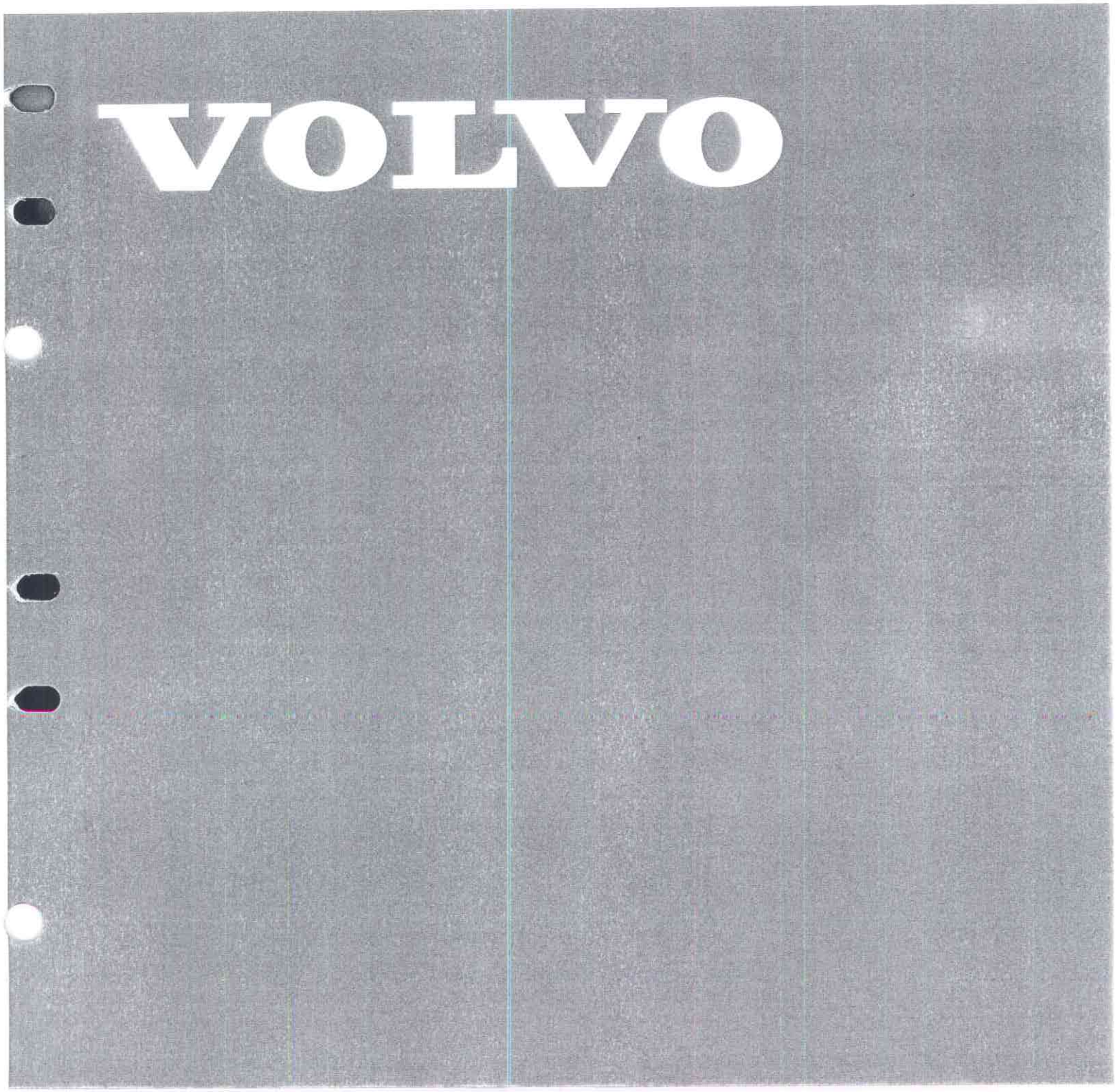
Service Manual

Trucks

Part 0 (03)

Specifications

C 303
Civilian Version



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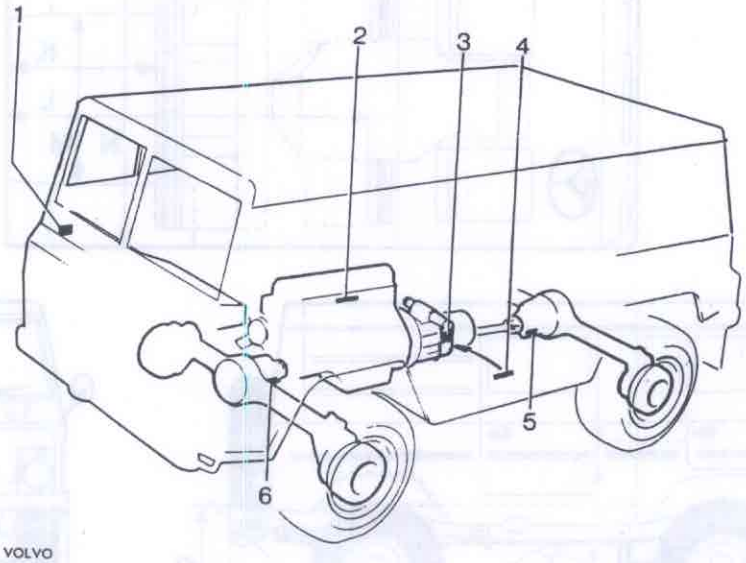
TYPE DESIGNATION PLATES



VOLVO
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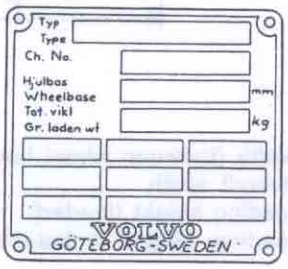
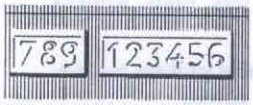


VOLVO
109 935

1. Type designation plate at right-hand end of instrument panel.



VOLVO
109 938

2. Engine number stamped on left-hand side of cylinder block.

VOLVO

3. Type designation plate on left-hand side of gearbox.

VOLVO
109 940

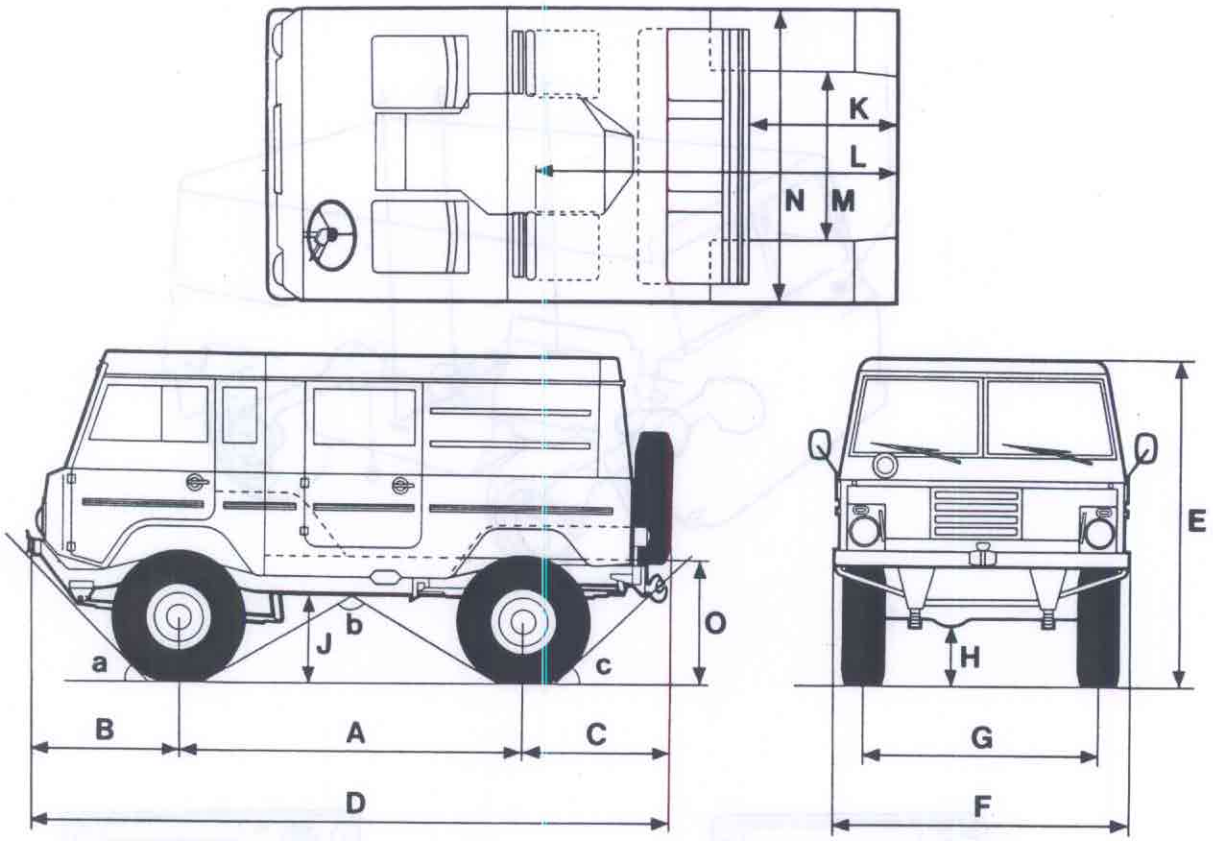
4. Transfer gearbox plate on front flange.

VOLVO
109 941

5, 6. Axle gear plate on front and rear axles.

GENERAL DATA

Hard top



Dimensions, mm (in)

A	Wheelbase	2300	(91)
D	Overall length	4350	(171)
F	Overall width	1900	(75)
E	Overall height (loaded)	2170	(85)
	Overall height (unloaded)	2300	(91)
B	Front overhang	965	(38)
C	Rear overhang	925	(36)
G	Track width, front and rear	1540	(61)
	Turning circle diameter	11460	(451)
H	Smallest ground clearance	380	(15)
J	Ground clearance between axles	420	(17)
b	Underbody angle	125°	
a	Angle of incidence, front	45°	
c	Angle of incidence, rear	45°	
	Side stability	40%	
	Climbing ability	80%	
	Max. fording depth	700	(28)
Loading space			
	Height	1250	(49)
K	Length	1000	(39)
L	Length (backrest let down)	2300	(91)
M	Width (between wheel housings)	1070	(42)
N	Overall width	1700	(67)
O	Loading height (loaded)	830	(33)
	Loading height (unloaded)	960	(38)

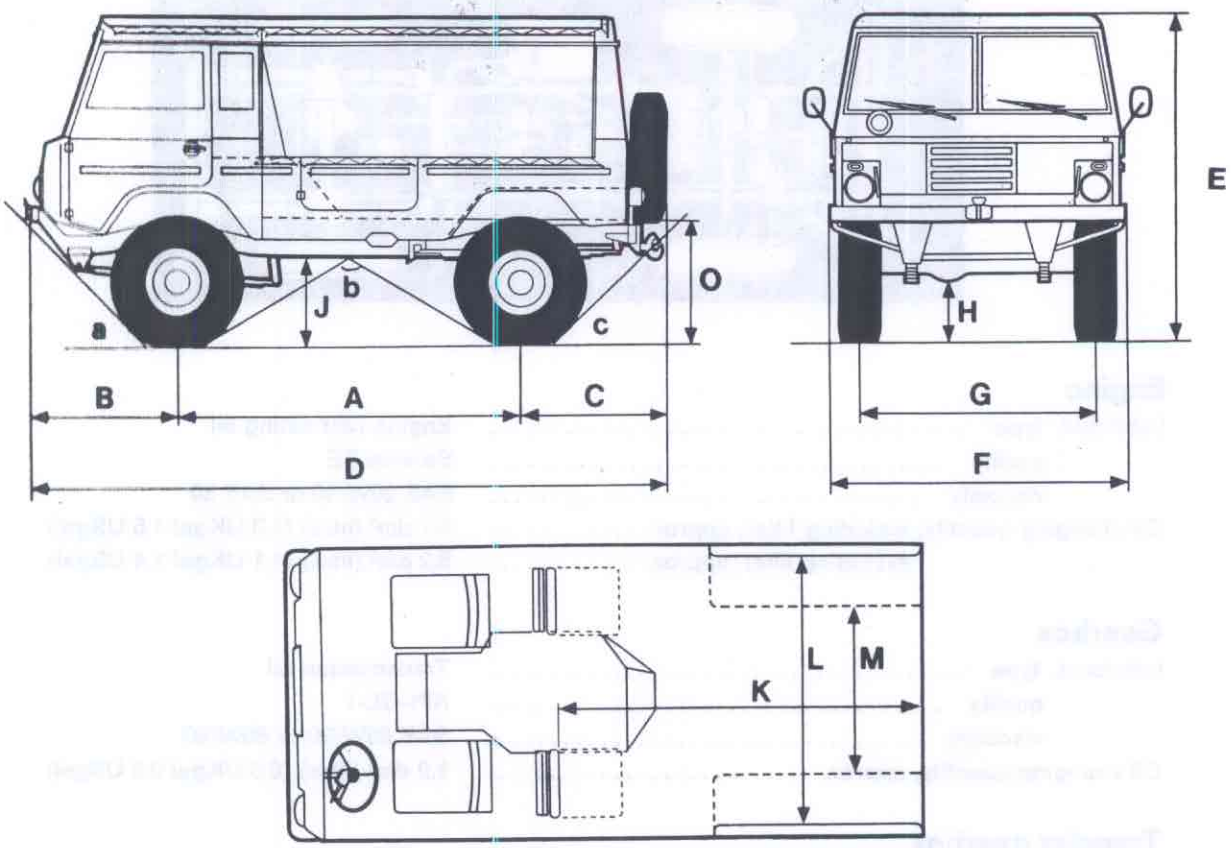
Weights, kg (lb)

Service weight, front	1230	(2705)
Service weight, rear	990	(2180)
Service weight, total	2220	(4885)
Max. front axle pressure	1650	(3630)
Max. rear axle pressure	1800	(3960)
Max. gross weight	3450	(7590)
Max. pay load, approx.	1150	(2530)

Speed and pulling power

Max. speed	125 km/h (78 mile/h)
Cruising speed at 4000 rev/min	100 km/h (62 mile/h)
Min. speed at 1000 rev/min	2.9 km/h (1.8 mile/h
Max. pulling power	23250 N (2370 kgf 5215 lbf)
Max. trailer weight	2500 kg (5500 lbf)

Canvas



Dimensions, mm (in)

A	Wheelbase	2300 (91)
D	Overall length	4350 (171)
F	Overall width	1900 (75)
E	Overall height (loaded)	2170 (85)
	Overall height (unloaded)	2300 (91)
B	Front overhang	965 (38)
C	Rear overhang	985 (39)
G	Track width, front and rear	1540 (61)
	Turning circle diameter	11460 (451)
H	Smallest ground clearance	380 (15)
J	Ground clearance between axles	420 (17)
b	Underbody angle	125°
a	Angle of incidence, front	45°
c	Angle of incidence, rear	45°
	Side stability	40%
	Climbing ability	80%
	Max. fording depth	700 (28)
Loading space		
	Height	1250 (49)
K	Length	2300 91)
M	Width (between upright seats)	1330 (52)
L	Overall width	1550 (61)
O	Loading height (loaded)	830 (33)
	Loading height (unloaded)	960 (38)

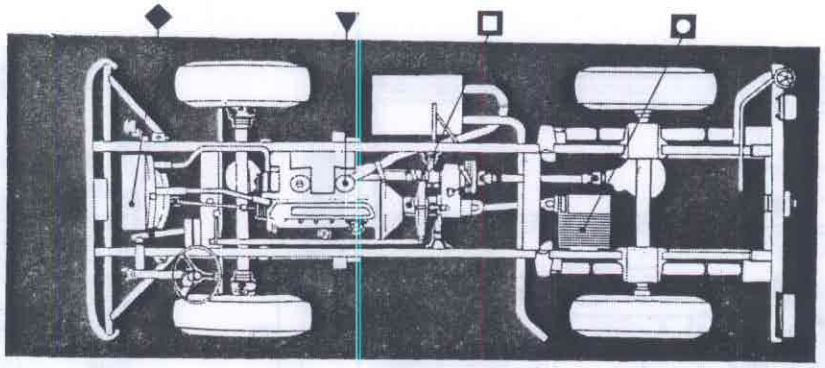
Weights, kg (lb)

Service weight, front	1140 (2510)
Service weight, rear	960 (2110)
Service weight, total	2100 (4620)
Max. front axle pressure	1650 (3630)
Max. rear axle pressure	1800 (3960)
Max. gross weight	3450 (7590)
Max. pay load, approx.	1150 (2530)

Speed and pulling power

Max. speed	120 km/h (75 mile/h)
Cruising speed at 4000 rev/min	100 km/h (62 mile/h)
Min. speed at 1000 rev/min	2.9 km/h (1.8 mile/h)
Max. pulling power	23250 N (2370 kgf 5225 lbf)
Max. trailer weight	2500 kg (5512 lbf)

LUBRICATION



Engine

Lubricant, type	Engine lubricating oil
quality	Service SE
viscosity	SAE 20W/30 or SAE 30
Oil changing quantity, including filter, approx.	5.7 dm³ (litre) (1.3 UKgal 1.5 USgal)
excluding filter, approx.	5.2 dm³ (litre) (1.1 UKgal 1.4 USgal)

Gearbox

Lubricant, type	Transmission oil
quality	API-GL-1
viscosity	SAE 85W/90 or 80W/90
Oil changing quantity, approx.	1.2 dm³ (litre) (0.3 UKgal 0.3 USgal)

Transfer gearbox

Lubricant, type	Transmission oil
quality	API-GL-1
viscosity	SAE 85W/90 or 80W/90
Oil changing quantity, approx.	1.3 dm³ (litre) (0.3 UKgal 0.4 USgal)

Axle centre gear

Lubricant, type	Transmission oil
quality	API-GL-5 (MIL-L-2105 B or C)
viscosity	SAE 90 or 80W/90
Oil changing quantity, front, approx.	1.5 dm³ (litre) (0.3 UKgal 0.4 USgal)
rear, approx.	1.5 dm³ (litre) (0.3 UKgal 0.4 USgal)

Hub gear

Lubricant, type	Transmission oil
quality	API-GL-5 (MIL-2105 B or C)
viscosity	SAE 90 or 80W/90
Oil changing quantity, front, approx.	0.3 dm³ (litre) (0.07 UKgal 0.08 USgal)
rear, approx.	0.4 dm³ (litre) (0.09 UKgal 0.10 USgal)

Steering gear

Lubricant, type	Transmission oil
quality	API-GL-5 (MIL-L-2105 B or C)
viscosity	SAE 90 or 80W/90
Oil changing quantity, approx.	0.5 dm³ (litre) (0.1 UKgal 0.1 USgal)

Camshaft

Marking/max. lifting height	A/6 mm (0.24 in)
Number of bearings	4
Bearing journal, diameter	46.975–47.000 mm (1.8494–1.8504 in)
Max. permissible out-of-round (with new bearings)	0.07 mm (0.0028 in)
Radial clearance	0.020–0.075 mm (0.0008–0.0030 in)
End float	0.020–0.060 mm (0.0008–0.0024 in)
Valve clearance for checking camshaft setting (cold engine)	1.10 mm (0.043 in)
Inlet valve should then open at	10° A.T.D.C.

Camshaft bearing

Bearing diameter	47.020–47.050 mm (1.8512–1.8524 in)
Max. permissible wear	0.02 mm (0.0008 in)

Crank mechanism

CONNECTING RODS

End float on crankshaft	0.15–0.35 mm (0.006–0.014 in)
Length, centre – centre	144.9–145.1 mm (5.70–5.71 in)
Max. permissible weight deviation between connecting rods in same engine	10 grammes (0.35 oz.)

CRANKSHAFT

Crankshaft end float	0.037–0.147 mm (0.0015–0.0058 in)
max. permissible end float	0.15 mm (0.0060 in)
Main bearings, radial clearance	0.028–0.083 mm (0.0011–0.0033 in)
Big-end bearings, radial clearance	0.024–0.070 mm (0.0009–0.0028 in)

MAIN BEARINGS

Main bearing journals

Diameter, standard	63.451–63.464 mm (2.4981–2.4986 in)
undersize 0.010 in	63.197–63.210 mm (2.4881–2.4886 in)
0.020 in	62.943–62.256 mm (2.4781–2.4786 in)
Width on crankshaft for pilot bearing shell	
standard	38.960–39.000 mm (1.5338–1.5354 in)
oversize 1 (undersize shell 0.010 in)	39.061–39.101 mm (1.5378–1.5394 in)
2 (undersize shell 0.020 in)	39.163–39.203 mm (1.5419–1.5434 in)
Max. permissible out-of-roundness	0.05 mm (0.0020 in)

Main bearing shells

Thickness, standard	1.975–1.985 mm (0.0780–0.0781 in)
undersize 0.010 in	2.102–2.112 mm (0.0827–0.0831 in)
0.020 in	2.229–2.239 mm (0.0878–0.0881 in)

BIG-END BEARINGS

Big-end bearing journals

Width of bearing recess	29.95–30.05 mm (1.1779–1.1830 in)
Diameter, standard	53.987–54.000 mm (2.1255–2.1260 in)
undersize 0.010 in	53.733–53.746 mm (2.1155–2.1160 in)
0.020 in	53.479–53.492 mm (2.1055–2.1060 in)
Max. permissible out-of-round	0.07 mm (0.0028 in)

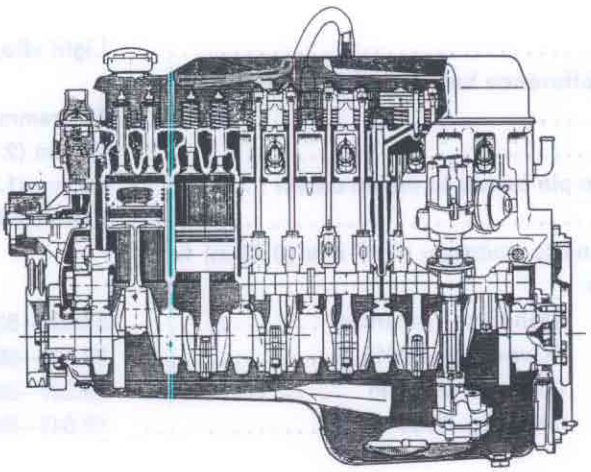
Power take-off

Lubricant, type	Transmission oil
quality	API-GL-1
viscosity	SAE 85W/90 or 80W/90
Oil changing quantity, approx.	0.2 dm³ (litre) (0.04 UKgal 0.05 USgal)

Winch

Lubricant, type	Transmission oil
quality	API-GL-1
viscosity	SAE 85W/90 or 80W/90
Oil changing quantity, winch housing, approx.	1.2 dm³ (litre) (0.26 UKgal 0.32 USgal)
planetary gear, approx.	0.6 dm³ (litre) (0.13 UKgal 0.16 USgal)

ENGINE



VOLVO
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GENERAL

Type designation	B 30 A–498218
Max. output, kW at rev/s DIN	92/71
hp at rev/min DIN	125/4250
Max. torque, Nm at rev/s DIN	219/42
kgf m (lbf ft) at rev/min DIN	22.4 (162)/2500
Compression pressure (warm engine) when cranking with starter motor 4.2–5 rev/s (250–300 rev/min)	1000–1200 kPa (10–12 kgf/cm²) (142–170 lbf/in²)
Compression ratio	9.3:1
Number of cylinders	6
Cylinder bore	88.9 mm (3.5 in)
Stroke	80 mm (3.15 in)
Displacement	2.98 dm³ (litre) (182 in³)
Idling speed	11.67–13.33 rev/s (700–800 rev/min)

ENGINE ASSEMBLY

Cylinder head

Height, measured from cylinder head contact face to face for bolt heads	86.7 mm (3.413 in)
Distance from top side of head to overflow pipe upper end (pipe placed under thermostat)	35 mm (1.38 in)
Cylinder head gasket, thickness, unloaded	0.8 mm (0.031 in)
loaded	0.7 mm (0.028 in)

Cylinder block

Material	Special alloy cast iron
Bore	
Standard (D-marked)	88.91—88.92 mm (3.5004—3.5008 in)
"Oversize" 0.03 mm (0.0012 in)	88.94—88.95 mm (3.5016—3.5020 in)
Oversize 0.015 in	89.29—89.30 mm (3.5153—3.5157 in)
Oversize 0.030 in	89.67—89.68 mm (3.5303—3.5307 in)
The cylinders should be rebored at a wear of (if engine has abnormal oil consumption)	0.25 mm (0.010 in)

Pistons

Material	Light alloy
Permissible weight difference between pistons in same engine	10 grammes (0.35 oz.)
Height, total	71 mm (2.79 in)
Height from gudgeon pin centre to piston crown	46 mm (1.81 in)
Piston clearance	0.01—0.03 mm (0.0004—0.0012 in)
Diameter, right angles to gudgeon pin 7 mm (0.28 in) from lower edge of piston:	
Standard, D-marked	88.890—88.900 mm (3.4995—3.5000 in)
"Oversize" 0.0012 in	88.920—88.930 mm (3.5008—3.5011 in)
Oversize 0.015 in	89.267—89.282 mm (3.5144—3.5150 in)
Oversize 0.030 in	89.647—89.662 mm (3.5294—3.5300 in)

Piston rings

Piston ring gap, measured in ring opening	0.40—0.55 mm (0.016—0.022 in)
Oversize on piston rings	0.03 mm (0.0012 in)
	0.015 in
	0.030 in

Compression rings

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

Oil scraper rings

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

Gudgeon pins

Floating fit. Circlips at both ends on piston.	
Fit in connecting rod bushing	Close running fit (light thumb pressure)

Clearance, gudgeon pin – connecting rod bushing	0.0100–0.0135 mm (0.0004–0.0005 in)
Fit in piston	Slide fit (thumb pressure)
Clearance, gudgeon pin – piston	0.0035–0.0070 mm (0.00001–0.00003 in)
Diameter, standard	24.00 mm (0.945 in)
oversize 0.05 mm (0.002 in)	24.05 mm (0.947 in)

Valve mechanism

VALVES

Inlet

Disc diameter	42 mm (1.654 in)
Stem diameter	7.955–7.970 mm (0.3132–0.3138 in)
Stem, max. permissible wear	0.02 mm (0.0008 in)
Valve seat angle	44.5°
Cylinder head seat angle	45.25°
Seat width in cylinder head	2 mm (0.08 in)

Exhaust

Disc diameter	35 mm (1.378 in)
Stem diameter	7.925–7.940 mm (0.3120–0.3126 in)
Stem, max. permissible wear	0.02 mm (0.0008 in)
Valve seat angle	44.5°
Cylinder head seat angle	45.25°
Seat width in cylinder head	2 mm (0.08 in)

Valve clearance

Clearance, hot and cold engine, exhaust	0.40–0.45 mm (0.016–0.018 in)
Clearance, hot and cold engine, inlet	0.40–0.45 mm (0.016–0.018 in)

VALVE GUIDES

Length, inlet valve	52 mm (2.047 in)
exhaust valve	59 mm (2.323 in)
Inner diameter	8.000–8.022 mm (0.3150–0.3158 in)
Height above upper face of cylinder head	17.5 mm (0.689 in)
Clearance, valve stem – valve guide, inlet valve	0.030–0.067 mm (0.0012–0.0026 in)
exhaust valve	0.060–0.097 mm (0.0024–0.0038 in)
max. permissible clearance	0.15 mm (0.006 in)

VALVE SPRINGS

Length, unloaded, approx.	45 mm (1.77 in)
with a loading of 255 ± 20N (25.5 ± 2 kgf 56 ± 4.4 lbf)	39 mm (1.54 in)
with a loading of 660 ± 35N (66 ± 3.5 kgf 145 ± 7.7 lbf)	30.5 mm (1.20 in)

ROCKER ARM MECHANISM

Rocker arm radius at valve end	12 mm (0.48 in)
Rocker arm bushing, max. permissible wear	0.1 mm (0.004 in)

Camshaft transmission

Timing gears

Crankshaft gear, number of teeth	28
Camshaft gear, number of teeth	56
Backlash	0.04–0.08 mm (0.0016–0.0032 in)
Max. permissible backlash	0.12 mm (0.0048 in)
End float, camshaft	0.02–0.06 mm (0.0008–0.0024 in)

BRENDON O'BRIEN

VOLVO SERVICE

PART 2

ENGINE

C3-series

SERVICE MANUAL

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GROUP 20 GENERAL

Data

GENERAL

Type designation	B 30 A – 498211
Max output, kW at r/s DIN	86/67
h.p. at r/m DIN	117/4 000
Max. torque, Nm at r/s DIN	206/42
kpm at r/m DIN	21/2 500
lbftf	152
Compression pressure (hot engine) when turned over with starter motor 4.2–5.0 r/s (250–300 r/m)	1 000–1 200 kPa (10–12 kp/cm^2) (142–170 lbf/in^2)
Compression ratio	9.3:1
Number of cylinders	6
Bore	88.9 mm (3.50")
Stroke	80 mm (3.15")
Displacement	2.98 dm^3 (litres)
Idle speed	11.67–13.33 r/s (700–800 r/m)

CYLINDER HEAD

Height, measured from cylinder head contact face to face for bolt heads	86.7 mm (3.413")
Distance from top side of head to overflow pipe upper end (pipe placed under thermostat)	35 mm (1.38")
Cylinder head gasket, thickness, unloaded	0.8 mm (0.031")
loaded	0.7 mm (0.028")

CYLINDER BLOCK

Material	Special alloy cast iron
Bore, mm (in.)	
Standard (D-marked)	88.91–88.92 mm (3.5004–3.5008")
"Oversize" 0.03 mm (0.0012")	88.94–88.95 mm (3.5016–3.5020")
Oversize 0.015"	89.29–89.30 mm (3.5153–3.5157")
Oversize 0.030"	89.67–89.68 mm (3.5303–3.5307")
The cylinders should be drilled with a wear of (if engine has abnormal oil consumption)	0.25 mm (0.010")

PISTONS

Material	Light alloy
Permissible weight difference between pistons in same engine	10 grammes (0.35 oz.)
Height, total	71 mm (2.79")
Height from piston pin centre to piston crown	46 mm (1.81")
Piston clearance	0.01–0.03 mm (0.0004–0.0012")
Diameter, right angles to gudgeon pin 7 mm (0.28") from lower edge of piston:	
Standard, D-marked	88.890–88.900 mm (3.4995–3.5000")
"Oversize" 0.0012"	88.928–88.930 mm (3.5008–3.5011")
Oversize 0.015"	89.267–89.282 mm (3.5144–3.5150")
Oversize 0.030"	89.647–89.662 mm (3.5294–3.5300")

Piston rings

Piston ring gap, measured in ring opening	0.40–0.55 mm (0.016–0.022")
Oversize on piston rings	0.03 mm (0.0012")
	0.015"
	0.030"

Compression rings

Upper ring chromed	
Number on each piston	2
Height	1.98 mm (0.078")
Compression ring clearance in groove	0.040–0,072 mm (0.0016–0.0028")

Oil scraper rings

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

Gudgeon pins

Floating fit. Circlips at both ends on piston.	
Fit in connecting rod bushing	Close running fit (light thumb pressure)
Clearance, gudgeon pin-connecting rod bushing	0.0100–0.0135 mm (0.0004–0.0005")
Fit in piston	Slide fit (thumb pressure)
Clearance, gudgeon pin – piston	0.0035–0.0070 mm (0.00001–0.00003")
Diameter, standard	24.00 mm (0.945")
oversize 0.05 mm (0.002")	24.05 mm (0.947")

VALVE MECHANISM

Valves

Intake

Disc diameter	42 mm (1.654")
Stem diameter	7.955–7.970 mm (0.3132–0.3138")
Stem, max. permissible wear	0.02 mm (0.0008")
Valve seat angle	44.5°
Cylinder head seat angle	45.25°
Seat width in cylinder head	2 mm (0.08")

Exhaust

Disc diameter	35 mm (1.378")
Stem diameter	7.925–7.940 mm (0.3120–0.3126")
Stem, max. permissible wear	0.02 mm (0.0008")
Valve seat angle	44.5°
Cylinder head seat angle	45.25°
Seat width in cylinder head	2 mm (0.08")

Valve clearance

Clearance, hot and cold engine, exhaust	0.40–0.45 mm (0.016–0.018")
Clearance, hot and cold engine, intake	0.40–0.45 mm (0.016–0.018")

Valve guides

Length, inlet valve	52 mm (2.047")
exhaust valve	59 mm (2.323")
Inner diameter	8.000–8.022 mm (0.3150–0.3158")
Height above upper face of cylinder head	17.5 mm (0.689")
Clearance, valve stem – valve guide, inlet valve	0.030–0.067 mm (0.0012–0.0026")
exhaust valve	0.060–0.097 mm (0.0024–0.0038")
max. permissible clearance	0.15 mm (0.006")

Valve springs

Length, unloaded, approx.	45 mm (1.77")
with a loading of 255±20N (25.5±2 kp = 56±4.4 lbf.)	39 mm (1.54")
with a loading of 660±35 N (66±3.5 kp = 145±7.7 lbf.)	30.5 mm (1.20")

Rocker arm mechanism

Rocker arm radius at valve end	12 mm (0.48")
Rocker arm bushing, max. permissible wear	0.1 mm (0.004")

CAMSHAFT TRANSMISSION

Timing gears

Crankshaft drive, number of teeth	28
Camshaft gear, number of teeth	56
Backlash	0.04–0.08 mm (0.0016–0.0032")
Max. permissible backlash	0.12 mm (0.0048")
End float, camshaft	0.02–0.06 mm (0.0008–0.0024")

Camshaft

Marking/max. lifting height	A/6 mm (0.24")
Number of bearings	4
Bearing journal, diameter	46.975–47.000 mm (1.8494–1.8504")
Max. permissible out-of-round (with new bearings)	0.07 mm (0.0028")
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 checking camshaft setting (cold engine)	1.10 mm (0.043")
Intake valve should then open at	10° A.T.D.C.

Camshaft bearing

Bearing diameter	47.020–47.050 mm (1.8512–1.8524'
Max. permissible wear	0.02 mm (0.0008")

CRANK MECHANISM

Connecting rods

End float on crankshaft	0.15–0.35 mm (0.006–0.014")
Length, centre-centre	144.9–145.1 mm (5.70–5.71")
Max. permissible weight deviation between connecting rods in same engine	10 grammes (0.35 oz.)

Crankshaft

Crankshaft end float	0.037–0.147 mm (0.0015–0.0058")
max. permissible end float	0.15 mm (0.0060")
Main bearings, radial clearance	0.028–0.083 mm (0.0011–0.0033")
Big-end bearings, radial clearance	0.024–0.070 mm (0.0009–0.0028")

Main bearings

Main bearing journals

Diameter, standard	63.451–63.464 mm (2.4981–2.4986")
undersize 0.010"	63.197–63.210 mm (2.4881–2.4886")
0.020"	62.943–62.956 mm (2.4781–2.4786")
Width on crankshaft for pilot bearing shell	
standard	38.960–39.000 mm (1.5338–1.5354")
oversize 1 (undersize shell 0.010")	39.061–39.101 mm (1.5378–1.5394")
2 (undersize shell 0.020")	39.163–39.203 mm (1.5419–1.5434")
Max. permissible out-of-roundness	0.05 mm (0.0020")

Main bearing shells

Thickness, standard	1.975–1.985 mm (0.0780–0.0781")
undersize 0.010"	2.102–2.112 mm (0.0827–0.0831")
0.020"	2.229–2.239 mm (0.0878–0.0881")

Big-end bearings

Big-end bearing journals

Width of bearing recess	29.95–30.05 mm (1.1779–1.1830")
Diameter, standard	53.987–54.000 mm (2.1255–2.1260")
undersize 0.010"	53.733–53.746 mm (2.1155–2.1160")
0.020"	53.479–53.492 mm (2.1055–2.1060")
Max. permissible out-of-round	0.07 mm (0.0028")

Big-end bearing shells

Thickness, standard	1.978–1.988 mm (0.0779–0.0783")
undersize 0.010"	2.105–2.115 mm (0.0829–0.0833")
0.020"	2.232–2.242 mm (0.0879–0.0883")

Flywheel

Minimum permissible thickness (after grinding)	29.7 mm (1.17")
Permissible axial throw, max.	0.05 mm (0.002")/150 mm (5.9") diameter
Ring gear (chamfer forwards)	153 teeth

LUBRICATING SYSTEM

Lubricating oil, type	See lubricating chart
Oil change quantity	5.2 litres (4.5 Imp. qts. = 5.5 US qts.)
incl. oil filter	5.7 litres (5.0 Imp. qts. = 6.0 US qts.)
Incl. oil filter and oil cooler	6.2 litres (5.5 Imp. qts. = 6.5 US qts.)
Oil pressure at 33 r/s (2000 r/m) (with hot engine and new oil filter)	250–600 kPa (2.5–6.0 kp/cm^2 = 35–85 lbf/in^2)

Lubricating oil pump

Lubricating oil pump, type	Gear
number of teeth on each gear wheel	9
end float	0.02–0.10 mm (0.0008–0.0039")

Lubricating oil pump, radial clearance (between tooth crown and pump body)	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	39 mm (1.54")
loaded with 50±4 N (5.0±0.4 kp = 11.0±8.8 lbf.)	26.25 mm (1.03")
70±8 N (7.0±0.8 kp = 15.4±1.7 lbf.)	21.0 mm (0.83")

Lubricating oil filter

Type	Full-flow

FUEL SYSTEM

Carburettors

Type	Horizontal
Make and designation	Zenith-Stromberg 175 CD-2S E
Number	2
Air intake diameter	41.3 mm (1.63")
Metering needle designation	B2 BA
Idling speed	11.67–13.33 r/s (700–800 r/m)
CO-test	2.5%

Fuel pump

Diaphragm pump alt. 1	Pierburg PE 15695
alt. 2	SEV 200 050 12
Fuel pressure at 16.6–100 r/s (1000–6000 r/m) min	15 kPa (0.15 kp/cm^2 = 2.1 lbf/in^2)
max.	28 kPa (0.28 kp/cm^2 = 4.0 lbf/in^2)

Fuel filter

Make and designation	Carter F 827 S

Fuel tank

Capacity, two- axle with wheelbase 2300 mm	125 litres
(90.5")	(27.5 Imp. gals. = 33.0 US gals.)
two-axle with wheelbase 2530 mm	
(99.6")	150 litres
and three-axle	(33.0 Imp. gals. = 40.0 US gals.)

COOLING SYSTEM

Type	Sealed system
Expansion tank valve (in cap) opens at	70 kPa (0.7 kp/cm^2 = 10 lbf/in^2)
Capacity	10 litres (2,2 Imp. gals. = 2.6 US gals.)
Drive belts, designation	two HC-38x888

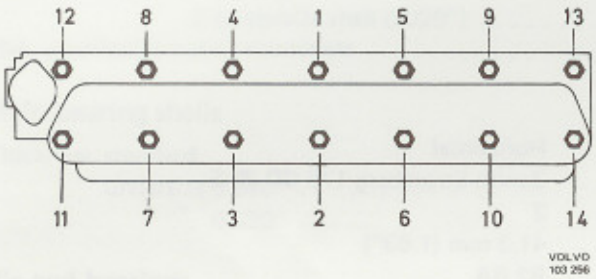
Thermostat

Type	Wax
Marked	82°
Starts opening at	79–83°C (175–182°F)
Fully open at	95°C (203°F)

TIGHTENING TORQUES

	Nm	Kpm	Lbftf
Cylinder head bolts (oiled)[1]	90	9	65
Spark plugs	40	4	29
Main bearing bolts	120–130	12–13	87–94
Big-end bearing nuts	63–70	6.3–7.0	45–50
Flywheel bolts	65–70	6.5–7.0	47–50
Oil sump bolts	8–11	0.8–1.1	6–8
Camshaft gear nuts	130–150	13–15	94–108
Crankshaft pulley bolts	95–105	9.5–10.5	69–75
Nipple for oil cooler and filter	45–55	4.5–5.5	32–40
Oil cooler nuts	30–35	3.0–3.5	22–25
Manifold nuts	18–22	1.8–2.2	13–16

1)



The cylinder head bolts should be tightened in three stages and according to the sequence illustrated here; step 1: 40 Nm (4 kpm = 29 lbftf), step 2: 80 Nm (8 kpm = 58 lbftf), step 3: after running the engine for about 10 minutes, allow the engine to cool and final-tighten the cylinder head bolts to 90 Nm (9 kpm = 65 lbftf).

Special tools

The following special tools are required for work on the engine

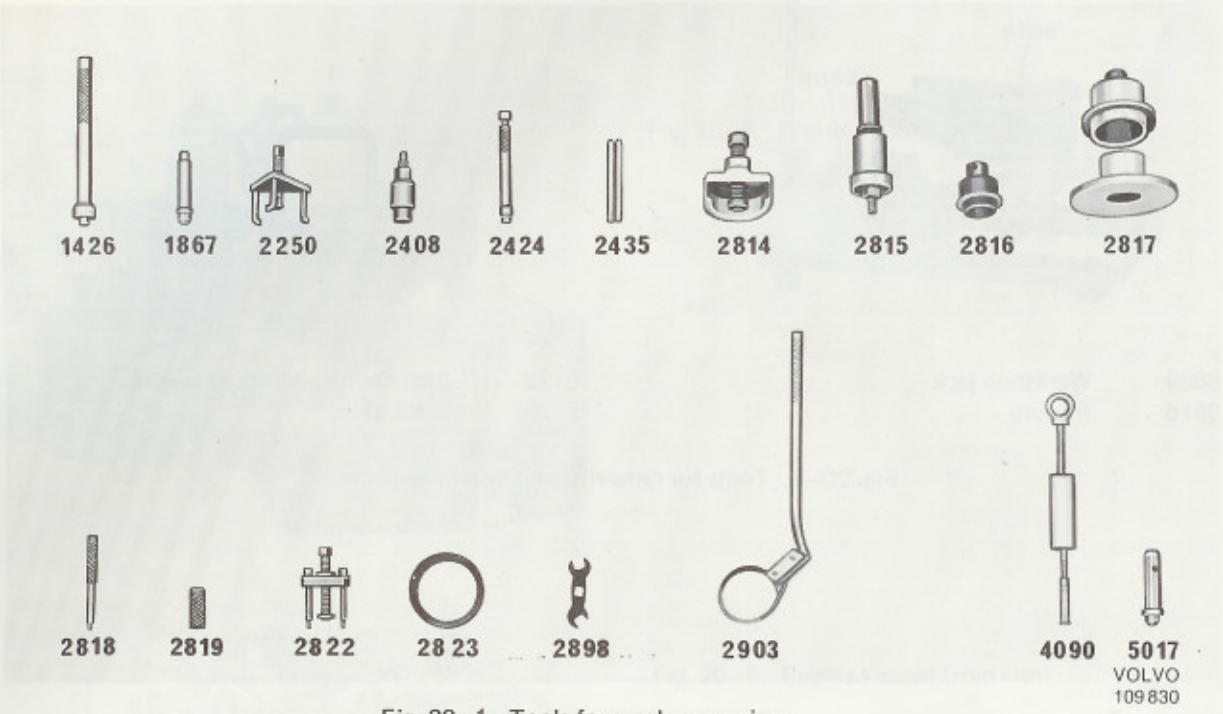
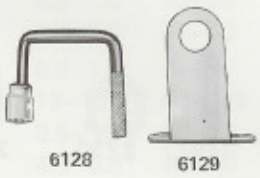


Fig. 20–1. Tools for work on engine

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



9809	Workshop jack	6128	Spanner for speedometer wire
9916	Fixture	6129	Lifting lug

Fig. 20–2. Tools for removing and installing engine

Fig. 20-3. Stand for engine

2520 Stand. Used together with fixture 2820

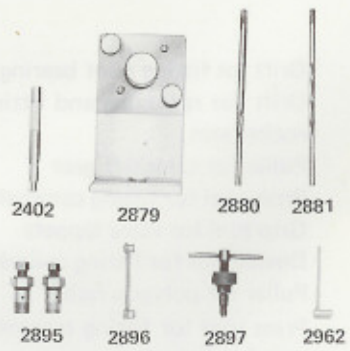


Fig. 20-4. Carburettor tools

2402	Drift for throttle spindle bushing
2879	Fixture for carburettor housing
2880	Reamer for seat, throttle spindle bushing
2881	Reamer for throttle spindle bushing
2895	Press tool for pressing out fuel jet
2896	Gauge, placed between air valve and fuel jet
2897	Press tool for pressing down fuel jet
2962	Drift for pressing out fuel jet

Description

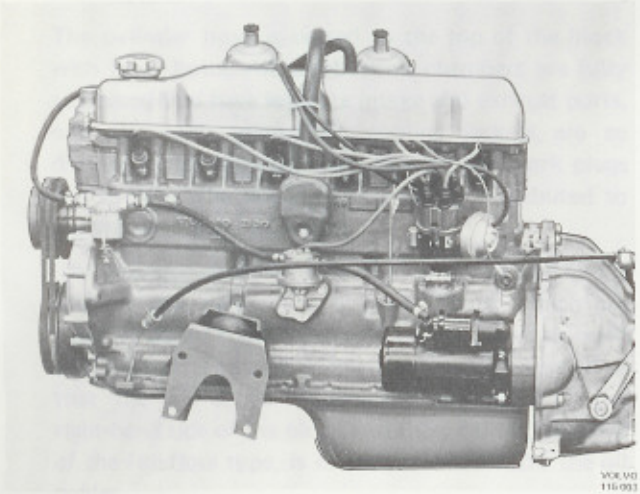


Fig. 20–5. Engine viewed from left

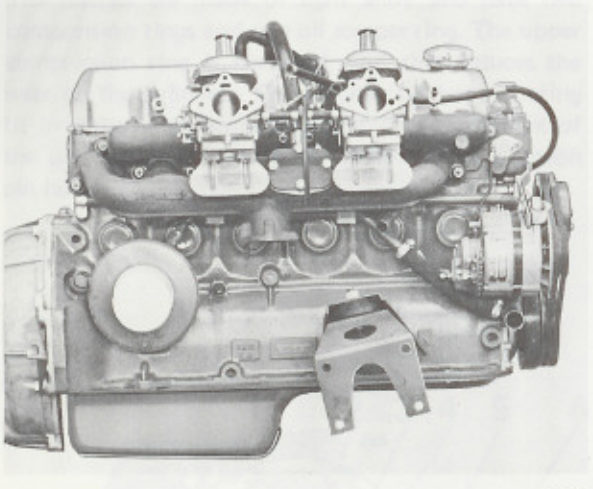


Fig. 20–6. Engine viewed from right

GENERAL

The engine has type designation B30A-498211 and is a six-cylinder, fluid-cooled overhead valve engine. It is provided with twin horizontal carburettors. The cylinder head has separate intake and exhaust ports. Engine performance can be seen from Fig. 20-7.

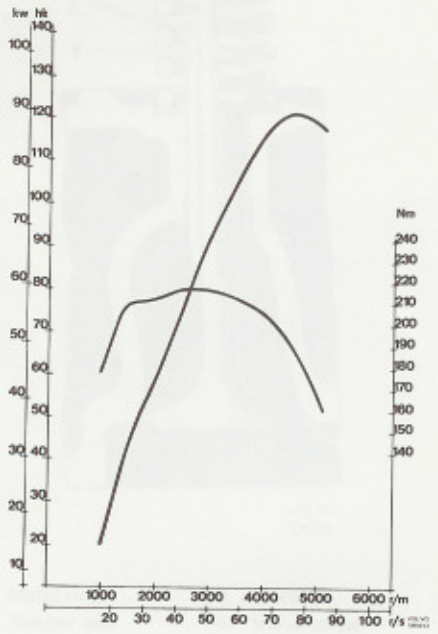


Fig. 20–7. Output and torque curves (DIN)

GROUP 21 ENGINE ASSEMBLY

Description

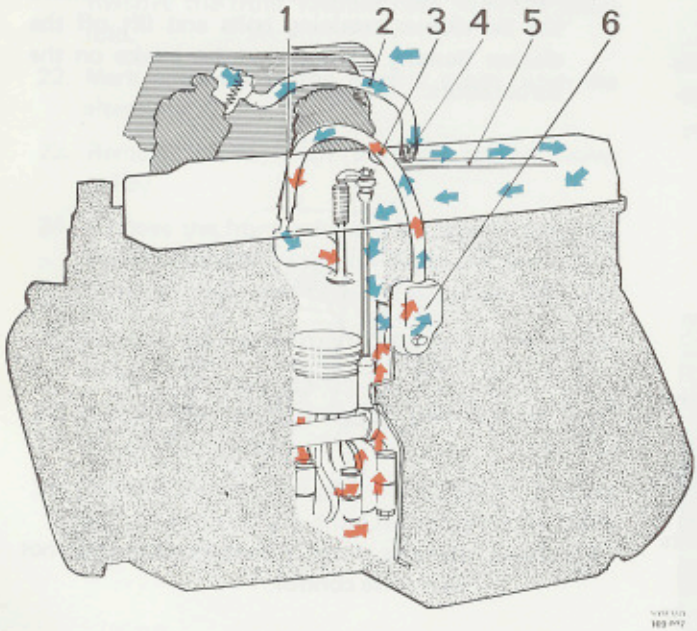
The cylinder head is bolted to the top of the block with head bolts. All combustion chambers are fully machined and have separate intake and exhaust ports, one for each valve. The cooling jackets are so designed that even the areas next to the spark plugs are cooled. The coolant otherwise is distributed to the warmest parts by piping.

The cylinder block is made of special cast iron and is cast in one piece. The cylinder liners, which are surrounded by cooling jackets, are machined directly in the block. The oilways in the block are arranged so that the oil cooler is directly connected to the right-hand side of the block and the oil filter, which is of the full-flow type, is directly connected to the oil cooler.

The pistons are made of light alloy and have two compression rings and one oil scraper ring. The upper compression ring is chromed, and this reduces the wear on the cylinders. The gudgeon pin has a floating fit in piston and connecting rod. The movement of the pin axially is limited by circlips in the gudgeon pin hole.

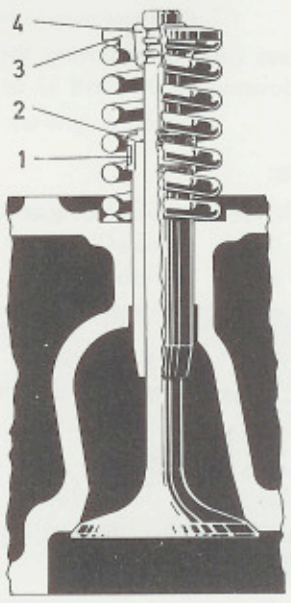
The engine has so-called "positive crankcase ventilation", that is, it is vented in an enclosed system. This is in order to prevent crankcase gases being released into the atmosphere and to prevent gas forming in the engine compartment. Fresh air is supplied via the air filters on the carburettors, and from there through a hose (2, Fig. 21-1) to the rocker arm casing. Fresh air is sucked through a metal filter (flame arrester, 4), is distributed by a plate (5) and mixed with the crankcase gases. The crankcase gases are sucked through an oil trap (6), through a hose (3) and a calibrated nipple (1) to the intake manifold. With this arrangement the exhaust gases take part in the combustion process. Residues are blown out through the exhaust pipe together with the other combustion residues.

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, see Fig. 21-2. The valves are provided with valve guide rubber seals. Viewed in order from the front, the valves are placed: intake, exhaust, intake, exhaust, and so on.



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

Fig. 21–1. Positive crankcase ventilation



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

Fig. 21–2. Valve collet and valve guide seal

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. The camshaft is carried in four bearings.

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.

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

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

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

The front end of the camshaft is in the shape of a polygon. On this sits the hub (polygon hub) for the flywheel damper.

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

Service Procedures

(Concerns the engine in the vehicle, unless otherwise indicated)

ENGINE

Removing the engine

There are two ways of removing the engine. Either remove it downwards (Method 1) or upwards (Method 2).

Special tools:

Method 1	6128	Spanner for speedometer wire
	9916	Fixture
	9809	Workshop lift
Method 2	6129	Lifting lug

1. Open the battery box and disconnect the battery earth cable.
2. **Method 1:** Remove the retaining bolts and lift off the floor cover in the platform.
   Method 2: Remove the platform retaining bolts and lift off the platform.
3. Drain the coolant by disconnecting the lower radiator hose from the engine and remove the drain plug in the oil cooler.
4. Drain the engine oil.
5. Remove the inspection cover on the front engine casing.
6. Remove the upper part of the air cleaner and lift out the insert. Remove the hot-start valve control from the rear carburettor, Fig. 21–3. Remove the air cleaner retaining bolts and lift off the cleaner housing. Cover over the intake on the carburettors.

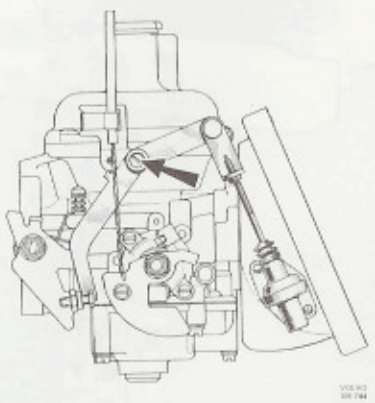


Fig. 21–3. Remove from the carburettor the hot start valve control

7. Remove the choke wire from the rear carburettor and the rear vacuum hose from the intake manifold.
8. Remove the coolant hose from the coolant pipe under the manifold.

9. Remove the hose for the oil pressure gauge from the nipple in the cylinder block.
10. Disconnect the electric cables from the temperature sender and the gearbox and distribution box.
11. Remove the vacuum hose from the vacuum box on the distribution box.
12. Remove the speedometer wire from the gearbox, using spanner 6128.
13. Remove the ignition cable and electric cable to the ignition distributor from the ignition coil.
14. Remove the ventilation hoses (3) from the clutch casing, gearbox and distribution box.
15. Remove the shift controls from the gearbox.
16. Remove the clutch wire from the throw-out clutch lever and from the clutch casing.
17. Disconnect the electric cables from the starter motor.
18. Remove the fuel hose from the fuel pump.
19. Pull loose the lock clip for the parking brake wire sleeve, front end. Remove the lock nut and the adjuster sleeve. Remove the rubber bellows and the wire through the body attachment.
20. Remove lock clip and disconnect link rods of carburettors from throttle control shaft. Remove shaft's lock clip and then the shaft from the manifold bracket. Hang up the shaft.
21. Remove the upper radiator hose from the engine. Remove the front vacuum hose from the manifold.
22. Mark and remove the electric cables from the alternator.
23. Remove the fan shaft from the coolant pump pulley.
24. Remove the front exhaust pipe section from the manifold flange, the silencer flange and the attachment on the clutch casing. Take down the pipe.
25. Remove the earth connection from the clutch casing.
26. Remove the front propeller shaft section from the distribution box.
27. Remove the rear propeller shaft section. Fit two nuts which hold the drum for the propeller shaft brake in position.

28. **Removing the engine downwards**

Method 1

a. Remove the reinforcing bracket between the engine and clutch casing. Take care not to deform the sealing plate.

b. Place engine fixture 9916 on workshop lift 9809. Run the jack in under the engine, jack up and screw tight the fixture, see Fig. 21–4.

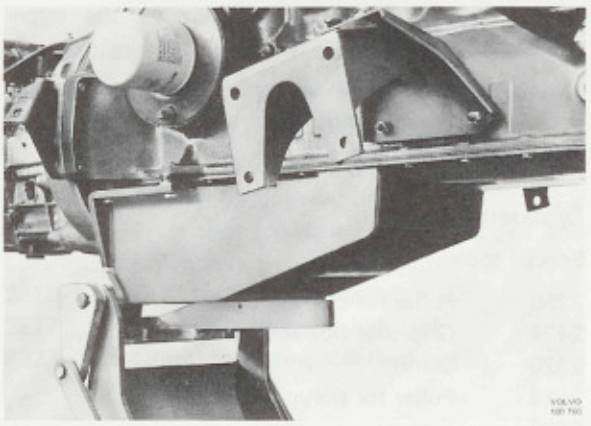


Fig. 21–4. Fixing the engine in fixture 9916

c. Remove the engine mounts (4) from the frame members.

d. Lower the engine.

e. Jack up and place stands under the vehicle. Pull the engine forwards.

29. **Removing the engine upwards**

Method 2

a. Fit lifting lug 6129 on the rear cylinder head bolts, see Fig. 21–5.

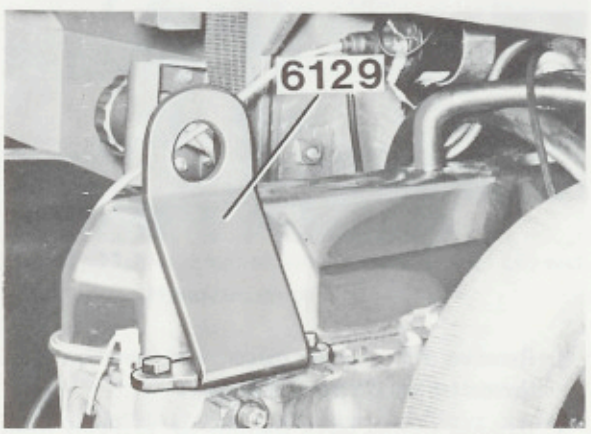


Fig. 21–5. Attaching the lifting lug 6129

b. Run the engine jack in under the engine. Swing in hoist over the engine and secure its lifting hook to the lifting lug 6129.

c. Remove the lower retaining bolts (in the frame members) for the rear engine mounts.

d. Raise the engine jack so as to off-load the front engine mounts. Remove the retaining bolts in the frame members (4 per side) for the engine mounts.

e. Lower the engine jack so as to off-load the rear engine mounts. Remove the upper retaining bolts.

f. Lift out the engine. Take care that the engine does not knock against brake pipes or the fuel pipe.

Disassembling

Special tools:

2250	Puller for camshaft gear
2424	Grip tool (for valve tappets)
2520	Stand
2814	Puller for polygon hub
2820	Fixture
2822	Puller for crankshaft gear

After the engine has been lifted out of the vehicle, it should be disassembled more or less according to below. (For the instructions concerning the individual parts, see under their respective headings.)

1. Remove the oil trap, fuel pump and left engine mount. Mount the engine on stand 2520 with fixture 2820, Fig. 21–6.

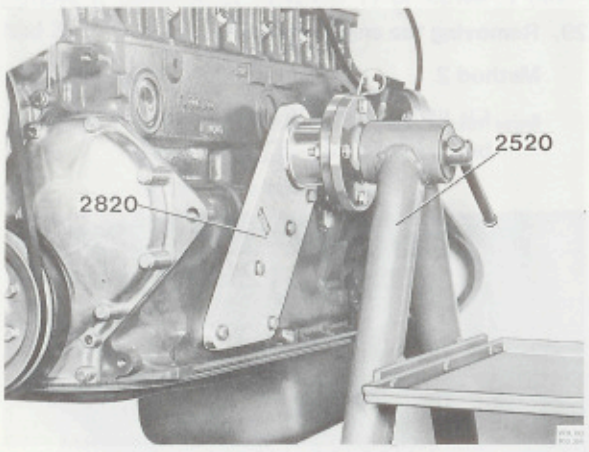


Fig. 21–6. Engine on stand

2. Remove the starter motor and gearbox and thereafter the clutch and flywheel.

3. Remove fixture 9916 (reinforcing bracket) from the engine.

4. Remove the alternator, coolant pump, distributor, rocker arm casing, rocker arm mechanism, push rods, oil filter and oil cooler. Remove the manifold and carburettors. Remove the cylinder head. Remove the valve tappets with tool 2424, Fig. 21–7.

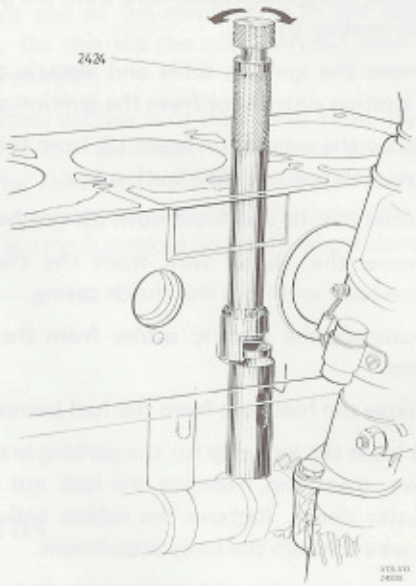


Fig. 21–7. Lifting out valve tappets

5. Remove the crankshaft pulley and vibration damper.

6. Remove the centre bolt and pull off the polygon hub with puller 2814, Fig. 21–8.
(First test to see whether the polygon hub can be pulled off by hand.)

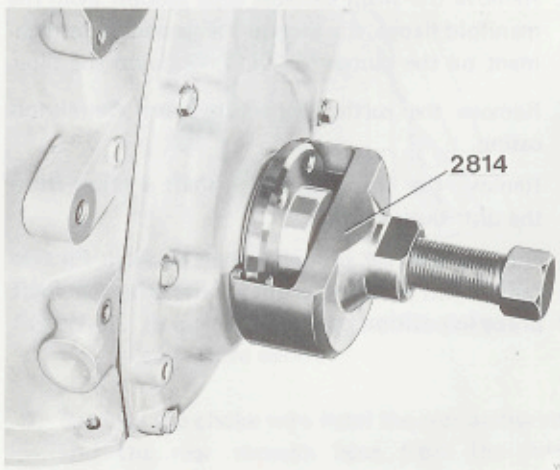


Fig. 21–8. Removing the polygon hub

7. Remove the timing gear casing.
8. Remove the camshaft nut and pull off the gear with puller 2250, Fig. 21–9.

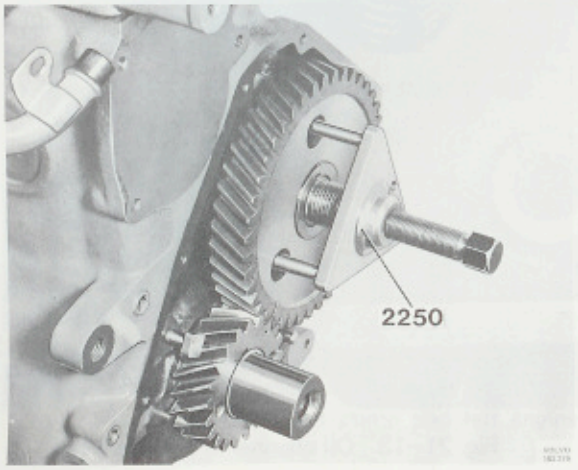


Fig. 21–9. Removing the camshaft gear

9. Pull off the crankshaft gear with puller 2822, Fig. 21–10.

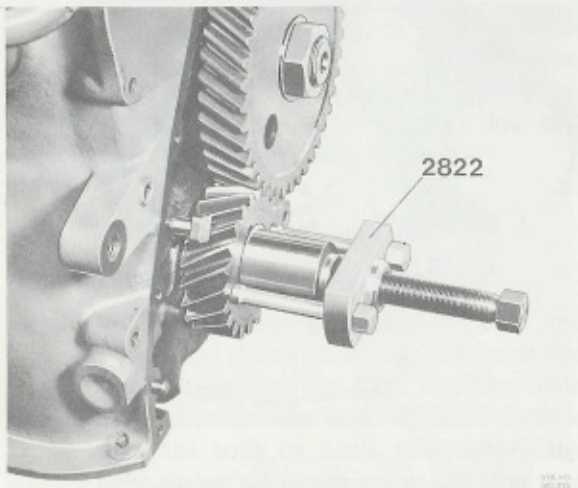


Fig. 21–10. Removing the crankshaft gear

10. Remove the camshaft and oil nozzle.
11. Remove the carbon border on the cylinder liners.
12. Turn over the engine so that the underside is up.
13. Remove the oil sump, rear sealing flange, oil pump and pistons with connecting rods. Put back the caps correctly on their respective rods.
14. Remove the crankshaft. Place the caps properly in their respective positions.

Cleaning

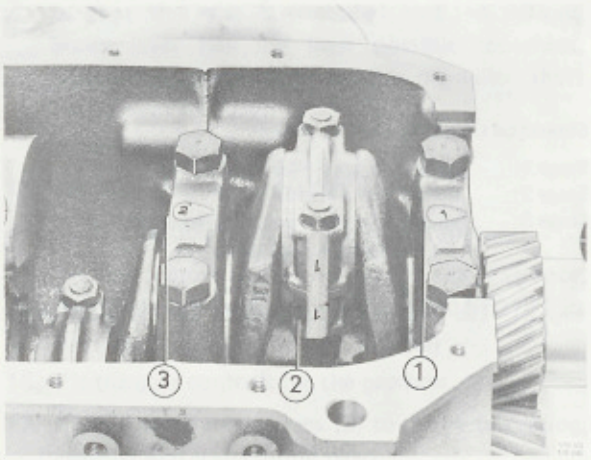
After disassembling the parts, wash them thoroughly. Parts made of steel or cast iron can be washed in a degreasing tank with a caustic soda solution. Light-alloy parts can, however, be damaged by caustic soda so that they should preferably be cleaned in white spirit. Rinse the parts with warm water and blow them dry with compressed air after washing. Clean the oilways with particular thoroughness. All sealing plugs at the oilway openings in the cylinder block must be removed during the cleaning process.

Assembling

Special tools:

2408	Press tool for fitting camshaft gear
2424	Grip tools for valve tappets
2435	Dowels for cylinder head
2815	Press tool for fitting crankshaft gear and polygon hub
2816	Drift for front crankshaft seal
2817	Drift for rear crankshaft seal
2823	Dowel for fitting standard piston

When assembling the engine, follow the instructions for the components concerned. Check the marking of the bearings according to Fig. 21–11. The main bearings are marked 1–7, and the big-end bearings 1–6, counting from the front.



1. Main bearing No. 1
2. Big-end bearing No. 1
3. Main bearing No. 2

Fig. 21–11. Marking of main bearings and big-end bearings

Check that all parts are clean and lubricate sliding surfaces with oil before assembling. Always use new gaskets, split pins and lock washers. No adhesive should be used on the gaskets. Sealing at the ends of

both the oil pump delivery pipe and the water pumps is provided with 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 made easier by coating the rings with soapy water. Slip the rings on the pipes and then press them into their respective positions before finally tightening the attaching screws. The oil pump flange should lie flush against cylinder block before tightening.

Crankshaft seals at the front and rear ends respectively are installed according to the instructions given on pages 21:16 and 21:20. When reconditioning, replase the connecting rod, bolts and nuts with new ones. Use dowels 2435 for fitting the cylinder head. The bolts must be tightened in a certain sequence, see Fig. 21–12, in order to avoid unnecessary stresses. The bolts should be tightened in two stages and final-tightened after the engine has been run warm and allowed to cool.

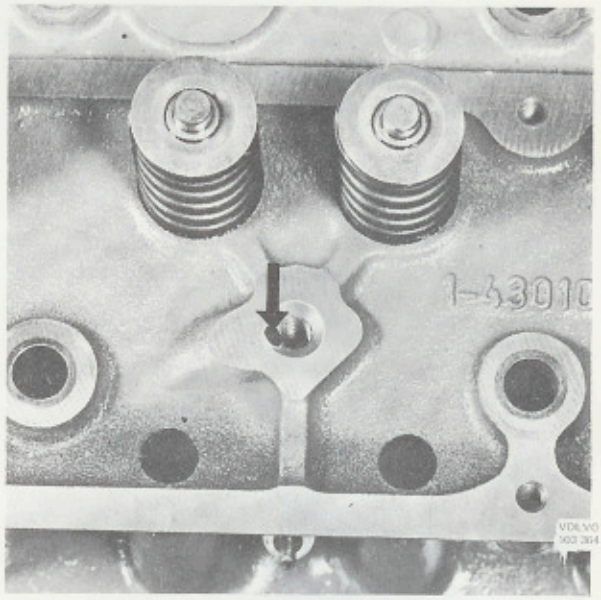
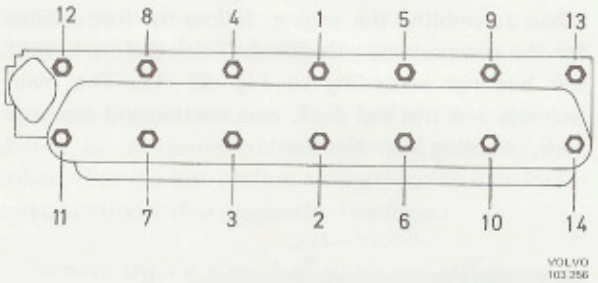


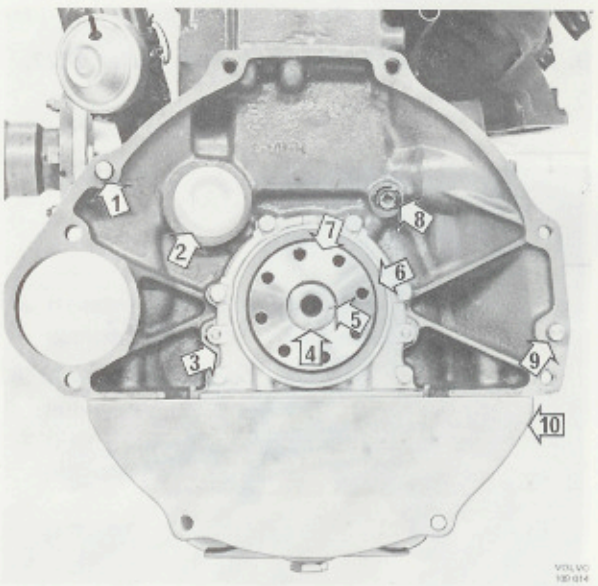
Fig. 21–13. Oil channel in cylinder head



Should be tightened in three stages

Stage 1:	40 Nm (4 kpm = 29 lbftf)
Stage 2:	80 Nm (8 kpm = 58 lbftf)
Stage 3:	engine run warm and allowed to cool
	90 Nm (9 kpm = 65 lbftf)

Fig. 21–12. Tightening sequence for cylinder head bolts



1. Dowel
2. Sealing washer
3. Sealing flange
4. Circlip
5. Pilot bearing
6. Sealing ring
7. Crankshaft
8. Plug
9. Dowel
10. Sealing plate

Fig. 21–14. Rear end of engine

Check that the oil hole (Fig. 21–13) for lubricating the rocker arms is not blocked.

The pilot bearing (5, Fig. 21–14) should be lubricated before being fitted with heat-resistant ball bearing grease. The bearing and protecting washer are held in position by a circlip (6).

Fit the flywheel and clutch and then the gearbox and starter motor.

The most important bolts and nuts should be tightened with a torque wrench, see "Tightening Torques" in the data section, page 20:6.

Installing the engine

The engine can be installed in two ways. Either from underneath (Method 1) or it can be lifted into position from the top (Method 2).

Special tools:

	6128	Spanner for speedometer wire
Method 1	9916	Fixture
	9809	Workshop lift
Method 2	6129	Lifting lug

1. **Installing the engine from underneath**

   Method 1

   a. Remove the engine from fixture 2820 and place it in engine fixture 9916, Fig. 21–4. Fit the oil trap, fuel pump and left engine mount.

   b. Run the engine into position under the vehicle. Lower the vehicle and make sure that the engine does not catch on anything.

   c. Raise the engine and screw tight the engine mounts (4).

   d. Remove fixture 9916 from the engine.

   e. Fit the reinforcing bracket between the engine and clutch casing. Do not forget the spacer wahsers on the front retaining bolts between the bracket and engine. First screw the bolts tight by hand, then tighten the bolts against the clutch casing and after that the bolts against the engine.

2. **Installing the engine from above**

   Method 2

   a. Fit the reinforcing bracket between the engine and clutch casing. Do not forget the spacer washers on the front retaining bolts between the bracket and engine. First screw tight the bolts by hand, then tighten the bolts against the clutch casing, and after that the bolts against the engine.

   b. Fit lifting lug 6129 on the rear cylinder head bolts.

   c. Secure the engine lift to the lifting lug and remove the engine from fixture 2820.

   d. Fit the oil trap, fuel pump and left engine mount.

   e. Lift the engine into position taking care to make sure that the brake pipes and fuel pipe do not get jammed.

   f. Fit the upper front retaining bolts to the front engine mounts.

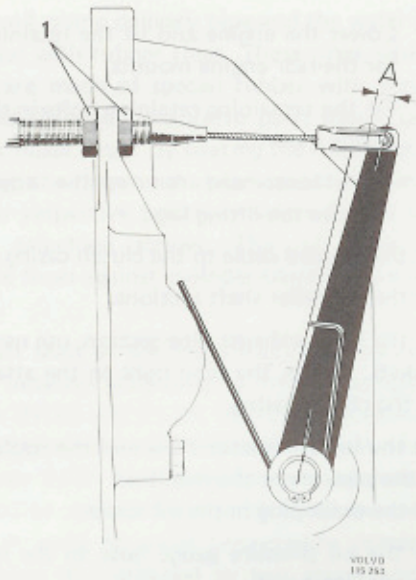
   g. Lower the engine and fit the retaining bolts for the rear engine mounts.

   h. Fit the remaining retaining bolts in the front engine mounts.

   i. Hook loose and remove the engine lift. Remove the lifting lug.

3. Fit the braided cable to the clutch casing.
4. Fit the propeller shaft sections.
5. Fit the front exhaust pipe section, use new flange gaskets. Clamp the pipe tight to the attachment on the clutch casing.
6. Fit the lower radiator hose and the coolant hose to the pipe under the manifold.
   Fit the drain plug in the oil cooler.
7. Fit the oil pressure gauge hose to the nipple in the cylinder block.
8. Fit the fan shaft to the coolant pump pulley.
9. Connect the electric cables to the alternator.
10. Fit the throttle control shaft to the manifold bracket. Fit the lock clip. Fit the link rods to the shaft. Fit the shaft lock clip.
11. Fit the upper radiator hose and connect the front vacuum hose to the manifold.
12. Insert the wire for the parking brake through the body attachment. Fit the rubber bellows and the sleeve lock clips. Fit the adjuster nut and adjust so that the wire is stretched and the parking brake lever has the least possible looseness. Concerning adjustment of the propeller shaft brake, see Part 5.

    Fit the lock nut.
13. Fit the fuel hose to the fuel pump.
14. Fit the electric cables to the starter motor.
15. Fit the clutch wire and adjust the clearance, which should be 4–5 mm (0.016–0.020"), Fig. 21–15.
16. Fit the gear controls for the gearbox.
17. Fit the ventilation hoses (3) to the clutch casing, gearbox and distribution gear.
18. Fit the ignition cable and electric cable to the ignition coil and the electric cable to the temperature sender.
19. Fit the speedometer wire to the gearbox, using spanner 6128 tightening.
20. Fit the electric cables to the gearbox and the distribution gear.
21. Fit the vacuum hose to the distribution gear vacuum box.
22. Connect the rear vacuum hose to the manifold.



A = 4–5 mm (0.16–0.20")
1. Adjuster nut

Fig. 21–15. Throw-out lever travel

23. Fit the air cleaner housing. Fit the hot start valve control to the rear carburettor. At idle position, the valve control should be against the throttle control lever. Fit the air cleaner insert and put on the upper part of the air cleaner.
24. Fit the choke wire to the rear carburettor.
25. Fill with coolant through the opening in the radiator, the heater control should be at max. heat. Fill the radiator fully and put on the cap. Also fill the expansion tank to the MAX mark.
26. Fill with engine oil.
27. Connect the battery earth cable and close the battery box.
28. Start the engine and carry out a function check.
29. Fit the inspection cover on the front engine casing.
30. **Method 1:** Fit the roof cover in the platform.

    Method 2: Fit the platform.

CYLINDER HEAD

Special tools:

2435	Dowels
2898	Spanner for final-tightening cylinder head bolts

Removing

1. Open the battery lid and disconnect the battery earth cable.
2. Remove the platform.
3. Drain the coolant by opening the drain cock on the lower radiator pipe.
4. Remove the inspection cover on the front engine casing and the floor cover in the platform.
5. Remove the upper radiator hose from the engine.
6. Remove the fuel hose from the distribution pipe at the carburettors and from the clamp at the thermostat housing. Bend the hose to the one side.

   Remove the vacuum hose from the front carburettor and the hoses for the crankcase ventilation from the manifold and air cleaner.
7. Remove the alternator tensioning bar from the cylinder head.
8. Remove the clasps and take off the upper part of the air cleaner housing.
9. Disconnect the electric cable from the temperature sender and the choke wire from the rear carburettor.
10. Remove the front exhaust pipe section from the silencers and the attachment on the clutch casing.
11. Remove the flange nuts "manifold – cylinder head" and move the manifold to the one side.
12. Disconnect the spark plug cables from the spark plugs.
13. Remove the rocker arm cover and the rocker arm mechanism and push rods.
14. Remove the cylinder head bolts and lift off the head.
15. Remove the cylinder head gasket, the manifold gasket and the sealing rings for the coolant pump. Clean the contact surfaces.

Checking surface unevenness (Grinding even)

Deviations in the cylinder head surface unevenness may amount to max. 0.05 mm (0.002") per 100 mm (4") length. Check the surface evenness with a surface gauge. If the cover has to be ground smooth, grind off as little as possible.

Fitting the cylinder head

1. Check to make sure that the sealing surfaces on the cylinder block and head are clean, even and undamaged, also that the oil channel in the cylinder head (Fig. 21–16) for the rocker arm mechanism is clean.

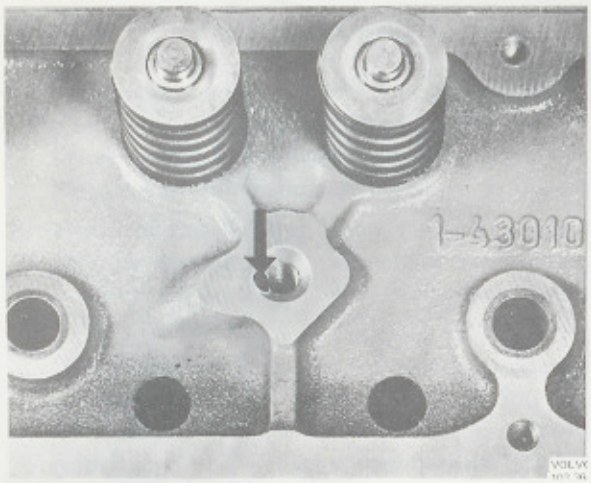


Fig. 21–16. Oil channel in cylinder head

2. Place the cylinder head gasket with TOP facing upwards (wide edge facing upwards) on the cylinder block.
   Fit the coolant pump sealing rings.
   Screw dowels 2435 into the cylinder block, one at the rear left and one at the front right screw hole.
3. Fit the cylinder head and the retaining bolts. Tighten in the sequence shown in Fig. 21–17 and in two stages: 1–40 Nm (4 kpm = 29 lbftf), stage 2–80 Nm (8 kpm = 57 lbftf).

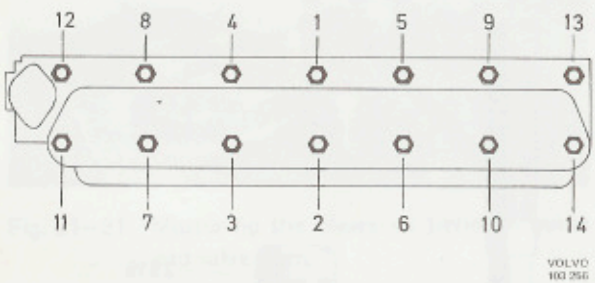


Fig. 21–17. Tightening sequence for cylinder head bolts

4. Fit the push rods in position and mount the rocker arm mechanism.
5. Adjust the valve clearance to 0.45–0.50 mm (0.018–0.020"). **NOTE!** These values are not the final ones.
6. Fit the rocker arm cover.
7. Connect the spark plug cables to the spark plugs.
8. Fit the new manifold gasket to the cylinder head and lift the manifold into position.
   Fit the washers and flange nuts.
9. Fit the front exhaust pipe section to the silencer and to the attachment on the clutch casing.
10. Fit the electric cable to the temperature sender and choke wire to the rear carburettor.
11. Fit the air cleaner housing upper part.
12. Fit the alternator tensioning bar and adjust the belt tension.
13. Fit the fuel hose to the clamp at the thermostat housing and the branch pipe at the carburettors. Fit the vacuum hose to the front carburettor and the hoses for the crankcase ventilation to the manifold and air cleaner.
14. Fit the radiator hose.
15. Close the drain cock on the lower radiator pipe.
16. Fill with coolant through the radiator opening, the heater control should be at MAX heat. Fill the radiator fully and fit the cap. Also fill the expansion tank to the MAX mark.
17. Connect the battery earth cable to the battery and close the battery box.
18. Start the engine and carry out a function check. Run the engine for about 10 minutes (preferably under load).
19. Remove the rocker arm cover.
20. Check-tighten the cylinder head bolts, after the engine has cooled, in correct sequence to 90 Nm (9 kpm = 65 lbftf). Use spanner 2898 for this purpose, see Fig. 21–18.

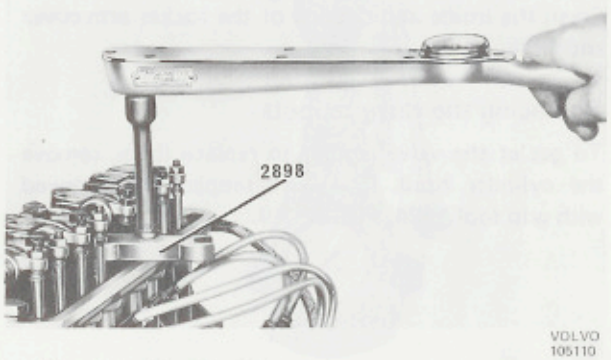


Fig. 21–18. Check-tightening cylinder head bolts

21. Check and if necessary adjust the valve clearance to 0.40–0.45 mm (0.016–0.018").
22. Fit the rocker arm cover.
23. Fit the inspection cover on the front engine casing.
24. Fit the platform.

VALVE MECHANISM

Special tools:

1867	Drift
2425	Grip tool
2818	Drift
2819	Drift

Adjusting the valve clearance

It is an advantage to adjust the valve clearance with the engine switched off, either cold or hot. The clearance is the same for both inlet and exhaust valves (0.40–0.45 mm = 0.016–0.018"). 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.

The clearance is adjusted so that the thinnest gauge can be inserted easily while the thicker one must not enter.

Remove the rocker arm cover. Turn over the crankshaft until No. 1 is at firing position. The rocker arms for No. 6 "rock". The marking on the pulley is at 0. Adjust the valve clearance for No. 1.

Turn over the crankshaft until No. 2 rocker arms "rock" -adjust the clearance for No. 5.

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

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

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

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

Clean the inside and outside of the rocker arm cover and fit it.

Replacing the valve tappets

To get at the valve tappets to replace them, remove the cylinder head. The valve tappets are removed with grip tool 2424, Fig. 21–19.

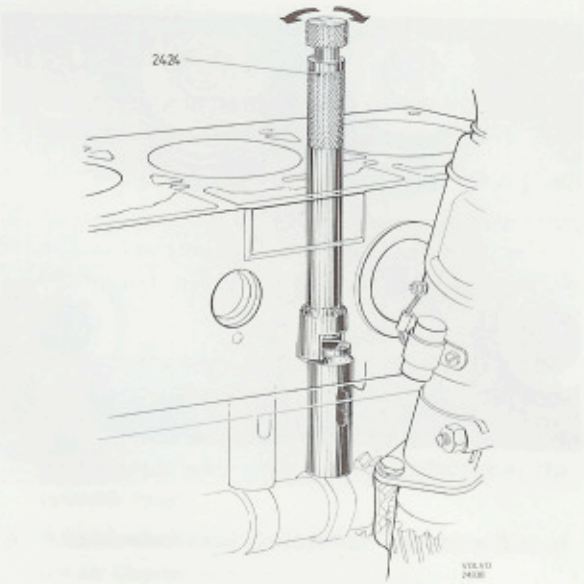
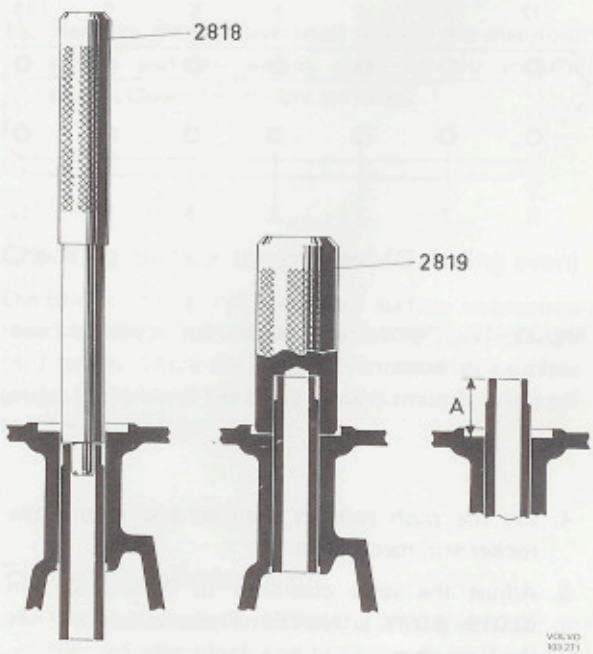


Fig. 21–19. Removing and installing valve tappets

Replacing the valve guides

1. Press out the old guides with drift 2818.
2. Press in the new guides with drift 2819, which gives the correct pressing-in depth, Fig. 21–20.
3. Check that the guides are free from burr and that the valves move easily in them.



A = 17.5 mm (0.69")

Fig. 21–20. Replacing valve guides

Grinding the valves and valve seats

1. Remove the valve springs by first compressing them with valve spring pliers and then remove the valve collets after which release the pliers. Place the valves in order on a rack.
2. With rotating brushes clean the valves, combustion chambers and channels of carbon and combustion deposits. Check the surface condition of the cylinder head.

   The surface unevenness of the cylinder head may amount to max. 0.05 mm (0.0020") per 100 mm (4") length. The surface condition is checked with a level disc. If the cylinder head surface has to be machined level, remove as little material as possible.
3. Measure the clearance between the stem and guide, Fig. 21–21. With a new valve the clearance should not exceed 0.15 mm (0.0060")
   Also check to make sure the valves are not excessively worn. Wear on the valve stems may amount to max. 0.02 mm (0.0008").

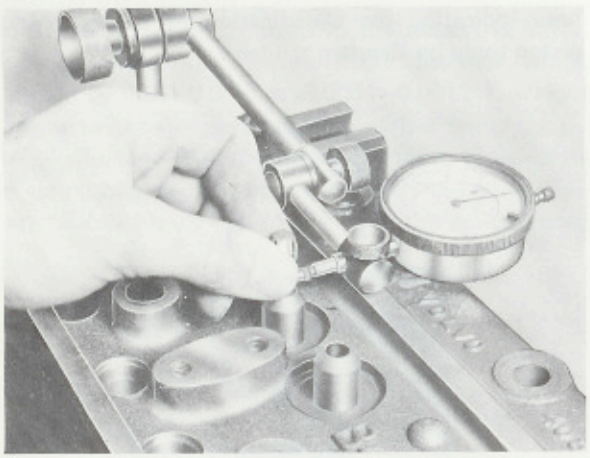
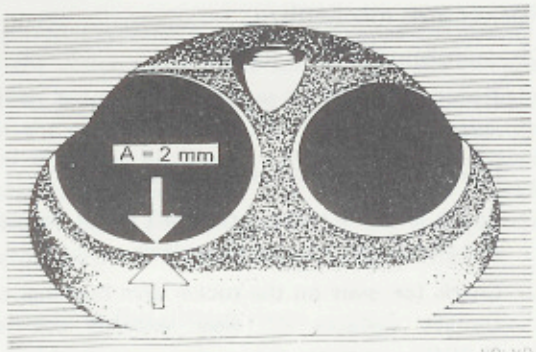


Fig. 21–21. Measuring the clearance between guide and valve stem

4. Grind the valves in a valve grinding machine after cleaning them. The valve seat angle should be 44.5°. Replace valves if excessively worn.
5. Grind the valve seats in the cylinder head. 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 by new ones. The seat should be ground until a good sealing surface is obtained. The angle is 45.25° and the width of the sealing surfaces approx. 2 mm (0.08"), see "A", Fig. 21–22.



A = 2 mm (0.08")

Fig. 21–22. Valve seat width

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.

6. Check the sealing with marking colour and if necessary grind the valves with fine grinding paste.
7. Check the valve springs with a spring tester, Fig. 21–23. If the springs are not according to the values given in the data for springs, see page 20:3, they should be scrapped.

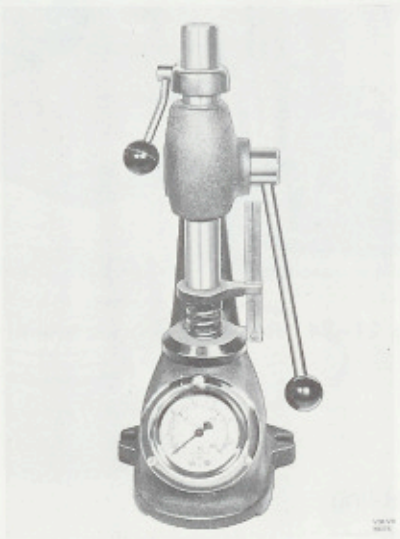


Fig. 21–23. Testing a valve spring

8. Oil the valve stems and place the valves in their guides. Fit the valve guide seals, valve springs, washers and locks.

Rocker arm mechanism

Disassembling and checking

1. Remove the lock rings on both ends of the rocker arm shaft.
2. Dismantle the rocker arm mechanism.
3. Check that the rocker arm shaft is not damaged and that the oil channels are clean.
4. Check for wear on the rocker arm bushings and contact surfaces. If wear exceeds 0.1 mm (0.004"), replace the rocker arm bushing. If necessary grind the thrust area against the valve in a special grinding machine.
5. If the bushings are to be replaced, use drift 1867 for pressing them out and in, Fig. 21–24. Then ream the bushing with a suitable reamer to an accurate fit on the shaft. The hole in the bushing should be opposite the hole in the rocker arm.

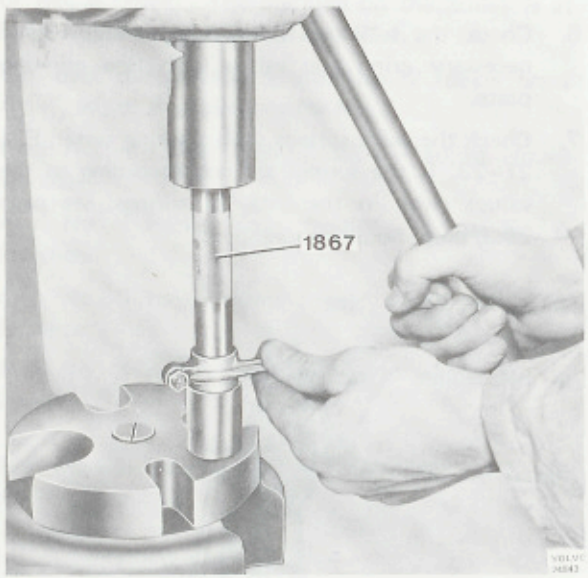


Fig. 21–24. Replacing a rocker arm bushing

Assembling

1. Before assembling the rocker arm mechanism clean all parts thoroughly and check them.
2. Assemble the bearing brackets, springs, rocker arms and shaft according to Fig. 21–25. Lock the parts with new lock rings. Note that the rocker arms are of two types, left and right.

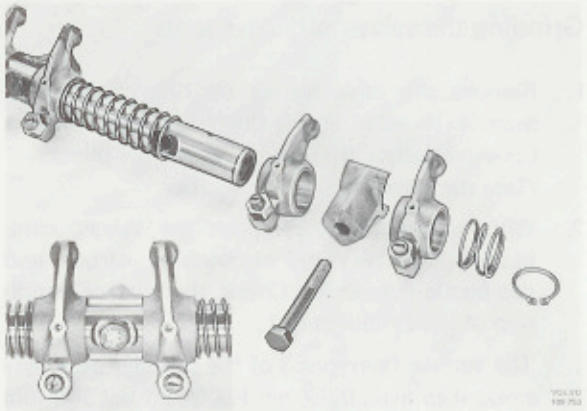


Fig. 21–25. Rocker arm mechanism

CYLINDER BLOCK

Measuring the cylinder bores

The cylinder bores are measured with a special dial indicator, Fig. 21–26.

The measuring should be carried out just below the top edge of the bore only in the transverse direction of the engine. A letter is stamped on each cylinder bore indicating the classification of the bore and piston (only on standard models).

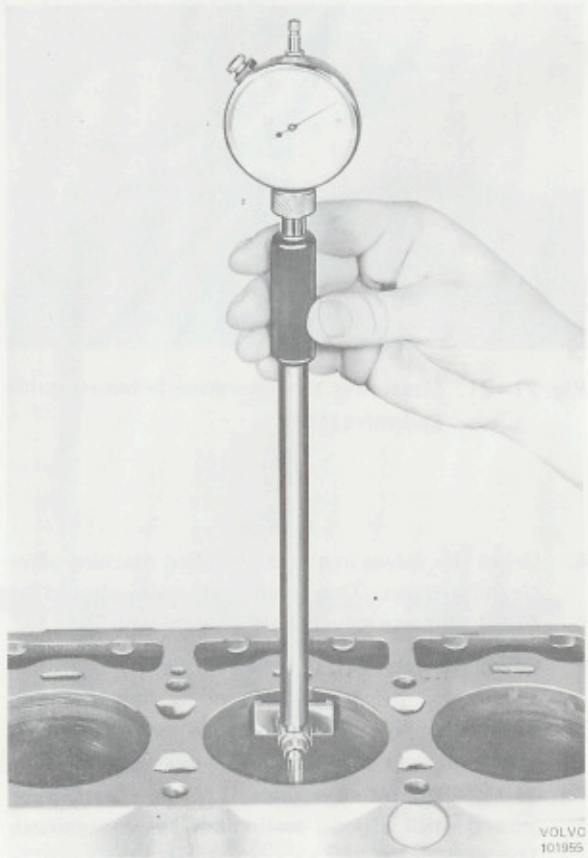


Fig. 21–26. Measuring a cylinder bore

PISTONS AND CONNECTING RODS

Special tools:

5017	Drift
2873	Installation ring

Removing

1. Remove the cylinder head. See under "Removing the cylinder head", page 21–8.
2. Drain the engine oil.
3. Remove the reinforcing bracket between the cylinder block and the clutch casing. Remove the oil sump.
4. Remove the big-end bearing caps and move up the pistons and connecting rods through the cylinder bores. Put back the caps properly on their respective connecting rods. Hang up the pistons and connecting rods on a special rack or place them on a clean, soft base.

Measuring the pistons and piston fit

Measure the piston diameter with a micrometer, at right angles to the gudgeon pin hole and 7 mm (0.28") from the lower edge.

Test the fit of the pistons in the respective bores, without piston rings. Measure the clearance, which should be 0.01–0.03 mm (0.0004–0.0012"), at right angles to the gudgeon pin hole with a feeler gauge, 1/2" wide and 0.02 mm (0.0008") thick, attached to a spring balance. The pulling force should be 10 N (1 kp = 2.2 lbft.), see Fig. 21–27. With this pulling force a piston clearance is obtained equal to the thickness of the feeler gauge blade used. The blade thickness which is equally as thick as the indicated outer values for the piston clearance can, therefore, also be used. Try this out at several different depths. Cylinder bores of standard bore size have a letter marking which indicates the measurement and the respective piston should be marked with the same letter.

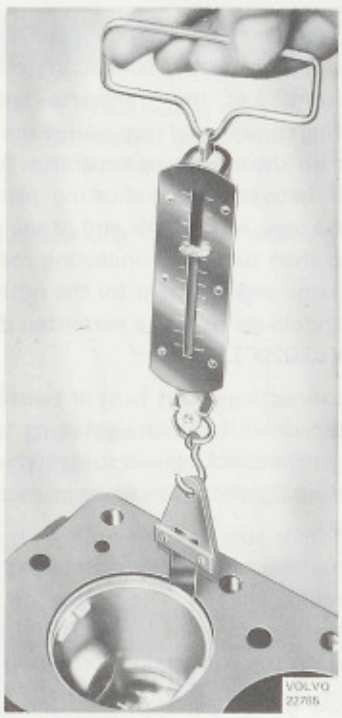


Fig. 21–27. Measuring the piston clearance

Replacing the piston rings

1. Remove the piston rings with piston ring pliers.
2. Clean the pistons, taking particular care with the piston ring grooves.
3. Fit the piston rings, one after the other, down into the cylinder bore. Use an inverted piston to ensure that the rings are fitted properly.
4. Measure the ring gap with a feeler gauge. The gap should be 0.40–0.55 mm (0.016–0.022"). If necessary, the gap can be increased with the help of a special file.

   NOTE! 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.

5. Check the piston rings in the respective ring grooves by rolling them in the groove. Also measure the clearance at several points, Fig. 21–28. This clearance should be 0.040–0.072 mm (0.0016–0.0028") for both compression rings and the oil scraper ring.

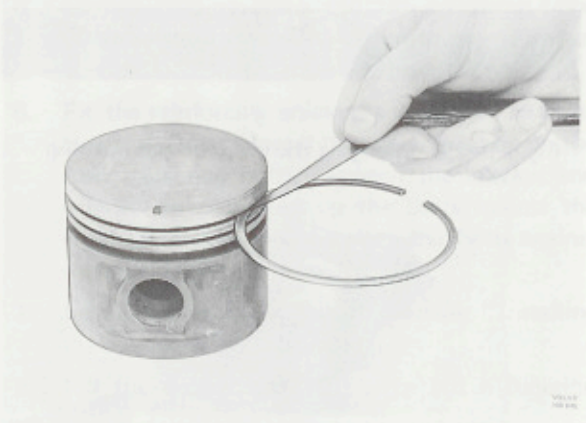


Fig. 21–28. Measuring the piston ring clearance in groove

6. Fit the piston rings with piston ring pliers. The chromed compression ring should be at the top. Turn the rings so that their gaps are apart from each other.

Replacing the gudgeon pins and gudgeon pin bushings

1. Remove the piston rings with piston ring pliers.
2. Remove the circlips and pull out the gudgeon pin.
3. Check the gudgeon pin hole in the piston. If the gudgeon pin hole in the piston is worn so that the oversize (+0.05 mm = 0.002") is required, first ream up the hole to the correct measurement. Use a reamer fitted with pilot guide and take only small cuts at a time.
   The fit is correct when the gudgeon pin can be pushed through the hole by hand with light resistance.
4. If the gudgeon pin bushing is too worn, press it out with drift 5017, Fig. 21–29. A new bushing is pressed in with the same tool, the other end of which is now used. Make sure that the lubricating holes are opposite the holes in the connecting rods. Then ream the bushing to the correct fit.

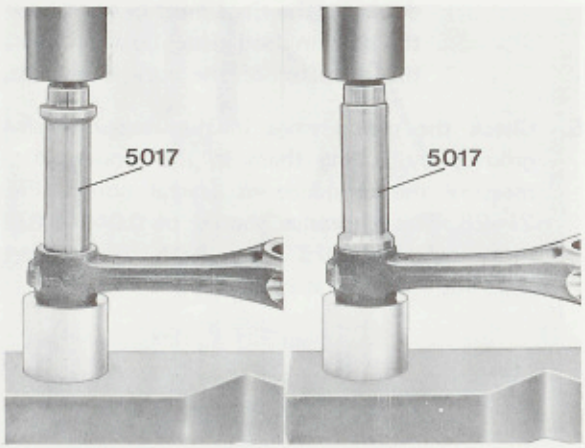


Fig. 21–29. Changing the gudgeon pin bushing

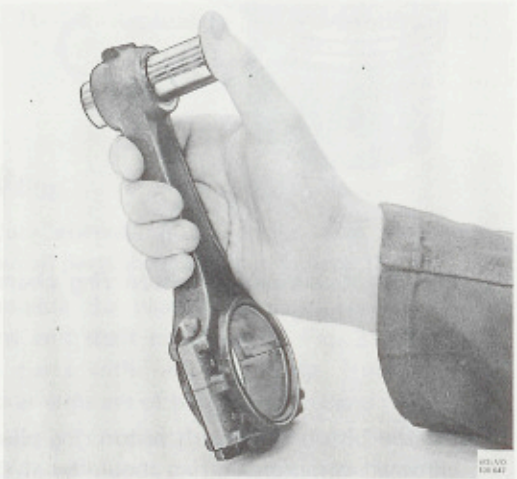


Fig. 21–30. Gudgeon pin fit

The gudgeon pin should glide through the hole under light thumb pressure but without any noticeable looseness, Fig. 21–30.

5. If necessary check the connecting rods for straightness and warp, Fig. 21–31.

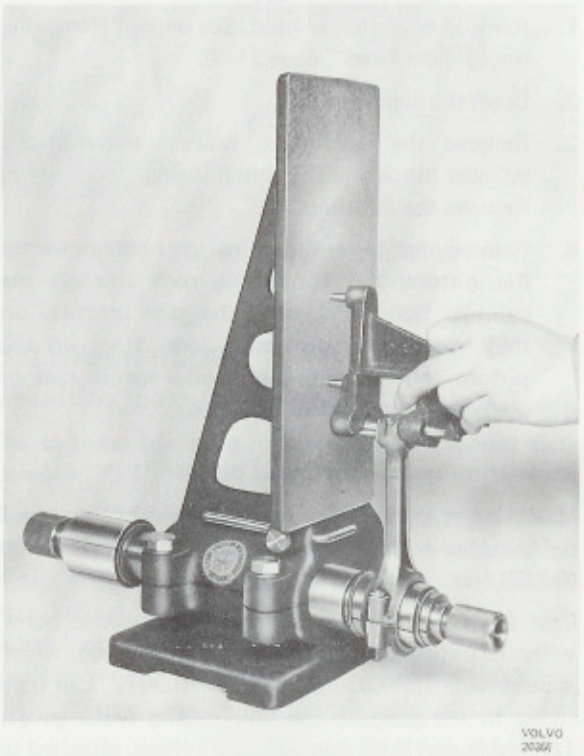


Fig. 21–31. Checking the connecting rod

6. If necessary check the connecting rods for any S-distortion. Let the transverse areas at the connecting rod big end rest against the pulled out support on the measuring apparatus. Measure the distance between the indicating plate and the transverse area at the little end of the connecting rod, and then turn the connecting rod and carry out the same measurement for the other side. The results should agree with a permitted deviation of 0.5 mm (0.020").
7. If the connecting rod is bent or twisted it can be straightened with the straightening tools which belong to the checking and straightening apparatus. The straightening must be carried out with great care.
8. Assemble the piston and connecting rod, using new circlips. NOTE! The groove on the top of the piston should point forwards and the number marking on the connecting rod should face away from the camshaft side, Figs. 21–32 and 21–33.
9. Replace the connecting rod bolts and nuts with new ones.

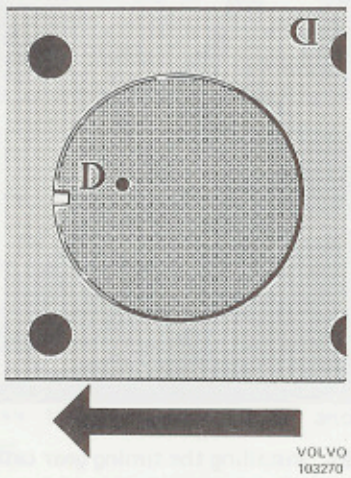
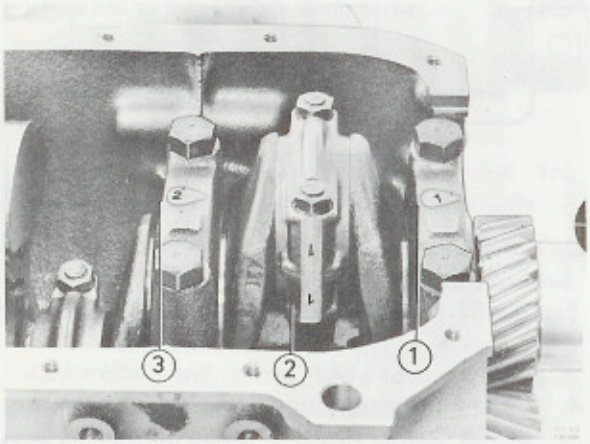


Fig. 21–32. Marking on piston and block



1. Main bearing No. 1
2. Big-end bearing No. 1
3. Main bearing No. 2

Fig. 21–33. Marking the main and big-end bearings

Installing

1. Check that pistons and connecting rods are properly located in relation to each other and to the cylinder block, Figs. 21–32 and 21–33.
2. Turn the piston rings so that their gaps are apart from each other. Oil pistons and bearing surfaces.
3. Fit the pistons with connecting rods in the cylinder bores. Use installation ring 2823, Fig. 21–34. Make sure that the number markings on the connecting rods are facing away from the camshaft side and that the groove in the gudgeon pin points forwards, Figs. 21–32 and 21–33.

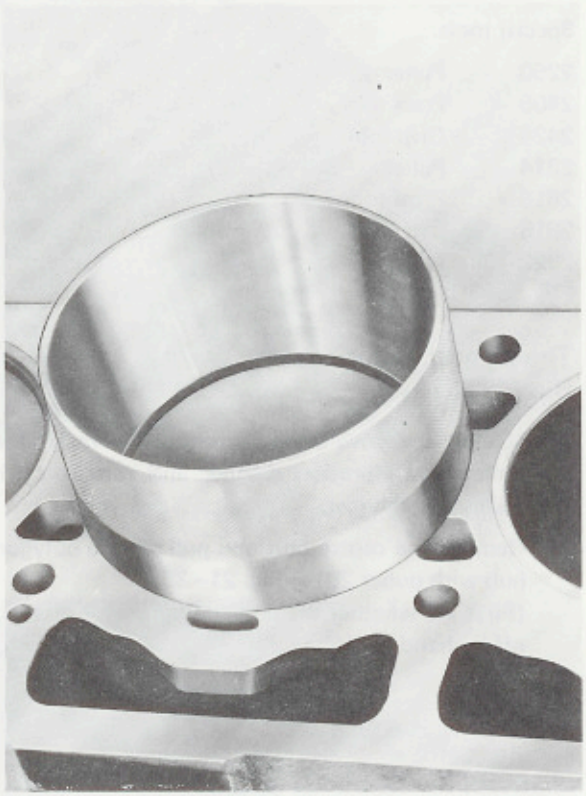


Fig. 21–34. Installing a piston

4. Fit the connecting rod caps. Fit and tighten up the connecting rod nuts to a torque of 63–70 Nm (6.3–7.0 kpm = 45–50 lbftf).
5. Fit the sealing plate and the oil sump. The "tongue" on the oil sump gasket should face towards the starter motor flange.
6. Fit the reinforcing bracket, and tighten all bolts by hand. Do not forget the spacer washers on the front retaining bolts, between the bracket and engine. Then tighten up the bolts against the flywheel casing and therafter the bolts against the cylinder block.
7. Install the cylinder head. See under "Installing the cylinder head", page 21:8.
8. Fill the engine with oil. Carry out a function check.

CRANKCASE VENTILATION (inspection)

Remove the nipple in the intake manifold, hoses and flame arrester (metal filter) and clean them. If necessary replace the flame arrester. At the same time check the hoses and replace them if in poor condition.

TIMING GEARS

Special tools:

2250	Puller
2408	Press tool
2424	Grip tool
2814	Puller
2815	Press tool
2816	Drift
2822	Puller

Timing gear casing

Replacing the sealing ring

1. Slacken the drive belts. Remove the bolts for the pulley and vibration damper and remove both pulley and damper.
2. Remove the centre bolt and pull off the polygon hub with puller 2814, Fig. 21–35.
   (First see whether the polygon hub can be pulled off by hand.)

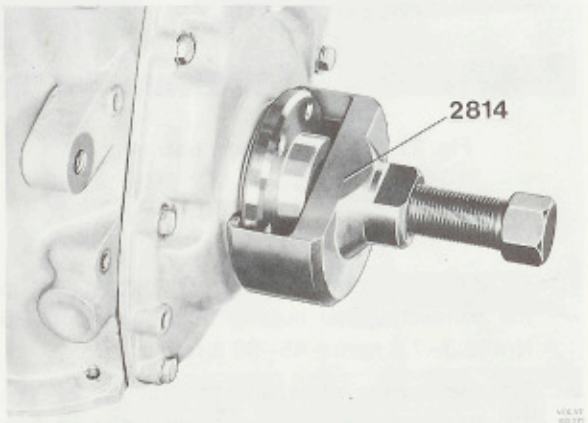


Fig. 21–35. Removing the polygon hub

3. Lever out the sealing ring. Oil the sealing lip on the new sealing ring and fit the ring with drift 2816, Fig. 21–36.

   NOTE! First inspect the wear surface on the polygon hub. The sealing ring can be fitted in three positions with drift 2816. With a new polygon hub the tool centre bolt should be screwed in fully, Fig. 21–37. In this position, the sealing ring will be placed in its outer position (position 1). With a wear mark on the polygon hub place the sealing ring in position 2 (centre bolt screwed out 1 1/4 threads). With two wear marks place the sealing ring in position 3 (centre bolt screwed out fully). With three wear marks the polygon hub should be replaced with a new one.

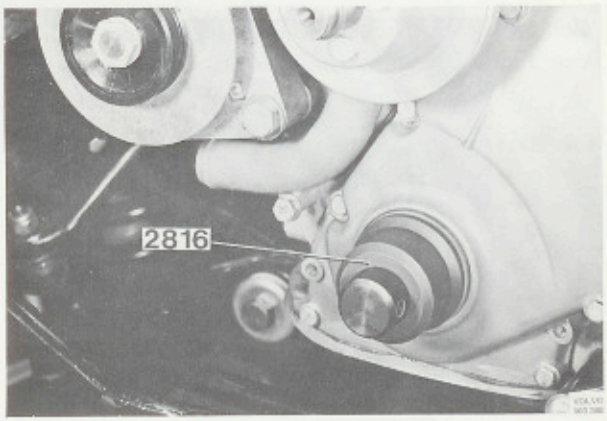


Fig. 21–36. Installing the timing gear casing seal

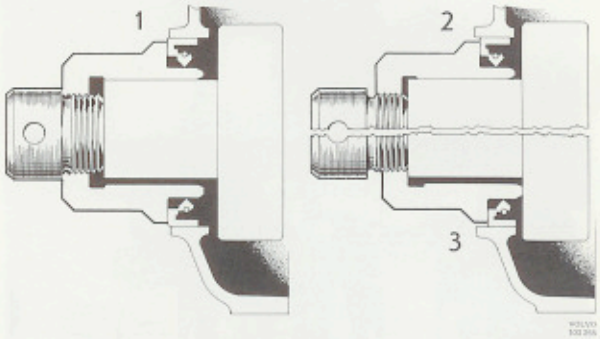


Fig. 21–37. Locations of centre bolt on tool 2816

4. Fit the polygon hub with press tool 2815, Fig. 21–38. Before fitting it, grease the slide surfaces of the hub. **Note the marking,** punch pops on the end of the crankshaft and polygon hub. Fit the centre bolt and tighten it to a torque of 95–105 Nm (9.5–10.5 kpm = 69–76 lbftf).

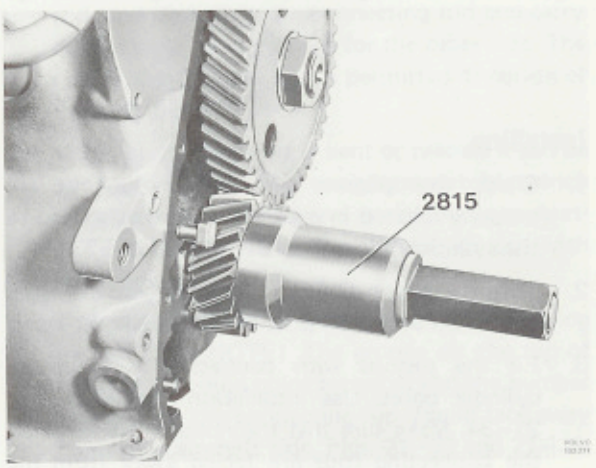


Fig. 21–38. Installing the polygon hub

5. Fit the vibration damper and pulley. The bolt holes are asymmetrically placed so that these components can only be fitted in one position.
6. Fit the drive belts and adjust the belt tension.

Removing the timing gear casing

1. Remove the fan shaft from the coolant pump pulley. Slacken the drive belts and remove the pump pulley.
2. Remove the crankshaft pulley and vibration damper.
3. Remove the centre bolt and pull off the polygon hub with puller 2814, Fig. 21–35.
   (But first try to see whether the polygon hub can be pulled off by hand.)
4. Remove the timing gear casing. Slacken a couple of bolts extra for the oil sump and observe due care not to damage the sump gasket.

Installing

1. Install the timing gear casing with gasket. The casing is located properly by means of dowels.
2. Fit the polygon hub with press tool 2815, Fig. 21–38. Before installing the hub, grease the hub slide surfaces. **Note the marking**, punch pops on the crankshaft end and polygon hub, fit the centre bolt and tighten it to a torque of 95–105 Nm (9.5–10.5 kpm = 69–76 lbftf).
3. Fit the vibration damper and pulley. The bolt holes are asymmetrically placed so damper and pulley can be fitted in one position.
4. Fit the coolant pump pulley and drive belts, and adjust the belt tension.
5. Install the fan shaft.

Timing gears

Replacing

1. Remove the timing gear casing. See under "Removing the timing gear casing", above.
2. Remove the camshaft nut and pull the gear off with puller 2250, Fig. 21–39.
3. Pull off the crankshaft with puller 2822, Fig. 21–40.
4. Screw out the oil nozzle, blow it clean and re-fit it according to Fig. 21–41.
   The gears are lubricated by oil from the nozzle.

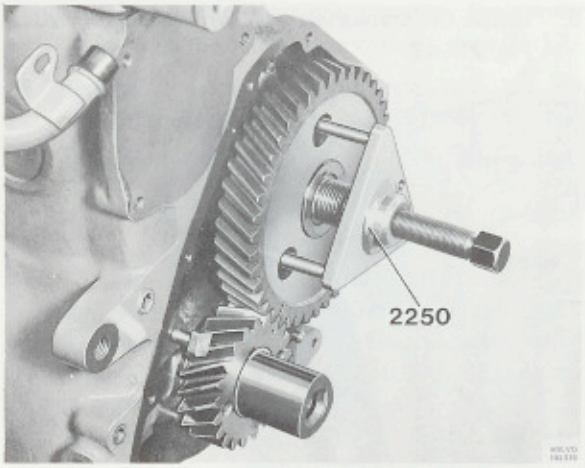


Fig. 21–39. Removing the camshaft gear

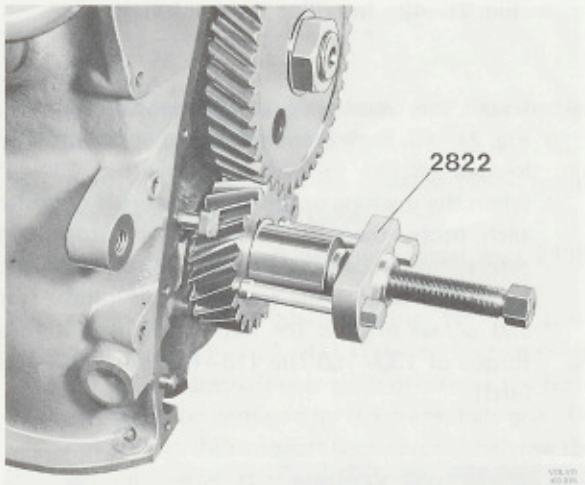
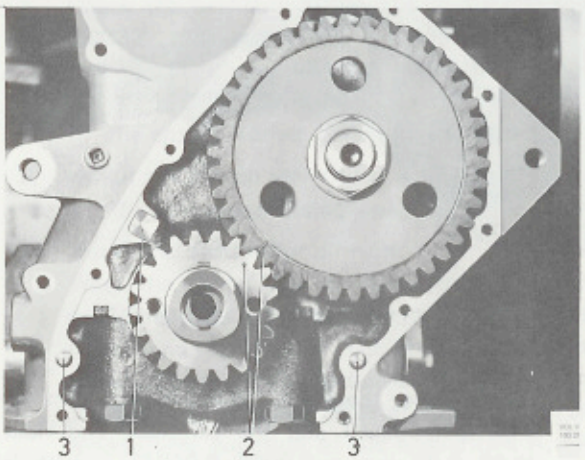


Fig. 21–40. Removing the crankshaft gear



1. Oil nozzle
2. Line-up marks
3. Dowels

Fig. 21–41. Timing gears

5. Install the crankshaft gear with press tool 2815, Fig. 21–42.

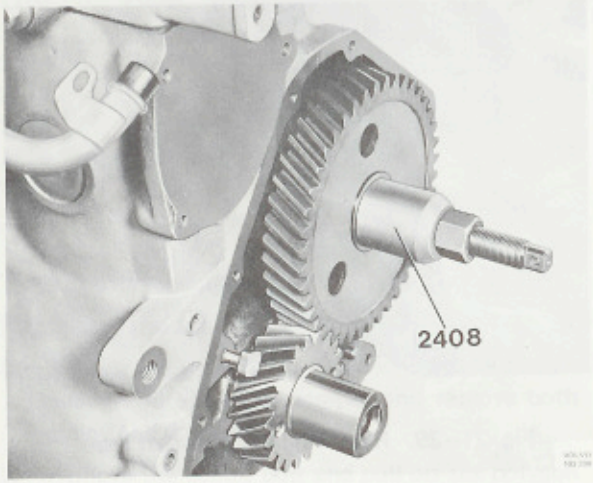


Fig. 21–42. Installing the crankshaft gear

6. Install the camshaft gear with press tool 2408, Fig. 21–43. Both gear wheels should be correctly located relative to each other, see Fig. 21–41. When the marking on the timing gears is opposite each other, then No. 6 piston is at top dead centre, firing position. Do not press the camshaft backwards so that the sealing washer on the rear end comes off. Fit the nut and tighten it to a torque of 130–150 Nm (13–15 kpm = 94–108 lbftf).

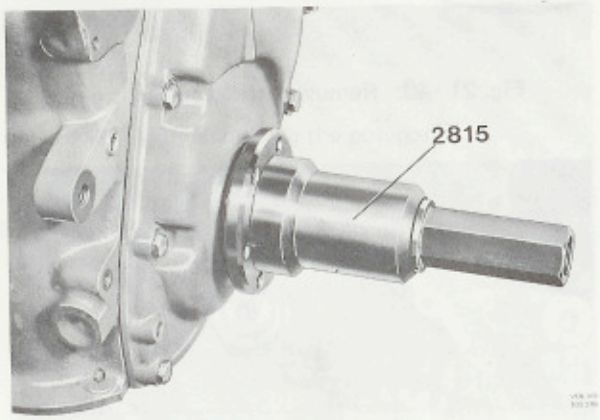


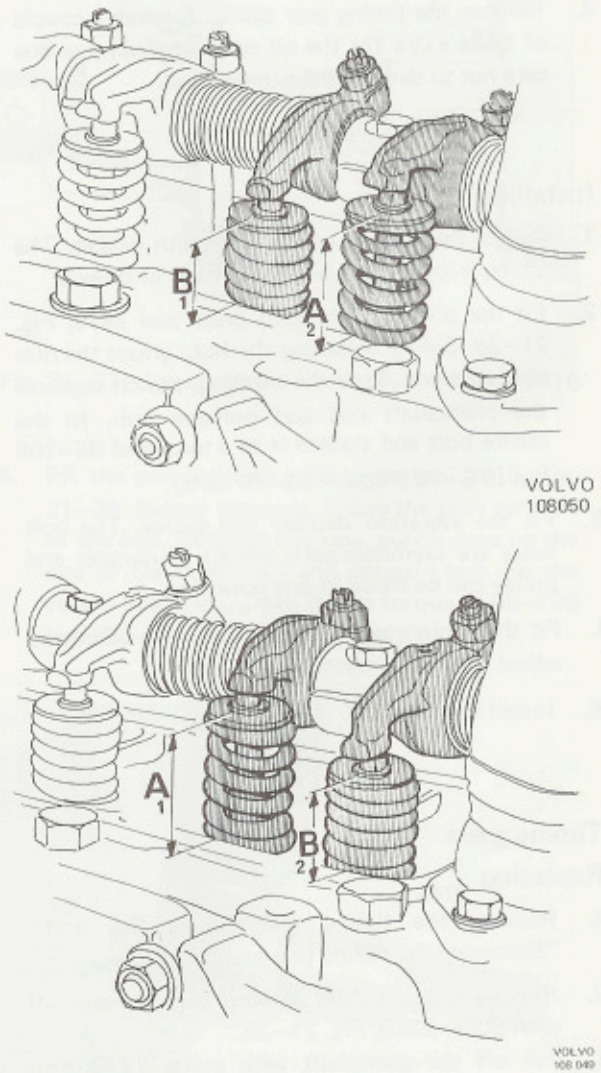
Fig. 21–43. Installing the camshaft gear

7. Check the backlash (0.04–0.08 mm = 0.0016–0.0032") and the camshaft end float (0.02–0.06 mm = 0.0008–0.0024"), which is determined by the spacer washer behind the camshaft gear.
8. Install the timing gear casing. See under "Installing the timing gear casing", page 21:17.

Camshaft

Checking camshaft wear, engine in vehicle

1. Remove the rocker arm casing.
2. Clean the rocker arm casing contact surface against the cylinder head.
3. Zero-set the valve clearance.
4. Turn over the engine until No. 1 cylinder intake valve is fully open and the exhaust valve fully closed.
5. With slide calipers measure the distance between the valve spring washer and the contact surface of the timing gear casing against the cylinder head for both the No. 1 cylinder intake and exhaust valves, Fig. 21–44. Note the measurements.



Valve lift height:
$A_1 - B_1$ and $A_2 - B_2$

Fig. 21–44. Checking the camshaft lift height

6. Turn over the engine so that the exhaust valve is fully open and the intake valve fully closed.
7. Measure the distance again between the valve spring washer and the contact surface of the rocker arm cover, for both the valves, Fig. 21–44. Note the measurements.
8. Calculate the lifting height of the valves deducting the measurement for the open valve from the measurement for the closed valve.
9. Measure and calculate correspondingly for the other cylinders. The difference between the maximum and minimum lifting height should not exceed 0.7 mm (0.028").
10. If necessary replace the camshaft.
11. Adjust the valve clearance, which should be 0.40–0.45 mm (0.016–0.018").
12. Install the rocker arm cover.

Removing and checking

1. Remove the cylinder head. See under "Removing the cylinder head", page 21:8.
2. Lift up the valve tappets with tool 2424, Fig. 21–45.

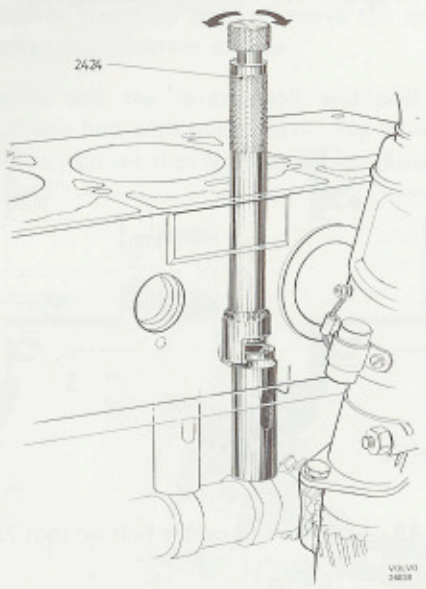


Fig. 21–45. Lifting out valve tappets

3. Remove the fuel pump.
4. Remove the ignition distributor and the distributor pinion.
5. Remove the timing gear casing. See under "Removing the timing gear casing", page 21:17.
6. Remove the camshaft nut and pull off the camshaft gear with puller 2250, Fig. 21–39.
7. Remove the thrust flange and the spacer washer.
8. Take out the camshaft.
9. Check the camshaft for straightness and wear. The out-of-round on the bearing journals may amount to 0.07 mm (0.0028"), providing that the bushings are replaced. The diameter of the bearing journals should be 46.975–47.000 mm (1.8494–1.8504").
   If the indicated values are not maintained or if the cams are worn, replace the camshaft.
10. Also check that the camshaft bearings are not excessively worn. Permissible wear up to 0.02 mm (0.0008").

Installing

1. Check that the camshaft has an "A" punched onto the front end.
2. Insert the camshaft in the cylinder block. Install the spacer washer and thrust flange.
3. Install the camshaft gear with press tool 2408, Fig. 21–43.
   Make sure that the marking on the gears coincide (2, Fig. 21–41). Take care when pressing in the camshaft gear since otherwise the teeth can easily be damaged by the crankshaft gear. Do not press in the camshaft backwards otherwise the sealing washer at the rear camshaft bearing will fall off. Install and tighten up the camshaft nut to a torque of 130–150 Nm (13–15 kpm = 94–108 lbftf).
4. Check the backlash (0.04–0.08 mm = 0.0016–0.0032", max. permitted 0.12 mm = 0.0048") and the camshaft end float (0.02–0.06 mm = 0.0008–0.0024"). The end float is determined by the spacer washer behind the camshaft gear.
5. Install the timing gear cover. See under "Installing the timing gear casing", page 21:17.
6. Install the distribuitor pinnion.
   When the engine is at top dead centre and firing on No. 1 cylinder, install the pinion for the oil pump and distributor. The small end of the groove is faced obliquely upwards-backwards and the groove is set at an angle of about 35° to the longitudinal direction of the engine (see A, Fig. 21–46). Make sure that the shaft goes down into its groove in the pump shaft. (NOTE! When the marking on the timing gears are opposite each other then the No. 6 piston is at top dead centre, firing position.)

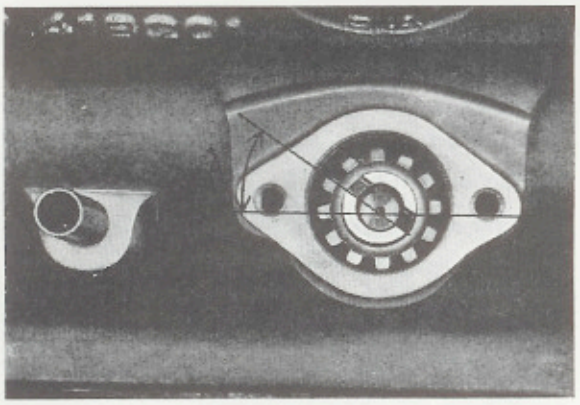


Fig. 21–46. Location of distributor pinion

A =approx 35°

7. Install the valve tappets, with grip tool 2424.
8. Install the distributor and fuel pump.
9. Install the cylinder head. See under "Installing the cylinder head", page 21:8.

Camshaft bearings

Replacing (engine removed)

When the camshaft bearings are worn more than 0.02 mm (0.0008") they should be replaced with new ones. If this work is to be done fully satisfactorily, a drilling machine must be available. When pressing in the new bearings make sure that the lubricating holes are opposite the oil channels in the block.

CRANK MECHANISM

Special tools

1426	Drift
2814	Puller
2815	Press tool
2816	Drift
2817	Tool for pressing sealing ring in and out
4090	Extractor

Crankshaft

Replacing rear crankshaft seal (gearbox removed)

1. Remove the reinforcing bracket.
2. Line-up mark and remove the clutch and flywheel.
3. Remove the two oil sump bolts fixed to the sealing flange. Slacken a couple of the oil sump bolts so that the sump does not press against the sealing flange.
4. Remove the sealing flange.
5. Press out the old seal with the drift for tool 2817. Use a suitable cushion for the sealing flange in order not to damage it.
6. Press in the sealing ring with tool 2817, Fig. 21–47. **NOTE!** First inspect the wear surface of the crankshaft. The sealing ring can be installed in three positions with 2817, see Fig. 21–48. With a new crankshaft or with a crankshaft without noticeable wear on the surface, place the sealing in its outer position (centre bolt screwed in fully). With wear marks on the crankshaft, place it with the centre bolt screwed out two threads or screwed out fully.

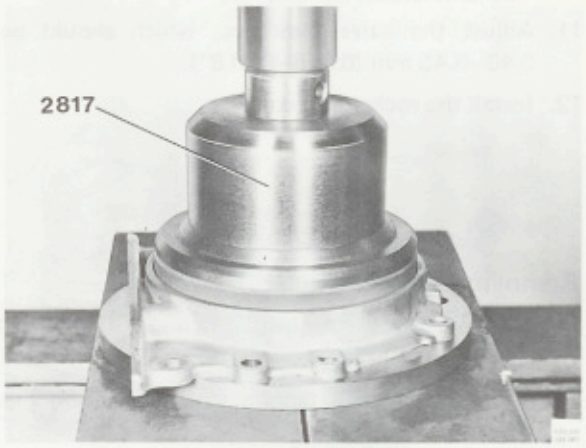


Fig. 21–47. Pressing in sealing ring

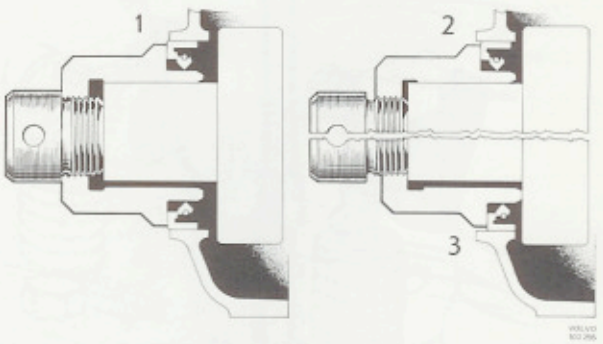


Fig. 21–48. Locations of centre bolt on tool 2817

7. Install the sealing flange with a well-cleaned sealing surface and new gasket. (Oil first the sealing lip.) The sealing flange should be fitted on the crankshaft with due care, see Fig. 21–49. Fit on the sealing lip with a finger.

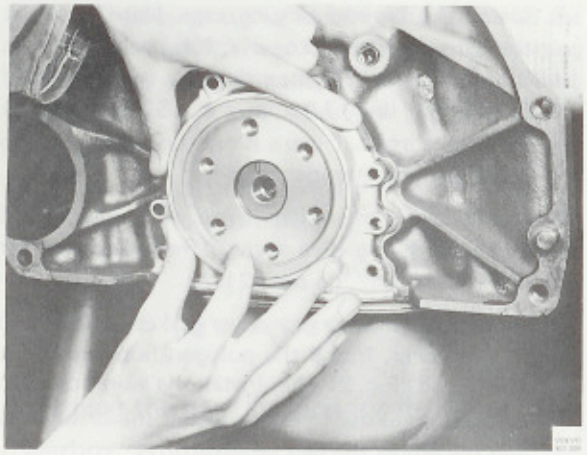


Fig. 21–49. Installing the sealing flange

8. Install the oil sump bolts.
9. Install the flywheel and clutch. Note the line-up marks, see point 1.
10. Install the reinforcing bracket.

Removing the crankshaft (engine removed)

1. Line-up mark and remove the clutch and flywheel.
2. Remove the oil sump, sealing plate and oil pump.
3. Slacken the drive belts. Remove the crankshaft pulley and vibration damper.
4. Screw out the centre bolt and pull off the polygon hub with puller 2814, Fig. 21–50. (But first try to see that the hub can be pulled off by hand.)

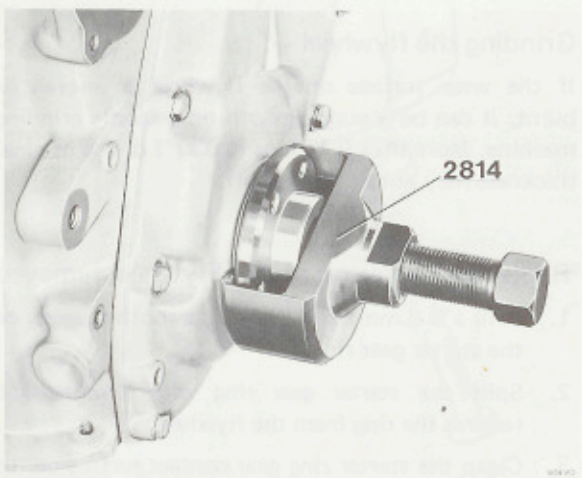


Fig. 21–50. Removing the polygon hub

5. Remove the timing gear casing and the rear sealing flange.
6. Remove the caps for the big-end and main bearings.
7. Lift out the crankshaft.

Checking

After cleaning the crankshaft measure its journals with a micrometer. Measure at different points round the circumference and on the length. Out-of-roundness on the main bearing journals may not exceed 0.05 mm (0.0020"), and that on the connecting rod journals 0.07 mm (0.0028"). Taper may not be greater than 0.05 mm (0.0020") for any of the journals.

If the measurements are close to or exceed the wear indicated above, grind the crankshaft to undersize. Suitable bearing shells are available in 2 undersizes. Concerning measurements, see the data on page 20:4.

Check that the shaft is straight within 0.05 mm (0.0020") by means of a dial indicator. Place the shaft in two V-blocks and place a dial indicator on the centre journal and then rotate the shaft. If necessary straighten the shaft in a press.

Grinding

Before being ground, the crankshaft must be straight. This should be checked according to the previous paragraph. Grinding is carried out in a special machine and the main bearing and big-end bearing journals are ground to similar measurements. These measurements, which are indicated in the data given on page 20:4, must be accurately followed in order to get the correct bearing clearance with the ready-machined bearing shells.

Under no circumstances whatsoever may the bearing shells be shaved or the caps filed.

The journal fillets should be 2.0–2.5 mm (0.08–0.10") for all journals, Fig. 21–51. The width measurement (A) for the pilot bearing will depend on the size of the journal and should be ground so that the correct measurement is obtained. After the grinding the oil channel openings should be carefully cleaned and all journals lapped with a fine lapping paste to best surface finish, after which the shaft is washed. Clean all oil channels with particular thoroughness in order to remove all residues of filings and grinding paste.

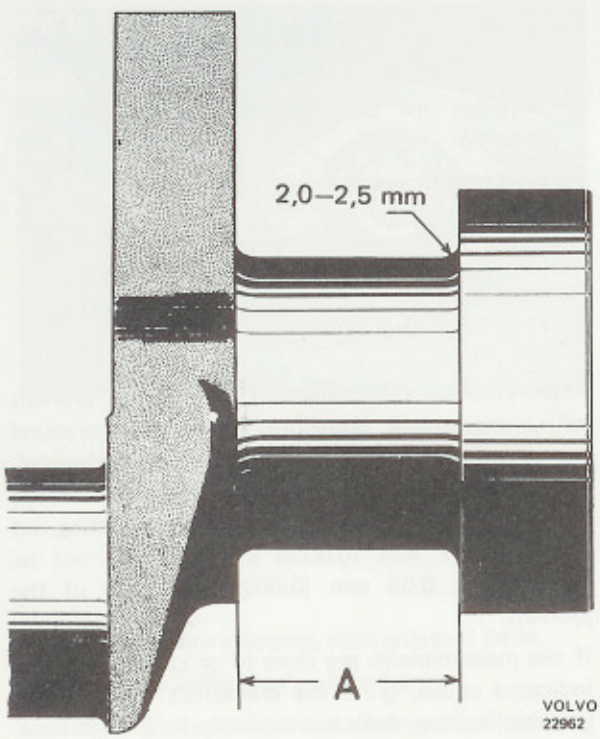


Fig. 21–51. Bearing journal

Installing

1. Clean all the bearing seats and fit bearing shells with the correct size.
   In addition to the standard size, there are bearing shells available with undersizes 0.010" and 0.020". The rear main bearing shells are provided with flanges and have a wider width in relation to the size. If the crankshaft has been ground to the correct measurement, the correct bearing clearance will be obtained when the corresponding bearing shell is fitted. The bearing shells must not be shaved and the caps must never be filed in order to get a tighter fit for the bearings.
2. Oil the bearing shells and carefully install the crankshaft in position.
   Note the line-up marks on the timing gears.
3. Install the lower main bearing shells in the caps and oil them.
4. Install the main bearing caps. Tighten the bolts in stages to a torque of 120–130 Nm (12–13 kpm = 87–94 lbftf). Between tightenings turn over the crankshaft and check that it does not jam.
5. Measure the crankshaft end float which should be 0.037–0.147 mm (0.0015–0.0058").
6. Install the big-end bearings in the caps and oil them.
7. Install the big-end bearing caps. Make sure that the caps are fitted properly. New bolts and nuts should be used. Tighten the nuts to a torque of 63–70 Nm (6.3–7.0 kpm = 45–51 lbftf). Check to make sure that there is end float and that no bearing shows a tendency to jam.
8. Install the rear sealing flange, with new gasket and sealing ring. See under "Replacing the rear crankshaft seal", on page 21:20.
9. Replace the timing gear cover gasket and seal and fit the cover. Install the polygon hub with press tool 2815, Fig. 21–52. Install the vibration damper and crankshaft pulley. Install the drive belts and the adjust the belt tension.

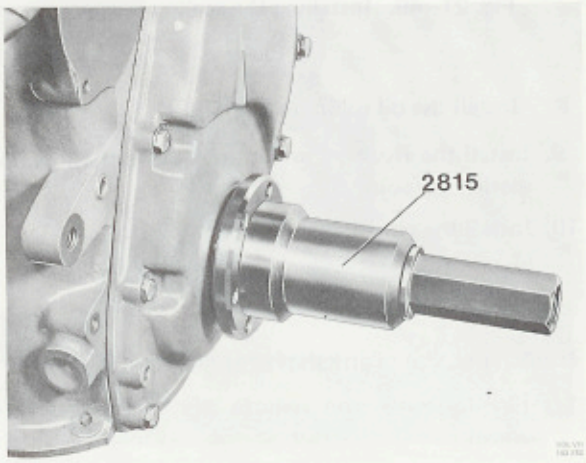


Fig. 21–52. Installing the polygon hub

10. Install the oil pump, sealing plate and oil sump with new gasket. The "tongue" on the oil sump gasket should face the starter motor flange.
11. Install the flywheel and clutch. Note the line-up marks for these components, see point 1 "Removing".

Grinding the flywheel

If the wear surface on the flywheel is uneven or burnt, it can be ground smooth on a saddle grinding machine. More than 0.75 mm (0.030") of the original thickness may not be ground off.

Replacing starter gear ring (Flywheel removed)

1. Drill a Ø 6 mm (1/4") hole in a tooth opening on the starter gear ring.
2. Split the starter gear ring with a chisel and remove the ring from the flywheel.
3. Clean the starter ring gear contact surface on the flywheel.
4. Polish the starter gear ring at three points.

5. Heat the ring with a welding flame. Spread the heat evenly all round. Discontinue the heating when the polished surfaces become blue. **Note!** Be careful not to overheat the ring otherwise it might warp.
6. Place the starter gear ring on the flywheel and drive it into position with a copper drift or similar tool. The bevel on the ring should face forwards.
7. Allow the ring to cool in the open air.

Replacing the pilot bearing for the input shaft (Gearbox removed)

1. Make line-up marks on the clutch and remove the clutch.
2. Remove the bearing circlip and protective washer and pull out the bearing with puller 4090.
3. Check the bearing after having cleaned it in white spirit. Replace it if it is worn.
4. Pack the bearing with heat-resistant ball bearing grease.
5. Install the bearing with drift 1426.
6. Install the protective washer and circlip.
7. Install the clutch. Note the line-up marks, see point 1.

Replacing the rear engine mount

Fig. 21–53 Rear engine mount

Replacing the front engine mount

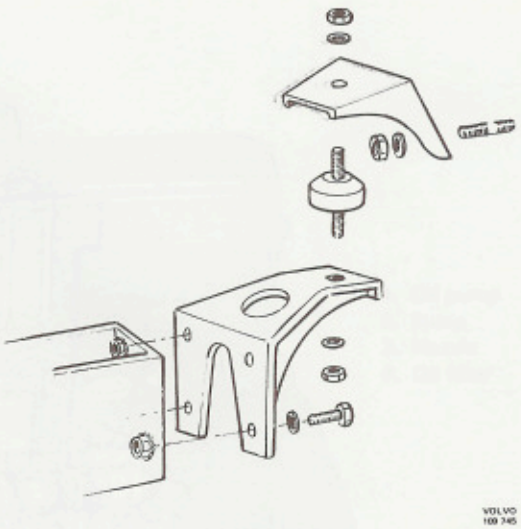


Fig. 21–54. Front engine mount

GROUP 22 LUBRICATING SYSTEM

Description

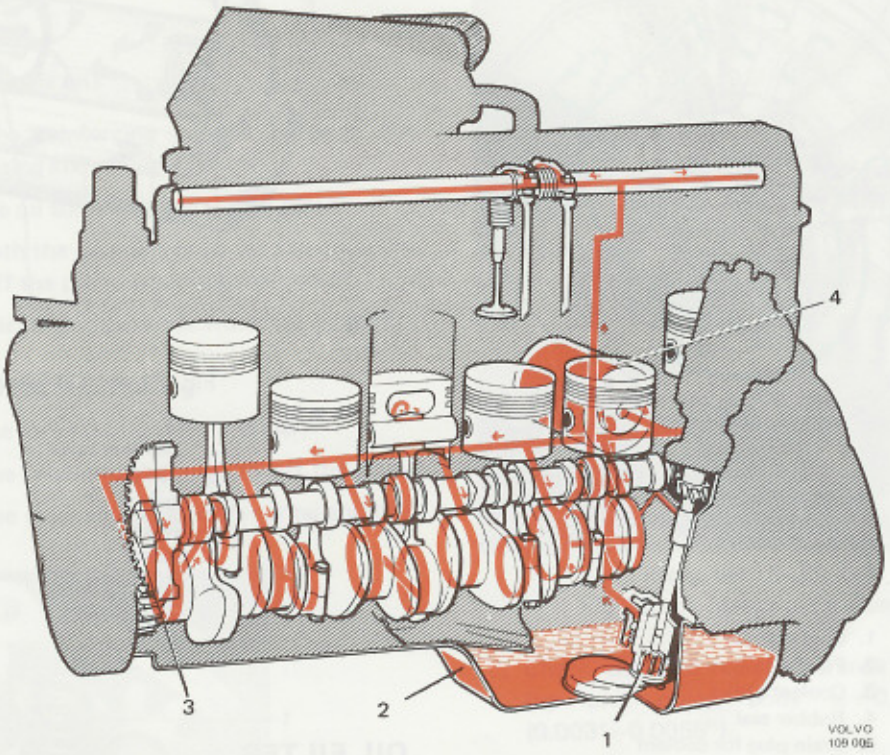


Fig. 22–1. Lubricating system

The engine has a force-feed lubricating system, Fig. 22–1. Pressure is provided by a gear pump driven from the camshaft and fitted under the crankshaft in the sump. The gear pump forces oil past the relief valve, which is also fitted on the pump, through the oil filter and then through oilways out to the various lubricating points. All the oil supplied in the lubricating points, therefore, first passes through the oil filter.

OIL PUMP, RELIEF VALVE

The oil pump (Fig. 22–2) is of the gear type and is driven via a gear train from the camshaft. When the pump gear is set in rotation, oil is transported to the tooth gaps along the walls of the pump body from the suction to the discharge side. The discharge pipe from the pump to the block does not have screw unions and is, therefore, automatically tightened in position when the attaching bolts for the pump are tightened up. At each end of the pipe there are sealing rings made of special rubber.

The relief valve is located in the pump and consists of a spring-loaded ball which seals against a seat in the pump body.

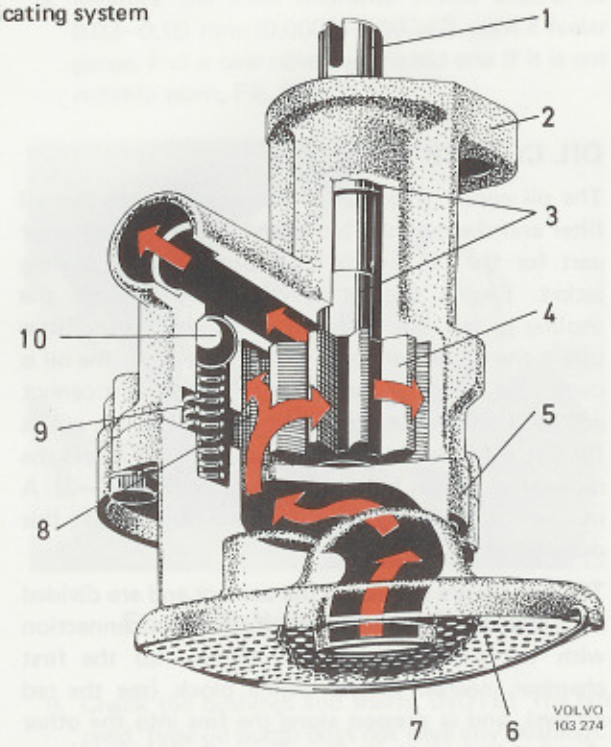


Fig. 22–2. Oil pump

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

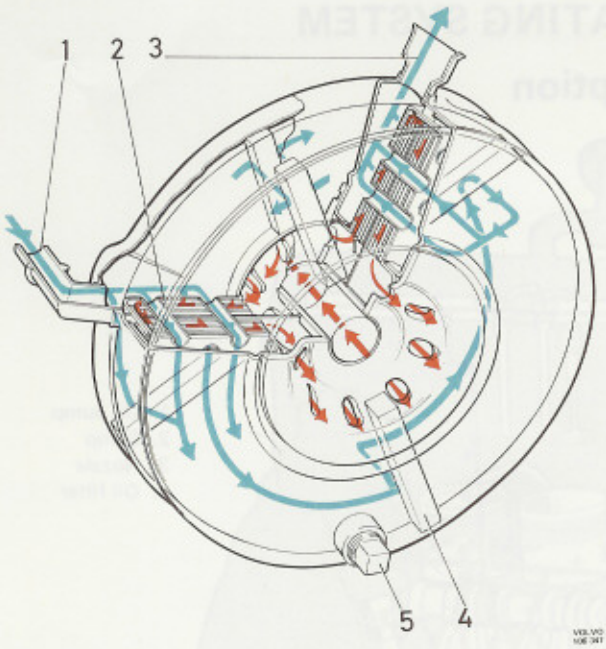


Fig. 22–3. Oil cooler

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

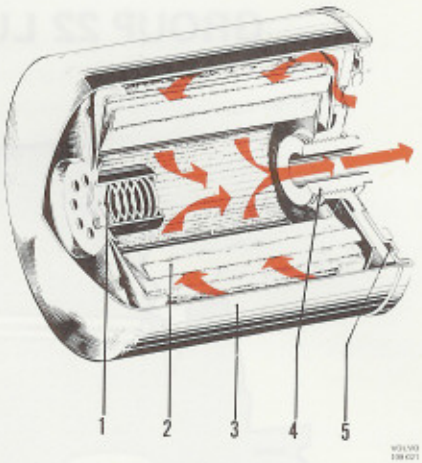


Fig. 22–4 Oil filter

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

OIL COOLER

The oil cooler (Fig. 22–3) is fixed between the oil filter and the cylinder block and consists of an inner part for the oil, which is surrounded by a cooling jacket. Engine coolant is conducted through the cooling jacket. Since the oil on its way to the filter passes the oil cooler some of the heat from the oil is cooled by means of the coolant. The coolant cannot go the shortest route from the inlet (1) to the outlet (3) but is forced to take a zig-zag path and round the radiator as shown by the blue arrows (Fig. 22–3). A number of rubber seals (4) force the fluid to take this definite route.

The fins (2) are cooled by the coolant and are divided by a plate into two chambers which are in connection with the fin periphery. Oil comes into the first chamber, nearest to the engine block (see the red arrows), and is pressed along the fins into the other chamber and along its fins. From there it continues on into the oil filter.

OIL FILTER

The oil filter (Fig. 22–4), which is made as a single unit complete with element, is of the full-flow type and is screwed directly onto the cylinder block. Oil 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 blocked so that it has to be replaced, remove and discard the old filter and fit a new one.

Service Procedures

OIL PUMP

Removing

1. Drain the engine oil.
2. Remove the reinforcing bracket between the flywheel casing and cylinder block.
3. Remove the oil sump and the sealing plate.
4. Remove both the retaining bolts for the oil pump and take off the pump and discharge pipe.
5. Pull the discharge pipe loose from the oil pump.

Checking and reconditioning

1. Remove the lock clasp and the strainer.
2. Remove the retaining bolts and lift off the cover.
3. Lift out the gears and relief valve spring and ball.

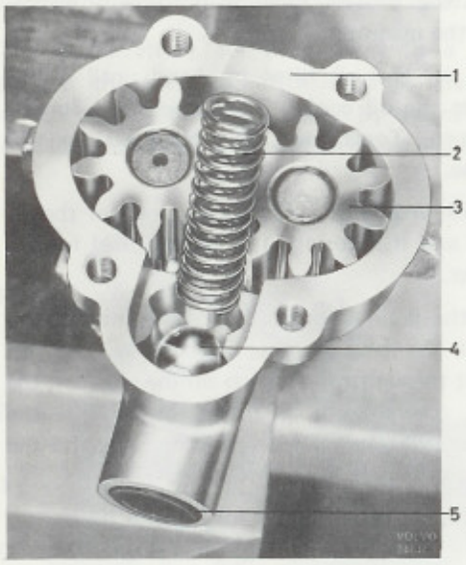


Fig. 22–5. Oil pump

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

4. Clean all parts.
5. Check the relief valve seat, ball and spring. Test the spring in a spring tester. Unloaded it should be 39 mm (1.5") in length, loaded with 50 ±4 N (111 ±9 lbf) it should be 26.25 mm (1.0") and loaded with 70 ±8 N (154 ±18 lbf) it should be 21 mm (0.8") in length.
6. Check to see whether the gear flanks, tops or ends are worn. Replace damaged or worn gears. Check that the backlash is 0.15–0.25 mm (0.006–0.010"), Fig. 22–6.

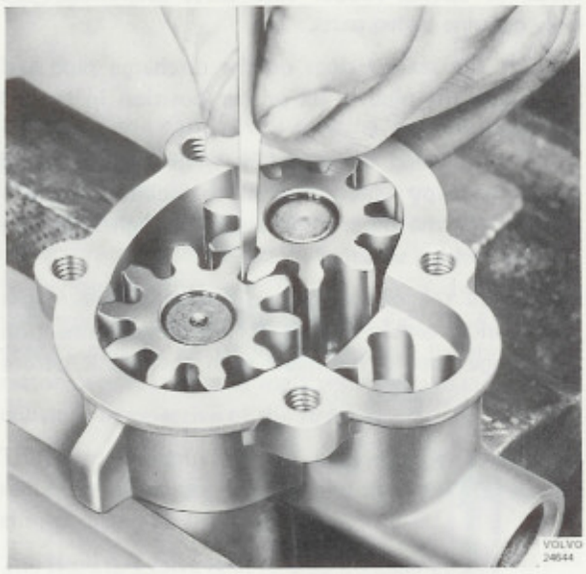


Fig. 22–6. Measuring the backlash

7. Check that the radial clearance between tooth top and pump body is 0.08–0.14 mm (0.0031–0.0055").
8. Measure the axial clearance which should be 0.02–0.10 mm (0.0008–0.0039") with a feeler gauge, and a new cover or the old one if it is not notably worn, Fig. 22–7.

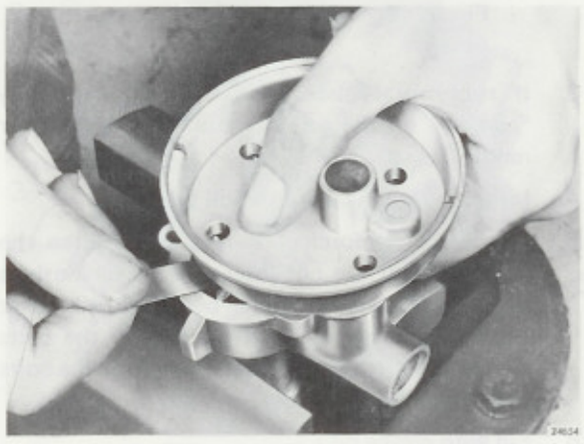


Fig. 22–7. Measuring the axial clearance

9. Check the bushings and shafts. (NOTE! The late prod. type oil pump does not have any bushings.) If necessary replace them with new ones. The drive shaft and gear wheel are replaced as a single unit.
   After being pressed in, the new bushings should be reamed with a guided reamer.
10. Assemble the oil pump.

Installing

The sealing rings at the ends of the discharge pipe are made of special rubber with close tolerances. Use only genuine Volvo parts.

1. Fit the sealing rings on the discharge pipe and insert the pipe in its proper position in the oil pump.
   Before being installed, the rings can be coated with soapy water in order to facilitate installation of the pipe. If necessary tap lightly on the pipe with a soft mallet.
2. Install the oil pump and discharge pipe in the cylinder block, Fig. 22–8. The pump connection flange should be flush with the block before being tightened up.

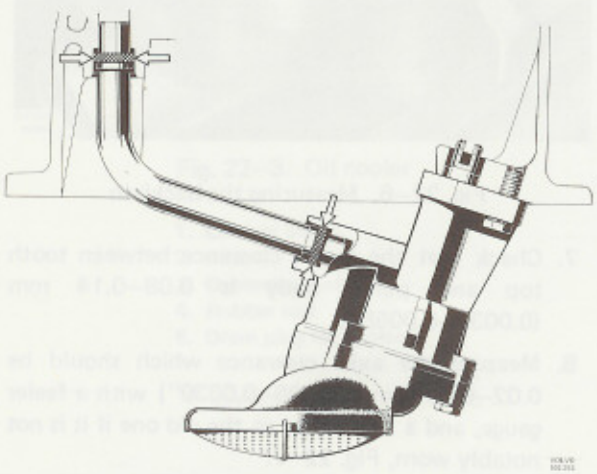


Fig. 22–8. Sealing rings on discharge pipe

3. If necessary replace the oil sump gasket. The "tongue" on the gasket should face the starter motor flange.
4. Install the sealing plate and oil sump.
5. Install the reinforcing bracket and tighten the bolts by hand. Do not forget the spacer washers on the front retaining bolts, between the bracket and cylinder block. Then tighten up the bolts against the clutch casing and thereafter the bolts against the cylinder block.
6. Fill with engine oil.
7. Start the engine and check for oil leakage.

Replacing the oil cooler

1. Drain the coolant by opening the drain cock on the lower radiator pipe running from the engine and remove the plug in the oil cooler.
2. Remove the oil filter. Use tool 2903 or similar, e.g., chain tongs.
3. Remove the clamps holding the coolant pipes together under the manifold.
4. Unscrew the nut from the nipple in the centre of the oil cooler.
5. Remove the coolant pipe from the oil cooler and pull the oil cooler from the nipple.
   If the nipple is replaced, the new nipple should be tightened to a torque of 45–55 Nm (4.5–5.5 kpm = 33–40 lbftf).
6. Fit the new sealing washers for the coolant pipe connections. The groove for the sealing ring in the oil cooler should be coated with a light layer of glue, resistant to oil up to 140° C (284° F) (e.g. Pliobond). Install the sealing ring.
7. Install the oil cooler on the nipple in the cylinder block and fit the nut. Tighten the nut to a torque of 10 Nm (1 kpm = 7 lbftf) and check that the oil cooler is tight against the cylinder block. Then tighten the nut to a torque of 30–35 Nm (3.0–3.5 kpm = 22–25 lbftf).
8. Install the coolant pipe.
9. Clamp the coolant pipes in position, 2 clamps under the manifold.
10. Screw on the oil filter by hand until it just touches the oil cooler. Then screw it a further half turn. **Tools must not be used for this purpose.**
11. Fill with engine oil, 1/2 litre (1 pint) for the oil cooler and if necessary 1/2 litre (1 pint) for the oil filter.
12. Close the drain cock on the lower radiator pipe and fit the plug in the oil cooler. Fill with coolant through the opening on the radiator, the heater control should be at MAX. Fill the radiator fully and put on the cap. Also fill the expansion tank to the MAX. mark.
13. Start the engine and check for leakage.

Replacing the oil filter

Together with the insert and overflow valve, the oil filter forms a single unit screwed on to a nipple which is attached to the cylinder block. When replacing, scrap the old oil filter. Replacement is as follows:

1. Remove the oil filter with tool 2903 or similar, e.g., chain tongs.
2. Apply oil to the new oil filter rubber gasket and make sure that the contact surface is free from dirt.
3. Screw on the new oil filter until it just touches the oil cooler. Then screw the filter a further half turn. **Tools are not to be used for this purpose.**
4. Fill with 1/2 litre (1 pint) engine oil.
5. Start the engine and check for leakage at the joints.

GROUP 23 FUEL SYSTEM

Description

CARBURETTORS

The engine is fitted with two horizontal carburettors of type Stromberg 175 CD-2SE. The design and construction can be seen from Figs. 23–1, 23–2, 23–3 and 23–4.

The carburettor consists of three main parts of light-alloy, the middle part of which comprises the carburettor housing. The lower section is made up of a floatchamber, which houses 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. The suction chamber is linked by means of channels in the valve to the space between the carburettor throttle and valve.

The carburrettors are provided with a fixed jet pressed into the carburettor housing. The fuel flow orifice area of this jet is varied by means of a movable tapered needle. The position of the needle is determined by the carburettor housing vacuum operating an air valve in which the needle is fitted in a spring-loaded suspension. The spring force always presses the needle against the same side of the jet, and this ensures an accurately controlled fuel flow through the jet. Both carburettors are fitted with a temperature compensator (6, Fig. 23–2 and 2, Fig. 23–4). This is constructed as an air valve regulated by the carburettor temperature and maintains the fuel-air mixture constant irrespective of the fuel temperature.

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

The hot-start valve is described on page 23:5.

The front carburettor has a vacuum connection for positive advance setting of the ignition distributor. The rear carburettor is provided with a cold-start device.

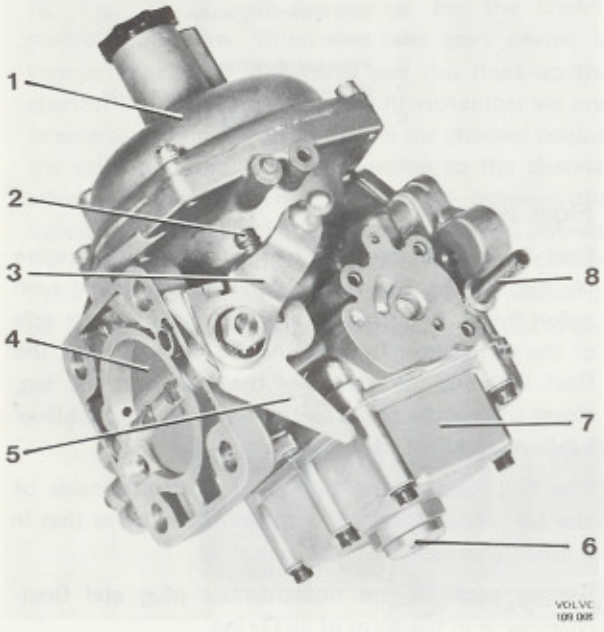


Fig. 23–1. Front carburettor, from left

1. Suction chamber
2. Throttle stop screw
3. Lever
4. Primary throttle
5. Throttle spindle cam (for regulating secondary throttle)
6. Floatchamber plug
7. Floatchamber
8. Fuel inlet

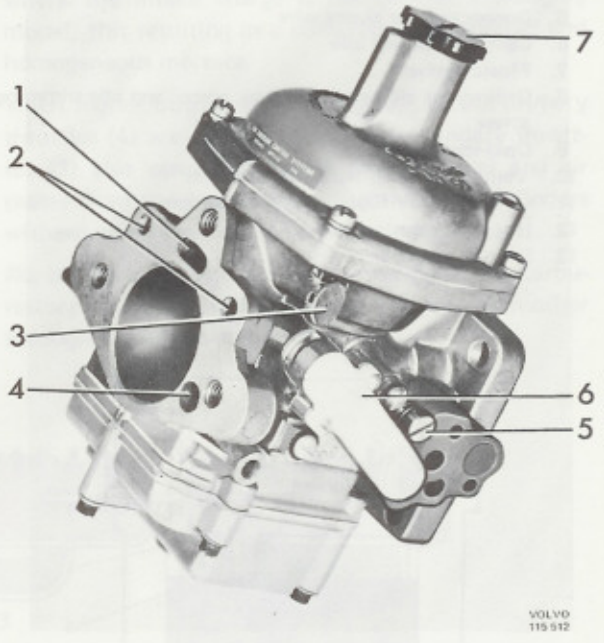


Fig. 23–2. Front carburettor, from right

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

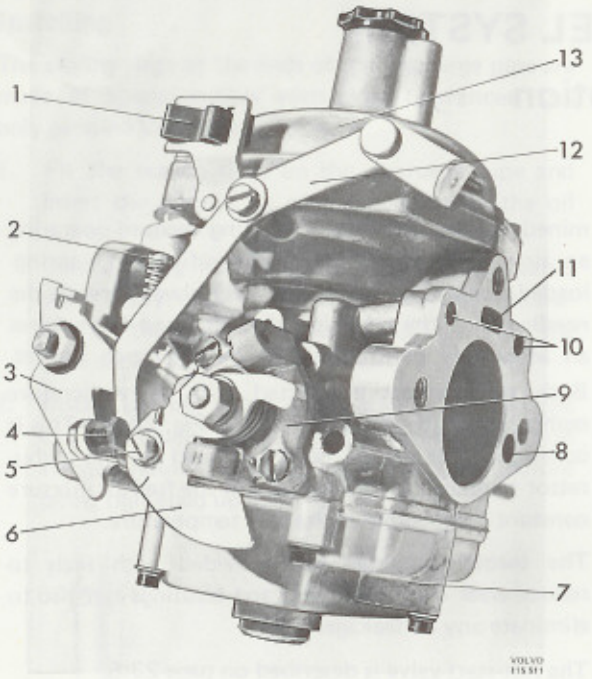


Fig. 23–3. Rear carburettor, from left

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

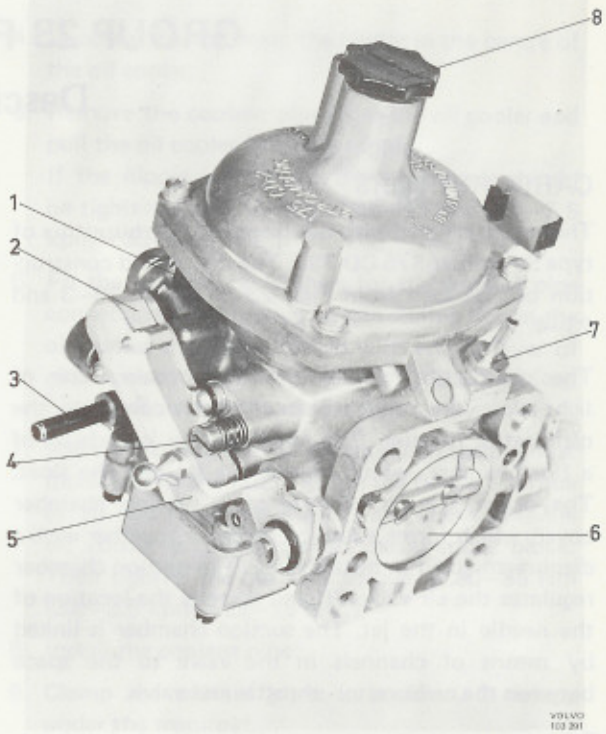


Fig. 23–4. Rear carburettor, from right

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

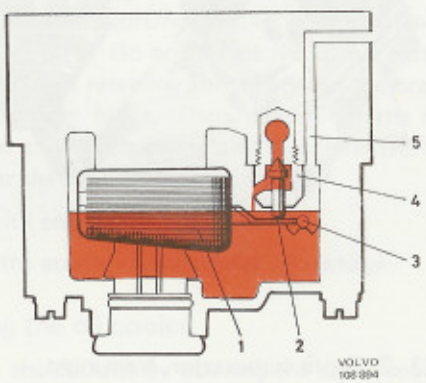


Fig. 23–5. Float system

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

Float system

Fuel flows into the floatchamber via the float valve (4, Fig. 23–5). The float, which is made up of twin nylon floats, is carried on a bridge on the lower side of the carburettor housing. As the fuel level rises, the float lifts and, by means of the float arm and tag, closes the needle on its seating when the correct level has been reached.

The fuel rises in the fuel jet pipe to the inside of the jet, where the level becomes the same as that in the floatchamber.

Sealing between the floatchamber plug and floatchamber is in the form of an O-ring.

Cold start device and fast idle

To make starting easier during cold weather, the rear carburettor is fitted with a cold start device (9, Fig. 23–3).

The cold start device consists of a valve disc (3, Fig. 23–6) provided with four calibrated holes and an elongated opening as well as a disc (4) mounted on a spindle which is operated by the choke. Outside the

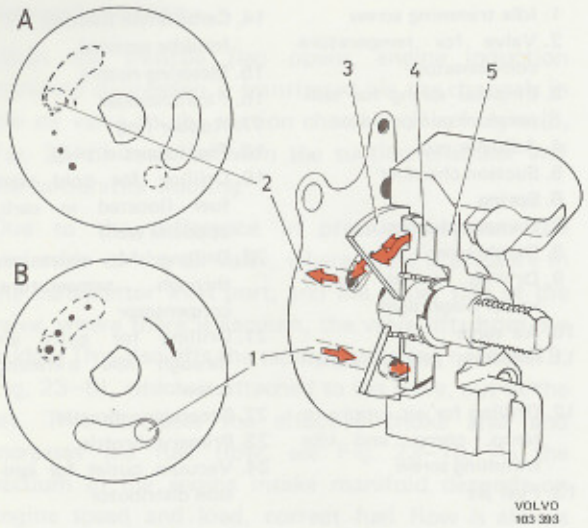


Fig. 23–6. Cold start device

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

housing (5) on the same spindle, there is a cam disc (6, Fig. 23–3) 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. 23–6) from the floatchamber via one or several of the calibrated holes to the channel behind the valve disc and then the opening to the channel which terminates in the ventury (2) between the vacuum plunger and choke flap. Through this link-up, the engine receives extra fuel (richer mixture), to facilitate cold starts. At the same time a small supply of air is also obtained through the choke device. When the choke is pushed in, the valve disc turns and closes the inlet to the channel. At the same time the cam disc is operated, the throttle flap opening is also influenced in such a way that turning the cam disc opens the throttle through the fast idle stop screw (4, Fig. 23–3) and the lever, before any of the calibrated holes open the connection to the fuel drilling. Thanks to this arrangement, the idling speed can if necessary be raised by the driver of the vehicle during the warming-up period of the engine.

Exhaust emission control system

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

How the system works is illustrated in Fig. 23–7.

The intake manifold is fitted with a secondary throttle (3) at each carburettor. For normal driving, (with low power output) the throttles (3) are closed thus forcing the mixture of fuel and air from the carburettors to a central pre-heating chamber (6) where the intake charge is heated and thoroughly mixed, this resulting in a completely evaporated and homogeneous mixture.

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

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

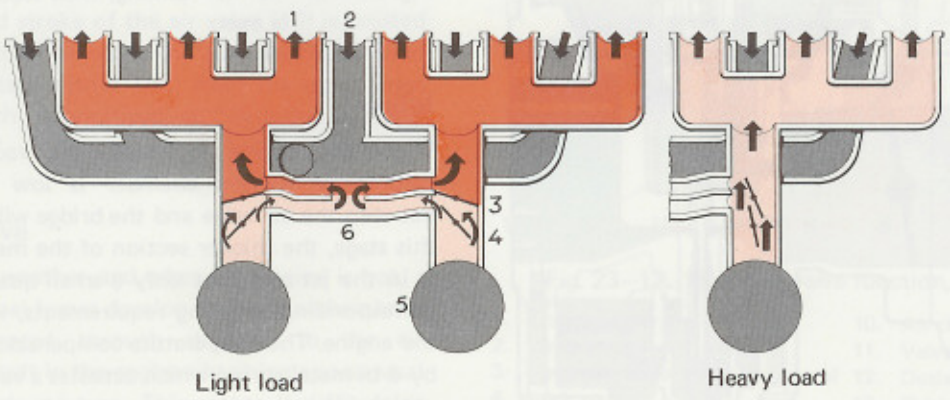


Fig. 23–7. Exhaust emission control system, principle of operation

1. Intake manifold
2. Exhaust manifold
3. Secondary throttle
4. Primary throttle
5. Carburettor
6. Pre-heating chamber

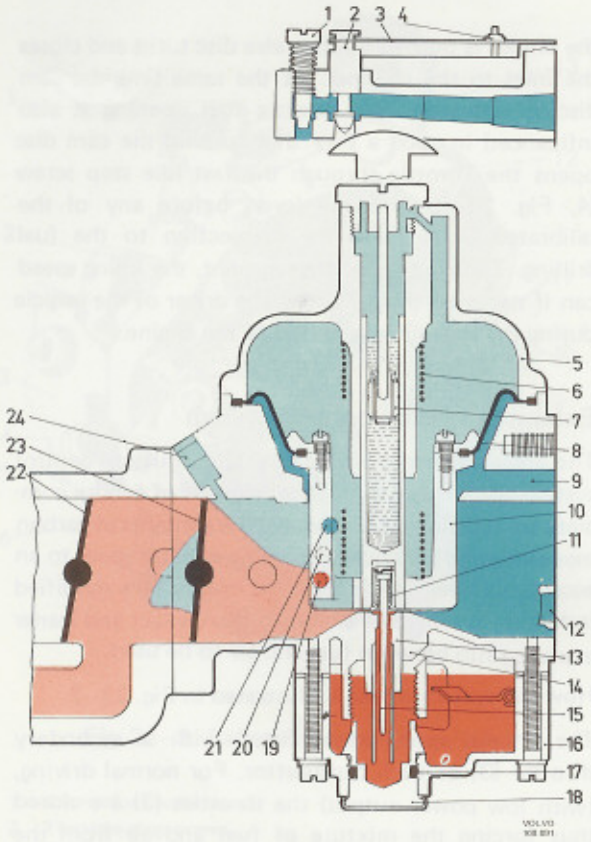


Fig. 23–8. Cold starting, principle

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. comp. and idle trimming screw
13. Fuel jet
14. Carburettor housing (middle section)
15. Metering needle
16. Floatchamber
17. Rubber ring
18. Floatchamber plug
19. Drilling for cold start fuel (located in carb. opposite wall)
20. Drilling for extra air through temperature compensator
21. Drilling for extra air through idle trimming screw
22. Secondary throttle
23. Primary throttle
24. Vacuum outlet for ignition distributor

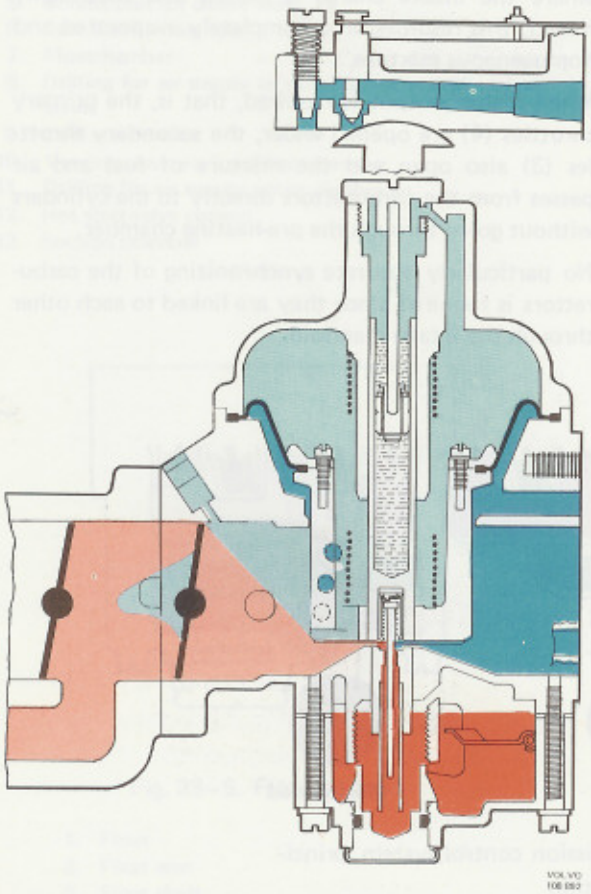


Fig. 23–9. Idling engine

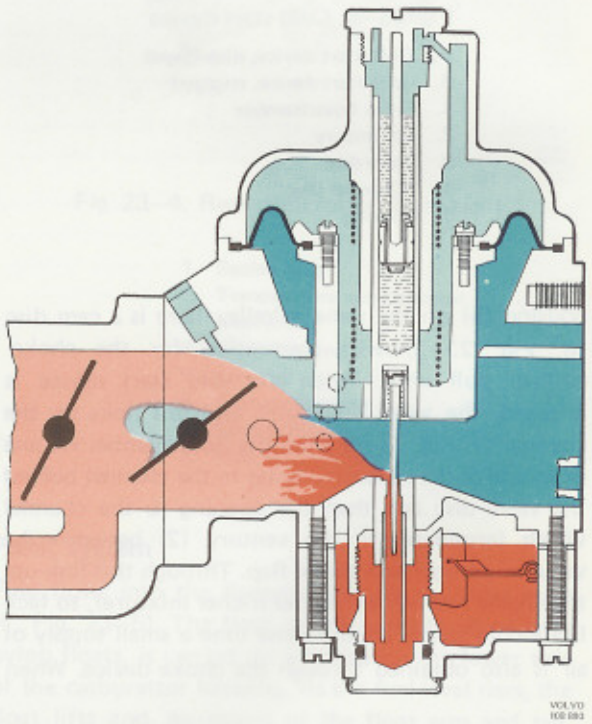


Fig. 23–10. Normal running, with secondary throttle open

Idling

When the engine is idling, the vacuum in the carburettor suction chamber is low and the gap between the air valve and the bridge will be small. 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 is regulated by a bi-metal spring which actuates a valve. When the engine is hot and the temperature in the carburettor rises, the valve opens and air is supplied to the carburettor ventury to compensate for the increase in the fuel flow, which is obtained due to the alteration in the fuel's viscosity, see Fig. 23–9.

Normal running

When the throttle flap opens, engine induction manifold depression is transferred via the channels in the air valve to the suction chamber. Diaphragm (8, Fig. 23–8) seals between the suction chamber and the carburettor housing.

Due to the difference in pressure between the underside of the air valve, where there is pressure in the carburettor inlet port, and the upper side of the valve, where there is vacuum, the valve lifts from the bridge. This also lifts the tapered metering needle (15, Fig. 23–8), which is attached to the valve, out ot the jet. This increases the effective choke area and increases the fuel flow, see Fig. 23–10. As the vacuum in the engine intake manifold depends on engine speed and load, correct fuel flow is always 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 a temporarily richer mixture at any point in the throttle range at the moment the throttle is suddenly open, a hydraulic damper is arranged inside the valve rod. The hydraulic damper consists of a plunger mounted on a rod. The plunger works in oil. When the throttle is suddenly opened, the vacuum in the suction chamber increases rapidly.

When the air valve (10, Fig. 23–8) lifts, the damper plunger (7) is forced against its seat and oil is prevented from flowing past from the bottom side to the top of the damper plunger, this retarding the movement of the valve (10). This temporarily results in a more powerful vacuum above the jet so that the fuel-air mixture becomes for the moment richer.

The downward stroke of the air valve (10) is assisted by the spring (6). The rod in the valve should be filled to approximately within 1/4" from the upper edge with oil which is approved as "Automatic Transmission Fluid".

Hot start valve

During warm weather and when the engine is hot, a great deal of fuel fumes develop in the floatchambers. These are vented through channels to the air cleaner and result in the engine obtaining a somewhat "richer" fuel-air mixture. This makes it difficult to start the engine. To counteract this, the hot start valve is fitted to the connection between the floatchamber and air cleaner by means of hoses (Fig. 23–11).

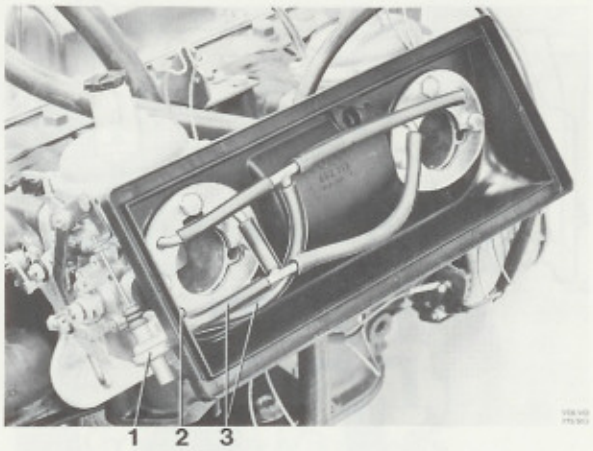


Fig. 23–11. Hose connection for hot start valve

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

When the throttle is at idle, the lever (1, Fig. 23–12) presses against the valve control. The piston (14) is thereby lifted to its upper position by the control rod. The connection between the floatchamber and air cleaner is closed and fuel fumes are led directly out into the atmosphere through the outlet (12).

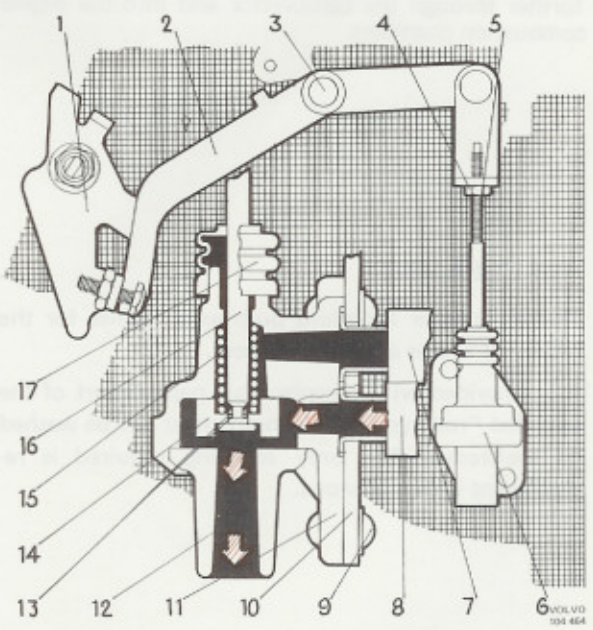


Fig. 23–12. Hot start valve function, idling

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

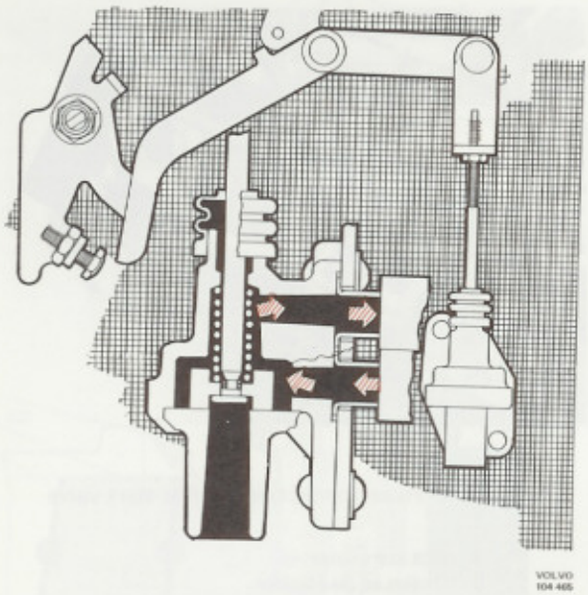


Fig. 23–13. Hot start valve function, driving

When the accelerator pedal is depressed, the throttle control lever (1, Fig. 23–13) breaks contact with the valve control and the piston (14) is pressed by the spring (15) to its bottom position. The outlet (12) is shut off, fuel fumes are led into the air cleaner, and when the engine starts running, these fumes are led further through the carburettor and into the engine combustion chambers.

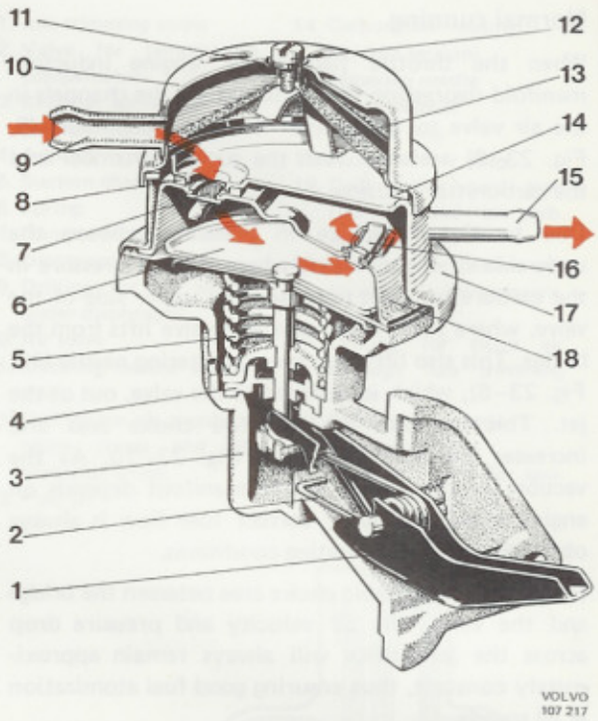


Fig. 23–14. Fuel pump, Pierburg

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

AIR CLEANER

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

It is provided with a replaceable paper insert of the so-called "rod type". This insert must not be washed or moistened. The only servicing required is replacement with a new one.

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. 23–14) and fuel is fed to the floatchamber in the carburettor. When the level in the floatchamber is sufficiently high, the float valve closes and the pressure in the discharge line rises until the pressure on the upper side of the diaphragm exeeds the spring pressure and pumping ceases.

Two alternative fuel pumps are used. One comes from Pierburg (Fig. 23–14) and the other is a S.E.V. make (Fig. 23–15).

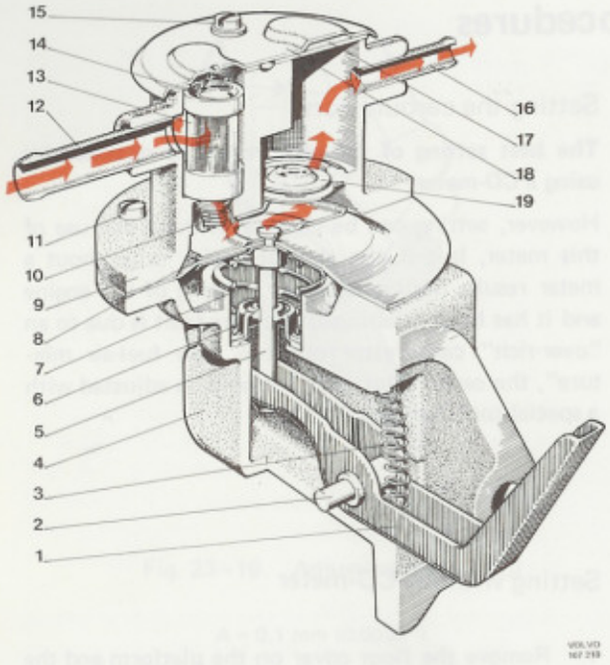


Fig. 23–15. Fuel pump, S.E.V.

1. Lever
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
12. Inlet
13. Filter
14. Spring
15. Screw
16. Outlet
17. Seal
18. Cover
19. Oulet valve

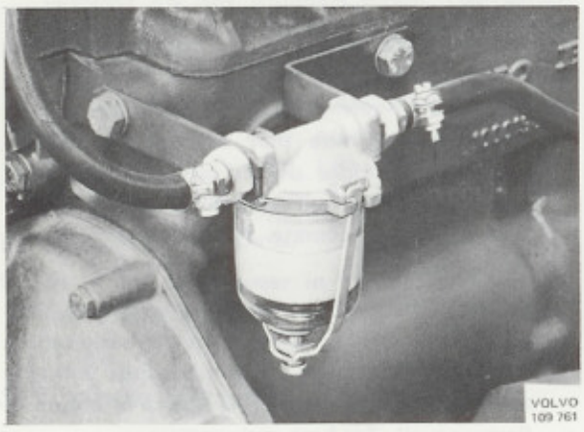


Fig. 23–16. Fuel filter

FUEL FILTER

The fuel filter is fixed to the front of the cylinder block by means of brackets, see Fig. 23–16.
It is provided with a replaceable ceramic insert.

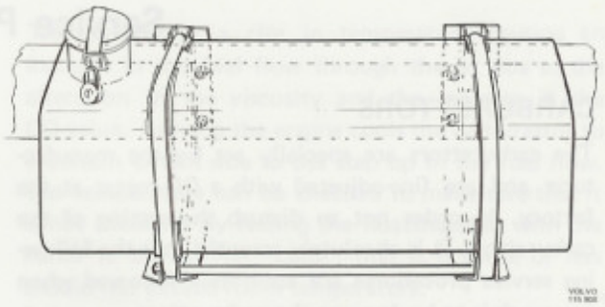


Fig. 23–17. Fuel tank

FUEL TANK AND FUEL LINES

The filler pipe is provided with a strainer to prevent impurities getting into the fuel tank.

Concerning the tank level gauge unit, see Part 3, Group 38.

Service Procedures

CARBURETTORS

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

Periodical Check

Check regularly to see that there is oil in the damper cylinders (Fig. 23–18). The spindle in the piston should be filled to about 1/4" from the upper edge with oil approved as "Automatic Transmission Fluid". **NOTE!** The damper cylinders must not be filled with engine oil.

Before any adjustment or repairs to the carburettor are carried out, the following should be checked and, if necessary, remedied:

Valve clearance, spark plugs, compression, ignition contact breaker (dwell angle) and ignition setting. Also check that there is no air leakage on the intake side and that the air cleaner is not blocked. The function of the throttle controls should be checked as well.

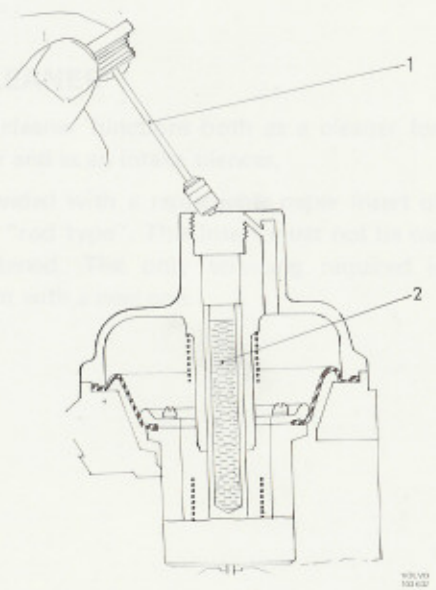


Fig. 23–18. Checking the damper oil level

1. Damper plunger
2. Damper oil (Automatic Transmission Fluid)

Setting the carburettors

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

However, setting can be checked without the use of this meter, but if the checking with or without a meter results in unsatisfactory running of the engine and it has been established that the fault is due to an "over-rich" carburettor or "too lean fuel-air mixture", the carburettor nozzle should be adjusted with a special tool, see page 23:11.

Setting without CO-meter

1. Remove the floor cover on the platform and the inspection cover on the front engine casing.

1. Check that there is oil in the damper cylinders. See under "Periodical Check".

3. Run the engine warm. The adjustment should be carried out within about 10 minutes after the coolant thermostat has opened. (One way of finding this out is by feeling the upper radiator hose at the radiator which should suddenly become hot, approx. 80°C = 176°F.)

4. Adjust the engine speed to 13.3 r/s (800 r/m) with the throttle stop screws (2, Figs. 23–1 and 23–3).
   NOTE! Screw equally for both carburettors. Check to make sure that both carburettors have the same air valve lift. This is easily checked by simply making sure that the distance visually between the bridge of the carburettor housing and the air valve is the same for both carburettors. A more accurate synchronization is not required.

5. Adjust with the idle trimming screws (5, Fig. 23–2, and 4, Fig. 23–4) from the basic setting (they are screwed to bottom). Adjust with the screws until the best idling speed is obtained. Screw equally for both carburettors.

6. Adjust the link rods between the carburettors and throttle control shaft. With the control against its stop on the manifold bracket, adjust the link rods to obtain a clearance of approx. 0.1 mm (0.0039") between lever and throttle shaft flange, see Fig. 23–19.

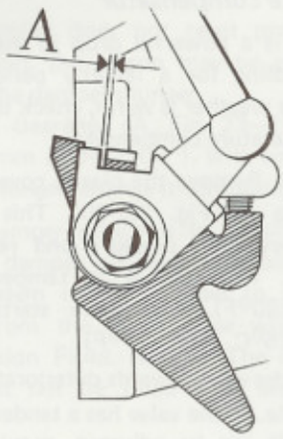


Fig. 23–19. Adjusting the control

A = 0.1 mm (0.0039")

7. Adjust so that the valve control of the hot start valve is against the carburettor lever with the valve piston in the upper position and the throttle control at idle. Lubricate the contact surfaces with Molykote. Rev up the engine, release the control and check that the engine returns to idling speed. Repeat this a couple of times.
8. Setting the fast idle: Pull out the choke 20 mm (0.8"). The mark on the cam disc should now be opposite the idle trimming screw. Then adjust the fast idle screw to give an engine speed of 23.3–25.0 r/s (1400–1500 r/m).
9. Check and if necessary adjust the throttle control to remove play. When accelerator is fully depressed, there should be a play of 1 mm (0.0039") at full throttle. See also point 6.
10. Lubricate all ball joints.
11. Re-fit the floor cover in the platform and the inspection cover.

Setting with CO-meter

The setting should be made at a temperature of +15°C to 25°C (60–80°F) and must be made within 8 minutes after the coolant thermostat has opened. Warming-up should be done with a completly cold engine.

When measuring with a CO-meter, it is important that the **temperature of the carburettors** is correct. 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 little.

This results in a rise in temperature causing an increase in the fuel flow through the jet due to the alteration in the viscosity and the increase in the CO-value. Revving the engine cools the carburettor to a certain extent due to the step up in the fuel flow. The temperature can be checked to make sure that it is not excessive by feeling the floatchamber with the hand. It should feel "cold", that is it more or less should not exceed room temperature.
Before reading off the CO-meter, briefly rev up the engine so that the air valve is in the proper position. To be certain that the measured CO-value is correct, **measuring should be carried out within the time period mentioned above.**

There is a number of different types of CO-meters available which function with acceptable accuracy. Instructions on their use are supplied with 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 in the exhaust manifold. A funnel could suitably be used here. With it 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. Measure as follows:

1. Remove the floor cover on the platform and the inspection cover on the front engine casing.
2. Check that there is oil in the damper cylinders. They should be filled to about 6 mm (1/4") from the upper edge with Automatic Transmission Fluid. **NOTE!** The damper cylinders must not be filled with engine oil.
3. Connect a tachometer and run the engine warm at 25 r/s (1500 r/m) until the coolant thermostat opens. (One way of finding this out is by feeling the upper radiator hose at the radiator which should start to get hot.)
4. Adjust the engine speed to 13.3 r/s (800 r/m) with the throttle stop screws (2, Figs. 23–1 and 23–3).
   NOTE! Screw equally for both carburettors. Check that both carburettors have the same air valve lift. This is easily checked by measuring with the eye the distance between the carburettor housing bridge and the air valve. The distance should be the same for both carburettors. More accurate synchronization is not required.

5. Connect a CO-meter and check the CO-content which should be 2.5%. **NOTE!** Before each reading, rev up the engine briefly. With the help of the idle trimming screws (5, Fig. 23–5) the CO-content can be adjusted with small deviations. (If the CO-content is too high, first check the temperature compensator, see under "Tem-Perature Compensator" on page 23:15.
6. Adjust the link rods between the carburettors and the throttle control shaft. 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 (0.0039") between the lever and the flange of the throttle spindle. See Fig. 23–19.
7. Adjust so that the valve control of the hot-start bar is against the carburettor lever with the valve piston in the upper position and the throttle control at idle. Lubricate the contact surface with Molykote. Rev up the engine. Release the control and check that the engine returns to idling speed. Repeat this a couple of times.
8. Setting the fast idle: Pull out the choke 20 mm (0.8"). The mark on the cam disc should now be opposite the idle trimming screw. Then adjust the fast idle screw to give an engine speed of 23.3–25.0 r/s (1400–1500 r/m).
9. Check and if necessary adjust the throttle control to remove play. When accelerator pedal is fully depressed, there should be a play of 1 mm (0.0039") at full throttle. See also point 6.
10. Lubricate all ball joints.
11. Install the floor cover in the platform and the inspection cover.

Faulty carburettor function

1. Check to make sure that the reason for the fault in the function is not due to wrong damper oil or oil level, impurities in the floatchamber or a faulty float valve and float. See the respective headings.
2. Remove the air cleaner insert and check that the air valves operate easily without jamming. (The damper plungers removed.) If this is not the case, remove the suction chamber covers and clean the valves. At the same time check to make sure the diaphragm is in good condition.
   NOTE! If the metering needle must be released or removed, it should be adjusted, see under "Replacing the metering needle". **A CO-meter is recommended for this purpose.**

Temperature compensator

3. If there is 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.

   Checking: Remove the plastic cover and push in the valve (3, Fig. 23–20). This should move under very light pressure and return without jamming. This applies at temperatures above +26°C (80°F). The valve starts opening at +20°C–25°C (70°–77°F).

   Pressing the valve inwards deteriorates the quality of the idle. If the valve has a tendency to be stiff or jam, it can be adjusted, providing it is not scored or lined, on which occasions it should be replaced complete. See under "Replacing the temperature compensator" on page 23:15.

   Adjusting: Slacken one of the cross-slotted screws (8, Fig. 23–20) for the bi-metal spring and centre the valve. The valve should move under very little pressure and return without jamming. This applies at temperatures above +26°C (80°F). Then remove the temperature compensator from the carburettor and store it at a temperature of +20°C–25°C (70°–77°F) until it reaches this temperature. The valve should just start to open at this temperature. In other words, the valve should be loose in its seat at this temperature. If necessary adjust with the nut (9, Fig. 23–20).

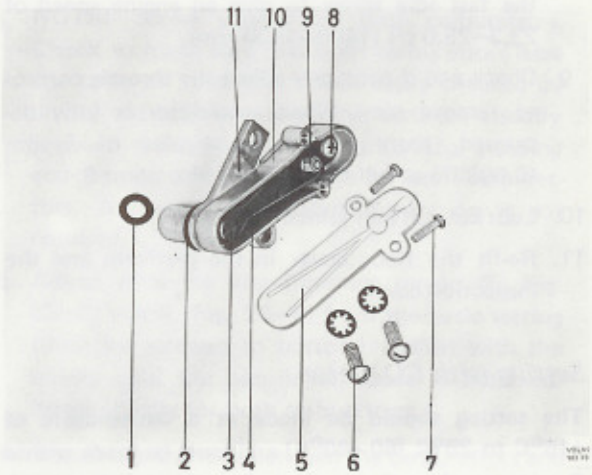


Fig. 23–20. Temperature compensator

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

Damper device

4. If the engine does not react properly during acceleration, the reason may be a faulty clearance on the damper plunger.
   The axial clearance (A, Fig. 23–21), 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 properly, then the damper oil level must be correct. The plunger stem must be filled to about 6 mm (1/4") from the upper edge with Automatic Transmission Fluid. **NOTE!** The damper cylinders must not be filled with engine oil.

Fig. 23–21. Damper plunger clearance

A = 1.0–1.8 mm (0.04–0.07")

Adjusting the fuel jets

Special tools:

2895	Press tools, 2 (1 per carburettor)
2896	Spacer drift
2897	Press tool

1. Remove the floor cover in the platform and the inspection cover on the front engine casing.
2. Remove the upper part of the air cleaner and the cleaner insert.
3. Screw in the idle trimming screws to the bottom.
4. Remove the plugs in the floatchambers by inserting a screwdriver between the floatchamber cover and the plug and by levering out the plug. Screw tight the press tool 2895 in the floatchamber covers, Fig. 23–22.

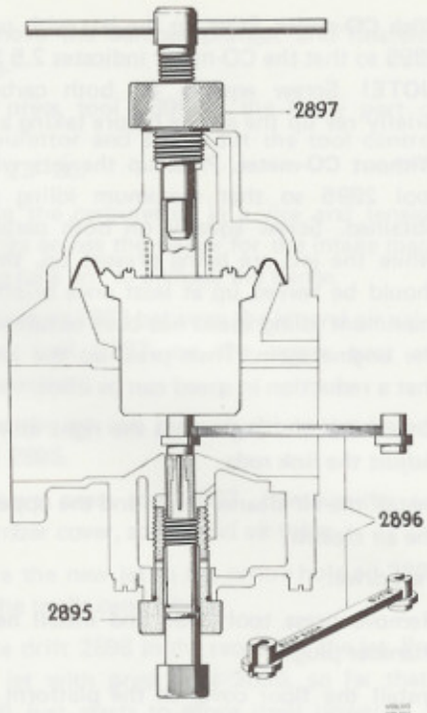


Fig. 23–22. Adjusting the fuel jet

5. Place spacer drift 2896 between the air valve and jet on one of the carburettors.
   NOTE! The marking on the drift should face upwards. Use the drift marked B 20 B on the end. Check to make sure that there is a clearance between the drift shoulder and the carburettor housing bridge. If none exists, press up the the jet with press tool 2895 in order to obtain such a clearance. Then unscrew the spindle several turns so that the jet can be pressed down.
6. Remove the damper plunger and screw tight press tool 2897.
7. Press down the jet by screwing in the spindle on tool 2897 so far that the shoulder on the drift goes against the carburettor housing bridge (the carburettor is now adjusted to give "rich" fuel-air mixture).
8. Remove the upper press tool and spacer drift. Install the damper plunger.
9. Carry out points 5, 6, 7 and 8 on the other carburettor.
10. Connect a rev counter and possibly a CO-meter. Run the engine warm until the coolant thermostat opens. The adjustment (that is points 11 and 12) should be carried out within 8 minutes from the time the thermostat opens.
11. Adjust idling speed to 13.3 r/s (800 r/m). Check that the air valves have the same lift (correct with the idle trimming screws).

12a. **With CO-meter.** Press up the jets with press tool 2895 so that the CO-meter indicates 2.5 %.
NOTE! Screw equally for both carburettors. Briefly rev up the engine before taking a reading.

12b. **Without CO-meter.** Press up the jets with press tool 2895 so that maximum idling speed is obtained. Screw equally on both carburettors. While the jets are being pressed up, the engine should be revved up at least once briefly. When maximum idling speed has been obtained, rev up the engine again. Then press up the jets so far that a reduction in speed can be discerned.

13. Check that the engine has the right idling speed. Adjust the link rods.

14. Install the air cleaner insert and the upper part of the air cleaner.

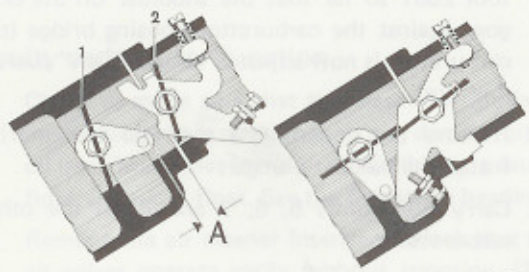
15. Test drive.

16. Remove press tool 2895 and install **new** float-chamber plugs.

17. Install the floor cover in the platform and the inspection cover.

Checking the secondary throttles

Check to make sure that the secondary throttles are centred and can be turned without jamming. Check the location ("A", Fig. 23–23) of the levers. When the secondary throttle is closed, the distance "A" between the lever pin and the intake manifold flange should be 2.7–4.3 mm (0.11–0.17").



Throttle postion at low output Fully open throttle

Fig. 23–23. Throttle position

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

Removing the carburettors

1. Remove the floor cover in the platform and the inspection cover on the front engine casing.
2. Remove the hot start valve control from the rear carburettor. Remove the air cleaner.
3. Remove the ball joints of the link rods from the carburettors.
4. Remove the fuel hose, vacuum hose and choke wire from the carburettors. Remove the retaining nuts for the carburettors. Remove the carburettors and the protective plates and gaskets.
Cover the holes in the intake manifold.

Replacing the diaphragm

1. Screw out the damper plunger. Make line-up marks in the suction chamber cover and carburettor housing. Remove the screws and lift off the suction chamber cover.
Remove the spring.
2. Pull up the air valve with the diaphragm. Remove the diaphragm by releasing the four screws. Clean the air valve.
NOTE! Take care not to bend or displace the needle.
3. Install the new diaphragm, Fig. 23–24. The rubber register should fit into the valve groove.

Fig. 23–24. Diaphragm in air valve

4. Move the air valve down and fit in the rubber register, Fig. 23–25. Install the spring and cover. Fill with damper oil (Automatic Transmission Fluid). **NOTE!** The damper cylinders must not be filled with engine oil.
5. Install the suction chamber cover and the damper plunger.

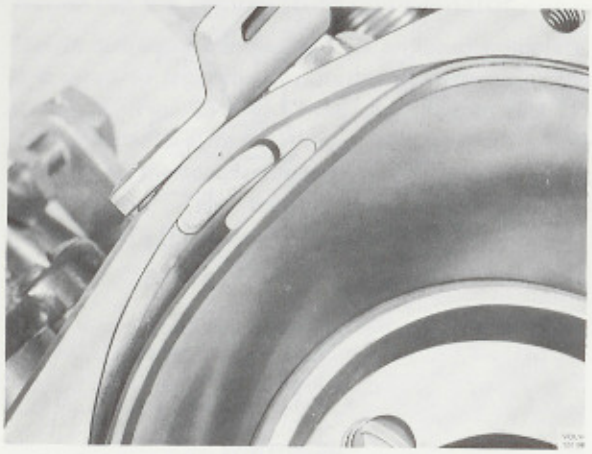


Fig. 23–25. Diaphragm in carburettor housing

Replacing the fuel jet

Special tools:

2895	Press tool
2896	Spacer drift
2897	Press tool
2962	Drift

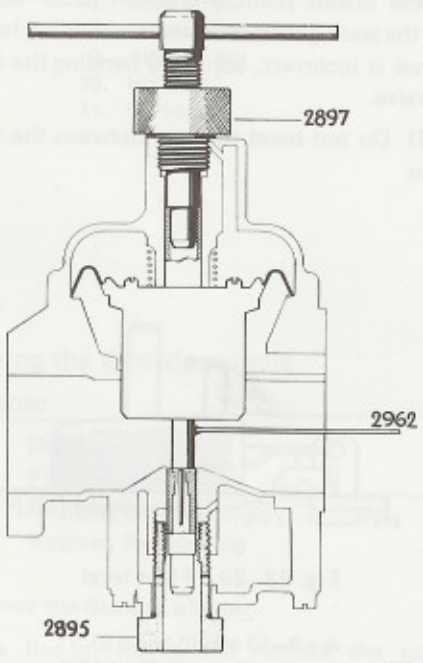


Fig. 23–26. Replacing the fuel jet

1. Remove the damper plunger and floatchamber plug.
2. Fit press tool 2895 in the lower part of the carburettor and screw out the tool centre bolt, Fig. 23–26.
3. Place the carburettor in a vice and tension the shanks across the flange for the intake manifold. Take care not to damage the flange.
4. Place drift 2962 between the jet and air valve. Fit press tool 2897 on the upper part of the carburettor.
5. Press the jet out through the centre hole in the tool 2895.
6. Remove press tool 2897. Remove the suction chamber cover, spring and air valve.
7. Place the new jet in the centre hole on 2895 and fit the tool's centre bolt.
8. Place drift 2896 in the recess for the jet. Press up the jet with press tool 2895. so far that drift 2896 just starts to move itself upwards. Screw out the tool centre bolt a couple of turns.
9. Replace the metering needle. See under "Replacing the metering needle", below.
10. Install the air valve, spring and cover. Fill with damper oil (Automatic Transmission Fluid) and fit the damper plunger.

    NOTE! The damper cylinders must not be filled with engine oil.

11. Install the carburettor on the engine and adjust the fuel jet according to the instructions given under "Adjusting the fuel jet", points 10–16, page 23:11.

Replacing the metering needle

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

1. Remove the vacuum chamber cover. Take out the air valve and clean it.
2. Remove the needle by unscrewing the lock screw and pull the needle out together with the spring suspension.
3. Before installing the new needle, check that the needle designation is B 2 BA. This is punched on the needle and can be seen by pulling the needle out of the spring suspension far enough to reveal it.

4. Install the needle together with the spring suspension so that the flat surface faces the lock screw. The needle should incline from the holes in the air valve, that is, in towards the air cleaner flange.
   The needle should be inserted so far that the plastic washer lies flush with the valve, see Fig. 23–27.
   Tighten up the lock screw.

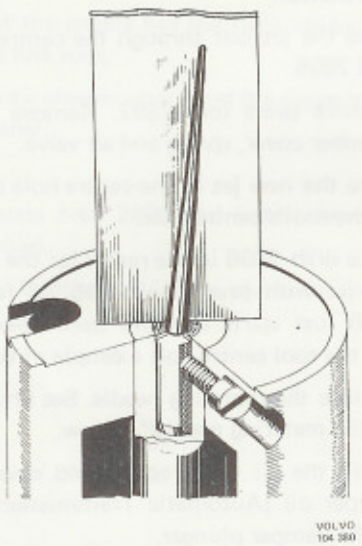


Fig. 23–27. Installing the metering needle

5. Install the air valve in the carburettor.
   NOTE! Fit the diaphragm according to Fig. 23–25.
6. Install the vacuum chamber cover.

Cleaning the floatchamber

1. Remove the screws (1, Fig. 23–28).
2. Remove the floatchamber.
3. Clean the surface of the gasket using compressed air.
4. Install the floatchamber with new gasket.
   NOTE! If the floatchamber plug is removed, a new plug must be fitted in order to ensure that it is properly fixed in the floatchamber.
   The plug is removed by bending it out with a suitable tool between the floatchamber cover and plug.

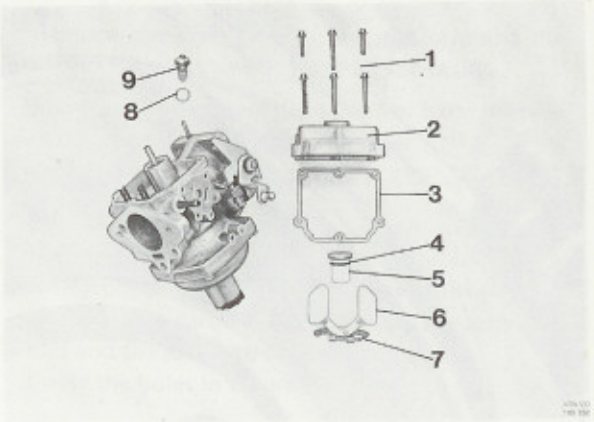


Fig. 23–28. Floatchamber dismantled

1. Screws for floatchamber
2. Floatchamber
3. Gasket
4. O-ring
5. Plug
6. Float
7. Float pin
8. Washer
9. Needle valve

Float level

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

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

At the correct float level, the top point on the float should lie 15–17 mm (0.59–0.67") (B, Fig. 23–29) with the lowest point 9–13 mm (0.35–0.51") (A) above the sealing surface of the carburettor housing. 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.

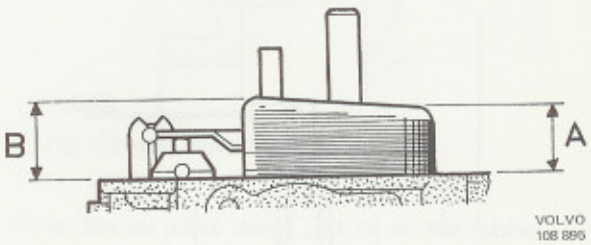


Fig. 23–29. Float level

A = 9–13 mm (0.36–0.51")
B = 15–17 mm (0.59–0.67")

Replacing the temperature compensator

The temperature compensator is replaced complete. It is removed from the carburettor by unscrewing the screws (6, Fig. 23–30). Take out the old seal (1) from the carburettor and fit a new one. Place a new seal (2) on the temperature compensator and fit the compensator. The temperature compensator is marked "60" (11).

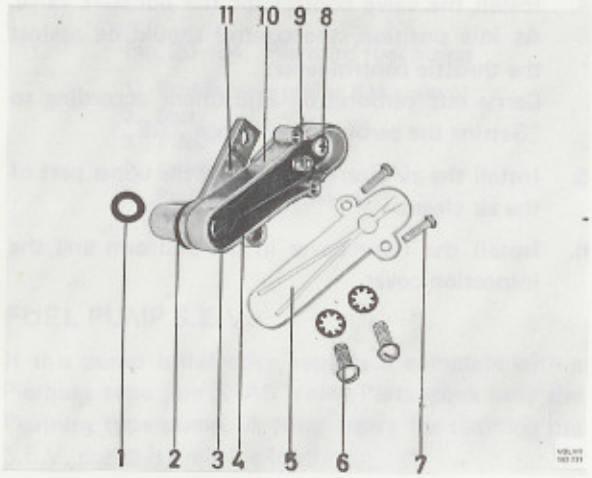


Fig. 23–30. Temperature compensator

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

Re-bushing the throttle spindle

Special tools:

2402	Drift
2879	Fixture
2880	Reamer, for seat
2881	Reamer, for bushing

1. Remove the damper plunger.
2. Make line-up marks and remove the vacuum chamber cover. Lift out the spring together with the air valve.
3. Remove the floatchamber and float.
4. Remove the levers and the return spring from the throttle spindle.
5. Remove the throttle. Knock out the sealing washer together with the old throttle spindle (only front carburettor). Remove the throttle spindle.
6. Remove the spindle seal (seals). Remove the nipple for the upper vacuum outlet (only front carburettor).
7. Fix the fixture in a vice and fit the carburettor on the fixture, Fig. 23–31. Make sure that the fixture pin holes are in line with the holes in the spindle bushings.

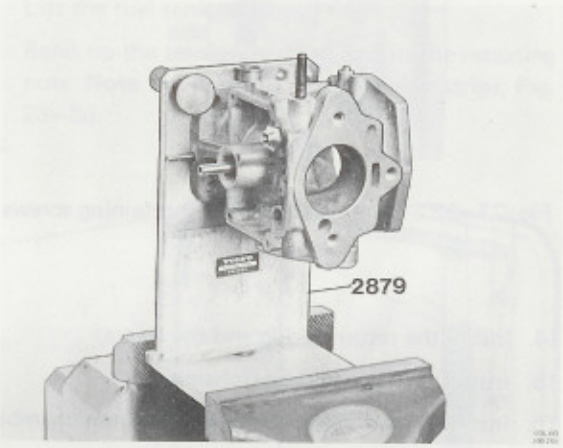


Fig. 21–31. Mounting carburettor on fixture 2879

8. Ream off the old bushings with reamer 2880. NOTE! Do not pull the reamer back through the bushings but move it in the working direction through the hole in the bottom plate of the fixture.
9. Turn the fixture pin 90° so that it forms a stop internally inside the carburettor housing for the bushings and drive in the bushings with drift 2402.
10. Turn the fixture pin a further 90° so that the holes in the pin come in line with the holes in the bushings. Ream the bushings with reamer 2881. NOTE! Do not pull the reamer back through the bushings but move it in the working direction through the hole in the bottom plate of the fixture.
11. Remove the carburettor from the fixture. Blow the carburettor clean.
12. Install the seal (seals) and if necessary a sealing washer.

13. Install the throttle and throttle spindle. Centre the throttle and rivet the retaining bolts, Fig. 23–32.
NOTE! The "bosses" on the throttle should face the floatchamber and the manifold flange.

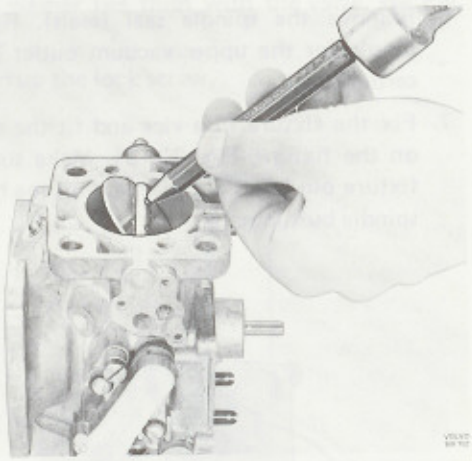


Fig. 23–32. Riveting throttle flap retaining screws

14. Install the return spring and the levers.
15. Install the float and floatchamber.
16. Install the air valve, spring and vacuum chamber.
17. Install the nipple for the upper vacuum output (only front carburettor).

Installing the carburettors

1. Clean the gasket surface. Install the protecting plates, new gaskets, one on each side of the plates, and the carburettors, Fig. 23–33.

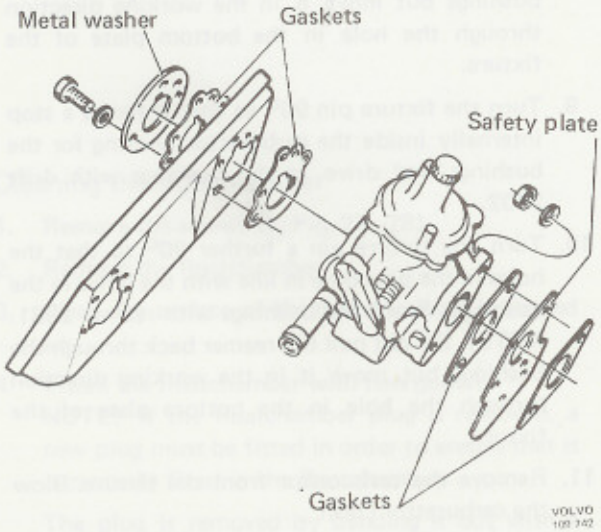


Fig. 23–33. Installing the carburettor

2. Connect the ball joints, fuel hoses, vacuum hose and choke wire. Make sure that the choke control on the instrument panel is pushed in. Then lock tight the pull wire on the rapid idle cam clamping screw. Thereafter fix the pull wire outer sleeve with the clips intended for this purpose.
3. Install the lower part of the air cleaner and the hose for the crankcase ventilation.
4. Install the valve control for the hot-start valve. At idle position, the control should be against the throttle control lever.
Carry out carburettor adjustment according to "Setting the carburettors", page 23:8.
5. Install the air cleaner insert and the upper part of the air cleaner.
6. Install the floor cover in the platform and the inspection cover.

Replacing the air cleaner insert

No cleaning etc, need be done between insert changes. Under no circumstances may the insert be moistened or oiled.

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

FUEL PUMP

Pierburg

If the pump is defective, replace it complete. A filter insert for cleaning is available in stock.

Cleaning (pump removed)

1. Remove the cover retaining screw (1, Fig. 23–34). Lift off the cover (6), the filter (3) and the seal (2).
2. Clean the pump body and cover. Blow clean or replace the filter.
3. Place the gasket and filter in position on the pump body.
4. Install the cover. Make sure that the profiles in the pump body and cover coincide.

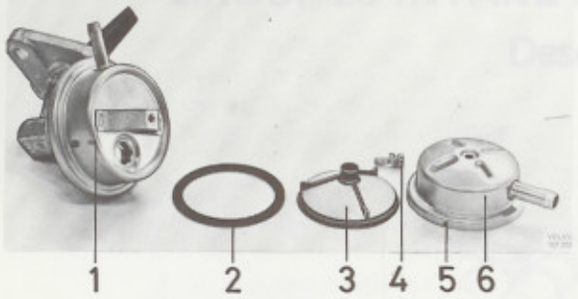


Fig. 23–34. Pierburg fuel pump

1. Profile (suits profile 5 in cover 6)
2. Seal
3. Filter
4. Cover screw
5. Profile (suits profile 1)
6. Cover

FUEL PUMP S.E.V.

If this pump is defective, replace it complete with a Pierburg type pump. AB Volvo Parts stock only the Pierburg type pump. A filter insert for cleaning the S.E.V. pump is available in stock.

Cleaning (pump removed)

1. Remove the cover (1, Fig. 23–35), the spring (5) and the seal (4).
2. Clean the pump body.
3. Remove the filter (6) and blow it clean or replace it.
4. Install the filter. Place the seal with the open part over the filter. Install the spring and cover. The pin (2) in the cover should fit in the spring (5).

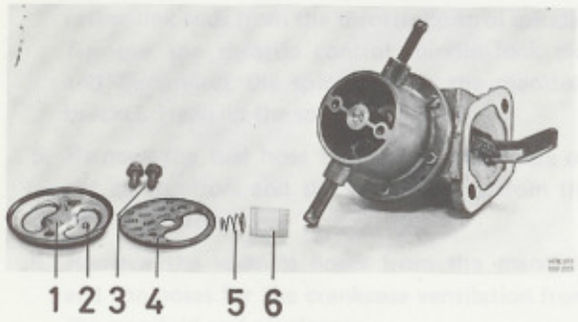


Fig. 23–35. S.E.V. fuel pump

1. Cover
2. Pin for centering spring (5)
3. Cover screws
4. Seal
5. Spring
6. Filter

FUEL TANK

Removing

1. Remove the plug underneath the tank and drain the fuel.
2. Remove the breather hose from the filler pipe.
3. Remove the electric cables from the tank level gauge unit.
4. Remove the fuel pipe from the tank.
5. Remove the tensioning band adjuster nuts.
6. Bend down the tensioning band and remove the fuel tank.

Installing

1. Lift the fuel tank into position.
2. Bend up the tensioning band and fit the retaining nuts. **Note** the location of the rubber strips, Fig. 23–36.

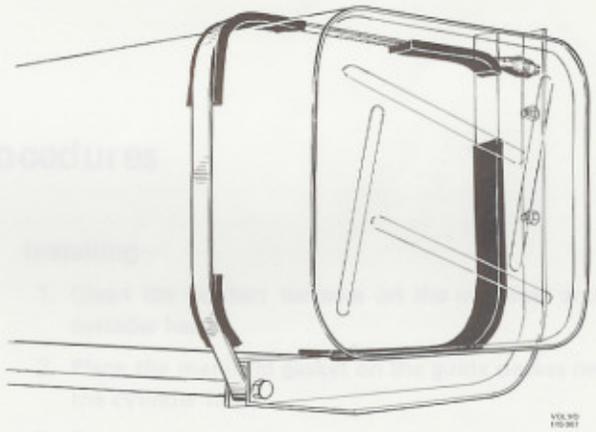


Fig. 23–36. Installing the fuel tank

3. Install the fuel pipe and drain plug.
4. Install the electric cables for the tank fuel level gauge.
5. Install the breather hose on the filler pipe.

GROUP 25 INTAKE AND EXHAUST SYSTEM

Description

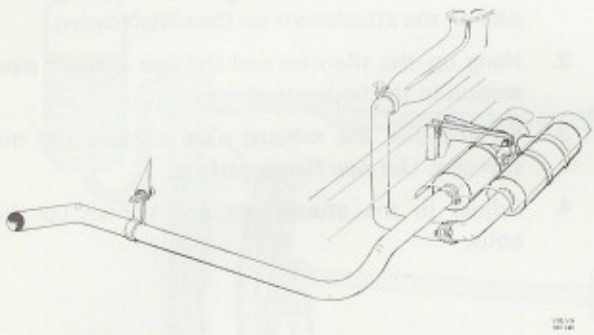


Fig. 25–1. Exhaust system

The intake and exhaust manifolds are made of nodular iron and are cast onto a branch pipe.

Each intake port houses a spring-loaded throttle (secondary throttle). The function of the secondary throttle is described on page 23:3.

Otherwise the system consists of a front exhaust pipe section, two silencers and a rear exhaust pipe section.

Service Procedures

MANIFOLD

Removing

1. Remove the inspection cover from the front engine casing and the floor cover in the platform.
2. Release the clasps and remove the upper part of the air cleaner housing.
3. Remove the choke wire from the rear carburettor.
4. Remove the lock clips and disconnect the carburettor link rods from the throttle control spindle. Remove the throttle control spindle lock clip and disconnect the spindle from the manifold bracket. Hang up the spindle.
5. Remove the fuel hose from the branch pipe on the carburettors and the vacuum hose from the front carburettor.
6. Remove the vacuum hoses from the manifold and the hoses for the crankcase ventilation from the manifold and air cleaner.
7. Remove the front exhaust pipe section from the manifold and from the attachment to the clutch casing.
8. Remove the manifold retaining nuts.
9. Lift forward the manifold.
10. Remove the manifold gasket.

Installing

1. Clean the contact surfaces on the manifold and cylinder head.
2. Place the manifold gasket on the guide sleeves on the cylinder head.
3. Position the manifold and install the washers and retaining nuts.
4. Install the front exhaust pipe section and clamp the pipe securely to the attachment on the clutch casing.
5. Fit and connect the vacuum hoses to the manifold and the hoses for the crankcase ventilation to the manifold and air cleaner.
6. Install and fit the vacuum hose to the front carburettor and the fuel hose to the branch pipe on the carburettors.
7. Press firmly the throttle control spindle on to the branch bracket and fit the lock clip. Press the link rods firmly on to the throttle spindle for the carburettors and fit the lock clips.
8. Install the choke wire onto the rear carburettor.
9. Install the upper part of the air cleaner housing.
10. Install the floor cover in the platform and the inspection cover on the front engine casing.

EXHAUST SYSTEM

Removing

1. Remove the nuts on the manifold flange. Remove the front exhaust pipe section from the gearbox attachment.
2. Remove the silencers from the body attachment. Take down the exhaust system.

Installing

1. Install a new flange gasket and lift the front exhaust pipe section up into position. Fit the nuts on the manifold flange and clamp tight the pipe to the attachment on the clutch casing.
2. Hang up the silencers and the rear exhaust pipe section to the body attachment.
3. Fit together the exhaust pipe sections and the silencers. Use new flange gaskets.
4. Adjust in the attachment and tighten up the bolts.

GROUP 26 COOLING SYSTEM

Description

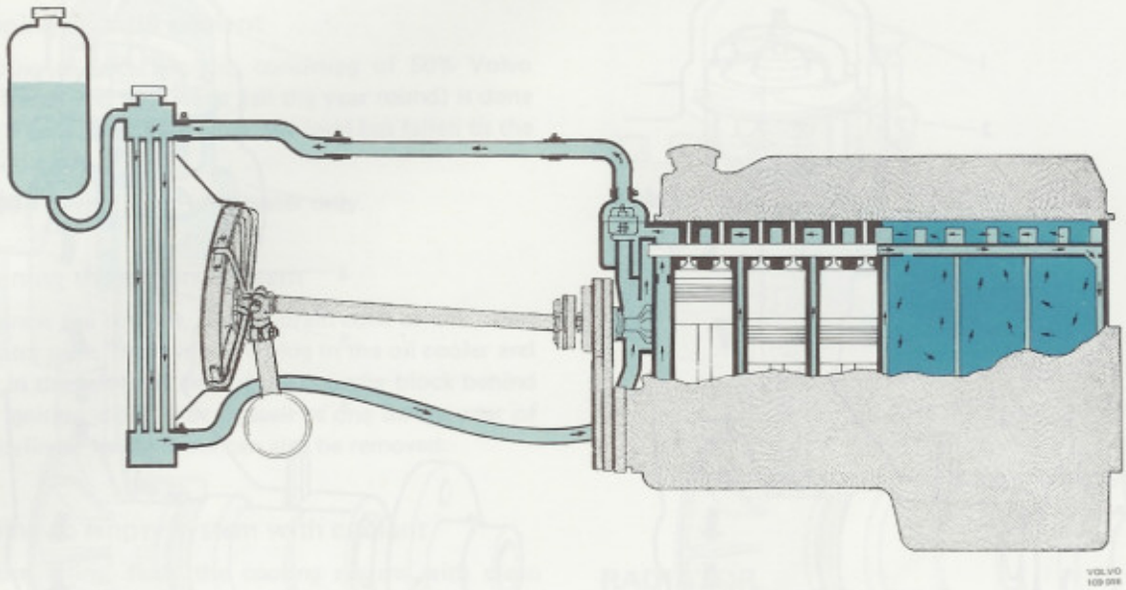


Fig. 26–1. Sealed cooling system

The engine is fluid-cooled and the cooling system is of the sealed type, see Fig. 26–1. Coolant circulation is provided by a centrifugal pump, Fig. 26–2, and a double-operating thermostat ensures rapid heating of the engine and contributes to the maintenance of the most suitable temperature for the engine under all operating conditions.

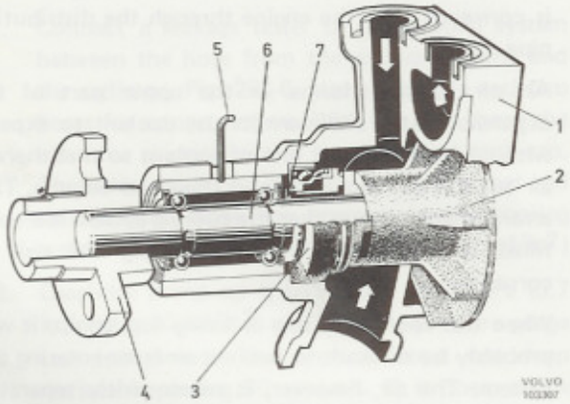


Fig. 26–2. Coolant pump

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

To achieve the desired effect with the sealed cooling system, it must be well-filled and it must not leak. As coolant, a mixture of 50% Volvo anti-freeze* and 50% water should be used all the year round. This mixture provides protection against frost down to –35°C (–32°F). The coolant should be changed every other year. On this occasion the engine, radiator and expansion tank should be flushed clean with water at the same time.

*Volvo anti-freeze (red-coloured) should not be mixed with other types of anti-freeze.

The cooling fan drive mechanism can be seen from Fig. 26–3.

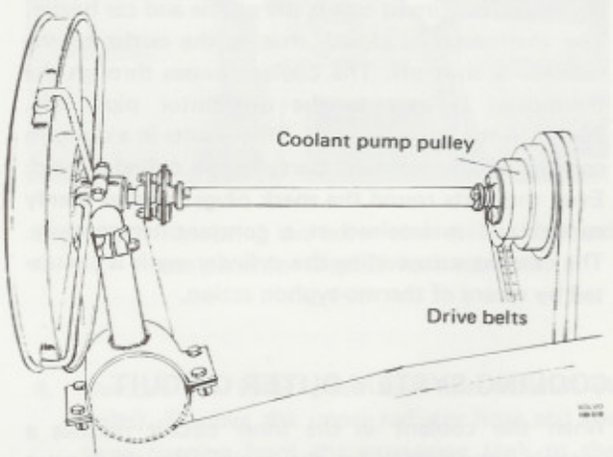


Fig. 26–3. Fan coupling

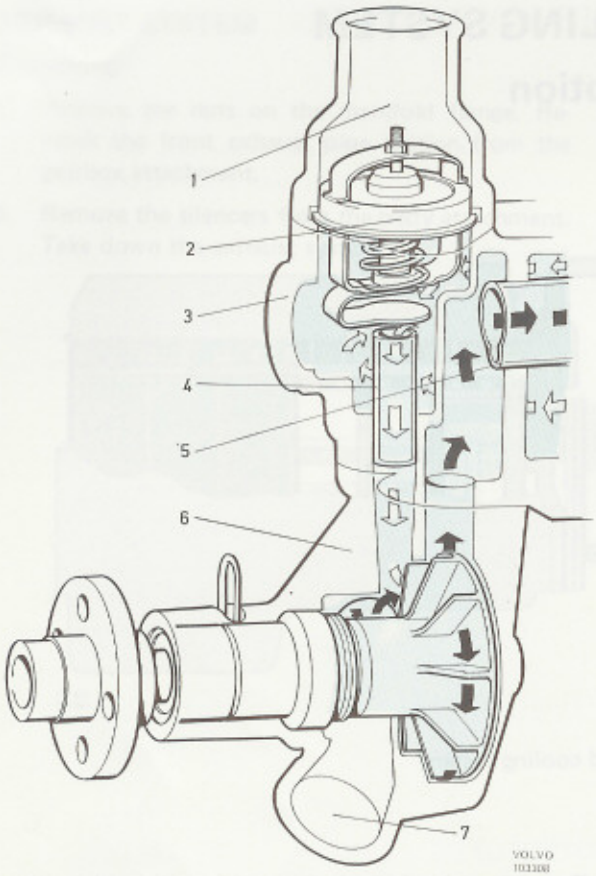


Fig. 26–4. Coolant flow, thermostat closed

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

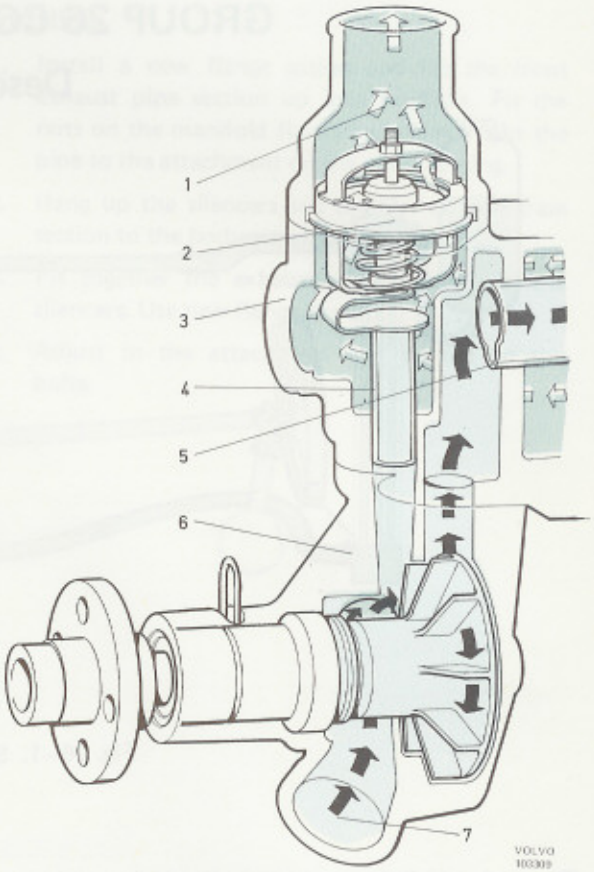


Fig. 26–5. Coolant flow, thermostat open
Concerning numbers above, see previous figure

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 heating up the inside of the car, the coolant circulates almost exclusively through the inner circuit (the by-pass). This circuit covers the engine and car heater. The thermostat is closed, that is, the outlet to the radiator is shut off. The coolant passes through the thermostat by-pass to the distributor pipe (Fig. 26–4) in the cylinder head. This results in a uniform cooling of the warmest parts in the cylinder head. Even the parts round the spark plugs are also evenly cooled and maintained at a constant temperature. The coolant surrounding the cylinder walls is circulated by means of thermo-syphon action.

COOLING 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. 26–5.

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 the 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 vacuum in the system and admits air into the expansion tank.

Service Procedures

Topping-up with coolant

Topping-up with coolant, consisting of 50% Volvo anti-freeze and 50% water (all the 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 the cooling system

To drain the coolant, open a drain cock on the lower radiator pipe. There is also a plug in the oil cooler and one in the left-hand side of the cylinder block behind the ignition distributor as well as one on the rear of the cylinder head. These can also be removed.

Filling an 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 to MAX. Fill the radiator to the top and fit the cap. Also fill the expansion tank to MAX or to max. 30 mm (1/8") above this mark. Run the engine for several minutes at different speeds. If necessary, top up with more coolant and then fit the expansion tank cap. After driving for a short time, check the coolant level and top up with more coolant since it takes some time before the system is completely devoid of air.

Cooling system leakage check

1. Connect a leakage tester to the cooling system between the hose from the expansion tank and the radiator, Fig. 26–6. Use a T-nipple and two hoses for connecting up. With this also check the valve for overpressure in the expansion tank cap. The valve should be pressed up from its seat and should open when the pressure in the cooling system exceeds 70 kPa (0.7 kp/cm^2 = 10 lbf/in^2)
2. Carefully pump up the pressure to 70 kPa (0.7 kp/cm^2 = 10 lbf/in^2) and note the pressure gauge test instrument. The pressure must not drop noticeably during 30 seconds. If it does, check this and remedy any leakages.
3. Remove the pressure tester for the cooling system and connect the hose from the expansion tank to the radiator.
4. Remove the expansion tank cap. Feel to see whether the valve for the vacuum, in the centre of the cap has not stuck against its seat.
5. Fit the cap.

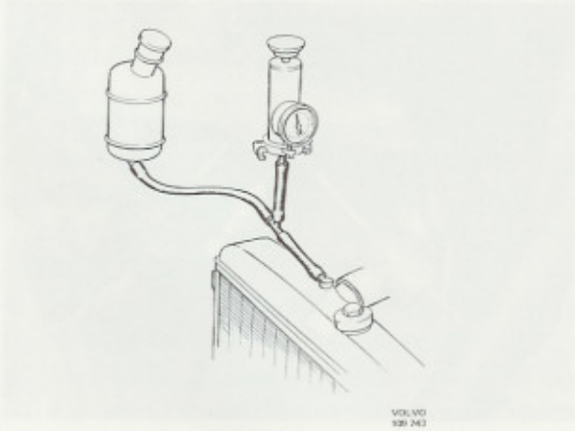


Fig. 26–6. Pressure-testing the cooling system

RADIATOR

Removing

1. Remove the lower radiator pipe clamps (2) from the side member.
2. Remove the lower radiator hose from the radiator and drain the coolant.
3. Remove the cover on the dashboard (part with ashtray) and the panel for the diff. lock controls, Fig. 26–7.

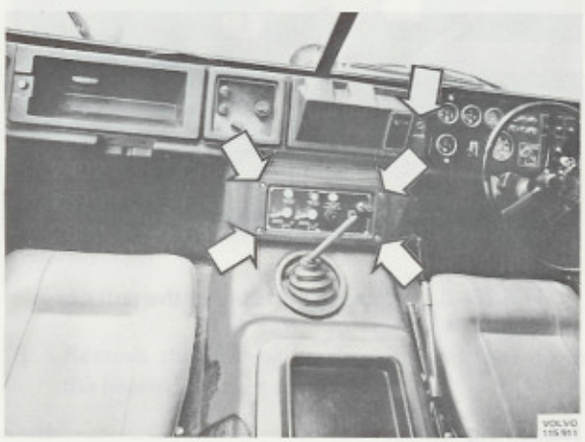


Fig. 26–7. Removing the cover over the radiator and the panel for the diff. lock controls

4. Remove the cover plate over the radiator (4 bolts). Remove the upper radiator hose and the hose running from the expansion tank to the radiator.

5. Remove the retaining bolts on the side of the radiator (1 per side), Fig. 26–8.

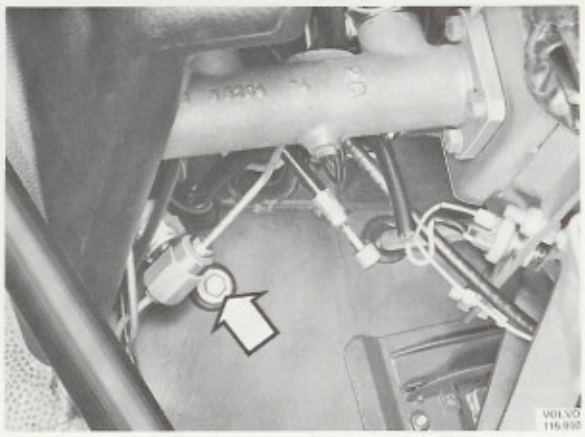


Fig. 26–8. Retaining bolt on side of radiator

6. Remove the bumper centre stay and the clamp for the clutch wire, Fig. 26–9.
7. Remove the member under the radiator, Fig. 26–9. Move the wires to the one side and take down the radiator.

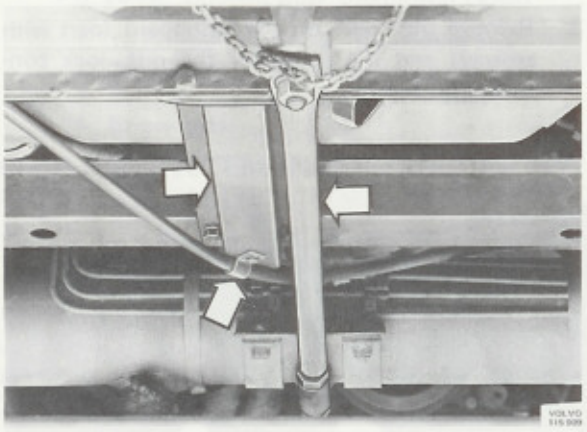


Fig. 26–9. Removing parts under the radiator

Installing

1. Lift up and fit in the radiator.
2. Install the member under the radiator.
3. Install the lower radiator hose and clamp tight the radiator pipe to the side member (2 clamps).
4. Install the bumper centre stay and clamp tight the clutch wire.
5. Install the retaining bolts on the side of the radiator.
6. Install the upper radiator hose and the hose running from the expansion tank to the radiator.
7. Fit the panel for the diff. lock controls.
8. Fill with coolant through the opening on the radiator, the heater-control on the panel should be at MAX. Also fill the expansion tank to the MAX mark.
9. Install the cover plate over the radiator and the cover over the dashboard.

Replacing the coolant pump

1. Drain the coolant by opening the drain cock on the lower radiator pipe.
2. Slacken the drive belts.
3. Remove the fan shaft retaining nuts at the flanges on the coolant pump pulley and at the fan bearing bracket.
4. Release the clamping screw securing the fan bearing to the bearing bracket. Move the fan bearing forwards and remove the fan shaft.
5. Remove the coolant pump pulley.
6. Remove the retaining bolts for the coolant pipes and pull the pipes out of the coolant pump.
7. Screw loose and remove the coolant pump. The fan shaft is carefully moved to the one side.
8. Clean the cylinder block of old gasket residues.
9. Install the sealing rings on top of the pump and the rings on the pipes.
10. Provide the pump with a new gasket, "pump – cylinder block".
11. Install the pump in position with the upper coolant pipe pushed into the pump. Press the pump upwards against the cylinder head extension under the bolting so as the obtain complete sealing between pump and cylinder head.
12. Install the lower coolant pipe. Push the coolant pipes well into position before tightening up their retaining bolts.
13. Close the drain cock on the lower radiator pipe.
14. Install the pulley and drive belts, and adjust the belt tension.
15. Install the fan shaft and tighten up the fan bearing clamping screw.
16. Fill the system with coolant through the opening on the radiator, with the heater control at MAX. Also fill the expansion tank to the MAX mark. Test-run the engine and check for leakage.

Testing the thermostat

After being removed, the thermostat can be tested in a vessel containing heated water, Fig. 26–10. The thermostat, which is marked 82°, should start opening at 79–83°C (175–182°F) and should be fully open at 95°C (203°F).

If necessary replace the thermostat. Use a new gasket when installing the thermostat.

Fig. 26–10. Testing the thermostat

Replacing the drive belts

1. Slacken the drive belts.
2. Remove the fan shaft retaining nuts at the flanges on the coolant pump pulley and at the fan bearing bracket.
3. Release the clamping screw securing the fan bearing to the bearing bracket. Move the fan bearing forwards and remove the fan shaft.
4. Carefully move the fan shaft to the one side. Remove the drive belts and fit new ones (HC 38x888).
5. Install the fan shaft and tighten up the fan bearing clamping screw.
6. Tension the drive belts. If the belts are properly tensioned it should be possible to depress them 5–10 mm (3/8") halfway with the thumb between the alternator and coolant pump pulleys.

   NOTE! The alternator must be obliquely loaded. If a levering bar is used for the adjustment, this should be applied between the engine and the front of the alternator.

   NOTE! If the lower alternator bolt is not slackened for this adjustment, there will be a great deal of stress on the drive bearing shield.

FAN DRIVE ASSEMBLY

Removing fan and bearing bracket

1. Remove the fan shaft retaining nuts for the flanges on the coolant pump pulley and at the fan bearing bracket.
2. Release the clamping screw securing the fan bearing to the bearing bracket. Move the fan bearing forwards and remove the fan shaft.
3. Remove the screw for the clamp round the fan shroud. Release the air bellows from the fan shroud and remove it forwards.
4. Remove the band clamps securing the brake pipes to the front tubular member.
5. Mark up the location of the bearing bracket, see Fig. 26–11. **Note!** This must be done to ensure that the bearing bracket is re-installed in the correct position.

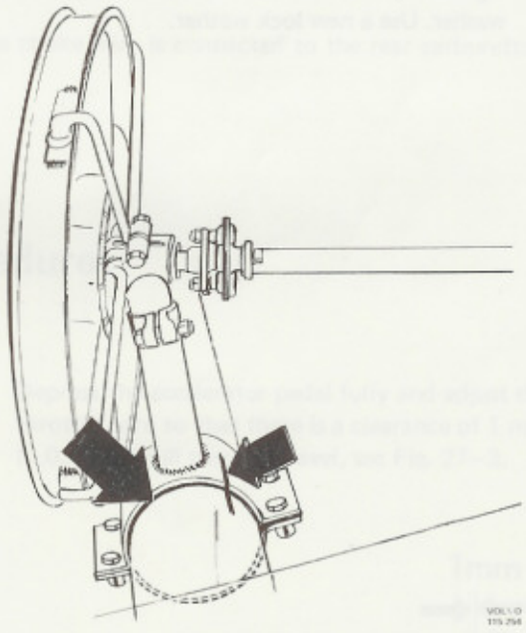


Fig. 26–11. Marking of fan bearing bracket

6. Remove the bearing bracket cap and take down the bearing bracket and fan.

Replacing cooling fan (Removed from vehicle)

1. Bend up the lock washer and remove the fan's retaining screws.
2. Remove the fan.
3. Install the fan, washer and lock washer. Fit and tighten up the screws. Lock with the lock washer. Use a new lock washer.

Replacing fan journalling (Removed from vehicle)

1. Bend up the lock washer and remove the fan's retaining screws. Remove the fan.
2. Pull off the rear flange (against the fan shaft) with a standard puller.
3. Pull the fan journalling out of the bearing bracket.
4. Press the fan hub off the fan journalling.
5. Press. the fan hub onto the new fan journalling. There should be a gap of about 3 mm (1/8") between hub and bearing.
6. Install the fan journalling in the bearing bracket.
7. Press the flange onto the fan journalling. The flange should be flush with the end of the bearing shaft.
8. Install the fan, washer and lock washer. Fit and tighten up the screws and lock with the lock washer. Use a new lock washer.

Installing fan and bearing bracket

1. Place the bearing bracket and fan on the tubular member.
2. Fit the cap and tighten up the front screws. Adjust the bearing bracket according to the line-up marks and tighten up the rear screws.
3. Install the band clamps round the brake pipes.
4. Fit the air bellows and clamp round the fan shroud. Fit the screw and tighten up the clamp ring.
5. Install the fan shaft.
6. Tighten up the fan bearing clamping screw.

GROUP 27 THROTTLE CONTROLS

Description

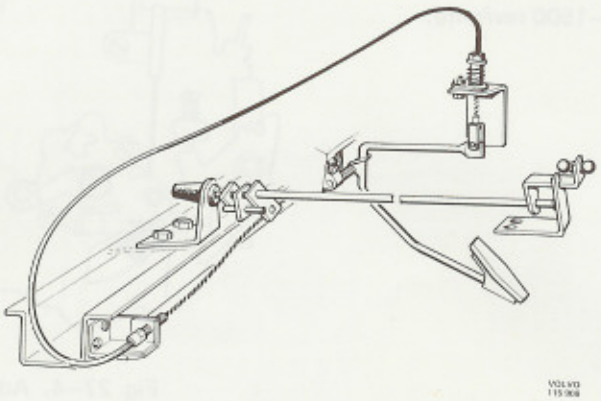


Fig. 27–1. Throttle controls

The acclerator pedal is of the suspended type. It operates the throttle shaft via a wire. Movement is subsequently transferred via link rods to the carburettors.

The choke wire is connected to the rear carburettor.

Service Procedures

Adjusting throttle controls

1. Adjust the link rods between the throttle control shaft and carburettors, with engine idling. There should be a clearance of approx. 0.1 mm (0.0039") between the lever and throttle shaft flange, see Fig. 27–2.

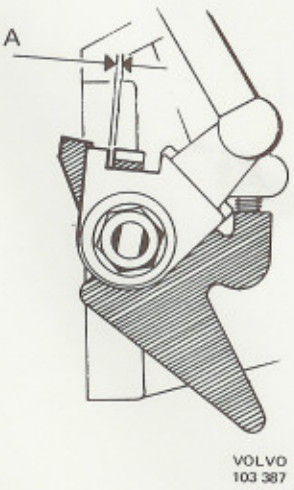


Fig. 27–2. Adjusting throttle control, idle position
A = 0.1 mm (0.0039")

2. Depress the accelerator pedal fully and adjust the throttle wire so that there is a clearance of 1 mm (0.039") at full throttle travel, see Fig. 27–3.

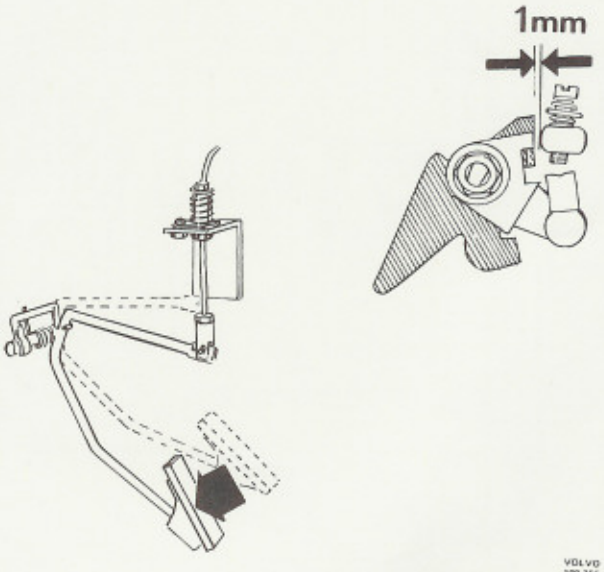


Fig. 27–3. Adjusting throttle wire

3. Pull out the choke approx. 20 mm (3/4"). The mark on the cam disc should now be opposite the fast idle trimming screw, see Fig. 27–4. Adjust engine speed with the fast idle trimming screw to 23.3–25.0 rev/sec (1400–1500 rev/min).
4. Lubricate all stud bolts.

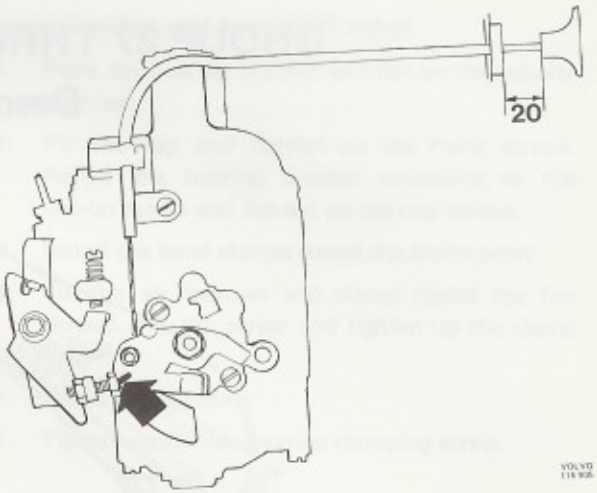
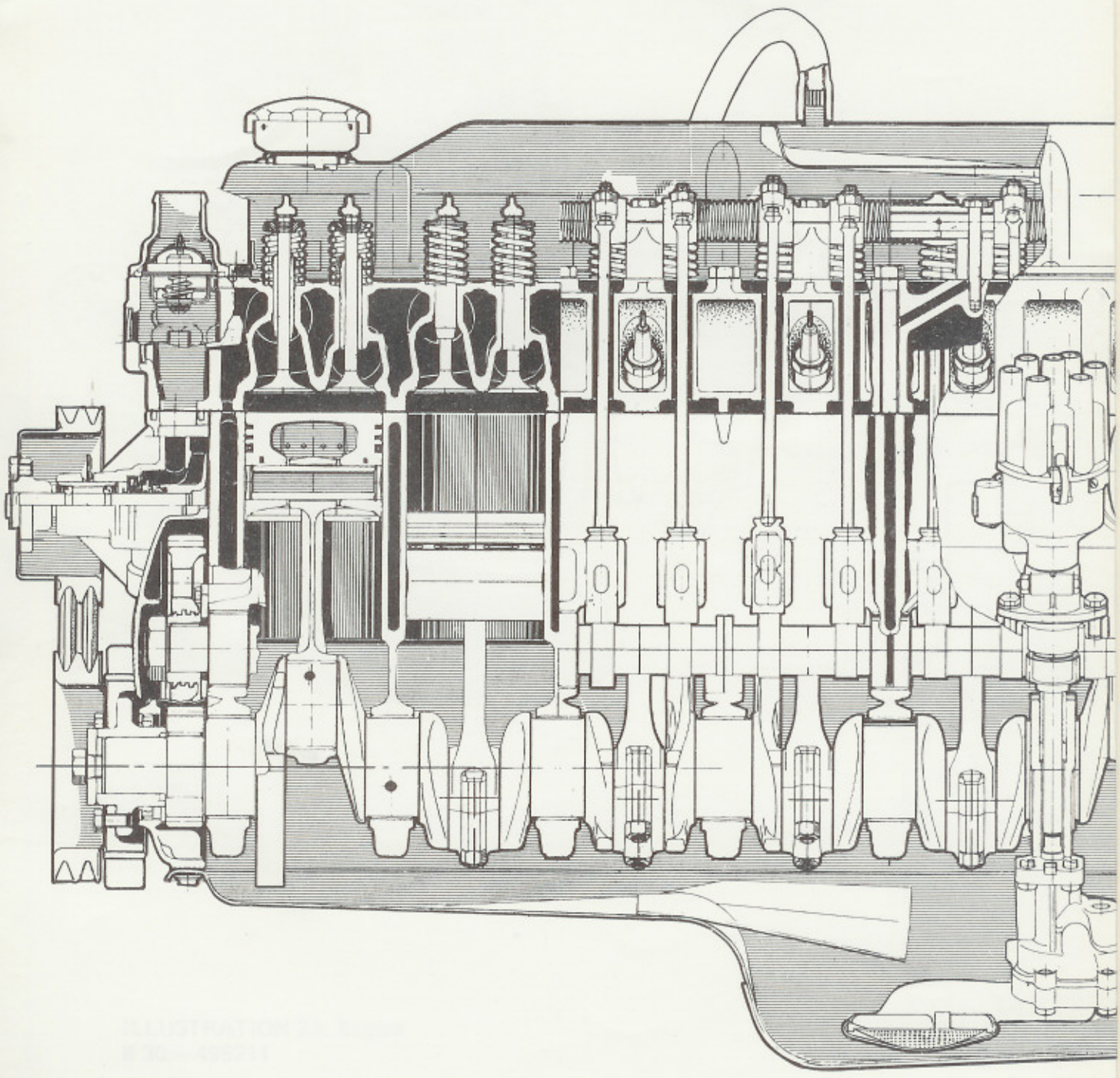
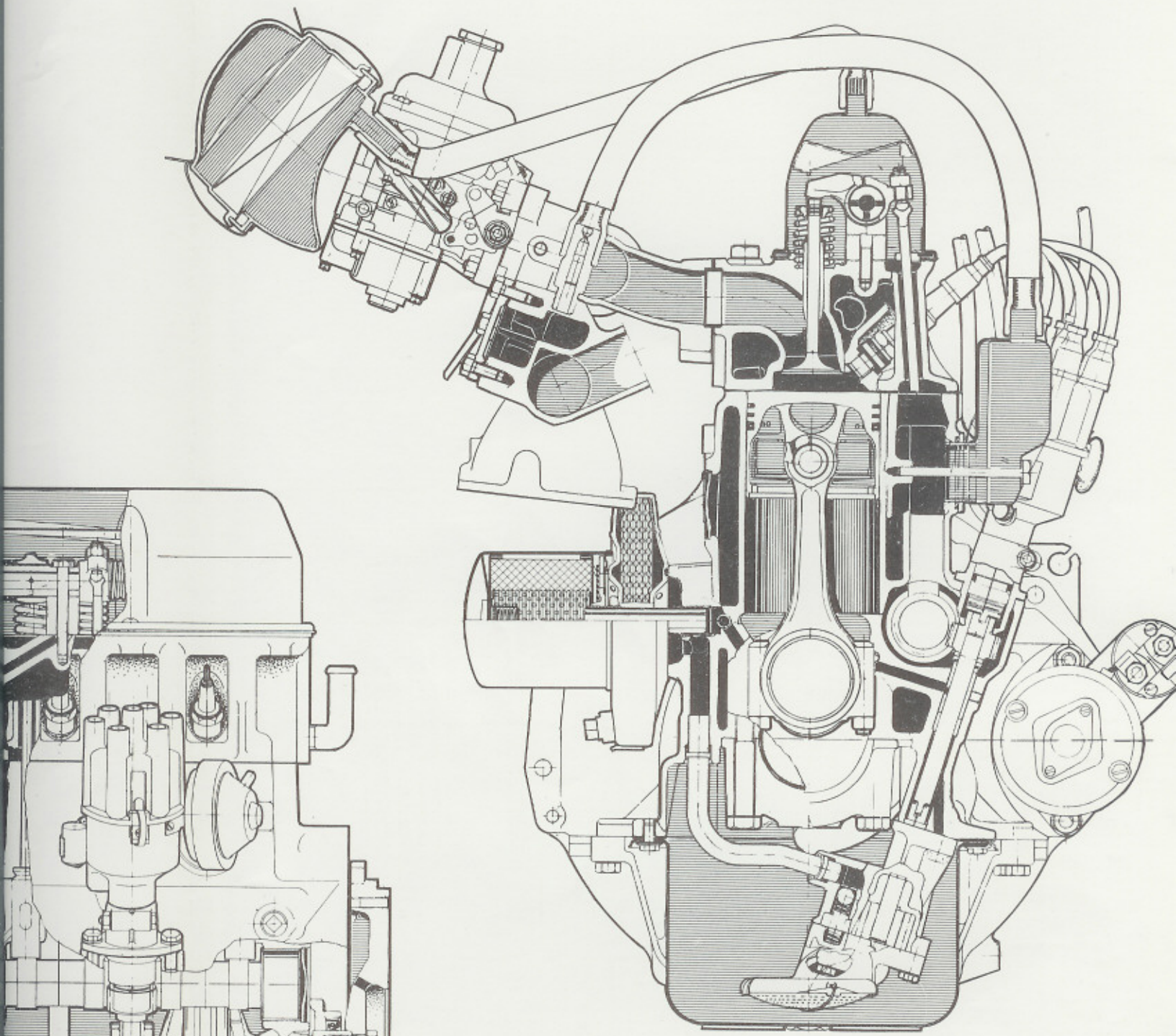


Fig. 27–4. Adjusting the choke





VOLVO
109 019

VOLVO
109 02

TP 11076/1
Engelska
2500.5.75
Printed in Sweden

R.1000.11.78

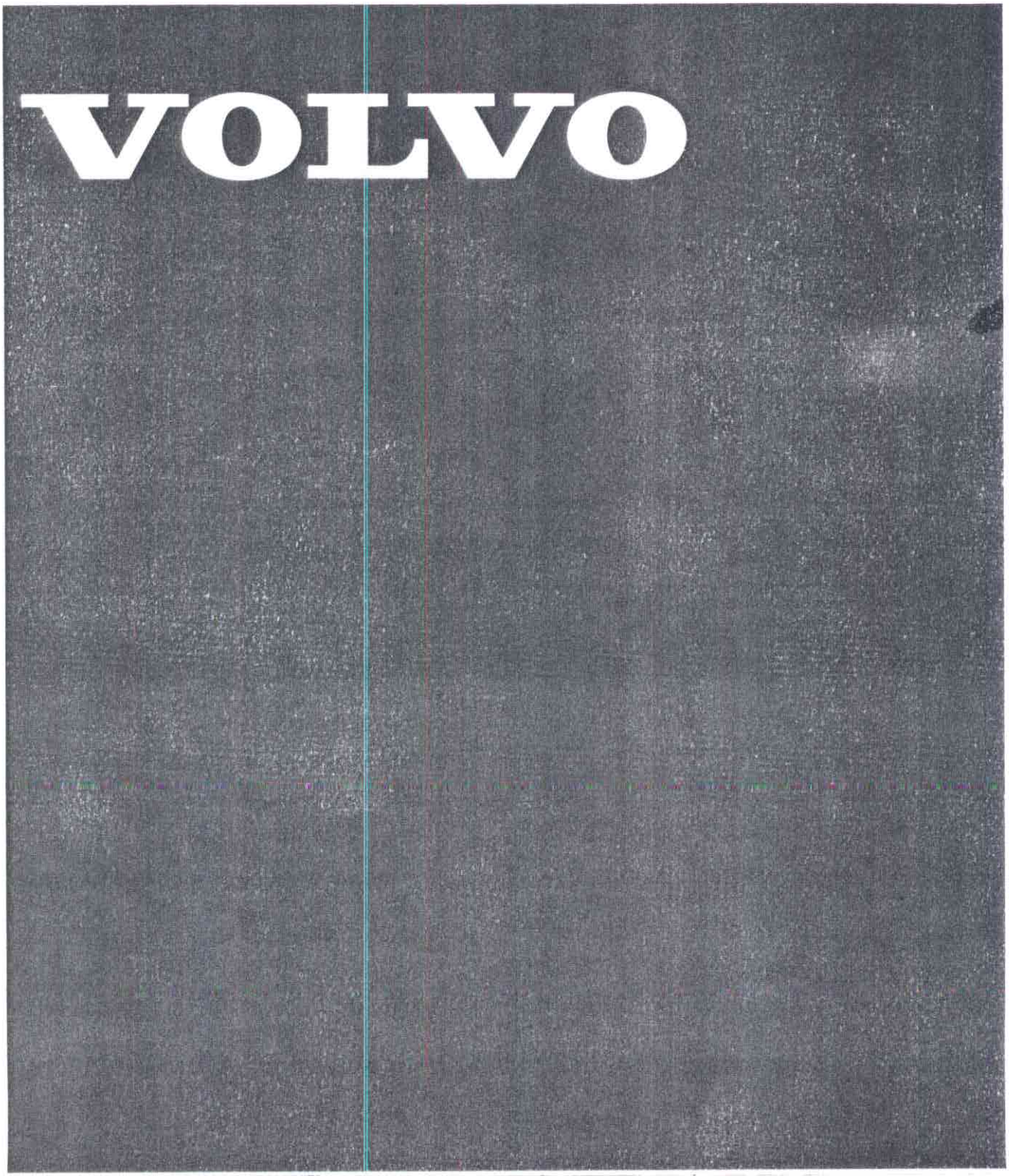
Printed in Sweden, Götab, Kungälv, 1978.25689

Service Manual

Section 3

Electrical System
C303
CIVIL

Trucks



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Indicator/warning lights 64

Group 39 Wiring Diagram

Wiring Diagram ..... Fold-out

Reproduction permitted if source quoted

Group 30 General

Specifications

Battery

Type	Noack 12H60B or corresponding
Number	One
System voltage	12 V
Capacity	60 Ah
Electrolyte specific gravity:	
Fully charged battery	1.28
When re-charging should be done	1.21
Recommended charging current	6.0 A

Alternator

Type	Bosch 14V/55A 0120400686
Output	770 W
Max. amperage	55 A
Max. speed	200 r/s (12000 r/min)
Direction of rotation	Clockwise
Ratio, engine-alternator	1:1.72
Rotor, resistance	4.0–4.4 ohm
Stator, resistance	0.14–0.15 ohm
Min.-diameter of slip rings	31.5 mm
Maximum permissible radial throw for slip rings	0.03 mm
Max. permissible radial throw for rotor body	0.05 mm
Min. length of brushes	14 mm
Brush spring force	3–4 N
Tightening torque for pulley	40 Nm (4 kgf m = 30 lbf ft)
Output test (at approx. 14 V)	
Alternator should generate min. 25A at alternator speed	25 r/s (1500 r/min)
engine speed	14.5 r/s (870 r/min)
Alternator should generate min. 55A at alternator speed	100 r/s (6000 r/min)
engine speed	58 r/s (3500 r/min)

Charging regulator

Type	Bosch AD 14 V
Control voltage	At 67 alternator r/s (4000 r/min)
Engine speed	39 r/s (2300 r/min)
Cold regulator read off within 30 secs, lower pair of contacts	13.9–14.8 V
Load current (regulated by lower pair of contacts)	28–30 A
Load current (regulated by upper pair of contacts)	3–8 A

Starter motor

Type	Bosch GF 12 V 1.1 Ps
Voltage	12 V
Direction of rotation	Clockwise
Output	Approx. 810 W (1.1 h.p.)
Number of brushes	4
Test values, mechanical	
Rotor end float	0.05–0.3 mm
Brush spring tension	11.5–13.0 N 1.15–1.30 kgf (2.5–3.0 lbf)

Distance from pinion to ring gear	1.2–4.4 mm (0.048–0.173")
Rotor brake frictional torque	0.22–0.40 Nm 2.2–4.0 kgf m (16–30 lbf ft)
Pinion idling torque	0.13–0.18 Nm 1.3–1.8 kgf m (9.5–13.0 lbf ft)
Backlash	0.35–0.50 mm (0.014–0.020")
Minimum diameter of commutator	33 mm (1.3")
Minimum length of brushes	13 mm (0.5)
Test values, electrical (with a battery capacity of 135 Ah)	
Unloaded starter motor 11.5 V and 30–50 A	96.7–130.0 r/s (5800–7800 r/min)
Locked starter motor (rotor) 6 V and 330–420 A	0 r/s
Control solenoid cut-in voltage	Min. 7.5 V

Ignition system

Firing sequence	1-5-3-6-2-4
Ignition timing (vacuum governor disconnected)	10° at 13.3 r/s (800 r/min)
Basic firing position (engine switched off)	10° B.T.D.C.
Spark plugs	W 200 T 35 or corresponding
Spark plugs, electrode gap	0.7–0.8 mm
Spark plugs, tightening torque	35–40 Nm 3.5–4.0 kgf m (26–30 lbf ft)
Ignition coil, condenser	0.45 μF
Spark plug cables, damper resistance at 20°C (68°F)	1000 Ω at distributor 5000 Ω at spark plug

Distributor

Type	PFU 6
Direction of rotation	Anti-clockwise
Cam angle (dwell angle)	39°–45°
Breaker contacts, gap	Min. 0.25 mm (0.010")
contact pressure	5.0–6.3 N (0.5–0.63 kgf = 1–1.4 lbf)

Centrifugal governor

Advance, total		11.5–13.5 distr. degrees
Advance begins at	10.2–12.1 distr. r/s	(610–725 distr. r/min)
Values, 5°	14.3–16.7 distr. r/s	(860–1000 distr. r/min)
10°	26.3–32.9 distr. r/s	(1575–1975 distr. r/min)
Advance, maximum, at	37.5 distr. r/s	(2250 distr. r/min)

Vacuum governor (positive)

Advance, total		4–6 distr. degrees
Advance begins at	10.7–16.0 kPa	(80–120 mm Hg) (3–5")
Values at 2.5 distr. degrees	15.3–21.3 kPa	(115–160 mm Hg) (4.5–6.3")
Advance, maximum, at	23.3–25.3 kPa	(175–190 mm Hg) (7–7.5")

Lighting

Bulbs

	Qty	Output	Socket	Type
Headlamps	2	60/55 W		H 4
Direction indicators	4	23 W	Ba 15 s	
Parking lights	2	4 W	Ba 9 s	
Stop lights	2	23 W	Ba 15 s	
Tail lights	2	10 W	Ba 15 s	
Interior lighting	2	10 W	S 8.5	

Indicator and warning lights

Fullbeams	1	2 W	Ba 9 s
Direction indicators	2	2 W	Ba 9 s
Diff. locks	2	2 W	Ba 9 s
Front-wheel drive	1	2 W	Ba 9 s
Battery charging	1	2 W	Ba 9 s
Oil pressure	1	2 W	Ba 9 s
Brakes	1	2 W	Ba 9 s

Instruments

Speedometer	1	2 W	Ba 9 s
Coolant temperature gauge	1	2 W	Ba 9 s
Fuel gauge	1	2 W	Ba 9 s

Switches

Lights	1	2 W	Ba 7 s
Windscreen wipers	2	2 W	Ba 7 s
Washers	1	2 W	Ba 7 s
Hazard warning lights	1	2 W	Ba 7 s
Headlamp wipers	1	2 W	Ba 7 s

Fuses

Qty	Rated current
18	8 A

ore carrying out any repairs, disconnect the negative lead n the battery.

cables have been coloured in order to facilitate identation.

following cable colours are used:

l	Blue BL	Green GN	Black SB
iite	Brown BN	Yellow Y	Grey GR

en about to do any electrical welding work on the vehicle, connect both battery cables and the cables to the charging ulator. The welding machine should be connected as near possible to where the welding is to take place and on same main component. For example, if the frame is to welded, the welding machine should be earthed to the ne.

ayout wiring diagram has been made for the following ctions:

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onnection designations on various mponents

listing below is to show the association between wire nection and the component terminal designation.

om	To
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Starter motor	B+ Alternator
Starter motor	30 Ignition switch

From	To
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61 Ignition switch across battery charging warning light	61 Alternator
Group 33	
50 Ignition switch	50 Solenoid, starter motor
Group 34	
15 Ignition switch	15 Ignition coil
75 Ignition switch	Fuses B2, B3, B4 and B5
75 Ignition switch across battery charging warning light	61 Alternator
Group 35	
56 Lighting switch across relay for headlight flashers	56 Step relay
56a Step relay	56a Fullbeams
56b Step relay	56b Dipped beams
58 Lighting switch across relay for parking lights	Fuses A2, A3, A4 and A5
81a Step relay	56a Fullbeams
Group 36	
49a Flasher unit	56 Direction indicator lever
L Direction indicator lever	Left direction indicator
L Switch for hazard warning lights	Left direction indicator
R Direction indicator lever	Right direction indicator
R Switch for hazard warning flashers	Right direction indicator
C Flasher unit	Indicator light, direction indicator
C2 Flasher unit	Indicator light, direction indicator (trailer)
53 Switch for wipers	Headlamp wiper motors and windscreen wiper motors, low speed
53a Switch for wipers	Wiper motors, wipers', parking position
53b Switch for wipers	Windscreen wipers, full speed
53e Switch for wipers	Windscreen wipers, brake coil
31 Wiper motor	Chassis connection
85 Relay coil (possibly via sender)	Chassis connection
86 Relay coil	Battery + (direct or across switch)
87 Relay (possibly via terminal 30)	Consumer
87a Relay	Consumer
30 Battery "+" (direct or across switch)	Relay
30 Relay	Consumer
Group 38	
G Instruments	Senders

Group 31. Battery

Construction and Function

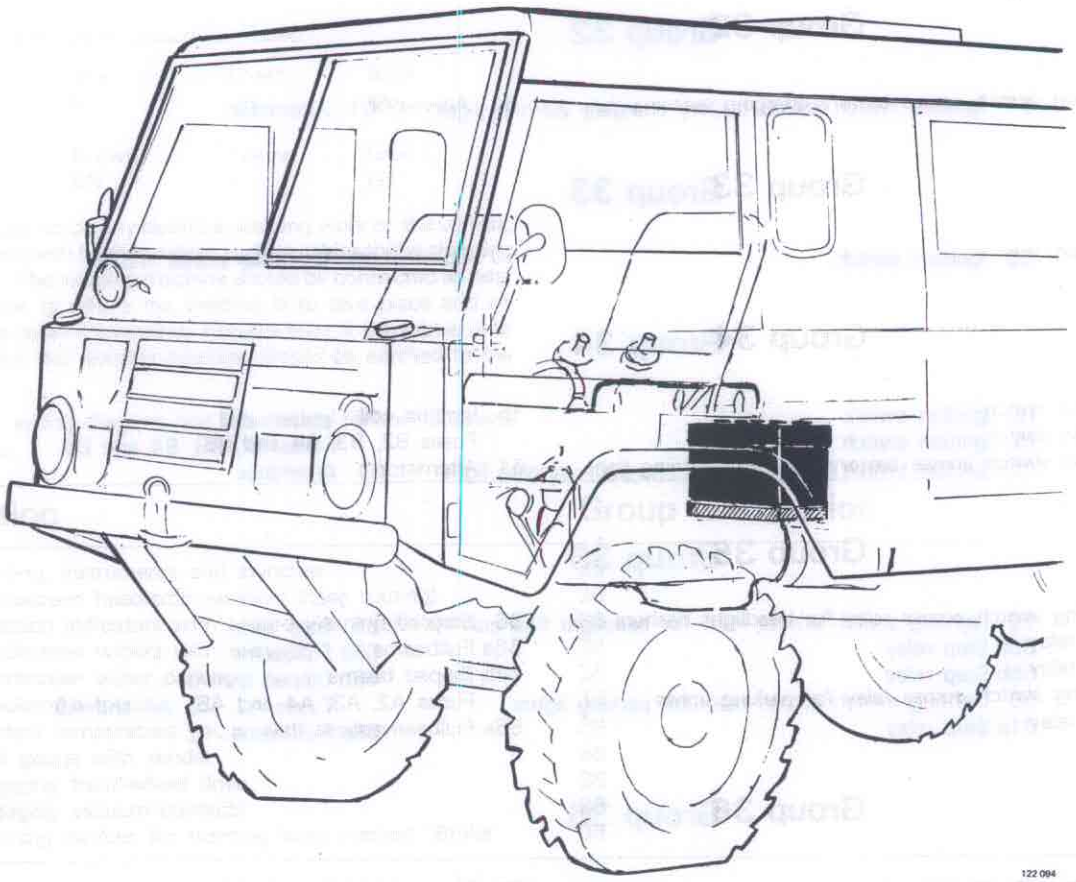


Fig. 31–1. Battery

attery

e battery is situated on the left-hand side, behind the driv-
s seat.

consists of a 12-volt lead-type battery with a capacity
60 Ah.

ıe battery negative pole (–) is wired to the vehicle chassis.

apacity

ıe capacity of the battery is given in ampère hours (ab-
eviated Ah). When we say that a battery has a capacity
twenty hours, we mean that the battery develops, e.g.,
) A during 20 hours. It then has a capacity of 60 Ah.

The capacity of a battery depends among other things on its ambient temperature. A low temperature has a negative effect on the capacity. When we indicate the capacity of a battery, we very often mean the capacity at 20°C (68°F).

Capacity differences at different temperatures:

100 % capacity at 20°C (68°F) gives about 55 % capacity at –18°C (0°F)
70 % capacity at 20°C (68°F) gives about 35 % capacity at –18°C (0°F)
40 % capacity at 20°C (68°F) gives about 25 % capacity at –18°C (0°F).

Battery

When replacing the battery, make sure that the new one is connected up with the correct polarity (minus to vehicle chassis).

The battery cables must not be disconnected when the engine is running.

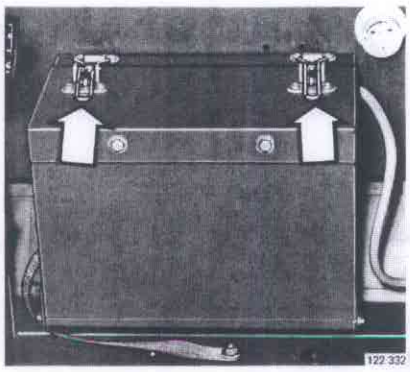
To ensure that the battery operates without any trouble, always maintain the fluid at the prescribed level. Make sure that it is about 5 mm (3/16") above the cell plates. Top-up if necessary with sufficient distilled water. Also make sure that the battery cable shoes are fixed securely. The cable shoes and pole studs should be coated with a light layer of grease, e.g., Bosch Ft 40 V 1 or corresponding.

31102-3

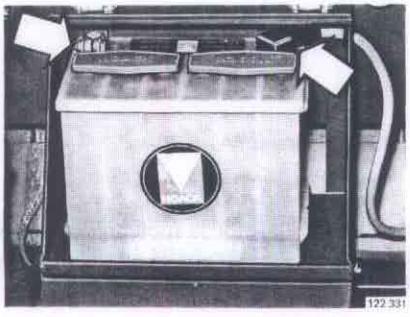
Changing the battery

Removal

1. Unclasp the lock clasps and fold down the cover.



2. Remove the insulation across B+.
3. Disconnect the battery cables from the battery.
4. Remove the battery.



Installation

1. Place the battery in the battery box.
2. Grease the studs and cable shoes with suitable grease, e.g., Bosch Ft 40 V 1 or corresponding.
3. Connect the battery cables to the battery and fit the insulation across B+. Fit the cover over the battery.

Group 32. Alternator

Construction and Function

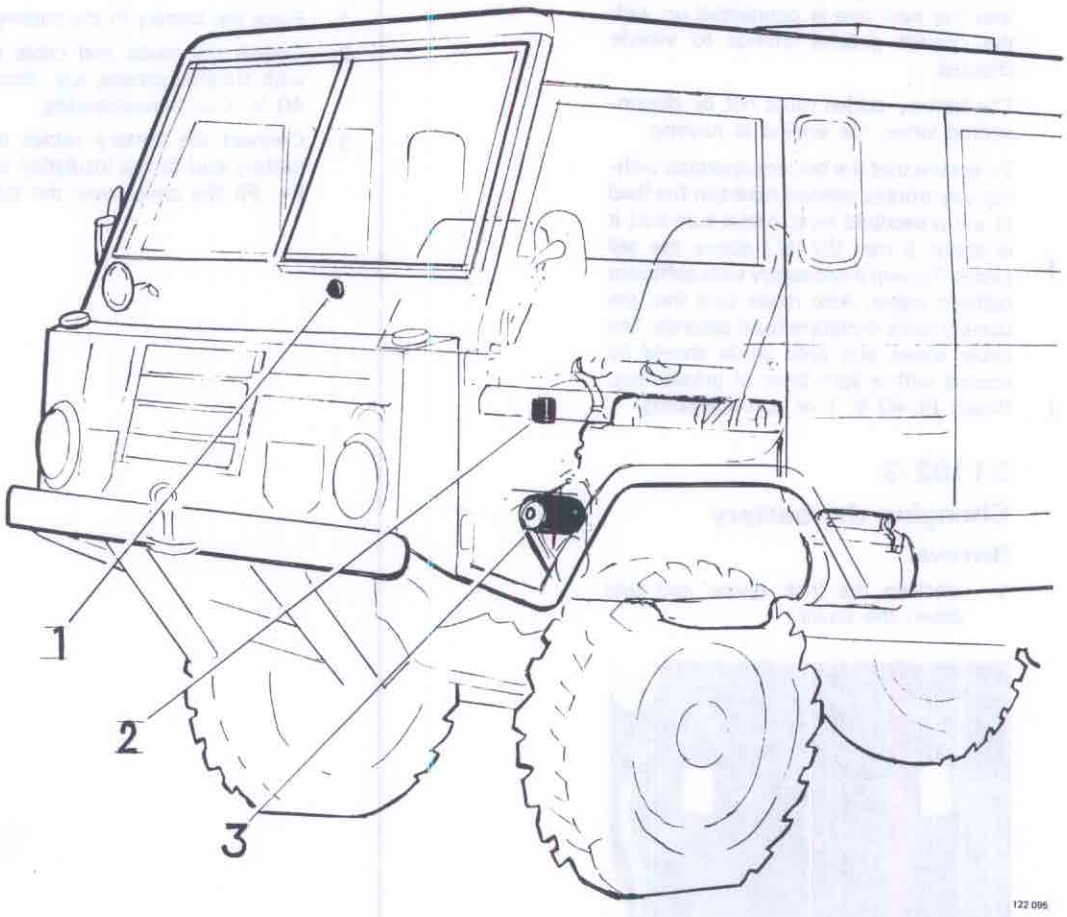


Fig. 32–1. Alternator

1 Battery charging warning light
2 Charging regulator
3 Alternator

ternator

alternator is situated on the right-hand side of the engine is driven by two belts from the crankshaft pulley. The nator develops an output of max. 770 W.

The charging regulator is mounted on the right-hand side of the rear engine casing lock device. The battery charging warning light is on the instrument panel.

The alternator is a three-phase, delta-connected alternator unit, of make Bosch 14V/55A. The rectifier, which is built into the slip ring end shield, consists of six silicon diodes. The drive end shield houses three magnetizing diodes which feed the rotor winding via the charging regulator.

An alternator differs from a dynamo in that it has a rotating field coil (rotor) and stationary generating winding (stator).

The rotor is of the claw-pole type with the field windings fed across two slip rings. Since the alternator is self-limiting with regard to current (max. 55A), a simple, mechanical charging regulator can be used with only voltage control.

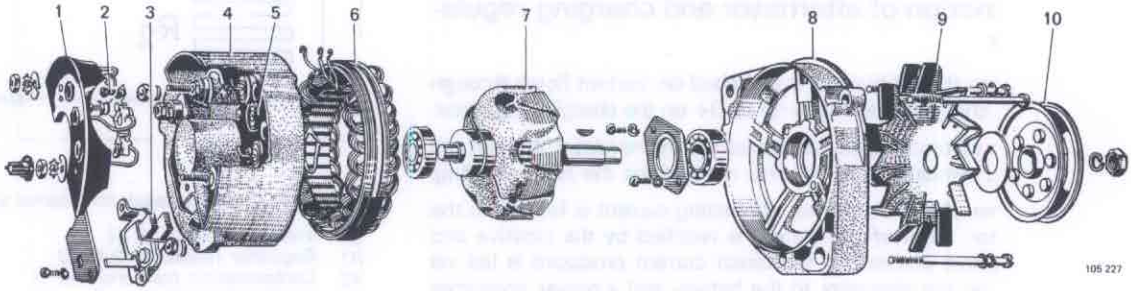


Fig. 32–2. Exploded view of alternator

1 Rectifier (positive 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

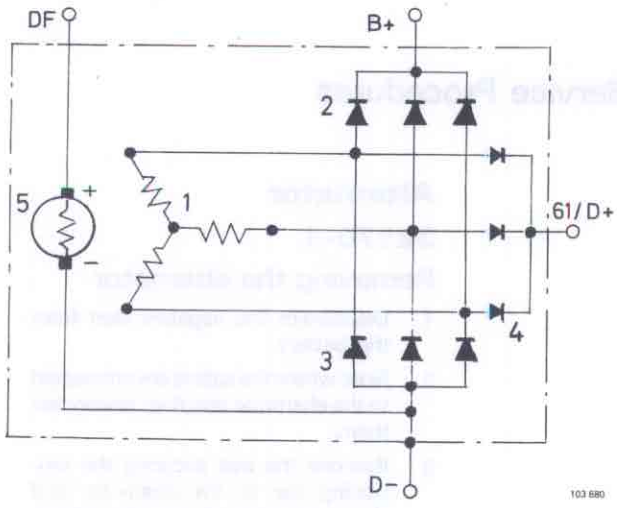


Fig. 32–3. Alternator internal wiring

1 Stator windings
2 Positive rectifier diodes
3 Negative rectifier diodes
4 Magnetizing diodes
5 Rotor winding

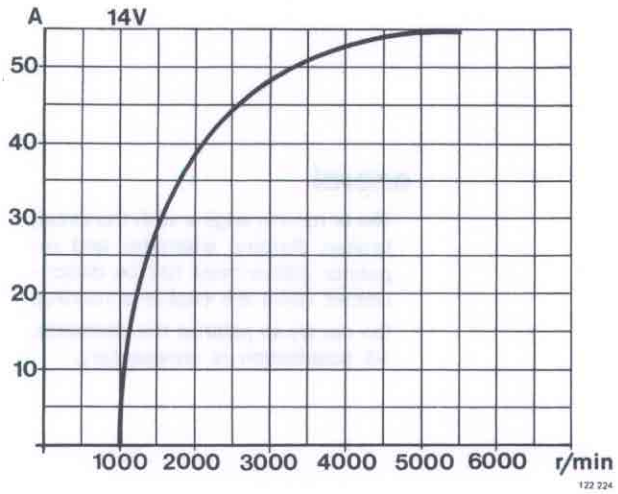


Fig. 32–4. Output curve
The avobe speed applies to alternator

ıarging regulator Bosch AD 14 V

ɜ charging regulator is a mechanical, single-pole voltage ulator.

as a contact system which consists of 1, a movable con- t, 2, a lower contact, 3, an upper contact, see Fig. 32-5.

ɜ regulator resistor is placed under a plate underneath regulator. Temperature compensation is operated by a ıetal spring which influences the spring tension so that regulator receives lower regulating voltage at higher tem- atures.

ınction of alternator and charging regula- r

ıen the ignition key is switched on, current flows through charging warning lamp to D+ on the charging regulator.

ɜ current is then conducted via the regulator through the d winding to earth. This magnetizes the rotor winding.

ıen the rotor rotates, alternating current is formed in the tor. Most of the current is rectified by the positive and ɡative diodes and the direct current produced is led via on the alternator to the battery and a power consumer consumers) if switched on. A small part of the current ecitified by the magnetizing diodes and is led via 61/D+ the charging regulator and then onto the rotor winding. ɐ cycle is repeated until the regulating voltage has been ıched. When this has been reached, contact is broken bet- ıen 1 and 2 on Fig. 32-5. This forces the magnetizing rent to the rotor winding to pass resistance R_1, Fig. 32-5. :he voltage rises in spite of this, the armature is drawn ther down in the voltage coil and the movable contact meets the upper contact (3), Fig. 32-5. This earths the d winding at both ends and the voltage drops. The cycle epeated continuously so that voltage is maintained con- nt.

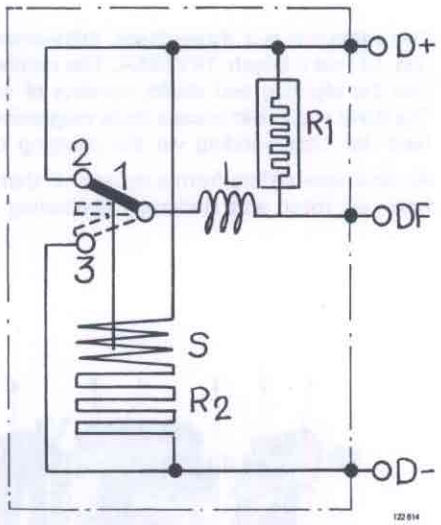


Fig. 32-5. Charging regulator internal wiring

S Voltage winding 35 Ω
R1 Regulator resistance 2.45 Ω
R2 Compensation resistance 50 Ω
L Contact impendance coil

1 Movable contact
2 Lower contact
3 Upper contact

Service Procedures

eneral

Never run the engine with the circuit broken. Battery, alternator and regulator cables must not be disconnected while the engine is running.

Do not try to polarize the alternator. All polarization is unnecessary.

Alternator

32170–1

Removing the alternator

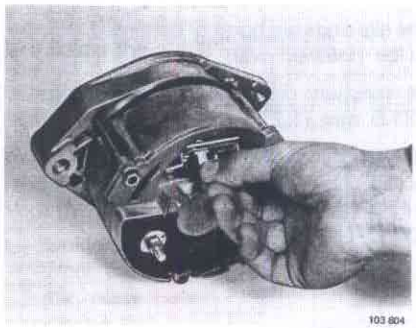
1. Disconnect the negative lead from the battery.
2. Note where the cables are connected to the alternator and then disconnect them.
3. Remove the bolt securing the tensioning bar to the alternator and slacken a couple of turns the bolt securing the tensioning bar to the cylinder head.
4. Remove the alternator retaining bolt and its spacer washer. Remove the drive belts and the alternator.

Alternator (removed)

Overhauling

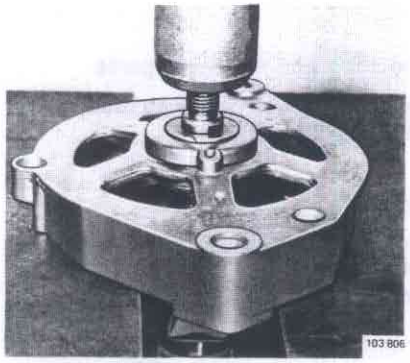
Disassembling

1. Fit the alternator pulley and pulley belt in a vice with soft jaws. Remove the nut, washer, pulley, fan and key.
2. Remove the screws securing the brush holder. Pull out the holder.

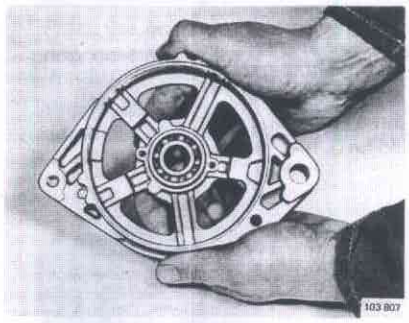


3. Mark the drive end shields and stator to ensure they are re-fitted correctly when assembling.
4. Remove the three screws holding the alternator together. Separate the drive end shield and rotor from the slip ring end shield and stator.

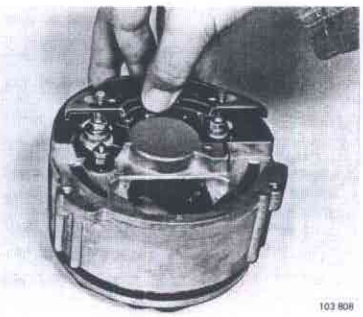
5. Press the rotor out of the drive end shield.



6. Remove the screws for the cover washer which holds the drive end bearing and press out the bearing.



7. Remove the nuts for the positive diode plate and lift up and bend the plate aside.



Solder loose the stator connections from the terminals and remove the stator.

Pull the slip ring bearing from the rotor.

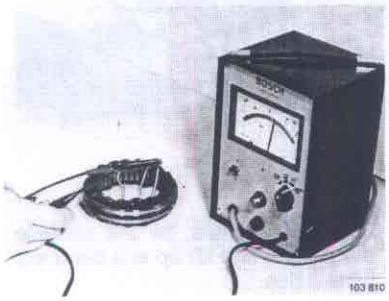
ıecking and replacing parts

ean the removed parts with white spirit fore checking them.

ator

ıeck the stator insulation by connecting 40 V alternating current between the assis and a phase winding.

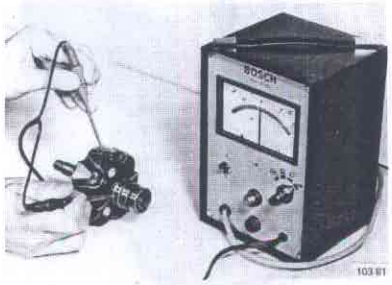
ıeck the stator for any short-circuiting measuring the resistance between the ator windings (three measurements). ıe resistance should be 0.14–0.15 ohm.



0,14–0,15 Ω

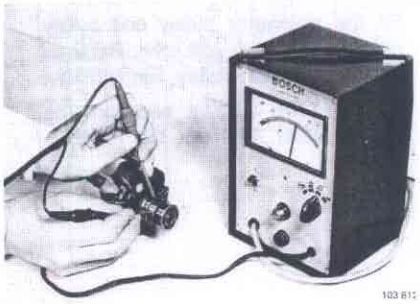
otor

heck the rotor insulation by connecting 40 V alternating current between the ıtor body and a slip ring.



Measure the resistance between the slip rings with the help of an ohmmeter.

The resistance should be 4,0–4.4 ohms.



4,0–4,4 Ω

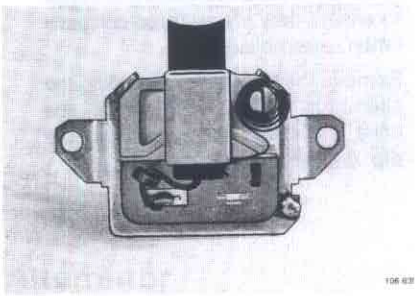
If the slip rings are burnt or damaged, they can be polished with, e.g., pinol chuck.

The minimum diameter for the slip rings is 31.5 mm (1.2").

After polishing, check the roundness on the slip rings with a dial indicator. Max. permissible radial throw is 0.03 mm (0.0012").

Brush holder

Check the brush holder insulation with a 40 V alternating current. Measure the brush length which should be minimum 14 mm (0.5").



Diodes

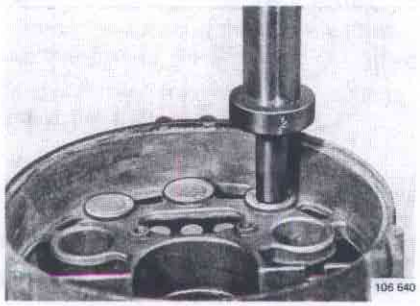
Check the diodes with a diode tester. Faulty diodes must be replaced as follows.

Replacing the diodes
Positive diodes

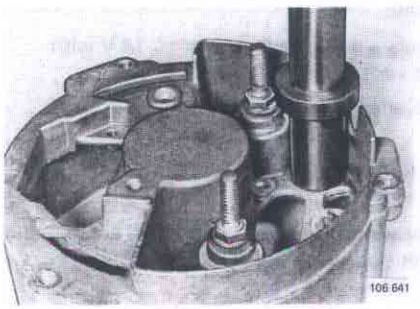
1. Solder loose the positive diode plate from the connections. Press out the faulty diode with a suitable drift.
2. Calibrate the hole in the positive diode plate with a suitable tool (e.g. Bosch EFLJ 57/0/3 and 57/05).
3. Oil the new diode with silicon oil (e.g. Bosch OI 63V2) and press it in with a suitable drift.
4. Paint the new diode and any bare spots on the outside of the positive diode plate with black paint (Bosch F 1 87 V 1 corresponding) to prevent corrosion.
5. Solder the positive diode plate to the connections. Check with a diode tester.

Negative diodes

1. Solder loose the negative diodes from the connections. Screw loose the plate holding the magnetizing diodes and lift off the plate together with the positive diode plate.
2. Press out the faulty diode with a suitable tool.



3. Oil the new diode with silicon oil (e.g. Bosch OI 63V2) and fit it in the bearing shield.



4. Solder on the negative diodes to the connections and check with a diode tester.

Magnetizing diodes

1. If any of the magnetizing diodes is faulty, replace the entire plate and all three diodes.

Bearings

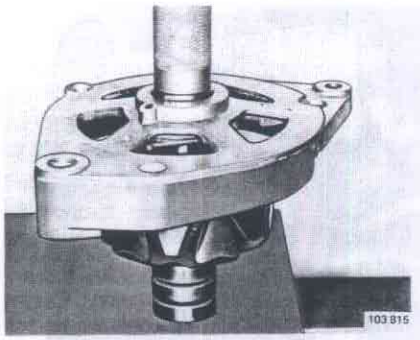
Check to make sure the bearings are not damaged or worn.

Grease the old bearings (or new ones if fitted) with Bosch special grease Ft 1 V 34 or corresponding.

Fit the bearing on the rotor. Fit the bearing in the drive end shield and fix the washer over the bearing.

Assembling

1. Fix the stator in the slip ring end shield and solder the stator windings to the connections. Fit the positive diode plate.
2. Press the bearing shield and spacer ring onto the rotor.



3. Smear the bearing rear seat with a light layer of Molykote paste and assemble the alternator. (Do not forget the spring ring on the bearing rear seat.) Assemble the alternator by means of the screws and nuts (check the marking).
4. Fit the brush holder.
5. Fit the key, fan, pulley, washer and nut.
6. Tighten the nut to a torque of 40 Nm (4 kgf m = 29 lbf ft). After assembling the alternator, test it on a test bench before installing it in the vehicle, see under "Charging Test" (on test bench or in vehicle), page 14. — 40 Nm

:172-1

stalling the alternator

Place the alternator in position and fit the retaining bolt and spacer washer. (Do not tighten up the bolt.)

Fit the drive belts.

Fit the bolt securing the tensioning bar. (Do not tighten up the bolt.)

Tension the drive belts by levering with a suitable tool on the alternator drive bearing end and then tighten up the bolt securing the tensioning bar.

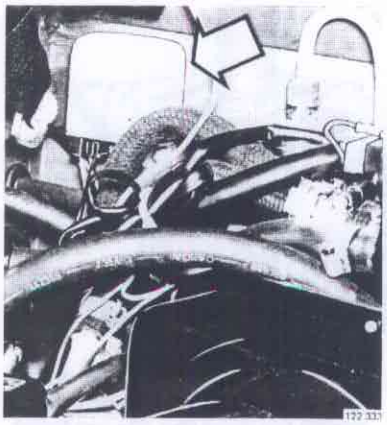
Tighten up the alternator retaining bolt.

Tighten up the bolt on the cylinder head and connect the cables to their terminals.

Fit the front engine cover. Connect the negative cable to the battery and fit the cover over the battery.

:205-3

placing the charging regu-or



Pull the insert plug out of the charging regulator.

Remove the bolts securing the regulator.

Check that the number on the new regulator is the same as that on the old one.

Mount and secure the regulator and connect the insert plug.

Testing the alternator and regulator

Before testing the alternator or regulator in the vehicle, check the battery and test the electrical circuit for faulty cables or insulation, loose or corroded cable shoes and poor earthing. **Check the drive belts.** Any faults discovered must be put right before doing any electrical checks.

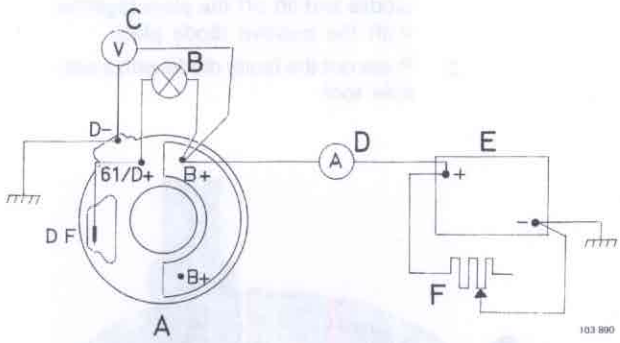
Always make sure that the circuit is not broken when checking the alternator equipment. A disconnected cable can ruin both alternator and regulator.

32183-4, 32174-2

Charging test (on test bench or in vehicle)

Alternator

Wire the alternator according to the diagram below.



A	Alternator	D	Ammeter 0–60 A
B	Check lamp (12 V 2 W)	E	Battery
C	Voltmeter 0–20 V	F	Load resistance

Run the alternator at 100 r/s (6000 r/min) (engine speed 58 r/s = 3500 r/min).

Regulate the voltage to approx. 14 V with load resistance F.

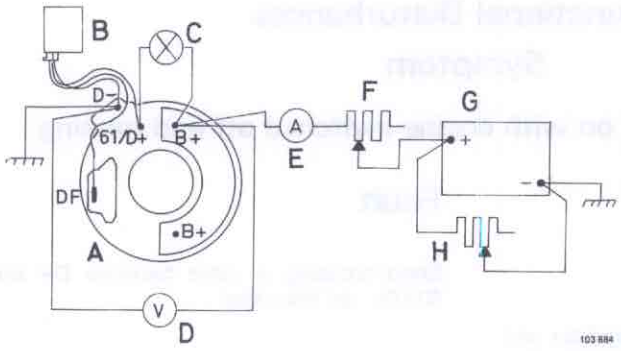
The alternator should now generate 55 A.

If it does not, first check the brushes and the diodes.

If speeds differing from the above are obtained, compare with the output curve in Fig. 32-4.

Testing and adjusting the regulator (in the vehicle or on test bench)

Connect the regulator to a fault-free alternator according to the wiring diagram below.



A	Alternator	E	Ammeter 0–60 A
B	Regulator	F	Control resistance
C	Control lamp (12 V 2 W)	G	Battery
D	Voltmeter 0–20 V	H	Load resistance

Run the alternator at 67 r/s (4000 r/min) (engine speed 39 r/s = 2300 r/min). Load the alternator to 44–46 A. Lower the alternator speed to approx. 16.7 r/s (1000 r/min) (engine idling speed). Again increase the speed to the above and adjust the load to 44–46 A.

Read off the voltmeter. The voltage should be 13.9–14.8 volts.

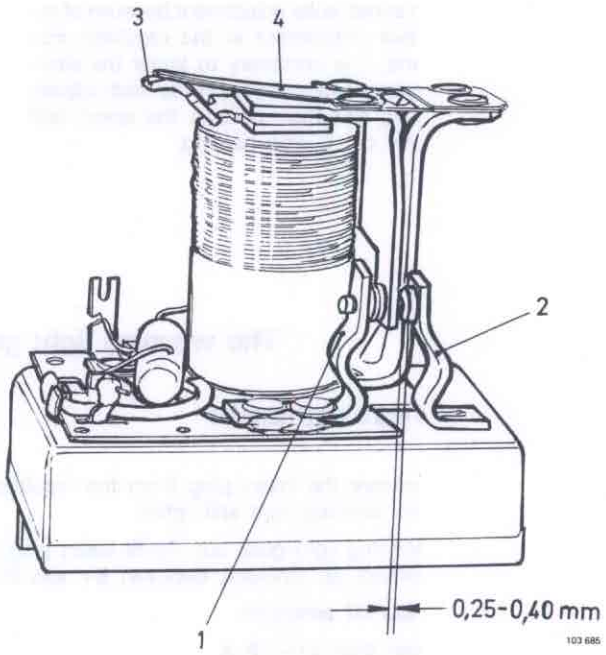
13,9–14,8 V

The regulator should regulate on the left (lower) contact. Read-off within 30 seconds after starting the test.

Reduce the alternator load to 3–8 A and read off the control voltage. 3–8 A

The control voltage should now be within the tolerance 0 V to minus 0.4 V in relation to the first reading.

The regulator should now regulate on the right (upper) contact.

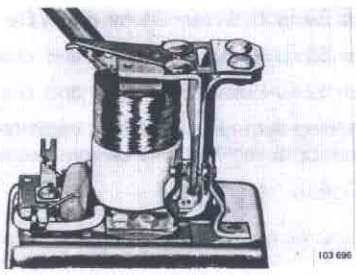


1	Regulator contact for lower control range (lower contact)
2	Regulator contact for upper control range (upper contact)
3	Stop bracket
4	Spring upper section: Steel spring lower section: Bimetal spring

If the control voltage in the upper control range is high or low in relation to the lower control range 0 V to minus 0.4 V, adjust by bending the retainer for the left (lower) contact while correcting the gap between the right (upper) contact and the movable contact according to the Fig. above.

If the holder is bent towards the right (upper) contact, this lowers the control voltage in the upper control range.

The control voltage in the lower control range is adjusted by bending the stop bracket for the bimetal spring.



If the stop bracket is bent downwards, this lowers the control voltage, if it is bent upwards, this increases the voltage.

o avoid faulty adjustment because of re-
dual magnetism in the regulator iron
arts, it is necessary to lower the alter-
ator speed towards 0 after each adjust-
ent, and then increase the speed and
arry out a new reading.

(If the adjusting work is going to take some time and the regulator is warm, it can be suitably cooled to room temperature with compressed air before carrying out the final reading.)

Functional Disturbances

Symptom

The warning light goes on with engine switched off and running

Test measure	Fault
emove the insert plug from the regulator: he warning light still lights.	Short-circuiting in cable between D+ on regulator and 61/D+ on alternator.
Varning light goes out. Re-fit insert plug in regulator and onnect an ammeter between B+ and D+ on alternator.	
ead-off ammeter:	
ess than 2.0–2.5 A	Defective regulator (breakage).
reater than 2.0–2.5 A.	Short-circuiting in cable between DF on regulator to DF on alternator. Short-circuiting in rotor winding.

Warning light goes on with engine switched off but starts to glint when engine is running

est lamp between B+ and 61/D+ on alternator with engine unning:	
amp does not light	Transit resistance in charging circuit or in cable to warning light.
amp glints	Regulator defective (battery overcharges) or alternator defective (insufficient charging of battery).
it new regulator.	
est lamp between B+ and 61/D+:	
amp does not light	Removed regulator defective
amp glints	Alternator defective

Warning lamp does not light with engine switched off

est lamp (12 V and 2 W) between B+ and 61/D+ on lternator lights.	Burnt-out warning light or breakage in its circuit to D+ on regulator.
est lamp between B+ and 61/D+ does not light.	
est lamp between 61/D+ and chassis lights.	Short-circuiting in a positive diode.
est lamp between 61/D+ and chassis glints.	
Varning light glints. Remove insert plug from regulator and onnect an ammeter between B+ and DF on alternator.	
mmeter shows: 0 A	Worn brushes, oxide layer on slip rings or breakage in rotor winding.
2.0–2.5 A	Breakage in regulator or in cable DF from regulator to DF on alternator.

Group 33 Starter Motor

Construction and Function

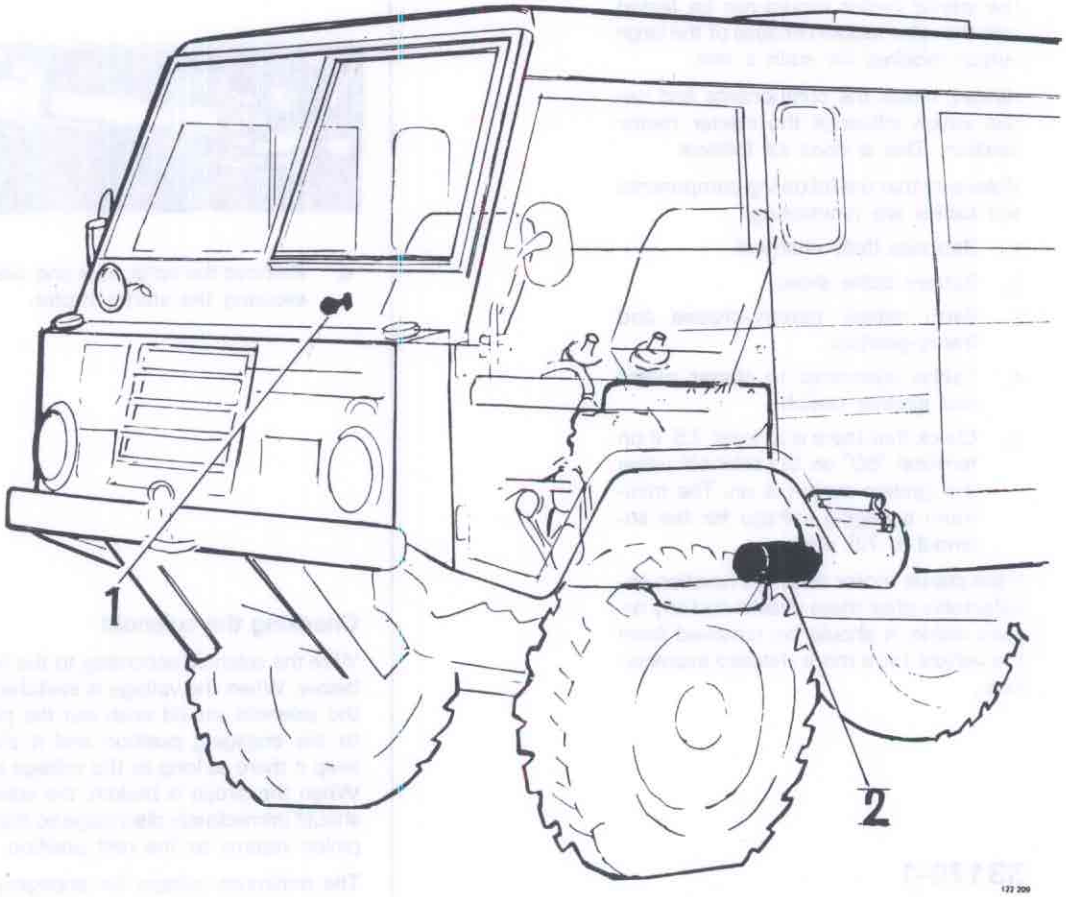


Fig. 33–1. Starter motor

1 Ignition switch
2 Starter motor

Starter motor

The starter motor is a four-pole, series-wound motor and has an output of approx. 815 W (1.1 h.p.). It is situated on the left-hand side of the engine. The starter motor rotor shaft pinion moves axially to engage with the flywheel ring gear. The pinion is controlled by a solenoid. Turning the ignition key to the starting position cuts in the solenoid, this 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.

Starter Motor

Testing in vehicle

The starter motor should not be tested with the rotor locked because of the large output required for such a test.

Instead, check the components and cables which influence the starter motor function. This is done as follows:

Make sure that the following components and cables are functioning.

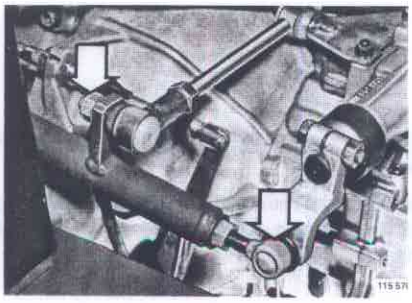
1. Batteries (fully charged)
2. Battery cable shoes.
3. Earth cables, battery-chassis and frame-gearbox.
4. Cables connected to starter motor and ignition switch.
5. Check that there is at least 7.5 V on terminal "50" on the solenoid when the ignition switch is on. The minimum engaging voltage for the solenoid is 7.5 volts.

If the starter motor does not function satisfactorily after these checks and any repairs made, it should be removed from the vehicle for a more detailed examination.

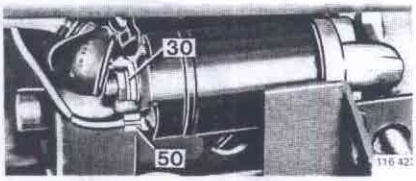
33170-1

Removing the starter motor

1. Disconnect the negative cable from the battery.
2. Remove the rear engine casing. Remove the gear lever control ball joints from the gearbox and lift up the control pipe.



3. Disconnect the cables from the starter motor.

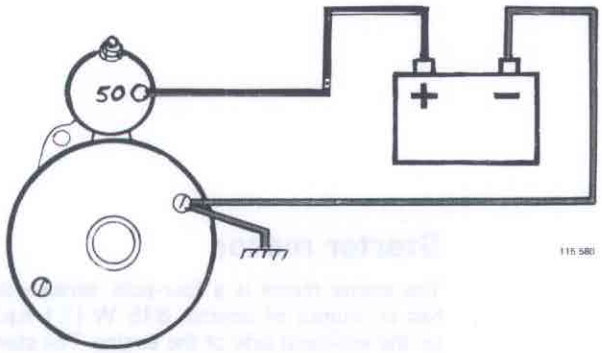


4. Remove the bolts, nuts and washers securing the starter motor.

Checking the solenoid

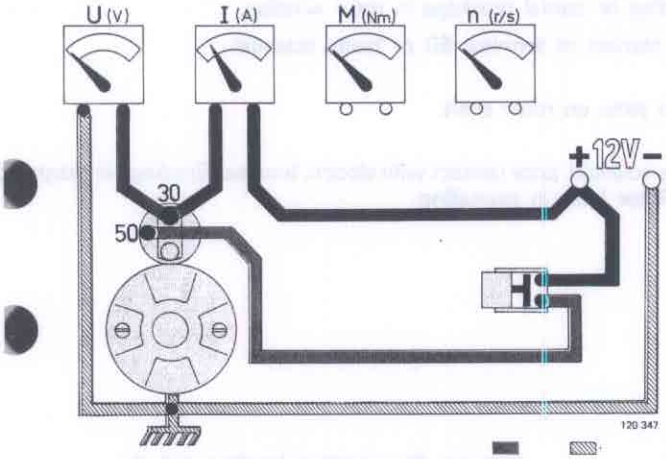
Wire the solenoid according to the figure below. When the voltage is switched on, the solenoid should push out the pinion to the engaging position and it should keep it there as long as the voltage is on. When the circuit is broken, the solenoid should immediately disengage so that the pinion returns to the rest position.

The minimum voltage for engaging the solenoid is 8 volts.



Testing the starter motor on test bench

Wipe the outside of the starter motor with a damp cloth and then secure it on a test bench. Connect the measuring instruments according to the diagram below. NOTE! The test bench must be provided with a shunt for minimum 500 A.



The following values should be obtained:

1. Starter motor unloaded
   Power consumption 40–50 A Voltage 12 V
   Speed 115–135 r/s (6900–8100 r/min)
2. Starter motor loaded
   Power consumption 185–200 A
   Voltage 9 V
   Speed 17.6–22.5 r/s (1050–1350 r/min)
3. Starter motor locked
   Power consumption 300–350 A
   Voltage 6 V
   Speed 0 r/s

If the values deviate from the guide values of the maker, this may be due to the fact that the battery capacity of the test bench differs slightly from the capacity available when the guide values were drawn up.

In order to check whether the measured values agree, they should be re-calculated according to the following formula:

$$I = \frac{Ix \cdot U}{Ux}$$

I = Maker's guide value (300–350 A according to Test 3)
Ix = The current measured by you on test bench
U = Maker's guide value (6 V according to Test 3)
Ux = The voltage measured by you on test bench

Example: Starter motor locked

$$I = \frac{Ix \cdot U}{Ux}$$

Measured values Ix = 270 A Ux = 5 V
Makers' guide values I = 300–350 A U = 6 V

Calculate what I will be and compare this with the maker's guide value (I).

$$I = \frac{Ix \cdot U}{Ux} \quad I = \frac{270 \cdot 6}{5} \quad I = \frac{1620}{5} \quad I = \underline{\underline{324\ A}}$$

The calculated value, 324 A, is within the maker's guide value, which was 300–350 A.

Comments

The measured value, 270 A, has thus been re-calculated to 324 A, which is an approved value.

Concerning functional disturbances, see overleaf.

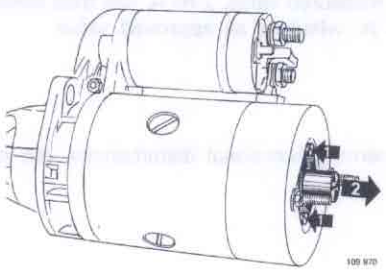
nctional Disturbances

ult	Reason
ow speed and low current.	Large resistance because of dirty commutator, worn brushes or low brush spring pressure (poor batteries).
ow speed and high current.	Short-circuiting in magnetic windings. Rotor slips round against pole shoes because of worn bearings or bent rotor shaft.
owerful sparking, low rotation.	Low spring pressure because of worn brushes or displaced brush springs. Short-circuiting or partial breakage in rotor winding.
inion goes back to rest position before oltage cuts-out.	Poor contact at terminal 50 or faulty solenoid.
inion does not go back to rest position /hen voltage cuts-out.	Pinion jams on rotor shaft.
olenoid cuts in, but starter motor does ot start.	Faulty solenoid, poor contact with electric brushes. Breakage in magnetic winding. Rotor jams in journalling.

'erhauling the starter otor

assembling the starter tor

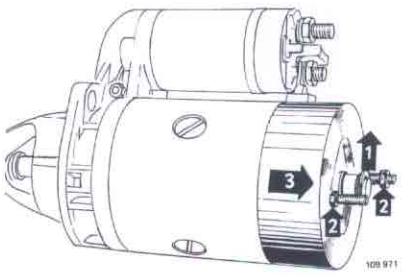
ove the cover from the commutator frame.



109 970

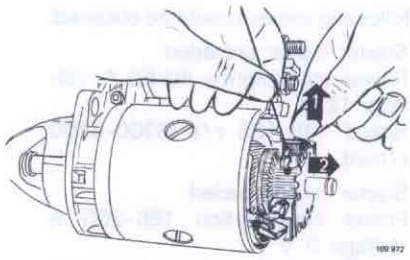
nove the lock washers and adjusting shers as well as the two nuts.

nove the frame.



109 971

Remove the negative brushes and the brush holder.



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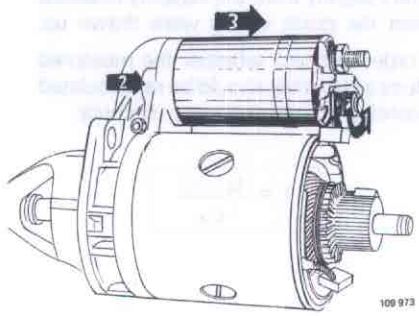
Remove the nut securing the magnetic winding terminal from the solenoid. Remove the screws holding the solenoid.



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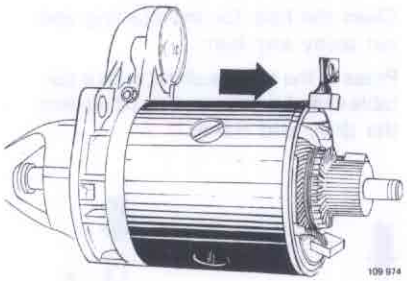
Remove the pole housing from the armature and drive end frame.



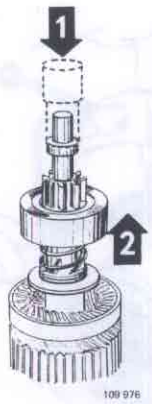
Remove the rubber washer and metal washer.

Remove the screw on which the shift lever is carried.

Remove the armature and shift lever.

Knock back the stop washer with the help of a suitable sleeve.

Remove the snap ring, stop washer and pinion.

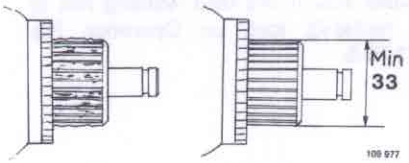


Checking and replacing parts

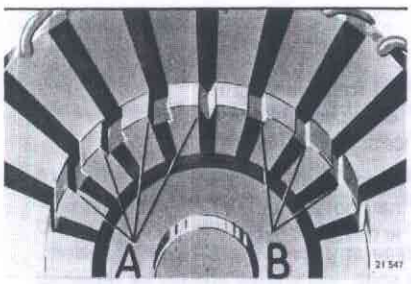
Armature

Examine the armature for mechanical damage. A bent or worn armature shaft must be replaced.

If the commutator is scored or unevenly worn, it should be turned. The minimum diameter is 33 mm (1.3").



After turning the commutator, check it with a micrometer. A radial throw of up to 0.08 mm (0.003") is permitted. The insulation between the laminations should be milled down to 0.4 mm (0.016") below the surface. This work is to be carried out in a special apparatus intended for this purpose, or if such is not available, with a ground-off hacksaw blade.



(max. 0.4 mm = 0.016" milling)

A = incorrectly milled
B = correctly milled

Examine the armature for shorts by placing it in a growler.

Switch on and hold a hacksaw blade a few mm from the armature. If the blade

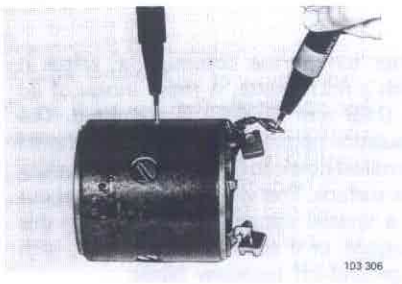
vibrates in any position when the armature is rotated, one of the following faults can be the reason.

Shorting through the armature frame, shorting in the commutator or between the windings.

ole housing

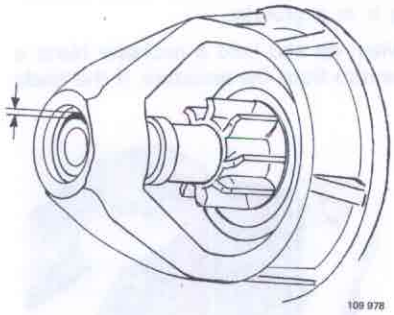
ieck the field winding for shorting. Test th 40 volts A.C.

so test the winding for breakage with volts A.C. If the field winding has to replaced, look up Operation No. 3175-5.



xamine the drive end frame and brush olders. If damaged or excessively worn, iey must be replaced.

ne clearance between the armature iaft and bushings may not exceed 0.12 im (0.005"). Examine the other parts and eplace any that are damaged or worn. ne snap ring should always be replaced ith a new one, since it may have been amaged or lost its tension when being moved.



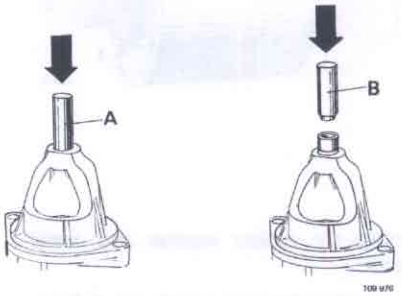
A = max. 0.12 mm (0.005")

eplacing the self-lubricating bushings

he self-lubricating bushings, so-called compo-bushings" should wear insignicantly during operation if lubricated corectly.

The bushings should be immersed in oil for at least 1/2 hour (use e.g. Bosch 01 1V 13 or corresponding) before being fitted.

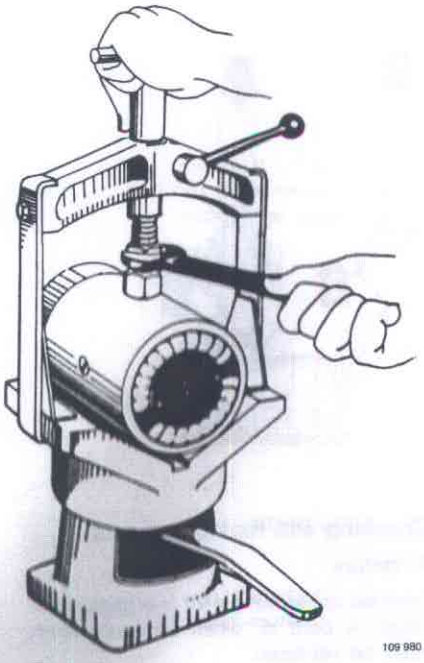
1. Drive out the worn bushing with the help of a suitable tool. Use a counterhold against the drive end frame.
2. Clean the hole for the bushing and cut away any burr.
3. Press in the new bushing with a suitable drift. Use a counterhold against the drive end frame.



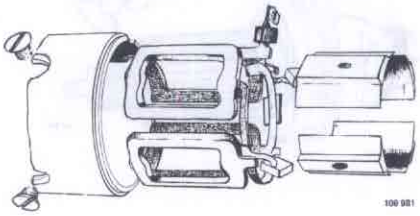
33175-5

Replacing the field coils

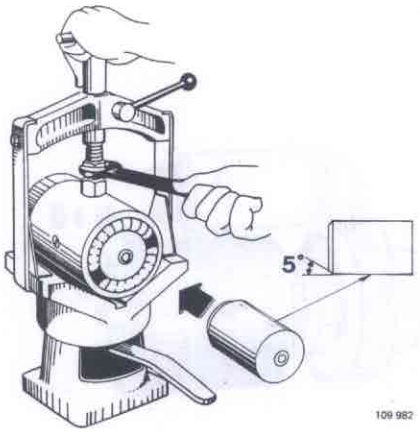
1. Mark the pole shoes and pole housing in a suitable manner so that they are re-fitted in their initial position.
2. Place the pole housing in a rotating clamping block (Bosch EFAW 9) and remove the pole shoes.



3. Remove the pole shoes and magnetic winding from the pole housing.
4. Fix the new magnetic windings loosely in the housing together with the pole shoes. Make sure the pole shoes are located according to the marks.



5. Press in a suitable drift in the housing and tighten up the pole shoes.

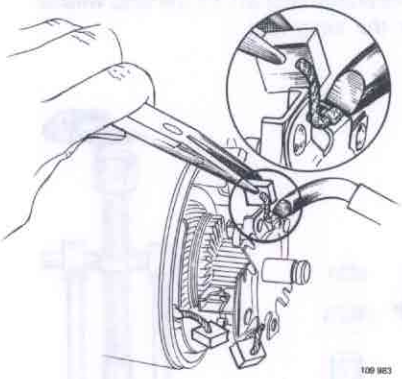


6. Remove the press drift.
   Remove the housing from the clamping block.
7. Check the installed field coils for breakage and shorts (with 40 volts A.C.).

Replacing the brushes

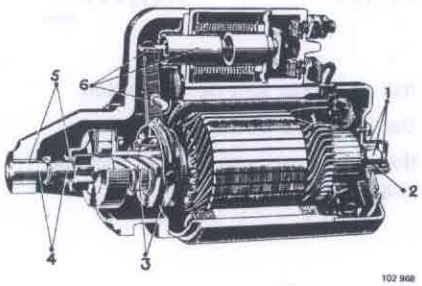
Brushes shorter than 14 mm (approx. 1/2") must be replaced with new ones.

1. Solder loose the brushes from their respective attachments.
2. Solder well the new brushes. This must be done rapidly and with sufficient heat. The solder must not run down onto the brush wires, since this will impede the movement of the brushes in the holder and thereby reduce the brush spring pressure.



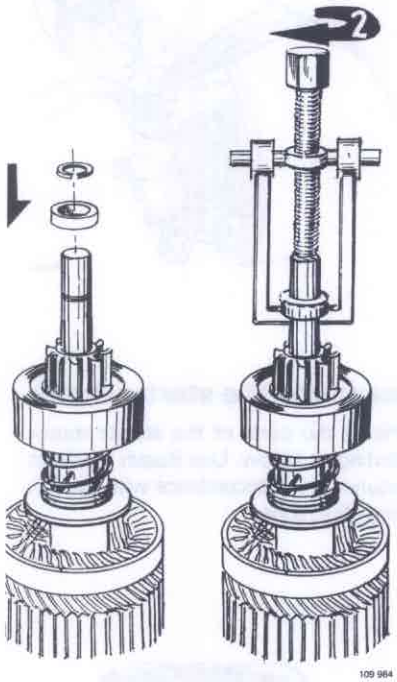
Assembling the starter motor

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



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

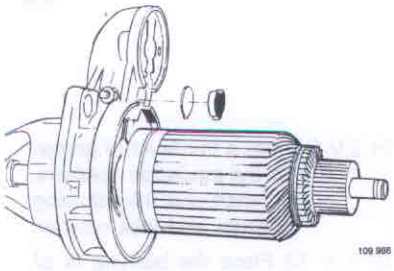
the pinion, stop washer and snap ring the armature shaft. Fit the stop washer ər the snap ring.



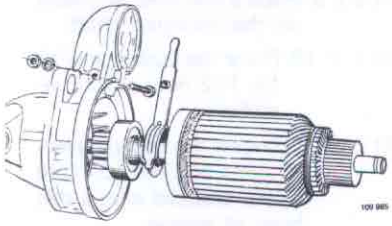
t the engaging arm on the pinion.

t the armature in the drive frame.

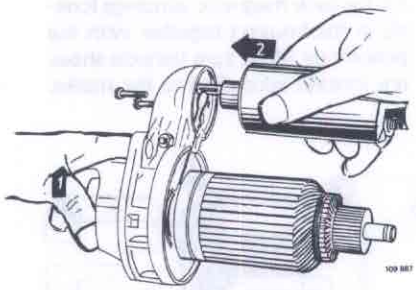
t the screw, nut and washer securing e engaging arm.



t the metal washer and rubber washer.

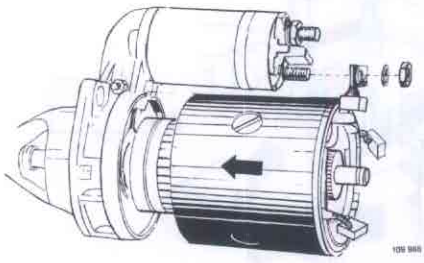


Fit the solenoid.

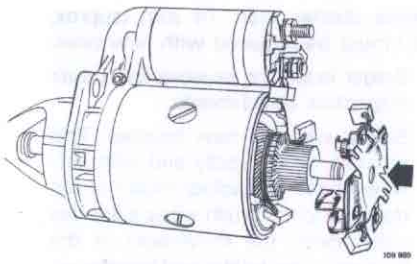


Fit the starter motor housing.

Connect the cable to the solenoid.

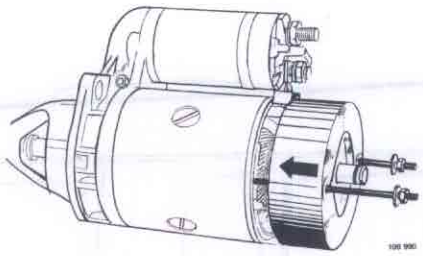


Fit the brush holder in position. Fit the brushes.



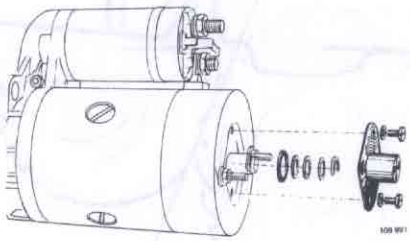
Fit the commutator bearing frame.

Screw the starter motor together with the two long bolts.



Fit the adjusting washers and snap ring on the shaft end. Check the armature axial clearance.

This should be 0.05–0.0.30 mm (0.002–0.012"). If necessary, adjust with a suitable number of washers until the clearance is correct. Screw tight the small casing of the shaft end.



Before installing the starter motor, run it on a test bench. Compare Figs. from page 19.

33172-1

Installing the starter motor

1. Screw the starter motor into position on the flywheel casing.
2. Connect the cables to the starter motor.
3. Fit the gear lever control ball joints on the gearbox.
4. Fit the rear engine casing.
5. Connect the negative cable to the battery.

Group 34 Ignition System

Construction and Function

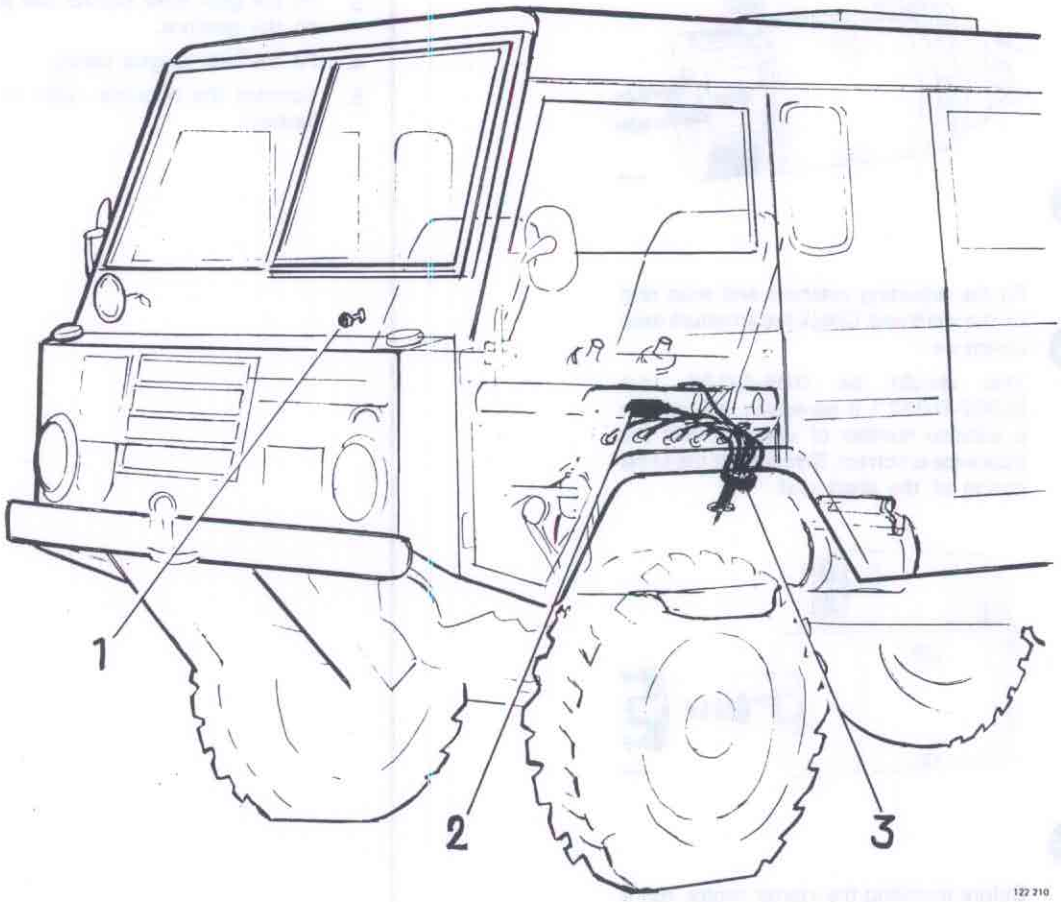


Fig. 34–1. Ignition components

1. Ignition
2. Ignition coil
3. Distributor

ıe ignition system is of the battery-ignition type. It consists
the following main components: ignition coil, ignition, dis-
outor, ignition cables and spark plugs.

Ignition coil

The ignition coil is situated in the engine compartment on the left-hand side, see Fig. 34–2.

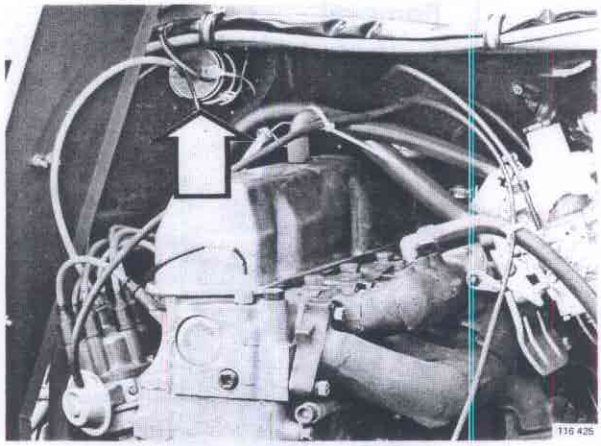


Fig. 34–2. Ignition coil

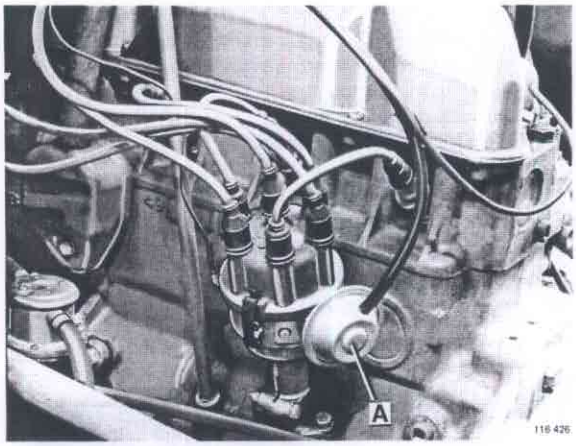


Fig 34–4. Distributor with ignition cables

Firing order: 1-5-3-6-2-4

Its setting in relation to engine speed is regulated by the centrifugal governor located under the breaker plate (see 8, Fig. 34–5).

Ignition

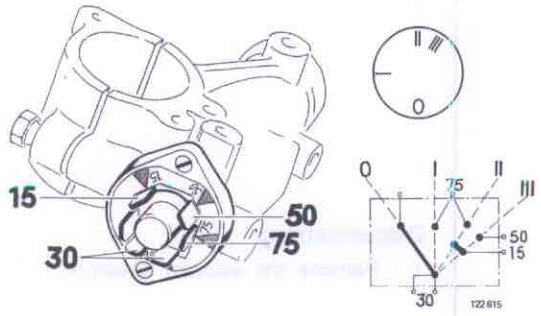
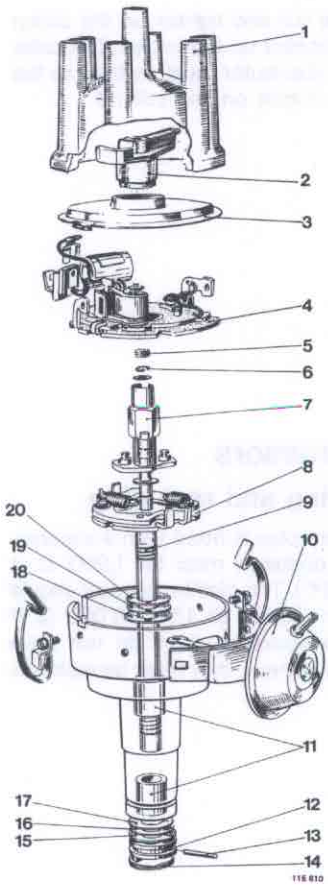


Fig. 34–3. Ignition

Distributor

The distributor is situated on the left-hand side of the engine, see Fig. 34–4, and is driven from the camshaft.

Its setting in relation to engine speed is regulated by the vacuum governor mounted on top of the distributor (see A, Fig. 34–4).



1 Distributor cap
2 Rotor
3 Condensate trap
4 Breaker plate
5 Lubricating felt
6 Circlip
7 Breaker arm
8 Centrifugal governor
9 Shaft
10 Vacuum governor
11 Bushings
12 Companion flange
13 Pin
14 Resilient ring
15 Large steel washer
16 Fibre washer
17 Small steel washer
18 Large steel washer
19 Fibre washer
20 Small steel washer

Fig. 34–5. Exploded view of distributor

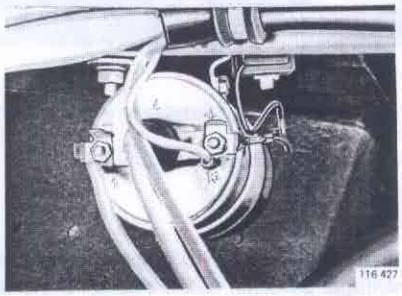
nition coil

emoval

Disconnect the cables from the ignition coil.

Release the screw securing the ignition coil.

Remove the ignition coil.



stalling

tall the coil and tighten up the clamp ew. Connect up the cables. The cable m the distributor must be fixed to the gative output on the coil (1).

uppressors

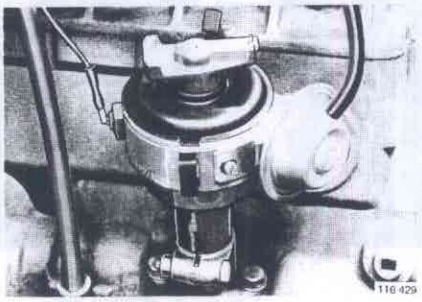
hecking and replacing

ch spark plug is fitted with a suppres-r. Its resistance must be 1,000 Ω at)°C (68°F). The distributor rotor should ve a resistance of 4,500–6,000 Ω. If e suppressors or rotor do not have ese resistances, they must be replaced.

Distributor

Removal

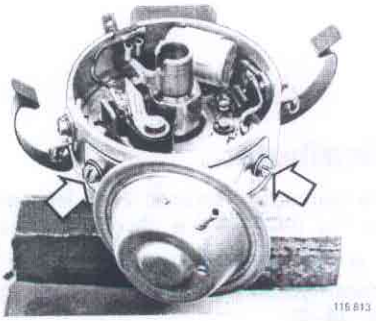
1. Unclasp the lock clasps for the distributor cap and lift off the cap.



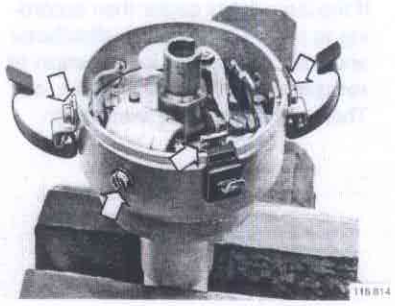
2. Disconnect the low-voltage cable at the distributor. Remove the vacuum hose from the vacuum governor. Lift off the distributor rotor and remove the condensate trap. Release the retaining screw and pull up the distributor.

Disassembling

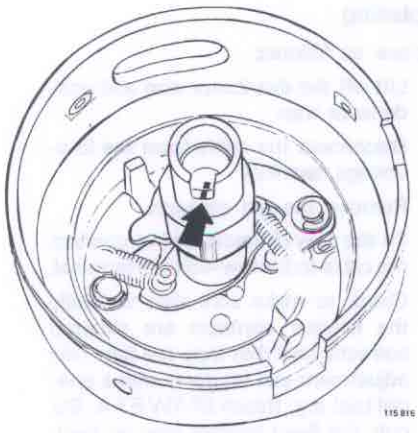
1. Remove the vacuum governor.



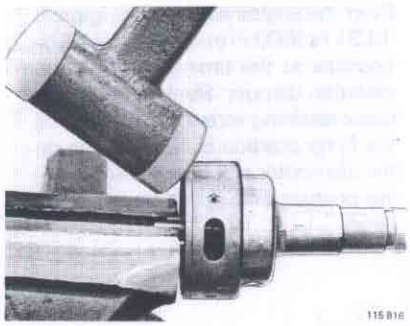
2. Unclasp the lock clasps for the cap. Disconnect the cable from the breaker contacts and remove the condenser with its low-voltage terminal.



3. Mark the location of the breaker plate in relation to the distributor housing and lift up the plate.
4. Release the springs for the centrifugal governor. Remove the lubricating felt and line-up mark to ensure that the breaker cam is re-fitted in the right place in relation to the distributor shaft.

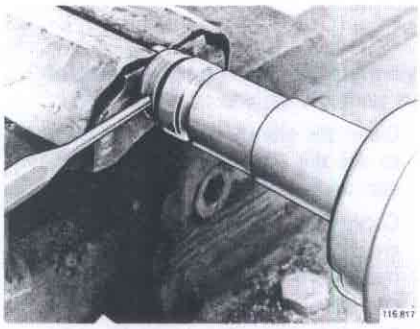


5. Fix the breaker cam in a vice with soft jaws. Carefully tap on the distributor housing with a plastic mallet until the circlip loosens. Take care of the circlip and the washers.



6. Remove the resilient ring and line-up mark the flange to ensure that it is refitted in the proper place in relation to the distributor shaft.

   Tap out the pin. Lift off the flange and pull up the distributor shaft. Take care of the washers.



7. Remove the lock pins for the centrifugal weights and lift off the weights.

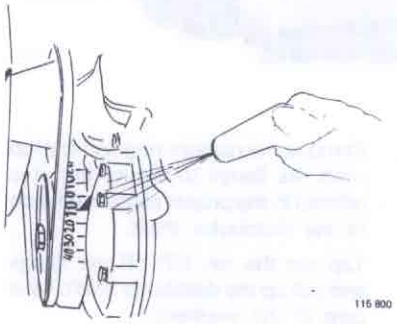
Checking and replacing parts

Breaker plate

The contacts should be smooth and even on the contact surfaces. The colour of the contacts should be grey.

Replace oxidized or burnt contacts. The breakers can get worn after being used for some time and the spring can become fatigued, so that the contacts should be replaced if the distributor is disassembled for some reason or other.

Start the engine and run it at approx. 13.3 r/s (800 r/min). Aim the Stroboscope at the timing mark on the vibration damper. Slacken the distributor retaining screw and turn it until the firing position is 10°. Tighten up the distributor and check that the firing position and speed have not altered.



Remove the Stroboscope and connect the hose to the vacuum governor.

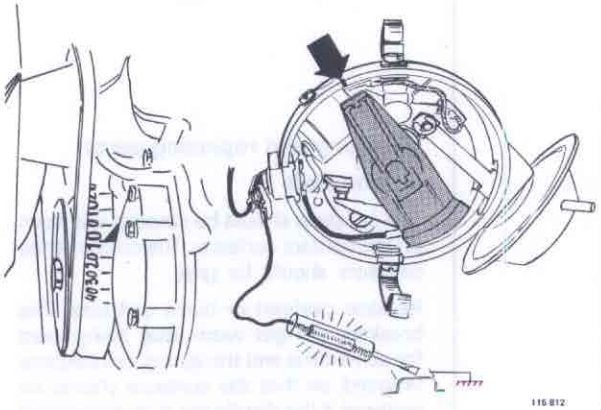
e firing setting can be adjusted as fol-vs with the engine switched off:

Clean the vibration damper in order to see the firing mark. Remove the cap and condensate trap.

Connect a 24 V lamp between the engine body and the low-voltage terminal on the distributor. Do not disconnect the cable.

Turn the ignition key to the firing position.

Slowly rotate the crankshaft (by hand) **in the rotational direction of the engine** until the 10° timing mark on the vibration damper is opposite the firing mark. The distributor rotor should then point to the line-up mark on the edge of the distributor housing. The test lamp should light.



5. If the lamp does not light, slacken the distributor and turn it slowly **opposite to its direction of rotation** until the lamp does light. When the lamp lights, tighten up the distributor.
6. If the lamp lights earlier than according to point 4, slacken the distributor and turn it slowly **in its direction of rotation** until the lamp goes out. Then tighten up the distributor.

34202-2

Breaker contacts

Replacing

Replace as follows:

1. Lift off the distributor arm and condensate trap.
2. Disconnect the cable from the low-voltage terminal.
3. Remove the old contacts.
4. Fit the new contacts and re-connect the cable to the low-voltage terminal.
5. Check to make sure that vertically the breaker contacts are situated correctly and that they are flat. This adjustment can be done with a special tool, e.g., Bosch EFAW 57 A. But only the fixed contact may be bent.

   Cover the breaker cam and fibre tab with a light layer of grease.
6. Clean the breaker contacts with trichloroethylene or chemically pure petrol.
7. Run the distributor on a test bench and adjust according to the distributor data. See under: "Test-running a distributor on a test bench".
8. Fit the condensate trap and the distributor rotor.

Group 35 Lighting

Construction and Function

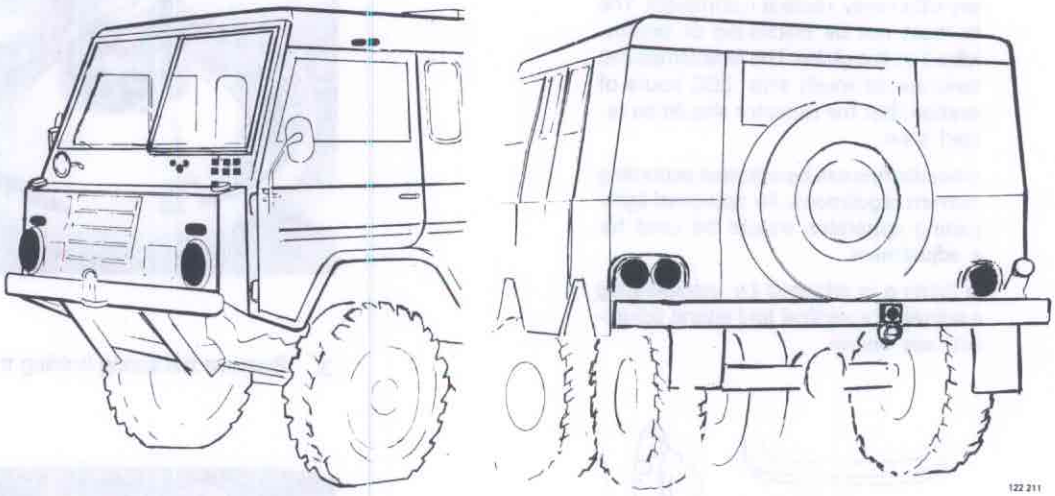


Fig. 35–1. Vehicle lighting

The lighting system comprises the following:

Headlamps, parking and direction indicator lights, instrument panel lighting, switch lighting, interior lighting, tail lights, reversing lights and a 7-pole output for trailer lighting.

Switching between fullbeams and dipped beams is done by moving the direction indicator lever towards the steering wheel. This causes the step relay, see Fig. 36–1, to switch on the beams.

The tail lights are provided with separate bulbs for the tail light, stop lights and direction indicators.

eadlamps

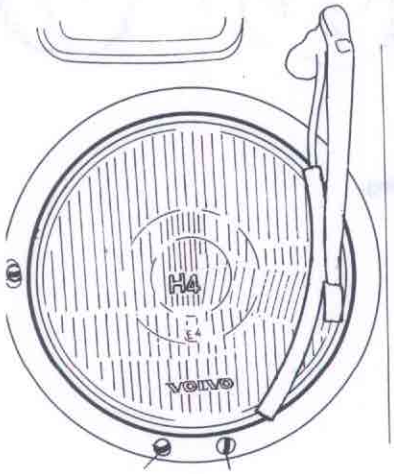
hecking and adjusting

ıeck the headlamp glass, reflector and lb. If the glass has been damaged by ɜvel, or cracked or defective in any other ɜy, replace the insert. The lighting from ıeadlamp with cracked glass will have teriorated and give rise to irritating split ams.

he reflector is mat, buckled or damaged any other way, replace it complete. The lb must not be blackened or brown-idized on the globe. The headlamps can teriorate so much after 200 hours of ıeration that the reflector should be re-ɜced then.

ıe headlamps can be adjusted according current regulations. An approved light-ljusting apparatus should be used for e adjustment.

ıe lighting is adjusted by manipulating e screws for vertical and lateral adjust-ent, see below.



1 Lateral adjustment
2 Retaining screw
3 Vertical adjustment

eplacing the headlamp in-ɜrt

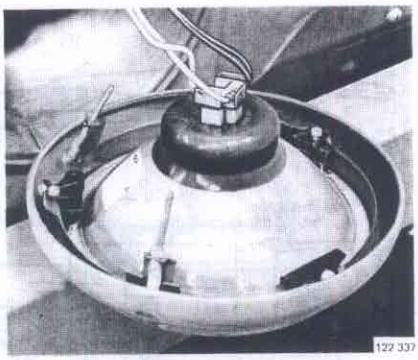
ɔ replace the bulb carry out points 1–3 ıd 6–9 below.

Remove the retaining screw in the headlamp rim, see above.

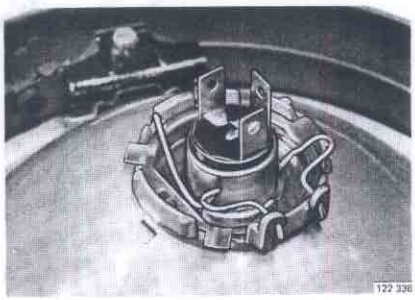
2. Lift forwards the rim and insert.

   Disconnect the connector from the bulb.

   Remove the rubber dust cover from the bulb base.



3. Remove the spring holding the bulb.



4. Remove the three screws securing the insert.
5. Fit the new insert and secure it with the three screws.
6. Fit the new bulb in the insert.

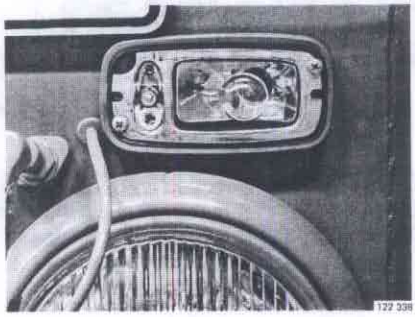
   NOTE! Do not touch the globe with your fingers. Grease, etc., on the globe causes a vapour to be emitted when the globe is heated and this can damage the reflector.
7. Fit the rubber dust cover over the bulb base, etc., and connect the connector to the bulb.
8. Restore the rim and insert.
9. Adjust the lighting.

Parking and direction indicator lights

36130-2

Replacing the bulbs

1. Remove the screws securing the lens.
2. Remove the faulty bulb by pressing it inwards and then turning it (bayonet fitting).



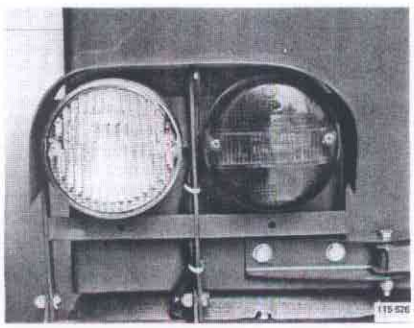
3. Fit the new bulb. (Do not touch the bulb globe with your fingers.)
4. Wipe the lens with a moist cloth and re-fit it and tighten up with the two screws.

Tail and reversing lights

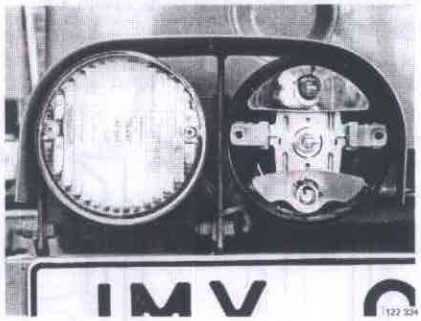
36132-2

Replacing the bulbs

1. Remove the screws securing the lens over the bulb to be replaced.



2. Remove the faulty bulb by pressing it in and turning it.



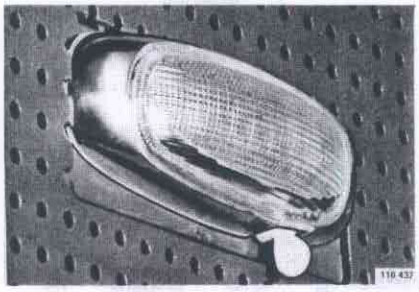
3. Fit the new bulb but do not touch the globe with your fingers. Wipe the lens with a moist cloth and re-fit it.

Interior light

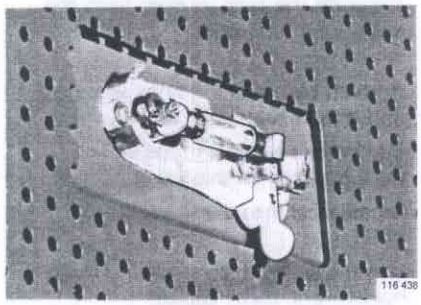
35303-3

Replacing the bulb

1. Remove the glass by pulling it rearwards.



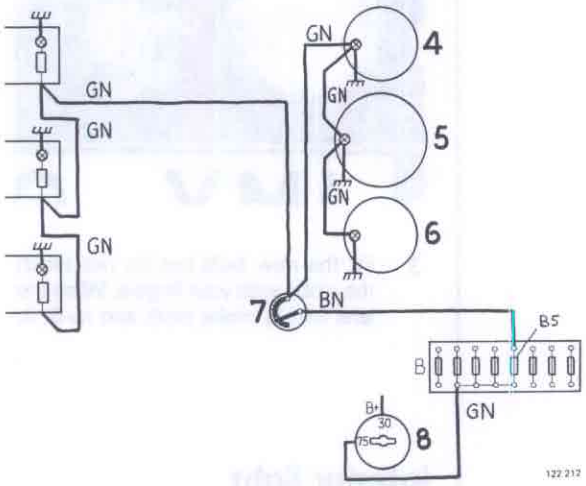
2. Remove the bulb and fit a new one.



3. Place the glass in position and push it straight in.

ıstrument panel and ʌvitch lighting

e illustration below shows the instru-ɛnt panel and switch lighting circuit via ɛ rheostat.



Wiring diagram

1	Switch, windscreen washer
2	Switch, windscreen wiper
3	Switch, windscreen wiper
4	Fuel gauge
5	Speedometer
6	Temperature gauge
7	Rheostat
8	Ignition
B	Fuse holder (B)

ɛplacing the bulbs in ʌvitches and instruments

Remove the cover from the batteries and disconnect the negative cable from the battery.

Separate the bulb retainer from the switch and instrument by pulling it straight out.

Remove the faulty bulb by pressing it in and turning it. Fit the new bulb.

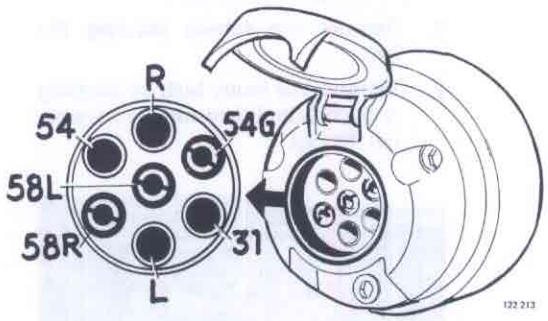
Fit the bulb retainer in the switch or instrument by pushing it straight in.

Re-connect the negative cable to the battery.

Note! The cables to the switch bulb holders are earth cables.
The cables to the instrument bulb holders are feed cables, which go directly from the rheostat.

Trailer socket output

The vehicle is equipped with a 7-pole trailer socket output.



54G	Not used	L	Direction indicator, left
58L	Tail light	54	Stop light
58R	Tail light	31	Chassis
R	Direction indicator, right		

Group 36 Direction indicators and hazard warning flashers, horn, windscreen wipers and washers, switches and relays

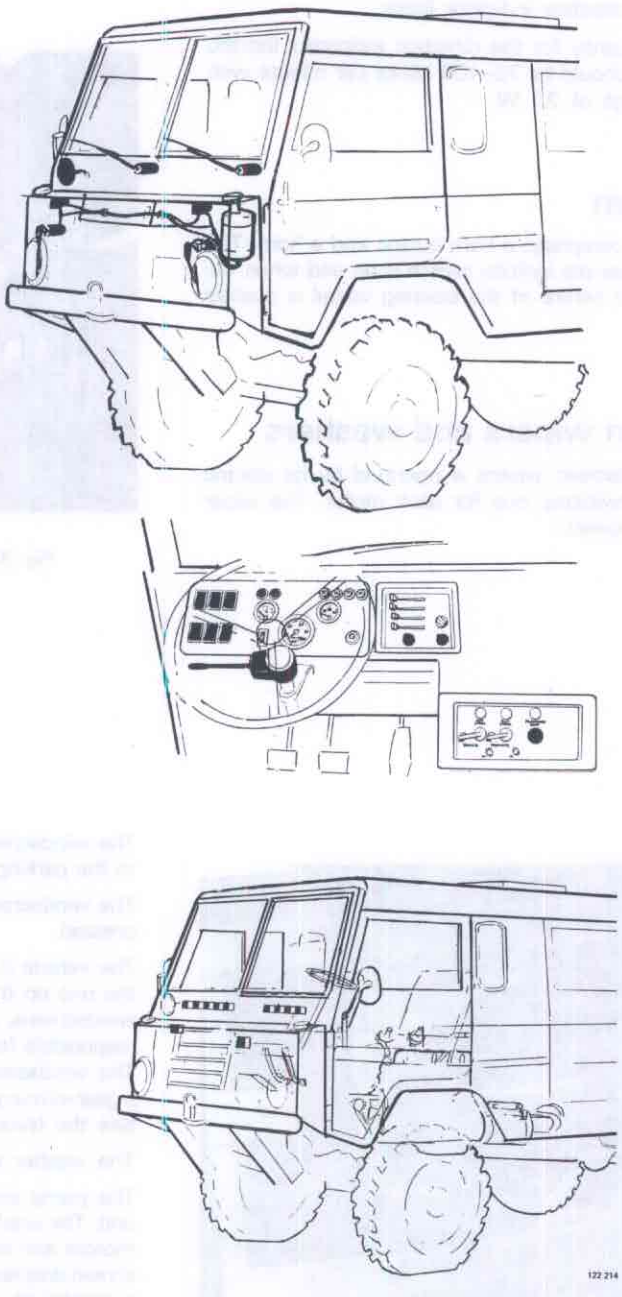


Fig. 36–1. Wipers, direction indicators, switches and relays

Direction indicators and hazard warning flashers

The direction indicator system includes an electronically operated flasher device, switches, indicator lights (for vehicle and trailer) as well as indicator lights front and rear.

The hazard warning flasher system includes a switch with built-in blinker, flasher device and lights (front and rear) which also function as direction indicator lights.

The blinking frequency for the direction indicators (hazard warning flashers) should be 75–105 blinks per minute with bulbs with wattage of 21 W.

Horn system

The horn system comprises a horn button and a horn. The horn operates when the ignition switch is on and when the horn button in the centre of the steering wheel is pushed.

Windscreen wipers and washers

Each of the windscreen wipers is operated by its electric motor and two switches, one for each motor. The wiper motors are two-speed.

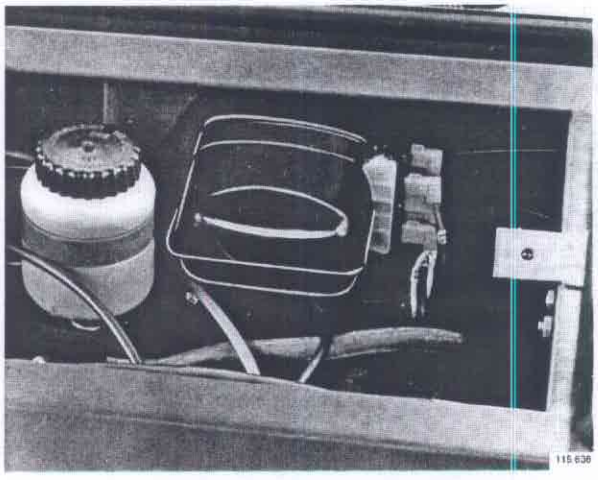


Fig. 36–2. Windscreen wiper motor, R/H side

Each of the headlamp wipers is operated by its electric motor and a switch, which automatically returns to the shut-off position.

The headlamp wiper motors can be engaged when the parking lights at least are on.

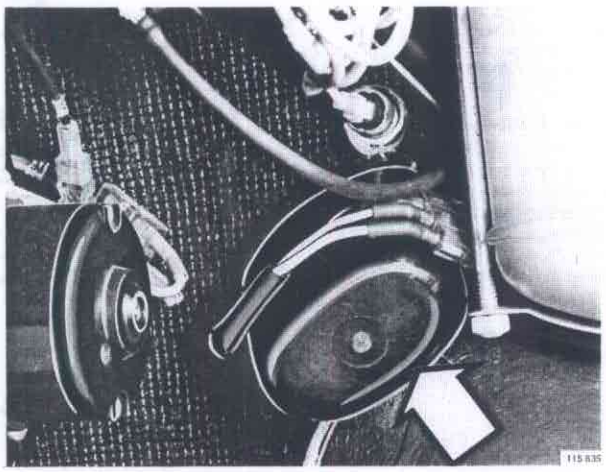


Fig. 36–3. Headlamp wiper motor, R/H side

The windscreen and headlamp wipers automatically return to the parking position as long as the ignition switch is on.

The windscreen and headlamp wiper motors are radio-suppressed.

The vehicle is equipped with two different washer motors, the one on the left-hand side which is responsible for the windscreens, and the one on the right-hand side which is responsible for the right-hand headlamps and washer fluid. The windscreen and headlamp washer system consists of a gear-driven pump, electric motor, hoses, valves and nozzles. See the layout diagram on Fig. 36–4.

The washer motors are radio-suppressed.

The pump and the electric motor are integrally built as a unit. The washer fluid container is the same for both washer motors and holds about 3 dm^3 (3 litres/3 qts.). The windscreen washer motor is operated by means of a switch, which automatically returns to the shut-off position.

The headlamp washer motor functions only when the headlamp wipers are engaged.

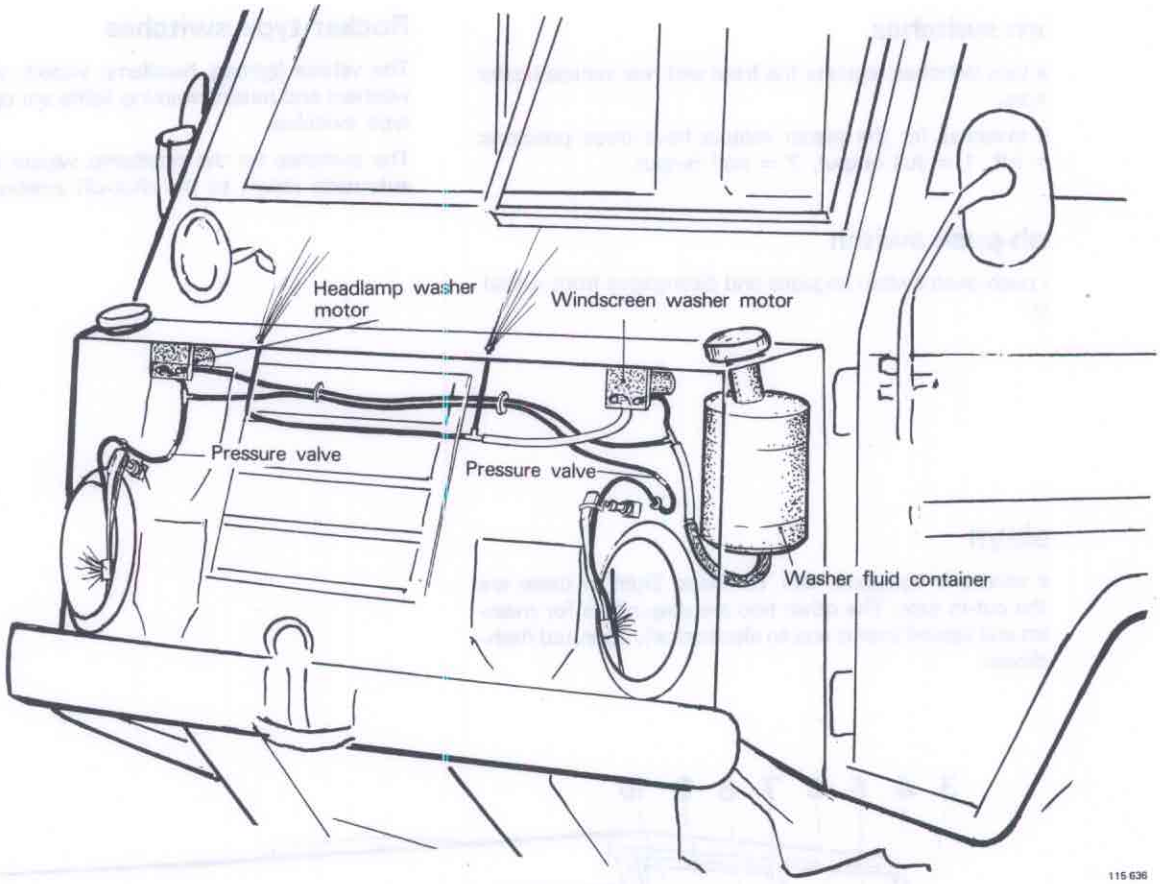


Fig. 36–4. Layout diagram, washers

Switches

The vehicle is equipped with three types of switches: rocker, turn and push-push switches.

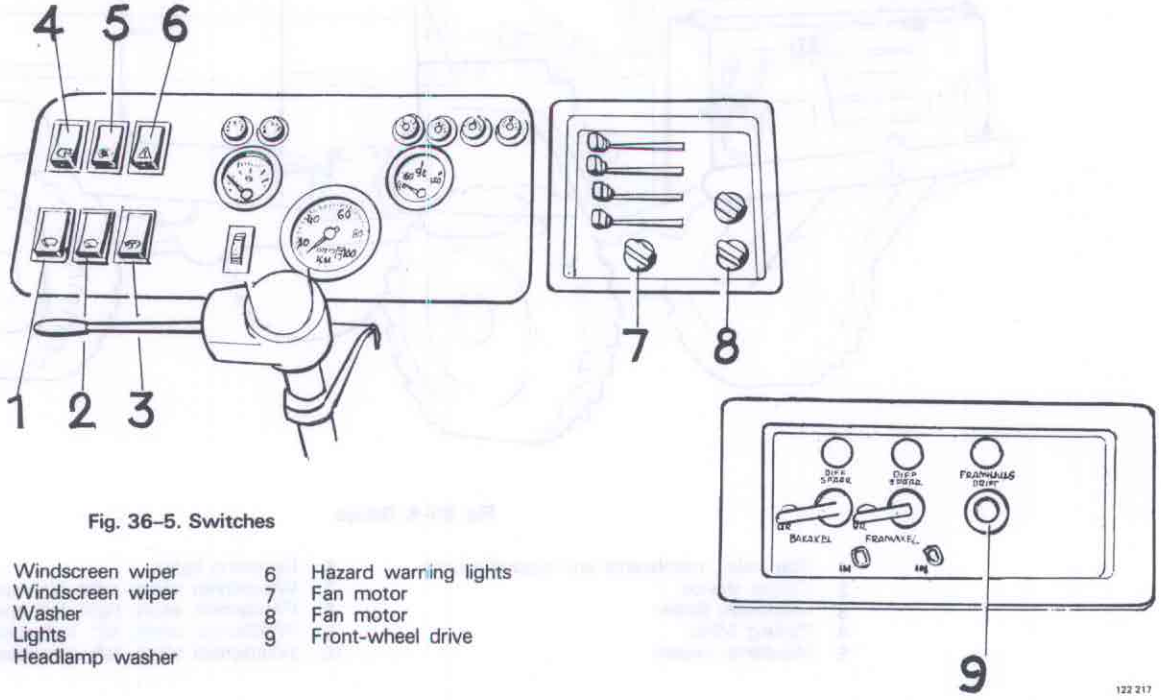


Fig. 36–5. Switches

1	Windscreen wiper	6	Hazard warning lights
2	Windscreen wiper	7	Fan motor
3	Washer	8	Fan motor
4	Lights	9	Front-wheel drive
5	Headlamp washer		

ırn switches

e turn switches regulate the front and rear vehicle heater ›tors.

e switches for the heater motors have three positions: = off, 1 = full output, 2 = half output.

ısh-push switch

› push-push switch engages and disengages front-wheel ›e.

elays

e vehicle is equipped with 10 relays. Eight of these are the cut-in type. The other two are step-relays for main-ım and dipped beams and an electronically operated flash-device.

Rocker-type switches

The vehicle lighting, headlamp wipers, windscreen wipers, washers and hazard warning lights are operated by rocker-type switches.

The switches for the headlamp wipers and washers have automatic return to the shut-off position.

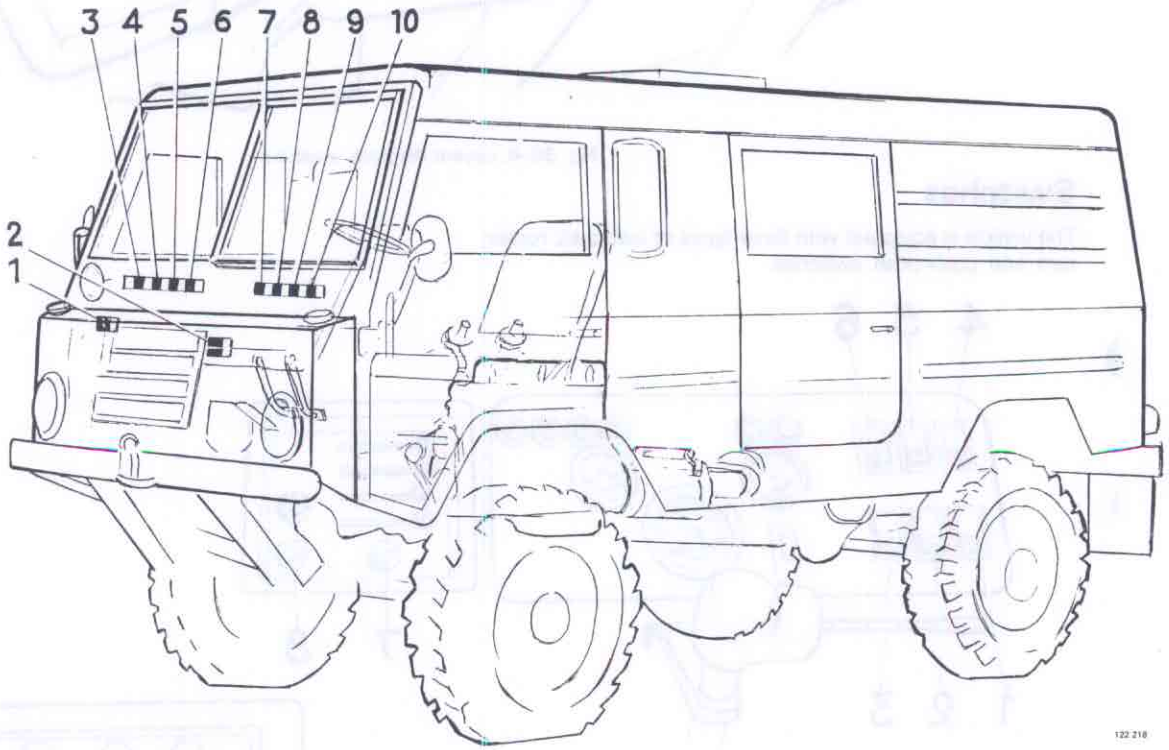
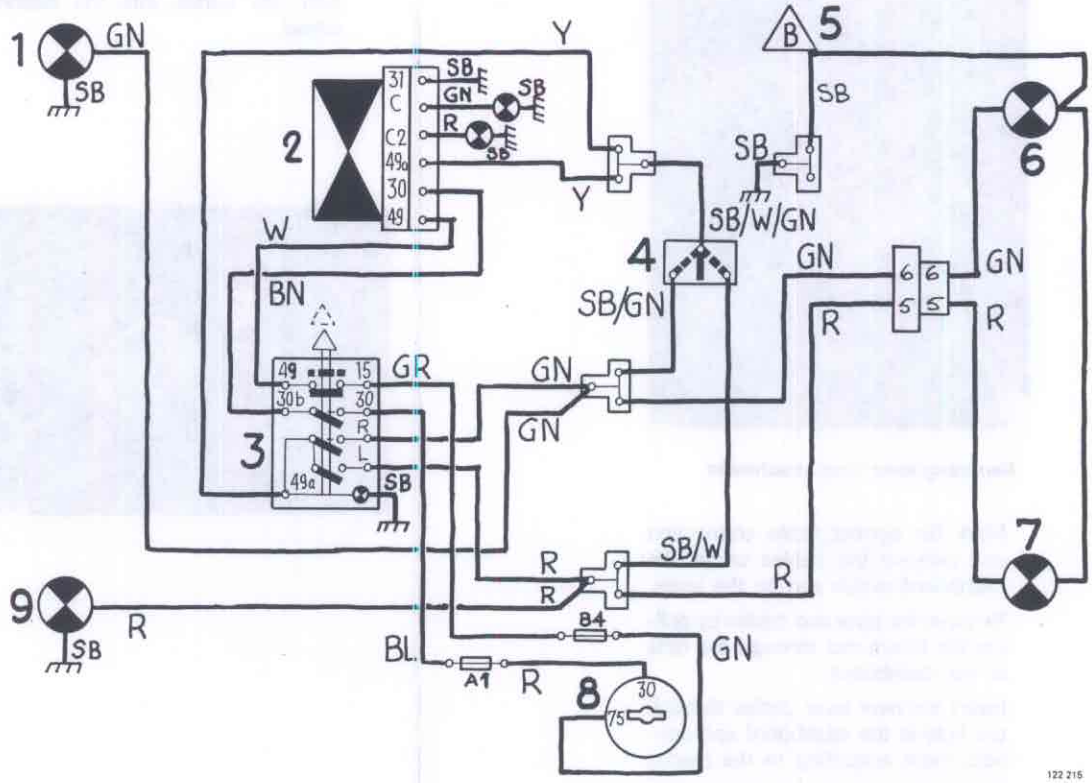


Fig. 36–6. Relays

1 Step relay, mainbeams and dipped beams
2 Flasher device
3 Mainbeam flasher
4 Parking lights
5 Headlamp wipers
6 Reversing lights
7 Windscreen wiper, right, high-speed
8 Windscreen wiper, right, low-speed
9 Windscreen wiper, left, high-speed
10 Windscreen wiper, left, low-speed

Direction indicators and hazard warning flashers



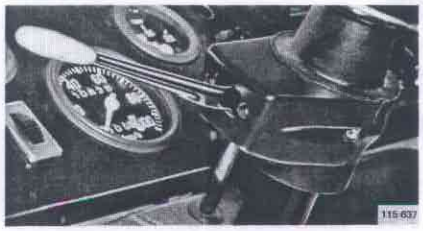
Wiring diagram for direction indicators and hazard warning flashers

1 Bulb, dir. indicator, front
2 Flasher device
3 Switch, hazard warning lights
4 Dir. indicator lever
5 Fuel gauge sender
6 Bulb, dir. indicator, left-rear
7 Bulb, dir. indicator, right-rear
8 Ignition
9 Bulb, dir. indicator, left-front

36108-2

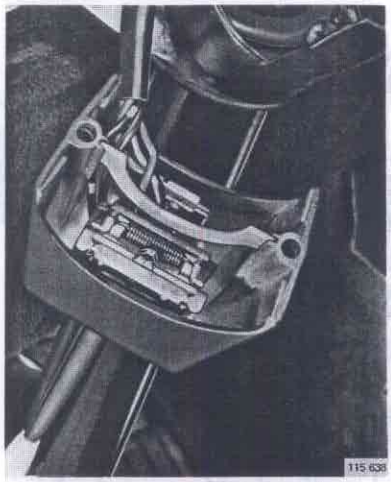
Replacing the direction indicator lever

1. Remove the screws securing the switch to the steering column.



Removing the screws securing dir. ind. lever

Remove the U-shaped washer and the two screws securing the lever to the attachment.



Removing lever from attachment

Mark for correct cable connection and remove the cables under the dashboard which run to the lever.

Remove the lever and cables by pulling the levers out through the hole in the dashboard.

Insert the new lever cables through the hole in the dashboard and connect them according to the marks.

Fix the lever to the attachment and fit the U-shaped washer.

Secure the lever and attachment to the steering column.

lorn

6202-2

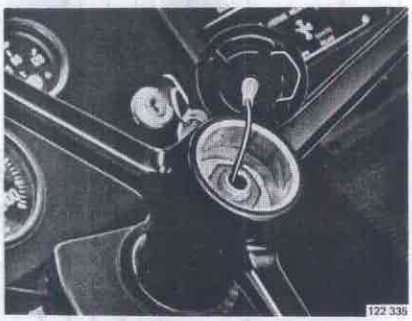
eplacing

Disconnect the cables and the nut which secures the horn.

Fit the new horn and connect up the cables.

Replacing the horn button

1. Remove the horn button by levering it up with a small screwdriver or similar tool.
2. Disconnect the cable from the button.
3. Fit the cable to the new button and push the button into the steering wheel.

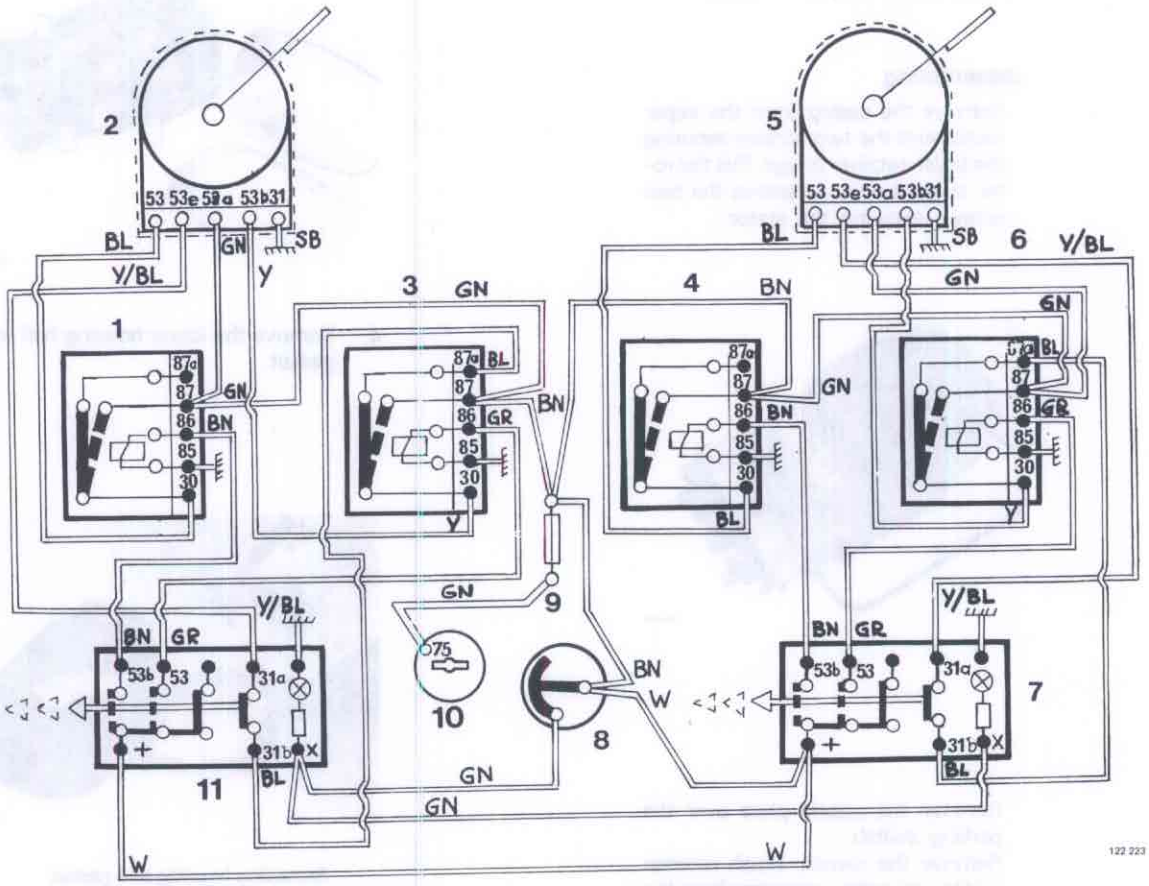


Windscreen wipers and washers

Windscreen wiper

Checking

If the windscreen wipers do not function (ignition switched on) either at high or low speed, check to make sure fuse B5 is in good condition. If it is not, probably the reason is a short-circuit to the vehicle chassis at the wiper motors, switches, relays, rheostat or on the cables to these components. Use the wiring diagram overleaf as an aid when fault-tracing and connecting up replaced parts.

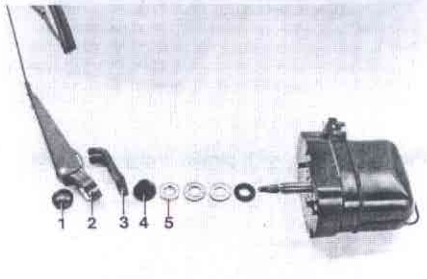


1 Relay, low-speed
2 Windscreen wiper motor
3 Relay, high-speed
4 Relay, low-speed
5 Windscreen wiper motor
6 Relay, high-speed
7 Switch
8 Rheostat
9 Fuse B5
10 Switch

Windscreen wipers

Removing

1. Remove the cover from the batteries and disconnect the negative cable from the battery.
2. Remove the protective cap and wiper arm.
3. Remove the flange, dust cover, nut, washer and seal.



1. Protective cap
2. Wiper arm
3. Flange
4. Dust cover
5. Nut

4. Lift forwards the wiper motor, mark for correct re-installation and disconnect the cables.

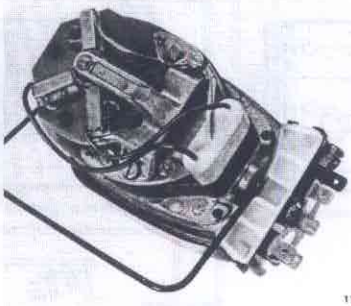
Installing

1. Connect up the cables according to the marking and fit the wiper motor with seal, washers and nut.
2. Fit the dust cover. Adjust and fit the flange so that the wiper arm is located properly.
3. Secure the wiper arm to the wiper shaft with the protective cap.
4. Connect up the negative cable to the battery and fit the cover over the battery.

'indscreen wiper motor

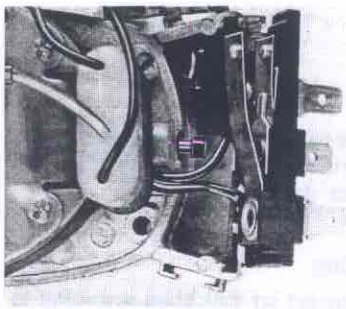
;assembling

Remove the casing from the wiper motor and the two screws securing the brush retainer bridge. Pull the rotor straight up and remove the two screws securing the stator.



115 644

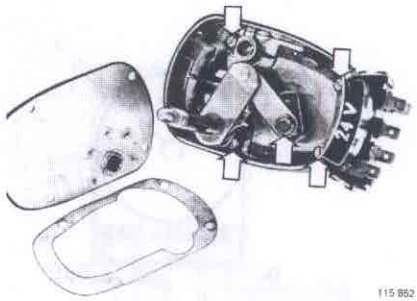
Remove the plastic plate over the parking switch.
Remove the switch, brush retainer bridge and radio suppressor from the housing.



115 851

Removing the parking switch

Remove the end and gasket from the output shaft.
Remove the output shaft and tooth segment.
Remove the four screws securing the lower housing half.



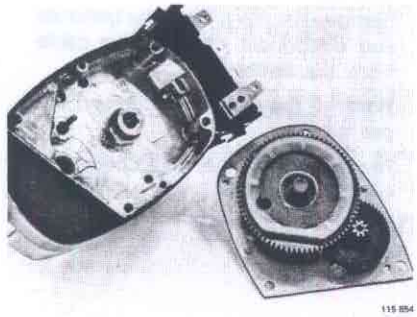
115 852

4. Remove the lower housing half and gasket.

115 853

Removing housing and gasket

5. Lift off the plate, gasket, gear wheel and pinion from the pinion housing.



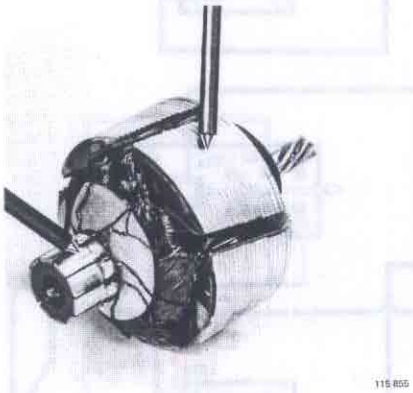
115 854

Pinion housing with pinion and gear wheel

Checking and replacing parts

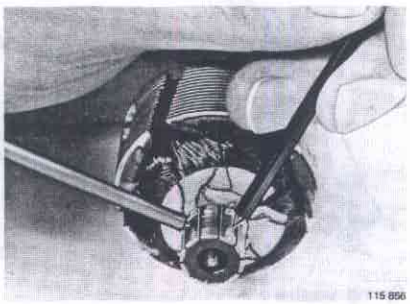
Clean all the parts and check for wear or any other defect. Check also the rotor for flash-over between commutator and rotor body as well as flash-over between, and breakage in, the winding coils.

Test for flash-over between commutator and rotor body by connecting a test lamp (40 V A.C.) between them. The lamp must not light.



Insulation test, rotor

Test for flash-over between the winding coils with a smaller type of growler or with a Bosch coil tester EFAW 90 or 95 with ancillary test probe EFAW 96 or corresponding. Total breakage in any of the commutator discs can be checked with a test lamp (12 V D.C.). One of the measuring points of the test lamp is placed on a commutator disc and the other measuring point is moved round the commutator. The lamp should light.

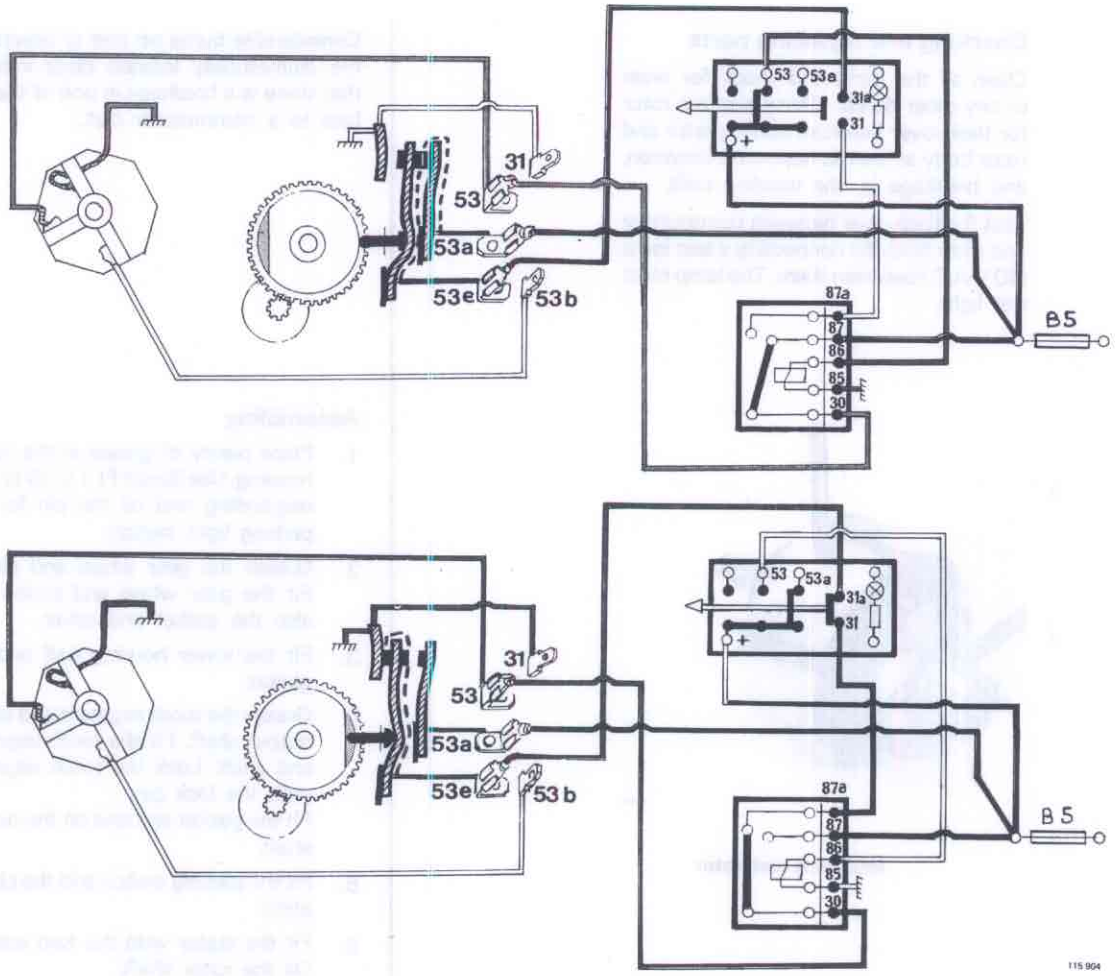


Breakage test, rotor

Considerable burns on one or several of the diametrically located discs indicate that there is a breakage in one of the cables to a commutator disc.

Assembling

1. Place plenty of grease in the pinion housing. Use Bosch Ft 1 V 35 or corresponding and oil the pin for the parking light switch.
2. Grease the gear wheel and pinion. Fit the gear wheel and pinion and also the gasket and cover.
3. Fit the lower housing half and the gasket.
4. Grease the tooth segment and oil the output shaft. Fit the tooth segment and shaft. Lock the tooth segment with the lock pin.
   Fit the gasket and end on the output shaft.
5. Fit the parking switch and the plastic plate.
6. Fit the stator with the two screws. Oil the rotor shaft.
   Fit the rotor and secure the suppressor.
7. Fit the brush retainer bridge on the stator.
8. Fit the protective casing and test-run the windscreen wiper motor.
   Check the parking function. See the layout diagram on the next page.



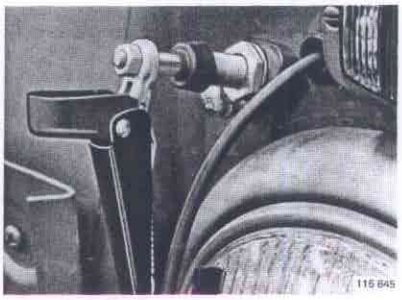
Layout diagram for parking function

eadlamp wiper motor

moving

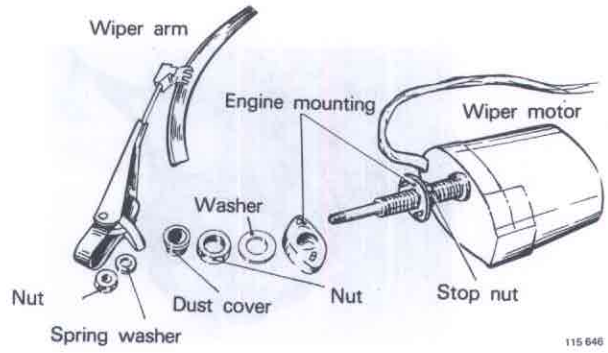
Remove the clamp and washer hose from the wiper arm.

Bend up the cover and remove the nut as well as the wiper arm from the shaft.



Removing the wiper arm

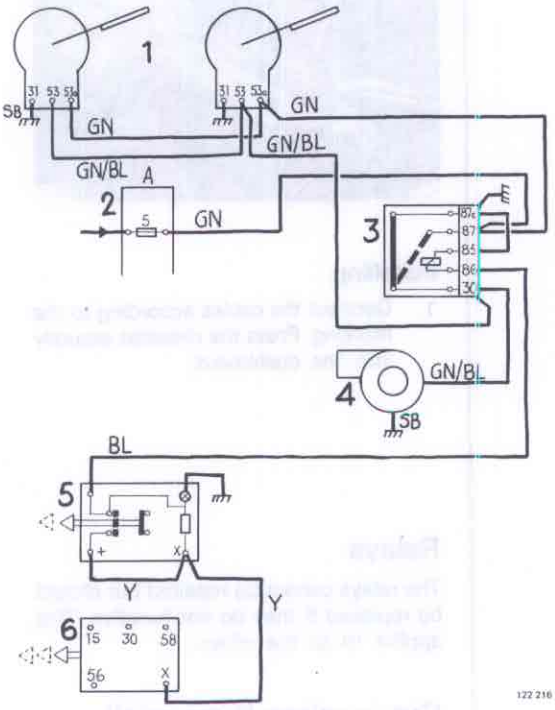
3. Remove the dust cover, nut, washer and spacer, and lift forwards the wiper motor.
4. Mark where the cables are connected and disconnect them.



Headlamp wiper assembly complete

Installing

1. Connect up the cables according to the marking.
2. Fit the wiper motor and wiper mounts (make sure that the guide pins fit in the guide holes), also the washer, nut and dust cover.
3. Switch on the ignition and the parking lights. Start the wiper motor and allow it to take up the parking position by manipulating with the switch button. The parking position is taken up automatically.
4. Fit the wiper arm and nut and connect the washer hose to the nozzle.
5. Clamp the hose to the wiper arm with the clamps.



Layout diagram for headlamp wipers and washers

1 Headlamp wiper
2 Fusebox (A5)
3 Relay, headlamp wiper
4 Headlamp washer
5 Switch
6 Switch, lighting

Washer motor

Removing

1. Remove the screws securing the motor.
2. Mark-up for correct re-installation and disconnect the hoses and cables from the washer motor.

Installing

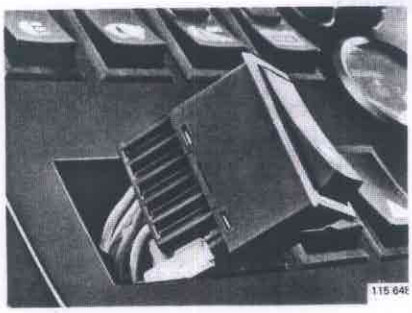
1. Connect up the hoses and cables according to the markings. See Fig. 36–4.
2. Screw tight the motor to the body.

Switches

Rocker-type switches

Removing

1. Remove the cover over the batteries and disconnect the negative cable from the battery.
2. Push out from the reverse side of the instrument panel the switch complete with connector and bulb holder.



3. Separate the connector and bulb holder from the switch.

Installing

1. Fit the bulb holder and connector to the new switch.
2. Push in and secure the switch on the instrument panel.
3. Connect-up the negative cable to the battery. Fit the cover over the batteries.

Turn switch (car heater)

Removing

1. Remove the cover over the batteries and disconnect the negative cable from the battery.
2. Remove the cover to the right of the switches.
3. Remove the knob from the switch by pulling it straight out and unscrewing the nut.
4. Lift forwards the switch. Mark how the cables are connected and then disconnect them.

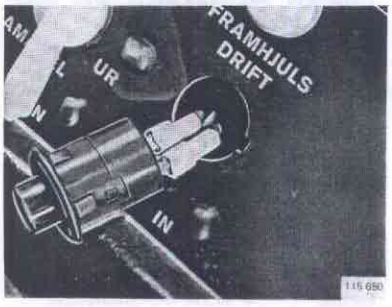
Installing

1. Connect-up the cables according to the marking and fit the switch.
2. Fit the nut, knob and cover.
3. Connect the negative cable to the battery and fit the cover over the batteries.

Push-push switches

Removing

Lift out the switch from the panel.



2. Mark-up for correct re-installation and disconnect the cables from the switch.

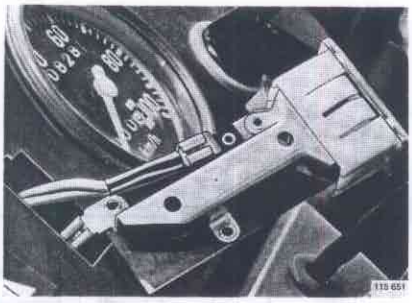
Installing

1. Connect-up the cables according to the marking.
2. Secure the switch to the panel.

Rheostat

Removing

1. Make sure that the ignition is switched off. Mark-up for correct re-installation and disconnect the cables from the rheostat.
2. Push out the rheostat from the reverse side of the dashboard.



Installing

1. Connect the cables according to the marking. Press the rheostat securely into the dashboard.

Relays

The relays cannot be repaired but should be replaced if they do not function. This applies to all the relays.

Cut-in relays (type mini)

Replacing

1. Pull the relay straight out from the relay socket.
2. Check that the new relay is of the correct rating before fitting it. Push the new relay securely into the socket.

Flasher device

Removing

1. Remove the screws securing the flasher device clamp.

2. Remove the flasher device from the clamp and separate it from the connector.

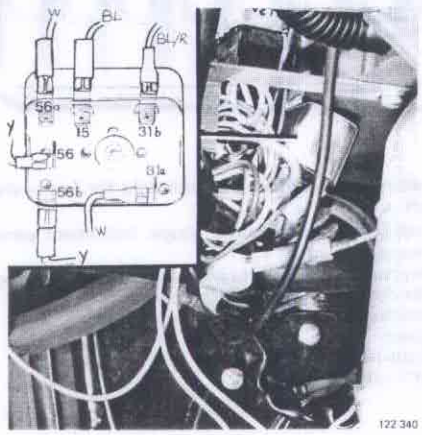
Installing

1. Wire the connector to the new flasher device.
2. Place the device in position behind the clamp and tighten up the screws.

Step relay for main-beams/dipped beams

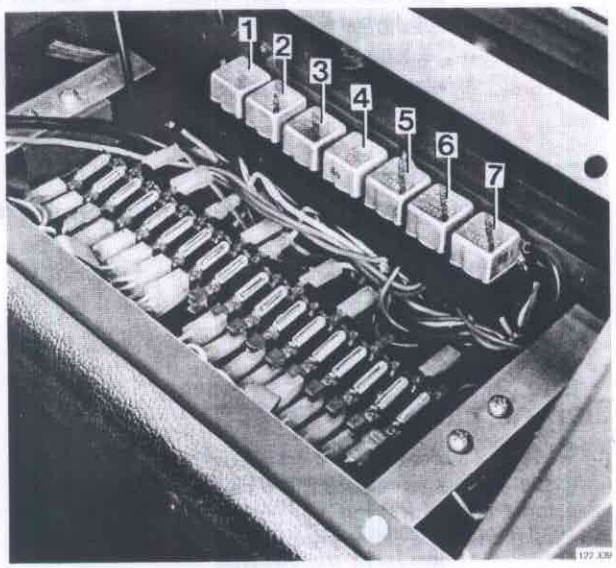
Removing

1. Remove the cover from over the batteries and disconnect the negative cable from the battery.
2. Mark-up and disconnect the cables from the step relay.
3. Remove the screws securing the relay.



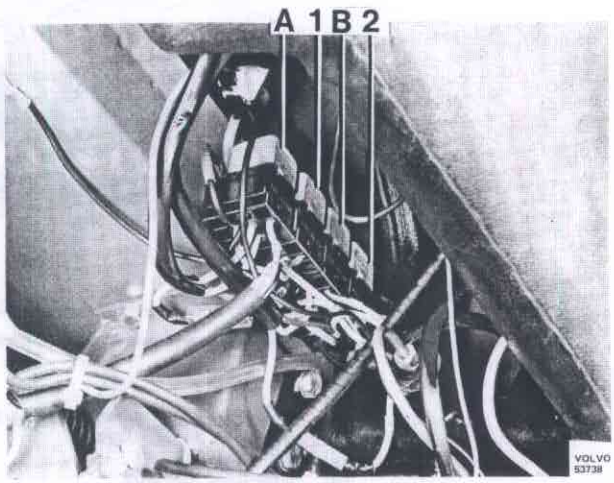
Installing

1. Fit the relay.
2. Connect the cables according to the markings.
3. Connect the negative cable of the battery and fit the cover over the batteries.



Relays underneath oddments locker

1	Reversing light	5*	Motor and cab heater
2	Headlamp wiper	6*	Motor and cab heater
3	Parking light	7*	Motor and cab heater
4	Headlamp	*	Not standard



Relays under dashboard

A	L/H windscreen wiper, low-speed
1	L/H windscreen wiper, high-speed
B	R/H windscreen wiper, low-speed
2	R/H windscreen wiper, high-speed

Group 37 Cables and Fuses

Construction and Function

ables

e cables installed in the vehicle have different colours. ese have been abbreviated in the fold-out diagram and the layout diagrams as follows:

= blue, GN = green, R = red, Y = yellow, SB = black, = grey, W = white and BN = brown.

ıses

e vehicle is fitted with two fuseboxes, each of which has 9 fuses. The fuseboxes are located under the oddments locker in the dashboard, right-hand side. Each fuse is rated for a current of 8 A.

Connectors

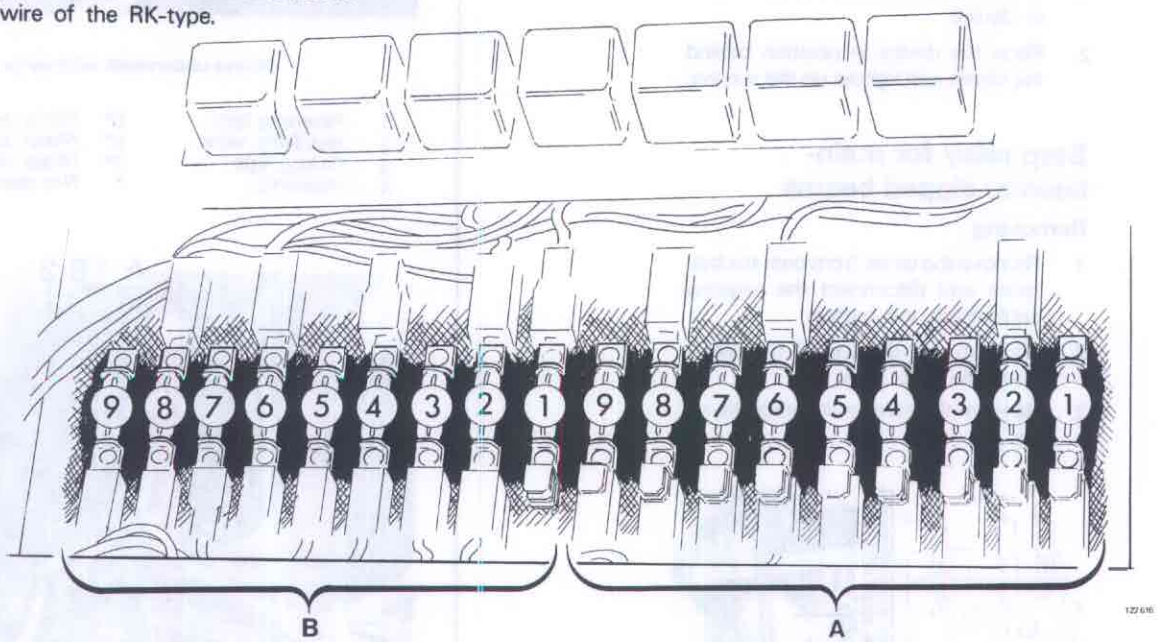
The vehicle is equipped with two connectors: a 6-pole and an 8-pole connector. They are located at the right-hand side of the rear engine cover.

Service Procedures

ectric cables

:he event of a breakage or short-circuit a cable, it must be replaced. The new ole must have the same area, colour d insulation as the old one and also be ltiwire of the RK-type.

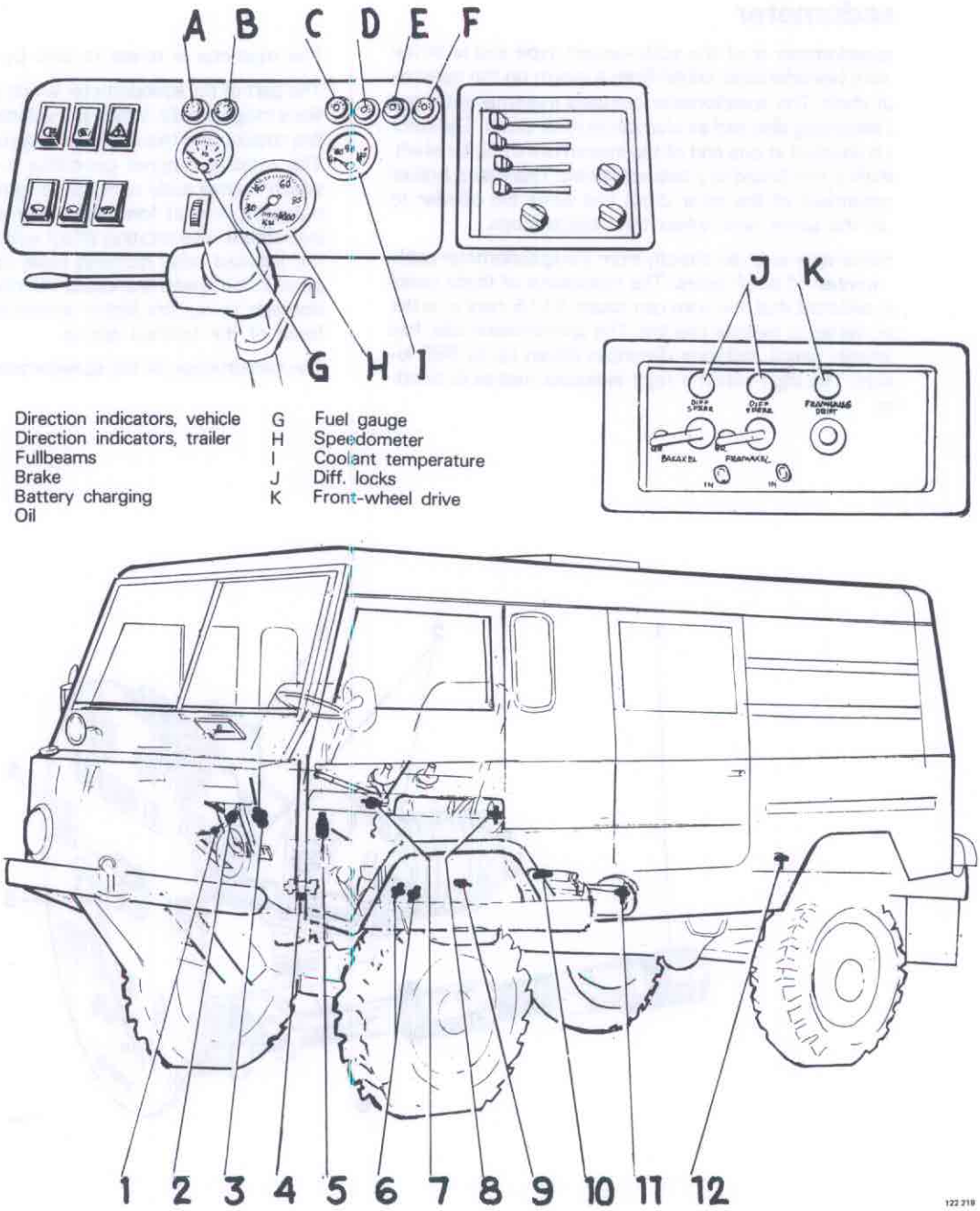
Fuses



A1 Interior lighting, socket, warning light
A2 Left-hand parking light
A3 Left-hand tail light
A4 Right-hand tail light
A5 Right-hand parking light, headlamp wiper
A6 Left-hand dipped beam
A7 Right-hand dipped beam
A8 Left-hand fullbeam
A9 Right-hand fullbeam, fullbeam indicator light
B1 Spare

B2 Fan motor, solenoid, indicator light for front-wheel drive and diff. lock
B3 Fuel gauge, temperature gauge, instrument panel light, horn, reversing lights
B4 Direction indicators, brake warning light, lighting
B5 Windscreen wipers, oil pressure
B6 Headlamp flasher, brake light contact
B7 Spare
B8 Right-hand stop light
B9 Left-hand stop light

Group 38 Instruments, Contacts and Indicator/Warning Lights



A	Direction indicators, vehicle	G	Fuel gauge
B	Direction indicators, trailer	H	Speedometer
C	Fullbeams	I	Coolant temperature
D	Brake	J	Diff. locks
E	Battery charging	K	Front-wheel drive
F	Oil		

Fig. 38–1. Instruments, contacts and indicator/warning lights

1	Pedal movement	7	Parking brake
2	Stop lights	8	Coolant temperature
3	Front-wheel drive	9	Oil pressure
4	Brake-circuit failure	10	Reversing light
5	Solenoid, front-wheel drive	11	Front-wheel drive
6	Diff. locks	12	Fuel level

eedometer

speedometer is of the eddy-current type and is driven wire (speedometer cable) from a worm on the gearbox ut shaft. The speedometer contains a permanent mag- a mounting disc and an aluminium rotor drum. The rotor is situated at one end of the instrument's pointer shaft. shaft is also linked to a balance spring. This spring brakes novement of the rotor drum and turns the pointer to at the same time when the vehicle stops.

nileometer is driven directly from the speedometer cable number of small gears. The reductions of these gears o selected that the wire can rotate 617.5 revs in order he meter to register one km. The speedometer also has ometer which indicates distances driven up to 999 ki- ters. The digit extreme right indicates metres in hund- ns.

The tripmeter is re-set to zero by turning the small knob.

The part of the speedometer which indicates the speed functions magnetically. When the vehicle starts moving, the drive line rotates and this causes the permanent magnet to rotate. The rotating magnet generates a rotating magnetic field, which causes eddy currents to form in the rotor drum. The magnet's lines of force flow over the mounting disc of the instrument. The rotating effect which the magnetic field and the induced eddy currents have on the rotor drum is dependent on speed (insreased vehicle speed causes the speedometer to register higher speed) and on the counteracting force of the balance spring.

The construction of the speedometer is shown in Fig. 38–2.

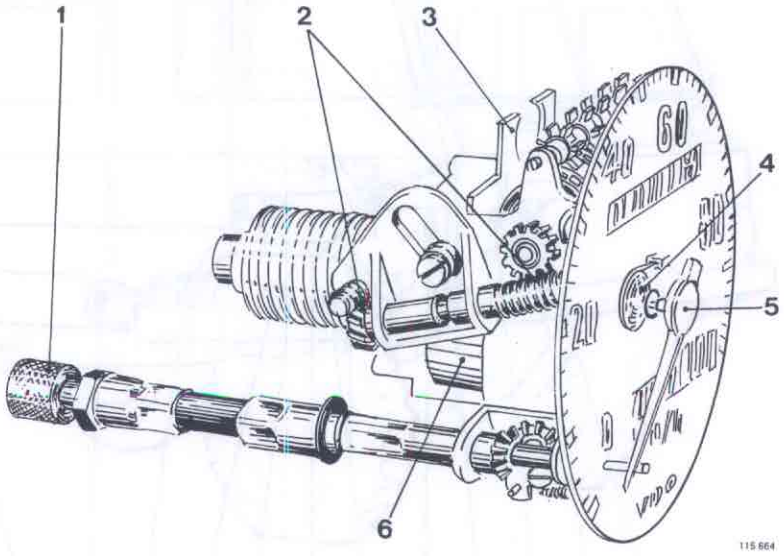


Fig. 38–2. Speedometer layout

1 Re-set knob for tripmeter
2 Worm
3 Mounting disc
4 Balance spring
5 Speedometer pointer
6 Rotor drum with permanent magnet

Engine temperature gauge

The engine temperature gauge system has two main parts: a temperature gauge on the dashboard and a temperature sender in the engine block.

The temperature sender consists of a temperature-sensitive semi-conductor. The resistance through the sender reduces as the temperature of the engine rises.

The temperature gauge has three coils which function as electromagnets. One is connected in series to the sender, the other two are wired to the vehicle chassis via a fixed resistor, see Fig. 38–3.

When the engine coolant is cold (high resistance in the sender), most of the current goes through the two coils connected in series and through the fixed resistor to the vehicle chassis.

The magnetic force which arises at these coils attracts the armature plate so that the pointer points to 40°C (104°F) or less.

When the engine coolant temperature starts rising (the resistance in the sender reduces), more and more current passes through the coil connected in series to the sender. The magnetic force which arises attracts the gauge pointer armature plate in the opposite direction to previously. The gauge pointer moves on the dial, and thus indicates the temperature, in relation to the amount of current flowing through the coils. The amount of current flowing through the coils is determined by the temperature of the coolant.

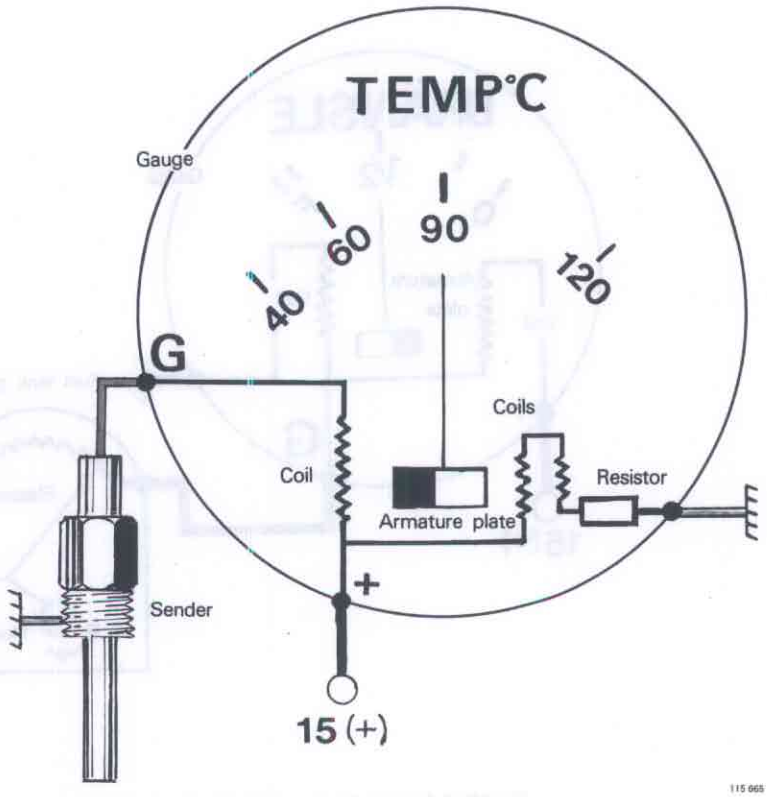


Fig. 38–3. Temperature gauge with sender, layout diagram

:uel gauge

he fuel gauge system, see Fig. 38–4, has two main parts: fuel gauge on the dashboard and a tank gauge sending nit in the fuel tank.

he tank gauge sending unit consists of a float which is contact with a contact plate via a lever. The contact plate lides over a rheostat. When there is more or less fuel in ıe tank (the fuel level rises or drops) more or less of the ıeostat coils are in circuit.

he fuel gauge has two coils, which function as solenoids. he gauge needle armature plate is attracted to whichever f the two coils has the greatest magnetic force, and this its turn will depend on how much current is flowing through ther of these coils, see Fig. 38–4. If, for example, the mag-ətic force is the same in each coil, then the gauge pointer dicates that the tank is 1/2 full. The fuel tank indicator nit determines how much current will flow through the coil.

Ex: When the float is at the bottom position (the tank is empty), then there is little resistance in the rheostat. Most of the current will then flow through the coil which is connected in series to the rheostat, and only a little part of the current flows through the oil which is connected to the vehicle chassis.

When the float is at its top position, then there is great resistance in the rheostat. Most of the current will then flow through the coil which is connected to the vehicle chassis.

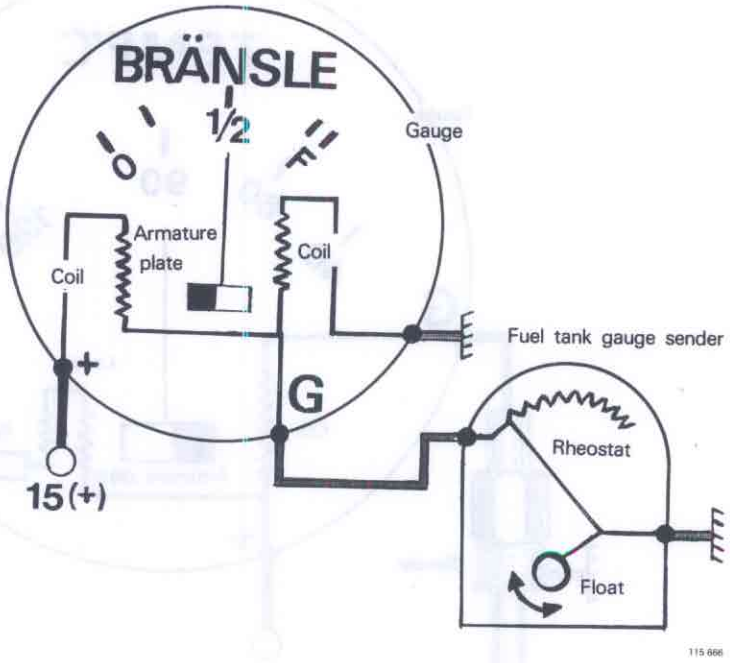


Fig. 38–4. Layout diagram of fuel gauge and fuel tank sending unit

1 Coil
2 Armature plate
3 Coil
4 Gauge
5 Fuel tank gauge sender

Solenoid, front-wheel drive

The electrical system which operates the mechanical engagement of the front-wheel drive comprises the following components: solenoid, switch, contacts and indicator light, see layout diagram, Fig. 38–5.

When the ignition is switched on, current flows through the solenoid winding, the pressure contact in the transfer box, the push-push switch on the instrument panel and then to the push contact on the brake line to the vehicle chassis. The current circuit is closed and the armature in the solenoid has been pulled to its top position. When the current circuit is opened, the armature in the solenoid goes to its lowest position and this engages the front-wheel drive.

As the above shows, this engaging and disengaging the front-wheel drive will depend on whether there is current through the solenoid winding or not. The front-wheel drive can thus be operated with:

A. Ignition. With the ignition key in neutral, the current is broken and front-wheel drive is engaged. When the key is turned, the front-wheel drive is disengaged, providing that the contacts and switches are in the position shown in Fig. 38–5.

B. Gear lever. When a low gear is engaged, the contact breaks the auxiliary gearbox current and the front-wheel drive engages.

C. Panel switch. Pushing in the switch breaks the current circuit and engages the front-wheel drive.

D. Brake pedal. When the brake pedal is depressed and the hydraulic pressure in the pressure switch exceeds 0.8–1.0 MPa (8–10 kgf/cm^2 = 11–14 lbf/in^2), the current circuit is broken and the front-wheel drive is engaged.

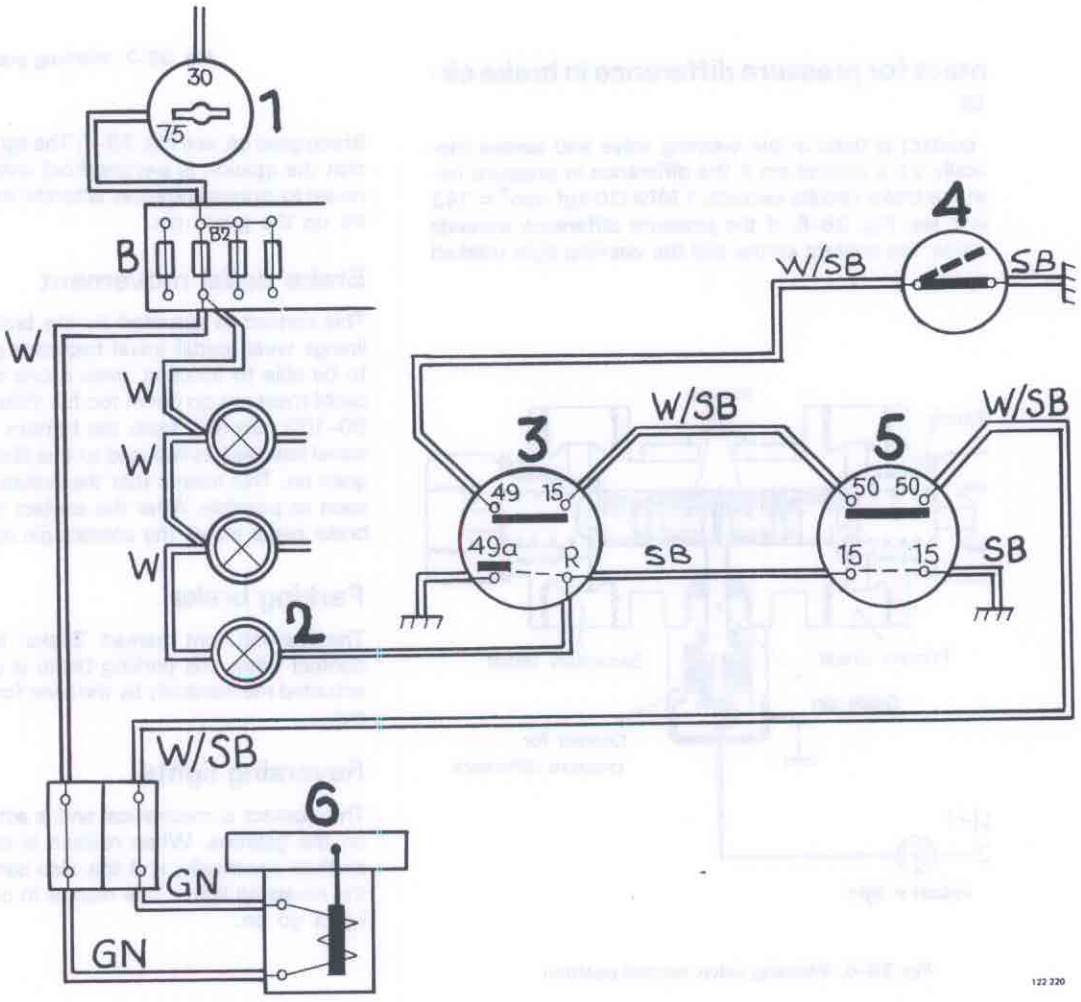


Fig. 38–5. Wiring diagram for front-wheel drive

1 Ignition
2 Fusebox (B)
2 Indicator light, front-wheel drive
3 Switch, instrument panel
4 Pressure contact, brake line
5 Contact, transfer box
6 Solenoid

nder contacts

pressure

en the ignition is switched on, current flows through the ressure warning light and further through the oil pressure ler to the vehicle chassis. When the engine starts and oil pressure exceeds 40–70 kPa (0.4–0.7 kgf/cm^2 = 0 lbf/in^2), this actuates a diaphragm which breaks the trical circuit between the sender and chassis. Warning goes out.

ntacts

op lights

contact for the stop lights is mechanical and is actuated he brake pedal. When the pedal is not depressed, the ent circuit is broken. When the pedal is depressed, the ent circuit to the stop lights is closed so that the lights on.

ntact for pressure difference in brake cir-ts

contact is fixed in the warning valve and senses me-ically via a control pin if the difference in pressure be-en the brake circuits exceeds 1 MPa (10 kgf/cm^2 = 142 in^2), see Fig. 38–6. If the pressure difference exceeds value, the contact earths and the warning light marked

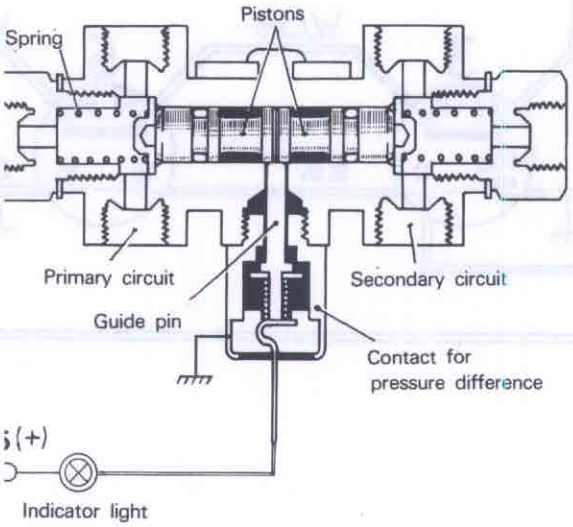


Fig. 38–6. Warning valve, normal position

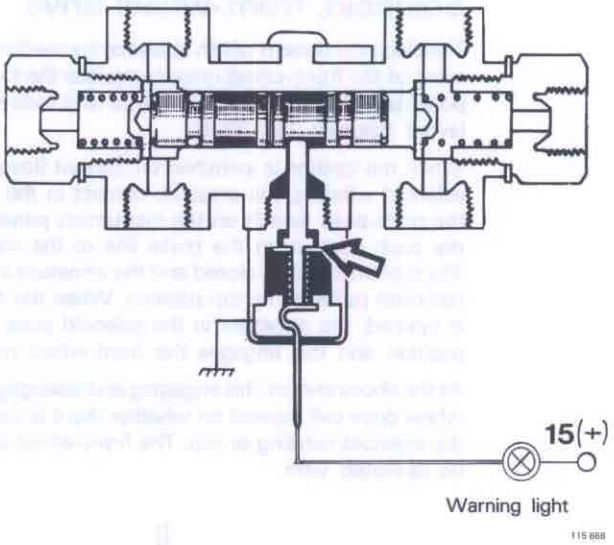


Fig. 38–7. Warning position

Brake goes on, see Fig. 38–7. The light remains on (providing that the ignition is switched on) until the contact has been re-set to its initial position, whereby the warning valve pistons lift up the guide pin.

Brake pedal movement

This contact is actuated by the brake pedal. As the brake linings wear, pedal travel becomes greater. For the brakes to be able to function, even if one of the circuits fails, the pedal must not go down too far. When the pedal goes down 90–100 mm (4"), from the bottom position, that is, pedal travel reserve has reduced to this distance, the warning light goes on. This means that the brakes should be adjusted as soon as possible. After the contact has indicated excessive brake pedal travel, the contact pin must be re-set by hand.

Parking brake

The warning light marked "Brake" lights by means of this contact when the parking brake is applied. The contact is actuated mechanically by the lever for the parking brake control.

Reversing lights

This contact is mechanical and is actuated by the shift gear on the gearbox. When reverse is engaged, the contact is earthed electrically, and this also earths the cut-in relay for the reversing lights. The relay is in circuit and the reversing lights go on.

Differential locks

The contacts are connected on the vacuum lines which run to the front and rear control cylinders, see Fig. 38–8.

The function of the contacts is to switch on the indicator lights marked "Diff.lock" when vacuum exceeds 39.5–40.5 kPa (0.395–0.405 kgf/cm^2 = 5–6 lbf/in^2).

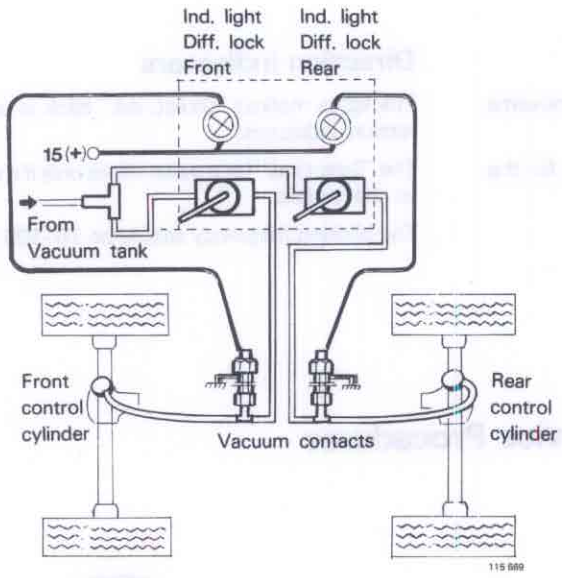


Fig. 38–8. Layout diagram for link-up of vacuum contacts

Warning / indicator lights

Battery charging

This light is marked "Charging". It is connected between the ignition terminal 61 and the alternator terminal 61. When the alternator voltage is lower than the battery voltage, the light goes on. When the voltage rises and the alternator starts charging the battery, the light goes out. This indicates that the alternator is charging.

Oil pressure

The light marked "Oil" should go on when the lubricating oil pressure in the engine goes below 40–70 kPa (0.4–0.7 kgf/cm^2 = 6–10 lbf/in^2).

Brake

The light marked "Brake" should go on: when the parking brake is applied, or when the brake pedal travel exceeds a certain distance, see Fig. 38–9.

Diff. lock

The lights marked "Diff. lock" go on when the vacuum in the lines to the control cylinders for the front and rear differential locks exceeds 39.5–40.5 kPa (0.395–0.405 kgf/cm^2 = 5–6 lbf/in^2).

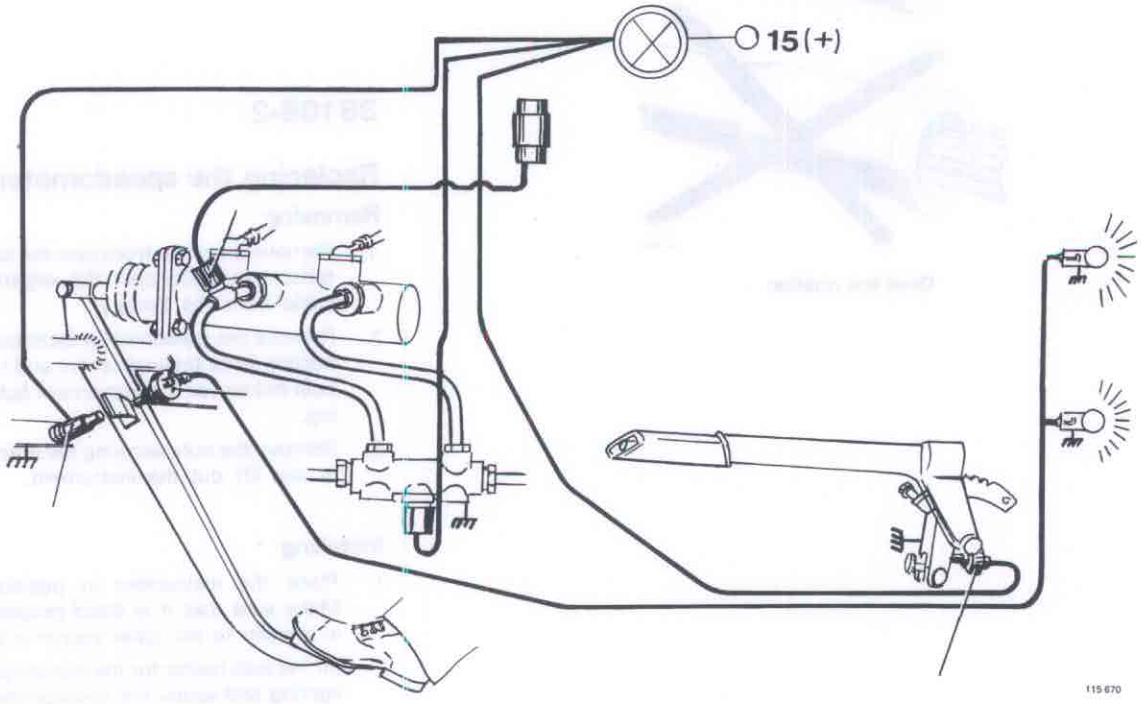


Fig. 38–9. Warning system for warning light marked "Brake"

ainbeams

ɜ light marked "Mainbeam" goes on when the mainbeams on.

ɜ light is connected in parallel with the mainbeam for the ıt-hand side at the fuse (A9).

Direction indicators

The lights marked "Direct. ind." blink in unison with the direction indicators.

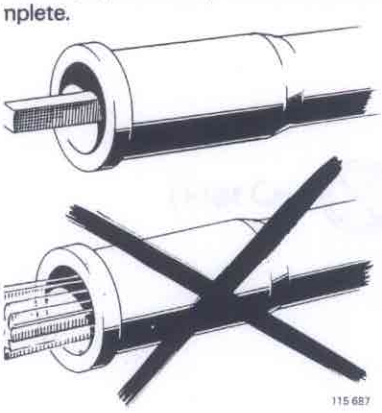
The "Direct ind." for a trailer blinks only if a trailer is connected to the vehicle.

The blinking frequency should be 75–105 blinks per minute.

Service Procedures

ɔeedometer

ne speedometer does not give a read- but the mileometer is functioning or ıe speedometer is functioning but not mileometer, then the fault is in the ıedometer. If the instrument is not rking at all, or if the speedometer nter swings, probably the drive line is ken or is jamming in its sleeve. If this ıe case, replace the speedometer cable nplete.



115 687

Drive line rotation

115 672

Speedometer

38108-2

Replacing the speedometer

Removing

1. Remove the cover from over the batteries and disconnect the negative cable from the battery.
2. Remove the speedometer cable connection from the instrument and the bulb holder for the instrument lighting.
3. Remove the nuts securing the bracket and lift out the instrument.

Installing

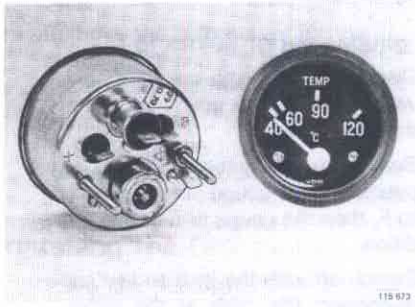
1. Place the instrument in position. Make sure that it is fitted properly in relation to the other instruments.
2. Fit the bulb holder for the instrument lighting and screw the speedometer cable nut on the instrument.
3. Connect up the negative cable to the battery and fit the battery cover.

Engine temperature gauge

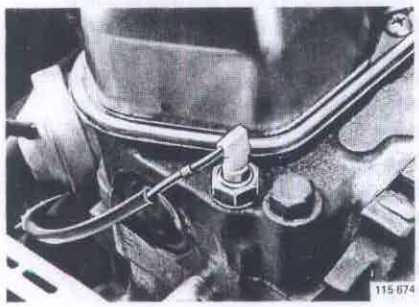
Testing

If the engine temperature gauge gives incorrect temperature or no temperature at all, then the fault may lie in the instrument, its sender or in the cables. The first thing to check is that there is good contact between the various instruments and sender connections and that the instrument is properly wired to the vehicle chassis.

Examine with a voltmeter or test lamp to make sure there is voltage on the instrument feed side. If the cables and contacts are without fault, carry out the following tests:



Engine temperature gauge



Sender for engine temperature gauge

Temperature gauge indicates 40°C (100°F)

1. Disconnect the cable at the sender.
2. Switch on the ignition.
3. Hold the cable end against a scraped clean part on the engine in order to get an earth connection. If the gauge pointer goes over to 120°C (250°), then the cable and instrument are in good condition so that the fault must be looked for in the sender. See under "Checking the sender".
4. If the gauge pointer does not swing to 120°C (250°F), disconnect the cable also at the instrument. Connect contact pin "G" to the chassis. If the instrument is functioning properly, the indicator should swing over to 120°C (250°F). And if the instrument is without fault, there must be a breakage in the cable to the sender. If this is the case, repair or replace the cable.

Temperature gauge shows 120°C (250°F)

1. Disconnect the cable running from the instrument to the sender, the blue-coloured cable.
2. Switch on the ignition. If the gauge pointer swings to 40°C (100°F), then the gauge is in good condition.
3. Switch off the ignition and connect up the cable between instrument and sender.
4. Disconnect the cable at the sender and insulate it from the vehicle chassis.
5. Switch on the ignition. If the gauge pointer also swings to 40°C (100°F) now, then the cable is in good condition. The fault must be looked for in the sender. See under "Checking the sender".

Checking the sender

Check the sender with an ohmmeter, which is connected between the connection terminal and the vehicle chassis. The following temperatures apply (the sender body should be lowered into the coolant as far as to where the threads start):

Temperature	Resistance in sender
60°C (140°F)	120.5–147.5 Ω
90°C (194°F)	46.9–55.5 Ω
100°C (212°F)	35.5–41.5 Ω

Replace sender if faulty.

38230-2

Replacing the temperature sender

1. Remove the rear engine cover and disconnect the cable from the temperature sender.
2. If necessary, drain a little coolant from the cooling system.
3. Remove the sender and its gasket.
4. Fit a new sender and gasket and connect up the cable.
5. If necessary, top-up the cooling system with coolant and re-fit the engine cover.

cking the temperature gauge

temperature gauge is checked with ıltless sender connected up. Lower sender body into the coolant as far ɔ where the threads start. Heat the ant in a suitable way and check the ɔerature with the help of a mercury nometer.

noving the temperature ıge

Remove the cover from over the batteries and disconnect the negative cable from the battery.

Remove the bulb holder for the instrument lighting and disconnect the cables to the instrument.

Remove the nuts securing the bracket and the earth cable. Remove the bracket and lift out the temperature gauge.

:alling the temperature ıge

Place the temperature gauge in position and make sure that it is fitted properly in relation to the other instruments.

Fit the bracket and tighten up the gauge with the two nuts.

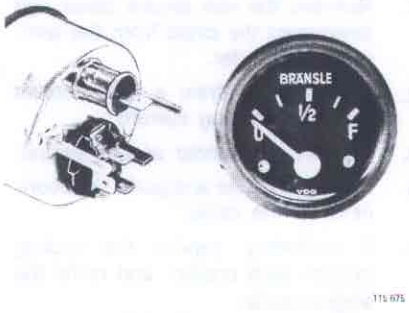
Fit the bulb holder for the instrument lighting and connect the cable connections to the gauge. The blue coloured cable is connected to "G", and the two yellow ones to "+".

Connect up the negative cable to the battery and fit the cover over the batteries.

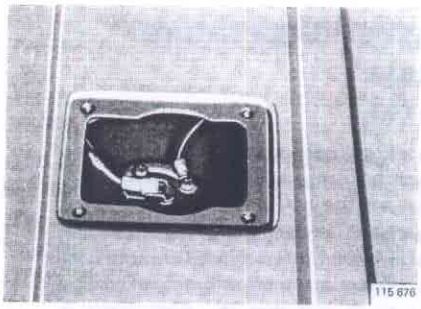
ɜl gauge

ting

gauge gives a wrong reading or no ng at all, then the fault may be in nstrument, the fuel gauge sending ɔr in the cables. Before starting the check that the connections at the ıment and sending unit are in good ition. Also check the earth to the fuel e sending unit. With a voltmeter or



Fuel gauge



Gauge sender unit

test lamp find out if there is voltage on the feed side of the instrument (when the ignition is switched on). If the cables and contacts are in good condition, continue testing as follows:

Fuel gauge pointer points to 0

1. Disconnect the green-coloured cable which runs to the gauge sender at the instrument.
2. Switch on the ignition to the firing position. If the gauge pointer swings to F, then the gauge is in good condition.
3. Switch off with the ignition key and re-connect the cable at the instrument.
4. Disconnect the cable at the gauge sending unit and keep it insulated from the vehicle chassis. Turn the ignition key to firing. If the gauge pointer swings to F, then the cable is also in good condition. The fault is probably in the gauge sending unit, which should be removed and tested with an ohmmeter.
5. The resistance with an empty tank (the float is at its lowest position) should be 0–6 Ω.
   With a full tank (the float is at its top position) the resistance should be 178–192 Ω.
   Move the gauge sending unit float up and down. The ohmmeter pointer should follow the movement of the float without jerking or without interruption.

Fuel gauge pointer points to F

1. Disconnect the green-coloured cable at the gauge level sending unit.
2. Switch on the ignition.
3. Hold the end of the disconnected cable against the chassis. If the pointer swings over to 0, then the cable and gauge are without fault, so the fault is probably in the gauge sending unit. See point 5 under the above previous test.

4. If, when doing the test described above, the gauge pointer does not swing to 0, disconnect the cable at the gauge. Connect the contact washer to the chassis with a piece of cable or corresponding. If the gauge is in good condition, the pointer will swing to 0. And if the instrument is without fault, then the fault is probably a poor contact at the connections to the instrument or in the cables to the gauge level sending unit.

Removing the fuel gauge

1. Remove the cover from over the batteries and disconnect the negative cable from the battery.
2. Remove the bulb holder for the instrument lighting and the cable connections at the instrument.
3. Remove the nuts securing the bracket and disconnect the earth cables. Remove the bracket and lift out the intrument.

Installing the fuel gauge

1. Place the fuel gauge in position. Make sure that it is located properly in relation to the other instruments.
2. Fit the bracket and connect up the earth cables. Tighten up the gauge with the two nuts.
3. Fit the bulb holder for the instrument lighting and connect the flat-pin sleeves as follows: the green-coloured cable is connected to the terminal marked "G". The yellow-coloured cables are connected to the terminal marked "+".
4. Connect up the negative cable to the battery and fit the cover over the batteries.

Removing the fuel gauge level sending unit

1. Remove the four screws securing the cover over the unit.
2. Disconnect the cables from the unit. Make a line-up mark (with, e.g., a screw-driver) on the unit and the tank.
3. Remove the screws securing the unit and then take out the unit. Remove the unit gasket.

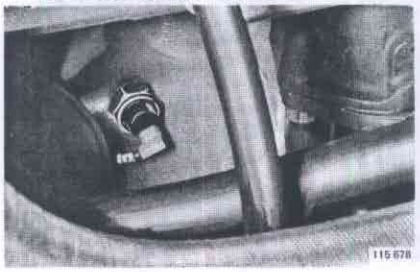
Installing the fuel gauge level sending unit

1. Fit a new gasket and restore the sending unit back in position.
2. If necessary replace the rubber washer for the screws. Screw tight the sending unit and connect up the cables.
3. Fit and secure the cover over the sending unit.

38202-2

Replacing the contact for oil pressure gauge sender

1. Remove the rear engine cover.
2. Disconnect the cable from the oil pressure gauge contact.

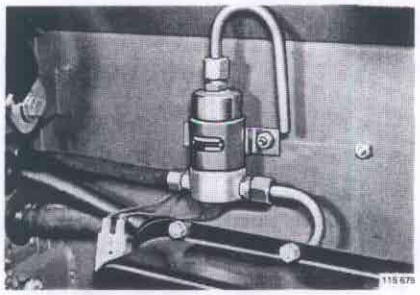


3. Have the new sender ready and fit it as soon as the old one has been removed.
4. Connect up the cable and re-fit the engine cover.

Solenoid for front-wheel drive

Removing

1. Make sure that the ignition is switched off. Then disconnect the cables at the connector.
2. Slacken pipe and hose connections at the solenoid several turns.



Solenoid for front-wheel drive

3. Remove the screws securing the solenoid as well as the pipe and hose connections.

Installing

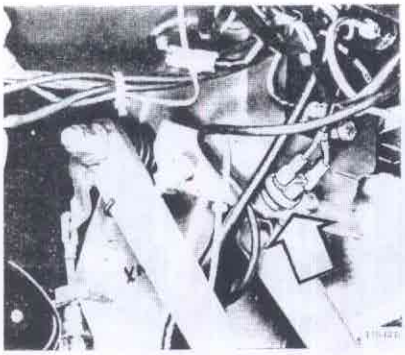
1. Fit the pipe and hose connections to the solenoid without tightening up.
2. Fit the solenoid.
3. Screw tight the pipe and hose connections and connect the cables to the connector.

ontact for stop lights

3408-2

eplacing

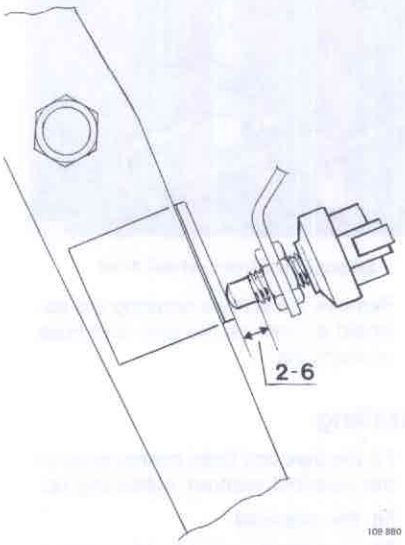
Disconnect the cables and remove the nut securing the contact to the bracket.



Fit the contact to the bracket and connect up the cables.

djusting

or the contact to function correctly and prevent it from being damaged, it must ave a certain position in relation to the ake pedal. The distance between the edal in the rest position and the brass eeve on the contact should be 2–6 mm / 16"). With a different distance, slacken e nuts and move the contact in order obtain the correct distance. Thereafter ghten up the nuts.

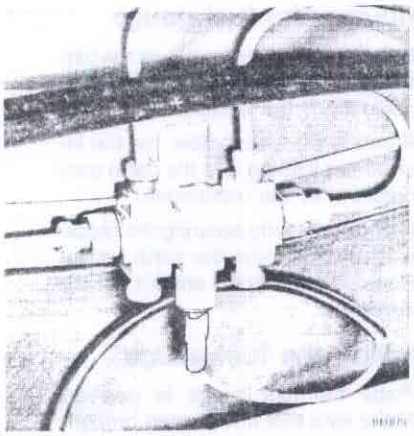


Contact for stop lights, adjustment measurement

Contact for pressure difference in brake circuits

Replacing

1. Disconnect the cable and unscrew the old contact.
2. Carefully screw the new contact into the warning valve. The tightening torque is approx. 15 Nm (1.5 kgf m = 22 lbf ft). Connect up the cable.



Contact for brake pedal travel

36424-2

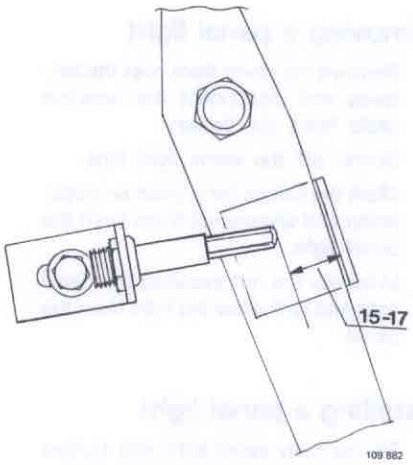
Replacing

1. Disconnect the cable and remove the nut securing the contact to the bracket.
2. Fit and tighten up the new contact to the bracket and connect up the cable.

Adjusting

The contact should give warning when there is about 90–100 mm (4") left of pedal travel, measured at the centre of the footplate. Since normally this can only be checked by means of bleeding, check the position of the contact by measuring the distance between the brake pedal bracket and the contact pin, with the brake pedal in the rest position. This distance should be 15–17 mm (5/8"). If the distance is otherwise, slacken the nut and move the contact in order to obtain the correct distance. Thereafter tighten up the nut.

The contact is re-set from the warning position by pushing back the contact pin to the rest position.



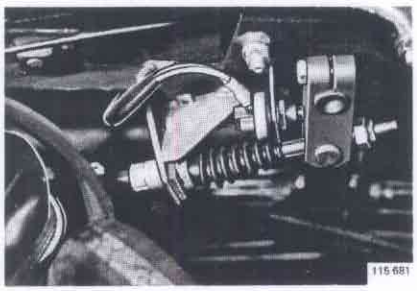
Contact for brake pedal travel, adjustment measurement

Contact for parking brake

36422-2

Replacing

1. Remove the inspection cover.

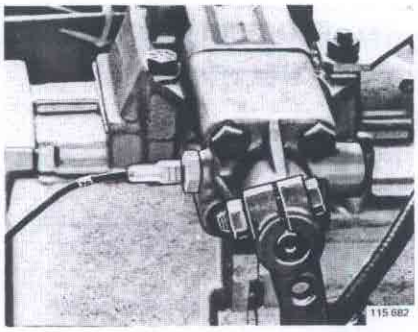


2. Disconnect the cable and remove the nut securing the contact to the bracket.
3. Fit and tighten up the new contact to the bracket and connect the cable. The contact should cut in the circuit to the warning light marked "Brake" at the second or third ratchet notch. Put back the inspection cover.

Contact for reversing lights

Replacing

1. Remove the cover from over the gearbox.
2. Disconnect the cable and remove the contact.
3. Fit the new contact and connect up the cable.



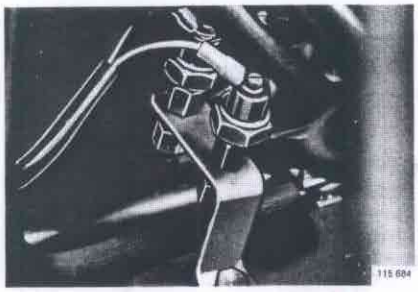
4. Put back the cover over the gearbox.

Vacuum contact for diff. locks

38240-2

Replacing

1. Disconnect the cable from the contact.
2. Remove the contact.
3. Fit the new contact and connect up the cable.

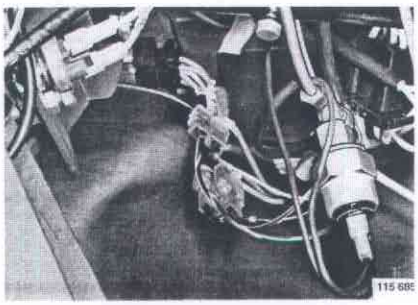


Contact for front-wheel drive (underneath instrument panel)

36452-2

Replacing

Have a new contact and gasket ready for fitting. Disconnect the cable and unscrew the contact. Quickly fit the new contact and gasket. Connect up the cable. Check the level in the brake fluid containers and test the brakes.



ontact for front-wheel ·ive (at transfer box)

ɜmoving

Remove the cover from over the gearbox.

Mark for correct re-installation and disconnect the cables from the contact.

Remove the contact and copper washer.

ıstalling

Screw in the contact together with a new copper washer.

Connect up the cables according to the marking.

Put back the cover over the gearbox.

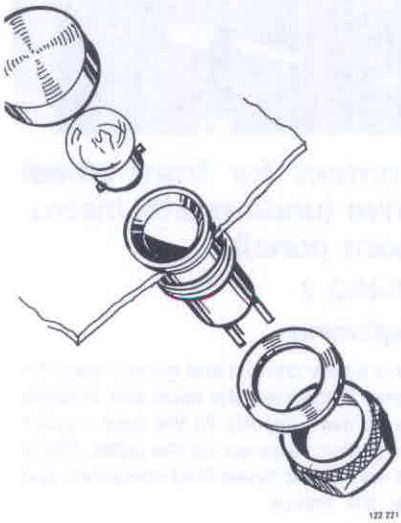
anel lights

8161-3

eplacing a bulb

Unscrew the panel light lens and remove the bulb.

Fit the new bulb and screw on the lens.



122 221

Removing a panel light

1. Remove the cover from over the batteries and disconnect the negative cable from the battery.
2. Screw off the panel light lens.
3. Mark the cables for correct re-installation and disconnect them from the panel light.
4. Unscrew the nut securing the panel light and withdraw the light from the panel.

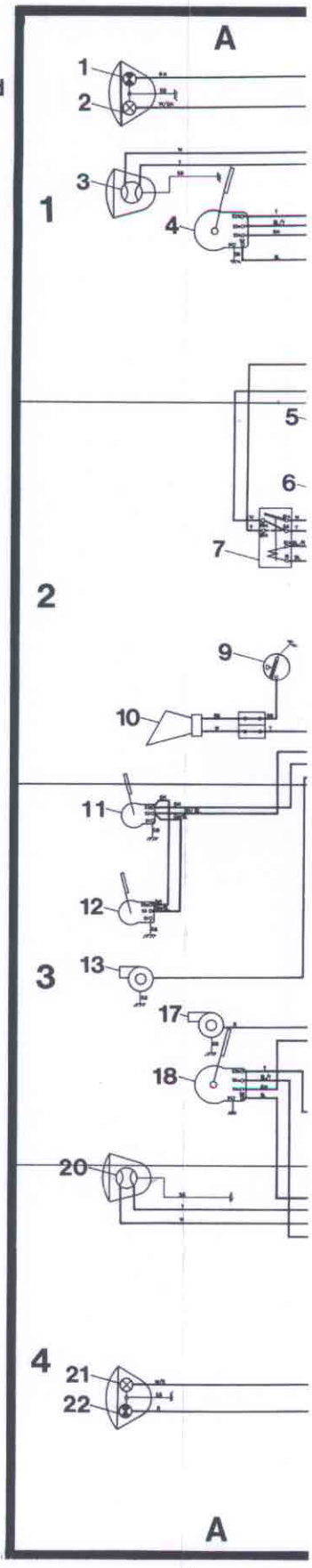
Installing a panel light

1. Fit the new panel light and tighten it to the panel with the nut.
2. Connect up the cables according to the marking.
3. Fit a new bulb if necessary and screw on the lens.
4. Connect up the negative cable to the battery and re-fit the cover over the batteries.

List of electrical components

letter and figure within brackets indicat the square in which the component is placed

ılb, direction indicators	(A1)	64	Reversing light contact	(D2)
ılb, parking lights	(A1)	65	Contact, parking brake	(D2)
ılb, fullbeams and dipped beams	(A1)	66	Starter motor	(D2)
'indscreen wipers	(A1)	67	Battery	(D2)
ılay, headlight flasher	(A2)	68	Distributor	(D3)
ılay, parking lights	(A2)	69	Capacitor	(D3)
ep relay, fullbeams and dipped beams	(A2)	70	Ignition coil	(D3)
ılay, headlamp ipers	(A2)	71	Charging regulator	(D3)
›rn button	(A2)	72	Alternator	(D3)
›rn	(A2)	73	Contact, oil pressure	(D3)
ıadlamp wiper	(A3)	74	Contact, front-wheel drive	(D4)
ıadlamp wiper	(A3)	75	Contact, front-wheel drive	(D4)
ıadlamp washers	(A3)	76	Solenoid valve	(D4)
ılay, windscreen wiper	(A3)	77	Switch, interior lighting	(D4)
ılay, windscreen wiper	(A3)	78	Bulb, interior light	(D4)
ılay, windscreen wiper	(A3)	79	Bulb, tail light	(E1)
indscreen washers	(A3)	80	Bulb, direction indicator	(E1)
indscreen wiper	(A3)	81	Bulb, stop lights	(E1)
ılay, windscreen wipers	(A3)	82	Trailer contact	(E3)
ılb, fullbeams and dipped beams	(A4)	83	Bulb, reversing lights	(E4)
ılb, parking light	(A4)	84	Bulb, tail light	(E4)
ılb, direction indicator	(A4)	85	Bulb, direction indicator	(E4)
n motor, extra	(B2)	86	Bulb, stop light	(E4)
vitch, fan motor	(B2)			
n motor	(B2)			
ntact, front-wheel drive	(B2)			
ntact, brake pedal movement	(B2)			
arning light, battery charging	(B3)			
arning light, oil pressure	(B3)			
arning light, brakes	(B3)			
eostat	(B3)			
licator light, fullbeams	(B3)			
olant temperature gauge	(B3)			
licator light, direction indicator	(B3)			
ısher device	(B3)			
licator light, direction indicator	(B3)			
eedometer	(B3)			
el gauge	(B4)			
vitch, windscreen wash	(B4)			
vitch, hazard warning lights	(B4)			
vitch, headlamp wipers	(B4)			
vitch, windscreen wiper	(B4)			
vitch, windscreen wiper	(B4)			
vitch, lights	(B4)			
g socket	(C1)			
ıke light contact	(C2)			
ection indicator stalk	(C2)			
ay, reversing lights	(D2)			
ntact, brake circuit	(D2)			
ark plugs	(D2)			
mper resistance	(D2)			
ntact, differential lock	(C3)			
ntact, differential lock	(C3)			
icator light, differential lock	(C4)			
ıder, coolant temperature gauge	(C4)			
icator light, differential lock	(C4)			
icator light, front-wheel drive	(C4)			
ition switch	(C4)			
el level sender	(D1)			
ıole, connector	(D1)			
ıole, connector	(D1)			



List of electrical components

letter and figure within brackets indicat the square in which the component is placed

1	Bulb, direction indicators	(A1)
2	Bulb, parking lights	(A1)
3	Bulb, fullbeams and dipped beams	(A1)
4	Windscreen wipers	(A1)
5	Relay, headlight flasher	(A2)
6	Relay, parking lights	(A2)
7	ep relay, fullbeams and dipped beams	(A2)
8	Relay, headlamp ipers	(A2)
9	Horn button	(A2)
10	Horn	(A2)
11	Headlamp wiper	(A3)
12	Headlamp wiper	(A3)
13	Headlamp washers	(A3)
14	Relay, windscreen wiper	(A3)
15	Relay, windscreen wiper	(A3)
16	Relay, windscreen wiper	(A3)
17	Windscreen washers	(A3)
18	Windscreen wiper	(A3)
19	Relay, windscreen wipers	(A3)
20	Bulb, fullbeams and dipped beams	(A4)
21	Bulb, parking light	(A4)
22	Bulb, direction indicator	(A4)
23	Fan motor, extra	(B2)
24	Switch, fan motor	(B2)
27	Fan motor	(B2)
28	Contact, front-wheel drive	(B2)
29	Contact, brake pedal movement	(B2)
30	Warning light, battery charging	(B3)
31	Warning light, oil pressure	(B3)
32	Warning light, brakes	(B3)
33	Rheostat	(B3)
34	Indicator light, fullbeams	(B3)
35	Coolant temperature gauge	(B3)
36	Indicator light, direction indicator	(B3)
37	Flasher device	(B3)
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57	Sender, coolant temperature gauge	(C4)
58	Indicator light, differential lock	(C4)
59	Indicator light, front-wheel drive	(C4)
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61	Fuel level sender	(D1)
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63	Console, connector	(D1)
64	Reversing light contact	(D2)
65	Contact, parking brake	(D2)
66	Starter motor	(D2)
67	Battery	(D2)
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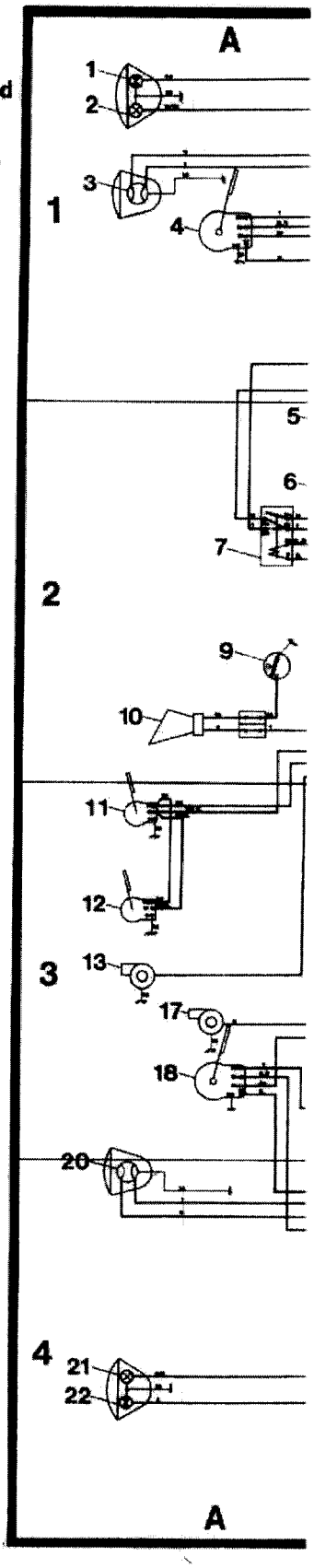
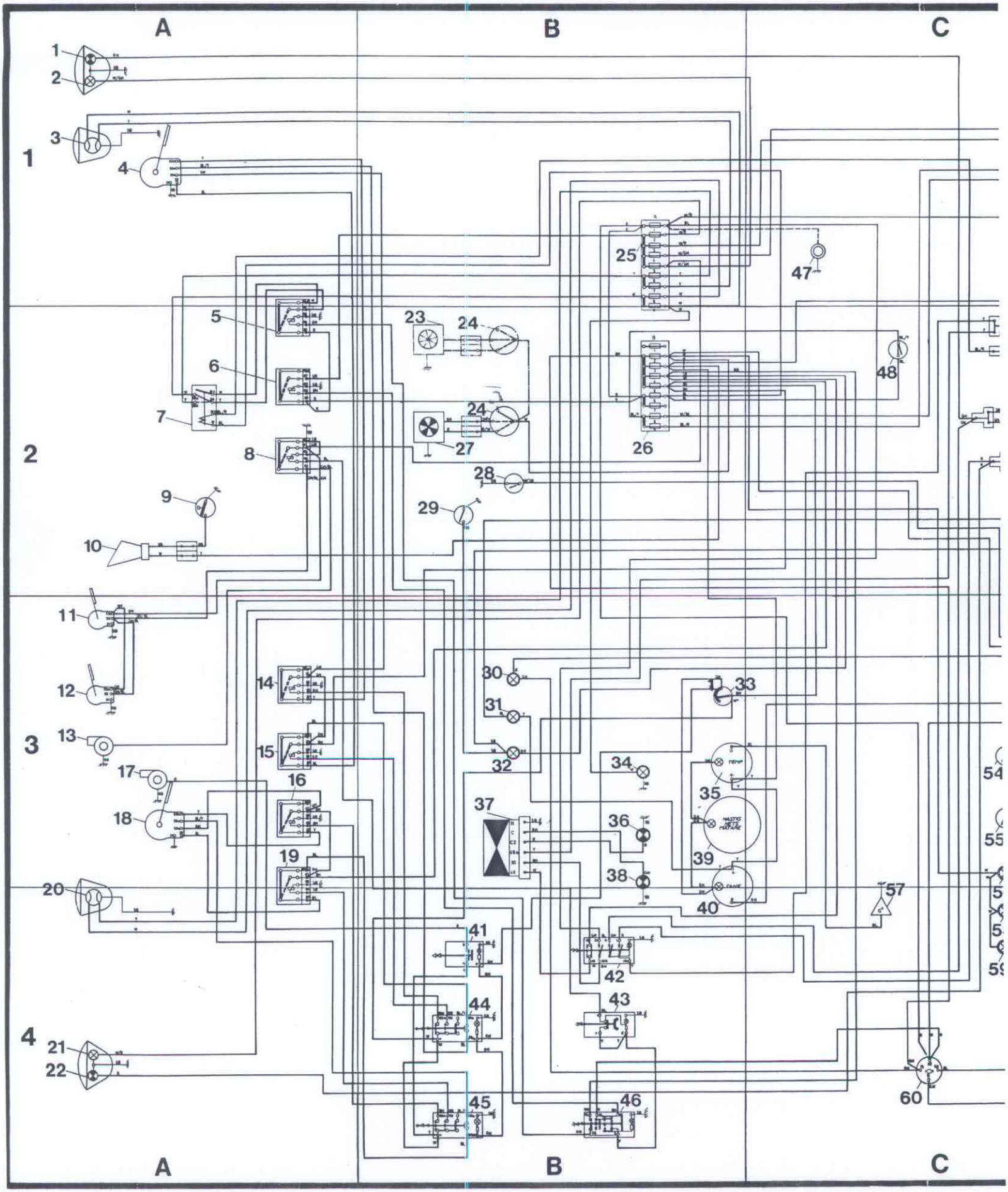
69	Capacitor	(D3)
70	Ignition coil	(D3)
71	Charging regulator	(D3)
72	Alternator	(D3)
73	Contact, oil pressure	(D3)
74	Contact, front-wheel drive	(D4)
75	Contact, front-wheel drive	(D4)
76	Solenoid valve	(D4)
77	Switch, interior lighting	(D4)
78	Bulb, interior light	(D4)
79	Bulb, tail light	(E1)
80	Bulb, direction indicator	(E1)
81	Bulb, stop lights	(E1)
82	Trailer contact	(E3)
83	Bulb, reversing lights	(E4)
84	Bulb, tail light	(E4)
85	Bulb, direction indicator	(E4)
86	Bulb, stop light	(E4)

25 FuseBlock (B1)

26 FuseBlock (B2)

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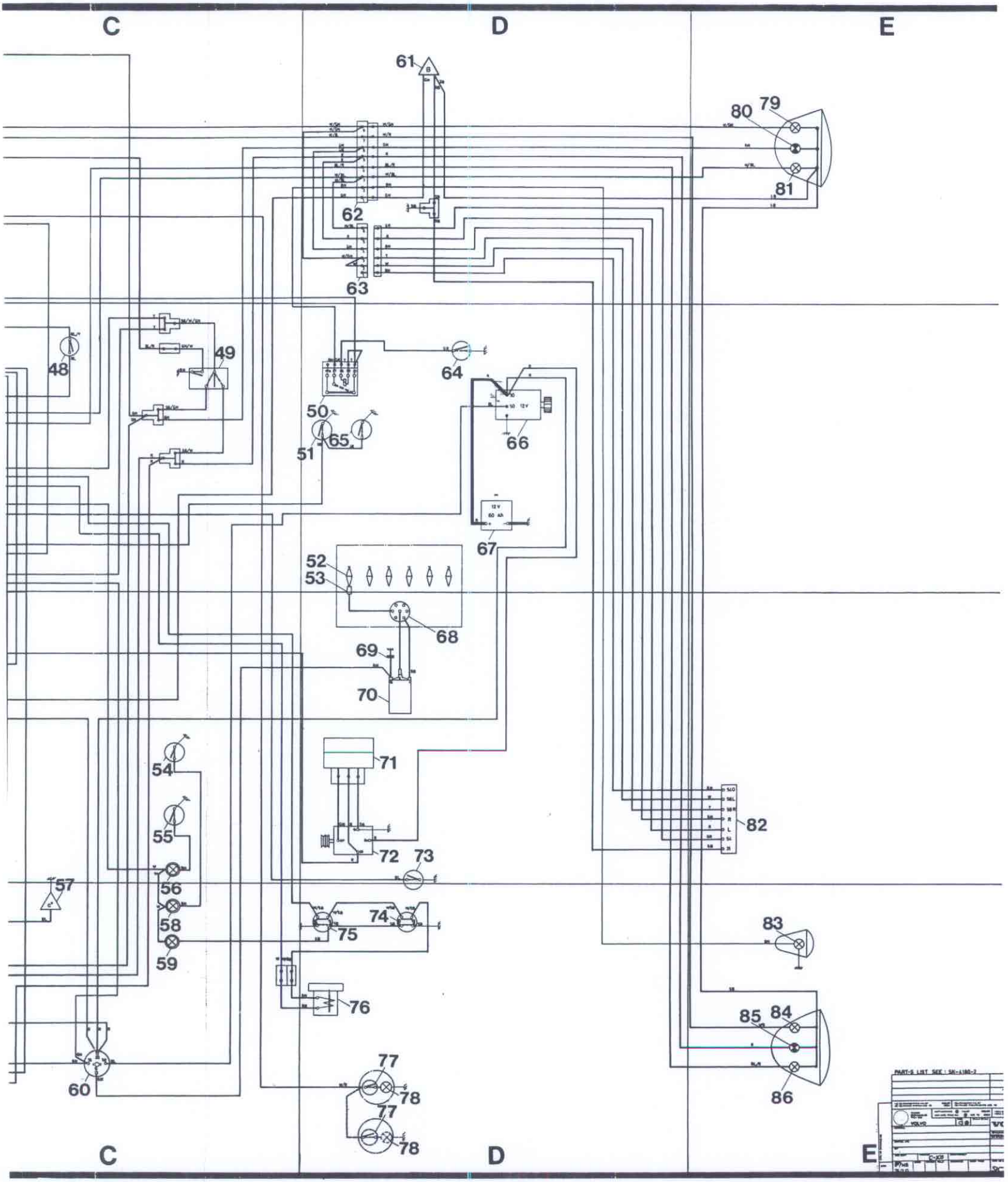
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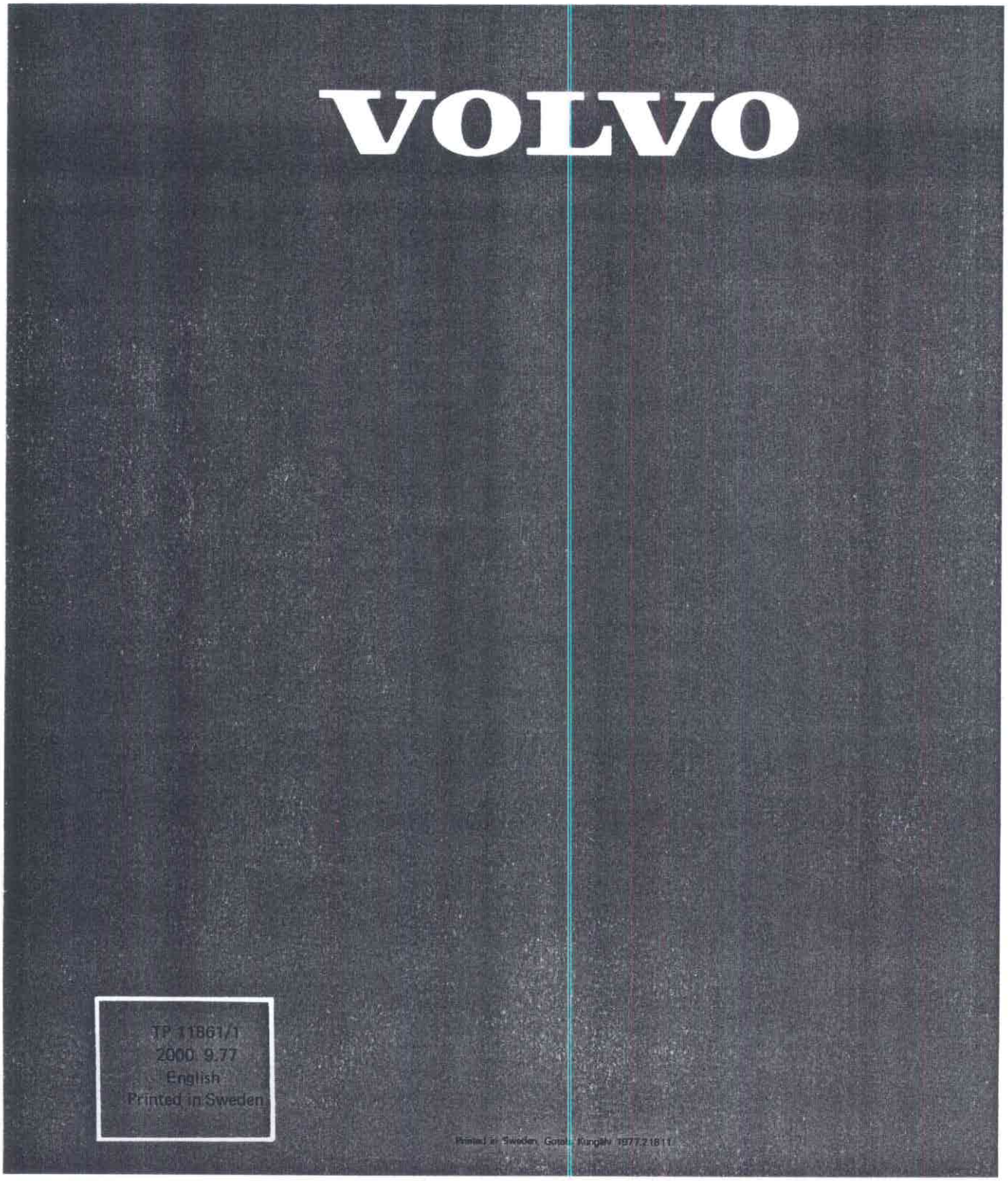

TP 11861/1
2000 9.77
English
Printed in Sweden

Printed in Sweden, Göteborg, Kungälv 1977.21811

VOLVO SERVICE

PART 4

POWER TRANSMISSION

C3-series

SERVICE MANUAL

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GROUP 40 GENERAL

Data

CLUTCH

Clutch type	Single disc, dry plate	
Size	9 1/2"	
Friction surface	456 cm^2	
Spring type	Disc spring	
Rivets for clutch lining, number	36	
size	3.6 x 5.2 mm	(0.142–0.205")
Withdrawal lever free play	5 mm	(0.20")
Maximum permissible taper, thrust plate	0.025 mm	(0.0010")

GEARBOX

Type designation	S 4 18/3 ZF	
Reduction ratios:		
1st gear	3.87:1	
2nd gear	2.08:1	
3rd gear	1.39:1	
4th gear	1:1	
reverse	4.16:1	
Shims, bearing – input shaft, alt.	0.5–1.5 (0.020–0.060")	(in stages 0.1 mm – 0.0039")
cover – input shaft, alt.	0.4–1.0 (0.016–0.039")	(in stages 1 mm = 0.0039")
cover – bearing, countershaft, alt.	0.5–1.5 (0.020–0.060")	(in stages 0.1 mm = 0.0039")
cover – bearing, output shaft	0.4–1.0 (0.016–0.039")	(in stages 0.1 mm = 0.0039")
Circlip, output shaft	1.8, 1.9 and 2.0 mm (0.071, 0.075 and 0.080")	
Axial clearances, cover – bearing, input shaft	± 0.05 mm	(0.0020")
bearing – input shaft	0.0 ± 0.1 mm	(0.0039")
cover – bearing, countershaft	+ 0.1 mm	(0.0039")
cover – bearing, output shaft	± 0.05 mm	(0.0020")
Oil change quantity	1.2 litres	(2 pints)
Oil type	Gear oil API-GL-1 SAE 80 or SAE 80/90	

Tightening torques

Nut, output shaft	140–160 Nm	(14–16 kpm = 101–115 lbftf)
Nuts, housing pistons	20– 25 Nm	(2.0–2.5 kpm = 14–18 lbftf)
Allen bolts, housing pistons	8– 12 Nm	(0.8–1.2 kpm = 5.8–8.7 lbftf)
Bolts, front cover	22– 25 Nm	(2.2–2.5 kpm = 15–18 lbftf)
Nuts, clutch casing	41– 51 Nm	(4.1–5.1 kpm = 30–37 lbftf)
Nuts, auxiliary gearbox – gearbox	23– 28 Nm	(2.3–2.8 kpm = 17–20 lbftf)

AUXILIARY GEARBOX

Type designation	FD 51	
Reduction ratio:		
Low gear	2.39:1	
High gear	1:1	
Shims, bearing – rear cover, alt.	0.10, 0.15, 0.35 and 0.50 mm (0.0039, 0.0060, 0.0140 and 0.020"	
Circlip, alt.	1.9 and 2.0 mm (0.075 and 0.080")	
End play, intermediate gear	0.01–0.05 mm (0.0004–0.0020")	
output shaft	0.03–0.08 mm (0.0012–0.0031")	
control mechanism flange	0.1 mm (0.0039")	
pull rod – cover bolt	approx. 8 mm (0.31") or 5.3 turns	
Oil change quantity	1,3 litre ((2,3 pints.)	
Oil type	Gear oil API-GL-16 SAE 80 or SAE 80/90	

Tightening torques:		
nut, output shaft	100–120 Nm (10–12 kpm = 72–87 lbftf)	
nut, countershaft	100–120 Nm (10–12 kpm = 72–87 lbftf)	

PROPELLER SHAFTS

Type designation	1300	
Lubricant	Grease MP	
Tightening torque:		
flange bolts	55–65 Nm	(5.5–6.5 kpm = 40–48 lbftf)

DIFFERENTIAL CARRIER

Type designation	EV II	
Reduction ratio	2.91:1	
Shims, spacer sleeve-bearing pinion	0.08 mm	(0.003")
	0.13 mm	(0.005")
	0.25 mm	(0.010")
	0.75 mm	(0.030")
Shims, bearing-pinion	0.08 mm	(0.003")
	0.13 mm	(0.005")
	0.25 mm	(0.010")
Thrust washers, diff. side gears	0.74–0.98 (0.029–0.039")	(in stages 0.04 mr = 0.0016"
Oil change quantity	1.5 litres	(2,6 pints.)
Oil type	Rear axle oil API-GL-5 or MIL-L-2105B, SAE 80	

Tightening torques:		
pinion nuts:	280–300 Nm	(28–30 kpm = 202–217 lbftf)
bolts, crown wheel	80–100 Nm	(8–10 kpm = 58–72 lbftf)
caps	55– 67 Nm	(5.5–6.7 kpm = 40–48 lbftf)

WHEEL CARRIERS

Reduction ratio	2.06:1	
Oil change quantity, wheel carrier, front	0.3 litre	(0,5 pints)
rear	0.4 litre	(0,7 pints)
Oil type:	Gear oil API-GL-1 SAE or SAE 80/90	

Tightening torques:		
bolts, rear axle casing-wheel carrier housing	100–120 Nm	(10–12 kpm = 72–87 lbftf)
front axle casing	100–120 Nm	(10–12 kpm = 72–87 lbftf)

POWER TAKE-OFF, rear axle

Reduction rafio	1:1	
Shims, drivegear	1.25, 1.30, 1.35, 1.40, 1.60, 1.65, 1.85, 1.90, 1.95, 2.00 mm.	
Axial elearances, duivegear bearing	0.03–0.08 mm	
Tightening torques:		
not, out put shatt	100–120 Nm	(10–12 kpm = 72–87 lbftf)
not, drive gear	25–41 Nm	(2.5–4.1 kpm = 15–30 lbftf)

POWER-TAKE-OFF

Reduction rafio	1:1	
Oil change quantityc	0,2 litre	(0,4 pints)
Tightening torques:		
bolf, outpot shaff	41–51 Nm	(4.1–5.1 kpm = 30–37 lbftf)
bolf, front housing and housing half	20–25 Nm	(2.0–2.5 kpm = 14–18 lbftf)

The following special tools are required for work on the clutch, gearbox, auxiliary gearbox, differential carriers, wheel carriers, power take-off differential carriers, power take-off auxiliary gearbox.

		Clutch	Gearbox	Auxiliary gearbox	Diff. carriers	Wheel carriers	Power take-off auxiliary gearbox	Power take-off diff. carriers
1426	Drift	X						
1784	Drift		X				X	
1801	Standard handle	X	X	X	X		X	X
1817	Extractor		X					
1821	Extractor					X		
1845	Press tool			X	X			
2014	Drift		X	X			X	
2022	Sleeve		X	X		X	X	X
2039	Drift			X				
2097	Extractor			X		X		
2116	Puller		X	X				
2132	Drift		X			X		
2261	Extractor		X	X	X		X	X
2267	Drift			X				X
2284	Retainer				X			
2291	Drift			X				
2337	Drift			X				
2370	Extractor				X	X		
2392	Extractor				X			
2395	Drift		X	X	X			
2404	Spanner				X			
2413	Drift					X		
2490	Drift							X
2520	Stand		X	X				
2564	Drift	X	X					
2567	Extractor				X			
2584	Sleeve					X		
2600	Measuring fixture				X			
2636	Holder				X			
2685	Adjusting ring				X			
2686	Press tool				X			
2806	Drift			X	X			
2837	Counterhold			X	X			X
2841	Socket spanner				X			
4030	Extractor	X	X					X
4090	Extractor	X	X					
6011	Drift		X					
6012	Drift		X					
6024	Drift		X					
6100	Extractor		X					
6101	Fixture		X					
6102	Sleeve		X		X			
6103	Press tool		X					
6104	Drift		X					
6105	Drift		X					
6108	Drift		X				X	
6109	Plate			X			X	
6110	Sleeve			X			X	X
6111	Sleeve			X				
6112	Fixture				X			
6113	Measuring tool				X			
6114	Drift				X			
6115	Drift				X			
6116	Drift			X	X			
6117	Sleeve					X		
6120	Guide			X				
6122	Ring			X				X
6126	Bleeder tool				X	X		
6128	Spanner	X	X	X				
6129	Lifting eyelet	X	X	X				
6131	Guide pin				X	X		
6133	Gauge				X	X		
6135	Spanner				X	X		
6136	Lifting tool	X	X	X				
6137	Lifting eyelet		X	X				
6140	Fixture			X				
6141	Separating bolt				X	X	X	
6145	Centring drift	X						
6146	Parallel block				X			

Description

The power transmission for the 2-axle vehicle consists of a clutch, gearbox, auxiliary gearbox, propeller shaft sections and a front and rear axle with differential carries and wheel carries, see Fig. 40–3. In addition to an extra rear axle on 3-axle trucks, there is a power take-off for driving this rear axle. The description and repair instructions for these components are to be found in their respective groups.

In order to prevent dirt and impurities from getting into the evacuation systems in the auxiliary gearbox, gearbox, front and rear axle casings, evacuation is by means of a common hose which runs up to the engine compartment, see Fig. 40–4. Extra sealing has been introduced between the engine and clutch casing and the casing has an evacuation which is connected to the other evacuation system. The sealing between the engine and casing consists of a plate with two washers, see Fig. 40–5. The plate is situated between the oil sump and the engine block and the washers are placed between the reinforcing bracket and the sump, see Fig. 40–6.

The cylinder for engaging the front wheels and the cylinders for operating the differential locks for the front and rear differential carriers are operated by vacuum and for this reason the frame crossmembers have been utilized as vauum reservoirs, see Fig. 40–7.

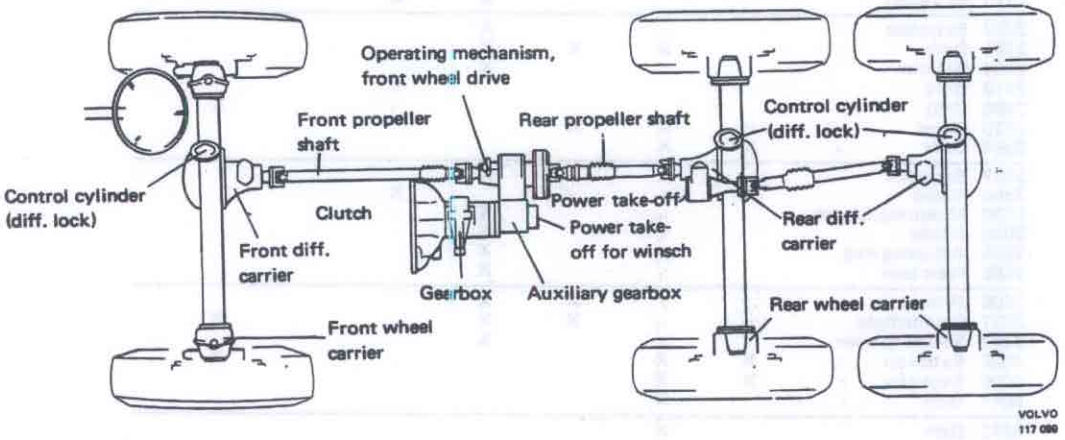


Fig. 40–3. Power transmission

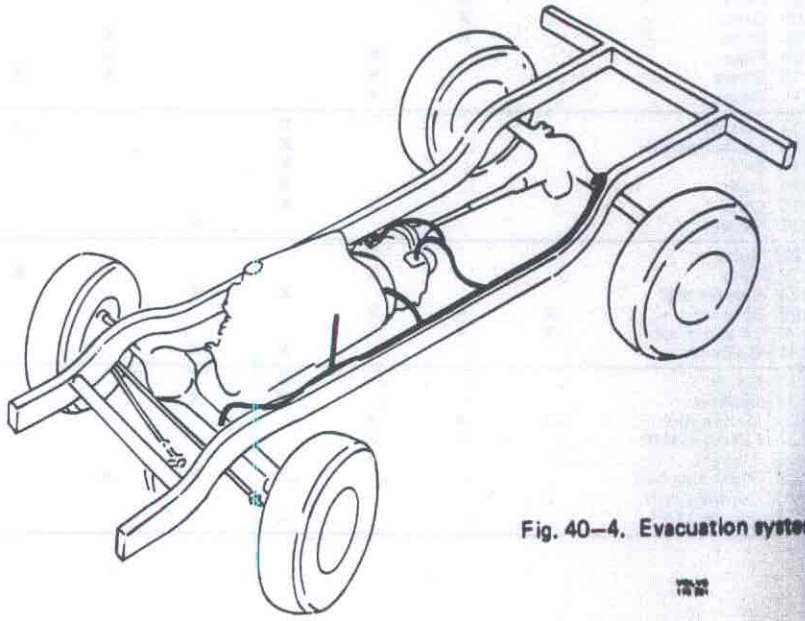


Fig. 40–4. Evacuation systems

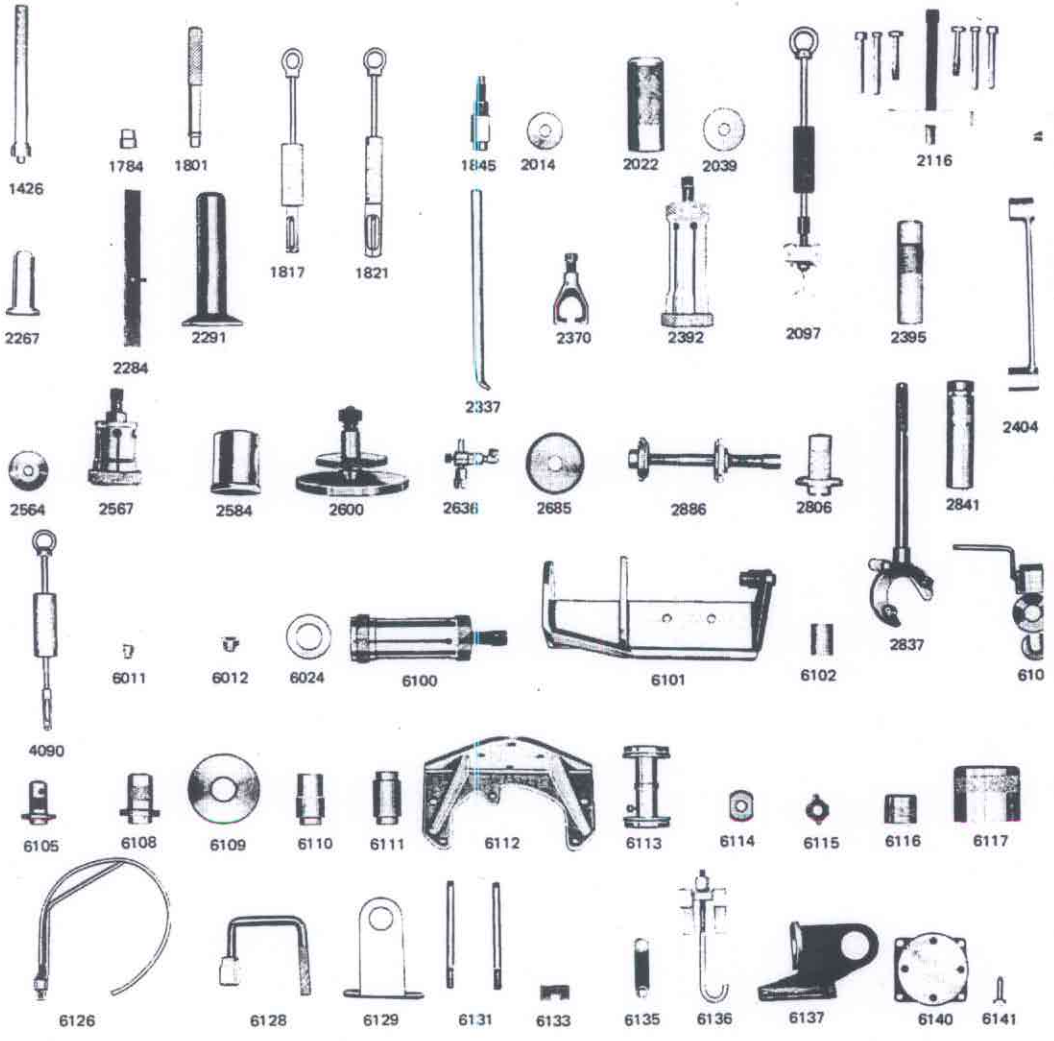
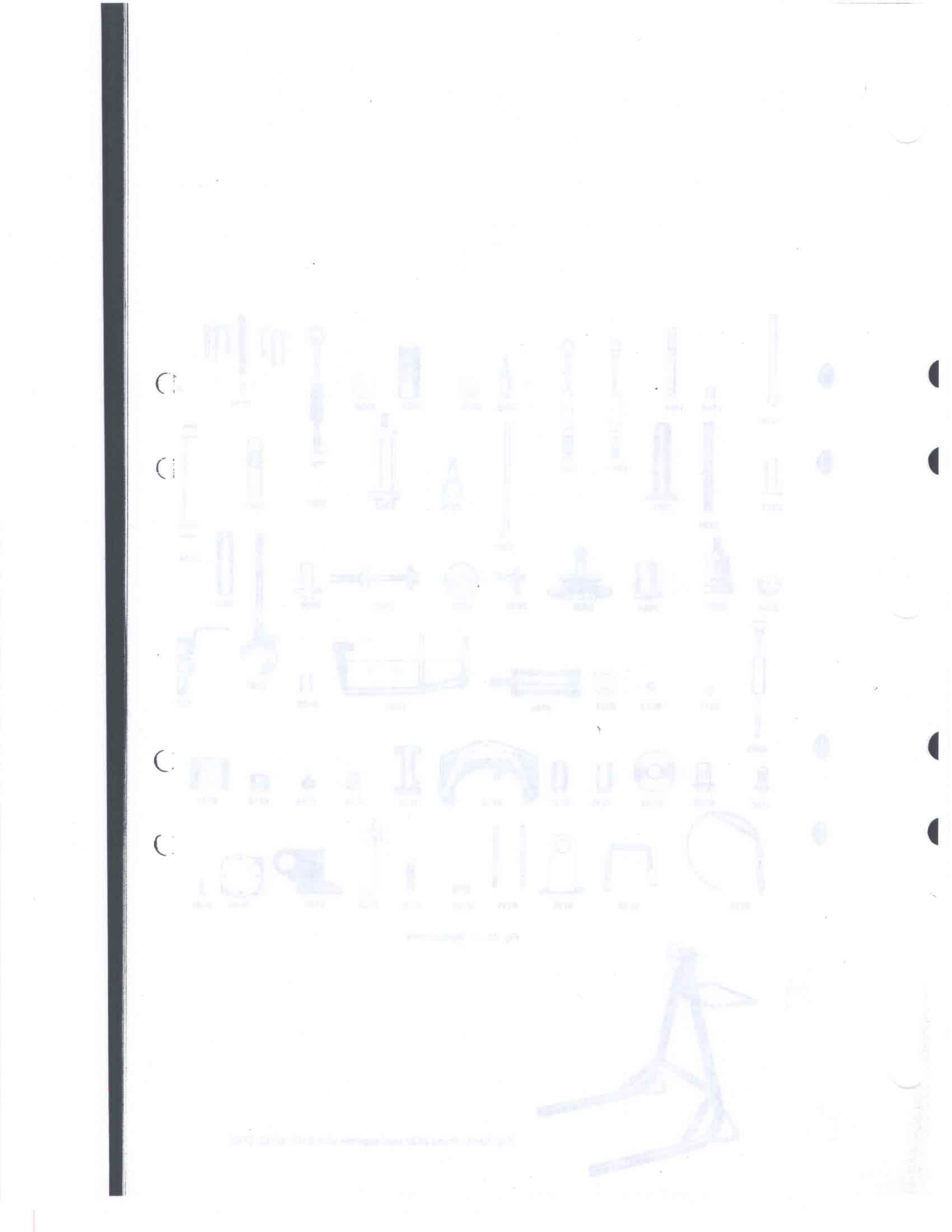


Fig. 41–1. Special tools

Fig. 40–2. Stand 2520 used together with 6101, 6112, 6140



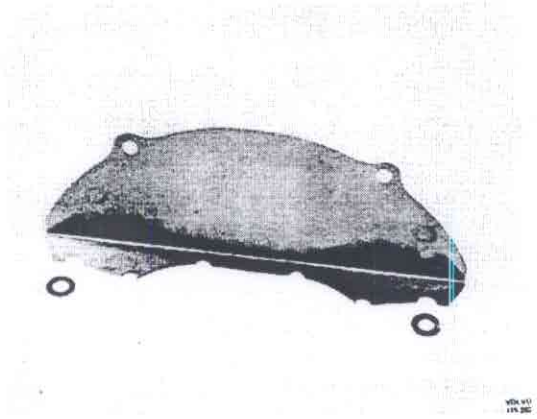


Fig. 40–5. Requisite sealing between engine and gearbox

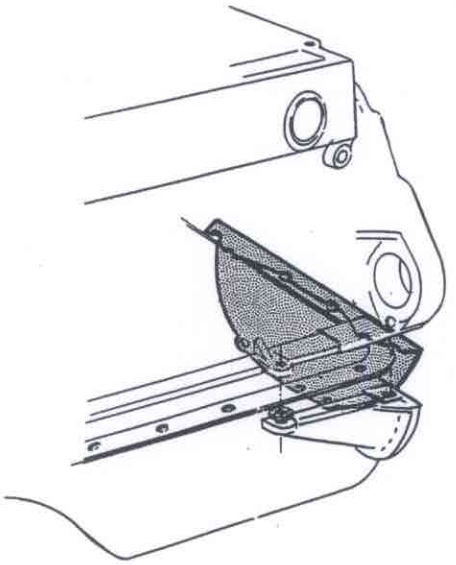


Fig. 40–6. Location of seals

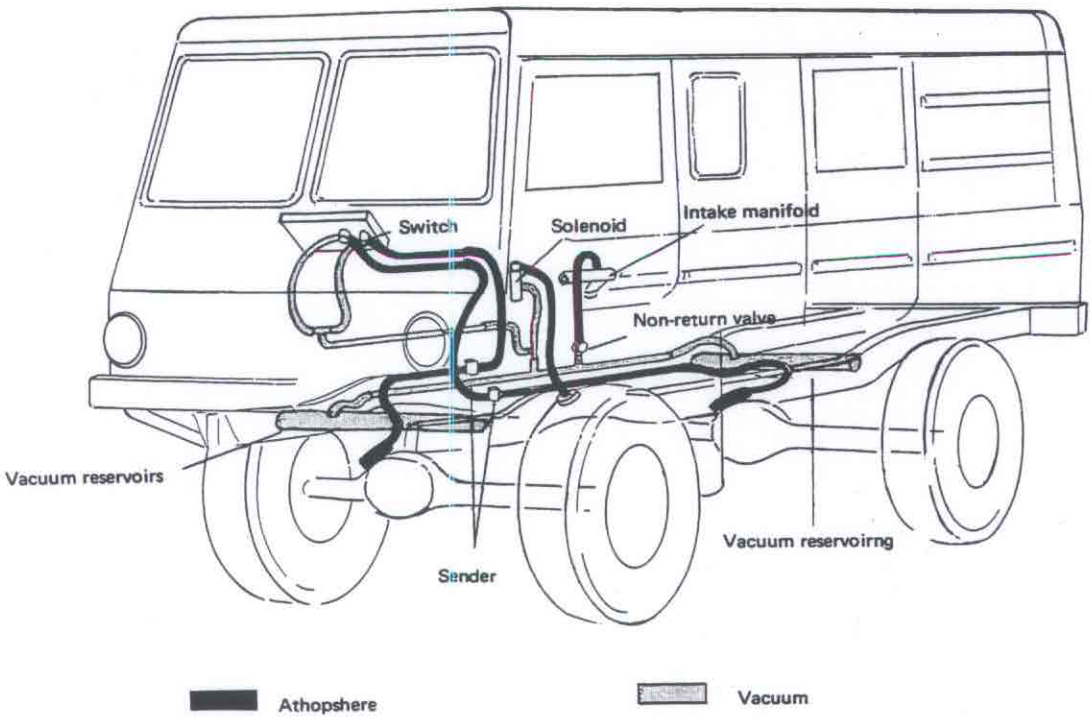
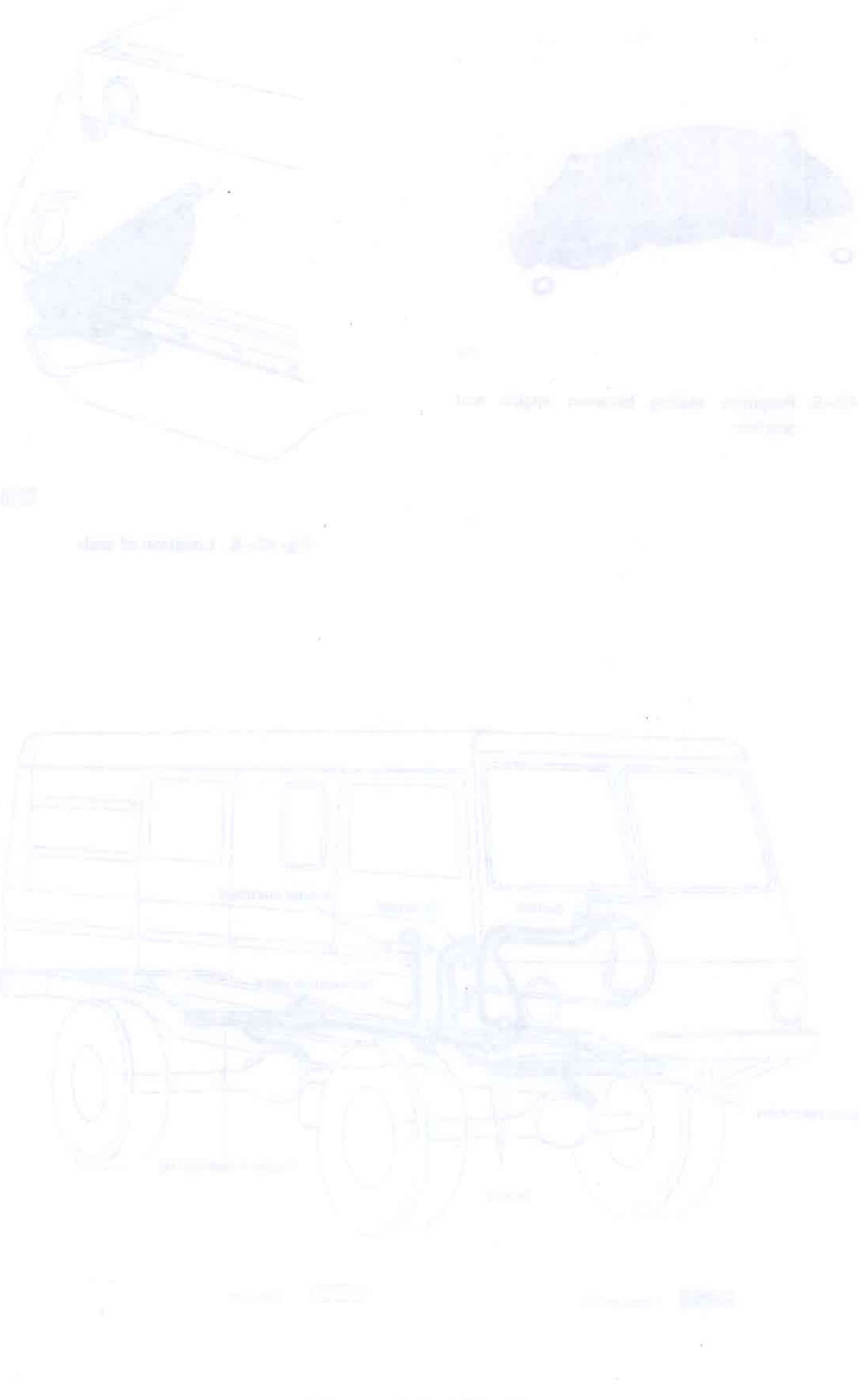


Fig. 40–7. Vacuum system



GROUP 41 CLUTCH

Description

The clutch is of the disc-spring type, see Fig. 41–1. It consists of a thrust plate, disc spring and metal casing. The disc spring has a double function – partly that of a lever when disengaging the clutch and partly that of a thrust spring when engaging the clutch.

Clutching and declutching is by means of the clutch pedal, the movements of which are transmitted to the clutch via a wire, a lever and a release bearing. See illustration 41-A.

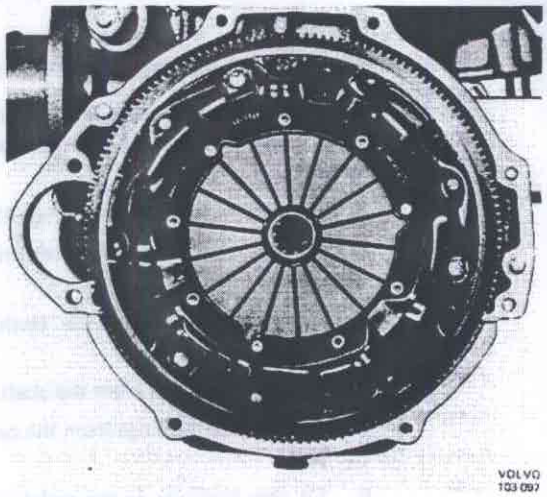


Fig. 41–1. Clutch

Service procedures

CLUTCH WORK IN VEHICLE

Adjusting clutch pedal play

Correct clutch pedal play is obtained by adjusting the release lever, see Fig. 41–2, so that a play of about 5 mm (0.20"), A, is obtained. Play is adjusted by moving the clutch wire sleeve by means of the nuts (1) at the clutch casing attachment.

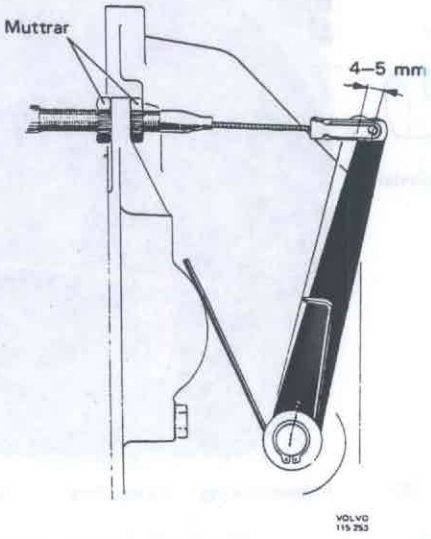


Fig. 41–2. Clutch lever play

Replacing clutch wire

1. Unhook the return spring for the release lever, see Fig. 41–3. Disconnect the wire from the lever.
2. Unscrew the rear nut and remove the wire sleeve from the clutch casing.
3. Disconnect the wire from the clutch pedal. Unscrew the nut for the wire sleeve. Remove the wire.

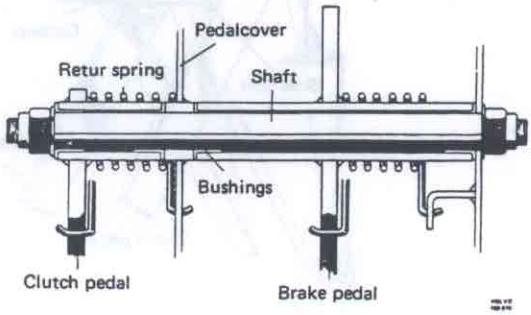


Fig. 41–3. Pedal carrier

4. Fix the wire to the clutch pedal. Secure the wire sleeve and tighten up the nut.
5. Fit the wire sleeve on the clutch casing and tighten up the nuts.
6. Fit the fork to the clutch lever. Adjust the play, see under "Adjusting clutch pedal play".

Replacing clutch pedal or bushings

The following description is applicable if it concerns either the replacement of the pedal or of the bushings.

1. Remove the stop bult, see Fig. 41–4.
2. Remove the wire and the return spring from the pedal.
3. Remove the nut and the washer on the pedal shaft.
4. Remove the pedal from the shaft.
5. Remove the bushings from the pedal and clean all parts.
6. Fit new bushings on the pedal and lubricate with universal grease.
7. Fit the spring on the pedal. Place the pedal in position and tighten up.
8. Hook on the return spring and the clutch wire.
9. Fit the stop bult.

RECONDITIONING THE CLUTCH

Removing

NOTE! Before removing the clutch, any external faults, wrongly adjusted clutch linkage, should first be checked and put right.

1. Remove the gearbox in accordance with the instructions given in Group 43, Gearbox.
2. Slacken the bolts holding the clutch to the flywheel by loosening them crosswise a couple of turns at a time to prevent warping. Remove the clutch and clutch plate.

Replacing the release components

1. Remove the bolt in the release fork. Take out the release bearing. Pull out the release shaft.
2. If the clutch casing bushings have to be replaced, drive out the old bushings with a suitable drift, for example 1801.
3. Apply a light layer of grease to the release bearing sleeve and fit the bearing in position.
4. Fit a new seal on the release shaft and grease it. Hold the release fork in position and insert the release shaft. When the seal is compressed and the distance between the lever and casing is as shown in Fig. 41–5 then tighten up the bolt.

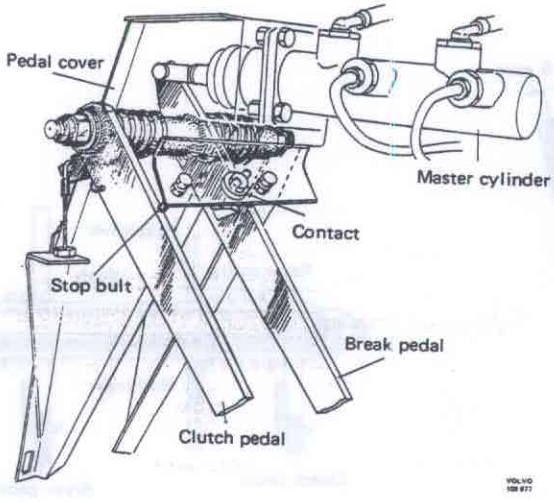


Fig. 41–4. Checking the curvature of thrust plate

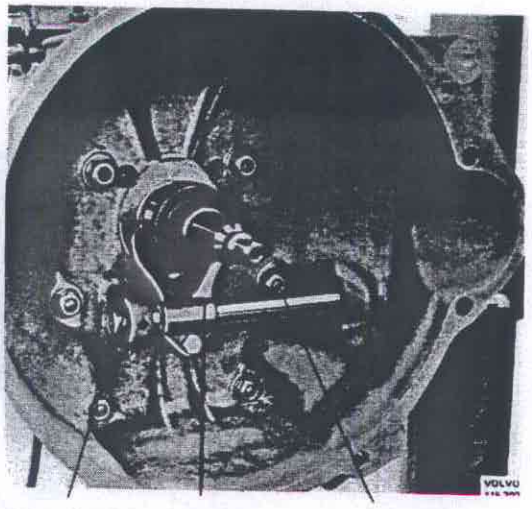


Fig. 41–5. Installing the clutch

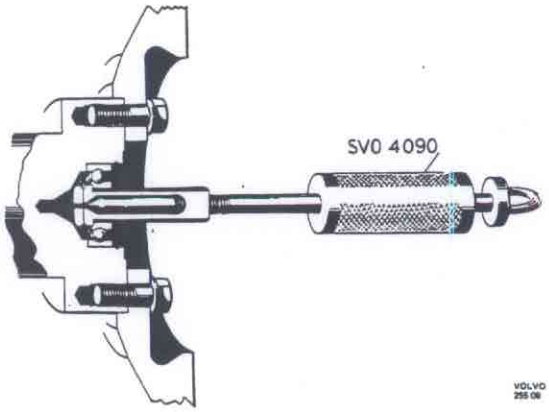


Fig. 41–6. Removing the bearing

Replacing the input shaft pilot bearing

1. Remove the circlip from the bearing. Pull out the bearing with puller 4090, see Fig. 41–6.
2. Pack the bearing with heat-resistant grease. Drive it in with drift 1426. Fit the circlip.

Replacing the clutch plate linings

1. Drill out the old rivets with a 3.4 mm (1/8") drill. Remove the old linings.
2. Check that the tabs on the linings are even. The linings must not be warped. The lining springs and rivets on the hub should be firmly fitted and should not be loose. Check for cracks. If any of these faults are to be found, replace the linings.
3. Rivet on the new linings (preferably in a rivet press). NOTE! The rivets should be fitted from the side where the lining is and should be riveted from the opposite side towards the disc. Use every alternative hole in the lining. After the riveting, the linings should have a distance from each other which is determined by the layout of the clutch disc. This is very important in order to obtain smooth clutching during driving and starting off.
   The clutch linings must be absolutely free from oil. Oil on the linings can result in clutch judder.

Checking and replacing parts

Check the clutch thoroughly. Check the thrust plate for heat damage, cracks, scoring or other damage on the friction surface. If the clutch is only blued, it is not necessary to replace it. Circular scoring can be tolerated if the thrust plate friction surface has not been reduced by more than 10 % and the depth of the scoring does not exceed 1 mm (0.039"). This also applies to the flywheel. The dish design of the thrust

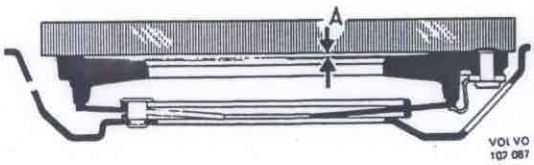


Fig. 41–7. Checking thrust plate dished design

A = max. 0.03 mm

plate can be checked by means of a 240 mm (9.5") long steel ruler, which is placed across the thrust plate friction area. Then measure the distance between the ruler and the thrust plate inner diameter. This measurement should be max. 0.03 mm (0.0012"), (A, Fig. 41–7). Curvature, that is, clearance between the ruler and the outer diameter of the friction surface is not permitted. Check at several points.

Installing the clutch

Before installing the clutch plate linings, check to make sure the flywheel and thrust plate are absolutely free from oil. Then clean with petrol and dry with a clean cloth.

1. Place the linings (the highest side of the hub facing towards the rear) together with the clutch against the flywheel and fit centering drift 6145 so that the guide pin on the drift reaches into the pilot bearing in the flywheel, see Fig. 41–8.
2. Fit the six bolts securing the clutch and tighten them crosswise and a couple of turns at a time. Remove the centering drift.
3. Install the gearbox according to the instructions given in Group 43, Gearbox. Adjust the clutch pedal play, see the separate instructions for this.

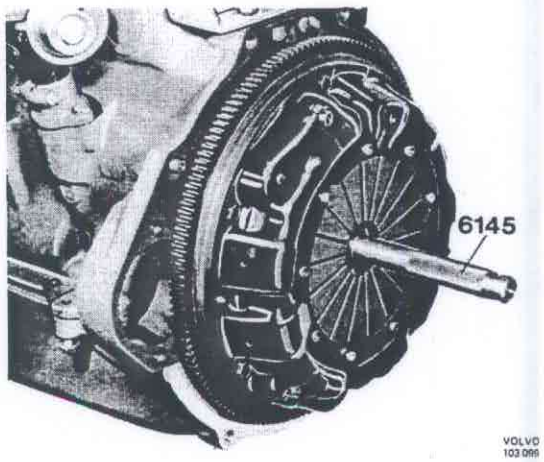


Fig. 41–8. Centring the clutch

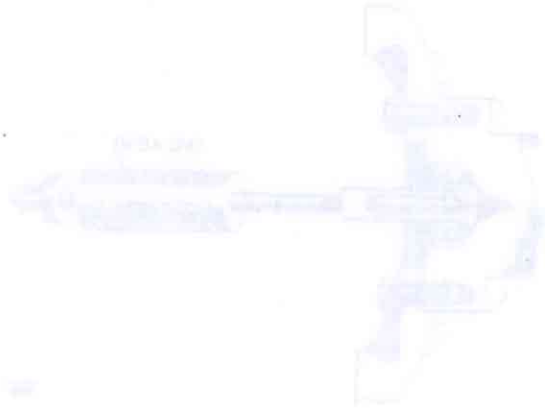
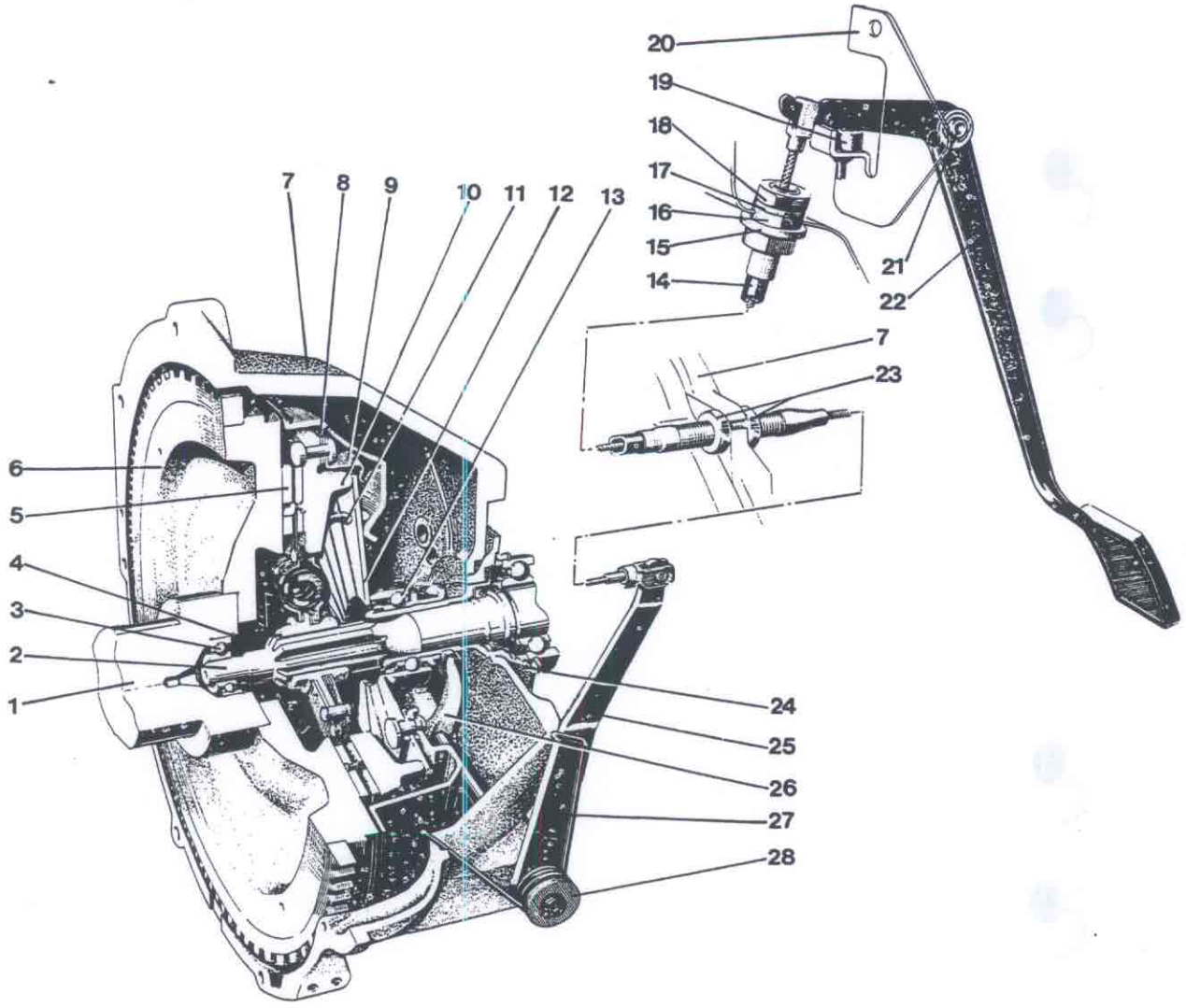


Illustration 41-A. Clutch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Clutch

1. Crankshaft
2. Disc shaft (gearbox input shaft)
3. Support bearing in crankshaft
4. Circlip
5. Disc
6. Flywheel
7. Clutch casing
8. Cover
9. Retainer
10. Thrust plate
11. Support rings
12. Thrust spring
13. Throw-out bearing
14. Clutch wire
15. Washer
16. Rubber bushing
17. Washer
18. Nut
19. Rubber stop
20. Stop bracket
21. Pedal shaft
22. Clutch pedal
23. Adjusting nuts
24. Gearbox casing
25. Lever and throw-out shaft
26. Throw-out fork
27. Return spring
28. Washer

GROUP 43 MANUAL GEARBOX

Desription

GEARBOX

The gearbox, see Fig. 43–1, is a four-speed, synchronized gearbox with all gears except reverse synchronized. The synchronizing design can be seen from Fig. 43–2. Engaging and disengaging the synchronizing is shown in Figs. 43–3 and 43–4. Power from the gearbox to the differential carriers is transmitted by an auxiliary gearbox which is fixed to the rear end of the gearbox.

The gearbox design can be seen from Illustrations 43-A, B and C. The gearbox housing is in two sections one front and one rear, and is made of aluminium. The input and output shafts in the housing are journalled in ball bearings and the countershaft in roller bearings. The reverse shaft is not journalled and is driven directly in the housing. All gears are of the helical type and all except the gears for reverse shaft are in continuous mesh.

Gear-changing is by means of the gear lever, see Fig. 43–5, the movements of which are transmitted via a gear shift bar and link arms, see Fig. 43–6. The gear lever is also used for operating the auxiliary gearbox, and a special housing is mounted on the gearbox selector fork housing. The various gear positions and the path taken by the transmission in different gears can be seen from Figs. 43–7–43–11.

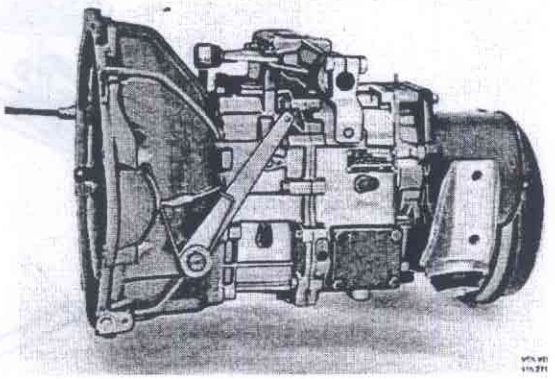


Fig. 43–1. Gearbox

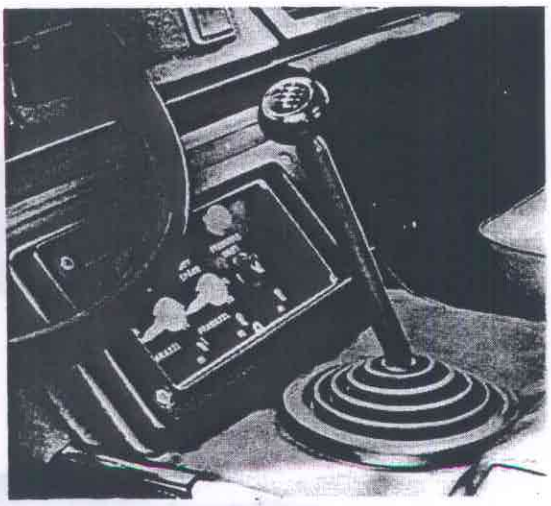


Fig. 43–5. Gear lever

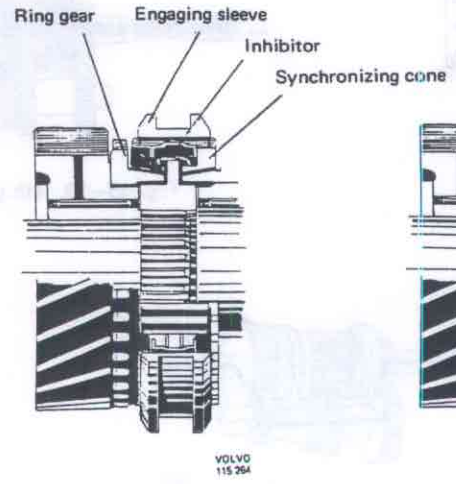


Fig. 43–2. Synchronizing, neutral

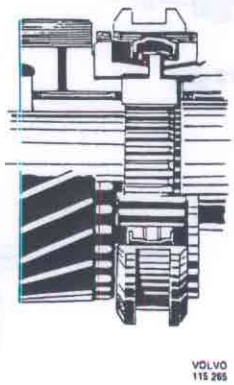


Fig. 43–3. Synchronizing

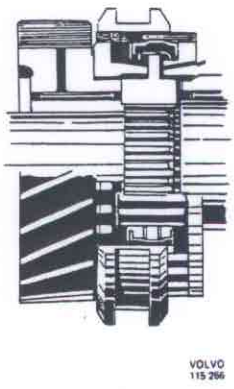


Fig. 43–4. Gear engaged

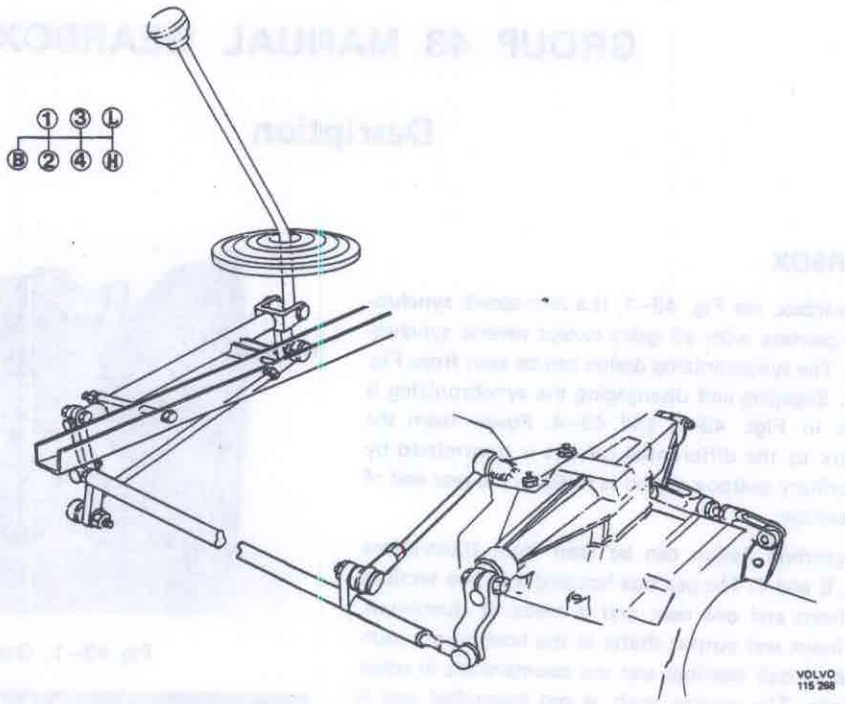


Fig. 43–6. Gear-change linkage

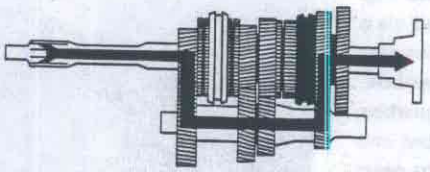


Fig. 43–7. 1st gear

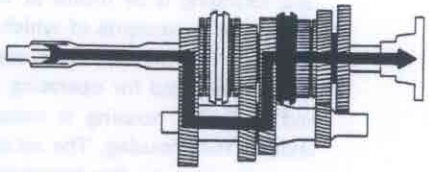


Fig. 43–8. 2nd gear

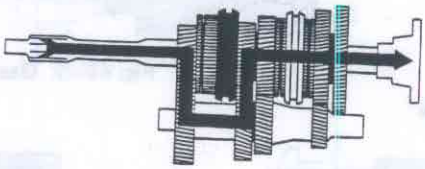


Fig. 43–9. 3rd gear

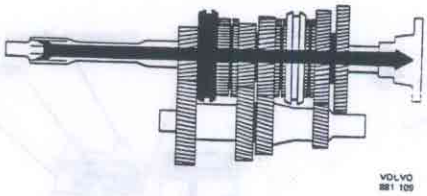


Fig. 43–10. 4th gear

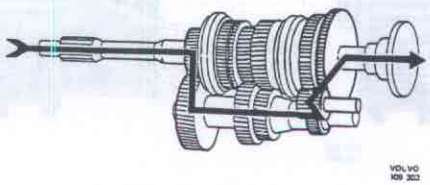


Fig. 43–11. Reverse

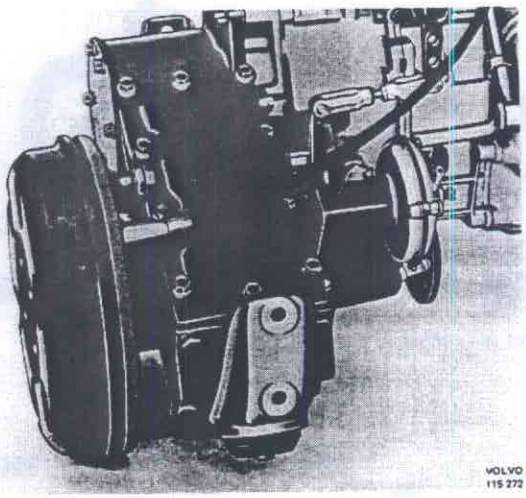


Fig. 43–12. Auxiliary gearbox

AUXILIARY GEARBOX

The auxiliary gearbox, Fig. 43–12, has a high gear and a low gear and is synchronized on both. The synchronization is of the same type and size as that of the main gearbox.

The high gear is primarily intended for road driving and the low gear for cross-country driving.

The auxiliary gearbox is mounted on the rear end of the standard gearbox and its function is to transfer the power from the standard gearbox to the front or rear differential carriers. The gear lever for the standard gearbox is used for gear-changing the auxiliary gearbox. An indicator is situated on the dashboard, see Fig. 43–13, which shows the gear engaged.

When any of the auxiliary gearbox's gears is engaged, rear wheel drive is also engaged. Front wheel drive is engaged separately by means of the control mechanism at the front of the auxiliary gearbox, see Fig. 43–16.

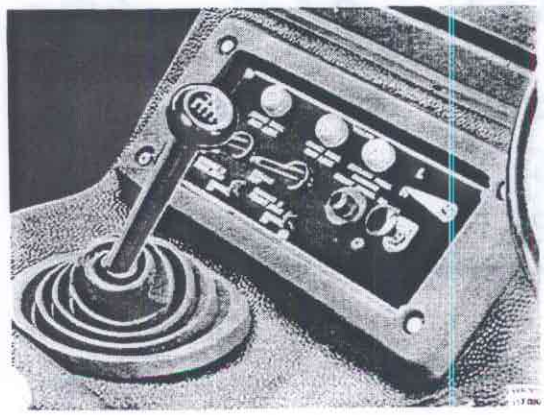


Fig. 43–13. Indicator

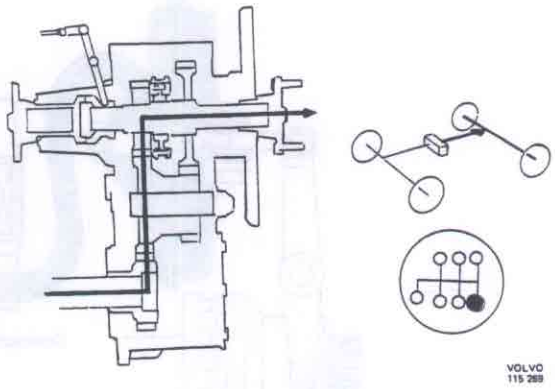


Fig. 43–14. High gear

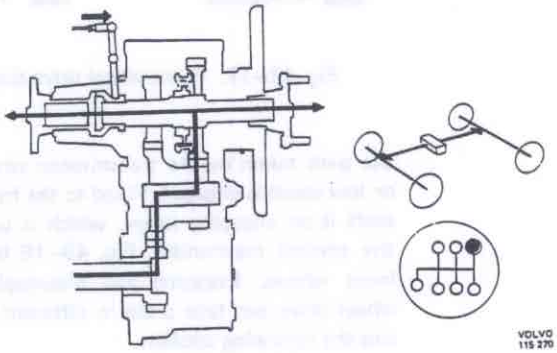


Fig. 43–15. Low gear

The auxiliary gearbox has a cluster gear, a countershaft and an output shaft. Power from the standard gearbox is transmitted via the cluster gear, which is linked to the auxiliary gearbox by means of a sleeve mounted on the output shaft for the standard gearbox. On the auxiliary gearbox output shaft there are two idler gears, one for the high speed and one for the low speed as well as a synchronizing unit. Fitted on the output shaft is a flange which is used for driving the rear wheels. Figs. 43–14 and 43–15 show

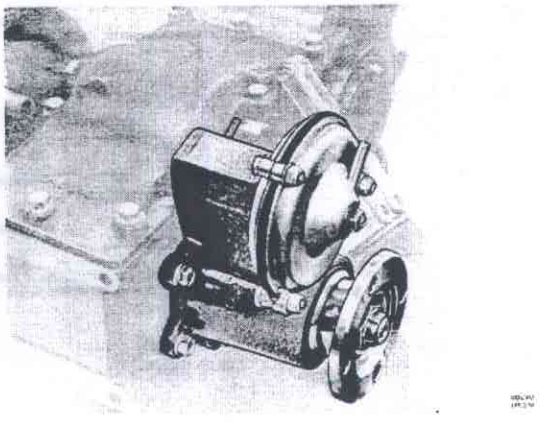


Fig. 43–16. Sleeve mounted.

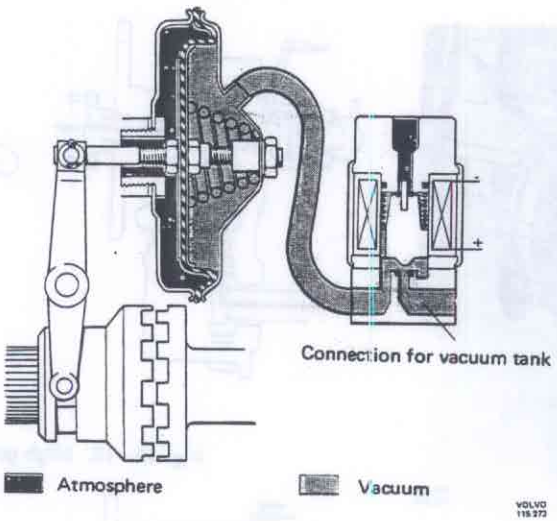


Fig. 43–17. Front wheel drive disengaged

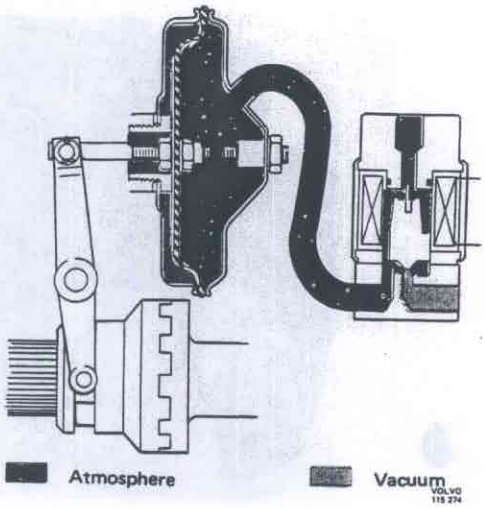


Fig. 43–18. Front wheel drive engaged

the path taken by the transmission when high speed or low speed is engaged. Fixed to the front end of the shaft is an engaging sleeve, which is used to engage the control mechanism, Fig. 43–16 for driving the front wheels. Engaging and disengaging the front wheel drive can take place in different ways and for this the following applies:

FRONT WHEEL DRIVE

Disengaged position

When the solenoid valve is in current its armature is pulled upwards, see Fig. 43–17. This opens the connection between the vacuum tank in the frame and the control cylinder on the control mechanism. As a result of the vacuum in the diaphragm, the pull rod pulls from the flange sleeve in the control mechanism and disengages the front wheel drive.

Engaged position

When there is no current through the solenoid valve, its armature is pressed down by the spring, Fig. 43–18. This breaks the connection between the vacuum tank and the control cylinder and the cylinder is connected up instead with the outside air. Since there is then atmospheric pressure on both sides of the diaphragm, the thrust spring in the cylinder can press in the pull rod to engage the flange sleeve and thus also engage the front wheel drive.

Front-wheel drive is also engaged when there is no vacuum.

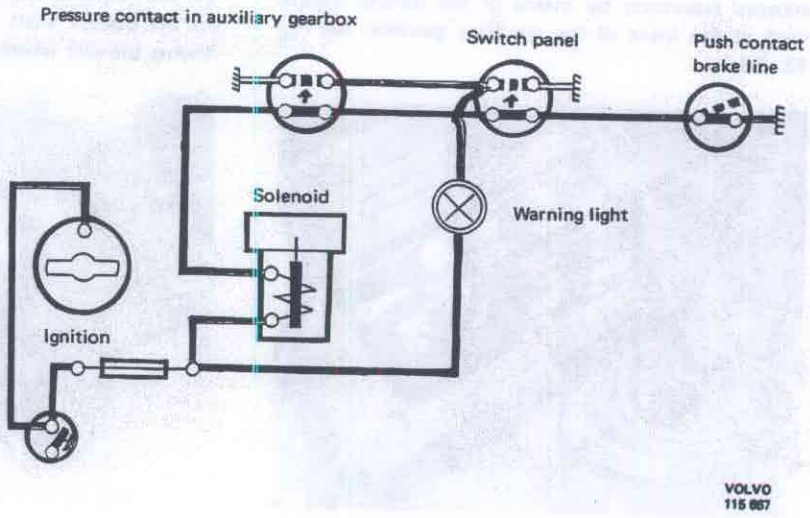


Fig. 43–19. Wiring diagram, front wheel drive

Operation

As the above shows, disengaging and engaging of the front wheel drive is governed by the fact whether the solenoid valve is in current or not. Fig. 43–19 shows the wiring diagram and the various possibilities for operating the front wheel drive.

A. Ignition. With the ignition key in neutral, the current circuit is broken and front wheel drive is thus engaged. Turning the key disengages the front wheel drive providing that there is vacuum in the frame tanks and the contacts and switch are in the position shown by Fig. 43–19.

B. Gear lever. Engaging low gear breaks the contacts 50–50 in the auxiliary gearbox. This cuts out the current through the solenoid valve and front wheel drive is engaged. At the same time contacts 15–15 close and the control light goes on.

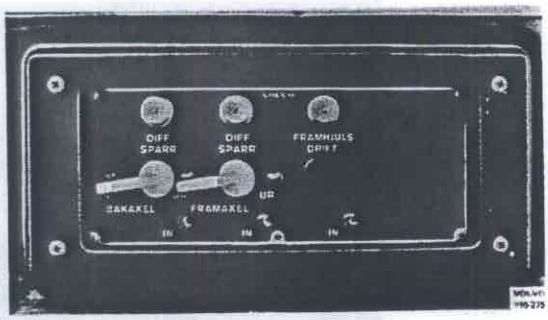


Fig. 43–20. Switch

C. Panel switch see Fig. 43–20. Pushing in this switch breaks the contact 49–15. This cuts out the current through the solenoid valve and front wheel drive is engaged. At the same time switch 49a–R closes and the control light goes on.

Service procedures

WORK ON TRANSMISSION IN VEHICLE

Adjusting the gear-position indicator

1. Move the gear selector to neutral.
2. Slacken the nut securing the indicator arrow.
3. Turn the arrow so that it points to N. See Fig. 43–21 a.
4. Tighten up the nut.

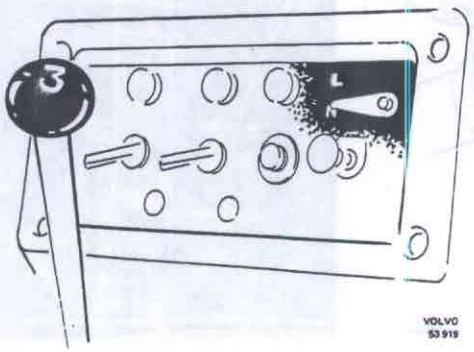


Fig. 43–21a. Indicator

Auxiliary gearbox

Removing the cover

1. Remove the casing over the engine.
2. Remove the bolts securing the floor plate and remove the plate.
3. Remove the stowage box and cover over the engine casing.

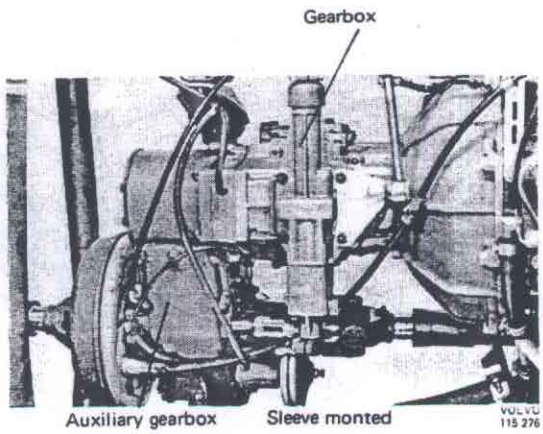


Fig. 43–21b. Gearbox in vehicle

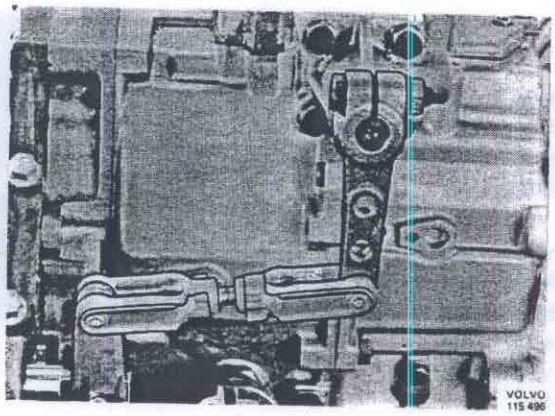


Fig. 43–22. Link

4. Remove the parking brake wire from the lever. Remove the clamp securing the wire to the engine.
5. Disconnect the cable to the sender on the cover. Remove the link arm from the lever on the auxiliary gearbox, see Fig. 43–22.
6. Remove the screws for the cover. Pull the wire out of the guide sleeve on the propeller shaft brake and lift up the cover.

Installing the cover

1. Clean the contact surface on the cover and the auxiliary gearbox. Coat the surface of the auxiliary gearbox with sealing agent.
2. Hold the wire out of the way and fit the cover in position. Tighten up the screws.
3. Fit the link arm and connect up the cable to the sender.
4. Fix the wire to the lever. Clamp the wire to the engine with the clamp. Tighten the nut so that full braking is obtained at the 4th–5th ratchet with the propeller shaft brake properly adjusted. If necessary, adjust the parking brake according to points 6 and 7.
5. Place the floor plate in position and screw tight the bolts. Fit the engine casing.
6. Adjust out one of the brake shoes with a screwdriver (Fig. 43–23) until it is just possible to rotate the drum with the rear end jacked up. Slacken the adjuster screw until the drum rotates freely, but maximum five teeth. Adjust the other brake shoe in the same way.
7. Check the function of the control lever. If the parking brake does not give full braking at 4th–5th ratchet, in spite of the fact that the propeller shaft brake is properly adjusted, alter the length of the wire with the nut at the front end.

Replacing the control mechanism

Removing

1. Remove the casing from the engine. Remove the bolts securing the floor plate.
   Remove the plate.
   Drain the oil from the auxiliary gearbox.

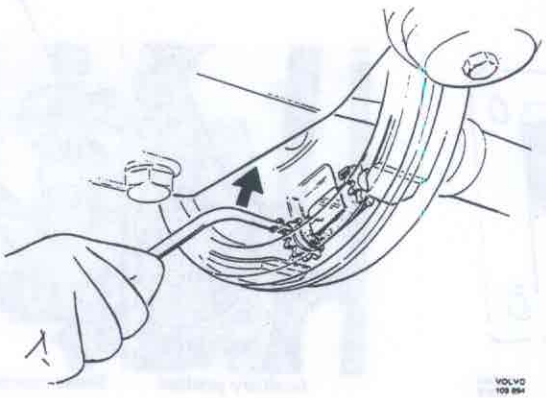


Fig. 43–23. Adjusting brake shoes

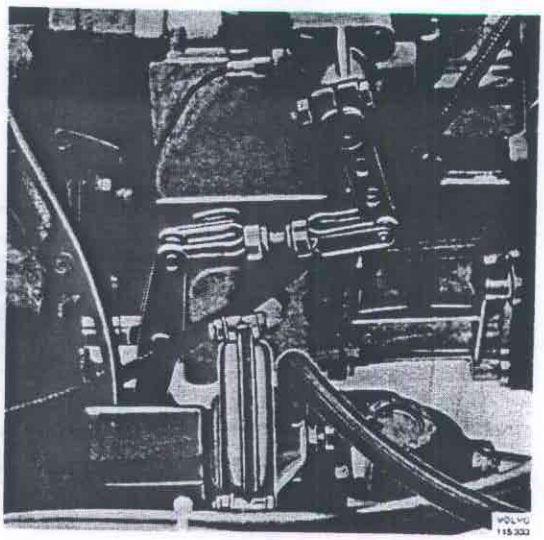


Fig. 43–24. Control mechanism

Fig. 43–25. Removing cover

2. Remove the bolts securing the propeller shaft and remove the shaft.
3. Disconnect the hose to the control cylinder, see Fig. 43–24. Remove the evacuation hose to the control mechanism housing.
4. Remove the bolts securing the control mechanism housing to the auxiliary gearbox.

Installing

1. Clean the contact surface on the auxiliary gearbox.
2. Coat the control mechanism contact surface with sealing agent and secure the mechanism to the auxiliary gearbox.
3. Remove the cover on the control cylinder and the spring, see Fig. 43–25.
4. Remove the nut on the pull rod. Remove the diaphragm and the washers, see Fig. 43–26. Take care of the washer in the centre of the diaphragm.
5. Pull the pull rod and check that the flange is in full mesh with the output shaft. Screw in the nut on the pull rod so that it is on the inside of the holed nut. Fit the inner washer for the diaphragm on the rod. Press the washer against the holed nut. When the pull rod is pulled back and forth there should be a clearance of 0.1 mm (0.0039"). If necessary, adjust until the correct clearance is obtained, see Fig. 43–27.
6. Fit the diaphragm and place the sapcer washer in the centre of the diaphragm, see Fig. 43–26. Fit the outer washer and lock nut. Hold the diaphragm and washer when tightening up the nut.
7. Fit the thrust spring, see Fig. 43–25, and the cover, see Fig. 43–28. Screw the bolt to the bottom. Screw out the bolt 53/10 tourns (8 mm = 5/16"). Tighten up the lock nut.

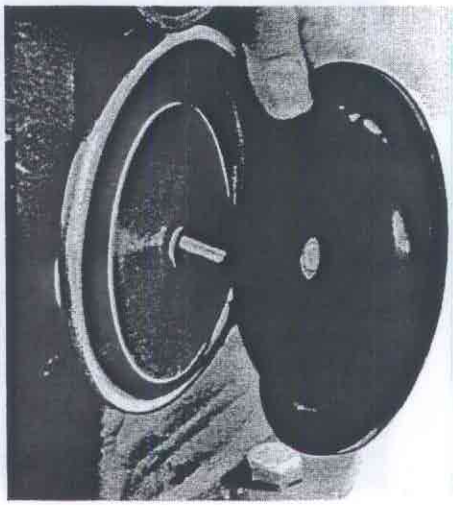


Fig. 43–26. Remove diaphragm

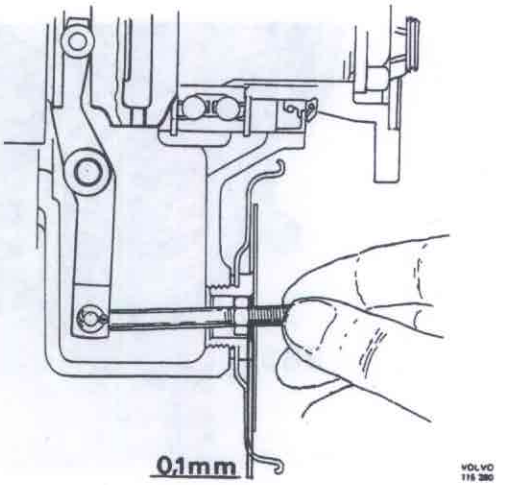
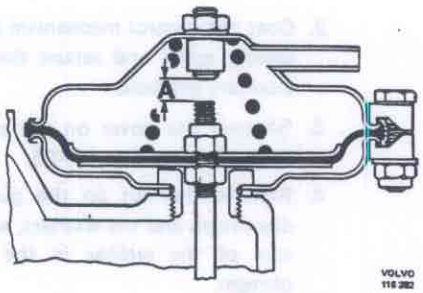


Fig. 43–27. Adjusting clearance



A = 5 3/10 turns (8 mm)

Fig. 43–28. Adjusting screw

8. Fit the propeller shaft and tighten up the bolts to a torque of 55–65 Nm (5.5–6.5 kpm = 40–47 lbftf).
9. Fit and tighten up the evacuation and vacuum hoses.

   Fill the auxiliary gearbox with oil. Concerning quantity and type, see under "Data".
10. Place the floor plate in position and screw it tight. Fit the engine casing.

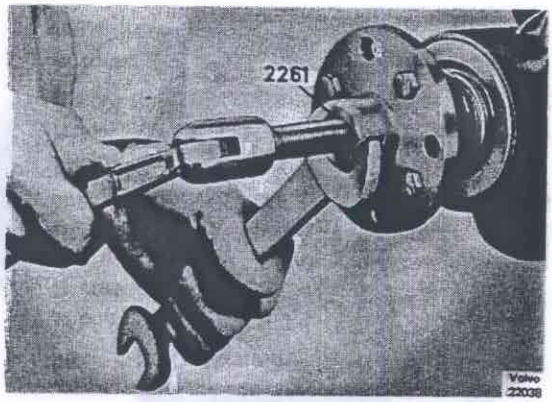


Fig. 43–30. Removing flange

Replacing flange seal for control mechanism and output shaft

Special tools: 1845, 2261, 2806, 2837, 4030.

1. Remove the propeller shaft from the flange.
2. Fit counterhold 2837, see Fig. 43–29, on the flange (applies only to the control mechanism). Unscrew the nut.
3. Fit not puller 2261, see Fig. 43–30, and pull off the flange.
4. Pull out the seal with 4030, see Fig. 43–31.
5. Fill the space between the sealing lips and their reverse sides with grease, see Fig. 43–32.

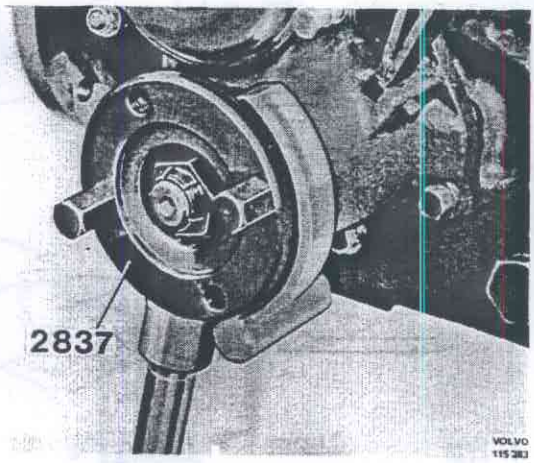


Fig. 43–29. Fitting counterhold

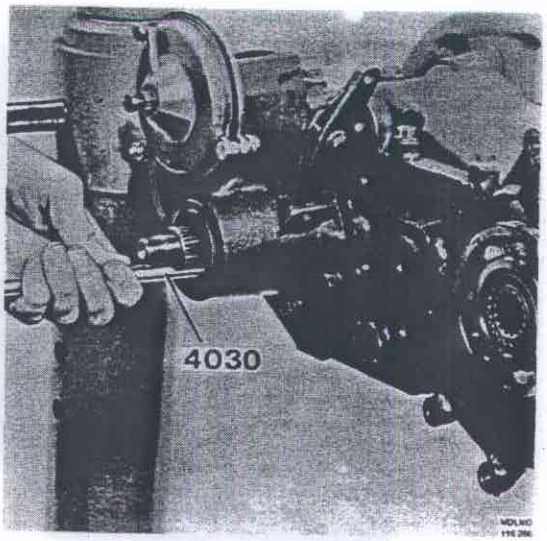


Fig. 43–31. Removing seal

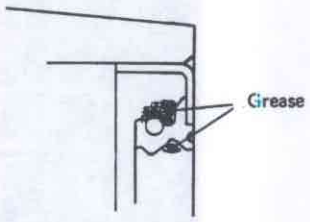


Fig. 43–32 Placing grease

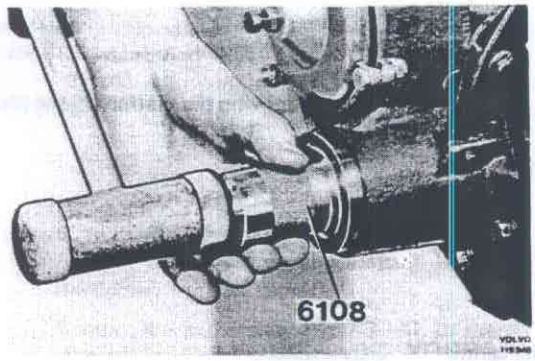


Fig. 43–33. Driving seal

6. Drive the seal into the housing with 2806, see Fig. 43–33.

   Fit a new seal on the flange, see Fig. 43–34.

7. Pull on the flange wirh 1845, see Fig. 43–35. Remove the tool and fit 2837. Fit the nut and tighten it to a torque of 280–300 Nm (28–30 kpm = 202–217 lbftf).

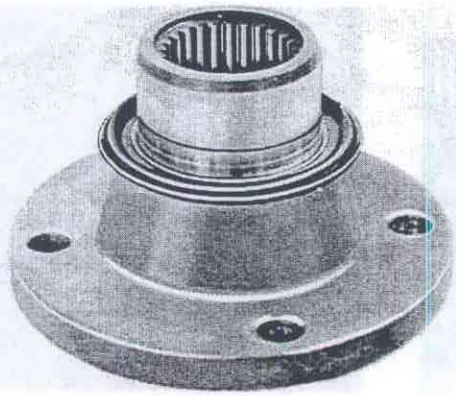


Fig. 43–34. Flange seal

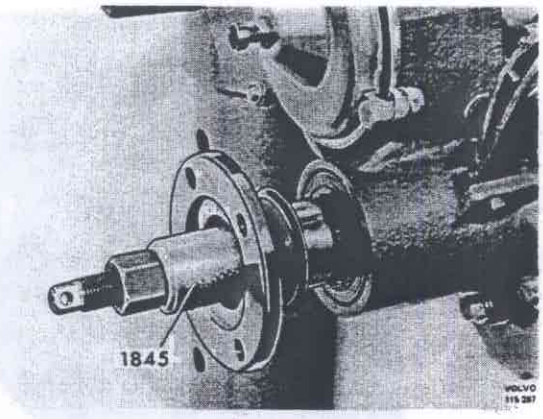


Fig. 43–35. Pressing flange

8. Fit and tighten up the propeller shaft. Tighten the bolts to a torque of 55–65 Nm (5.5–6.5 kpm = 40–47 lbftf).

Replacing the diaphragm in control cylinder

1. Remove the casing over the engine. Remove the bolts securing the floor plate. Remove the plate.
2. Remove the bolts securing the cover. Remove the cover and the spring, see Fig. 43–36.
3. Remove the nut on the pull rod. Hold the thrust washer and diaphragm securely so that they do not twist. Remove the thrust washer and dia-

Fig. 43–36. Removign cover

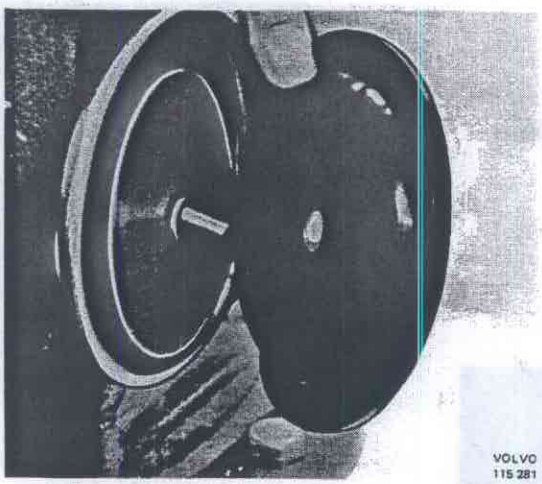
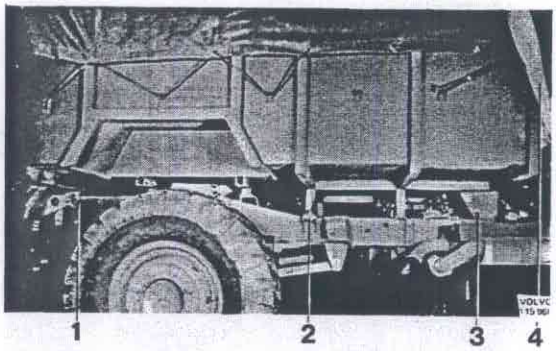


Fig. 43–37. Removing diaphragm



1. Bolting
2. Bolting
3. U-bolts
4. Hoist straps

Fig. 43–39. Removing the platform

phragm and take care of the washer in the centre of the diaphragm, see Fig. 43–37.

4. Fit the new diaphragm. Place the washer in the centre of the diaphragm and also the thrust washer.
5. Tighten up the nut. Hold the thrust washer and diaphragm securely so that they do not twist when the nut is tightened up.
6. Fit the spring with the larger contact surface facing the thrust washer. Fit the cover. Space the bolts evenly round the cover and tighten up.
7. Place the floor plate in position and bolt it tight. Fit the engine casing.

GEARBOX

Removing the gearbox

Special tool: 6128, 6129, 6136, 6137.

1. Drain the oil from the gearbox.
2. Release the parking brake.
3. If the gearbox os to be removed woth a block and tackle and teh vehicle has a platform superstructure, the platform must be removed.
   The platform can be removed after the bolts and the U-bolts, Fig. 43–39 have been removed. Lift off the platform woth a hoist which is fixed to the lifting eyelets, see Fig.

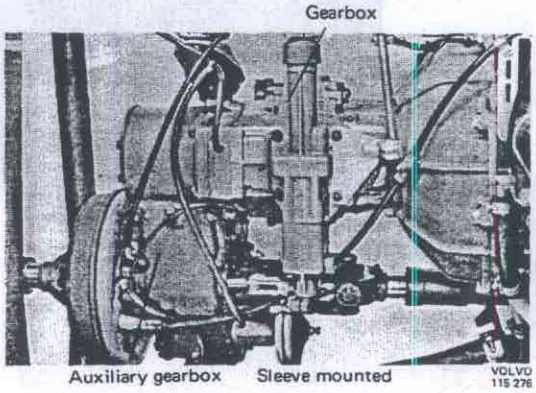


Fig. 43–38. Gearbox in vehicle

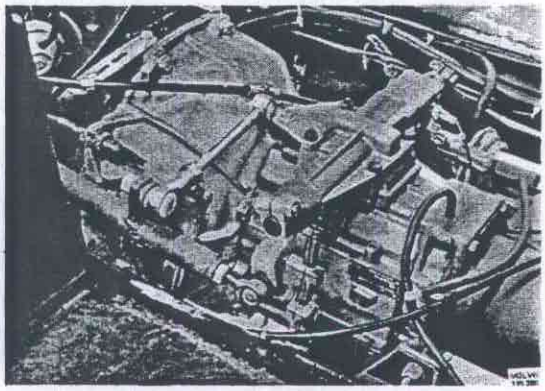


Fig. 43–40. Gear shift with cross stay

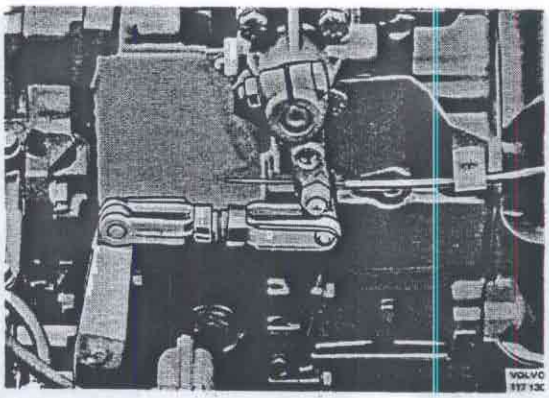


Fig. 43–41. Wire for shift indicator

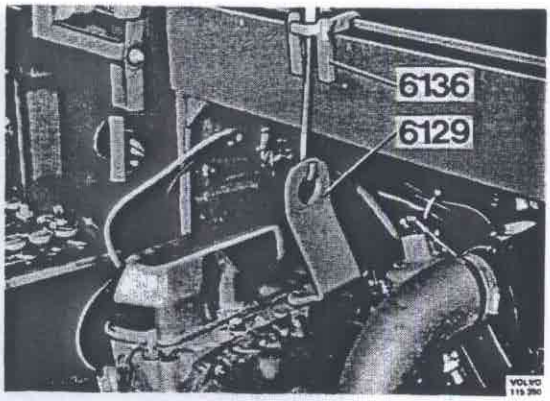


Fig. 43–43. Attaching hoist eyelet

4. Remove the cover over the battery. Disconnect the battery negative cable.
5. Remove the cross stay, Fig. 43–40, to the gear shift bar and remove the bar from the gearbox lever.
6. Remove the wire for the shift indicator, see Fig. 43–41, from the outer shift axle housing.
7 Remove the retainer which holds the fork to the disengaging lever. Remove the rear nut for the disengaging wire. Remove the wire.
8 Remove the exhaust manifold.
9 Remove the hose to the auxiliary gearbox control mechanism.
10 Remove the cables to the sender on the gearbox and auxiliary gearbox.
11 Remove the evacuation hoses to the clutch casing, gearbox and auxiliary gearbox control mechanism.
12 Unscrew the speedometer wire with 6128, Fig. 43–42. Fix the hoist hooks 6129 to the two rear cylinder head bolts, Fig. 43–43 amd fit lifting tool 6136.
13 Remove the front and rear propeller shafts from the auxiliary gearbox. Remove the rear axle from the rear differential carrier.
14 Remove the rear exhaust pipe attachment to the body. Remove the bolts on the flange at the silencer. Remove the silencer from the body.
15 Remove the drum from the propeller shaft brake. Remove the brake shoes and disconnect the wire from the lever.

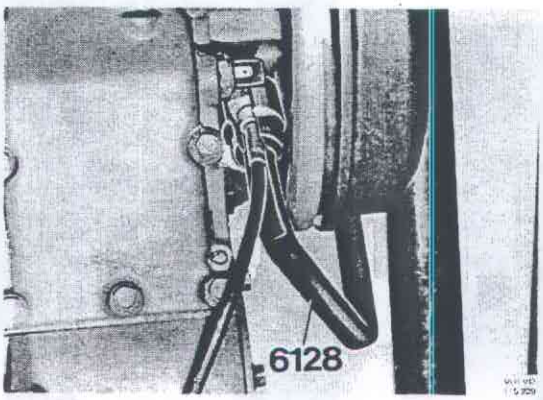


Fig. 43–42. Removing speedometer wire

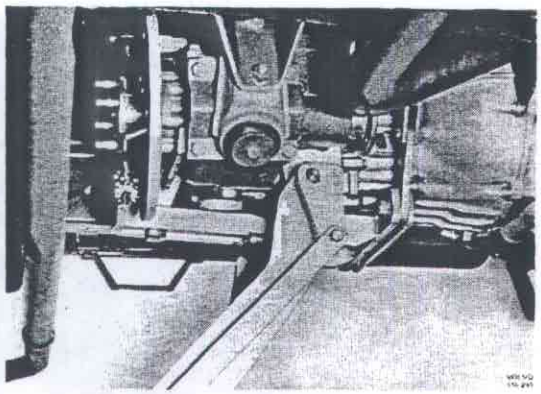


Fig. 43–44. Jack under gearbox

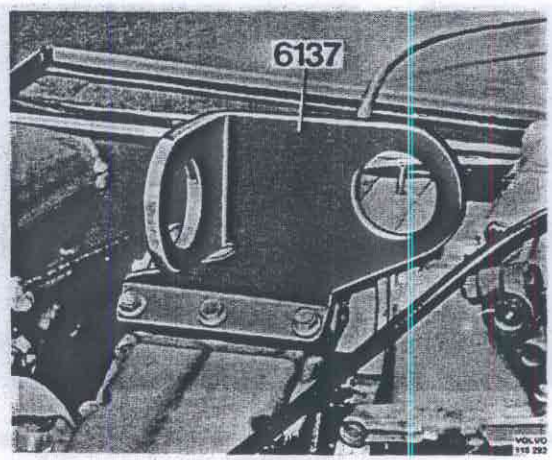


Fig. 43–45. Atteching haist

16 Place a jack under the gearbox, Fig. 43–44. Remove the bolts securing the rear engine mounts to the frame.
When removing the gearbox with a block and tackle, use tool 6137, see Fig. 43–45.

17 Lower the gearbox so that the engine hangs by the bracket on the engine. Remove the lower bolts round the clutch casing. Remove the bolt for the starter motor. Remove the screw securing the earth terminal (pleat) to the casing.

18 Remove the remaining bolts round the clutch casing. Remove the bolt for the starter motor and lift off the starter motor.

19 Pull the gearbox backwards. Observe due care that the clutch casing surface against the engine is not damaged since the sealing between engine and clutch casing must be in very good condition. For this reason do not use an iron jemmy or similar for this purpose. Lower the jack and pull forward the gearbox.

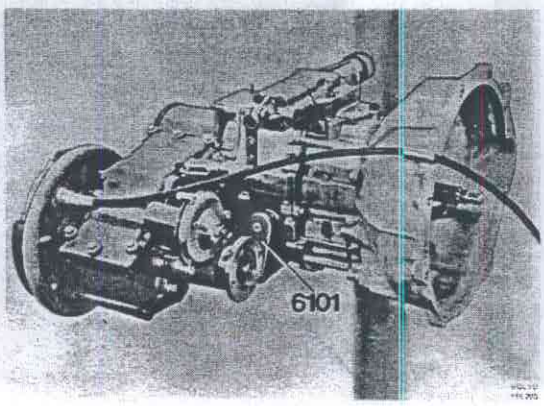


Fig. 43–46. Fixing gearbox on stand

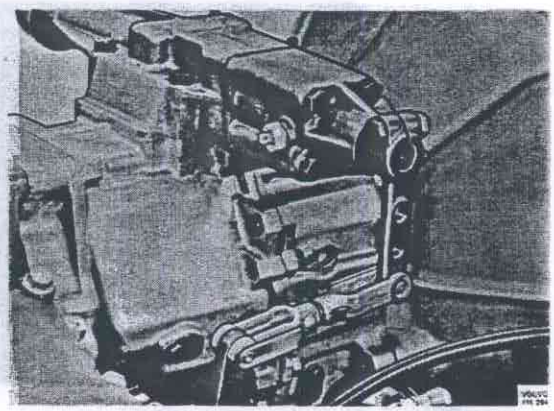


Fig. 43–47. Link between gearbox and aux. gearbox

Disassembling the gearbox

Special tools: 1784, 1801, 1817, 2014, 2116, 4090, 6100, 6101.

1. Clean the outside of the gearbox and auxiliary gearbox.
2. Remove the cover on the left-hand side of the gearbox and the gearbox filler plug. Fit fixture 6101 on the gearbox, see Fig. 43–49. Secure the gearbox on a reconditioning stand, see Fig. 43–46.
3. Remove the link arm between the gearbox and auxiliary gearbox, Fig. 43–47.
4. Remove the rear cover on the auxiliary gearbox and the nuts securing the box. Fit puller 2116, Fig. 43–48, and pull the auxiliary gearbox from the gearbox.
5. Remove the lever on the shift axle and remove the cover. Remove the outer part of the selector shaft housing.

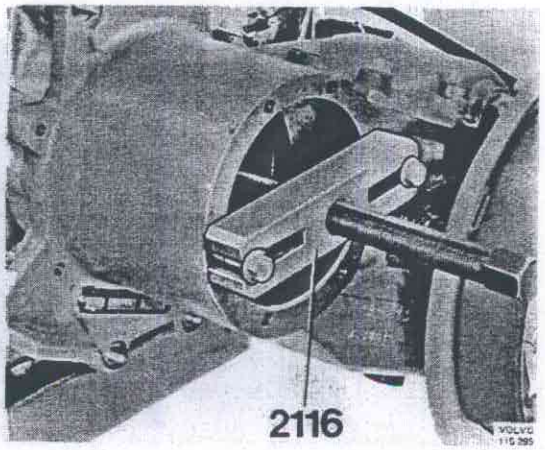


Fig. 43–48. Attaching puller

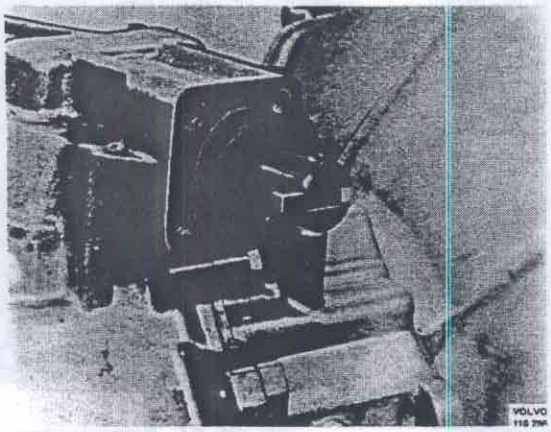


Fig. 43–49. Tube pin in selector shaft

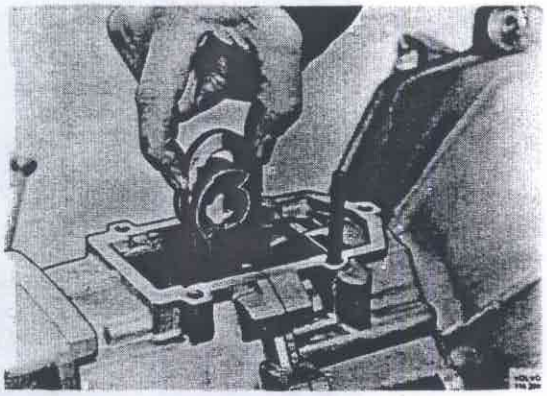


Fig. 43–51. Removing gear shift bar

6. Remove the tubular pin from the selector shaft, Fig. 43–49 and remove the lug.
   Remove the circlip holding the selector fork.
7. Remove the circlip, washer, spring, spacer tube, washer, spring and spacer tube.
8. Pull out the selsctor shaft and remove the lock shaft, Fig. 43–50.
9. Remove the bolts and nuts securing the selector shaft housing. Remove the housing.
10. Remove the intermediate gear shift bar, Fig. 43–51. Remove the packing.
11. Engage two gears. Remove the nut on the output schaft, Fig. 43–52, and pull off the sleeve. Remove the nuts for the rear cover and take care of the washers.
12. Remove the cover, shims and packing, Fig. 43–53.

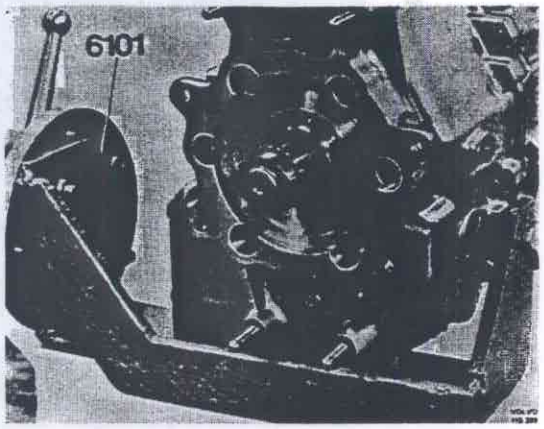


Fig. 43–52. Output shaft nut

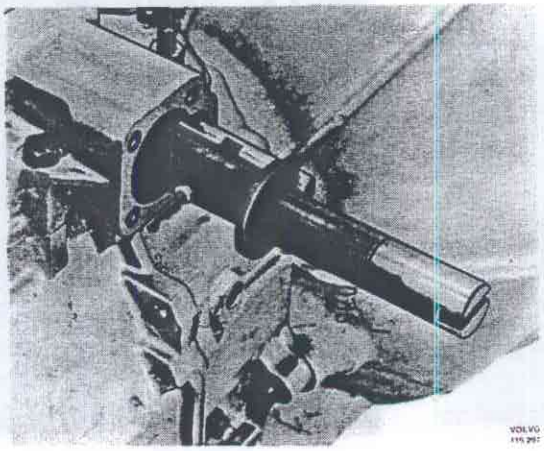


Fig. 43–50. Selector shaft with lock shaft

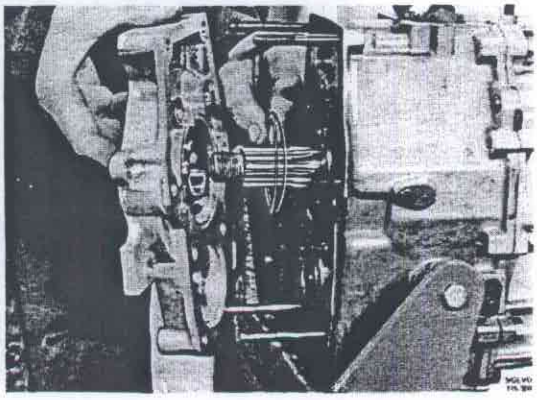


Fig. 43–53. Removing rear cover and shim

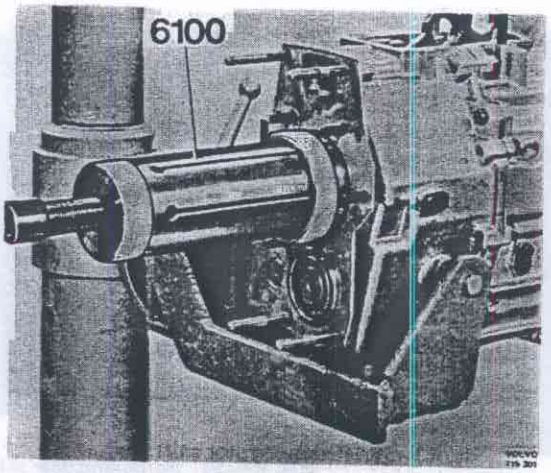


Fig. 43—54. Removing rear bearing

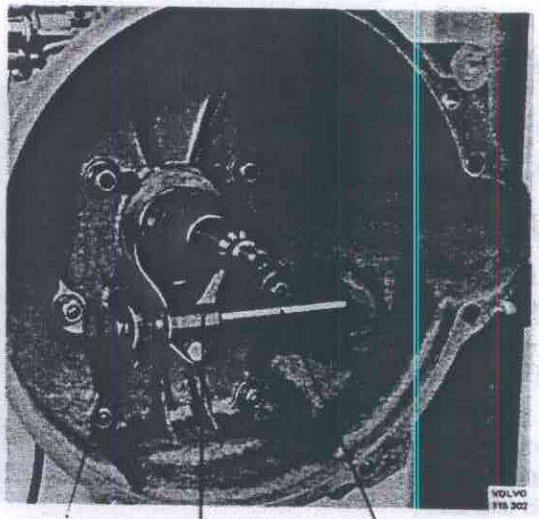


Fig. 43—55. Throw-out shaft and bearing

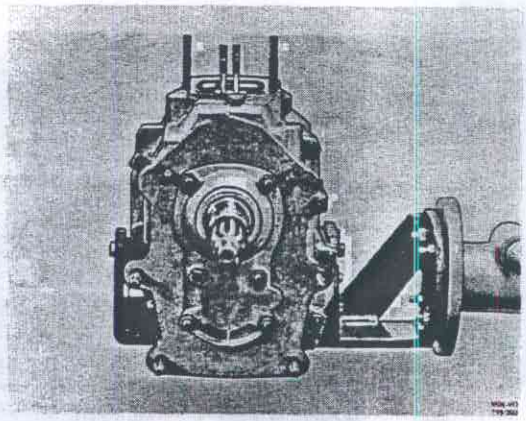


Fig. 43—56. Front cover

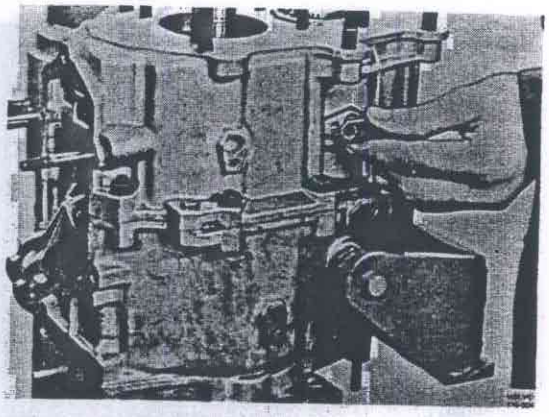


Fig. 43—57. Removing bearing pins

13. Remove the circlip for the output shaft bearing. Remove the shims behind the circlip. Remove the bearing with 6100, Fig. 43—54. Turn the gearbox.
14. Remove the disengaging bearing, lever and disengaging shaft, Fig. 43—55. Remove the nuts securing the clutch casing. Remove the casing.
15. Remove the front cover, Fig. 43—56. Remove the shims for the input shaft and intermediate shaft.
16. Remove the packing. Remove the circlip on the input shaft. Remove the shims behind the circlip. Remove the circlip on the input shaft bearing. Remove the bearing with 6100.
17. Turn the gearbox. Remove the bearing journals for the selector forks, Fig. 42—47.
18. Knock out both the guide pins holding together the gearbox housing halves, Fig. 43—58. Remove the nuts and the Allen bolts (6 mm = 1/4").

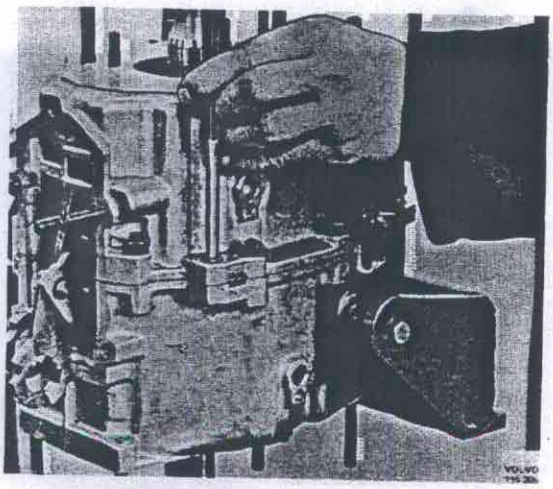


Fig. 43—58. Driving out guide pin

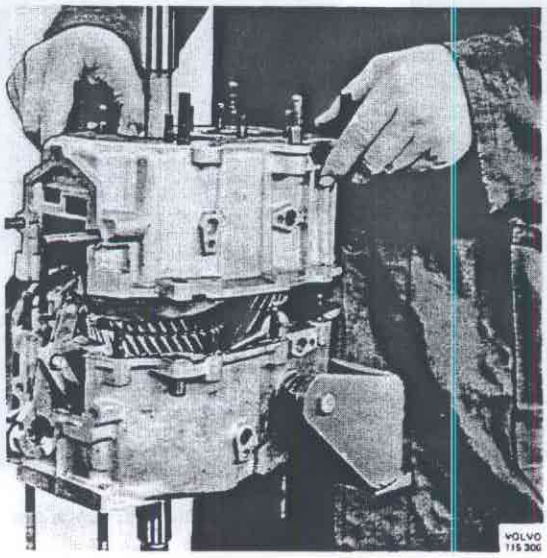


Fig. 43–59. Removing housing half

19. Remove the front housing half, Fig. 43–59. Remove the lock pin and spring for 3rd–4th synchronizing.
20. Remove the input shaft, the synchronizing cone and roller bearing, Fig. 43–60.
21. Remove the engaging sleeve and selector fork for 3rd–4th synchronizing, Fig. 43–61. Remove the interlock units.
22. Lift up the output shaft and remove the selector fork for 1st–2nd synchronizing, Fig. 43–62.
23. Lift the output shaft to the one side and remove the intermediate shaft, Fig. 43–63.

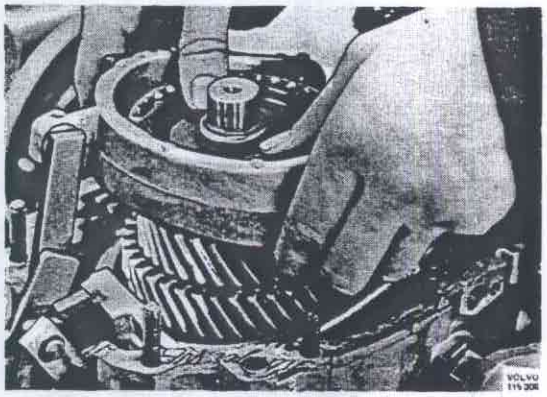


Fig. 43–61. Removing engaging sleeve

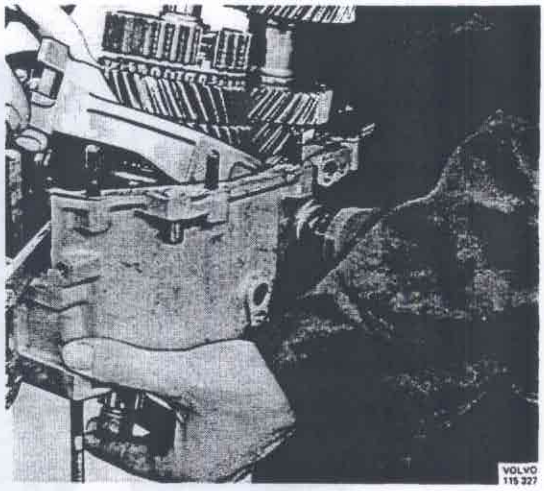


Fig. 43–62. Removing selector fork

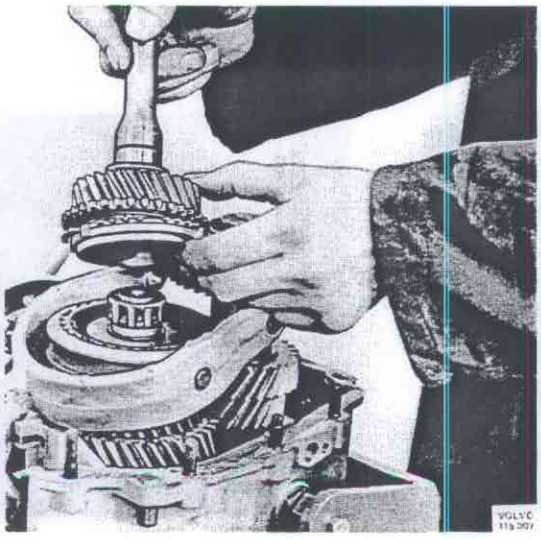


Fig. 43–60. Removing input shaft

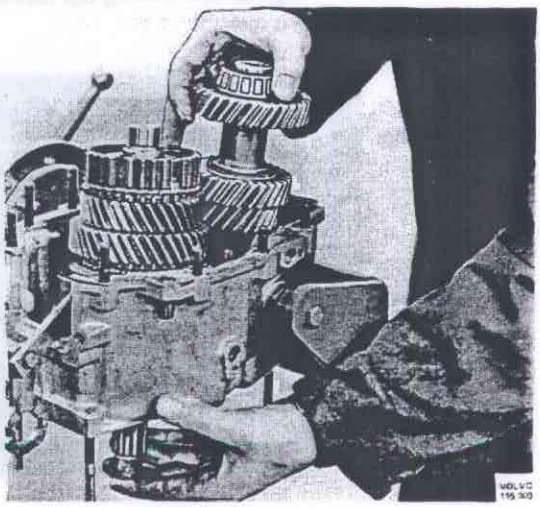


Fig. 43–63. Removing intermediate shaft

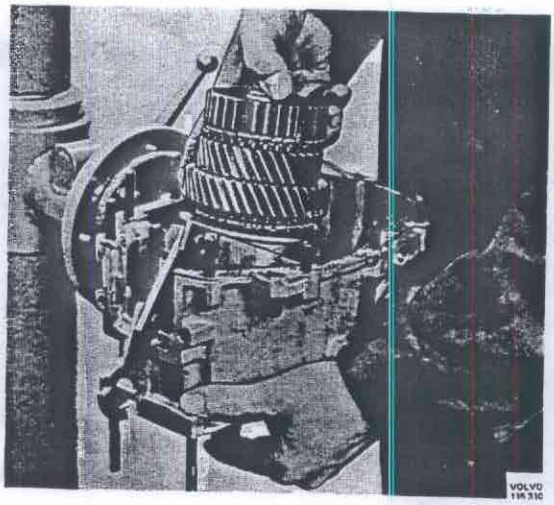


Fig. 43–64. Removing output shaft

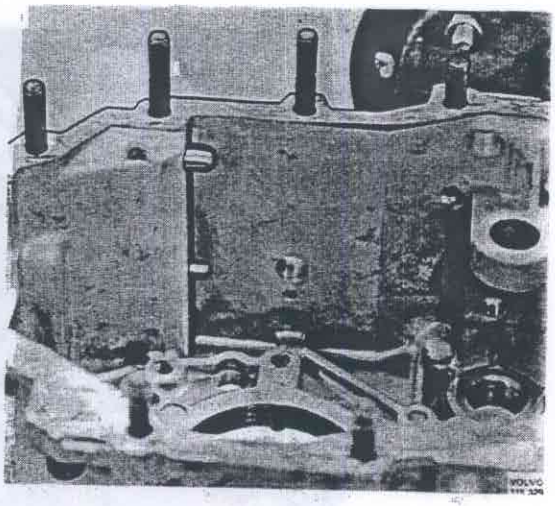


Fig. 43–67. Lock pin

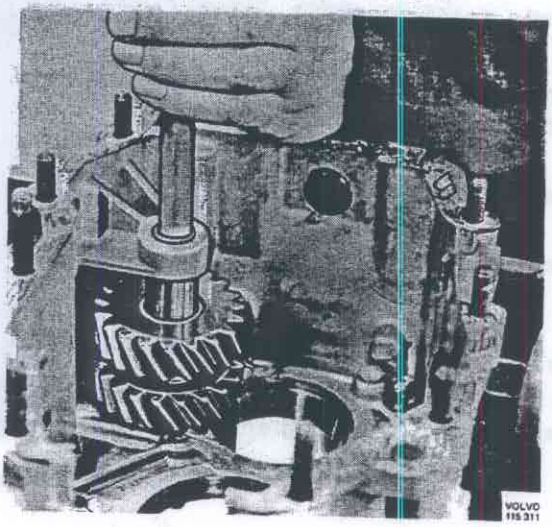


Fig. 43–65. Driving out reverse gear shaft

24. Remove the output shaft and the selector fork for the reverse shaft, Fig. 43–64.
25. Drive out backwards the shaft for the reverse gear, Fig. 43–65, and remove the gear.
26. Drive out the outer races for the intermediate shaft bearing with 2014 + 1801, Fig. 43–66.
27. Remove the lock pins and the springs, Fig. 43–67, for the selector forks. Remove the housing half from the fixture.

Disassembling the output shaft

1. Place the shaft in a press with a counterhold under 1st gear, Fig. 43–68. Press off the inner race, the reverse gear and 1st gear. Remove the needle bearing.

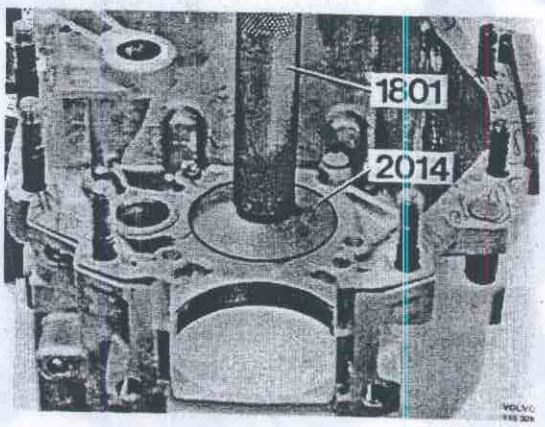


Fig. 43–66. Driving out outer race

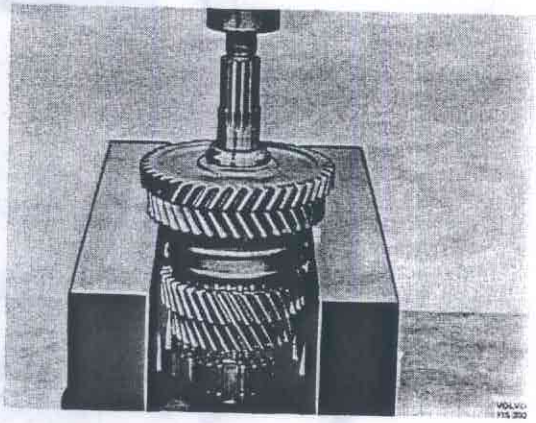


Fig. 43–68. Removing 1st gear

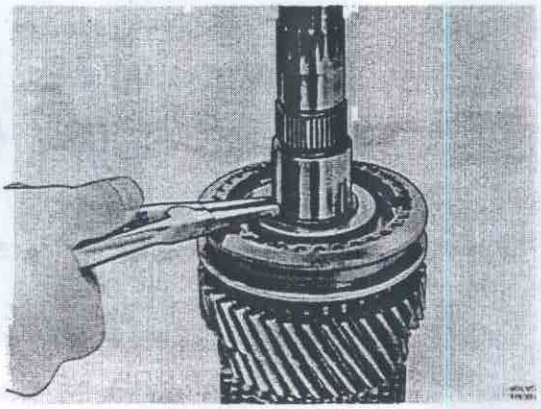


Fig. 43—69. Removing circlip

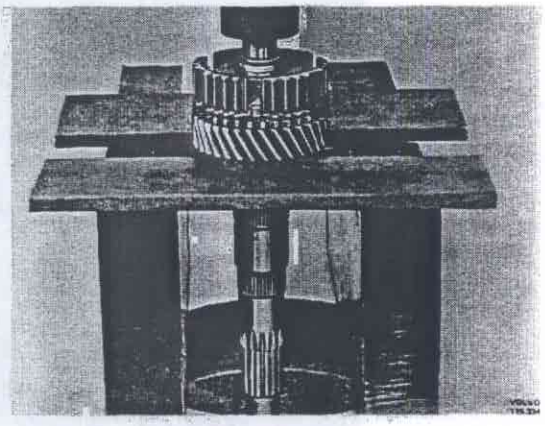


Fig. 43—71. Removing hub and gear

2. Remove the lock ring for 1st—2nd synchronizing hub, Fig. 43—69. Place the shaft in a press with a counterhold under 2nd gear, Fig. 43—70. Press off the synchronizing hub and gear. Remove the engaging sleeve and the interlock units. Remove the needle bearing.
3. Remove the lock ring for 3rd—4th synchronizing hub. Place the shaft in a press with a counterhold under 4th gear, Fig. 42—71. Press of the synchronizing hub and gear. Remove the needle bearing.

Disassembling the countershaft

1. Remove the circlip for the front bearing. Press off the cluster gear and the front roller baring, Fig. 43—72.
2. Remove the circlip for 3rd gear and press of the gear, Fig. 43—73.
3. Press off the rear roller bearing, Fig. 43—74.

   Make sure that the counterhold lies against the bearing when removing.

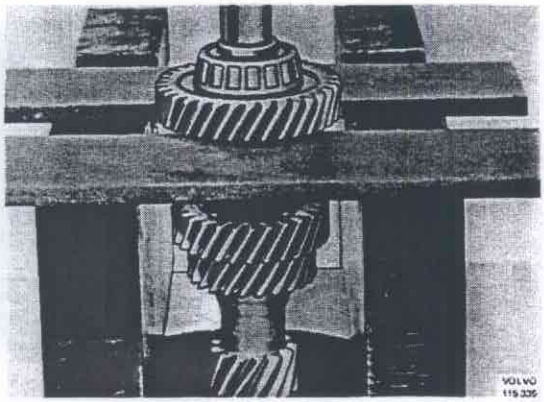


Fig. 43—72. Removing cluster gear

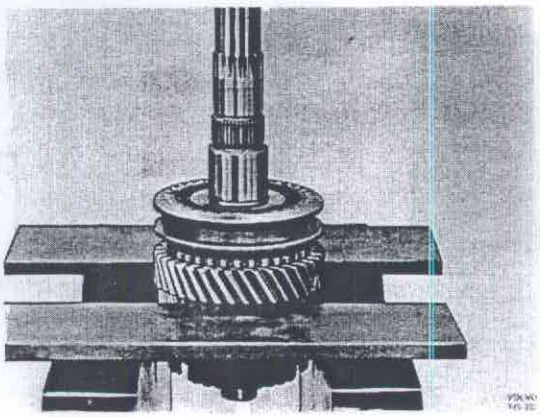


Fig. 43—70. Removing hub and gear

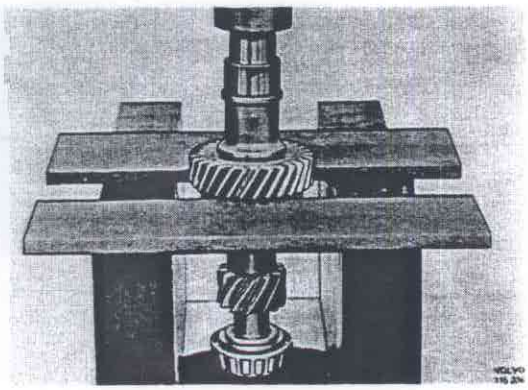


Fig. 43—73. Removing 3rd gear

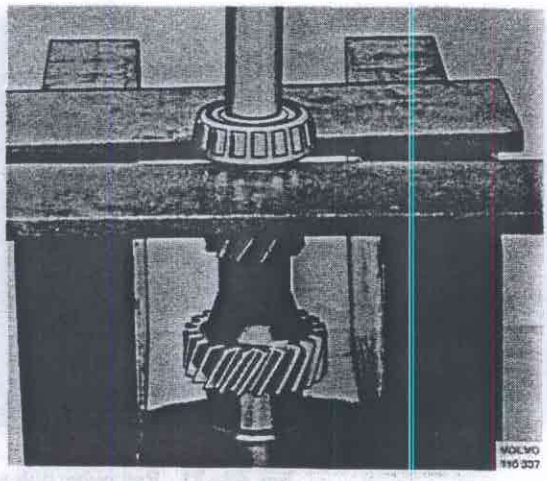
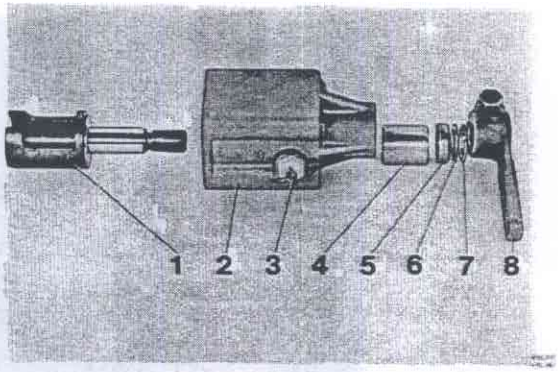
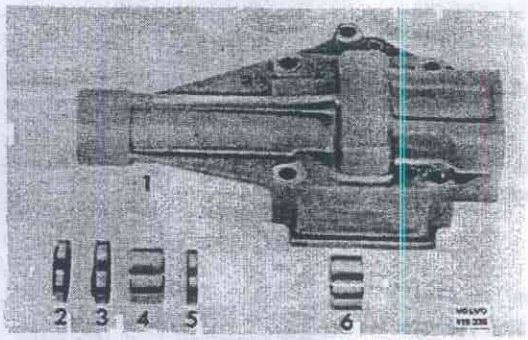


Fig. 43—74. Removing bearing



1. Selector fork
2. Housing
3. Contact
4. Bushing
5. Seal
6. Washer
7. Circlip
8. Lever

Fig. 43—77. Outer selector shaft housing



1. Housing
2. Seal
3. Seal
4. Bushing
5. Seal
6. Bushing

Fig. 43—75. Removing seal and bushing

Disassembling the selector shaft housing

1. Fit the housing in a vice. Pull out the seal, bushing and seals, Fig. 43—75 with 1817, Fig. 43—76.
2. Pull out the bushing with 1817.

Disassembling the outer selector shaft housing

1. Remove the screw on the lever. Remove the lever (8, Fig. 43—74).
   Remove the reverse light contact.
2. Remove the selector fork from the housing.
3. Knock out the bushing 4 and seal 5 with 4090, Fig. 43—78.

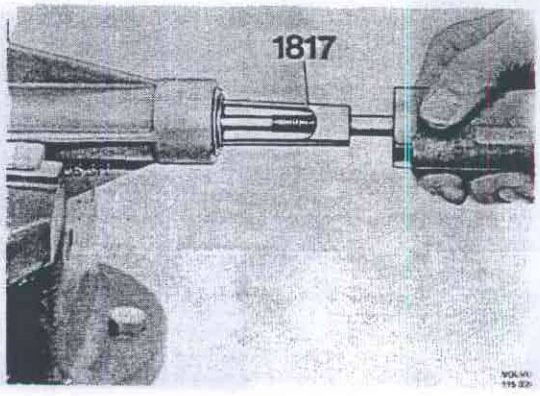


Fig. 43—76. Gear selector housing

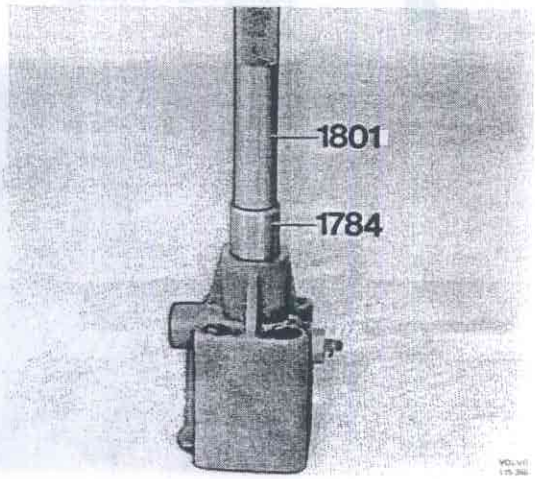


Fig. 43—78. Driving out bushing and seal

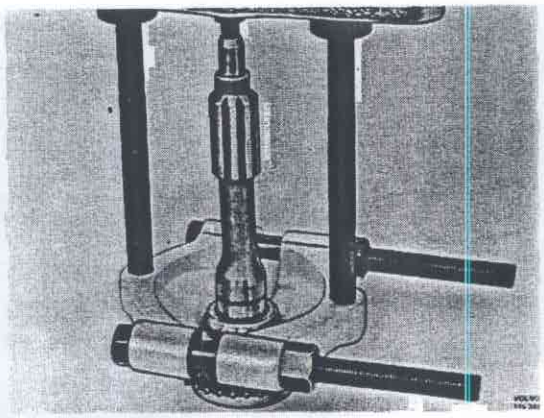


Fig. 43–79. Removing inner race

Checking and replacing parts

Clean all parts and check for wear and damage. All damaged or worn parts should be replaced. Sealing rings, O-rings and packings should always be replaced. When replacing sealing rings, make sure that the surfaces which provide the sealing are carefully checked. If the surfaces are scored or damaged in any other way, the sealing must be replaced.

In order to be able to adjust the clearance in the gearbox, the inner bearing race on the input shaft must be pulled off with a standard puller, see Fig. 43–79.

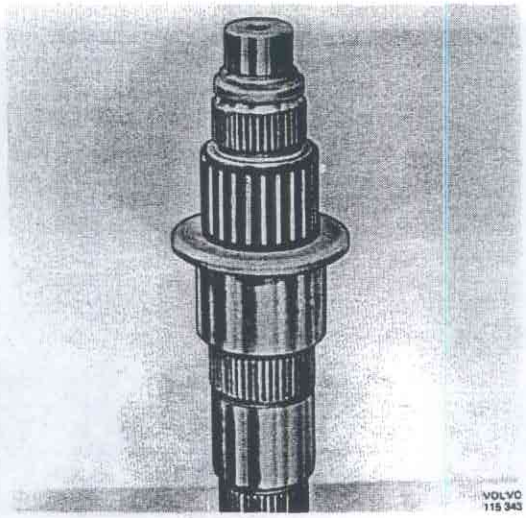


Fig. 43–80. Needle bearing for 3rd gear

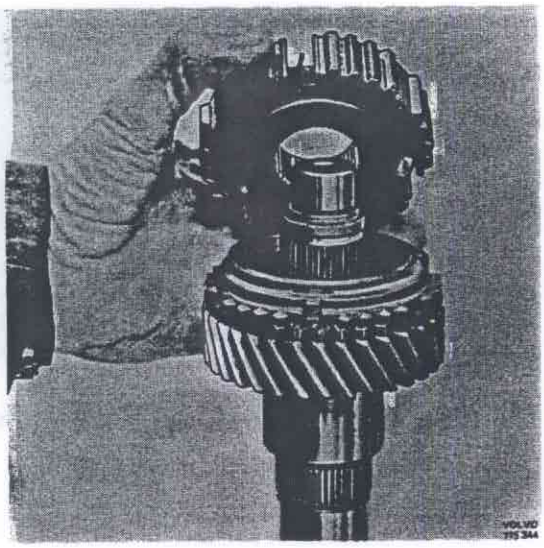


Fig. 43–81. Installing synchronizing hub

Assembling the gearbox

Special tools: 1784, 1801, 2022, 2395, 2564, 6011, 6012, 6024, 6101, 6102, 6103, 6104.

Output shaft

1. Oil the needle bearing for 3rd gear and place it on the shaft, Fig. 43–80.
2. Fit 3rd gear and the synchronizing cone. Place the spring on the interlock bodies in the synchronizing hub. Fit the hub, Fig. 43–81.
3. Press on the hub with 2022, Fig. 43–82. Check that the cone lugs enter the hub. Fit the lock ring which gives minimum clearance. Lock rings are available in sizes 1.8, 1.9 and 2.0 mm (0.072, 0.076 and 0.079").

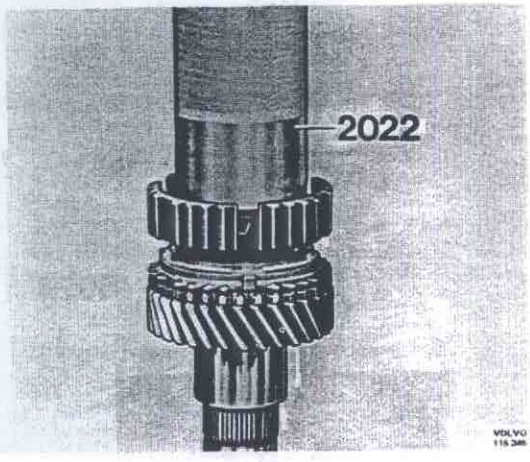


Fig. 43–82. Pressing on hub

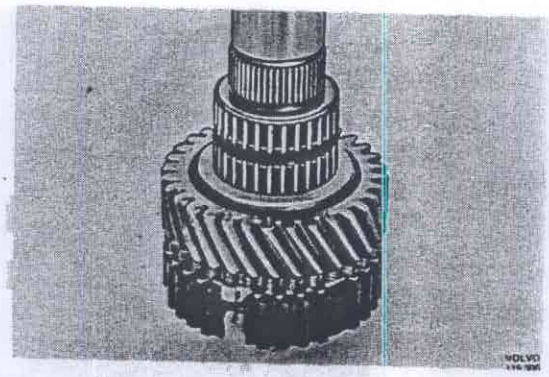


Fig. 43–83. Needle bearing

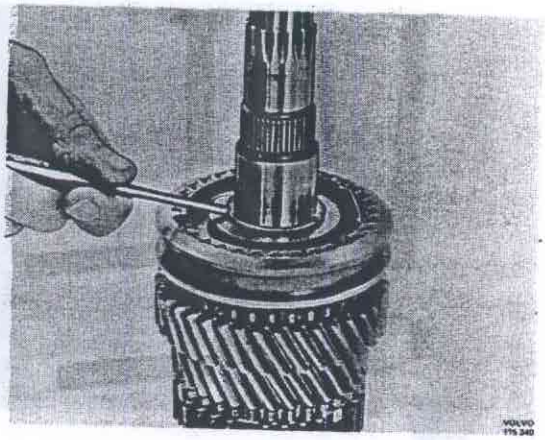


Fig. 43–86. Driving on lockring

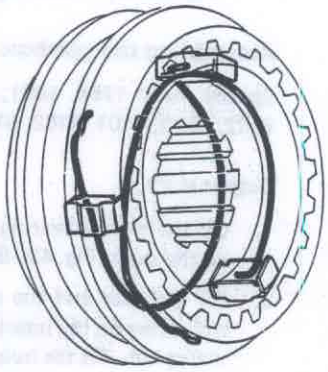


Fig. 43–84. Placing spring

4. Fit the needle bearings for 2nd gear, Fig. 43–83. Fit 2nd gear and the synchronizing cone.
5. Assemble the synchro unit for 1st–2nd gears. The springs for the interlock units are placed as shown in Fig. 43–84, starting off with different interlock units.
6. Fit the hub. Place the shaft on 6024, Fig. 43–85, and press on the hub.
7. Fit the lock ring which gives minimum clearance. Lock rings are available in sizes 1.8, 1.9 and 1.0 mm (0.072, 0.076 and 0.079"). Check that the lock ring has bottomed properly by driving it down with a drift, Fig. 43–86.

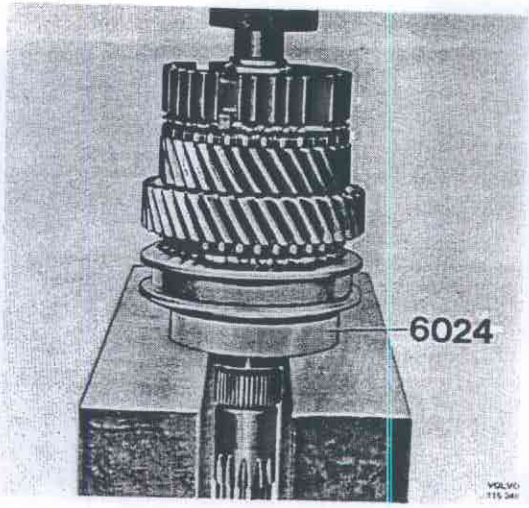


Fig. 43–85. Pressing on hub

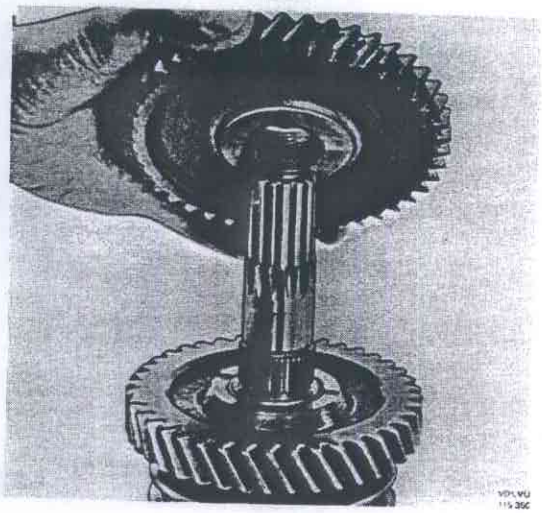


Fig. 43–87. Installing reverse gear

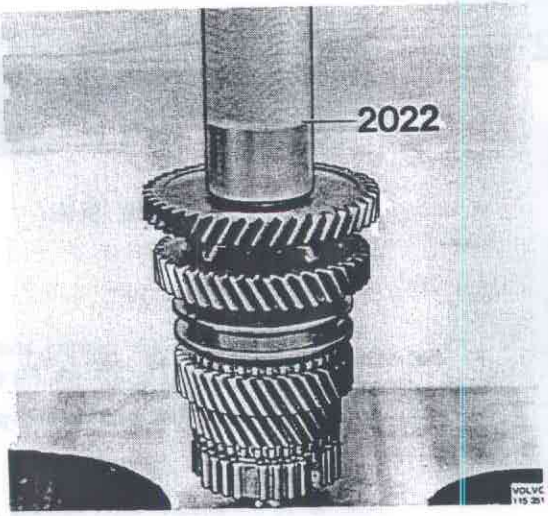


Fig. 43–88. Pressing on gear

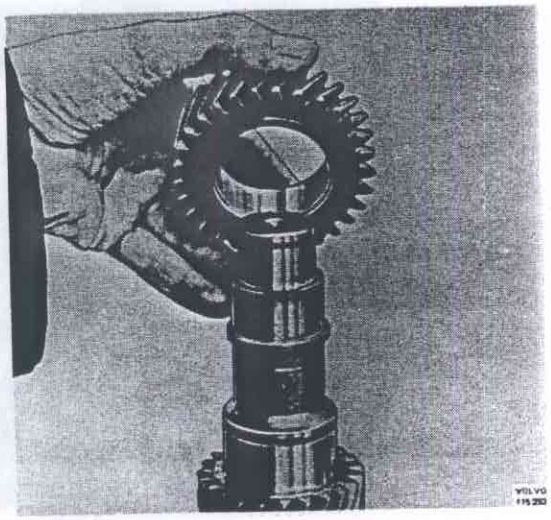


Fig. 43–90. Placing 3rd gear

8. Oil the needle bearing for 1st gear and fit it. Fit the synchronizing cone and 1st gear. Place the gear for reverse in position, but turn it as shown in Fig. 43–87 with the larger hub section facing 1 st gear. Press it on with 2022, Fig. 43–88.
9. Fit the inner race for the rear ball bearing. Press it on with 2395, Fig. 43–89.

Countershaft

1. Place 3rd gear on the shaft with the bevelled edge of the gear facing downwards, see Fig. 42–90. Press on the gear with 2022, Fig. 43–91. Fit the lock ring.
2. Fit the cluster gear with the larger part of the hub facing downwards, Fig. 43–92. Press on the gear with 2022.

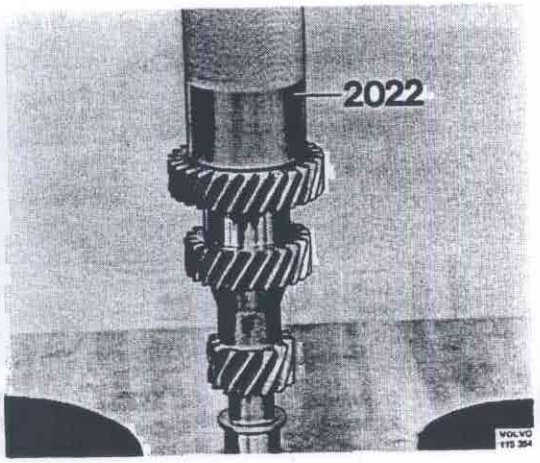


Fig. 43–91. Pressing on gear

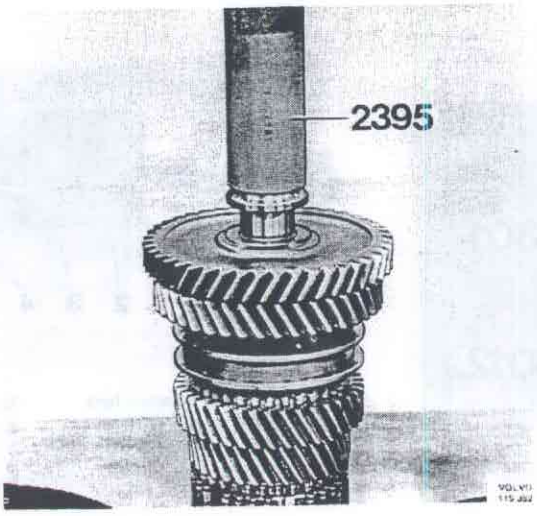


Fig. 43–89. Pressing on inner race

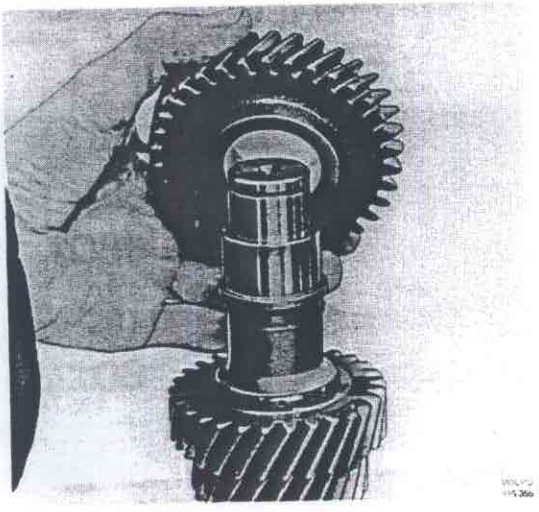


Fig. 43–92. Placing gear

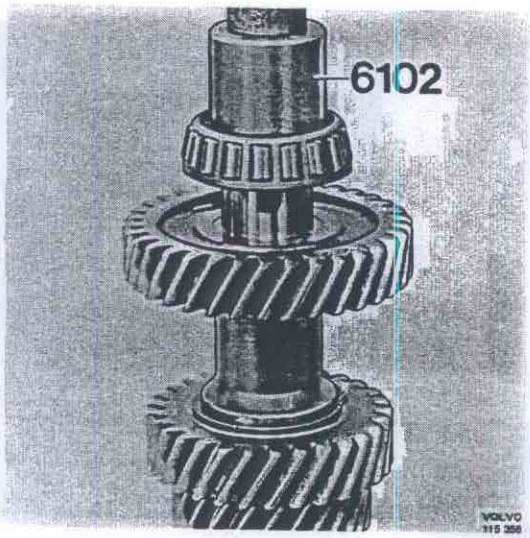
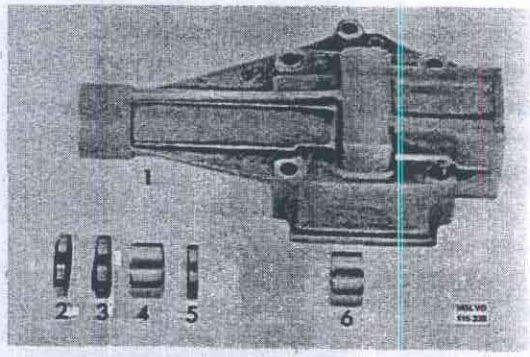


Fig. 43–93. Pressing on bearing



1. Housing
2. Seal
3. Seal
4. Bushing
5. Seal
6. Bushing

Fig. 43–94. Gear selector housing

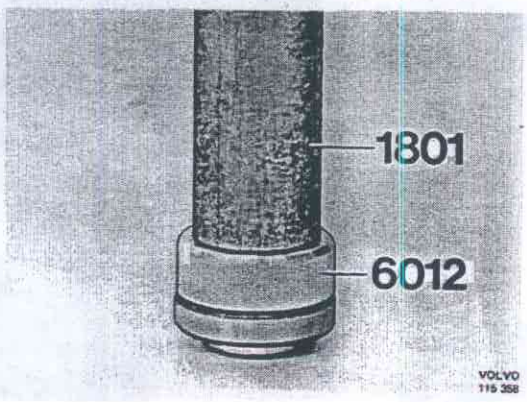


Fig. 43–95. Drift with seal

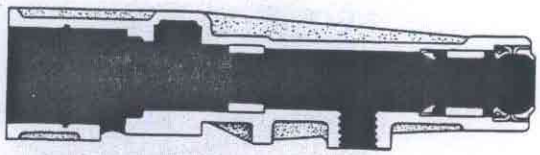


Fig. 43–96. Seals

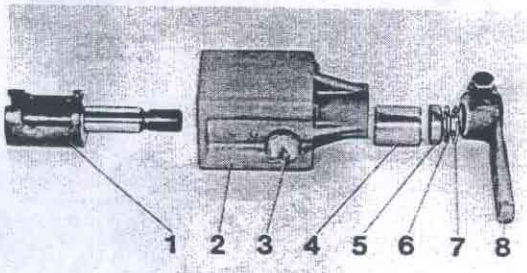
3. Fit the front roller bearing and press it down with drift 6102, Fig. 43–93. Fit the circlip.
4. Fit the rear roller bearing and press it on with 6102.

Assembling the selector shaft housing

1. Oil the new bushings and seals before fitting them.
2. Drive in the bushing (6 Fig 43–94) with 6011 + 1801, Fig. 43–95. Note its location.
3. Place the seal (5) on drift 6012 + 1801 and drive it into the housing. Note Fig. 43–96 to make sure that the sealing is located properly.
4. Oil the bushing (4) and drive it in.
5. Oil the seals and place them on the drift. Drive them into the housing.

Assembling the outer selector shaft housing

1. Oil the bushing (4 Fig 43–97) and press it into the housing with 1801 + 1784, Fig. 43–98.
2. Press in the sealing with 1801 + 1784.
3. Grease the selector shaft and place it in the housing.



1. Selector fork
2. Housing
3. Contact
4. Bushing
5. Seal
6. Washer
7. Circlip
8. Lever

Fig. 43–97. Outer selector shaft housing

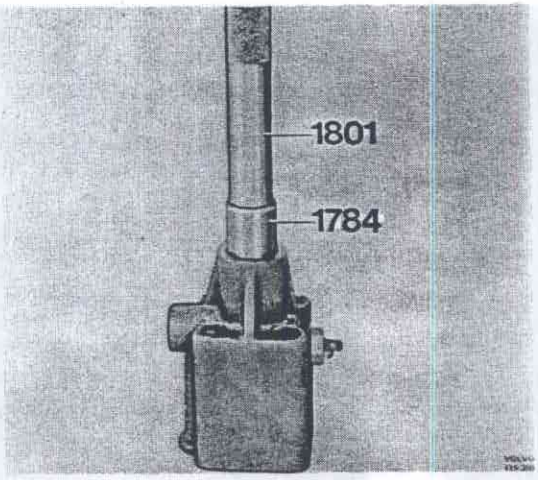


Fig. 43–98. Pressing in bushing

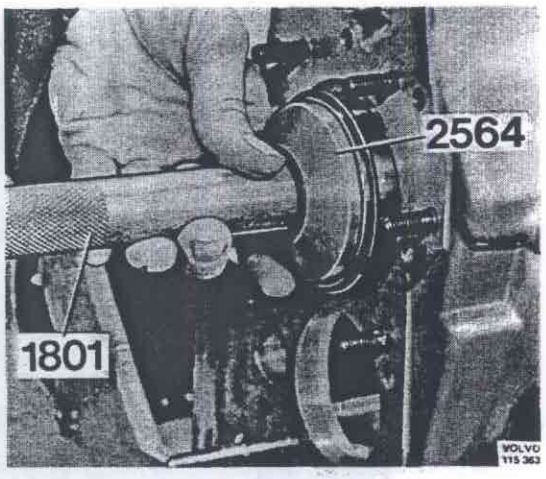


Fig. 43–100. Driving in outer race

4. Turn the shaft so that it comes into the locked position. Place the lever so that it points straight down.
5. Fit the reverse light contact.

Other assembly work on the gearbox

In certain places, the gearbox has shims and lock rings of alternative thicknesses in order to provide a choice to obtain the correct clearance. Fig. 43–99 shows where these places are.

1. Fix the rear half of the gearbox housing in fixture 6101.
2. Place the circlip on the bearing for the output shaft. Drive the bearing into the housing with 2564 + 1801, Fig. 43–100.

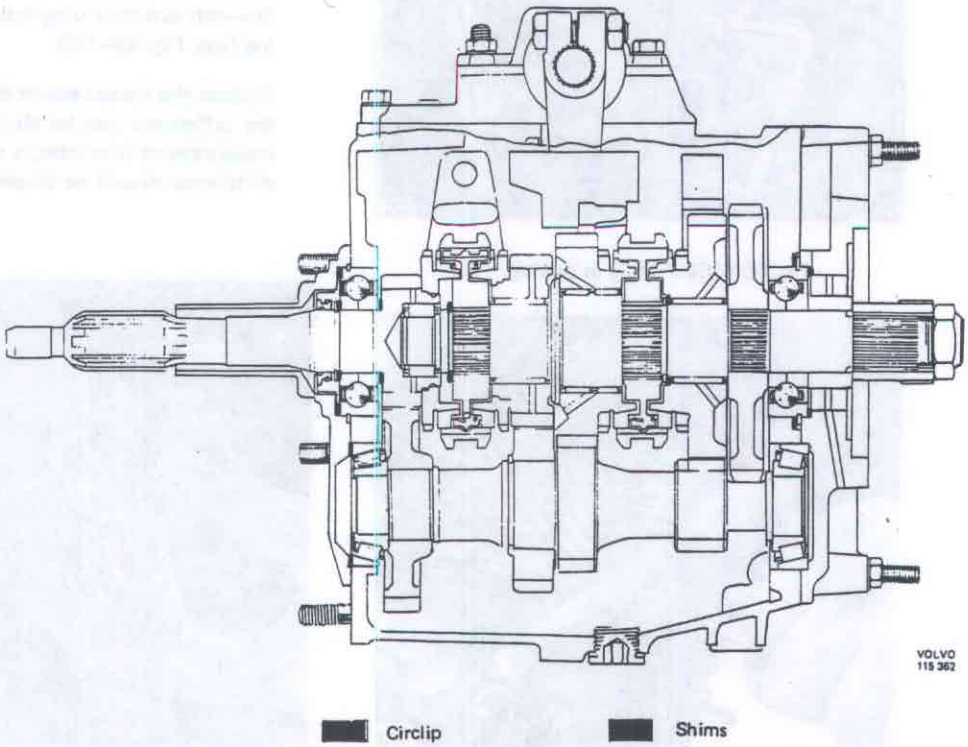


Fig. 43–99. Alternative shims and circlips in gearbox

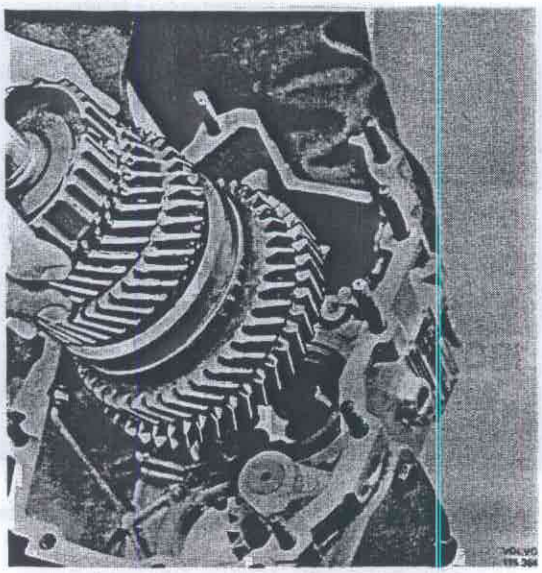


Fig. 43—101. Fitting output shaft

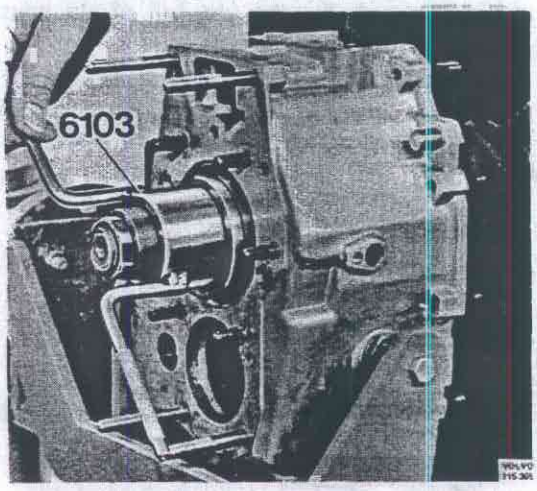


Fig. 43—102. Pulling in bearing

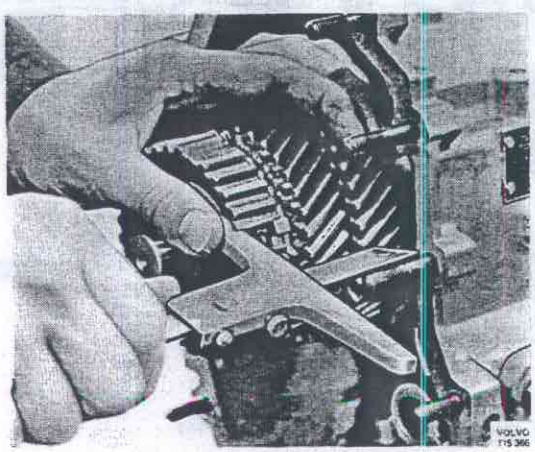


Fig. 43—103. Checking distance

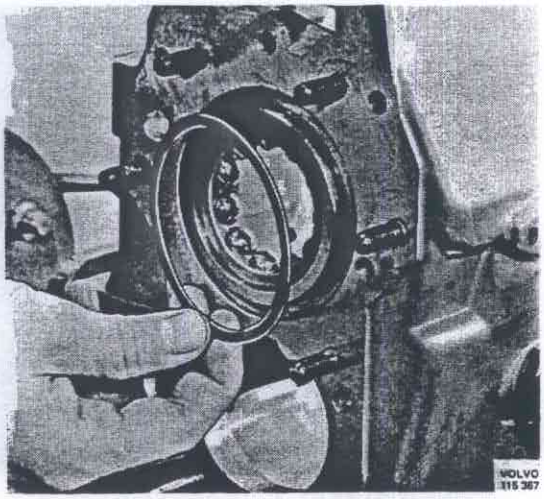


Fig. 43—104. Placing circlip

3. Place the output shaft in the housing, Fig. 43—101. Centre the shaft properly in the bearing. Fix on press tool 6103 and drive in the sprindle so that the shaft is held in position, Fig. 43—102. Check that the inner race on the output shaft is correctly centered in the bearing when the tool is pulled in.
4. With a depth gauge measure the distance from 3rd—4th synchronizing hub to the gearbox housing face, Fig. 43—103.

   Reduce the measurement by 53.5 mm (2.1") and the difference may be ±0.1 mm (0.0039"). If the measurement is greater, a shim of corresponding difference should be placed between the housing

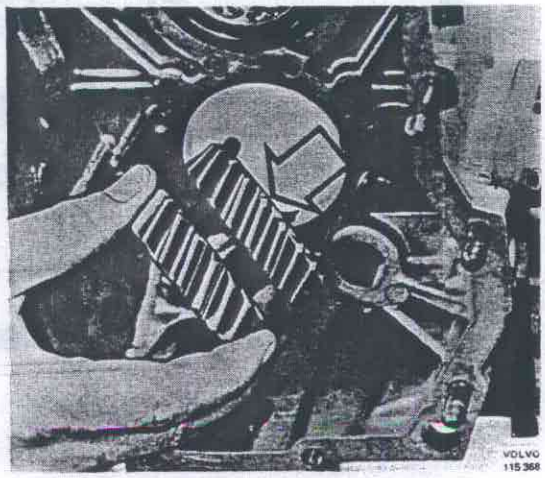


Fig. 43—105. Placing reverse gear

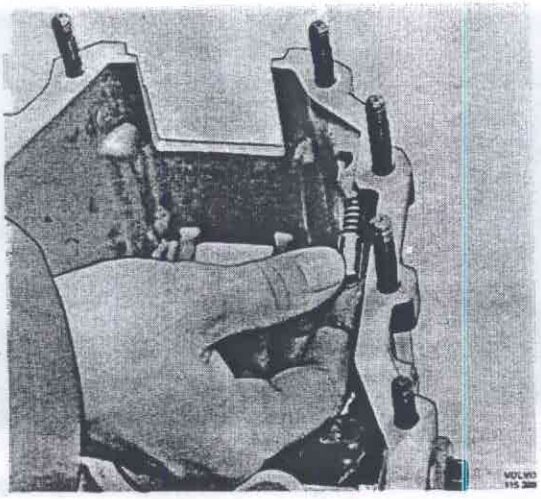


Fig. 43–106. Placing lock pin

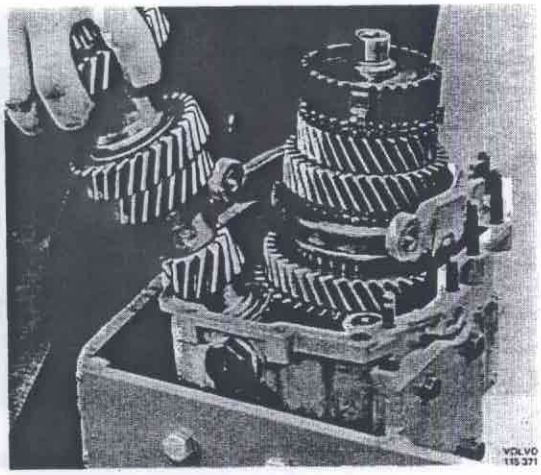


Fig. 43–108. Fitting countershaft

and the circlip on the output shaft bearing. Shims are available in sizes 0.6, 0.8, 1.0, 1.2 and 1.4 mm (0.024, 0.032, 0.039, 0.048 and 0.056").

5. Remove the tool and lift off the output shaft. Drive out the output shaft bearing approx. 2 mm (0.08") with 1801 + 2564. Remove the circlip and place the requisite shims in position, Fig. 43–104. Fit the circlip and drive in the bearing.
6. Fit the reverse drive in the gearbox. Note that the gear with the bevelled teeth must face the rear end of the gearbox, see Fig. 43–105.
7. Turn the gearbox. Grease the lock pins for 1st–2nd and reverse gears and place them and the springs in the housing, Fig. 43–106.
8. Fit the output shaft and selector fork for reverse gear, Fig. 43–107, and the selector fork for 1st–2nd engaging sleeve.
9. Lift up the output shaft and reverse gear and fit the countershaft, Fig. 43–108.
10. Centre the output shaft in the rear bearing. Fix press tool 6103 on the shaft.
11. Place in position the spring for 3rd–4th synchronizing. Note that it should be placed with the resilient part anti-clockwise, Fig. 43–109. Grease the interlock units and fit them, Fig. 43–110. Fit the selector fork on 3rd–4th engaging sleeve and fit the sleeve on the hub.

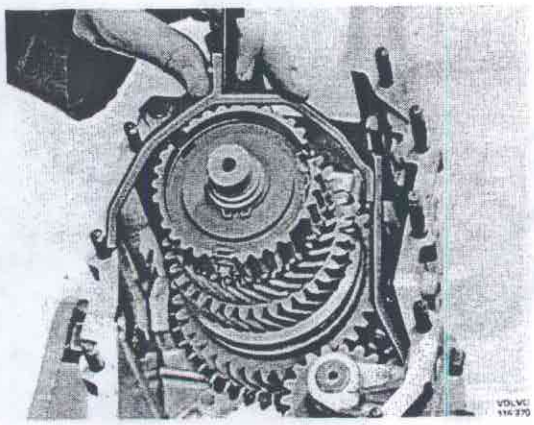


Fig. 43–107. Fitting selector fork

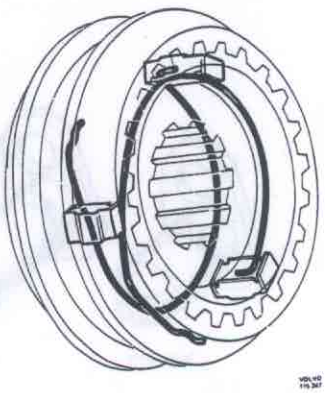


Fig. 43–109. Placing springs

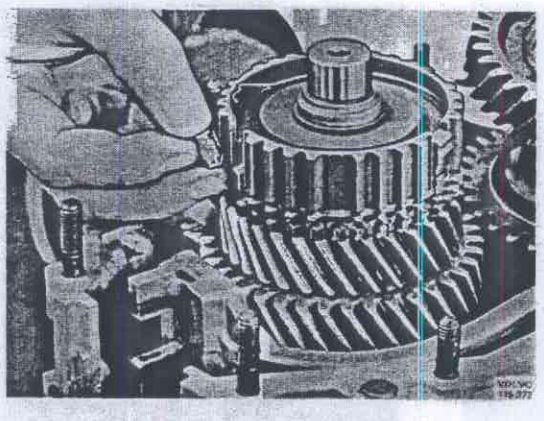


Fig. 43–110. Fitting lock units

Fig. 43–113. Fitting roller bearing and cone

12. Fit the bearing pins in the selector forks for reverse and 1st–2nd, see Fig. 43–111. There are three types of bearing pins, see Fig. 43–112.
13. Place the roller bearing and synchronizing on the output shaft, Fig. 43–113. Fit the input shaft in position.
14. Place a new gasket on the gearbox housing. Check that the countershaft is fitted properly, Fig. 43–114.
    Grease the lock pin for 3rd–4th.
15. Place the spring and pin in the front housing half.
16. Fit the two sections together. Check that the interlock for 3rd–4th selector fork takes up its correct position.
    Fit all washers and nuts holding the housing halves together. Knock in the guide pins. Tighten the nuts to a torque of 20–25 Nm (2.0–2.5 kpm =

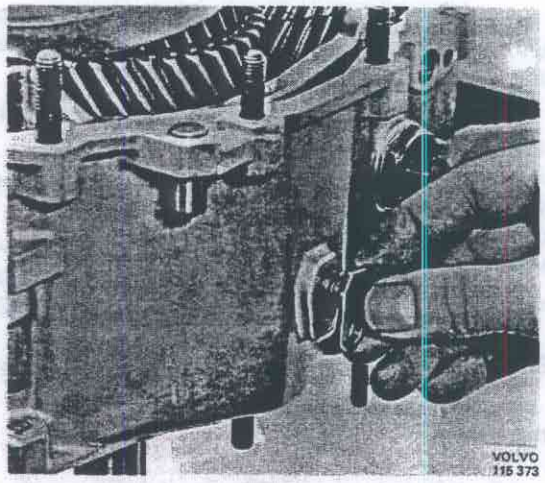


Fig. 43–111. Fitting bearings pins

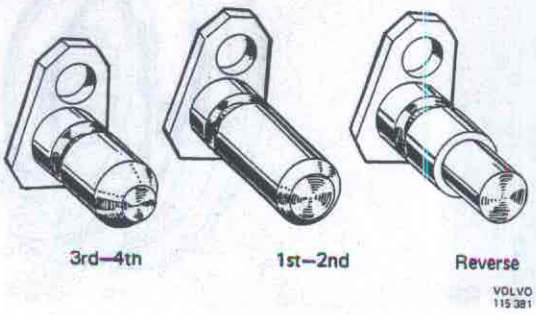


Fig. 43–112. Bearing pins

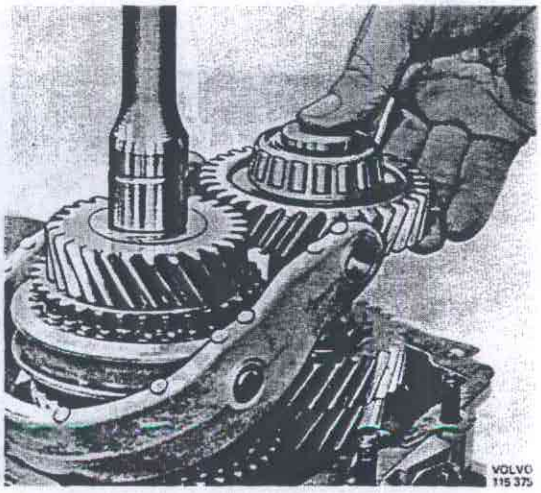


Fig. 43–114. Checking countershaft

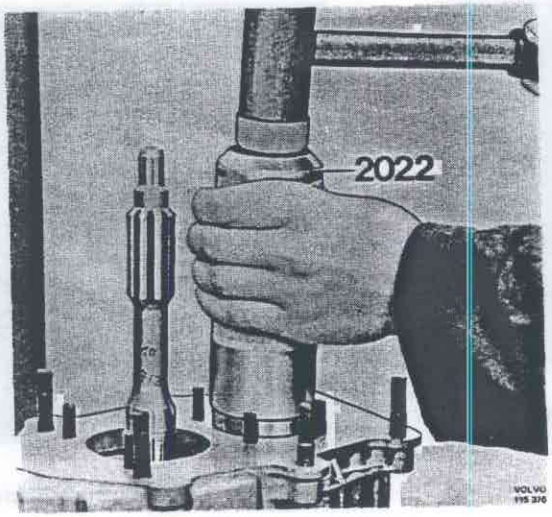


Fig. 43–115. Driving in outer race

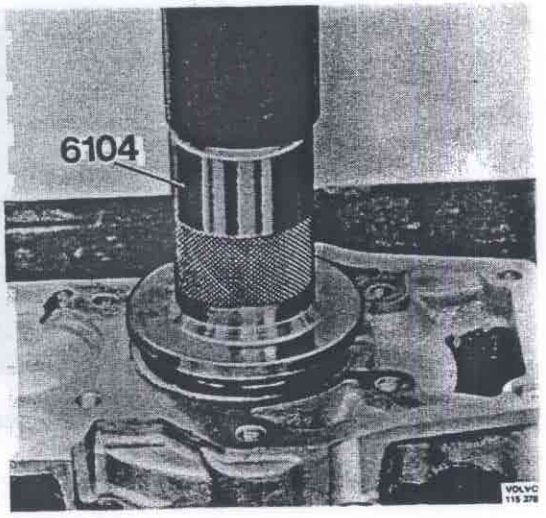


Fig. 43–117. Driving in seal

14–18 lbftf) and the Allen bolts to a torque 8–12 Nm (0.8–1.2 kpm = 5.8–8.7 lbftf).

17. Fit the bearing pins for 3rd–4th selector fork. Fit the bolts.
18. Drive in the outer race for the countershaft front bearing with 2022, Fig. 43–115.
19. Turn round the gearbox and drive in the outer race for the rear bearing with 2022. Engage two gears.
20. Remove press tool 6103 from the output shaft. Place the bearing inner race on the shaft. Fix on the tool and press in the race, Fig. 43–116. Remove the tool.
21. Place a new seal for the rear cover on the gearbox. Check that the countershaft bearing is in its bottom position.
22. Drive new seals into the rear cover, Fig. 43–117, with 6104. Measure the depth of the machined recess in the rear cover for the output shaft bearing, Fig. 43–118. Measure the distance between the bearing and the face of the seal, Fig. 43–118. The difference between the two measurements may be ±0.05 mm (0.002"). Shims are available in the following sizes: 0.2, 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0 mm (0.016, 0.020, 0.024, 0.028, 0.032, 0.036 and 0.039"). Grease the seal in the cover and fit on the cover.

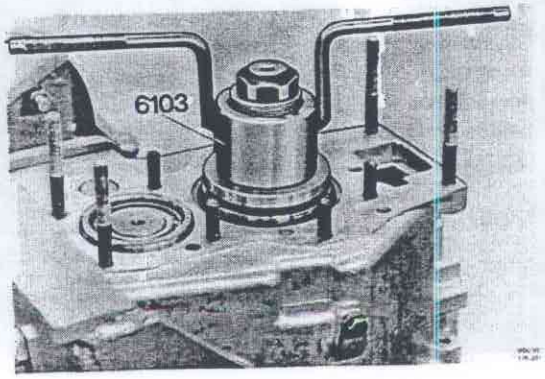


Fig. 43–116. Pressing in inner race

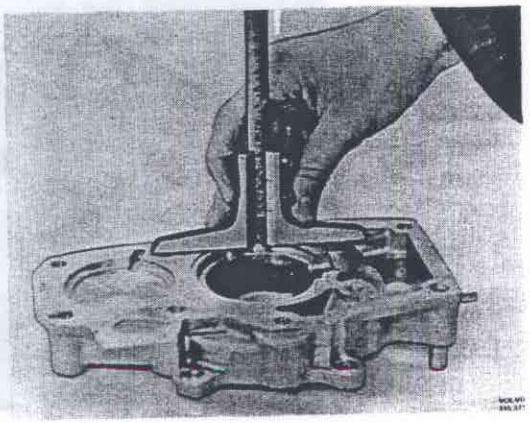


Fig. 43–118. Calcualting clearance

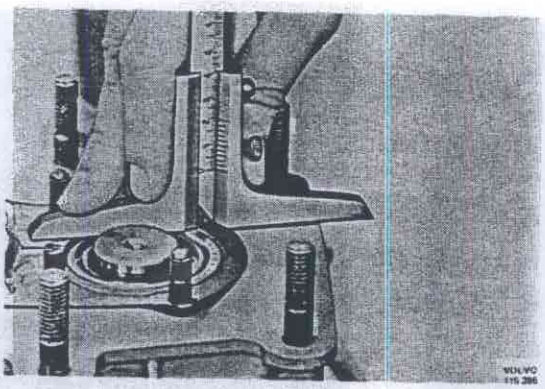


Fig. 43–119. Calcualting clearance

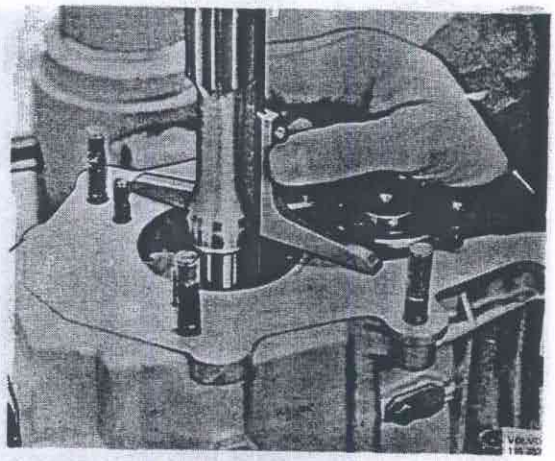


Fig. 43–121. Calcualting clearance

23. Place the shim on the bearing. Fit the wear ring, Check that the cover bottoms properly against the gearbox before fitting the washers and nuts in position. Tighten the nuts to a torque of 20–25 Nm (2.0–2.5 kpm = 14–18 lbftf).

24. Fit on the gear and the nut. Tighten the nut to a torque of 140–160 Nm (14–16 kpm = 101–115 lbftf). Lock the nut by peening the edge of the nut, Fig. 43–120.

25. Turn the gearbox. Disengage the gears and rotate the input shaft.

26. Measure the distance from the gearbox housing, Fig. 43–121, to the contact surface of the bearing on the input shaft.

    Fit the circlip on the bearing and measure the distance from the circlip to the edge of the bearing, Fig. 43–122. The difference between the two measurements may be 0.5–0.7 mm (0.020–0.028''), which is the clearance. If the distance is greater, fit a shim of corresponding size on the input shaft.

    Shims are available in the following sizes: 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4 and 1.5 mm (0.020, 0.024, 0.028, 0.032, 0.036, 0.039, 0.044, 0.048, 0.052, 0.056 and 0.060'').

27. Engage two gears.

    Place the inner race and outer race on the input shaft. Place the inner race on the bearing and check that it fits properly on the bearing. Turn the thread insert in the tool. Fix in position the press tool with the tool stop washer between the spline and the tool, Fig. 43–123. Press the bearing into the housing. Then tap on the end of

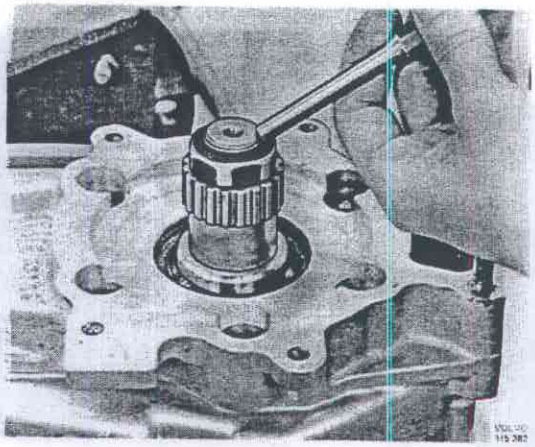


Fig. 43–120. Nut locking

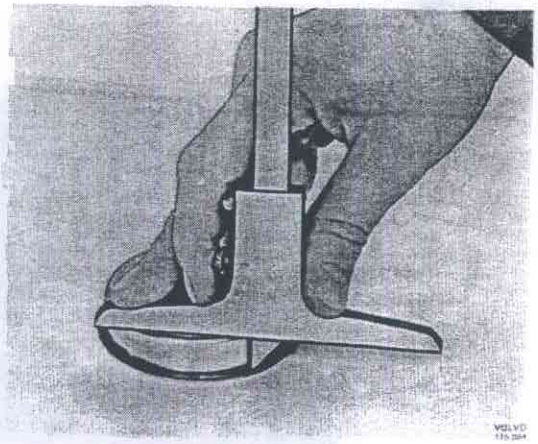


Fig. 43–122. Calculating clearance

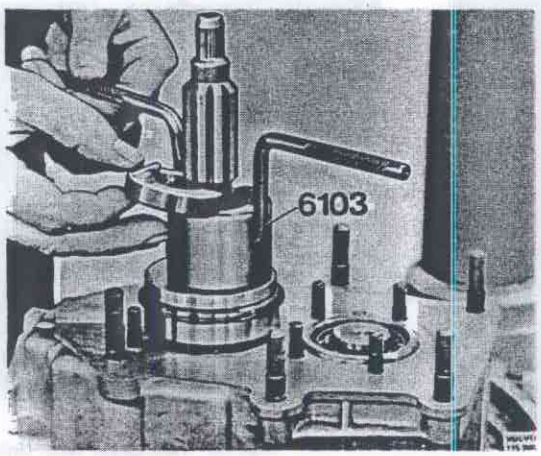


Fig. 43—123.Pressing in bearing

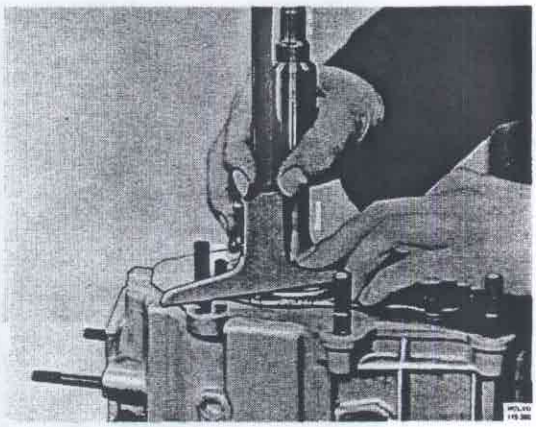


Fig. 43—124. Calculating clearance

the input shaft a plastic maller so that the bearing circlip goes down against the housing.

28. Remove the press tool. Place the shim between the bearing and circlip which gives minimum clearance. The adjuster washer is of the same type as that placed behind the bearing.

29. Disengage the gears.

    Tap in the countershaft to the bottom while rotating the input shaft at the same time. Knock down the outer race. Place a new seal for the front cover on the gearbox. Measure the distance from the outer race on the input shaft bearing to the seal. Measure the distance from the outer race on the countershaft bearing to the seal. Fig. 43—124.

30. Measure the distance from the contact face on the cover to the recesses for the outer races for the bearings, Fig. 43—125. The difference between the measurements obtained may be ±0.05 mm (0.002") for the input shaft and from 0 to +0.1 mm (0.0039") on the countershaft.

    Shims are available in the following sizes: Input shaft: 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0 mm (0.016, 0.020, 0.024, 0.028, 0.032, 0.036 and 0.039"). Countershaft: 0.5, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4 and 1.5 mm (0.020, 0.028, 0.032, 0.036, 0.039, 0.044, 0.048, 0.052, 0.056 and 0.060").

31. Drive a new seal into the cover.

    Place the shims required on the bearings for the input shaft and countershaft. Fit the cover and make sure that it is fitted properly against the gearbox before tightening up the bolts with the washers. Tighten the bolts to a torque of 22—25 Nm (2.2—2.5 kpm = 16—18 lbftf).

32. Fit the clutch casing and all washers and nuts. Tighten the nuts to a torque of 41—51 Nm (4.1—5.1 kpm = 30—37 lbftf).
    Grease the throw-out shaft and insert it in the casing while placing in position the throw-out fork. Grease the neck of the input shaft cover and fit on the throw-out bearing. Tighten the fork bolts.

33. Turn the gearbox to the horizontal position. Place the gear shift bar for 1st—2nd in position. Place a new gasket for the selector shaft housing on the gearbox.

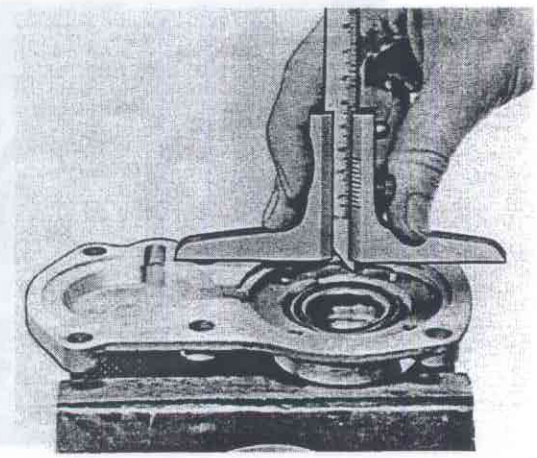


Fig. 43—125. Calculating clearance

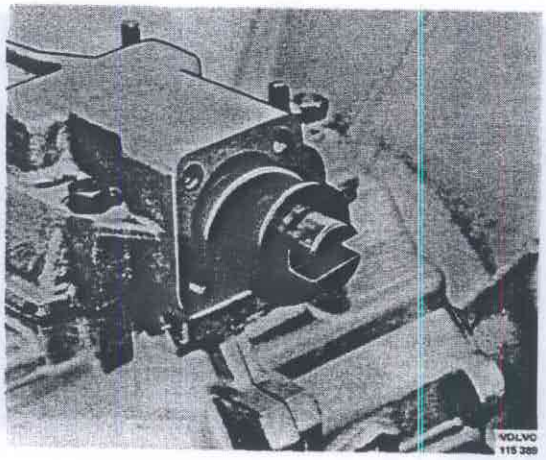


Fig. 43–126. Small spring with spacer rings

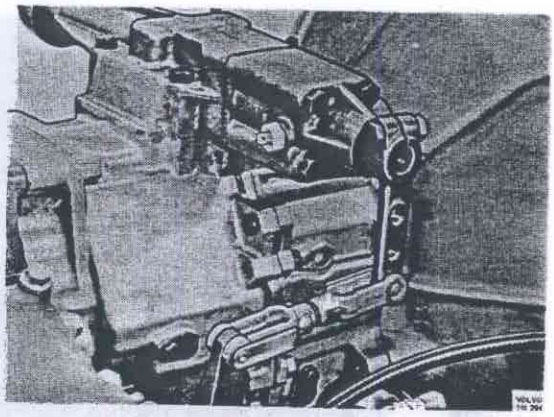


Fig. 43–128. Lever with link

34. Fit on the selector shaft housing. Fit washers and bolts. Grease the selector shaft and place it in the housing. Fit the lock pin and the lock ring in the housing. Fit the spacer ring, the small spring, washer, spacer ring, Fig. 43–126, the large spring, washer, Fig. 43–127, and the lock ring. Place the lug in position and drive in the tubular pin on the shaft.
35. Fit the selector shaft housing outer part. Fit the bolts and tighten them to a torque of 100–120 Nm (10.0–12.0 kpm = 72–86 lbftf).
    Fit the reverse inhibitor pawl on the selector shaft housing. Place the cover and lever on the selector shaft.
36. Coat the outer cover on the gearbox with sealing agent and oil the drive on the output shaft. Fit the auxiliary gearbox and all nuts and washers. Tighten up the nuts. Fit the cover on the auxiliary gearbox using a new gasket.
37. Place the lever on the gearbox selector shaft housing and the auxiliary gearbox in neutral. The hole in the gearbox lever and link should coincide so that the lock pin fits easily, compare Fig. 43–128. If necessary adjust the link fork.

Installing the gearbox

Special tool: 6128, 6136

1. Place the gearbox on a jack, see Fig. 43–129.

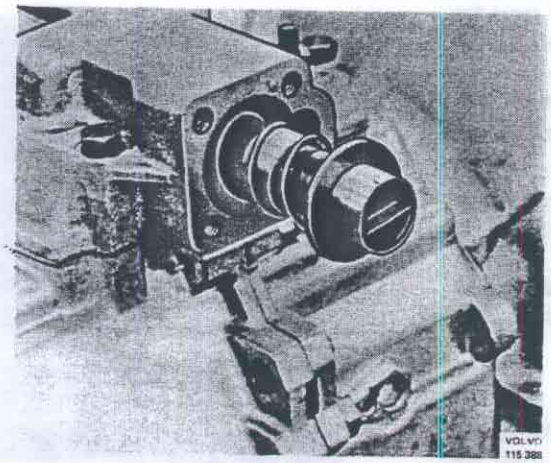


Fig. 43–127. Large spring with washer

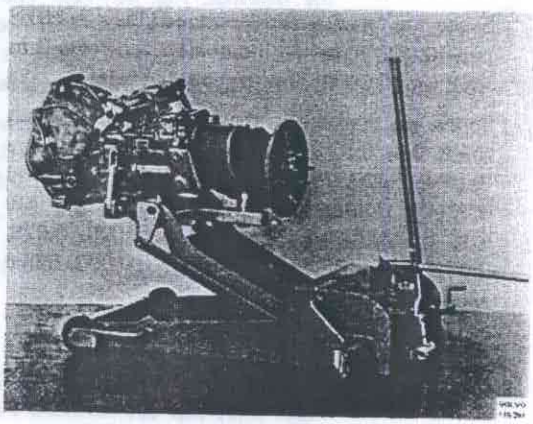


Fig. 43–129. Gearbox on jack

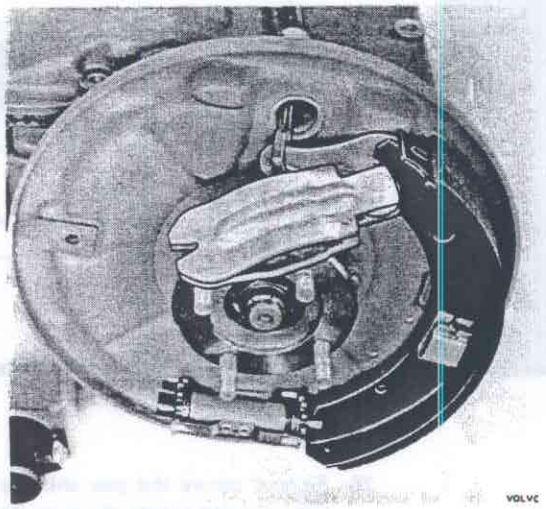


Fig. 43–130. Fitting brake shoe

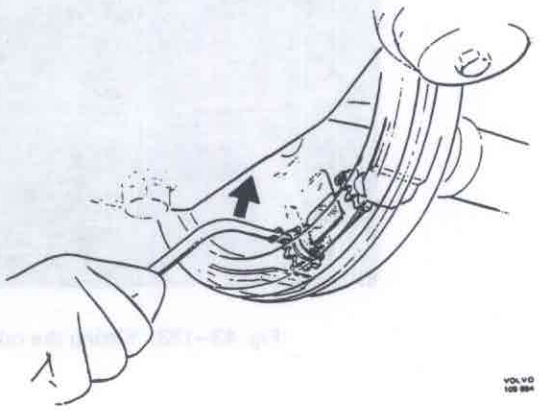


Fig. 43–131. Adjusting brake shoe

2. Push the gearbox on the jack in under the vehicle. Jack up the gearbox so that the input shaft comes opposite the clutch disc lands.
3. Engage a gear. Rotate the output shaft on the auxiliary gearbox while pushing the gearbox at the same time. Place in position the plate for the exhaust manifold bracket.
4. Fit the other bolts round the casing.
5. Place the starter motor in position and fit and tighten up the bolt.
6. Mount the bracket for the exhaust manifold. Fit the parking brake wire in position.
7. Fit and screw tight the bolts for the rear engine mounts. Remove the gearbox jack or lifting tool 6136 from the auxiliary gearbox.
8. Fit the lower bolts round the clutch casing. Fix the earth connection (pleat) to the casing.
9. Assemble the propeller shaft brake. Fit first the lower brake shoe. The fit the lever, Fig. 43–130, the upper return spring, the upper shoe, the lower return spring and the drum.
10. Adjust out one of the brake shoes with a screwdriver, Fig. 43–131, until it is just possible to rotate the drum. The drum should be fixed with nuts. Slacken the adjuster screw until the drum rotates freely, but max. five teeth. Adjust the other brake shoe in the same way.
11. Check the function of the parking brake lever. If the parking brake does not function properly at the 4th ratchet in spite of the fact that the propeller shaft brake has been properly adjusted, alter the length of the wire by means of the nut at the front end.
12. Install the front and rear propeller shafts.
13. Install the silencer. Screw tight the flange bolts. Fit the attachment for the exhaust manifold.
14. Remove the attaching plate and tighten up the cylinder head bolts to a torque of 90 Nm (9 kpm = 65 lbftf).
15. Fit and secure the clutch wire sleeve on the clutch casing. Tighten up the nuts. Fit and secure the fork on the clutch lever. Adjust the lever play with the help of the sleeve nuts. The play should be 4–5 mm (0.16–0.20"), see Fig. 43–132.

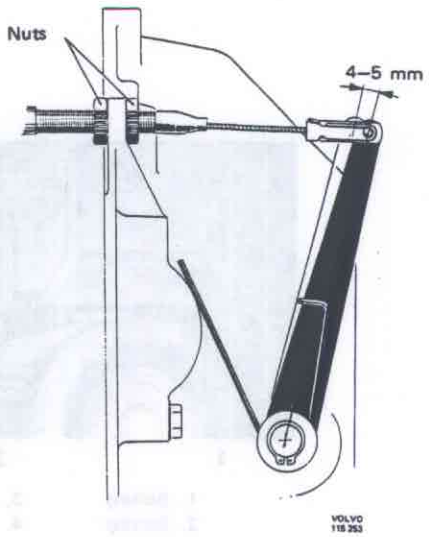


Fig. 43–132. Clutch clearance

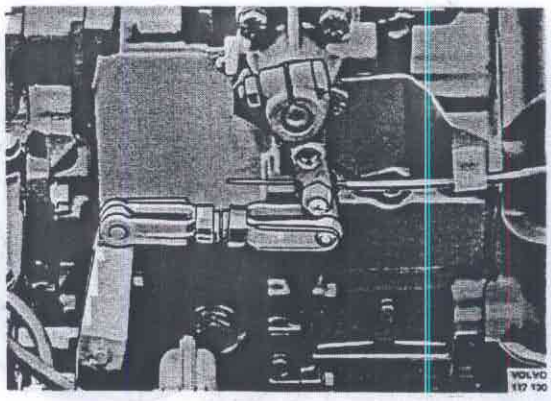


Fig. 43—133. Fitting the cable

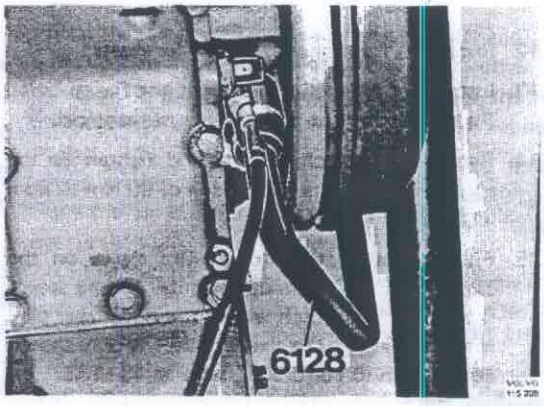
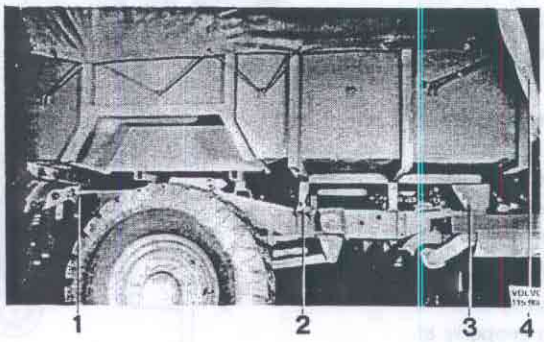


Fig. 43—134. Fitting speedometer wire



1. Bolting
2. Bolting
3. U-bolts
4. Hoist straps

Fig. 43—135. Fitting the platform

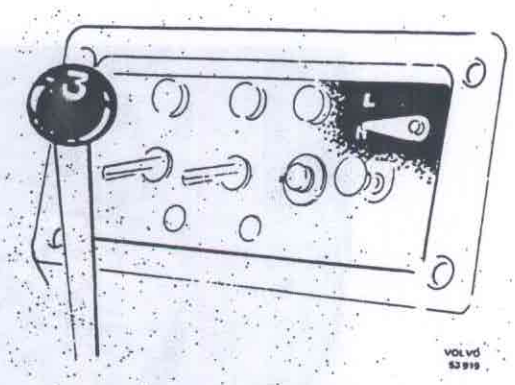


Fig. 43—136. Fitting the indicator arrow

16. Fit and secure the gear shift bar to the gearbox lever. Fit and secure the cross stay.
17. Place the axuliary gearbox in neutral. Fix the cable for the gear position indicator in the lever, see Fig. 43—133.
18. Screw tight the speedometer wire with 6128. See Fig. 43—134.
19. Connect up the evacvation hoses to the gearbox, auxiliary gearbox and clutch casing.
20. Fit the hose to the control mechanism on the auxiliary gearbox. Connect the cables to the senders on the gearbox auxiliary gearbox.
21. Fill the gearbox and auxiliary gearbox with oil, if these units have been emptied of oil. Concerning quantity and quality, see under "Data".
22. Place the platform, see Fig. 43—135, in position and tighten the bolts and U-bolts.
23. Check that the indicator arrow, see Fig. 43—136, points to N, when the auxiliary gearbox is in neutral. If necessary, adjust the arrow by slackening the nut and turning the arrow to point to N. Tighten up the nut again.
24. Connect up the earth cable to the battery and fit on the cover.

AUXILIARY GEARBOX

Removing the auxiliary gearbox

Special tools: 2116, 6128

1. Drain the oil from the auxiliary gearbox. Engage reverse and low gear.
2. If the gearbox is removed with a block and tackle and the vehicle has a platform superstructure, the platform must be removed. This is done after removing the bolts and U-bolts, see Fig. 43—138. Remove the platform with a hoist straps which is fixed to the lifting eyelets, see Fig.

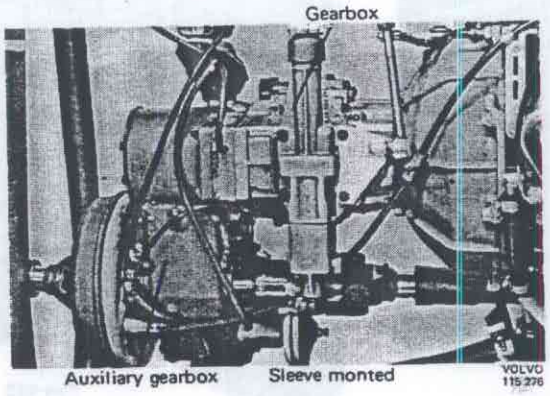


Fig. 43–137. Auxiliary gearbox in vehicle

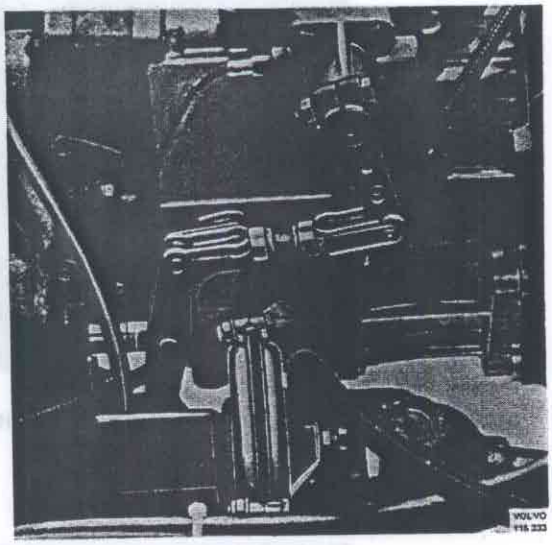
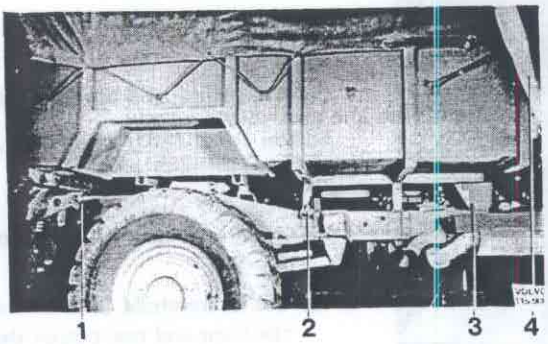


Fig. 43–139. Link between gearbox and auxiliary gearbox

3. Remove the link, Fig. 43–139, from the auxiliary gearbox. Remove the wire from the shift indicator, see Fig. 43–133, from the outer gear shaft housing.
4. Remove the evacution and vacuum hoses for the auxiliary gearbox control mechanism. Disconnect the electric cable for the auxiliary gearbox sender.
5. Unscrew the speedometer cable with 6128, Fig. 43–140.
   If the wire does not loosen from the bearing, remove the lock bolt for the bearing and remove the bearing from the auxiliary gearbox. Make sure dirt does not get into the gearbox.

   Fit the attaching plate 6129 to the cylinder head bolts and place lift tool 6136 as shown in Fig. 43–141.
6. Release the parking brake. Remove the rear propeller shaft from the auxiliary gearbox and differential carrier. Remove the front propeller shaft from the auxiliary gearbox. Remove the exhaust pipe outer attachment. Remove the bolts at the flange on the silencers. Remove the silencers and the rear exhaust pipe section.
7. Remove the propeller shaft brake drum. Remove the brake shoes. Disconnect the wire from the lever on the propeller shaft brake.



1. Bolting
2. Bolting
3. U-bolts
4. Hoist straps

Fig. 43–138. Removing the platform

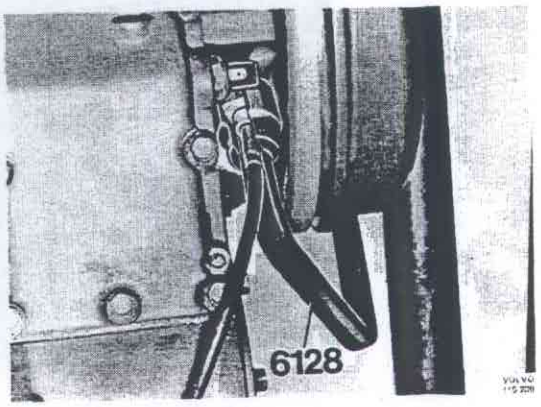


Fig. 43–140. Removing speedometer wire

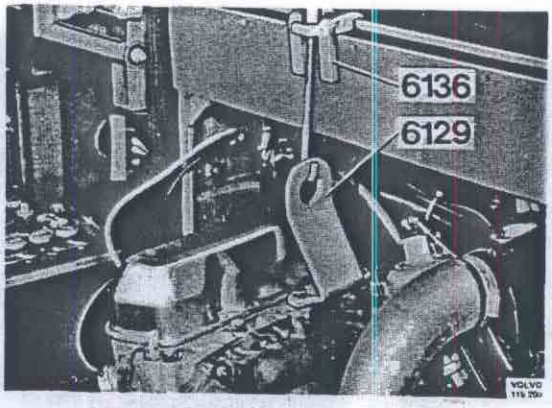


Fig. 43–141. Fitting the attaching plate

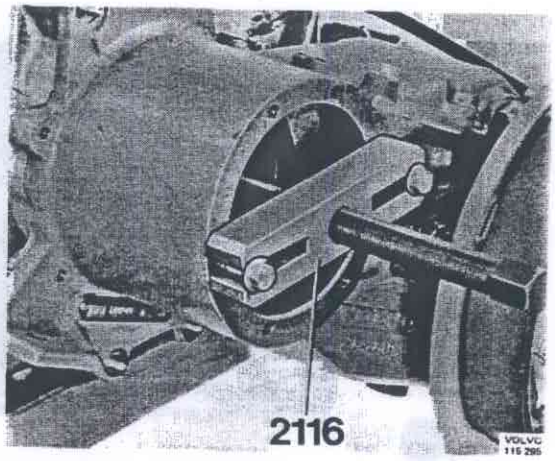


Fig. 43–144. Removing auxiliary gearbox

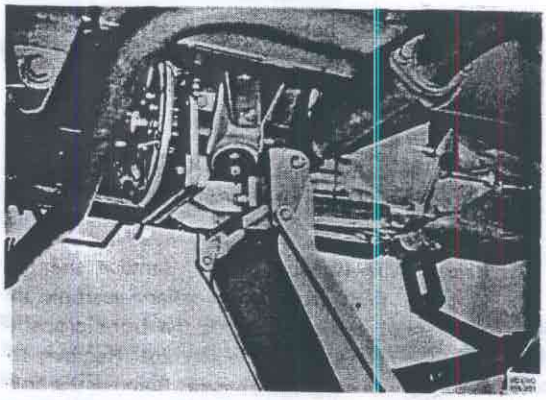


Fig. 43–142. Jack under auxiliary gearbox

8. Place the gearbox jack under the auxiliary gearbox gear assembly, see Fig. 43–142. Lower the jack so that the engine rests on its mounts. Remove the bolts securing the rear engine mounts. Lower the auxiliary gearbox. Remove the lower bolts holding the gearbox and auxiliary gearbox together.
   Use bracket 6137 (see Fig. 43–143) when removing the auxiliary gearbox with the help of a block and tackle.
9. Remove the rear cover. Remove the nut on the gearbox output shaft. Fit the puller tool 2116, Fig. 43–144.
10. Remove the bolts and nuts holding the gearbox and auxiliary gearbox together.
11. Screw in the puller tool spindle. Remove the tool. Lower the auxiliary gearbox when it has released from the gearbox. Lower the gearbox.

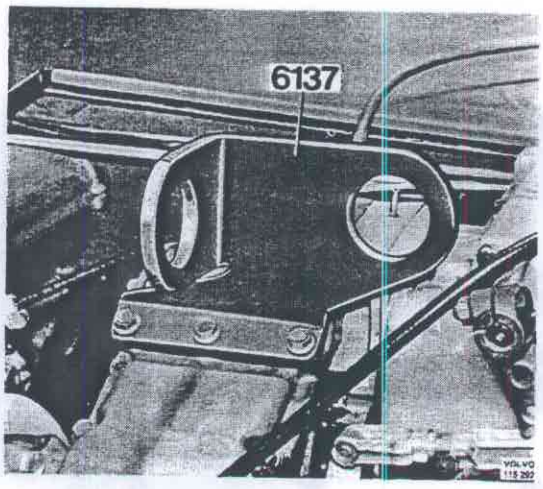


Fig. 43–143. Fitting the bracket

Disassembling the auxiliary gearbox

Special tools: 1801, 2039, 2097, 2261, 2267, 2291, 2337, 2395, 2837, 6140

1. Place the auxiliary gearbox in fixture 6140 and secure the unit on an overhaul stand, see Fig. 43–145.
2. Use counterhold 2837 and remove the nuts on the front and rear output shafts. NOTE! Take a firm hold of the tool when slackening the nut (otherwise the control mechanism can get damaged).

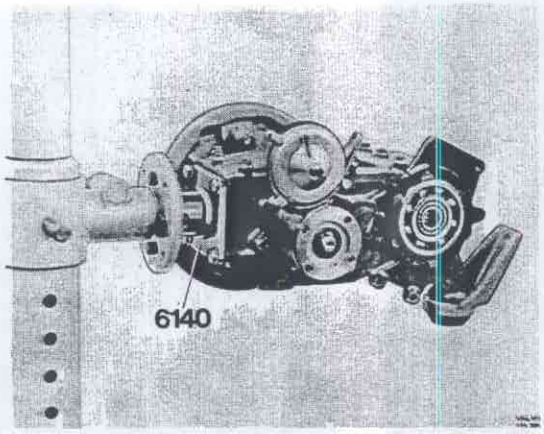


Fig. 43–145. Auxiliary gearbox in vice

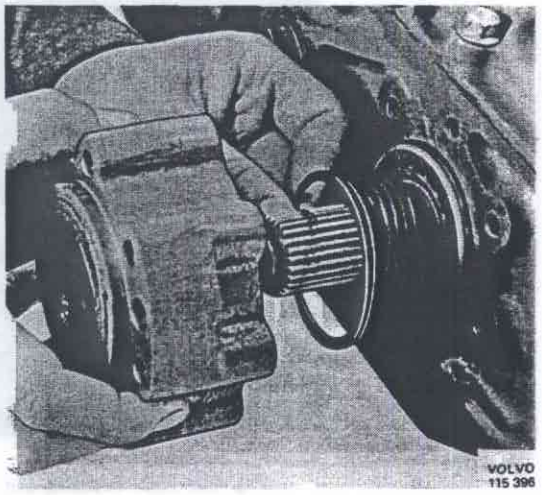


Fig. 43–147. Removing rear housing half

Remove the flanges with 2261, Fig. 43–146.

3. Remove the propeller shaft brake backing plate.
4. Remove the rear housing and the shims, Fig. 43–147. Remove the speedometer pinion.
5. Remove the control housing for the front wheel drive.
6. Remove the cover on the auxiliary gearbox, Fig. 43–148.
7. Remove the nut on the intermediate gear shaft, Fig. 43–149. (If necessary use a shift spanner as counterhold.)
8. Remove the circlip for the cluster gear bearing, Fig. 43–149. Place the auxiliary gearbox in a press with the rear part of the box resting on the press table. Check that the bearing for the output shaft runs freely. Use a drift with the same

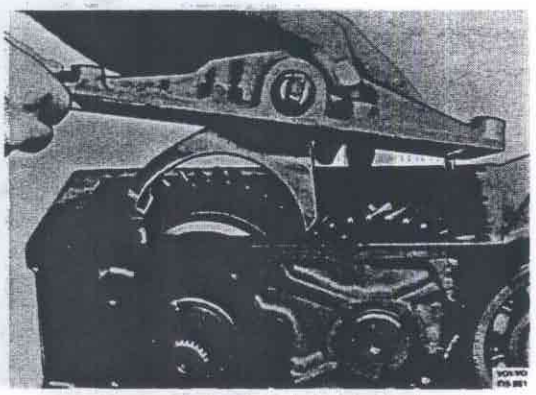


Fig. 43–148. Removing cover

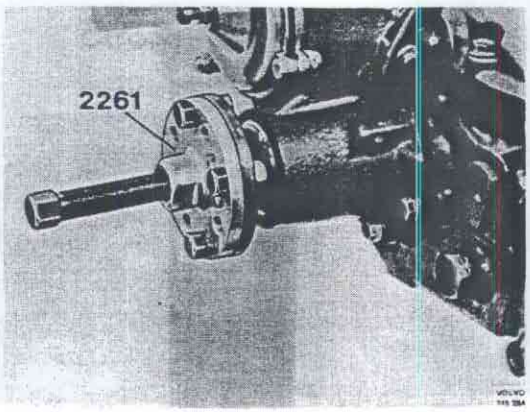


Fig. 43–146. Removing flange

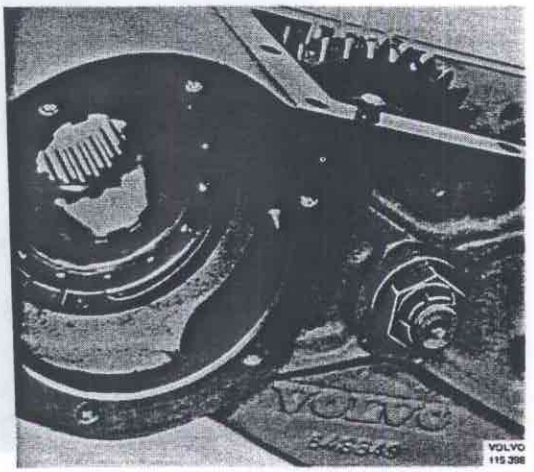


Fig. 43–149. Circlip cluster gear, nut, intermediate gear

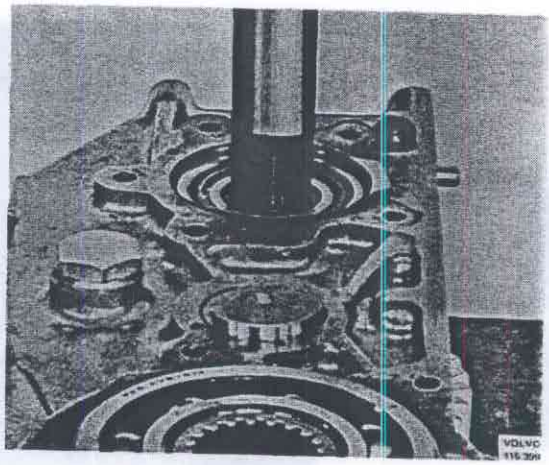


Fig. 43–150. Pressing out output shaft

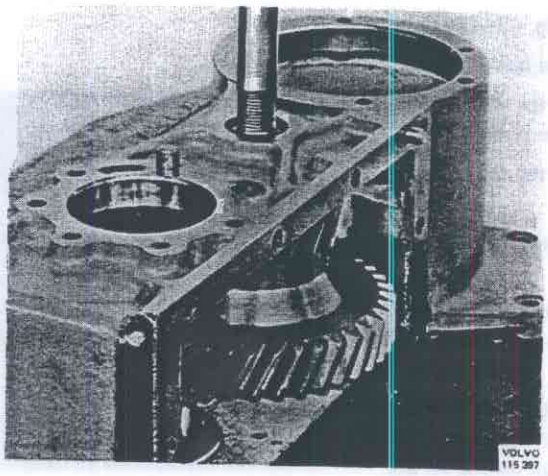


Fig. 43–151. Pressing out shaft, intermediate gear

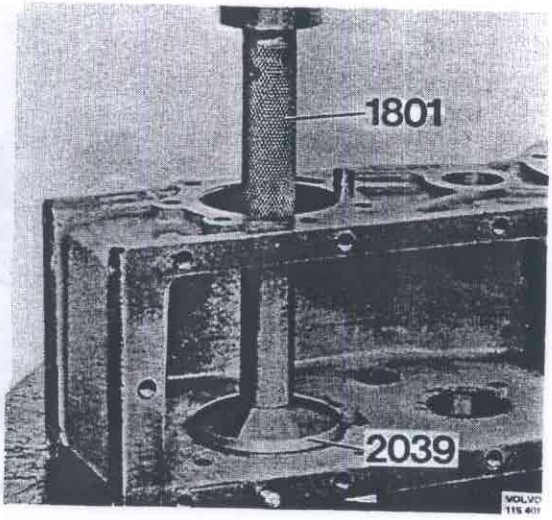


Fig. 43–153. Driving out outer races

diameter as that of the shaft, Fig. 43–150. Press out the shaft and take hold of it underneath. Take care of the outer race, output shaft and needle bearings. Lift out the synchronizing with the high and low speed gears, also the roller bearing.

9. Turn the auxiliary gearbox. Press out the intermediate gear shaft. Use a drift with the same diameter as that of the shaft, Fig. 43–151. Lift out the intermediate gear with bearing, spacer sleeve and shim.
10. Press out the cluster gear and bearing with 2291, Fig. 43–152.
11. Press out the outer race for the output shaft bearing with 1801 + 2039, Fig. 43–153.

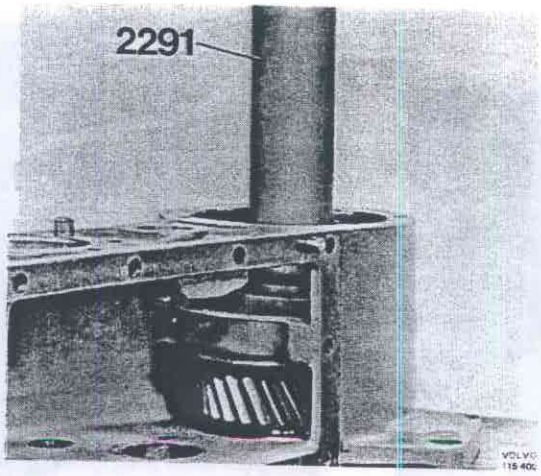


Fig. 43–152. Pressing out cluster gear

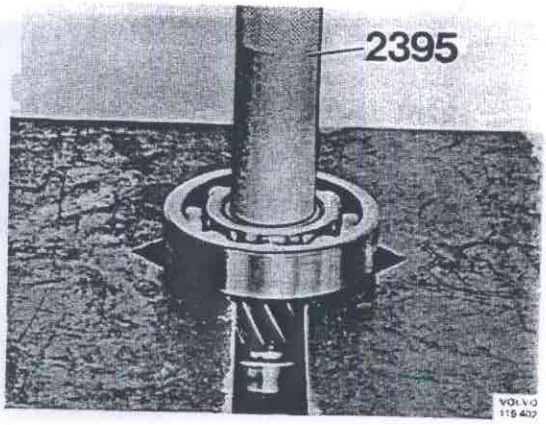


Fig. 43–154. Removing bearing

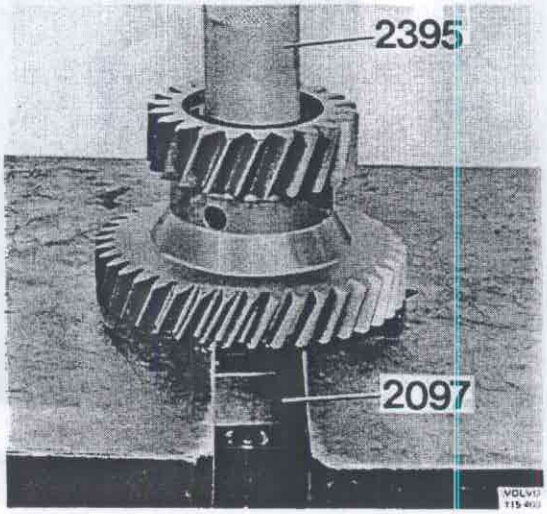


Fig. 43–155. Pressing out outer races

Disassembling the cluster gear

1. Place the cluster gear in a press, see Fig. 43–154, and press off the bearing with 2395.
2. Turn the gear and press off the other bearing with 2395.

Disassembling the intermediate gear

1. Remove the shims, spacer sleeve and inner race.
2. Press out the outer races from the intermediate gear with 2097 + 2395, Fig. 43–155.

Disassembling the synchronizing and output shaft gear

1. Remove the thrust washer, needle bearing and bearing race from the high speed gear wheel.

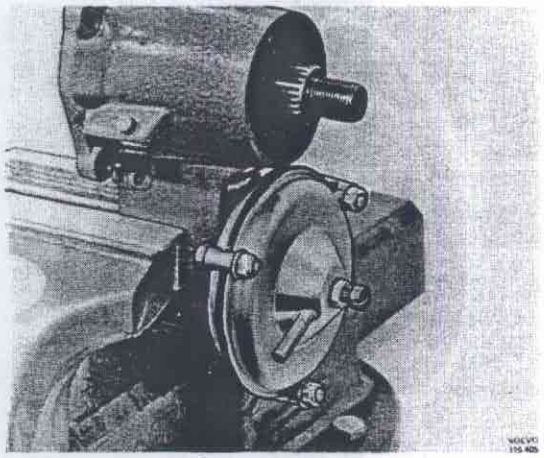


Fig. 43–157. Fitting control mechanism

2. Remove the gear wheel for the high speed and the synchronizing cone.
3. Remove the synchronizing from the low-speed gear wheel.
4. Disassemble the synchronizing.

Disassembling the output shaft

Place the shaft in a press with counterhold under the thrust washer, Fig. 43–156, and press off the bearing.

Disassembling the control mechanism

1. Fix the control mechanism securely in a vice, see Fig. 43–157.
2. Remove the bolts securing the cover to the control cylinder. Remove the cover and the thrust spring, Fig. 43–158.

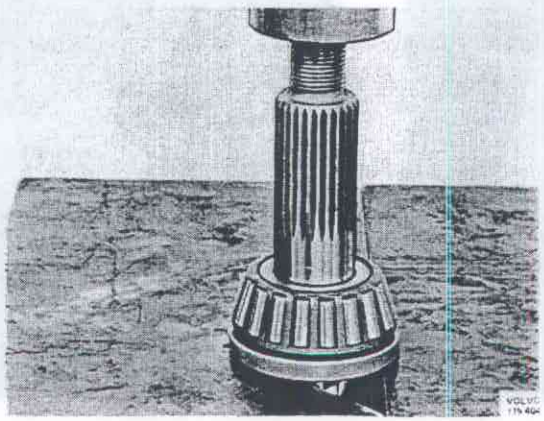


Fig. 43–156. Removing bearing

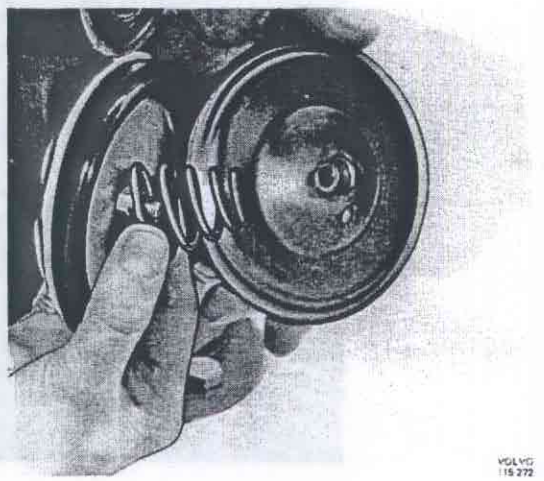


Fig. 43–158. Removing cover and spring

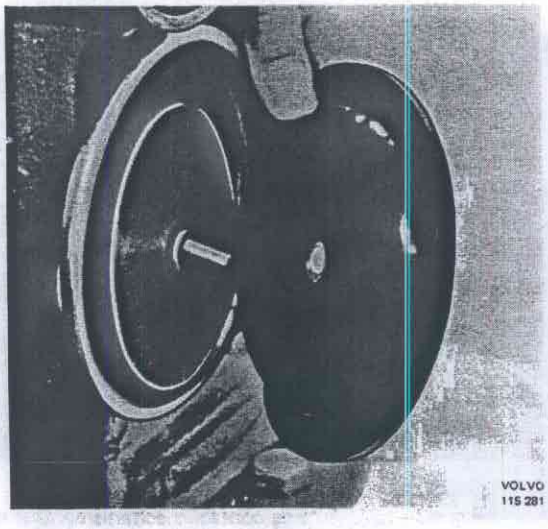


Fig. 43—159. Removing diaphragm

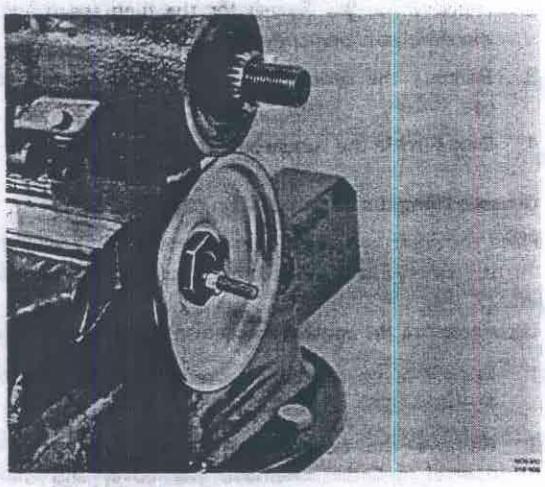


Fig. 43—160. Holed nut

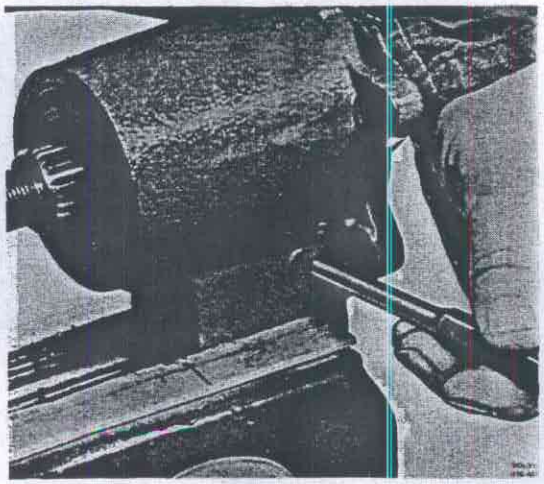


Fig. 43—161. Driving out shaft

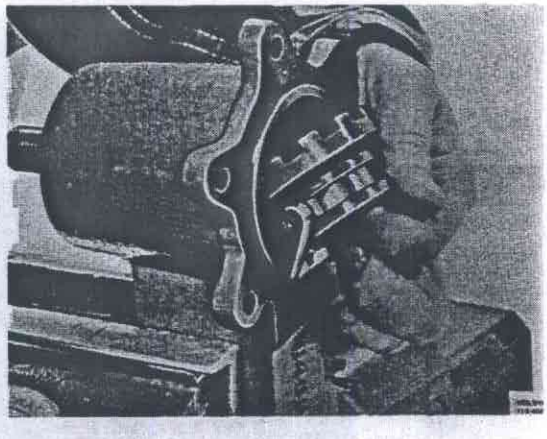


Fig. 43—162. Removing engaging sleeve

3. Remove nut on the push rod. Remove the washer and the diaphragm, Fig. 43—159. Take care of the spacer washer on the push rod and remove the other washer.
4. Remove the holed nut securing the control cylinder, Fig. 43—160.
5. Drive out the shaft holding the selector fork, Fig. 43—161. Note that the shaft can only be driven out in one direction, see Fig.
6. Remove the engaging sleeve and the selector fork, Fig. 43—162.
7. Drive out the output shaft with a plastic mallet. Drive out the seal with 2337, Fig. 43—163.
8. Remove the circlips, Fig. 43—164. for the bearing and press out the bearing with 2267.

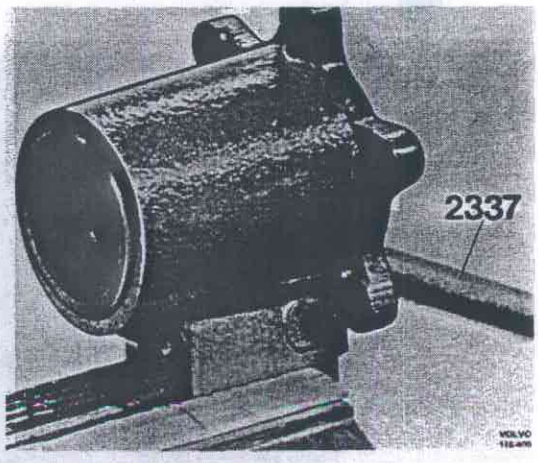


Fig. 43—163. Driving out seal

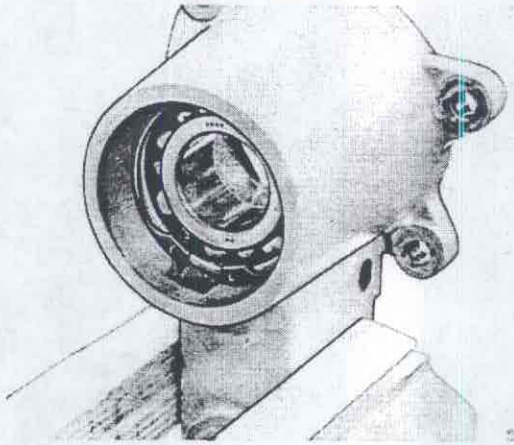


Fig. 43–164. Pressing out bearing

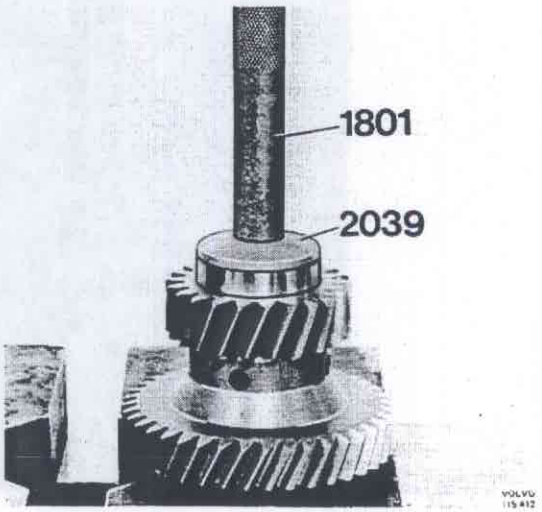


Fig. 43–166. Pressing in outer race

Checking and replacing parts

Clean all parts and check for damage and wear. All damaged or worn parts should be replaced. Sealing rings, O-rings and gaskets, etc., should always be replaced. When replacing sealing rings, always make sure that the surfaces which perform the sealing are carefully checked. If these are scored or damaged, then the seal in question should be replaced.

Assembling the auxiliary gearbox

Special tools: 1801, 1845, 2014, 2022, 2039, 2267, 2291, 2395, 2837, 6108, 6109, 6110, 6111, 6120, 6122.

In certain places the auxiliary gearbox has shims of alternative thicknesses as well as circlips in order to obtain correct clearance. Fig. 43–165 a shows where these places are.

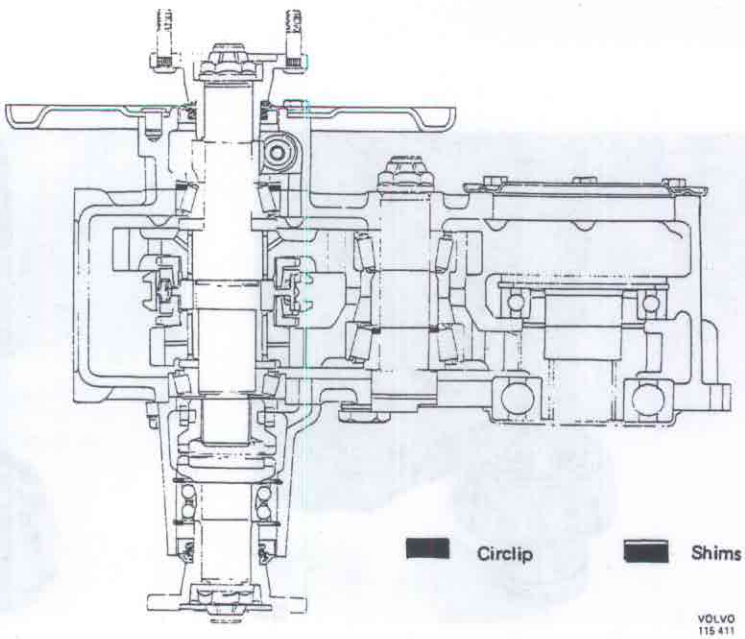


Fig. 43–165. Alternative shims and circlips in auxiliary gearbox

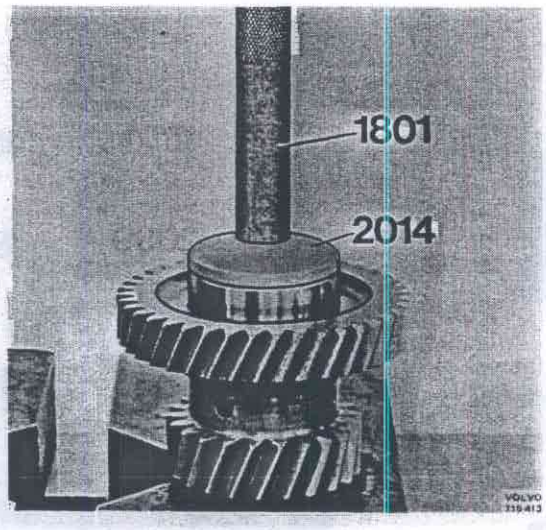


Fig. 43–167. Pressing in outer race

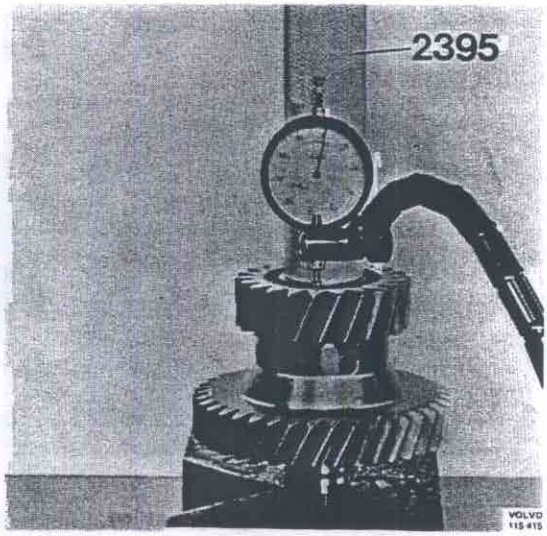


Fig. 43–169. Checking clearance

Assembling the intermediate gear

1. Press in the new outer races with 2014 or 2039 + 1801, Figs. 43–166 and 43–167.
2. Place the large bearing on the shaft for the intermediate gear.
3. Place the same number of shims that were removed plus a shim of about 0.2 mm (0.008") on the shaft. Fit spacer sleeve as shown in Fig. 43–168 with the bevelled end upwards.
4. Oil the bearing and fit the intermediate gear and the small bearing (oiled).
5. Place the intermediate gear complete in a press and fit 2395 on the small bearing inner race, Fig. 43–169. Press on the bearing using a force of about 1 ton. Check the axial clearance of the gear with a dial indicator. The clearance should be $^{+0.01}_{+0.06}$ mm ($^{+0.0004}_{+0.0024}$"). Remove the requiste number of shims in order to get the proper clearance.

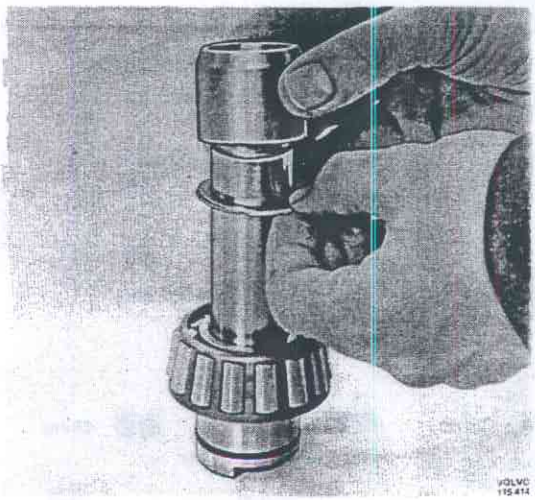


Fig. 43–168. Fitting spacer sleeve

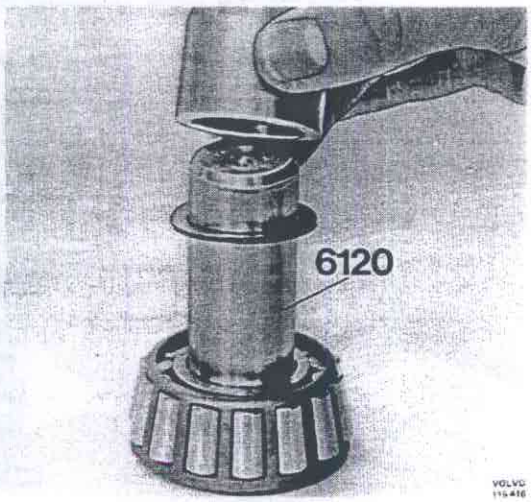


Fig. 43–170. Fitting spacer sleeve

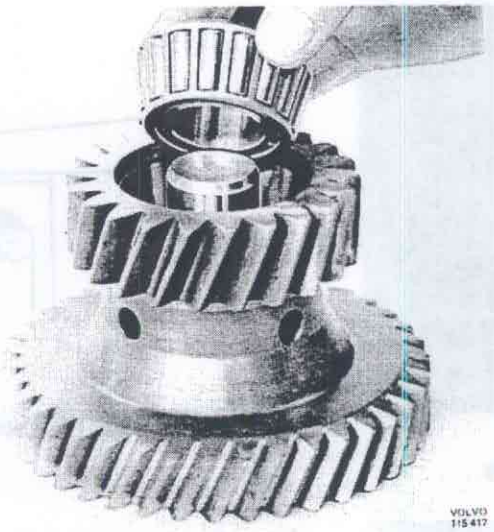


Fig. 43–171. Fitting bearing

6. Place 6120 on a flat base and fit on the large bearing, Fig. 43–170. Fit the requisite number of shims according to point 5 and the spacer sleeve.
7. Fit the intermediate gear and the small bearing, Fig. 43–171.

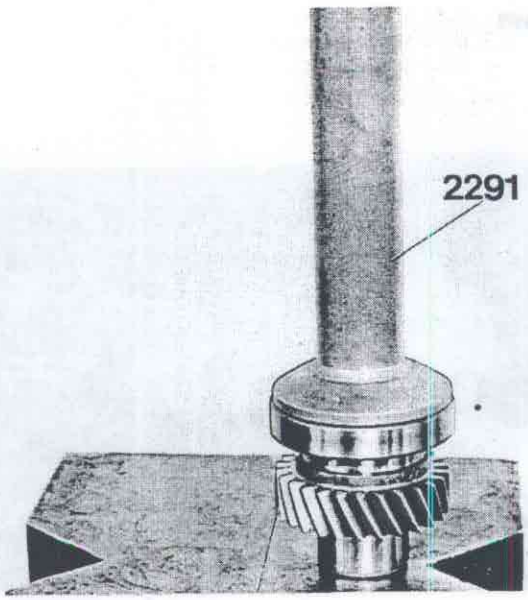


Fig. 43–172. Pressing on bearing

Fig. 43–173. Assembling synchronizing

Assembling the cluster gear

1. Press the small ball bearing first on the shaft (on the side where the shaft has lands) with 2291, Fig. 43–172.
2. Press on the large ball bearing with 2291.

Assembling the synchronizing

1. Place the synchronizing hub on a flat base. Fit the engaging sleeve.
2. Fit the interlock units in position and fit the spring, Fig. 43–173.
3. Fit the other spring so that it does not come on the same interlock body, Fig. 43–174.

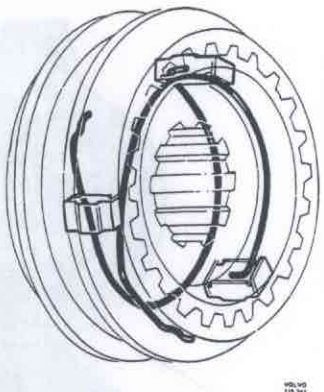


Fig. 43–174. Placing springs

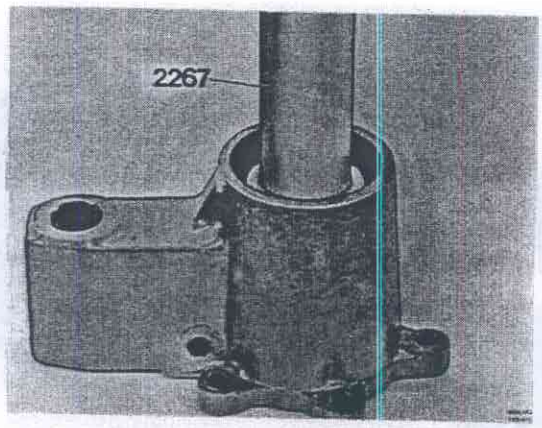


Fig. 43–175. Pressing in bearing

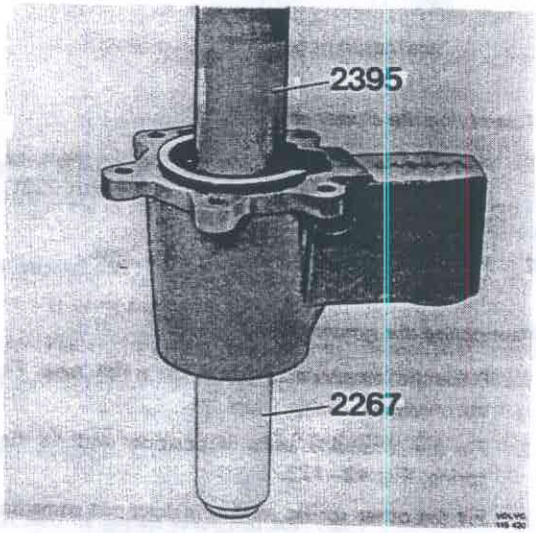


Fig. 43–176. Pressing in output shaft

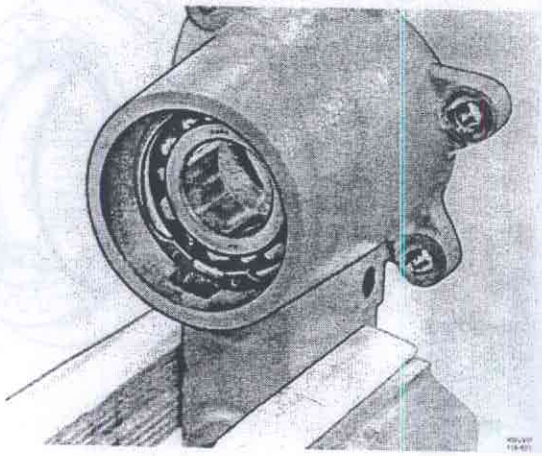


Fig. 43–177. Rear bearings circlip

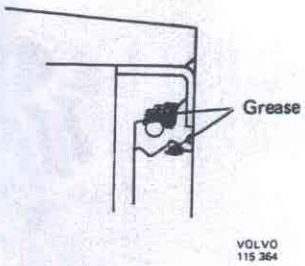


Fig. 43–178. Placing grease

Assembling the control mechanism

1. Fit the inner circlip (thickness 2.0 mm = 0.08") in position in the housing. Press in the bearing with 2267, Fig. 43–175.
2. Press in the output shaft. Use 2395 and place 2267 as a counterhold under the bearing, Fig. 43–176.
3. Fit the outer circlip. Circlips are available in thicknesses of 1.9 and 2.0 mm (0.076 and 0.080"), and use the circlip which gives the smallest clearance. Note that the opening of the circlip should be placed at the oil channel in the housing, Fig. 43–177.
4. Coat the contact surface for the seal in the housing with sealing agent..

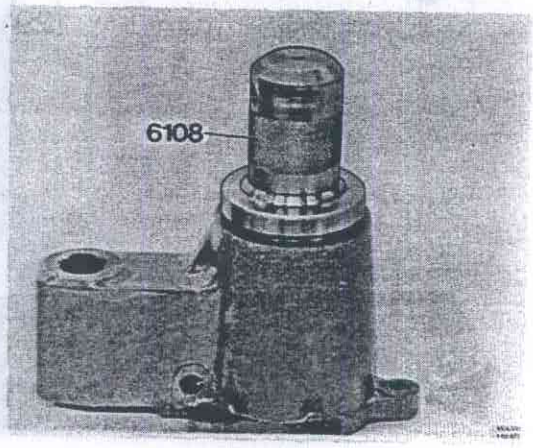


Fig. 43–179. Pressing in seal

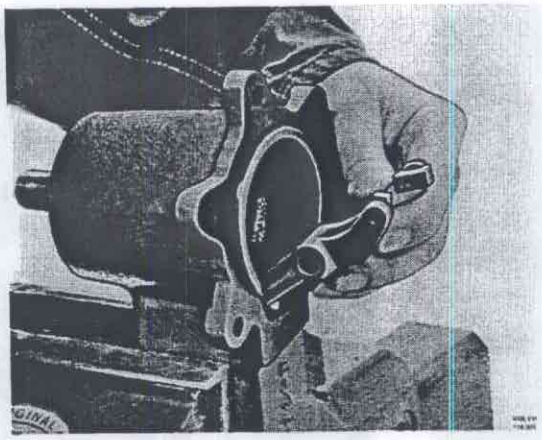


Fig. 43–180. Fitting selector fork

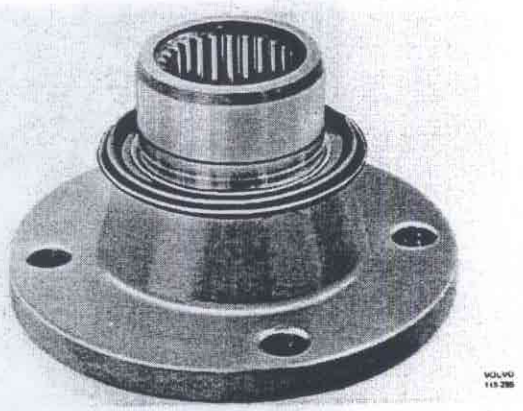


Fig. 43–182. Flange seal

5. Fill about a fourth of the space between the sealing lips and the space between the spring on the reverse side of the sealing lip with grease, Fig. 43–178. Press the seal into the housing with 6108, Fig. 43–179.
6. Secure the control mechanism in a vice. Fig. 43–180.
7. Fit the pins in the selector fork and place the fork and flange in the housing, Fig. 43–181. Coat the shaft holding the selector fork with sealing agent and drive it into the housing.
8. Place the bottom of the control cylinder and the copper washer on the holed nut. Tighten the cylinder to the control mechanism.
9. Fit a new seal on the flange, see Fig. 43–182, and grease the flange wear surface.
10. Pull on the flange with 1845, see Fig. 43–183. Remove 1845 and fit counterhold 2837, see Fig. 43–184. Fit the flange nut and tighten it to a torque of 100–120 Nm (10–12 kpm = 72–87 lbftf).

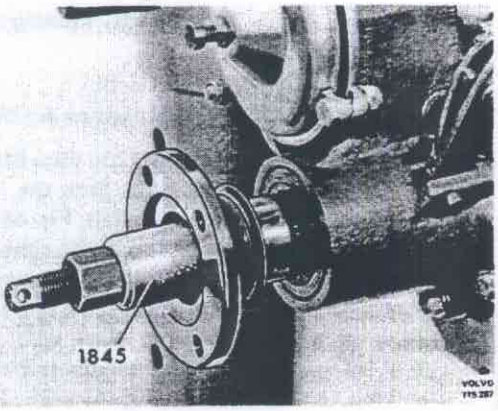


Fig. 43–183. Pressing on flange

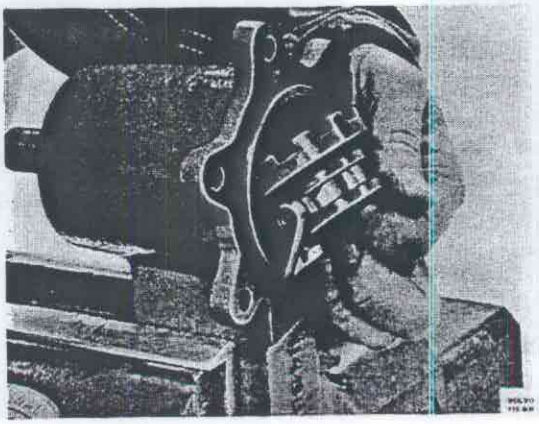


Fig. 43–181. Fitting flange

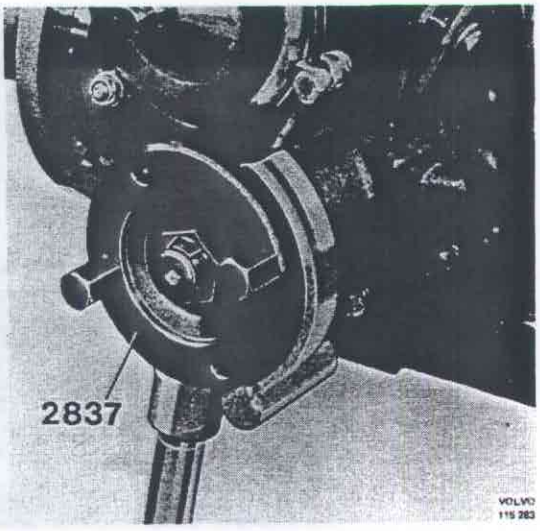


Fig. 43–184. Fitting counterhold

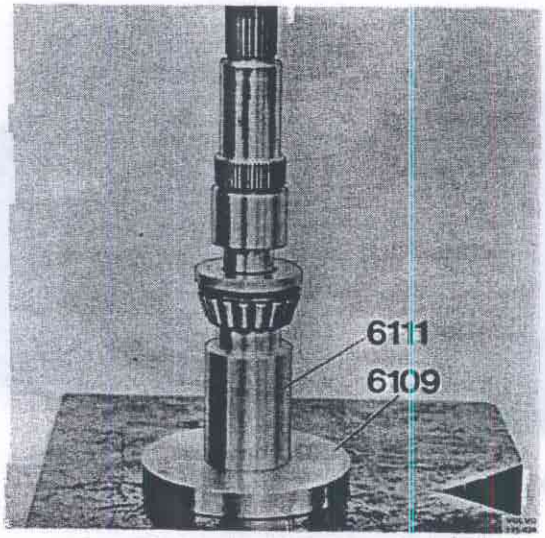


Fig. 43–185. Pressing on bearing

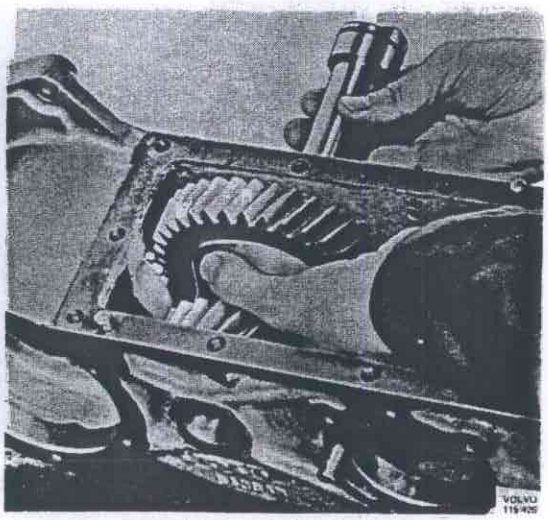


Fig. 43–187. Fitting intermediate gear shaft

Assembling other parts on auxiliary gearbox

1. Place drift 6111 in plate 6109 and place them on the press table. Press the inner race and washer on the output shaft, Fig. 43–185.
   Fit the circlip for the cluster gear bearing in the housing. The circlip should be fitted with the dished side facing the bearing. Place the auxiliary gearbox in a press with the rear end resting against the press table. Press in the cluster gear with 2291, Fig. 43–186. Note that the bearing will lie about 8 mm (5/16") outside the face of the housing before the circlip is inserted.
2. Place the intermediate gear in the auxiliary gearbox, fit a new O-ring on the intermediate gear shaft and screw it tight in the guide sleeve, Fig. 43–187. Press in the shaft and remove the sleeve, Fig. 43–188.
3. Turn the auxiliary gearbox and fit a new O-ring on the shaft. Fit the washer and nut.
4. Oil the needle bearing for the output shaft low-speed gear and place it on the gear. Place the synchronizing unit with gears in the auxiliary gearbox, Fig. 43–189.

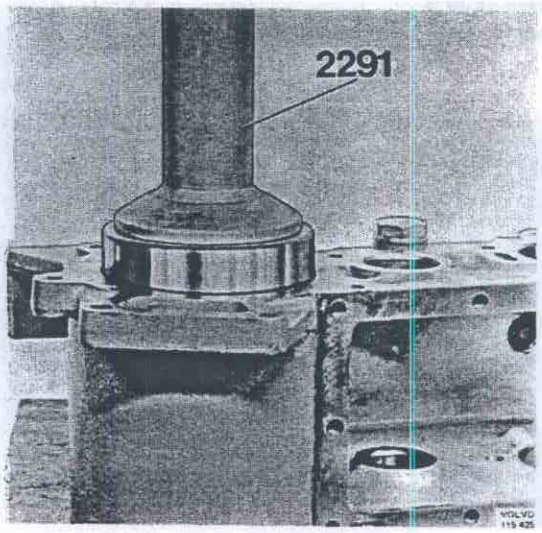


Fig. 43–186. Pressing in cluster gear

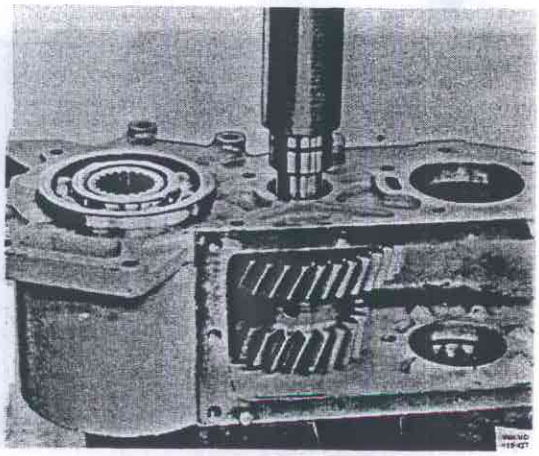


Fig. 43–188. Pressing in intermediate gear shaft

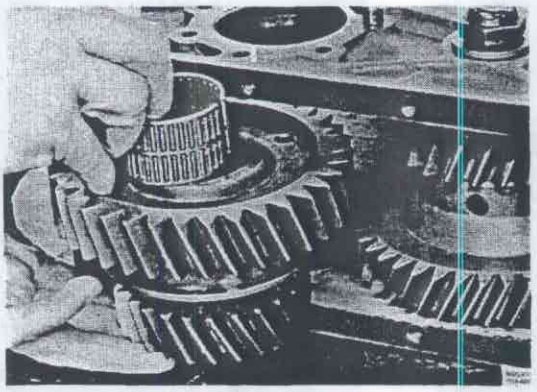


Fig. 43–189. Placing gears in aux. gearbox

5. Fit the drift 6110 in the plate 6109 and place them on the press table. Place the auxiliary gearbox on the drift, with the synchronizing hub resting against the drift, Fig. 43–190. Support under the box so that it is horizontal.
6. Fit the output shaft, rotate the shaft so that the lands on the shaft enter the hub. Press in the shaft, Fig. 43–191.
7. Remove the auxiliary gearbox. Replace the drift with 6111 and fit the ring 6122 on the drift. Turn the auxiliary gearbox and place it on the drift with ring 6122 resting against the rear bearing inner race, Fig. 43–192. Support under the auxiliary gearbox.
8. Check to make sure the synchronizing cone for the high speed is properly fitted in the hub. Fit the needle bearing inner race on the shaft and press it in with 6110, Fig. 43–193. Oil the

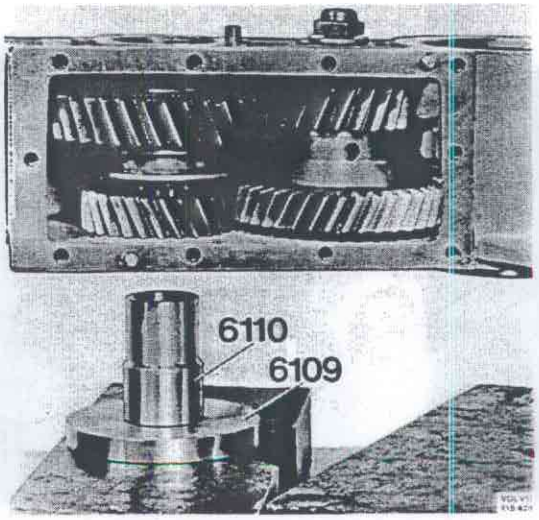


Fig. 43–190. Placing aux. gearbox on counterhold

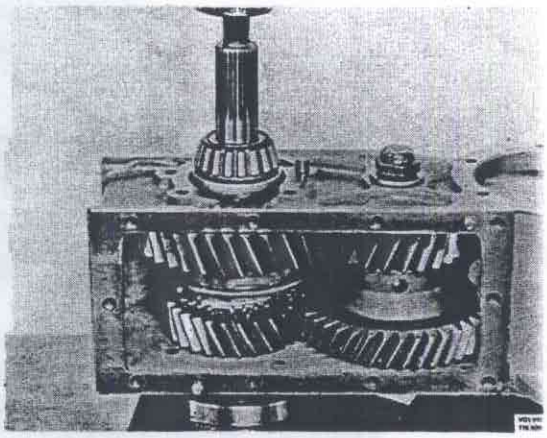


Fig. 43–191. Pressing in output shaft

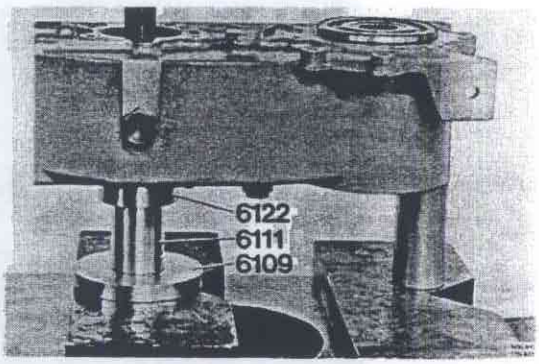


Fig. 43–192. Placing aux. gearbox

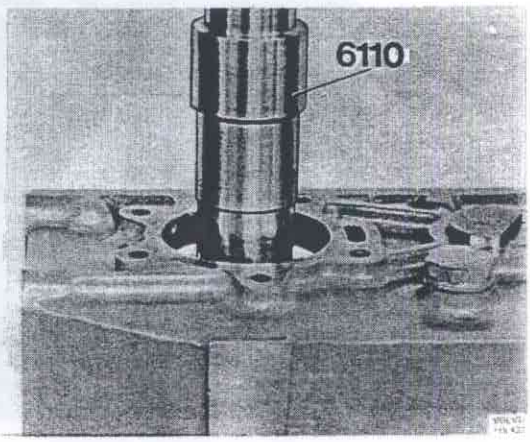


Fig. 43–193. Pressing on inner race

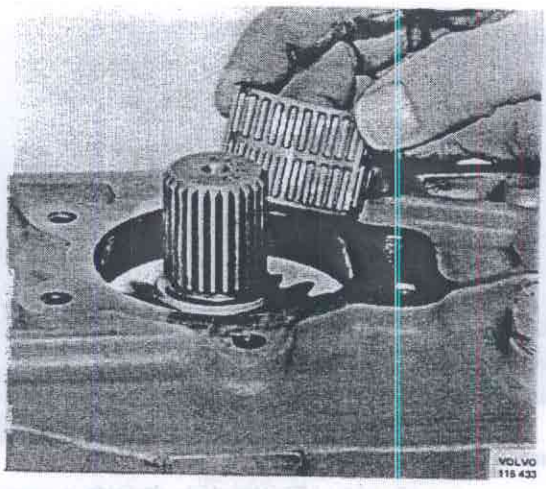


Fig. 43–194. Fitting needle bearings

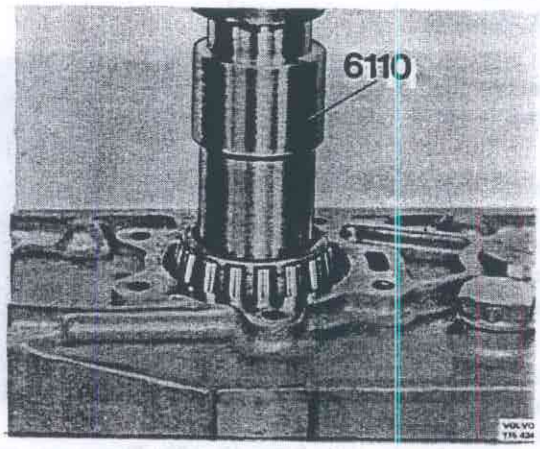


Fig. 43–195. Pressing on inner race

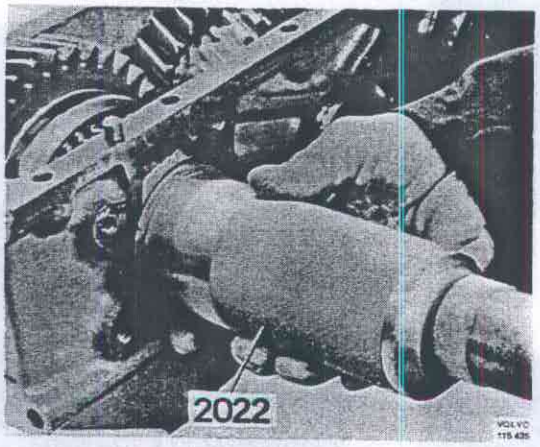


Fig. 43–196. Driving in outer race

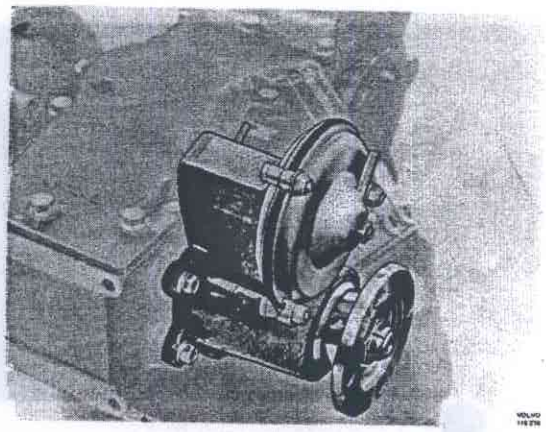


Fig. 43–197. Fitting control mechanism

needle bearings and fit them in position, Fig. 43–194.

9. Fit the axial washer and the front bearing inner race on the shaft, with the inner bevel of the washer facing upwards. Press them on with 6110, Fig. 43–195.
   Fix the auxiliary gearbox in fixture 6140.
10. Drive in the outer race for the output shaft front bearing with 2022, Fig. 43–196. The race should lie about 2 mm (0.08") on the inside of the housing.
11. Coat the control mechanism contact surface with sealing agent and fit it securely in the auxiliary gearbox, see Fig. 43–197. Tighten the bolts to a torque of 20–25 Nm (2.0–2.5 kpm = 14–18 lbftf).
    The engagement of the control mechanism should always be checked. See under "Adjusting the control mechanism".

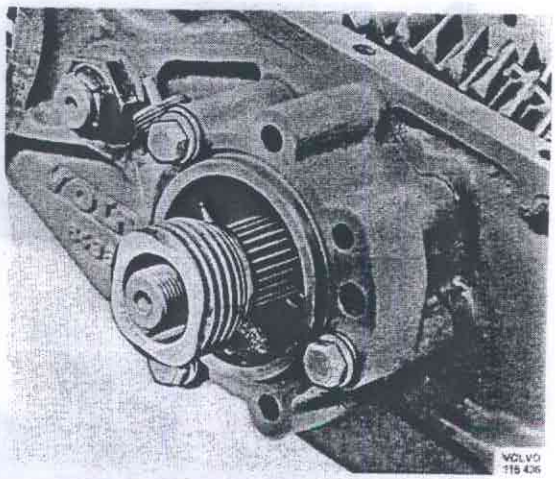


Fig. 43–198. Fitting rear housing half

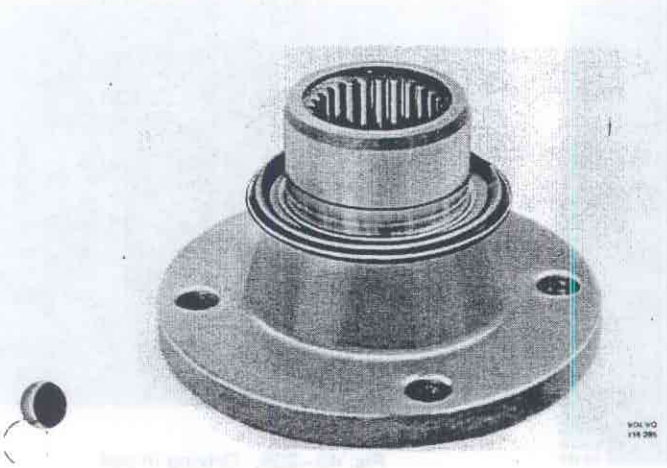


Fig. 43–199. Flange seal

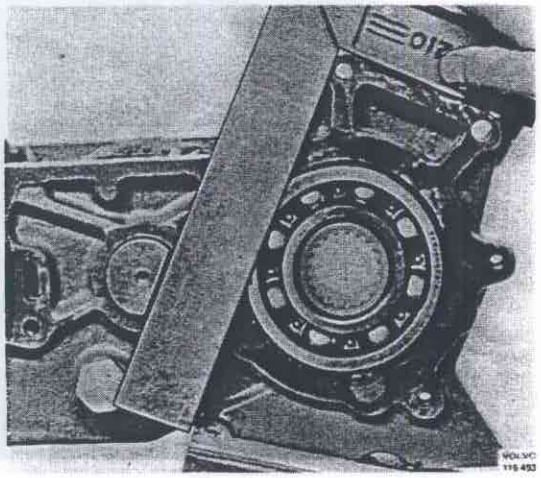


Fig. 43–201. Adjusting shaft

12. Place shims in the rear housing (use those shims removed during disassembling less one shim). Place the outer race in the housing. Fix the housing in position with the three bolts, using double washers under the bolts, Fig. 43–198.
13. Fit the speedometer pinion with the tapered part facing the rear bearing, Fig. 43–198. Fit a new seal on the flange, Fig. 43–199. Pull on the flange with 1845, Fig. 43–200. Coat the sealing lip with grease. Remove the press tool and tighten up the nut. Tighten the nut to a torque of 100–120 Nm (10–12 kpm = 72–87 lbftf).
14. Remove the auxiliary gearbox from the press and place it in a vice. Rotate the intermediate gear shaft so that the stop lug is at an angle of about 90° in relation to the connection face against the gearbox, Fig. 43–201. Tighten the nut for the shaft to a torque of 100–120 Nm (10–12 kpm = 72–87 lbftf).

Rotate the output shaft. Check the shaft's axial clearance with a dial indicator, Fig. 43–202. Place the point of the indicator against the shaft pin. The axial clearance may be $^{+0.08}_{+0.03}$ mm. ($^{+0.0032''}_{+0.0012''}$). The difference between the obtained and permitted measurement is the measurement for the number of shims requires. Shims are available in the following sizes: 0.1, 0.15, 0.35 and 0.50 mm (0.004, 0.006, 0.014 and 0.020").

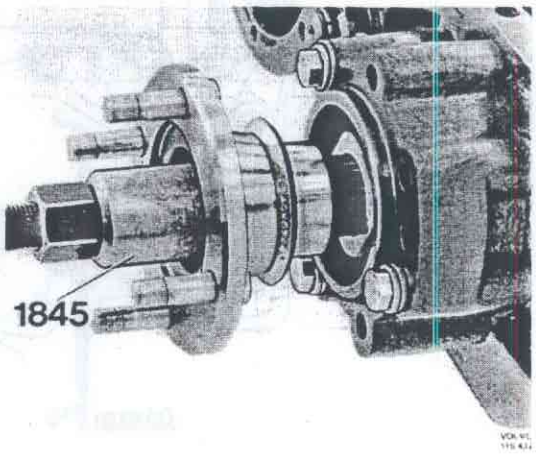


Fig. 43–200. Pressing on flange

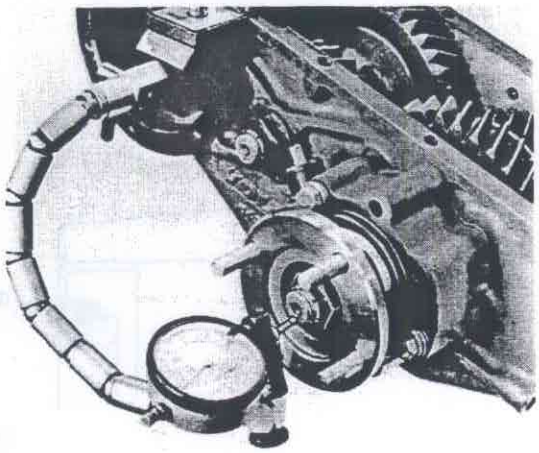


Fig. 43–202. Checking axial clearance

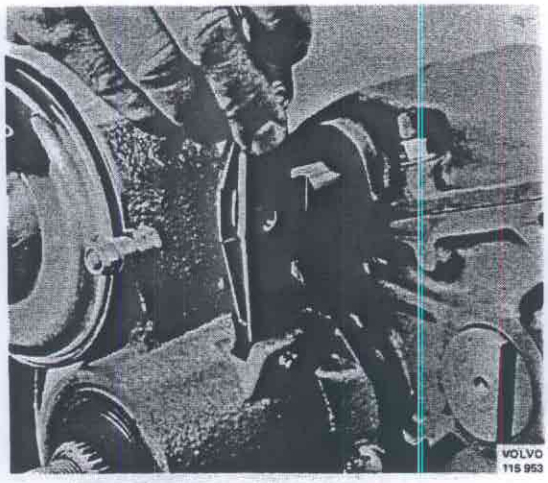


Fig. 43–203. Placing the lever

Fig. 43–205. Driving in seal

16. Remove the indicator and remove the rear flange with 2261. Remove the rear cover and the shims. If the lever has been removed, fit it according to Fig. 43–203.
17 Coat the sealing ring seat in the rear housing with sealing agent. Fill 1/4 of the space between the seal lips with grease, Fig. 43–204. Fit the seal on drift 6108 and drive the seal into the housing, Fig. 43–205. Remove the drift and grease the seal slide surfaces.
18 Coat the contact surface of the housing with sealing agent. Place the correct number of shims according to point 15 in the housing and fix the housing on the auxiliary gearbox.
19. Fit the backing plate for the propeller shaft brake. Fit a new seal on the flange and grease it. Pull on the flange and fit the nut and tighten it to a torque of 280–300 Nm (28–30 kmp = 202–217 lbftf).
20. Coat the contact surface on the selector shaft with sealing agent and fix the shaft on the auxiliary gearbox.

Adjusting the control mechanism

When adjusting the control mechanism the cover as well as the washer and diaphragm must be removed from the control cylinder.

1. Pull the pull rod so that the flange is in full mesh with the output shaft. Screw in the pull rod nut so that it is a bit on the inside of the holded nut. Fit the inner washer for the diaphragm on the rod. Press the washer against the holed nut. When the pull rod is pulled back and forth there should

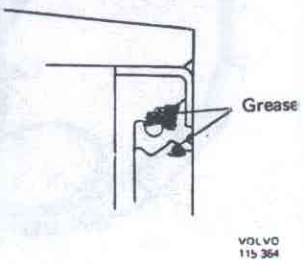


Fig. 43–204. Placing grease

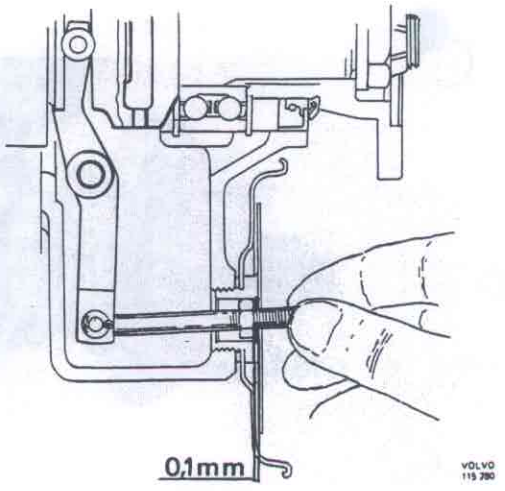


Fig. 43–206. Checking clearance

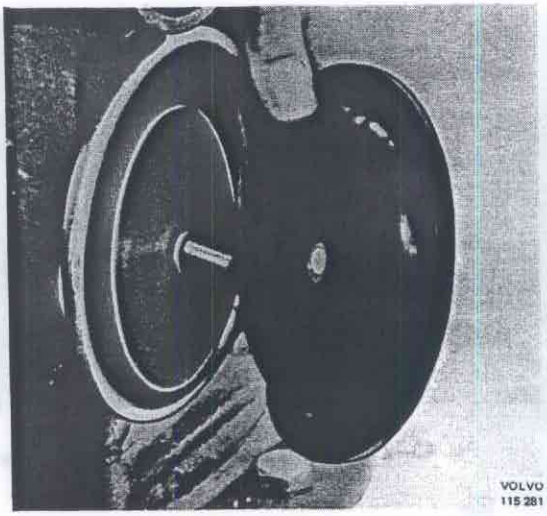
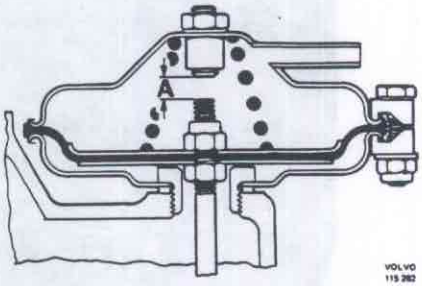


Fig. 43—207. Fitting diaphragm



A = 5 3/10 turns (8 mm)

Fig. 43—209. Screw in cover

be a clearance of about 0.1 mm (0.004"). If necessary, adjust so that the correct clearance is obtained, Fig. 43—206.

2. Fit the diaphragm and place the spacer washer in the centre of the diaphragm, Fig. 43—207. Fit on the outer washer and the lock nut. Hold the diaphragm and washer when tightening up the nut.
3. Fit the thrust spring, Fig. 43—208, and the cover. Fit the clamp bolts for the cover and make sure that they are distributed evenly round the cover.
4. Release the lock nut securing the bolt in the cover, Fig. 43—209. Screw the bolt to the bottom. Unscrew the bolt 5 3/10 turns (approx. 8 mm = 0.32") Tighten up the lock nut.

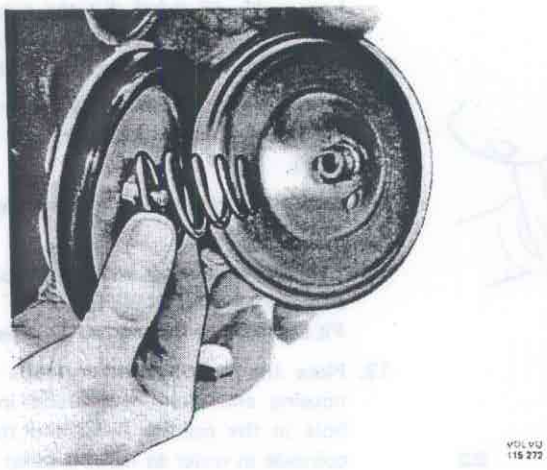


Fig. 43—208. Fitting spring and cover

Installing the auxiliary gearbox

Special tools: 2837, 6128, 6136

1. Place the auxiliary gearbox on the gearbox jack, Fig. 43—210. Check that the sleeve fot the gearbox output shaft can easily be pushed back and forth in the auxiliary gearbox gear cluster. If the sleeve is stiff, the lands must be ground with carburundum. Remove the sleeve.
2. Push the auxiliary gearbox on the jack in under the vehicle. Coat the surface of the auxiliary gearbox which is in contact with the standard gearbox with sealing agent. Jack up and fit the auxiliary gearbox to the gearbox. Fit the nuts round the auxiliary gearbox connection flange.

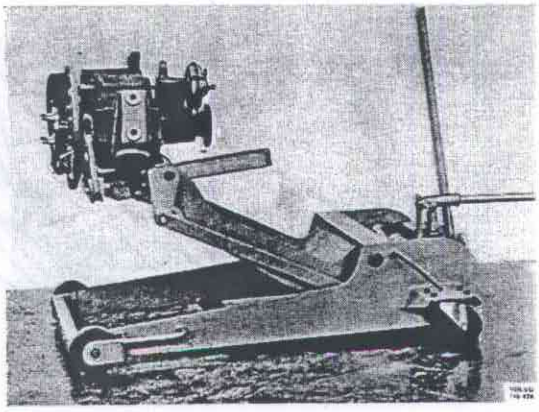


Fig. 43—210. Gearbox placed on jack

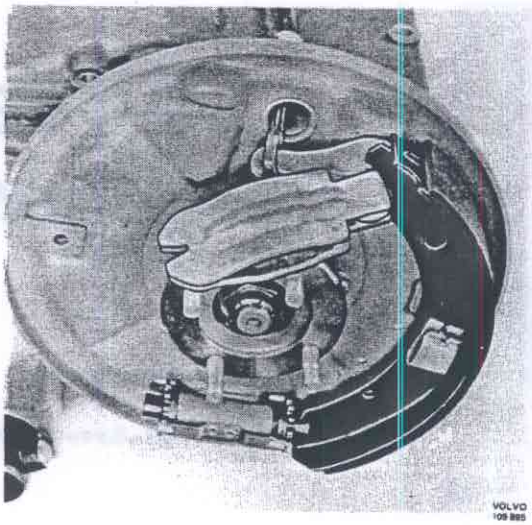


Fig. 43–211. Fitting the brakeshoe

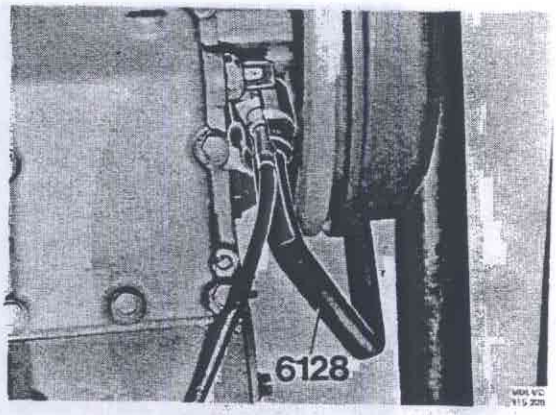


Fig. 43–213. Fitting speedometer wire

3. Fit the sleeve. Rotate the output shaft on the auxiliary gearbox while pushing in the sleeve at the same time. Engage low gear. Engage front wheel drive. Fit and tighten up the nut to a torque of 280–300 Nm (28–30 kpm = 202–217 lbftf). If necessary use 2837 on the control mechanism flange.
4. Coat the contact surface of the cover with sealing agent. Screw tight the cover. Fit the parking brake wire in position.
5. Fit the bolts for the rear engine mounts. Remove the jack.

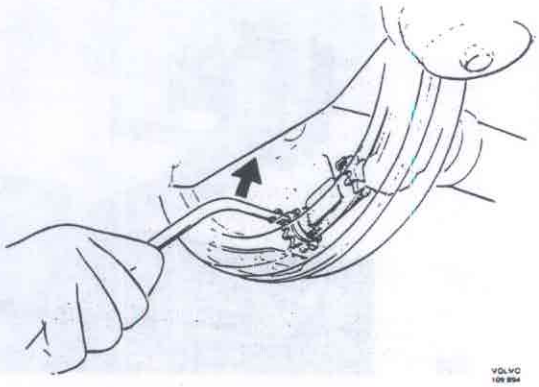


Fig. 43–212. Adjusting brake shoes

6. Assemble the propeller shaft brake. First fit the lower brake shoe. Then the lever (Fig. 43–211), the upper return spring, the upper shoe, the lower return spring and the drum.
7. Adjust out one of the brake shoes with a screwdriver, Fig. 43–212, until it is just possible to rotate the drum. The drum should be fixed with nuts. Slacken the adjuster screw until the drum rotates freely, but max. 5 teeth. Adjust the other brake shoe in the same way.
8. Check the movement of the parking brake lever. If the parking brake does not give full brake application at the 4th–5th ratchet, in spite of the fact that the propeller shaft brake has been properly adjusted, alter the length of the wire with the nut at its front end.
9. Fit the front and rear propeller shafts and tighten the bolts to a torque of 55–65 Nm (5,5–6,5 kpm = 40–47 lbftf). Fit the exhaust manifold. Fill the auxiliary gearbox with oil. Concerning quantity and quality, see under "Data".
10. Remove the hoist eyelet and tighten the cylinder head bolts to a torque of 90 Nm (9 kpm = 66.4 lbftf).
11. Screw tight the speedometer wire with 6128, Fig. 43–213.
12. Fit and connect up the evacvation and vacuum hoses to the control mechanism.
    Fit and connect up the cable to the sender.
13. Place the lever on the gearbox selector shaft housing and auxiliary gearbox in neutral. The hole in the gearbox lever and the link should coincide in order to make it easier to fit the lock pin, see Fig. 43–214. If necessary, adjust the link fork.

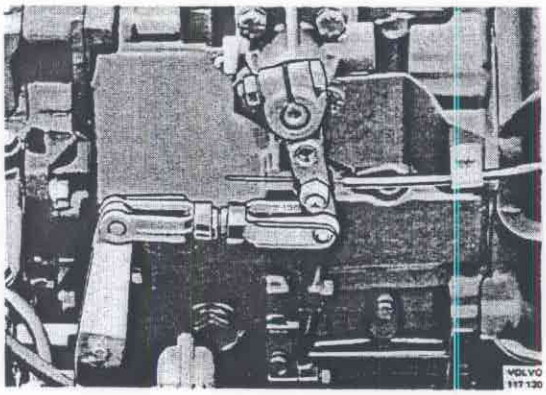
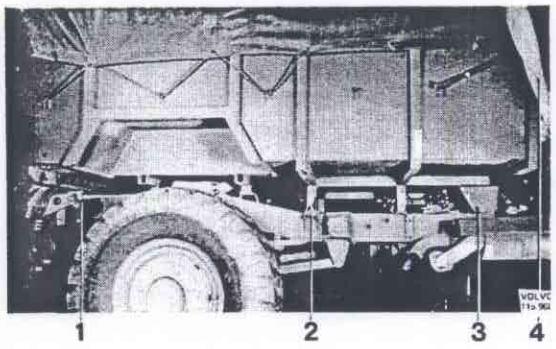


Fig. 43–214. Place the lever



1. Bolting
2. Bolting
3. U-bults
4. Hoist straps

Fig. 43–215 Fitting the platform

14. Place the wire fot the indicator in the gear shaft housing. Turn the indicator arrow to the zero position. Fix the wire to the gear shaft lever, see Fig. 43–214.
15. Place the platform in position, see Fig. 43–215, and tighten up the bolts and U-bolts.
16. Connect the earth connection to the battery and fit the cover.

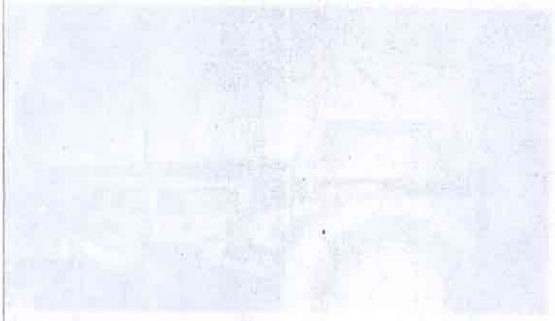
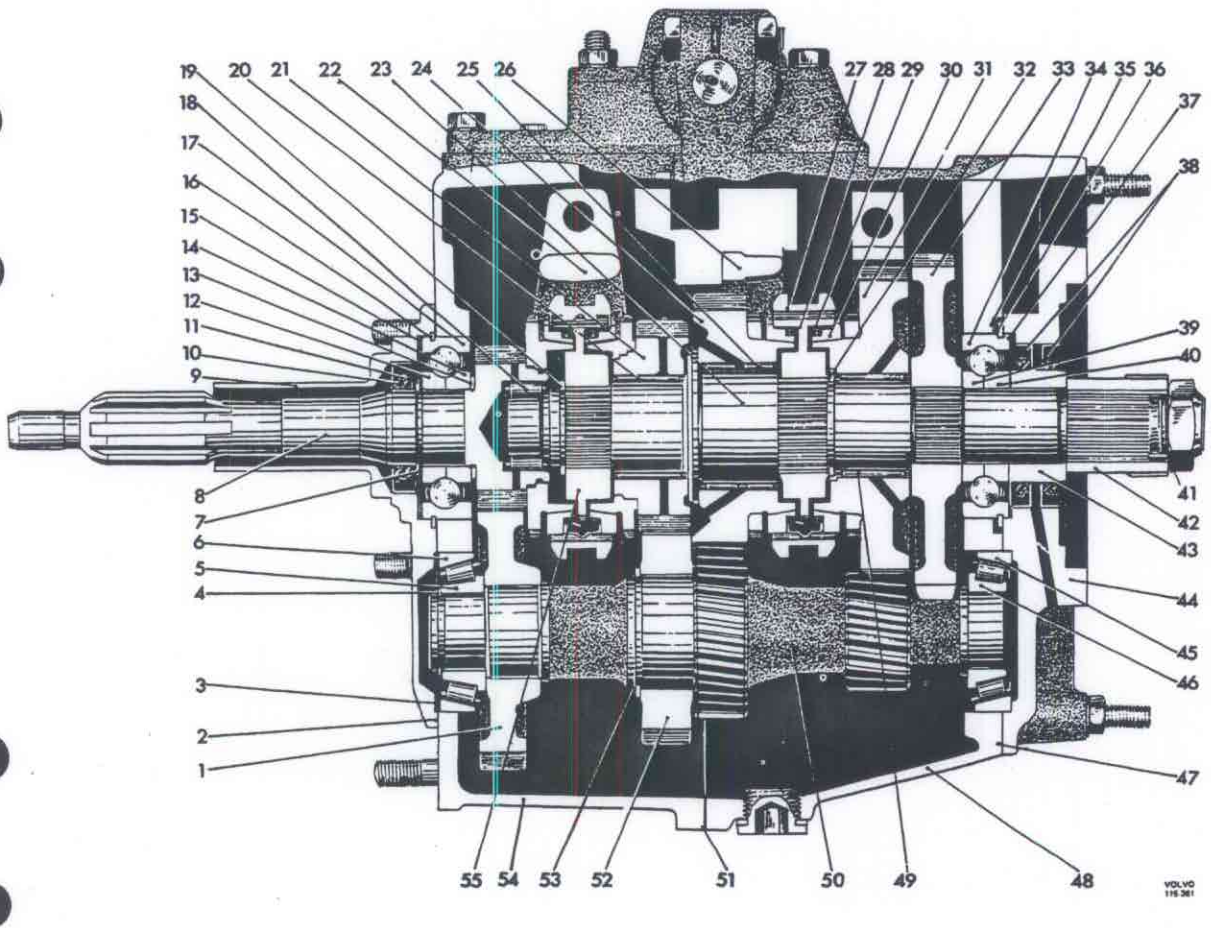


Illustration 43-A Gearbox

Gearbox

1. Gear
2. Gasket
3. Shim
4. Circlip
5. Inner race
6. Outer race
7. Shim
8. Input shaft
9. Sleeve10.
10. Seal
11. Circlip
12. Inner ring
13. Shim
14. Inner ring
15. Shim
16. Circlip
17. Ball bearing
18. Roller bearing
19. Circlip
20. Needle bearing
21. Gear, 3rd
22. Selector fork, 3rd—4th
23. Output shaft
24. Gear, 2nd
25. Needle bearing
26. Selector fork, 1st—2nd
27. Engaging sleeve, 1st—2nd
28. Hub, 1st—2nd
29. Spring
30. Cone
31. Gear, 1st
32. Circlip
33. Reverse gear
34. Ball bearing
35. Shim
36. Circlip
37. Shim
38. Seals
39. Inner race
40. Inner race
41. Nut
42. Gear
43. Wear ring
44. Rear cover
45. Outer race
46. Inner race
47. Gasket
48. Inner housing
49. Needle bearing
50. Intermediate shaft
51. Gasket
52. 3rd gear
53. Circlip
54. Outer housing
55. Hub, 3rd—4th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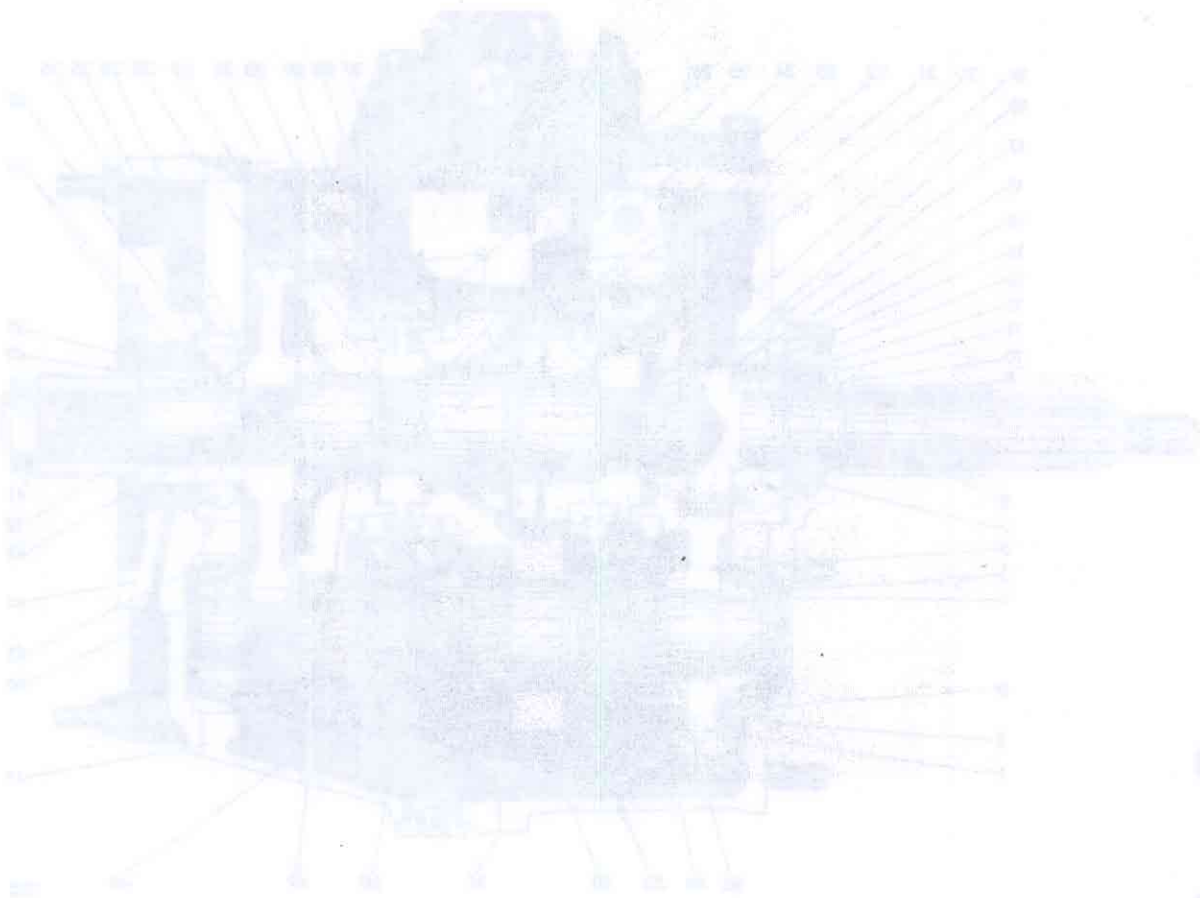

Illustration 43-B. Gearbox

Gearbox

1. Dowel
2. Selector fork, 3rd—4th
3. O-ring
4. Bearing pin, 3rd—4th
5. Washer
6. Bolt
7. Gear shift bar
8. Circlip
9. Gear shift bar
10. Shift fork, 1st—2nd
11. Bearing pin, 1st—2nd
12. Lever
13. Circlip
14. Washer
15. Seal
16. Bushing
17. Tubular pin
18. Shift fork, reverse
19. Bearing pin, reverse
20. Case
21. Seal
22. Seal
23. Bushing
24. Seal
25. Bushing
26. Inhibitor
27. Gasket
28. Selector shaft housing
29. Selector shaft
30. Inhibitor shaft
31. Spacer tube
32. Spring
33. Washer
34. Spacer tube
35. Spring
36. Washer
37. Circlip
38. Circlip
39. Pin
40. Selector shaft
41. Outer selector shaft housing
42. Reverse light contact
43. Sealing ring
44. Plug
45. Housing, outer
46. Ball
47. Spring
48. Pin
49. Seal
50. Rear cover
51. Seal
52. Shim
53. Gasket
54. Housing, inner
55. Bolt
56. Washer
57. Cover
58. Gasket
59. Plug
60. Washer
61. Gasket
62. Inhex bolt

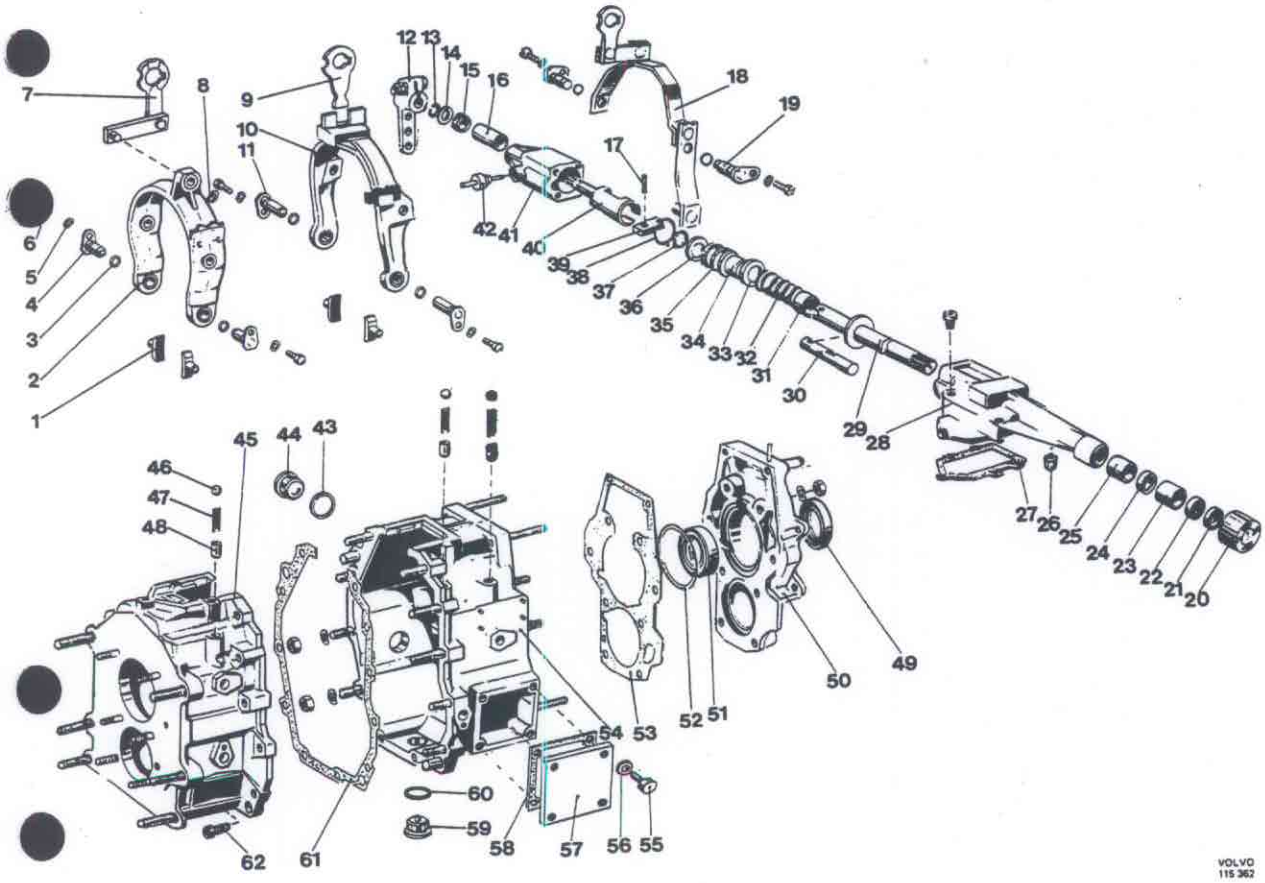
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Illustration 43-C.Gearbox

Gearbox

50. Front cover
51. Gasket
52. Sleeve
53. Seal
54. Circlip
55. Shim
56. Shim
57. Circlip
58. Inner ring
59. Bearing
60. Shim
61. Input shaft
62. Roller bearing
63. Circlip
64. Synchronizing cone
65. Spring
66. Inhibitor
67. Hub
68. Engaging sleeve
69. 3rd gear
70. Needle bearing
71. Output shaft
72. 2nd gear
73. Needle bearing
74. Cone
75. Hub
76. Engaging sleeve
77. Lock ring
78. 1st gear
79. Needle bearing
80. Reverse
81. Shim
82. Circlip
83. Shim
84. Wear ring
85. Drive
86. Nut
87. Circlip
88. Shim
89. Outer ring
90. Bearing
91. Drive gear
92. Circlip
93. 3rd gear
94. Intermediate shaft
95. Bearing
96. Outer ring
97. Gear
98. Reverse shaft

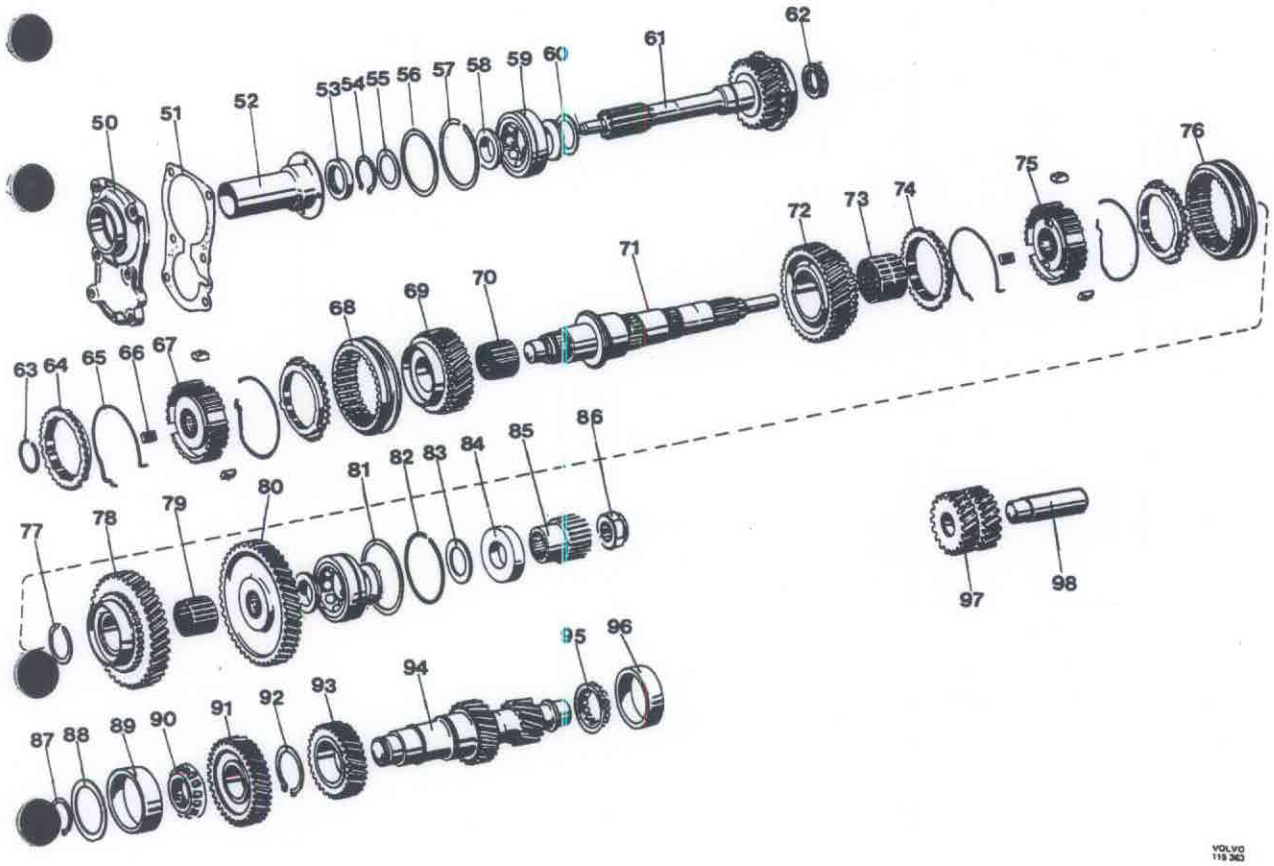
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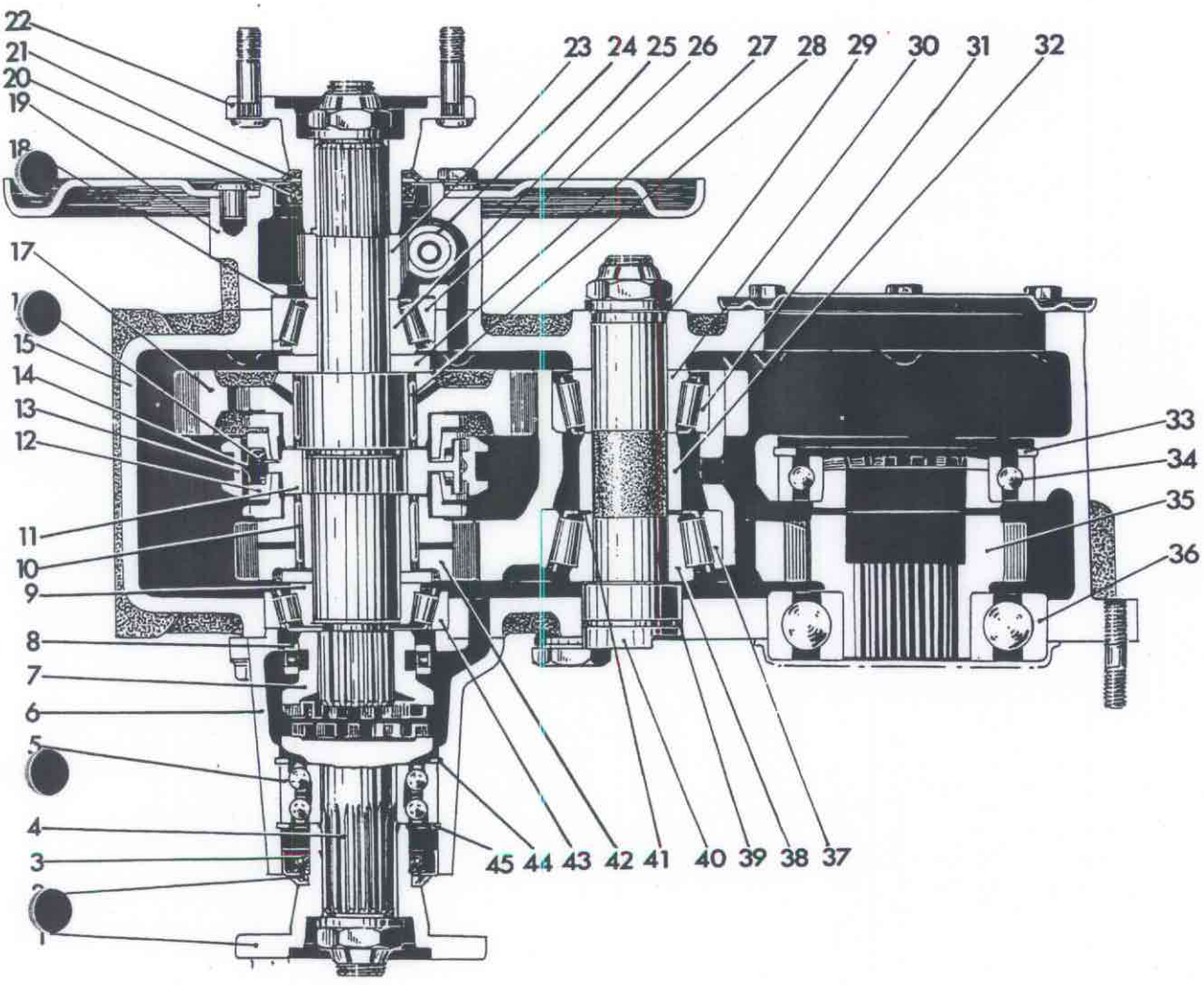
Illustration 43-D. Auxiliary gearbox

Auxiliary gearbox

1. Flange
2. Flange seal
3. Seal
4. Output shaft
5. Ball bearing
6. Housing
7. Flange
8. Shift fork
9. Roller bearing, inner race
10. Needle bearing
11. Hub
12. Cone
13. Engaging sleeve
14. Inhibitor
15. Housing
16. Spring
17. Gear, low-speed
18. Shims
19. Housing
20. Seal
21. Flange seal
22. Flange
23. Speedometer gear
24. Speedometer spindle
25. Roller bearing, inner race
26. Roller bearing, outer race
27. Washer
28. Needle bearing
29. O-ring
30. Roller bearing, inner race
31. Roller, bearing outer race
32. Spacer washer
33. Circlip
34. Ball bearing
35. Drive gear
36. Ball bearing
37. Roller bearing, inner race
38. Roller bearing, inner race
39. O-ring
40. Shaft
41. Shims
42. Gear, high-speed
43. Roller bearing, outer race
44. Circlip
45. Circlip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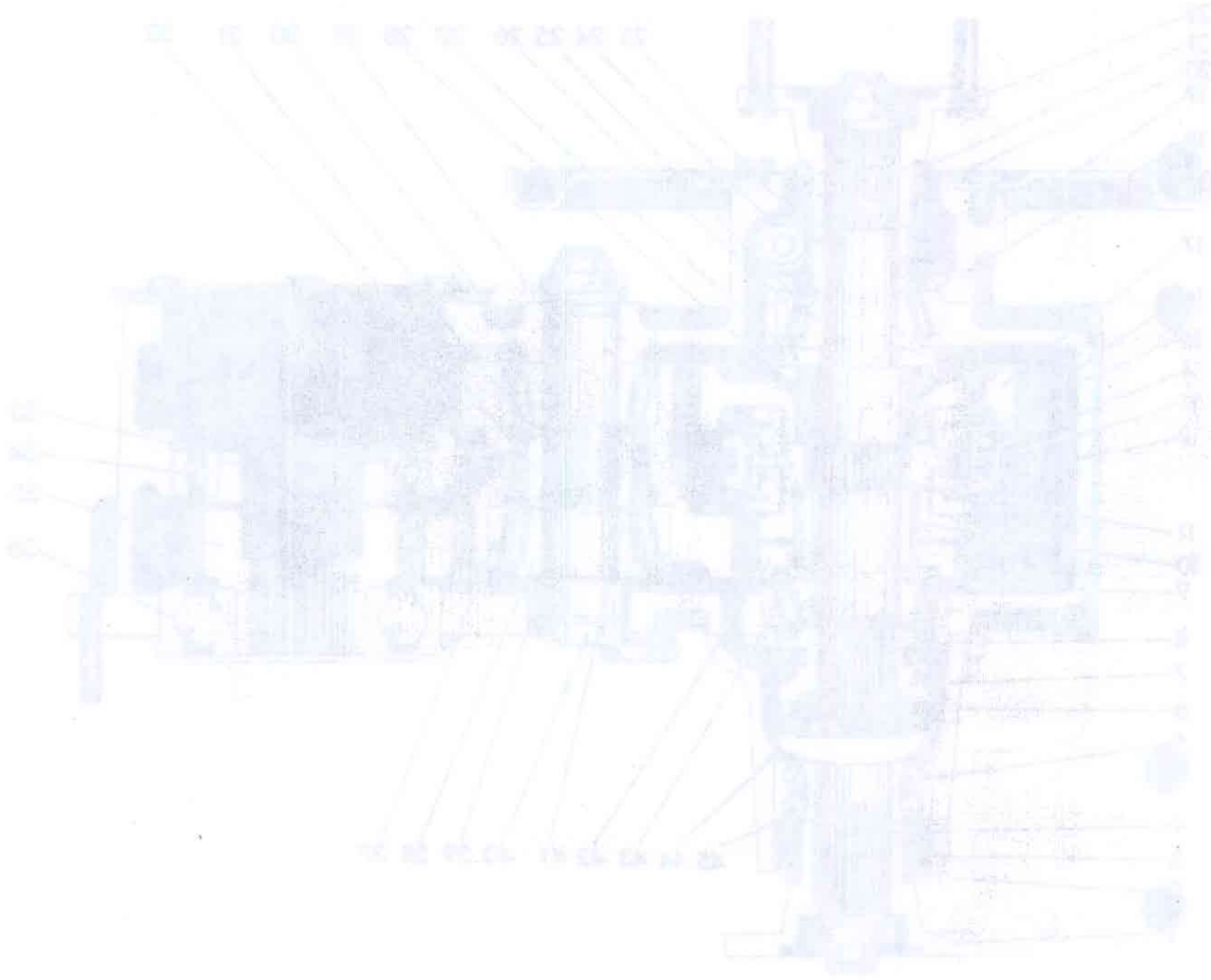
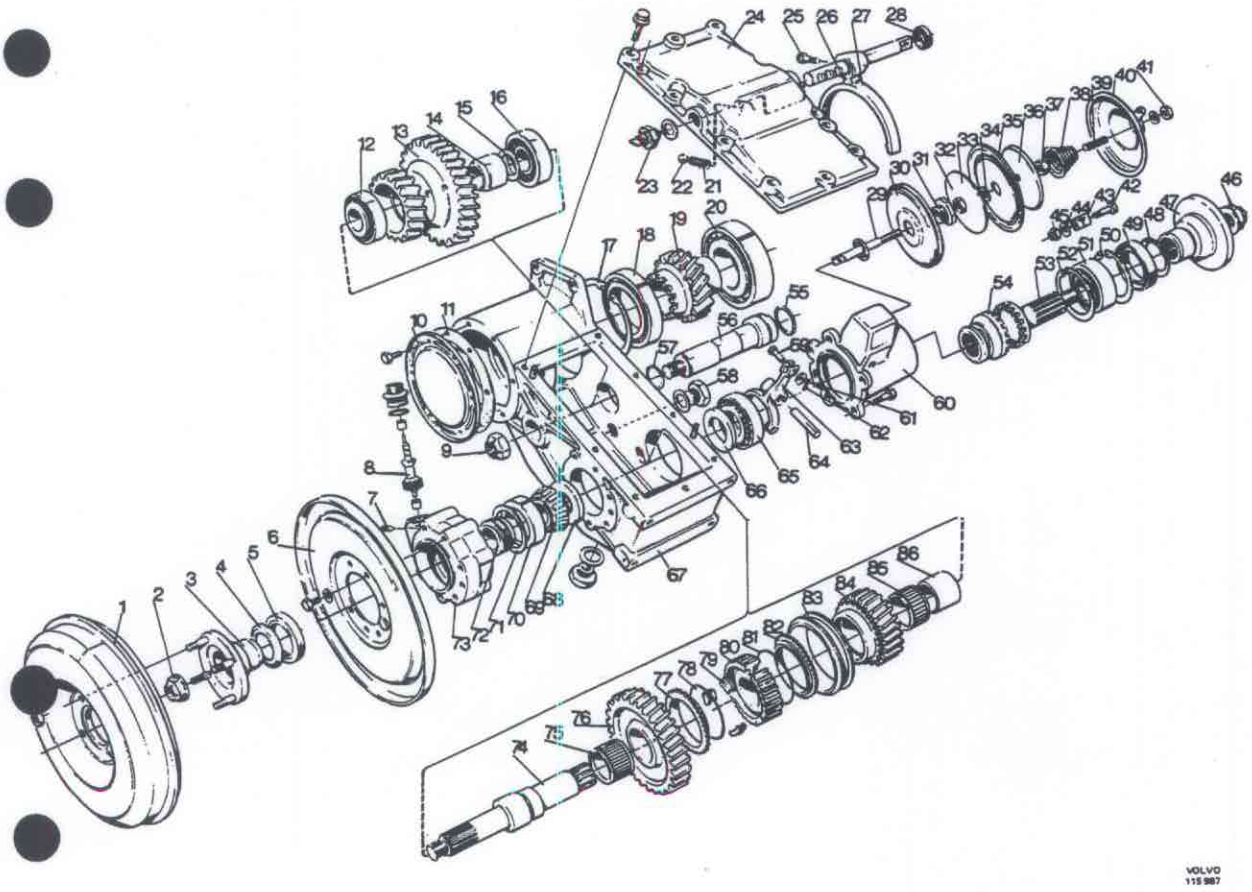


Illustration 43-E. Auxiliary gearbox

Auxiliary gearbox

1. Brake drum
2. Nut
3. Flange
4. Flange seal
5. Seal
6. Shield
7. Stop screw
8. Speedometer spindle
9. Nut
10. Cover
11. Gasket
12. Roller bearing
13. Intermediate gear
14. Spacer sleeve
15. Shims
16. Roller bearing
17. Circlip
18. Ball bearing
19. Cluster gear
20. Ball bearing
21. Spring
22. Ball
23. Switch
24. Cover
25. Bolt
26. Shift rail
27. Shift fork
28. Seal
29. Thrust rod
30. Cover
31. Holed nut
32. Nut
33. Washer
34. Spacer washer
35. Diaphragm
36. Washer
37. Nut
38. Thrust spring
39. Screw
40. Vacuum cylinder
41. Nut
42. Bolt
43. Clamp
44. Washer
45. Nut
46. Nut
47. Flange
48. Flange seal
49. Seal
50. Circlip
51. Ball bearing
52. Circlip
53. Output shaft
54. Flange
55. O-ring
56. Shaft
57. O-ring
58. Plug
59. Split pin bolt
60. Housing
61. Washer
62. Split pin
63. Shift fork
64. Shaft
65. Roller bearing
66. Washer
67. Housing
68. Washer
69. Roller bearing
70. Outer ring
71. Shims
72. Speedometer gear
73. Housing
74. Shaft
75. Needle bearing
76. Gear, low-speed
77. Cone
78. Spring
79. Inhibitor
80. Hub
81. Spring
82. Cone
83. Engaging sleeve
84. Gear, high-speed
85. Needle bearing
86. Inner race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GROUP 45 PROPELLER SHAFTS

Description

The vehicle is provided with two propeller shafts which are placed between the auxiliary gearbox and the differential carrier, see Figs. 45–1 and 45–2. Both propeller shafts are provided with slip joints in order to take up the changes that arise between the gearbox and differential carrier. To ensure complete lubrication of the spiders in the universal joints and the slip joints, the shafts are provided with lubricating nipples and in order to protect the slip joint, it is protected with a rubber bellows cover.

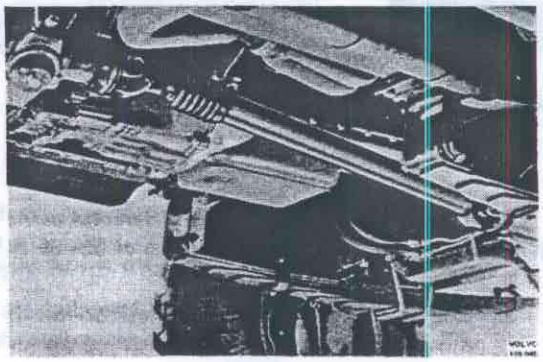


Fig. 45–1. Front propeller shaft

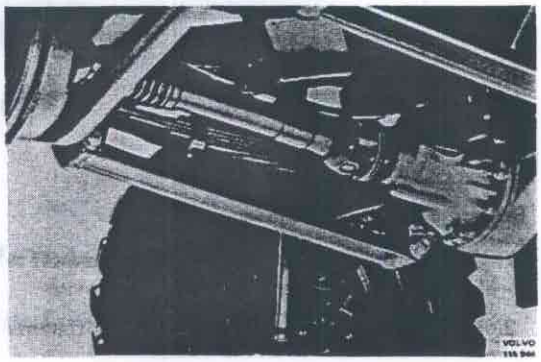


Fig. 45–2. Rear propeller shaft

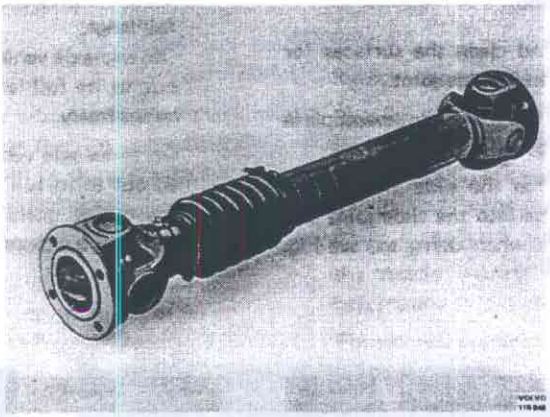


Fig. 45–3. Propeller shaft

Service procedures

Replacing a propeller shaft

When replacing a propeller shaft, any lock washers should be replaced and the slip joint rubber bellows cover checked for damage. When fitting the flanges, always make sure that the contact surfaces are clean and free from dirt. The bolts should always be tightened to a torque of 55–65 Nm (5.5–6.5 kpm = 40–47 lbftf) and the spiders as well as the slide joint should be lubricated. The spider should be greased so much that grease squeezes out at all four needle bearings. Grease the slide joint until squeezes out at the overflow valve (in the centre of the fork or when the slide joint shows a tendency to extend itself).

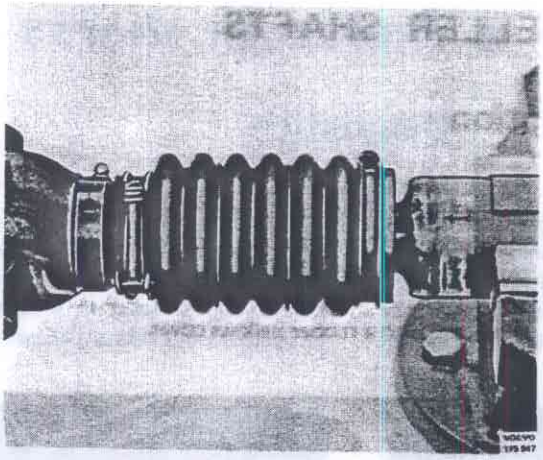


Fig. 45—4. Removing the axel

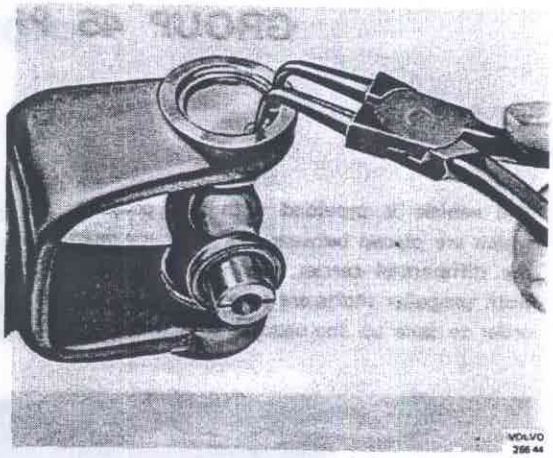


Fig. 45—6. Removing the circlip

Replacing the rubber bellows

1. Jack up the vehicle so that the wheels are off the ground.
2. Remove the propeller shaft from the differential carrier flange.
3. Remove the hose clamps on the rubber bellows. Pull out the propeller shaft tube from the slide joint.
4. Remove the bellows and clean the surfaces for the bellows on the tube and slide joint.
5. Fit the hose clamps on the new bellows and place the bellows on the propeller shaft tube.
6. Check to make sure that the slide joint is free from dirt. Push the tube into the slide joint and note the line-up marks when doing so, see Fig. 45—4.
7. Fit the propeller shaft to the differential carrier. Tighten up the bolts to a torque of 55—65 Nm (5.5—6.5 kpm = 40—47 lbftf).
8. Place the rubber bellows in position on the propeller shaft tube. Fit and tighten up the hose clamp.
9. Before tightening up the other end of the bellows, the propeller shaft must be pulled out to its full lengt.
   On two-axle vehicles, the propeller shaft is pulled out to its full lengt when the wheel carrier gear hangs freely.

   On three-axle vehicles, the propeller shaft is pulled out to its full lenght to the bogie when one of the carrier gears hangs freely and the other is raised to a maximum.

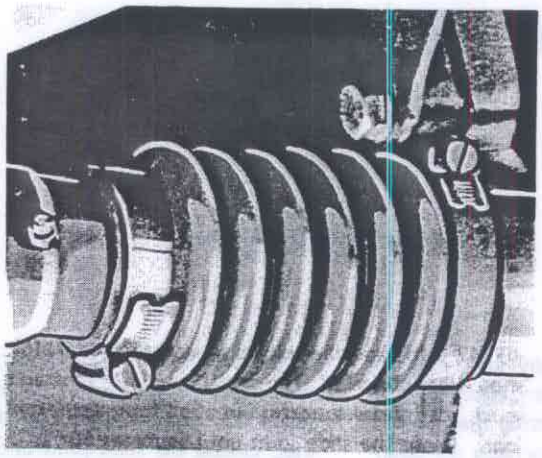


Fig. 45—5. Adjusting the clamp

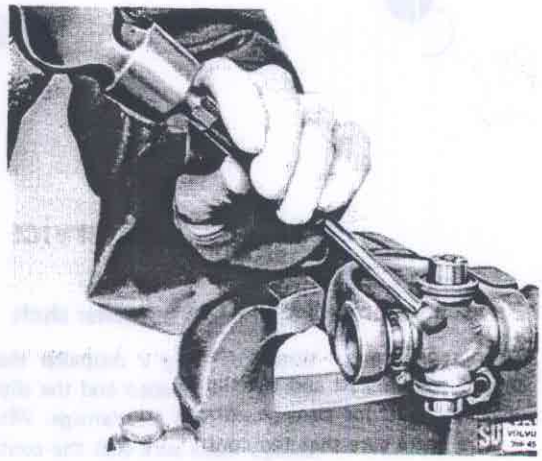


Fig. 45—7. Driving out the bearing

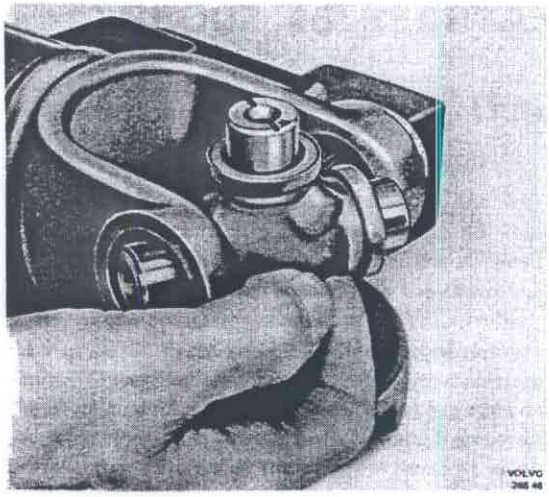


Fig. 45—8. Removing the spider

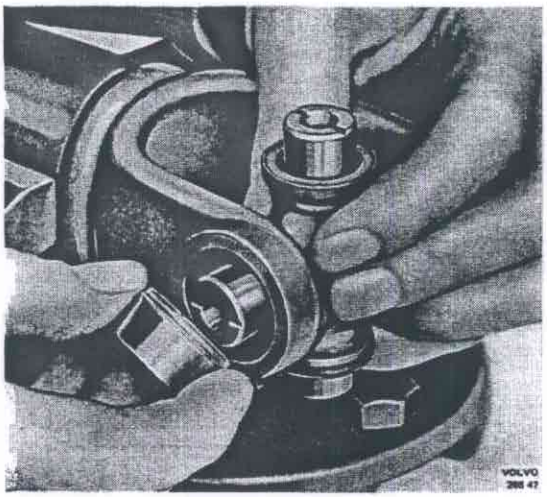


Fig. 45—9. Fitting the bearing

10. Lower the vehicle.
11. Lubricate the slide joint. This must be done when the vehicle is lowered otherwise too much grease can be added.

Replacing universal joint

Disassembling

1. Secure the propeller shaft tube in a vice so that the universal joint is as near the vice as possible. Note that the tube must not be damaged since if it is deformed it can cause imbalance.
2. Remove the circlips securing the needle bearings, see Fig. 45—6.
3. With the help of a drift drive the spider as far as possible in one direction, see Fig. 45—7.
4. Then drive the spider in the opposite direction as far as possible.
5. Drive out one of the needle bearings with a narrow drift. Remove the spider, see Fig. 45—8. Drive out the other needle bearing.
6. Fit the flange in a vice and remove the spider from the flange in the same way as from the tube.

Assembling

1. Remove the needle bearings from the spider.
2. Place the spider in the flange, see Fig. 45—9, and fit the needle bearing. Make sure that the rollers in the bearing are located correctly. Press in the bearing and fit the circlip.
3. Push the spider in the one direction so far that the needle bearing can be fitted. Press in the bearing and fit the circlip.
4. Fix securely the spider in the propeller shaft tube in the same way.
5. Lubricate the spider.

GROUP 46 REAR AXLE AND FRONT AXLE

Description

DIFFERENTIAL CARRIERS

The differential carriers, see Figs. 46–1 and 46–2 as well as Illustrations 46-A and -B, are of the so-called "spiral-bevel" type which means that the centreline of the pinion coincides with that of the crown wheel, see Fig. 46–3. Front and gear differential carriers are similar. Since they are turned in their own direction, the drive side of the crown wheel is not regarded as the same side as the gears in both carriers. In order to prevent the differential pinion from rotating when driving on a slippery surface, the differentials are provided with a lock, see Figs. 46–4 and 46–5. The lock is operated from a control panel, see Fig. 46–6. The control cylinder on the rear axle casing or front axle casing is actuated by vacuum. In order to indicate when the control cylinder is under vacuum, indicators are placed on the line to the front and rear axle casings respectively (Fig. 46–7). They switch on the differential lock lights on the instrument panel.

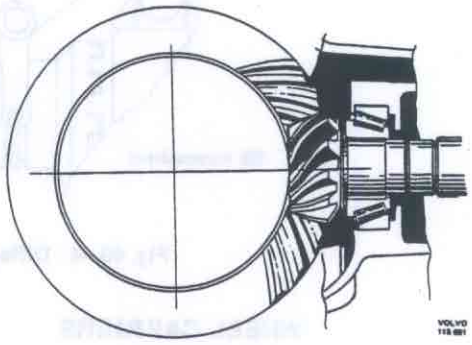


Fig. 46–3. Spiral bevel

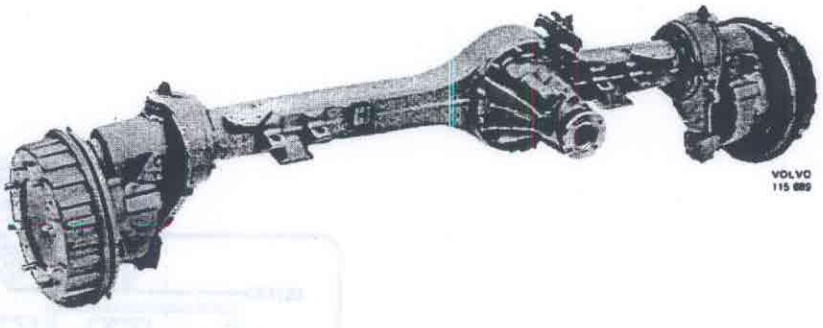


Fig. 46–1. Front axle

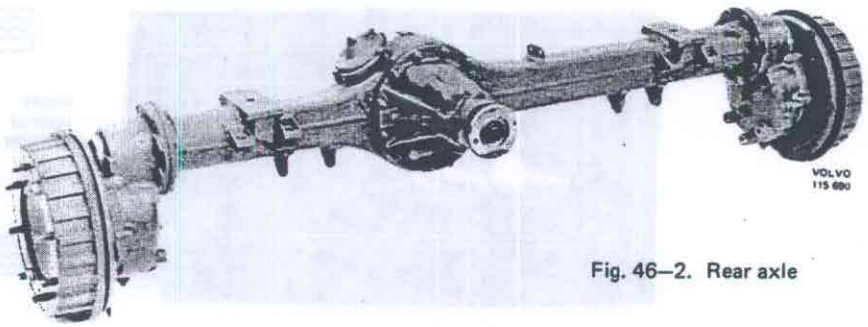


Fig. 46–2. Rear axle

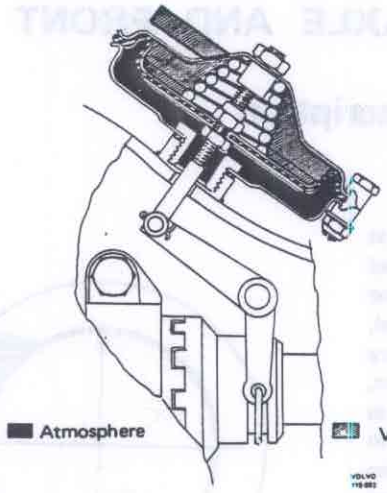


Fig. 46–4. Differential lock

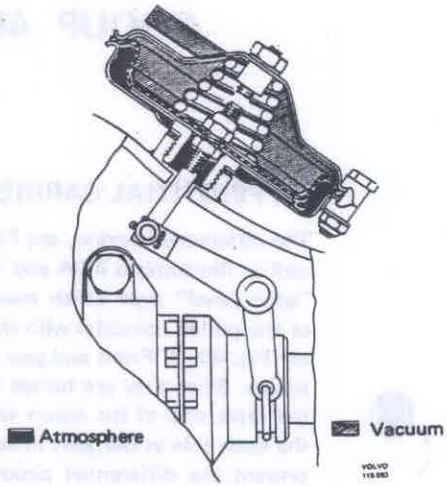


Fig. 46–5. Differential lock

WHEEL CARRIERS

In order that the vehicle should have a high ground clearance without the necessity of having excessively large wheels, the front and rear axles have been provided with wheel carriers, see Figs. 46–8 and 46–9. The wheel carries consist of a large and a small gear, see the Illustration 46-C, E and F. the gears have straight teeth. The small gear is journalled in the wheel carrier housing in a ball bearing and a needle bearing. The large gear is fixed to the wheel hub shaft, which is journalled in a housing bolted to the wheel carrier housing. The housing is partly filled with oil for lubricating the wheel carriers.

To prevent oil from the wheel carrier running over into the differential carrier casing, a seal is fixed on the rear wheel carrier housing. This seal consists of a sealing ring with wear ring, Illustration 46-D, and an X-ring which sits on the drive shaft. The seal for the front wheel carrier consists of rubber bellows, see Illustration 46-C.

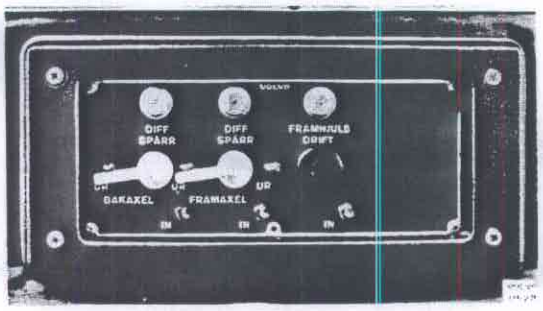


Fig. 46–6. Operating controls

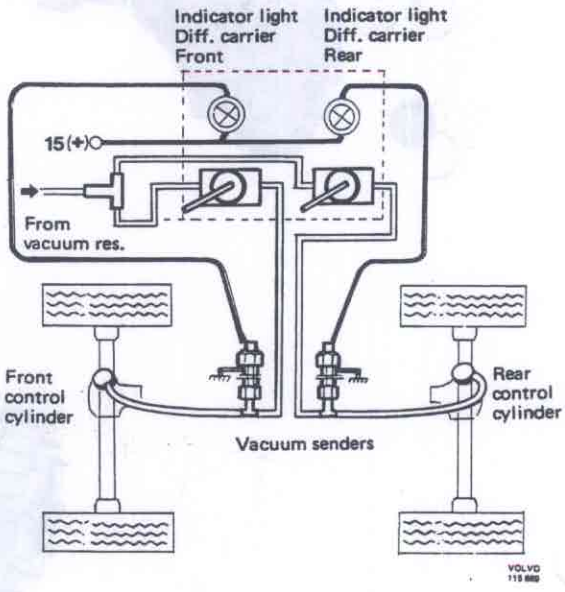


Fig. 46–7. Diff. carrier senders and indic. lights

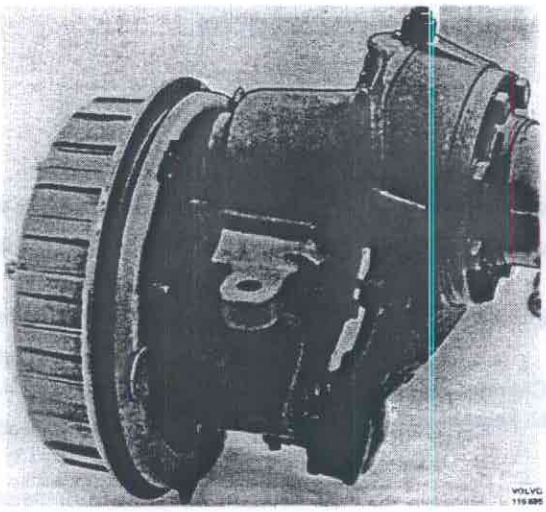


Fig. 46–8. Front wheel carrier

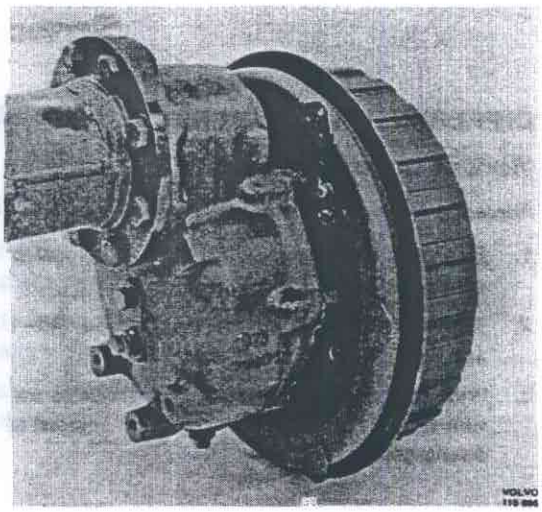


Fig. 46–9. Rear wheel carrier

Power take-off for tandem drive

On 3-axle vehicles with tandem drive, the leading differential carrier, Fig. 46–10, is fitted with a power take-off for driving the trailing differential carrier. A propeller shaft is fitted between the power take-off and the trailing differential carrier. The power take-off is fixed to the differential carrier housing. It differs, therefore, from the vehicle's two other differential carriers by the fact that it has a cover in the housing and a gear wheel which sits on the pinion.

The construction of the power take-off can be seen from Fig. 46–11 and Illustrations 46–G and H. It consists of two parts, a housing in which two gears are journalled and a housing in which the output shaft is journalled. One of the gears, called the intermediate gear, cannot be displaced on its shaft but is in constant mesh with the gear on the pinion and the gear on the power take-off. The power take-off output shaft will, therefore, always rotate at the same speed as the speed of the pinion.

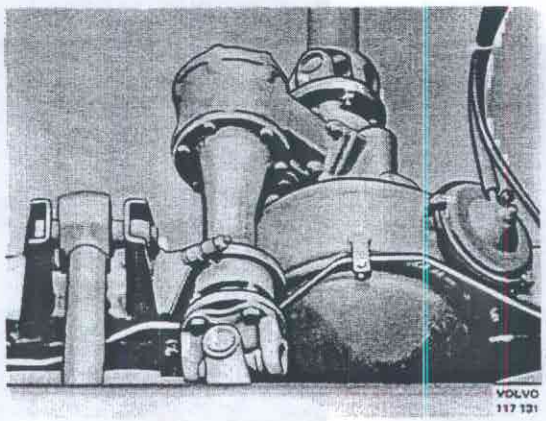


Fig. 46–10. Power take-off on the differential carrier

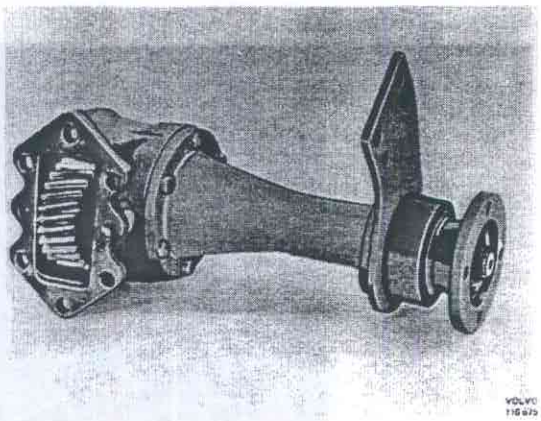


Fig. 46–11. Power take-off

Service procedures

DIFFERENTIAL CARRIERS

Work on carriers in vehicle

Replacing O-rings on differential lock control handle

1. Place a suitable tool under the handle, and pull the handle out of the housing.
2. Replace the O-ring on the handle, Fig. 46–12, and coat it with a little grease.
3. Press the handle into the housing. Check to make sure that the differential lock can be engaged and disengaged.

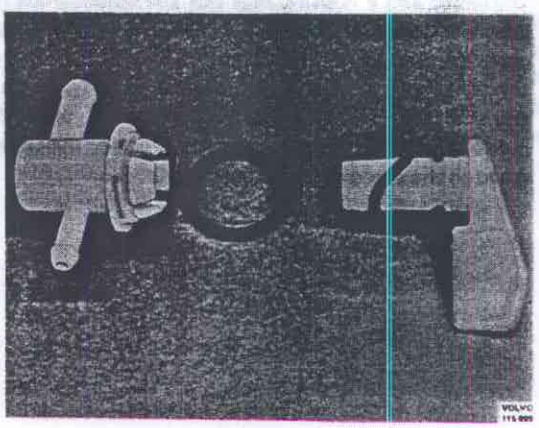


Fig. 46–12. Differential lock control

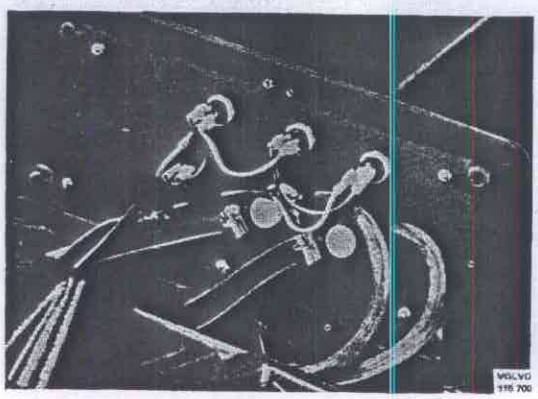


Fig. 46–13. Differential lock controls

Replacing differential carrier control

1. Place a suitable tool under the knob and pull the knob out of the housing.
2. Remove the four screws securing the plate.
3. Remove the lock ring which holds the control housing to the controls panel.

   Screw loose the panel. Disconnect the hoses from the housing, see Fig. 46–13.
4. Remove the knob from the new control.
5. Place a new O-ring on the housing and fit the housing on the panel. Fit the lock ring.
6. Connect up the hoses. Fit the panel. Screw tight the plate.
7. Press the knob into the housing. Check the function of the differential carriers.

Replacing the flange seal

1. Remove the bolts holding the propeller shaft and remove the shaft.
2. Fix counterhold 2837 on the flange, Fig. 46–14. Unscrew the nut.
3. Fit puller 2261, Fig. 46–15, and pull off the flange.
4. Pull out the seal with 4030, Fig. 46–16.

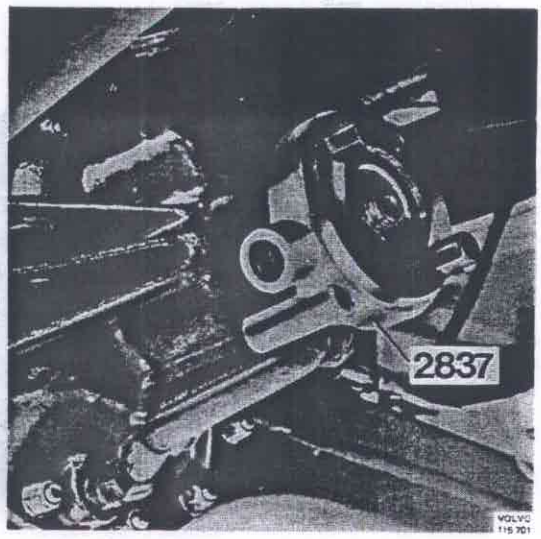


Fig. 46–14. Fitting a counterhold

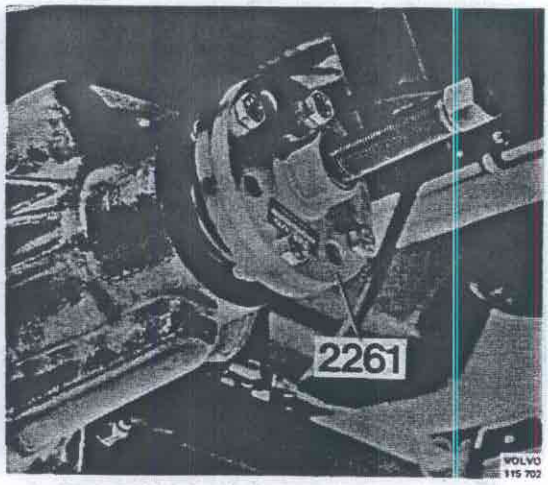
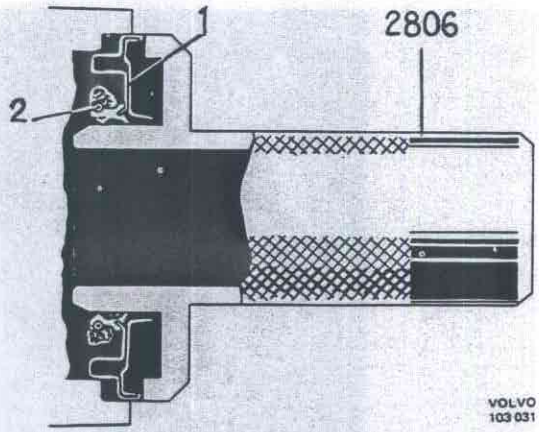


Fig. 46–15. Removing the flange



1. Sealing ring
2. Spring with grease layer

Fig. 46–17. Installing the sealing ring

5. Grease the contact surface of the new seal which faces the flange and on the reverse side of the sealing lip, Fig. 46–17.
6. Drive the seal into the housing with 2806.
7. Pull on the flange with 1845, Fig. 46–18. Remove the tool and fit 2837. Fit the nut and tighten it to a torque of 280–300 Nm (28–30 kpm = 202–217 lbftf).
8. Fit and tighten up the propeller shaft. Tighten the bolts to a torque of 55–65 Nm (5.5–6.5 kpm = 40–47 lbftf).

Replacing the control cylinder diaphragm

1. Remove the bolts, Fig. 46–19, holding the cylinder cover. Remove the cover.
2. Remove the spring. Remove the nut on the pull rod. Hold securely the thrust washer and diaph-

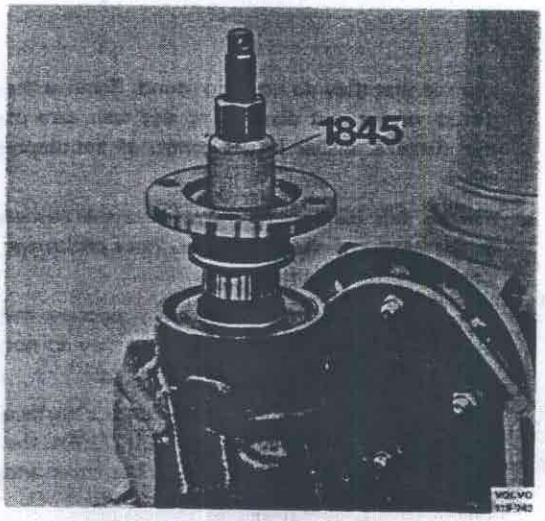


Fig. 46–18. Pressing on the flange

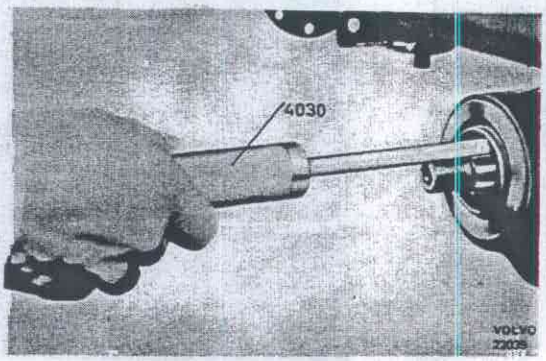


Fig. 46–16. Removing the seal

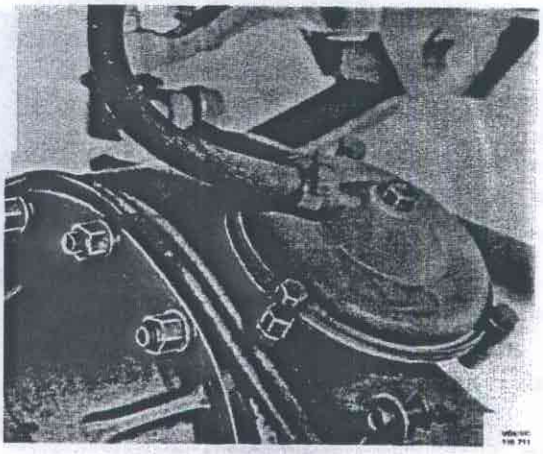


Fig. 46–19. Control cylinder

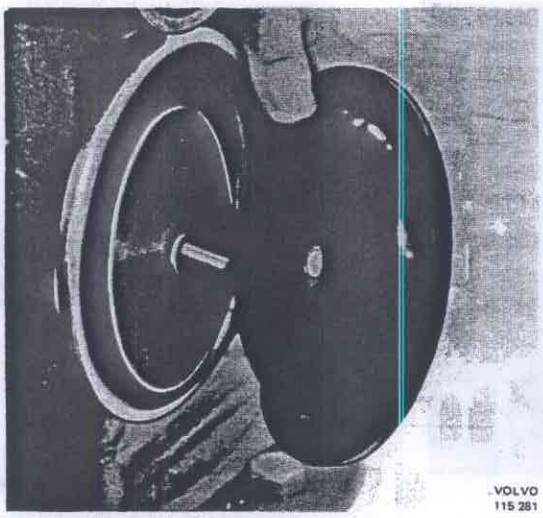


Fig. 46–20. Fitting diaphragm

ragm so that they do not spin round. Remove the thrust washer and diaphragm, and take care of the distance washer in the centre of the diaphragm.

3. Fit the new diaphragm. Fit the distance washer in the centre of the diaphragm. Place the thrust washer on the diaphragm.
4. Fit and tighten up the nut. Hold securely the thrust washer and diaphragm so that they do not spin round when the nut is tightened up.
5. Fit the spring with the large contact surface facing the thrust washer, Fig. 46–21. Fit the cover. Fit the bolts evenly round the cover and tighten up.

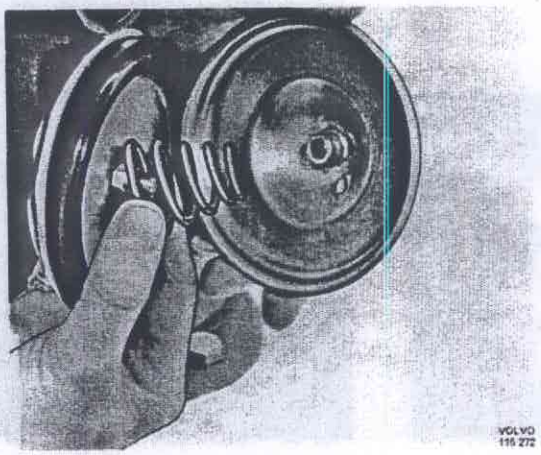


Fig. 46–21. Installing the spring

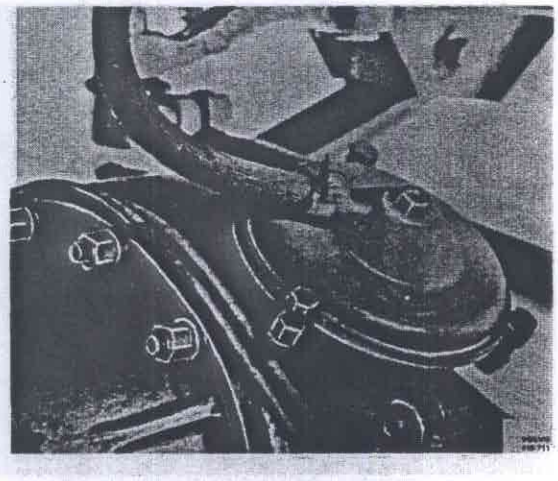


Fig. 46–22. Control cylinder

Adjusting the differential lock

1. Unscrew the wheel nuts on the wheel which is on the same side as the control cylinder (right-hand side).
2. Jack up the vehicle and remove the wheel.
3. Remove the bolts securing the control cylinder cover, Fig. 46–22. Remove the cover.
4. Remove the spring. Remove the nut on the pull rod. Remove the diaphragm and the thrust washers. Take care of the washer in the centre of the diaphragm.
5. Lift up the pull rod and adjust the nut, Fig. 46–23, so that it is flush with the gauge 6133. If there is no gauge, the distance should be 9 mm (0.36") between the holed nut and the nut, when the differential lock is engaged.

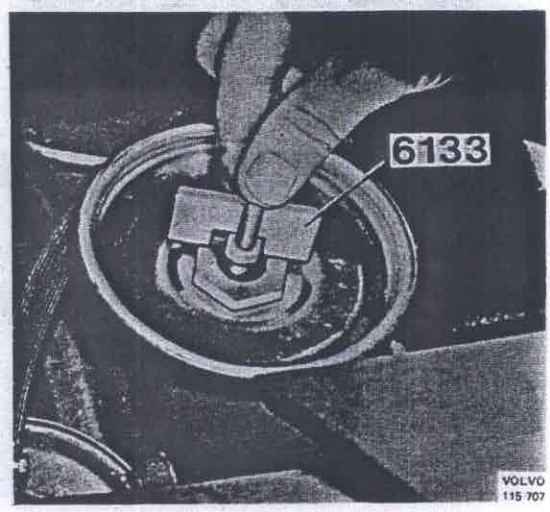
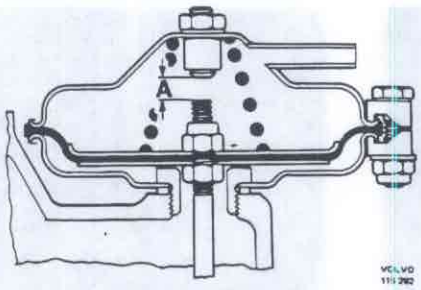


Fig. 46–23. Adjusting the pull rod



A = 6 3/8 turns (9,2 mm)

Fig. 46–24. Adjusting the bolt

6. Fit the thrust washer and diaphragm. Fit the copper washer in the centre of the diaphragm. Fit the other thrust washer.
7. Fit on the upper nut. Hold securely the lower nut, the thrust washers and the diaphragm so that they do not rotate when the nut is tightened up.
8. Fit the spring with the large contact surface facing the thrust washer, Fig. 46–24. Fit the cover. Fit the bolts evenly round the cover and tighten up.
9. Remove the lock nut for the bolt on the cover. Screw down the bolt so that it bottoms against the thrust rod. Then screw it back 6 3/8, approx 9,2 mm (0.36") turns and lock it with the lock nut, Fig. 46–24.
10. Check with the control for the differential lock that the lock engages and disengages properly.

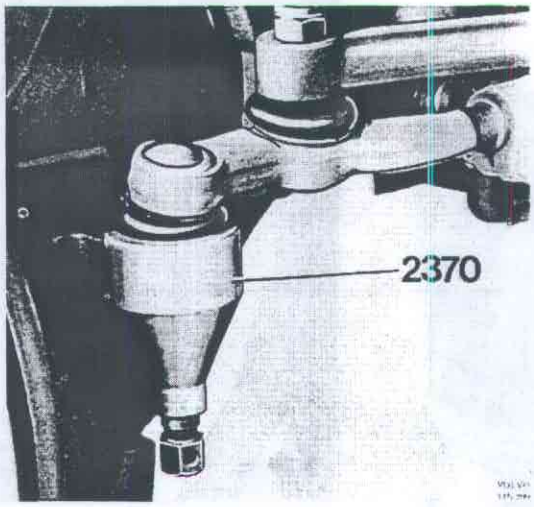


Fig. 46–25. Removing the ball joint

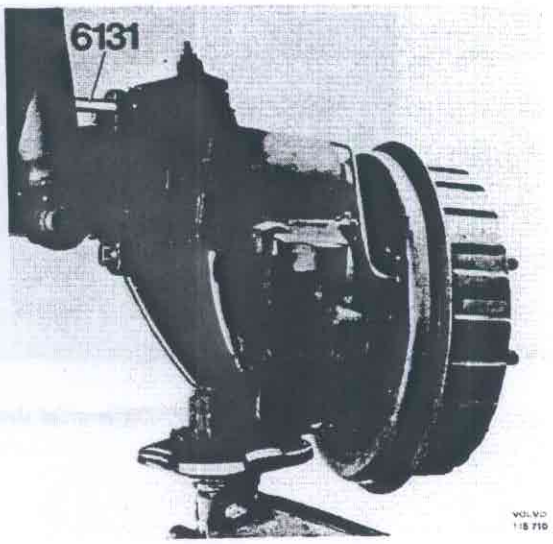


Fig. 46–26. Removing the wheel carrier

Replacing the differential carriers

Removing the front differential carrier

1. Release the wheel nuts on both wheels. Jack up the vehicle.
2. Remove the wheels.
3. Drain the oil from the differential carrier. Remove the nut on the ball joints for the steering rods. Disconnect the ball joint from the steering arm with 2370, Fig. 46–25.
4. Remove the plate for the hollow rubber spring. Remove the upper bolts and fit the guide pins 6131, see Fig. 46–26.
5. Remove the lower bolts securing the wheel carrier housing to the front axle casing. Place a jack under the wheel carrier housing.
6. Pull out the wheel carrier housing with drive shaft at least 100 mm (4") or the maximum length permitted by the brake hoses. Remove the jack and support under the wheel carrier housing.
7. Disconnect the other wheel carrier housing in the same way.
8. Remove the propeller shaft from the differential carrier flange, Fig. 46–27.
9. Remove the nuts securing the differential carrier and remove the carrier.
10. For replacement of the differential sleeve, see under "Replacing the differential sleeve".

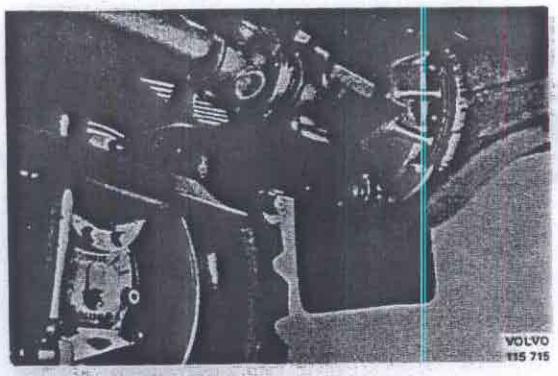


Fig. 46–27. Differential sleeve

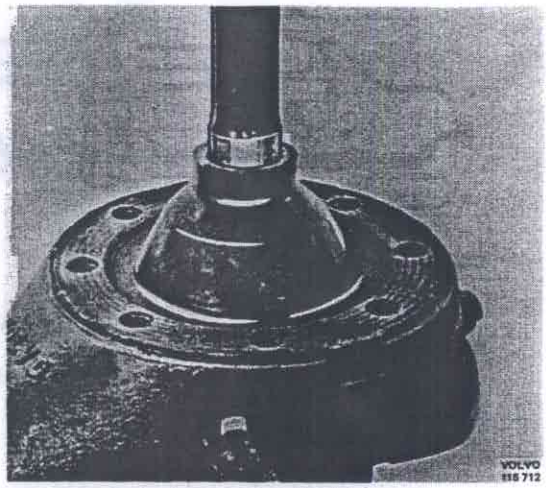


Fig. 46–29. Location of rubber dust cover

Installing the front differential carrier

1. Check the selector fork for the differential gear for wear. Concerning eventual replacement of the differential lock or fork, see under "Replacing the differential sleeve".
2. Clean the contact face of the casing and coat it with sealing agent. Make sure that the flange sleeve of the differential lock on the differential carrier is on the right side. Place the differential carrier in position. Fit the washers and nuts in position and tighten up the carrier.
3. Fit the propeller shaft. Tighten the bolts to a torque of 55–65 Nm (5.5–6.5 kpm = 40–47 lbftf).
4. **NOTE! Check that the rubber dust cover for the drive shaft is fitted properly on the steering knuckle support, see Fig. 46–29, before fitting the wheel carrier and support together.**

   Lift up the drive shaft while pushing in the differential carrier, Fig. 46–30. When the drive shaft touches the differential, rotate the differential carrier flange while pushing the carrier to the bottom at the same time.

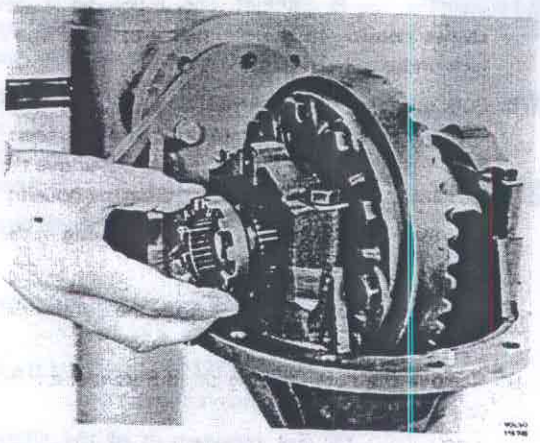


Fig. 46–28. Flange sleeve

Fig. 46–30. Fitting the carrier

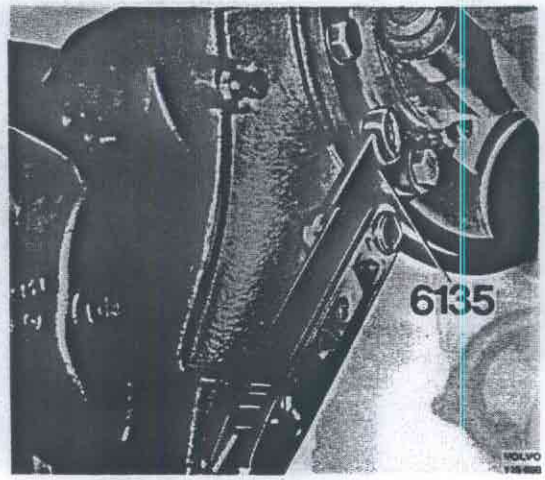


Fig. 46–31. Tighten the nuts

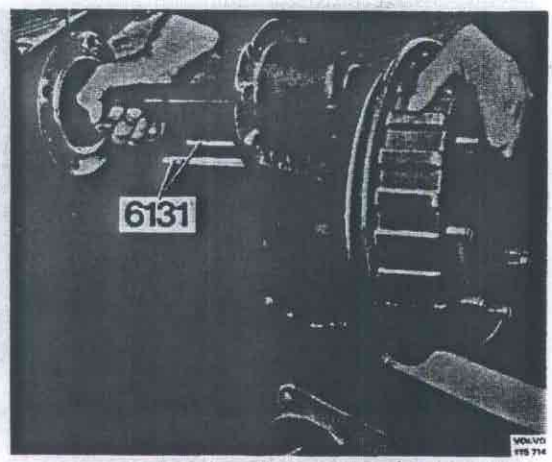


Fig. 46–33. Removing the wheel carrier

5. Fit the bolts round the front axle casing. Remove the guide pins. Tighten the bolts to a torque of 100–120 Nm (10–12 kpm = 72–87 lbftf). Use 6135, see Fig. 46–31. Remove the jack.
6. Fix the plate on for the hollow rubber spring.
7. Fit the lower steering rod. Check that the lubricating nipple is not damaged.
8. Fit the other wheel carrier housing in the same way (points 4–6).
9. Fill the carrier with oil. Concerning quantity and type, see under "Data".
10. Adjust the differential lock, see the separate instructions.

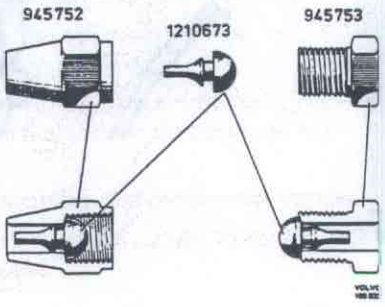


Fig. 46–32. Sealing nipples

11. Fit the wheels. Lower the vehicle and tighten the wheel nuts to a torque of 210 Nm (21 kpm = 152 lbftf).

Removing the rear differential carrier

1. Release the wheel nuts on both rear wheels. Jack up the rear of the vehicle.
2. Remove the wheels.
3. Drain the oil from the differential carrier.
4. Remove the shock absorber from its lower attachment. Disconnect the brake line from the wheel cylinder. Plug the line with a sealing nipple, see Fig. 46–32. Volvo nos. 245752 + 1210673.
5. Place a jack under the wheel carrier housing, see Fig. 46–33. Remove the bolts securing the wheel carrier housing to the rear axle casing. Allow two bolts to remain. Tap carefully on the bolts so that the housing loosens from the casing.
6. Remove the bolts and pull out the wheel carrier housing with the drive shaft.
7. Remove the other wheel carrier housing in the same way.
8. Remove the propeller shaft from the differential carrier flange, Fig. 46–27.
9. Remove the nuts securing the differential carrier and remove the carrier.
10. For replacement of the differential sleeve, see under "Replacing the differential sleeve".

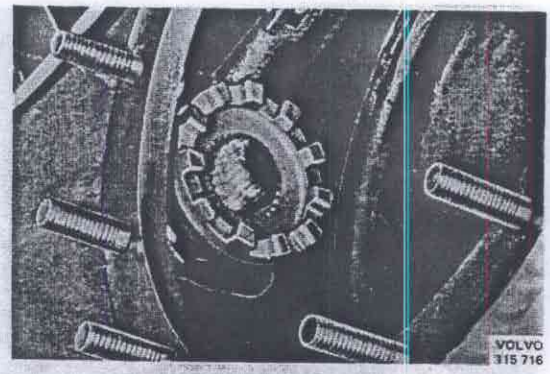


Fig. 46–34. Differential carrier

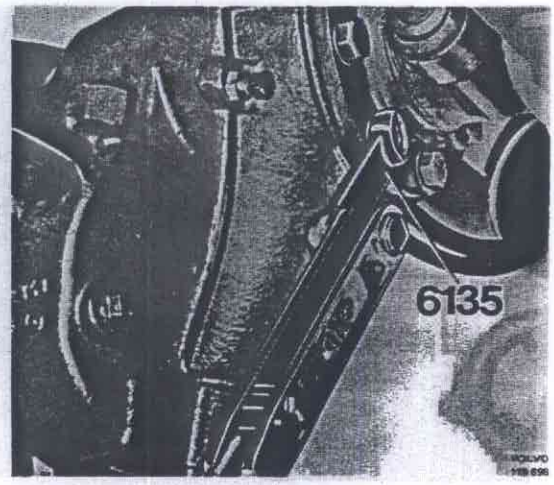


Fig. 46–36. Tighten the nuts

Installing the rear differential carrier

1. Check the selector fork for the differential lock for wear. In the event the lock or the fork has to be replaced, see the special instructions. Lift up the flange and hold it in position with a suitable tool, see Fig. 46–35.
2. Clean the contact face of the casing and coat it with sealing agent. Check that the differential lock flange sleeve on the differential carrier is on the right side. Place the differential carrier in position. Fit washers and nuts in position and tighten up the carrier.
3. Fit the propeller shaft. Tighten the bolts to a torque of 55–65 Nm (5.5–6.5 kpm = 40–47 lbftf).
4. Remove the tool holding the flange.
   Fit two guide pins 6131 in the lower holes of the wheel carrier housing, Fig. 46–33. Place the housing on a jack. Lift up the carrier so that the guide pins can enter the rear axle casing. Rotate the differential carrier flange while pushing in the carrier at the same time.
5. Fit the bolts round the casing. Remove the guide pins. Tighten the bolts to a torque of 100–120 Nm (10–12 kpm = 72–87 lbftf). Use 6135, see Fig. 46–36. Remove the jack.
6. Fit the shock absorber. Fit and tighten up the brake pipe.

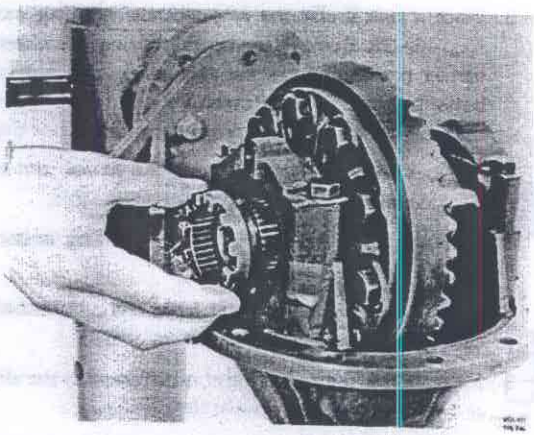


Fig. 46–35. Differential lock flange

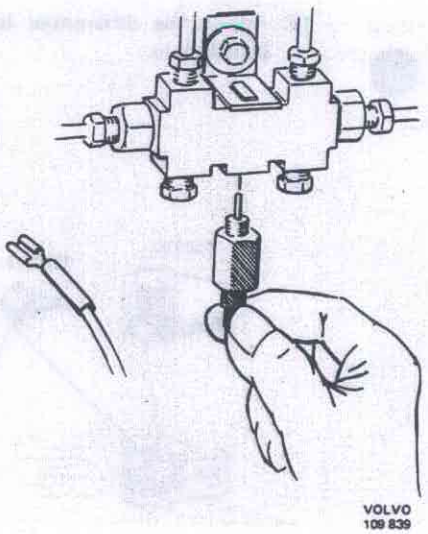
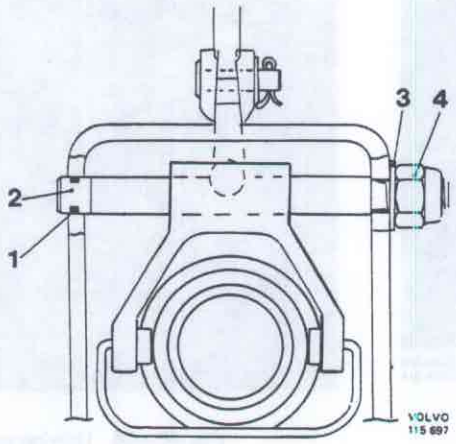


Fig. 46–37. Removing the contact



1. O-ring
2. Shaft
3. Washer
4. Nut

Fig. 46–38. Differential sleeve

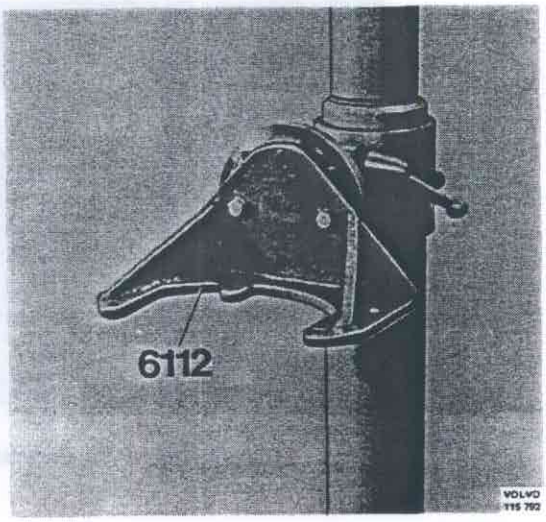


Fig. 46–39. Fixture for the diffentail carrier

7. Fit the other wheel carrier housing in the same way. Bleed the wheel cylinders on the rear wheels. The electrical contact for the pressure difference should be removed, see Fig. 46–37, during the bleeding. If a bleeder unit is used, the working pressure should be 0.2 MPa (2 kp/cm^2 = 28 lbf/in^2). For more detailed instructions with regard to bleeding, see Part 5. Fill the differential carrier with oil. Concerning quantity and type, see under "Data".
8. Fit the wheels.
9. Lower the vehicle. Tighten the wheel nuts to a torque of 210 Nm (21 kpm = 152 lbftf).

Replacing the differential sleeve (with differential carrier removed)

1. Remove the nut from the shaft (Fig. 46–38). Drive out the shaft with a plastic mallet.
2. Remove the sleeve from the drive shaft. Remove the sleeve from the fork.
3. Check that the fork, or the shaft, is not damaged. If necessary, replace the requisite parts.
4. Fit the new sleeve on the fork. Push the sleeve onto the drive shaft.
5. Fit a new O-ring on the shaft. Place the shaft in position. Fit and tighten up the nut.

Disassembling the differential carrier

Special tools: 1801, 2261, 2392, 2567, 2837, 4030, 6014, 6115.

1. Clean the outside of the carrier. Place the carrier in fixture 6112, Fig. 46–39.
2. Check to make sure the bearing caps are marked.
3. Bend up the tabs on the lock washer for the cap bolts. Remove the bolts and the lock rings for the adjuster nuts.
4. Remove the cap bolts. Remove the caps.
5. Remove the differential housing with adjuster nuts and bearing.
6. Remove the oil scraper and spring, Fig. 46–40.

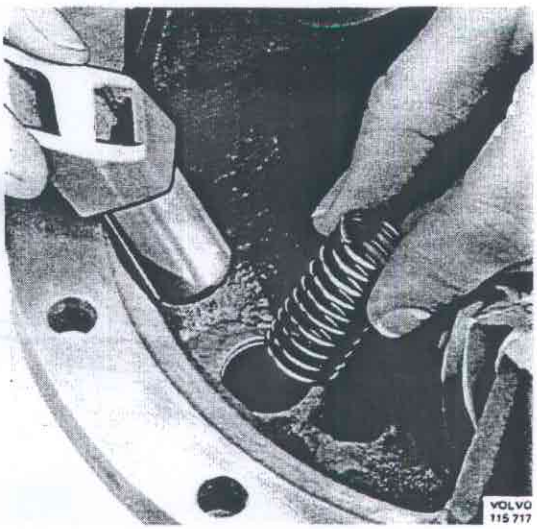


Fig. 46–40. Removing the oil scraper

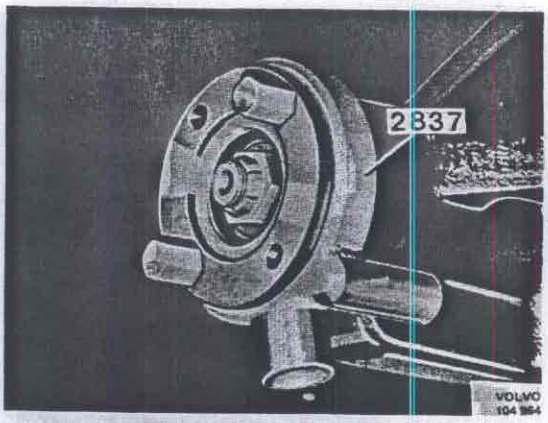


Fig. 46–41. Fitting a puller

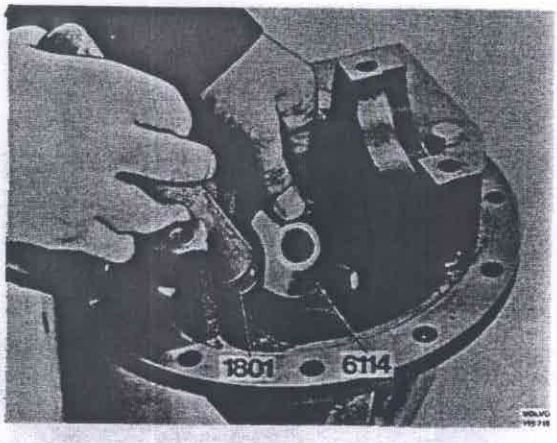


Fig. 46–44. Driving out the seal

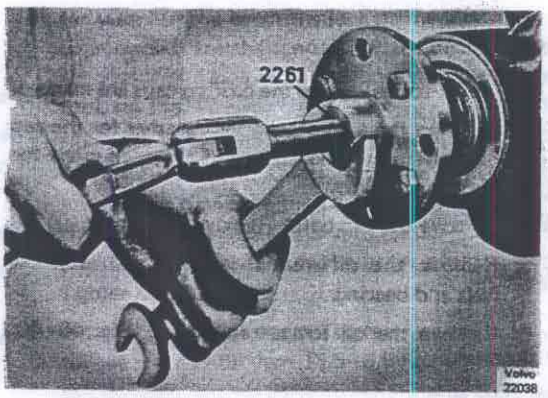


Fig. 46–42. Removing the flange

7. Turn the carrier. Fit counterhold 2837 on the flange, Fig. 46–41. Remove the flange nut.
8. Remove the counterhold. Fit 2261 on the flange, Fig. 46–42. Remove the flange.
   Pull out the flange seal with 4030, see Fig. 46–43. Remove the oil deflector plate.
9. Drive out the pinion with a plastic mallet. Take care of the shims and spacer sleeve.
10. Turn the carrier. With 6014 + 1801 drive out the flange seal, front bearing and outer race, Fig. 46–44.
11. Turn the carrier. Drive out the outer race for the rear bearing with 6115 + 1801.
12. Remove the bearing from the pinion with 2392, Fig. 46–45. Note how the tool is attached, Fig. 46–46.

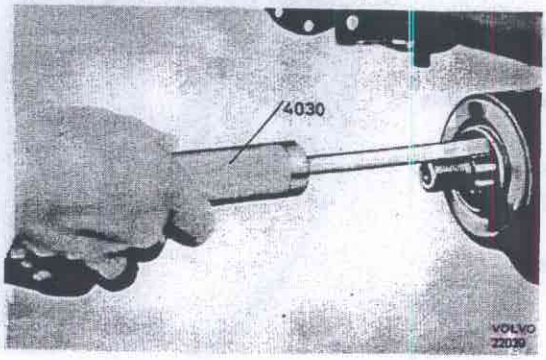


Fig. 46–43. Removing the seal

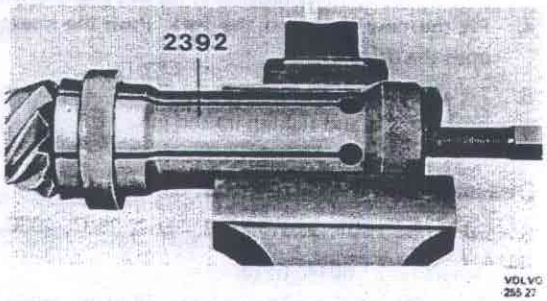
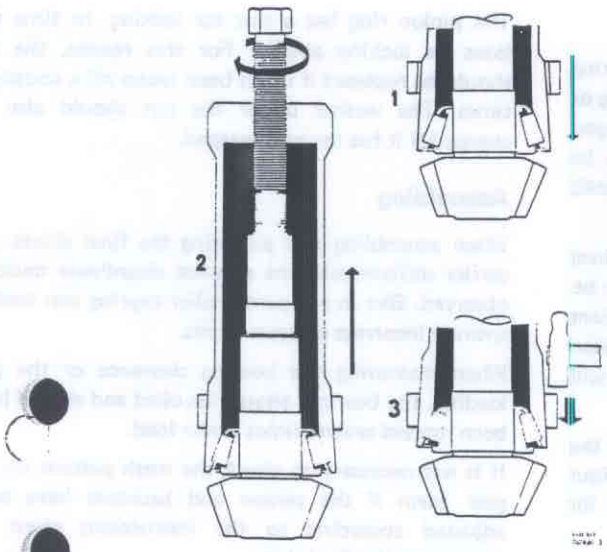


Fig. 46–45. Removing the bearing



1. Puller is pushed over the rollers
2. Rollers pulled up
3. Circlip knocked tight

Fig. 46–46. Fitting the puller

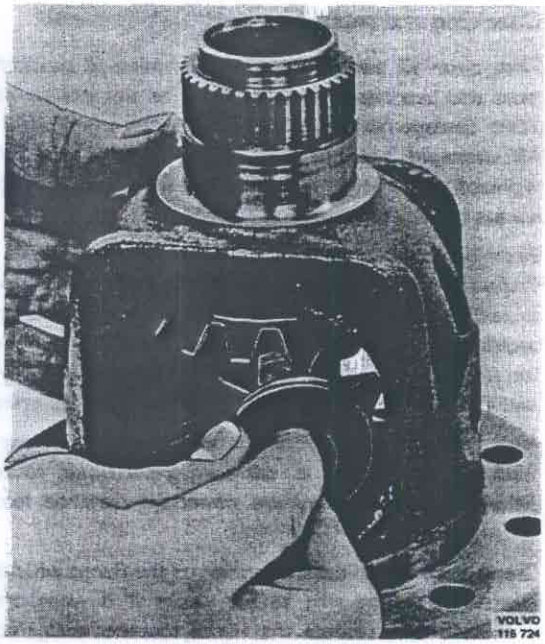


Fig. 46–48. Removing the washer

Disassembling a differential housing

1. Fix the housing in a vice. Remove the bolts securing the crown wheel. Remove the crown wheel.

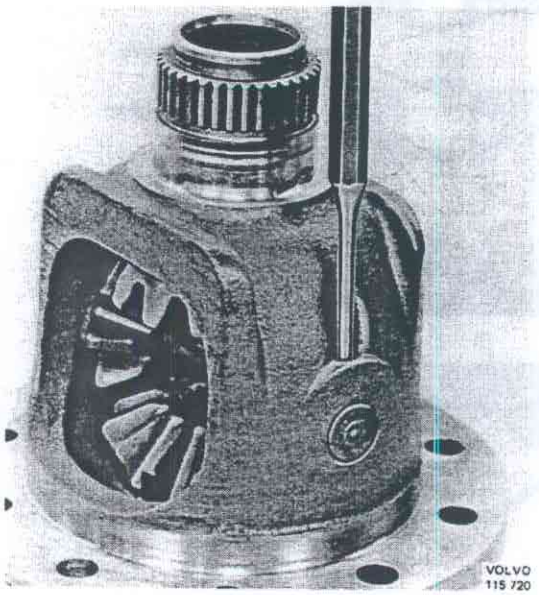


Fig. 46–47. Driving out the lock pin

2. Drive out the lock pin, Fig. 46–47, which holds the shaft for the differential gears.
3. Drive out the shaft. Rotate the differential side gears. Remove the pinions and thrust washers, Fig. 46–48. Remove the differential side gears and washers.
4. Remove the differential bearings with 2567, Fig. 46–49.

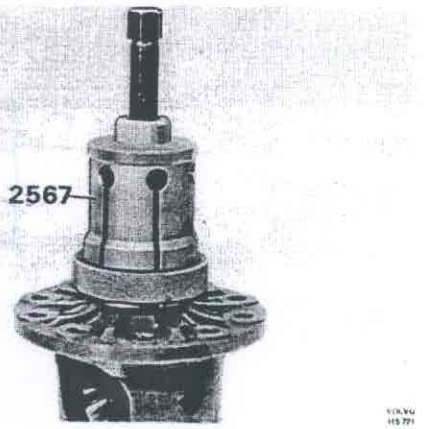


Fig. 46–49. Removing the bearing

Checking and replacing parts

First clean all parts thoroughly. Examine all bearing races and bearings. There must not be any scoring or other damage on the bearings, rollers or roller cages. All damaged bearings and bearing races are to be replaced and the bolts for the crown wheel should always be replaced.

Examine both the pinion and crown wheel thoroughly for damage to the gear teeth. This can be caused by incorrect running-in, wrong oil, insufficient backlash or incorrect tooth mesh. Unless the reason for the seizing is removed at an early stage, this will lead eventually to entirely ruined gears.

Also check the differential gears for damage to the teeth. If any gear is damaged replace all four differentials, since they are nowadays matched for better meshing.

Check also the cylindrical section of the flange which enters the sealing ring to see where it is worn or scored. If it is, replace the flange together with the sealing ring.

The pinion ring has a slot for locking. In time this loses its locking ability. For this reason, the nut should be replaced if it has been taken off a couple of times. The washer under the nut should also be changed if it has become warped.

Assembling

When assembling and adjusting the final drives and carrier differentials, the greatest cleanliness must be observed. Dirt in a tapered roller bearing can lead to entirely incorrect measurements.

When measuring the bearing clearance or the pre-loading, the bearings should be oiled and should have been rotated several times under load.

It is not necessary to check the mesh pattern on the gear teeth if the pinion and backlash have been adjusted according to the instructions given for assembling the final drive.

Washers and shims of different thicknesses are fitted in some places (see Fig. 46–50) in order to obtain correct clearance.

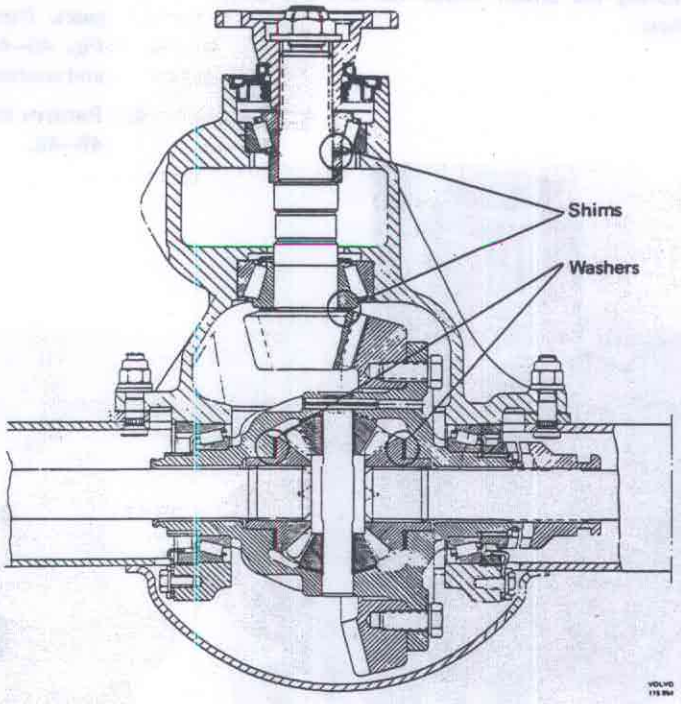


Fig. 46–50. Shims or washers

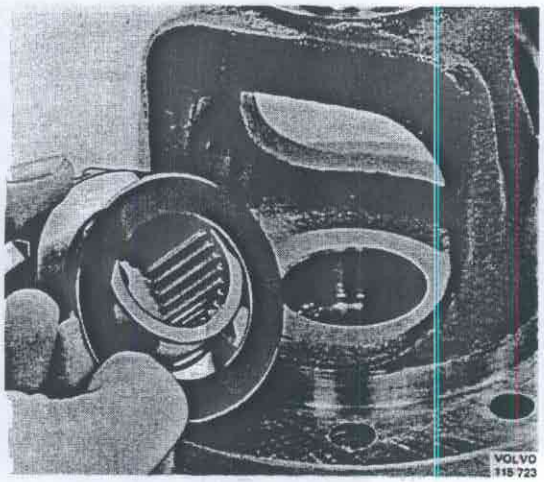


Fig. 46–51. Fitting the thrust washers

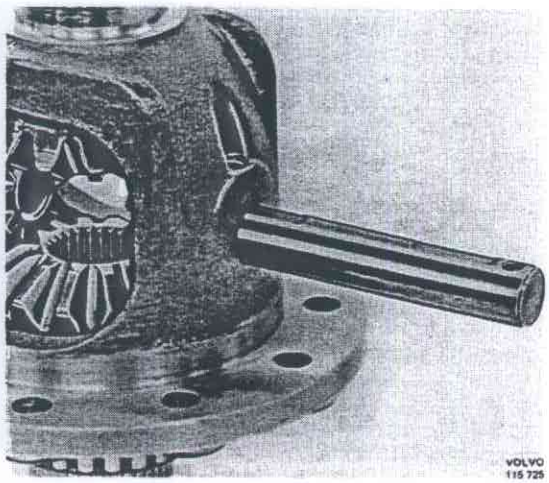


Fig. 46–53. Driving in the shaft

Assembling the differential housing

1. Grease the teeth and slide surfaces on the differential gears. Oil the thrust washers.
2. Place the differential side gears and thrust washers in the housing, see Fig. 46–51.
3. Place the dished thrust washers on the differential pinions. Place the pinions opposite each other on the differential side gears, Fig. 46–52. Roll in the pinions at the same time. Check to make sure the washers are fitted properly.
4. Drive in the shaft, Fig. 46–53. While driving in check to make sure that the thrust washers are fitted properly.
5. Rotate the gears so that the grease is evenly distributed on them.
6. Fit the differential housing in a vice. Check the backlash with a rocker indicator, Fig. 46–54. The clearance may be max. 0.22 mm (0.0088"). If the backlash is greater than this, replace the thrust washers for the differential side gears. Washers are available in the following sizes: 0.74, 0.78, 0.82, 0.86, 0.90, 0.94 and 0.98 mm (0.029, 0.030, 0.032, 0.033, 0.035, 0.037").

Fig. 46–52. Fitting the diff. side gears

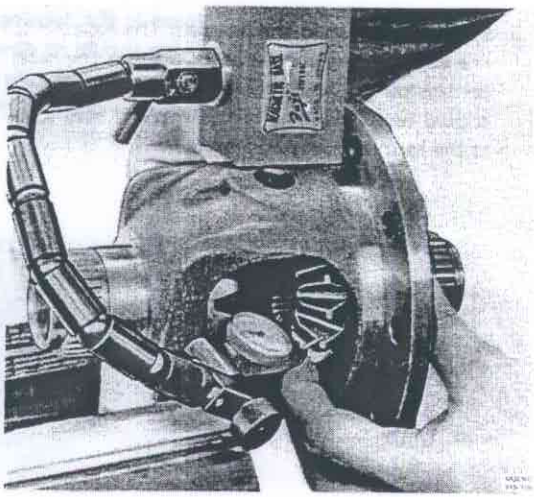


Fig. 46–54. Checking the clearance

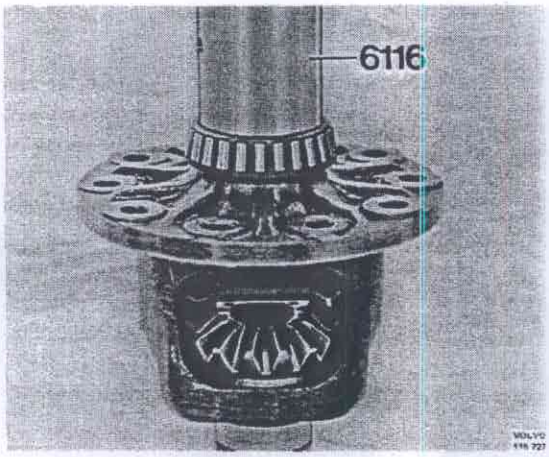


Fig. 46–55. Pressing on the bearing

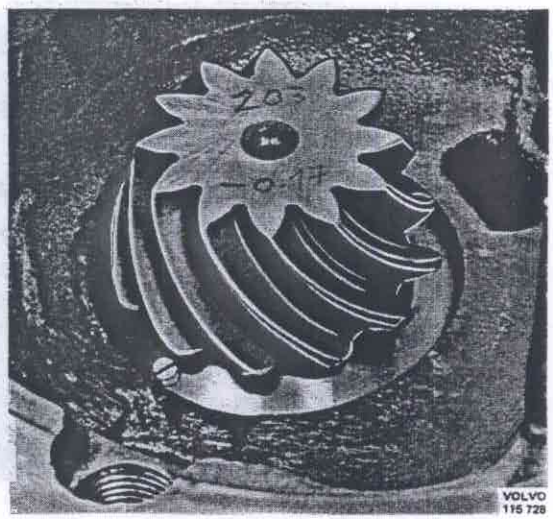


Fig. 46–57. Lock bolt

7. When correct backlash has been obtained, drive in the shaft lock pin.
8. Press on the differential bearings with 6116, Fig. 46–55.
9. Fit the crown wheel. Fit and tighten the bolts to a torque of 80–100 Nm (8–10 kpm = 58–72 lbftf).

Assembling the rear differential carrier

Special tools: 1845, 2284, 2395, 2404, 2600, 2636, 2685, 2686, 2806, 2841, 6102, 6113, 6146.

1. Polish the pinion mesh face with a fine emery cloth.
2. Place the adjuster ring 2685 with lock screw facing the pinion. Tighten up spanner 2841, Fig. 46–56.
3. Place the pinion in the housing. The lock pin for the adjuster ring should go down into the recess on the carrier housing bearing face and the ring should be turned in order to make it easy to get at the lock bolt, Fig. 46–57.

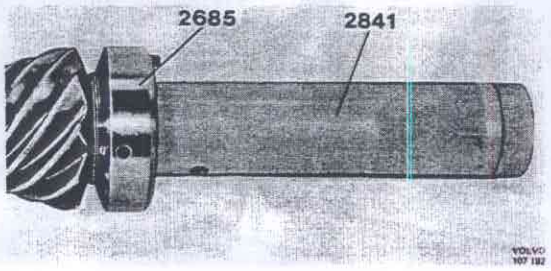


Fig. 46–56. Adjuster ring and sleeve for pinion location

4. The pinion should have a certain nominal measurement (1, Fig. 46–58) to the crown wheel centreline. Due to tolerances in manufacture, deviations from the nominal measurement arise. Deviation is indicated on the ground face of the pinion with a figure. Deviation (e.g. 1 = 0.01 mm = 0.0004") can either be + or –. To check the pinion location, use a dial indicator as well as a measuring tool 6113, which consists of two parts: a pinion gauge and an adjuster jigg.

   The check is carried out as follows:
   Place the pinion gauge on the pinion face and the adjuster jigg in the differential bearing seats, see Fig. 46–59. Scren tight parallel block 6146 on the differential carrier housing, Fig. 46–60. Place the indicator holder 2284 on the carrier housing and zero-set the indicator to the highest point on

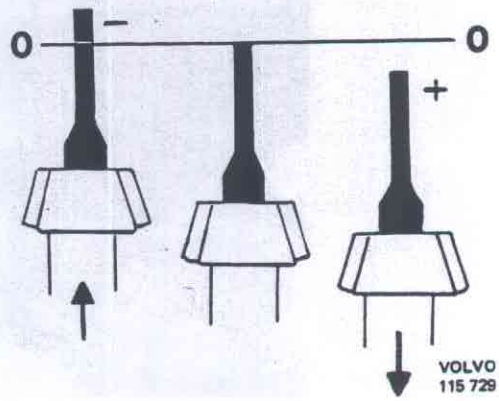


Fig. 46–58. Pinion location

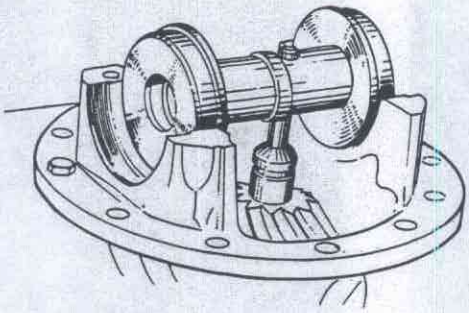


Fig. 46–59. Checking the location

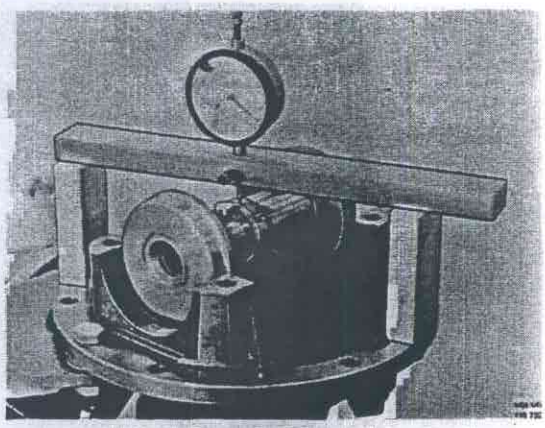


Fig. 46–61. Checking the location

the adjuster jigg, Fig. 46–60. Then turn over the indicator holder so that the indicator comes towards the pinion gauge, Fig. 46–61. Read off the indicator.

If the pinion is marked 0, the adjuster jigg and pinion gauge should be at the same height, if it is marked – then the pinion gauge should be higher than the adjuster jigg, and if it is marked +, then the pinion gauge should be lower than the adjuster jigg for correct adjustment. This is adjusted by turning the spanner on the pinion until the dial indicator shows correct value. Then lock the adjuster ring with the lock bolt. Remove the measuring tool and pinion. Remove the adjuster ring and the spanner from the pinion.

5. Place the rear pinion bearing with outer race in measuring fixture 2600. Fit on the plate, spring and nut. Turn the nut until the flat side faces downwards. Rotate the plate (and thereby the bearing) back and forth several times so that the rollers take up their proper positions. Place the adjuster ring on the fixture, Fig. 46–62. Use holder 2284 and a dial indicator. Point the dial indicator pointer towards the bearing outer race and zero-set the indicator. Then place the pointer to point to the adjuster ring. The indicator will now indicate the thickness of shims required. NOTE! It is not always possible to obtain shims with precisely the right thickness. However, they must not be more than 0.03 mm (0.0012") thicker than the measured value but up to 0.05 mm (0.0020") thinner. Shims are available in the following dimensions: 0.08, 0.13 and 0.25 mm (0.0032, 0.0052 and 0.0098").

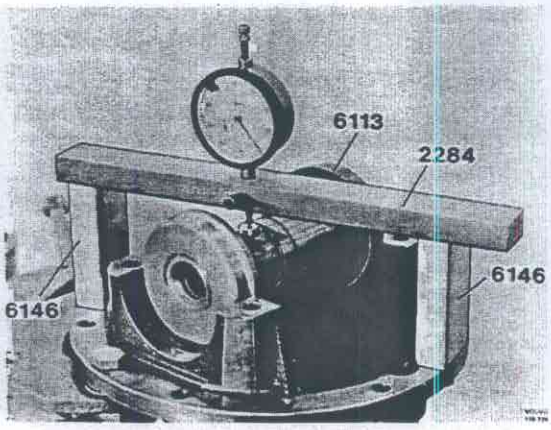
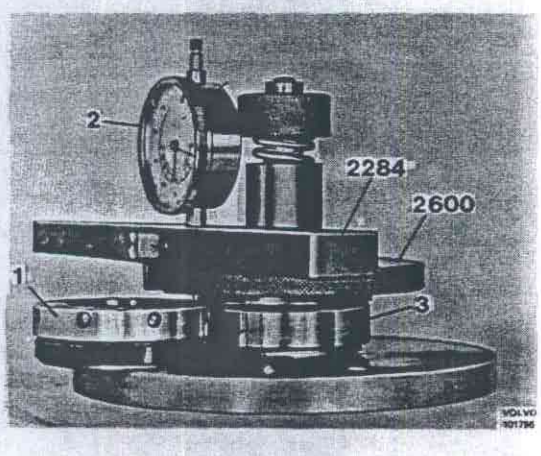


Fig. 46–60. Checking the location



1. Adjuster ring 2. Dial indicator 3. Bearing, complete

Fig. 46–62. Determining shim thickness

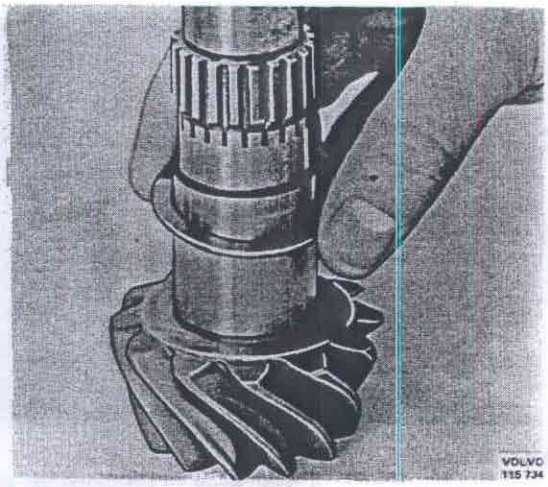


Fig. 46–63. Installing shims

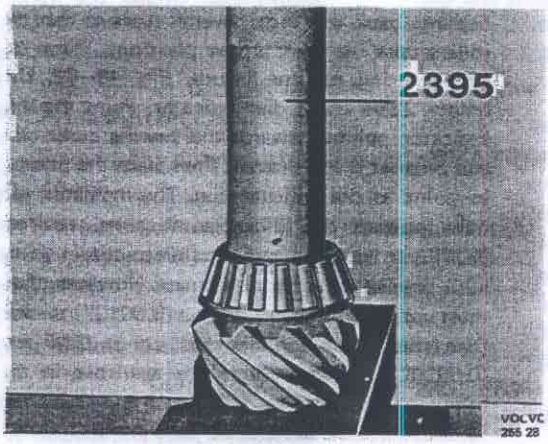


Fig. 46–64. Pressing on the bearing

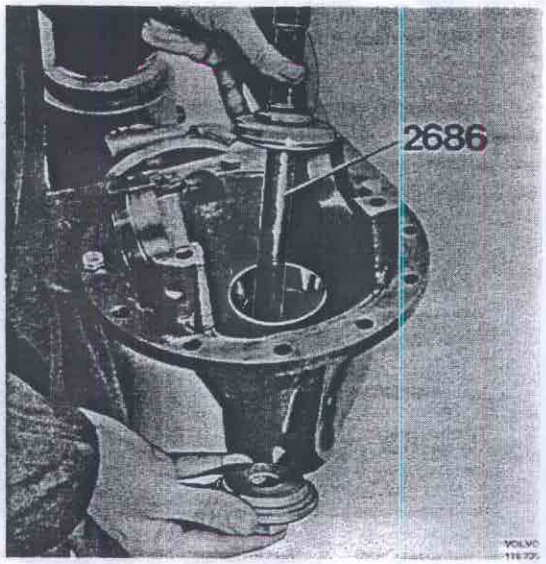


Fig. 46–65. Pressing in the bearing

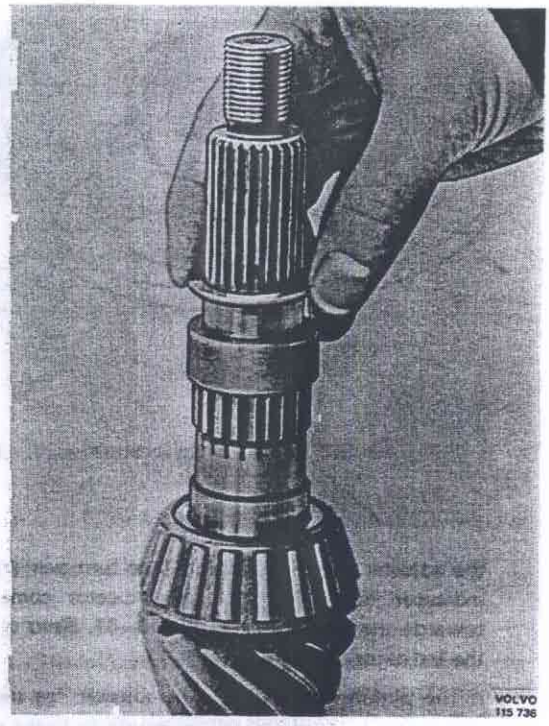


Fig. 46–66. Fitting the spacer ring

6. Place the requisite number of shims on the pinion, Fig. 46–63. Press on the bearing with 2395, Fig. 46–64.
7. Press in the rear pinion bearing outer race with 2686, Fig. 46–65.
8. Separate the tool and press in the front bearing outer race.

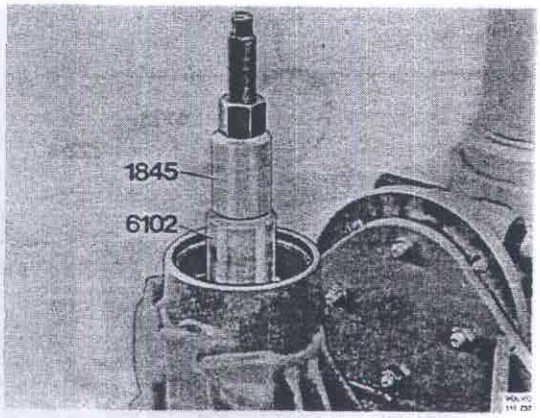


Fig. 46–67. Pressing on the bearing

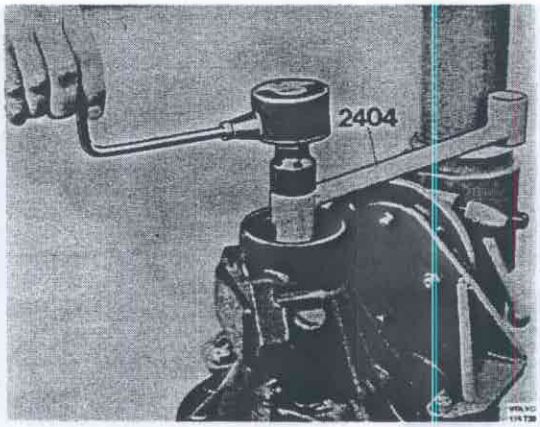
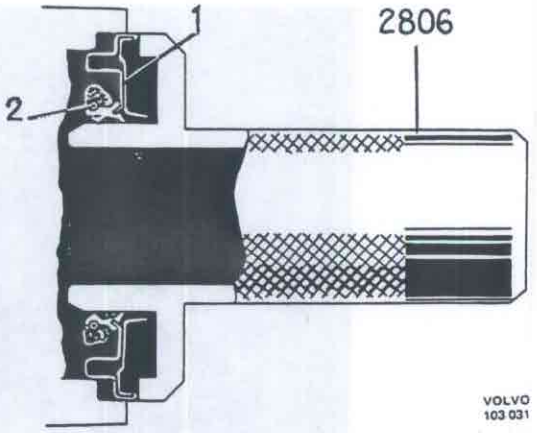


Fig. 46–68. Fixing the tool



1. Sealing ring
2. Spring with layer of grease

Fig. 46–69. Placing the grease

9. Place the spacer sleeve and the shims on the pinion, Fig. 46–66. Use those shims which were removed during the disassembling plus a shim of 0.5 mm (0.020").
10. Turn the carrier. Place the pinion in the housing. Place the front bearing, sleeve 6102 and press tool 1845 on the pinion, Fig. 46–67. Pull in the bearing.
11. Remove the press tool and the sleeve. Fit 2404 on the pinion and tighten with the pinion nut, Fig. 46–68. Tighten the nut to a torque of 280–300 Nm (28–30 kpm = 202–217 lbftf).
12. Turn the carrier. Place a dial indicator on the pinion measuring face. Rotate the pinion while pulling it out at the same time. Zero-set the indicator when the pointer is at its outer position. Push in the pinion while rotating it at the same time. Read off the amount the pinion is pressed in.
13. Remove the dial indicator.
    Turn the carrier. Remove the press tool and the sleeve from the pinion. Drive out the pinion with a plastic mallet.
14. The shims on the pinion should be reduced with the axial clearance obtained plus 0.06–0.08 mm (0.0024–0.0032") for new bearings and 0.04–0.06 mm (0.0016–0.0024") for old bearings.
15. Fit the pinion with the correct number of shims according to point 14. Place the sleeve 6102 and press tool 1845 on the pinion, pull in the bearing. Remove the sleeve and the press tool.
16. Fit the spanner 2404 and the flange nut. Tighten the nut to a torque of 280–300 Nm (28–30 kpm = 202–217 lbftf).
    Check the torque (see Fig. 46–68). It should be 0.6–2.0 Nm (0.06–0.2 kpm = 0.4–1.5 lbftf) for run-in bearings and 1.5–3.5 Nm (0.15–0.35 kpm = 1.1–2.5 lbftf) for new bearings. If the torque wrench indicates another value than what is recommended, shims must be removed or added accordingly.
17. Check the location of the pinion according to point 4.
18. Remove the flange nut and spanner.
19. Place the oil deflector plate on the front bearing. Fill 1/4 of the space between the lips with grease. See Fig. 46–69. Drive in a new seal with 2806, Fig. 46–70.
20. Fit the flange with counterhold 2837. Press on the flange with 1845, Fig. 46–74.

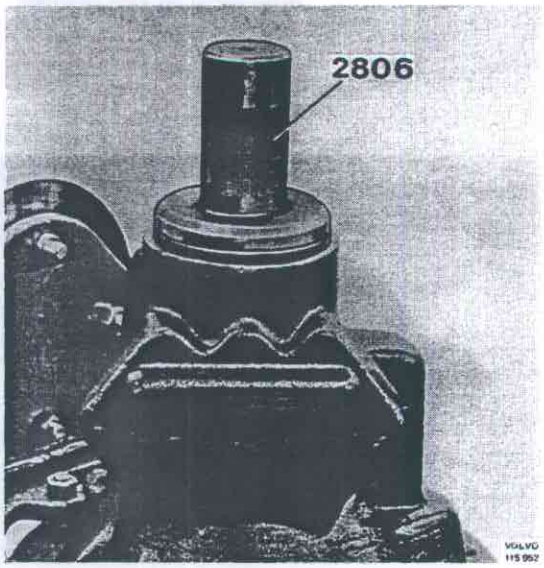


Fig. 46–70. Driving in the seal

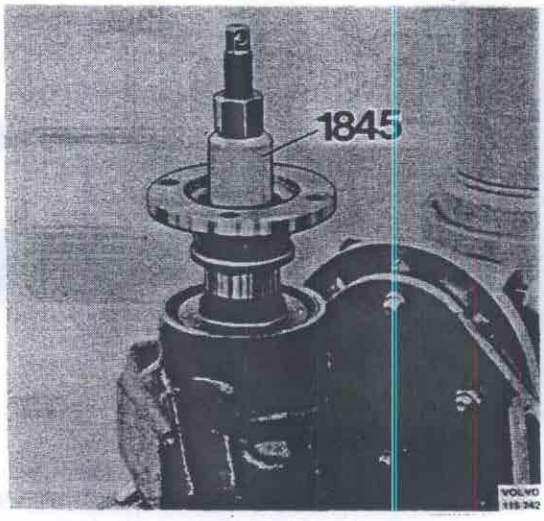


Fig. 46–71. Pressing on the flange

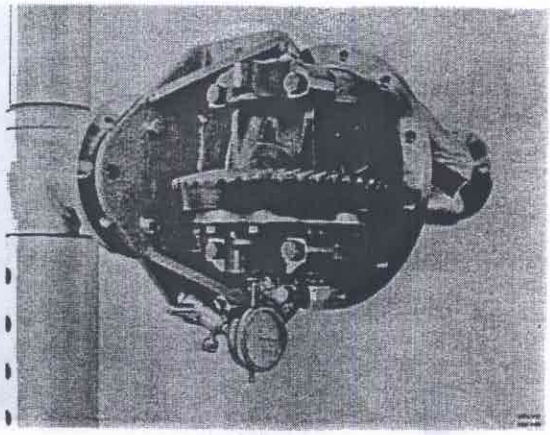


Fig. 46–73. Checking the clearance

21. Remove the press tool. Fit the washer and the flange nut. Tighten the nut to a torque of 280–300 Nm (28–30 kpm = 202–217 lbftf). Remove the counterhold.
22. Turn the carrier. Place the spring and oil scraper in the housing.
23. Fit the differential housing in position. Oil the adjuster nuts and place them and the outer races on the housing. Check that the adjuster nuts are screwed on properly. Fit the caps, observing the line-up marks. Fit the cap bolts and tighten up. Slacken the bolts approx. 1/8 turn. Adjust the adjuster nuts so that a backlash is obtained at the same time as there is a certain clearance in the differential housing bearings.

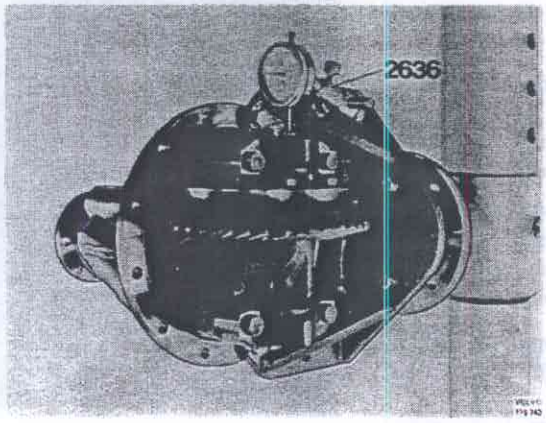


Fig. 46–72. Fixing the dial indicator

Adjusting the backlash and pre-loading on differential housing bearings

1. Fix the dial indicator holder 2636 on the fixture, Fig. 46–72. Fix the dial indicator in position. Set the measuring point to the bearing inner race.
2. Turn the carrier so that the indicator faces downwards, see Fig. 46–73. Rotate the crown wheel while pressing down the differential housing at the same time. Zero-set the indicator.
3. Turn the carrier and rotate the crown wheel a couple of turns while pressing it down at the same time. Zero-set the indicator.
4. Turn the carrier and rotate the crown wheel a couple of turns. Adjust the lower adjuster nut so that the bearing clearance disappears until the indicator is again set to zero. Then turn the adjuster nut a further two notches and even more so that the lock washer can be fitted.
5. Rotate the carrier and start adjusting the backlash. Adjust with a rocker indicator. The indicator pointer is placed approx. 3 mm (0.12") from the heel of a tooth and three teeth at different places on the crown wheel are measured. The backlash may be 0.12–0.18 mm (0.0048–0.0072").

   When adjusting, turn the adjuster nuts an equal number of notches in order to maintain the correct bearing pre-loading.
6. Lock the adjuster nuts and tighten up the cap bolts to a torque of 55–67 Nm (5.5–6.7 kpm = 40–48 lbftf). Lock the bolts.

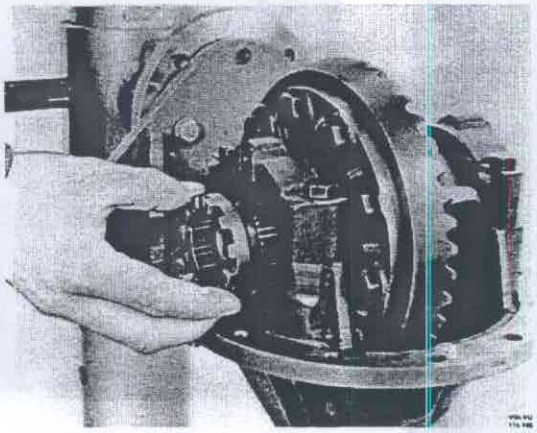


Fig. 46—74. Fitting the flange sleeve

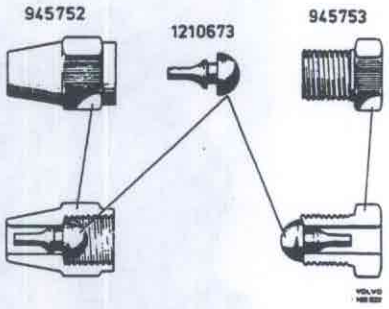


Fig. 46—76. Sealing nipples

After the carrier has been assembled and the pinion position adjusted according to the line-up marks, it is not necessary to check tooth mesh.

7. Fit the flange for the differential lock, Fig. 46—74. Fit the washer and the lock ring.
Remove the carrier from the fixture.

WHEEL CARRIERS

Front wheel carrier

Removing a wheel carrier

1. Remove the wheel nuts from the wheel. Jack up the vehicle.
2. Remove the wheel.
3. Drain the oil from the wheel carrier housing.
Remove the steering joint from the steering rod with puller 2370, Fig. 46—75.
4. Remove the brake lines from the brake hoses. Plug the hoses with sealing nipples, see Fig. 46—76 for a suitable nipple, Volvo part nos. 945752 + 1210673. Remove the bracket with hoses from the wheel carrier housing.
5. Remove the stop plate for the hollow rubber spring.
6. Remove the upper bolts securing the wheel carrier housing to the front axle casing. Fit the guide pin 6131 in the upper holes, Fig. 46—77. Place a jack under the wheel carrier housing.
7. Remove the lower bolts and pull out the wheel carrier housing with drive shaft.

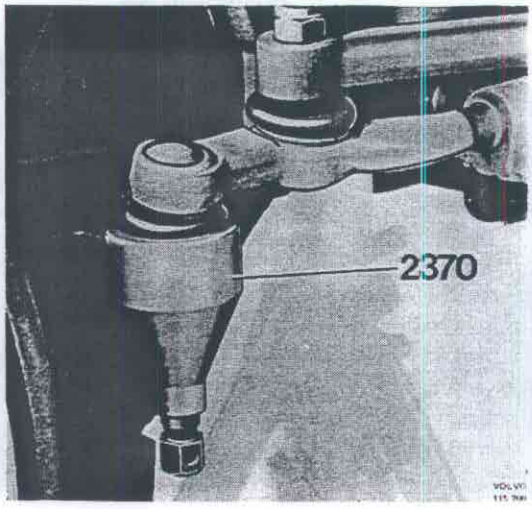


Fig. 46—75. Removing the steering rod

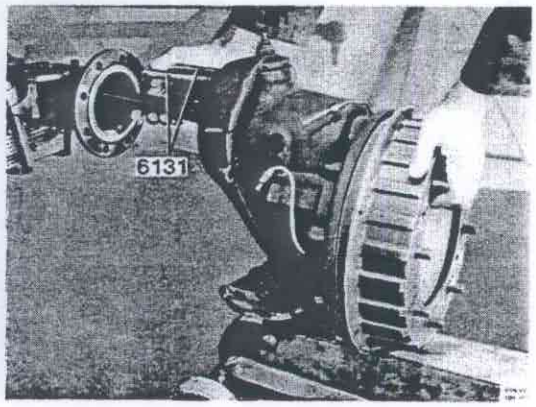


Fig. 46—77. Removing the wheel carrier

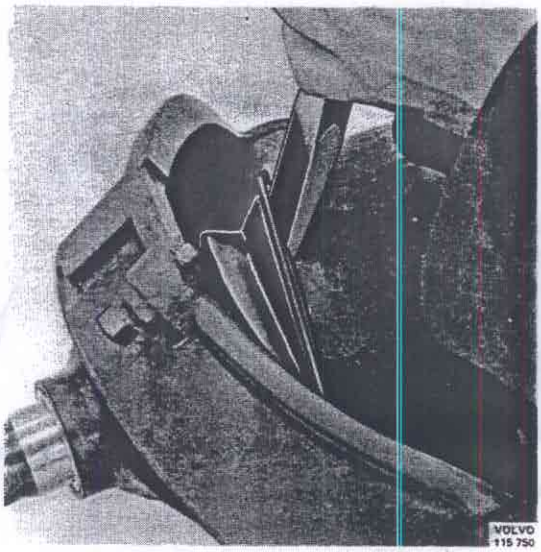


Fig. 46–78. Removing the rubber dust cover

Replacing rubber dust cover, wheel carrier

1. See under "Removing the front wheel carrier".
2. Remove the rubber dust cover with a suitable tool, Fig. 46–78.
3. Remove the bushing in the dust cover. If the bushing is in good condition, it can be re-fitted together with the new dust cover.
4. Check to make sure that the guide edge of the dust cover is clean. Grease the edge and the bushing.
5. Place the dust cover in position and drive it down with 6117, Fig. 46–79. **Take care not to damage the dust cover should the shaft fall against the steering knuckle support.**

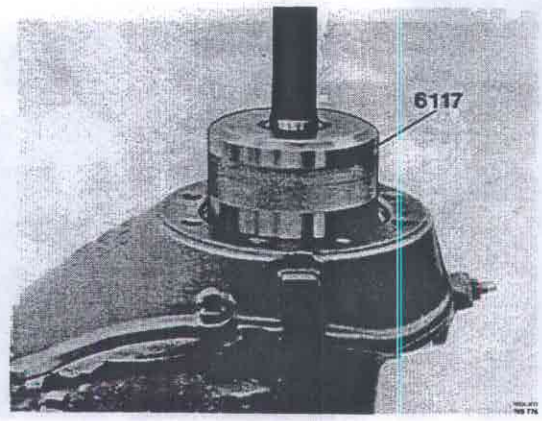


Fig. 46–79. Driving in the seal

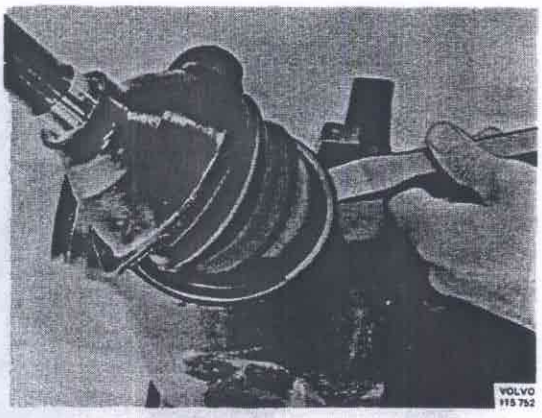


Fig. 46–80. Removing the rubber dust cover

6. See under "Installing the front wheel carrier".

Replacing the drive shaft joint

1. See under "Removing the front wheel carrier housing".
2. Remove the rubber dust cover with a suitable tool, Fig. 46–80.
3. Lift the drive shaft and knock on the wheel carrier housing with a plastic mallet at the same time, Fig. 46–81.

   If the shaft pin accompanies the drive shaft:

   Secure the drive shaft in a vice with copper jaws or similar. Knock out the pin with a plastic mallet, see Fig. 46–82.

   If the shaft pin does not accompany the drive shaft:

   Fit a standard puller, see Fig. 46–83, and pull off the shaft pin.

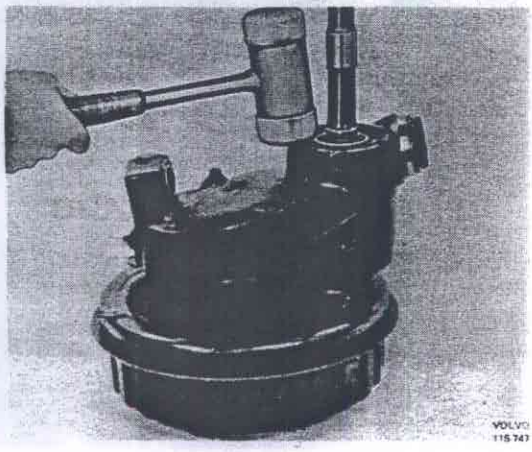


Fig. 46–81. Removing the drive shaft

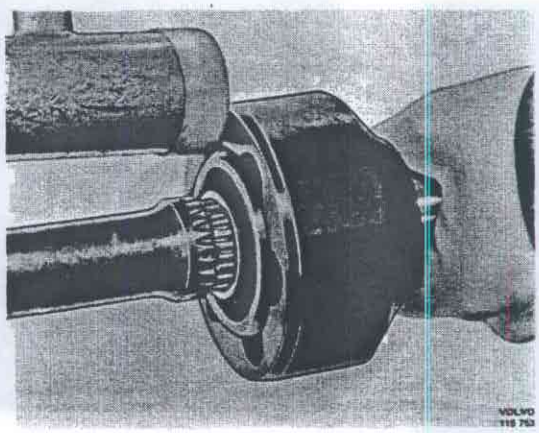


Fig. 46—82. Removing the drive shaft joint

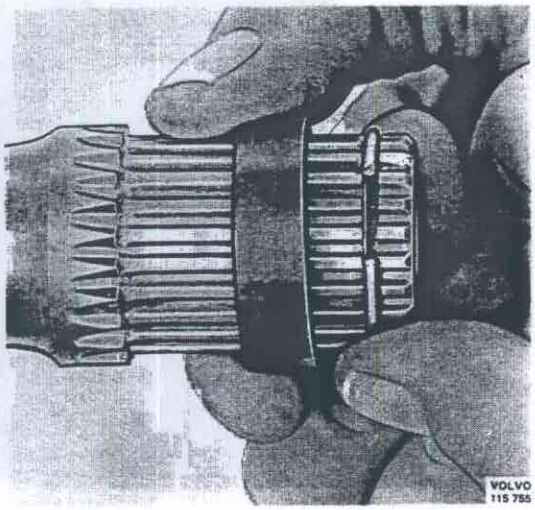


Fig. 46—84. Placing the spacer ring

4. Replace the circlip on the drive shaft and push the spacer ring over the circlip, Fig. 46—84. Grease the circlip and splines.
5. Place the shaft pin on a flat surface, Fig. 46—85, and the drive shaft in the flange. Knock on the rear end of the drive shaft so that it glides into the flange.
6. Replace the circlip on the shaft pin. Grease the circlip and splines. Place the shaft in the gear wheel of the wheel carrier. Knock down the shaft pin so that the circlip grips in the gear wheel.
7. Grease the guide edge of the rubber dust cover and bushing. Fit the dust cover over the shaft. Knock down the dust cover with 6117, Fig. 46—86.
8. See under "Installing the front wheel carrier". NOTE! The rubber dust cover can easily be damaged if the shaft rests against the steering knuckle support.

Reconditioning the drive shaft joint (removed)

The drive shaft joint can be disassembled for cleaning and checking. The components of the joint are not sold separately since, like a ball bearing which is matched with its inner and outer races, the joint parts are matched. The joint is disassembled and assembled as follows:

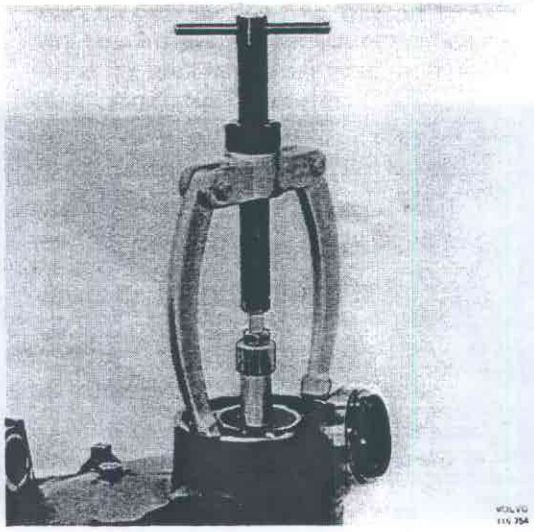


Fig. 46—83. Removing the shaft pin

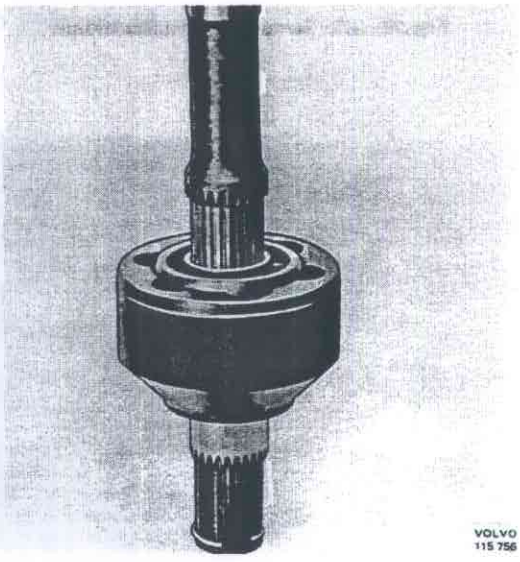


Fig. 46—85. Driving in the drive shaft

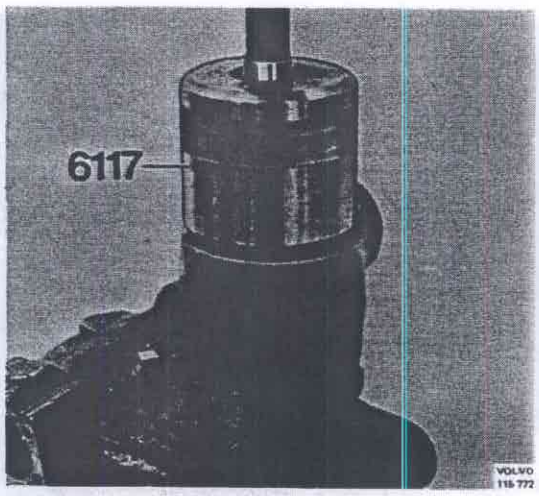


Fig. 46–86. Driving in rubber dust cover

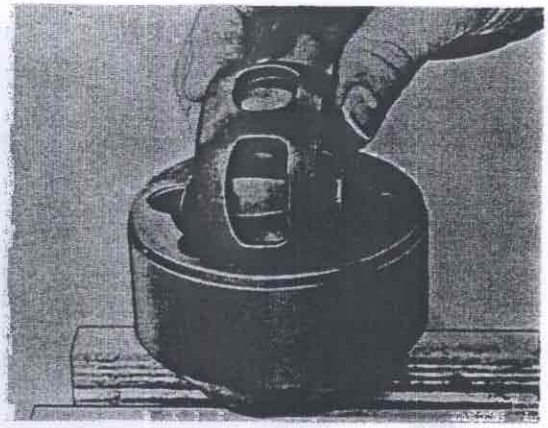


Fig. 46–89. Removing the ball cage

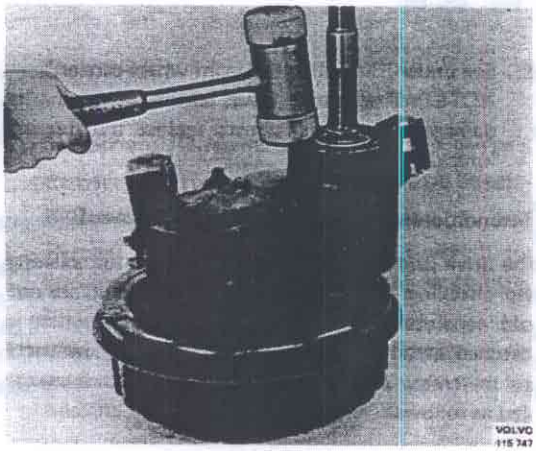


Fig. 46–87. Removing drive shaft joint

Disassembling

1. Secure the drive shaft in a vice provided with copper jaws or similar. Knock the drive shaft joint out of the drive shaft by knocking on the shaft pin, Fig. 46–87, with a plastic mallet.
2. Secure the shaft pin in a vice. Rotate the ball cage and flange so that a ball can be plucked up, Fig. 46–88. Repeat this and pluck up the remaining balls.
3. Rotate the ball cage and flange according to Fig. 46–89 and pluck it out of the shaft pin.
4. Rotate the flange according to Fig. 46–90 and take it out of the cage.

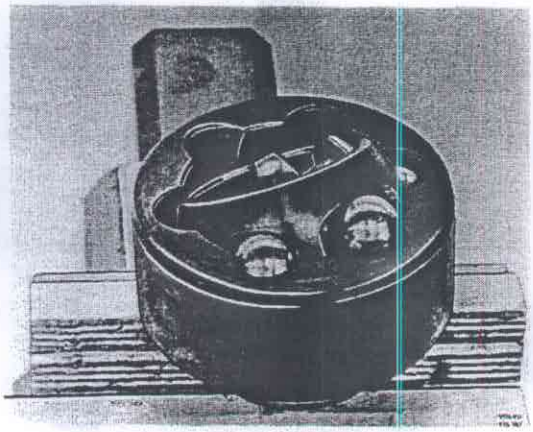


Fig. 46–88. Drive shaft joint

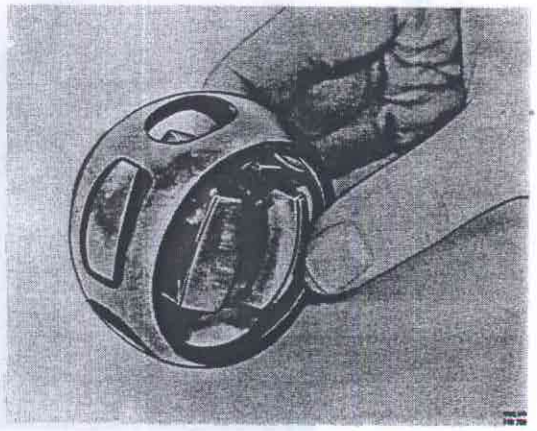


Fig. 46–90. Removing the flange

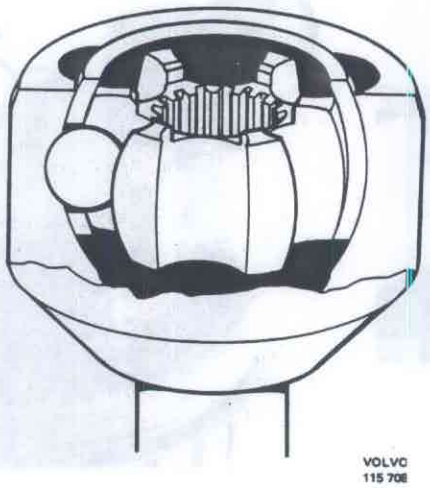


Fig. 46—91. Location of flange

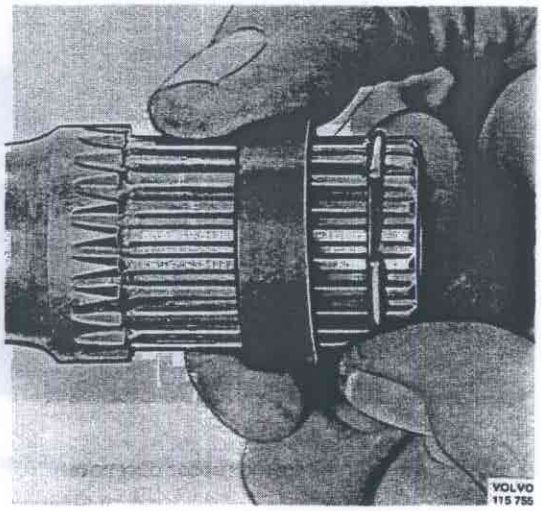


Fig. 46—92. Placing the circlip

Checking and replacing parts

Clean all parts and dry them thoroughly. If the balls, cage, flange or shaft pin are damaged in any way, then the shaft pin and joint must be replaced complete.

When assembling, fill the inside of the shaft pin and the parts with grease of the long-fibre type for wheel bearings, e.g., MP lubricating grease.

Assembling

1. Place the flange in the cage and fit them in the shaft pin.
2. Insert the balls one at a time. When all the balls have been inserted, the flat side of the flange as well as the small inner diameter of the cage, Fig. 46—91, should face downwards.
3. Replace the circlip on the drive shaft and push the spacer ring over the circlip, Fig. 46—92.
4. Place the shaft pin on a flat surface, Fig. 46—93, and fit the drive shaft in the flange. Knock on the rear end of the drive shaft so that it glides into the flange.

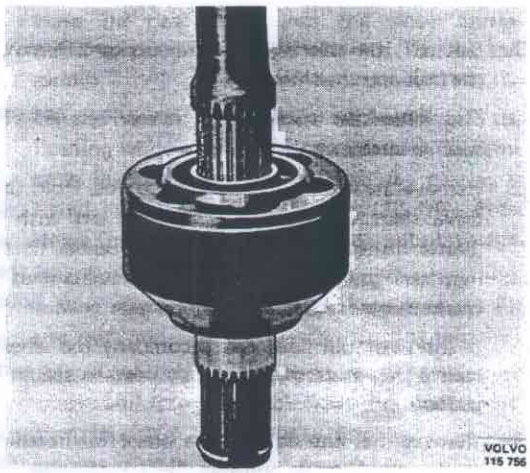


Fig. 46—93. Driving in the drive shaft

Reconditioning a wheel carrier (removed)

Disassembling

Special fools: 2413, 6141.

1. Clean the wheel carrier housing and the steering knuckle support.
2. Remove the cover for the lower steering knuckle joint. Unscrew the nut for the bolt. Push in the bolt and remove the ball shell, Fig. 46—94.

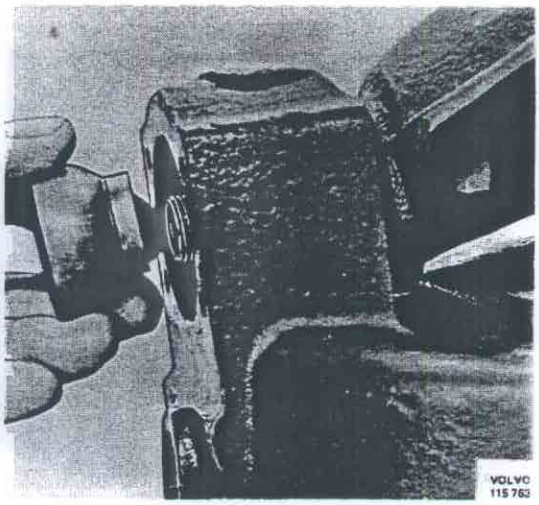


Fig. 46—94. Removing the ball shell

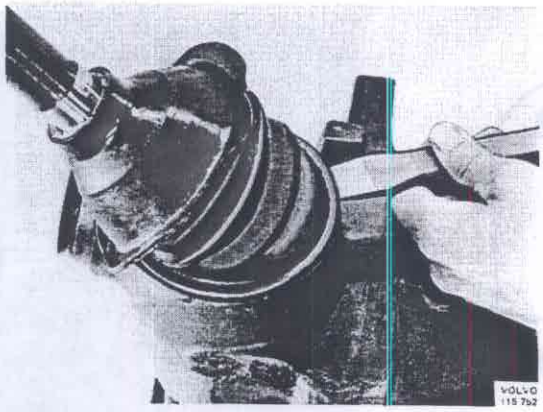


Fig. 46–95. Removing rubber dust cover

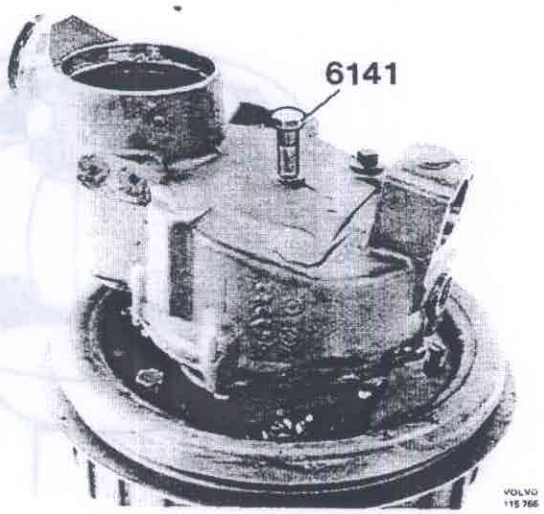


Fig. 46–97. Pressing housing apart

3. Lift off the steering knuckle support. Remove the bolt and the shims.
4. Tap loose the rubber dust cover, Fig. 46–95, with a suitable tool.
5. Remove the wheel carrier from the vice. Hold the drive shaft upwards, Fig. 46–96, and with a plastic mallet knock on the wheel carrier housing, see Fig. 46–96, so that the shaft pin releases from the gear wheel in the housing.

   If the shaft pin does not accompany the wheel carrier, it must be pulled out with a standard puller.
6. Remove the nuts securing the wheel hub housing to the wheel carrier housing. Remove the plug on the wheel carrier housing. Fix and pull in the dismantling bolt 6141, Fig. 46–97. Remove the hub when it loosens from the final gear. Remove the bolt 6141.
7. Remove the bearing circlip from the housing.
8. Place the final gear in a press and press out the gear wheel, bearing and needle bearing at the same time with 2413, Fig. 46–98.
9. Remove the circlip on the gear wheel and press off the bearing with 2413, Fig. 46–99.

Checking and replacing parts

Clean all parts and also the contact surfaces thoroughly. Replace the ball and needle bearings.

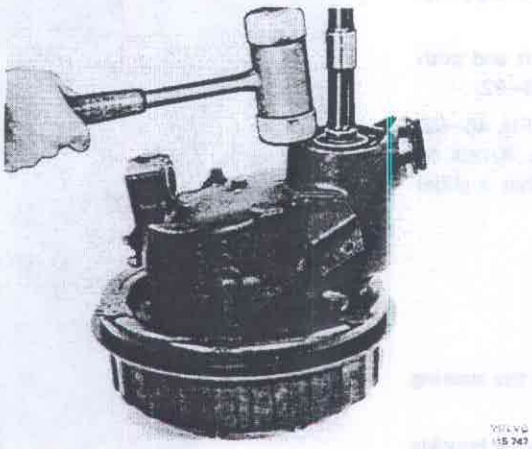


Fig. 46–96. Removing the drive shaft

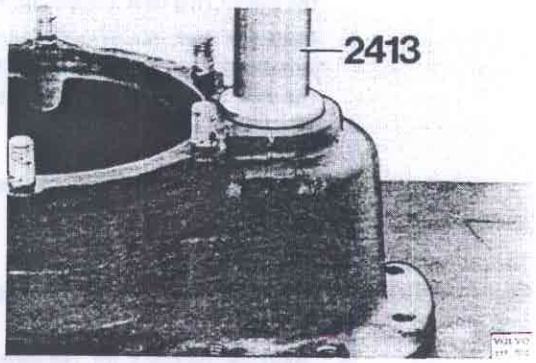


Fig. 46–98. Pressing out gear wheel

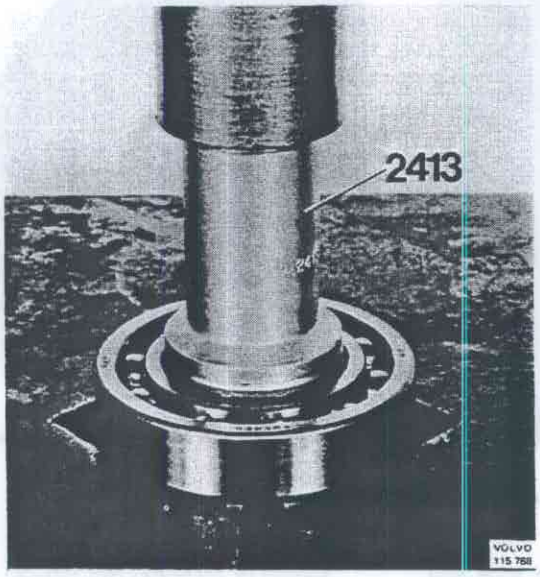


Fig. 46–99. Removing the bearing

Check the teeth on the gear wheel and if they are damaged the gear wheel should be replaced. With replacement of the gear wheel, the wheel hub should also be replaced, see special instructions under "Wheel and hub, Part 6".

Check the rubber dust cover to make sure it is not damaged. Also check the steering knuckle bolt and the ball shells for damage, see Part 6.

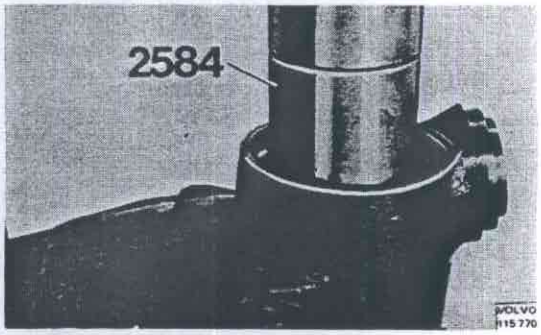


Fig. 46–101. Pressing in the gear wheel

Assembling

1. Press the ball bearing on the gear wheel with 2022, Fig. 46–100. Fit the circlip.
2. Press the gear wheel into the wheel carrier housing, using 2584, Fig. 46–101. Secure the circlip.
3. Oil the needle bearing. Press the bearing into the housing while rotating the gear wheel at the same time in order to make sure that the bearing is fitted properly, using 2413, Fig. 46–102. Press down the bearing so that it is flush with the edge.
4. Coat the contact surface against the hub with sealing agent. Place the hub in the housing. Fit the nuts and tighten hub and housing together.
5. Replace the circlip on the shaft pin. Grease the circlip and splines. Knock down the shaft pin so that the circlip grips in the gear wheel.

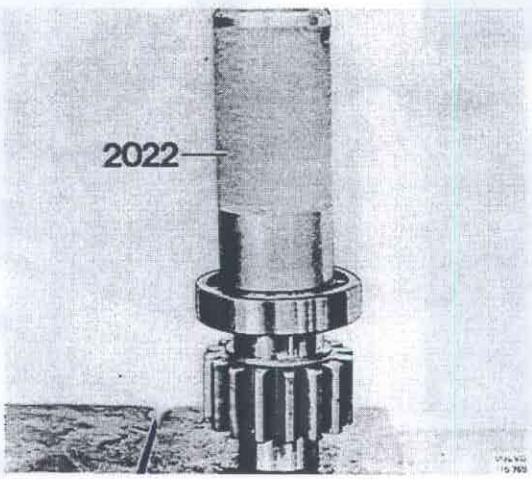


Fig. 46–100. Pressing on the bearing

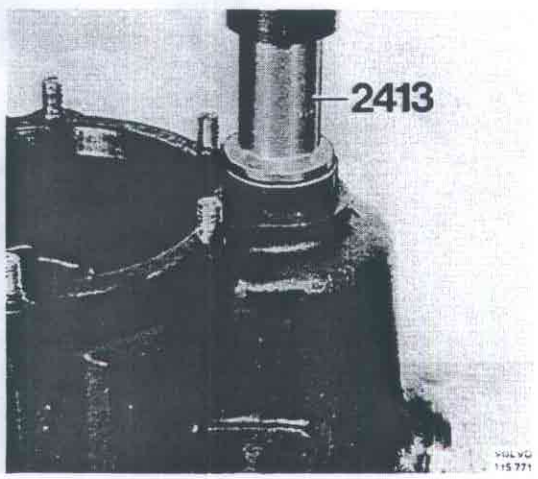


Fig. 46–102. Pressing in the needle bearing

Fig. 46–103. Driving in rubber dust cover

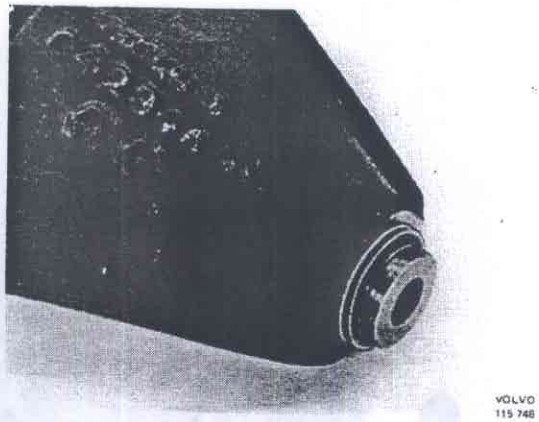


Fig. 46–105. Fitting the seal

6. Grease the rubber dust cover guide edge and bushing. Fit the dust cover over the shaft. Drive down the cover with 6117, Fig. 46–103.
7. Replace the upper seal on the wheel carrier housing, Fig. 46–104, and the seal on the support Fig. 46–105. Fit the support on the wheel carrier housing.
8. Fit the lower bolt in position. Place the same number of shims on the bolt that was removed during disassembling. Fit the ball shell in position, Fig. 46–106. Fit the nut and tighten it to a torque of 150–200 Nm (15–20 kpm = 108–145 lbftf).
9. Fit the lower cover.

Installing a wheel carrier

1. Clean the contact surface on the shaft casing and coat it with sealing agent.
2. Fit the two guide pins 6131 in the upper holes of the steering knuckle support. See Fig. 46–107. Place the wheel carrier on a jack. Jack up the carrier so that the guide pins can fit into the front axle casing.

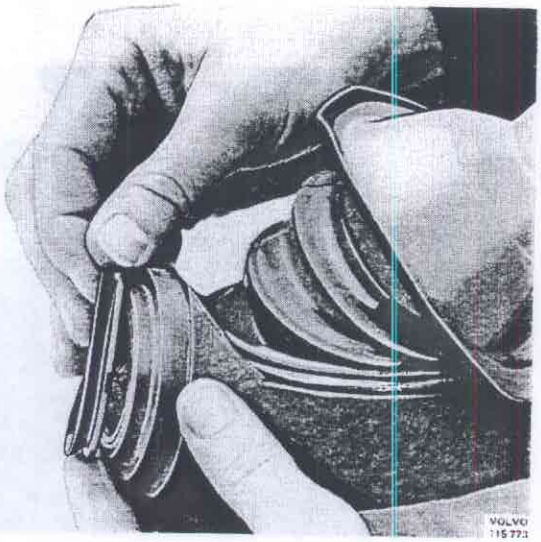


Fig. 46–104. Fitting the seal

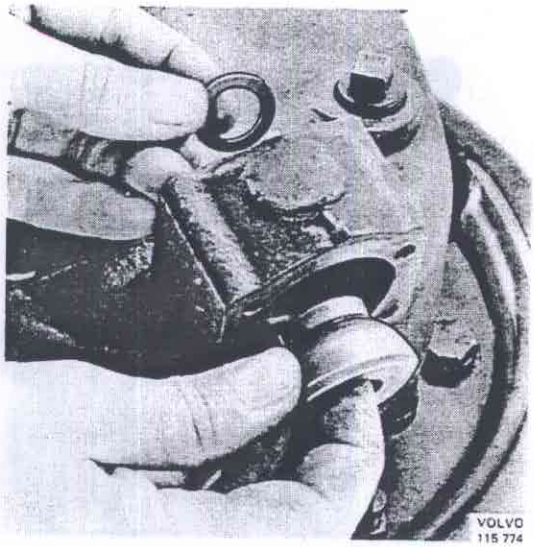


Fig. 46–106. Installing the ball shell

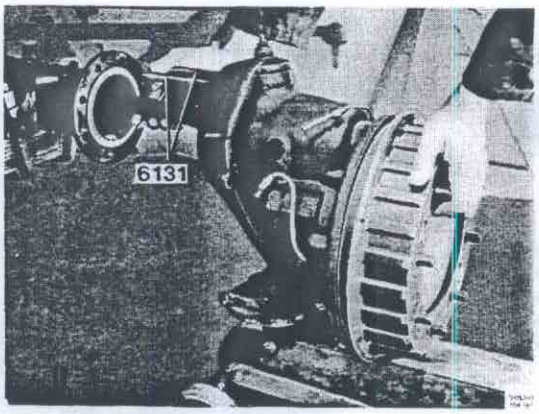


Fig. 46–107. Fitting the wheel carrier

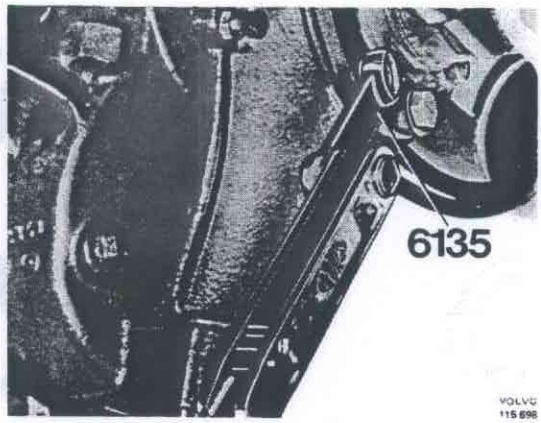


Fig. 46–109. Tighten the bolts

NOTE! Check that the rubber dust cover for the drive shaft is in good condition and is fitted properly in the steering knuckle support, Fig. 46–108 before it is fitted entirely in position.

Lift up the drive shaft while pushing in the carrier at the same time. When the drive shaft comes in contact with the differentials, rotate the differential carrier flange while pushing the wheel carrier to the bottom at the same time.

3. Fit the bolts round the front axle casing. Remove the guide pins. Tighten the bolts to a torque of 100–120 Nm (10–12 kpm = 72–87 lbftf). Use 6135, Fig. 46–109. Remove the jack. Fit the bracket for the brake pipes on the front axle casing.
4. Connect the hoses to the brake pipes. Fit the bracket for the hoses on the wheel carrier housing.
5. Fit the plate for the hollow rubber spring.
6. Check that the lower lubricating nipple is not damaged. Fit the steering rod.
7. Bleed the wheel cylinders. The pressure-difference contact should be removed before bleeding, see Fig. 46–110. If a bleeder unit is used, the working pressure should be 0.2 MPa (2 kp/cm^2 = 28 lbf/in^2). For more detailed instructions about bleeding, see Part 5.
8. Fill the carrier with oil. Concerning quantity and quality, see under "Data".
9. Fit the wheel.
10. Lower the vehicle. Tighten the wheel nuts to a torque of 210 Nm (21 kpm = 152 lbftf).

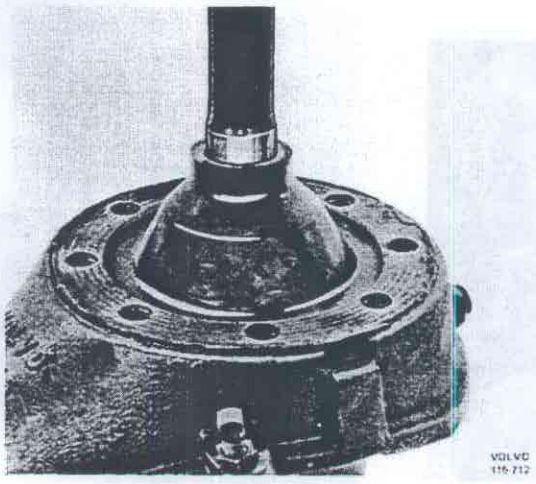


Fig. 46–108. Checking rubber dust cover

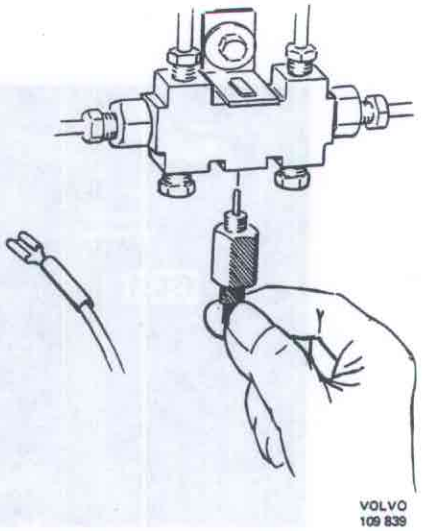


Fig. 46–110. Removing the contact

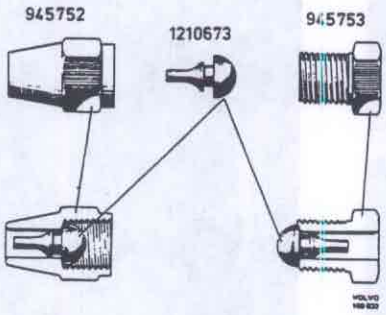


Fig. 46–111. Sealing nipple

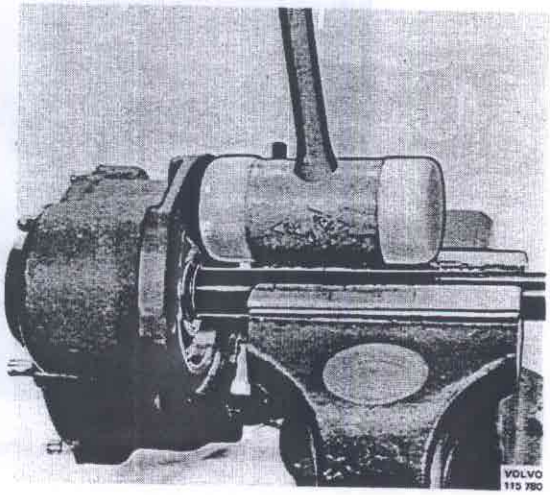


Fig. 46–113. Removing the drive shaft

Rear wheel carrier

Removing a wheel carrier

1. Remove the wheel nuts. Jack up the rear of the vehicle.
2. Remove the wheel.
3. Drain the oil from the carrier.
4. Remove the shock absorber from its lower anchorage. Disconnect the brake pipe from the brake backing plate. Plug the pipe with sealing nipples. Concerning a suitable nipple, see Fig. 46–111. Volvo Part Nos. 945752 + 1210673.
5. Place a jack under the wheel carrier housing. Remove the bolts round the rear axle casing which secure the wheel carrier. Allow two bolts to remain. Carefully tap on the bolts so that the housing loosens from the casing.
6. Remove the bolts and pull out the wheel carrier housing with drive shaft, see Fig. 46–112.

Replacing the wear ring and seal

Special tools: 1821, 2097, 2132.

1. See under "Removing the rear wheel carrier".
2. Clean the wheel carrier housing.
3. Hold the drive shaft and with a plastic mallet knock the drive shaft and with a plastic mallet knock on the wheel carrier housing, see Fig. 46–113, so that the drive shaft releases from the gear wheel.
4. Remove the sealing wear ring with 1821, Fig. 46–114.

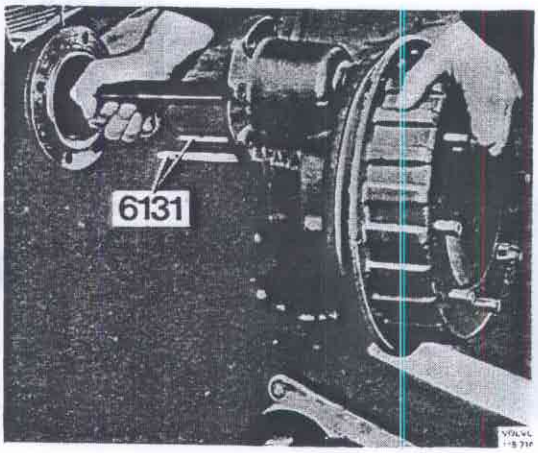


Fig. 46–112. Removing the wheel carrier

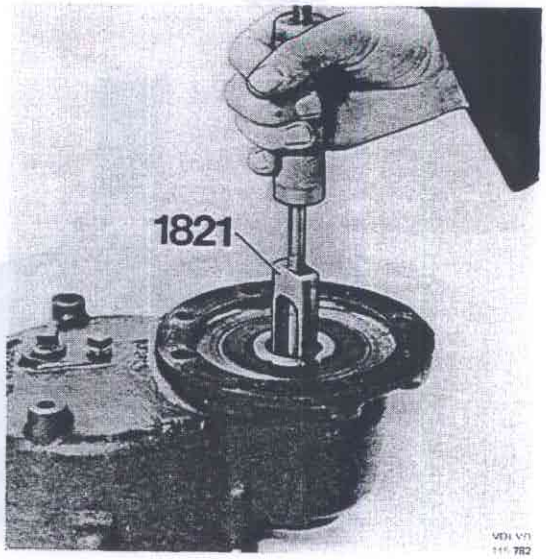


Fig. 46–114. Removing the wear ring

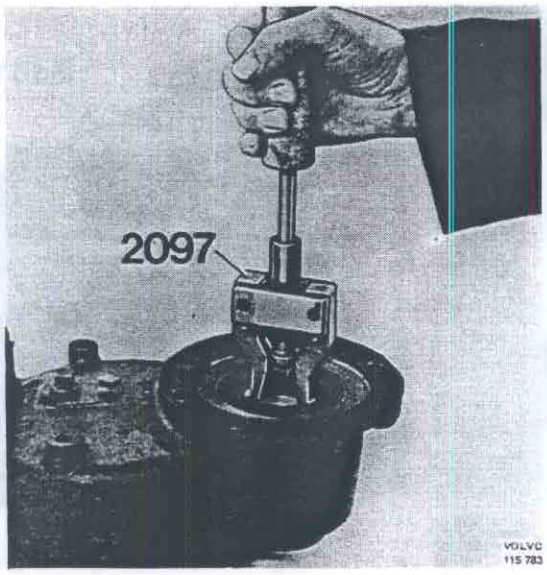


Fig. 46–115. Removing the seal

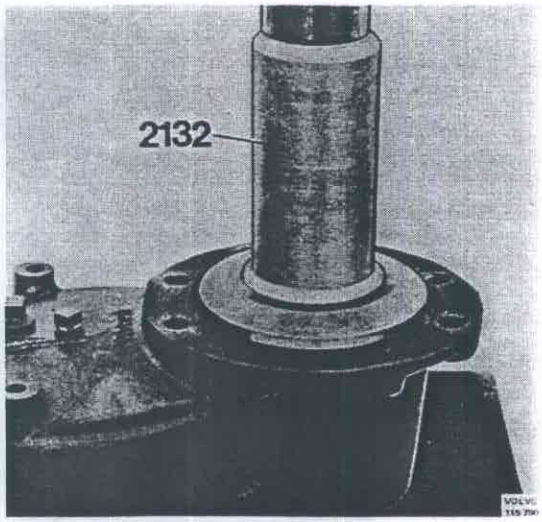


Fig. 46–117. Pressing in the seal

5. Remove the seal with 2097, Fig. 46–115.
6. Press the wear ring into gear wheel, Fig. 46–116. Grease the sealing ring surface. Press down the seal with 2132, Fig. 46–117.
7. Replace the circlip and X-ring onn the drive shaft. Grease the circlip and splines. Fit the shaft in the gear wheel and drive it down so that the circlip grips the gear wheel. Grease the X-ring, Fig. 46–118, and press it down into the wear ring.
8. See under "Install the rear wheel carrier".

Reconditioning the wheel carrier

Disassembling

Special fools: 1821, 2097, 6141.

1. Clean the wheel carrier housing.
2. Hold the drive shaft and with a plastic mallet knock on the wheel carrier housing, see Fig. 46–119, so that the drive shaft releases from the gear wheel.

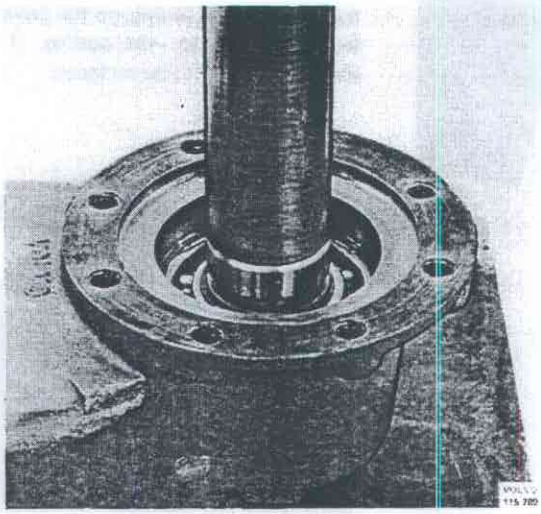


fig. 46–116. Pressing in the wear ring

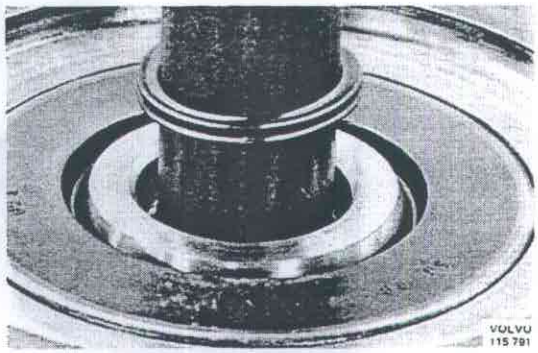


Fig. 46–118. Installing the X-ring

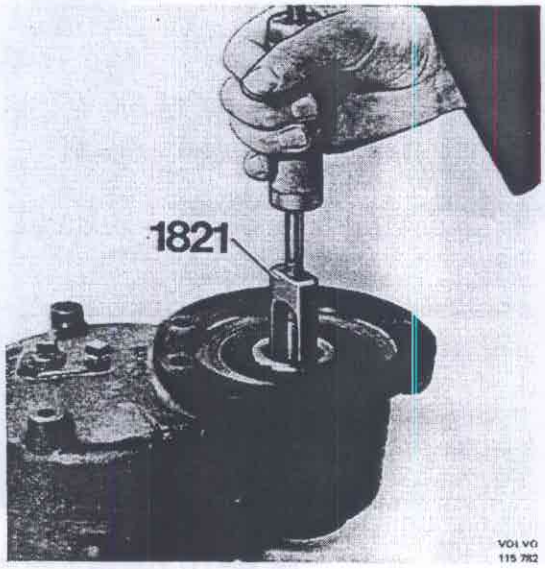


Fig. 46–119. Removing the wear ring

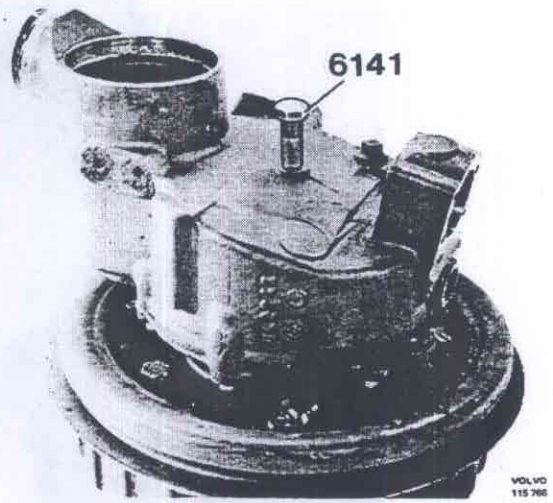


Fig. 46–121. Pressing housing apart

3. Remove the sealing wear ring with 1821, Fig. 46–119.
4. Remove the seal with 2097, Fig. 46–120.
5. Remove the nuts securing the wheel hub housing to the wheel carrier housing. Remove the plug on the wheel carrier housing. Fit and pull in the dismantling bolt 6141, Fig. 46–121. Remove the hub when it loosens from the wheel carrier. Remove the bolt 6141.
6. Remove the bearing circlip from the housing.
7. Place the wheel carrier in a press and press out the gear wheel, bearing and needle bearing at the same time with 2413, Fig. 46–122.
8. Remove the circlip on the gear wheel and press off the bearing with 2413, Fig. 46–123.

Checking and replacing parts

Wash all parts and clean the contact surfaces thoroughly. Replace the ball and needle bearings. Check the teeth on the gear wheel and if they are damaged the gear wheel should be replaced. With replacement, the wheel hub for the gear wheel should also be replaced, see special instructions under "Wheel and hub", Part 6. Replace the sealing in the housing like the X-ring on the drive shaft. Also check the wear ring for the sealing. If the wear ring is damaged, it should be replaced.

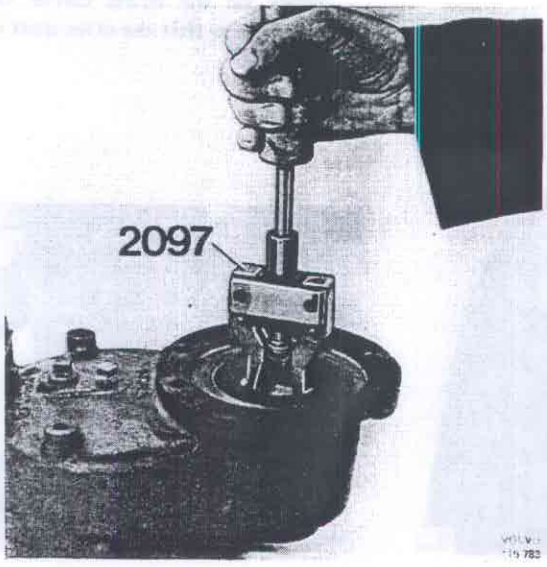


Fig. 46–120. Removing the seal

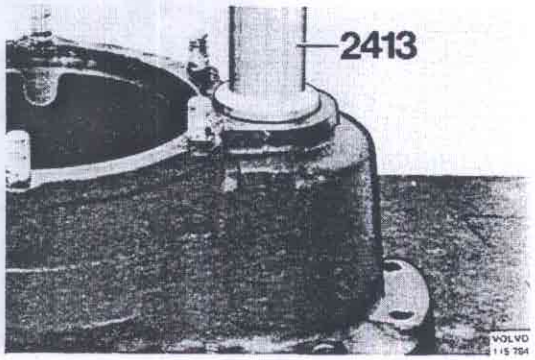


Fig. 46–122. Pressing out gear wheel

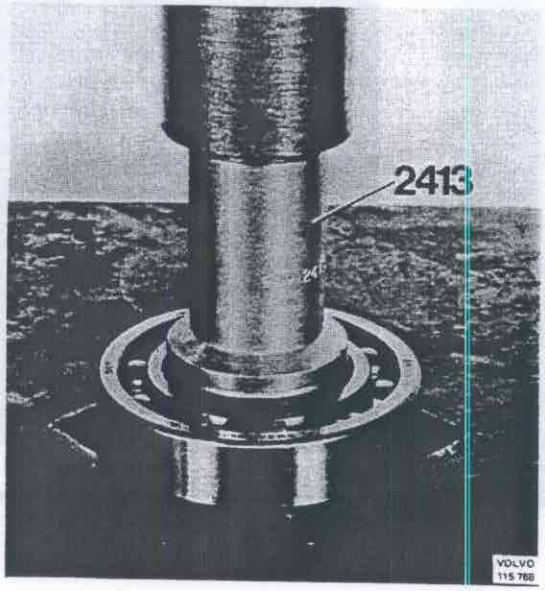


Fig. 46–123. Removing the bearing

Assembling

Special fools: 2022, 2132, 2413, 2584.

1. Press the ball bearing on the gear wheel with 2022, Fig. 46–124. Fit the circlip.
2. Press the gear wheel into the wheel carrier housing using 2584, Fig. 46–125. Fit the circlip.
3. Oil the needle bearing. Press the bearing into the housing and rotate the gear wheel at the same time to make sure that the bearing is fitted properly. Use 2413, see Fig. 46–126. Press down the bearing so that it comes flush with the edge.
4. Press the wear ring into the gear wheel, Fig. 46–127. Grease the sealing ring surfaces. Press down the seal with 2132, Fig. 46–128.

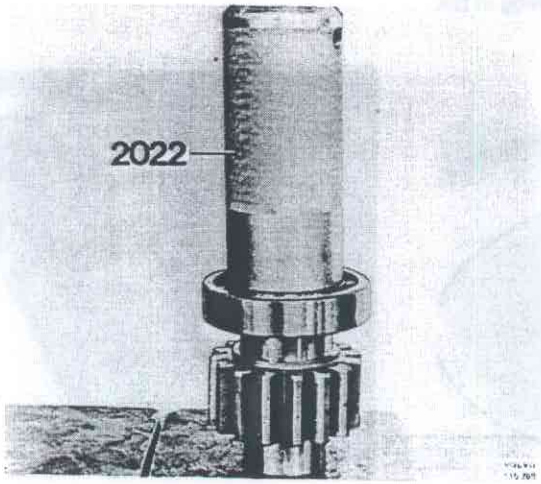


Fig. 46–124. Pressing on the bearing

Fig. 46–125. Pressing in the gear wheel

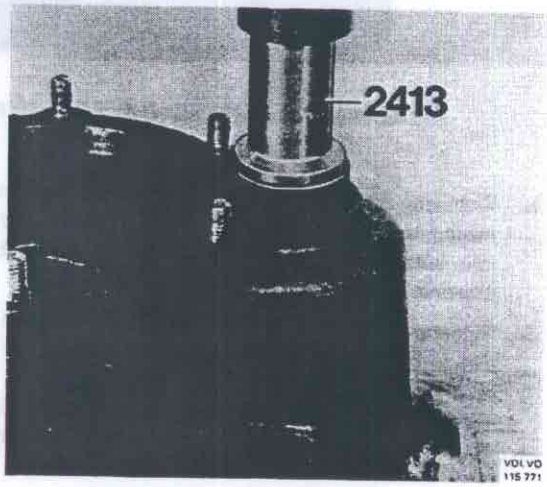


Fig. 46–126. Pressing in the needle bearing

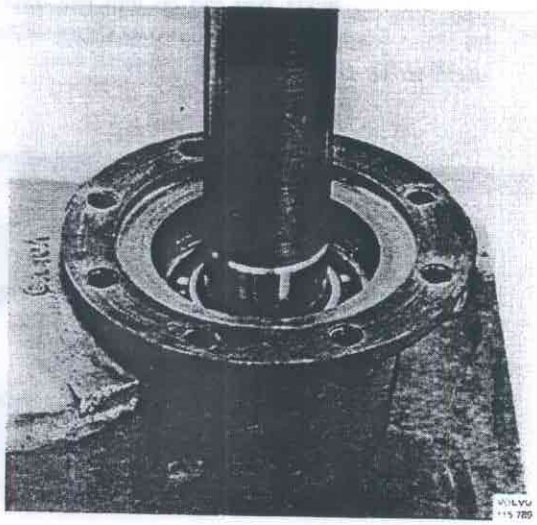


Fig. 46–127. Pressing in the wear ring

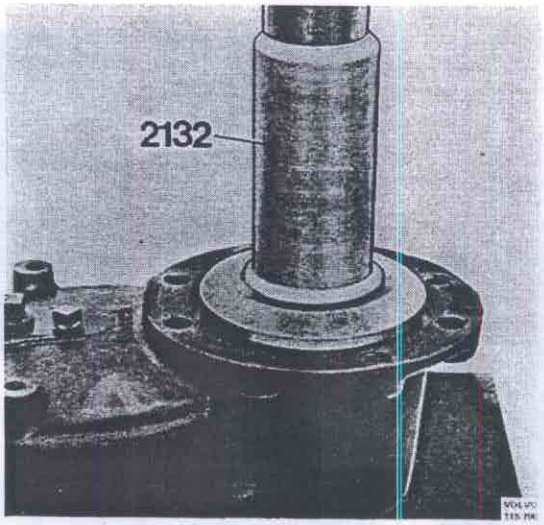


Fig. 46–128. Pressing in the seal

5. Coat the contact surface against the hub with sealing agent. Place the hub on the housing. Fit the nuts and tighten the hub and housing together.
6. Replace the circlip and X-ring on the drive shaft. Grease the circlip and splines. Fit the shaft in the gear wheel and drive it down so that the circlip grips the gear wheel. Grease the X-ring, Fig. 46–129, and press it down into the wear ring.

Installing the wheel carrier

1. Clean the contact surface on the rear axle casing and coat it with sealing agent.
2. Fit the two guide pins 6131 in the lower holes in the wheel carrier housing, Fig. 46–130. Place the housing on a jack. Jack up the carrier so that the guide pins can go into rear axle casing. Rotate the differential carrier flange while pushing in the wheel carrier at the same time.

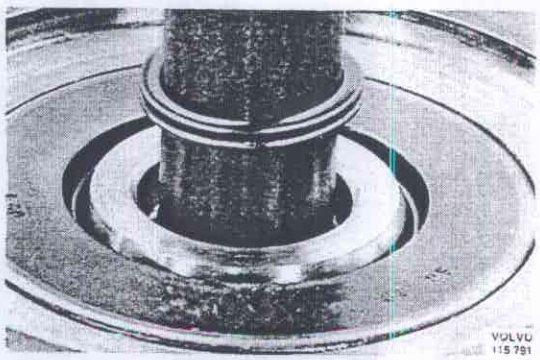


Fig. 46–129. Installing the X-ring

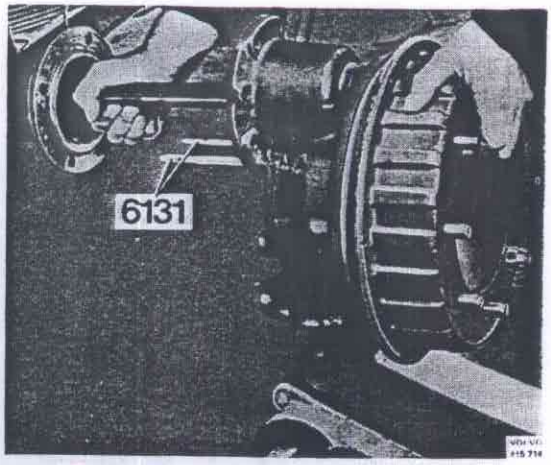


Fig. 46–130. Installing the wheel carrier

3. Fit the bolts round the casing. Remove the guide pins. Tighten the bolts to a torque of 100–120 Nm (10–12 kpm = 72–87 lbftf). Use 6135, see Fig. 46–134. Remove the jack.
4. Fit the shock absorber and the brake pipe.
5. Bleed the wheel cylinders. The pressure difference contact should be removed before bleeding, see Fig. 46–132. If a bleeder unit is used, the working pressure should be 0.2 MPa (2 kp/cm^2 = 28 lbf/in^2). For more detailed instructions about bleeding, see Part 5.

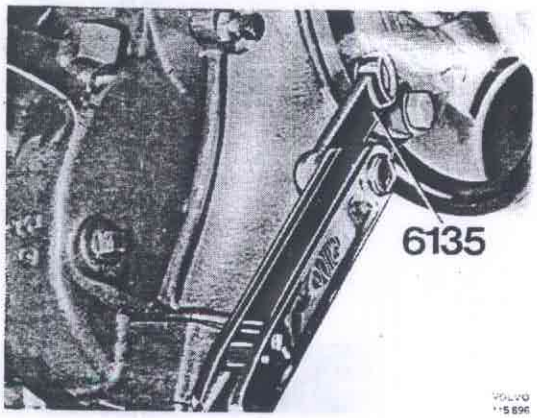


Fig. 46–131. Tighten the bolts

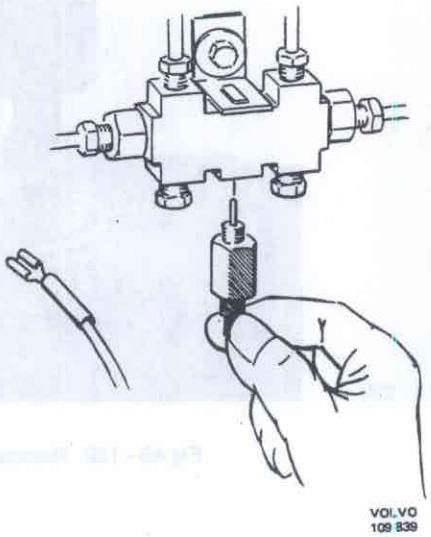


Fig. 46–132. Removing the contact

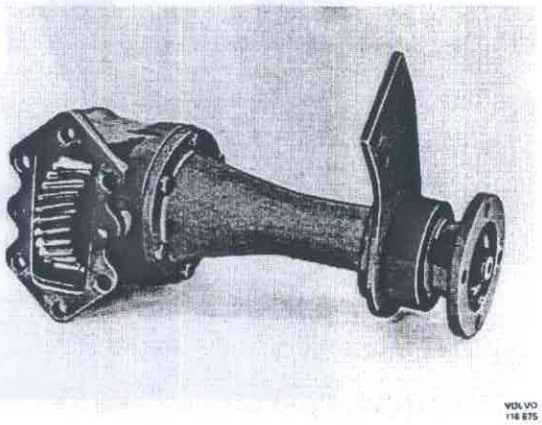


Fig 46–134 Power take-off

6. Fit the wheel.
7. Lower the vehicle. Tighten the wheel nuts to a torque of 210 Nm (21 kpm = 152 lbftf).
8. Fill the wheel carrier with oil. Concerning quantity and quality, see under "Data".
   Power take-off rear differential carrier.

POWER TAKE-OFF

Removing the power take-off from the rear differential carrier

1. Remove the propeller shaft.
2. Remove the nuts securing the power- take-off to the rear differential carrier, see Fig. 46–133.
3. Remove the bolts securing the power take-off to the rear axle casing. Remove the power take-off.

Servicing the power take-off (removed)

Disassembling

Special fools: 1801, 2261, 2490, 2837, 4030, 6122

1. Clean the power take-off.
2. Fit it in a vice. Fit counterhold 2837 on the flange, see Fig. 46–135.
   Remove the flange nut.
3. Remove the counterhold. Remove the flange with 2261, see Fig. 46–136.

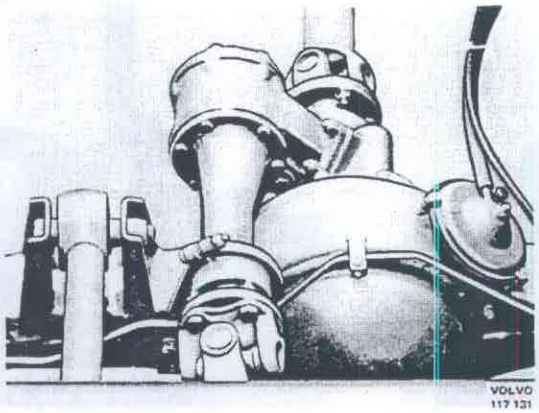


Fig 46–133 Power take-off on the differential carrier

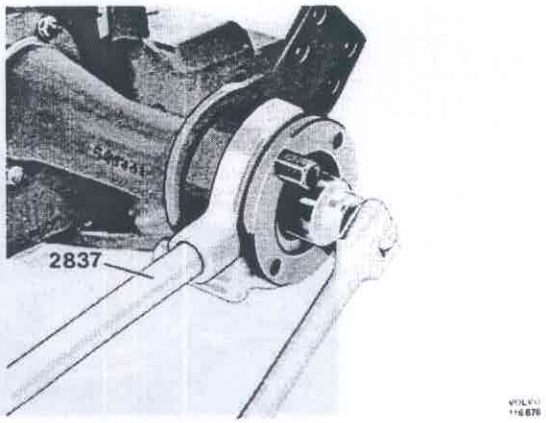


Fig. 46–135. Removing the nut

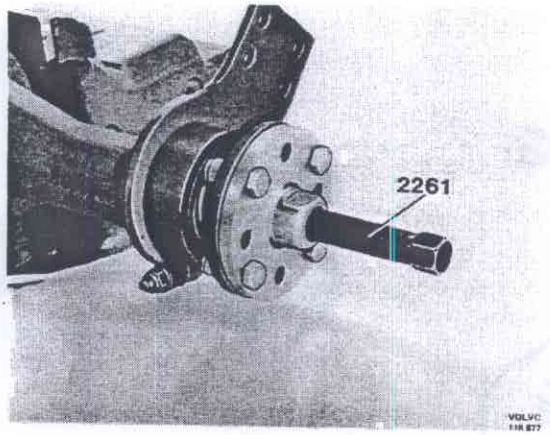


Fig 46–136 Removing the flange

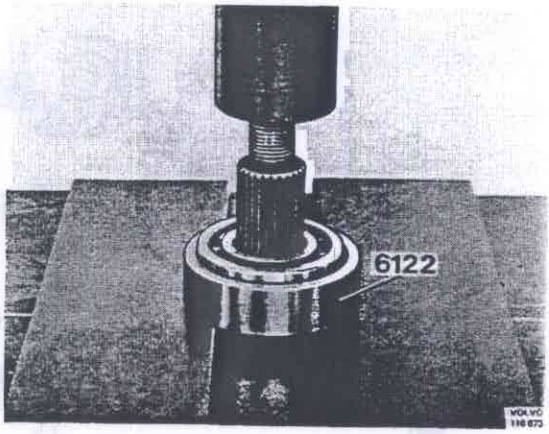


Fig 46–139 Removing the bearing

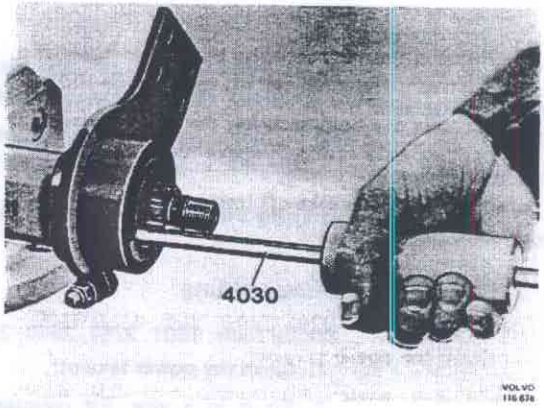


Fig. 46–137 Removing the seal

4. Remove the sealing rings with 4030, Fig. 46–137.
5. Remove the circlip holding the bearing in the housing.
6. Remove the cover on the housing for the gears. Place the power take-off in a press and press out the drive with a suitable drift, Fig. 46–138.
7. Place the drive shaft in 6122, Fig. 46–139, and press off the bearing.
8. Mark up the locating of the housing in relation to each other. Remove the bolts holding the housing together and separate the housing.
9. Remove the bolt securing the drive gear shaft. Press out the shaft with a suitable drift, Fig. 46–140. Remove the drive gear.

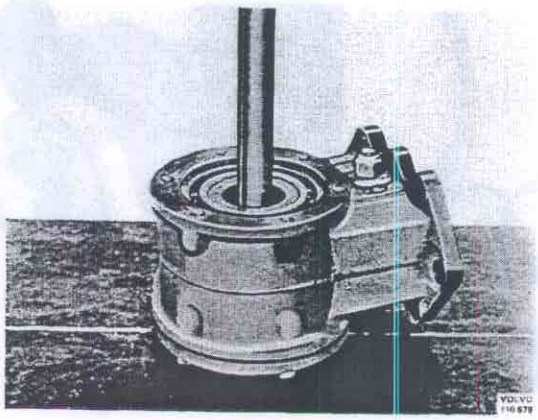


Fig 46–138 Removing the drive

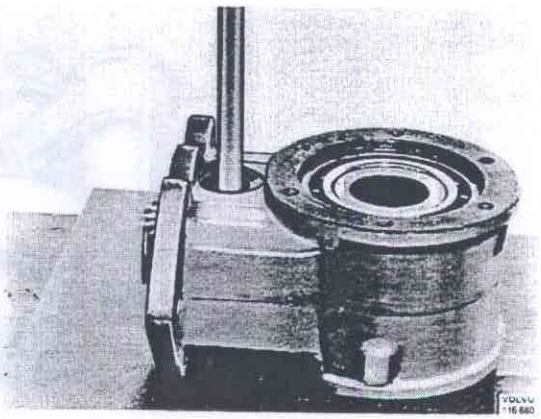


Fig 46–140 Removing the shaft

Fig 46—141 Removing the races

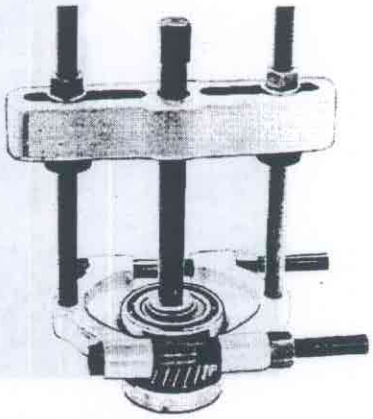


Fig 46—143 Removing the bearing

10. Remove the roller bearings and the shims from the gear. If necessary pull out the outer races with a standard puller, Fig. 46—141.
11. Press out the gear and bearing from the housing with 2490 and 1801, see Fig. 46—142.
12. Pull the ball bearings from the gear with a bearing extractor, Fig. 46—143.

Checking and replacing parts

Clean all parts and check for damage and wear. All damaged or worn parts must be replaced. As far as seals and O-rings are concerned, they must always be replaced. When replacing a gear because of wear, always check the gear on the rear differential carrier.

Assembling

Special fools: 2022, 2267, 2762, 6110, 6122

1. Press one of the ball bearings onto the gear with 2022, Fig. 46—144.
2. Press the gear into the housing with 2022, Fig. 46—145:

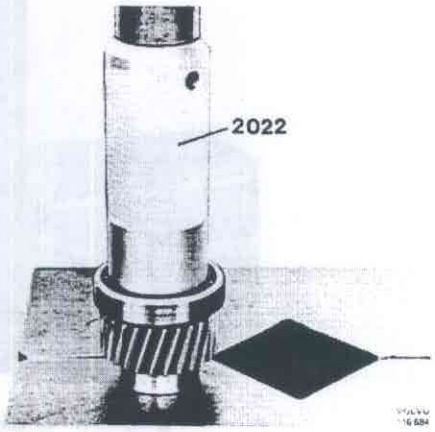


Fig 46—144 Pressing on the bearing

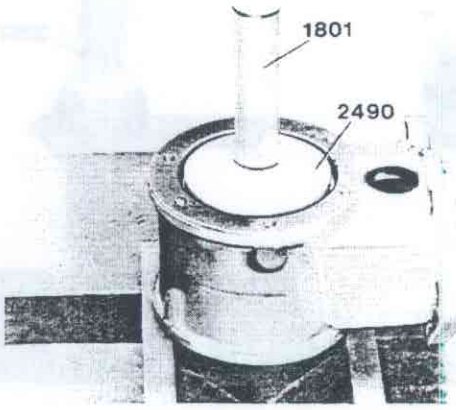


Fig 46—142 Removing the bearing

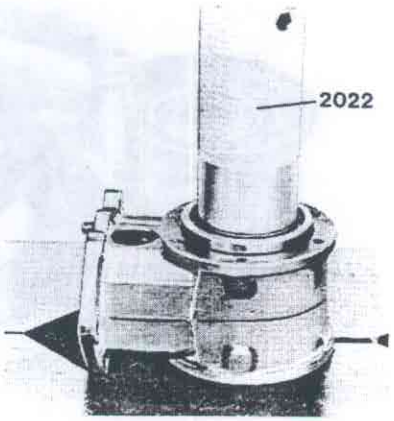


Fig 46—145 Pressing in the bearing

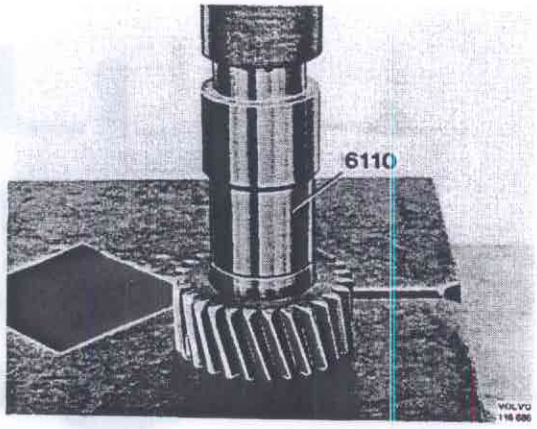


Fig 46—146 Pressing in the bearing

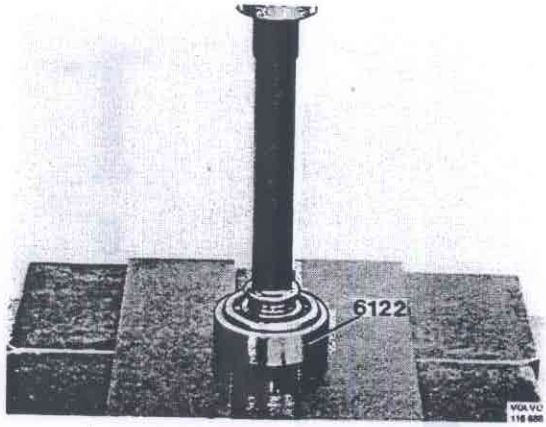


Fig 46—149 Pressing on the bearing

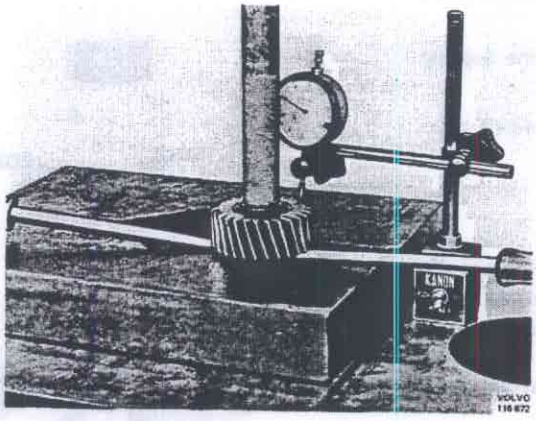


Fig 46—147 Checking the gearsaxial

3. Turn the housing and press the other bearings onto the gear.
4. Press the outer rings into the drive gear with 6110, Fig. 46—146.
5. Place the inner rings with the old shims in the drive gear.
6. Place the drive gear in a press, Fig. 46—147. Press the bearings together with a pressure of about 1 ton. Place a dial indicator with measuring point against the flat surface of the gear, see Fig. Check the gear axial clearance with the help of screwdrivers. The clearance must be 0.03—0.08 mm (0.012—0.032"), which is adjusted by means of shims from the following sizes: 1.25; 1.30; 1.35; 1.40; 1.60; 1.65; 1.85; 1.90; 1.95; 2.00 mm.
7. Fit new O-rings on the drive shaft.
8. Oil the drive gear bearings and place the drive gear in the housing, Fig. 46—148, and fit the shaft in position. Press in the shaft.

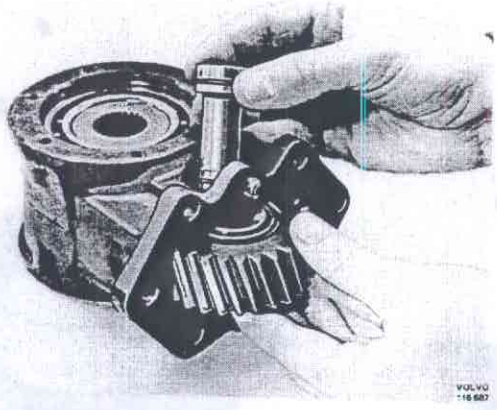


Fig 46—148 Fitting the gear

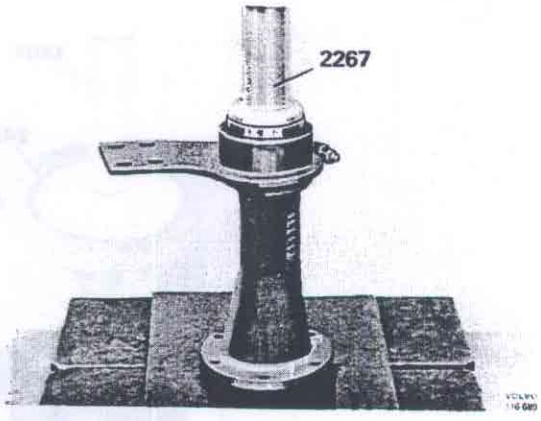


Fig. 46—150 Pressing in the drive shaft

Fig 46–151 Placing grease

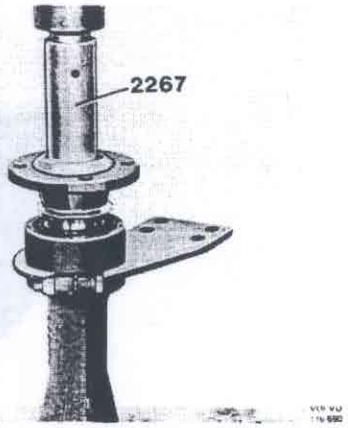


Fig 46–153 Pressing on the flange

9. Coat the sealing surface of the housing cover with sealing agent and fit the cover.
10. Press the bearing onto the shaft with 6122, Fig. 46–149.
11. Press the drive shaft into the housing with, 2267, Fig. 46–150. Fit the circlip.
12. Fill the space between the flange seal lips to 1/4th with grease, see Fig. 46–151. Press in the seal with 2267.
13. Fit a new seal on the flange, Fig. 46–152. Grease the sealing lip. Press the flange onto the shaft with 2267, Fig. 46–153.
14. Fit counterhold 2837 on the flange and fit the nut and washer. Tighten the nut to a torque of 41–51 Nm (4,1–5,1 kpm = 30–37 lbftf).
15. Coat the sealing surface on the drive shaft housing with a sealnt. Place the housing and gears in the press, Fig. 46–154, and fit the drive shaft housing in position. Press the housing together. Fit the bolts and tighten up.
16. Coat the bolt head, on the bolt for the drive gear shaft, with sealing agent. Place the bolt in the shaft, and note from the flange side, see Fig. 46–155. Coat the washer with sealing agent and fit it in position. Fit the nut and toghten it to a torque of 20–25 Nm (2,0–2,5 kpm = 14–18 lbftf).

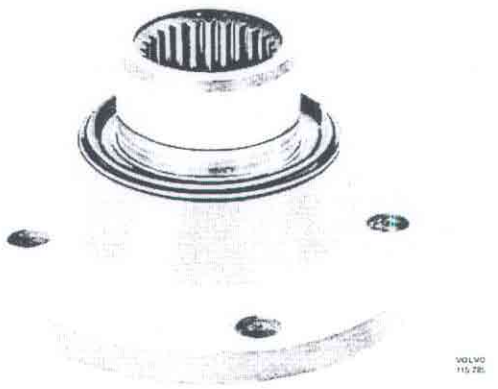


Fig 46–152 Flange seal

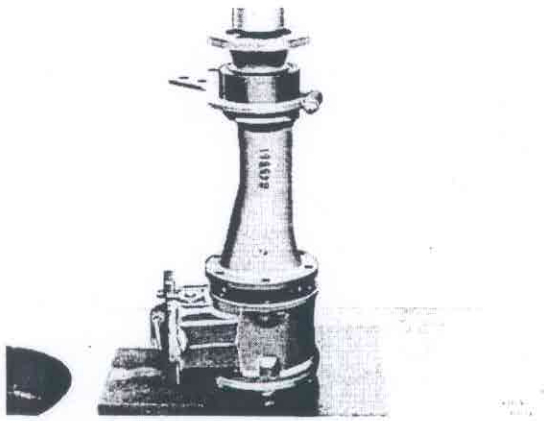


Fig 46–154 Pressing together the hosing

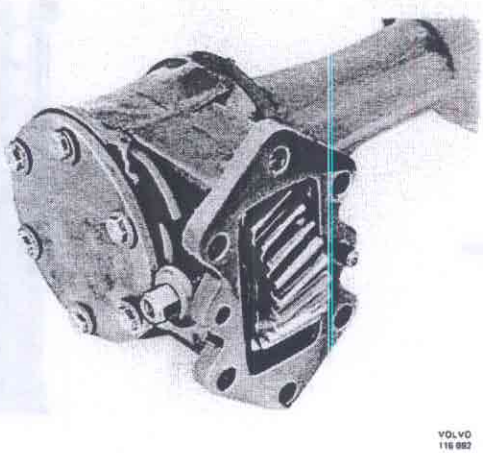


Fig. 46–155 Placing the bolt

Installing the power take-off

1. Clean the contact surface on the rear differential carrier and coat it with sealing agent.
2. Place the power take-off in position and tighten up.
3. Tighten up the propeller shaft. Tighten the bolts to a torque of 56–65 Nm (5.5–6.5 kpm = 40–48 lbftf).

Illustration 46-A. Differential carriers

Differential carriers

1. Pinion
2. Shims
3. Roller bearing, inner ring
4. Outer ring
5. Housing
6. Spacer ring
7. Shims
8. Outer ring
9. Roller bearing, inner ring
10. Oil deflector plate
11. Seal
12. Flange seal
13. Nut
14. Differential gear, large
15. Roller bearing, inner ring
16. Outer ring
17. Sleeve
18. Adjusting nut
19. Washer
20. Circlip
21. Flange sleeve
22. Bolt
23. Lock washer
24. Bearing cap
25. Differential housing
26. Bolt
27. Crown wheel
28. Thrust washer
29. Thrust washer
30. Differential gear, small
31. Shaft

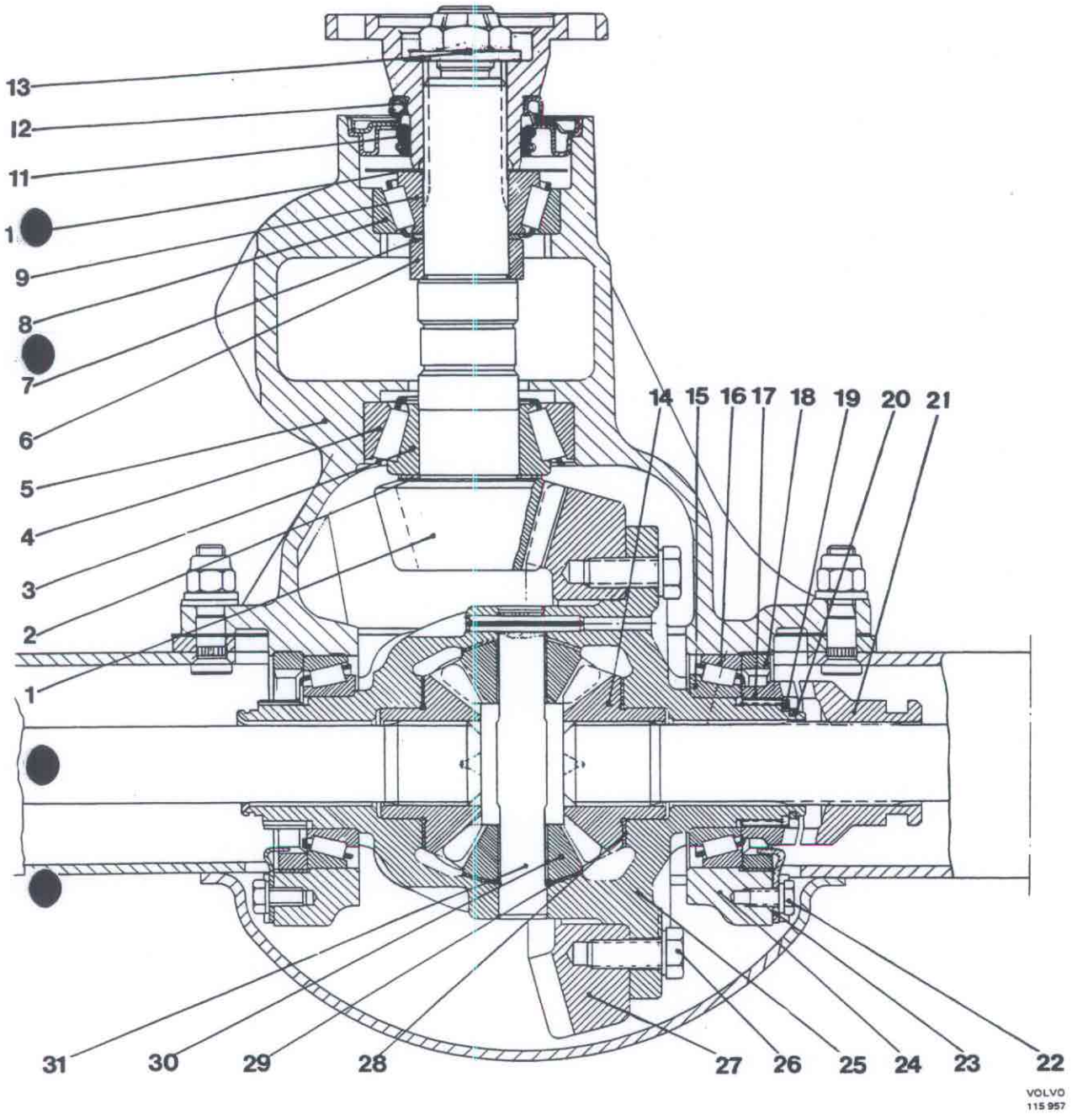

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Illustration 46-B. Differential carriers

Differential carriers

1. Nut
2. Flange
3. Flange seal
4. Seal
5. Oil deflector plate
6. Roller bearing, inner ring
7. Outer ring
8. Shims
9. Spacer ring
10. Carrier housing
11. Gear wheel (only 3-axle vehicle)
12. Spacer ring
13. Outer ring
14. Roller bearing, inner ring
15. Shims
16. Pinion
17. Adjuster nut
18. Outer ring
19. Roller bearing, inner ring
20. Crown wheel
21. Thrust washer, large
22. Differential gear, large
23. Differential gear, small
24. Thrust washer
25. Differential housing
26. Bolt
27. Bolt
28. Lock screw
29. Cap
30. Lock screw
31. Washer
32. Bolt

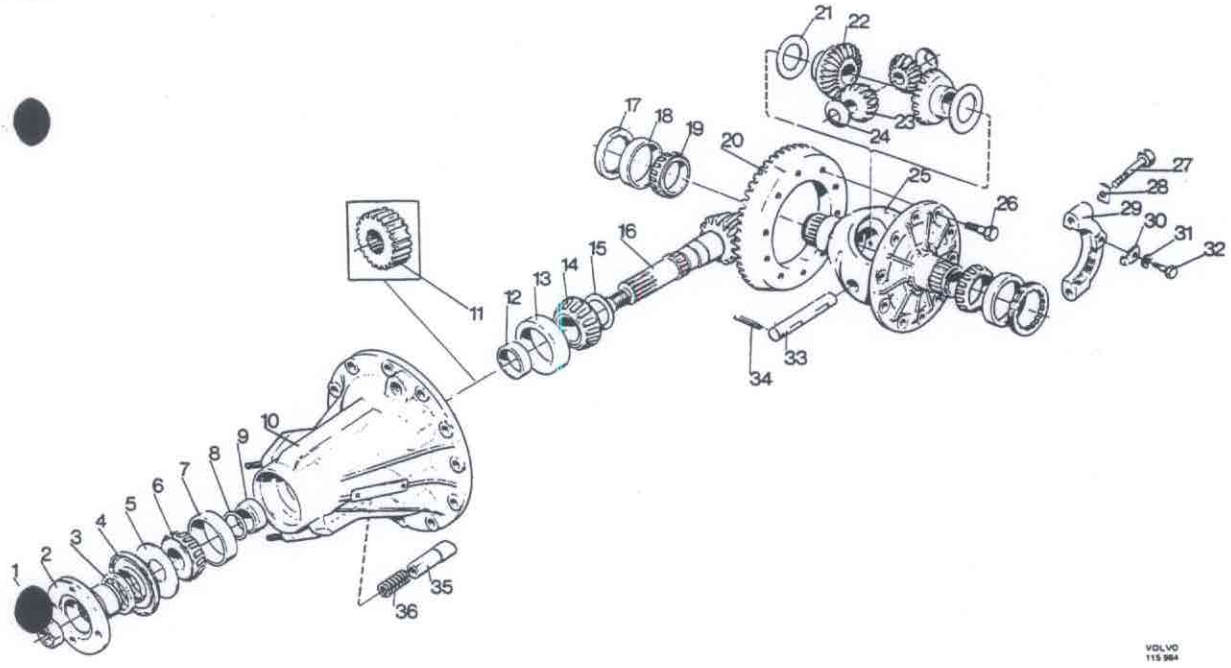
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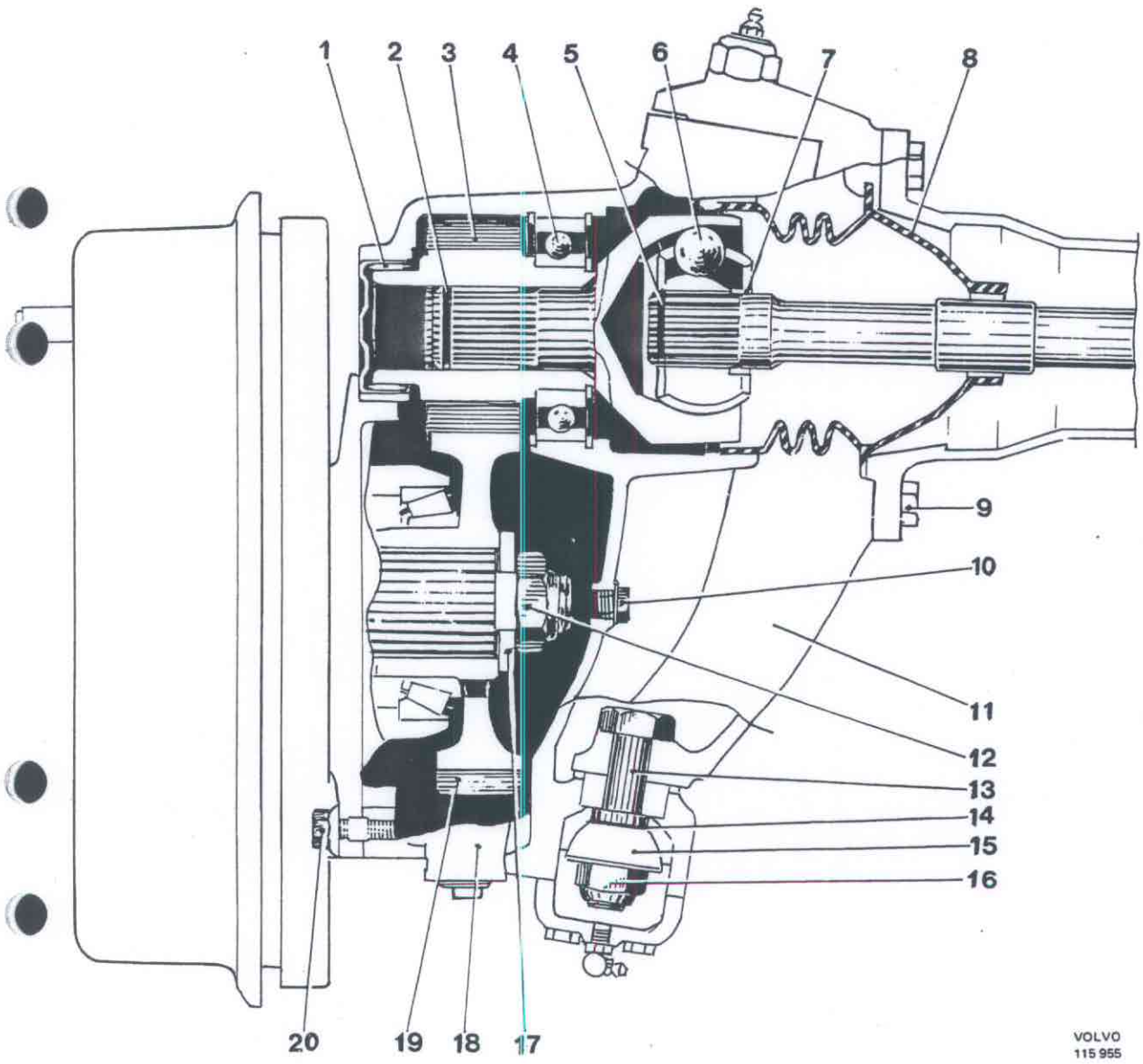
Illustration 46-C. Wheel carriers front

Wheel carriers

1. Needle bearing
2. Circlip
3. Gear wheel
4. Ball bearing
5. Circlip
6. Drive shaft joint
7. Spacer ring
8. Rubber bellows
9. Bolt
10. Bolt
11. Knuckle casing
12. Nut
13. Bolt
14. Shims
15. Ball shell
16. Nut
17. Washer
18. Wheel carrier housing
19. Worm gear
20. Nut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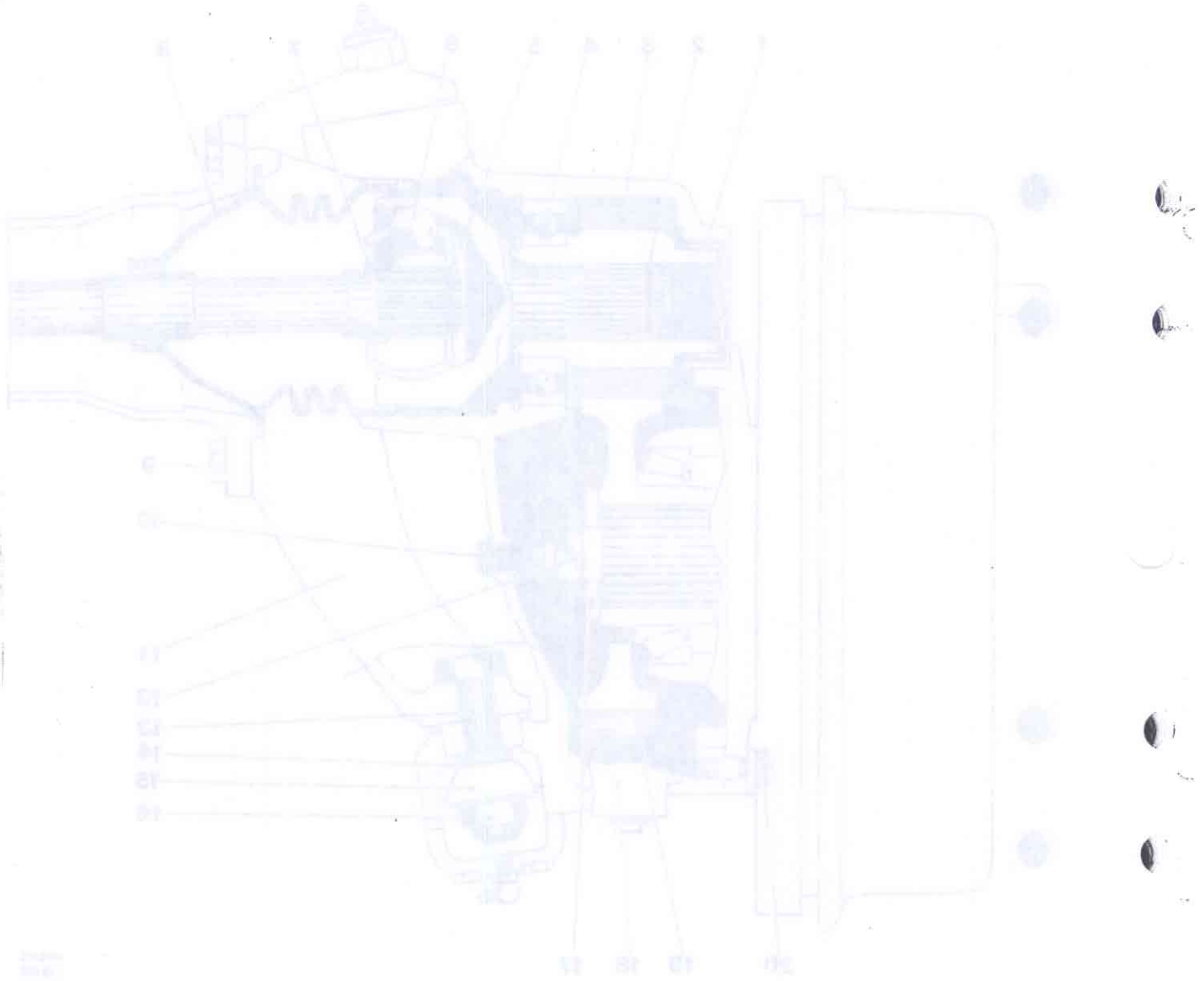

Illustration 46-D. Wheel carriers front

Wheel carriers

1. Drive shaft
2. Bushing
3. Rubber bellows
4. Spacer ring
5. Circlip
6. Steering knuckle support
7. Shaft pin
8. Circlip
9. Circlip
10. Circlip
11. Ball bearing
12. Circlip
13. Worm gear
14. Sealing ring
15. Wheel carrier
16. Needle bearing
17. Nut
18. Washer
19. Shims
20. Worm gear
21. Lubricating nipple
22. Cover
23. Nut
24. Ball shell
25. Bushing
26. Plug
27. Bolt
28. Seal
29. Bolt

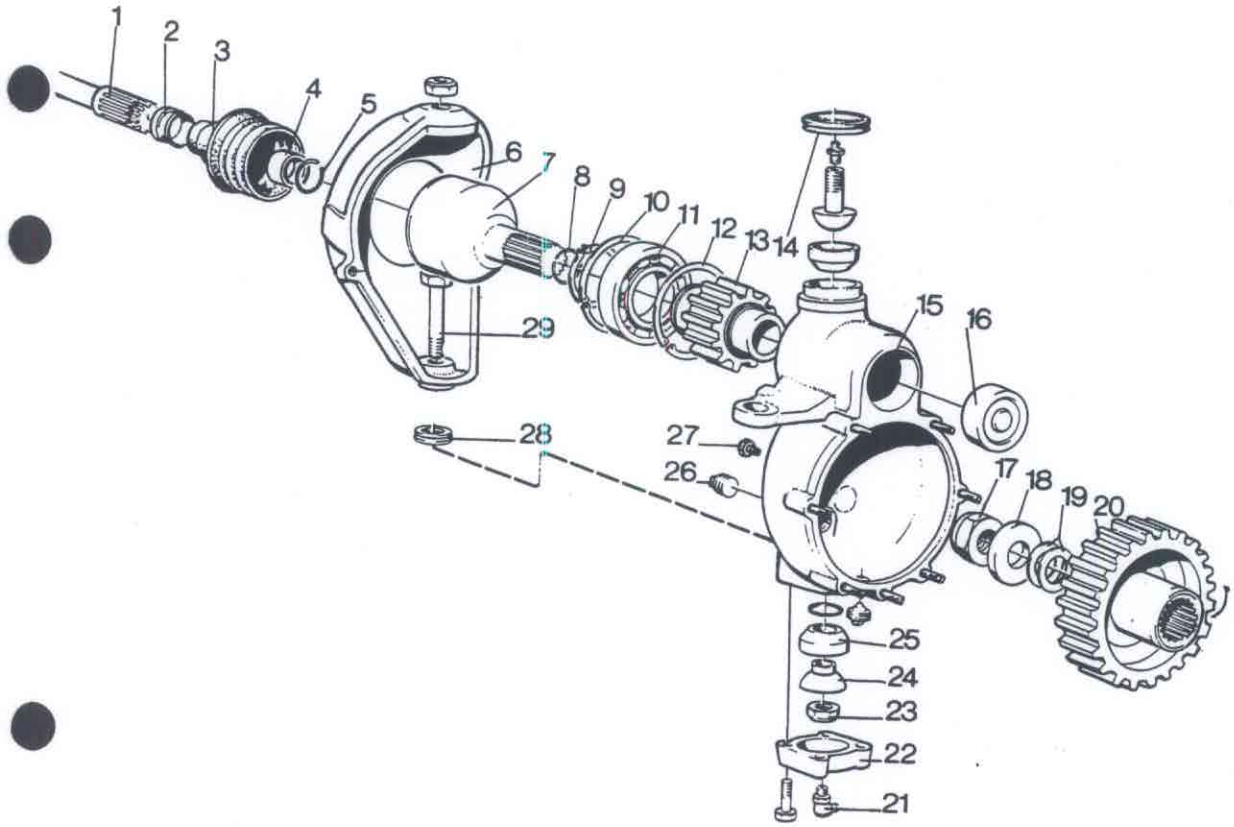
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Illustration 46-E. Wheel carriers rear

Wheel carriers

1. Needle bearing
2. Circlip
3. Worm gear
4. Circlip
5. Ball bearing
6. Circlip
7. Circlip
8. Seal
9. X-ring
10. Shaft casing
11. Wear ring
12. Bolt
13. Bolt
14. Nut
15. Plug
16. Washer
17. Worm gear
18. Wheel carrier
19. Nut

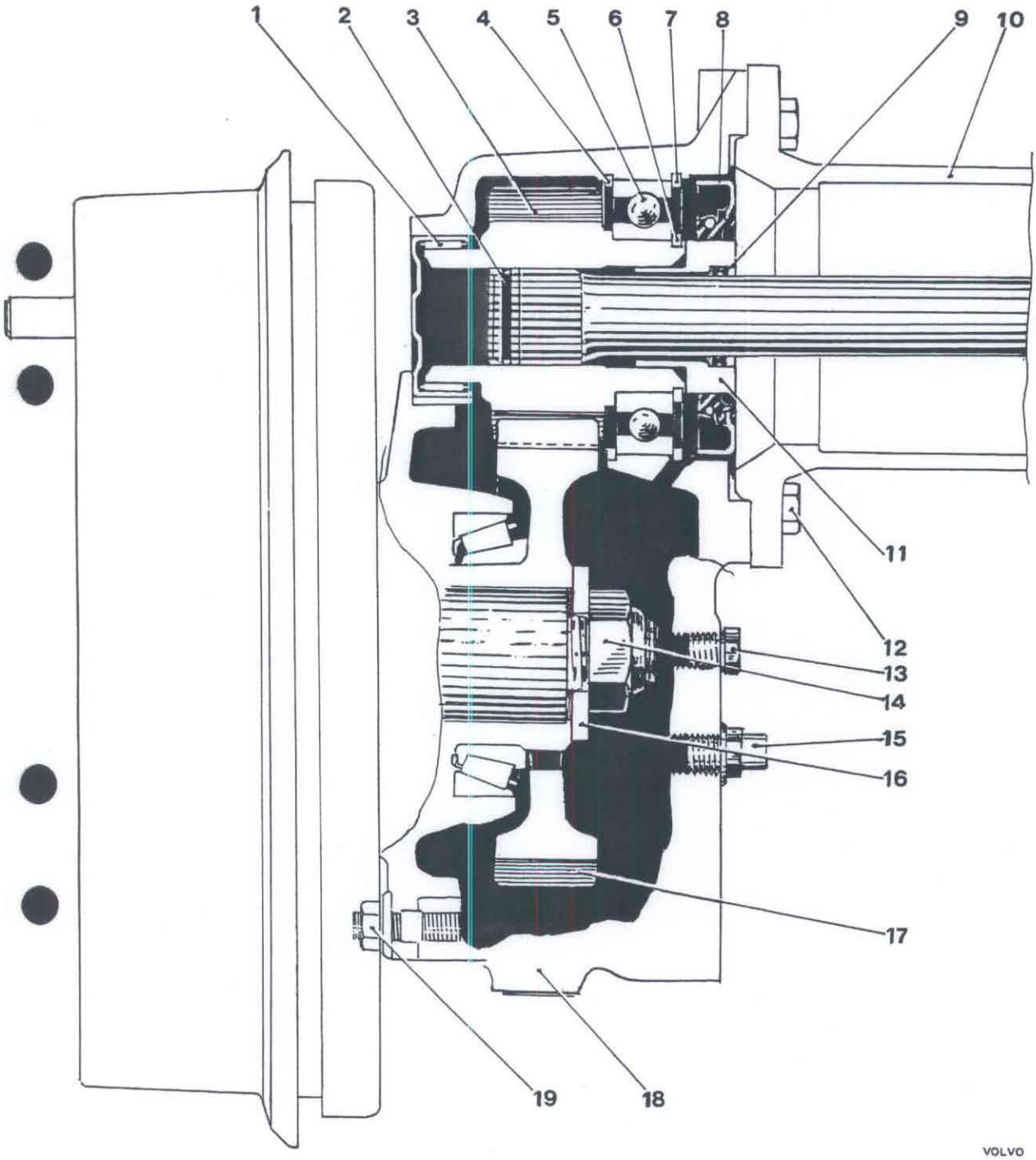

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Illustration 46-F. Wheel carriers rear

Waeel carriers

1. Drive shaft
2. X-ring
3. Circlip
4. Seal
5. Wear ring
6. Circlip
7. Circlip
8. Ball bearing
9. Circlip
10. Worm gear
11. Wheel carrier
12. Needle bearing
13. Nut
14. Washer
15. Shims
16. Worm gear
17. Plug
18. Bolt

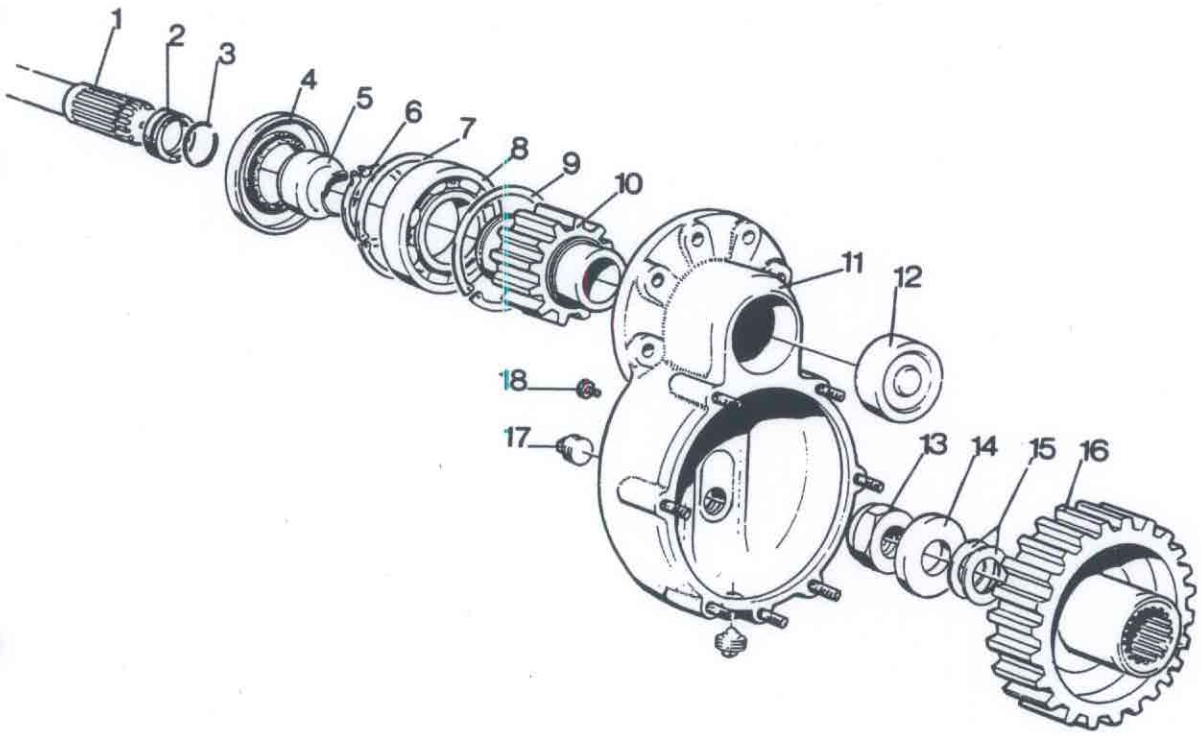
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Illustration 46-G. Power take-off

Power take-off

1 Drive shaft
2 Bearing
3 Circlip
4 Seal
5 Seal
6 Flange
7 Washer
8 Nut
9 Cover
10 Bearing
11 Gear
12 Housing
13 Housing
14 Nut
15 Washer
16 Bearing
17 Chims
18 Gear
19 D-ring
20 Shaft
21 O-ring
22 Bolt

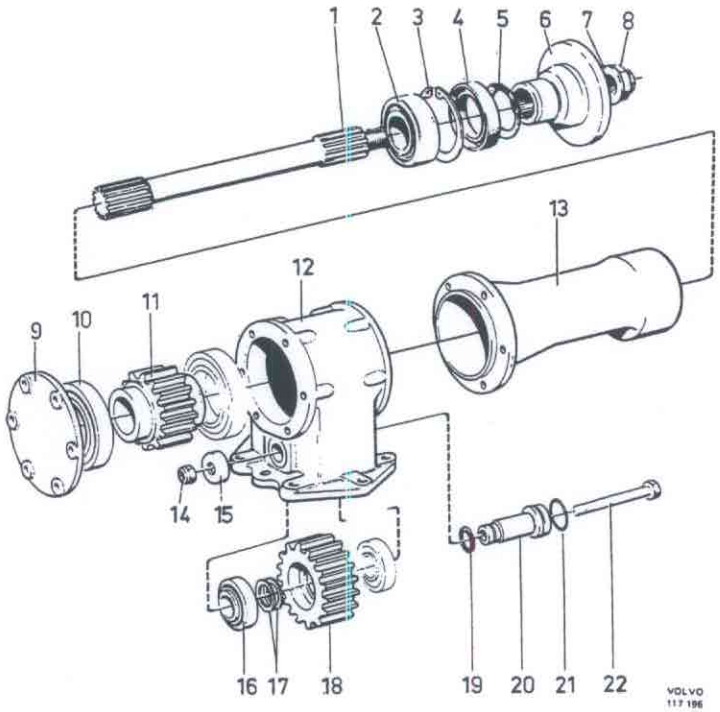
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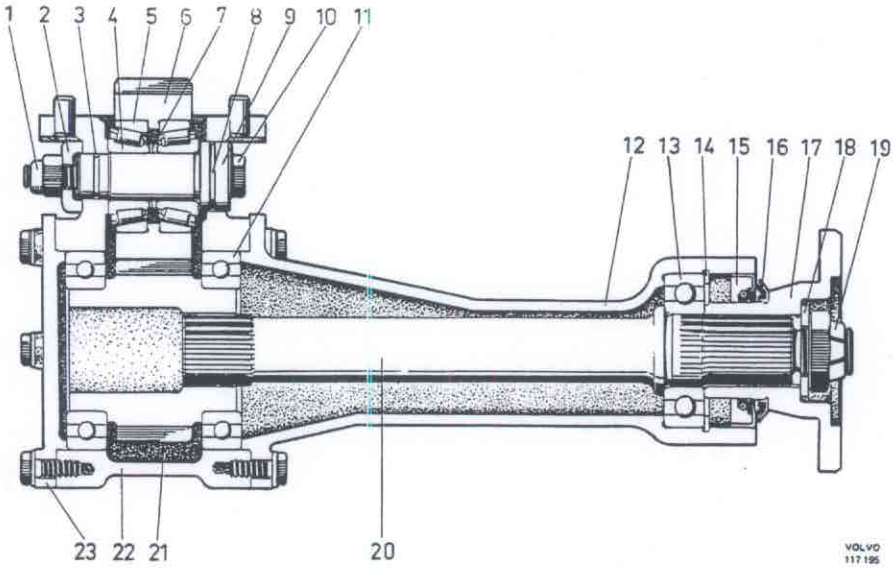
Illustration 46-H. Power take-off

Power take-off

1 Nut
2 Washer
3 O-ring
4 Outer ring
5 Roller bearing, innerring
6 Gear
7 Chims
8 O-ring
9 Washer
10 Bolt
11 Bearing
12 Housing
13 Bearing
14 Circlip
15 Seal
16 Seal
17 Flange
18 Washer
19 Nut
20 Drive shaft
21 Gear
22 Housing
23 Cover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GROUP 48 POWER TAKE-OFF

Description

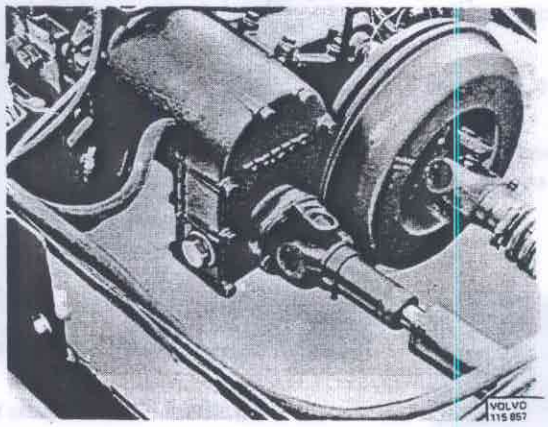

Fig. 48–1. Power take-off

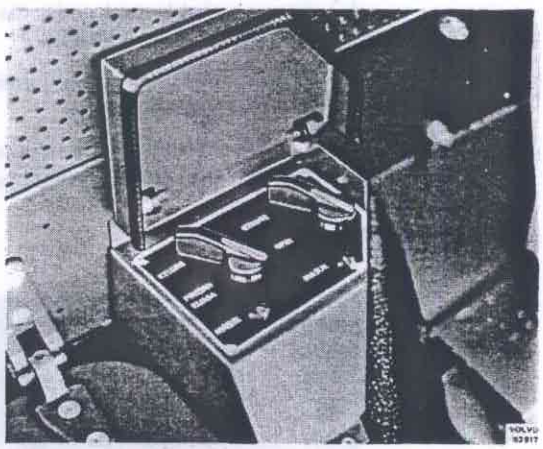

Fig. 48–2. Control for power take-off

POWER TAKE-OFF

For driving optional equipment, for example, a winch, a power take-off can be connected to the auxiliary gearbox. This type of power take-off is seen in Fig. 48–1.

The construction of the power take-off can be seen from Illustration 48-A. The power take-off housing is of aluminium and consists of two halves. Journalled in the housing is an input and an output shaft. On the input shaft is a flange, which is meshed with the drive gear of the auxiliary gearbox. The output shaft is driven via a gear on the input and the output shafts which are in constant mesh.

The power take-off is engaged by a control, Fig. 42–2, located at the side of the engine casing, which is connected to the vehicle vacuum system. When the power take-off is engaged, see Fig. 48–3 and 48–4, its bellows are actuated by a vacuum and the flange engages with the auxiliary gearbox drive gear.

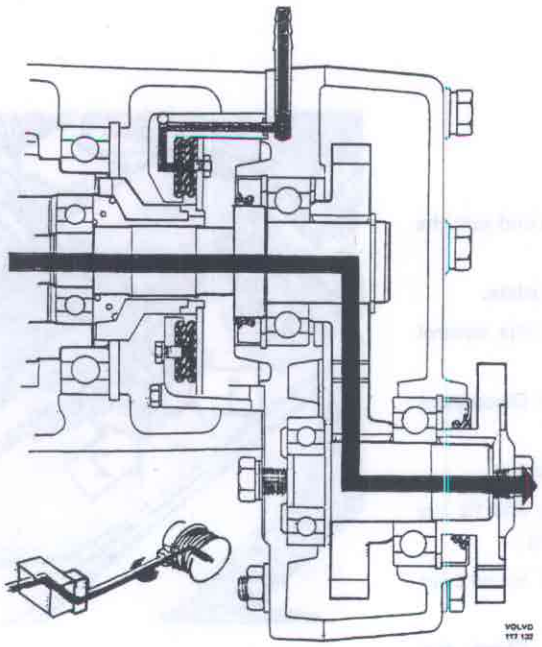

Fig 48–3 Pouver take-off is engaged

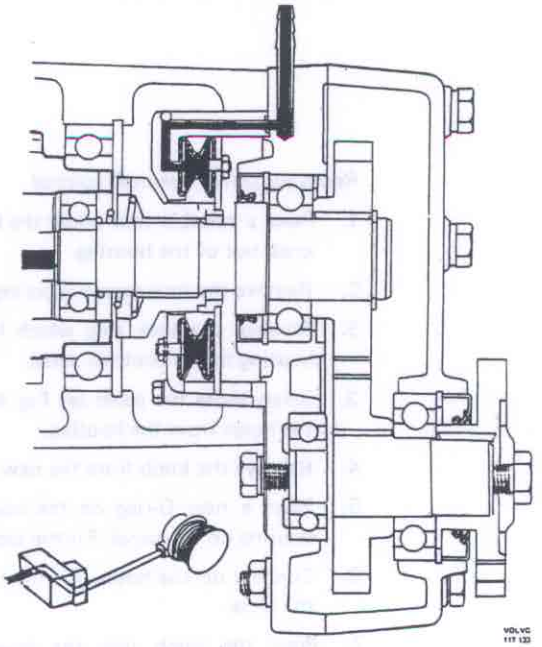

Fig 48–1 Power take-off is disengaged

Service procedures

Work which can be done in the vehicle

Replacing the O-ring on the control crank

1. Place a suitable tool under the handle, and pull the handle out of the housing.
2. Replace the O-ring on the handle Fig. 48–5 and coat it with a little grease.
3. Press the handle into the housing. Check to make sure that the differential lock can be engaged and disengaged.

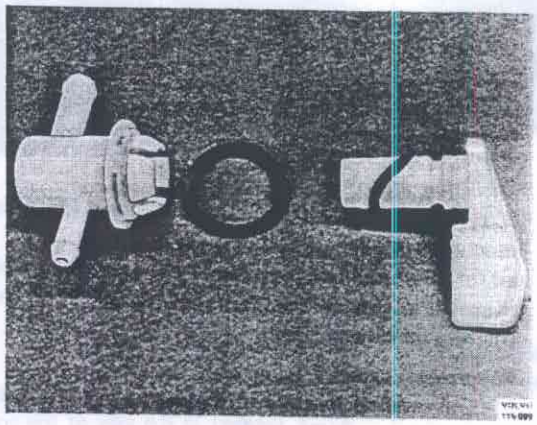

Fig. 48–4. Power take-off controls

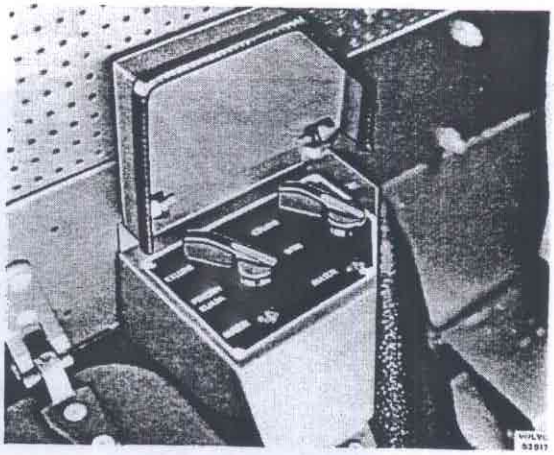

Fig. 48–5. Removing the housing

Removing of power take-off from auxiliary gearbox

1. Remove the propeller shaft.
2. Drain the oil from the power take-off by removing the screw (2, Fig. 48–6).
3. Remove the bolts securing the cover in the power take-off housing.

Replacing power takeoff control

1. Place a suitable tool under the knob and pull the knob out of the housing.
2. Remove the four screws securing the plate.
3. Remove the lock ring which holds the control housing to the controls panel.
3. Screw loose the panel see Fig. 48–5. Disconnect the hoses from the housing.
4. Remove the knob from the new control.
5. Place a new O-ring on the housing and fit the housing on the panel. Fit the lock ring.
6. Connect up the hoses. Fit the panel. Screw tight the plate.
7. Press the knob into the housing. Check the function of the power take-off.

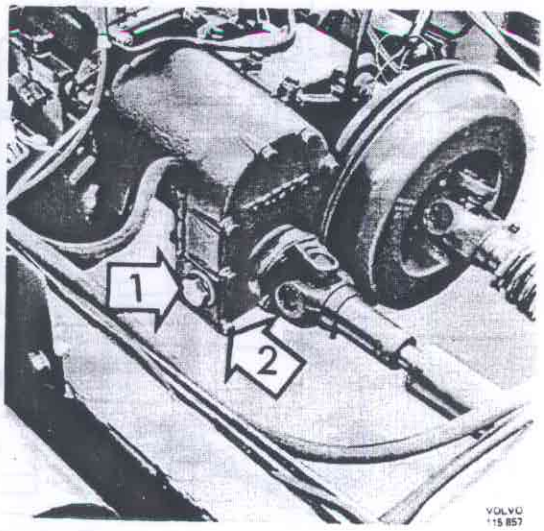

Fig. 48–6. Drain the oil

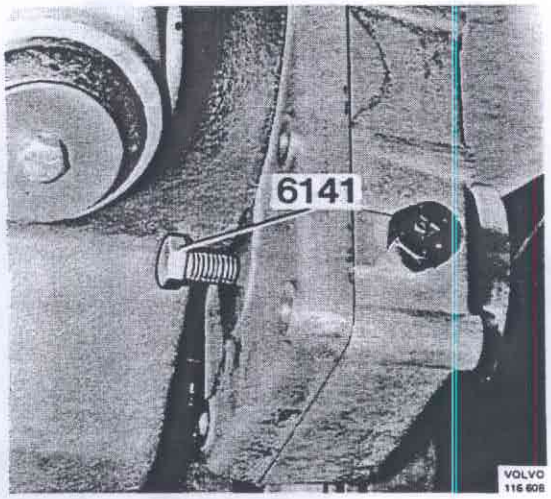

Fig. 48–7. Removing cover

4. Remove the plug, on the power take-off housing. Screw in the separating bolt 6141, Fig. 48–7 and press the cover from the housing. Remove the bolt and push in the plug again.
5. Remove both the inhex bolts, Fig. 48–8, securing the housing to the auxiliary gearbox.

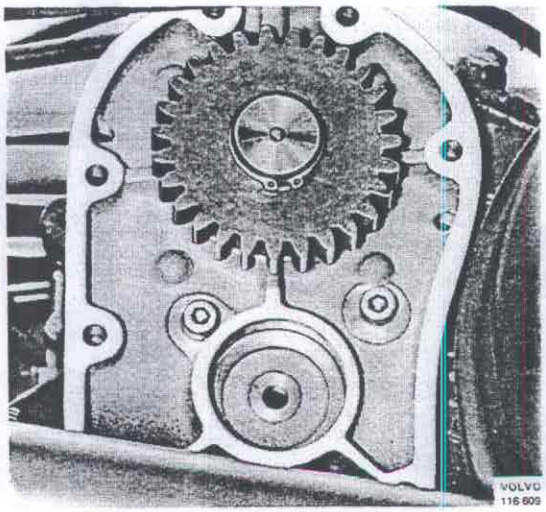

Fig. 48–8. Remove the inner bolts

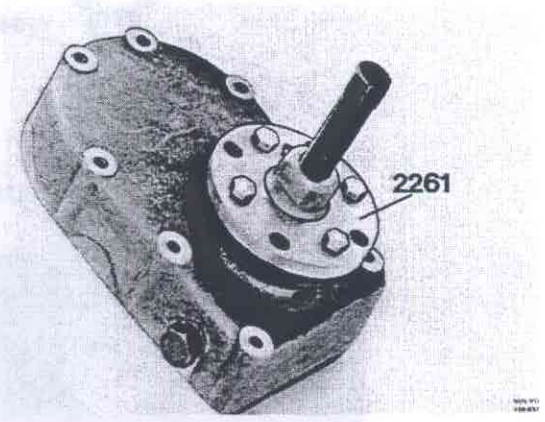

Fig. 48–9. Removing flange

Disassembling the power take-off

Special tools: 1784, 1801, 2014, 2022, 2261, 2873.

Rear housing half

1. Clean the power take-off. Fit counterhold 2873 on the flange and remove the bolt and washer securing the flange.
2. Pull off the flange using 2261, see Fig. 48–9.
3. Press out the output shaft and bearing with 1784, see Fig. 48–10.
4. Remove the key from the shaft.
5. Place the shaft in 2022 and press off the bearing using 1784, see Fig. 48–11.

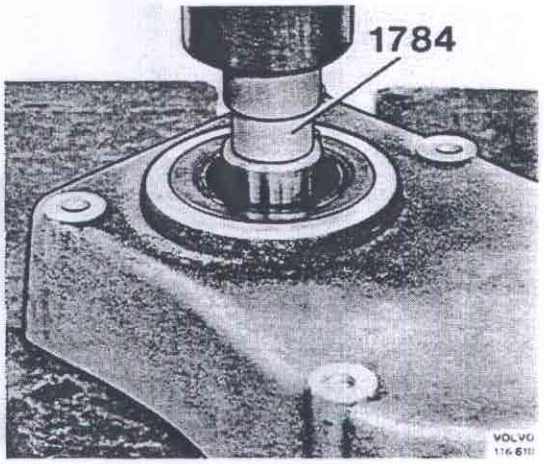

Fig. 48–10. Removing shaft

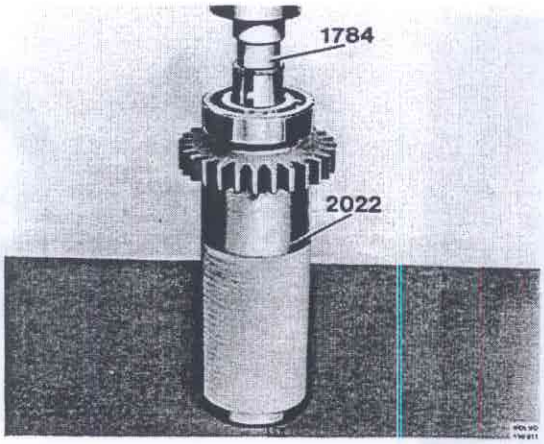

Fig. 48–11. Removing bearing

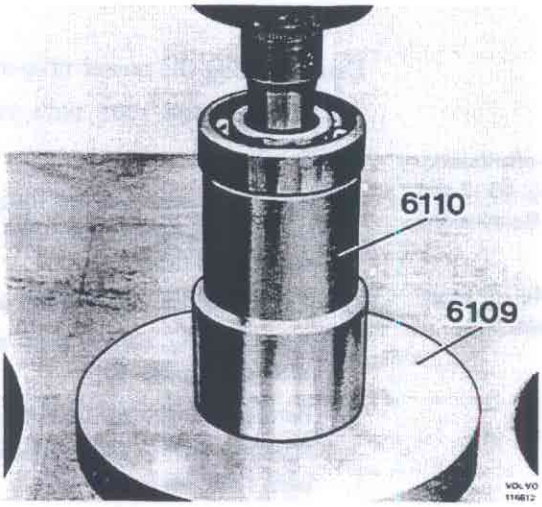

Fig. 48–12. Removing the inner bearing

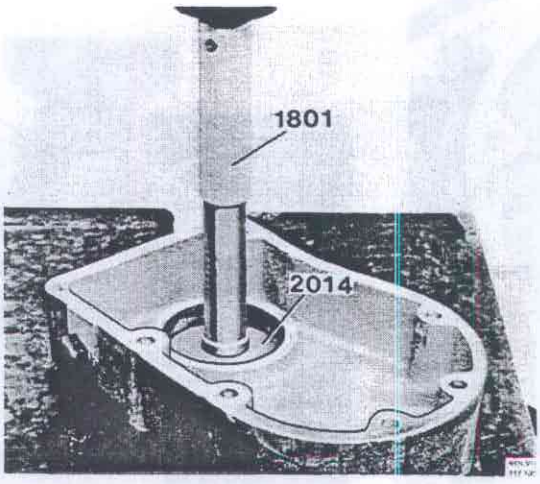

Fig. 48–13. Removing the seal

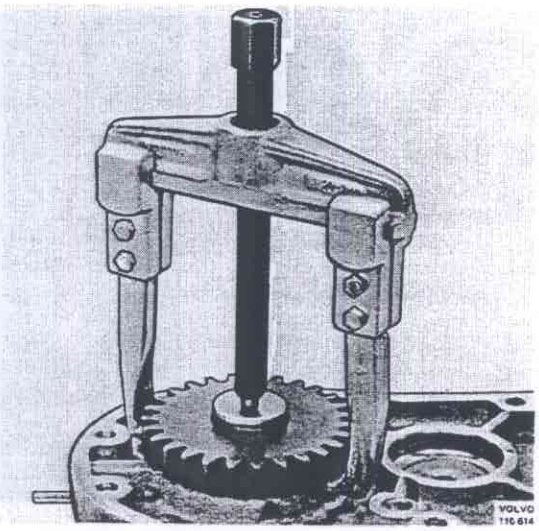

Fig. 48–14. Removing the drive

6. Place the shaft in 6110 and press off the inner bearing, see Fig. 48–12.
7. Remove the circlip in the housing and press out the seal with 1801 + 2014, see Fig. 48–13.

Front housing half

1. Remove the circlip on the input shaft and pull off the drive with a standard puller, see Fig. 48–14.

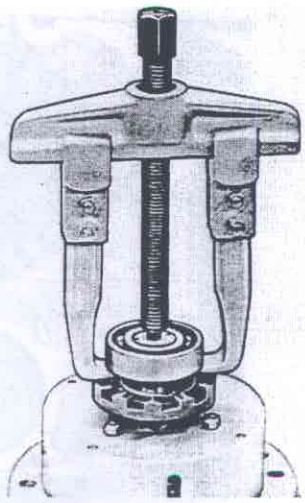

Fig. 48–15. Removing bearing

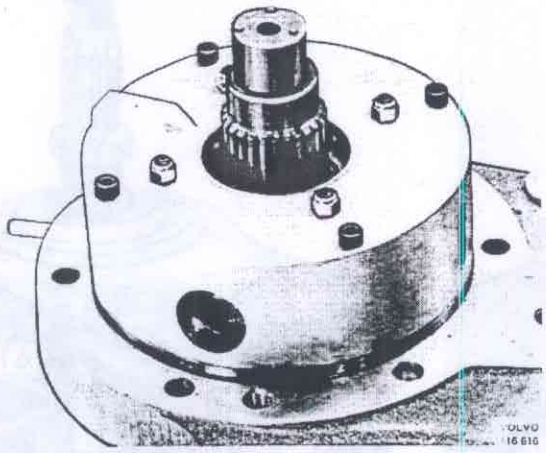

Fig. 48–16. Removing the bolts

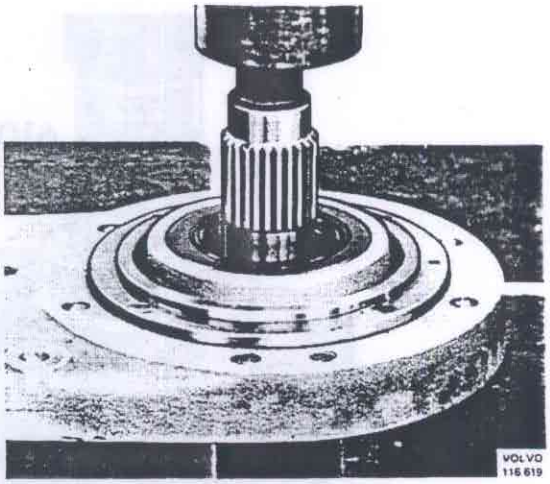

Fig. 48–18. Pressing out the shaft

2. Pull the support bearing off the shaft with a standard puller, see Fig. 48–15. Remove the spring and flange.
3. Remove the retaining bolts (inhex 3 mm = 1/8") holding the control housing, see Fig. 48–16. Remove the housing.
4. Remove the nuts securing the thrust plate, Fig. 48–17, to the bellows.
5. Remove the nuts securing the bellows to the control housing and take out the bellows.
6. Remove the circlip from the input shaft. Press out the shaft and bearing, see Fig. 48–18, from the housing.
7. Remove the key from the shaft.
8. Place the shaft in 2022 and press off the bearing using 1784, see Fig. 48–19.
9. Remove the circlip from the housing and press out the seal with 1801 + 2014.

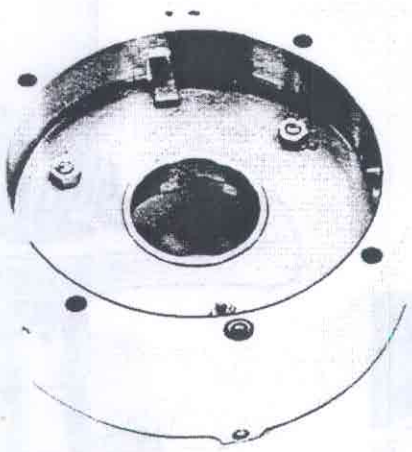

Fig. 48–17. Removing the nuts

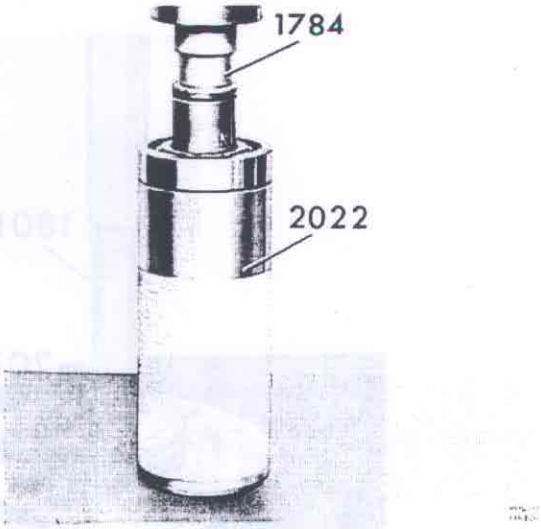

Fig. 48–19. Removing the bearing

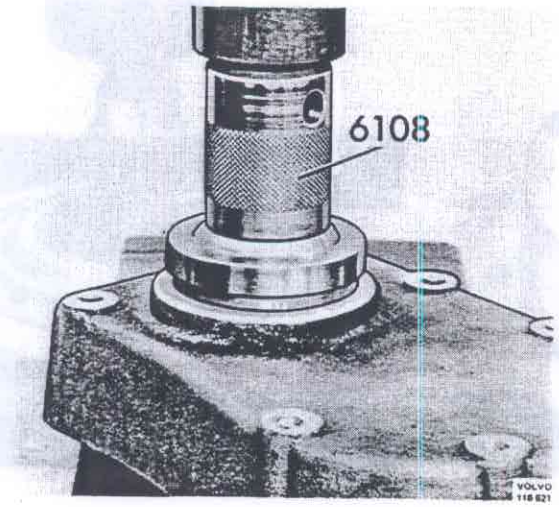

Fig. 48–20. Pressing in the seal

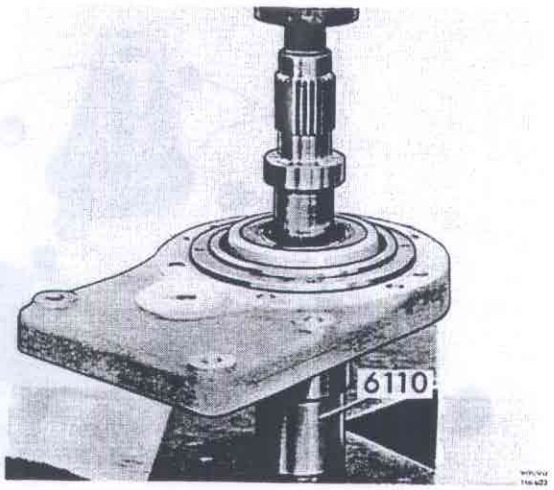

Fig. 48–22. Pressing in the shaft

Checking and replacing parts

Clean all parts and check them for damage and wear. All damaged or worn parts should be replaced, but sealing rings, O-rings and gaskets must always be replaced. When replacing sealing rings, check carefully the surfaces which have been covered by these rings. If a surface is scored or damaged in any other way, then the particular component with the damaged surface must be replaced.

Assembling

Special tools: 1801, 2014, 2022, 6108, 6110

Assembling the front housing half

1. Place the circlip nearest the sealing in the housing.
2. Place the sealing in the housing with 6108, see Fig. 48–20.
3. Press the bearing into the housing using 1801 + 2014, see Fig. 48–21. Place the circlip which secures the bearing.
4. Place the housing on 6110, see Fig. 48–22, and press in the input shaft.

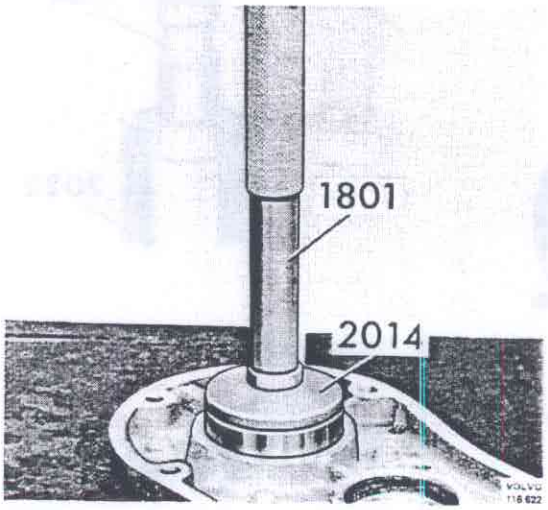

Fig. 48–21. Pressing in the bearing

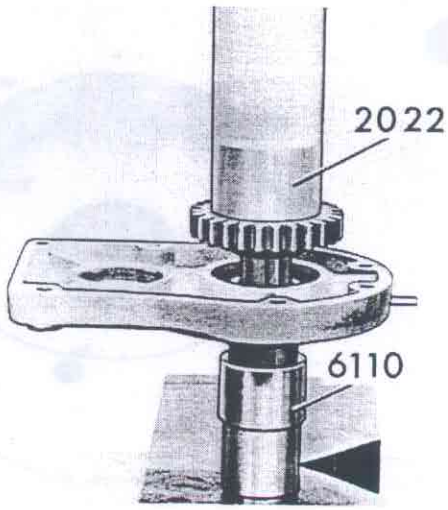

Fig. 48–23. Pressing on the wheel

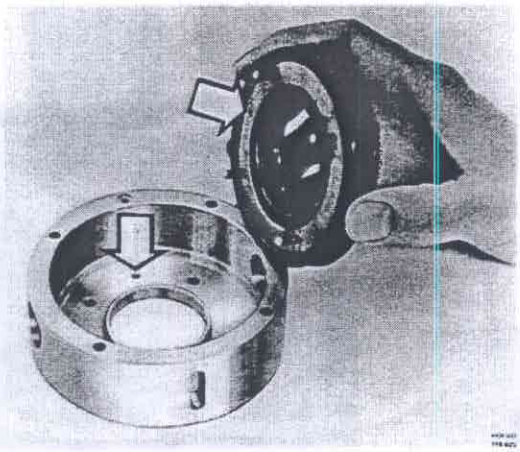

Fig. 48–24. Removing the bellows

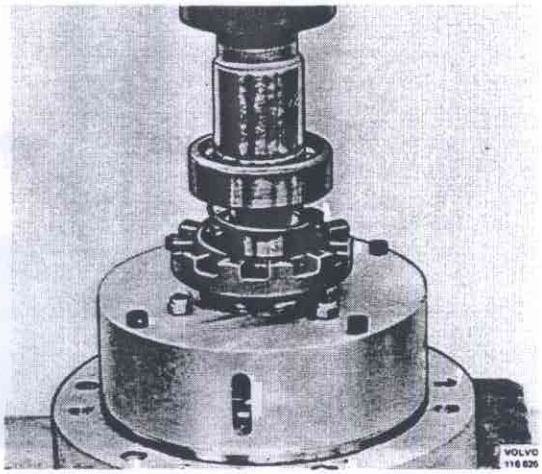

Fig. 48–26. Pressing on the bearing

5. Secure the key for the gear wheel. Place the housing on 6110 and press on the gear wheel with 2022, see Fig. 48–23. Secure the circlip for the gear.
6. Place the bellows on the control housing.
   NOTE! Make sure that the hole in the bellows is opposite the hole in the housing, see Fig. 48–24. Tighten up the bellows.
7. Make sure the bushing is firmly in position by peening it at three points. Place the plate in position and tighten it with the bellows.
8. Place a new O-ring on the control housing, see Fig. 48–25. Assemble the control housing to the housing half. Make sure that the air duct is located properly.
9. Place the flange and the thrust spring on the input shaft, see Fig. 48–26.
10. Press on the support bearing and peen it with three punch pops, see Fig. 48–27.

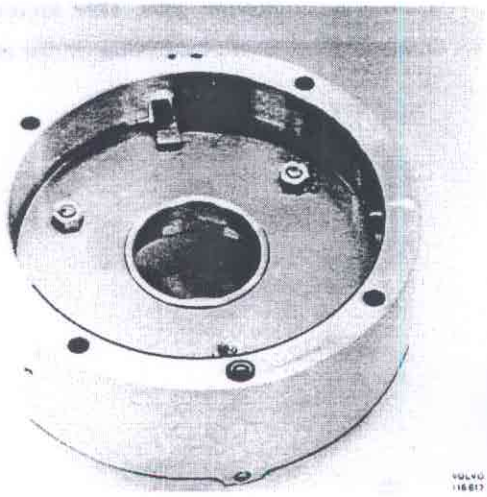

Fig. 48–25. Fitting the O-ring

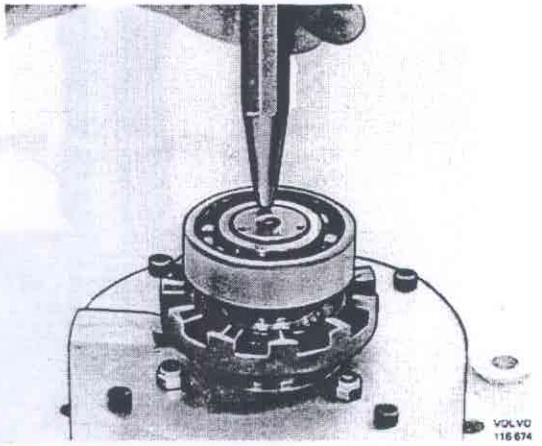

Fig. 48–27. Penning the bearing

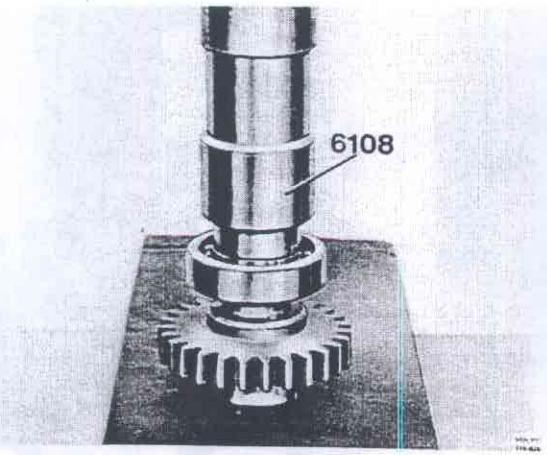

Fig. 48–28. Pressing on the wheel

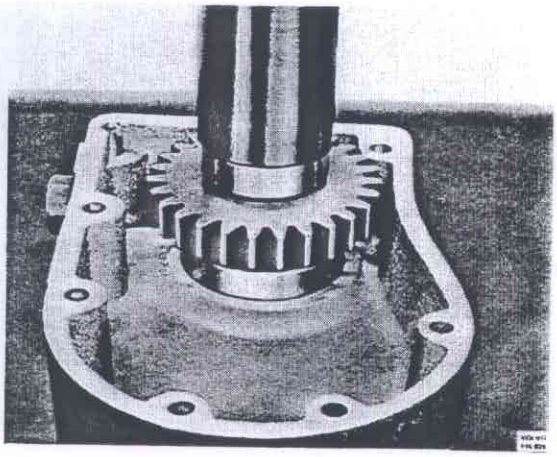

Fig. 48–30. Pressing on the shaft

Rear housing half

1. Press the support bearing on the output shaft.
2. Press on the gear wheel with 6110, see Fig. 48–28.
3. Press on the rear bearing with 6110, see Fig. 48–29. Fix the flange key in position.
4. Fit the circlip on the housing half.
5. Press the seal into the housing with 6108. Coat the seal with grease.
6. Press the output shaft into the housing, see Fig. 48–30.
7. Press the flange on the output shaft. Place the washer on the flange and tighten up the bolt to a torque of 41–51 Nm (4.1–5.1 kpm = 30–37 lbftf).

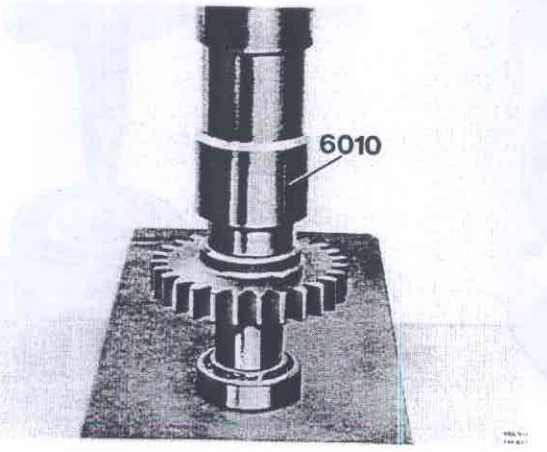

Fig. 48–29. Pressing on the bearing

Installing the power take-off on the auxiliary gearbox

1. Clean the contact surface on the auxiliary gearbox and coat it with sealing agent.
2. Fit the front housing half on the gearbox. Tighten the bolts to a torque of 20–25 Nm (2.0–2.5 kpm = 14–18 lbftf).
3. Coat the rear housing half contact surface with sealing agent. Mount the housing on the gearbox, turn the flange while putting the housing halves together. Tighten the bolts to a torque of 20–25 Nm (2.0–2.5 kpm = 14–18 lbftf).
   Fit the ventilation hose.
4. Fit the propeller shaft and tighten the bolts to a torque of 55–65 Nm (5.5–6.5 kpm = 40–47 lbftf).
5. Fill the power take-off with oil. Concerning quantity and quality, see under "Data".
6. Check the function of the power take-off.

Illustration 48-A. Power take-off

Power take-off

1 Spring
2 Flange
3 Bushing
4 Nut
5 Contral housing
6 Ball
7 Attaching plate
8 Bellows
9 Support plate
10 Trust plat
11 Input shaft
12 Key
13 Seal
14 Housing
15 O-ring
16 Circlip
17 Bearing
18 Circlip
19 Drive wheel
20 Circlip
21 Housing
22 Bearing
23 Flange
24 Washer
25 Screw
26 Screw
27 Bearing
28 Output shaft
29 Key
30 Wheel
31 Bearing
32 Circlip
33 Screw

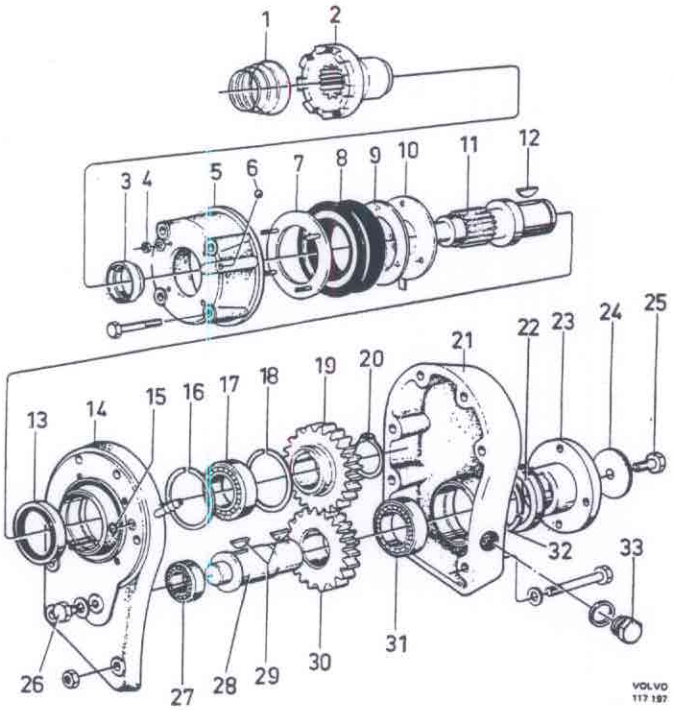
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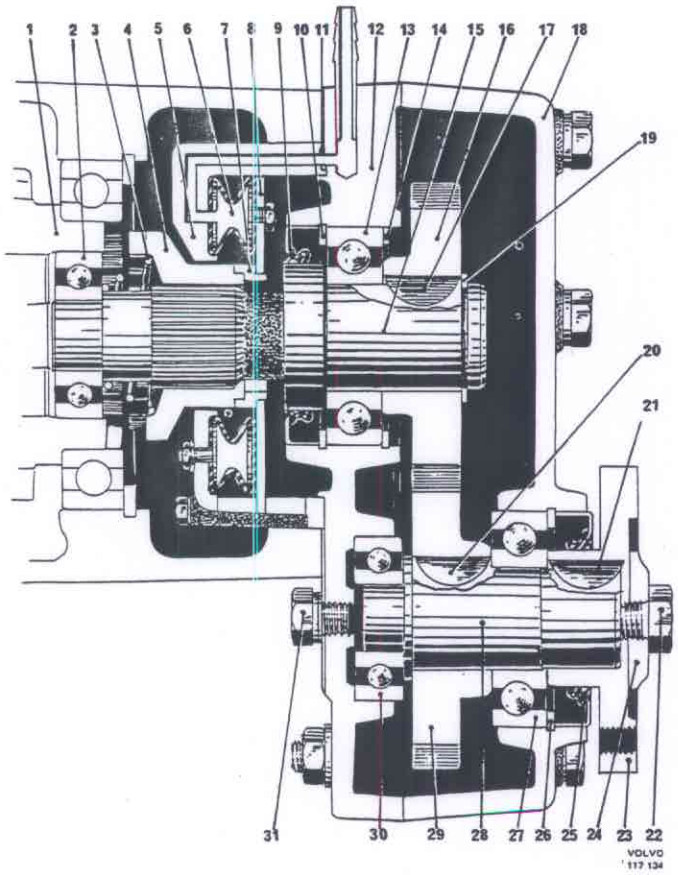
Illustration 48-B. Power take-off

Power take-off

1 Drive gear and auxiliary gearbox
2 Bearing
3 Spring
4 Flange
5 Control housing
6 Bellows
7 Bushing
8 Thrust plate
9 Seal
10 Circlip
11 O-ring
12 Housing
13 Bearing
14 Circlip
15 Input shaft
16 Drive wheel
17 Key
18 Housing
19 Circlip
20 Key
21 Key
22 Screw
23 Flange
24 Washer
25 Seal
26 Circlip
27 Bearing
28 Output shaft
29 Wheel
30 Bearing
31 Screw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TP 11078/1
Engelska
2500. 7.75
Printed in Sweden

Printed in Sweden, Gotab, Kungälv 75.15864

VOLVO SERVICE

PART 5

BRAKES

C3-series

SERVICE MANUAL

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GROUP 50 GENERAL

Data

SERVICE BRAKES

Wheel brakes

Type	Drum brakes	
Brake drum:		
Diameter, nominal	279.4 mm (11")	
max.	282.4 mm (11.12")	
Radial throw, max.	0.1 mm (0.004")	
Brake linings:		
Type	Mintex, bonded	
Effective area per front wheel	414 cm^2 (64 in^2)	
per rear wheel	256 cm^2 (40 in^2)	
total	1340 cm^2 (208 in^2)	
Wheel cylinder, front wheels:		
Nominal diameter	28.57 mm (1.125")	
Bore, max.	28.68 mm (1.129")	
Piston diameter, min.	28.42 mm (1.120")	
Clearance, piston – cylinder, max.	0.26 mm (0.01")	
Wheel cylinder, rear wheels:		
Nominal diameter	31.75 mm (1.250")	25.40 mm (1.000")
Bore, max.	31.84 mm (1.254")	25.51 mm (1.004")
Piston diameter, min.	31.58 mm (1.243")	25.25 mm (0.994")
Clearance, piston – cylinder, max.	0.26 mm (0.01")	0.26 mm (0.01")

Master cylinder

Type	Tandem cylinder
Nominal diameter	28.57 mm (1.125")
Bore, max.	28.68 mm (1.129")
Piston diameter, min.	28.42 mm (1.120")
Clearance, piston – cylinder, max.	0.26 mm (0.01")

Brake lines

Outer diameter	3/16"

Warning valve

Pressure difference for warning function	0.5–1.5 MPa (5–15 kp/cm^2 = 71–213 lbf/in^2)

Servo unit

Designation	Lockheed type 7
Control piston, diameter	9.5 mm (3/8")
Min. hydraulic pressure for servo operation (cut-out point)	0.32 MPa (3.2 kp/cm^2 = 45 lbf/in^2)
Reduction	approx. 1:4

PARKING BRAKE

Brake drum	
Diameter, nominal	250 mm (9.84")
max.	253 mm (10.0")
Radial throw, max.	0.1 mm (0.004")
Imbalance, max.	4 mNm (40 gcm)
Brake linings:	
Type	Jurid, bonded
Effective area	176 cm^2 (27 in^2)
Return spring:	
Outer diameter, upper spring	11.2 mm (0.44")
lower spring	8 mm (0.32")
Pulling power for 1 cm (0.39") extension,	
upper spring	180 N (18 kp = 40 lbf)
lower spring	50 N (5 kp = 11 lbf)

Tools

The special tools shown in Figs. 50–1 and 50–2 are used for repairs on the brake system.

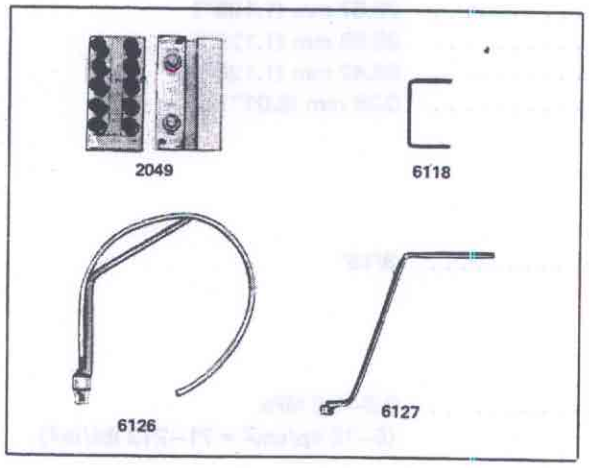


Fig. 50–1 Special tool

2049 Flanging tool
6118 Protective bracket for wheel cylinder, rear wheels
6126 Bleeder tool
6127 Spanner for adjusting rear wheel brakes

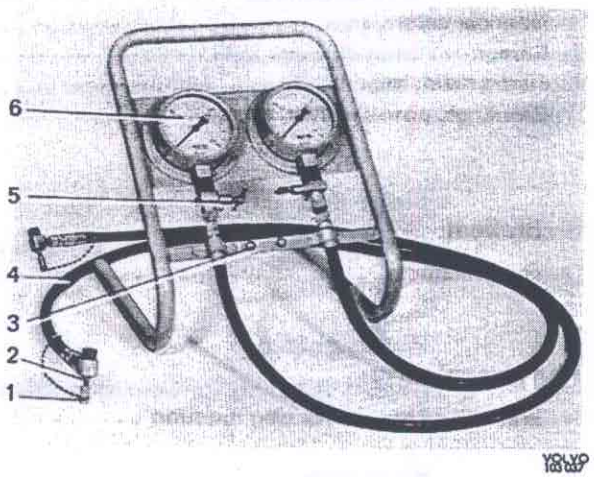


Fig. 50–2. Test device, 2741

1. Protective cap
2. Connection nipple
3. Expansion nipple
4. Hose
5. Bleeding device
6. Pressure gauge

For tightening up loose brake lines, use cap nut 945752 for the external thread and 945753 for the internal thread. In both cases the cap nuts are supplemented with rubber buffer 1210673, Fig. 50–3.

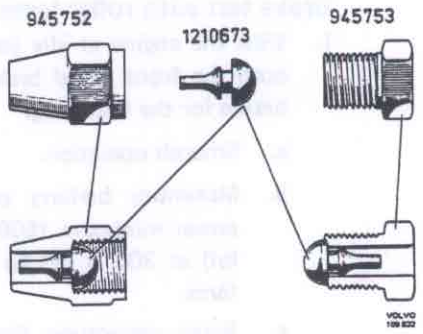


Fig. 50–3. Sealing nipples

Description

The vehicle has two brake systems independent of each other, the service brakes and parking brake.

The service brakes are vacuum-hydraulic drum brakes. The hydraulic part of these brakes as well as the control and operating devices are dealt with under Group 52. The vacuum section is dealt with under Group 54, and the brake shoes and brake drums under Group 51.

The parking brake is mechanical and operates on the propeller shaft. It is dealt with under Group 55.

Service Procedures

Cleaning

The components of the hydraulic brake system must be cleaned in clean brake fluid or denaturalized spirit which does not contain benzane (benzole).

Petrol, white spirit, trichloroethylene or spirit with benzane must not be used for the cleaning since these as well as the slightest drop of mineral oil will attack the rubber seals and cause them to swell out. For this reason, wash your hands with soap and water before touching the internal parts of the system. The mechanic appointed to work on the hydraulic components should be provided with natural rubber gloves.

The final cleaning should be done in a cleaning agent free from inpurities, after which the parts can be dried with air. Filtered compressed air free from water can be used to precipitate the drying and complete the cleaning. It is impotant that no spirit residues are left in the system when it is filled with brake fluid. Traces of spirit in the brake fluid lowers its boiling point and can give rise to vapourization and functional disturbance.

After cleaning and drying the components, coat them with brake paste, assemble them and then fill the complete unit with brake fluid as soon as possible in order to prevent attacks from rust through moisture in the air. This applies to units which are to be immediately installed in the vehicle. To counteract corrosion on brake components which are put in stock, pistons, cylinders and seals should be coated with a light layer of brake paste. Under no circumstances whatsoever may 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 meet the requirements according to the standard SAE J 1703 or DOT 3 may be used for the brake system.

When filling the brake fluid reservoirs, as well as with all work with connections, etc, observe the greatest cleanliness in order to prevent dirt getting into the system. The system should only be filled with clean, unused brake fluid. Any brake fluid that is expelled during bleeding may not be put back into the system.

After being in use a long time, it is normal that even first-class brake fluid gradually deteriorates due to the absorption of moisture and minor impurities. Thus, deteriorated brake fluid can be recognized by the fact that, compared with new brake fluid, it is darker or has altered its colour, it is relatively free from the smell which new brake fluid has, and when rubbed between the fingers it lacks the normal feeling of a light lubricating film. Such brake fluid should be replaced with new brake fluid. This also applies after doing any reconditioning on the master cylinder and wheel cylinders.

Brake test with roller tester

1. With the engine at idle (servo assistance), check both the front wheel brakes and the rear wheel brakes for the following:

   a. Smooth operation.

   b. Maximum braking power. Total braking power minimum 15000 N (1500 kp = 3300 lbf) at 300 N (30 kp = 66 lbf) brake pedal force.

   c. Brake application time. Braking should be obtained within 1/2 second after the brake pedal has been depressed.

   d. Brake release time. Braking power 0 within 1/2 second after brake pedal has been released.

   e. Check that the contact for the brake pedal travel is functioning properly by switching in the circuit by hand.

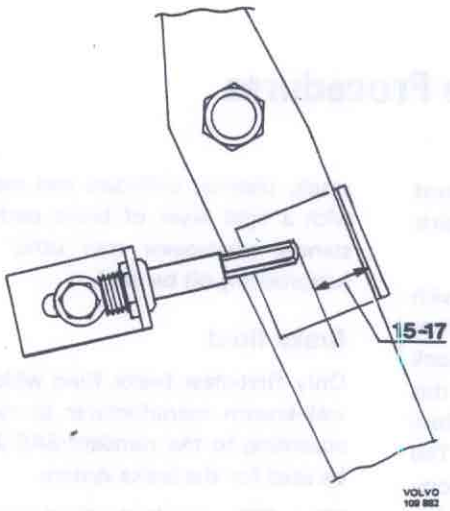


Fig. 50—4. Contact for brake pedal travel

If a fault is discovered during the test, supplementary fault tracing can be done by repeating the checks with the engine switched off (that is without servo assistance).

NOTE! Re-set the contact for the brake pedal travel by pushing the pin back to the rest position.

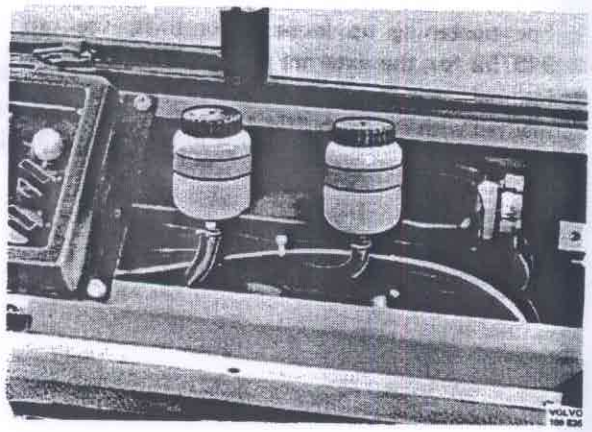


Fig. 50—5. Brake fluid reservoirs

Hydraulic test with test device

Special tool: 2741 Test device

Check to make sure that the brake fluid reservoirs are full, see Fig. 50—5.

Unscrew the bleeder nipples at rear wheels and connect it to the test device shown on Fig. 50—2. Connect up according to Fig. 50—6. If necessary, bleed the test device.

Depress the brake pedal several times in order to even out any vaccum in the servo units and in this way disengage them.

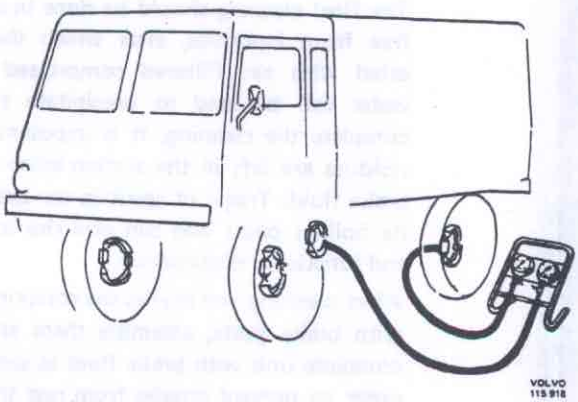


Fig. 50—6. Connecting up the test device

Leakage and pressure checks

2. With a pedal jack on the brake pedal, apply the service brakes to a hydraulic brake pressure of about 10 MPa (100 kp/cm^2 = 1422 lbf/in^2). Check lines and components for damage and leakage. The pressure should remain unchanged for at least 15 seconds.
3. Remove the brake pedal jack. Apply and release the footbrake while reading the test device gauges. The pressure in both the circuits should be similar. At 10 MPa (100 kp/cm^2 = 1422 lbf/in^2), the pressure in both the circuits may not differ more than 0.3 MPa (3 kp/cm^2 = 43 lbf/in^2). The pressure should drop to about 0.1 MPa (1 kp/cm^2 = 14 lbf/in^2) within 1/2 second after the pedal has been released.
4. Start the engine and stop it after it has been run at least 1 minute. Adjust the brake pedal jack to a hydraulic pressure of 2.5 MPa (25 kp/cm^2 = 355 lbf/in^2). Wait 2 minutes. The hydraulic pressure should not alter during this time more than 0.5 MPa (5 kp/cm^2 = 71 lbf/in^2).

Warning valve (only Swedish market)

Disconnect the electric cable from the contact for the pedal travel, see Fig. 50–7.

5. Depress the brake pedal several times in order to disengage the servo units. Connect a hose to one of the bleeder nipples on the test device and open the nipple. Turn the ignition key and check that the warning lamp goes on when the parking brake is applied.

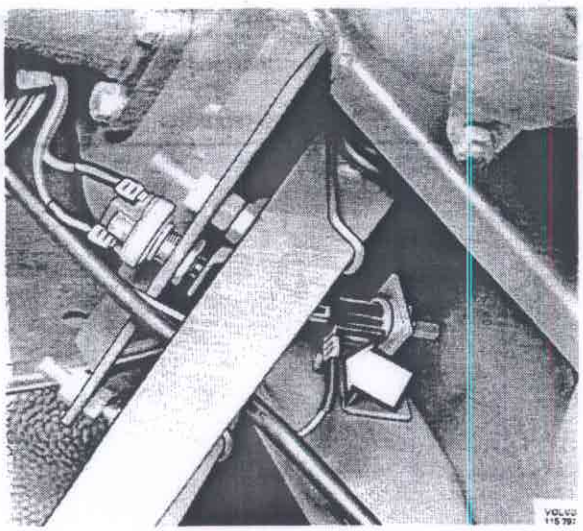


Fig. 50–7. Contact for pedal travel

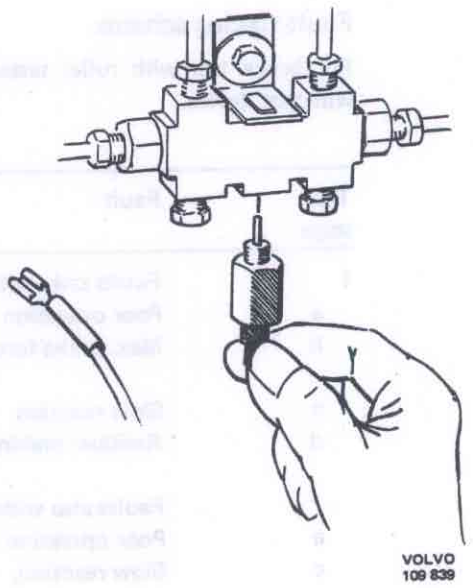


Fig. 50–8. Removing the contact

Release the parking brake. Carefully apply the service brakes with a brake pedal jack. When the warning lamp goes on, check the pressure on the gauge. The lamp should light at a pressure difference of 0.5–1.5 MPa (5–15 kp/cm^2 = 71–108 lbf/in^2) between the circuits.

After the test, close the bleeder nipple and remove the brake pedal jack. Connect the contact for the pedal travel. NOTE: Disconnect the electric cable and screw out the contact, Fig. 50–8, so that the warning valve returns to normal position. Screw in the warning contact carefully (approx. 15 Nm = 1.5 kpm = 11 lbftf). Reconnect the electric cable.

Servo units

6. Depress the brake pedal several times to disengage the servo units. Apply the service brakes with a brake pedal gauge to a hydraulic pressure of 2 MPa (20 kp/cm^2 = 284 lbf/in^2). Read off the brake pedal gauge. Start the engine and apply the brakes until the brake pedal gauge gives the same reading as before. Read off the hydraulic gauge, which will then indicate the servo pressure. At maximum servo effect, the pressure should be 8 MPa (80 kp/cm^2 = 1138 lbf/in^2), that is a reduction of 1:4.

Fault-tracing scheme

For brake test with roller tester and hydraulic test with test device.

Test stage	Fault		Reason
1	Faults only **with** servo assistance		
a	Poor operation		Servo units
b	Max. brake force too low,	one wheel	Wheel brake
		both wheels	Servo units
c	Slow reaction		Servo units
d	Residual braking		Servo units
	Faults also **without** servo assistance		
a	Poor operation		Wheel brakes
c	Slow reaction,	one wheel	Wheel brake
		both wheels	Master cylinder or wheel brakes
d	Residual braking,	one wheel	Wheel brake
		both wheels	Master cylinder or wheel brakes
2	Pressure drops		Leaking brake line Wheel cylinder Master cylinder
3	Lagging pressure Brake-release period greater than 1/2 second		Pinched brake line Wheel cylinders Master cylinder
4	Pressure drops more than 0.5 MPa (5 kp/cm^2 = 71 lbf/in^2)		One-way valve Servo units
	Pressure increases more than 0.5 MPa (5 kp/cm^2 = 71 lbf/in^2)		Servo units
5	Parking brake warning lamp does not go on		Electrical components
	Service brakes warning lamp does not go on		Contact on warning valve
	Warning at pressure difference other than 0.5–1.5 MPa (5–15 kp/cm^2 = 71–213 lbf/in^2)		Warning valve
	Warning lamp does not go out after being re-set		Warning valve
6	Faulty servo pressure		Servo units

Brake test without aids

1. Check to make sure that the brake fluid reservoirs are full, see Fig. 50–5.
2. Examine the brake lines and parts for damage and leakage.
3. Depress the brake pedal several times to even out any vacuum in the servo units and in this way disengage them.
4. Depress the brake pedal. Start the engine. You should clearly feel the pedal dropping when the servo units are functioning.
5. Open a bleeder nipple. Turn the ignition key and check that the warning lamp goes on when the parking brake is applied. Release the parking brake. Carefully apply the service brakes until the warning lamp goes on. If it does not, change the contact, see Fig. 50–9.

   After the test close the bleeder nipple.

   NOTE! Disconnect the electric cable and screw out the contact, see Fig. 50–9, so that the warning valve returns to normal position. Screw in the contact carefully (approx. 15 Nm = 1.5 kpm = 11 lbftf).

   Connect up the electric cable.

6. Check that the contact for the brake pedal travel is functioning by closing it with the hand. Then re-set the contact by pushing the pin back to the rest position.

Only Swedish market

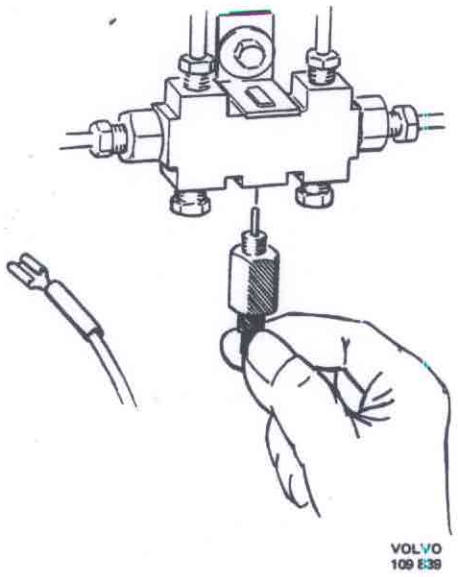


Fig. 50–9. Removing the contact

7. Raise the vehicle so that the wheels are off the ground. Get someone to rotate the wheels and apply and release the brakes. The wheels should not be braked a half second after the pedal has been released. This test should be carried out with and without vacuum in the servo unit.

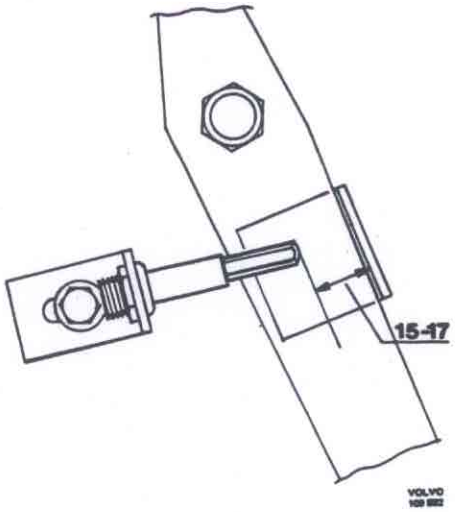
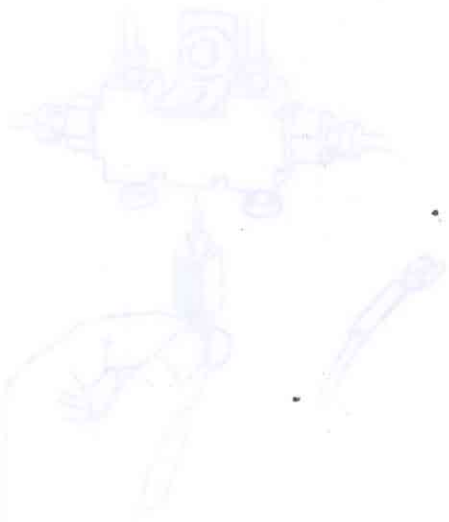


Fig. 50–10. Contact for brake pedal travel



GROUP 51 BRAKE SHOES, DRUMS AND LININGS

Description

The front wheel brake unit (see Fig. 51–1) has two single-operating wheel cylinders. This means that both shoes function as primary shoes.

The rear wheel brake unit (see Fig. 51–2) has a double-operating wheel cylinder. At the bottom the shoes rest against a support fixed to the brake backing plate.

The shoes can be displaced radially, they are therefore self-centering. The clearance between the brake lining and drum can be adjusted with a rotatable excentric. The brake linings are bonded.

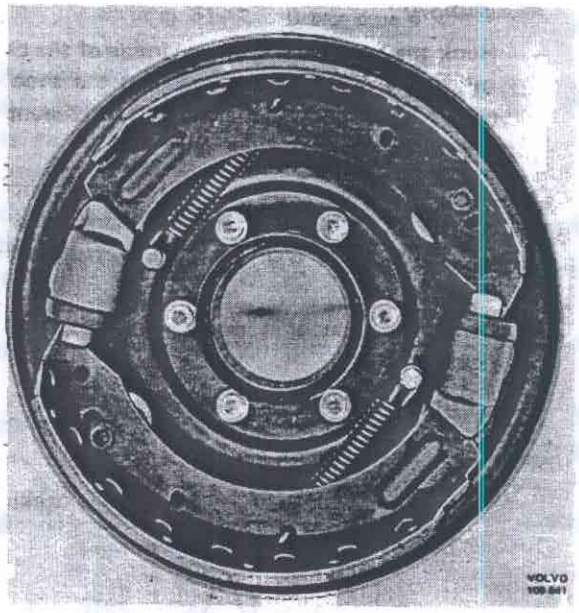


Fig. 51–1. Front wheel brake unit, left

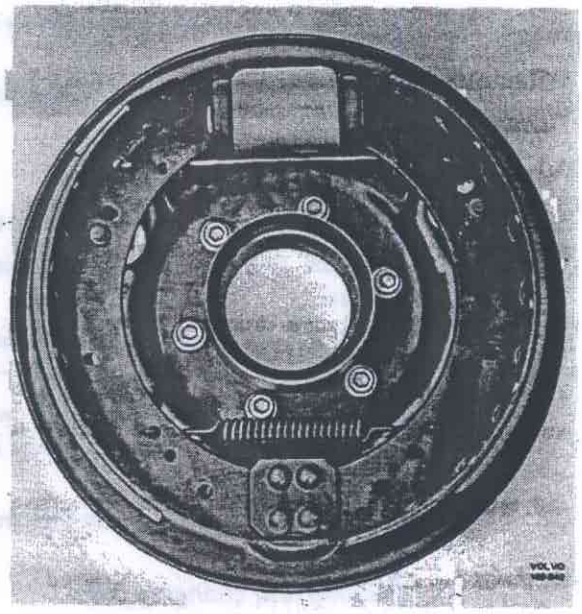


Fig. 51–2. Rear wheel brake unit, left

Service Procedures

Adjusting the wheel brakes

Special tool: 6127 Spanner, rear wheel brakes

1. Jack up the vehicle or at least one axle.
2. Turn the adjuster pin clockwise until the brake drum can just be rotated, see Fig. 51–3. For the rear wheels use spanner 6127 and for the front wheels an 11/16" spanner.
3. Slacken the adjuster pin until the drum can rotate freely.
4. Repeat this with the other adjuster pin and the other wheels.

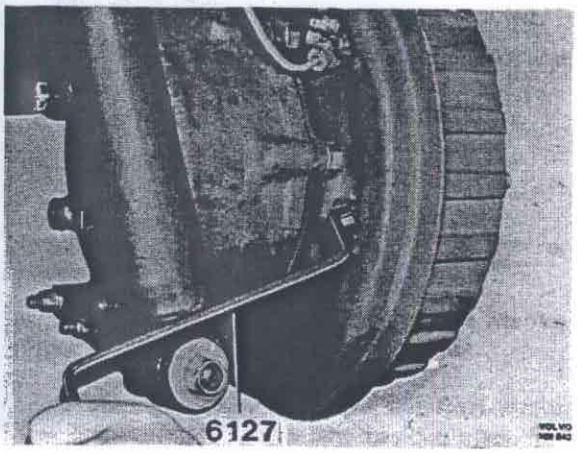


Fig. 51–3. Adjusting the wheel brake unit

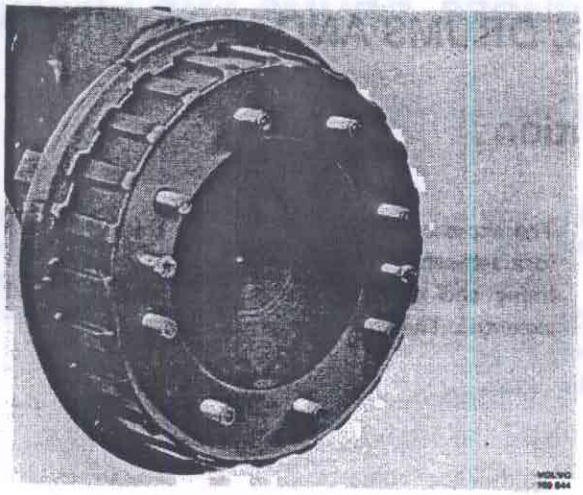


Fig. 51—4. Puller bolts in brake drum

Reconditioning the front wheel brakes

Dismantling

1. Slacken the wheel nuts a bit.
2. Jack up the front end and remove the wheel.
3. Adjust back both the brake shoes (anti-clockwise).
4. Pull off the brake drum. If necessary use two puller bolts 3/8—24 UNF, Fig. 51—4.
5. With a screwdriver or torque wrench lift the brake shoes out of their grooves in the cylinder housing, Fig. 51—5.
6. Unhook the springs and lift forward the shoes.

Checking and changing parts

Clean the brake components and the king pin location for the brake drum.

The wheel cylinder is dealt with under the heading "Wheel cylinder", Group 52.

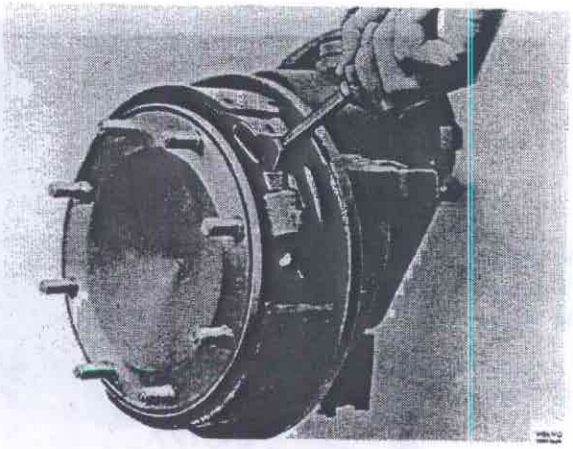


Fig. 51—5. Removing the brakes shoes

If the brake backing plate or the adjuster mechanisms are damaged, replace the plate. The king pin must be removed to do this, see under the heading "Wheel hub", Group 78.

If the brake linings are oily, damaged or worn so that there is not more than about 1.5 mm (1/16") of the lining thickness remaining, replace the shoes complete.

Check the friction surface and out-of-roundness of the brake drums. The out-of-roundness may not exceed 0.1 mm (0.004").

The friction surface can be machine-smoothed or ground but the diameter may not exceed 282.4 mm (11").

Assembling

1. Hook the return spring on the inside of the brake shoes, see Fig. 51—7. Check that the shoe pin comes inwards since the shoes are different on the left-hand and right-hand sides.
2. Place the shoe on the inside of the king pin and hook the return spring on the backing plate pin. Carefully fit the end of the shoe on the piston groove.
3. Tension the shoe in position in the cylinder housing groove.
4. Fit the other brake shoe in the same way.

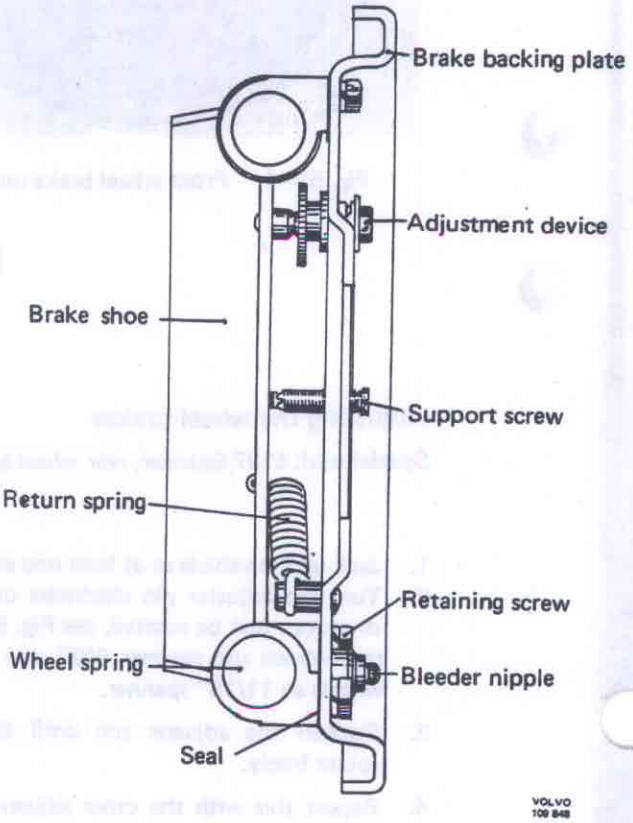


Fig. 51—6. Front wheel brake parts

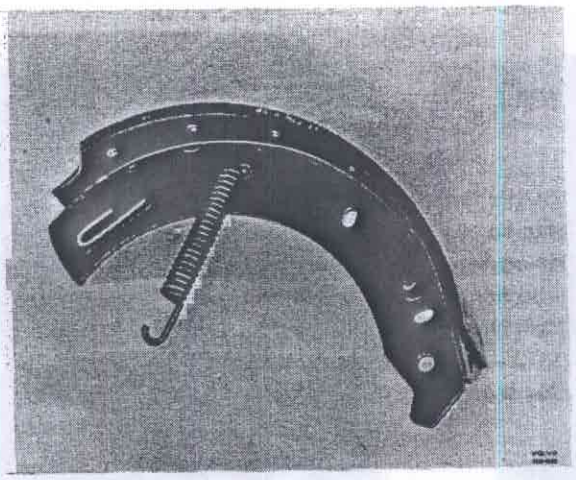


Fig. 51–7. Brake shoe

5. Check that the linings are at right angles to the king pin, see Fig. 51–8. To adjust use the support screw in the backing plate. Tighten up after adjusting.
6. Fit the brake drum. Make sure that it is fitted properly in position with the help of the two nuts.
7. Adjust the wheel brake unit.
8. Fit the wheel, lower the front end and tighten the wheel nuts to a torque of 160–210 Nm (16–21 kpm = 115–152 lbftf).

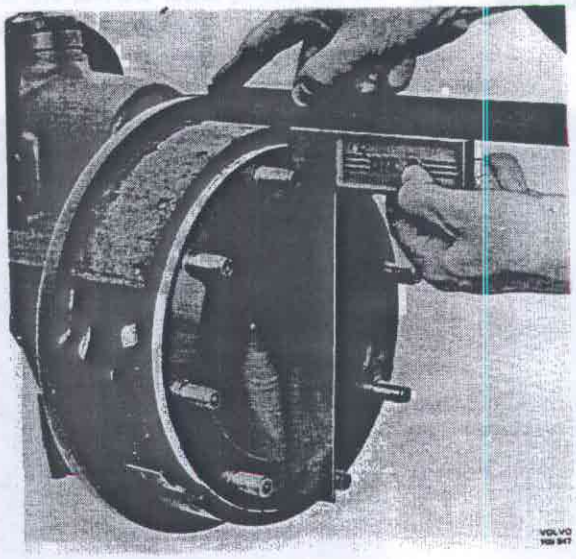


Fig. 51–8. Checking the right angle

Servicing the rear wheel brakes

Special tool: 6118 Protective bracket for wheel cylinder.

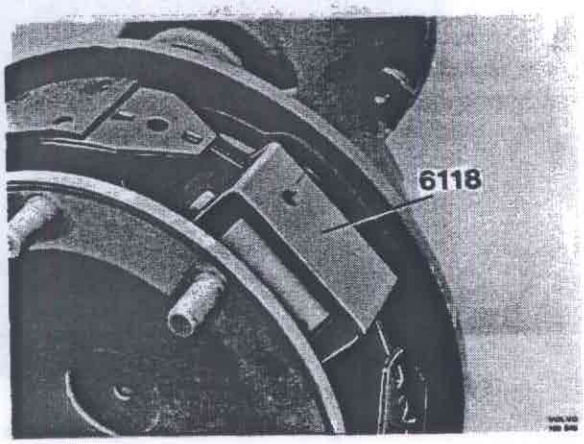


Fig. 51–9. Safety bracket

Dismantling

1. Slacken the wheel nuts a bit.
2. Jack up the rear end and remove a wheel.
3. Adjust back both the brake shoes (anti-clockwise).
4. Pull off the brake drum. If necessary use two puller bolts 3/8–24 UNF, see Fig. 51–4.
5. Lever out the shoes a bit at the top and place the protective bracket 6118 on the wheel cylinder, see Fig. 51–9.
6. Lever out the shoes from the guide at the bottom with two screwdrivers, see Fig. 41–10, or torque wrench.
7. Move the upper ends of the shoes to the side of the pistons and remove the protective bracket.
8. Unhook the upper spring with flat pliers. Pull forward the shoes.

Checking and replacing parts

Clean the brake parts and the king pin location for the brake drum.

The wheel cylinder is dealt with under the heading "Wheel cylinder", Group 52.

If the brake backing plate or the adjusting mechanisms are damaged, replace the backing plate. The king pin must be removed in order to do this, so see under the heading "Wheel hub", Group 78.

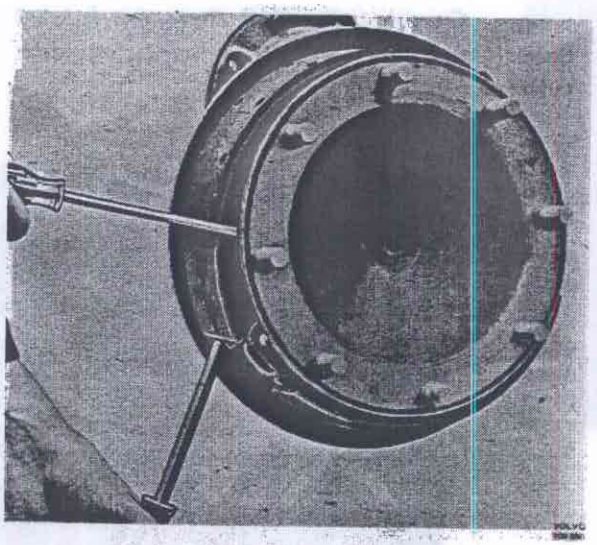


Fig. 51—10. Removing the brake shoes

If the brake linings are oily, damaged or worn so that there is not more than about 1.5 mm (1/16") of lining thickness remaining, replace the shoes complete.

Check the brake drum friction surface and out-of-roundness. The out-of-roundness may not exceed 0.1 mm (0.004").

The friction surface can be machine-smoothed or ground but the diameter may not exceed 282.4 mm (11").

Assembling

1. Hook the lower return spring on both the shoes and the upper on one of the shoes, see Fig. 51—11. Note that the lining on the primary shoe (the leading) is displaced downwards.

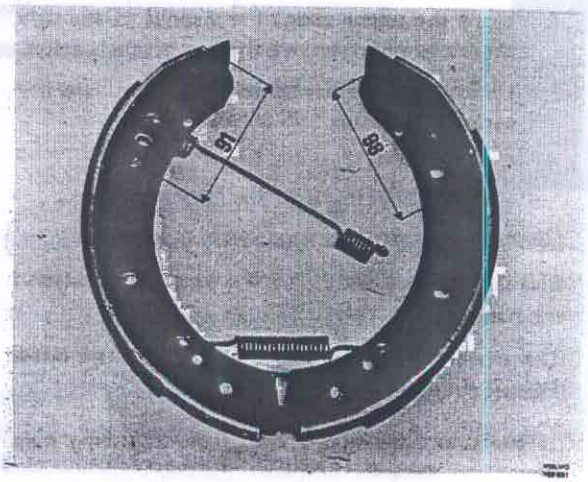


Fig. 51—11. Brake shoes

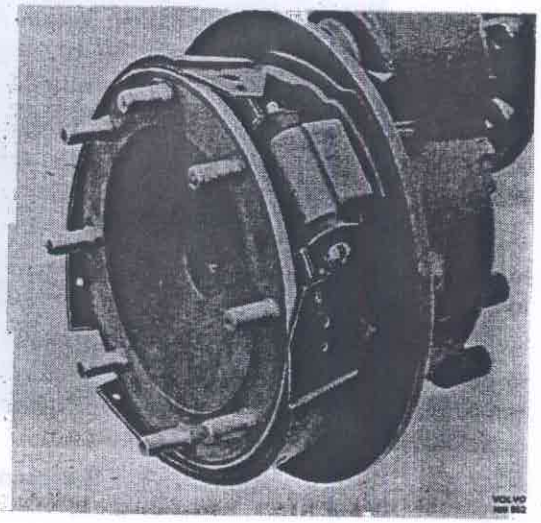


Fig. 51—12. Fitting the brake shoes

2. Fit the shoes on the inside of the king pin, see Fig. 51—12. Hook on the upper return spring with flat pliers.
3. Place the protective bracket 6118 on the wheel cylinder, see Fig. 51—13.
4. Carefully fit the shoes on the grooves on the pistons.
5. Tension out the shoes at the bottom so that they can be fitted in the guide.
6. Lever out the shoes a bit and remove the protective bracket.
7. Fit the brake drum. Make sure that it is fitted properly and align it with the help of two nuts.
8. Adjust the wheel brake unit.
9. Fit the wheel, lower the rear end and tighten the wheel nuts to a torque of 160—210 Nm (16—21 kpm = 115—152 lbftf).

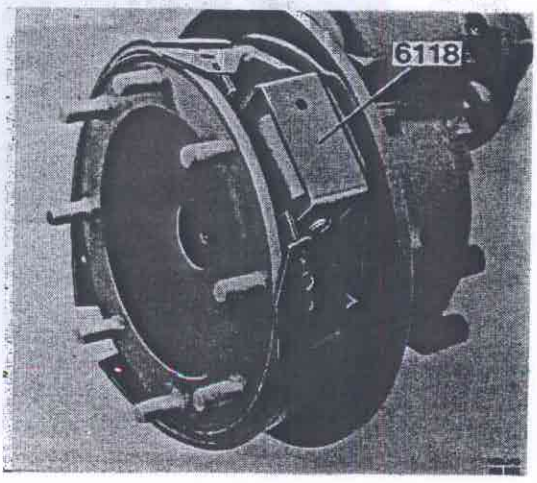


Fig. 51—13. Protective bracket

GROUP 52 HYDRAULIC SERVICE BRAKES

Description

The service brakes (Fig. 52–1) are vacuum-hydraulic. Layout is according to Fig. 52–1. It has two circuits, one of which (the primary circuit) operates on the front wheels and the left, rear wheel, and the other (the secondary circuit) on the front wheels and right, rear wheel. The service brakes have also an auxiliary brake with servo units which boost the hydraulic pressure.

Described on the following pages are the master cylinder, wheel cylinders, brake pedal and the warning devices for the brake system. Described under Group 51 are the brake shoes and brake drums, and under group 54 the servo units.

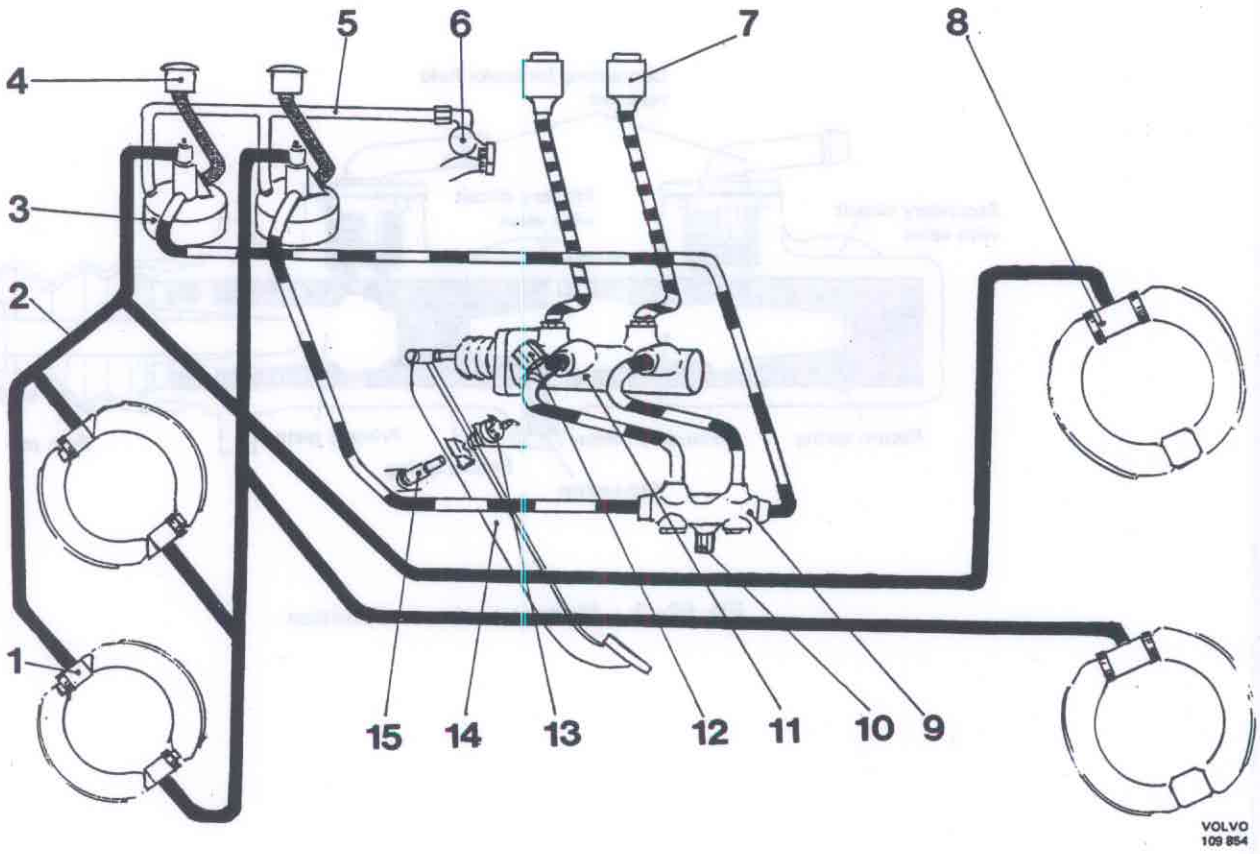


Fig. 52–1. Service brakes, layout diagram

1. Wheel cylinder, front wheels
2. Brake line
3. Servo unit
4. Air cleaner
5. Vacuum line
6. Suction pipe
7. Brake fluid reservoir
8. Wheel cylinder, rear wheels
9. Warning valve
10. Contact, press. diff.
11. Master cylinder
12. Contact (only Swedeish market)
13. Contact for stop lights
14. Brake pedal
15. Contact, brake pedal travel

Colour marking

Red	= brake fluid, primary circuit
Blue	= brake fluid, secondary circuit
Purple	= air

Pressure marking on lines

Uncoloured	= vacuum
Short dashes	= atmospheric pressure
Long dashes	= master cylinder pressure
Continuous line	= servo pressure

MASTER CYLINDER

The master cylinder design can be seen from Fig. 52–2. If functions as follows:

In the rest position, the pistons are held back by spring pressure. The connection is then open in both circuits between the brake fluid reservoir and the space in front of the piston. During braking the primary piston (right on Figure) is pushed in by the push rod. This closes the connection with the reservoir and the pressure in front of the piston rises. This pressure actuates the secondary piston and pushers it to the left. The same overpressure arises in front of both the pistons, the brake fluid is pressed out into the brake lines and all the wheel brakes are applied, providing the system is without fault.

When the brake pedal is released, the pistons return to the rest position. Both the valves at the outlets result in a low, hydraulic overpressure remaining in the circuits outside the master cylinder.

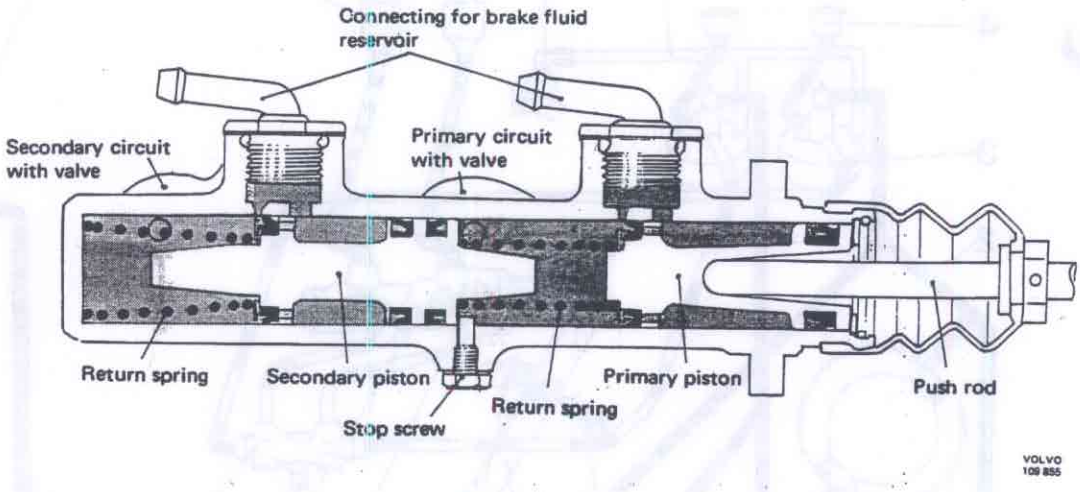


Fig. 52–2. Master cylinder, rest position

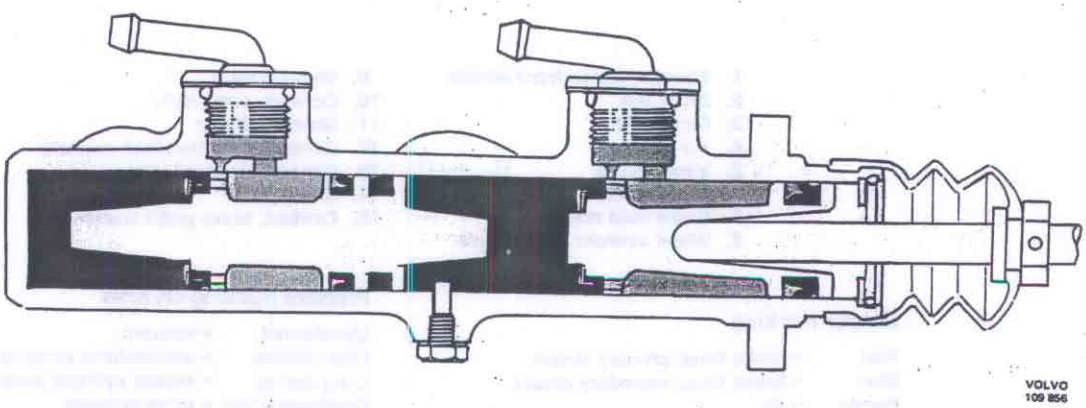


Fig. 52–3. Normal brake application

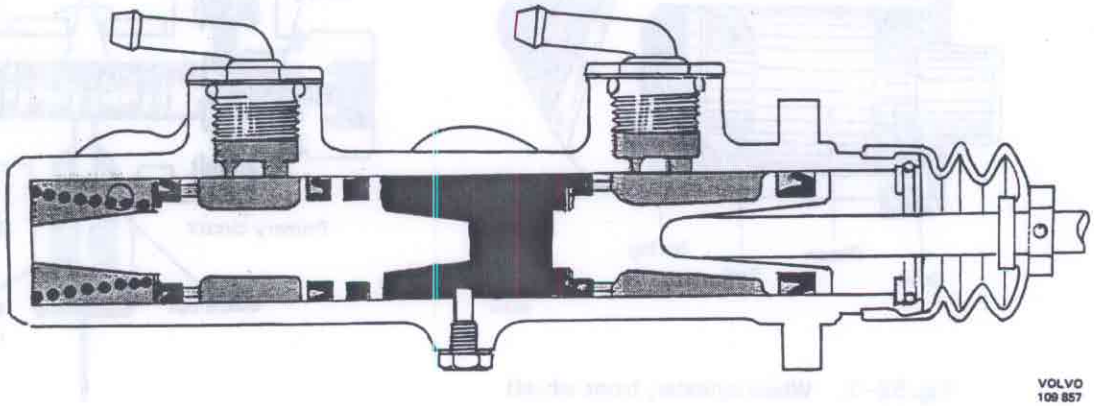


Fig. 52–4. Brake application with leakage in secondary circuit

If a leakage has arisen in the secondary circuit, no backpressure is formed in front of the secondary piston which is pushed inwards during brake application until stopped by the end of the cylinder. The hydraulic pressure between the pistons can thereafter rise and apply the brakes in the primary circuit.

If there is a leakage in the primary circuit, the primary piston is displaced during braking until it makes contact with the secondary piston. Both pistons are then pushed inwards, the pressure in front of the secondary piston rises and the brakes in the secondary circuit are applied.

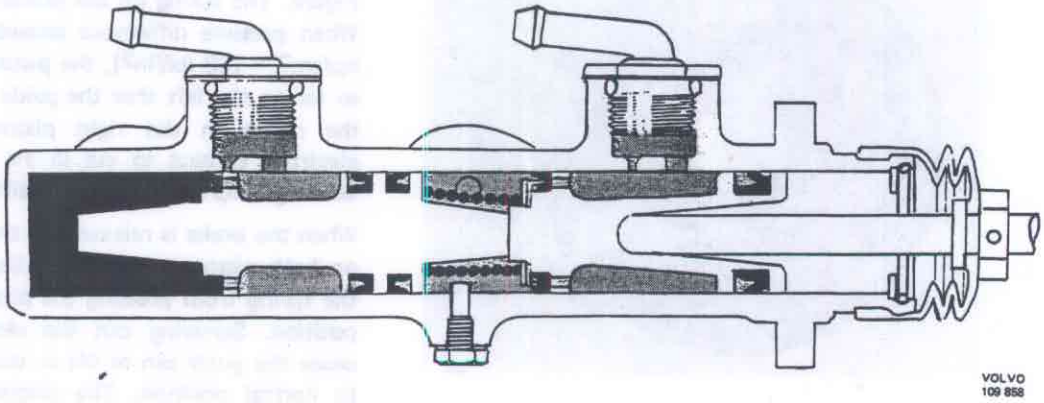


Fig. 52–5. Brake application with leakage in primary circuit

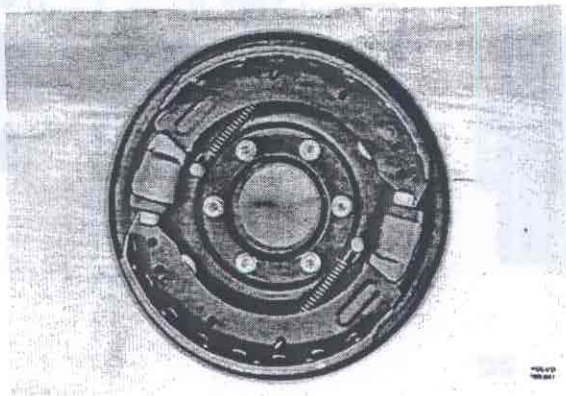


Fig. 52–6. Front wheel brake unit

WHEEL CYLINDERS

Each front wheel has two wheel cylinders. Fig. 52–6 shows the location and Fig. 52–7 the design. The leading cylinder is connected to the secondary circuit, the trailing to primary circuit. During braking, brake fluid pushes the piston outwards and applies one of the brake shoes. In the rest position, the piston is held pressed-in by the shoe's return spring.

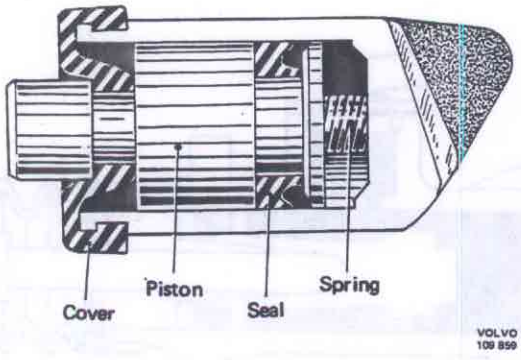


Fig. 52–7. Wheel cylinder, front wheels

Each rear wheel has a wheel cylinder. Fig. 52–8 shows the location and Fig. 52–9 the design. During braking, brake fluid pushes the piston outwards and the brake shoes are applied. In the rest position, the pistons are held pressed-in by the return springs for the shoes.

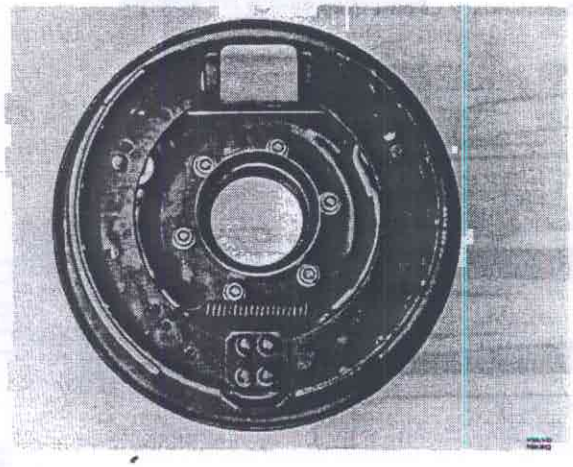


Fig. 52–8. Rear wheel brake unit

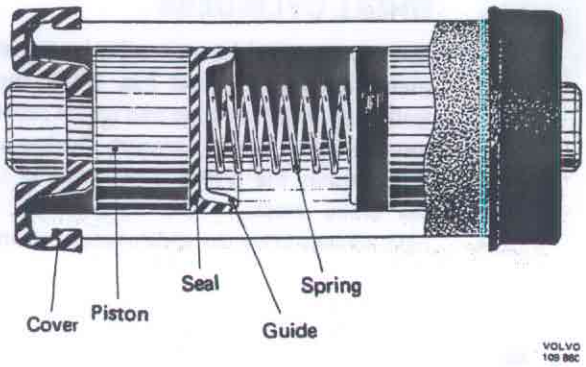


Fig. 52–9. Wheel cylinder, rear wheels

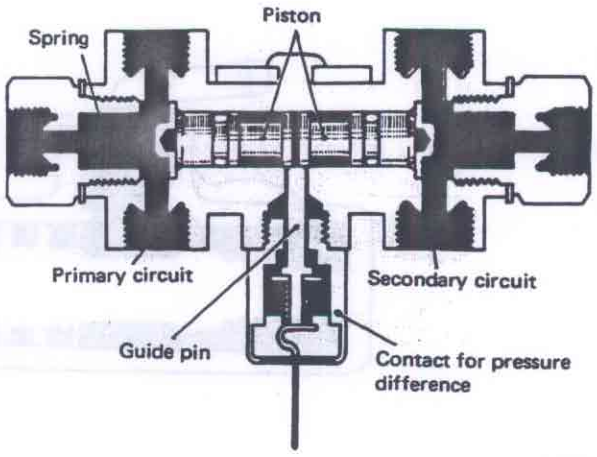


Fig. 52–10. Warning valve, normal position

WARNING VALVE

The warning valve design can be seen from Fig. 52–10. Concerning the electrical contacts for this valve, see Group 38.

During normal braking, pressure on both pistons is more or less the same. If the pressure in the secondary circuit is higher than that in the primary circuit, the pistons are pushed to the left on the Figure. The spring on the primary side opposes this. When pressure difference exceeds about 1 MPa (10 kp/cm^2 = 142 lbf/in^2), the pistons have been pushed so far to the left that the guide pin goes down into the recess in the right piston. This causes the electrical contact to cut in the current so that the warning lamp for the pressure difference goes on.

When the brake is relased and the hydraulic pressure on both pistons is the same, the guide pin prevents the spring from pressing the pistons back to normal position. Screwing out the electrical contact will cause the guide pin to lift so that the pistons return to normal position. The electrical contact should always be screwed out after warning position (and when bleeding) in order not to damage the guide pin and piston.

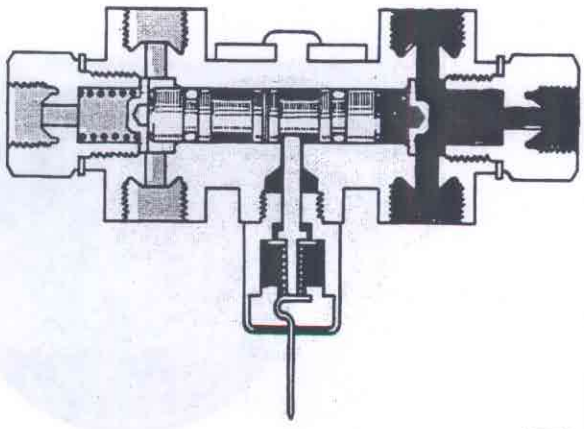


Fig. 52–11. Warning position

BRAKE PEDAL

The brake pedal is suspended, journalled in two bushings. The upper section actuates the push rod in the master cylinder. A stop bolt limits return travel.

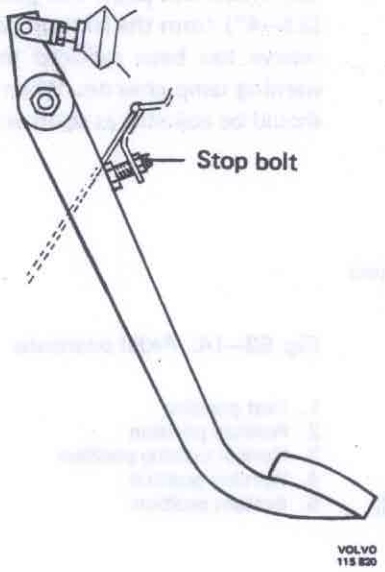


Fig. 52–12. Brake pedal

BRAKE SYSTEM WARNING DEVICES

Concerning the electrical part of the contacts, see Group 38. The location and connection of the electrical contacts can be seen from Fig. 52–13.

Contact for stop lights

The contact is mechanical and is actuated by the brake pedal. When the pedal is in rest position, there is no current to the ligths. When the pedal is depressed, current is cut in to the stop lights.

Contact for pressure difference

The contact is actuated by the warning valve. See under "Warning valve".

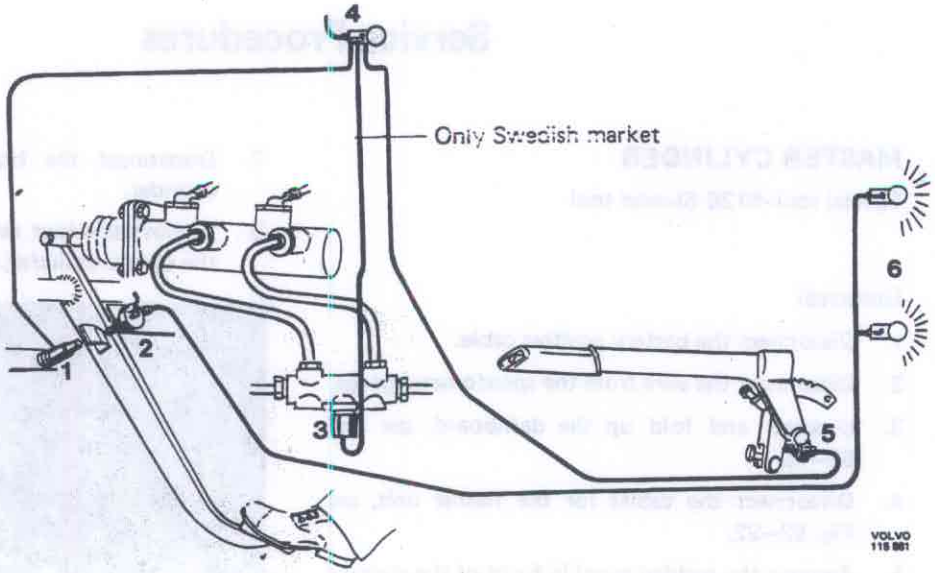
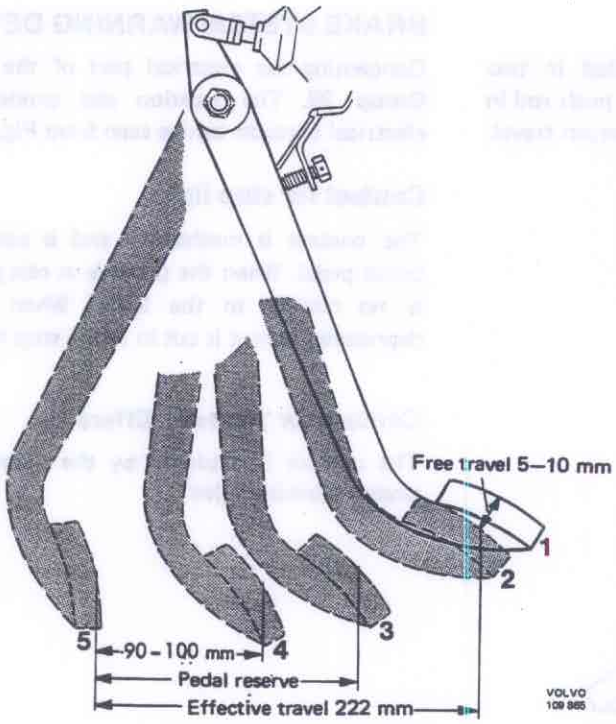


Fig. 52–13. Warning devices

1. Contact, brake pedal travel
2. Contact, stop lights
3. Contact, pressure difference
4. Warning lamp, brake system
5. Contact, parking brake
6. Stop lights



Contact for brake pedal travel

The contact is actuated by the pedal. The more the brake linings wear down, the greater will be the pedal travel. However, the pedal must not travel too far if the brakes are to function should one of the circuits fail. When the pedal has gone down to 90–100 mm (3.5–4") from the bottom position, that is, the pedal reserve has been reduced to this measurement, the warning lamp goes on. When this happens, the brakes should be adjusted as soon as possible.

Fig. 52–14. Pedal positions

1. Rest position
2. Pressure position
3. Normal braking position
4. Warning position
5. Bottom position

Service Procedures

MASTER CYLINDER

Special tool: 6126 Bleeder tool

Removal

1. Disconnect the battery positive cable.
2. Disconnect the wire from the speedometer gauge.
3. Unscrew and fold up the dashboard, see Fig. 52–15.
4. Disconnect the cables for the flasher unit, see Fig. 52–22.
5. Remove the padded panel in front of the steering column.
6. Place an empty vessel under the master cylinder. Remove the hoses from the master cylinder and plug them. To slow up the oil running out temporarily cover the breather hole in the cap of the brake fluid reservoirs with plastic cement or similar.
7. Disconnect the brake lines from the master cylinder.
8. Remove the four retaining bolts and lift forward the master cylinder, see Fig. 52–16.

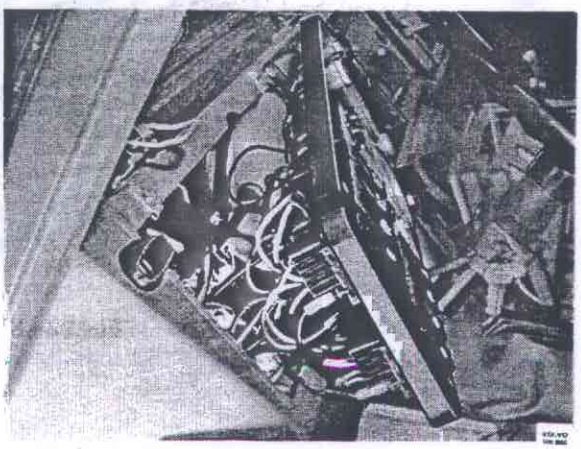


Fig. 52–15. Dashboard folded up

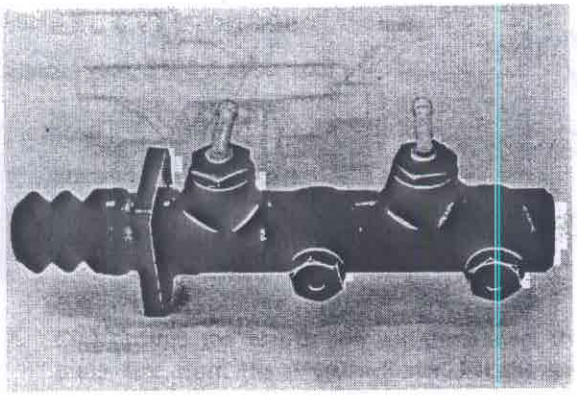


Fig. 52–16. Master cylinder removed

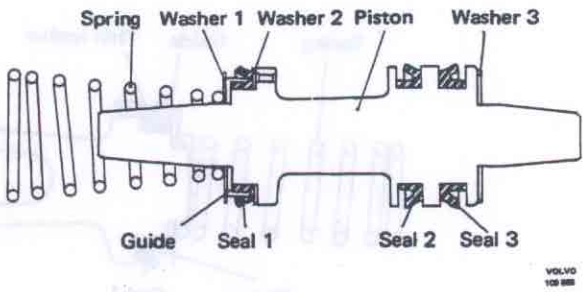


Fig. 52–17. Secondary piston

Dismantling

1. Fix the master cylinder flange securely in a vice.
2. Unscrew the connections for the brake fluid reservoirs.
3. Unscrew the ouput connections and remove the valves.
4. Unscrew the stop bolt.
5. Lever off the rubber cover and remove the push rod.
6. Remove the lock ring for the primary piston with the help of lock ring pliers. Shake out the valves, use compressed air if necessary.
7. Remove the parts from the pistons.

Checking and replacing parts

Before checking, clean the parts according to the instructions given under "Cleaning", Group 50.

Examine carefully the inside of the cylinder. If scored or damaged in any other way replace the cylinder. Rusting or similar can generally be removed by honing, etc. Clean the cylinder carefully after honing and check that all holes are open.

If wear is suspected on the cylinder or piston, measure the diameter with a micrometer or dial indicator. The cylinder bore may not exceed 28.68 mm (1.13") and the piston diameter may not be less than 28.42 mm (1.12").

Each time reconditioning is carried out, replace the used repair kit parts with new ones. The stop bolt, lock ring and all seals should also be replaced.

Assembling

Before assembling, coat the parts with brake paste.

1. Fit the thin washers 2, Fig. 52–17 and the seals on the secondary piston and make sure that the seals are turned correctly according to the Figure.
2. Fit the guide, washers 1 and 3 and the spring on the secondary piston, see Fig. 51–17. Carefully fit the piston in the cylinder. Use a feeler gauge for the seals, see Fig. 52–18.
3. Press in the piston and fit the stop bolt together with a new sealing washer.
4. Fit all the primary piston parts, see Fig. 52–19. Carefully insert the piston in the cylinder. Push in the pistons and fit the thrust washer and lock ring in position on the outside of the primary piston. This is made easier if the primary piston is held pressed in with the help of a 3 mm (1/8") drift through the by-pass hole.

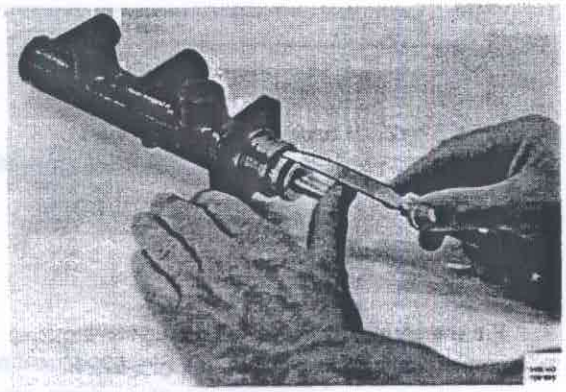


Fig. 52–18. Fitting the piston

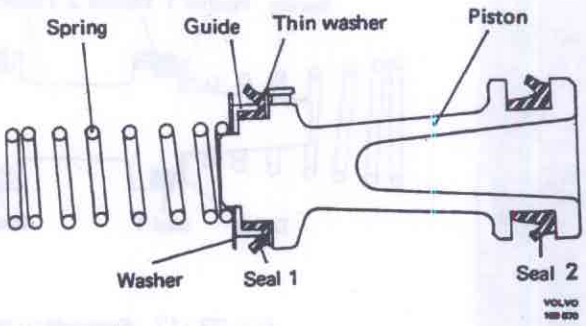


Fig. 52–19. Primary piston

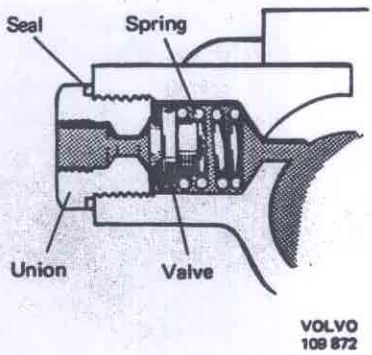


Fig. 52–21. Valves

5. Check the travel of the pistons and make sure that the through-flow holes are not blocked. Check the equalizing holes by inserting a soft copper wire with diameter 0.5 mm (1/64"), compare Fig. 52–20. If an equalizing hole is blocked, then generally the master cylinder has been incorrectly assembled.
6. Place in position the push rod and rubber cover.

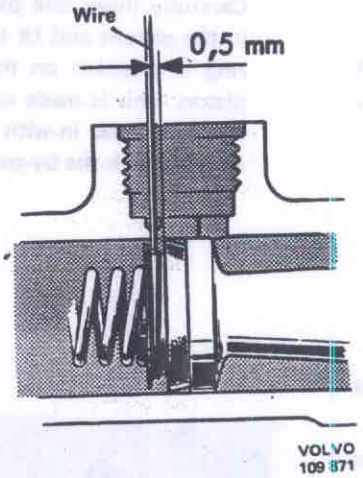


Fig. 52–20. Checking equalizing holes

Copper wire = 0.5 mm (1/64")

7. Fit the spring, valve, seal and plug for the output connections in their places, see Fig. 52–21.
8. Fit the seals and reservoir connections in their places.

Installing

1. Place the master cylinder in position. Tighten up the retaining bolts.
2. Fit the clamps and connect the hoses from the brake fluid reservoirs.
3. Pump with the brake pedal until brake fluid free from air bubbles emerges from the primary circuit connection. Connect up the brake line.

   Pump with the brake pedal until brake fluid fre from air bubbles emerges from the secondary circuit connection. Fit the brake line.
4. Run the cable through the hole and install the panel.
5. Connect the cables for the flasher unit as shown in Fig. 52–22.
6. Connect the wire to the speedometer.
7. Install the dashboard.
8. Connect up the battery.
9. Bleed the brake system, see page 4.

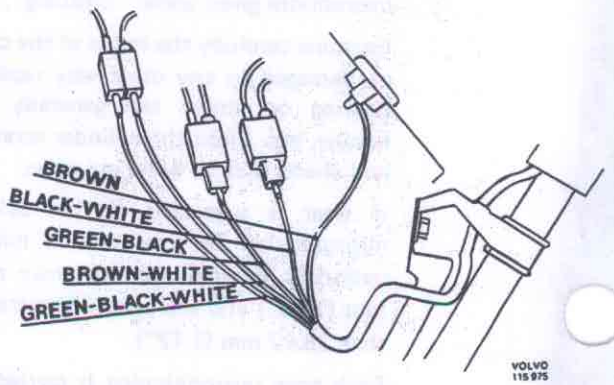


Fig. 52–22. Connecting the cable, flasher unit

WHEEL CYLINDERS

Special tool: 6126 Bleeder tool

Removal

1. Slacken the wheel nuts.
2. Jack up the vehicle and remove a wheel.
3. Adjust back both the brake shoes (anti-clockwise).
4. Clean round the connection and disconnect the brake line from the wheel cylinder. Fit the seal nipple.
5. Pull off the brake drum and remove the brake shoes according to the instructions given under "Front wheel brakes" and "Rear wheel brakes".
6. Remove the wheel cylinder bleeder nipple and retaining nuts. Lift forward the wheel cylinder.

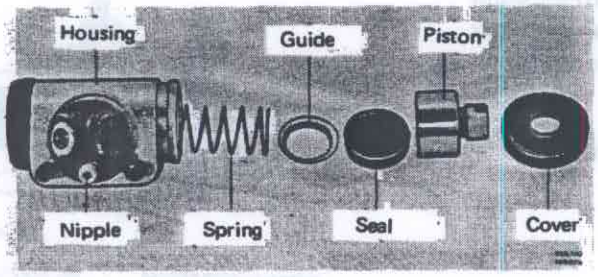


Fig. 52–23. Wheel cylinder parts, rear wheels

Overhauling

Lever off the rubber cover and take care of the piston and the other parts. Clean all the parts according to the instructions given under "Cleaning".

Examine the inside of the cylinder thoroughly. If scored or damaged in any other way, replace the cylinder. It would be pointless to hone or machine the inside of the cylinder in any other way since this would remove the rustproofing on the inside of the cylinder.

The clearance between the piston and cylinder may not exceed 0.26 mm (0.102") and can be measured with a feeler gauge. If the clearance exceeds 0.26 mm (0.102") try with a new piston. If this does not remedy the situation, replace the wheel cylinder.

Replace the seals and rubber covers each time reconditioning is carried out.

Put together the parts according to Figs. 52–24 and 52–25. Coat the piston and sela, also the groove for the rubber cover, with brake paste.

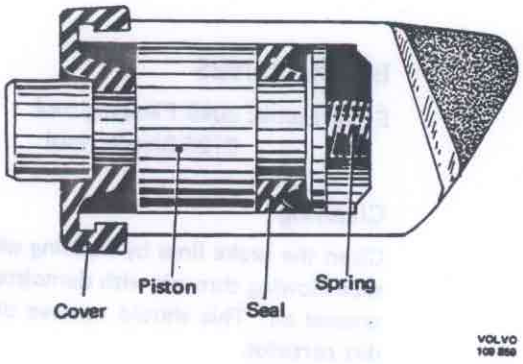


Fig. 52–24. Wheel cylinder, front wheels

Installing

1. Install the wheel cylinder, and if it applies to the front wheel brake unit also the seal, in position. Fit washers and nuts. Screw on the bleeder nipple.
2. Install the brake shoes according to the instructions given under "Front wheel brakes" and "Rear wheel brakes".
3. Install the brake drum. Adjust the wheel brakes.
4. Connect the brake line to the wheel cylinder.
5. Install the wheel.
6. Remove the seal on the breather hole in the brake fluid reservoir cap. Bleed the wheel brake unit.
7. Lower the vehicle and tighten the wheel nuts to a torque of 160–210 Nm (16–21 kpm = 227–299 lbftf).

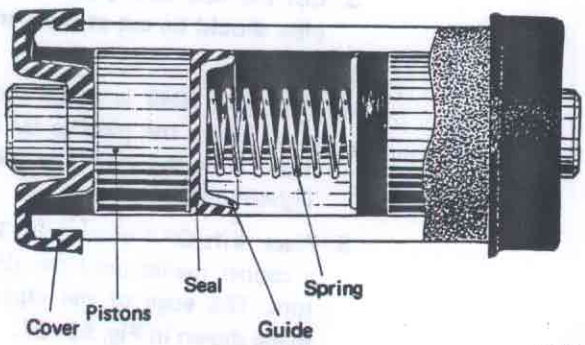


Fig. 52–25. Wheel cylinder, rear wheels

BRAKE LINES

Special tools: 2049 Flanging tool
6126 Bleeder tool

Cleaning

Clean the brake lines by flushing with brake fluid and then blowing through with demoistened, filtered compressed air. This should remove old brake fluid and dirt particles.

With full reconditioning, connect the bleeder unit to the master cylinder and then empty the system through the bleeder nipples. Next flush the system with brake fluid and blow it clean with compressed air. Then remove the main components in the hydraulic system and take each of them and thoroughly clean them.

If no bleeder unit is available, empty the lines by disconnecting them at the wheel cylinders and evacuating the brake fluid by pumping with the brake pedal. This will keep the liners blocked alternatively so that fluid is pressed out only through one line at a time.

IMPORTANT! Do not fill the system again with drained brake fluid.

Replacing the brake lines

With leakage or when the lines have been exposed to such damage that leakage or pinching can be expected, replace the damage lines according to the following instructions:

1. To prevent unnecessary loss of brake fluid, temporarily plug the cap on the brake fluid reservoirs with cement or similar.
2. Clean round the connections and remove the damaged brake line. Fit instead sealing nipples.
3. Cut the new steel pipe to the right lenght. The pipe should be cut at right angles all burr removed.
4. Place tool 2049 in a vice and double flange the pipe. Insert the pipe so far that its end comes flush with the clamping jaw, see Fig. 52–26. Tighten up the nuts.
5. Place drift OP 1 in the tool. Tip on the drift with a copper mallet until the drift goes to the bottom. The edge of the pipe then takes up the shape shown in Fig. 52–27.
6. Replace the drift with drift OP 2 and knock this into the bottom.
7. Fit the connection nuts and repeat points 4–6 at the other and of the pipe.

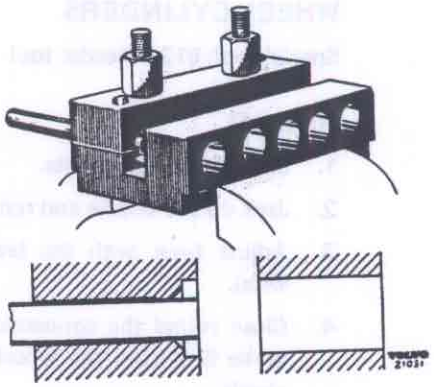


Fig. 52–26. Flanging the brake pipe

8. Bend the new brake line using the old one as a guide. The bending should be done round an object with the same radius as the bend desired.

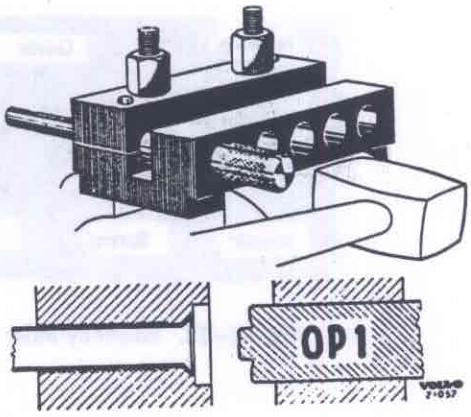


Fig. 52–27. Flanging the brake pipe

9. Blow the inside of the line clean and install it. Make sure that the line is routed so that it will not be damaged during driving.
10. Bleed the brake system. Remove the plug in the hole of the brake fluid reservoir cap.

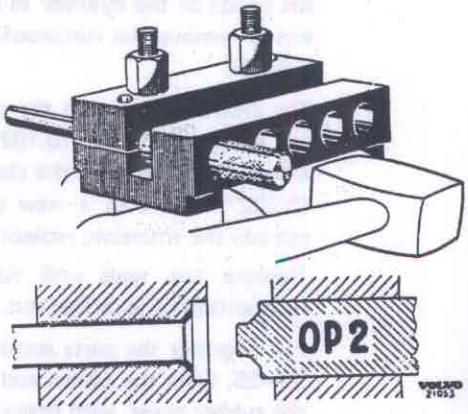


Fig. 52–28. Flanging the brake pipe

BRAKE FLUID RESERVOIRS

Checking the brake fluid level

To get at the brake fluid reservoirs remove the cover, see Fig. 52–29. The left-hand reservoir is for the primary circuit. The reservoirs should be almost full. If necessary top up with brake fluid according to the standard SAE J 1703, that is, Brake Fluid 430 or corresponding.

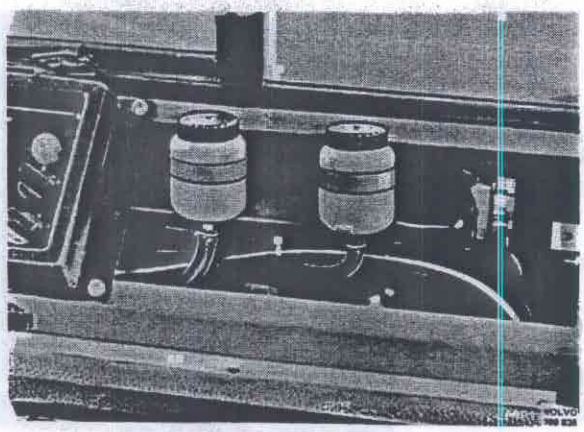


Fig. 52–29. Brake fluid reservoirs

BRAKE PEDAL

Adjusting the pedal position

The free travel, see Fig. 52–30, is the pedal travel from the rest position to the point where its piston in the master cylinder starts operating. If the free travel is too small, the equalizing holes in the master cylinder can be blocked by the piston seals so that the brake shoes are prevented from going back to their rest positions. The free travel is adjusted by means of the stop bolt and should be 5–10 mm (1/4") measured at the footplate. After adjusting tighten the lock nut and check the adjustment for the brake light contact.

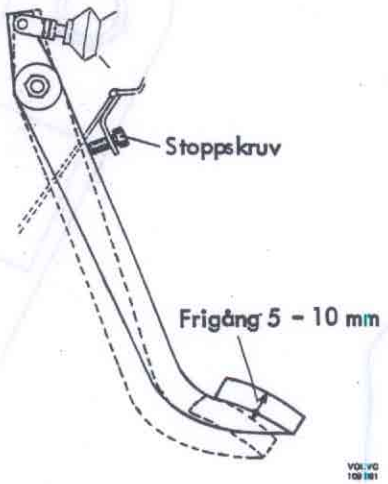


Fig. 52–30. Free travel

PEDAL JOURNALLING

Removing the pedal cover

1. Disconnect the battery positive cable.
2. Remove the retaining screws for the pedal cover.
3. Remove the bolts securing the master cylinder to the casing.
4. Remove the clutch pedal stop and disconnect the wire from the pedal. Remove the wire from the casing.
5. Disconnect the electric cables from the contact for the stop lights and the contact for the brake travel.
6. Lift forwards the pedal cover and pedals.

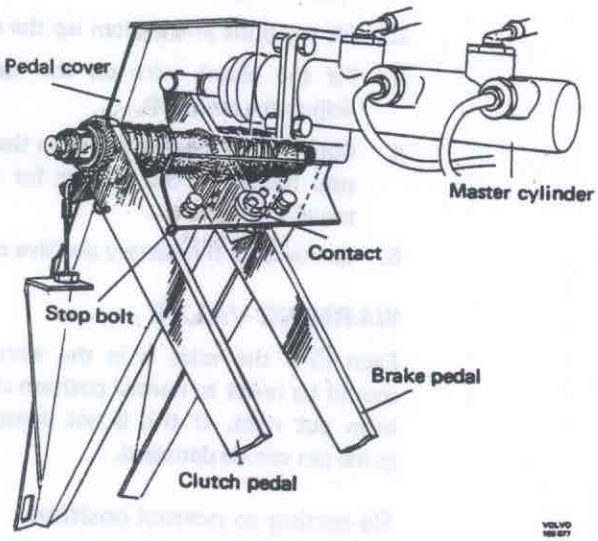


Fig. 52–31. Pedal journalling

Replacing pedal or bushings (loose casing)

1. Unhook the return springs.
2. Remove the nut and washer for the clutch pedal. Remove the pedal and spring.
3. Remove the nut and washer on the corresponding side and drive out the shaft. Lift forward the pedal and spring. REmove the bushing.
4. Clean the parts.
5. Fit new bushing and lubricate them with a light layer of universal grease.
6. Fit the spring on the brake pedal. Place the pedal in the casing and fit the shaft. Fit the washer and nut.
7. Place the clutch pedal spring in the casing. Fit the pedal and washer and tighten up the nut.
8. Hook the springs on the pedals.

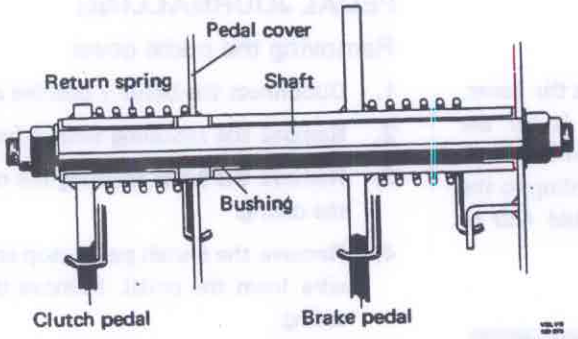


Fig. 52–32. Pedal journalling

Installing the pedal casing

1. Fit the pedal casing in position. Install the push rod in the master cylinder and tighten up the pedal casing.
2. Fit the bolts and tighten up the master cylinder.
3. Fit the clutch wire on the casing and pedal. Adjust the stop bolt.
4. Connect the electric cables to the contact for the stop lights and the contact for the brake pedal travel.
5. Connect up the battery positive cable.

WARNING VALVE

Each time the valve is in the warning position, it should be re-set to normal position after the fault has been put right. If this is not done, the piston and guide pin can be damaged.

Re-setting to normal position.

1. Disconnect the electric cable and unscrew the contact so that the pistons return to normal position, Fig. 52–33.
2. Clean and bleed the faulty hydraulic circuit.

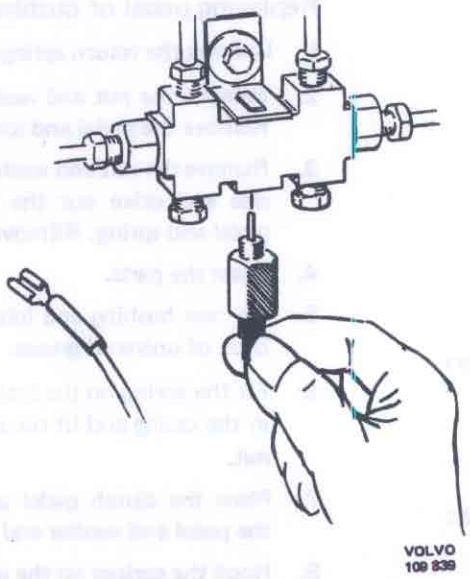


Fig. 52–33. Removing the contact

3. Carefully screw in the contact about 15 Nm (1.5 kpm = 11 lbftf). Connect up the electric cable.

Replacing the warning valve

Clean the outside of the valve. Remove the retaining bolts and the valve. Install the new valve. Fig. 52–34 shows the various connections. Bleed the brake system.

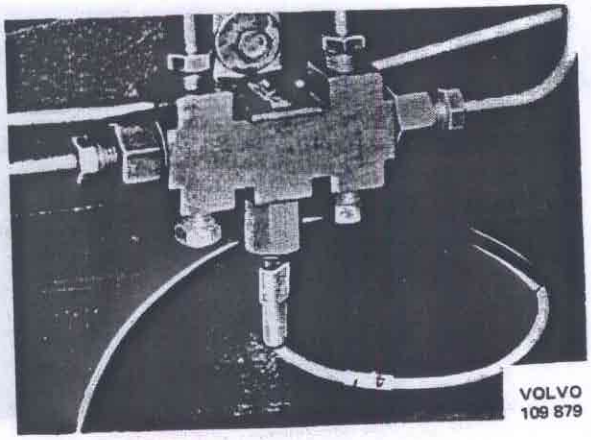


Fig. 52–34. Warning valve

CONTACT FOR STOP LIGHTS

Adjusting the position

For proper function and in order not to damage, the contact should have a certain location in relation to the pedal. The distance between the pedal in rest position and the brass sleeve on the contact should be 2–6 mm (0.08–0.24"), see Fig. 52–35. If the distance is otherwise, slacken the nuts and move the contact so that the correct gap is obtained. Then re-tighten the nuts.

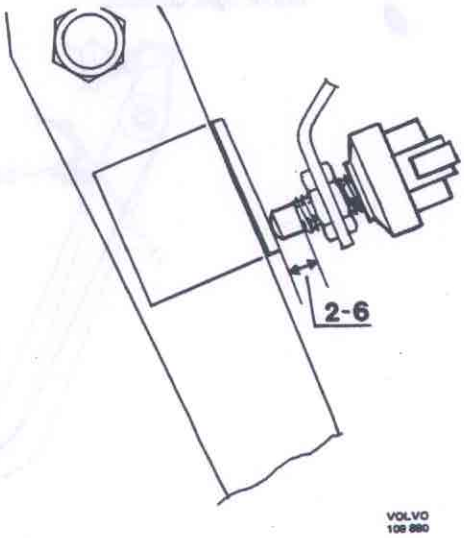


Fig. 52–35. Gap measurement

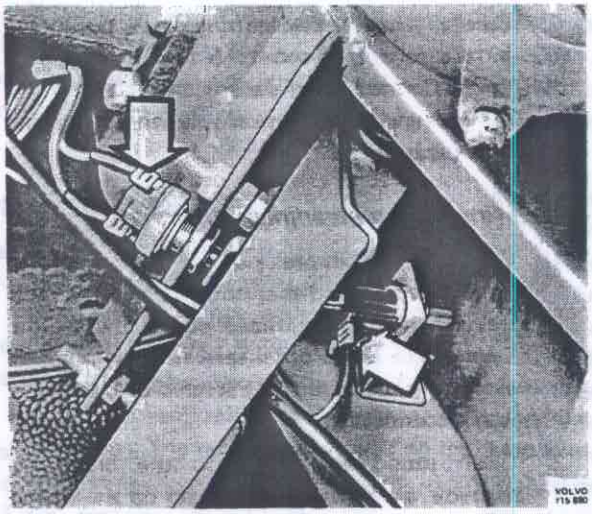


Fig. 52–36. Contact for stop lights and pedal travel

HYDRAULIC SYSTEM

Bleeding

Special tool: 6126 Bleeder spanner

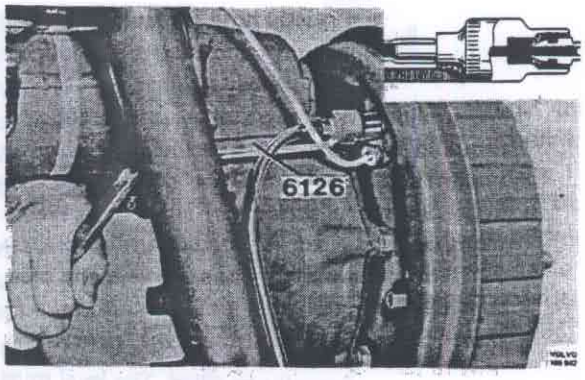


Fig. 52–38. Bleeder spanner

CONTACT FOR BRAKE PEDAL TRAVEL

Adjusting the position

The contact should give a warning when there remains 90–100 mm (3.5–4.0") of the pedal travel, measured at the centre of the footplate. Since this normally can be checked only when bleeding, the position of the contact can be checked instead by measuring the distance with the pedal at rest position between the pedal bracket and the contact terminal, see Fig. 52–37. This gap should be 15–17 mm (0.60–0.67"). If the gap is otherwise, slacken the nut and move the contact bracket so that the right gap is obtained. Then re-tighten the nut.

To re-set from the warning position, press back the contact terminal to the rest position.

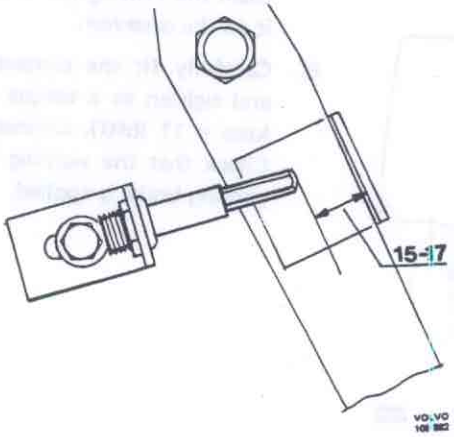


Fig. 52–37. Adjustment measurement

If no resistance is felt when depressing the brake pedal or if it feels spongy then there must be air in the system.

As soon as any part in the system has been removed, the system must be bled. Air can also get into the system due to the fact that too little brake fluid is in the reservoir. If, for example, only one wheel cylinder has been removed and an insignificant amount of brake fluid ran out, it is generally necessary to bleed only the cylinder. Otherwise the entire system must be bled.

With bleeding or similar work, brake fluid must not be allowed to run onto the friction surfaces or linings. Do not allow the brake fluid to spill onto the paintwork since this can damage the paintwork.

When topping up with brake fluid the following should be observed. The brake fluid must meet the requirements according to the standard SAE J 1703, for example, Brake Fluid 430.

Any brake fluid that has been bled from the system must not be put back into the bleeder unit or reservoir.

The entire brake system is bled as follows:

Mechanical bleeding

1. Check that the brake pedal returns fully to the rest position and that nothing prevents its full travel when using it for bleeding. Depress the brake pedal several times in order to even out any vacuum in the servo unit and in this way disconnect it.

2. Clean round the cap on the brake reservoir and round the contact on the warning valve. Remove the contact, see Fig. 52–34. If necessary top up with brake fluid. Blow clean the cap venting hole.
3. For bleeding a plastic hose is required which can be pressed onto and connected tight round the bleeder nipple. The lower end of the hose should be provided with a glass or plastic tube. Also required is a glass bottle provided with so much brake fluid that the opening of the tube can be kept under the surface in order to prevent air from being sucked in. To turn the nipple, use a 7/16" ring spanner for the servo unit and bleeder tool 6126 for the other points. New brake fluid must be available so that the reservoir can gradually be filled. The level must not be too low otherwise air can penetrate into the system via the reservoir.
4. Bleeding should be done in the order shown in Fig. 52–39 and as follows:

   Remove the protective cap and fit the ring spanner and plastic hose on the bleeder nipple. Allow the pipe opening to hang down under the surface of the fluid in the glass bottle. Open the bleeder nipple a maximum half turn. Slowly depress the brake pedal to the floor. When the pedal has reached the floor, wait for a brief moment and then quickly release the brake pedal. Repeat this procedure until brake fluid free from air bubbles flows out. Then depress the brake pedal to the floor and close the bleeder nipple. Re-fit the protective caps on the nipples.
5. Generally it is sifficient to bleed each circuit once. If the pedal can be depressed without any resistance worth mentioning or if it still feels spongy, repeat the bleeding.
6. Fill with brake fluid until the reservoirs are full.

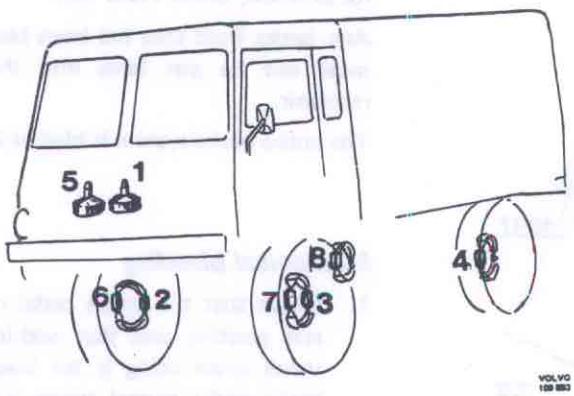


Fig. 52–39. Bleeding sequence

7. Carefully install the warning contact, tightening it to a torque of about 15 Nm (1.5 kpm = 11 lbftf). Connect up the electric cable. Check that the warning lamp goes on only when the parking brake is applied.

Bleeding with a bleeding apparatus

1. Check that the brake pedal goes back fully when released and that nothing prevents its full travel from being utilized during the bleeding. Depress the brake pedal several times in order to even out any vacuum in the servo unit and in this way disconnect it.
2. Clean round the cover on the brake fluid reservoir and round the contact on the warning valve. Remove the contact, see Fig. 52–33. If necessary fill with brake fluid.
3. Connect the bleeder apparatus, to the right reservoir, according to the instructions of the manufacturer. Working pressure is 0.2 MPa (2 kp/cm^2 = 30 lbf/in^2).
4. Fit the plastic hose on the upper servo unit nipple and allow the other end of the hose to hang down in a collecting vessel. Open the bleeder nipple with a 7/16" ring spanner but a maximum half turn. Pump several times with th brake pedal. Close the nipple when brake flu free from air bubbles flows out. Continue the bleeding with tool 6126 at wheel cylinders 2, 3 and 4, see Fig. 52–39.
5. Transfer the bleeder apparatus to the left reservoir and repeat the bleeding as above through nipples 5, 6, 7 and 8, see Fig. 52–39.
6. Generally it is sufficient 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.
7. After the bleeding has been completed, make the apparatus pressureless and unscrew the cap. Blow clean the venting hole in the standard cap and fit it on the reservoir.
8. Carefully fit the contact on the warning valve and tighten to a torque of approx. 15 Nm (1.5 kpm = 11 lbftf). Connect up the electric cable. Check that the warning lamp goes on when the parking brake is applied.

GROUP 54 AUXILIARY BRAKE

Description

SERVO UNITS

The function of the servo units is to boost the brake pressure so that less brake pedal force is required when braking. They function as follows:

When the brake system is at rest position (see Fig. 54–1), the vent valve for the control units is closed by a spring. The vaccum valve fixed on the same shaft has a certain position at this time. Another spring presses down the diaphragm with the vacuum valve seat and the control piston. The vacuum valve is, therefore, open and the space to the left of the vacuum piston is connected via the control unit to the space on the right-hand side of the piston. In other words, the same vacuum, is on both sides of the vacuum piston, which the return spring holds pressed to the right, see Fig. below. The pressure piston centre is off-load so that there is an open connection between the master cylinder and wheel cylinder.

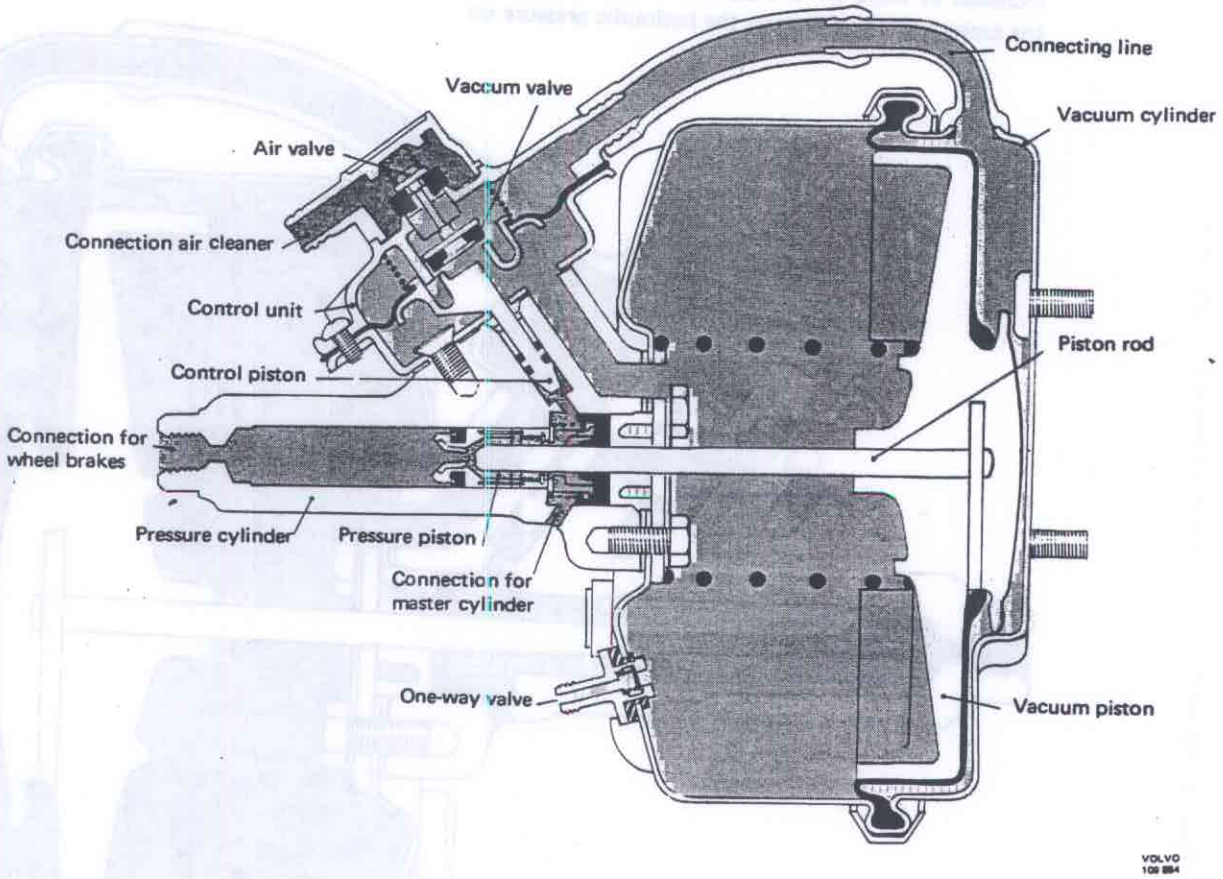


Fig. 54–1. Servo unit, rest position

When the brake pedal is depressed, the brake fluid is forced under pressure from the master cylinder through the servo unit discharge piston to the wheel cylinders and the brake is applied. When the hydraulic pressure rises under the control piston, the piston and the vaccum valve seat are pressed upwards. This closes the vacuum valve, and with the continued movement upwards the inner, minor section of the vent valve opens first and then the outer, larger section. Atmospheric pressure air flows past the air valve through the connection line to the space to the right of the vacuum piston. Since there is a vaccum on the left-hand side of the piston, the piston is pressed to the left and the piston rod pushes on the thrust piston. At the same time the piston rod closes the connection through the pressure piston centre. In this way, the outgoing hydraulic pressure for the wheel cylinders will be greater than the input pressure for the servo unit, compare Fig. 54-2.

In the control unit the pressure above the diaphragm increases as more air is supplied. If the pressure on the brake pedal and thereby the hydraulic pressure on the control piston is unchanged, this is finally overcome so that the diaphragm is pressed downwards and the air valve closes. The pressure to the right of the vacuum piston remains unchanged and is unable to overcome the pressure in the pressure cylinder. The moving parts of the servo unit remains therefore in this position and the braking remains constant as long as the same force is exerted on the brake pedal; compare Fig. 54–3.

If the brake pedal is released, the inlet pressure on the control piston reduces and the diaphragm is pressed downwards so that the vacuum valve is exposed. This results in the spaces on both sides of the vacuum piston coming into contact with each other so that the pressure reaches an equilibrium and the piston is pushed to the right. The piston in the pressure cylinder is pushed back to the initial position. Since the piston rod is pulled back further by the vacuum piston, this exposes the centre of the pressure piston so that the brakes are released and all parts return to rest position.

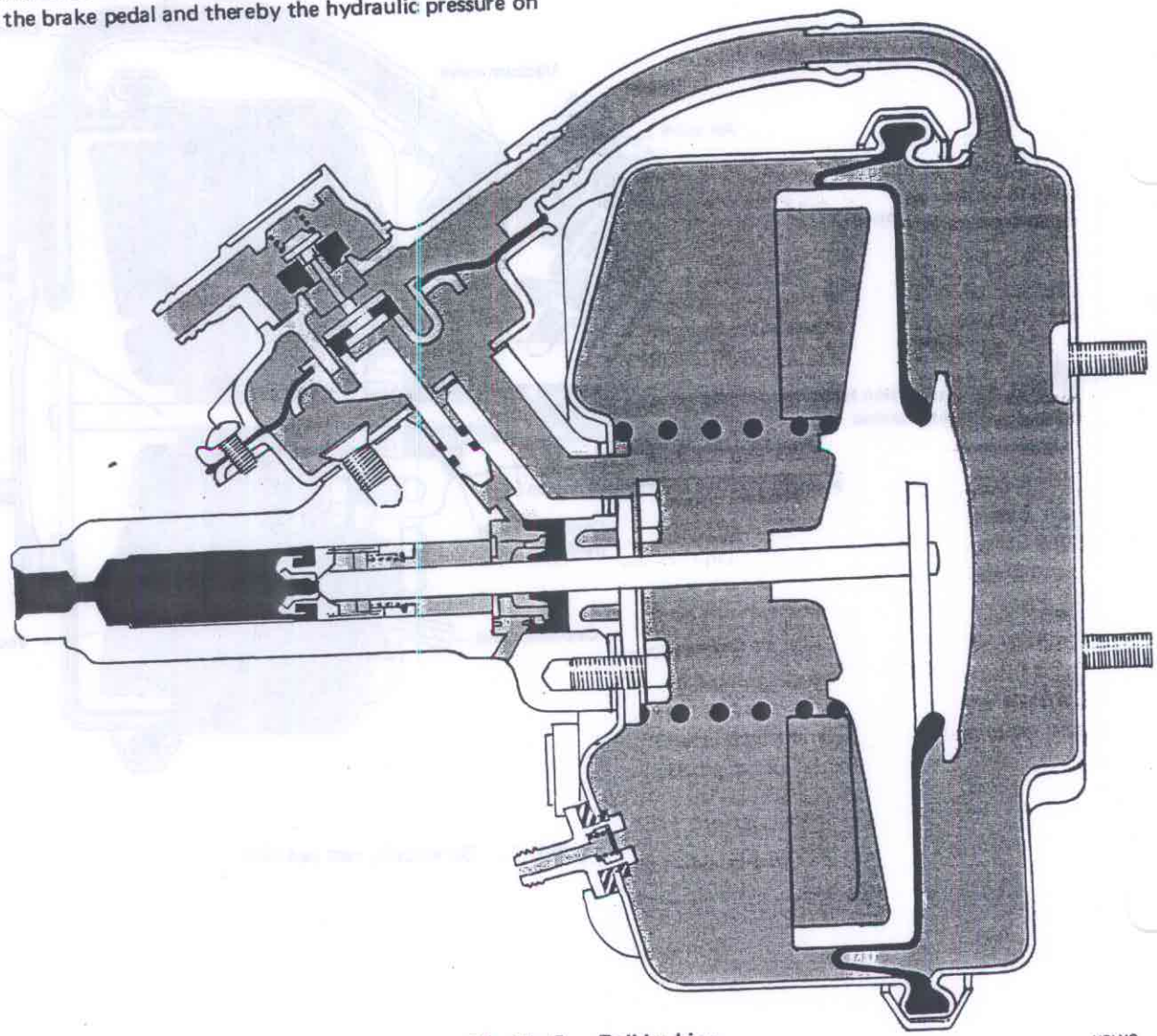


Fig. 54–2. Full braking

VOLVO
109 885

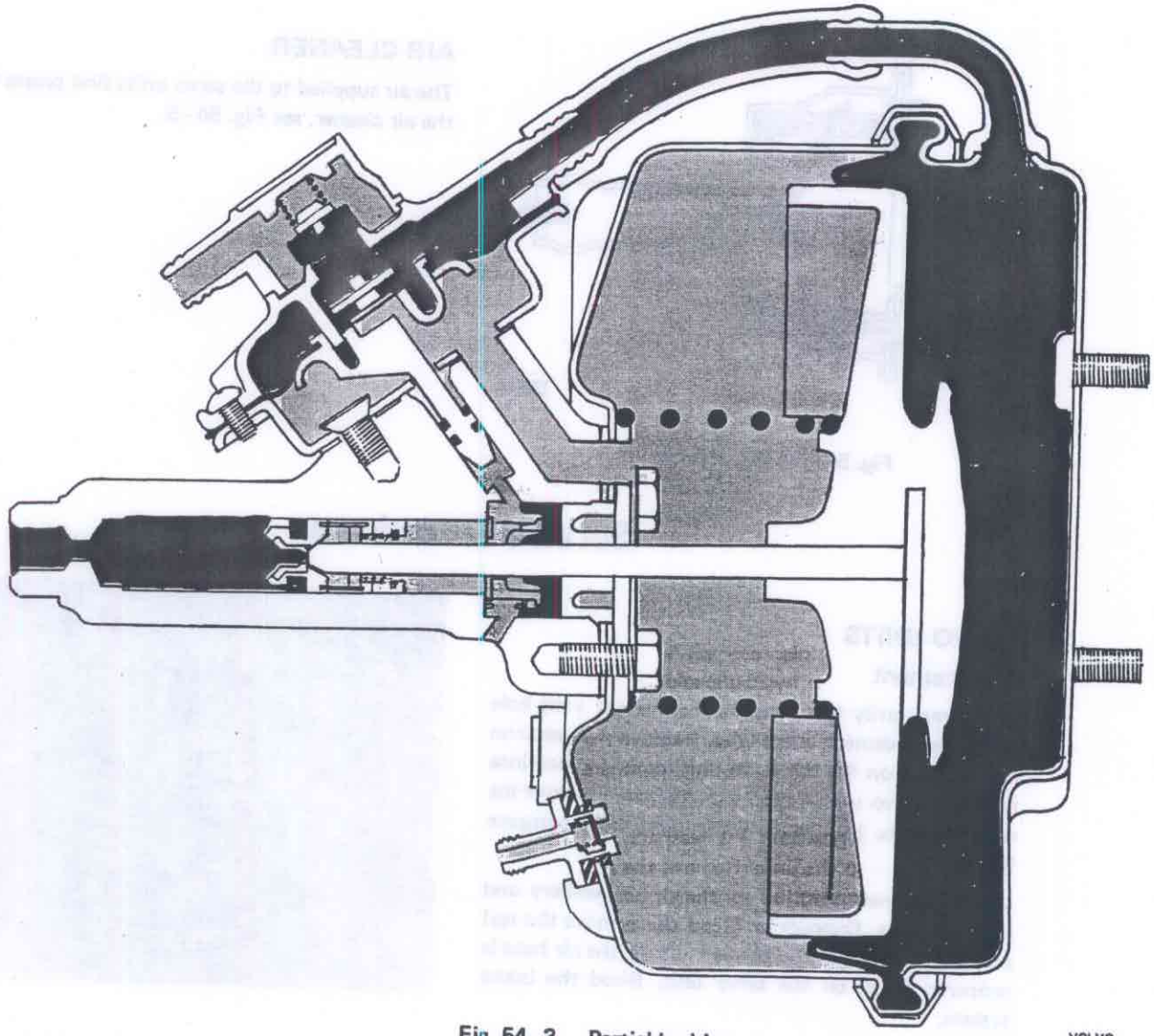


Fig. 54–3. Partial braking

VOLVO 109 886

ONE-WAY VALVE

The one-way valves are placed on the servo units and are connected to the lines from the engine intake manifold. Their function is to prevent air flowing back to the servo units. The valve opens only when the vacuum in the intake manifold is greater than that in a servo unit.

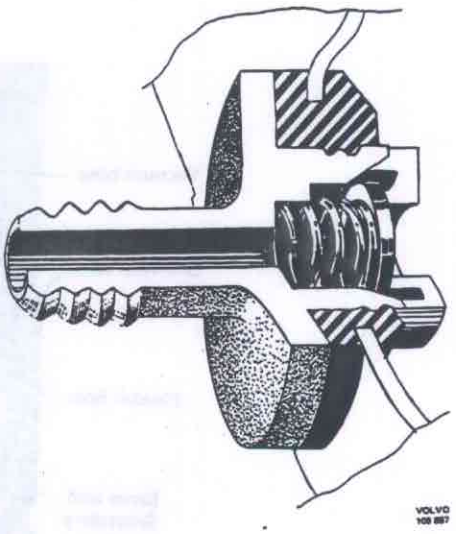


Fig. 54–4. One-way valve on servo unit

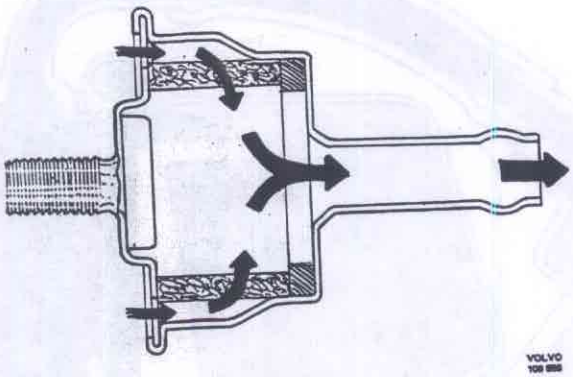


Fig. 54—5. Air cleaner

AIR CLEANER

The air supplied to the servo units first passes through the air cleaner, see Fig. 54—5.

Service Procedures

SERVO UNITS

Replacement

Plug temporarily the brake fluid reservoir vent hole with plastic cement. Clean the hydraulic and vacuum connections on the inside. Disconnect all connections from the servo unit. Plug the brake lines. Remove the retaining nuts. Lift forwards the servo unit, compare Fig. 54—7.

Install the new unit in position. Fit washers and retaining nuts. Connect up the lines. Remove the seal and make sure that the connection for the air hose is properly fitted on the servo unit. Bleed the brake system.

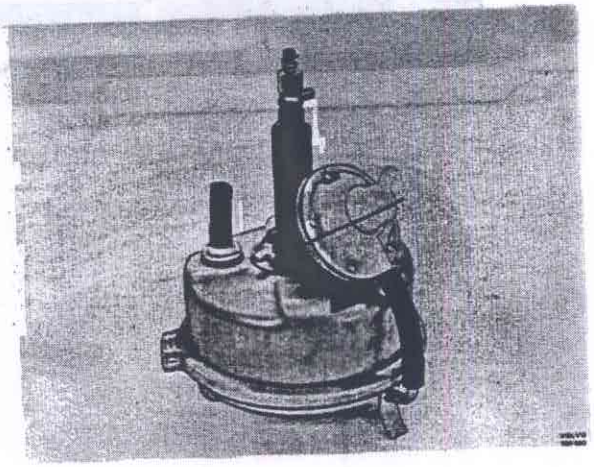


Fig. 54—7. Servo unit removed

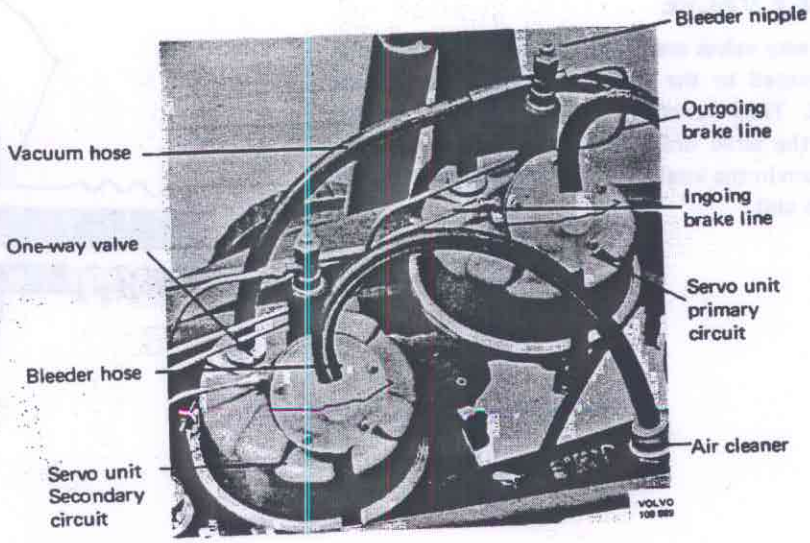


Fig. 54—6. Auxiliary brake components

ONE-WAY VALVE

Replacement (unit removed)

Lever the vacuum hose off the one-way valve. Lever out the one-way valve with the help of two screwdrivers. Remove the seal.

Fit a new seal and check that its flange is fitted properly in position on the servo unit, see Fig. 54—4. Coat the inside of the seal with brake paste and carefully press it into the one-way valve. Make sure that the seal remains properly in the correct position.

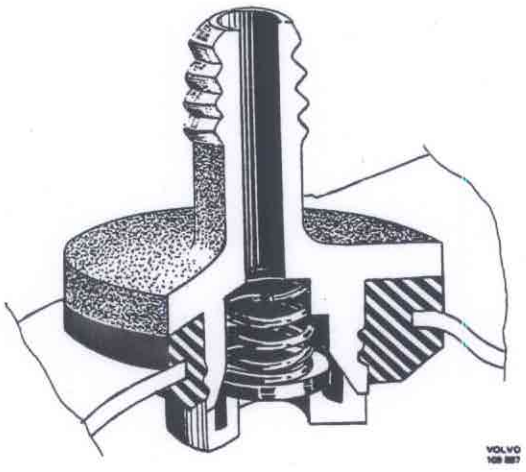


Fig. 54—8. One-way valve

AIR CLEANER

The air cleaner is accessible under the engine cover, see Fig. 54—8. With replacement, remove the rubber hose and the retaining nut, after which the air cleaner can be removed.

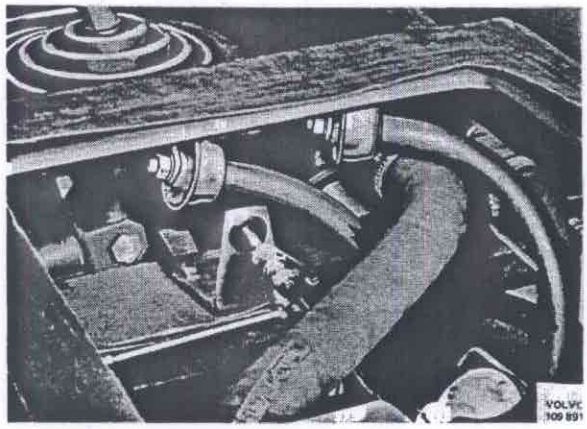


Fig. 54—9. Air cleaner

GROUP 55 PARKING BRAKE

Description

The parking brake design can be seen from Figs. 55—1 and 55—2.

The parking brake lever is located on the right-hand side of the driver's seat. Applying the parking brake lever actuates the cable so that it applies the propeller shaft brake located on the gearbox. There the levers press out the brake shoes against the brake drum. The brake linings are bonded.

The parking brake is adjusted with the adjuster mechanism in the propeller-shaft brake.

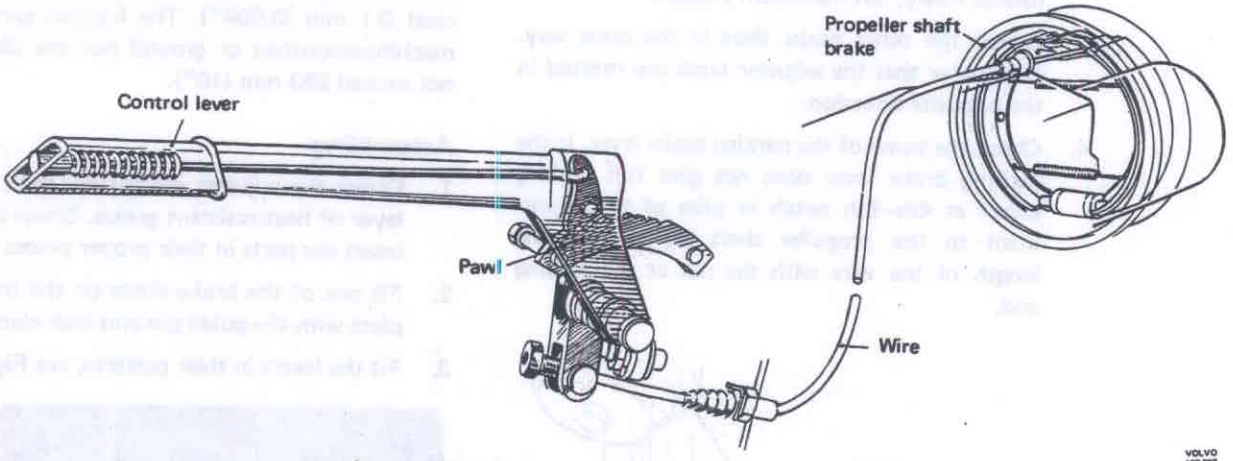


Fig. 55—1. Parking brake

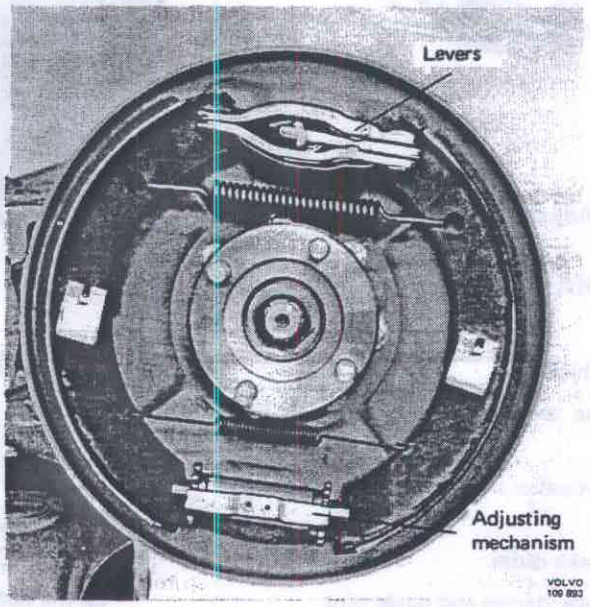


Fig. 55—2. Propeller shaft brake

Service Procedures

GENERAL

Adjusting the parking brake

The parking brake lever should give full parking brake effect at the 4th–5th notch. If it does not do this, adjust the parking brake lever as follows:

1. Jack up the rear end. Check that the parking brake lever is in its forward position and the gears and in neutral.
2. Adjust out one of the brake shoes with a suitable adjuster tool (curced screwdriver), see Fig. 55–3, until the brake drum can be just about rotated. Then slacken the adjuster screw until the drum rotates freely, but maximum 5 teeth.
3. Adjust the other brake shoe in the same way. Remember that the adjuster teeth are rotated in the opposite direction.
4. Check the travel of the parking brake lever. If the parking brake lever does not give full braking effect at 4th–5th notch in spite of the adjustment to the propeller shaft brake, alter the length of the wire with the nut at the leading end.

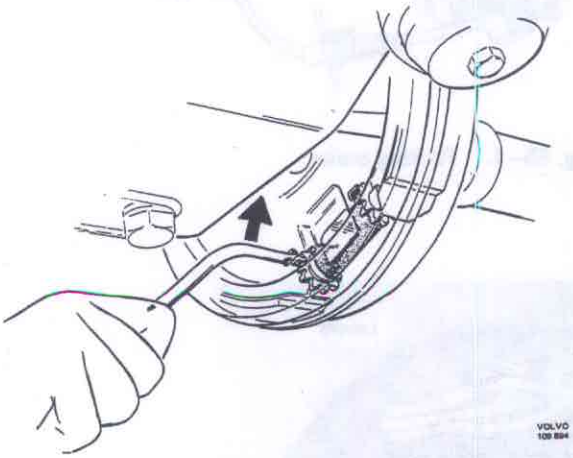


Fig. 55–3. Adjusting the parking brake

PROPELLER SHAFT BRAKE

Dismantling

1. Jack up the vehicle.
2. Disconnect the exhaust pipe on the left-hand side.
3. Remove the propeller shaft flange from the brake drum.
4. Pull off the brake drum.
5. Remove the lock clamps and guide pins.
6. Remove the brake shoes.
7. Remove the levers and adjuster screws.

Checking and replacing parts

Clean the parts before checking.

If the brake linings are oily, damaged or worn so that there is not more than 1.5 mm (1/16") left of the lining thickness, replace the shoes complete.

Check that the adjuster mechanism nut screws easily into the housing. If the housing or pawls are damaged, replace the brake backing plate. The flange is thereby removed when doing this, so see under the heading "Dismantling the distribution gearbox", Group 43.

Check the friction surface of the brake drum and its out-of-roundness. The out-of-roundness may not exceed 0.1 mm (0.004"). The friction surface can be machine-smoothed or ground but the diameter may not exceed 253 mm (10").

Assembling

1. Grease the adjuster mechanism parts with a light layer of heat-resistant grease. Screw together and insert the parts in their proper places.
2. Fit one of the brake shoes on the brake backing plate with the guide pin and lock clamp.
3. Fit the levers in their position, see Fig. 55–4.

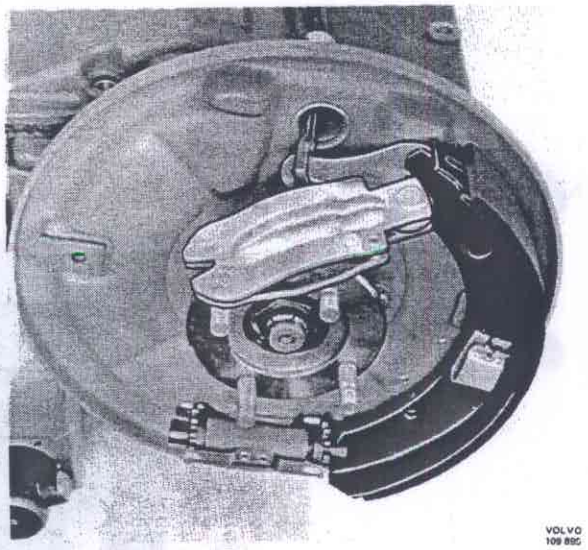


Fig. 55–4. Levers

4. Hook on the upper, stronger return spring on the brake shoes. Tension out the shoes in their location. Fit the guide pin and lock clamp.
5. Fit the lower return spring.
6. Fit the brake drum and propeller shaft. Tighten up the nuts.
7. Adjust the propeller shaft brake.
8. Fit the exhaust pipe.

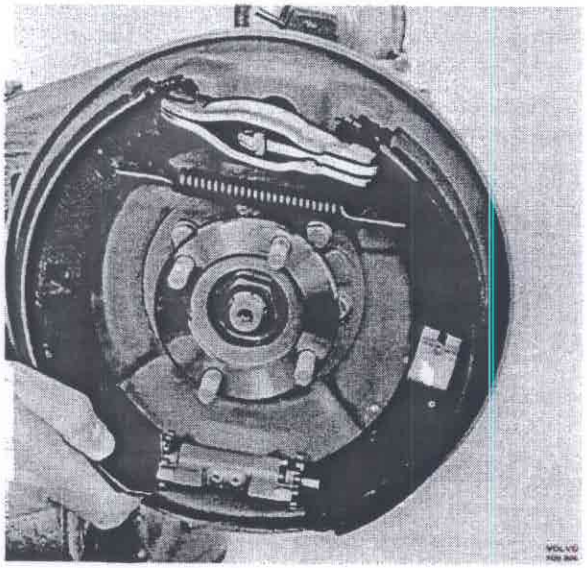


Fig. 55–5. Fitting the brake shoes

CONTROL MECHANISM

Replacing parking brake lever or ratchet components

1. Remove the clamp bolt and lever from the parking brake lever shaft.
2. Remove nuts and washers from the pawl segment attachment.
3. Pull forward the parking brake lever complete.
4. Remove the button and take the spring out of the parking brake lever. Drill out the rivet and remove the push rod and pawl.
5. Replace both bushings in the parking brake lever journalling. Coat them with a light layer of universal grease.
6. Fit the new parts in reverse order to removal, see Fig. 00. Make sure that the rivet is properly fitted without preventing the movement of the pawl.
7. When installing the parking brake lever, check the warning function of the contact. The lever should be placed so that the lamp lights at the 2 nd–3rd notch.
8. Check the function and if necessary adjust the parking brake.

WIRE

Replacement

1. Jack up the vehicle.
2. Remove the adjuster nut from the front end of the wire.
3. Remove the lock washer at the wire front attachment.
4. Remove the rear propeller shaft section.
5. Disconnect the exhaust pipe on the left-hand side.
6. Remove the brake drum.
7. Unhook the wire from the lever on the propeller shaft brake.
8. Hook on the new wire on the lever on the propeller shaft brake.
9. Fit the brake drum and the propeller shaft. Tighten up the nuts.
10. Adjust the propeller shaft brake.
11. Fit the exhaust pipe.
12. Tighten the adjuster nut until full braking effect is obtained at the 4th–5th notch with properly adjusted propeller shaft brake.

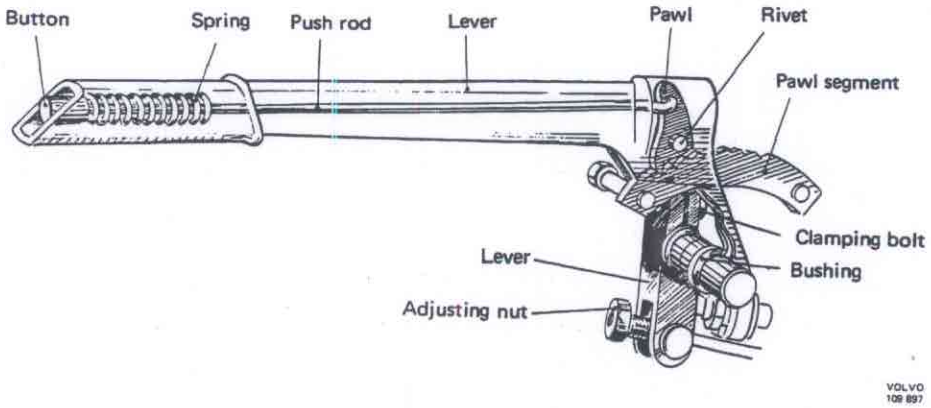
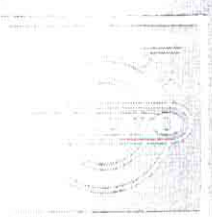


Fig. 55–6. Parking brake lever assembly



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VOLVO SERVICE

PART 6

FRONT END AND STEERING SYSTEM

C3-series

SERVICE MANUAL

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GROUP 60 GENERAL

Data

WHEEL ANGLES

Caster	3.0°
Camber	1.0°
King-pin inclination	8.0°
Toe-in	0–3 mm (0–0.12")
Wheel inclination angle	31–32°

FRONT AXLE

Type	Rigid
Track	1540 mm (60.6")

STEERING KNUCKLE

Pre-load, lower steering pin	0.3 mm (0.012")
With play in steering pin adjust pin by removing shims until bushings are worn.	
Shims, steering knuckle support – lower ball shell, thicknesses in mm (in.)	0.35, 0.45, 0.60, 0.80 (0.014, 0.018, 0.024, 0.032)

STEERING GEAR

Make and type	ZF, worm and roller
Reduction ratio	22:1
Number of steering wheel turns from lock to lock	5.1
Pre-load, worm bearing	25–55 N (2.5–5.5 kp = 5.5–12 lbf)
Pre-load over centre position, complete steering gear	15–25 N (1.5–2.5 kp = 3.3–5.5 lbf)
Shims for worm bearing, thicknesses in mm (in.)	0.10, 0.12, 0.15, 0.30 (0.004, 0.005, 0.006, 0.012")
Adjuster washer between adjuster screw and sector shaft, thickness in mm (in.) in steps of 0.05 mm = 0.002"	2.1–2.5 mm (0.08–0.10")
Lubricant	Hypoid oil
Viscosity	MP 80 or MIL-L-2105 B, SAE 80
Capacity	0.5 litre (1 pint)

AUXILIARY STEERING ARM

Axial clearance	0 mm
Shims, relay arm, thicknesses in mm (in.)	0.1 and 0.35 (0.004 and 0.014)

TIGHTENING TORQUES

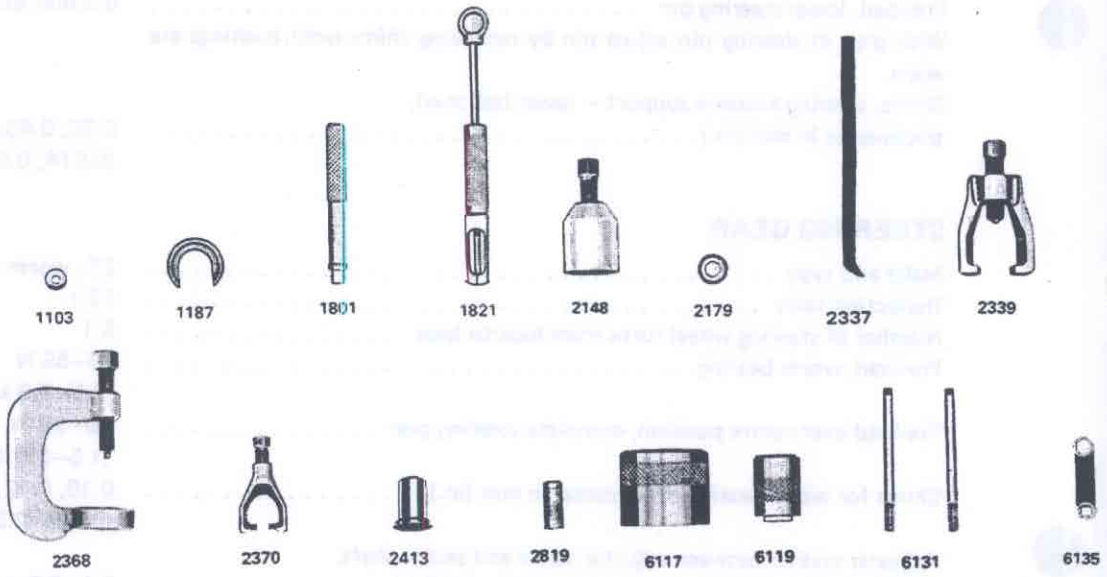
Steering wheel nut	35–35 Nm (3.5–4.5 kpm = 25–33 lbftf)
Nut, Pitman arm	250 Nm (25 kpm = 180 lbftf) and to nex hex for locking
Crown nut, aux. steering arm journalling	80–100 Nm (8–10 kpm = 57–72 lbftf)
Nut, king pins	150–200 Nm (15–20 kpm = 108–145 lbftf)

Bolt, steering knuckle support — wheel carrier	100—120 Nm (10—12 kpm = 72—87 lbftf)
Nut, tie rod[1]	140—180 Nm (14—18 kpm = 101—130 lbftf)
Nut, lower steering rod[1]	100—120 Nm (10—12 kpm = 72—87 lbftf)
Nut, upper steering rod[1]	140—180 Nm (14—18 kpm = 101—130 lbftf)

[1] See Fig. 64—2.

Tools

The following special tools are required for service work on the front end and steering system.



1103 Intermediate section for 2368 puller
1187 Clamp for 2368 puller
1801 Standard handle
1821 Puller for removing auxiliary steering arm bushings
2148 Puller for steering joint at sector arm
2179 Drift for fitting sector shaft bushings
2337 Drift
2339 Puller for removing pitman arm
2368 Puller for removing steering wheel
2370 Puller for removing steering pins
2413 Drift for installing auxiliary steering arm bushings
2819 Drift for installing bushing on lower steering pin
6117 Sleeve for installing rubber dust cover
6119 Sleeve for installing sector shaft sealing ring
6131 Guide pins for removing and installing wheel carriers
6135 Spanner for torque tightening

GROUP 63 FRONT END

Description

The ends of the front axle are provided with spherical steering knuckle supports (9, Fig. 63–1) on which the wheel carriers (1) are suspended in steering pins (6 and 14). The steering pins have ball shells (6 and 14) which are journalled in bushings (4 and 13) of synthetic material. The steering pins should be lubricated with grease of a quality specified according to the lubricating instructions. When being installed, the lower steering pin should be fitted with shims (12) so that there is pre-loading on the steering pins.

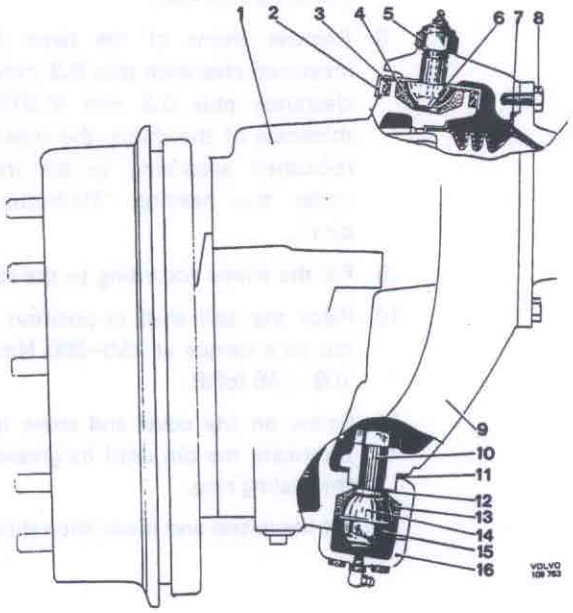


Fig. 63–1. Steering pins

1. Wheel carrier
2. Sealing washer
3. Sealing ring
4. Upper bushing
5. Nut
6. Upper ball shell
7. Rubber bellows
8. Attaching bolt
9. Steering knuckle support
10. Bolt
11. Sealing ring
12. Shims
13. Lower bushing
14. Lower ball shell
15. Nut
16. Cover

SERVICE PROCEDURES

STEERING KNUCKLES

Adjusting the steering pins

The steering pins must be adjusted when loose. This is done as follows:

1. Jack up the vehicle.
2. Remove the wheel.
3. Remove the lubricator on the cover (16, Fig. 63–1).
4. Place a dial indicator as shown in Fig. 63–2.

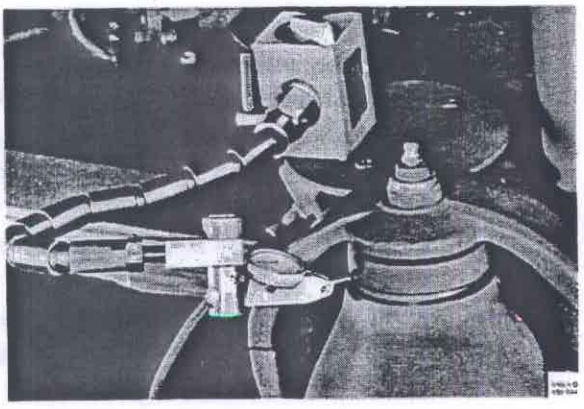


Fig. 63–2. Placing the dial indicator

5. Place a jack under the cover, Fig. 63–3. Push up the pin and release it entirely a couple of times. Read off the clearance measured.
6. Unscrew the cover (16).
7. Remove the nut (15), the lower ball shell (14) and the shims (12).
8. Remove shims of the same thickness as the measured clearance plus 0.3 mm (0.012"). If the clearance plus 0.3 mm (0.012") exceeds the thickness of the shims, the steering pins must be re-bushed according to the instructions given under the heading "Re-bushing the steering pins".
9. Fit the shims according to the above calculation.
10. Place the ball shell in position and tighten the nut to a torque at 150–200 Nm (15–20 kpm = 108–145 lbftf).
11. Screw on the cover and screw in the lubricator. Lubricate the pin until its grease squeezes out at the sealing ring.
12. Fit the wheel and lower the vehicle.

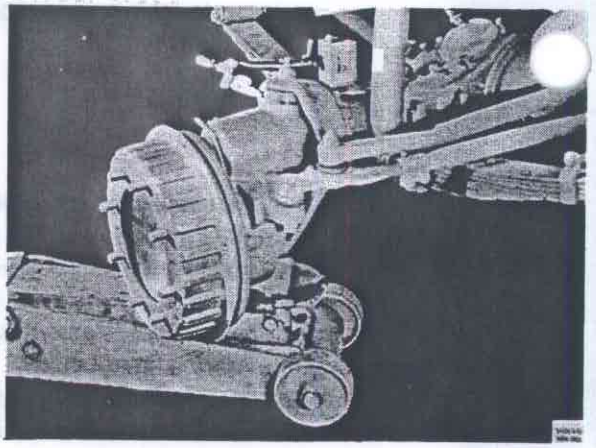


Fig. 63–3. Measuring the clearance

Re-bushing the steering pins

Special tools:

2370 Puller
2819 Drift
6131 Guide pins
6117 Sleeve
6135 Spanner

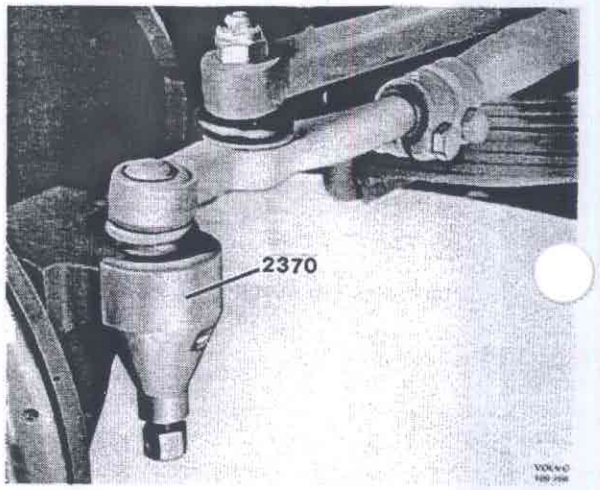


Fig. 63–4. Removing a steering joint

Removing the wheel carriers

1. Remove the wheel nuts on the wheel. Jack up the vehicle.
2. Remove the wheel.
3. Remove the steering joint from the steering arm with puller 2370, see Fig. 63–4.
4. Disconnect the brake lines from the brake hoses. Plug the hoses with sealing nipples. Remove the bracket with the hoses from the wheel carrier.
5. Remove the bracket plate for the hollow rubber spring.
6. Remove the upper bolts securing the wheel carrier to the front axle casing. Fit guide pins 6131 in the upper holes.
7. Remove the lower lubricator and place a jack under the wheel carrier.
8. Remove the upper bolts and pull out the wheel carrier and drive shaft, see Fig. 63–5. NOTE! Observe care so that the rubber bellows do not get clamped between the drive shaft and steering knuckle support.

Disassembling the steering pins

1. Clean well the removed unit.
2. Knock out the rubber bellows with a suitable tool.
3. Remove the cover (16, Fig. 63–1) under lower steering pin and unscrew the nut (15) holding the pin together. Pull out the bolt (10) and then the ball shell (14), also the shims (12). Take care of the shims.

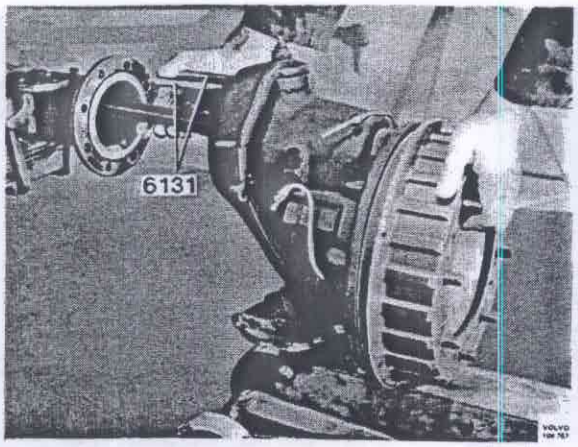


Fig. 63–5. Removing the wheel carrier

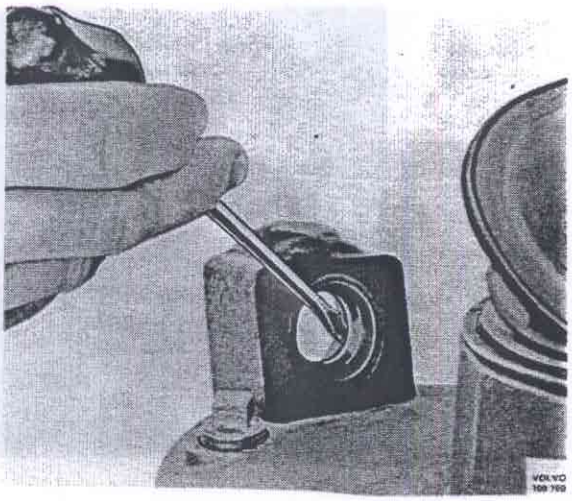


Fig. 63–7. Removing the lower bushing

4. Lift off the steering knuckle support (9) and remove the old sealing rings (3 and 11).
5. Knock out the old bushings (4 and 13) with a suitable tool, see Figs. 63–6 and 63–7.

Checking, replacing parts

1. Clean all parts thoroughly. Clean thoroughly the surfaces between the cover (16) and wheel carrier, and between the steering knuckle support and front axle.
2. Check the ball shells (6 and 14, Fig. 63–1) and the surface on the sealing washer (2) for the sealing ring. Replace worn parts.
3. Replace the upper ball shell and sealing washer by removing the nut (5). If necessary hold against the ball shell with an Allen spanner, see Fig. 63–8.
4. When assembling, tighten the nut to a torque of 150–200 Nm (15–20 kpm = 108–145 lbftf).

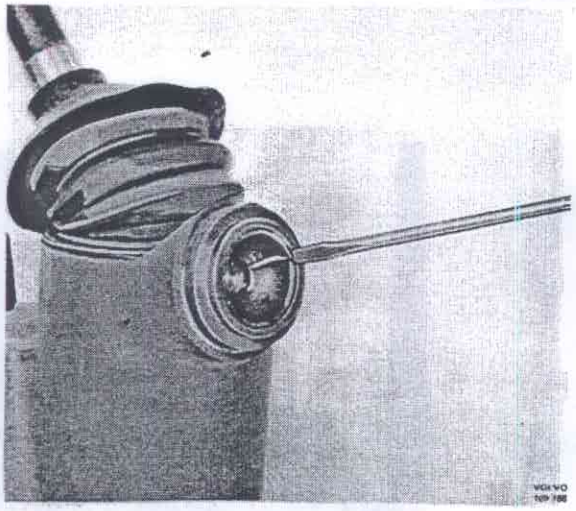


Fig. 63–6. Removing the upper bushing

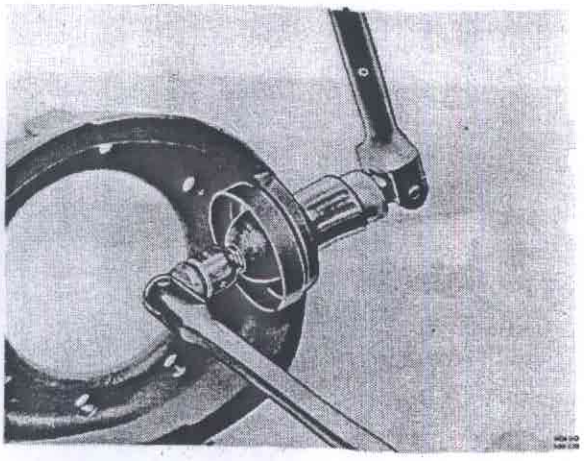


Fig. 63–8. Removing the upper ball shell

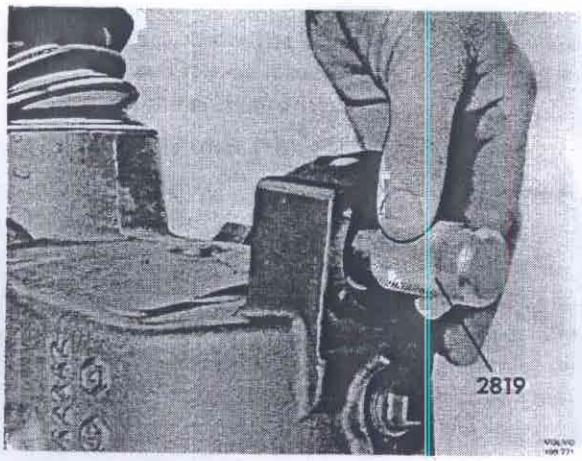


Fig. 63–9. Fitting the lower bushing

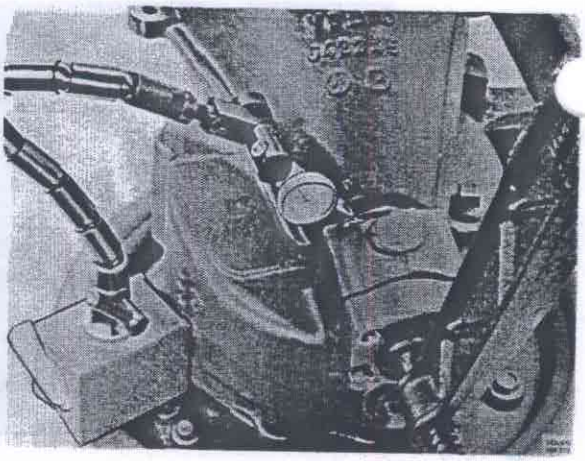


Fig. 63–11. Placing the dial indicator

Assembling the steering pins

1. Knock the new bushings into the wheel carrier. The upper bushing is carefully tapped in with a plastic mallet. The lower one is driven in with drift 2819 and a plastic mallet, see Fig. 63–9. Take care that the bushings are driven in properly all the way.
2. Place the steering knuckle support in position without any sealing rings. Fit the bolt through the lower pin. Place the old shims or new ones of the same thickness plus about 0.5 mm (0.02"). Place the ball shell and nut in position and tighten up the nut to a torque at 150–200 Nm (15–20 kpm = 108–145 lbftf).
3. Screw tight the cover under the lower pin and screw the lubricators out of the upper ball shell and the cover.
4. Place a screw clamp over the steering knuckle according to Fig. 63–10. Tighten up the clamp well (approx. 1500 N = 150 kp = 330 lbf) so that the knuckle does not have any clearance.
5. Place a dial indicator according to Fig. 63–11 and zero-set it. Note the measuring pointer position see Fig. 63–12.
6. Slacken the clamp and press the steering knuckle support in the other direction while turning it at the same time, see Fig. 63–13. Read-off the indicator and note the clearance.
7. Remove the dial indicator and unscrew the lower steering pin. Take care of the shims and lift off the steering knuckle support.

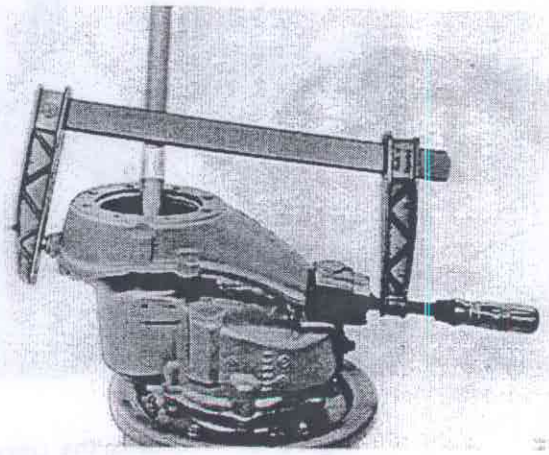


Fig. 63–10. Drawing together the steering pin assembly

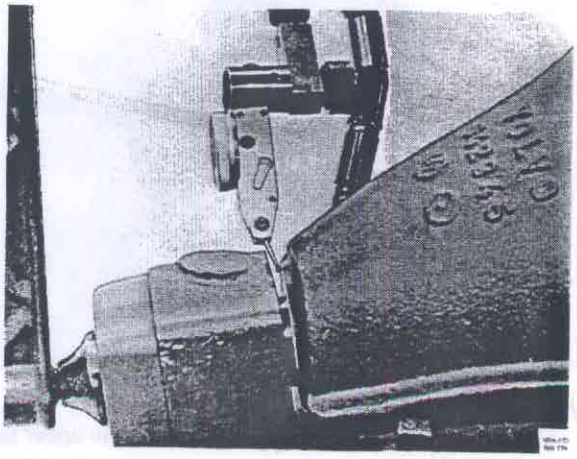


Fig. 63–12. Dial indicator pointer setting

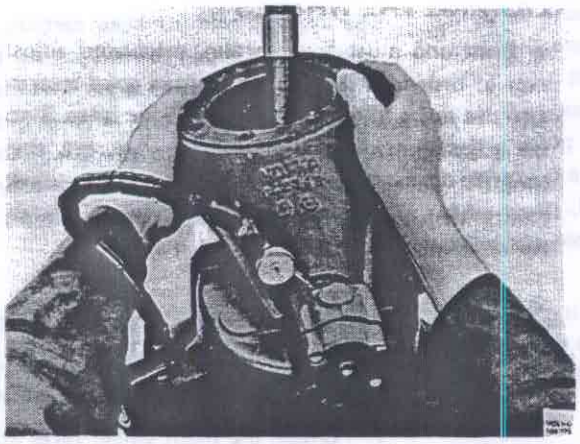


Fig. 63–13. Measuring the axial clearance

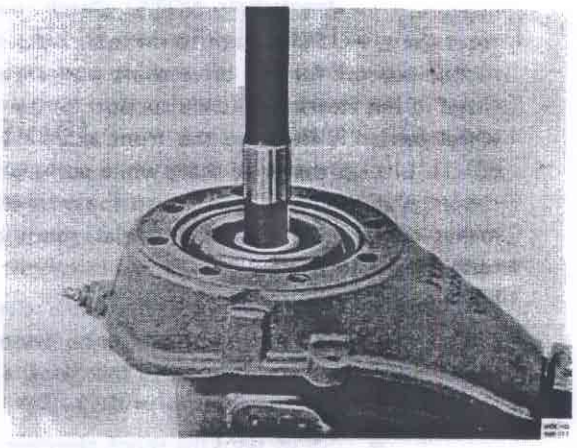


Fig. 63–15 Rubber bellows pushed down

8. Place new sealing rings on the wheel carrier and on the steering knuckle support, and fit the steering knuckle support in position. Insert the bolt through the lower steering pin.
9. Place shims of a thickness as follows: Shims when measured less measured clearance less 0.3 mm (0.012") (pre-load).
10. Place the lower ball shell and nut in position. Tighten up the nut to a torque of 150–200 Nm (15–20 kpm = 108–145 lbftf).
11. Apply sealing agent to the contact surface between the cover and wheel carrier and screw tight the cover. Screw the lubricators into the cover and upper ball shell.
12. Lubricate the steering pins until grease squeezes out at the sealing rings. Unscrew the lower lubricator.
13. Fit the rubber bellows over the drive shaft and knock them into position with sleeve 6117, see Fig. 63–14.
    NOTE! Observe great care that the rubber bellows are not clamped between the drive shaft and steering knuckle support.
14. Press down the rubber bellows as shown in Fig. 63–15. Let them remain pressed down until its shaft is in the support and the unit hangs on the guide pins.

Installing the wheel carrier

1. Apply sealing agent to the sealing surfaces on the steering knuckle support and front axle flange.
2. Fit the two guide pins 6131 in the upper holes of the steering knuckle support, see Fig. 63–16. Place the wheel carrier on a jack and lift the

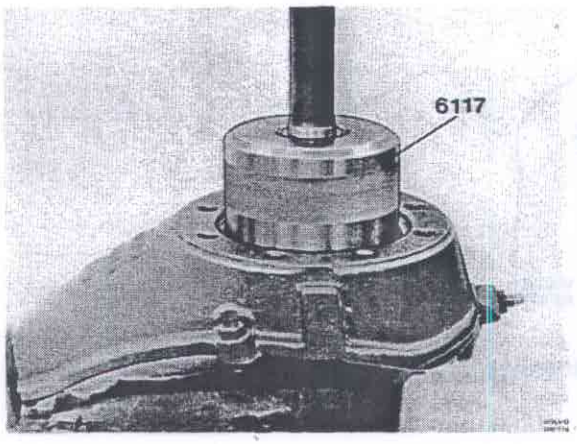


Fig. 63–14. Fitting the rubber bellows

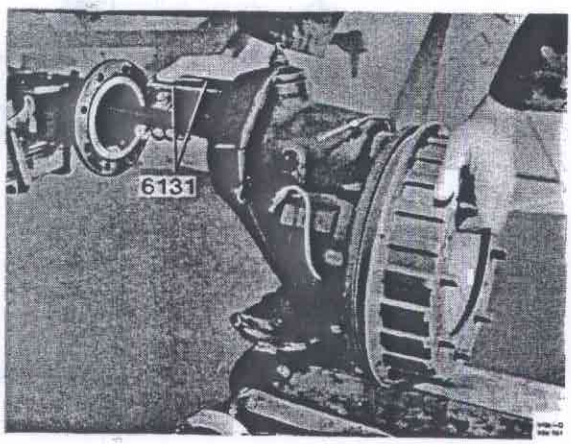


Fig. 63–16. Fitting the wheel carrier

carrier up so that the guide pins can fit in the front shaft. NOTE! Check to make sure that the rubber bellows for the drive shaft are properly fitted in the steering knuckle support before the wheel carrier is fitted to the front axle (7, Fig. 63–1). Lift up the drive shaft while pushing the carrier in at the same time. When the drive shaft makes contact with the differential, rotate the centre gear flange while pushing the carrier to the bottom.

3. Fit all the bolts between the steering knuckle support and front axle. Remove the guide pins. Tighten the bolts to a torque of 100–120 Nm (10–12 kpm = 72–87 lbftf).
4. Screw tight the shock absorber and the stop plate for the hollow rubber spring.
5. Screw in the lower lubricator. Screw tight the steering rod.
6. Screw tight the bracket for the brake lines and connect up the brake lines. Bleed the wheel cylinders whose brake lines have been disconnected. During the bleeding the contact for the pressure difference should be removed, see Fig. 63–17. If a bleeder unit is used, the working pressure should be 0.2 MPa (2 kp/cm^2 = 28 lbf/in^2). For more detailed instructions concerning the bleeding, see Part 5.
7. Install the wheel and lower the vehicle.

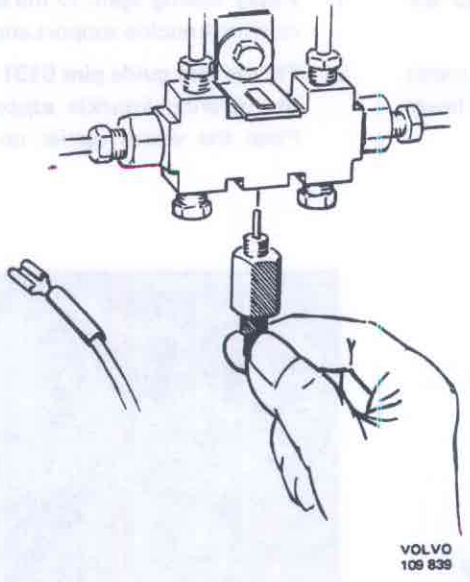


Fig. 63–17 Contact for pressure difference

ALIGNING THE WHEELS

The front end must have certain, calculated adjustments in order for the vehicle to have good steering properties and a minimum of wear on the tyres. Since these adjustments can alter due to wear, etc, they should be checked at regular intervals. Those adjustments which should be regularly checked are the caster, camber, king-pin inclination and toe-in.

Procedure before wheel adjusting

Before checking or adjusting the wheel adjustment, carry out the following checks and remedy any faults:

1. Check the front wheel tyres concerning pressure and wear.
2. Check that the radial and lateral throw on the wheels do not exceed 2.5 mm (0.10").
3. Check that the springs are in good condition and have equally efficient function.
4. Check the adjustment for the steering gear.
5. Check the steering rods for looseness and deformation.

Measuring and adjusting the wheel angles

The front wheel angles are measured with the instruments intended for this purpose. The only wheel angle which can be adjusted is the toe-in. It should be within the distance 0–3 mm (0–0.12"). Toe-in is adjusted on the lower steering rod (5, Fig. 64–2). The measuring is made in the middle of the wear tread and at hub height. If any of the other angles are faulty, examine which part is deformed and replace accordingly.

GROUP 64 STEERING SYSTEM

Description

STEERING GEAR

The steering gear is of the worm and roller type and its design can be seen from Fig. 64–1. The worm (5) is journalled in two ball bearings (7 and 14) and its pre-load is adjusted by means of shims (3) placed between the lower cover (15) and housing (6).

The sector shaft is journalled in three bushings (2, 4 and in the upper cover). The bushing in the cover cannot be replaced, so that the cover must be changed complete if there is looseness. The roller (11) is journalled in the sector shaft. It cannot be replaced so if there is looseness the sector shaft must be changed complete.

The steering gear is adjusted by altering the axial location of the roller in relation to the worm. This is adjusted by means of the adjuster screw (12), which is journalled in the sector shaft.

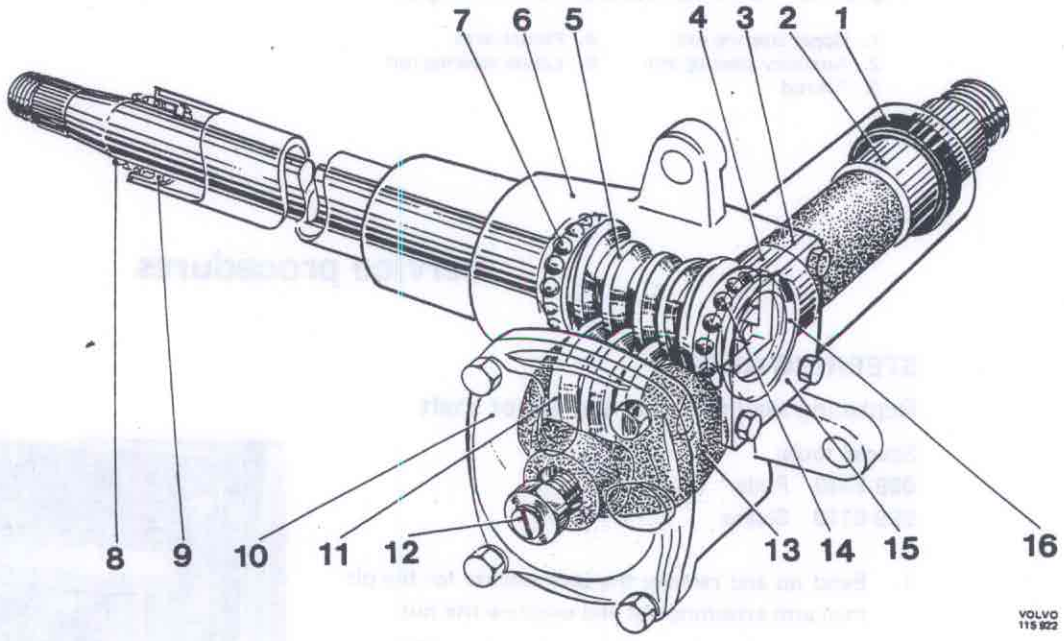


Fig. 64–1. Steering gear

1. Sealing ring
2. Bushing
3. Shims
4. Bushing
5. Worm
6. Housing
7. Ball bearing
8. Spring
9. Steering shaft bearing
10. Upper cover
11. Roller
12. Adjuster screw
13. Sector shaft
14. Ball bearing
15. Lower cover
16. Spacer ring

STEERING RODS AND AUXILIARY STEERING ARM

The steering gear has three steering rods, a lower steering rod (5, Fig. 64–2), an upper steering rod (1) and a tie rod (3). The toe-in is adjusted on the lower steering rod. All steering joints are lubricated-for-life and are to be replaced when loose.

The auxiliary steering arm (2) links the tie rod to the upper steering rod. The auxiliary steering arm is journalled in the front tubular member by means of two bushings (5 and 7, Fig. 64–3). Any axial looseness on the auxiliary steering arm can be remedied with the help of shims (8).

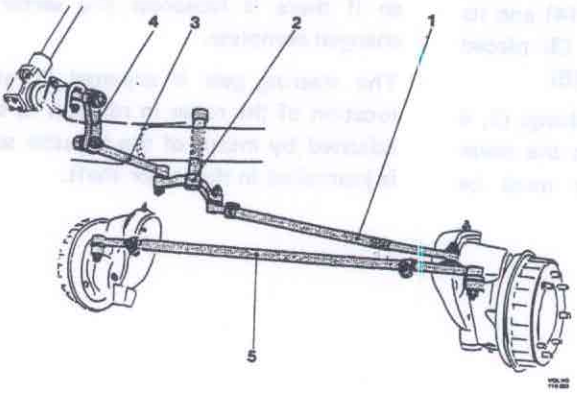


Fig. 64–2. Steering rods with aux. steering arm

1. Upper steering rod
2. Auxiliary steering arm
3. Tie rod
4. Pitman arm
5. Lower steering rod

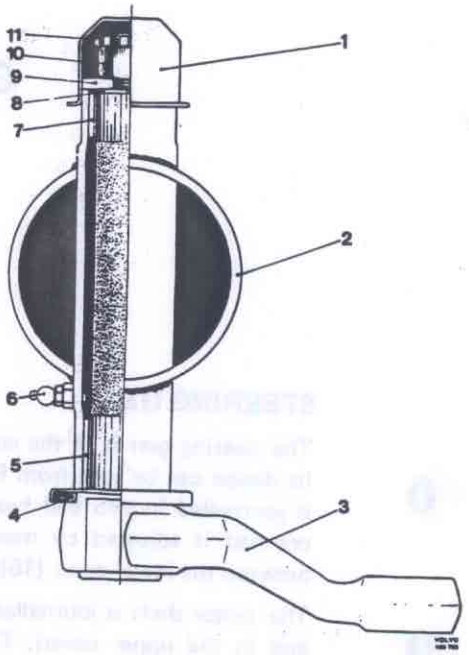


Fig. 64–3. Auxiliary steering arm

1. Cover
2. Tubular member
3. Aux. steering arm
4. Sealing ring
5. Lower bushing
6. Lubricator
7. Upper bushing
8. Shims
9. Washer
10. Nut
11. Split pin

Service procedures

STEERING GEAR

Replacing sealing ring at the sector shaft

Special tools:
999 2339 Puller
999 6119 Sleeve

1. Bend up and remove the lock washer for the pitman arm attaching nut and unscrew the nut.
2. Pull off the pitman arm with puller 2339, see Fig. 64–4.

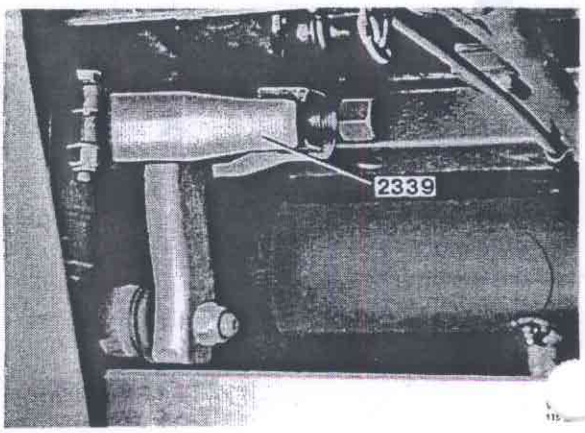


Fig. 64–4. Removing the pitman arm

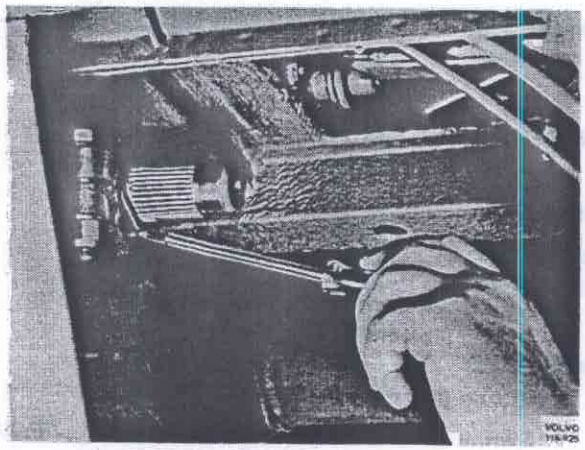


Fig. 64–5. Removing the sealing ring

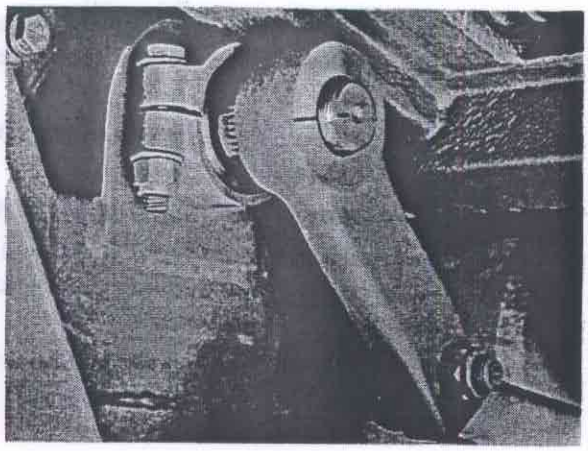


Fig. 64–7. Marking up pitman arm – sector shaft

3. Lever out the sealing ring with a screwdriver as shown in Fig. 64–5. Do not knock in the screwdriver too far otherwise it might damage the bushing for the sector shaft.
4. Knock the sealing ring in with sleeve 6119, see Fig. 64–6.
5. Place the pitman arm according to the marking on Fig. 64–7. Tighten the nut to a torque of 250–350 Nm (25–35 kpm = 180–253 lbftf) and lock the nut with the lock washer.

Replacing upper steering column bearing

Special tools:
999 2368 Puller
999 1187 Clamp
999 1103 Intermediate section

1. Remove the horn button with a screwdriver, see Fig. 64–8. Disconnect the electric cable from the horn button.
2. Mark the location of the steering wheel on the steering column with punch pops and unscrew the steering wheel nut.

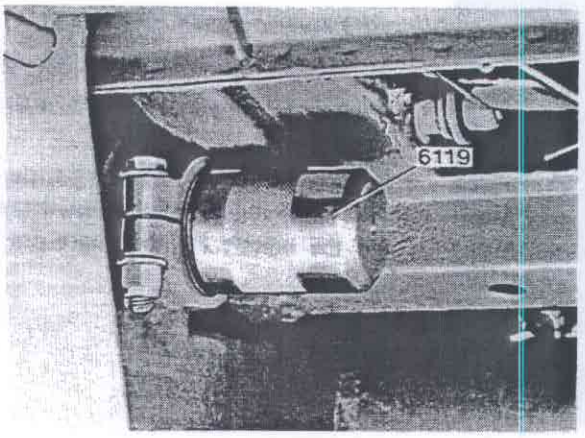


Fig. 64–6. Fitting the sealing ring

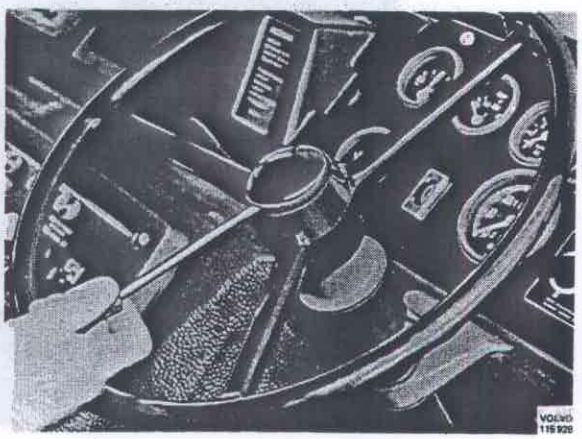


Fig. 64–8. Removing the horn button

3. Pull off the steering wheel with puller 2368, clamp 1187 and intermediate section 1103, Fig. 64–9.
4. Lift off the spring and drive out the bearing with a screwdriver, Fig. 64–10.
5. Knock down the bearing and fit the spring.
6. Re-fit the steering wheel according to the marking and tighten the nut to a torque of 35–45 Nm (3.5–4.5 kpm = 25–33 lbftf).
7. Connect up the electric cable to the horn button and press the button in position.

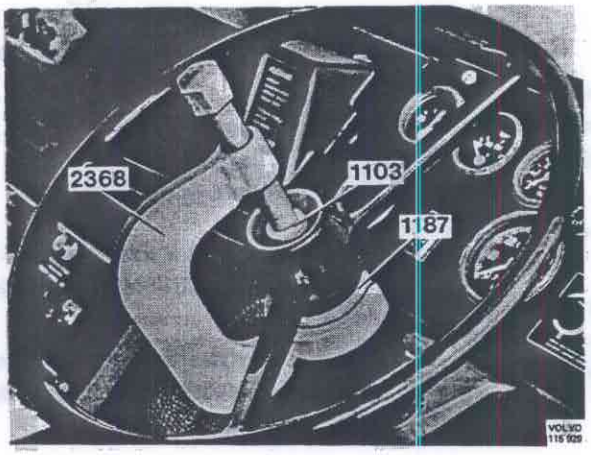


Fig. 64–9. Removing the steering wheel

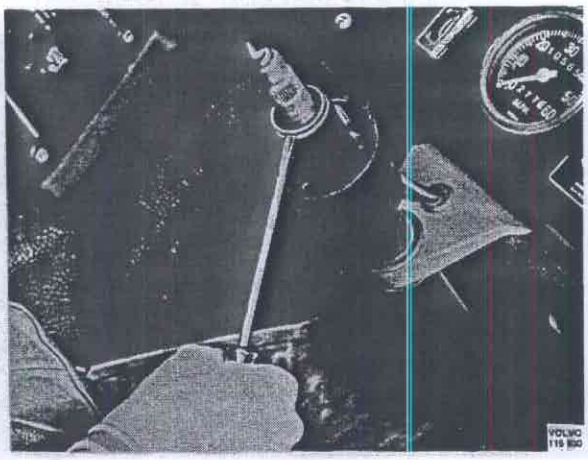


Fig. 64–10. Removing the upper steering shaft bearing

Reconditioning the steering gear

Special tools:

999 2368	Puller
999 1187	Clamp
999 1103	Intermediate section
999 2339	Puller
999 2337	Drift
999 2179	Drift
999 1801	Standard handle
999 6119	Sleeve

Removing the steering gear

1. Remove the horn button with a screwdriver, Fig. 64–8. Disconnect the electric cable from the horn button.
2. Mark the location of the steering wheel on the steering column with punch pops and unscrew the steering wheel nut.
3. Pull the steering wheel off with puller 2368, clamp 1187 and intermediate section 1103, Fig. 64–9. Remove the spring.
4. Remove the bracket for the direction indicator lever and steering wheel bracket. Disconnect the connections for the direction indicator lever under the dashboard and pull out the cable.
5. Fold aside the mat and remove the floor cc over the steering gear.
6. Bend off the lock washer for the pitman arm attaching nut and unscrew the nut.
7. Pull off the pitman arm with puller 2339, Fig. 64–11.
8. Remove the stay between the bumper and frame.
9. Release the clamp bolt over the sector shaft pipe. Pull out the horn cable.
10. Remove the three attaching bolts for the attachment round the sector shaft pipe and lower the steering gear.

Disassembling the steering gear

1. Clean the outside of the steering gear.
2. Fix the steering gear in a vice as shown in Fig. 64–12.
3. Place the steering gear in the centre position. Unscrew the lock nut for the adjuster screw (12, Fig. 64–1) and the bolts for the upper cover (10).

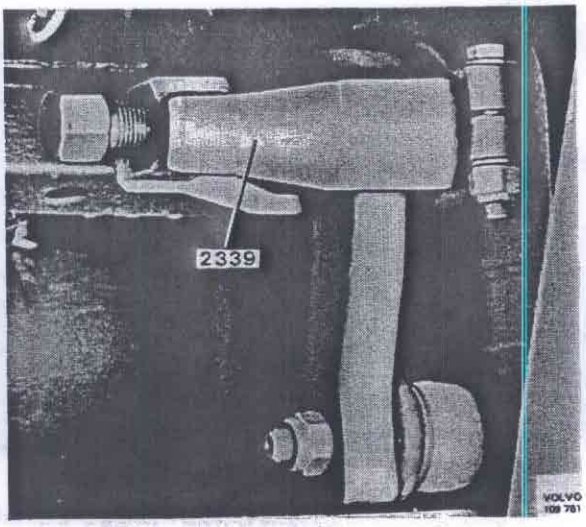


Fig. 64–11. Removing the pitman arm

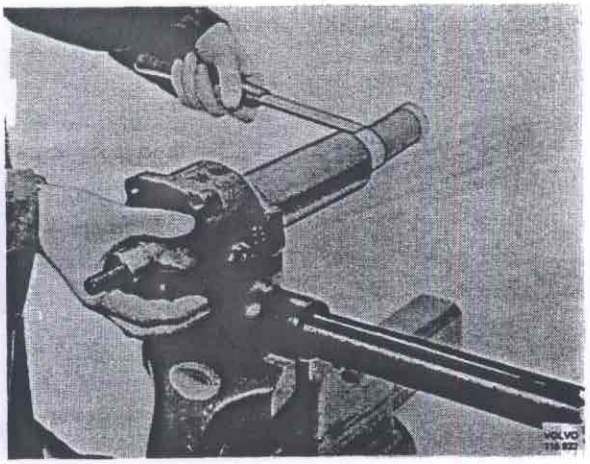


Fig. 64–13. Removing the sector shaft

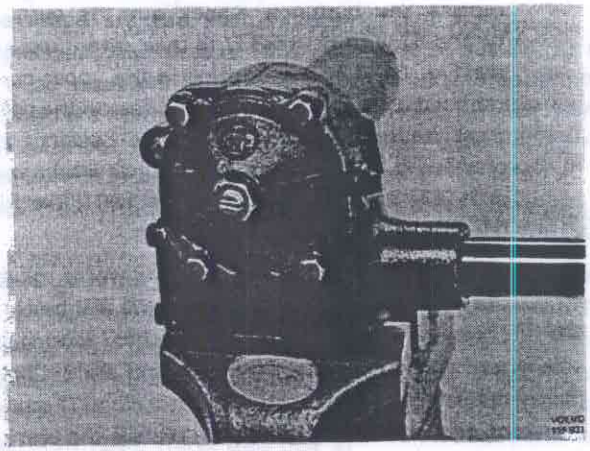


Fig. 64–12. Fixing steering box in vice

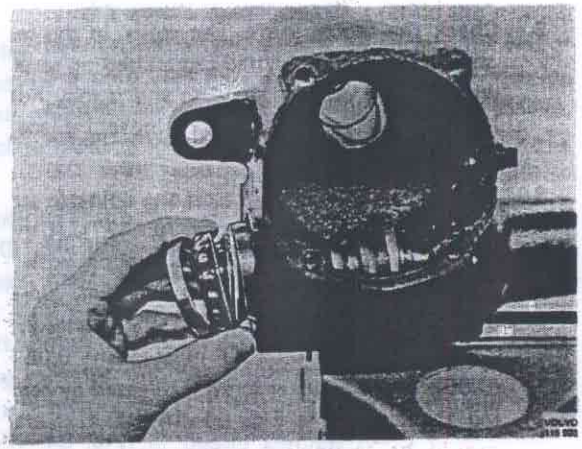


Fig. 64–14. Removing the worm

4. Screw in the adjuster screw until its cover slackens from the housing and empty the oil. Screw in the adjuster screw farther until its cover releases fully from the adjuster screw.
5. Carefully tap out the sector shaft (13) with a plastic mallet, see Fig. 64–13.
6. Remove the lower cover (15) at the end of the steering column and take care of the spacer ring (16) and shims (3).
7. Carefully knock out the steering column with a plastic mallet. Take hold of the worm's lower bearing race and bearing, see Fig. 64–14, and pluck the upper bearing (7) out of the housing.
8. Lever out the sector shaft sealing ring (1) with drift 2337, see Fig. 64–15.

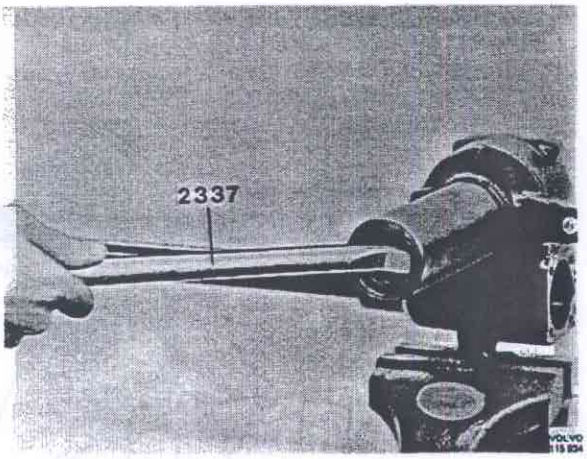


Fig. 64–15. Removing the sealing ring

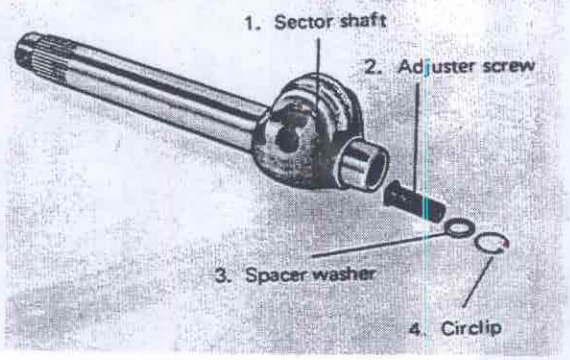


Fig. 64–16. Sector shaft

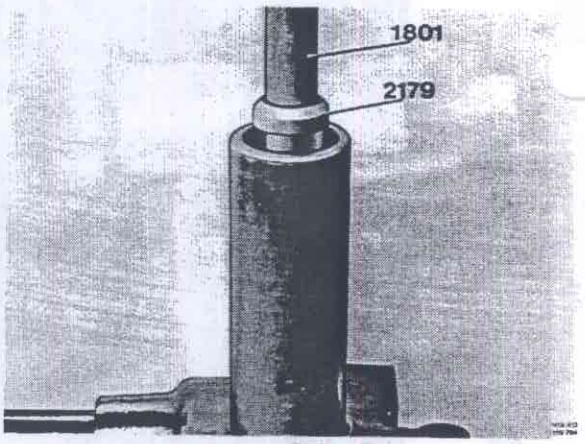


Fig. 64–18. Fitting the bushing

Checking, replacing parts

1. Clean all parts thoroughly.
2. Check the sector shaft. The roller in the sector shaft may not be scored, scratched or severely worn on the contact surfaces and it may not be loose on its shaft. If worn or loose, replace the sector shaft.
3. Check the axial clearance on the adjuster screw. It may not exceed 0.05 mm (0.002"). If this is the case, adjust the axial clearance with the spacer washer (3) according to Fig. 64–16. Spacer washers are available in thicknesses 2.10–2.50 mm (0.083–0.098") in steps of 0.05 mm (0.002"). The adjuster screw is released by removing the circlip (4, Fig. 64–16). The clearance should be as small as possible. However, it is important that the adjuster screw can be turned easily after adjustment.
4. Check the sector shaft bushings (2, 4 and the one in the upper cover), see Fig. 64–1. If loose, replace the bushings. Knock out the bushings (2 and 4) with drift 2337 in their own direction, see Fig. 64–17. The bushing in the upper cover cannot be replaced, and for this reason the cover must be replaced complete. The bushings are pressed in each from their own direction with drift 2179 and standard handle 1801, see Fig. 64–18.
5. Check the contact surfaces of the worm against the roller and the inner races for the ball bearings (7 and 14). If there are scratches, scoring or severe wear, replace the worm and shaft. Check the balls of the bearings and outer rings. If scored or damaged in any other way, replace the bearing parts. The upper bearing outer ring is pulled out with the help of a Kukko standard jackknife No. 21–6 kit 24B, see Fig. 64–19. Tap the ring in

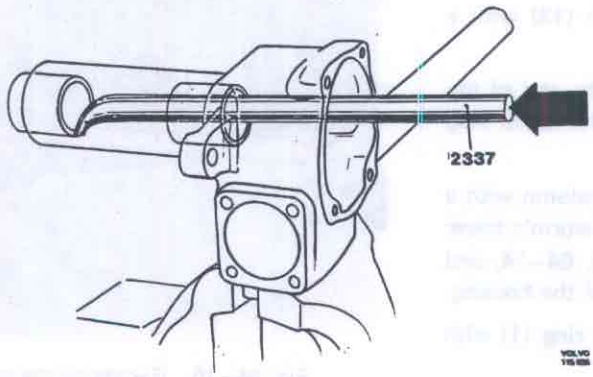


Fig. 64–17. Removing the bushing

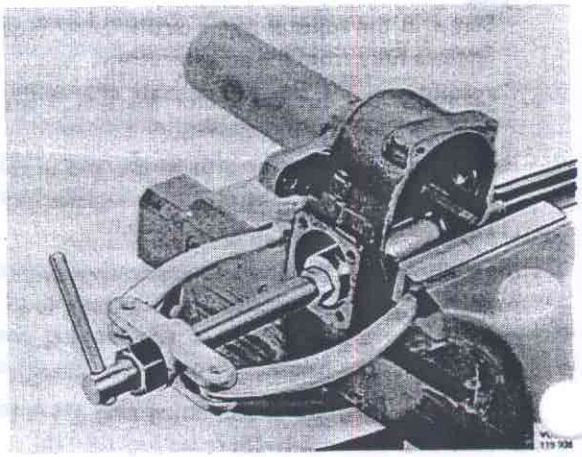


Fig. 64–19. Removing the upper bearing adjuster ring

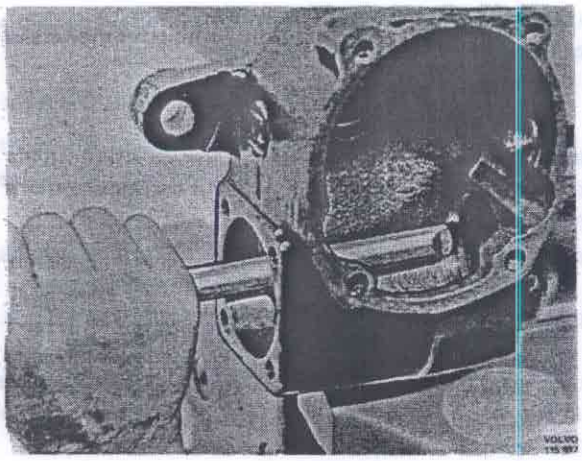


Fig. 64–20. Fitting the upper bearing outer ring

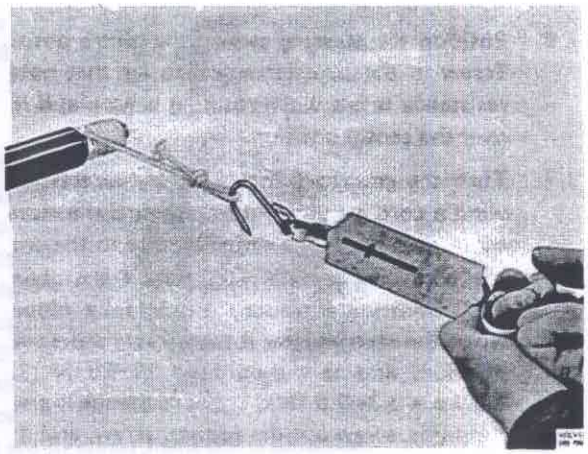


Fig. 64–22. Checking the pre-load

with a brass drift, see Fig. 64–20. Tap with light taps round the bearing race so that the key does not stick.

6. Check the bearing at the top of the steering column jacket. To replace the bearing, knock it out with a screwdriver, see Fig. 64–21. Knock in the new bearing with a plastic mallet.

Assembling the steering gear

1. Place the upper bearing on the steering column and place the steering column in position. Fit the lower bearing and its bearing race, the spacer ring and shims. Fit the same number of shims which were removed.
2. Fit the lower cover and tighten up the bolts while checking that the steering column can be rotated without any notable resistance.
3. Wind a cord a couple of times round the steering column and attach a spring balance to the end of the cord, see Fig. 64–22. Rotate the steering column and read off the force on the bearings, which should be between 2.5–5.5 kp (5.5–12 lbf). With excessive pre-load, add shims, and with too little pre-load, remove some.
4. Oil the sector shaft bushings and place the sector shaft in position in the housing. Coat the cover contact surface against the housing with sealing glue and screw the cover on the adjuster screw. Screw out the adjuster screw so far that the sector shaft is not clamped when the cover attaching bolts are tightened up.
5. Knock in the sealing ring for the sector shaft with sleeve 6119, see Fig. 64–23.

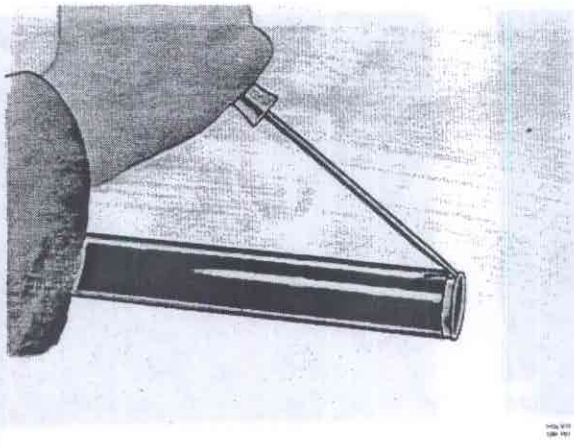


Fig. 64–21. Removing the upper steering shaft bearing

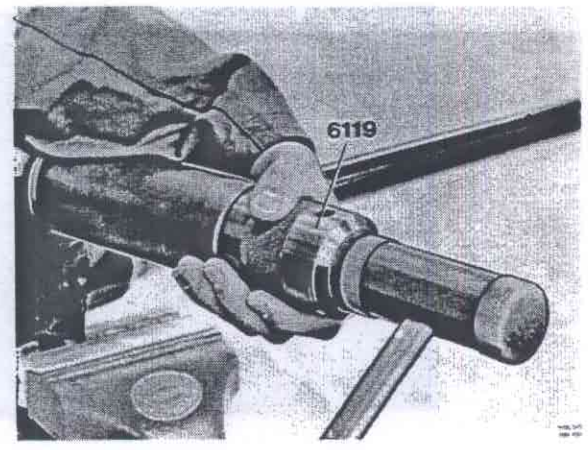


Fig. 64–23. Fitting the sealing ring

6. Position the steering gear in the centre position. Screw in the adjuster screw so far that notable resistance is felt when rotating it back and forth over the centre position.
7. Turn the gear to full lock in one direction and wind a cord a couple of times round the steering column and attach a spring balance to the end of the cord, see Fig. 64–22. Rotate the steering shaft. Maximum resistance should be obtained when the steering gear is turned across the centre position, and this should be 15–25 N (1.5–2.5 kp = 3.3–5.5 lbf). If the resistance is greater than this, screw out the adjuster screw, and if the resistance is too small, screw in the adjuster screw. When the correct value has been obtained, tighten up the lock nut. Re-check the value after having tightened up the lock nut.
8. Fill with 0.5 litre (1 pint) MP 80 oil.

Installing the steering gear

1. Position the steering gear with the attachment round the steering shaft pipe.
2. Screw the attachment tight to the frame with the three attaching bolts.
3. Screw tight the steering wheel bracket to the dashboard.
4. Tighten up the clamp bolt round the sector shaft pipe.
5. Screw tight the pitman arm according to the marking, see Fig. 64–24, and lock the nut with the lock washer.
6. Screw tight the stay between the bumper and frame.
7. Route the horn cable through the steering column jacket.
8. Put back and screw tight the floor cover.
9. Screw tight the bracket for the direction indicator lever and connect up the cables under the dashboard.
10. Place the spring in the steering column jacket and fit the steering wheel according to the marking, if the old steering shaft is still fitted. If the steering shaft has been replaced, point the wheels straight forwards and fit the steering wheel straight, that is, with one of the spokes pointing straight downwards.
11. Tighten the steering wheel nut to a torque of 35–45 Nm (3.5–4.5 kpm = 25–33 lbftf).
12. Connect up the electric cable to the horn button and push the button securely into position.

AUXILIARY STEERING ARM

Replacing the bushings for the auxiliary steering arm

Special tools:
999 2370 Puller
999 1821 Impact tool
999 2337 Drift
999 2413 Drift

Disassembling

1. Remove the nuts for both the steering rods attached to the auxiliary steering arm.
2. Pull off the steering rods from the auxiliary steering arm with puller 2370, see Fig. 64–25.

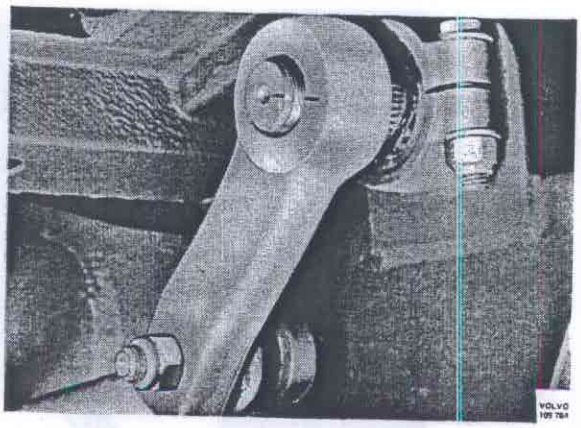


Fig. 64–24. Marking up pitman arm – sector shaft

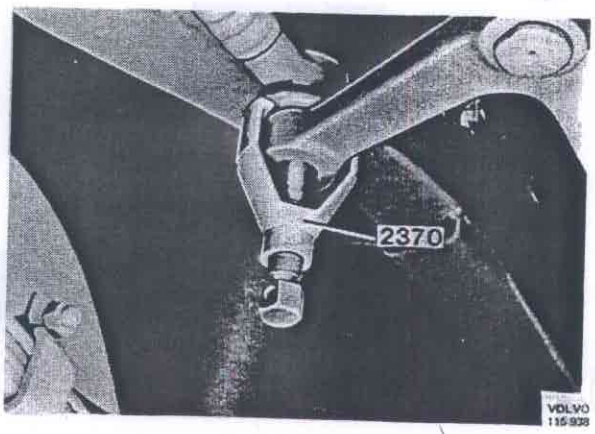


Fig. 64–25. Removing the steering rod

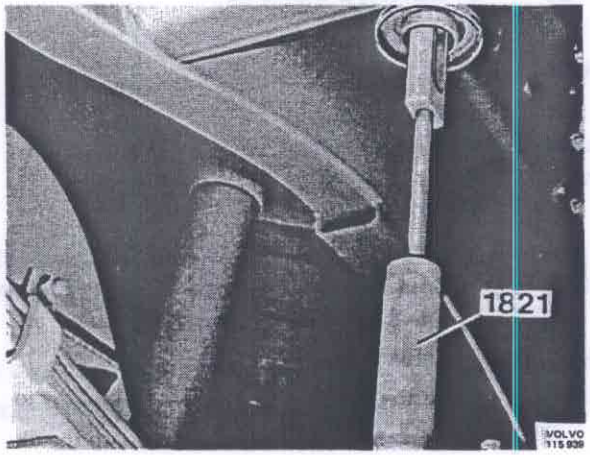


Fig. 64–26. Removing the lower bushing

3. Remove the cover (1, Fig. 64–28) at the top of the shaft.
4. Remove the split pin (11) and unscrew the nut (10).
5. Take down the auxiliary steering arm and take care of the washer (9) and shims (8).
6. Knock out the lower bushing (5) with impact tool 1821, see Fig. 64–26.
7. Knock out the upper bushing (7) with drift 2337, see Fig. 64–27.

Checking, replacing parts

1. Replace the sealing ring (4, Fig. 64–28). Check the contact surface of the sealing ring against the protector ring, and if necessary replace the ring. The ring is tapped securely in position with a plastic mallet.
2. Check the slide surfaces on the auxiliary steering arm. If they are damaged, replace the arm.

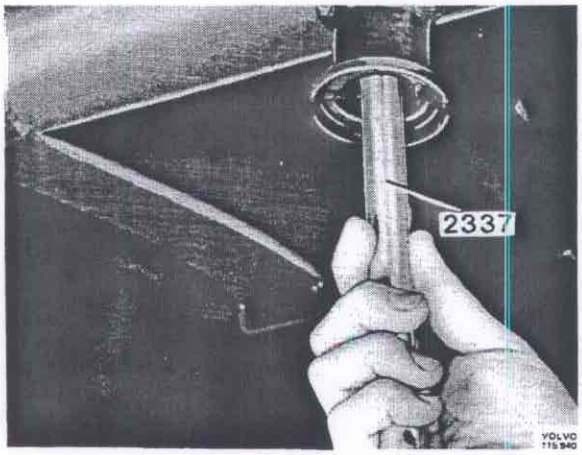


Fig. 64–27. Removing the upper bushing

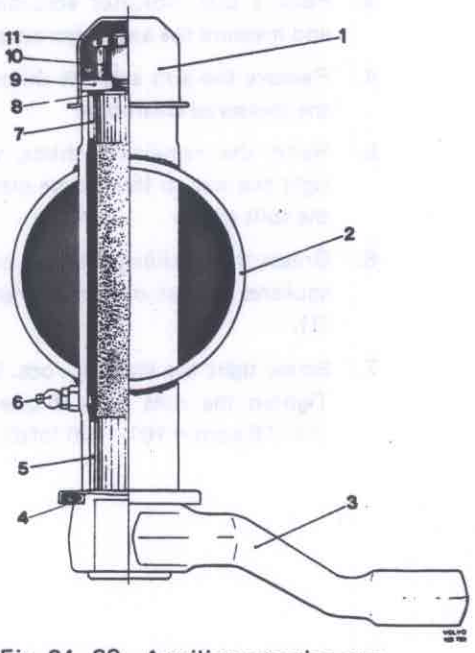


Fig. 64–28. Auxiliary steering arm

1. Cover
2. Tubular member
3. Auxiliary steering arm
4. Sealing ring
5. Lower bushing
6. Lubricator
7. Upper bushing
8. Shims
9. Washer
10. Nut
11. Split pin

Assembling

1. Knock in the bushings with drift 2413, Fig. 64–29. NOTE! Make sure that the bevel on the inside points downwards.
2. Ream the bushings so that the auxiliary steering arm can be fitted. Use an adjustable reamer approx. Ø 30 mm (1 3/16") and ream as little as possible. It is important that both bushings are reamed at the same time. Fit the auxiliary steering arm in position. Place shims of the same thickness at those that were removed plus about 0.5 mm (0.02"). Fit the washer (9, Fig. 64–3) and tighten up the nut to a torque of 80–100 Nm (8–10 kpm = 57–72 lbftf).

Fig. 64–29. Fitting the bushings

3. Place a dial indicator according to Fig. 64–30 and measure the axial clearance on the arm.
4. Remove the arm and the shims corresponding to the measured clearance.
5. Re-fit the remaining shims, washer and screw tight the nut to the torque mentioned above. Fit the split pin.
6. Grease the auxiliary steering arm until the grease squeezes out at one of the ends. Fit the cover (1).
7. Screw tight the steering rods. Use new lock nuts. Tighten the nuts to a torque of 140–180 Nm (14–18 kpm = 101–130 lbftf).

STEERING JOINTS

Replacing

Special tools:

999 2370 Puller
999 2148 Puller

1. Unscrew the nut.
2. Pull loose the steering joint with puller 2370, see Fig. 64–31. Pull off the steering joint at the sector arm with puller 2148.
3. Release the clamp bolts and screw out the joint.
4. Screw on the new joint and tighten up the clamp bolts.
5. Screw tight the steering joint to the torque given in the specifications.
6. Check the toe-in.

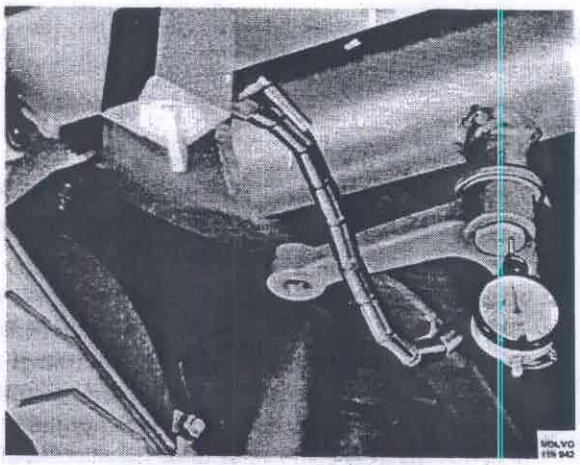


Fig. 64–30. Placing the dial indicator

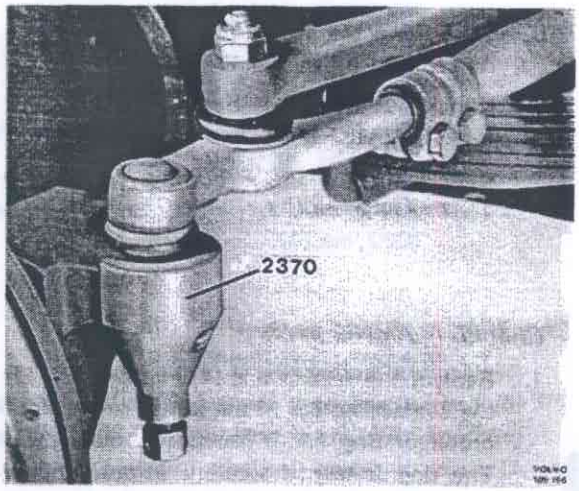


Fig. 64–31. Removing the steering joint

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VOLVO SERVICE

PART 7

FRAME
SUSPENSION
WHEELS

C 3-series

SERVICE MANUAL

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GROUP 70 GENERAL

Data

FRAME

Type	Fully welded with box-section side members
Length, 2-axle vehicle, wheelbase 2300 mm (90.5")	2530 mm (100")
, 2-axle vehicle, wheelbase 2530 mm (100")	3990 mm (157")
, 3-axle vehicle, wheelbase 2720 + 1050 mm (107 + 41")	5674 mm (223")

Front springs

2-axle vehicle, wheelbase 2300 mm (90.5")

Type	Leaf springs
Length between anchorage centres	1300 mm (51")
Width	76 mm (3")
Number of leaves	7
Thickness of leaves:	
Leaves 1–7	7 mm (0.28")
Test values (complete spring)	
Load with deflection of 1 cm (0.4")	560 N (56 kp = 123 lb.)
Load for straight spring (spring must first be loaded to negative deflection of 150 mm = 6")	5900 N (590 kp = 1300 lb.)

2-axle vehicle, wheelbase 2530 mm (100")

Type	Leaf springs
Length between anchorage centres	1300 mm (51")
Width	76 mm (3")
Number of leaves	8
Thickness of leaves:	
Leaves 1–8	7 mm (0.28")
Test values (complete spring)	
Load with deflection of 1 cm (0.4")	640 N (64 kp = 140 lb.)
Load for straight spring (spring must first be loaded to negative deflection of 150 mm = 6")	7000 N (700 kp = 1400 lb.)

3-axle vehicle

Type	Leaf springs
Length between anchorage centres	1300 mm (51")
Width	76 mm (3")
Number of leaves	8
Thickness of leaves:	
Leaves 1–8	7 mm (0.28")
Test values (complete spring)	
Load with deflection of 1 cm (0.4")	640 N (64 kp = 140 lb.)
Load for straight spring (spring must first be loaded to negative deflection of 150 mm = 6")	7000 N (700 kp = 1400 lb.)

Rear springs

2-axle vehicle, wheelbase 2300 mm (90.5")

Type	Leaf springs
Length between anchorage centres	1300 mm (51")
Width	76 mm (3")
Number of leaves	8

Thickness of leaves:		
Leaves 1–8	7 mm	(0.28")
Test values (complete spring)		
Load with deflection of 1 cm (0.4")	640 N	(64 kp = 140 lb.)
Load for straight spring must first be loaded to negative deflection of 150 mm = 6 ")	7000 N	(700 kp = 1400 lb.)

2-axle vehicle, wheelbase 2530 mm (100")

Type	Leaf springs	
Length between anchorage centres	1300 mm	(51")
Number of leaves	9	
Thickness of leaves:		
Leaves 1–9	7 mm	(0.28")
Test values (complete spring)		
Load with deflection of 1 cm (0.4")	720 N	(72 kp = 160 lb.)
Load for straight spring (spring must first be loaded to negative deflection of 150 mm = 6")	8300 N	(830 kp = 1825 lb.)

3-axle vehicle

Type	Leaf springs of parallel type	
Length	1320 mm	(51")
Width	76 mm	(3")
Number of leaves	4	
Thickness of leaves in centre:		
Leaves 1–4	13 mm	(0.5")
Test values (complete spring)		
Load with deflection of 1 cm (0.4")	1040 N	(104 kp = 230 lb.)
Load for straight spring	19900 N	(1990 kp = 4380 lb.)

Helper spring

Type	Hollow-rubber

Shock absorbers

Type	Telescopic	
Length between anchorage centres:		
Compressed	404 mm	(16")
Extended	671 mm	(26")

Wheels

Rims

Type	Disc	
Size	7.5 L x 16"	
Number of wheel nuts	8	
Max. radial throw	2 mm	(0.08")
Max. lateral throw	2 mm	(0.08")
Circle diameter of wheel studs	222 mm	(8.75")

Tyres

Size	280/85 x 16" 4-ply special	
Wheel revs per km (mile)	approx. 375	
Tyre pressure, front	1.6 kp/cm^2	(23 lbf/in^2)
, rear	1.75 kp/cm^2	(25 lbf/in^2)

Hubs (front and rear)

Pre-load, new wheel bearings	42–48 N (4.2–4.8 kp = 9–10 lbftf) + friction of sealing rings
, run-in wheel bearings	24–28 N (2.4–2.8 kp = 5–6 lbftf) + friction of sealing rings
Bearing clearance when about to adjust	0.08 mm (0.0032")

Bogie

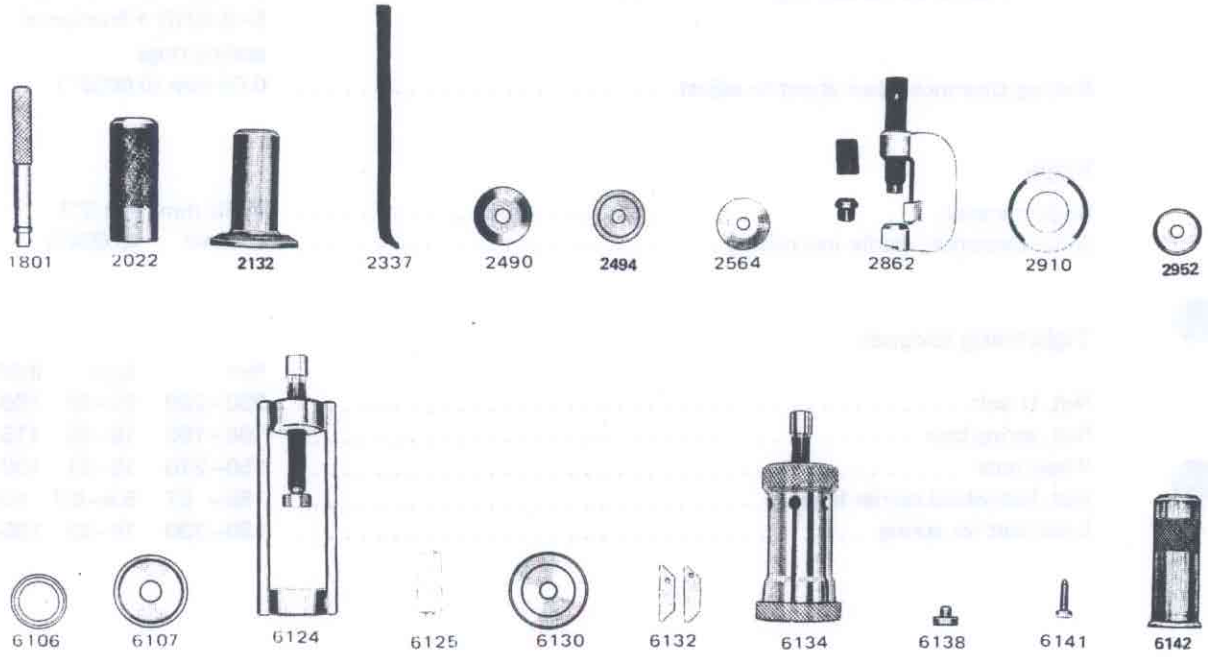
Bogie distance	1050 mm (41.3")
Axial clearance, cradle journalling	0.1 mm (0.004")

Tightening torques

	Nm	kpm	lbftf
Nut, U-bolt	230–280	23–28	166–202
Nut, spring bolt	160–190	16–19	115–137
Wheel nuts	150–210	15–21	108–152
Nut, hub-wheel carrier housing	55– 67	5.5–6.7	40– 48
Lock bolt for spring	180–230	18–23	130–166

Tools

The following special tools are required for work on the frame, suspension, wheels



1801 Standard handle
2022 Sleeve for pressing on gear wheel
2132 Sleeve for pressing sealing ring into cradle
2337 Drift
2490 Drift for removing outer bearing outer ring in hub
2494 Drift for pressing needle bearing into cradle
2564 Drift for removing inner bearing outer ring in hub
2862 Press tool for removing and installing wheel studs
2910 Sleeve for installing outer sealing ring in hub
2952 Drift for pressing needle bearing out of cradle
6106 Sleeve for installing inner and outer bearing inner ring in hub
6107 Drift for installing inner bearing outer ring in hub
6124 Press tool for removing and installing spring bushings
6125 Drift. Used together with 6124 when removing spring bushing and for removing and installing rubber bushings on reaction rods
6130 Drift for installing inner seals in hub
6132 Press washers for removing outer bearing outer ring in hub
6134 Puller for removing outer bearing inner ring in hub
6138 Guide. Used together with 6124 and 6125
6141 Bolt for pressing out hub
6142 Sleeve for installing bearing races

GROUP 71 FRAME

Description

The frame is made up of two box-profile side members which are joined together by means of four crossmembers. The front and rear crossmembers are of box-section while the two intermediate are gas-tight tubular members which function as vacuum tanks.

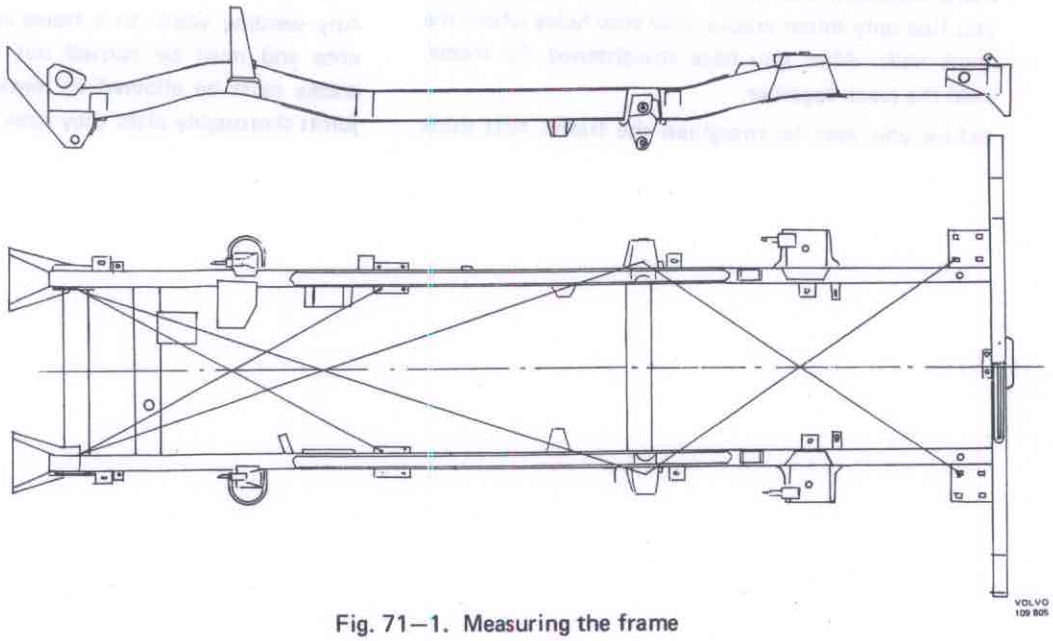


Fig. 71–1. Measuring the frame

Service Procedures

Measuring the frame

If it is suspected that for some reason or other the frame is faulty, it should be check-measured. This can be done by transferring the position for certain fixed points to a flat, clean floor. Measuring is then done on the floor. The points shown in Fig. 71–1, for example, can be used.

Suspend a pointed plumb over one of the points. The vehicle must be securely parked with the parking brake or blocks behind the wheels. At the point on the floor over which the plumb hangs mark clearly with chalk. Then with a pencil or scriber make a cross on this mark, immediately below the plumb pointer. Repeat this procedure at the other points. Then remove the vehcile. Talc a piece of string and stretch this between two of the points. Pull upp the middle of the string slightly and let it strike against the floor. This will cause the talced string to make a white line between the points. Do the same between the other points so that you get diagonal lines as shown on Fig. 71–1. When measuring between the points marked where the plumb was suspended, the length of two diagonals crossing each other should agree with a permitted deviation of max. 3 mm (1/8"). If the deviation exceeds this, then the frame is crooked and must be straightened.

To find out whether the frame is twisted or bent, place it on trestles with the side members straight upper edges parallel with the floor and both sides at the same height. Measure the distance from the floor to the straight upper edge on the frame. This measurement is then to be used as a basic measurement when check-measuring. If this measuring is to be reliable, the floor must be absolutely flat. Be particularly thorough when marking and measuring. A faultless frame should be flat and the side members straight and in parallel.

Straightening and repairing the frame

The frame should preferably be straightened when in a cold condition. If it must be heated, do not go too far with this. Under no circumstances may the frame be heated to more than a cherry colour, that is, a dark red heat.

Before you start to straighten the frame, examine it for cracks, etc. If you find major cracks in any of the frame members, then the frame should be replaced. If you find only minor cracks, drill stop holes where the crack ends. After you have straightened the frame, weld the crack together.

Before you start to straighten the frame, first think carefully the best way for doing this. Special jacks are available for straightening and these are fixed to the frame by means of hooks and chains.

If any part of the frame is to be cut off, the cutting must be done 10–15 mm (3/8–9/16") from the material that has to remain. The rest of the material to be removed must be removed by filing and sandpapering.

Any welding work on a frame requires great experience and must be carried out with great care. No cracks must be allowed to remain. Inspect the weld joints thoroughly after they have cooled.

GROUP 72 SPRINGS

Description

2-axle vehicle

Both the front and rear springs are of the conventional leaf type. The front end of the springs is rigidly suspended in spring bolts. The rear ends hang from spring shackles. The vehicle is provided with hollow-rubber springs, both front and rear.

3-axle vehicle

The design and suspension of the front springs is the same as for 2-axle vehicles. But the rear springs are of the parabel type. Rear springing is progressive with slip suspension at both ends, see Fig. 76–2. The vehicle has hollow-rubber springs front and rear.

Service Procedures

SPRINGS

2-axle vehicle and 3-axle vehicle (front)

Removing a spring

1. Jack up the vehicle.
2. Unbolt the wheel covering the spring.
3. Remove the front spring bolt.
4. Remove the four bolts for the rear spring anchorage so that the entire spring shackle is also removed at the same time.
5. Unscrew the nuts on the U-bolts and lift out the spring.

Installing a spring

1. Place the spring in position.
2. Bolt on the front spring bolt, but only a couple of threads. IMPORTANT! Make sure that the spring bolt in the rear spring takes the right thread in order no to damage the threads on the weld nut.
3. Fit the spring plate with the U-bolts. If you have any difficulty in centring the centre bolt on the rear spring, release the reaction rod. Tighten the nuts on the U-bolts.
4. Bolt tight the rear spring anchorage.
5. Make sure that all released spring bolts are not tightened up. Jack up the vehicle under the axle. Load the vehicle until there is an angle of 90° between the spring shackle and frame. Then tighten the spring shackle upper bolt. Load the vehicle further until the spring is flat and tighten up the remaining spring bolts.
6. Mount the wheel, tighten up the wheel studs and lower the vehicle.

Testing a spring

A spring can be tested in a hydraulic press. The press, however, must be provided with a sufficiently accurate pressure gauge and it must have such a device that the spring cannot slide out sideways.

Invert the spring and place it in the press. Place supports at both ends. Apply pressure to the centre bolt, see Fig. 72–1. Check the spring test value against the data. If the pressure gauge indicates that the spring is faulty, straighten it or replace it.

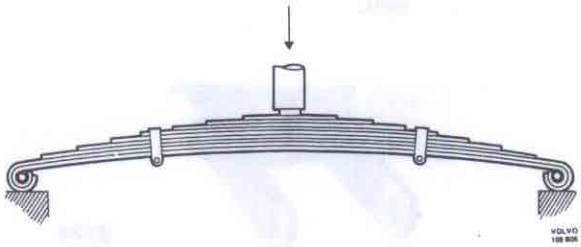


Fig. 72–1. Testing a spring

Fractured spring leaves

When one or several of the spring leaves are fractured, not only must they be replaced but the reason for the fracture should be looked into.

If the fracture is towards the middle of the spring, then the reason may be a faulty shock absorber. A fracture may also be due to a broken centre bolt or overloading.

Replacing spring bushings

Special tools:

6124 Press tool
6125 Drift
6138 Guide

Front springs

1. Jack up the vehicle.
2. Unbolt and remove the wheel covering the spring.

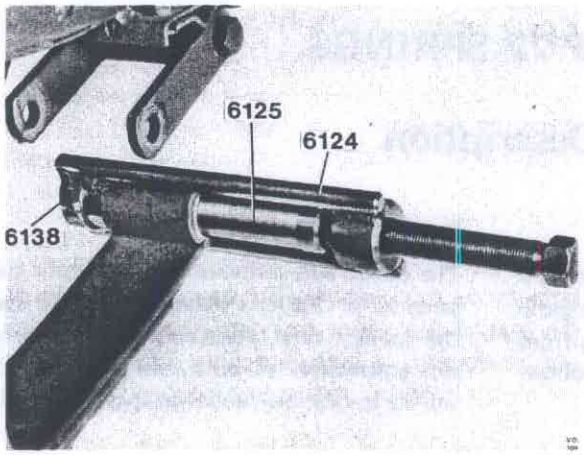


Fig. 72–2. Pressing out a spring bushing

3. Unscrew the spring bolt for the bushing to be replaced.
4. Fit press tool 6124, drift 6125 and guide 6138 according to Fig. 72–2 and press out the bushing.
5. Press in the new bushing using only press tool 6124, see Fig. 72–3, and screw in the spring bolt.

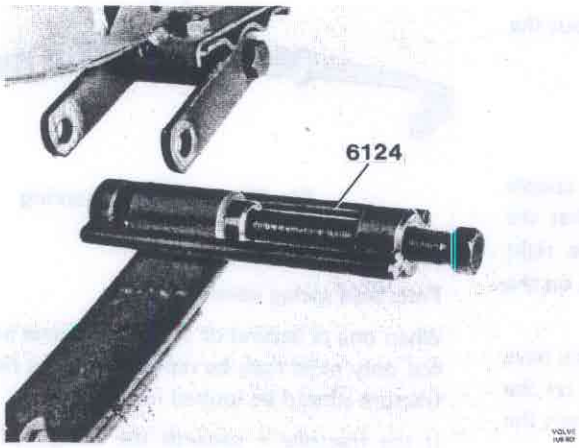


Fig. 72–3. Pressing in a spring bushing

6. Make sure that all spring bolts that were loosened are not tightened up. Jack up the vehicle under the axle. Load the vehicle to an angle of 90° between the spring shackle and frame. Then tighten up the spring shackle upper bolt. Load the vehicle further until the spring is straight and tighten up the remaining spring bolts.
7. Replace the upper bushing in the rear anchorage in the press with the drift 6125, see Fig. 72–4.
8. Mount and screw tight the wheel. Lower the vehicle.

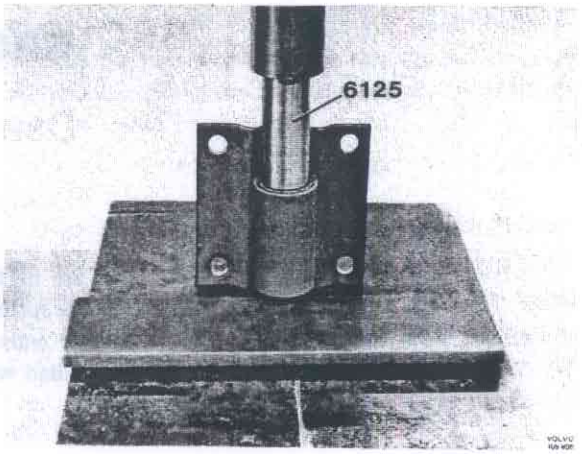


Fig. 72–4. Pressing bushing out of anchorage

Rear springs

1. Screw down the rear spring according to the instructions given under the heading "Removing a spring".
2. Press out the bushings in the spring with press tool 6124 and drift 6125, see Fig. 72–2.
3. Press in the bushings with only press tool 6124, see Fig. 72–3.
4. Replace the upper bushing in the rear anchorage in the press with drift 6125, see Fig. 72–4.
5. Bolt tight the spring according to the instructions given under the heading "Installing a spring".

3-axle vehicle, rear springs

Removing a rear spring

1. Jack up the vehicle and unbolt and remove the wheels.
2. Release the U-bolts and the lock bolts (4, Fig. 76–2). Lift out the spring.

Installing a rear spring

1. Place the spring and fit the U-bolts. Do not tighten up the U-bolts.
2. Torque the lock bolts to 230–280 Nm (23–28 kpm = 166–202 lbftf), and tighten up the lock nuts.
3. Torque the U-bolts to 230–280 Nm (23–28 kpm = 166–202 lbftf).
4. Mount the wheels, screw tight the wheel studs and lower the vehicle.

Testing a spring-fractured spring leaf

See under the heading "2-axle vehicle and 3-axle vehicle (front)".

GROUP 76 SHOCK ABSORBERS, STABILIZERS AND SUSPENSION COMPONENTS

Description

Shock absorbers

The shock absorbers are of the hydraulic, double-operating, telescopic type. They are maintenance-free but cannot be disassembled for repairs. If they leak or function poorly, the shock absorbers are replaced complete.

Design

The design of the shock absorbers can be seen from Fig. 76–1. The outer cylinder (1) protects against dust and dirt. The other two cylinders (2) and (4) are arranged concentrically with the one entirely pushed into the other. The inner cylinder (2) is the real working cylinder and has a valve (6) at its lower end. A piston (5) with channels regulated by valves run inside the inner cylinder. This piston is attached to a piston rod (3) at the opposite end of which there is a ring (9) for attaching the shock absorber to the frame. At the other end of the shock absorber there is a similar ring fixed to a cylinder (4). The intermediate space between the cylinders (2) and (4) serves as a reservoir and is only partly filled with fluid. The inner cylinder (2) is entirely filled with fluid on both sides of the piston (5). The cover (8) provides the sealing and guide for the piston rod (3). The ring (7) acts as a baffle for the fluid.

Function

When a shock absorber is compressed or extended according to the weight on the vehicle, the piston (5) moves in the inner cylinder (2). This causes fluid to flow through the valve-regulated channels in the piston. The speed at which the piston can move in the cylinder will depend on how fast the fluid flows through the channels from one side of the piston to the other side. Since the drilled channels are very narrow, the fluid can only pass through them slowly and this brakes the movement of the piston. It also has a damping effect on the movement of the spring. When a shock absorber is suddenly compressed or extended, further braking effect is caused by turbulence in the fluid passing through the channels in the piston. When the shock absorber is compressed or extended, this does not alter the volume equally on both sides of the piston due to the fact that the piston rod occupies a certain space. During compression of the absorber, some of the fluid flows through the valve (6) out into the reservoir, and when extension takes place, fluid is re-sucked into the cylinder (2) on the underside of the piston.

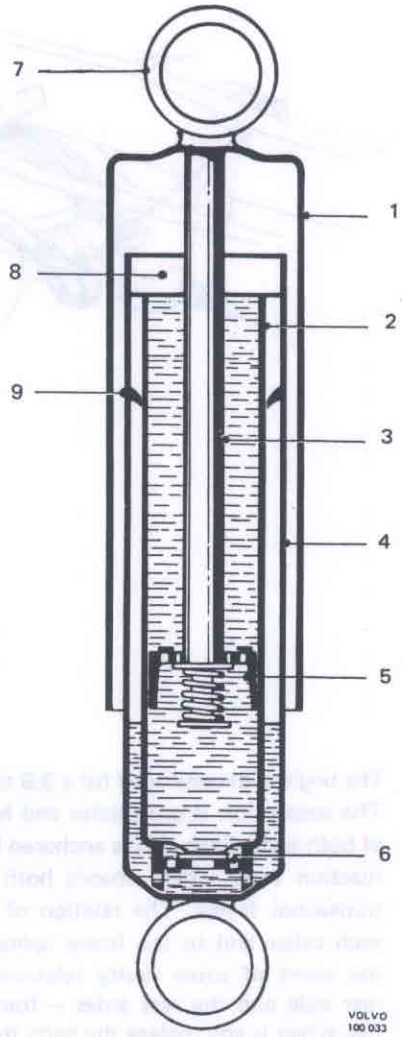


Fig. 76–1. Shock absorber

1. Outer cylinder
2. Inner cylinder
3. Piston rod
4. Intermediate cylinder
5. Piston
6. Valve
7. Ring
8. Cover
9. Ring

Reaction rods

2-axle vehicle

Two reaction rods have been fitted to the rear axle for more stable location.

The reaction rods are fixed at both ends with rubber bushings.

3-axle vehicle

See under the heading "Bogie"

Bogie

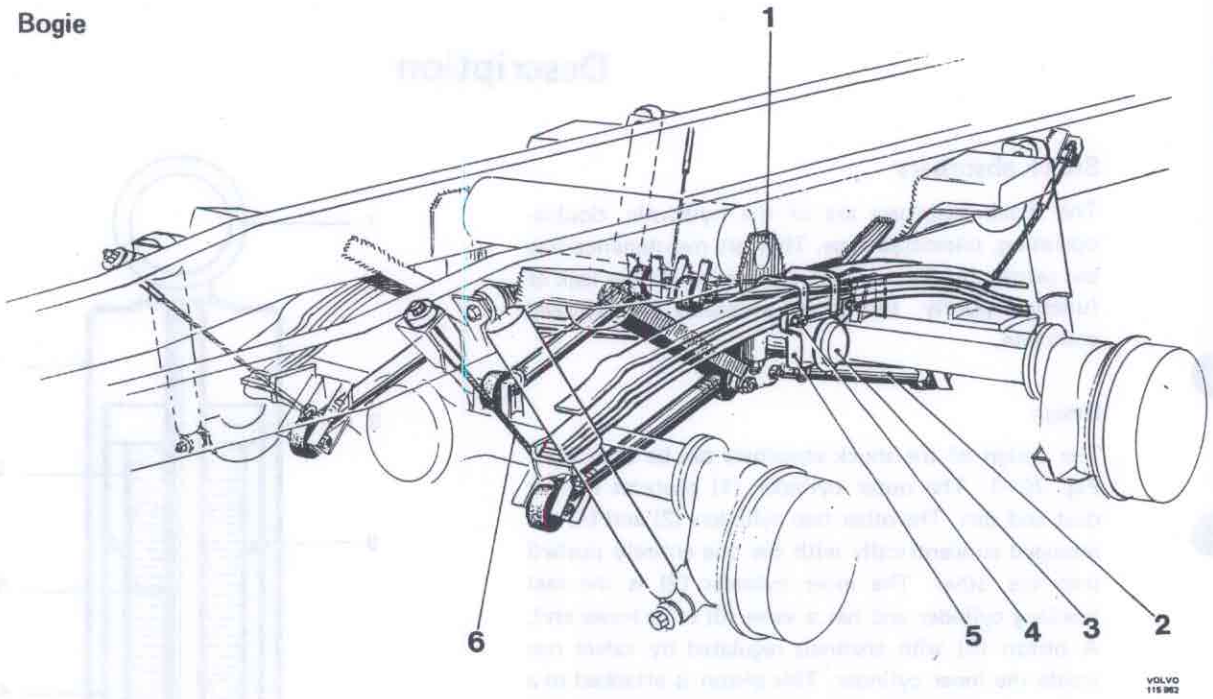


Fig. 76–2. Bogie

1. Bogie anchorage
2. Reaction rod
3. Cover
4. Lock bolt
5. Cradle
6. Stop line

The bogie is dimensioned for a 3.9 ton bogie pressure. The suspension is progressive and has slip suspension at both ends. Each axle is anchored by means of three reaction rods. These absorb both longitudinal and transversal forces. The relation of the rear axles to each other and to the frame cannot be adjusted. In the event of some faulty relationship between the rear axle and the rear axles – frame, examine what the defect is and replace the parts that are defective.

The cradle (5, Fig. 76–2) is journalled on the bogie attachment's (1) journal pin with needle bearings (4 and 8, Fig. 76–3) for radial forces and with synthetic thrust washers (3 and 9) for axial forces. Axial clearance is adjusted with the help of the nut (10).

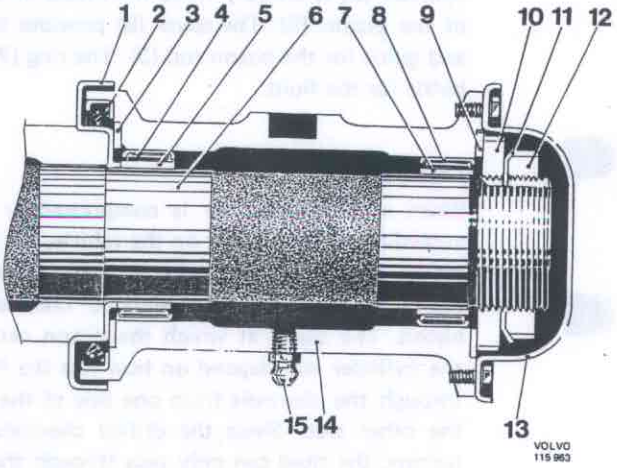


Fig. 76–3. Cradle journalling

1. Dust protective plate
2. Sealing ring
3. Inner thrust washer
4. Inner needle bearing
5. Inner bearing race
6. Bogie axle
7. Outer bearing race
8. Outer needle bearing
9. Outer thrust washer
10. Inner nut
11. Lock washer
12. Outer nut
13. Cover
14. Cradle
15. Lubricating nipple

Service Procedures

Shock absorbers

Removing

To remove a shock absorber, first remove the upper and lower anchorage bolts. A rear wheel must be removed in order to remove a rear shock absorber.

Installing

Before installing a shock absorber, bleed it by holding it in the vertical position with the protective cover upwards and pump 4–5 complete strokes or until you feel there is a certain amount of resistance in both directions. When installing a shock absorber, hold the dust protective cover upwards all the time.

Reaction rods

2-axle vehicle

Special tool:

6125 Drift

Replacing reaction rod rubber bushings

1. Unscrew the reaction rod.
2. Place the reaction rod in a press and press out the bushings with drift 6125, see Fig. 76–4.
3. Press in the bushings with the same drift used for pressing them out.
4. Screw tight the reaction rod with the vehicle loaded to a straight rear spring.

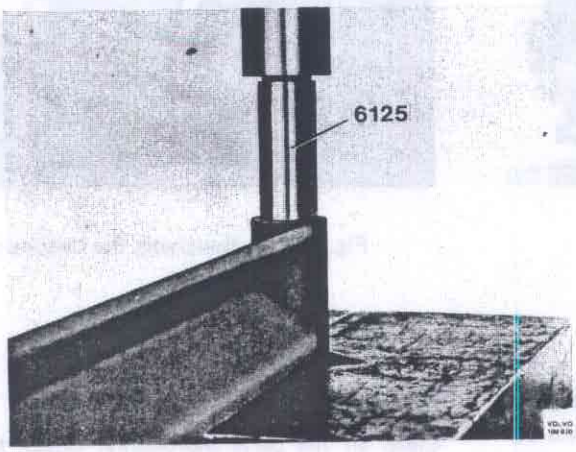


Fig. 76–4. Pressing out the bushing

3-axle vehicle

If any of the rod ends is loose, replace the rod compelte.

Bogie

Special tools:

2952 Drift
1801 Standard handle
2494 Drift
2132 Sleeve
6142 Sleeve

Removing the cradle

1. Jack up the vehicle and remove the wheels.
2. Release the U-bolts and the lock bolts, see Fig. 76–5. Lift out the spring.
3. Screw off the cover (13, Fig. 76–3).
4. Knock up the lock washer (11) and screw off the outer nut (12) with a wrench, see Fig. 76–6.
5. Screw off the inner nut with a wrench and pull off the cradle. Remove the outer axial washer (9) and clean the cradle and bogie axle.

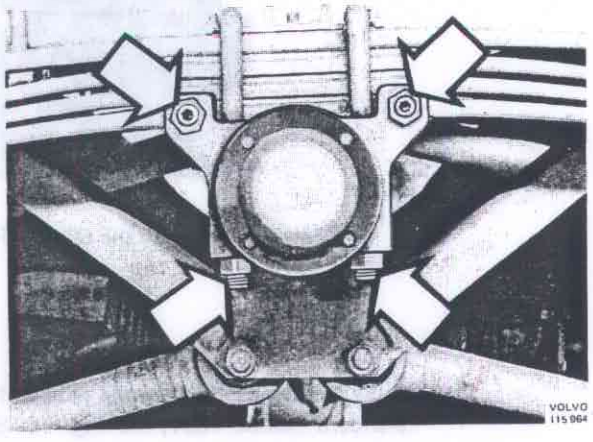


Fig. 76–5. Removing the spring

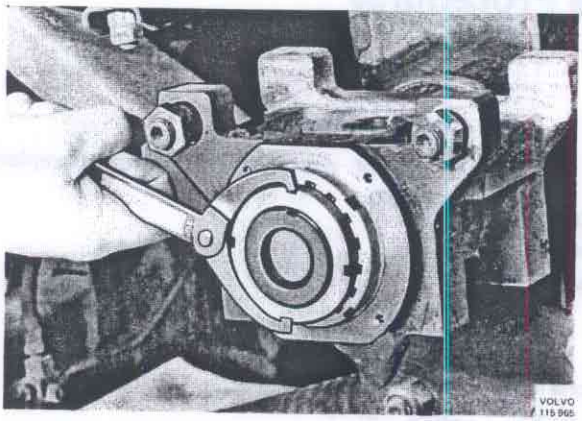


Fig. 76–6. Removing the outer nut

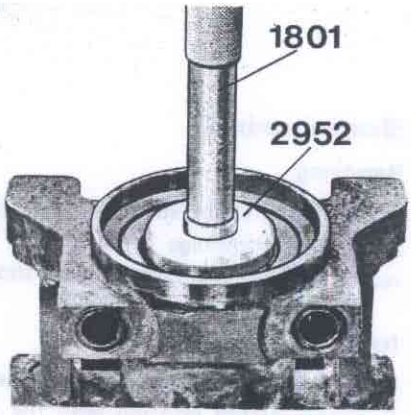


Fig. 76–8. Removing the needle bearing

Disassembling the cradle and removing the bearing races

1. Knock out the sealing ring with a chisel, see Fig. 76–7. If there is any burr underneath the sealing ring, remove it with a shaver.

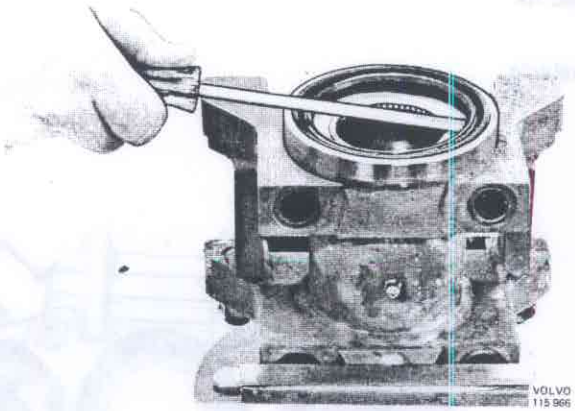


Fig. 76–7. Removing the sealing ring

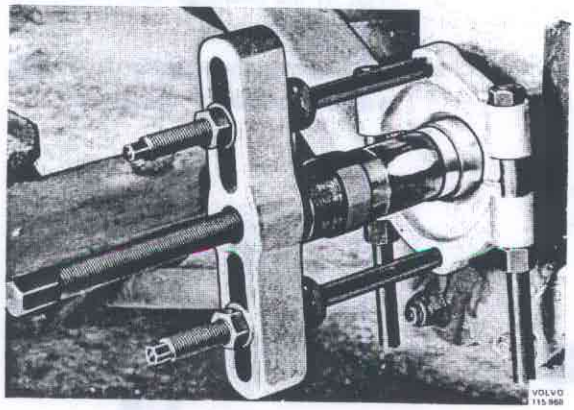


Fig. 76–9. Removing the bearing races

2. Press out the needle bearings with drift 2952 and standard handle 1801, see Fig. 76–8. Press out both the bearings at the same time. Pluck out the inner axial washer (3).
3. Pull off the bearing races (5 and 7) with a jackknife tool, see Fig. 76–9. Pull off both the races at the same time. Remove the dust protective plate by hand.

Inspection

Clean all the parts thoroughly. Check the bearings, bearing races, axial washers and bearing surfaces. Check the dust cover plate at the sealing surface for the sealing ring and the slide surface for the inner axial washer. The shaft pin where the dust cover plate sits must be properly cleaned.

Assembling and installing the cradle, also installing the bearing races

1. Press in the needle bearings with drift 2494 and standard handle 1801, see Fig. 76–10. Press in the bearings so that they are flush with the cradle.

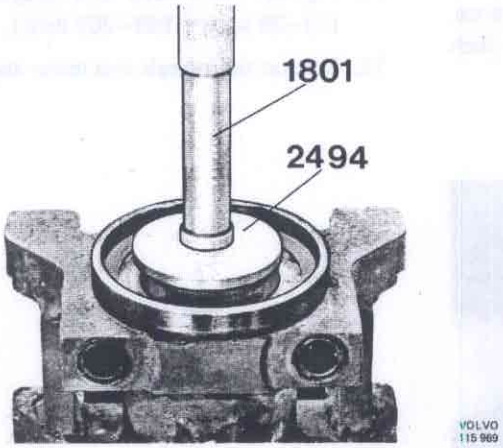


Fig. 76–10. Installing the needle bearing

2. Place the inner axial washer with a little grease on and press in the sealing ring with sleeve 2132, see Fig. 76–11.

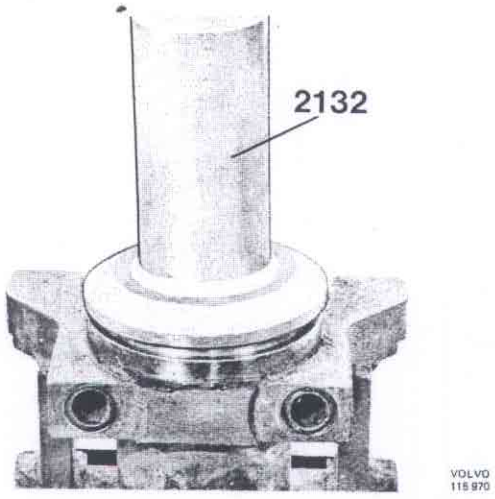


Fig. 76–11. Installing the sealing ring

3. Place the dust protective plate in position and fit the inner bearing race with sleeve 6142. Tap in the bearing race until it bottoms, see Fig. 76–12.

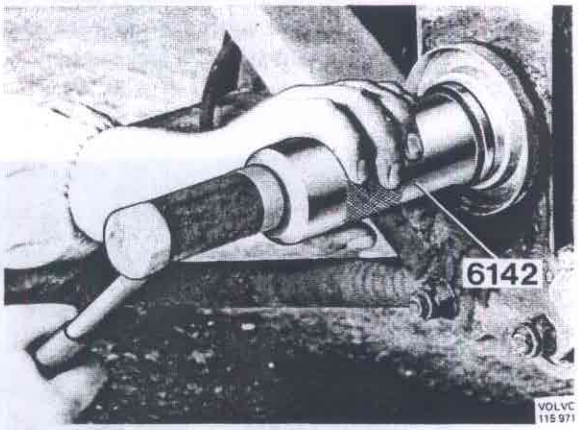


Fig. 76–12. Installing the inner bearing race

4. Tap in the outer bearing race halfway. Grease the lips of the sealing ring and the bearings with a little grease and place the cradle in position. Tap in the bearing race with sleeve 6142 until the sleeve goes against the cradle, see Fig. 76–13.

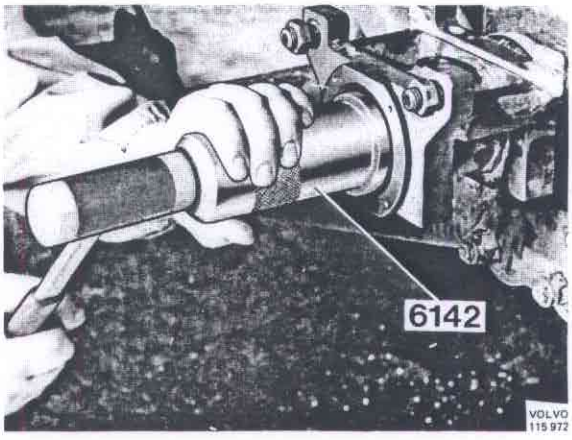


Fig. 76–13. Installing the outer bearing race

5. Grease the outer axial washer with a thin layer of grease and place it in position.
6. Screw on the inner nut and place the lock washer in postion. Screw on the outer nut and tighten it against the inner nut when the hub has a little clearance. Do not lock the lock washer.
7. Position a dial indicator according to Fig. 76–14. Turn the cradle while pressing it inwards at the same time and zero-set the dial indicator. Turn the cradle and pull it outwards. Read off the clearance. The correct clearance should be 0.1 mm (0.0039''). If necessary, adjust the clearance. When correct clearance has been obtained, lock both the nuts with the lock washer.

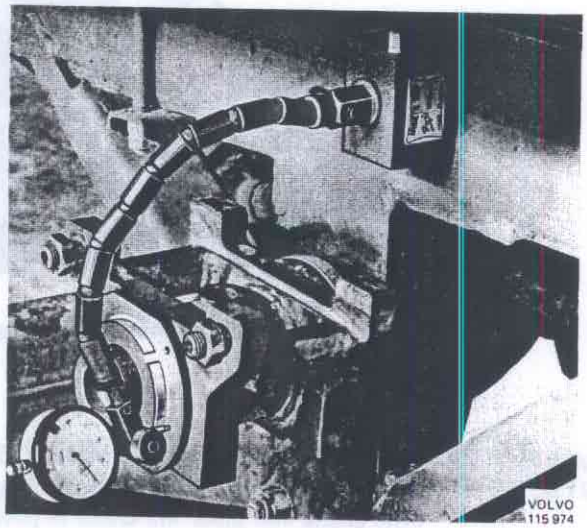


Fig. 76–14. Measuring the axial clearance

8. Grease the cradle journalling through the lubricator underneath the cradle.
   Lubricate until grease squeezes out at one of the cradle ends.
9. Fill the cover halfway with grease and screw it into position.
10. Place the spring in position and fit the U-bolts. Do not tighten up the U-bolts. Tighten the lock bolts to a torque of 230–280 Nm (23–28 kpm = 166–202 lbftf) and tighten up the lock nuts.
11. Tighten the U-bolts to a torque of 230–280 Nm (23–28 kpm = 166–202 lbftf).
12. Bolt on the wheels and lower the vehicle.

GROUP 77 WHEELS, HUBS

Description

Tyres

The tyres are balanced at the factory. The tyre tube should have its valve opposite (180°) the red centre of gravity marking on the tyre.

The front tyres should be fitted with the "points" on the tyre pattern facing opposite the direction of rotation, while they should be facing in the direction of rotation on the rear tyres.

Rims

The rims are of the disc type. They can be used for tyres with or without tubes.

Hubs

The front wheel and rear wheel hubs (Fig. 77–1) are of the same type. The stub axle (11) is journalled in the hub (10) by means of two tapered roller bearings (3 and 4). Oil sealing is provided by a sealing ring (1), which seals against a wear ring (2) and against the stub axle, as well as a sealing ring (9) which seals against the gear wheel (5).

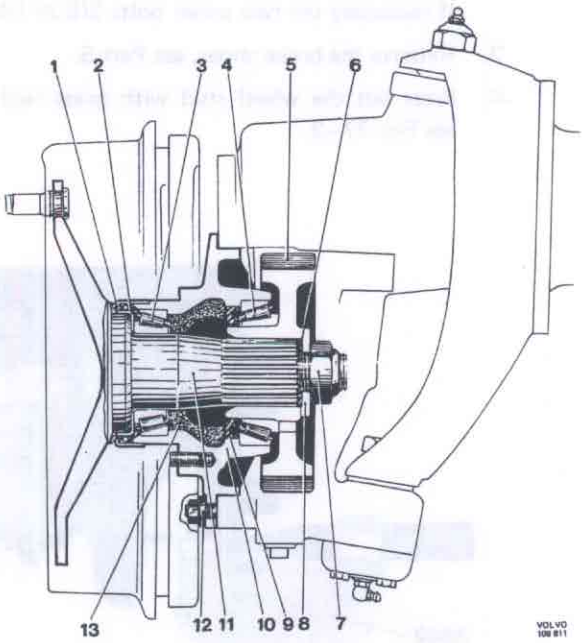


Fig. 77–1. Hub

1. Sealing ring
2. Wear ring
3. Outer bearing
4. Inner bearing
5. Gear wheel
6. O-ring
7. Nut
8. Washer
9. Sealing ring
10. Hub housing
11. Stub axle
12. Retaining nut
13. Grease

Service Procedures

Wheels

Removing a wheel

1. Slacken the wheel nuts several turns.
2. Jack up the front or rear end with a jack so high that the wheel to be removed comes off the ground.
3. Unscrew the wheel nuts and lift off the wheel.

Fitting a wheel

1. Clean thoroughly the contact surfaces on the rim and wheel nuts.
2. Lift the wheel in position and screw on the wheel nuts a couple of turns or so.
3. Lower the vehicle and tighten up the wheel nuts crosswise a little at a time until all are tightened to a torque of 160–210 Nm (16–21 kpm = 115–152 lbftf).

Replacing a wheel stud

Special tool:

2862 Press tool

1. Jack up the vehicle.
2. Remove the wheel, adjust down the brake shoes and remove the brake drum.

   If necessaey use two puller bolts 3/8-24 UNF.
3. Remove the brake shoes, see Part 5.
4. Press out the wheel stud with press tool 2862, see Fig. 77–2.

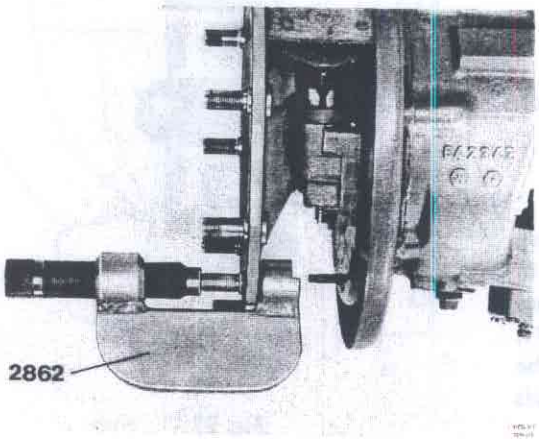


Fig. 77–2. Pressing out the wheel stud

5. Press in the new wheel stud with press tool 2862, see Fig. 77–3.

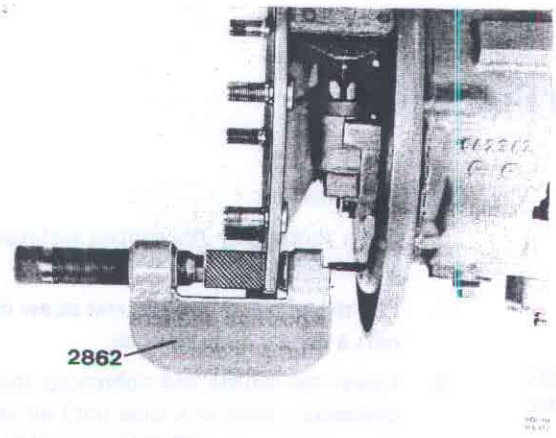


Fig. 77–3. Pressing in the wheel stud

6. Fit the brake shoes, see Part 5.
7. Fit the brake drum and adjust up the brake shoes.
8. Mount the wheel and tighten the wheel nuts crosswise to a torque of 160–210 Nm (16–21 kpm = 115–152 lbftf).
9. Lower the vehicle.

Hubs

Special tools:

6132 Press washer
2564 Drift
1801 Standard handle
2490 Drift
2337 Drift
6134 Puller
6107 Drift
6106 Sleeve
6130 Drift
2910 Sleeve
2022 Sleeve

Checking, adjusting the wheel bearings

1. Jack up the vehicle.
2. Remove the wheel for the hub or hubs to be checked.
3. Apply a dial indicator as shown in Fig. 77–4. Press in and rotate the hub, zero-set the dial indicator. Pull out and rotate the hub, read off any clearance in the bearings. If clearance exceeds 0.08 mm (0.0032"), adjust the wheel bearings as follows:

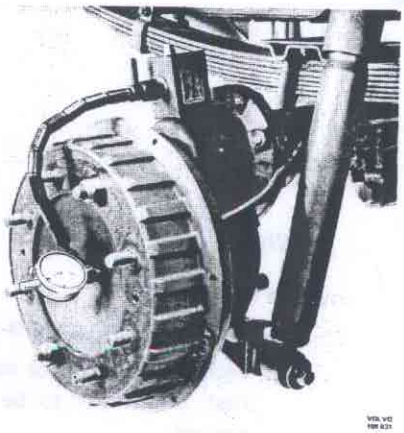


Fig. 77–4. Checking wheel bearing clearance

4. Remove the hub according to the instructions given under the heading "Removing a hub".
5. Disassemble the hub according to the instructions given under the heading "Disassembling a hub".
6. Check the wheel bearings. If damaged, replace the bearings according to the instructions given under the heading "Replacing wheel bearings".
7. Assembling, which also includes adjusting, is to be carried out according to the instructions given under the heading "Assembling a hub".
8. Installing is according to the instructions given under the heading "Installing a hub".

Removing a hub

1. Jack up the vehicle.
2. Remove the wheel for the hub concerned.
3. Drain the oil in the wheel carrier housing.
4. Disconnect the brake lines and plug them.
5. Unscrew the nuts between hub and wheel carrier housing.
6. Remove the plug on the reverse side of the wheel carrier housing and screw in a M10 bolt with thread length minimum 50 mm (2"), see Fig. 77–5. Screw in the bolt so that the hub releases fully.

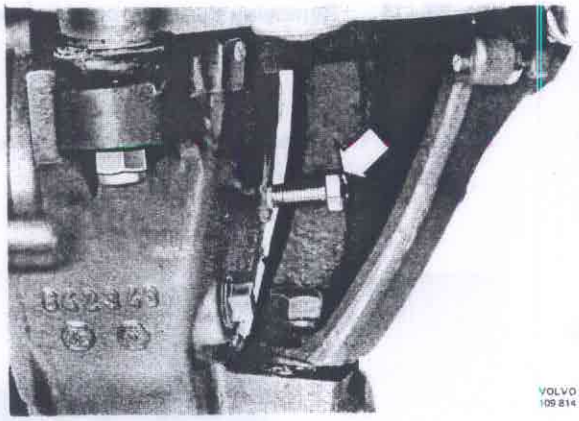


Fig. 77–5. Pressing out the hub

Disassembling a hub

1. Knock up the lock ring on the nut (7, Fig. 77–1) with a hammer and drift and unscrew the nut. Remove the washer (8) and the O-ring (6).
2. Pull off the gear wheel (5) with the Kukko standard jackknife 20–2, see Fig. 77–6. Lift off the hub (10) together with the brake backing plate.

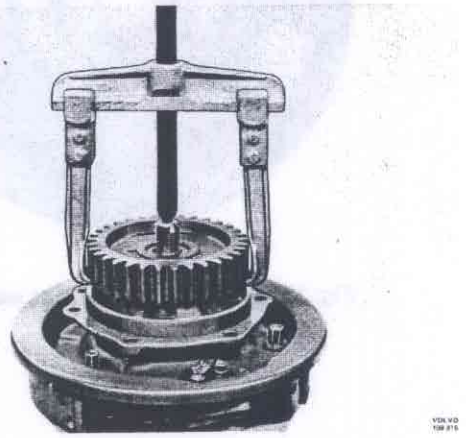


Fig. 77–6. Removing the gear wheel

3. Clean all the parts thoroughly. Clean the surface between the hub and the wheel carrier housing well so that no old sealing agent remains.

Replacing wheel bearings

1. Press out the inner bearing outer ring and inner sealing ring with two 6132, drift 2564 and standard handle 1801, see Fig. 77–7. Place tool 6132 as shown in Fig. 77–8.

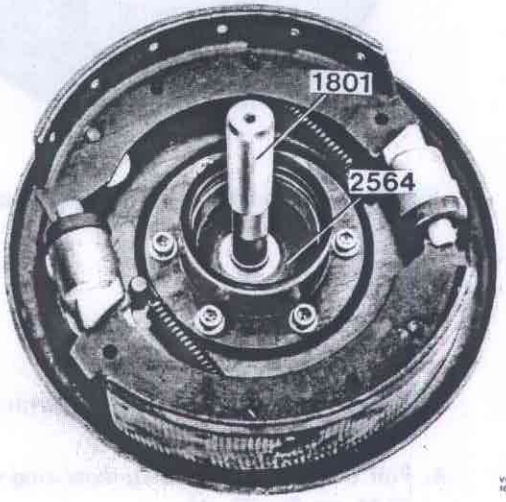


Fig. 77–7. Removing the inner bearing outer ring and inner sealing ring

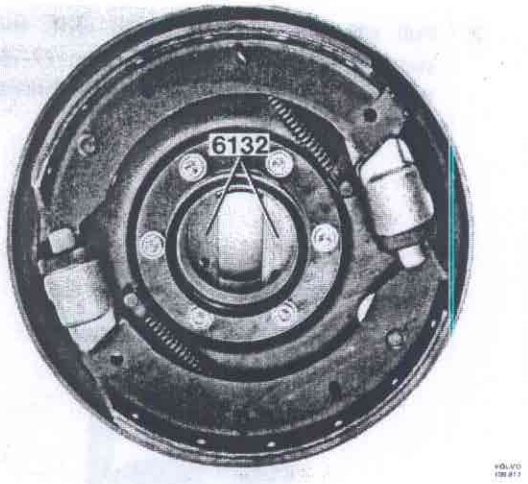


Fig. 77–8. Location of thrust washers 6132

2. Press out the outer bearing outer ring with drift 2490 and standard handle 1801, see Fig. 77–9.

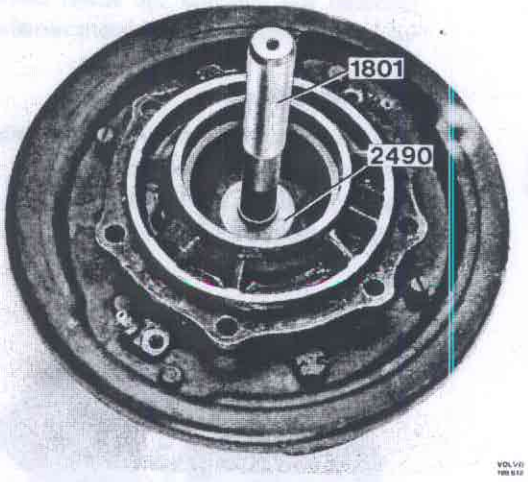


Fig. 77–9. Removing the outer bearing outer ring

3. Knock out the outer sealing ring with drift 2337, see Fig. 77–10.

4. Pull off the outer bearing inner ring with puller 6134, see Fig. 77–11.
IMPORTANT! Knock down the ring on the puller well.

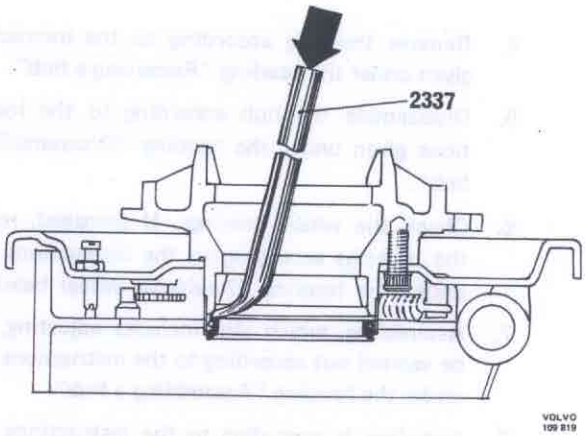


Fig. 77–10. Removing the outer sealing ring

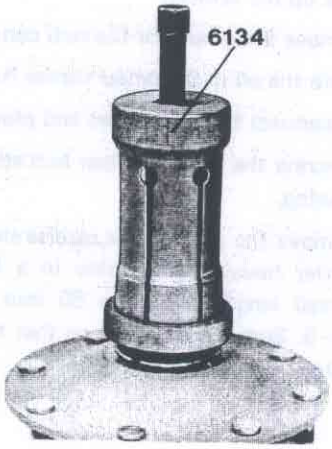


Fig. 77–11. Removing the outer bearing inner ring

5. Tap off the inner bearing inner ring with a 6 mm (1/4") drift, see Fig. 77–12.

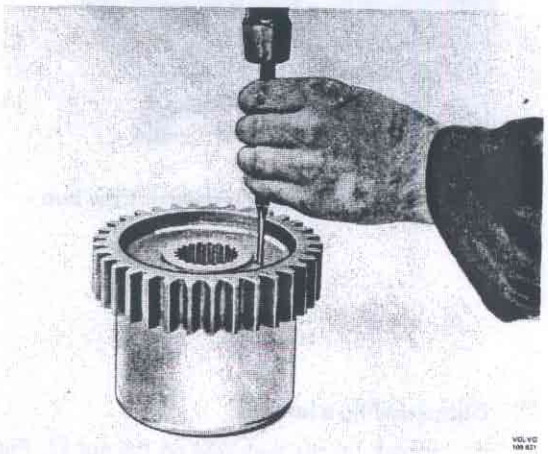


Fig. 77–12. Removing the inner bearing inner ring

6. Check the contact surfaces of the sealing rings according to the instructions given under the heading "Replacing sealing rings".
7. Press on the outer bearing inner ring with sleeve 6106, see Fig. 77–13.

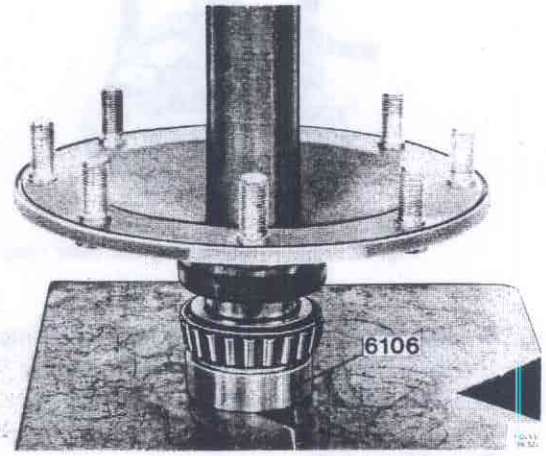


Fig. 77–13. Installing the outer bearing inner ring

8. Press on the inner bearing inner ring with sleeve 6106, drift 2490, and standard handle 1801, see Fig. 77–14.

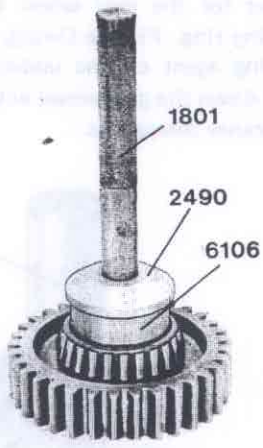


Fig. 77–14. Installing the inner bearing inner ring

9. Tap in the inner sealing ring with drift 6130, see Fig. 77–15. The sealing ring should be 2 mm (5/64") under the outer ring. Press in the inner bearing outer ring with drift 6107 and standard handle 1801, see Fig. 77–16.

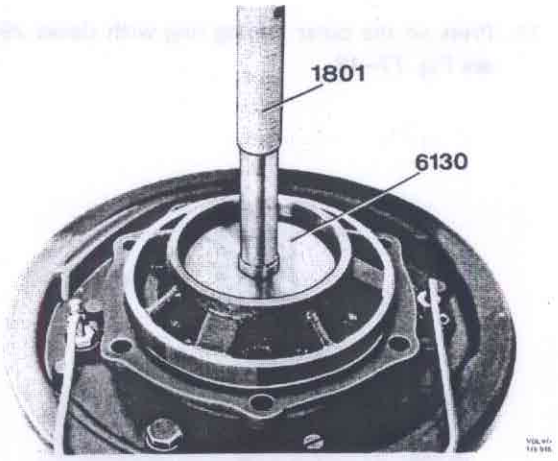


Fig. 77–15. Installing the inner sealing ring

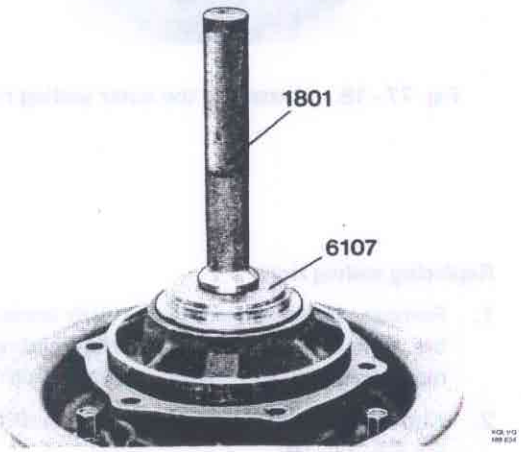


Fig. 77–16. Installing the inner bearing outer ring

10. Press on the outer bearing outer ring with drift 6107 and standrad handle 1801, see Fig. 77–17.

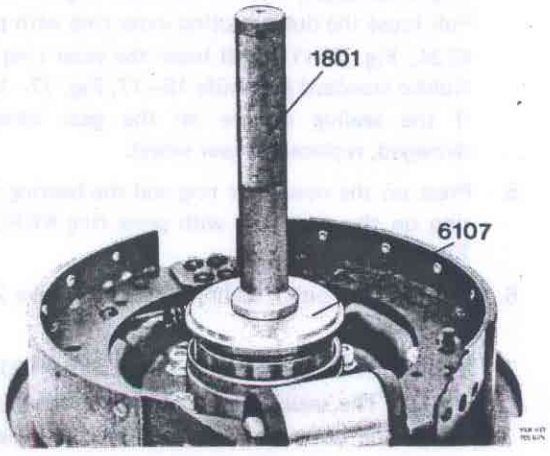


Fig. 77–17. Installing the outer bearing outer ring

11. Press on the outer sealing ring with sleeve 2910, see Fig. 77–18.

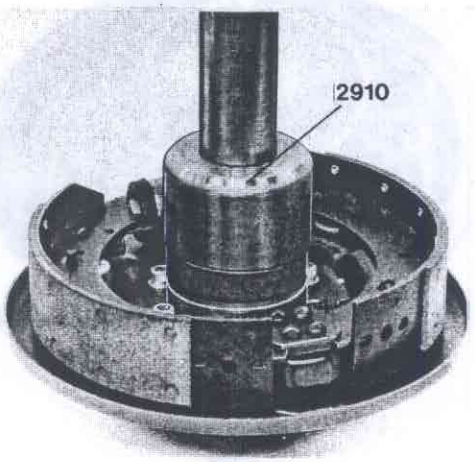


Fig. 77–18. Installing the outer sealing ring

Replacing sealing rings

1. Remove and disassemble the hub according to the instructions given under the headings "Removing a hub" and "Disassembling a hub".
2. Knock out the outer sealing ring with drift 2337, see Fig. 77–10.
3. Press out the inner sealing ring and inner outer ring with two 6132, drift 2564 and standard handle 1801, see Fig. 77–7. Place 6132 as shown in Fig. 77–8.
4. Check the sealing surfaces of the sealing rings. If the sealing surface on the stub axle is damaged, replace the stub axle. If the surface on the wear ring is damaged, replace the wear ring as follows: Pull loose the outer bearing inner ring with puller 6134, Fig. 77–11. Pull loose the wear ring with Kukko standard jackknife 15–17, Fig. 77–19. If the sealing surface on the gear wheel is damaged, replace the gear wheel.
5. Press on the new wear ring and the bearing inner ring on the stub axle with press ring 6106, Fig. 77–13.
6. Press on the outer sealing ring with sleeve 2910, Fig. 77–18.
7. Tap in the inner sealing ring with drift 6130, Fig. 77–15. The sealing ring should lie 2 mm (5/64") below the outer ring. Press in the inner bearing outer ring with drift 6107 and standard handle 1801, Fig. 77–16.

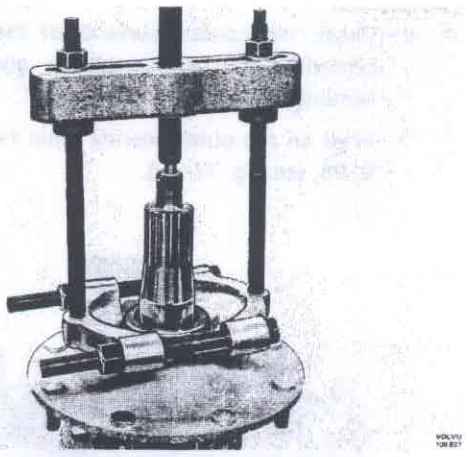


Fig. 77–19. Removing the wear ring

8. Assemble and install the hub according to the instructions given under the headings "Assembling a hub" and "Installing a hub".

Assembling a hub

1. Grease all bearings and sealing rings. Fill half the space in the hub with wheel bearing grease according to 13, Fig. 77–1. Grease the splines on the stub axle.
2. Place the hub with brake backing plate on the stub axle.
3. Press down the gear wheel with sleeve 2022 so far that the hub has a clearance of a small fraction of an inch, Fig. 77–20, while rotating the hub at the same time in order to make it easier for the gear wheel to fit into the inner sealing ring. Fit the O-ring, the washer with the sealing agent on the underside and a new nut. Pull down the gear wheel with the nut so that the clearance disappears.

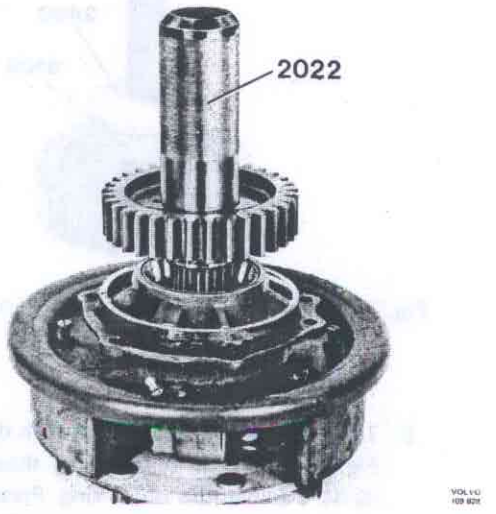


Fig. 77–20. Installing the gear wheel

4. Fit a spring balance like the one shown in Fig. 77–21. Note the reading on the balance. This shows the friction of the sealing rings.

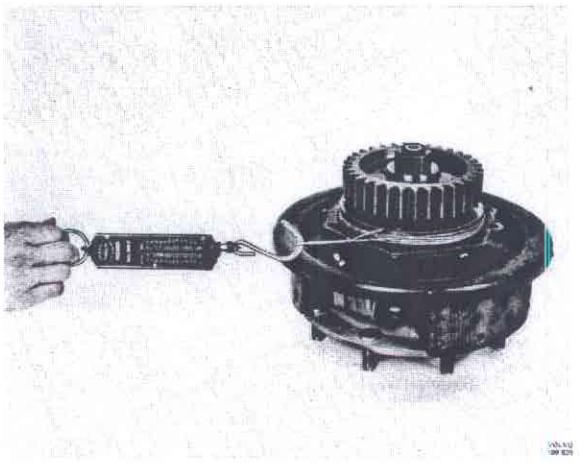


Fig. 77–21. Measuring the pre-load on hub

5. Tighten the nut so that the clearance disappears and changes to pre-loading. Check the pre-loading with the spring balance according to Fig. 77–21. Correct load on the spring balance should be the value obtained in point 4 plus 42–48 N (4.2–4.8 kp = 9.2–10.5 lbf) for new bearings. For run-in bearings, the load should be that obtained in point 4 plus 24–28 N (2.4–2.8 kp = 5.3–6.2 lbf).
6. When correct pre-load has been obtained, lock the nut by peening the edge in the shaft recess.

Installing a hub

1. Coat the sealing surfaces on the hub and wheel carrier housing with sealing agent.
2. Fit the hub and tighten up all retaining nuts.
3. Disconnect and plug the brake lines and bleed the wheel cylinders. Remove the contact for the pressure difference, see Fig. 77–22, during the bleeding. If a bleeder apparatus is used, the working pressure should be 0.2 MPa (2 kp/cm^2 = 28 lbf/in^2). For more detailed instructions concerning bleeding, see Part 5.

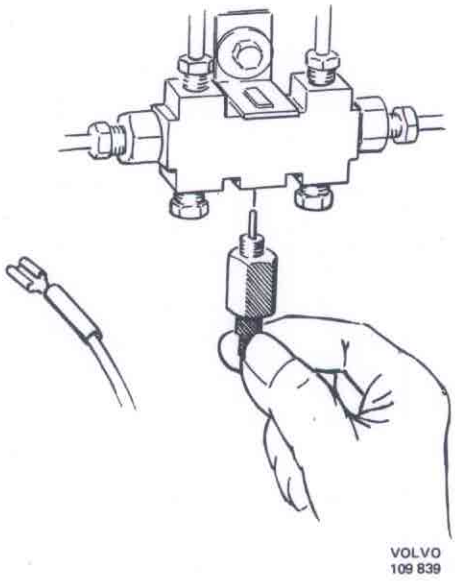


Fig. 77–22. Contact for pressure difference

4. Screw in the plug on the reverse side of the wheel carrier housing and fill with oil.
5. Mount the wheel, tighten up the nuts crosswise and lower the vehicle.

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VOLVO SERVICE

PART 8

BODY

C3-series

SERVICE MANUAL

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Group 87 Cab and platform

Description 1
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GROUP 83 DOORS AND ROOF HATCH

Description

The doors are constructed of an outer plate provided with powerful edge reinforcements. Each door has a replaceable upper section and a lower section with retainers and bolts. The doors have also insulation and interior panelling. Hinges are bolted to the lower section of the door and body.

The door lock is shown on Figs. 83-1 and 83-3 and the door stop on Fig. 83-4.

The roof hatch is shown on Fig. 83-2.

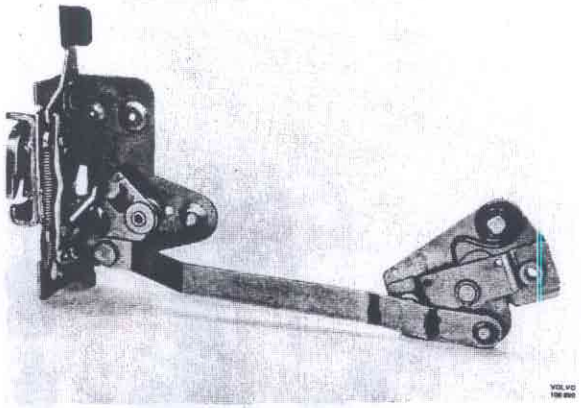

Fig. 83-1. Door lock (right-hand)

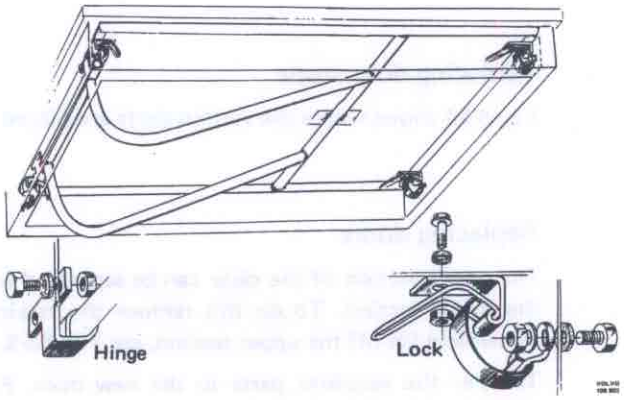

Fig. 83-2. Roof hatch

Service Procedures

Replacing door locks

1. Remove the handle and the lower door panel with strips.
2. Set the lock to the locked position, see Fig. 83-3.
3. Remove the five retaining screws and pull forward the lock.
4. Fit the new lock in the "locked position". Check the function after having tightened up the retaining screws.
5. Re-install the panel and the strips.

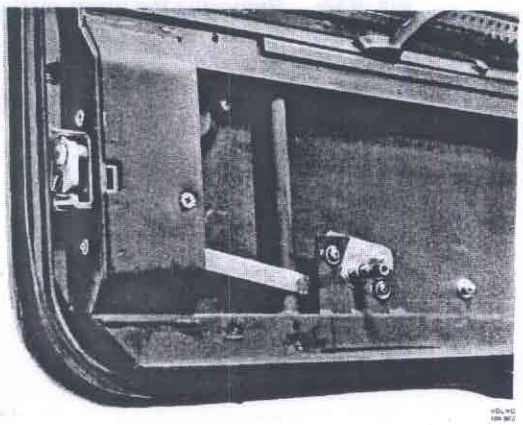

Fig. 83-3. Door lock (left-hand)

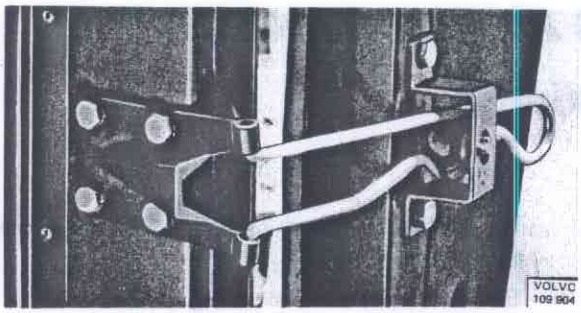

Fig. 83-4. Door stop

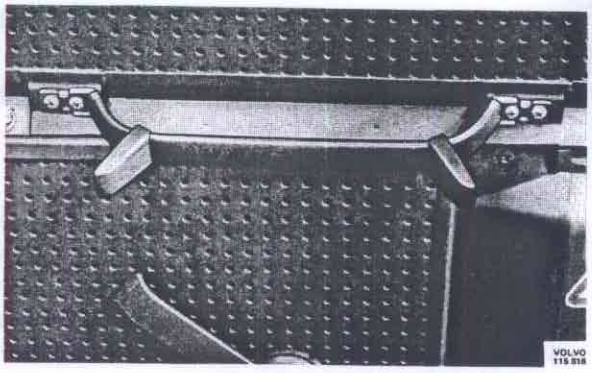

Fig. 83-6. Handle parts

Replacing door stops

Fig. 83-4 shows where the various parts are placed.

Replacing doors

The upper section of the door can be separated from the lower section. To do this remove the retaining screws and lift off the upper section, see Fig. 83-5.

Transfer the requisite parts to the new door. Figs. 83-6 and 83-7 show some of the parts.

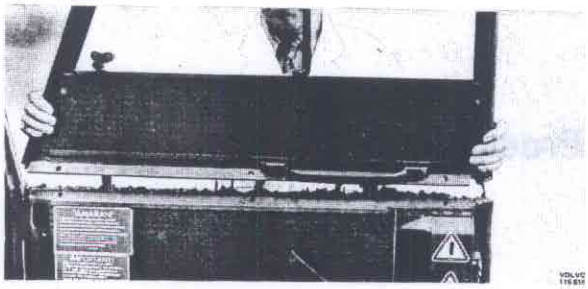

Fig. 83-5. Removing the upper section

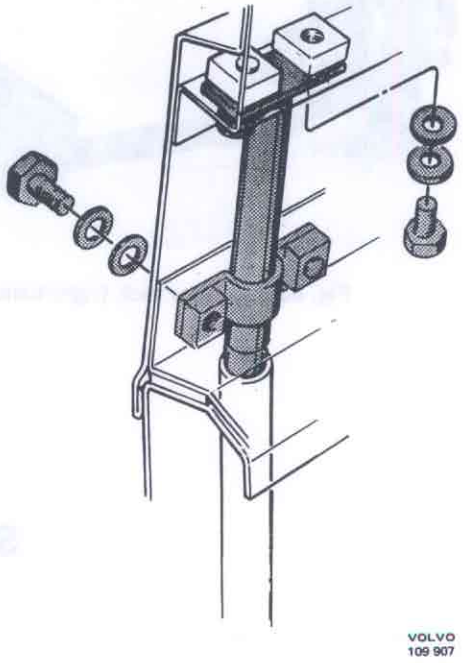

Fig. 83-7. Door parts

GROUP 84 WINDOWS AND WEATHERSTRIPS

Service Procedures

DOOR WINDOWS

Replacing a window

Remove the retaining screws for the upper slide rail. Carefully pull out the rail and windows. Install the rail and new windows. Tighten up the rail retaining screws.

Replacing the front pawl

The design of the front pawl is shown on Fig. 84-1. To replace lock the pawl in the lifted-up position.

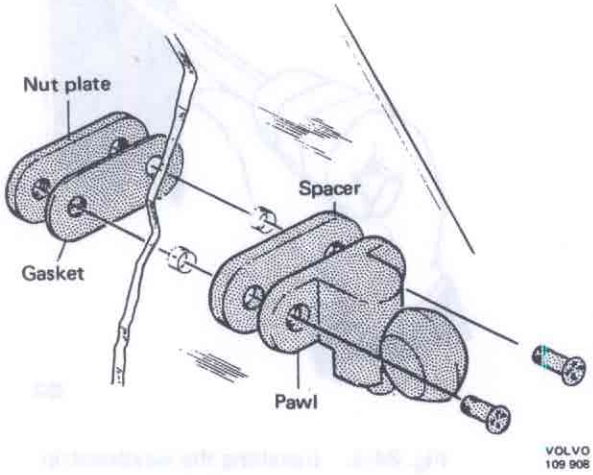

Fig. 84-1. Front pawl

Replacing the rear pawl

1. Remove the retaining screws for the slide rail.
2. Carefully pull out the rail and windows.
3. Drill out the rivets.
4. With new rivets secure the pawl firmly in position.
5. Re-install the windows and rail in position and tighten up the screws.

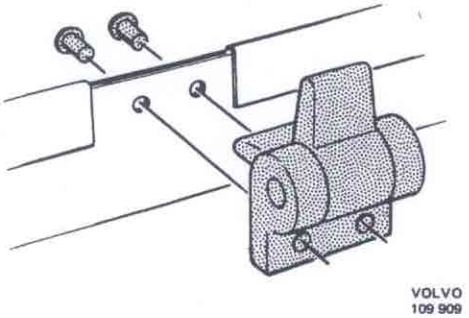

Fig. 84-2. Rear pawl

REAR WINDOW AND WINDSCREENS

Replacing

1. Remove the rubber seal adhesion from the plate.
2. Use force and press the glass outwards at the corner until the rubber seal releases from the guide edge on the body.
3. Remove the rubber seal and clean the seal and plate from sealing compound. Replace damaged or hard sealing.
4. Check to make sure the guide edge is not warped. Straighten it if necessary.
5. Place the glass in the rubber seal. Place a cord (suitably of terylene) in the seal groove for the plate edge, see Fig. 84-3.
6. Hold the glass pressed against the window opening and carefully pull out the cord from the inside. The rubber seal should thereby fit into position, see Fig. 83-4. It may sometimes be necessary to adjust the position of the glass with the palm of the hand. If the cord is stiff to pull, then there is risk of damaging the sealing.
7. If necessary adjust the location of the rubber seal. For windscreens and rear window seal round with sealing cement. Make sure that the cement fills the joints at the glass and plating.

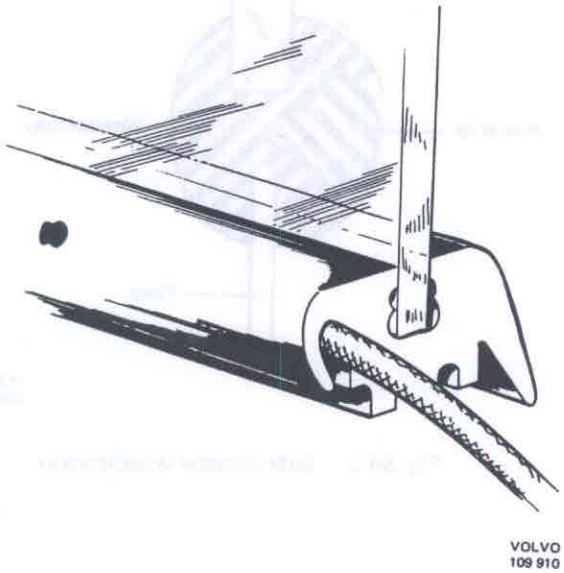

Fig. 84-3. Installing the cord

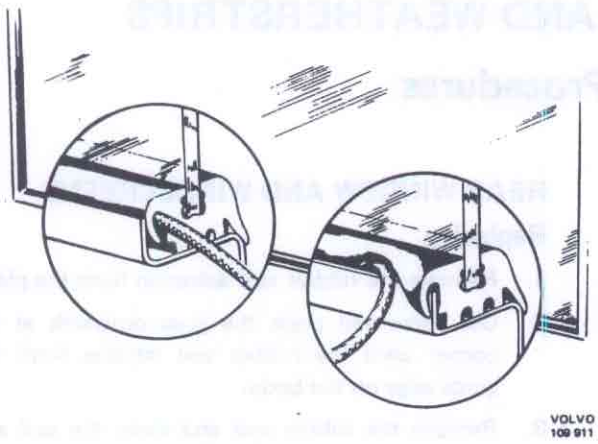

Fig. 84-4. Installing the strip

SIDE WINDOWS

Replacing

Pull out the key strip. Press out the window but let the sealing strip remain in the plate.

Fit the new window in the sealing strip groove. Re-fit the key strip. Usually a special tool is used for this purpose, but the glass can also be fitted with screwdrivers after the key strip has been coated with soap solution.

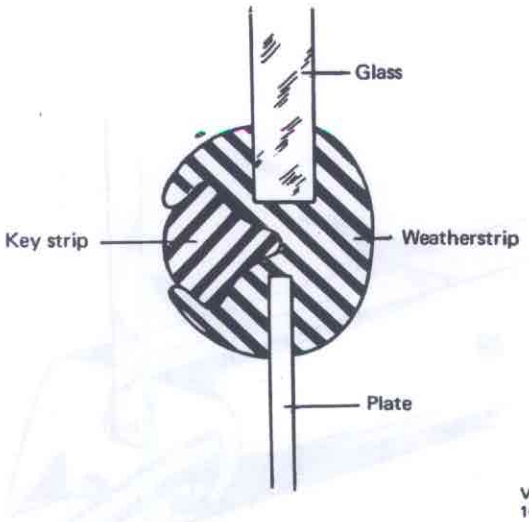

Fig. 84-5. Side window weatherstrip

WEATHERSTRIPS

Replacing

Remove the weatherstrip by pulling it outwards so that it releases from the rail.

When installing, place one of the edges in position in the rail and press the other down into the rail with a putty knife. The putty knife is moved along the rail as shown in Fig. 84-6.

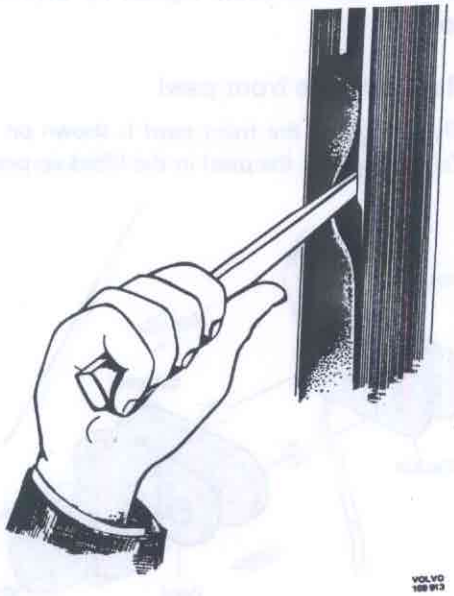

Fig. 84-6. Installing the weatherstrip

GROUP 85 SEATS AND VENTILATION SYSTEM

Description

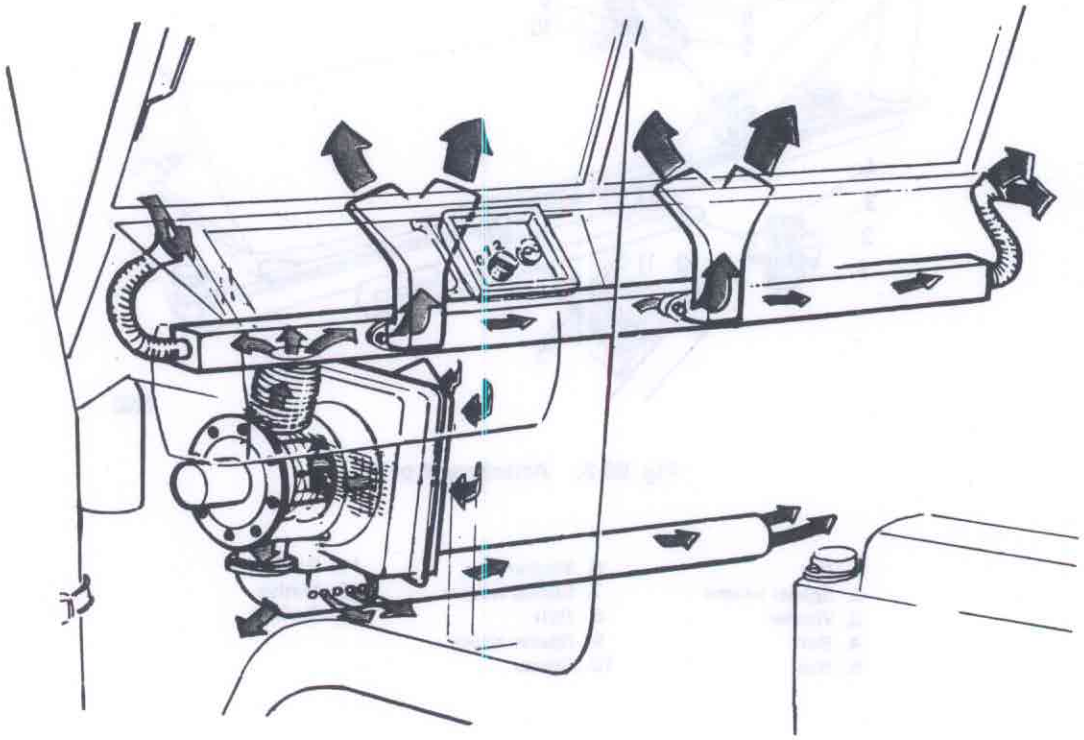

Fig. 85-1. Ventilation system

VENTILATION SYSTEM

See Fig. 85-1 for the lay-out of the system.

The air intake is placed between the radiator grille and the radiator. Air is sucked into the fan housing by means of the fan. It is then discharged to the defroster nozzles and the floor vents.

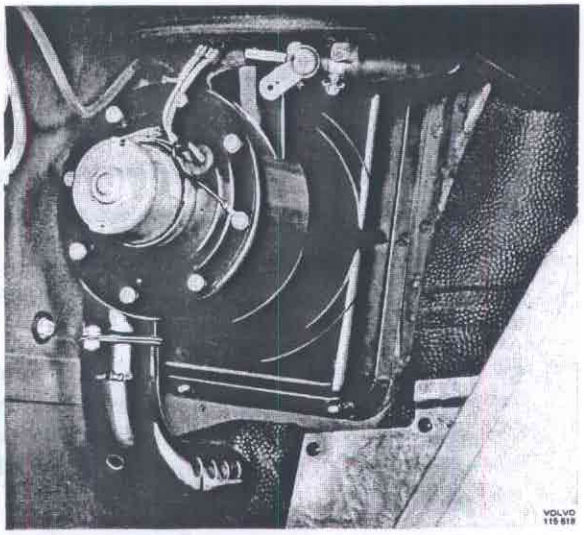

Fig. 85-2. Fan motor installed

Service Procedures

SEATS

The seat attachemnts are shown on Fig. 85-3.

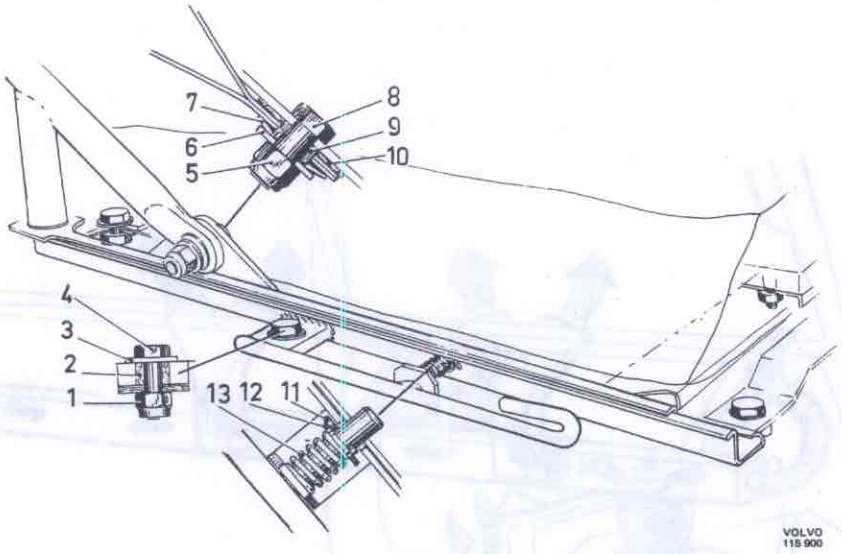

Fig. 85-3. Attachment parts

1. Nut
2. Spacer wleeve
3. Washer
4. Bolt
5. Nut
6. Washer
7. Spring washer
8. Bolt
9. Spacer sleeve
10. Spacer
11. Split pin
12. Washer
13. Spring

VENTILATION SYSTEM

Replacing motor and fan

1. Disconnect the electric cables from the motor.
2. Remove the screws for the fan cover.
3. Lift off the cover with fan and motor.
4. Release the clamp and remove the motor from the cover.
5. Fit the rubber ring and cover on the motor. Connect up the cable harness according to Fig. 85-4. Tighten the clamp when the adjustment has been made to the measurement 86 mm (3.5"), see Fig. 85-5.
6. Fit the cover with motor. Connect up the electric cables.

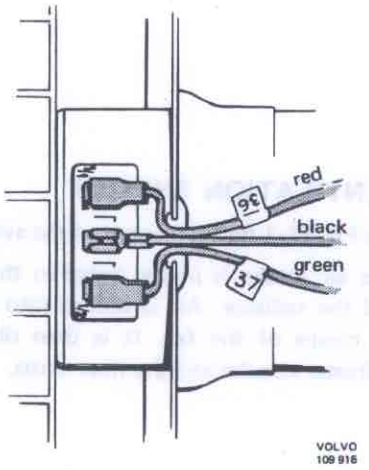

Fig. 85-4. Electrical connections

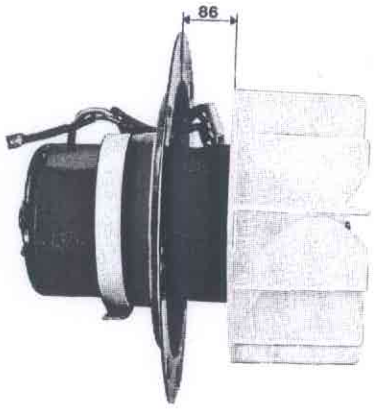

Fig. 85-5. Motor with cover

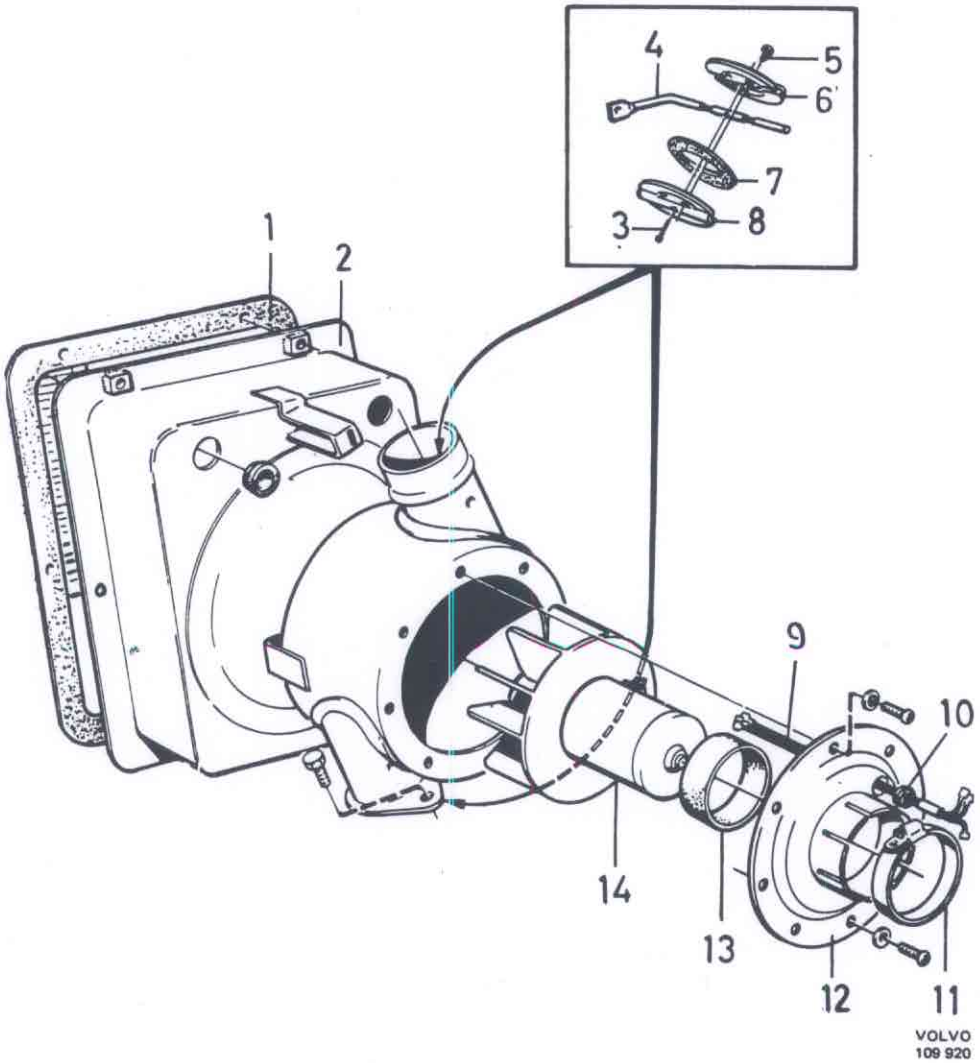

Fig. 85-6. Ventilation system parts

1. Sealing strip
2. Fan housing
3. Pin
4. Disc spindle
5. Screw
6. Disc half
7. Gasket
8. Disc half
9. Cable harness
10. Bushing
11. Clamp
12. Cover
13. Rubber ring
14. Motor with fan

GROUP 87 CAP AND PLATFORM

Description

The cab can be said to be made up of two main sections, a floor section and hardtop, made up of a number of form-pressed steel plates.

Among other things, the floor section consists of the following sections which are welded together: front floor, wheel housing, engine casing, firewall, side plates and front end with dashboard.

The hardtop forms an integral unit made up of roof, sides and windscreen frame welded together.

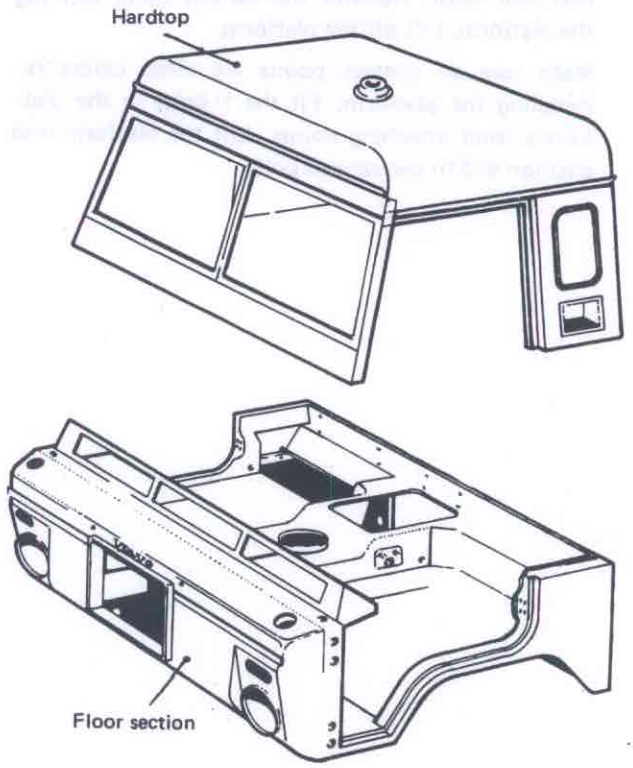

Fig. 87-1. Cab

Service Procedures

The procedure for repairing the cab (or body) will depend on the nature of the damage as well as the availability of tools and parts. The following general instructions apply:

Welding

When about to carry out any electric welding, first disconnect both battery cables. Also disconnect the cable from the charging regulator, see Fig. 87-2. Connect up the welding unit as near the welding point as possible.

Sealing

Use sealing agent Bostik Silikon or corresponding for the bolting.

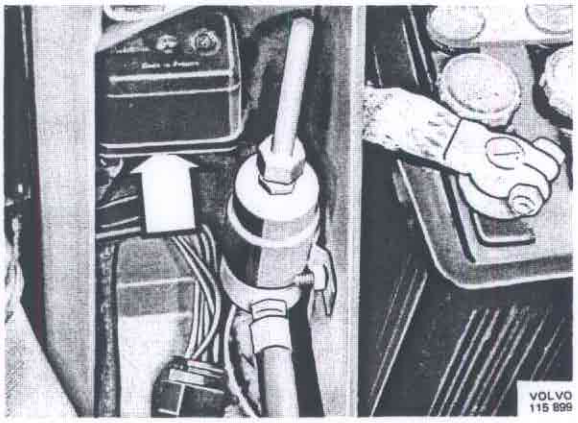

Fig. 87-2. Charging regulator connection

Platform

To remove the platform, fix one end of the hoist straps to the platform lift eyelets, see Fig. 87-3. Then fix the other end of the straps to the hooks on the overhead hoist. Remove the various bolts securing the platform. Lift off the platform.

Make sure all contact points are clean before re-installing the platform. Fit the U-bolts in the platform's front attaching points. Lift the platform into position and fit the various bolts.

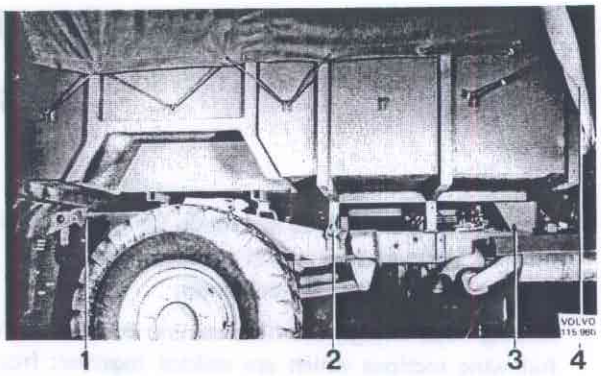

Fig. 87-3. Removing the platform

1. Bolting
2. Bolting
3. U-bolts
4. Hoist straps

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