WORKSHOP MANUAL

SYSTEM DIAGNOSIS

Diesel Fork Truck

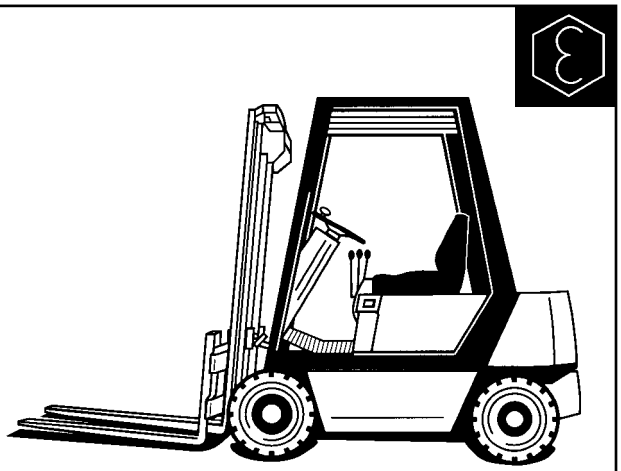
M15

LPG Fork Truck

M15T

STILL & SAXBY S.A.R.L.
Rue des Frères Lumière
F-77107 Meaux
Tel : 01 64 36 33 00

146975 - 10.90 **GB**



M15

Manual Organization and Utilization

Organization

The M15 Workshop Manual includes the repair instructions divided into assembly groups 01 to 25.

The Workshop Manual is designed as a supplementable collection of sheets for filling in a STILL-SAXBY binder.

The contents are divided similarly as the assembly group system known from the Spare Parts and Assembly List.

The number of the respective group is located at the top outer corner of each page so that the groups can be located easily. The assembly groups are separated by coloured pages which contain the table of contents for the following assembly group.

If required, there follows the table with important data for servicing, which even the experienced mechanic must read.

The construction and function of components/assembly groups are described.

The described work procedures includes notes, hints and explanatory pictures.

Objectives of the Manual

In future, the user will only receive Workshop Manuals for the different vehicle types (in this case, M15).
these are to replace the service bulletins, training letters and circuit diagrams (circuit diagram binder).

The Workshop Manual has the following advantages :

User friendliness :
Easy, quick, accurate and low error rate use of the Workshop Manual without needing to remember or reflect anything.

Accurate and unproblematic updating :
The form and division of the book as a collection of loose-leaf sheets results in an optimum and low-error method of filing information.

Updating

If single sheets or groups of sheets no longer reflect the to-date engineering state or the state of knowledge, updates will be supplied.

For organisational reasons, this can only be done within the STILL-SAXBY organisation.

The following types of updates are possible :

1. Replacement of a single sheet
   You remove the former sheet and replace it by the new one (for example in case of misprints, figure changes).

2. Inserting additional sheets
   These sheets have the page number of the page which is to precede it. For example, the sheet with the page numbers 6a and 6b should be inserted behind page 6. Then page 7 should follow (for example, expansions or product improvements).

3. Supplements/Multiple Supplements
   Additional sheets which only apply starting with a certain serial number or production date are printed on coloured paper. The previous sheets, in this case, must remain in the book since they continue to be valid for the first serial numbers (for example, in case of multiple product improvements).

Each update also includes filing instructions for the recipient, i.e. where to insert the new sheets and it the former sheets are to be remove.

Issue : August 1991
Identification Nr. : 146 975

Notes, Imprint

To be followed when working with this Workshop Manual

This Workshop Manual contains the to-date standard types as well as a few especially widely distributed variants. Differences between the series are noted at the appropriate place in the Workshop Manual.

Many pages in this manual are designated M16 in the header. These pages are valid for truck models M15 or M15T.

No warranty will be given for work according to this Workshop Manual. The STILL-SAXBY conditions of warranty remain unaffected.

Publisher :

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STILL-SAXBY continually improves its industrial trucks. We reserve the right to make changes, and the data, illustrations and descriptions in this Workshop Manual do not express or imply a warranty that the products necessarily conform to the illustrations or descriptions.

Notes on repair

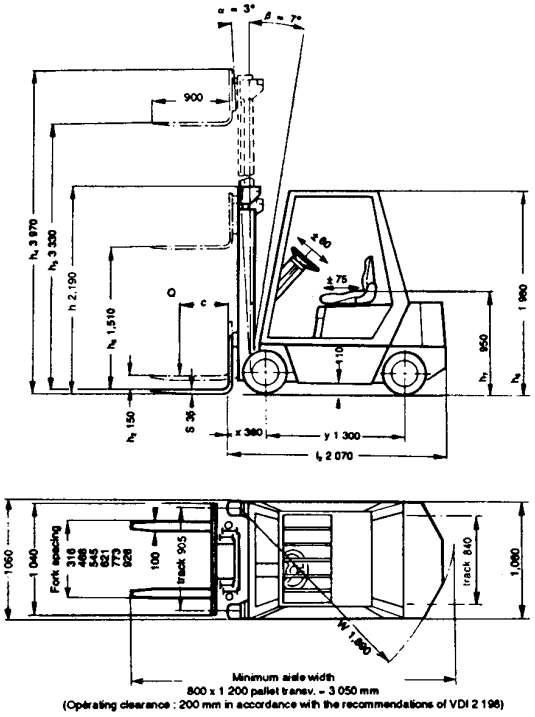
Table of Component Groups

00	General
01	Chassis
02	Running Axle
03	Drive Gear
04	Wheels and Tyres
05	Driving Controls
06	Steering
07	Brakes
08	Electrical Equipment
09	Lighting and Instruments
10	Hydraulic System
11	Engines
20	Mast
25	Tilt Cylinders

Table of Contents Page

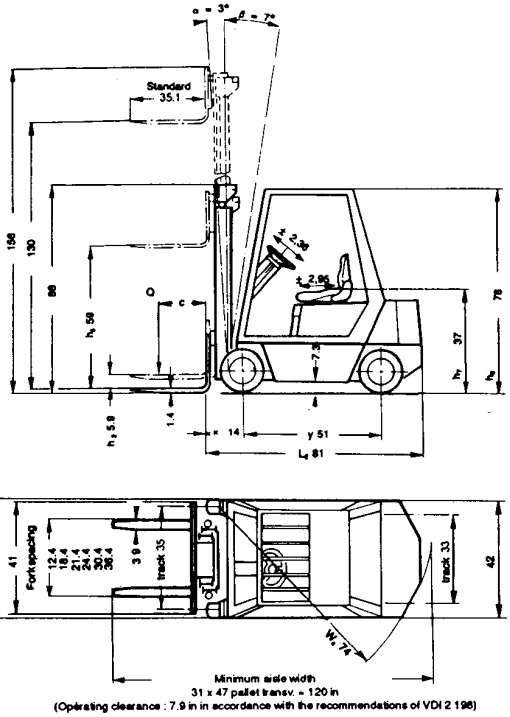
Data Sheet M15 00-1
Data Sheet M15 T 00-3
Data Sheet M15, M15 T new 00-5

Dimensions in mm



Minimum aisle width
800 x 1 200 pallet transv. – 3 050 mm
(Operating clearance : 200 mm in accordance with the recommendations of VDI 2 198)

Dimensions in Inches



Minimum aisle width
31 x 47 pallet transv. – 120 in
(Operating clearance : 7.9 in in accordance with the recommendations of VDI 2 198)

Notes on

Line 31 Acceleration time:
The time the fork truck requires to cover – from rest to top speed – a distance of 15 m on a dry level surface.

Line 58 Noise level:
Average noise peak at operator's ears (LAm = average noise peak) to DIN 45 653, Section 36, Appendix A covering measuring point at ear level. Fork trucks fitted with overhead guard but without rigid all weather cab or removable weather protection.

Mast unit variations

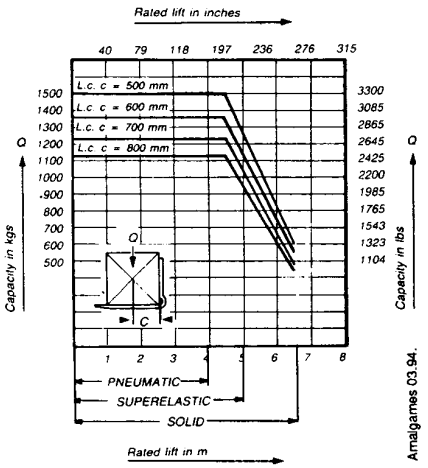
Mast features		Telescopic · Open centre · Part free lift				Niho · Open centre · Full free lift			Triplex · Open centre · Full free lift		
height of lift	h_3 mm	2 730	3 330	3 730	4 230	2 700	3 300	3 700	4 190	4 790	5 490
height, mast lowered	h mm	1 890	2 190	2 390	2 640	1 840	2 140	2 340	1 940	2 140	2 440
height, mast raised	h_4 mm	3 370	3 970	4 370	4 870	3 340	3 940	4 340	4 845	5 445	6 145
free lift	h_2/h_3 mm	150				1 210	1 510	1 710	1 310	1 510	1 810
Mast tilt angle	α / β ± °	3°		7°		3°		7°	1°30		5°30
Tyres solid		×		×		×			×		×
pneumatic		×				×					
superelastic		×		×		×			×		
length to front face of forks L_2	mm	2 070				2 070			2 095		
frame width — overall B	mm	1 060				1 060			1 060		
from centre of front axle to front face of forks (x)	mm	360				360			385		
Aisle width Ast*) pallet 800 × 1 200 ⊥ 1 000 × 1 200	mm	3 050		3 250		3 050		3 250	3 075		3 275

height of lift	h_3 in	107	131	147	166	106	130	145	165	188	216
height, mast lowered	h in	74	86	94	103	72	84	92	76	84	96
height, mast raised	h_4 in	132	156	172	191	132	155	171	190	214	242
free lift	h_2/h_3 in	5.9				48	59	67	51	59	71
Mast tilt angle	α / β ± °	3°		7°		3°		7°	1°30		5°30
Tyres solid		×		×		×			×		×
pneumatic		×				×					
superelastic		×		×		×			×		
length to front face of forks L_2	in	81				81			82		
frame width — overall B	in	42				42			42		
from centre of front axle to front face of forks (x)	in	14				14			15		
Aisle width Ast*) pallet 31 × 47 ⊥ 39 × 47	in	120		128		120		128	121		129

*) without allowance for operating clearance

Our products and specifications are subject to improvements and changes without notice

Capacity Chart



Amalgames 03.94.

STILL GmbH - International Division

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Complying with the VDI guidelines 2198, the technical specifications quoted below apply to the standard truck only. The specifications relating to tyres, mast types and ancillary equipment other than those figuring on the technical specification sheet, and where indicated in the quotation, may differ from the data marked with an ◦.

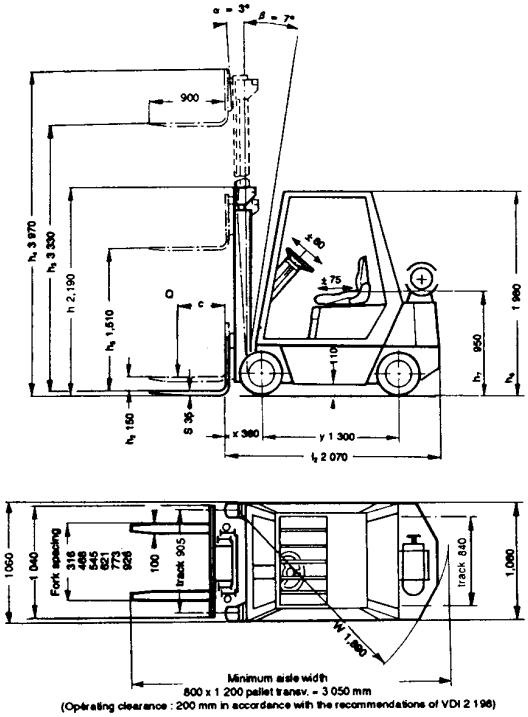
Diesel Fork Truck Series M 15

3300 lbs Imperial — **1.5 t** Metric

	1	Manufacturer					STILL & SAXBY			
Characteristics	2	Model	Manufacturer's designation				M 15			
	3	Carrying capacity	Q rated capacity (basic capacity)			lb/kg	3300 +		1500 +	
	4	Load centre	c from front face of forks			in/mm	20		500	
	5	Power supply	Battery, diesel, L.P.G., mains				Diesel		Diesel	
	6	Type of control	Pedestrian, stand-on, rider seated				Rider seated		Rider seated	
	7	Tyre equipment	S = solid, P = pneumatic, SE = superlastic		front	rear	S/P/SE	S/P/SE	S/P/SE	S/PSE
	8	Wheels (x = drive wheel)	Number front	rear			2x	2	2x	2
Dimensions	9	Lift double mast	h_3 height of lift			in/mm	130 +		3330 +	
	10		h_2 standard free lift			in/mm	5,9 +		150	
	11		h_5 full free lift			in/mm	59 +		1510 +	
	12	Fork carriage	to DIN 15 173 A/B/no (FEM...)				DIN 15 173 B (FEM II B)		DIN 15 173 B (FEM II B)	
	13	Fork (standard)	Length x width x thickness			mm	35.1 x 3.9 x 1.4		900 x 100 x 35 +	
	14	Mast tilt angle	forward	backward		degree	3 +	7 +	3 +	7 +
	15	Overall dimensions	L_2 length to front face of forks			in/mm	81 +		2070 +	
	16		B frame width - overall			in/mm	42 +		1060 +	
	17		h height, mast lowered			mm	86 +		2190 +	
	18		h_4 height, mast raised			in/mm	156 +		3970 +	
	19		h_6 height to top of overhead guard			in/mm	78 +		1980 +	
	20		h_7 seat height			in/mm	37 +		950 +	
	21	Turning radius	W_a			mm	74 +		1890 +	
	22	Load distance	x From centre of front axle to front face of forks			in/mm	14 +		360+	
	23	Aisle width	800 x 1,200 pallet (trans.)	1,000 x 1,200 pallet (trans)		in/mm	120* +	128* +	3050* +	3250* +
Performance data	24	Speeds	Travel speed laden	unladen		mph/km/h	11.30 +	11.30 +	18 +	18 +
	25		Lift speed laden	unladen		ft/min/m/s	98.5 +	108.35 +	0.50 +	0.55 +
	26		Lowering speed laden	unladen		ft/min/m/s	98.5 +	78.8 +	0.50 +	0.40 +
	27	Rated drawbar pull	laden	unladen (1 hr motor rating)		N	12000	7200	12000	7200
	28	Max. drawbar pull	laden	unladen		N	-	-	-	-
	29	Gradeability	laden	unladen		%	20	20	20	20
	30	Max gradeability	laden	unladen		%	-	-	-	-
	31	Acceleration time	for travelling laden	unladen, 15 m distance		s	6 +	5.4 +	6 +	5.4 +
Weight	32	Weight	unladen - standard mast fitted			lb/kg	6160 +		2795 +	
	33	Axle loadings	laden front	rear		lb/kg	8000	1460	3625	670
	34		unladen front	rear		lb/kg	2370 +	3790 +	1075 +	1720 +
Wheels and Tyres	35	Tyres	Number front	rear			2	2	2	2
	36		Size front			in/mm	S=457x152x308	P=18x7-8/16 PR	SE=18x7-8	
	37		rear			in/mm	S=457x152x308	P=18x7-8/16 PR	SE=18x7-8	
	38	Wheelbase	y			in/mm	51		1300	
	39	Track width	centre of tyre front	rear		in/mm	35	33	905	840
	40	Ground clearance	Laden	m_1 at the lowest point		in/mm	4.5		115	
	41			m_2 centre of wheelbase		in/mm	4.3		110	
	42	Service foot brakes	mech./hydr./electr./pneum.		electr.	hydr.	hydr.		hydr.	
	43	Parking handbrake	pedal-operated/hand/deadman				handbrake		handbrake	
Drive Unit and Transmission	44	Battery equipment	to DIN 43 535/36 A/B/C/no				-		-	
	45		Voltage	Capacity	V	amp. hrs.	12	55	12	55
	46		Weight			lb/kg	-		-	
	47	Electric motors	Drive motor hourly capacity			kW	-		-	
	48		Hoist motor capacity at 15 % duty factor			kW	-		-	
	49	I.C. engine	Manufacturer	Model			Peugeot	XUD9	Peugeot	XUD9
	50		Maximum engine rated power			kW (h.p.)	33.5	(46)	33.5	(46)
	51		Rated rpm to DIN 70 020			rpm	3000		3000	
	52		No of cyl.	Displacement		cu/in/cm³	4	1905	4	1905
	53		Fuel consumption			gall./lh	1.8 +		1.8 +	
	54	Speed control			Type	Stages	-		-	
	55	Transmission	for IC engined models		Type	Stages	Torque Converter		Torque Converter	
	56	Clutch	for IC engined models			Type	without		without	
	57	Operating pressure	for attachments			bar	180		180	
	58	Average noise - peak	at operator's ears			dB (A)	82,7		82,7	

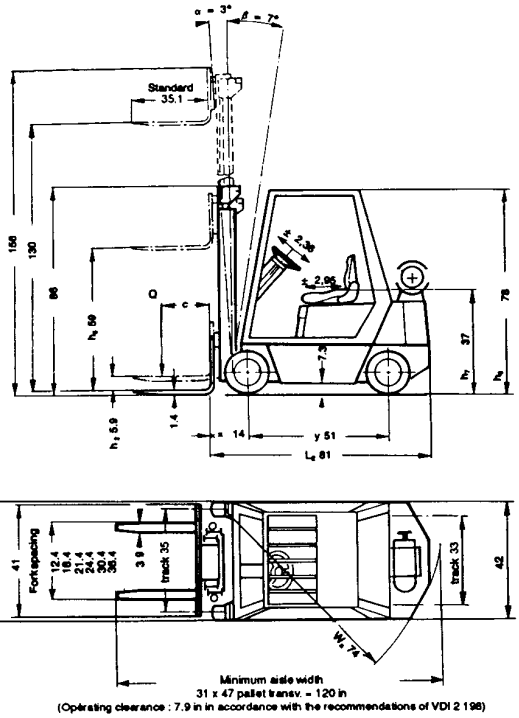
(*) Without allowance for operating clearance

Dimensions in mm



Minimum aisle width
800 x 1 200 pallet transv. = 3 050 mm
(Operating clearance : 200 mm in accordance with the recommendations of VDI 2 198)

Dimensions in inches



Minimum aisle width
31 x 47 pallet transv. = 120 in
(Operating clearance : 7.9 in in accordance with the recommendations of VDI 2 198)

Notes on

Line 31 Acceleration time:
The time the fork truck requires to cover – from rest to top speed – a distance of 15 m on a dry level surface.

Line 58 Noise level:
Average noise peak at operator's ears (Lm = average noise peak) to DIN 45 653, Section 36, Appendix A covering measuring point at ear level. Fork trucks fitted with overhead guard but without rigid all weather cab or removable weather protection.

Mast unit variations

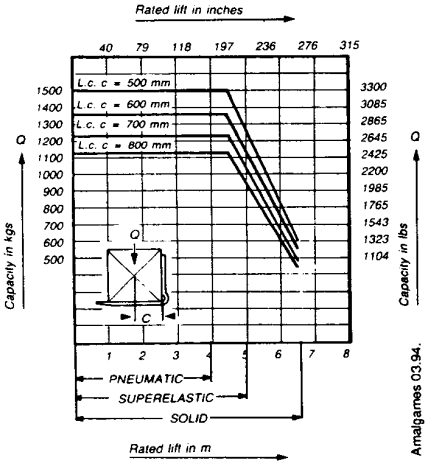
Mast features		Telescopic - Open centre - Part free lift				Nihc - Open centre - Full free lift			Triplex - Open centre - Full free lift		
height of lift	h_3 mm	2 730	3 330	3 730	4 230	2 700	3 300	3 700	4 190	4 790	5 490
height, mast lowered	h mm	1 890	2 190	2 390	2 640	1 840	2 140	2 340	1 940	2 140	2 440
height, mast raised	h_4 mm	3 370	3 970	4 370	4 870	3 340	3 940	4 340	4 845	5 445	6 145
free lift	h_2/h_5 mm	150				1 210	1 510	1 710	1 310	1 510	1 810
Mast tilt angle	α / β °	3°		7°		3°		7°	1°30		5°30
Tyres solid		×		×		×			×		×
pneumatic		×				×					
superelastic		×		×		×			×		
length to front face of forks L_2	mm	2.070				2 070			2 095		
frame width — overall B	mm	1 060				1 060			1 060		
from centre of front axle to front face of forks (x)	mm	360				360			385		
Aisle width Ast*) pallet 800 × 1 200 ⫽ 1 000 × 1 200	mm	3 050		3 250		3 050		3 250	3 075		3 275

height of lift	h_3 in	107	131	147	166	106	130	145	165	188	216
height, mast lowered	h in	74	86	94	103	72	84	92	76	84	96
height, mast raised	h_4 in	132	156	172	191	132	155	171	190	214	242
free lift	h_2/h_5 in	5.9				48	59	67	51	59	71
Mast tilt angle	α / β °	3°		7°		3°		7°	1°30		5°30
Tyres solid		×		×		×			×		×
pneumatic		×				×					
superelastic		×		×		×			×		
length to front face of forks L_2	in	81				81			82		
frame width — overall B	in	42				42			42		
from centre of front axle to front face of forks (x)	in	14				14			15		
Aisle width Ast*) pallet 31 × 47 ⫽ 39 × 47	in	120		128		120		128	121		129

*) without allowance for operating clearance

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Capacity Chart



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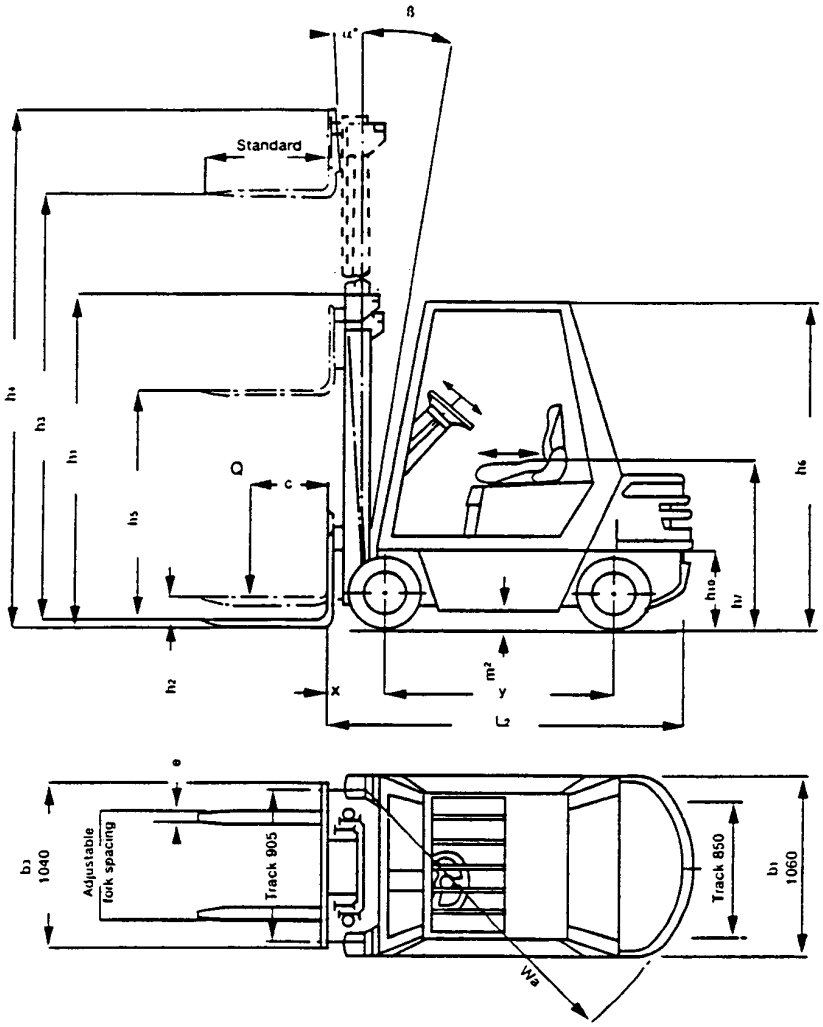
Complying with the VDI guidelines 2198, the technical specifications quoted below apply to the standard truck only. The specifications relating to tyres, mast types and ancillary equipment other than those figuring on the technical specification sheet, and where indicated in the quotation, may differ from the data marked with an ◦.

LPG powered Fork Truck Series M 15

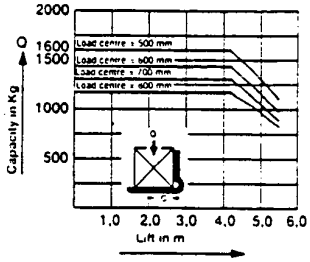
								3300 lbs Imperial		**1.5 t** Metric	
	1	Manufacturer						STILL & SAXBY			
Characteristics	2	Model	Manufacturer's designation					M 15 T			
	3	Carrying capacity	Q rated capacity (basic capacity)				lb/kg	3300 +		1500 +	
	4	Load centre	c from front face of forks				in/mm	20		500	
	5	Power supply	Battery, diesel, L.P.G., mains					LPG		LPG	
	6	Type of control	Pedestrian, stand-on, rider seated					Rider seated		Rider seated	
	7	Tyre equipment	S = solid, P = pneumatic, SE = superlastic			front	rear	S/P/SE	S/P/SE	S/P/SE	S/PSE
	8	Wheels (x = drive wheel)	Number front	rear				2x	2	2x	2
Dimensions	9	Lift double mast	h_3 height of lift				in/mm	130 +		3330 +	
	10		h_2 standard free lift				in/mm	5,9 +		150	
	11		h_5 full free lift				in/mm	59 +		1510 +	
	12	Fork carriage	to DIN 15 173 A/B/no (FEM...)					DIN 15 173 B (FEM II B)		DIN 15 173 B (FEM II B)	
	13	Fork (standard)	Length x width x thickness				in/mm	35.1 x 3.9 x 1.4		900 x 100 x 35 +	
	14	Mast tilt angle	forward	backward			degree	3 +	7 +	3 +	7 +
	15	Overall dimensions	L_2 length to front face of forks				in/mm	81 +		2070 +	
	16		B frame width - overall				in/mm	42 +		1060 +	
	17		h height, mast lowered				in/mm	86 +		2190 +	
	18		h_4 height, mast raised				in/mm	156 +		3970 +	
	19		h_6 height to top of overhead guard				in/mm	78 +		1980 +	
	20		h_7 seat height				in/mm	37 +		950 +	
	21	Turning radius	W_a				in/mm	74 +		1890 +	
	22	Load distance	x From centre of front axle to front face of forks				in/mm	14 +		360+	
	23	Aisle width	800 x 1,200 pallet (trans.)	1,000 x 1,200 pallet (trans)			in/mm	120* +	128* +	3050* +	3250* +
Performance data	24	Speeds	Travel speed laden	unladen			mph/km/h	11.9 +	11.9 +	19 +	19 +
	25		Lift speed laden	unladen			ft/min/m/s	98.5 +	108.35 +	0.50 +	0.55 +
	26		Lowering speed laden	unladen			ft/min/m/s	98.5 +	78.8 +	0.50 +	0.40 +
	27	Rated drawbar pull	laden	unladen (1 hr motor rating)			N	12000	7200	12000	7200
	28	Max. drawbar pull	laden	unladen			N	-	-	-	-
	29	Gradeability	laden	unladen			%	20	20	20	20
	30	Max gradeability	laden	unladen			%	-	-	-	-
	31	Acceleration time	for travelling laden	unladen, 15 m distance			s	6 +	5.4 +	6 +	5.4 +
Weight	32	Weight	unladen - standard mast fitted				lb/kg	5985		2715 +	
	33	Axle loadings	laden front	rear			lb/kg	7793 +	1499 +	3535 +	680 +
	34		unladen front	rear			lb/kg	2282	3704	1035 +	1680 +
Wheels and Tyres	35	Tyres	Number front	rear				2	2	2	2
	36		Size front				in/mm	S=457x152x308	P=18x7-8/16 PR	SE=18x7-8	
	37		rear				in/mm	S=457x152x308	P=18x7-8/16 PR	SE=18x7-8	
	38	Wheelbase	y				in/mm	51		1300	
	39	Track width	centre of tyre front	rear			in/mm	35	33	905	840
	40	Ground clearance	Laden	m_1 at the lowest point			in/mm	4.5		115	
	41			m_2 centre of wheelbase			in/mm	4.3		110	
	42	Service foot brakes	mech./hydr./electr./pneum.			electr.	hydr.	hydr.		hydr.	
	43	Parking handbrake	pedal-operated/hand/deadman					handbrake		handbrake	
Drive Unit and Transmission	44	Battery equipment	to DIN 43 535/36 A/B/C/no					-		-	
	45		Voltage	Capacity		V	amp. hrs.	12	55	12	55
	46		Weight				lb/kg	-		-	
	47	Electric motors	Drive motor hourly capacity				kW	-		-	
	48		Hoist motor capacity at 15 % duty factor				kW	-		-	
	49	I.C. engine	Manufacturer	Model				Renault	C1J 768	Renault	C1J 768
	50		Maximum engine rated power				kW (h.p.)	31 (42)		31 (42)	
	51		Rated rpm to DIN 70 020				rpm	3000		3000	
	52		No of cyl.	Displacement			cu/in/cm³	4	1397	4	1397
	53		Fuel consumption				gall./lh	1.6 +		1.6 +	
	54	Speed control				Type	Stages	-		-	
	55	Transmission	for IC engined models			Type	Stages	Torque Converter		Torque Converter	
	56	Clutch	for IC engined models				Type	without		without	
	57	Operating pressure	for attachments				bar	180		180	
	58	Average noise - peak	at operator's ears				dB (A)	81,3		81,3	

(*) Without allowance for operating clearance

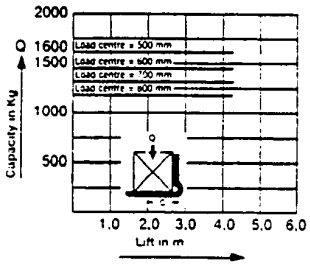
from series number : 717111004000 (Diesel)
717117004000 (LPG)



Load capacity with triplex mast



Load capacity with telescopic and full free lift mast



Types of mast for trucks with pneumatic, superelastic or solid rubber tyres

Type of mast			Telescopic				Full free lift a (Hi-Lo)					
Rated lift		h_3 mm	2730	3330	3730	4230	2700	3300	3700	4190	4790	5490
Closed height		h_1 mm	1890	2190	2390	2640	1840	2140	2340	1940	2140	2440
Height, mast raised		h_4 mm	3370	3970	4370	4870	3340	3940	4340	4845	5445	6145
Free lift		h_2/h_5 mm		150			1210	1510	1710	1310	1510	1810
Tilt angle	α/β	β +°	3°		7°		3°		7°	1°30		3°30
Tyres	Solid		x		x		x			x		x
	Pneumatic		x				x					
	Superelastic		x		x		x			x		
Length L_2		mm	2120				2120			2145		
Overall width b1		mm	1060				1060			1060		
Load distance (x)		mm	360				360			385		
Aisle width Ast with Pallet 1000 x 1200	800 x 1200	mm	3480		3680		3480		3680	3505		3705

Our products and specifications are subject to improvements and changes without notice

M15 • Technical Data

Par cette fiche technique élaborée conformément à la directive VDI, ne sont données que les valeurs techniques de l'appareil standard. Les valeurs portant sur des équipements de roues, de type de mâts et accessoires autres que ceux qui figurent sur la fiche technique, etc. (dans le cas ou ils sont mentionnés dans l'offre) peuvent être différentes.

	1.1	Manufacturer		STILL & SAXBY	STILL & SAXBY
Characteristics	1.2	Manufacturer's model designation		M15	M15 T
	1.3	Power source battery diesel gas mains electricity		diesel	gas
	1.4	Type of operation : hand, stand-on rider seated		rider seated	rider seated
	1.5	Carrying capacity load (basic capacity)	Q (kg)	1600	1600
	1.6	Load centre	c (mm)	500	500
	1.8	Load distance	x (mm)	360	360
	1.9	Wheelbase	y (mm)	1300	1300
Weight	2.1	Weight of truck unladen	kg	2760	2680
	2.2	Axle loadings laden - front	kg	3760	3680
	2.2.1	Axle loadings laden - rear	kg	600	600
	2.3	Axle loadings unladen - front	kg	1095	1055
	2.3.1	Axle loadings unladen - rear	kg	1665	1625
Wheels and tyres	3.1	Tyres - solid. superlastic, pneumatic		Solid. superlastic. pneumatic	
	3.2	Tyre dimensions - front		B=457x152x308\SE=18x7/8 P=18x7x8/16PR	
	3.3	Type dimensions - rear		B=457x152x308\SE=18x7/8 P=18x7x8/16PR	
	3.5	Number of front wheels (x = drive wheel)		2x	2x
	3.5.1	Number of rear wheels (x = drive wheel)		2	2
	3.6	Track width - front	b_{10} (mm)	905	905
	3.7	Track width - rear	b_{11} (mm)	850	850
Dimensions	4.1	Mast tilt angle - carriage forward	degrees	3	3
	4.1.1	Mast tilt angle - carriage backward	degrees	7	7
	4.2	Closed height	h_1 (mm)	2190	2190
	4.3	Free lift	h_2 (mm)	150	150
	4.4	Lift height	h_3 (mm)	3330	3330
	4.5	Height, mast raised	h_4 (mm)	3970	3970
	4.7	Height to top of overhead guard (standard)	H_6 (mm)	1980	1980
	4.8	Seat height	h_7 (mm)	975	975
	4.12	Coupling height	h_{10} (mm)	430	430
	4.19	Overall length	l_1 (mm)	3120	3120
	4.20	Length to front face of forks	l_2 (mm)	2120	2120
	4.21	Overall width	b_1 (mm)	1060	1060
	4.22	Fork thickness	s (mm)	40	40
	4.22.1	Fork width	e (mm)	80	80
	4.22.2	Fork length	l (mm)	1000	1000
	4.23	Fork carriage to DIN 15173 A / B		FEM II B	FEM II B
	4.24	Fork carriage width	b_3 (mm)	1040	1040
	4.31	Ground clearance beneath mast. laden	m_1 (mm)	115	115
	4.32	Ground clearance at centre of wheelbase	m_2 (mm)	110	110
	4.33	Aisle width for pallets 1.000 x 1.200 wide	Ast (mm)	3480*	3480
	4.34	Aisle width for pallets 800 x 1200 long	Ast (mm)	3680*	3680*
	4.35	Outer turning radius	Wa (mm)	1920	1920
	4.36	Inner turning radius	b_{13} (mm)		
Performance	5.1	Speed laden	km/h	19	19
	5.1.1	Speed unladen	km/h	19	19
	5.2	Lift speed laden	m/s	0,48	0,48
	5.2.1	Lift speed unladen	m/s	0,52	0,52
	5.3	Lowering speed laden	m/s	0,49	0,49
	5.3.1	Lowering speed unladen	m/s	0,42	0,42
	5.5	Rated drawbar pull laden	N	12000	12000
	5.5.1	Rated drawbar pull unladen	N	7200	7200
	5.7	Gradeability laden	%	20	20
	5.7.1	Gradeability unladen	%	20	20
	5.9	Acceleration time to cover 15 m laden	s	6	6
	5.9.1	Acceleration time to cover 15 m unladen	s	5,4	5,4
	5.10	Brakes		mechanical	mechanical
Engine	7.1	Engine manufacturer		Peugeot	Renault
	7.1.1	Type		XUD9	C1
	7.2	Engine rated power ISO 1585	kW	33,5	31
	7.3	Rated rpm	1/min	3000	3000
	7.4	Number of cylinders		4	4
	7.4.1	Displacement	cm^3	1905	1397
	7.5	Fuel consumption		1,8 l/h	1,6 kg/h
Other	8.1	Drive control		hydrodynamic	hydrodynamic
	8.2	Operating pressure for attachments	bar	210	210
	8.3	Oil flow for attachments	l/min		
	8.4	Average noise level at operations	db (A)	81,5	81,5
	8.5	Trailer coupling / DIN		pin	pin

*

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Removing the bonnet..... 01-2
Chassis and counterweight..... 01-2
Driver's overhead guard..... 01-3
Chassis and counterweight..... 01-4

Removing the bonnet

Disconnect the battery.

Dismantle the parking brake handle grip (2) from the cable holder (1).

Disconnect the plug (3) of the cable harness going to the instrument panel.

Open the bonnet and fasten with a sling to the overhead guard.

Remove the gas-filled strut (4) at the bonnet.

Loosen and remove the bonnet mounting screws (5) protected with plastic caps (6).

Detach the sling from the bonnet and remove the bonnet.

Installation is the reverse of removal.

NOTE
The elongated holes in the hinges allow an adjusment of the bonnet when closed.

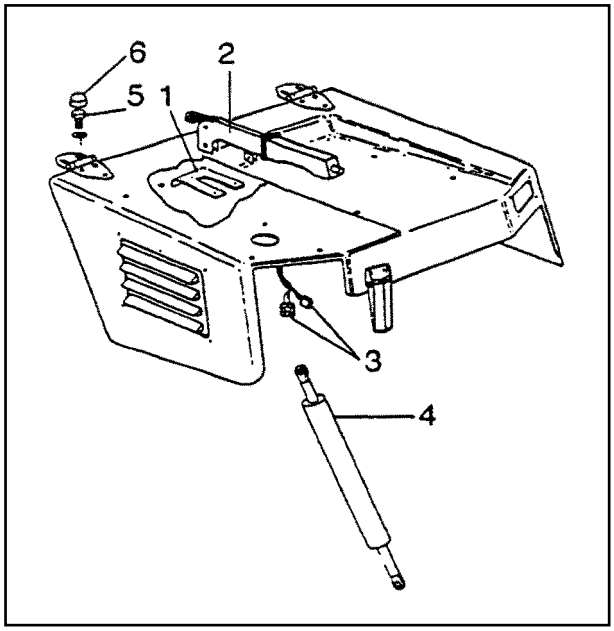


Figure 01-1

Chassis and conterweight

The cast counterweight is attached to the chassis which is made of welded thick steel plates.

The counterweight is bolted to the chassis with 4 M20x55 bolts.

All counterweight mounting bolts are torqued to 38.5 Mkg.

(1) Hexagon bolt M20x55

(2) Washer

Weight of the counterweight :
approx. 1140 kg

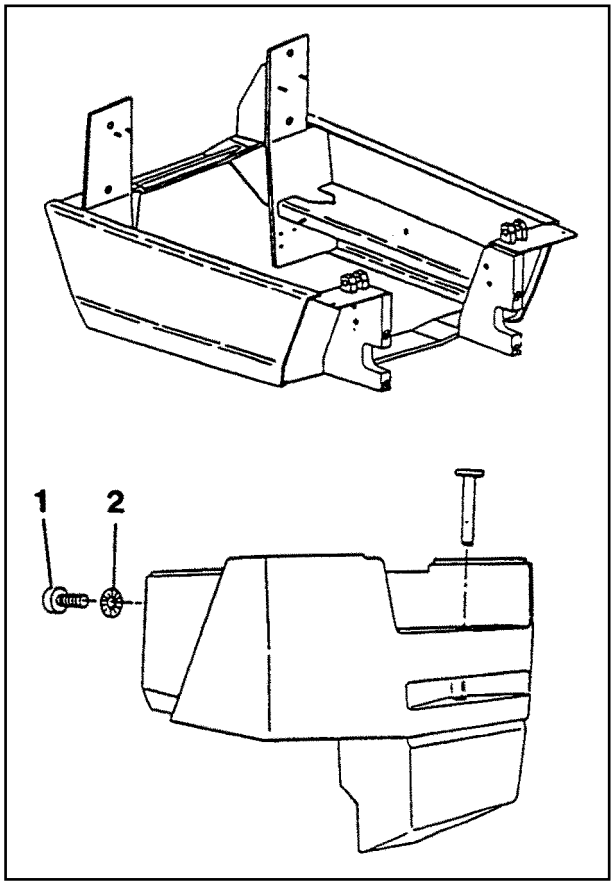


Figure 01-2

Driver's overhead guard

Remove the driver's overhead guard (1) (including the front engine compartment cover (2)).

- Unhook the accelerator pedal at the linkage.

- Remove the floor plate by unscrewing the 4 M10x20 screws (3).

- Dismantle the mounting for the tilt cylinder hose.

- Remove the steering unit oil return hose at the hydraulic oil tank.

- Mark and disconnect the two hydraulic hoses coming from the steering column and leading to the fixed lines at the bottom left of the chassis.

- Mark and disconnect the hoses and return lines coming from the way valve.

- Disconnect the steering unit hoses from the priority valve.

- Disconnect the electronic ignition :
  • magnet sensor plug
  • ignition coil cable
  • vacuum hose for ignition advance
  • ground leads in the engine compartment

- Remove the wiring harness mountings at the chassis and engine compartment cover.

- Remove in the engine compartment :
  • hose mounting
  • relay
  • brake fluid reservoir

- Remove the air filter hose.

- Remove the exhaust pipes (4).

- Unscrew the two M16 x 40 screws fastening the driver's overhead guard (5) to the counterweight and two fastening nuts (6) at the front of the chassis.

- *Remove the 2 fastening nuts at the driver's overhead guard at the back of the counterweight and the two fastening nuts at the front of the chassis.

- Remove the driver's overhead guard with the aid of a crane.

Installation is the reverse of removal.

Torque for rear fastening screws : 190 Nm
For front fastening screws : 80 Nm

NOTE
Make sure that the rubber mount is positioned correctly.

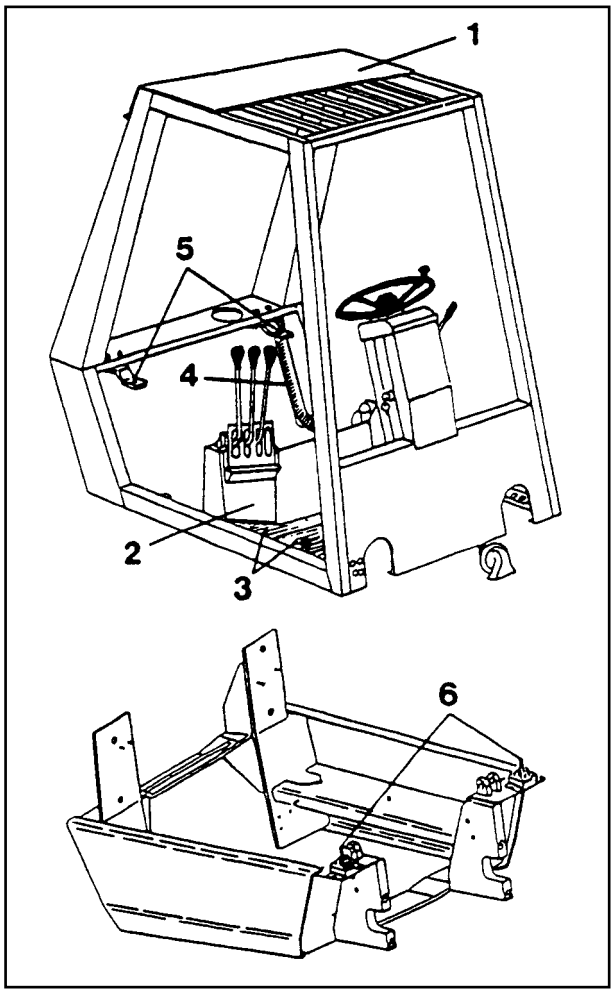


Figure 01-3

* The 2 mountings at the back of the driver's overhead guard are fitted to the counterweight with 2 M16x80 studs and M16.8 nuts. Torque to 195 Nm.

* Applies to new model M15 from serial numbers
717111004000 (Diesel) and
717117004000 (LPG)

Removing the bonnet

Disconnect the battery.

Disconnect the grip of the cable mounting (1) from the parking brake lever (2).

Disconnect the connector from the wiring harness for the instrument panel (3).

Open the bonnet and fasten it with a belt at the driver's overhead guard.

Remove the gas-filled springs (4) at the bonnet.

Remove the fastening nuts (5) from the bonnet including the plastic caps (6).

Remove the holding belt and take off the bonnet.

Installation of the bonnet is in the reverse order of removal.

NOTE
The longitudinal holes in the hinges allow the adjustment of the closed bonnet.

In conformance with Machine Directive No. 89392 dated 1/1/96, the bonnet is provided with a latch and lock.

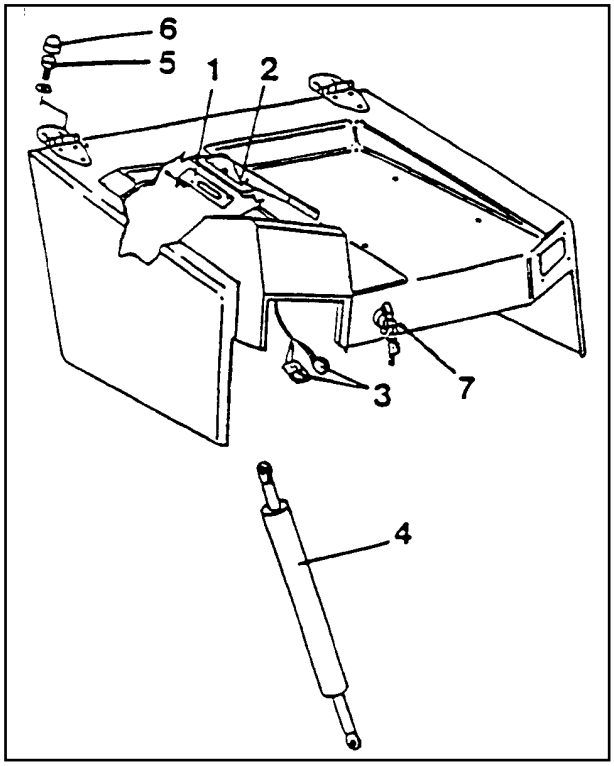


Figure 01-4

Chassis and counterweight

From serial numbers 717111004000 (Diesel) and 7171170040000 ((LPG) the counterweight has a round form. It is fastened by 4 screws 20x55 at the frame, which is made of strong welded steel plates.

The torque for the screws is 400 Nm.
(1) Hexagonal screw 20x55
(2) Washer

Weight of counterweight at the rear = approx. 1140 kg.

The cross member (5) connecting the 2 chassis boxes and protecting the hydraulic pump against bumps, is mounted at the front and fastened with four 14x30 screws (3) with washers (4).
The torque for these screws is 174 Nm.

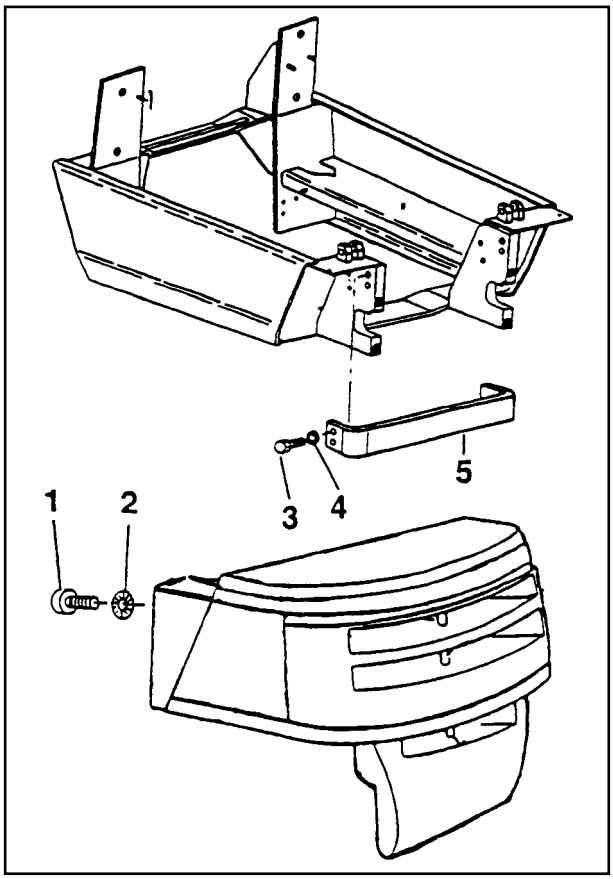


Figure 01-5

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Running axle

Remove the steering axle.

- Unscrew the wheel mounting nuts, block up the truck and remove the wheels.
- Mark and disconnect the hoses (1) at the steering cylinder (2).
- Place a lift truck under the steering axle and unscrew the mounting nuts and M16x130 bolts (3) at the rear bearing (4).
- Unscrew the M16x35 mounting screws (5) from the front bearing (6).
- Lower the lift truck and pull the axle out.
- Refitting is a reversal of removal.

NOTE
Tighten the front and rear bearings to 200 Nm torque. Secure bolt (5) with Loctite.

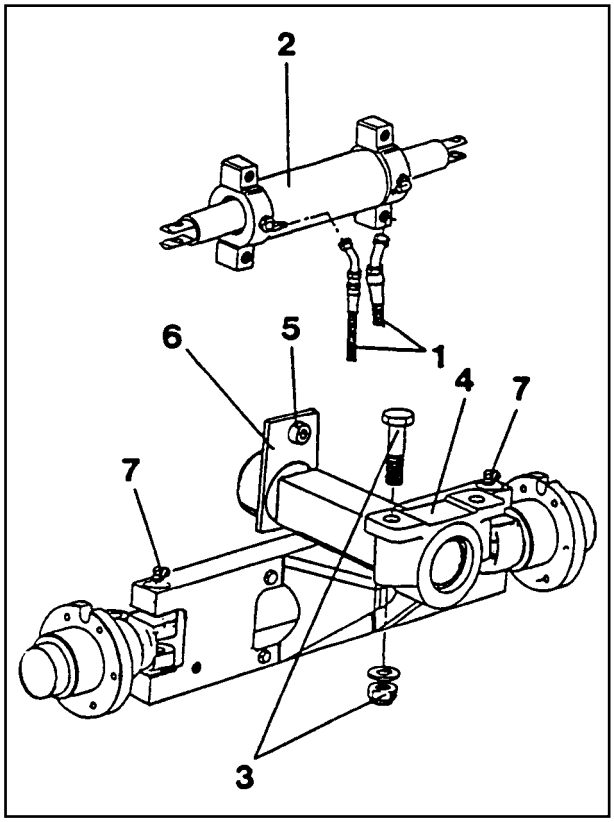


Figure 02-1

Removing the link of the steering wheel axles

- Unscrew the flat head bolt (1).
- Remove the washer (2).
- Drive the axle (3) out.

Refitting is a reversal of removal.

Removing the steering knuckle

- Drive out the retaining pin (4).
- Unscrew the grease nipple at the top of the axle (5).
- Screw the M8x150 threaded spindle (7) into the king pin (5).
- Support the tube (6) with a minimum dimension of 34x110 mm over the threaded spindle on the housing.
- Place a washer with an inner diameter of 8 mm and outer diameter of 40 mm minimum over the threaded spindle on the tube.
- Screw a M8 nut on the threaded spindle and pull the king ping (5) out.
- Remove the steering knuckle.

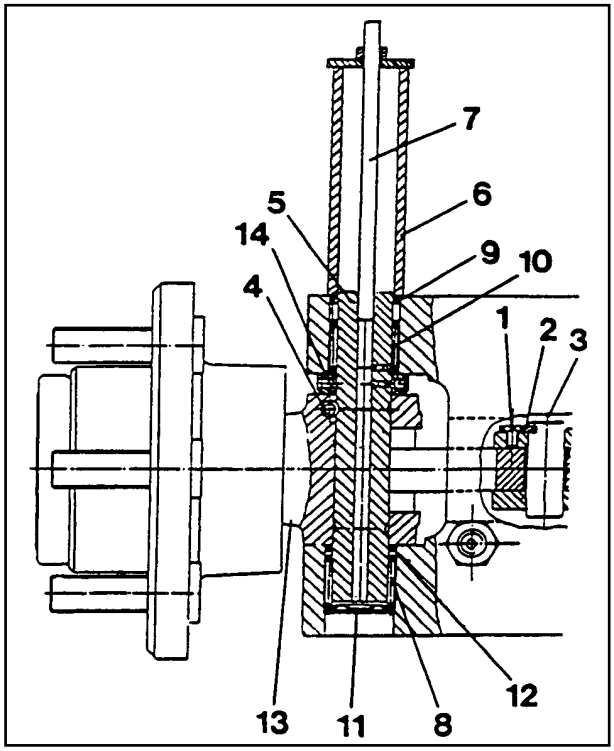


Figure 02-2

Removing the needle bearing

- Using the axle journal (5), drive the inner bearing (8) outwards.
- Pry the seal (9) from the top bearing (10) with a lever.
- Fit disk (11) of the lower bearing (8) in place of the seal (9) and drive out the top bearing (10) using the axle (5).

Refitting the needle bearing

- Put disk (11) in place.
- Coat the lower bearing (8) with grease.
- Drive the bearing in until it contacts the disk (11). Fit the seal (12).
- Grease the top bearing (10) and drive it in until it is flush with the lower part of the bearing receiver in the axle.
- Insert the seals (9).
- Insert the axle (13) with bearing (14) and secure it with retaining pin.

NOTE
Subsequently lubricate the axle bearing at the grease nipple (7) (see Figure 02-1).

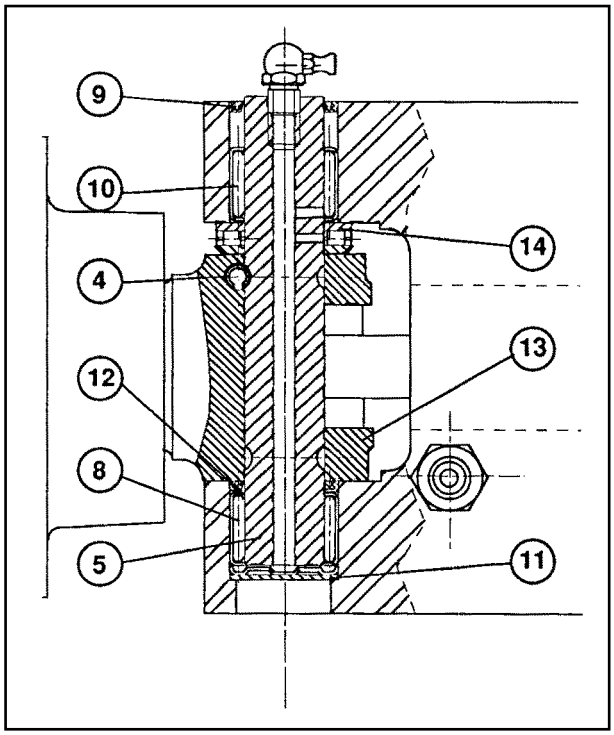


Figure 02-3

Removing the axle hub

- Take off the hub cap (1).
- Unlock the grooved nut (2), take out the retaining plate (3) and remove nut (4).
- Pull off the hub (5).
- Remove the sealing ring (6) and take out the two bearings (7) and (8).
- Clamp the hub into a soft-jawed vise, and drive bearing races (9) and (10) out with a drift punch.

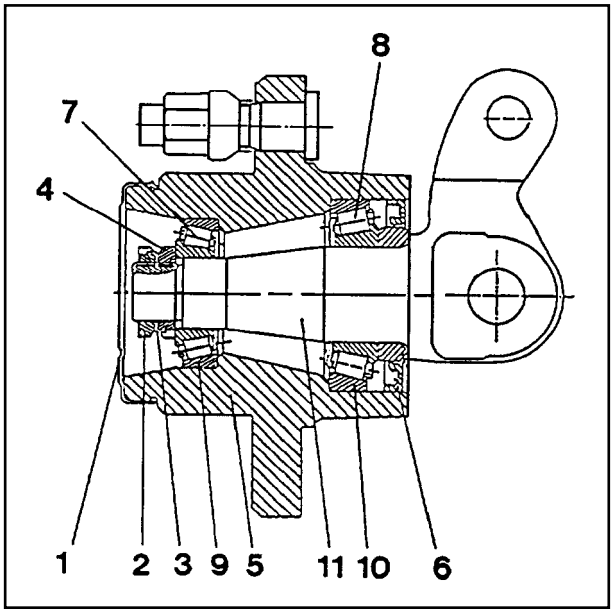


Figure 02-4

Renewing and installing the bearings

- Mount the bearing races of the new bearings on the hub (5).
- Fill the space between bearings (9) and (10) with grease.
- Grease the bearings and position them on the hub.
- Install a new sealing ring (6) the lips facing inwards.
- Slide hub on axle (11) and tighten nut (4) until the hub (5) is seated on the axle without play.
- Slacken grooved nut (4) by 1/4 turn.
- Insert the retaining plate (3) and secure grooved nut (2) and nut (4).
- Fill the cap with grease and install it.
- Secure the cap (1) by hitting it with a centre punch at the three equally apart points.

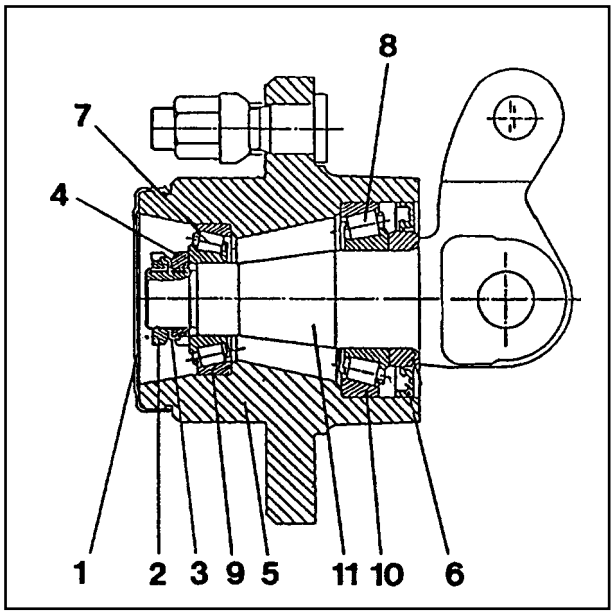


Figure 02-5

Nb : Nut (4) is placed chamfer **outwards.**

Adjusting the axle oscillation

For a correct adjustment, the lift truck must be parked on level ground.

- Using the adjusting screws for the mounting (2), adjust the distance between the screw head and the axle body (1) until both dimensions are equal.
- This adjustment varies depending on the type of tyres :
  - Truck with tyres : 20 +0/-3 mm
  - Truck with superlastic tyres : 20 +0/-3 mm
  - Truck with solid rubber tyres : 17 +0/-3 mm

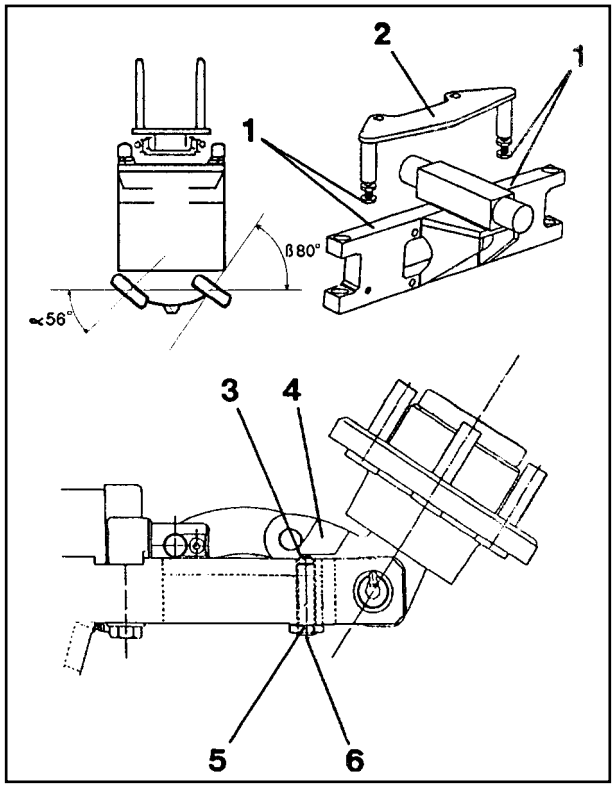


Figure 02-6

Adjusting the wheel angle stops

- Block up the lift truck and remove the wheels.
- Extend the steering cylinder fully, loosen nut (5) and adjust bolt (6) until there is a clearance of 1 mm between the end of the bolt (3) and steering knuckle stop (4).
- Repeat this procedure for the opposite steering knuckle.

NOTE
The steering lock cannot be adjusted.

Track rods with grease nipples

Applies to new model M15 from serial numbers 717111004000 (Diesel) and 717117004000 (LPG).

The track rod axles are now provided with grease nipples (1) and the track rods (3) with bronze ring (2). These have a substantially longer service life than the previous ones.

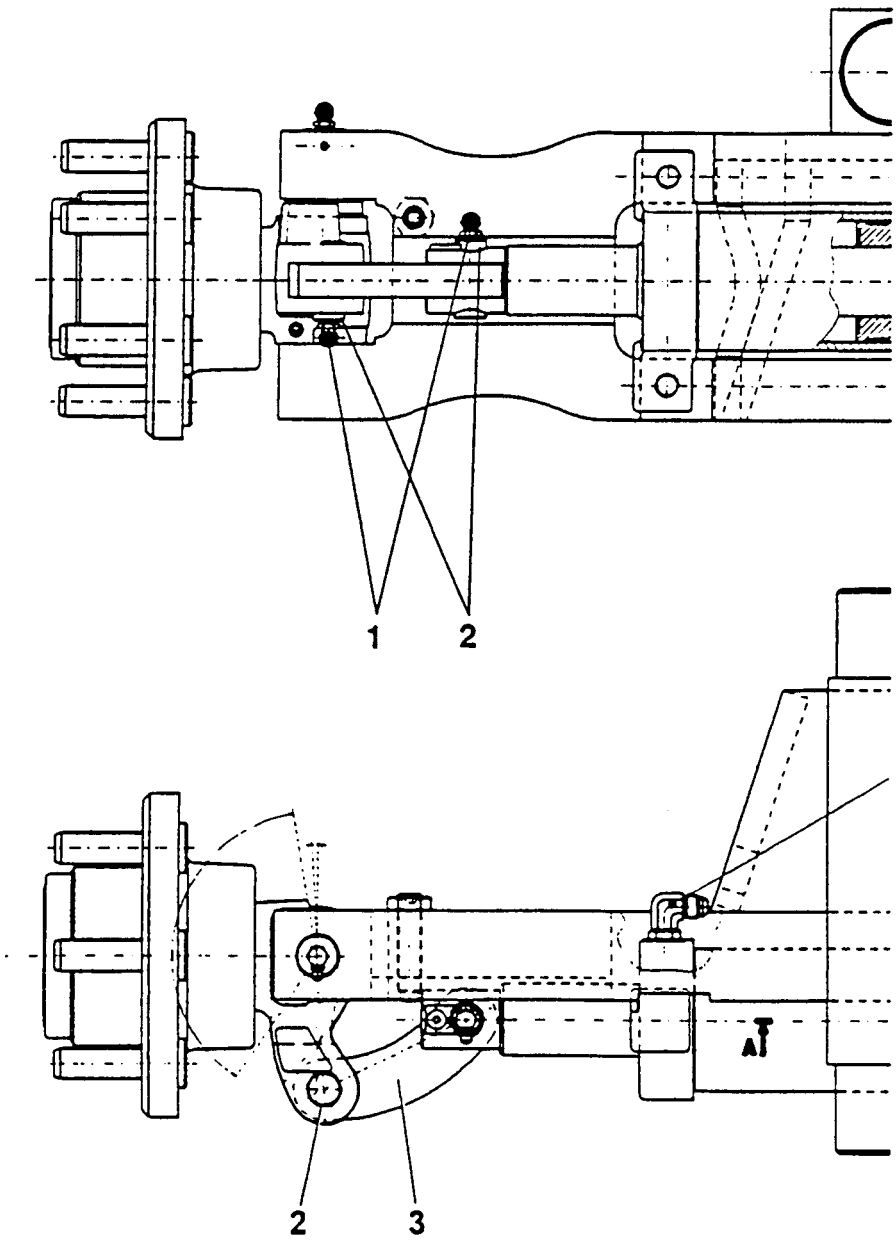


Figure 02-6

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Running-in instructions

Powershift transmission

The running-in time for the gearbox is approx. 80 hours. During this period the following rules must be observed :

a) Use the lift truck only for light applications.
b) Check the gearbox regularly for loss of oil.

Every 10 hours :

Check the gearbox oil level, add oil as needed (refer to table of capacities for the oil type). The oil level check must be performed with the engine running (idling) and the oil at operating temperature.

At the end of the running-in period :
- Renew the oil.
- Clean the filtering screen.
- Remove the filter in the valve block (see figure 03-0).

The above rules also apply to an overhauled gearbox.

Gearbox

Technical data

Clutches :
Control pressure ..... min. 10 bar, max. 11 bar

Converter :
Input pressure ..... min. 4 bar, max. 5 bar

Lube oil pressure ..... 0.8 to 1.2 bar

Temperature range .....80° to 100°C max. 120°C

NOTE
The aforementioned data applies for a normal gearbox operating temperature (80-100°C) and an engine speed exceeding 2000 rpm.

Electrical system
voltage ..... 12 DCV
power ..... 5 W

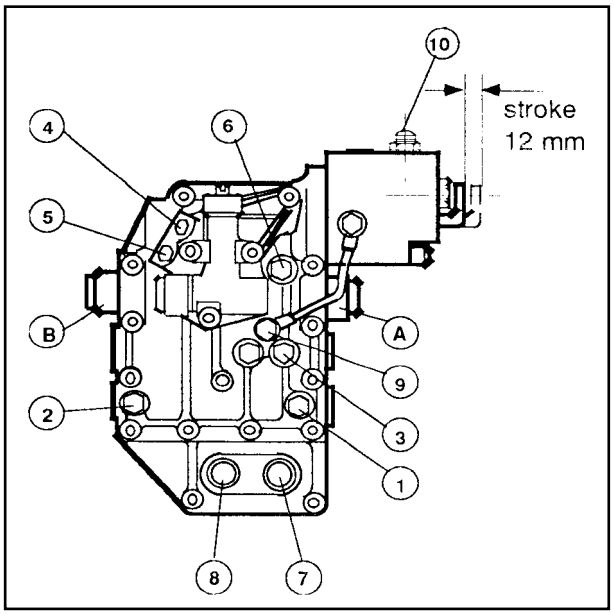


Figure 03-0

1 Main input pressure M10x1
2 Converter input pressure M10x1
3 regulator input pressure M10x1
4 1st gear fwd. input pressure M10x1
5 1st gear rev. input pressure M10x1
6 Control valve filter
7 Oil supply to gearbox M22x1.5
8 Oil return from gearbox M22x1.5
10 Drain of the Inching circuit

A Solenoid valve :
Excited : - forward gear
Unexcited : - neutral

B Solenoid valve :
Excited : - reverse gear
Unexcited : - neutral

C Stroke 12 mm

The permission of Graziano Transmissioni (project office) is required if the control valve mounting bolts on the gearbox are to be used for attaching additional parts.

Tightening torque for the bolts is 19-21 Nm.

Periodic Maintenance

Every 200 hours

Gearbox oil

Check the oil level with the dipstick and add oil if required (refer to the table of capacities for the oil quality). The oil level check must be performed with the engine running (idling and at operating temperature).

CAUTION

If the engine ist shut down, the oil level can rise distinctly.

Every 1000 hours

Gearbox oil

- Unscrew the oil drain plug and catch the oil.
- Clean the drain plug filter.
- Refit the drain plug and fill in new oil.
- Check the oil level.

NOTE

The oil must be renewed once a year minimum and every 1000 hours at the latest.

NOTE

A damaged filter must be replaced.

Table of capacities

Gearbox :	7.5 L
Converter :	1.2 L
Axle :	To lower edge of filler opening

NOTE

When the transmission is drained, 1.2 L oil remains on the converter.
The box should be refilled with 6.3 L oil.

Removing the gearbox

1 Block up the lift truck.
2 Disconnect the battery.
3 Remove the mast (see component group 20).
4 Drain the gearbox oil and catch the oil.
5 Remove the left brake pedal as well as the ground lead at the mounting.
6 Disconnect the lines at the brake master cylinder.
• Wheel brake cylinder D and G
7 Loosen the accelerator pedal mounting at the front right-hand side.
8 Pull off the 3-pole plug at the top of the gearbox.
9 Remove the hydraulic pump intake lines as well as the pressure hose.
10 Disconnect the 4 hoses at the priority valve on the gearbox.
11 Disconnect the two hoses at the bottom of the gearbox control valve.
12 Remove the gearbox dipstick as well as the oil drain at the bottom of the gearbox.
13 Disconnect the parking brake cable at the handbrake handle and draw it forward to the gearbox.
14 Unscrew the 8 gearbox bolts.
15 Place a support under oil pan to prevent it from tipping.
16 Support the counterweight at the rear with a block of wood.
17 Lower the wheels to ground level, slide a block of wood under the gearbox.
Unscrew the 4 M16x130 axle mounting bolts at the chassis, and pull the gearbox including axle in your direction, using the wheels if required.
18 To remove the converter, take off the ignition distributor, unscrew the 4 mounting screws and remove the converter.
19 On the diesel model the starter has to be removed to access the 4 converter mounting screws

Installation is in the reverse order of removal, and first mount the converter on the gearbox.

Note : Fill the converter with 1 L of transmission oil before refitting.

Removing the engine / gear drive

1 Disconnect the battery.
2 Block up the lift truck.
3 Remove the driver's overhead guard (see component group 01).
4 Loosen and remove the hoses at the radiator.
5 Remove the exhaust silencer.
6 Remove the accelerator pedal mounting at the chassis on the front right hand side.
7 Disconnect the ground lead at the brake pedal mount.
8 Remove the heat exchanger at the counterweight.
9 Disconnect the hydraulic pump intake hose at the hydraulic oil tank.
10 Slacken the brake cable clamps at the counterweight.
11 Remove the mast (see component group 20).
12 Remove the tilt cylinders including hoses at the chassis.
13 Remove the gearbox oil drain at the chassis.
14 Take off the gearbox oil dipstick.
15 Refit the wheels and subsequently lower the truck on its wheels.
16 Using a hoist and lifting gear, attach the chassis to the tilt cylinder fastening points.
17 Unscrew the M16x130 axle mounting bolts at the chassis.
18 Place a support underneath the chassis and disconnect the lifting gear.
19 Using a hoist and lifting gear, attach the lifting gear to the engine at the lifting eyes provided.
20 Unscrew the M10x160 bolt at the lower engine mount.
21 Take out the engine towards the front end, letting it roll on the wheels.

Installation is in the reverse order of removal. Take care the positioning of the transmission in the truck axle, see page 03-10d.

General note to removal, overhaul and installation

The following points must be observed before beginning with the removal, overhaul and installation of the component group.

Cleaning parts

WARNING

It is forbidden to use petrol, solvents or other inflammable fluids for cleaning parts. Only use commercial noninflammable and nonpoisonous solvents.

1) A complete cleaning is recommended when doing any work on the component group. For this reason the components must be cleaned carefully before refitting them.

2) The workshop must be clean and dust-free.

3) All the necessary tools must be available, especially those recommended in this manual. Damage to the truck can result from poorly mounted parts and particulary from chips and foreign objects.

4) During an overhaul it is recommended that the following parts be replaced :
   • Sealing rings, seals and gaskets, O-ring, caulked nuts, and any parts that may have been damaged during removal.

5) If breaks occur inside the component group, all lines and the housing must be carefully cleaned in order to prevent any contamination by residues in the circuit.

CAUTION

- Use hot plates, heating tubes or ovens to heat bearings. Never use naked flames for this purpose. If required, use a container filled with oil and heated with a flame.

- Lubricate all parts as required prior the to installation of axles, bearings, etc.

- It must be assured that parts installed in a warm state are seated properly after installation.

- O-rings must be lubricated prior to fitting in order to prevent them from dislocating during installation and to prevent tight seating.

Installing sealing elements

The use of sealing compounds is recommended for connections which have to be leakproof (oil or water) and which are not provided with a seal. Their proper use requires careful cleaning of the surfaces onto which the compound is to be applied. After a suitable degreasing, the sealant must be applied evenly. We recommend the following sealing compounds :

Rhodorsil CAF 1, Loctite Plastik Gasket, Silastic 732 RTV.

IMPORTANT NOTICE
In order to ensure proper function and to avoid problems with replacement parts, it is recommended to use genuine manufacturer's parts only.

WARNING
Only lift and move parts with hoisting gear having the appropriate capacity. Make sure that assembly groups and parts are lifted with slings and hooks with the proper capacity. It must be ensured that no person is standing in the vicinity of the lifted load.

Fault finding instructions

A General

Prior to fault finding :

- Check the oil for condition and level. Refer to the maintenance manual for further details,
- Check the gearbox, oil cooler and oil lines. Check for damage or leaks, and repair if required.
- Check whether the fault is not caused by the engine and/or axle.

Perform all pressure measurements at normal operating temperature.

Pressure gauge range : 0 - 15 bar. the gauges must be accurate.

WARNING
The gearbox must not remain blocked for more than 10 seconds. Return it to neutral and let it cool down. Heavy damages can results if this instruction is disregarded.

Check blocking of the gearbox in forward and reverse gear by breaking and by letting the engine run at maximum speed.

B Performing the fault finding

During the fault finding, turn the direction selector switch to all positions and determine at which moment the fault or noise occurs, if at all. Mark the parts during movement and at the moment the problem arises. This is very useful in determining the cause of the fault. If a faults is established, the following instructions will serve as a starting point.

Converter :
Gearbox problems connected with the converter.

Check or replace the converter in the following cases :
- Slow acceleration at maximum engine speed and overheating (normal stall speed) : The stator free-wheel is seized.
- Metallic noises emanating from the converter : Damaged converter blades.
- Stall speed to high : The converter free-wheel is not being driven.

Clutches : Check or replace the clutch if :

- the stall speed is too high. This symptom can indicate that the clutch is slipping (slipping moise).

NOTE
A slipping clutch will heat up. This overheating can cause a deformation of the discs. High overheating can cause the disc to fuse. Therefore : Blocking of the gearbox if another clutch is misaligned.

- If the truck already moves in neutral, the clutch is possibly damaged (discs are bent).

C Fault diagnosis

Problem	Cause	Remedy
Oil losses		
1. Seal at the pump input or output shaft is leaky	- Faulty seal - Poor adjustment - Damaged axle	Renew Adjust Replace
2. Leak between outer seal and housing	- Housing damaged	Apply a sealing compound at the outer circumference of the seal when renewing it
3. Leaks at the connecting housing through the seal	- Bolts loose	Tighten the bolts
4. Leaks at the drain	- Copper seal damaged	Renew
5. Gearbox oil losses difficult to localize	- Oil leak in the oil cooling circuit	Renew the oil cooler or faulty parts in the oil circuit
6. Oil leak at breather	- Oil level too high	Correct the oil level
Common causes for all faults		
1. Low oil pressure	- Regulating valve blocked	- Clean and polish the valve
	- Internal leak	- Renew the seals
	- Low oil level	- Correct the oil level
	- Pump faulty	- Replace the pump
	- Suction filter clogged	- Clean
	- Poor adjustment of slow travel control	- Adjust
2. Insufficient oil pressure	- Interal oil loss	- Replace faulty parts
	- Pump damaged	- Replace the pump
	- Regulating valve faulty	- Clean and polish the valve

Problem	Cause	Remedy
3. Clutch is hard	- High pressure is blocked, regulating valve	- Clean and polish the regulating valve
	- Engine speed is too high	- Correct
	- Faulty regulating valve	- Repair
	- Check valve blocked or not adjusted	- Adjust or replace the valve
	- Control valve is contaminated	- Disassemble and clean the control valve
4. Clutch reacts slowly	- Low clutch pressure	- See low oil pressure
	- Engine idling speed is too low	- Adjust
	- Faulty regulating valve	- Repair the valve
	- Check valve blocked or not adjusted	- Adjust or replace the valve
	- Control valve is contaminated	- Clean the control valve
5. High pressure	- Regulating valve is blocked	- Clean and adjust the valve
6. Oil temperature too high	- Faulty cooling circuit	- Replace faulty parts
	- Cooling circuit is blocked	- Disassemble the cooling circuit
	- Faulty cooler	- Replace the cooler
	- Converter is damaged	- Renew the converter
	- Oil level is too high	- Correct the oil level
7. Noises when driving forward and reversing	- Housing of converter and engine poorly aligned	- Align the converter and housing
	- Pinion gears damaged	- Replace damaged pinion gears
	- Universal shaft seal worn	- Repair or renew damaged seals
	- Converter blades damaged	- Replace the converter

Problem	Cause	Remedy
8. Pinion gears are not driven	- Insufficient pressure	- See lack of oil pressure
	- Damaged drive shaft	- Renew the shaft
	- Broken converter drive plate	- Renew the plate
	- Fault in the electronic system	- Repair the electrical system
	- Broken seal at output	- Renew the seal
9. Poorly functioning slow gear	- Blocked valve	- Repair or replace the valve
Poor function in reverse gear		
1. Clutch is sluggish or fails to disengage (truck moves in neutral)	- Blucked clutch discs	- Replace faulty parts
	- Mechanical fault	- Replace faulty parts
	- Clutches without play	- Adjust play as specified
	- Solenoid valve seized	- Replace the valve
	- Electrical fault	- Eliminate the fault
	- Dirt or foreign object in control valve	- Disassemble and clean the control valve
	- Travel direction selector blocked	- Clean and polish the travel direction selector
2. Clutch fails to engage (truck does not drive)	- Low pressure	- See low oil pressure
	- Solenoid seized	- Replace the solenoid valve
	- Electrical fault	- Eliminate the fault
	- Dirt or foreign object in control valve	- Disassemble and clean the control valve
3. Truck does not drive or drives only slowly	- Low pressure	- See low pressure
	- Faulty or worn sealing ring	- Replace faulty parts

Problem	Cause	Remedy
Poor function when driving forward		
1. Clutch is sluggish or fails to disengage (truck moves in neutral)	- Buckled clutch discs	- Replace faulty parts
	- Mechanical fault	- Replace faulty parts
	- Clutches without play	- Adjust play as specified
	- Solenoid seized	- Replace the valve
	- Electrical fault	- Eliminate the fault
	- Dirt or foreign object in control valve	- Disassemble and clean the control valve
	- Travel direction selector blocked	- Clean and polish the travel direction selector
2. Clutch fails to engage (truck does not drive)	- Low pressure	- See low oil pressure
	- Solenoid valve blocked	- Replace the solenoid valve
	- Electrical fault	- Eliminate the fault
	- Dirt or foreign object in control valve	- Disassemble and clean the control valve
3. Truck does not drive or drives only slowly	- Low pressure	- See low pressure
	- Faulty or worn sealing ring	- Replace faulty parts
Further problems		
1. Hydraulic noises or valve chatter	- Air in the hydraulic circuit or oil level too low	- Check the oil level and add oil if required. Let engine run at 1200 rpm and bleed the system
	- Regulating valve blocked	- Clean and polish the regulating valve
2. Gearbox noises when driving forwards	- Gears broken or worn	- Replace damaged parts
	- Bearings worn or damaged	- Replace bearings
3. Gearbox noises when reversing	- Gears broken or worn	- Replace damaged parts
	- Bearings worn or broken	- Replace bearings

Problem	Cause	Remedy
Poor function in neutral position		
1. Truck moves forward in neutral	- Clutch discs deformed or mechanical braking of clutch	- Renew faulty parts
1A. Truck reverses in neutral		
2. Gears of forward gear remain meshed	- Solenoid valve blocked	- Repair or replace parts
	- Travel direction selector blocked	- Clean and polish
2A. Gear of reverse gear remain meshed	- Electrical fault	- Eliminate the fault
	- Contamination or foreign object in control valve	- Disassemble and clean
Gearbox overheating	- Lines to cooler or oil lines too small	- All outer oil lines and the oil cooler must allow the proper amount of oil to pass through
	- Faulty cooler	- Replace the cooler
	- Converter damaged	- Replace the converter
	- Incorrect oil level	- Correct the oil level
	- Plugged suction filter	- Clean the filter
	- Improper operation of engine	- Do not let the engine run too long with the gearbox blocked
	- Low pump pressure, pump damaged or worn	- Check the gearbox oil level
		- Check the pump, if pressures are too low ; replace the pump if worn or damged
	- Clutches slip	- Check the seals and pressure
	- Low pressure	- See low oil pressure
	- Oil contains water	- Check the oil type used
	- Faulty thermoswitch	- Replace the thermoswitch

Checklist

Dealer : ..... Truck N° : .....

Customer : ..... Delivery date : .....

Address : ..... N° of hours : .....

Service engineer. : ..... Gearbox N° : .....

This sheet must be filled in for all problems concerning the gearbox and must be returned to the service (department 402)

Date : .....

ACCESSORIES FOR PRESSURE MEASUREMENT : P/N 5451745

Stated problems :	**yes**	**no**
- Unusual noise in gearbox at low idle	☐	☐
- Unusual noise in gearbox at high idle.....	☐	☐
- Any direction selection	☐	☐
- Forward travel	☐	☐
- Reverse travel	☐	☐
- Forward travel in neutral	☐	☐
- Reverse travel in neutral	☐	☐
- Sufficient clearance of master cylinder ?	☐	☐
- Inching valve okay ?	☐	☐
- Non-return valve okay ?	☐	☐
- Directional solenoid valves in order ?.....	☐	☐
- Solenoid valve oil supply in order ?	☐	☐
- Running-in filter removed ?.....	☐	☐
- Main filter clogged ?	☐	☐

Pressures in bar at 2000 RPM :

	FW	RE	Min.	Max.
- Main pressure :			10	11
- Clutches (with direction selection) :			10	11
- Torque converter :			4	5

Remarks : .....

.....

.....

Conditions of truck : .....

1. Remove the pin (1) at the non-return valve. Check that the spring (3) is in good condition. Place a shim (2) 2 mm thick between the pin and spring (3). Example : if the initial shim is 1.8 mm, add 0.2 mm (there are 3 different shims : 0.2, 0.5 and 1 mm).

2. Install a pressure gauge for measuring a pressure of 4 bar with a maximum pressure of 15 bar into the pipe for the forward travel clutch (5).

3. Install a tachometer to the engine.

4. Check the pressure indicated on the pressure gauge at an idle speed of 750 RPM and a gear oil temperature of 80 to 100°C. The rated value should be between 0.8 and 1 bar.
   If the pressure exceeds 1 bar, increase the diameter of the nozzle (4) by enlarging the opening to 3.1 mm.
   If the pressure is still incorrect after a new check, increase the opening to 3.2 mm.

Attention

Do not exceed a bore diameter of 4 mm and drill by 1/10.

5. After obtaining the correct value at step 4, progressively advance the engine RPM while verifying at the same time the pressure indicated by the pressure gauge and the engine speed indicated by the tachometer.

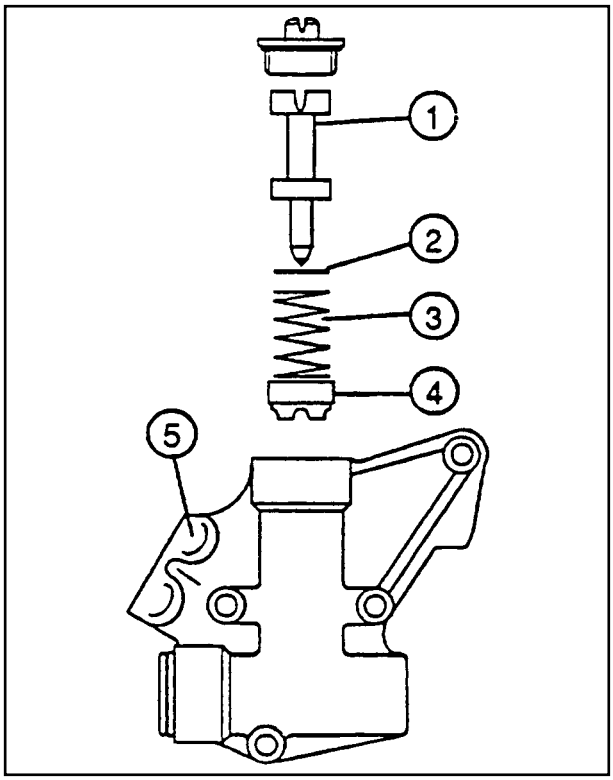
This procedure is intended to state the closing pressure of the non-return valve at a given speed.

The closing pressure of this valve must be greater than 3 bar.

The engine speed must be **imperatively** between 1300 and 1400 RPM at the same time.

The pressure obtained right after the valve has closed corresponds to the rated pressure applied to the clutches and is between 10 to 11 bar.

The adjustment is correct if, at an engine speed between 1300 and 1400 RPM, the pressure goes from the closing value (> 3 bar) to the operating pressure (10 to 11 bar).



Limit cases :

If the engine speed at which the valve closes is greater than 1400 RPM, the thickness of the shims should be reduced.

If the engine speed at which the valve closes is less than 1300 RPM, the thickness of the shims should be increased.

Attention

The total thickness of shims must not exceed 4 mm.

If the valve closing pressure is less than 3 bar, the nozzle diameter (4) must be reduced, i.e. restart the tests with a 3 mm nozzle.

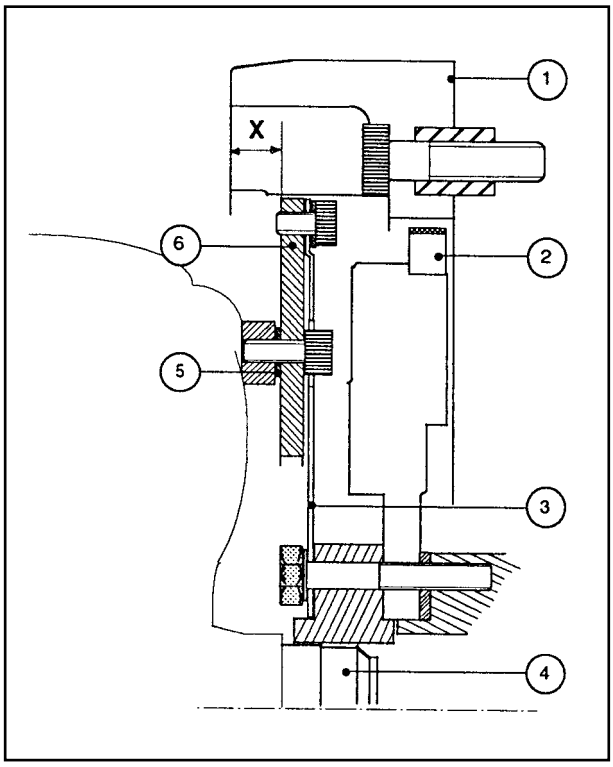
When the gearbox or the torque converter is replaced, check dimension X.

Dimension
X = min. 14.4 mm, max. 16.4 mm

If dimension X is larger than 16.4 mm, place a shim (5) 1.5 mm thick between the clutch thrust plate and the torque converter. See Fig. 03.

Remark

After replacing the torque converter fill with 1.2 L oil.

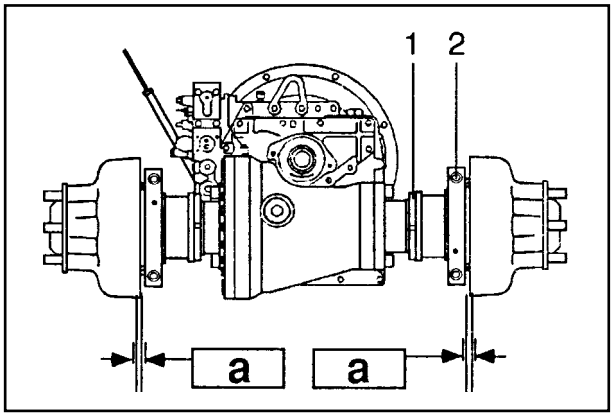


1 - Engine pump
2 - Flywheel
3 - Coupling plate
4 - Torque converter
5 - Washer M8 thick 1.5
6 - Clutch thrust plate

Adjusting the transmission in the truck axle

This consists of positioning the transmission in the truck axle by moving it along the axis of the wheels in order to even up the construction tolerance on each side.

When fitting the transmission, unscrew the nuts (1) by 5 turns each so as to free the bearings on the axle housings.



Fix the transmission onto the chassis by the 2 bearings. Pretighten the 4 fastening bolts (2).

Even up the construction tolerances (a) by screwing or unscrewing the right or left nuts (1) so that the brake drums are in the same position relative to the brake plate (to within ± 1 mm).

NOTE *:*

During this operation, always unscrew nut (1) opposite to where the movement is to be made so as not to cause any sideways (axial) load on the bearings.

- When the transmission is correctly positioned, place the two nuts (1) in contact with the bearings.

- Tighten the 4 bearings mounting bolts (2) fully. Lock them using retaining devices.

- Lock the 2 nuts (1) by bending the outer collar in the hole provided in the axle housing.

Remarks :

1) To make this operation casier, the rear part of the engine may be lifted slightly so as to relieve the load on the support.

2) The rear mounting bolt of the engine support must be completely free so as not to impede the positioning of the assembly.

Disassembly and assembly of the gearbox

- The illustration shows the pump suction filter. If overhauling, it is recommended that this part and the sealing ring be renewed.

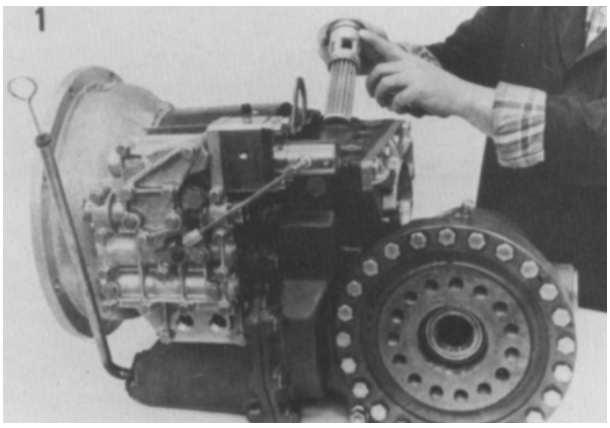


Figure 03-1

- Remove the check valve block with seal after unscrewing the fastening screws.

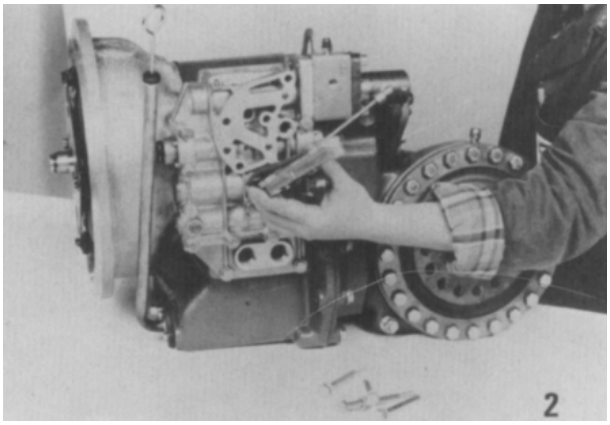


Figure 03-2

- Remove the mounting screws and then take off the control valve block.

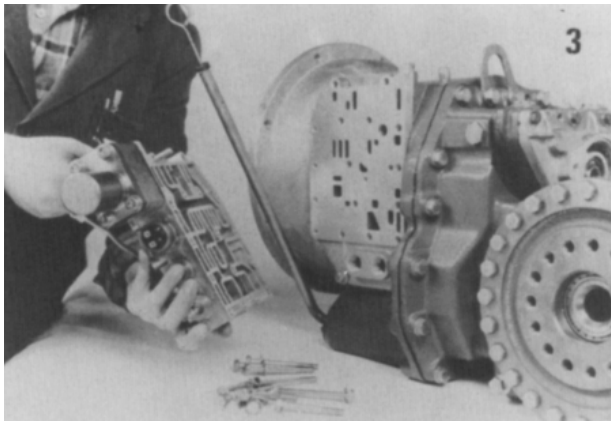


Figure 03-3

- Take off the control valve base plate at the gearbox case and remove the respective gasket after removing the fastening screws.

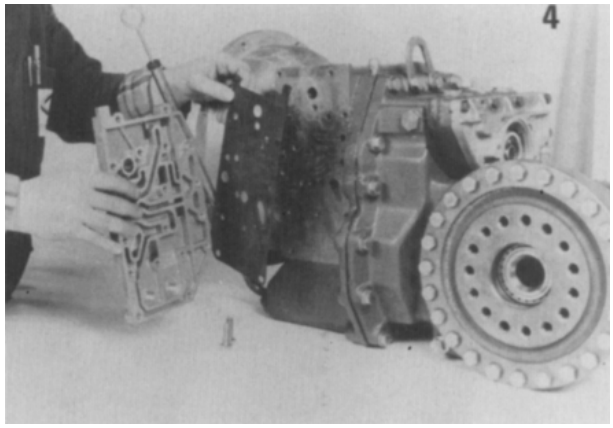


Figure 03-4

Disassembly and assembly of the control valve block

- Loosen and remove the line connections at the spool for slow gear at the control valve.

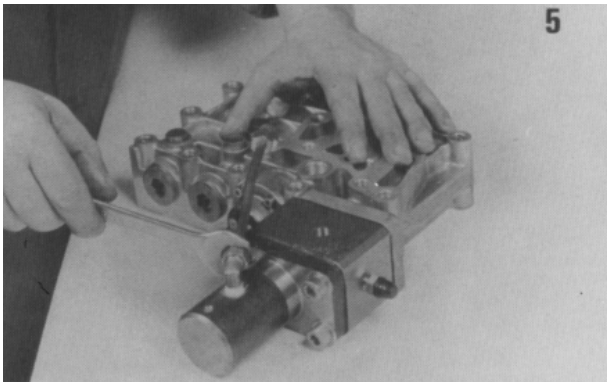


Figure 03-5

- Remove the mounting screws for the spool and cap at the control valve housing, then pull the assembly for slow gear straight out. Take care not to damage the lip seal.

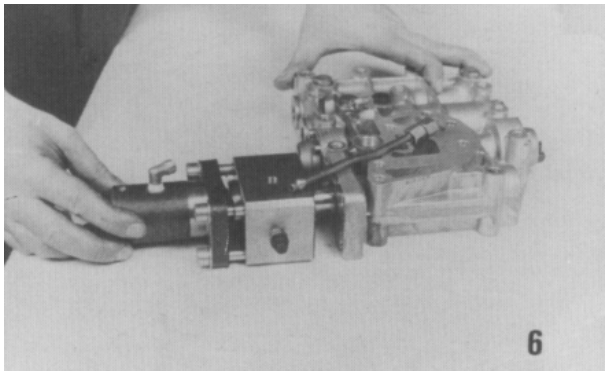


Figure 03-6

- Removing the reversing valve :
  Unscrew the socket head screws on the solenoid valve cover and remove it and the O-ring.

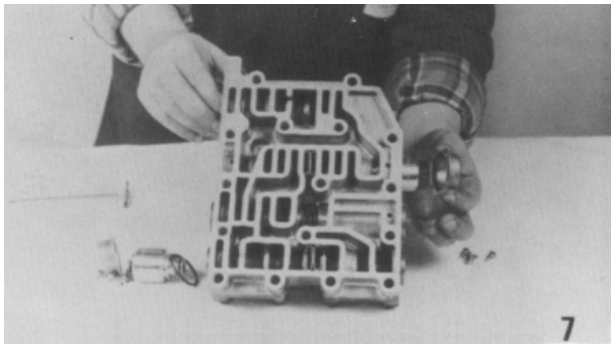


Figure 03-7

- Pull out the spool and return spring. Take out the valve end stops.

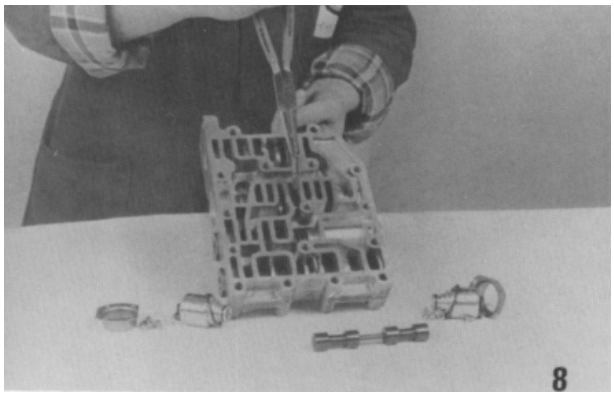


Figure 03-8

- Unscrew the control valve stop screws.

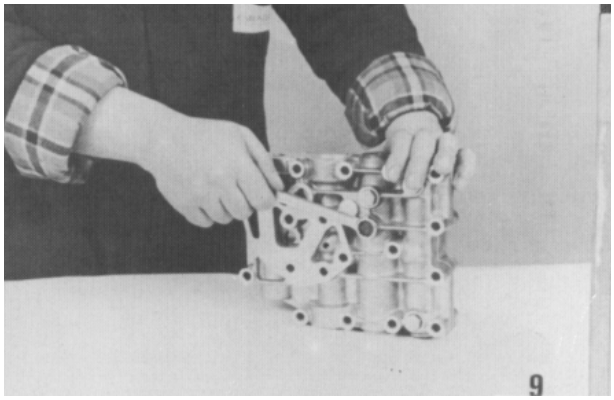


Figure 03-9

- Take the control valve out of its housing after removing the end plug.

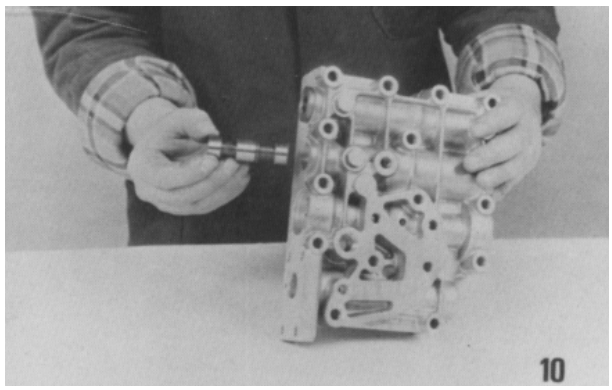


Figure 03-10

- Loosen the plug holding the control valve, pull out the plug and springs.

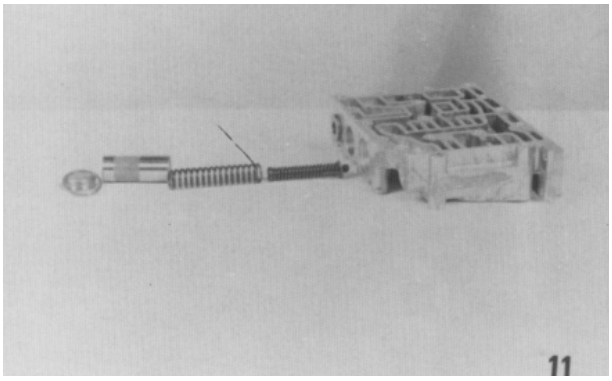


Figure 03-11

- Loosen the threaded plug at the end of the maximum pressure relief valve and the converter pressure relief valve. Pull the spool and springs out. Make sure that the shims do not get lost or are interchanged. Then remove the spring thrust washers from the converter housing.

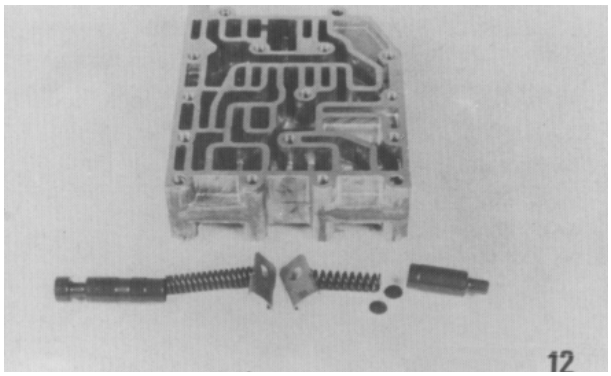


Figure 03-12

- Installing the pressure relief valve for maximum pressure and converter :
  Fit the washers into the control valve housing, insert the converter pressure relief valve with springs and then secure the shims, if any, by screwing on the end plug.

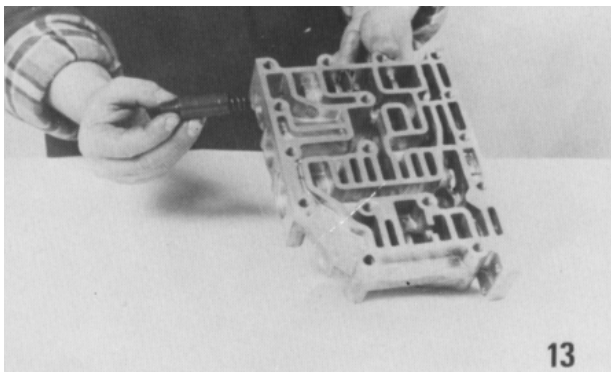


Figure 03-13

- Install the maximum pressure relief valve in the same way as that for the converter.

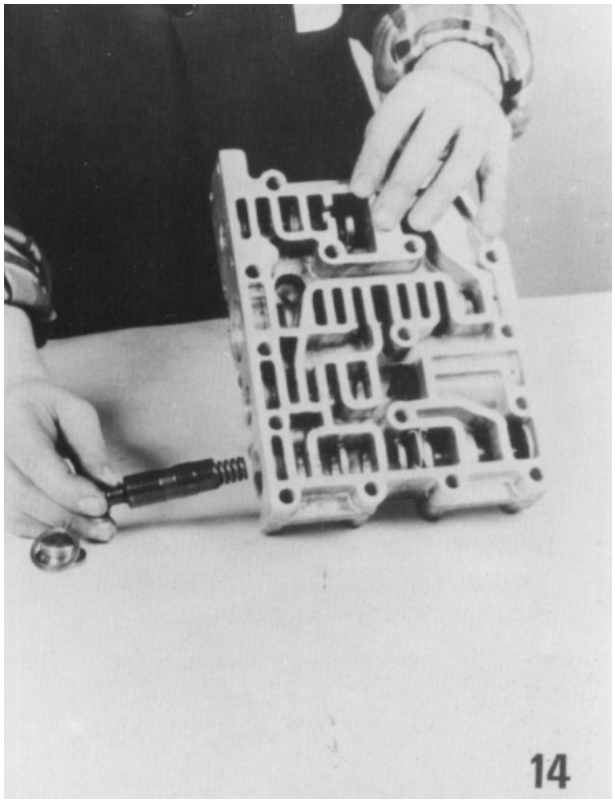


Figure 03-14

- Installing the control valve :
  Insert the spool so that the groove matches the end stop screw and secure it ; subsequently screw in the end plug.

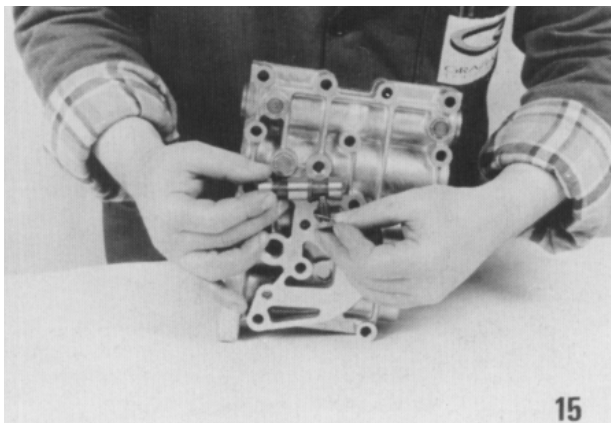


Figure 03-15

- Insert the control valve receiver with spring and shaft from the opposite side of the control valve block. Fit the shims and then screw in the end plug.

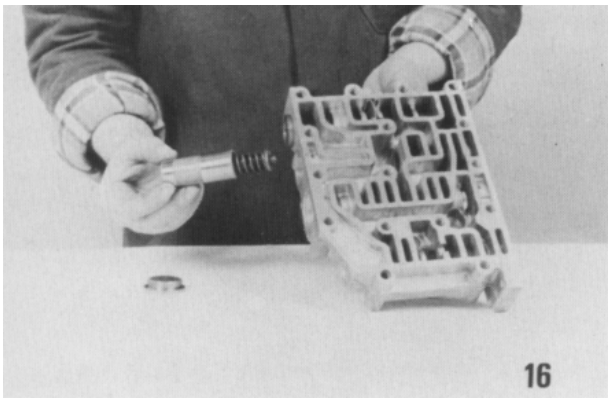


Figure 03-16

- Installing the reversing valves for forward and reverse gear :
  Insert the washers in the valve housing, making sure that they are positioned properly. Subsequently put in the springs and reversing valves.

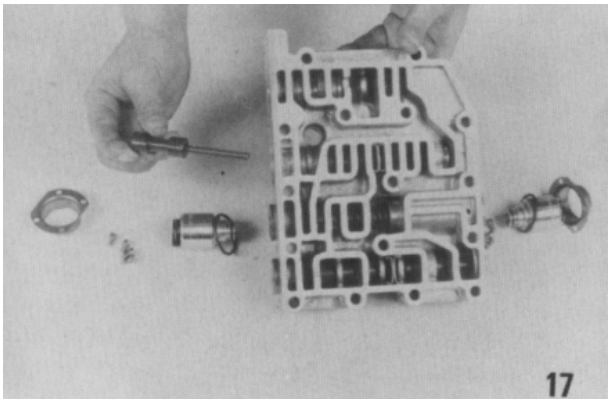


Figure 03-17

- After fitting the outer O-rings, install the solenoid valve and secure it with the retaining cover by tightening the cover screws to 3 Nm.

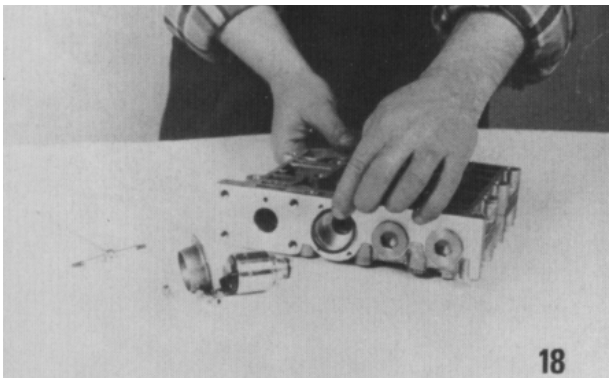


Figure 03-18

- Installing the slow gear spool :
  Refit the slow gear spool, shims (if any) and springs, and slide in as far as possible.

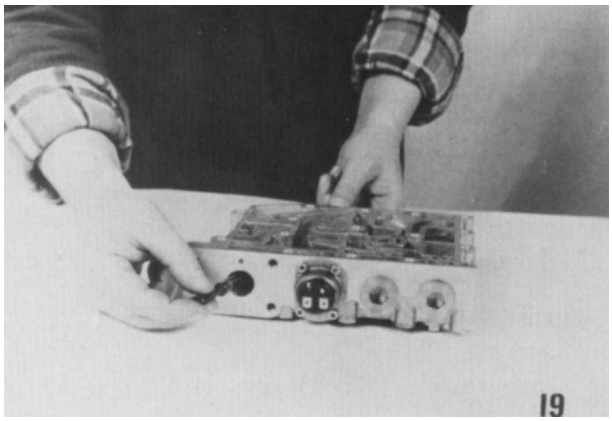


Figure 03-19

- If required, renew the lip seals in the control valve housing, hat the head and slow gear spool.

WARNING

Use genuine spare parts in order to prevent premature damages to the seals, which can result if incompatible oils are used, and in order to ensure the proper operation of the assembly group.

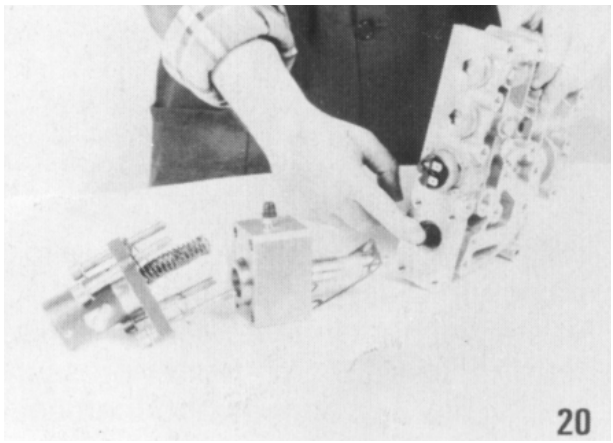


Figure 03-20

- Finally, fit the gaskets and the washer in the proper place at the head (as shown in the figure).

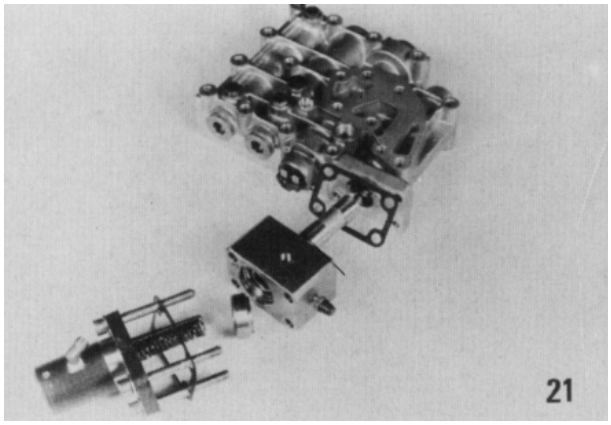


Figure 03-21

- Install the slow gear assembly group at the control valve housing, reconnect the lines and tighten the unions.

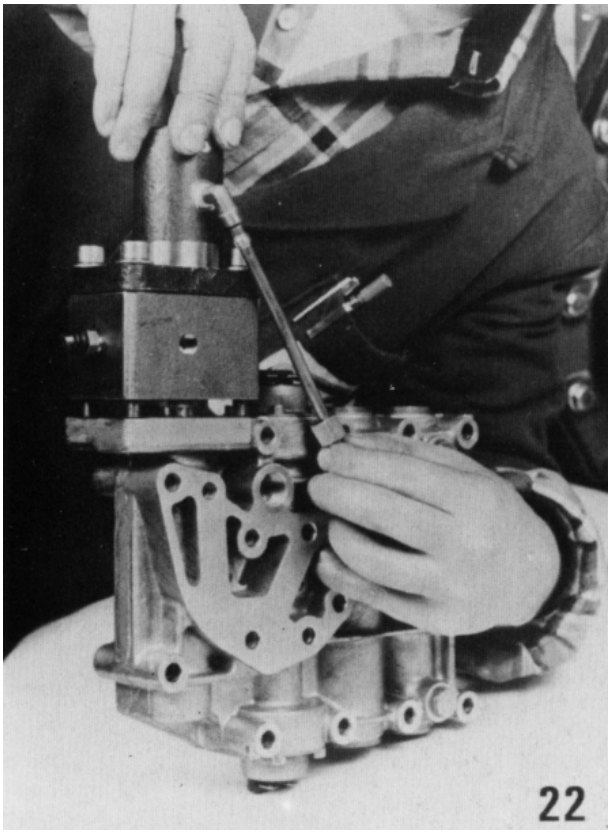


Figure 03-22

- Tighten the mounting screws for the slow gear assembly on the control valve housing to 1.8 - 2.0 daNm and lock them.

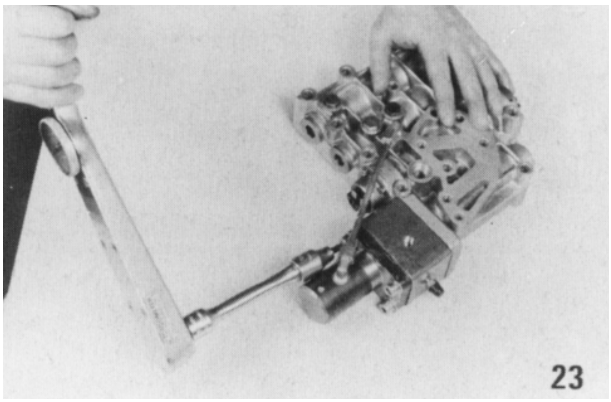


Figure 03-23

- Remove the retaining screws and disconnect the oil lines. Unscrew the bolts on the differential housing halves, and mark the position to each other.

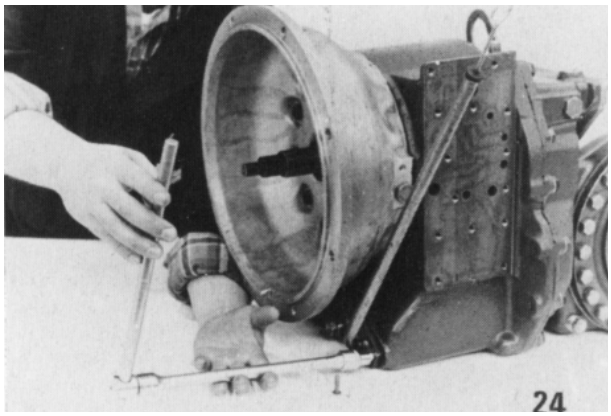


Figure 03-24

- After marking the position for later assembly, unscrew the differential mount cover bolts at the centre housing and then pull the differential off.

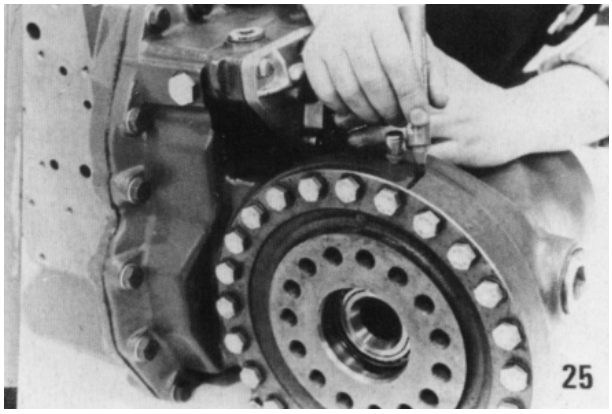


Figure 03-25

- Take the differential with the bevel gear out of the centre housing.

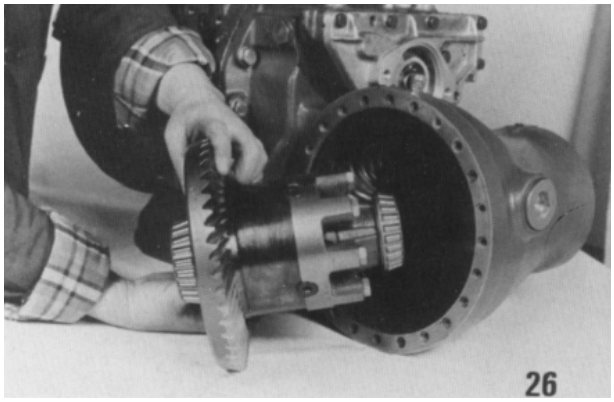


Figure 03-26

- Unscrew the housing half bolts and mark their position for refitting.

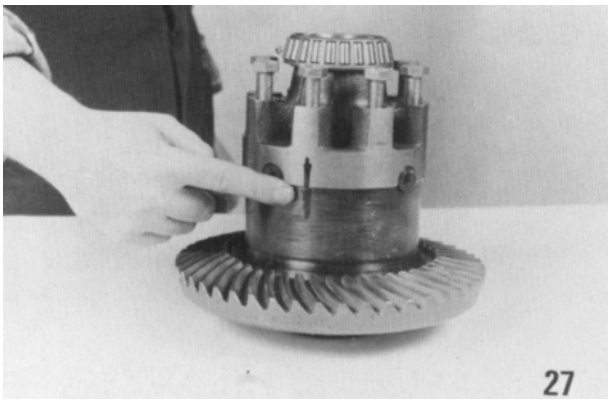


Figure 03-27

- Open the differential and inspect the pinion, bevel gear and thrust washers for wear.

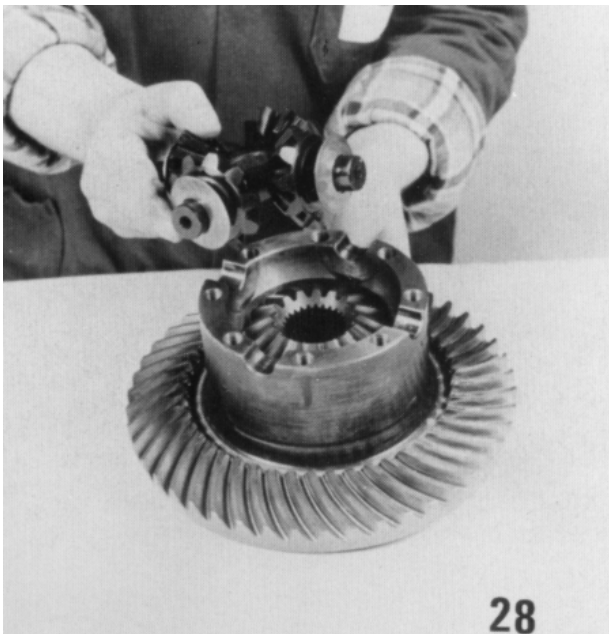


Figure 03-28

- If the taper roller bearings have to be replaced, they must be removed with an extractor. Heat them prior to refitting or use a suitable tool.

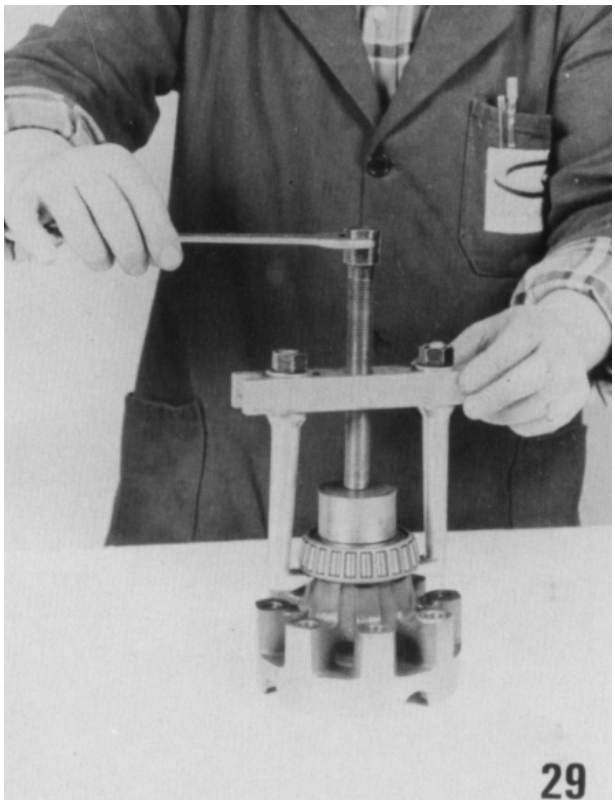


Figure 03-29

- Reassemble the differential and the housing halves. Make sure that the previously made marks are matched, fit the mounting bolts and torque to 4.8 - 5,2 daNm.

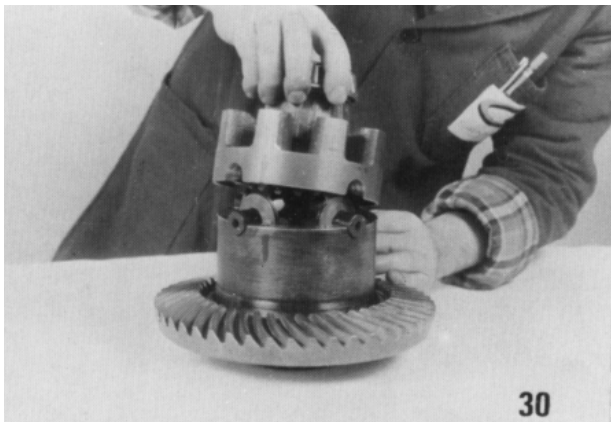


Figure 03-30

- Unlock and remove the converter housing bolts at the gearbox housing.

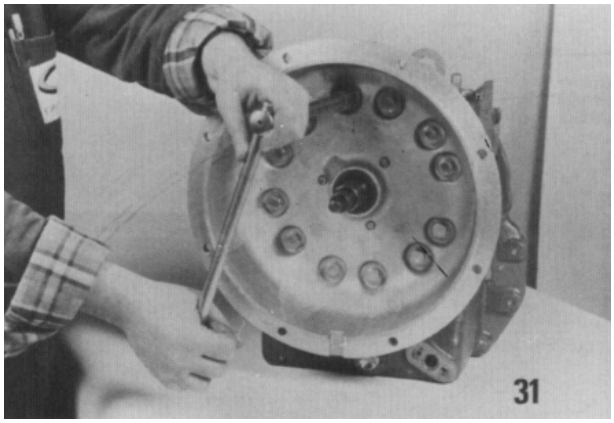


Figure 03-31

- Unlock and remove the 3 bearing housing cover bolts from the clutch basket cover.

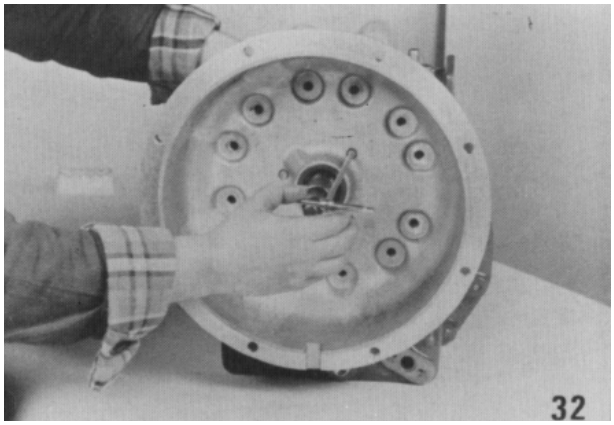


Figure 03-32

- Remove the converter housing with the gearbox housing.

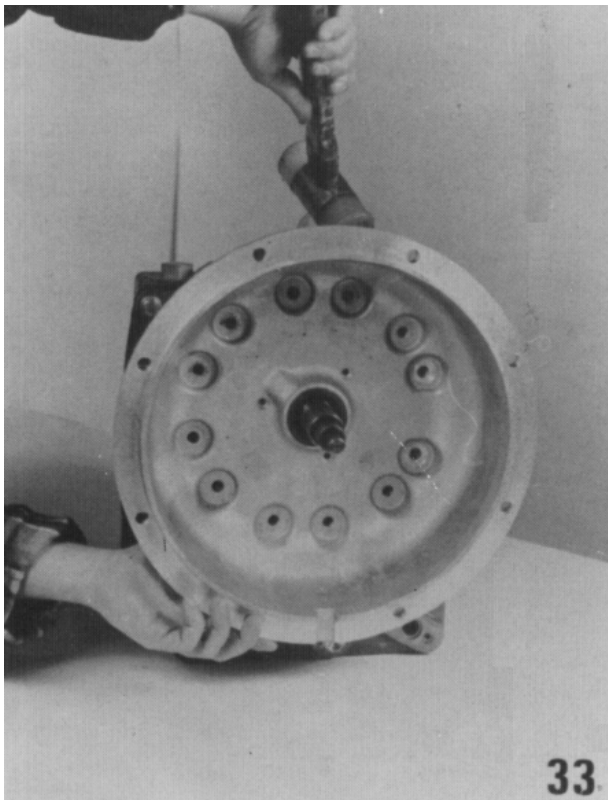


Figure 03-33

- If required, replace the lip sealing ring on

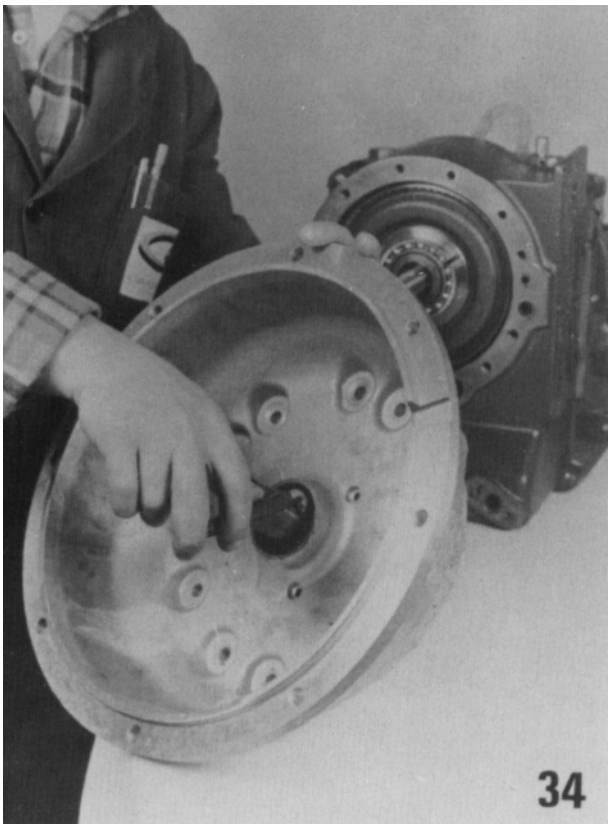


Figure 03-34

- Carefully clean the seats for the sealing rings of the converter oil supply (large hole) and the reverse gear clutch (small hole), then fit the sealing rings. To prevent the seal seats from moving during installation, it is recommended coating them with grease.

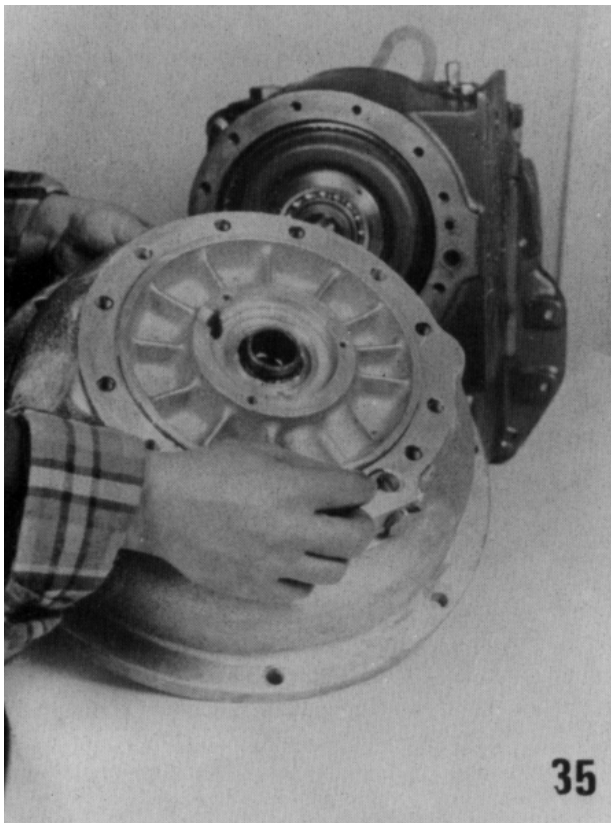


Figure 03-35

- Take out the cast hydraulic seal. Refit it with extreme care and fix it in a concentric position to the shaft with grease so that any damage during installation will be prevented.

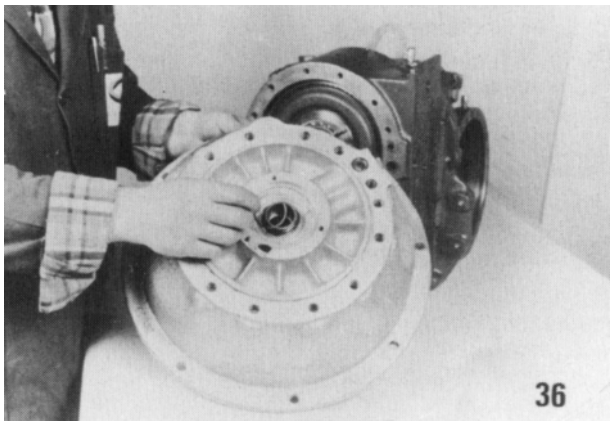


Figure 03-36

- Take out the circlip and draw out the final drive axle together with the bearing.

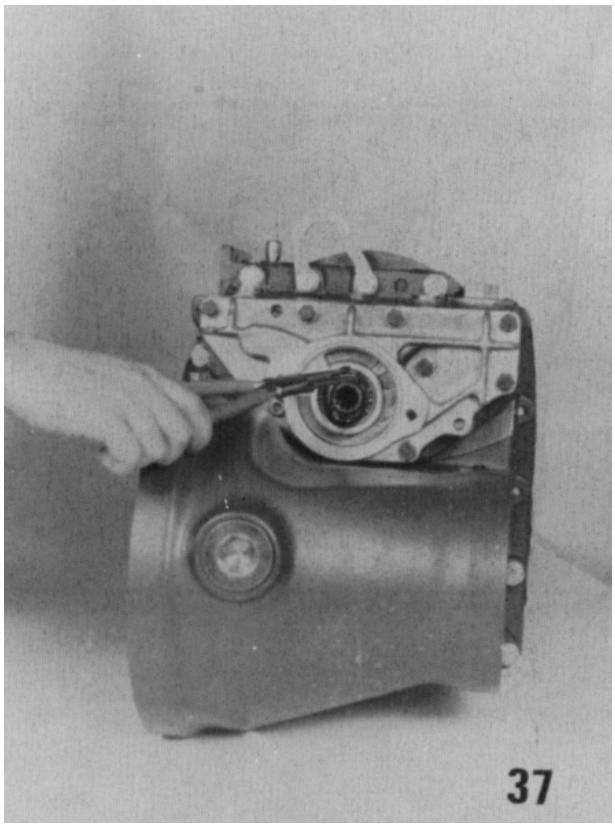


Figure 03-37

- If the bearing has to be replaced, remove the circlip from the axle.

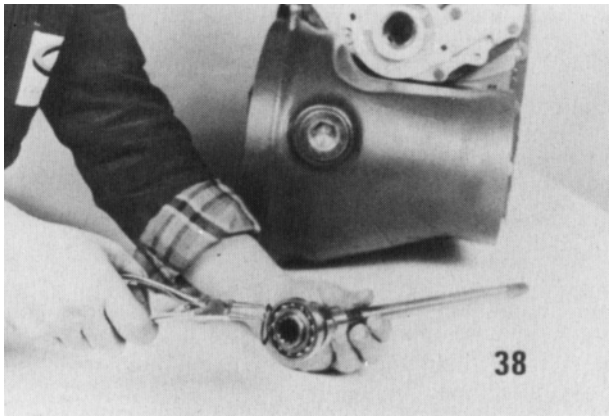


Figure 03-38

- Unlock and unscrew the pump mounting bolts, and then remove the pump assembly.

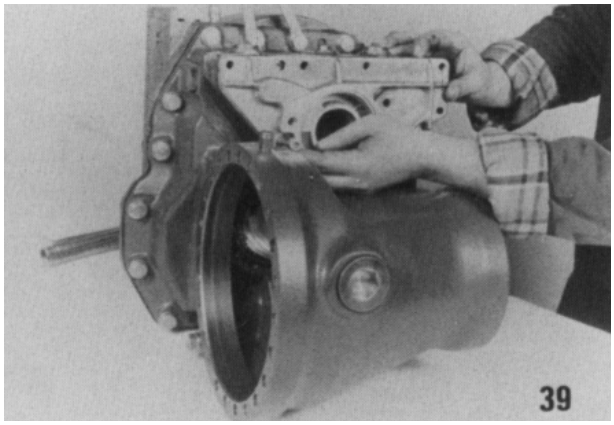


Figure 03-39

- Take out the pump centering ring, then remove the gasket from the mating surface.

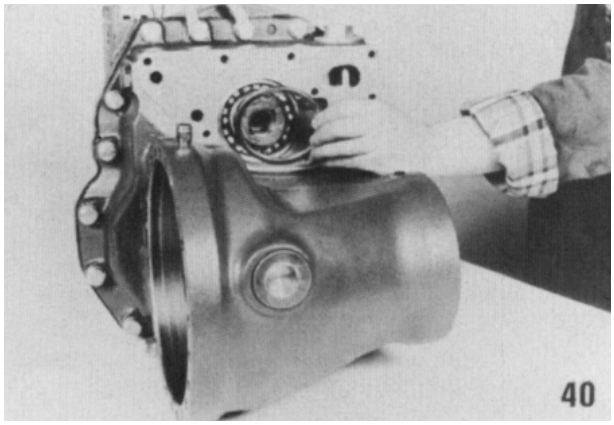


Figure 03-39

- Remove the pump housing cover.

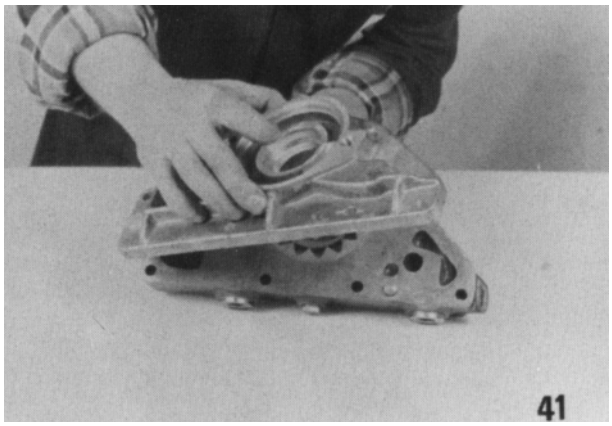


Figure 03-41

- Take the gears aou of the pump housing and make a visual inspection of the gears and receiver for wear. Reinstall in the correct position.

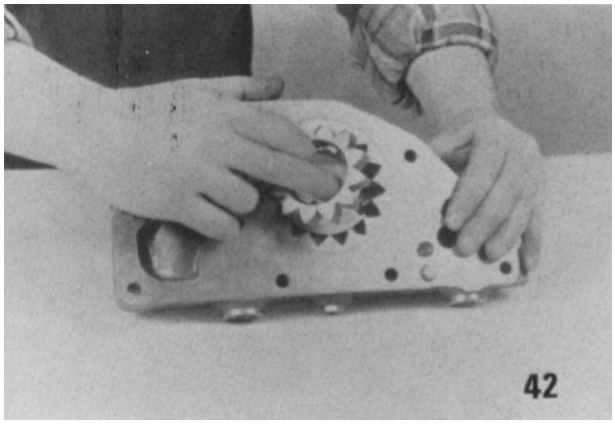


Figure 03-42

- Pull out the thrust collar of the reverse gear piston, then remove the clutch basket cover completely.

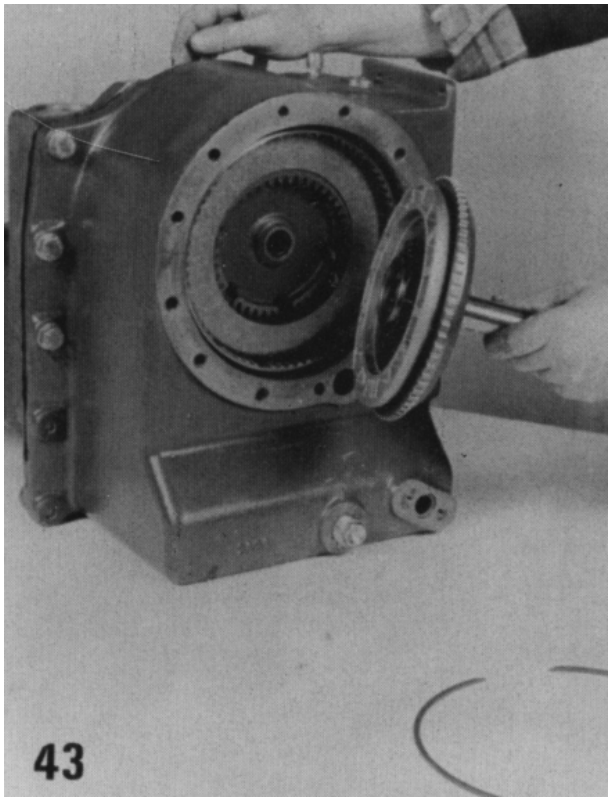


Figure 03-43

- Remove the snap ring from inside the drum cover, then the 3 clutch discs and the 3 steel clutch thrust discs for reverse gear.

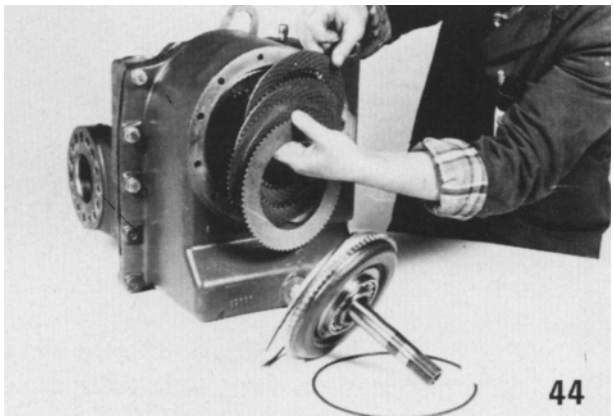


Figure 03-44

- Remove the clutch hub for reverse gear after removing the snap ring.

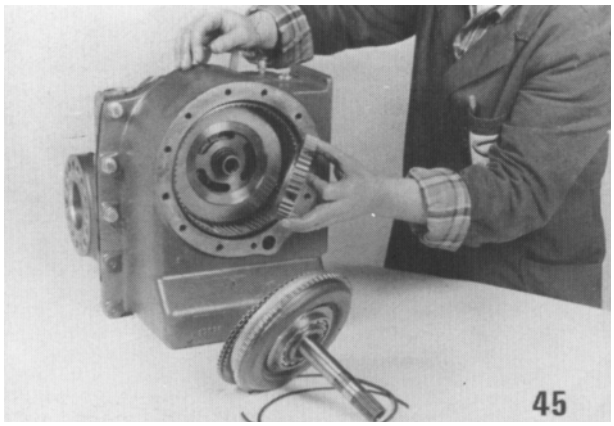


Figure 03-45

- Pull the axial thrust ring (outside) from the clutch thrust ring, and then take it out of the housing.

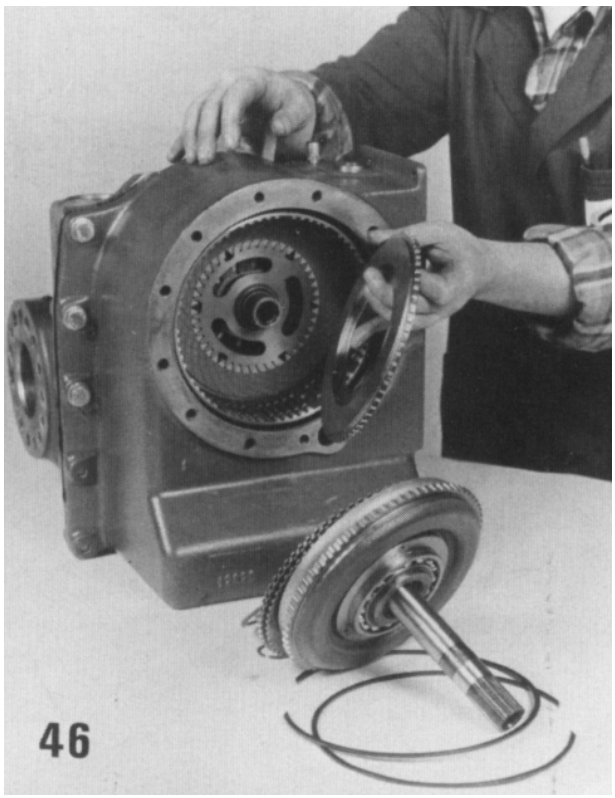


Figure 03-46

- Remove the axial thrust ring (inside) from the thrust ring, then the 3 clutch discs and the 3 clutch thrust discs for forward gear.

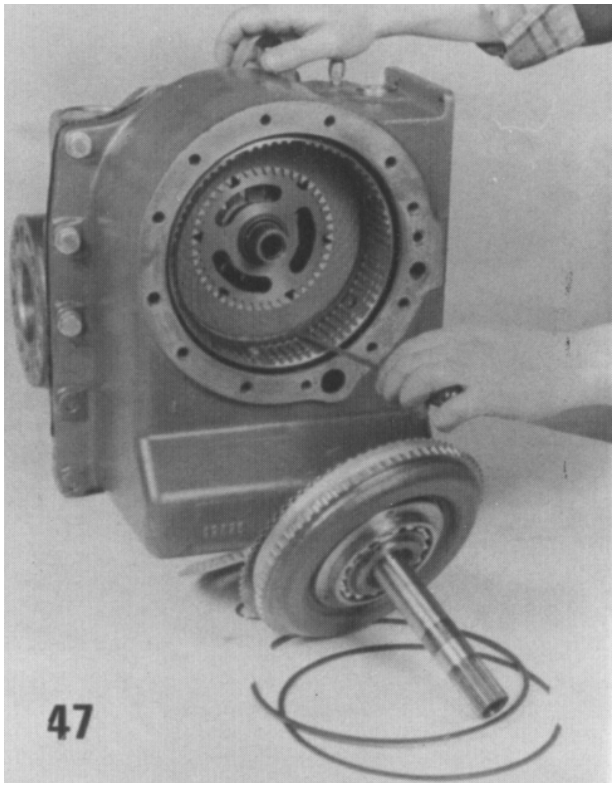


Figure 03-47

- Take off the circlip for the clutch hub from the axle for reverse gear.

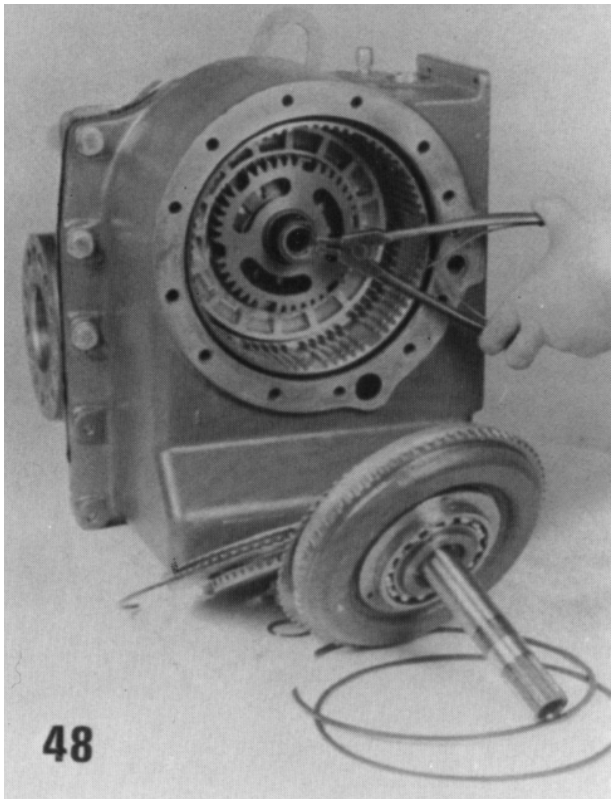


Figure 03-48

- After removing the circlip, take off the clutch hub for forward gear.

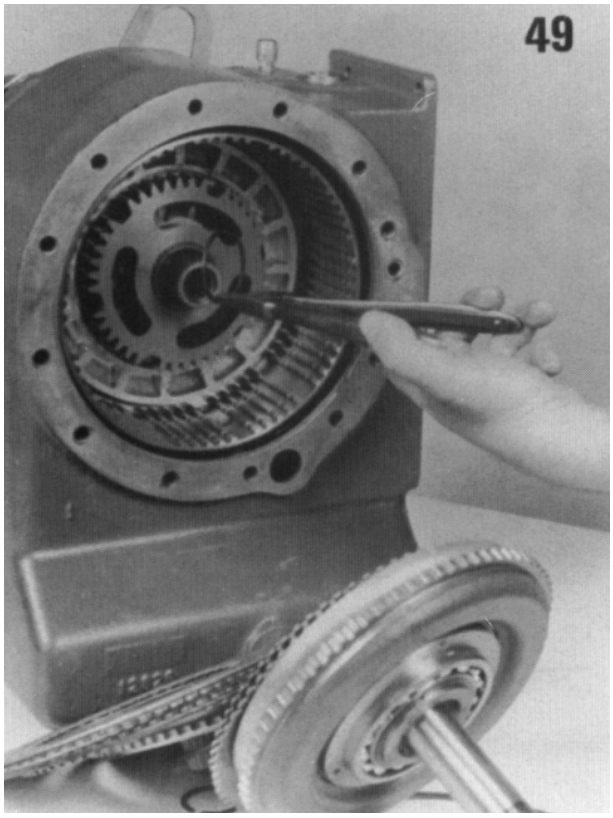


Figure 03-49

- Take out the clutch basket assembly.

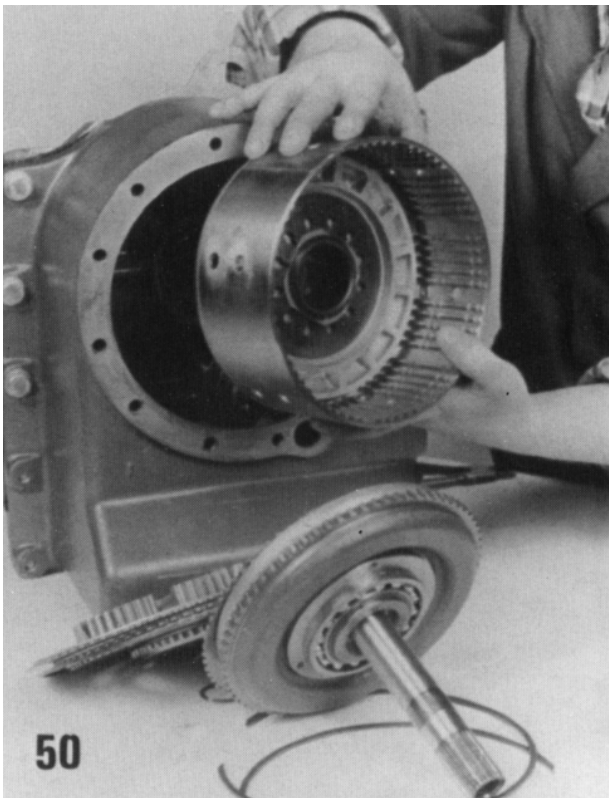


Figure 03-50

- Remove the bearing race of the clutch basket on the axle for forward gear.

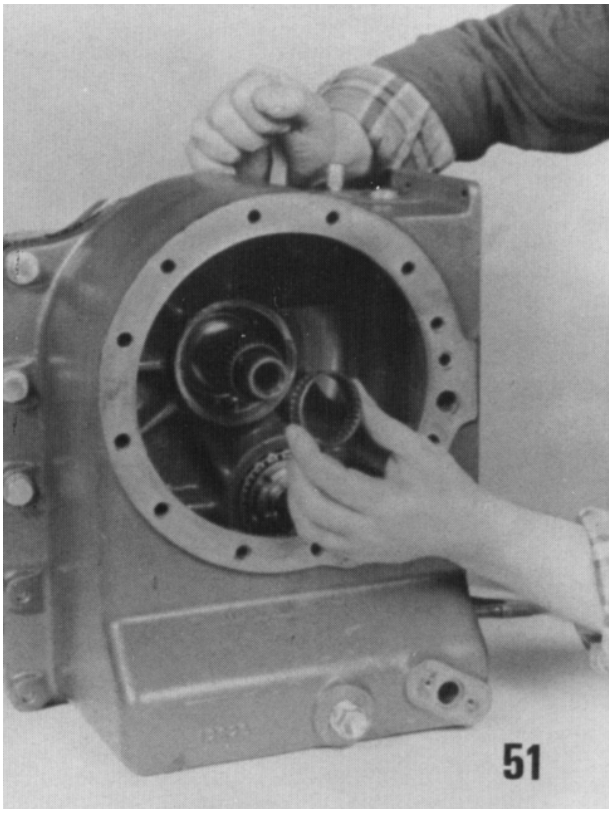


Figure 03-51

- To replace the drive shaft, remove it from the cover of the clutch basket after taking off the snap ring.

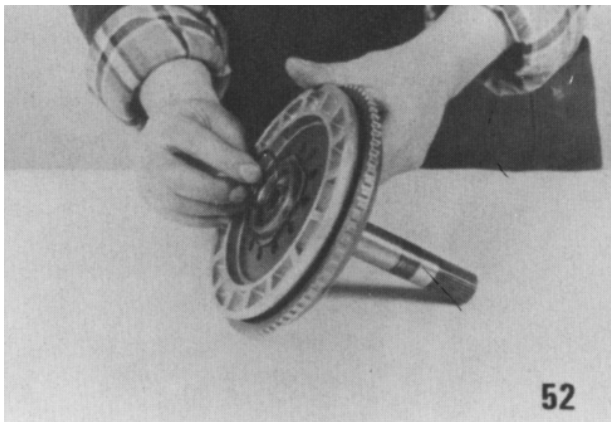


Figure 03-52

- Using a special tool, compress the Belleville spring for pulling back the desired value piston in order to make the removal of the snap ring possible.

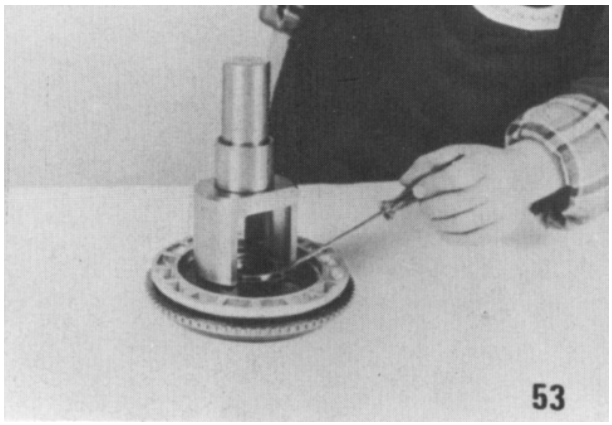


Figure 03-53

- Remove the piston for reverse gear from the basket cover and replace the inner and outer sealing rings.

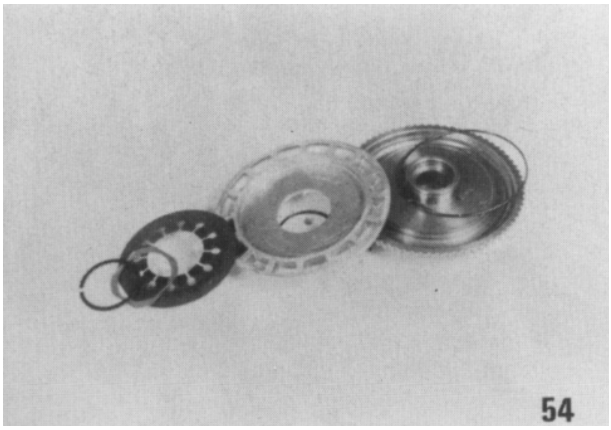


Figure 03-54

- Place the piston on the basket cover, put the Belleville spring and snap ring back in place, and then compress the spring using the appropriate tool until the snap ring can be refitted.

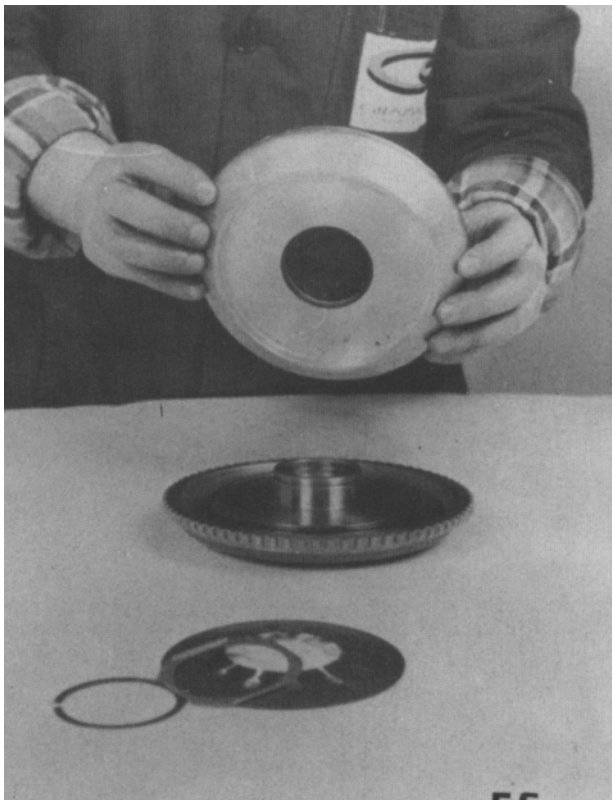


Figure 03-55

- After removing the snap ring, screw three M5 screws into the cover and tighten evently in order to press the bearing from the basket cover.

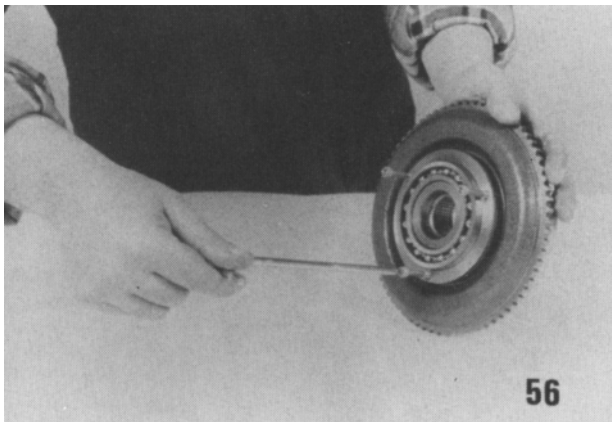


Figure 03-56

- Position the cover correctly, fit the bearing either after heating it or with a special tool. Fit the snap ring before fitting the drive shaft.

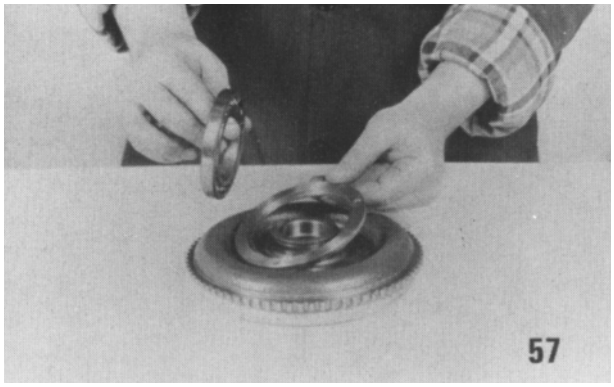


Figure 03-57

- Fit the O-ring in the basket cover and secure with a snap ring.

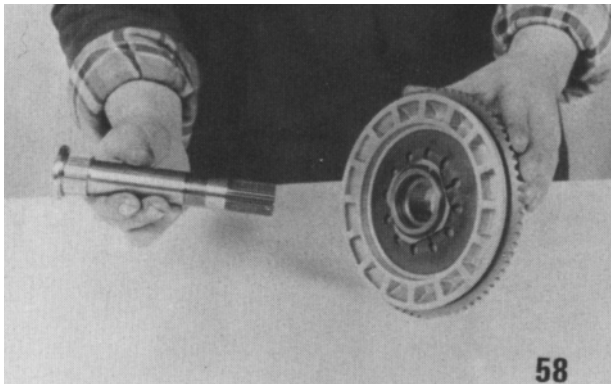


Figure 03-58

- Take off the cast hydraulic sealing ring and then slide it onto the clutch basket.

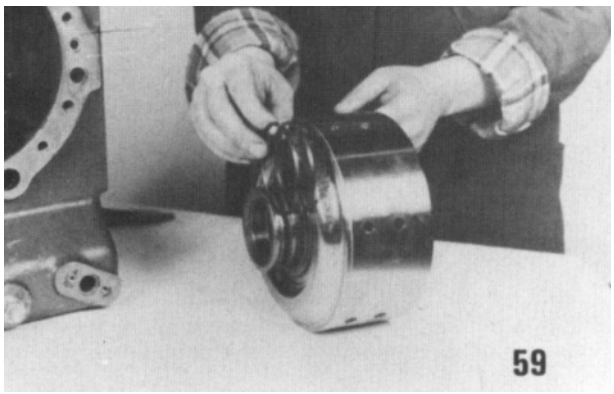


Figure 03-59

- When installing the cast hydraulic sealing rings, the parts must be fitted carefully, then secured in a concentric position with grease before finally refitting the bearing race.

NOTE
Proceed as for the reverse gear when removing and installing the forward gear piston located in the clutch basket. Also use the same tool.

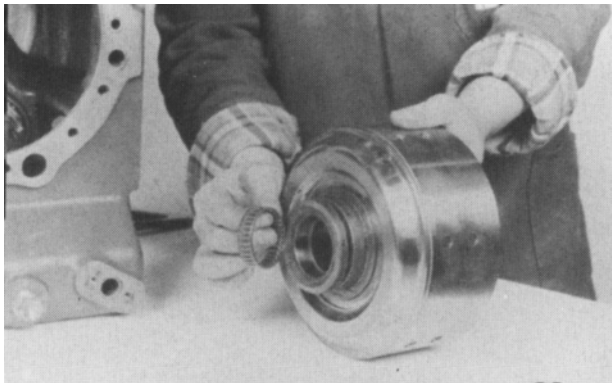


Figure 03-60

- Remove the pinion nut retainer, then loosen and unscrew the nut :
  For this work the rotation of the pinion must be prevented by using a special tool that is introduced into the clutch hub to couple the shafts of both gears.

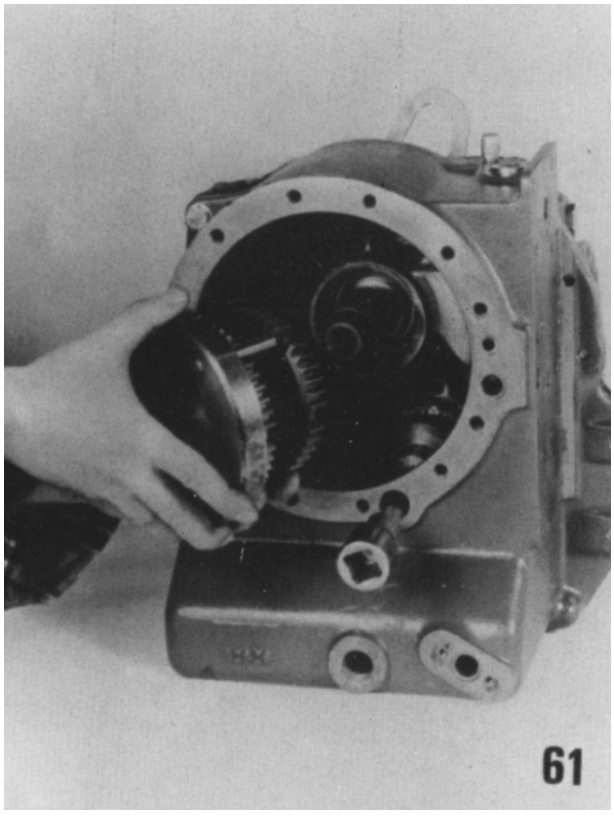


Figure 03-61

- Using a suitable punch, drive the bevel gear from the inner ring of the end bearing.

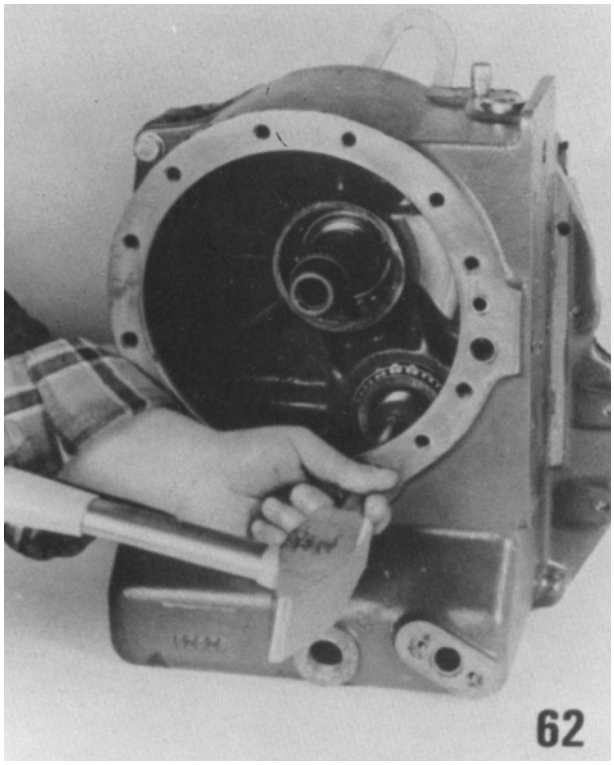


Figure 03-62

- Unscrew the mounting bolts and then separate the intermediate housing from the centre housing. Now the drive gear can be taken out and secured on the bevel gear. Remove the middle gear group.

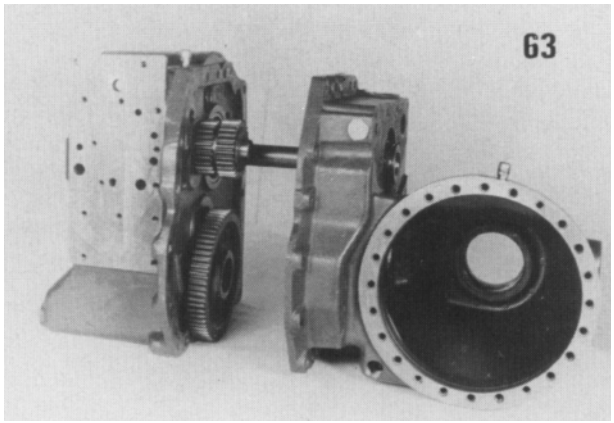


Figure 03-63

- Inspect the parts of the intermediate gear : roller bearings, thrust washers at the respective stop faces. Replace them, if necessary, and reassemble the gear.

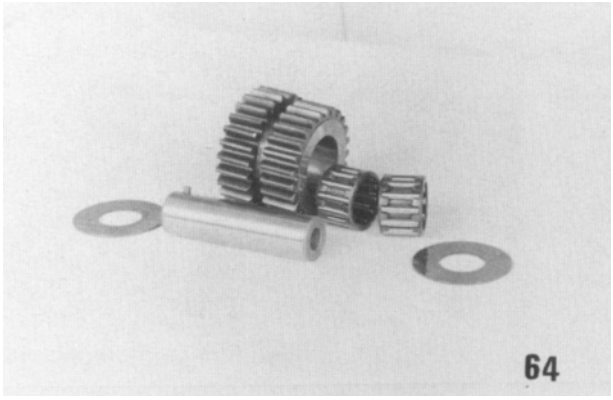


Figure 03-64

- Remove the reverse gear shaft from the centre housing :
  Remove the snap ring at the housing.
  Take the shaft completely out of the bearing.

NOTE
For the removal of the forward gear shaft, proceed in the same way as for the reverse gear shaft.

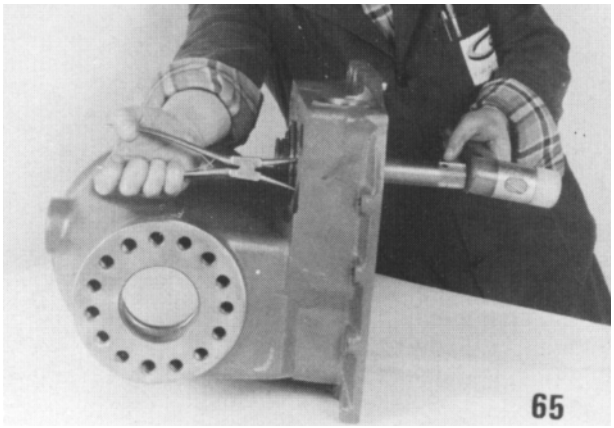


Figure 03-65

- Remove the bolts on the thrust plate at the bearing under the pinion. Replace the lip seals and O-rings.

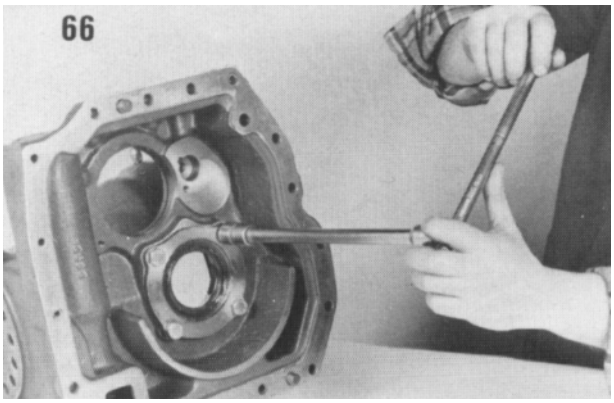


Figure 03-66

- Take out the axial adjustment washers for the pinion, and drive out the outer ring at the footstep bearing with a punch.

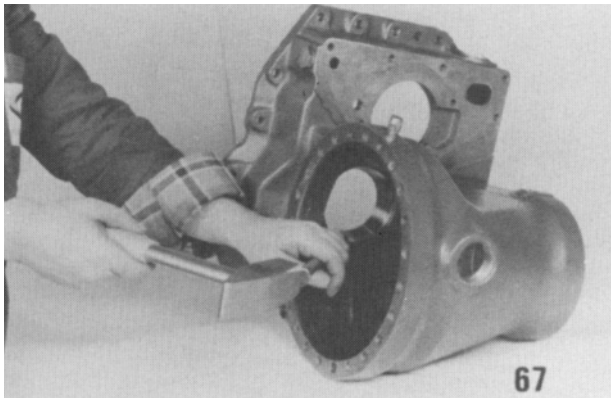


Figure 03-67

Installing the cone housing

Instead of the differential, centre a cylinder with a know diameter "D" between the bearing seats.

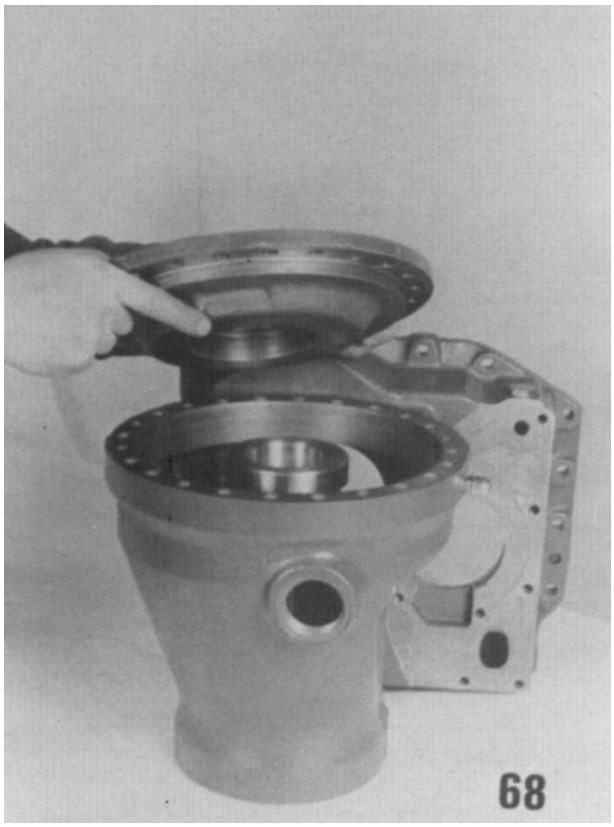


Figure 03-68

- Determine the dimension between the contact surface of the footstep bearing cover and cylinder "D". Mark this with the letter "A".

It is now possible to determine the distance between the contact surface of the cover and the pinion axle, which is dimension "B".
"B" = "A" ("D" : 2).

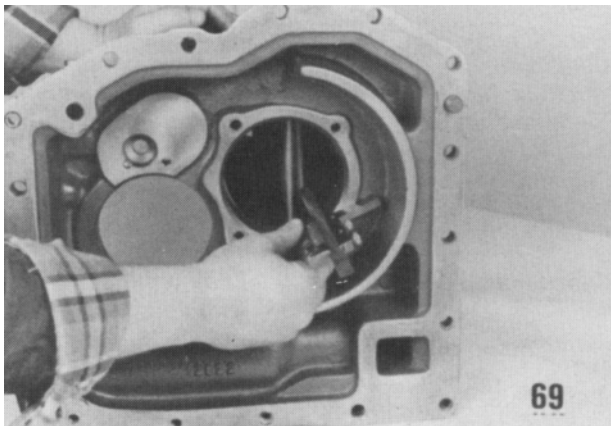


Figure 03-69

- A digit beginning with the sign (+) is stamped beside the serial number at the front of each pinion. This number expresses the theoritical distance between lower end of the pinion and the pinion shaft in tenths of millimeters (for example, + 2,5 = 0.25 mm).

The actual dimension, designated "F" :
F = 115 + clearance.

In our example : F = 115 + 0.25 = 115. 25.

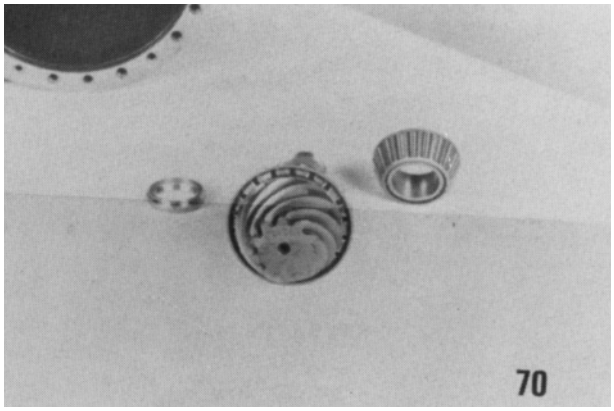


Figure 03-70

- Measure the thickness of the pinion footstep bearing and record it as dimension "H".

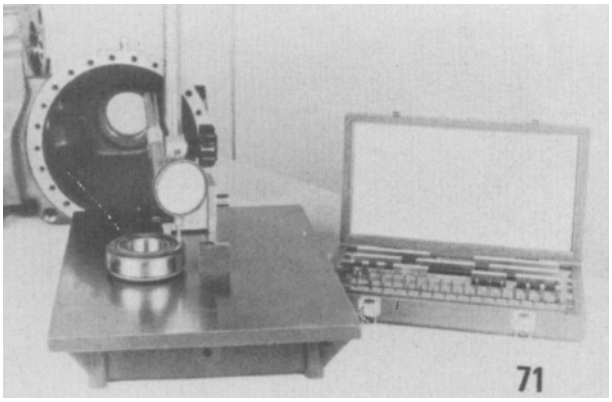


Figure 03-71

- Determine the dimension of the pinion footstep bearing cover between the shim and the mounting face on the centre housing : dimension "P".

At this stage it is possible to determine the thickness of shim "S" required between the cover and the pinion footstep bearing :
S = B - (F + H + P).

The calculated thickness "P" must be increased by 0.03 mm in order to compensate the bearing preload.

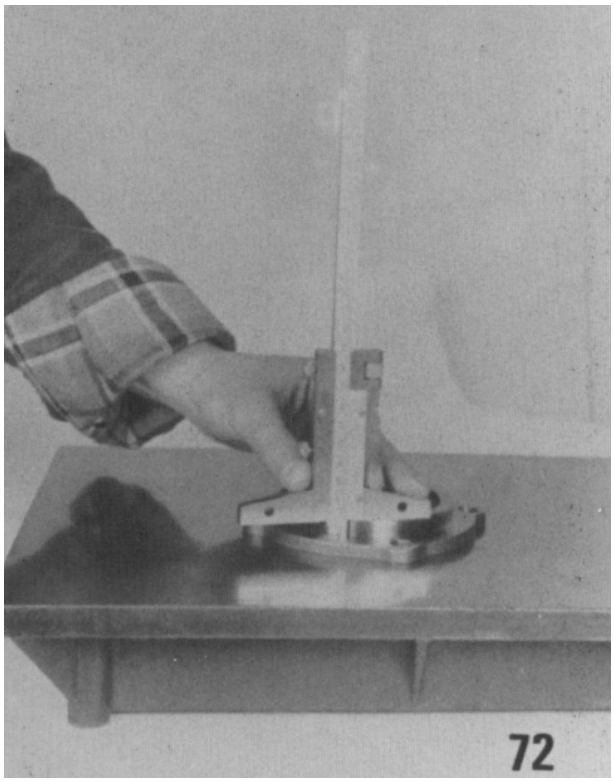


Figure 03-72

- Fit the outer ring of the footstep bearing in the centre housing, insert the shim with dimension "S" as determined in the previous measurements, and mount the bearing cover with lip seals and O-ring.

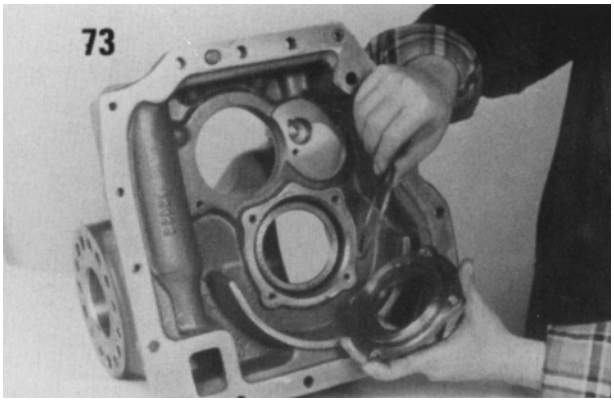


Figure 03-73

- Fit the cover bolts with the centre bolt retainer and tighten to 4.8 - 5.2 daNm.

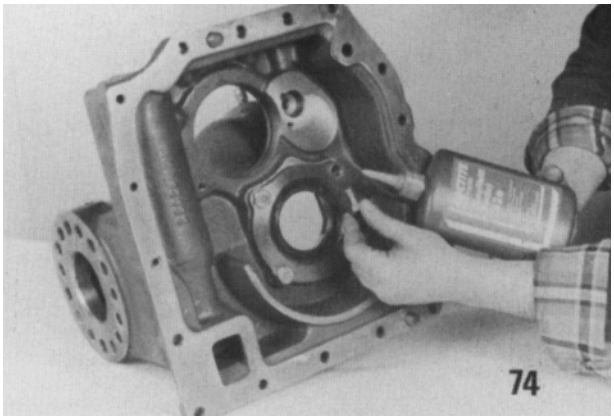


Figure 03-74

- Insert the snap ring at the intermediate housing and push apart so that the forward gear axle and bearing and the respective snap ring can be fitted.
  Position the outer ring for the pinion end bearing in the housing using a drift punch.

NOTE
The installation for the reverse gear axle in the intermediate housing is the same as for the forward gear axle.

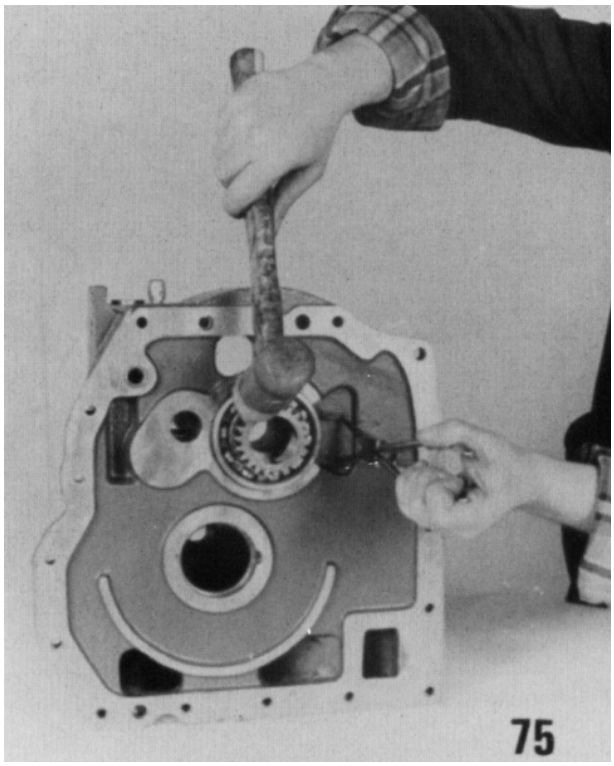


Figure 03-75

- Place the intermediate transmission into the centre housing, making sure that the centering journal is positionned correctly on the axle.

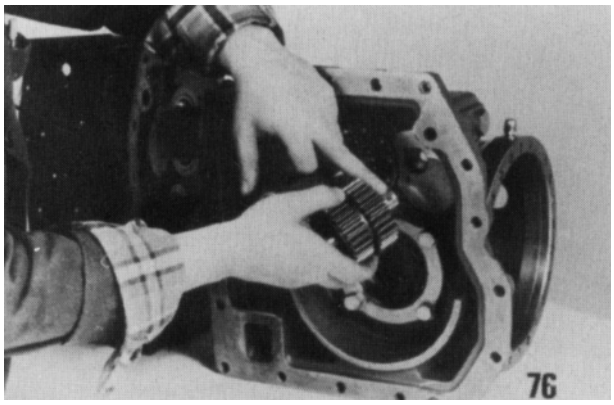


Figure 03-76

- Fit the appropriate taper roller bearings on the forward gear axle and fit the greased O-ring into the intermediate housing.

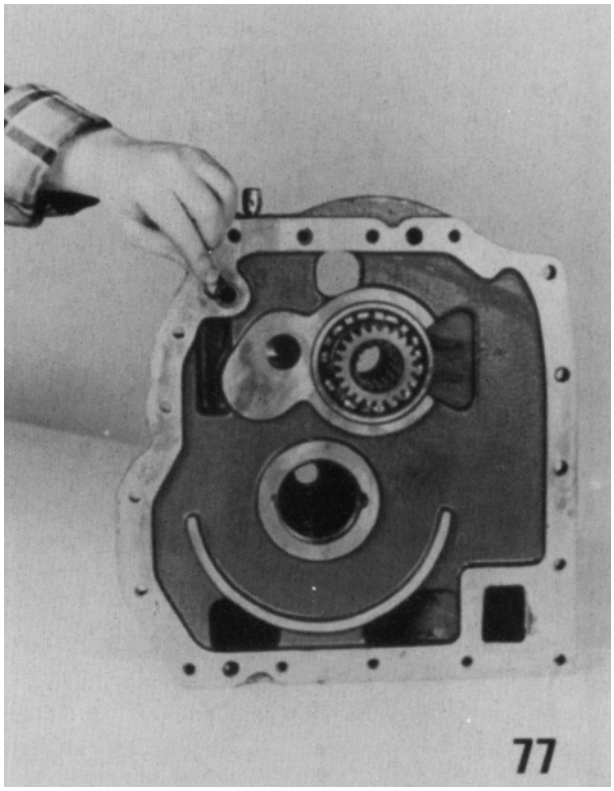


Figure 03-77

- Fit the drive gearbox into the centre housing while paying attention to its correct positioning, and apply adhesive to the sealing faces of the housing. Use a screw locking compound for the fastening bolts and tighten to 4.8 - 5.2 daNm.

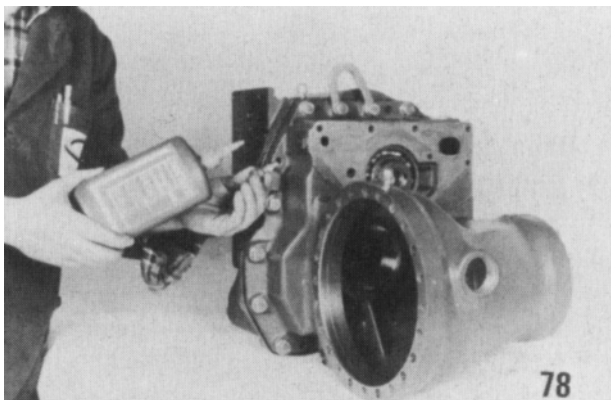


Figure 03-78

- Fit the inner bearing race of the footstep bearing onto the pinion after heating it or using a suitable tool, and install the appropriate spacer ring.

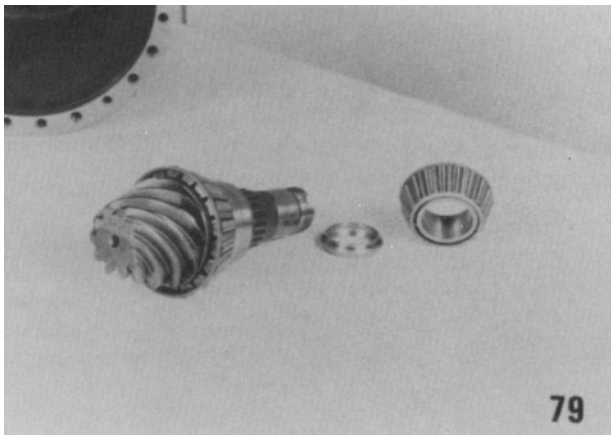


Figure 03-79

- Install the pinion through the centre housing, making sure that the gear of the drive transmission is aligned correctly. Fit the spacer ring and the non-reuseable preload ring, and secure at the head end using a suitable tool.
  The head end must now face the inner bearing race of the footstep bearing of the pinion.

CAUTION
The non-reuseable preload ring must be renewed at each assembly.

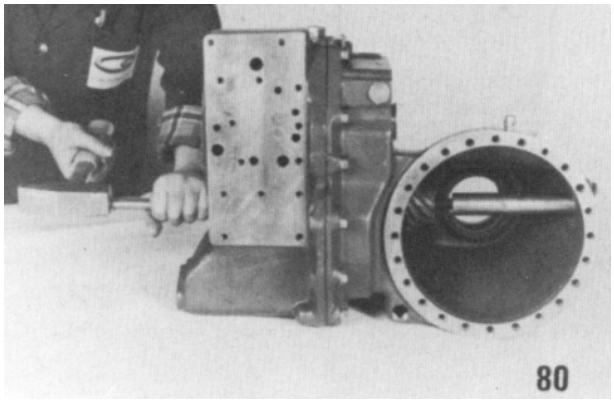


Figure 03-80

- Mount the pinion nut in order to be able to check the passive torque determined by the lip sealing ring without axial preload.

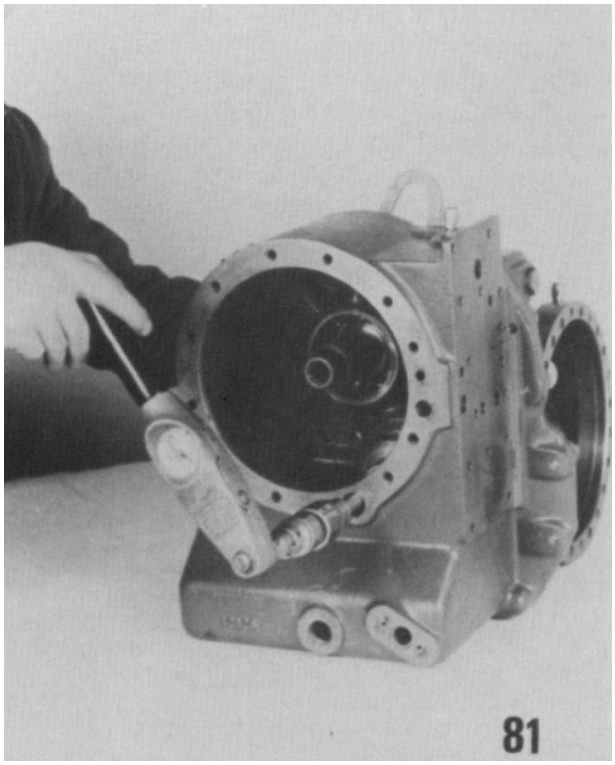


Figure 03-81

- Put the two clutch halves for forward and reverse gear into their respective gear teeth and fasten them with a suitable tool.

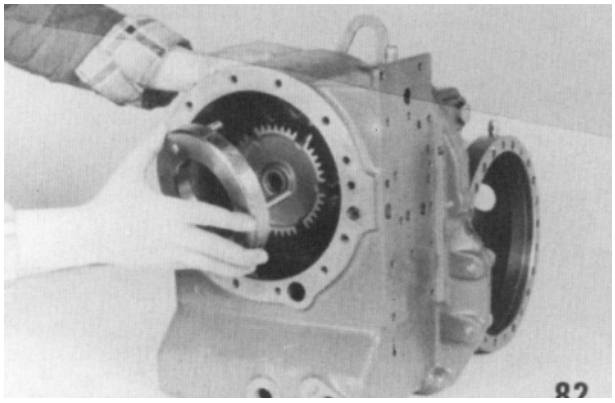


Figure 03-82

- Tighten the pinion nut in order to increase the tightening torque for the bearing from 0.15 to 0.35, compared to the previously determined passive torque.

CAUTION
During this work, the torque must be increased progressively. Prior to fitting the bearing, check several times that the maximum bearing tightening torque has not been exceeded. If this value is overrun, it will not suffice to slacken the pinion nut ; the non-reuseable preload ring must then be replaced.

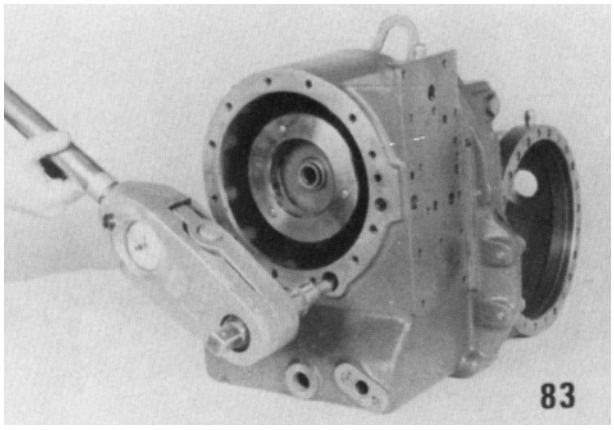


Figure 03-83

- After removing the grub screw sealing the hole, drive out the clamping pin securing the nut, remove the nut and repeat the above adjustment procedures.

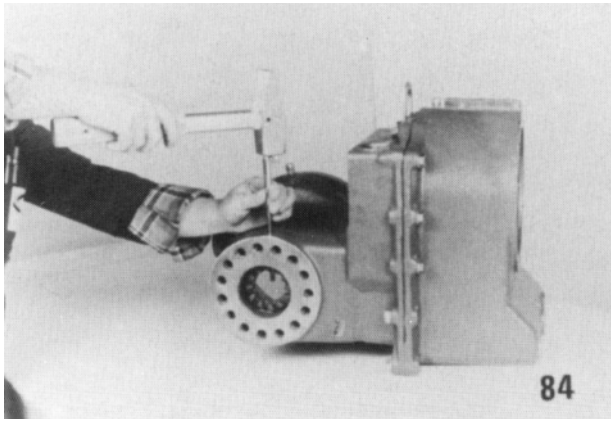


Figure 03-84

- Fit the outer snap ring for the differential bearing opposite the bevel gear.

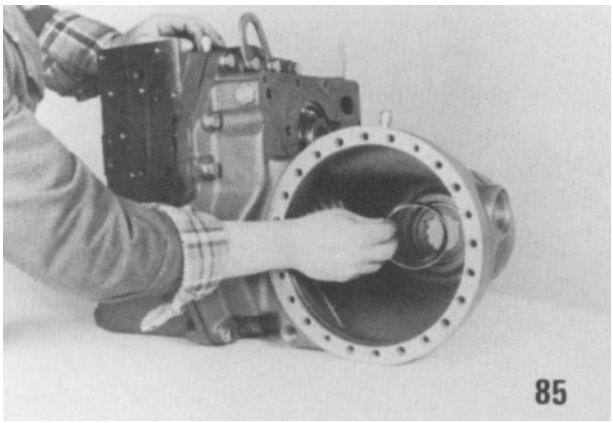


Figure 03-85

- Place the shims into the differential bearing seat at the taper roller bearing side, then install the outer bearing race.

NOTE
To simplify the adjusment of the differential (normal play between flank and bearing preload), it is recommended fitting a number of shims that are thicker than required in order to prevent the direct contact of cover and centre housing.



Figure 03-86

- To make contact faces visible, apply a suitable paint to the teeth of the bevel gear.

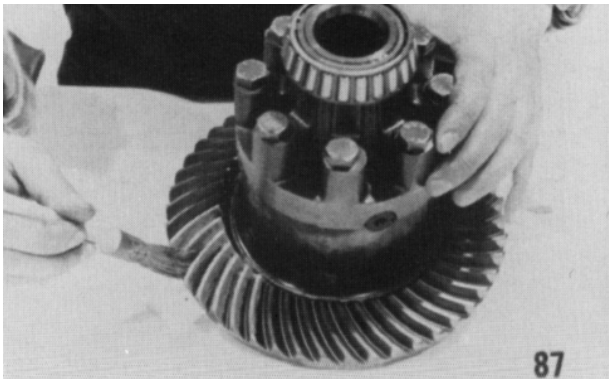


Figure 03-87

- Install the differential group fully in the centre housing.

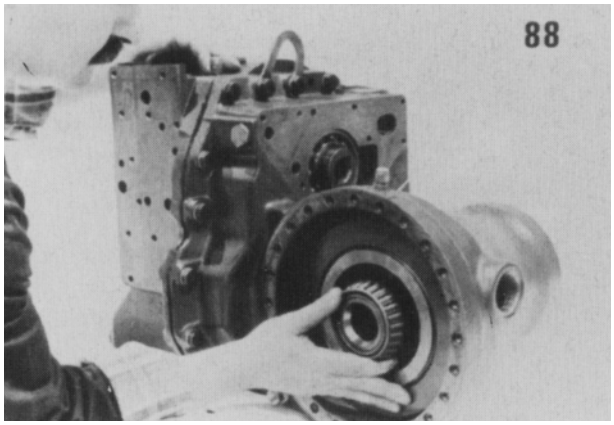


Figure 03-88

- For the adjustment, install the centre housing cover (without sealing ring) without tightening the housing mounting bolts

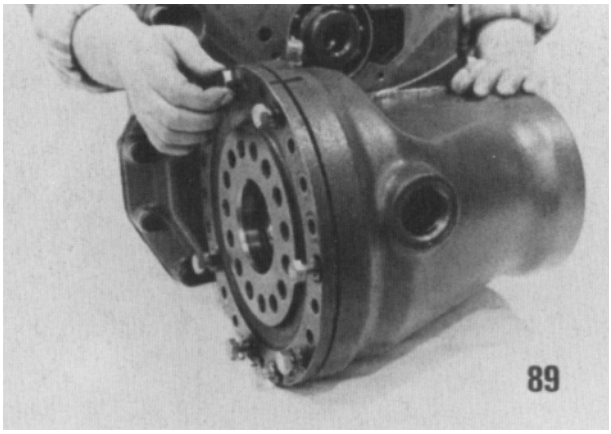


Figure 03-89

- Using the nut on the centre housing, adjust the axial play of the differential group so that the proper clearance of 0.13 - 0.18 mm between the flanks of the cone housing is obtained.

NOTE
For this work move the differential carrier cover with a fastening bolt until the required backlash is obtained. There should not yet be any play or axial preload at the bearings for the differential group.

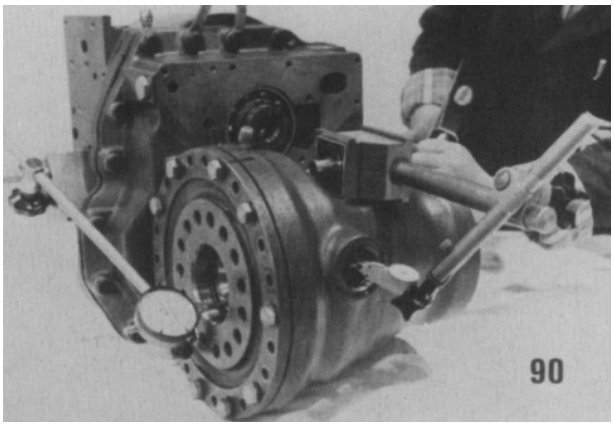


Figure 03-90

ATTENTION

In the final stage of the adjustment it is recommended taht a notch in the nut and the outer hole on the centre housing are aligned so that the clamping pin for securing the nut can be inserted subsequently.

- After the adjusment is completed, drive the pin tightly into the notch on the nut (to prevent any change in the adjustment).

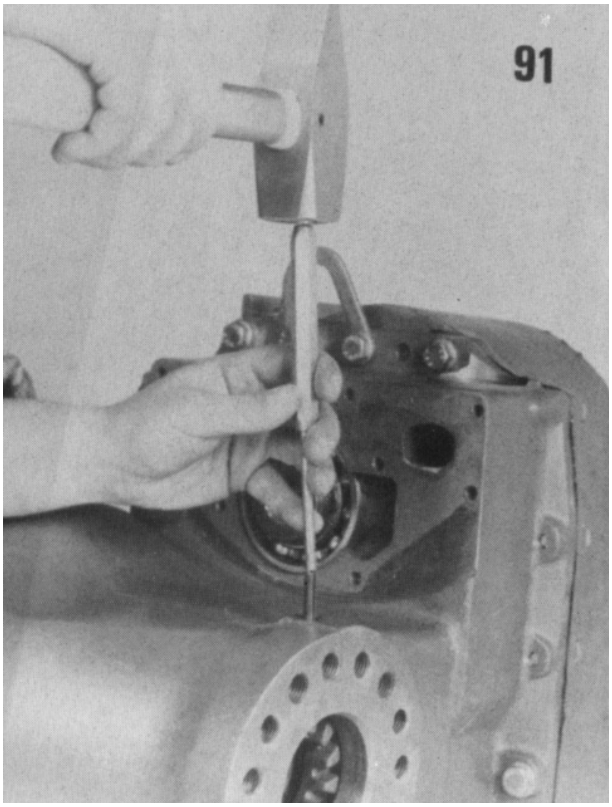


Figure 03-91

- Using a feeler gauge, determine clearance "L" between the contact faces of the differential retainer cover and the centre housing at various points.

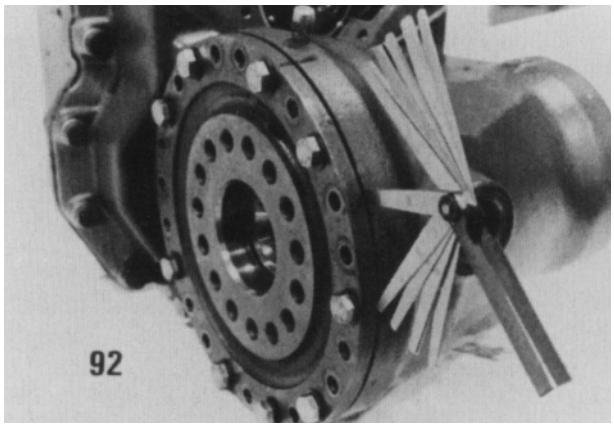


Figure 03-92

- Make several measurements while turning the pinion and bevel gear so that the contact prints appear on the teeth previously painted with lead oxide red.
  Remove the differential group from the centre housing in order to be able to make a visual check of the contact faces. The visual contact faces are traced on the teeth of a new cone housing due to the optimum test with a micrometer. For this reason these contact faces will again be visible if the axial adjustment of the pinion was correct.

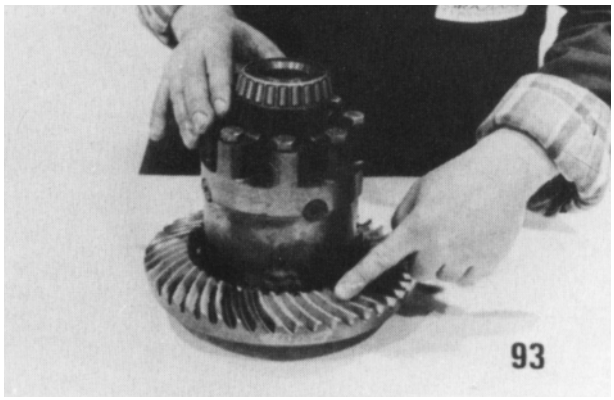


Figure 03-93

- Drive out the outer bearing race at the cover, then replace to preload shims with shims of the correct thickness as determined by the difference between dimension "L" and total thickness "D" of the shims fitted previously to simplify the procedure. The result is D - L : the adjustment dimension obtained without axial play at the bearing and without a relative preload.
  Add 0.05 mm to this dimension to obtain the axial preload on the bearings.



Figure 03-94

- Fit the outer bearing race and O-ring on the cover.

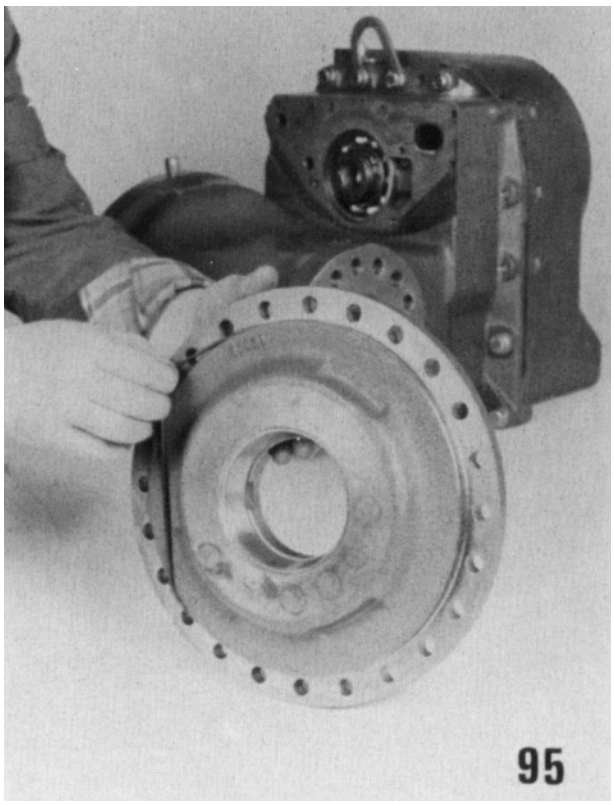


Figure 03-95

- Mount the cover on the centre housing, paying attention to the previously marked setting. Fit the bolts coated with screw locking comound and tighten them to 6.2 - 6.8 daNm.

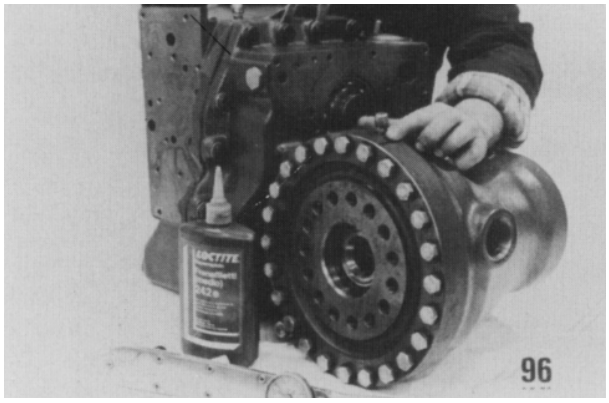


Figure 03-96

- Seal the radial hole for the clamping pin used to secure the nut in the housing with a suitable plug.

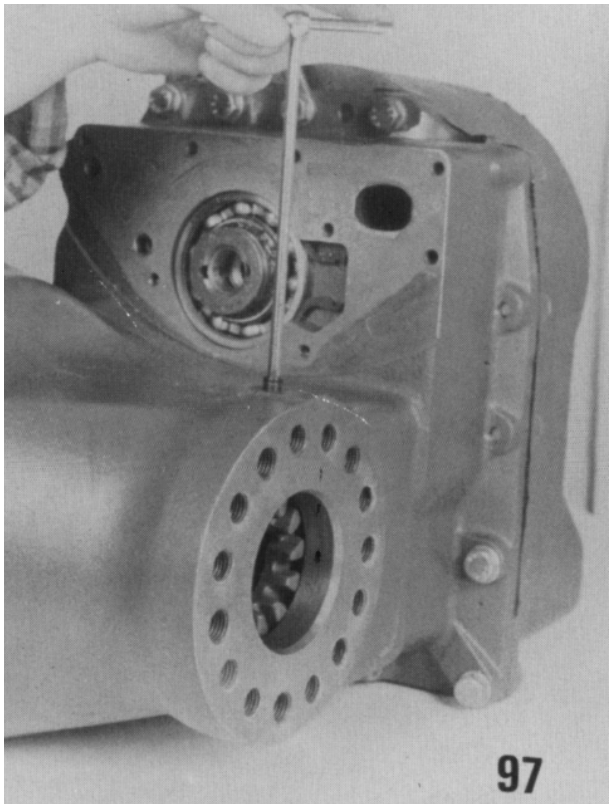


Figure 03-97

- Secure the pinion nut with a centre punch.

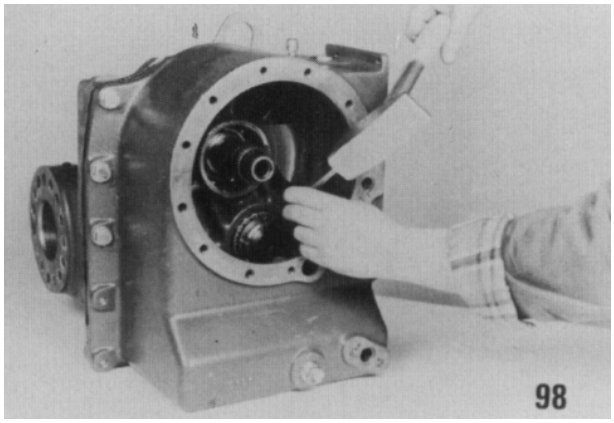


Figure 03-98

- Fit the clutch basket (with roller bearing cage and cast hydraulic seal positioned correctly as shown in Figure 35), taking care not to damage the hydraulic seal. If the seal is damaged, the hydraulic function of the transmission may be impaired.

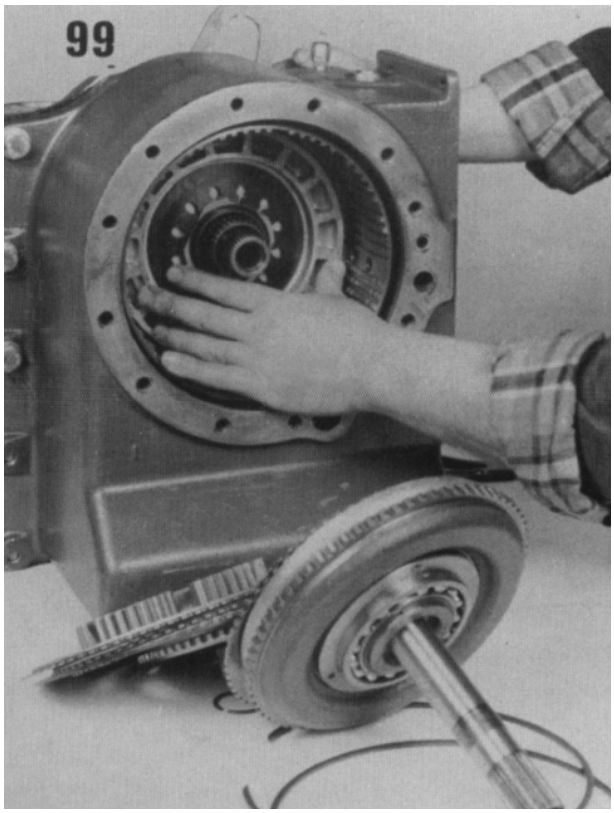


Figure 03-99

- Position the clutch hubs for forward gear in the appropriate teeth and secure it on the axle with the appropriate snap ring.

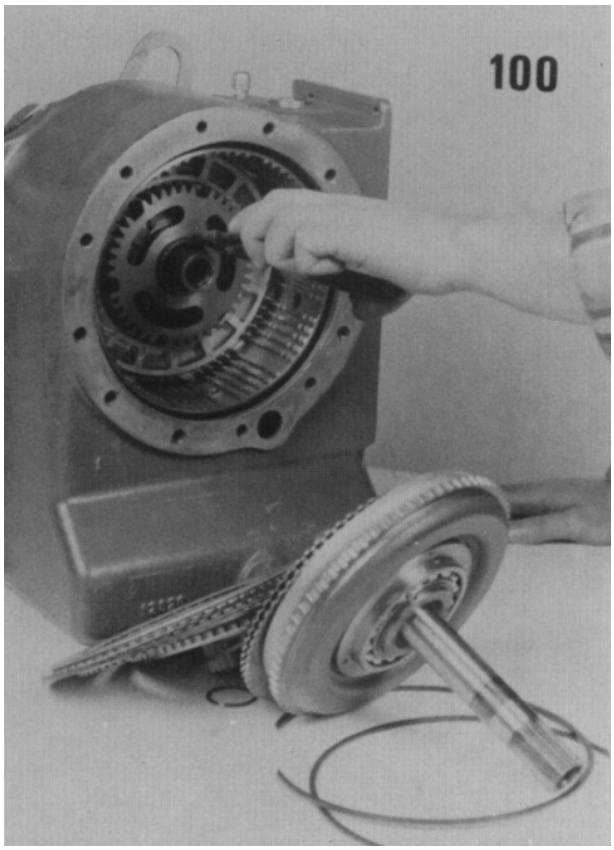


Figure 03-100

- Position the 3 clutch thrust plates and the 3 clutch discs in the appropriate teeth, making sure that the correct sequence is maintained.

NOTE
The correct sequence for fitting the clutch thrust plates and discs is as follow :
Move the steel clutch thrust plate against the piston, then complete the series by alternately fitting one clutch disc and one steel thrust plate.

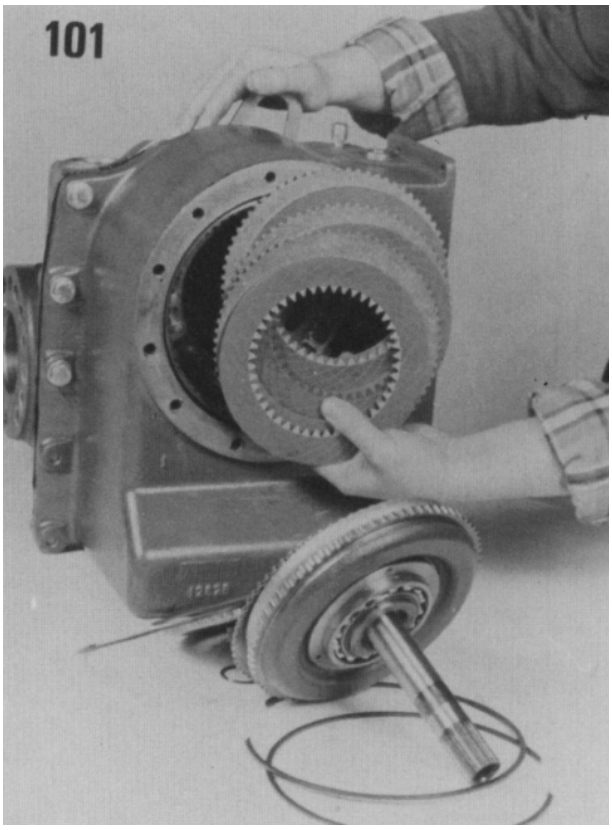


Figure 03-101

- Fit the thrust ring.

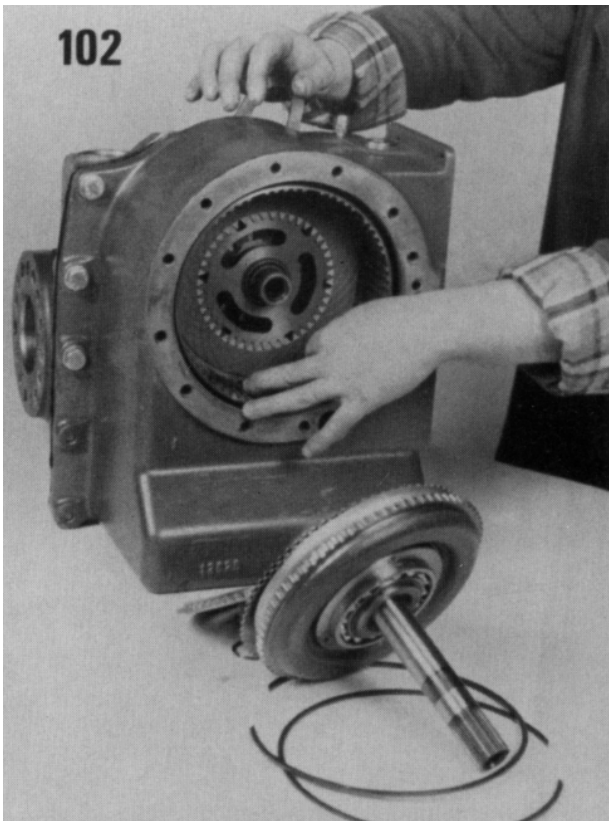


Figure 03-102

- Press the thrust ring against the snap ring while sliding it onto the appropriate teeth.

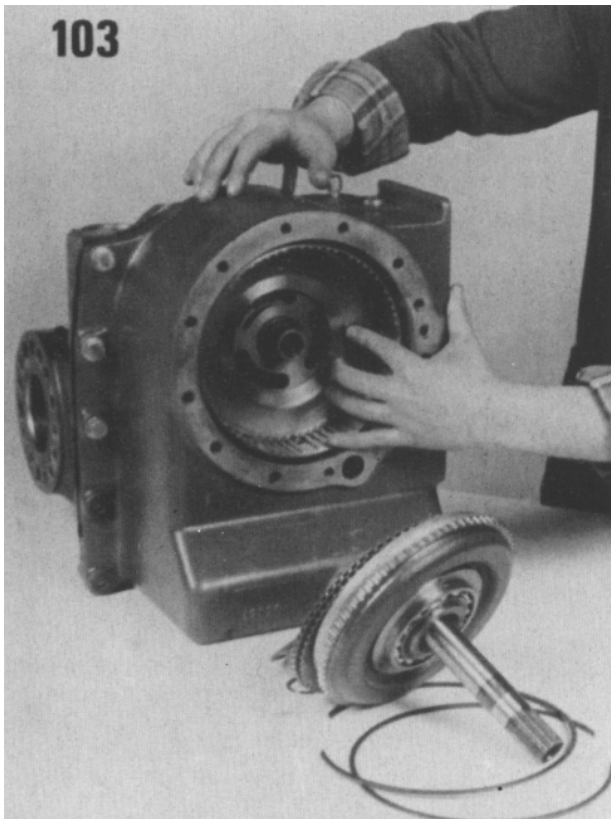


Figure 03-103

- Fit a snap ring again after the thrust ring and check (using a suitable feeler gauge) that the total clutch play is equal : 1.7 mm minimum, 3.0 maximum.

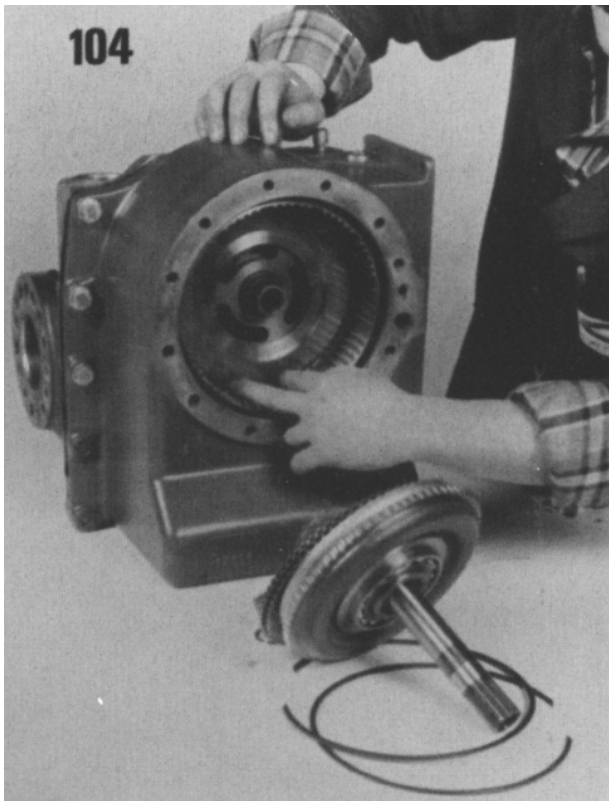


Figure 03-104

- After the thrust ring has been fitted, slide the clutch hub for reverse gear onto the shaft teeth and then lock the hub on the teeth with the next snap ring.

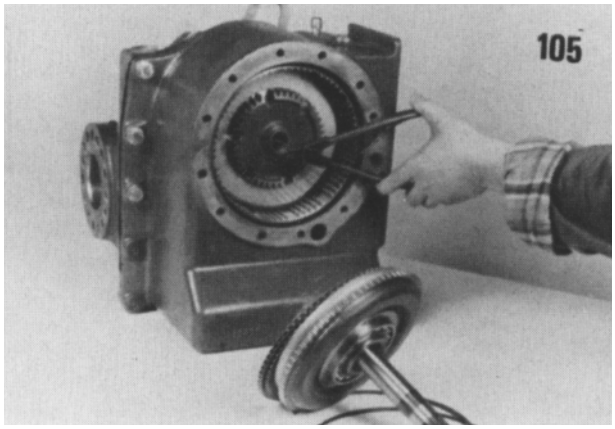


Figure 03-105

- Fit the 3 clutch discs and the 3 clutch thrust plates into the clutch housing in the proper sequence.

NOTE
The proper sequence for fitting the discs and thrust plates is as follow : First place the clutch discs against the thrust plate, then complete the series by alternately fitting one clutch disc and one steel thrust plate until only one thrust plate remains.

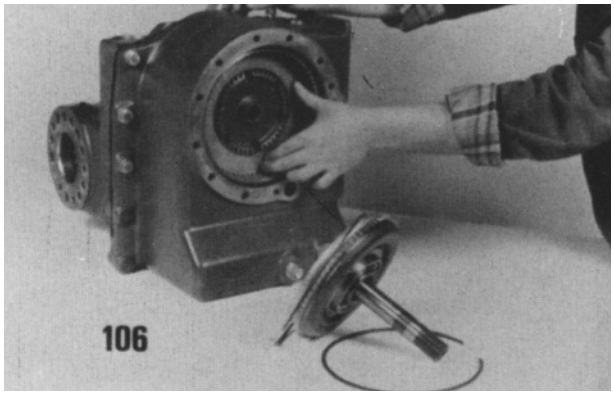


Figure 03-106

- Fit the cover assy. onto the clutch basket after the thrust ring is in place. Then secure the cover on the gear teeth with the next snap ring.

CAUTION
Before installing the clutch basket, check the play for reverse gear. The measured dimensions must be within the values given for forward gear play.

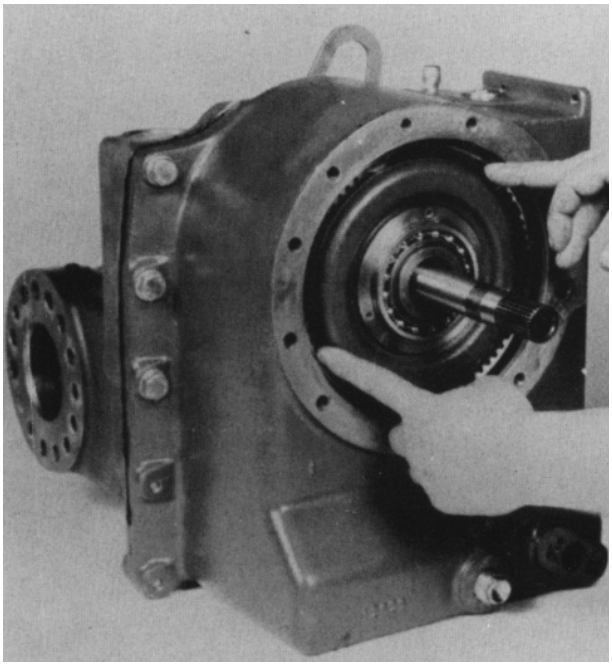


Figure 03-107

- To make it easier to fit the 3 converter housing bolts with the bearing thrust ring, it is recommended screwing in 3 threaded pins of suitable length to facilitate the centering with the respective through-holes in the housing. Connect the parts after applying sealing compound on the outer mounting surfaces. Make sure that the converter housing is centred on the proper mounting bolts and avoid damaging the O-ring.

CAUTION
If too much sealing compound is applied near the seat of the O-ring, the holes for oil supply can get plugged so that the proper function of the transmission may be impaired.

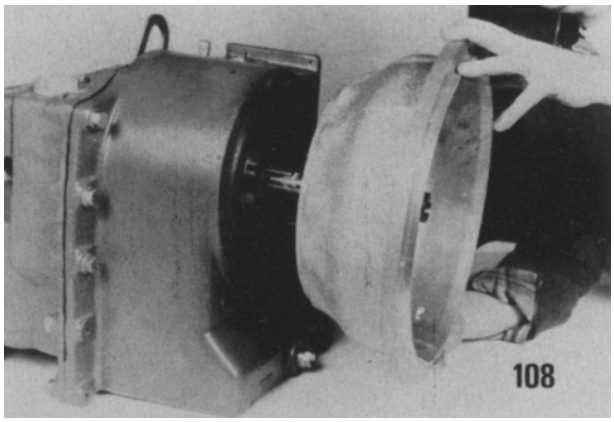


Figure 03-108

- Replace each threaded pin by a bolt and appropriate washers. Apply a screw locking compound on the bolts and tighten them to 0.5 - 0.6 daNm.

CAUTION
The copper washer under the bolt head is fitted primarily for sealing purposes, to prevent oil leaks. It is therefore recommended to fit them only at this place.

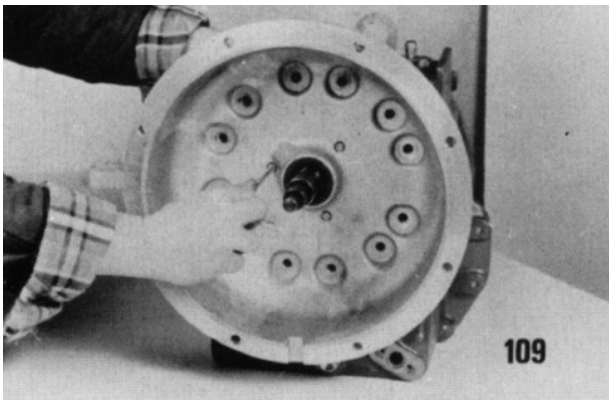


Figure 03-109

- Apply the screw locking compound to the converter housing bolts and tighten them with the appropriate washers to 4.8 - 5.2 daNm.

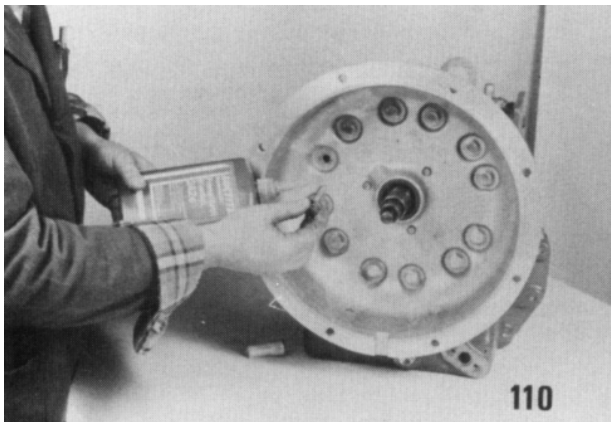


Figure 03-110

- Fit the pump housing centering ring into the centre housing, making sure that the ring load and the contact area of the centre housing coincide.

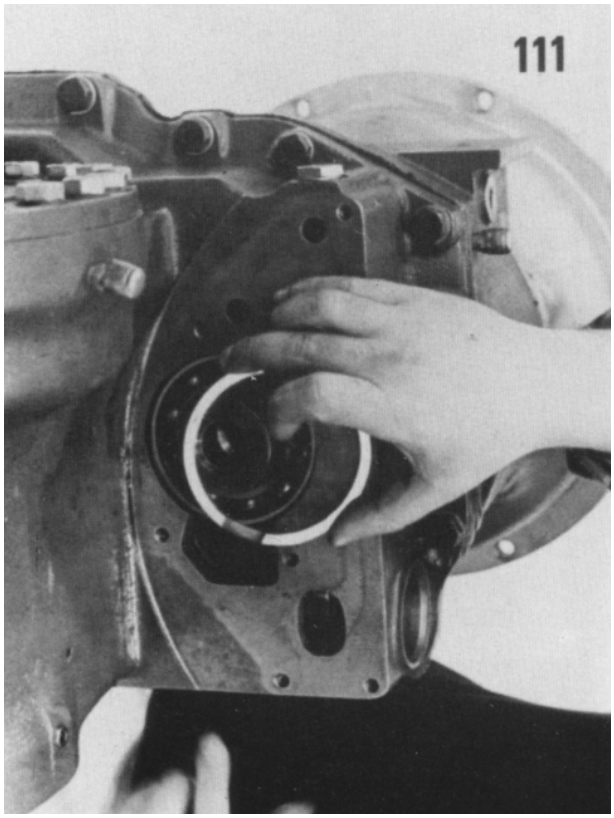


Figure 03-111

- Fit the cast seal on the reverse gear axle and secure it with a coat of grease.

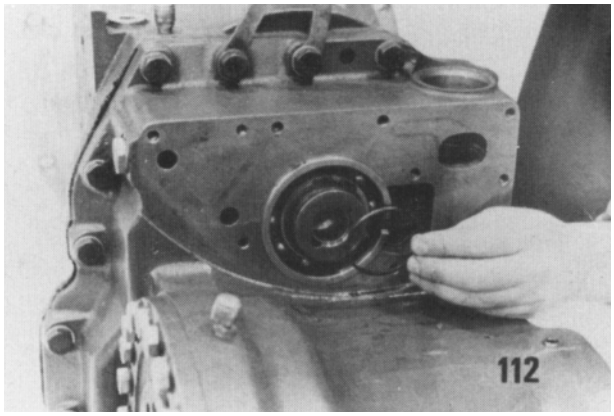


Figure 03-112

- Fix the pump housing gasket on the centre housing using grease.

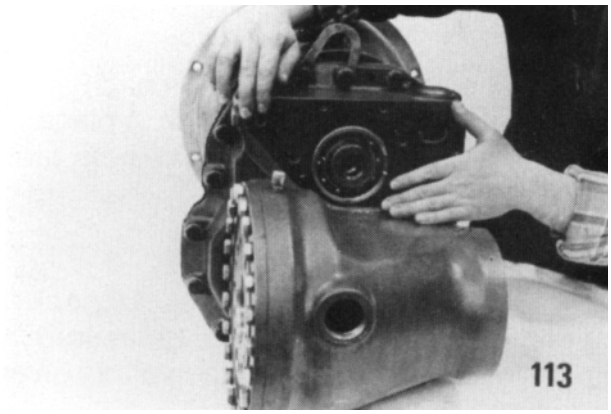


Figure 03-113

- Install the pump assembly in the centre housing. Make sure that the socket head screw is first screwed into the pump.

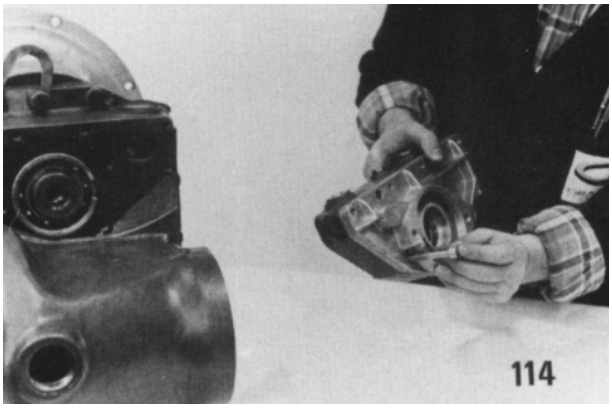


Figure 03-114

- Fit the pump mounting bolts with a screw locking compound and tighten them to 2.2 - 2.4 daNm.

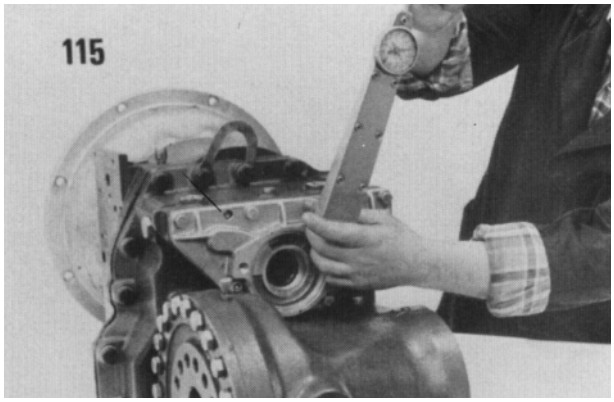


Figure 03-115

- Prior to installing the drive shaft in the gearbox, check the condition of the cast seals which must be fixed with a coat of grease in any case.

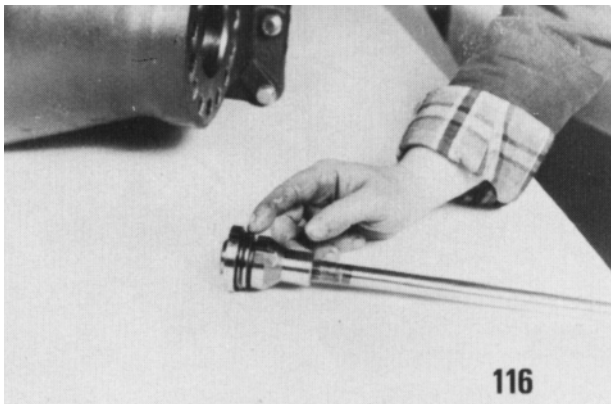


Figure 03-116

- Install the drive shaft assembly in the gearbox, taking care that the teeth of the pump drive gear and the splines on the drive shaft mesh.

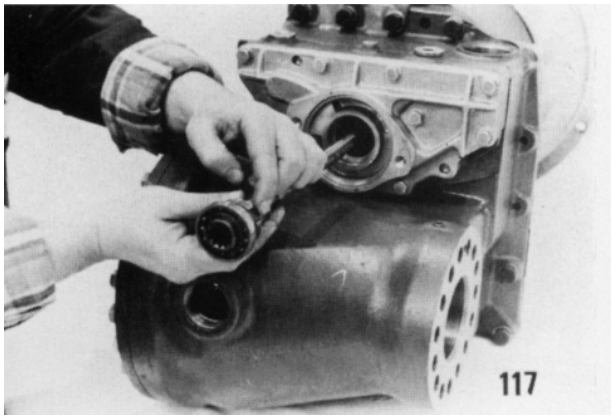


Figure 03-117

- Fit the circlip for the drive shaft bearing.

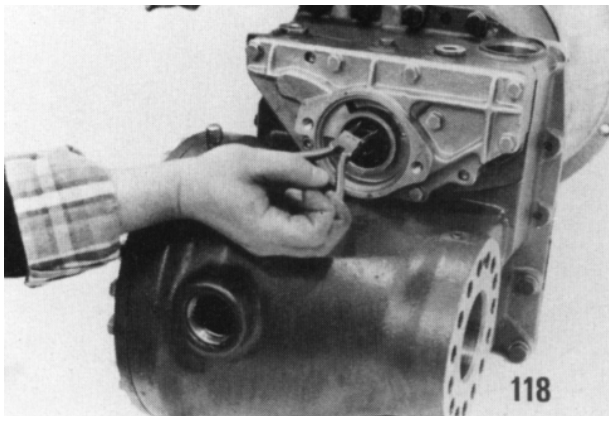


Figure 03-118

- After examining the condition of the O-ring (which may have to be replaced), install the tube for the oil dipstick. Apply locking compound to the bolts and tighten them to 0.95 - 1.05 daNm.

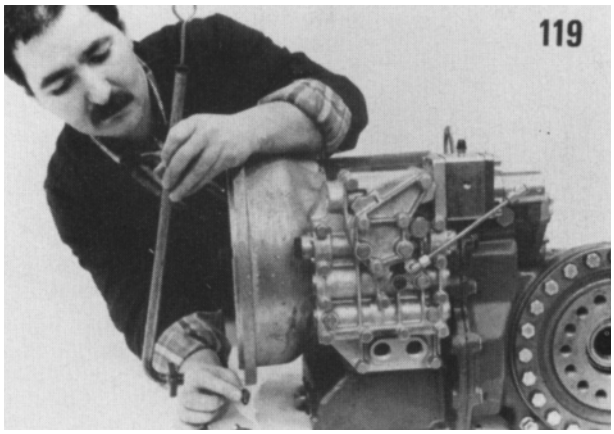


Figure 03-119

- Fit the paper gasket coated with grease and then put the greased O-ring into the control valve plate.

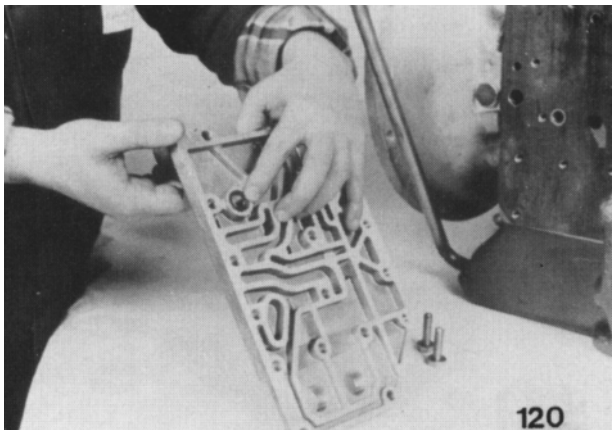


Figure 03-120

- Install the control valve plate on the intermediate housing. For this hold the two bolts with the hand.

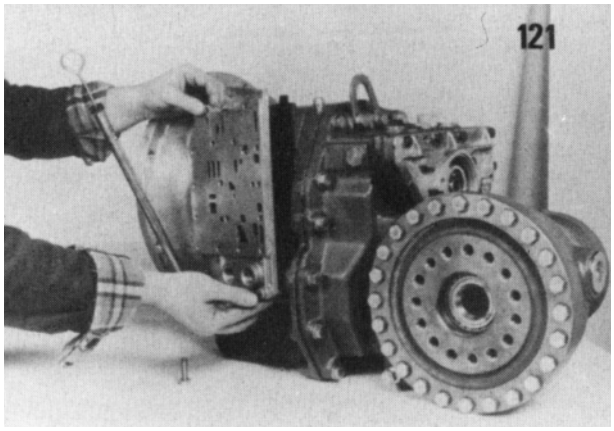


Figure 03-121

- Fit the spacer washer assembly by pressing on both bolts.

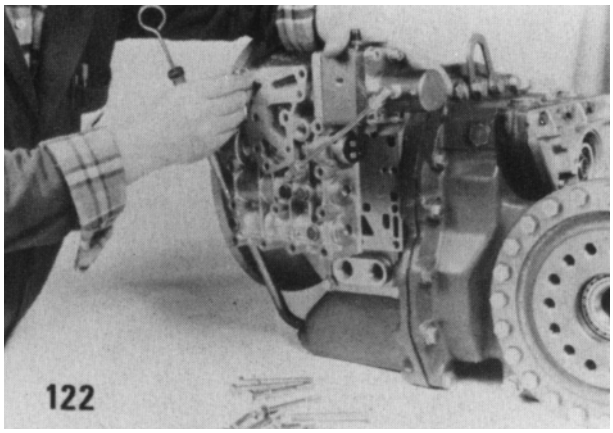


Figure 03-122

- After fitting the paper gasket, install the control valve cover and tighten the bolts to 2.2 - 2.4 daNm.

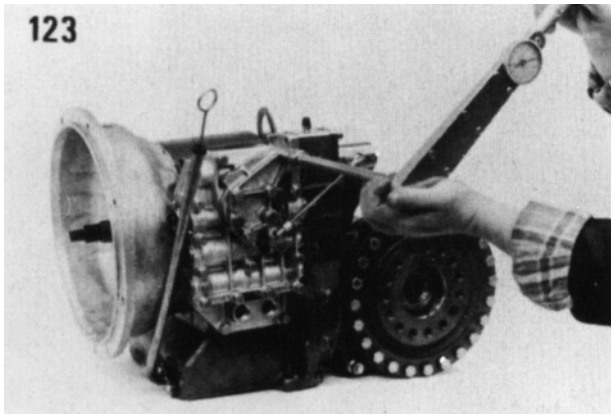


Figure 03-123

The picture shows the filter which has to be removed from a new gearbox after 60 to 80 service hours. A longer service time could lead to damage to the transmission due to contamination.

- It is recommended installing a new filter after overhauling the transmission and to leave it installed for the same time as indicated above.

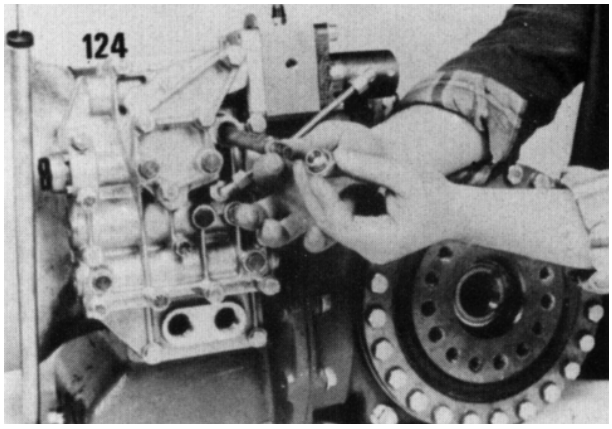


Figure 03-124

- Install the filter at the intake side of the pump and tighten it.

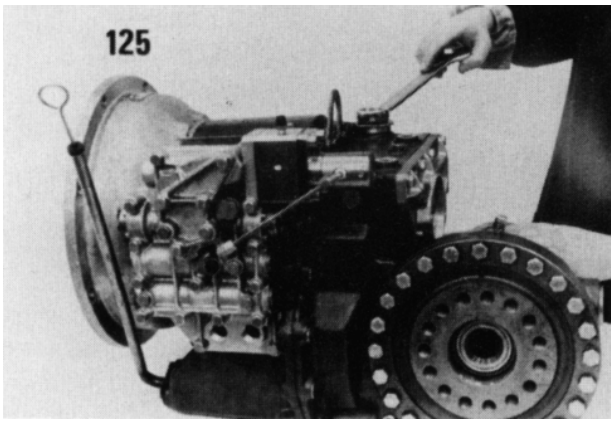


Figure 03-125

Disassembly and assembly of the wheel hub

- Unlock and remove the mounting bolts for the axle halves at the wheel hub.

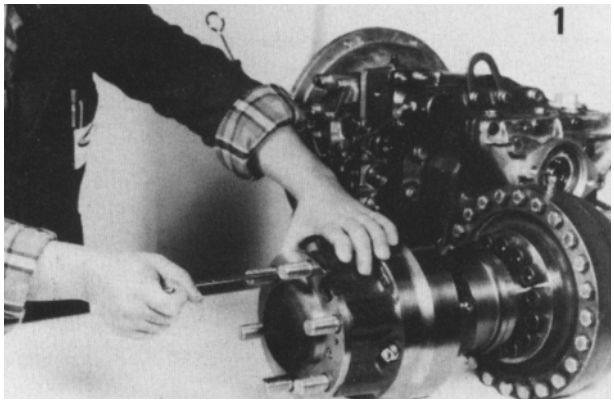


Figure 03-125-1

- Pull the axle halves off using two puller screws (M6) fitted in the holes provided for this purpose.

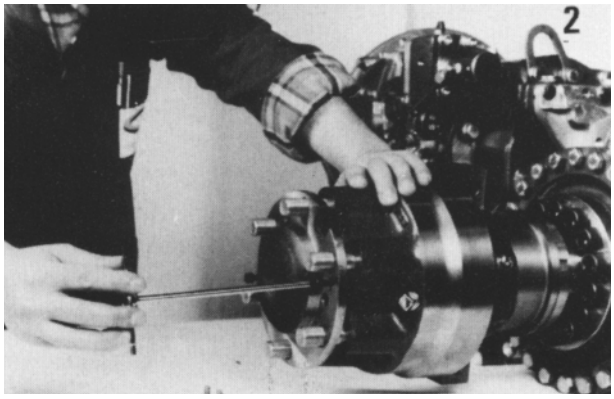


Figure 03-125-2

- Drive back the tab of lock washer for the nut.

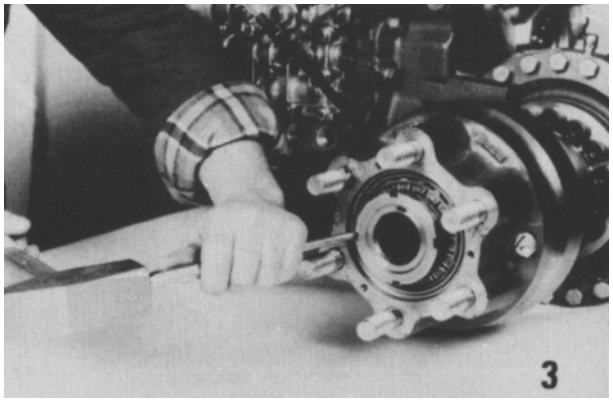


Figure 03-125-3

- Loosen and remove the wheel bearing retaining nut. Remove the lock washer and the hoop ring.

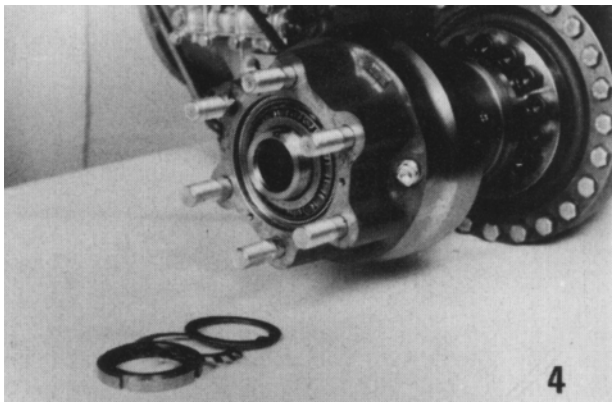


Figure 03-125-4

- Dismantle the wheel hub assembly from the flange and pull it off with the spacer ring and the inner bearing race on the outside of the wheel.

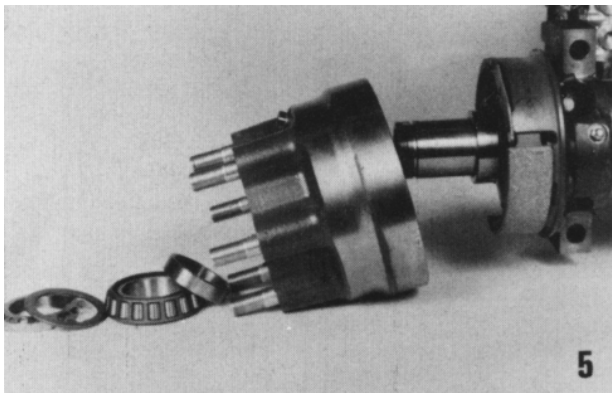


Figure 03-125-5

- Pull off the seal between wheel hub and flange, and then remove the inner bearing race on the inside of the wheel.

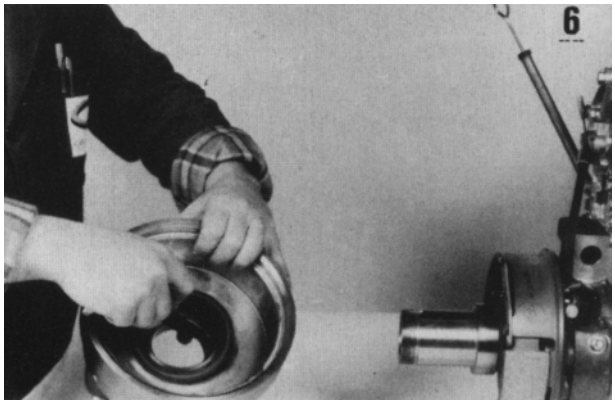


Figure 03-125-6

- Remove the outer bearing races from the wheel hub.

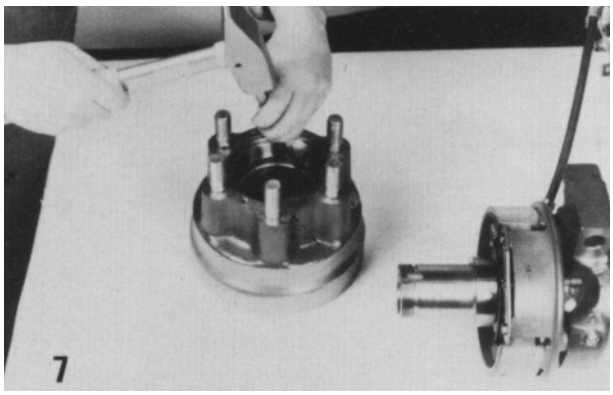


Figure 03-125-7

- To reassemble the wheel hub, fit the outer bearing races.

CAUTION
It is very important that the original mounting sequence for the bearings is retained. For this reason it is recommended marking them during disassembly so that no faults can occur later in the wheel group.

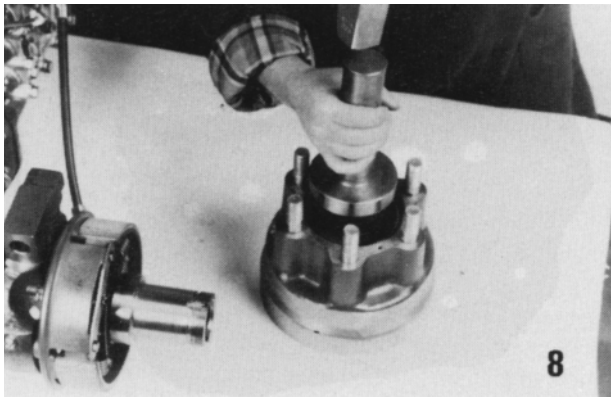


Figure 03-125-8

- Fit the inner bearing races on the inside of the wheel using a suitable drift punch. Fit the lip sealing ring.

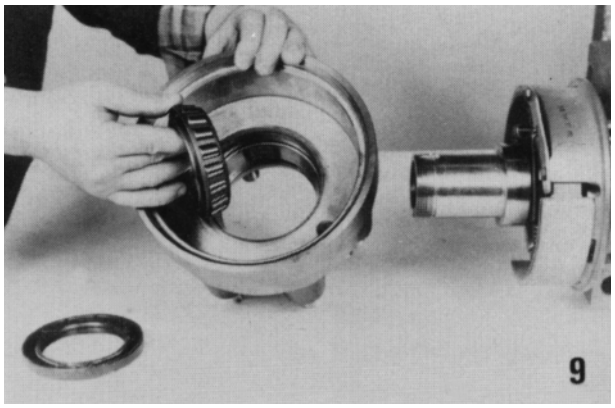


Figure 03-125-9

- Unhook the brake shoe return and holding spings at the brake anchor plate.

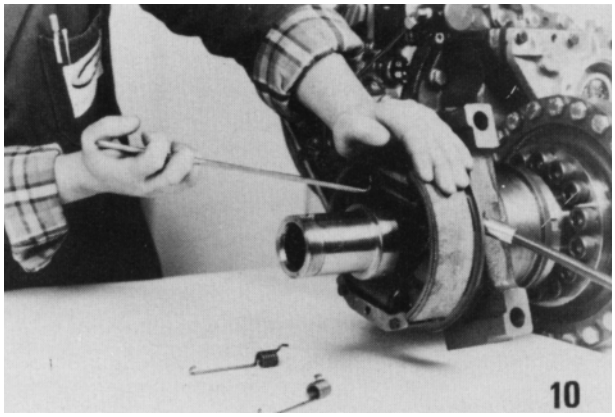


Figure 03-125-10

- Unscrew the brake adjuster and take the brake shoes off the brake anchor plate.

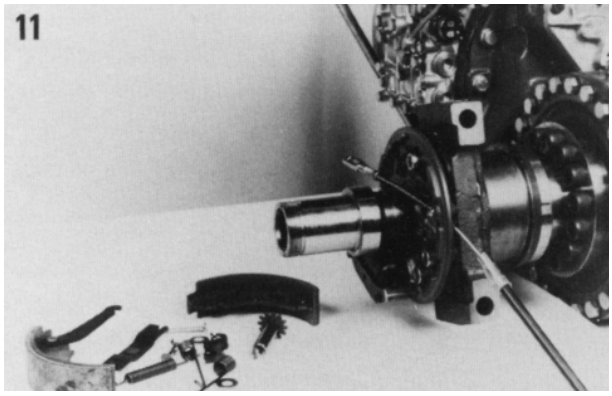


Figure 03-125-11

- To disconnect the parking brake cable, remove the spring washer and pull out the brake cable.

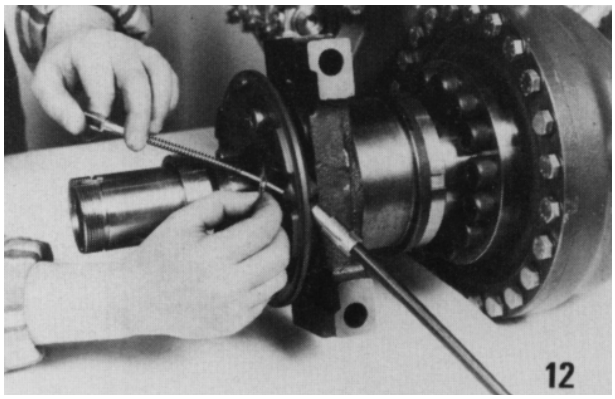


Figure 03-125-12

- Pull the chassis fastener at the brake anchor plate from the flange of the wheel hub.

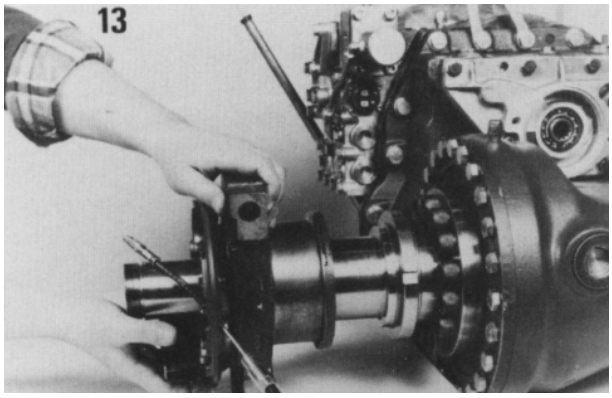


Figure 03-125-13

- Remove the brake anchor plate from the chassis mount by unscrewing the five mounting bolts.

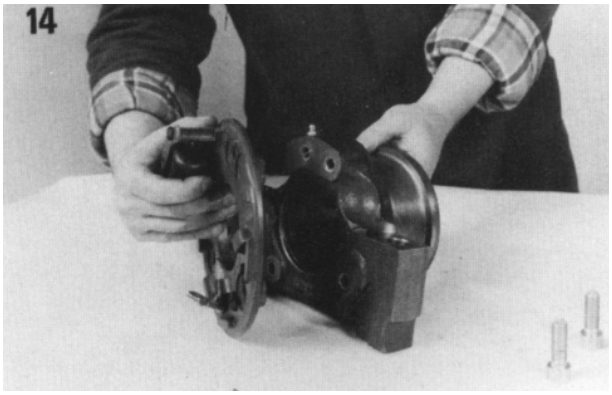


Figure 03-125-14

- Unscrew the chassis mount retaining nut at the flange.

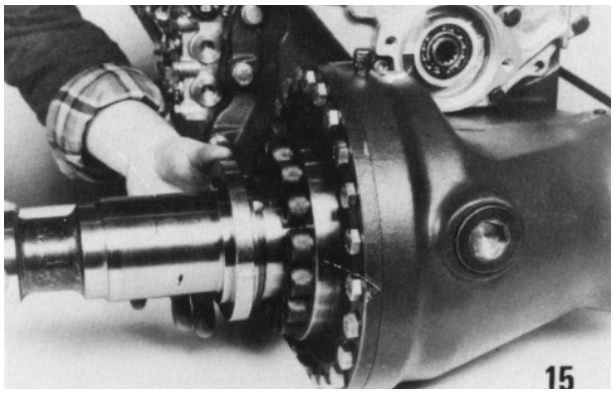


Figure 03-125-15

- Unscrew the flange mounting bolts at the wheel hub and remove the latter from the differential carrier.

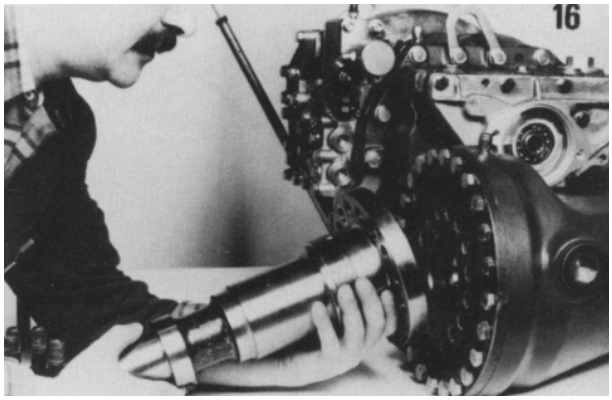


Figure 03-125-16

- If oil leaks were noticed, renew the O-rings on the differential side when reassembling the wheel group.

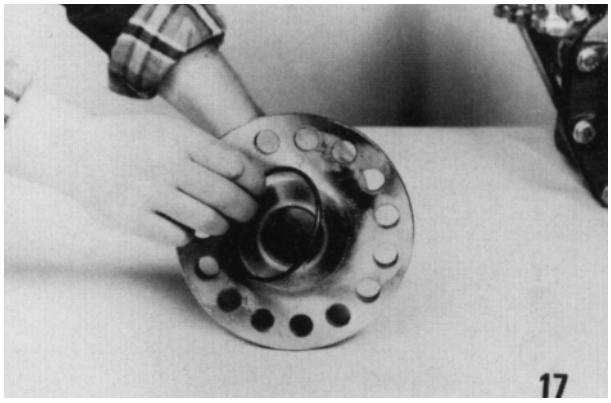


Figure 03-125-17

- Refit the flange. Tighten the fastening bolts to the differential after fitting them with a screw locking compound and torque them to 28.5 - 31.5 daNm.

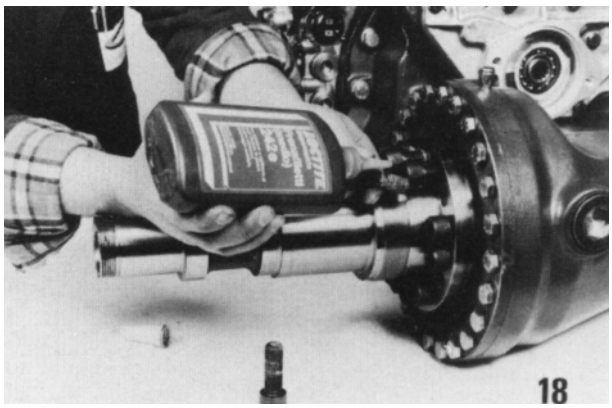


Figure 03-125-18

- Screw the retaining nut for the chassis mount at the wheel hub flange. This nut will be secured after installation in the truck.

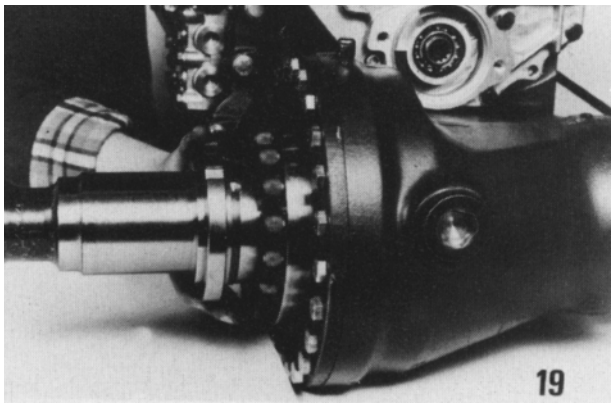


Figure 03-125-19

- If traces of grease are visible at the brake side, the O-ring to the frame mount must be renewed.

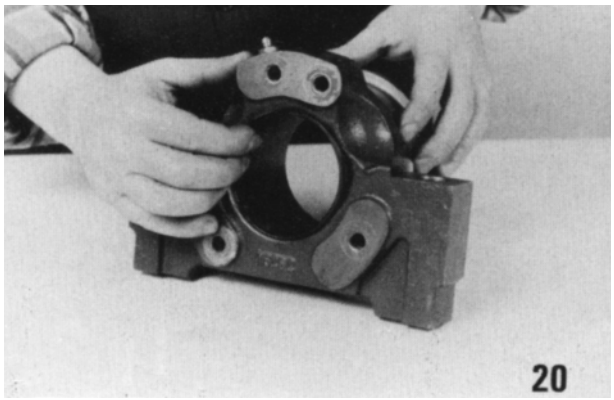


Figure 03-125-20

- Mount the brake anchor plate on the chassis mount, and after grease fitting the mounting bolts tighten them to 10.5 - 11.5 daNm.

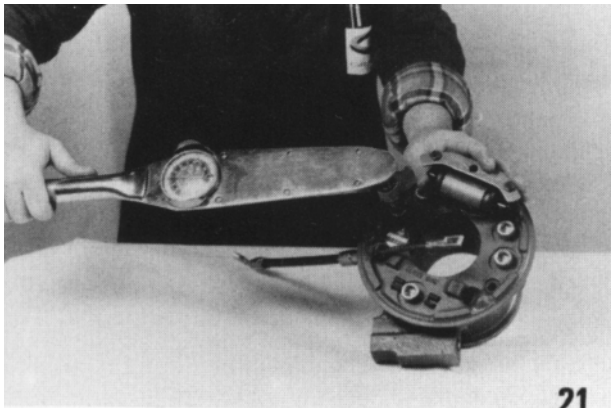


Figure 03-125-21

- Refit the chassis mount of the brake anchor plate on the flange of the wheel hub.

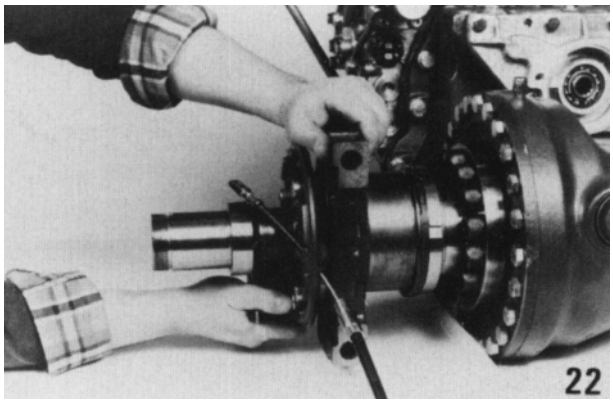


Figure 03-125-22

- Refit the brake shoes on the brake anchor plate and hook the parking brake cable to the brake shoes in the place provided at the brake lever.
  Subsequently fit spacer washer, adjuster screw and hook return springs into brake shoes.

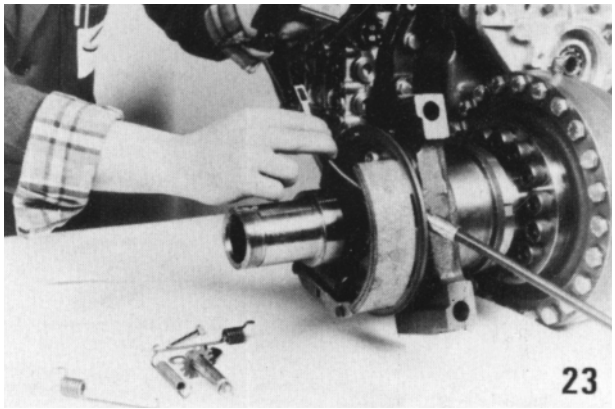


Figure 03-125-23

- Place the inner bearing on the flange and refit the wheel hub.

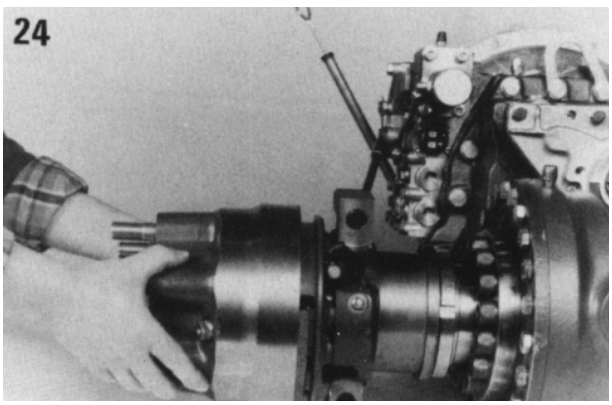


Figure 03-125-24

- Place the inner bearing race of the outer on the flange and screw on the hoop rings and grooved nut.

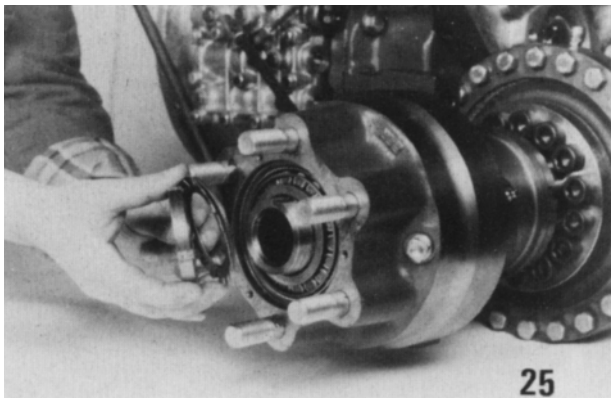


Figure 03-125-25

- Tighten the nut to 40 - 45 daNm, then drive the tab of the locking washer in the appropriate groove in the nut.

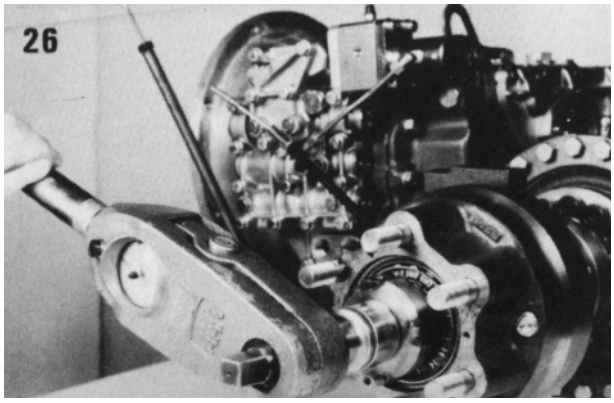


Figure 03-125-26

- Apply sealing compound to the contact faces of the wheel hub, then refit the axle half.

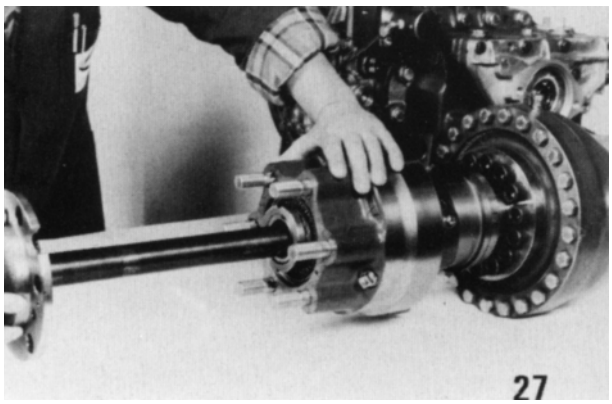


Figure 03-125-27

- Screw in the retaining bolt for the axle half at the wheel hub and tighten to 0.95 - 1.05 daNm. Repeat the procedure on the opposite wheel.

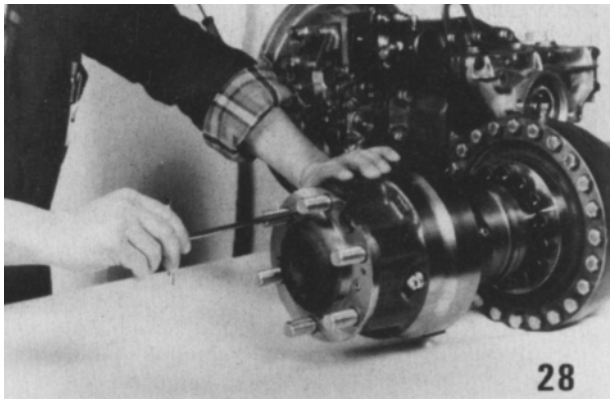
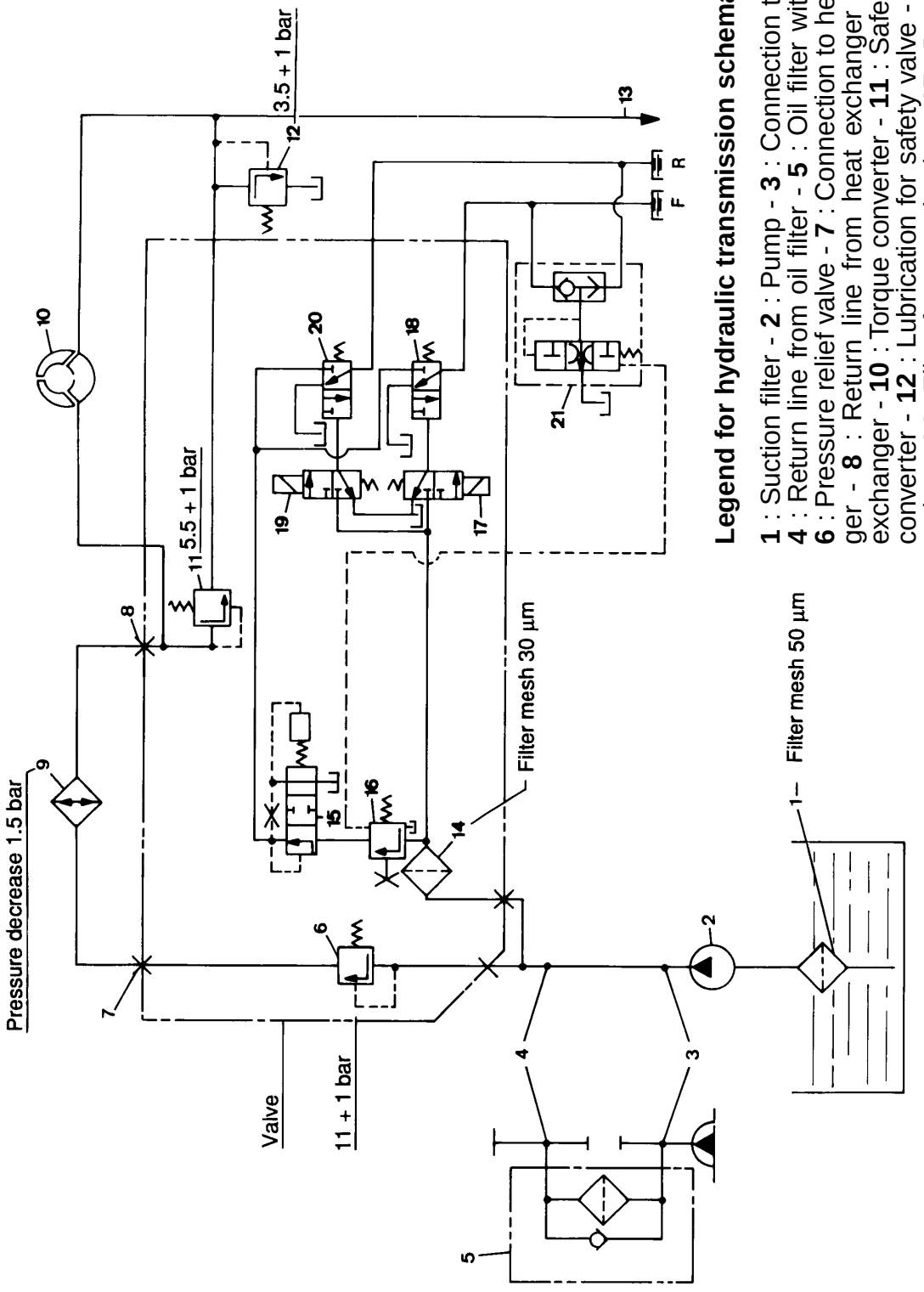


Figure 03-125-28

Hydraulic transmission schematic



Legend for hydraulic transmission schematic

1 : Suction filter - **2** : Pump - **3** : Connection to oil filter - **4** : Return line from oil filter - **5** : Oil filter with bypass - **6** : Pressure relief valve - **7** : Connection to heat exchanger - **8** : Return line from heat exchanger - **9** : Heat exchanger - **10** : Torque converter - **11** : Safety valve for converter - **12** : Lubrication for safety valve - **13** : Lubrication - **14** : Filter for control valve - **15** : Pressure regulating valve - **16** : Valve for slow speed - **17** : Forward gear solenoid valve - **18** : Valve for forward gear - **19** : Reverse gear solenoid valve - **20** : Valve for reverse gear - **21** : Check valve
F : Forward - **R** : Reverse

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Wheel and tyres 04-02

Wheels and tyres

The front and rear wheels are identical.

The truck can be equipped with three different types of tyres, depending on the mast.

1. Wheel with tyre (1) 18x7 - 8/16 PR
   Tube (2) 18x7 - 6 VTL
   Lining (3)
   Rim (4)
   Side ring (6)
   Snap ring (7)

2. Wheel with superlastic tyres (8) 18x7 - 8 without snap rings. The superelastic tyre is pressed onto the rim (9) in the workshop.

3. Wheel with solid rubber tyre (10) 457x152x308 pressed onto the rim (11).

NOTE

a) The spherical collar nuts (5) must be tightened to 270 Nm. The wheels must be checked regularly for tightness (see notice on the truck).

b) When mounting tyres, make sure that the proper seat between rim and tyre is obtained.

   In case of shrunk-on tyres, attention must be paid to the direction of chamfer on the offset.

The values given in the table below for fitting wheels according to the type of mast and the lift height must be complied with.

Tyre 18X7	A
Superelastic tyre 18X7	B
Solid rubber tyre 457x152x308	C

Fitting permitted with masts :

DUPLEX.....	≤ 3730 mm	ABC
DUPLEX.....	≤ 4230 mm	BC
DUPLEX FREE LIFT ..	≤ 3700 mm	ABC
TRIPLEX	≤ 4790 mm	BC
TRIPLEX	≤ 5490 mm	C

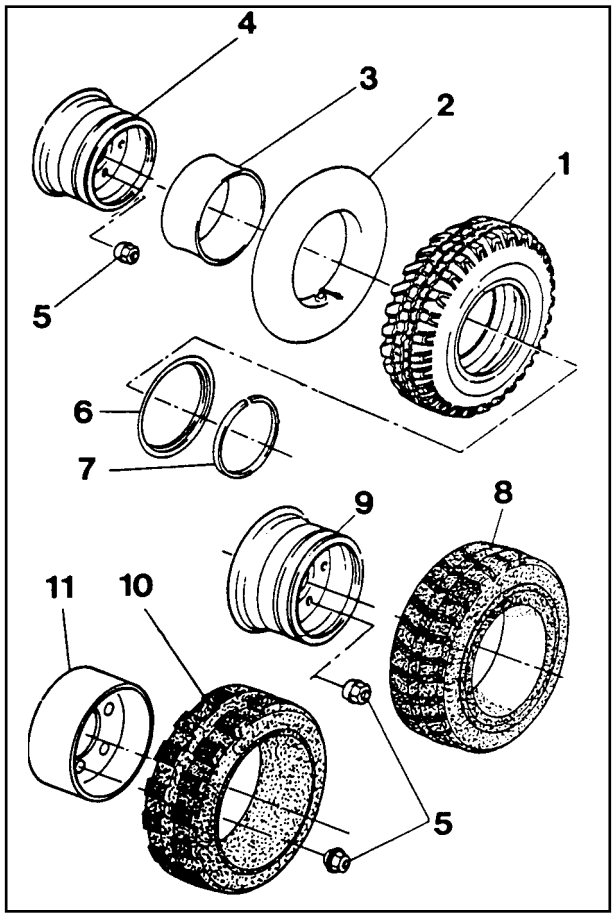


Figure 04-01

Nb :

For fitting and removing hoop wheels and tyres, comply with manufacturer's instructions and the current legislation : in France, circular TR2/51 dated 22.2.1951.

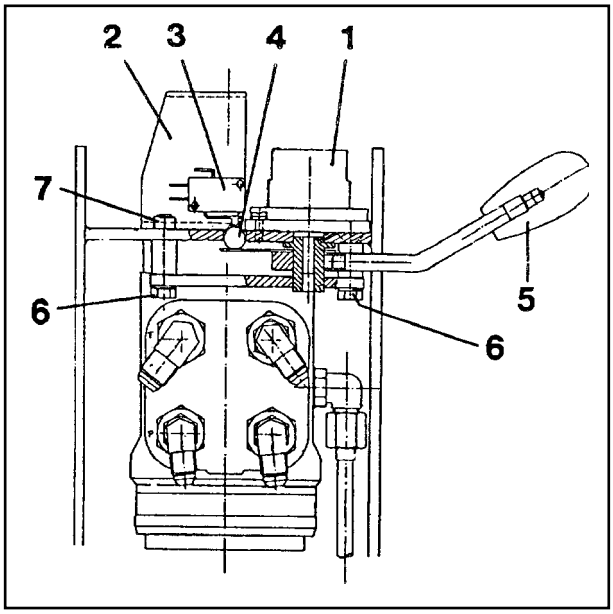
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Removing the direction selector switch 05-2

Drive controls

Removing the direction selector switch

- After removing the steering wheel and the protective covers, remove the two steering control valve mounting bolts (sse group 06) and let it down slowly.
- Mark the hydraulic lines and then remove the direction selector switch (1).
- Remove the fastener and micro-switches (2) and (3).
- Take out the ball (4) and the magnet.
- Unscrew the ball grip (5) on the direction selector switch.
- Remove the direction selector switch after unscrewing nuts (6) and the fastening screws (7).
- Installation is in the reverse order of removal.



Removing the reverser

from truck N°..161335.....onwards

- Take off the steering wheel, the upper cover and the driver side cover.
- Label and disconnect the wires.
- Take off the 4 mounting nuts and their washers.
- Swivel the reverser assembly from front to rear and from top to bottom in order to free it.
- To refit, carry out the above in reverse order. Centre the assembly carefully in the mounting holes.

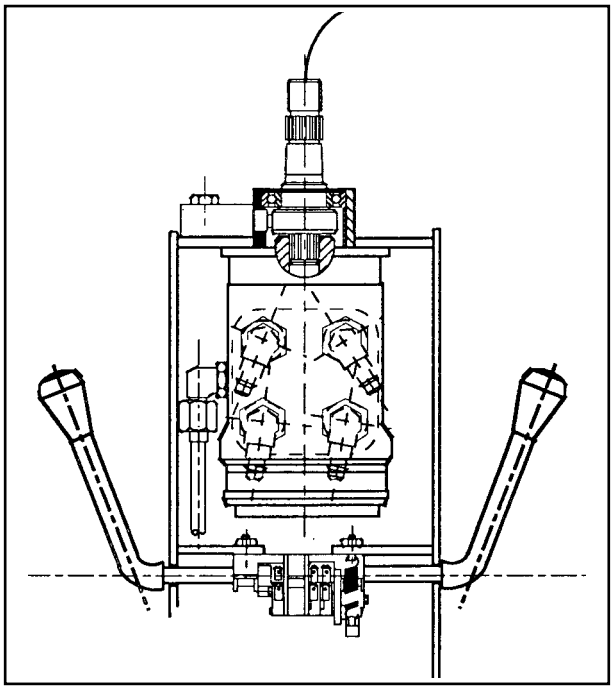


Figure 05-1

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Technical data

Steering system of previous M15 up to serial no. 162xxx

Manufacturer	Danfoss
Type	OSPC 80 LS 150 - 3121
Delivery	80 cc/rev
Pressure relief valve	100 bar + 5 bar
Check valve	160 bar + 15 bar

Steering system of new M15 from serial numbers 717111004000 (Diesel) and 717117004000 (LPG)

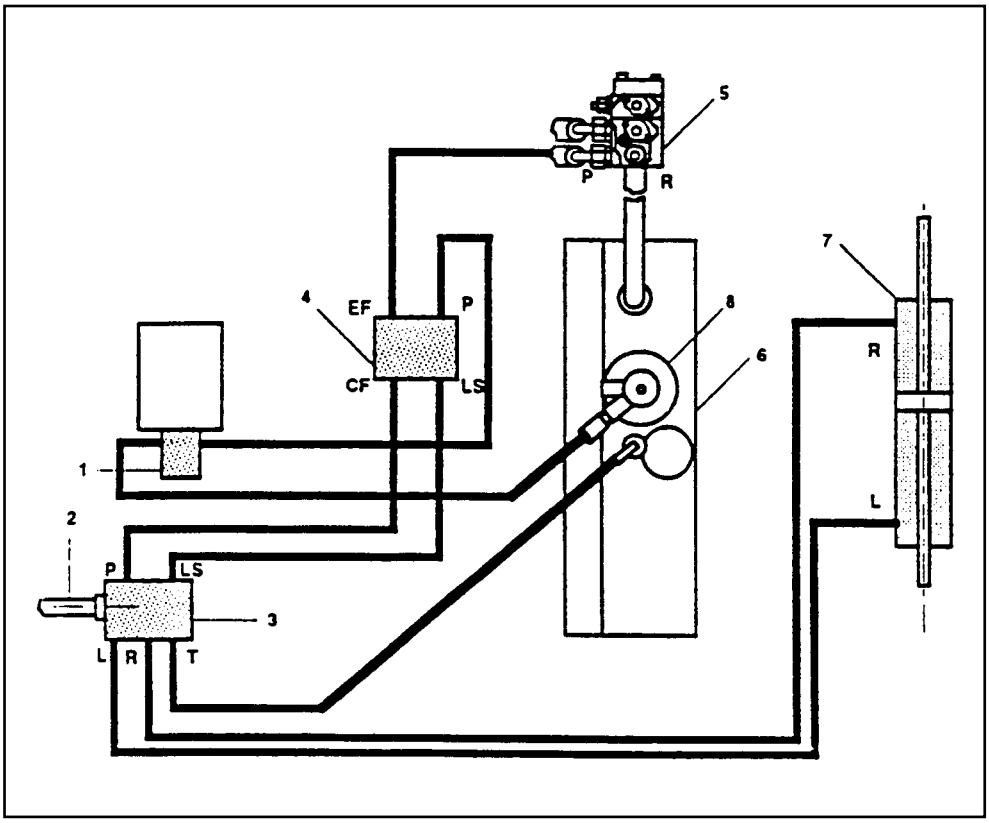
Manufacturer	Danfoss
Type	OSPC 80 LS dynamic 150 - 8109
Delivery	80 cc/rev
Pressure relief valve	100 bar + 5 bar
Check valve	160 bar + 15 bar

Load sensing method of operation
(Applies to former and new M15)

The truck is equipped with a hydrostatic power steering operating according to the "load sensing" (LS) principle. It operates the control piston of the steering cylinder (7) at the steering axle. A steering control valve (3) is mounted to the top end of the steering column. It consists of a rotary valve and a rotating metering pump. When the steering is operated, the quantity of oil required for the steering movement flows from the pump to the steering cylinder. The rotary valve lets the oil flow to either one of the cylinder ends, depending on which direction the steering wheel is turned. With LS systems the steering hydraulic circuit and the mast working hydraulic circuit are supplied with oil by a common pump unit (1).

A priority valve (4) ensures that the priority oil flow goes to the steering, i.e. that the oil delivery is always sufficient independent of the speed of the steering movement and also independent of the load on the steering hydraulics or working hydraulics.

In case of a hydraulics failure, the steering system automatically switches to manual operation.



1 Pump
2 Steering column
3 Steering control valve
4 Priority valve
5 Way valve
6 Hydraulic oil reservoir
7 Steering cylinder
8 Oil filter in the suction line

Adjusting the steering column
(Applies to former and new M15 models)

On trucks with a serial number smaller than 161335 the steering column is supported by a gas cylinder (2) and it can by adjusted by approx. 45 mm in its height. It is also possible to adjust its angle of tilt up to 10°.

On trucks starting with the serial number 161335 only the steering column abgle of tilt can be adjusted up to maximum 10°.

- Release the lever (1) by disengaging it (pull lever out the left side), then release it after turning it about 1/4 turn anti-clockwise.

- To lock the steering column in the selected position, turn the lever clockwise.

Removal of steering control valve

- Remove the steering wheel (3).

- Remove the protective covers (4, 5 and 6).

- Disconnect the hydraulic pipes and hoses (7).

- Remove the 2 fastening screw (9) from the steering control valve (10) and take out the valve.

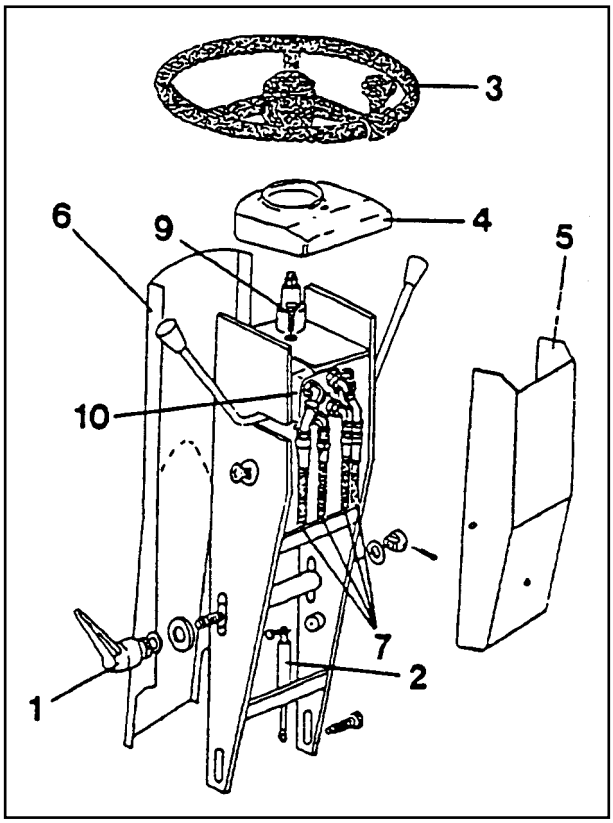


Figure 06-1

- From serial number 161335 : Remove 4 fastening screws (9). The axle of the steering wheel stays in the steering column. Before removing the axle, disconnect the current collector from the mounting. Drive out the axle, bearing and shim from the top down. The axle, bearing, collector ring assembly can not be disassembled.

Installing the steering control valve
(Applies to former and new M15 models)

Installation is the reverse of removal. Observe the torques in the following table.

No.	Description	Max. torque
1	Screw	50 Nm
2	Washer	
3	Fitting	35 Nm
4	Fitting	20 Nm
5	Fitting	80 Nm
6	Fitting	35 Nm
7	Fitting	80 Nm
8	Fitting	80 Nm
9	Fitting	80 Nm
10	Fitting	80 Nm

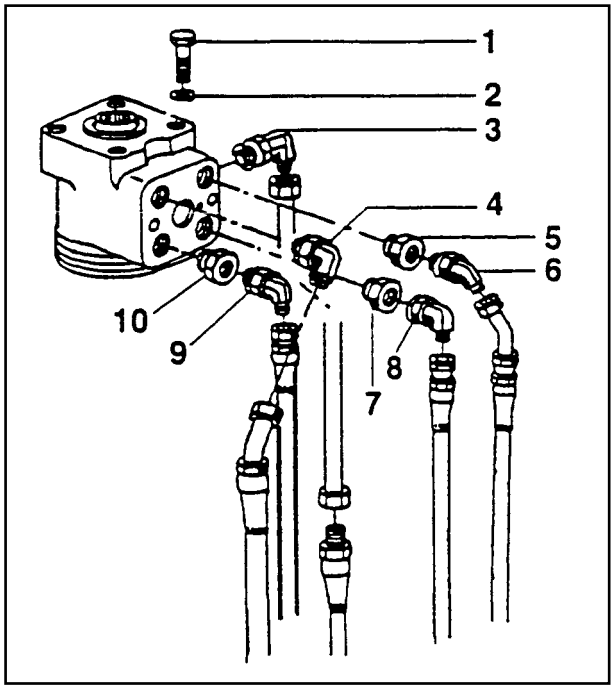


Figure 06-2

The two valves named below (they are adjusted by the manufacturer) are built into the steering control valve.

Pressure relief valve :
Set 100 bar + 5 bar
Check valve :
Set to 160 bar + 15 bar

ATTENTION
Do not change the valve setting under any circumstance.

SAFETY HAS PRIORITY !

In order to prevent the risk of accidents, always install the marked hydraulic hoses at the original place.

LS hydraulic schematic

Applies to former M15 models up to serial no. 162xxx

Legend

1 Hydraulic steering cylinder

2 Steering control valve (steering unit)

3 Pressure relief valve (built-in)

4 Double-acting safety valve with suction valve (built-in)

5 Hydraulic pump

6 Hydraulic oil reservoir

7 Priority valve

8 Oil filter in the pump intake line

9 Check valve (built-in)

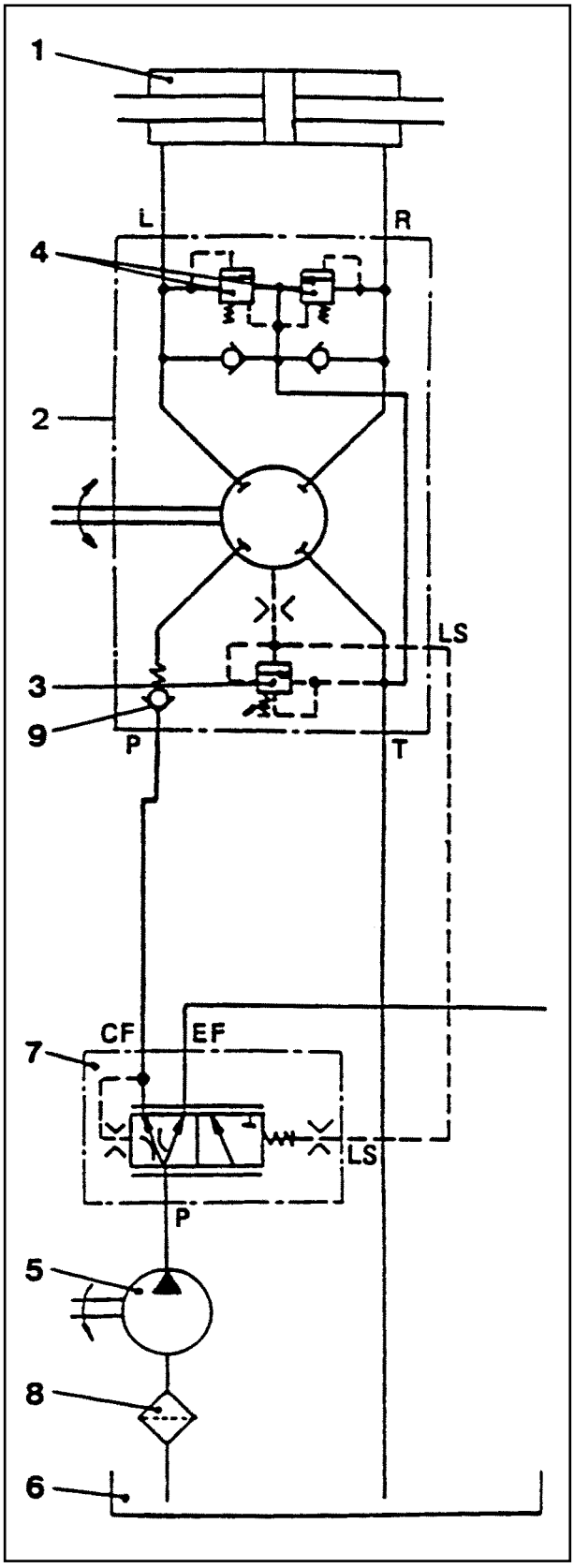


Figure 06-4

Applies to former M15 models up to serial no. 717111004000 (Diesel) and
717117004000 (LPG)

Method of operation of dynamic load sensing

In a classical LS circuit, the pressure in the LS line increases when the steering wheel is operated.

In a dynamic LS circuit, pressure is decreased constantly. This pressure decrease is due to the priority valve and it is sent to the steering. A check valve prevents this line from going dry.

The advantage of the dynamic LS circuit is a substantially faster increase of the LS control pressure, which prevents abrupt steering movements which could occur with some of the classic systems when the steering wheel was operated more or less forcefully.

Dynamic LS hydraulic schematic

Applies to former M15 models up to serial numbers 717111004000 (Diesel) and 717117004000 (LPG)

Legend

1 Hydraulic steering cylinder

2 Steering control valve (steering unit)

3 Pressure relief valve (built-in)

4 Double-acting safety valve with suction valve (built-in)

5 Hydraulic pump

6 Hydraulic oil reservoir

7 Priority valve

8 Oil filter in the pump intake line

9 Check valve (built-in)

10 Check valve LS-exit

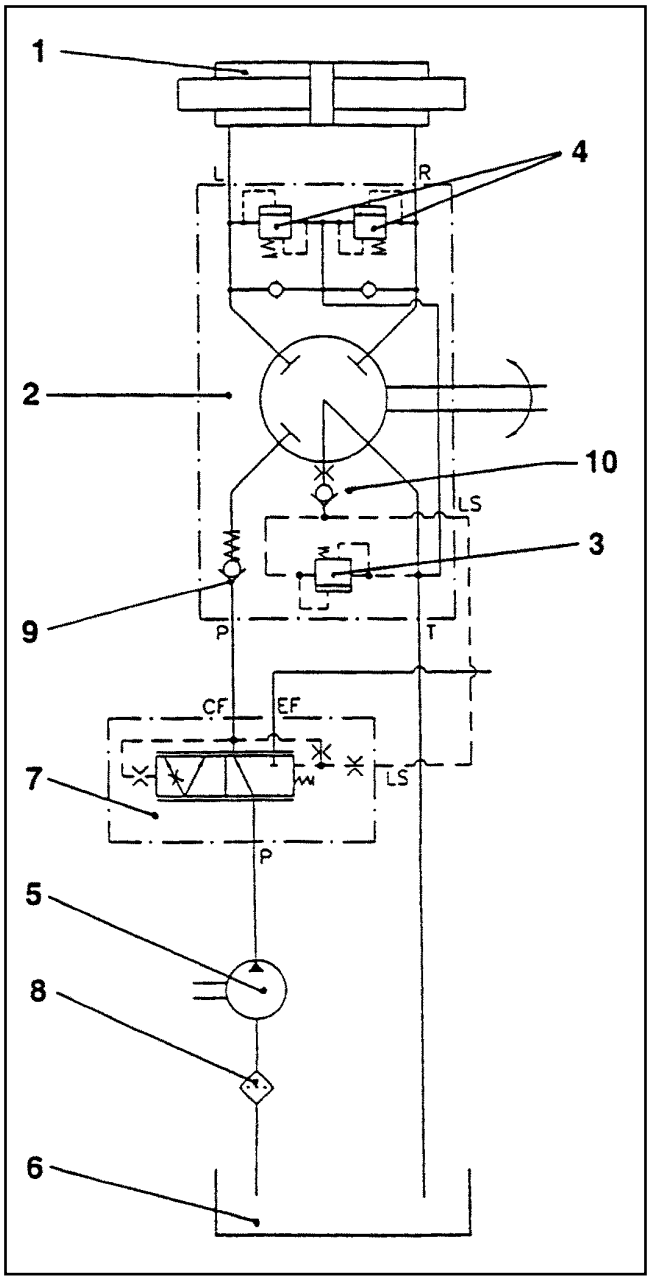


Figure 06-5

Steering cylinder

Applies to former and new M15 models.

The steering cylinder is built into the steering axle. This arrangement allows the steering cylinder to operate in its direction of stroke.

Removing the steering cylinder

- Slacken the rear wheel nuts and block up the truck.
- Remove the wheels.
- Mark the hydraulic hoses (1) and disconnect them.
- Remove stops (2) and axles on the cylinder side (3).
- Remove 4 fastening screws (4) from the bearing and remove cylinder.
- The installation is in the reverse order.
- Torque of bearing = 105 Nm

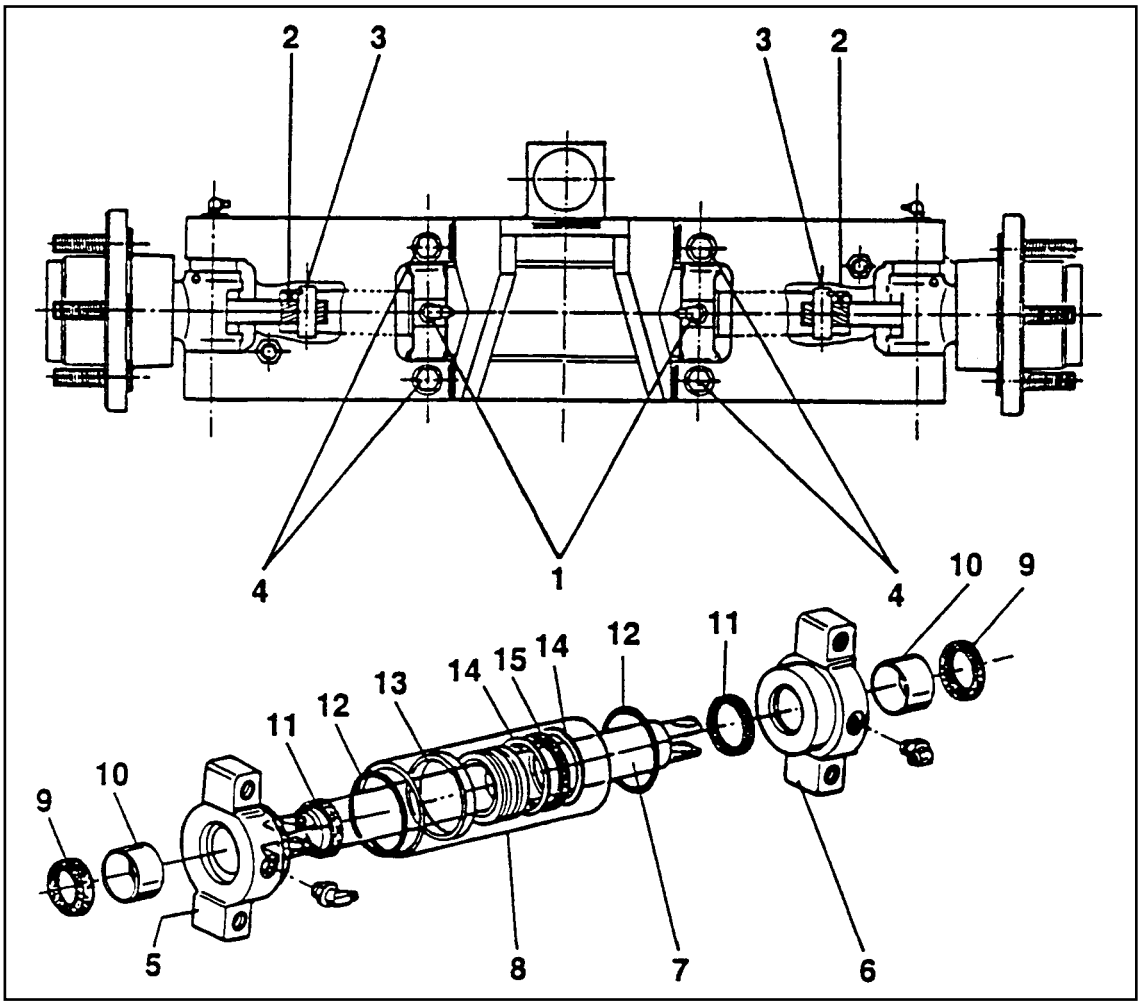


Figure 06-6

Replacing the cylinder seals

- Loosen the bearings (5 and 6) with a rubber hammer and remove them.
- Remove the piston rod (7) out of the cylinder (8).
- Replace seals (9-13). Use the seal kit provided.
- The installation is in the reverse order.

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Brakes
Hydraulic braking system

Brake master cylinder

The brake master cylinder (2) is located under the floor plate. It is connected to the brake pedal by an actuating mechanism.

The pedal support is fastened to the casing between engine and gearbox with 2 screws M12x35 (5).

Torque : 86 Nm

* The pedal linkage is held by an axle at the top, which is mounted in a bearing welded to the frame. At the bottom the pedal linkage is also mounted in a bearing welded to the frame.
* from serial numbers
  717111004000 (Diesel) and
  717117004000 (LPG)

The plastic brake fluid reservoir (3) is located at the front engine compartment cover and it also serves as expansion reservoir. In this way the correct quantity of brake fluid is always available and the equalisation between pressure and volume is always given.

The hole in the brake fluid reservoir filler cap (4) is a breather hole. It must always be open so that the brake fluid can flow into the brake master cylinder. The brake fluid reservoir must always contain sufficient fluid.

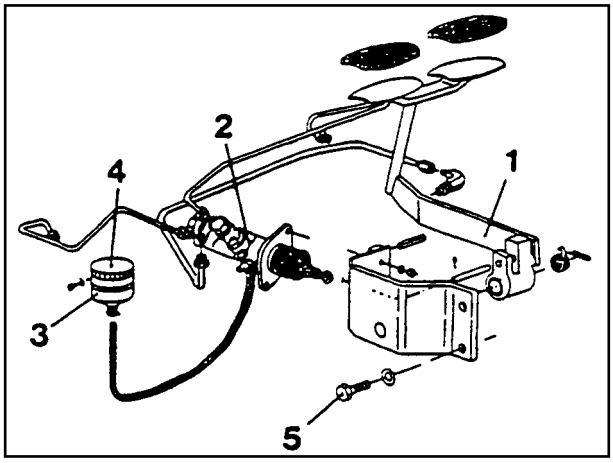


Figure 07-1

The brake fluid level must between 15 and 20 mm below the lower edge of the filler cap.

IMPORTANT NOTE
Do not fill the brake fluid reservoir with mineral oil ! Only use genuine brake fluid !

The specified brake fluid is LOCKEED N55 (brake Ø 170 and Ø 180).

The specified brake fluid is FAG DOT 4 (brake Ø 230).

Servicing instructions for the hydraulic drum brake

1. General

All service and repair work on the brakes must be performed by qualified and suitable trained personnel. The brake is a particularly important safety element whose effectiveness must not be reduced by unsatisfactory servicing.

Trucks driven on public roads are subject to the rules and regulations of national safety inspection associations which, among other things, require a strict brake inspection. Trucks not requiring an official approval must be inspected at least annually by an expert during the accident prevention inspection.

2. Renewing the brake linings

Worn, burnt, glazed or oily brake linings must be renewed. Always replace the shoes as a set i.e. on both brakes of the axle and only use brake shoes approved by the truck manufacturer. Bonded brake linings or bonded and riveted linings must be treated as required by engineering specifications. Every violation of the foregoing recommendations will void your operating license and any liability claims.

3. Other brake elements

The steel springs, sealing rings, protective caps and rubber boots must be renewed every two years minimum.

4. Running-in instructions

In order for new brakes to operate as effectively as possible, it is recommended running them on at low and medium speeds. The distance to be travelled generally depends on the use to which the vehicle is put and might however correspond to at least 100 hours of use. During this phase, the maximum temperature of the brake drums and discs must not exceed 200°C. An occasional overrunning of the temperature limit during braking must not exceed 15 % of the maximum temperature.

Prolonged or hard braking operations at maximum speed should also be avoided.

---

1 Right brake shoe
2 Left brake shoe
3 Adjustable strut
4 Return spring
5 Washer
6 Spring
7 Pin
8 Return spring
9 Pushrod left and right
10 Bracket
11 Hexagon screw M6x10x8.8
12 Wheel brake cylinder
13 Dust cap
14 Screw, left thread
15 Screw, right thread
16 Elastic washer
17 Hexagon screw M6x25x8.8
18 Brake-drum
19 Screw plug

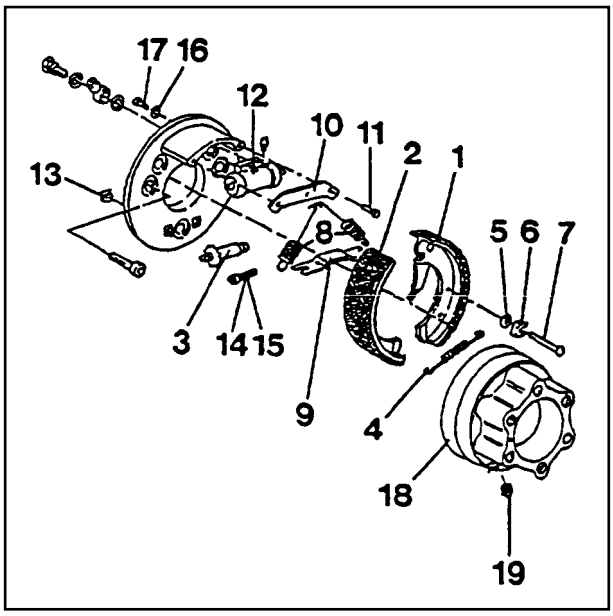


Figure 07-2 - **Brake Ø 170 et Ø 180**

---

1 Brake table
2 Binding plate
3 Washer A6 DIN 137
4 Screw M6x12 DIN 933
5 Automatic adjusting device
6 Washer A12 DIN 127
7 Screw HM12x20x20
8 Wheel cylinder
9 Washer A6 DIN 137
10 Screw M6x15 DIN 933
11 Brake shoe
12 Brake shoe with lever
13 Return spring
14 Return spring
15 Pressure spring
16 Pin
17 Brake cable
18 Washer
19 Drain screw
20 Screw M12x30 DIN 912

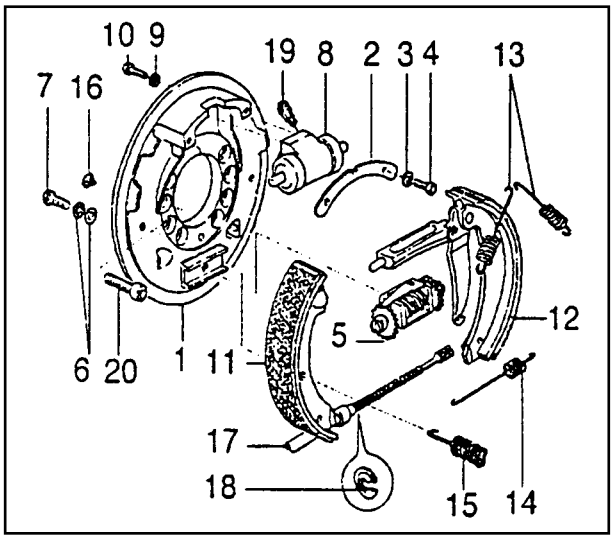


Figure 07-2 - **Brake Ø 230**

Description and adjustment of the brake master cylinder

The hydraulic brake master cylinder (21) is provided with a protective boot (22) which prevents the ingress of dirt and water. There is a breather hole in the boot so that the air in the protective boot can easily escape when the brake master cylinder is operated. The protective boot must be mounted such that the breather hole is at the bottom. If the hole in the protective boot is at the top, water can collect and enter the brake master cylinder during braking.

This can cause :

- Formation of rust in the brake cylinder hole, which can result in damage to the 2nd boot and thus the loss of brake fluid.

- The brake cylinder piston can freeze at temperatures below 0°.

There must be a play of 1 mm between plunger and the end of the piston (23). The adjustment is made by turning the plunger (24) slackening the locknut (25).

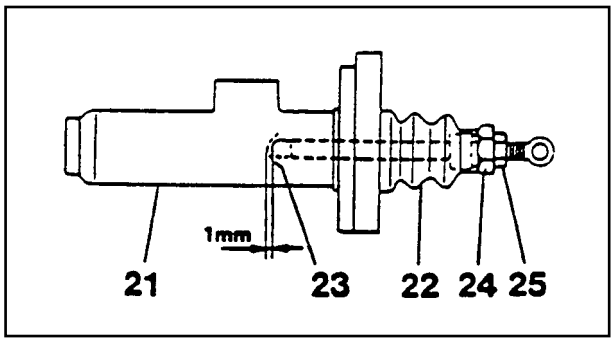


Figure 07-3

* The adjustment is made by operating the cable, item 2, Figure 07-5 Pedal assy. disassembled, page 07-7.

* applies from serial numbers 717111004000 (Diesel) and 717117004000 (LPG)

Adjusting the service brake Ø 170 and Ø 180

See Figure 07-2 on page 07-3

The brake drum (18) is provided with a plug (19) which closes the hole (20) provided for the adjustment of the brake linings.

- Fully release the parking brake.

- Turn the drum so that the hole below the plug (19) is located directly above the adjuster (3).

- Turn in the adjuster with a screwdriver until the brake drum is arrested.

- Turn the adjuster back until the brake drum can just be turned.

It is allowed to machine worn brake drums, but cutting should not increase the diameter over 0.6 %.

Standard brake linings with normal thickness can be used.

Adjusting the service brake Ø 230

Principle of operation

When the brakes are activated, the primary lining (compressed lining) driven by the rotation of the drum pushes the adjustment screw (1) which drives the sleeve (2) through the U shaped mounting. This movement causes the lever (4) to tilt by means of the adjustment disk (5).

As soon as the braking phase is completed and after the associated movement of the brake lining, the linings return to their initial position under the action of the compression spring (6) which recentres the assembly.

The lever (4) has indexed one or more teeth on the toothed wheel (7) and is applied by the holding spring (8). The lever (4) is returned by the spring (6) and unscrews the toothed wheel (7) in order to take up the play.

This adjustment process is repeated each time the brakes are operated and each time the play is greater than the admitted tolerance (marked on the lever (4)).

This value enables a constant functional play to be maintained between the linings and the drum.

The adjusment system works for both directions of rotation.

Initial adjusment

Adjustment must be carried out when :
- the play compensation system has been refurbished, dismantles and reassembled.
- new drum or brake linings have been fitted.
- the original setting has been changed by action on the compensation system.

The initial adjustment is carried out by turning the screws (1) to set the distance (a) to 79 mm. During this adjustment, maintain an identical distance (b) on both sides.

Final adjustment

IMPORTANT : During the adjustment :
1. Raise the truck wheels.
2. Ensure that the hand-brake cables are free and slack.
3. Remove the drums.
4. Do not force the wheels (7) to turn without having raised the levers (4) (using a screwdriver, for example), otherwise damage might result to the system.

The final adjustment is carried out by noting the dimension of the drum and adjusting the screws (1) to obtain a diameter on the linings equal to the diameter of the drum less 1 mm.

Adjust the hand-brake cables so that their action in the parking brake off position does not result in any increase in the diameter of the linings.

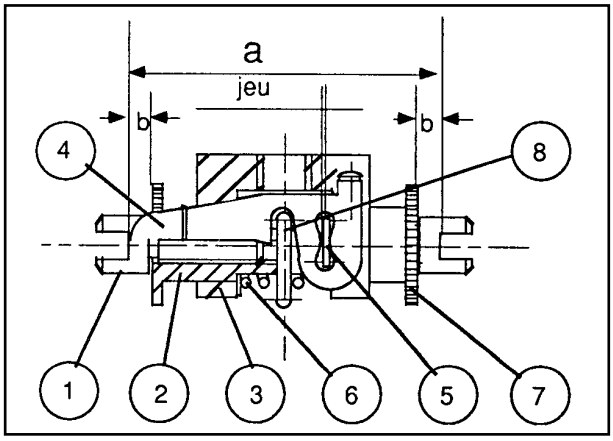


Figure 07-4

The hand-brake cables must not be pretightened, otherwise problems will result with the play compensation system.

Carry out a series of 10 consecutive brakings in forward and reverse, with the truck moving at average speed, and observe the behaviour of the braking.

This gives a perfectly adjusted braking system.

When refitting after the play compensation system has been removed, before fully tightening the fastening bolt (ref. 7, figure 07-2), operate the brakes several times in order to centre the linings and the whole system relative to the drum. Then tighten the bolt (ref. 7, figure 07-2) to 80 Nm.

Adjusting the parking brake

Before the tension of parking brake cable can be adjusted, a basic adjustment of the hydraulically-operated service brake must be performed (see page 2).

- Release the parking brake completely.
- Make sure that the ends of the parking brake (6) are attached exactly in their retainers below the handbrake lever (7) and at the other end of the cable in the respective brake anchor plate holes on the left-hand and right-hand side.
- Slacken the locknuts (8).
- Tension each of the cables in turn by turning the nut (9) at the adjustment ends towards the bearing points (7) until a play of about 0.5 mm is achieved.
  (This will equalize the play of the lever at the brake shoes.)

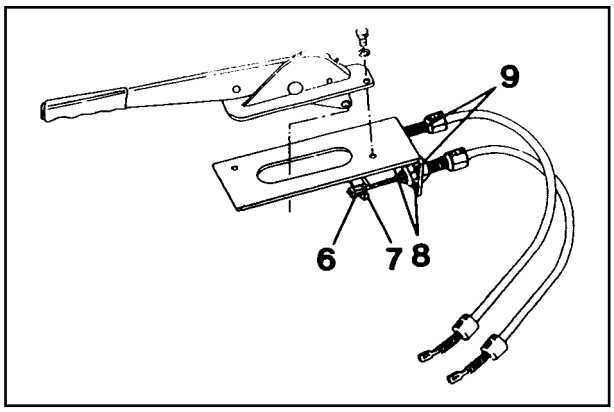


Figure 07-5

IMPORTANT NOTE

A uniform braking of the wheel brakes can only be achieved with a proper handbrake adjustment. This means that the braking power of one wheel brake must not differ from the other by more than 20 % maximum. If the service brake has an unequal braking action, tha parking brake. has an unequal braking action. The parking brake must have approximately the same degree of inequality. It makes no sense to achieve an equal braking action for the parking brake if the service brake evinces unequal action.

- With the wheels jacked up, apply the handbrake lever by 3 notches. The wheels should be just locked now if attempting to turn them by hand. If the resistance is noticeably greater at one wheel than at the other, slacken the appropriate cable until they are equally tight.
- If the parking brake is applied to the 5th or 6th notch, full braking action should be obtained, i.e. the wheels can no longer be turned by hand.
- The parking brake must achieve its full braking action when applied to the 8th and 9th notch.
- Tighten the locknut (8).

Method of operation

Applies to new M15 model from serial numbers
717111004000 (Diesel) and
717117004000 (LPG)

The method of brake operation is the same as for the former version of the M15, only the pedal linkage was changed. This pedal assembly is mounted separately, reducing the vibrations.
The original double pedal was replaced by a pedal with a larger surface.

Dimensions of foot pad

Former pedal = 110 x 65
New pedal = 226 x 86

The brake master cylinder has also been taken from the preceding model, but the stroke is now adjusted with a rod (2) on the right and left side.

Disassembly of the pedal assembly

- Drive out the pins (1 and 3) with a long special drift.
- Take the spring (4) out of the mounting.
- Remove the adjusting rod (2).

- Installation is in the reverse order of removal.

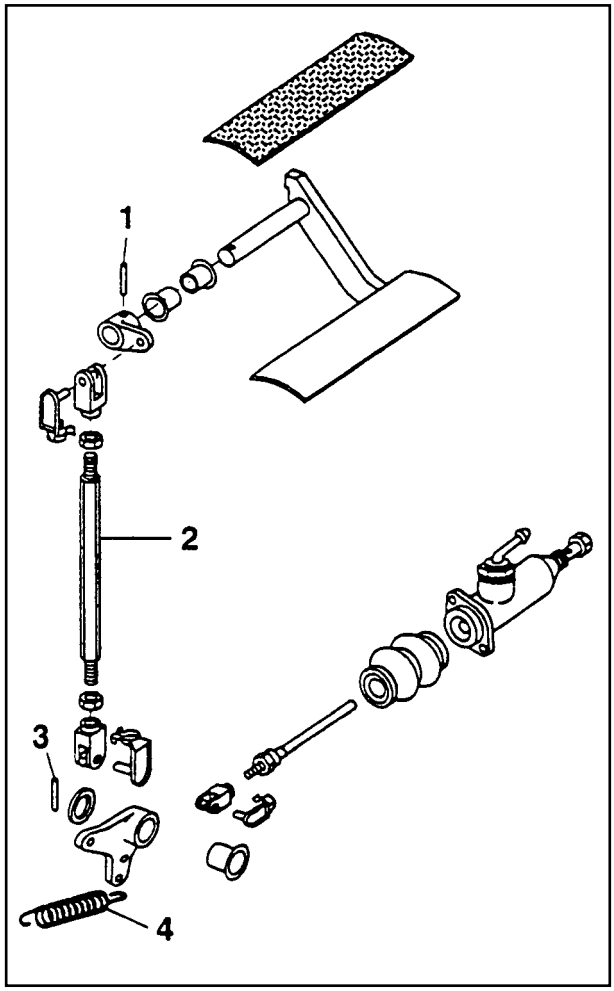


Figure 07-5

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Electrical system of LPG Model

The electrical system includes :

- 1 battery 12 V 55 Ah.
- The battery charged by the 12 V 60 A alternator.
- The key switch on the right-hand side of the steering column with a removal key. It has 5 positions : Stop - Attachments - Garage - On - Start.

Electrical system of Diesel model

The electrical system includes :

- 1 battery 12 V 55 Ah.
- The battery charged by the 12 V 55 Ah alternator.
- A preheating device consisting of :
- 1 relay (for electronic preheating system)
- 4 glow plugs (see group 11).
- The key switch on the right-hand side of the steering column with 3 positions : On - Off (and preheating) - Start (key turned clockwise).

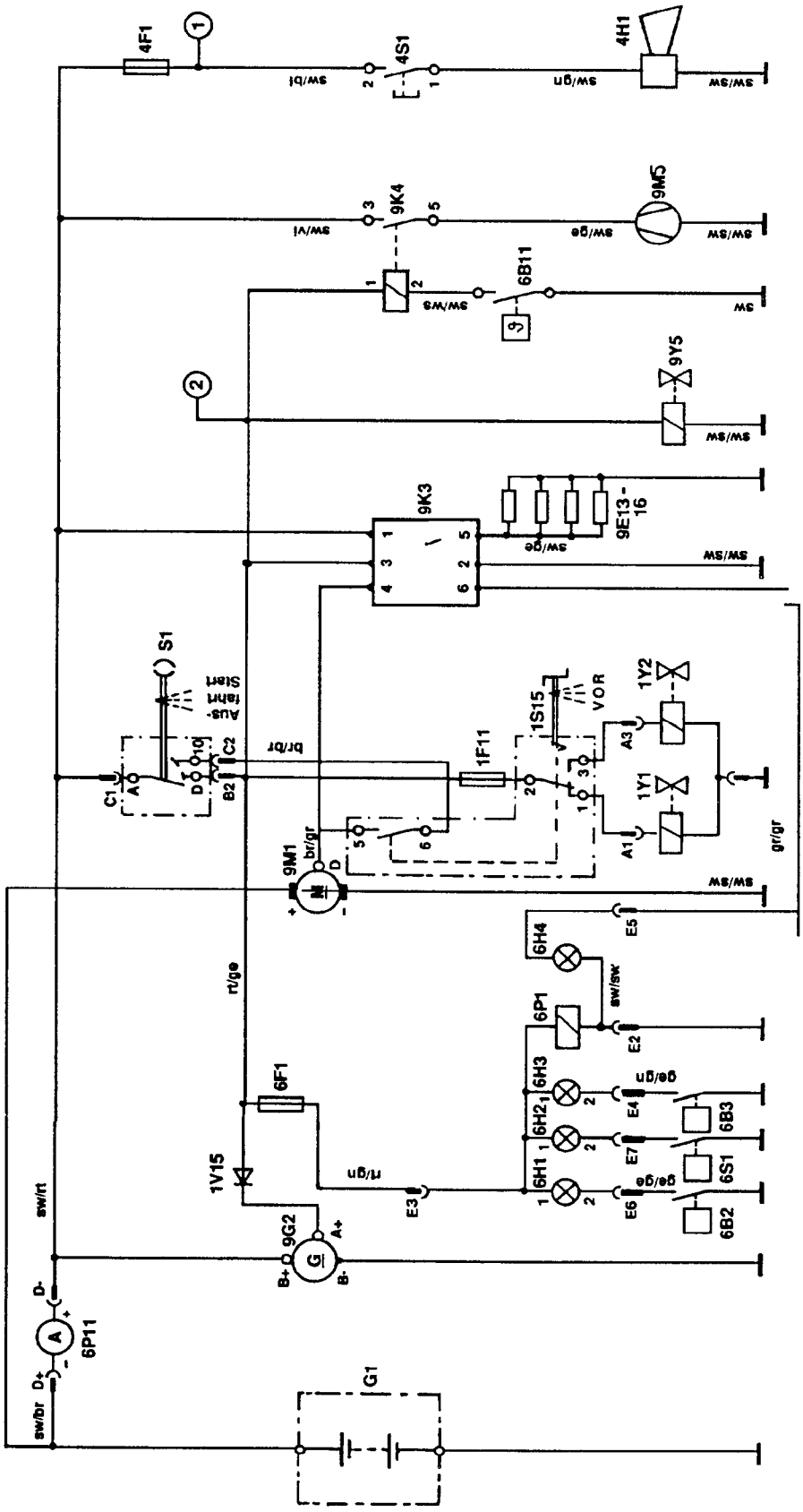
Data common to both models

- The key automatically returns to the ON position from the START position.
- The engine can only be started if the directional selector switch is in neutral.
- The battery is mounted under the floor plate on a bracket in front of the wheel.
- The directional selector switch is installed in the top section of the steering column (see group 5). It has 3 positions : FORWARD - NEUTRAL - REVERSE
- The horn microswitch is mounted on the directional selector switch mount. It is actuated by pushing the directional selector switch up.

From truck number N° 161335 onwwards.

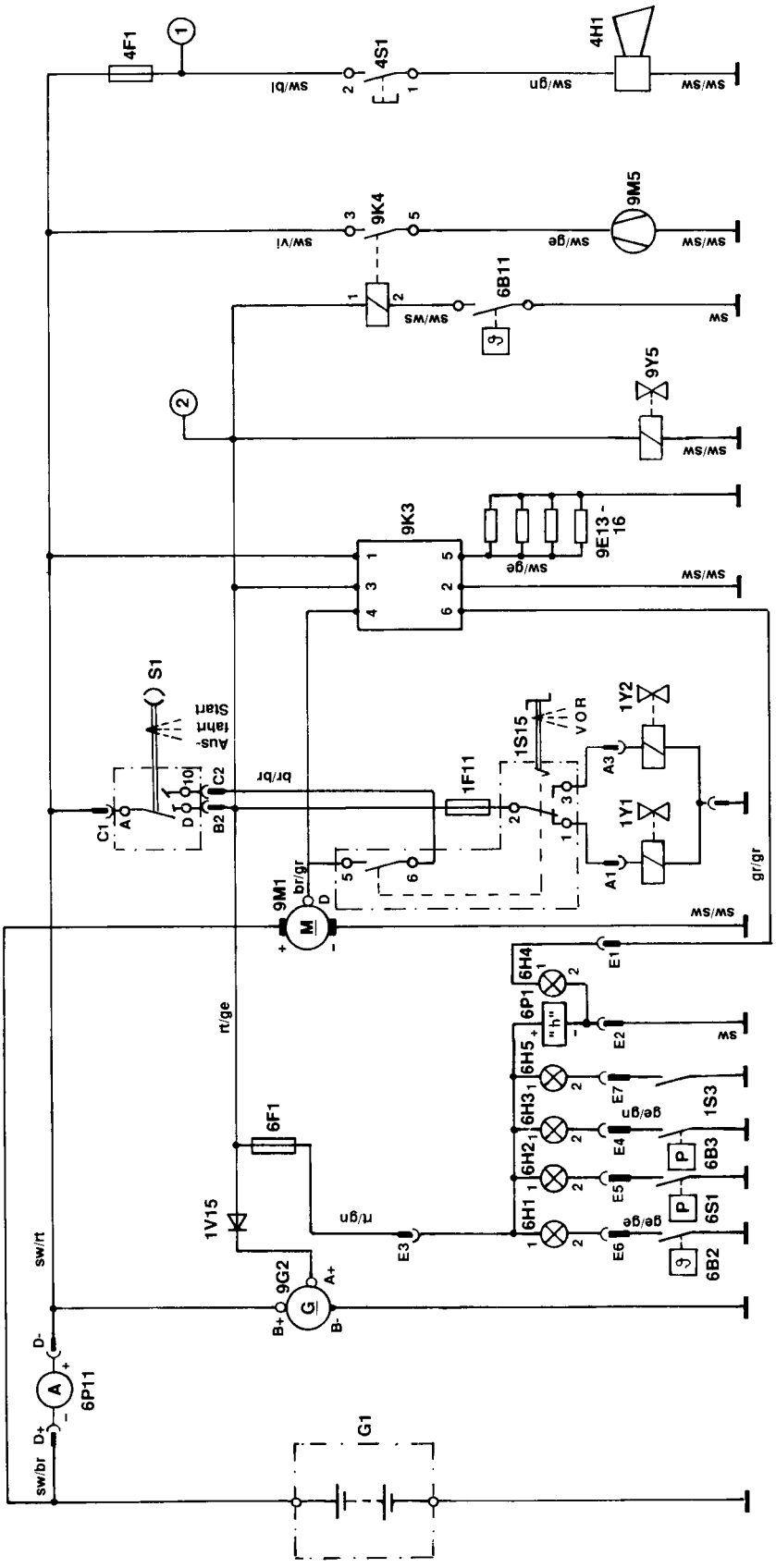
The horn is at the centre of the steering wheel.

Wiring diagram for Diesel model



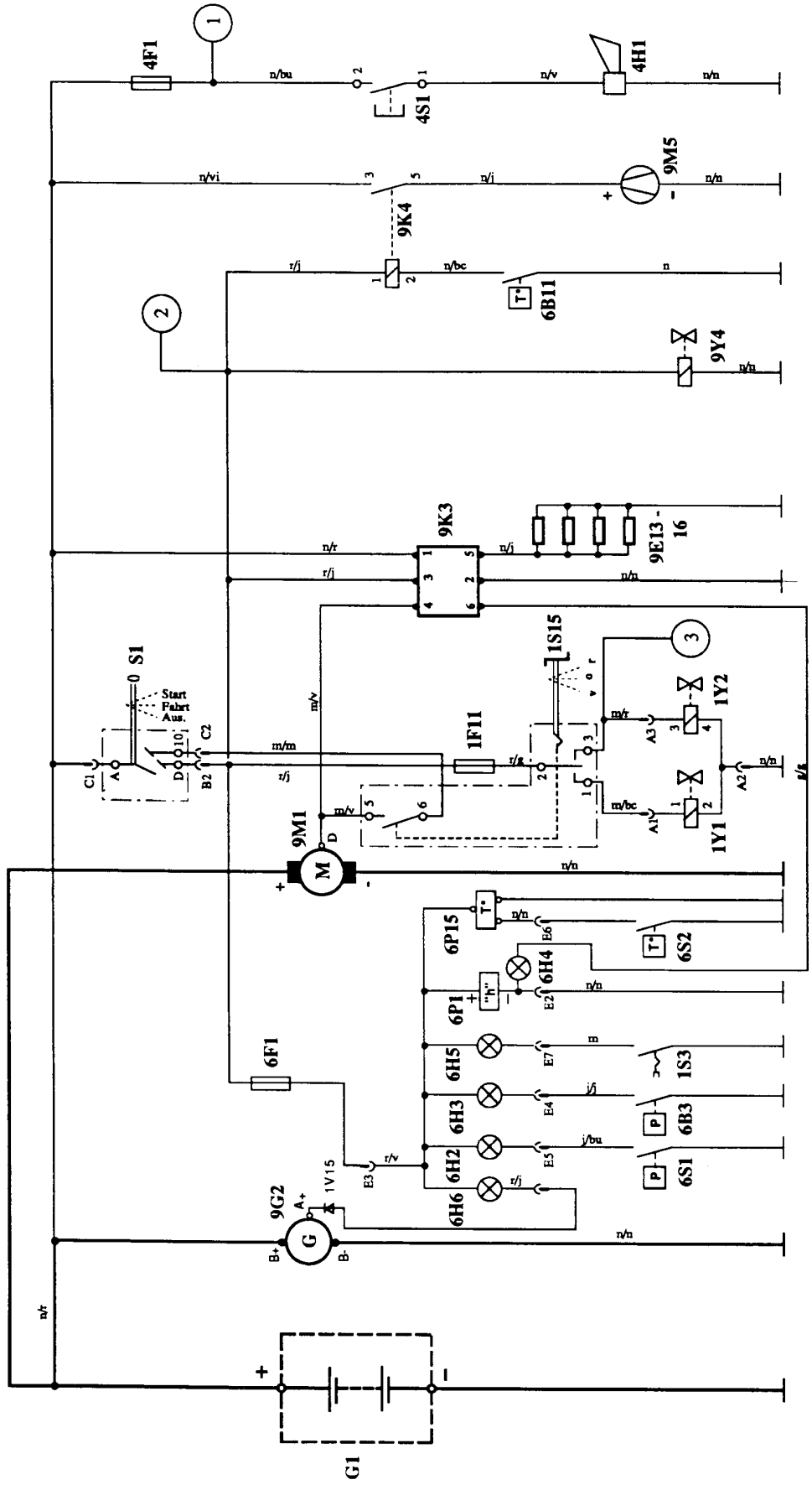
Wiring diagram* for Diesel model

*** From series No. 160317**



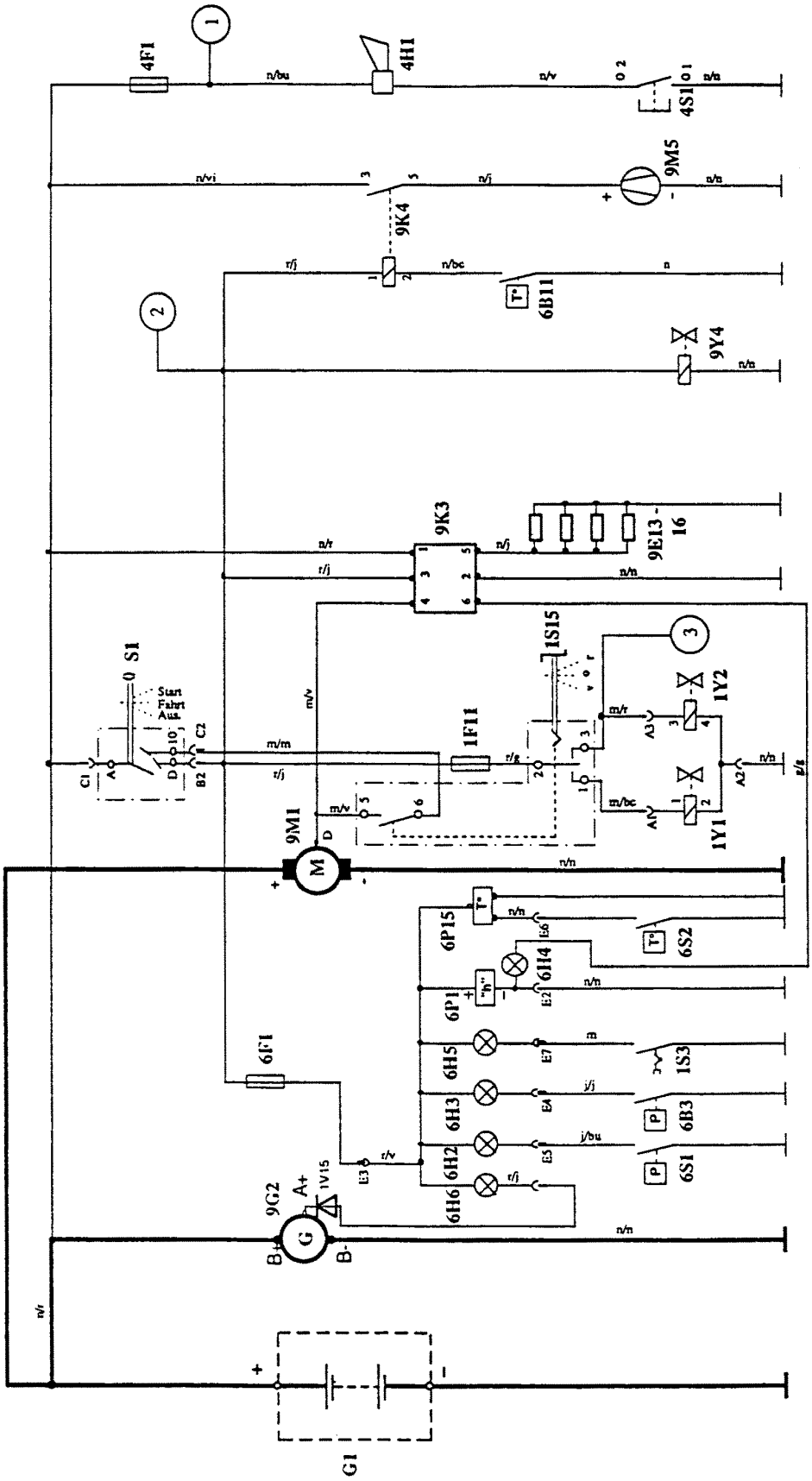
Wiring diagram* for Diesel model

*** From series No. 160575**



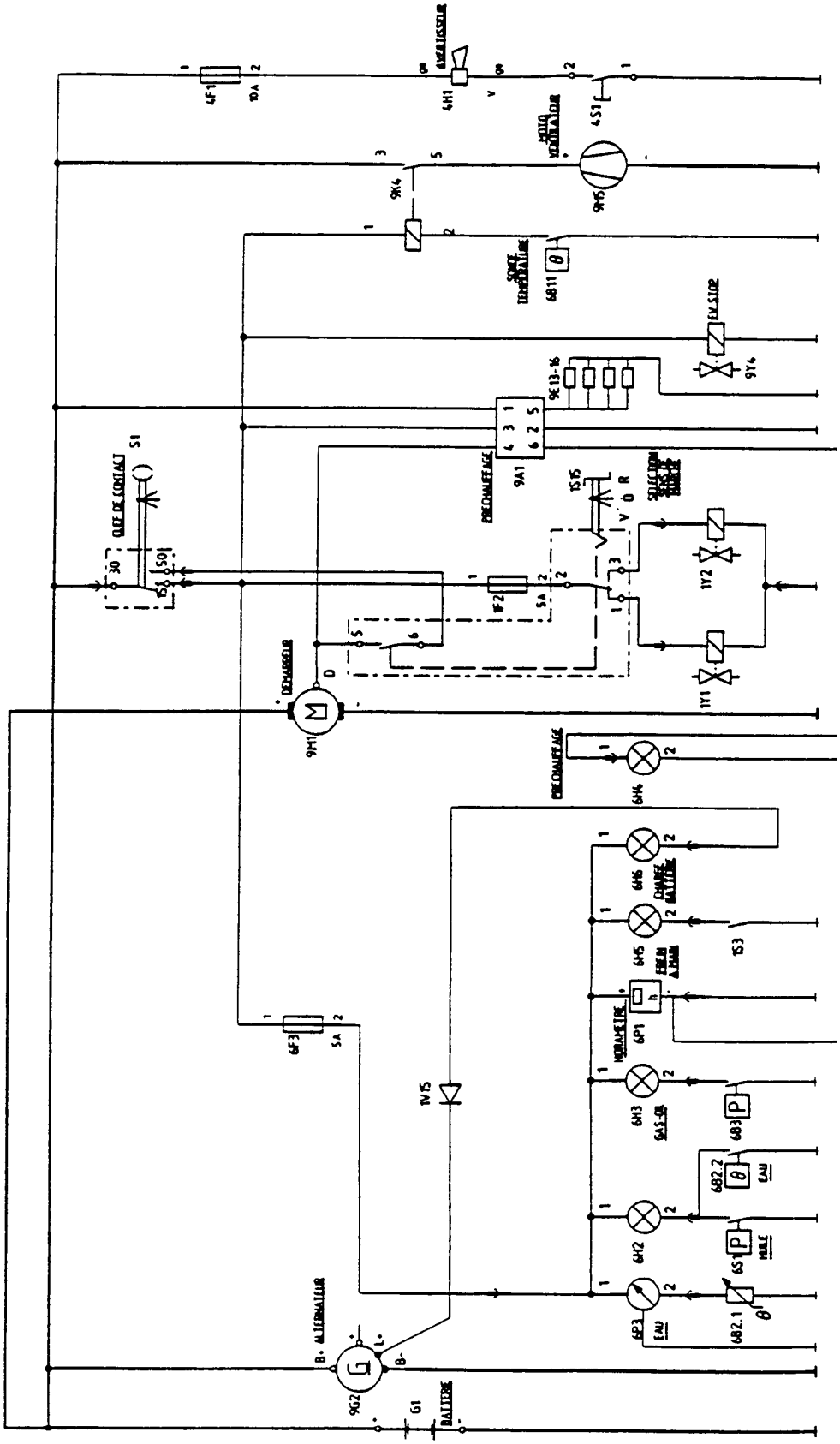
Wiring diagram for Diesel model

From truck n°161335 onwards



Wiring diagram (Diesel)*

*** applies from serial number 717111004000**



Wiring diagram for Diesel model

Legend to the diagram

NOTE
Components in the legend are not installed in all trucks.

1 Connection for optional equipment
2 Connection for optional equipment
3 Connection for optional equipment

6B2 Coolant temperature switch
6B2.1 Coolant temperature sending unit
6B2.2 Coolant temperature switch
6B3 Fuel level sending unit
6B11 Temperature switch for ventilator 9K4

1F2 Fuse, control circuit
1F11 Fuse, control circuit
4F1 Fuse for 4H1
6F1 Fuse for indicator lights
6F3 Fuse for indicator lights

G1 Battery
9G2 Alternator

4H1 Horn
6H1 Coolant temperature warning light
6H2 Oil pressure/coolant temperature warning light***
6H3 Fuel level warning light
6H4 Preheating indicator light
6H5 Parking brake warning light*
6H6 Battery charging light**

9K3 Preheating unit relay
9K4 Relay for fan motor

9M1 Starter
9M5 Fan motor

6P1 Hour meter
6P3 Coolant temperature gauge
6P11 Ammeter
6P15 Coolant warning light**

S1 Key switch
1S3 Parking brake switch*
1S15 Travel direction switch forward/reverse
4S1 Horn push
6S1 Oil pressure switch
6S2 Thermal resistor**

1V15 Diode

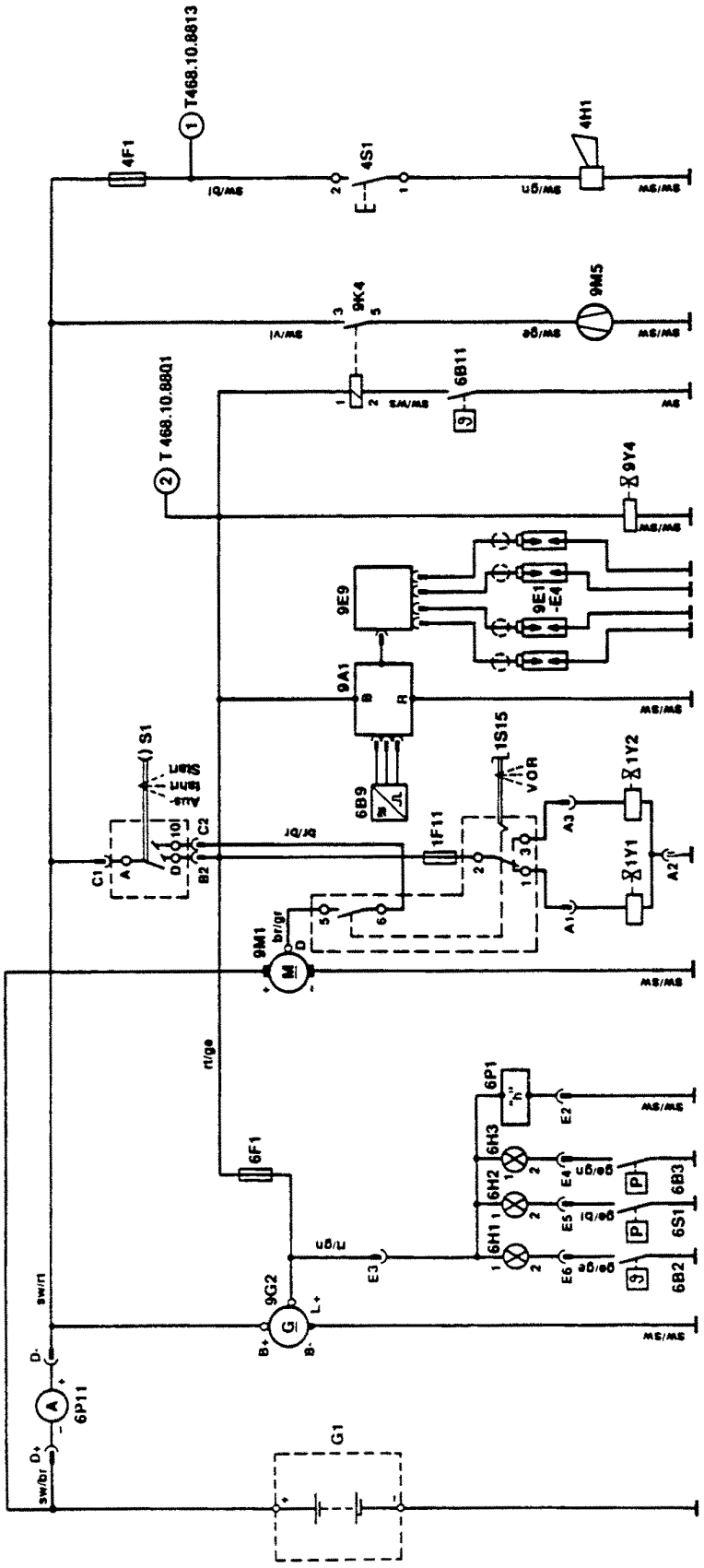
1Y1 Directional control valve, forward
1Y2 Directional control valve, reverse
9Y5 Solenoid shutoff device

Colour code

bc white
bu blue
g gray
j yelllow
m brown
n black
r red
v green
vi violet

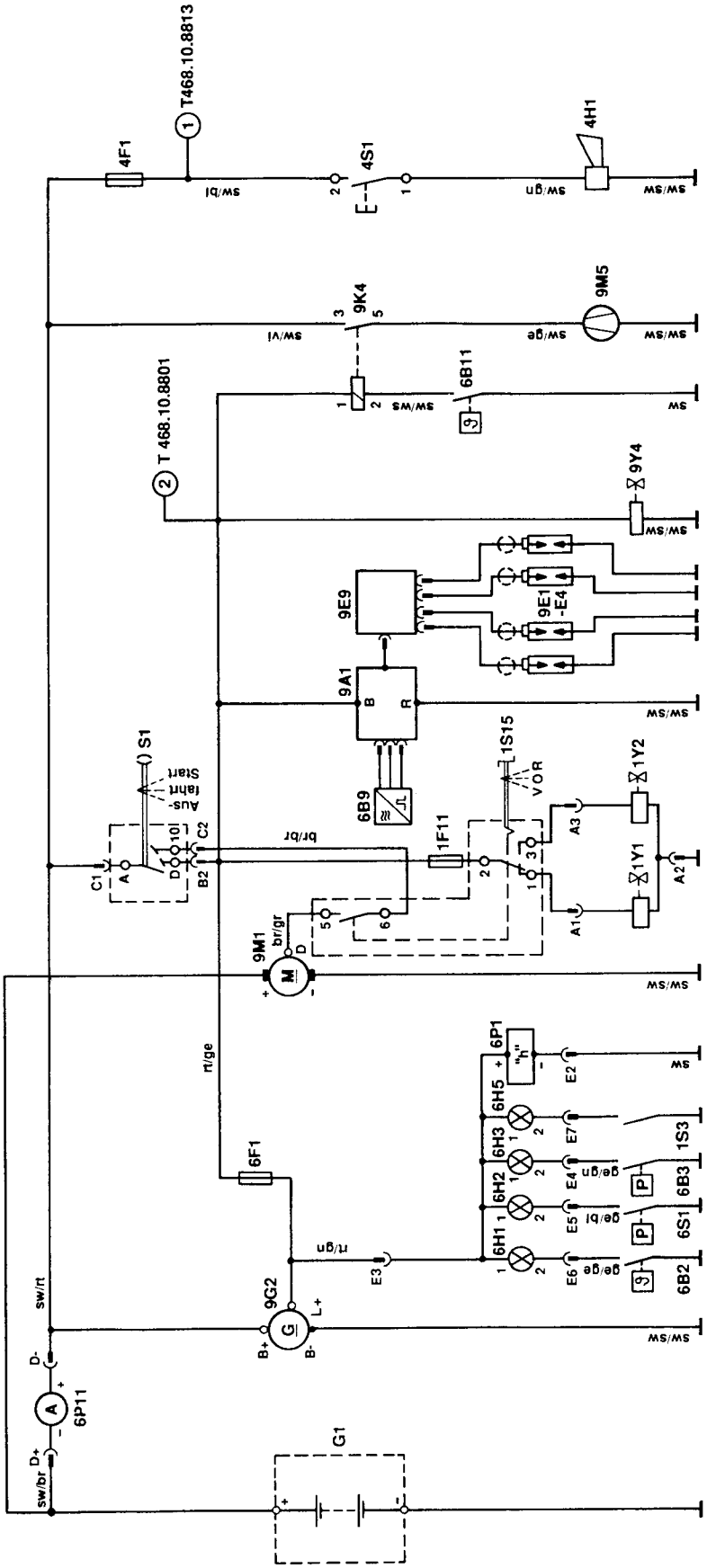
* from serial no. 160317
** from serial no. 160575
*** applies from serial number 717111004000 (Diesel)

Wiring diagram for LPG model



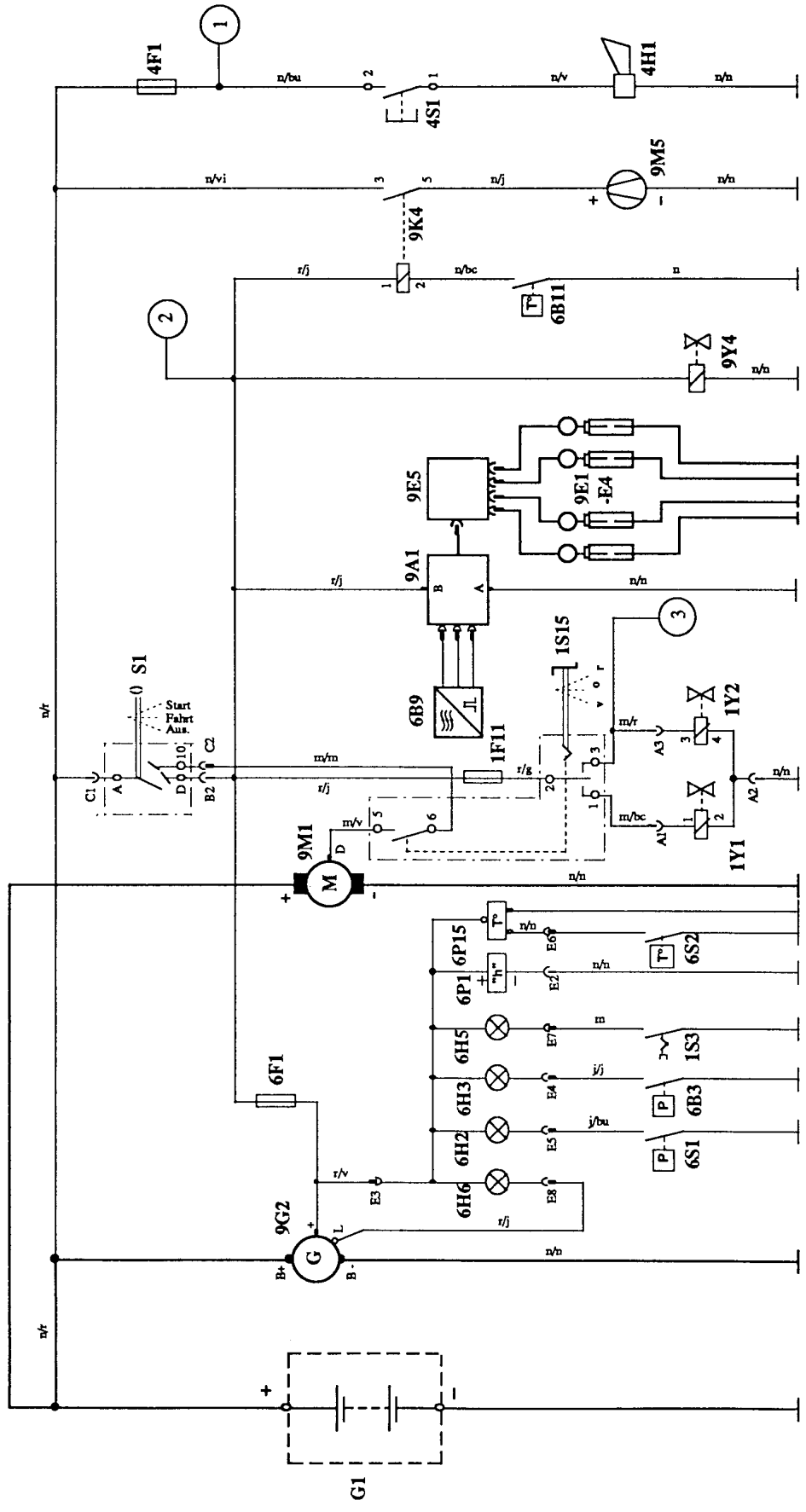
Wiring diagram* for LPG model

*** From series No. 160305**



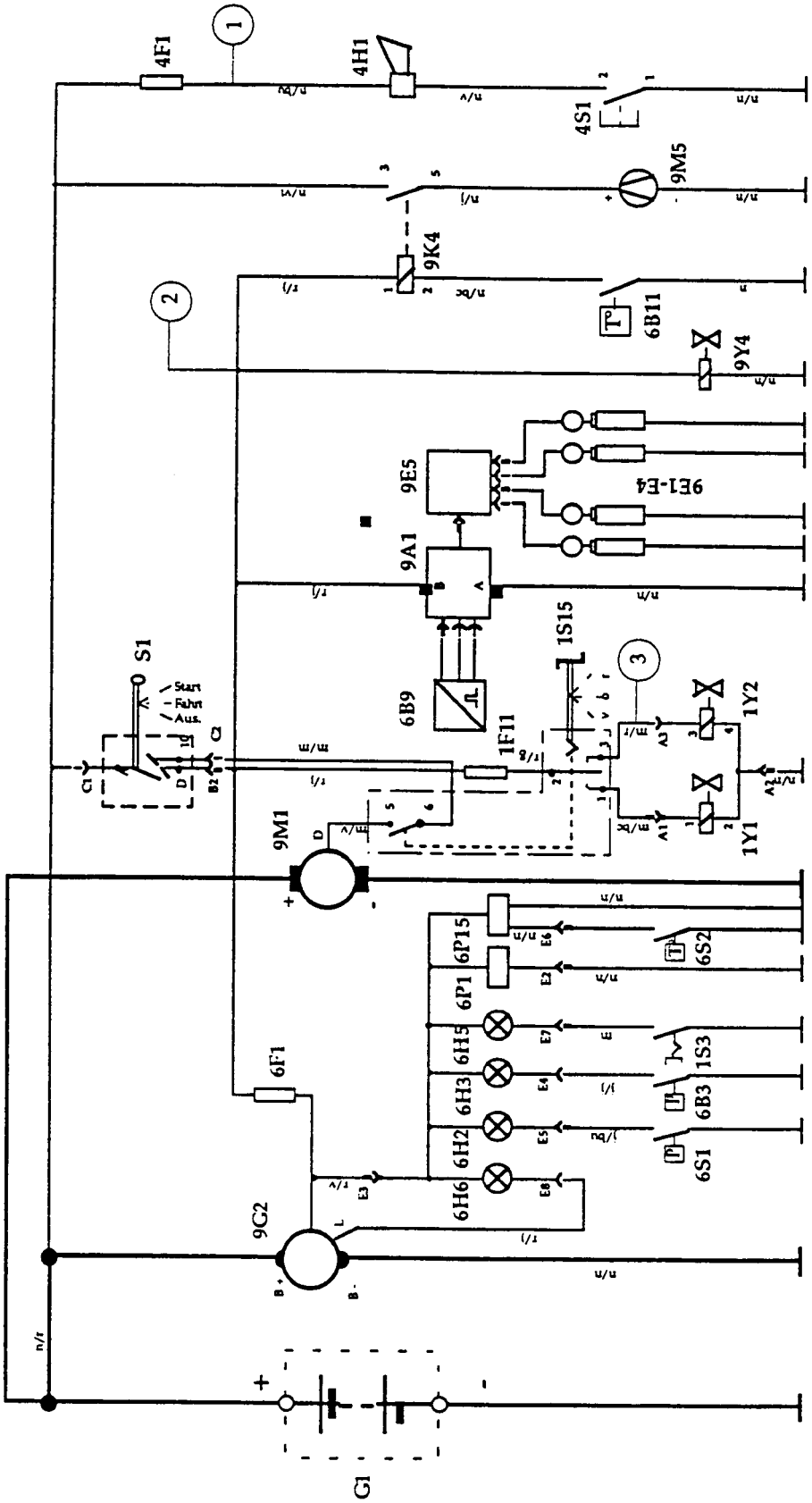
Wiring diagram* for LPG model

*** From series No. 160613**



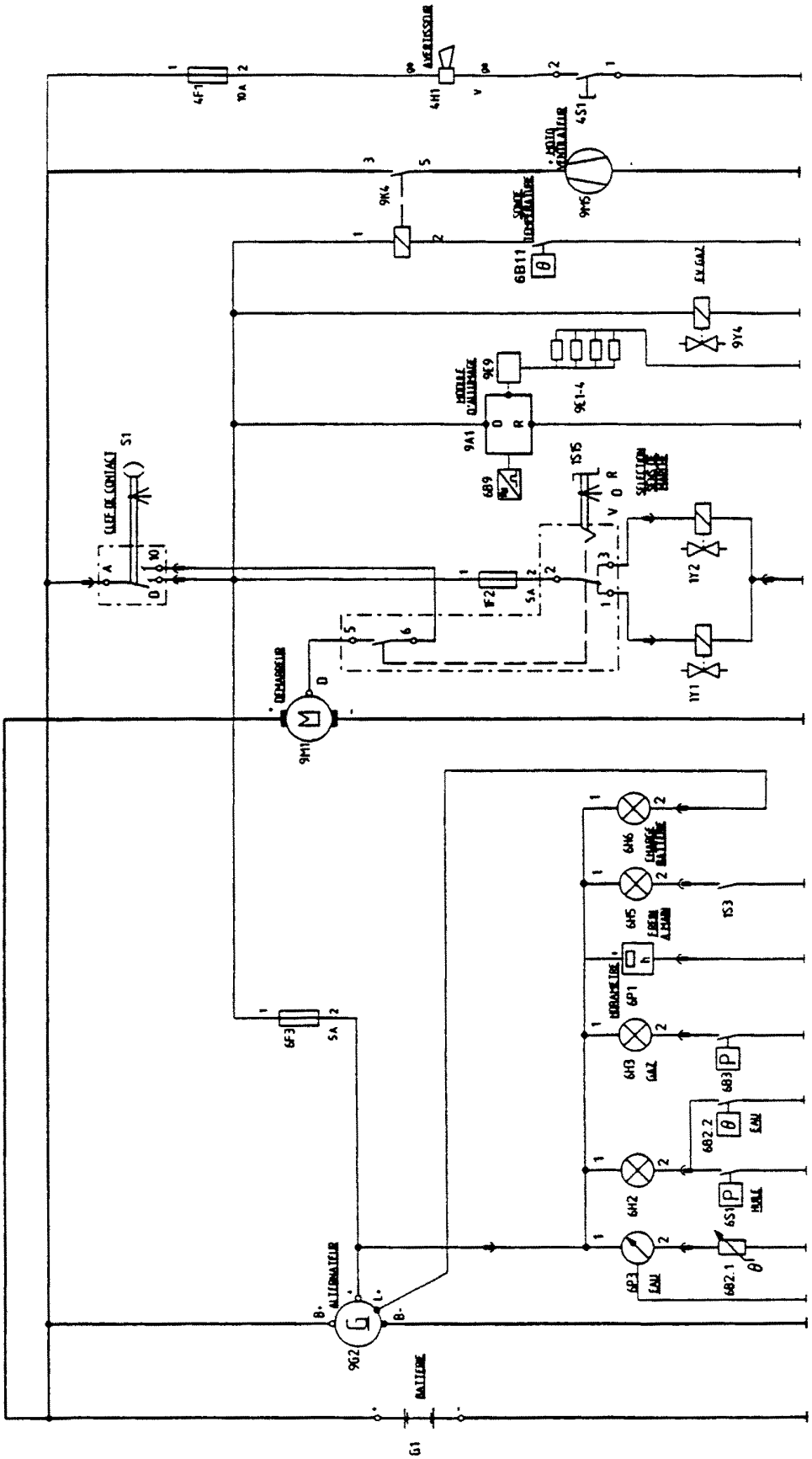
Wiring diagram* for LPG model

*** From truck n° 161335 onwards**



Wiring diagram (LPG)*

*** applies from serial number 717117004000**



Wiring diagram for LPG model

Legend to the diagram

NOTE
Components in the legend are not installed in all trucks.

1	Connection for optional equipment
2	Connection for optional equipment
3	Connection for optional equipment
9A1	Ignition control unit
6B2	Coolant temperature switch
6B2.1	Coolant temperature sending unit***
6B2.2	Coolant temperature switch***
6B3	LPG level sending unit
6B9	RPM sensor
6B11	Fan thermostat
9E1	Spark plug
9E2	Spark plug
9E3	Spark plug
9E4	Spark plug
9E5	Distributor
9E9	Distributor***
1F2	Fuse, control circuit***
1F11	Fuse, control circuit
4F1	Fuse for 4H1
6F1	Fuse for indicator lights
6F3	Fuse for indicator lights***
G1	Battery
9G2	Alternator
4H1	Horn
6H1	Coolant temperature light
6H2	Oil pressure warning light
6H2	Oil pressure/coolant temperature warning light***
6H3	LPG level light
6H5	Parking brake warning light*
6H6	Battery charge light**
9K4	Relay for fan motor
9M1	Starter
9M5	Fan motor
6P1	Hour meter
6P3	Coolant temperature gauge***
6P11	Ammeter
6P15	Coolant temperature gauge**
S1	Key switch
1S3	Parking brake switch*
1S15	Travel direction switch forward/ reverse
4S1	Horn push
6S1	Oil pressure switch
1Y1	Travel direction control valve, forward
1Y2	Travel direction control valve, reverse
9Y4	Solenoid shutoff valve

Colour code

bc	white
bu	blue
g	gray
j	yellow
m	brown
n	black
r	red
v	green
vi	violet

* from serial number 160317
** from serial number 160575
*** applies from serial number 717117004000 (LPG)

Battery

The electrolyte level must be between the min. and max. marks on the battery case.

If, due to evaporation, the electrolyte level drops below the min. mark, replenish with distilled water only since the acid does not overcharged.

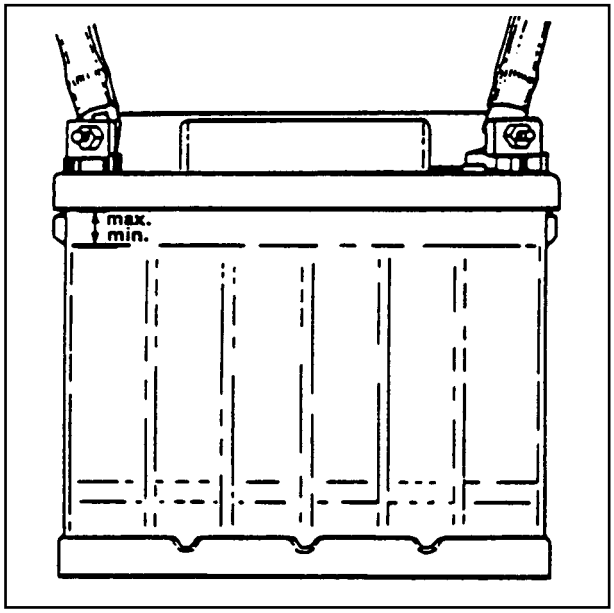


Figure 08-1

The specific gravity of the electrolyte (kg/l) changes with the charging state of the battery.
For a fully charged battery = 1.28 kg/l.
For a discharged battery = 1.14 kg/l (must never drop below this value).

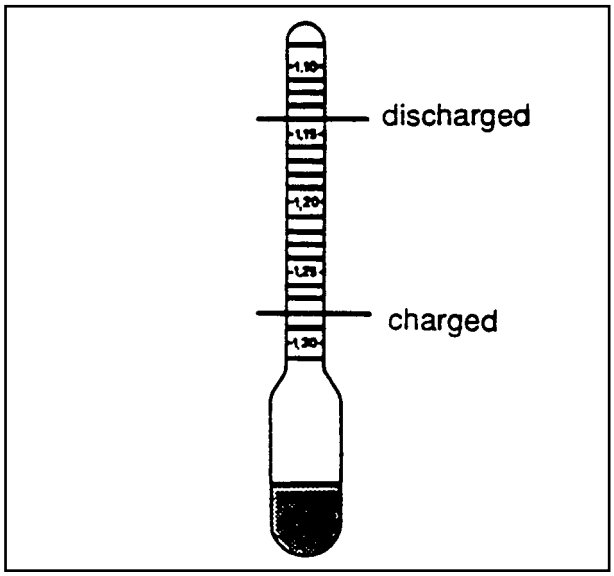


Figure 08-2

The specific gravity of the electrolyte in each cell is always given for a temperature of 30°.

The density of a cell rises by 0.0007 if the temperature drops 1°C, and conversely it drops by the same amount for each increase in temperature by 1°C.

The specific gravity of the electrolyte is measured with a hydrometer.

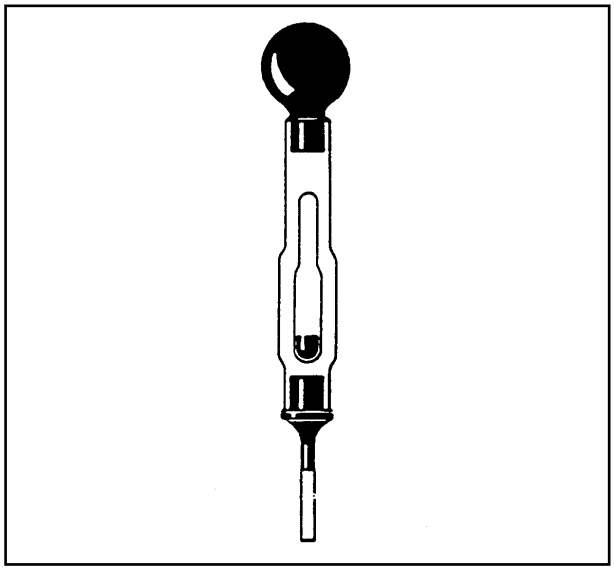


Figure 08-3

A hydrometer consists of a glass with a rubber ball for drawing in the electrolyte and a float with a calibrated scale allowing a direct reading of the specific gravity.

During the charging procedure, it takes considerable time for the electrolyte above the plates to reach the same density as the electrolyte between and inside the plates.
The measurement should therefore be performed about 30 minutes after charging is completed.
Make sure that the float in the glass is floating freely, i.e. that it does not hang on or touch the rubber ball.

A charged battery will reach its full capacity at 27°C. The capacity is lowered by 1 % if the temperature drops 1°C. This means that at 0°C the battery will suffer a loss of 27 % or, stated differently, only 73 % of its rated capacity is available.

Electrical equipment in the counterweight

Mounted in the counterweight are the battery (1) - the same type as the former M15 model - the fuse box (4) and the relay (3) for the fan.

The battery is provided with 2 screw-type terminals (2) for disconnecting the battery. The wiring harness is protected with annular sleeves and individual cables are marked. A wiring harness is fitted to the hydraulic oil reservoir with an angle.

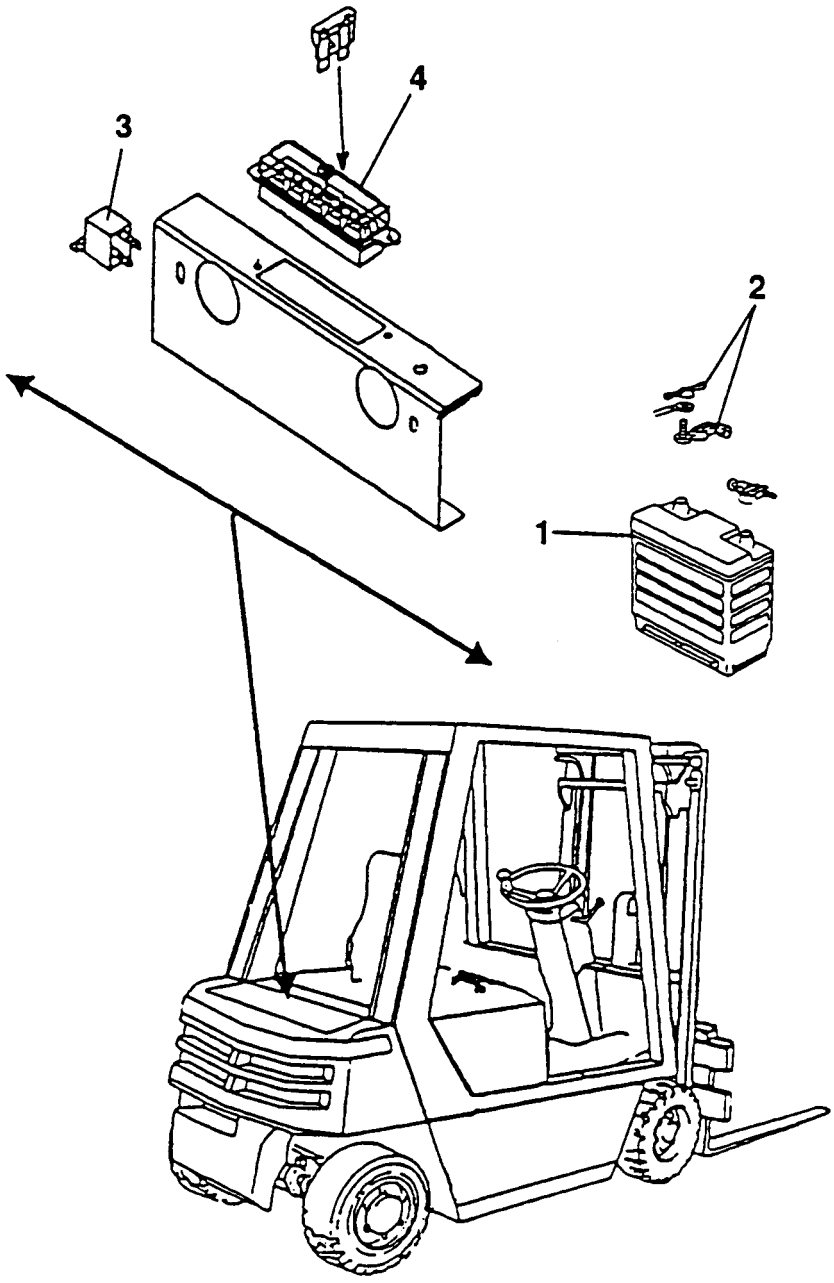


Figure 08-4

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View of driver's station

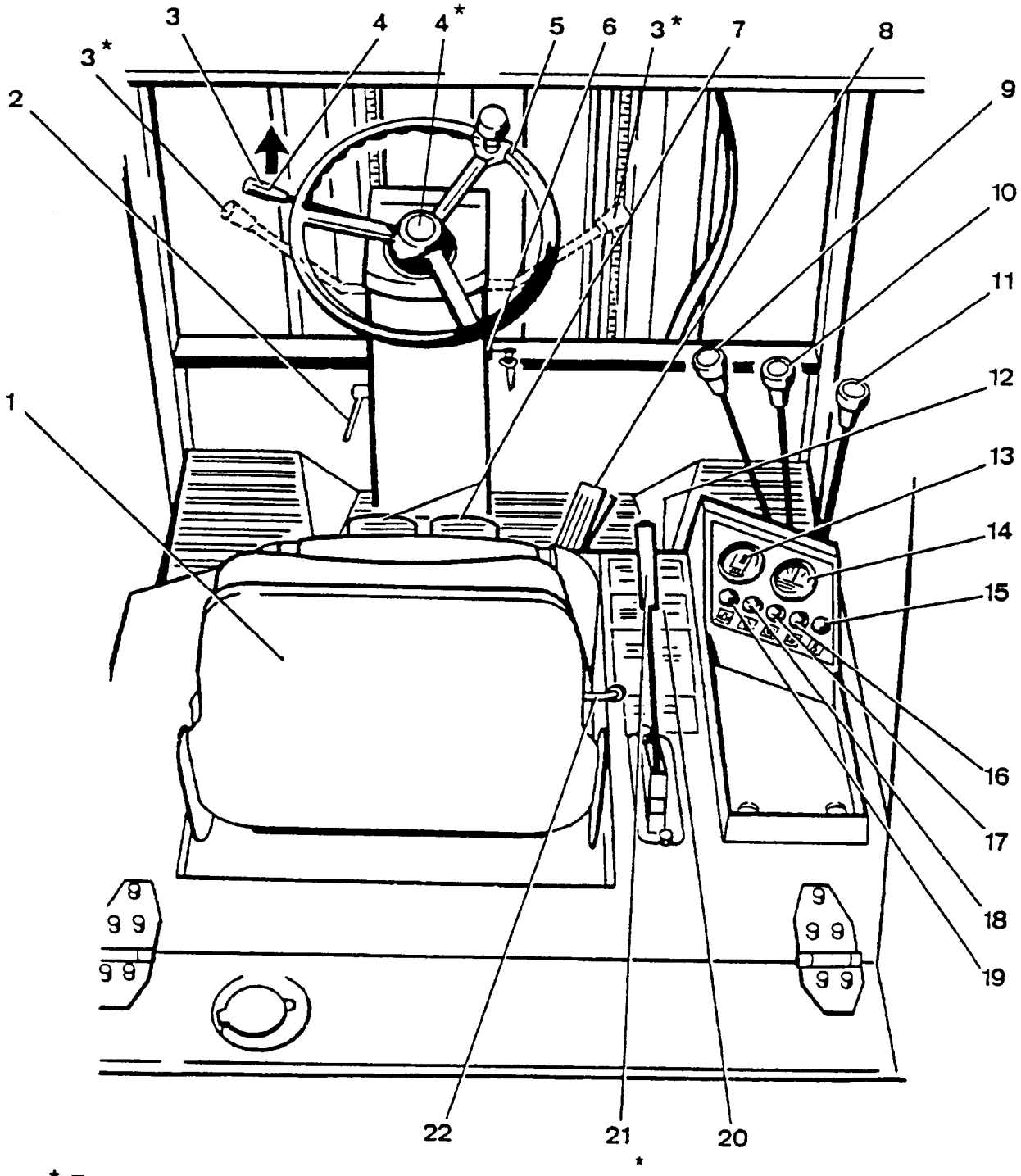


Figure 09-1

Legend

1 Driver's seat
2 Steering column adjustment lever
3 Direction selector lever
4 Horn button
5 Steering wheel with spinner knob
6 Key switch
7 Brake pedal/inching pedal
8 Accelerator pedal
9 Lift/lower lever
10 Tilt lever
11 Attachment lever
12 Type plate
13 Hour meter
14 Ammeter
14 Coolant temperature gauge**
15 Pre-heat indicator light - Diesel version
16 Parking brake indicator light*
17 Fuel reserve warning light
18 Battery charge indicator light**
19 Engine oil pressure warning light
20 Load capacity plate
21 Parking brake lever
22 Seat control lever

* From series no. 160317 - LPG
From series no. 160305 - Diesel

** From series no. 160613 - LPG
From series no. 160575 - Diesel

View of driver's station*

* applies from serial nos. 717111004000 (Diesel) and
717117004000 (LPG)

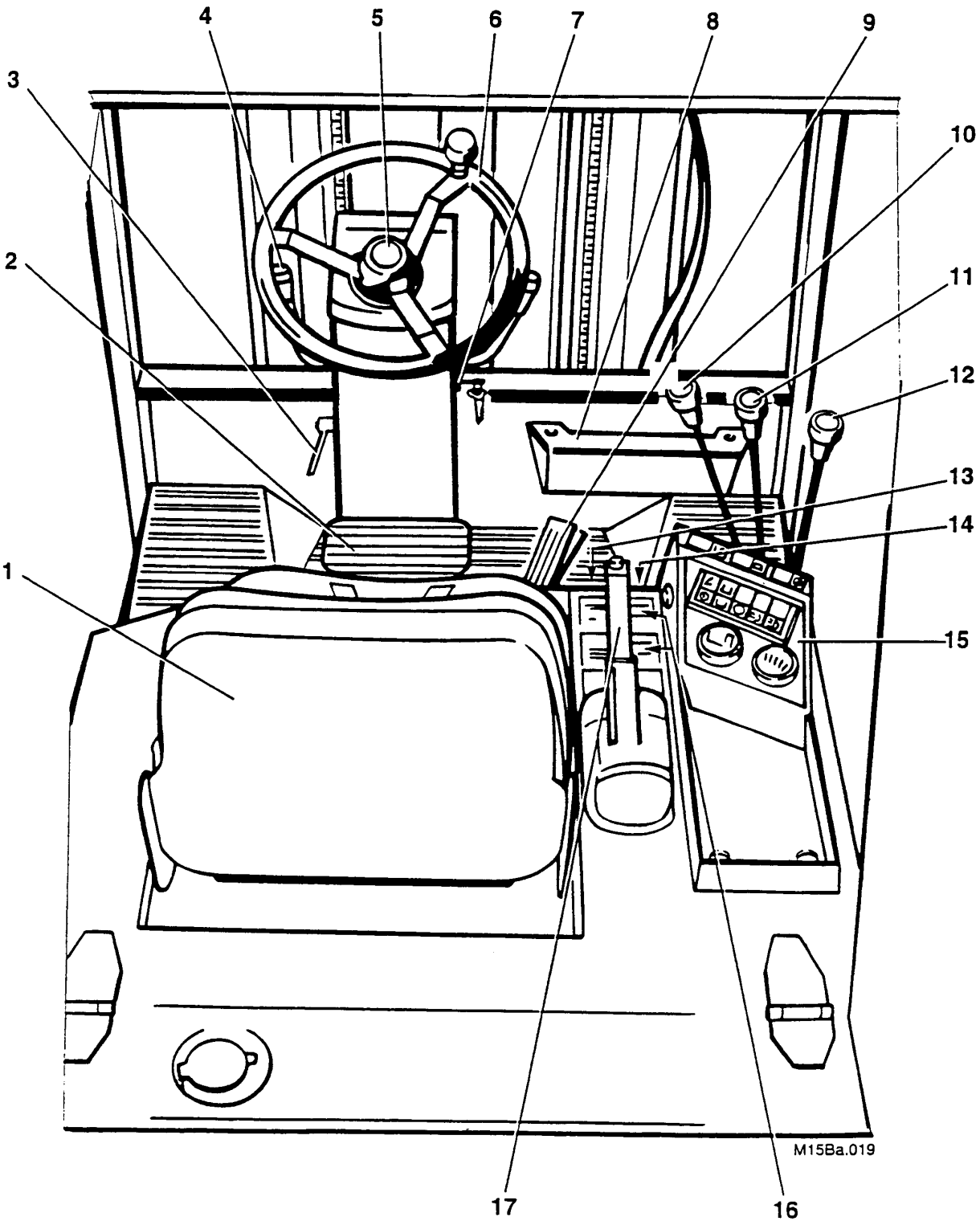


Figure 09-2

Driver's station*

1 Driver's seat
2 Brake pedal/inch pedal
3 Steering column adjustment lever
4 Direction selector lever
5 Horn button
6 Steering wheel with spinner knob
7 Key switch
8 Tray
9 Accelerator pedal
10 Lift / lower lever
11 Tilt lever
12 Attachment lever (option)
13 Engine bonnet lock
14 Type plate
15 Instrument panel
16 Load capacity plate
17 Parking brake lever

* applies from serial nos. 717111004000 (Diesel) and
717117004000 (LPG)

Instrument panel*

* applies from serial nos. 717111004000 (Diesel) and
717117004000 (LPG)

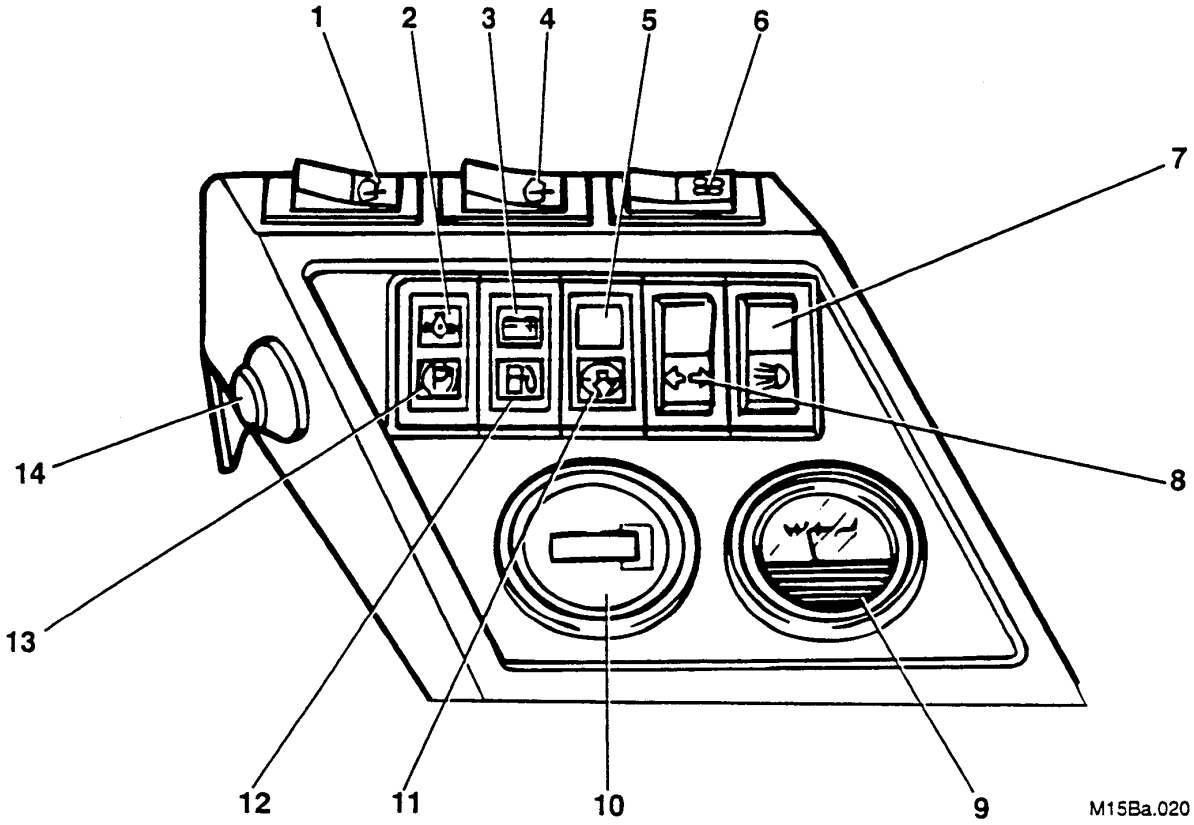


Figure 09-3

Instrument panel**

1 Front wiper switch*
2 Oil pressure/coolant temperature warning light
3 Battery charge indicator light
4 Rear wiper switch*
5 Free
6 Fan switch*
7 Light switch*
8 Turn signal switch*
9 Coolant temperature gauge
10 Hour meter
11 Air filter restricted warning light*
12 Fuel level warning light
13 Parking brake warning light
14 Hazard warning light switch*

* Option

** applies from serial numbers 717111004000 (Diesel) and
717117004000 (LPG)

Wiring diagram for optional equipment

* Modifications reserved

Legend

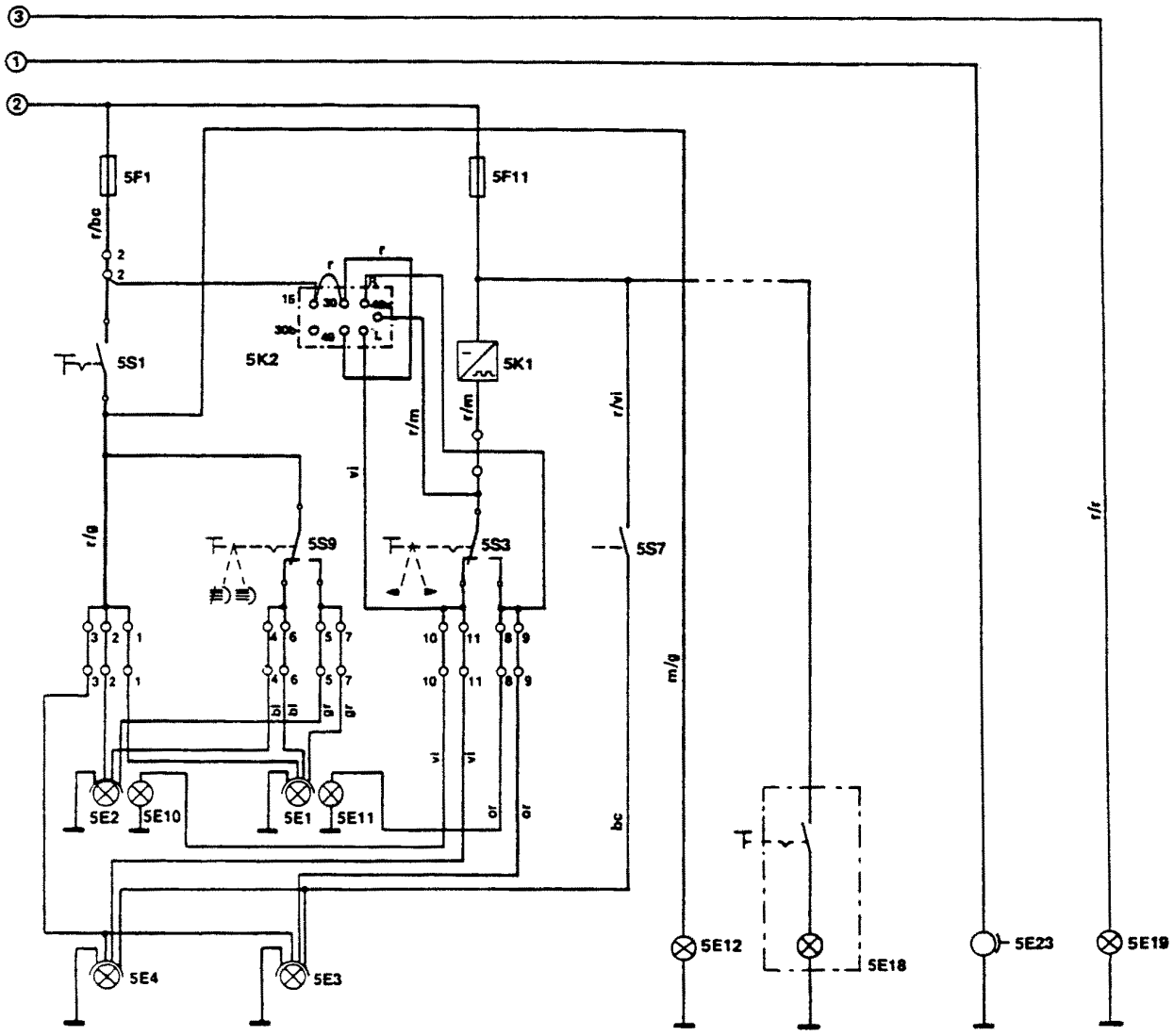
NOTE
Components listed in the legend are not installed in every truck.

5E1 Headlight, right
5E2 Headlight, left
5E3 Taillight, right
5E4 Taillight, left
5E10 Flasher, front left
5E11 Flasher, front right
5E12 Number plate light
5E18 Searchlight, left
5E19 Back-up light
5E23 Hazard warning light

5F1 Fuse for low beam
5F11 Fuse for flashers

5K1 Directional/hazard warning flasher relay
5K2 Warning relay

5S1 Light switch
5S3 Flasher switch
5S7 Stop light switch
5S9 Switch for high beam



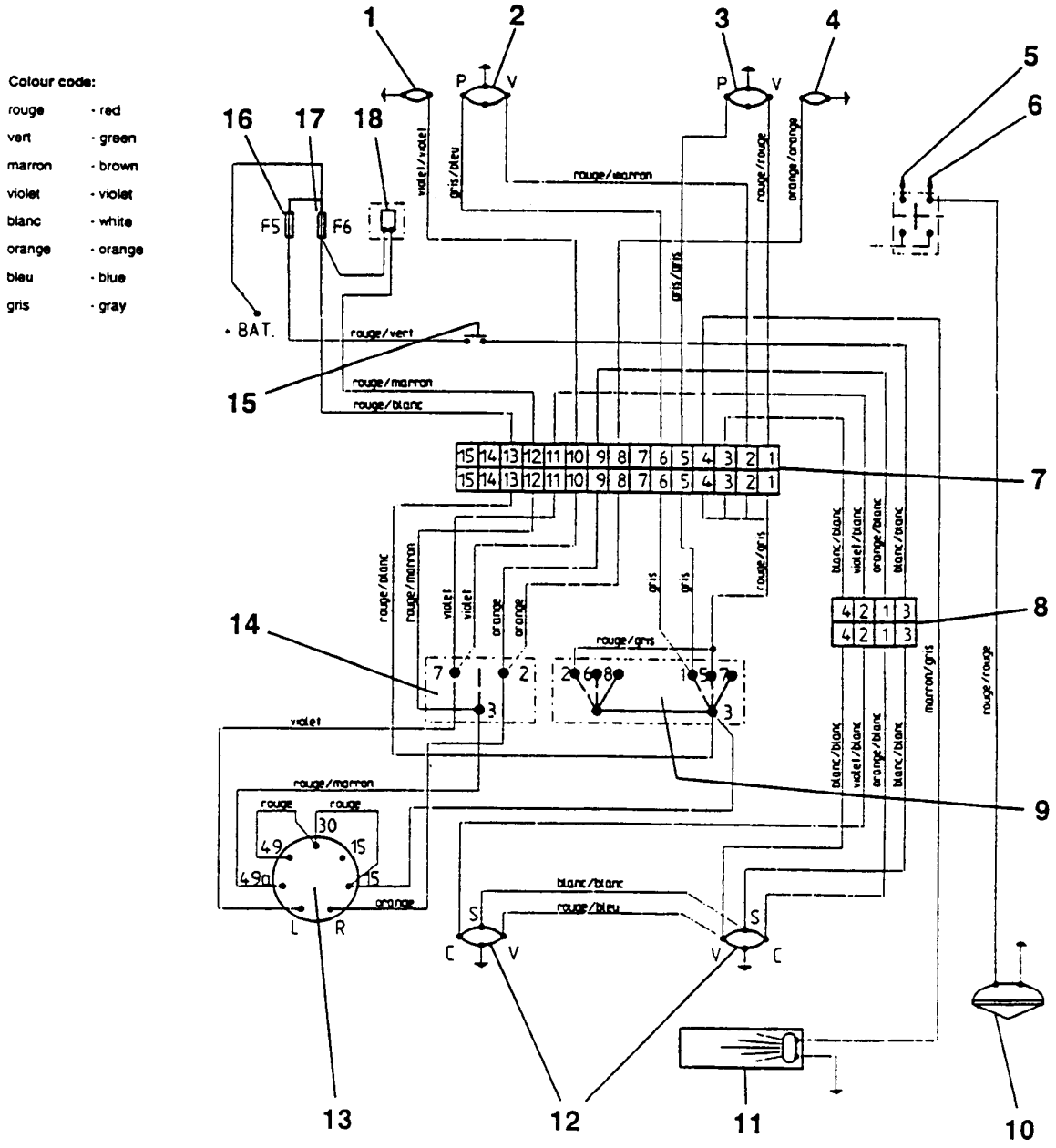
Wiring diagram* for optional equipment

* applies from serial numbers 717111004000 (version Diesel)
717117004000 (LPG)

** Modifications reserved

Legend

1 Turn signal, left
2 Headlight, left
3 Headlight, right
4 Turn signal, right
5 Direction selector switch, forward
6 Direction selector switch, reverse
7 AMP connector, 15 pins
8 AMP connector, 4 pins
9 Light switch
10 Back-up light
11 License plate light
12 Tail lights
13 Hazard warning light
14 Turn signal/hazard warning light relay
15 Stop light switch
16 Fuse F5
17 Fuse F6
18 Flasher relay



Hour meter

The hour meter is supplied with DC voltage. It is quartz controlled and has a digital indicator.

Operating voltage : 12 to 24 V.

The hour meter indicates the number of service hours.

It operates only if the key switch is on.

Oil pressure indicator

The indicator lamp (12 V, 0.1 A) lights if the key switch is in position "ON". It must extinguish when the engine is running.

LPG reserve warning light

The indicator lamp (12 V, 0.1 A) lights if the pressure in the gas cylinder drops below 2.5 bar.

Diesel fuel warning light

The indicator lamp (12 V, 0.1 A) lights if the fuel level in the tank is below approx. 1.5 L.

Coolant temperature gauge**

The gauge indicates the coolant temperature when the key is in the ON position or the engine is running.

NOTE : Replaces the ammeter

* From series no. 160317 - LPG version
160305 - Diesel version

** From series no. 160613 - LPG version
160575 - Diesel version

Ammeter

The ammeter indicates the current supplied by the battery (negative indication) and by the alternator (positive indication). After the engine has started, the needle must be in the positive range and when driving it should return to 0.

Parking brake control light*

The indicator lamp (12 V, 0.1 A) lights when the parking brake is applied and the key switch is turned to the ON position.

Preheating indicator for Diesel engine

The indicator lamp (12 V, 0.1 A) lights when the key switch is turned to the ON position. The lamp goes off after 6 to 7 seconds ; the negine can then be started.

(See group 15)

Battery discharge indicator light**

The 12 V, 0.1 A warning light illuminates when the key is in the ON position.
It should extinguish when the engine is running.

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* Applies to old M15 model to serial numbers 162xxx

** Applies to new M15 model from serial numbers 717111004000 (Diesel) and 717117004000 (LPG)

Technical data

Hydraukic pump	
Flow rate	12 cc/rev
Rotation	CW (marked with arrow on pump)
Torque of mounting screws	50 + 10 Nm
Control valve	
Pressure relief	setting = 210 bar* ; 230 bar
Torque of mounting screws	15 Nm
Thread of connectors	P, A, B = G 3/8 ; T = G 1/2
Oil filter in the supply circuit	
Filter mesh	25 µm (nominal)
Hydraulic oil tank	
Oil quantity	30 l
Hydraulic oil	Grade to ISO VG 46 HM
Priority valve	
Manufacturer	Danfoss
Type	OLS 40 - 152B8017* ; OLS 40 - 152B0233
Pressurisation	4 bar

* Applies to new M15 model from serial numbers 717111004000 (Diesel) and 717117004000 (LPG)

Hydraulic system
Method of operation of lift and tilt hydraulics

The oil in the reservoir (1) is drawn into the gear pump (2) via filter (3). The pump delivers this oil under pressure to the hydraulic control valve (4) via the priority valve. The oil enters in the hydraulic control valve at port (P). If the spools are in the neutral position or only moved slightly, the oil leaves the control valve at port (R) and returns to the tank.

The quantity of oil flowing through the control valve depends on how far the spool is moved. The oil leaving the valve through port (B) goes to the lift cylinders (6) and through port (C) or/and (D) to the tilt cylinders (5).

A throttle installed in the port reduces the amount of oil flowing to the tilt cylinders. The excess oil to the tilt cylinders returns through the return lines to the tank.

The control valve contains a pressure-relief valve which protects the circuits against hydraulic overloads.

The slow lowering valve (7) limits the load lowering speed and the safety valve (8) protects against possible breaks in the hydraulic lines.

Also see group 20.

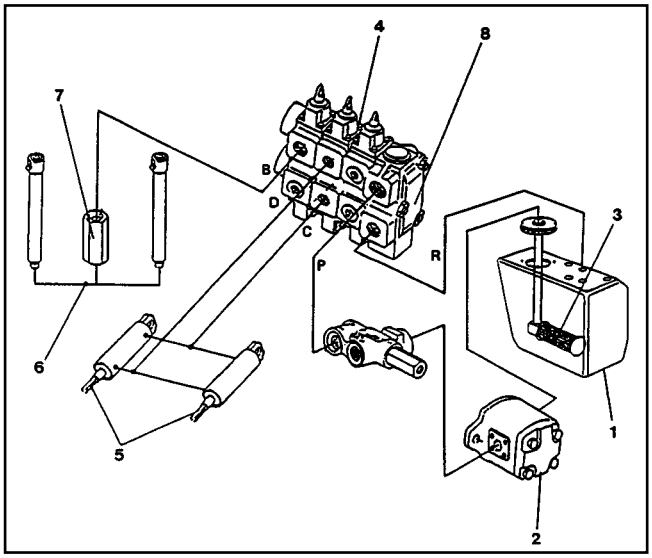


Figure 10-1

Control valve

Technical data :

Circuit	parallel
Flow rate at Δp = 5 bar	40 L/min
Valve pressure	230 bar
	210 - 215 bar*

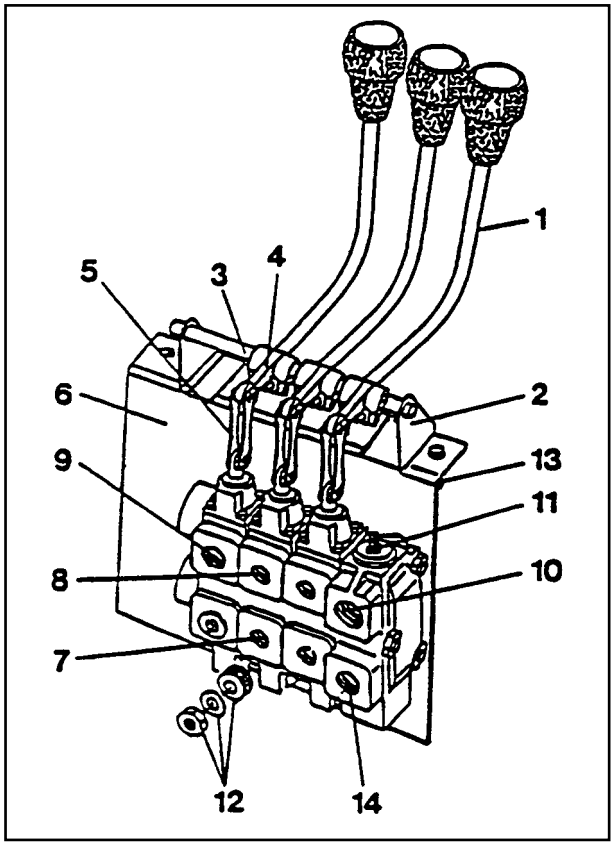


Figure 10-2

Control valve assembly with controls

1 Lever
2 Support for traverse (welded to holder (6))
3 Axle
4 Traverse
5 Linkage
6 Control valve mounting bracket
7 Outlet for tilting forward
8 Outlet for tilting back
9 Outlet for lifting
10 Pressure oil inlet
11 Pressure relief
12 Washer and fastening nut for control valve mounting bracket
13 Fixing pin (welded to mounting bracket (6))
14 return line

* applies for control valves with pilot control

The control valve mounting bracket (6) is fastened to the mounting bracket at the front bonnet by means of two pins (13). A screw and nut (12) fasten the mounting bracket on the bonnet. The bracket can be used for mounting control valves with 2, 3 or 4 sections. A throttle for reducing the oil flow rate is installed in the supply line (8) for tilting the mast back.

There are two types of throttles :
- one for DUPLEX masts
- another for TRIPLEX masts.

Removing the control valve

- Disconnect the hydraulic hoses (mark them first).

- Unscrew the fastening nut (12) for the control valve mounting bracket (6).

- Remove the control valve mounting bracket and control valve.

Installation of control valve

- Installation is the reverse of removal ; observe the torques given in the following table.

Connector	Torque
Connector at outlet 9	50 Nm
Connector at outlet 8	50 Nm
Connector at outlet 7	50 Nm
Connector at outlet 10	80 Nm
Connector at outlet 14	50 Nm
Pressure relief 11	20 Nm
Mounting screws (for connecting parts)	15 Nm

Priority valve

Applies to old M15 model up to serial number 162xxx

The control valve regulating the priority of the oil supply is a hydraulic component used to divide the oil delivered by the pump into two streams. A part of the oil goes to the power steering with priority and upon demand. The rest flows to the control valve for the hydraulic functions of the mast (lifting, tilting, etc.)

Method of operation

A compensating spring provides a holding pressure if no oil is supplied to the steering unit, which is closed in the centre position.

When the steering is operated, part of this pressure goes to the valve as "LS" signal. The spool now moves to a position providing enough oil to the steering unit with priority.

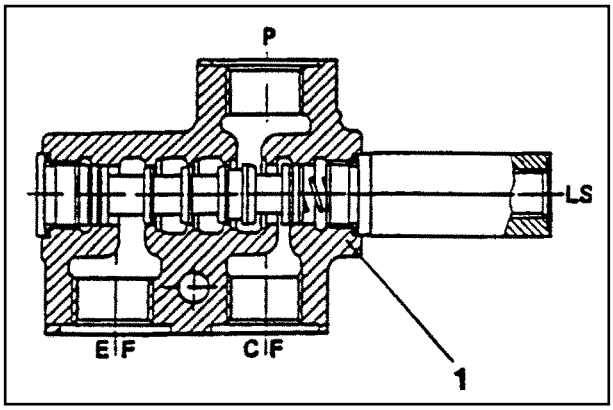


Figure 10-3

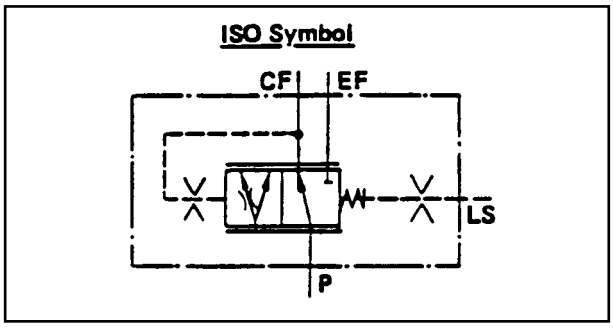


Figure 10-4

Hydraulic pump

Applies to old and new M15 models

Description

Type :	gear pump
Output :	12 cc/rev
Sense of rotation :	CW looking on shaft (arrow on pump)
Drive :	driven by main transmission shaft

Removing the pump

Slacken screws (4) and slightly loosen the intake line (6), then remove the O-ring (8).

Loosen screws (3) and slightly loosen supply lines (5), then also remove the O-ring (7).

Remove the pump mounting screws (10) and take out the pump, then remove the O-ring (9).

After fitting the O-rings correctly, install in the same order as for removal.

NOTE
It is recommended renewing the O-rings to ensure full tightness.

Torque the screws (10) to 48 Nm.

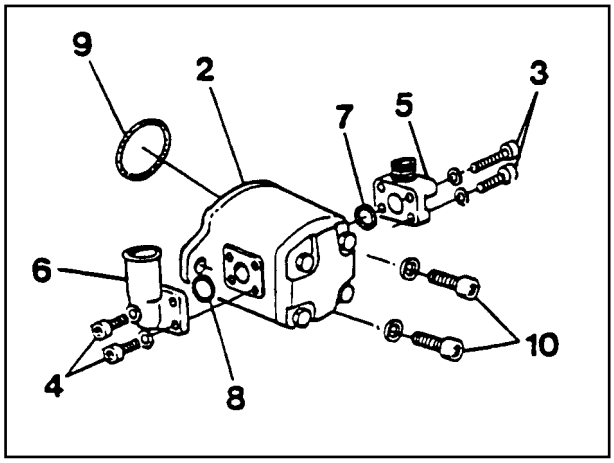


Figure 10-5

Hydraulic diagram*

* Applies to old M15 model up to serial number 162xxx

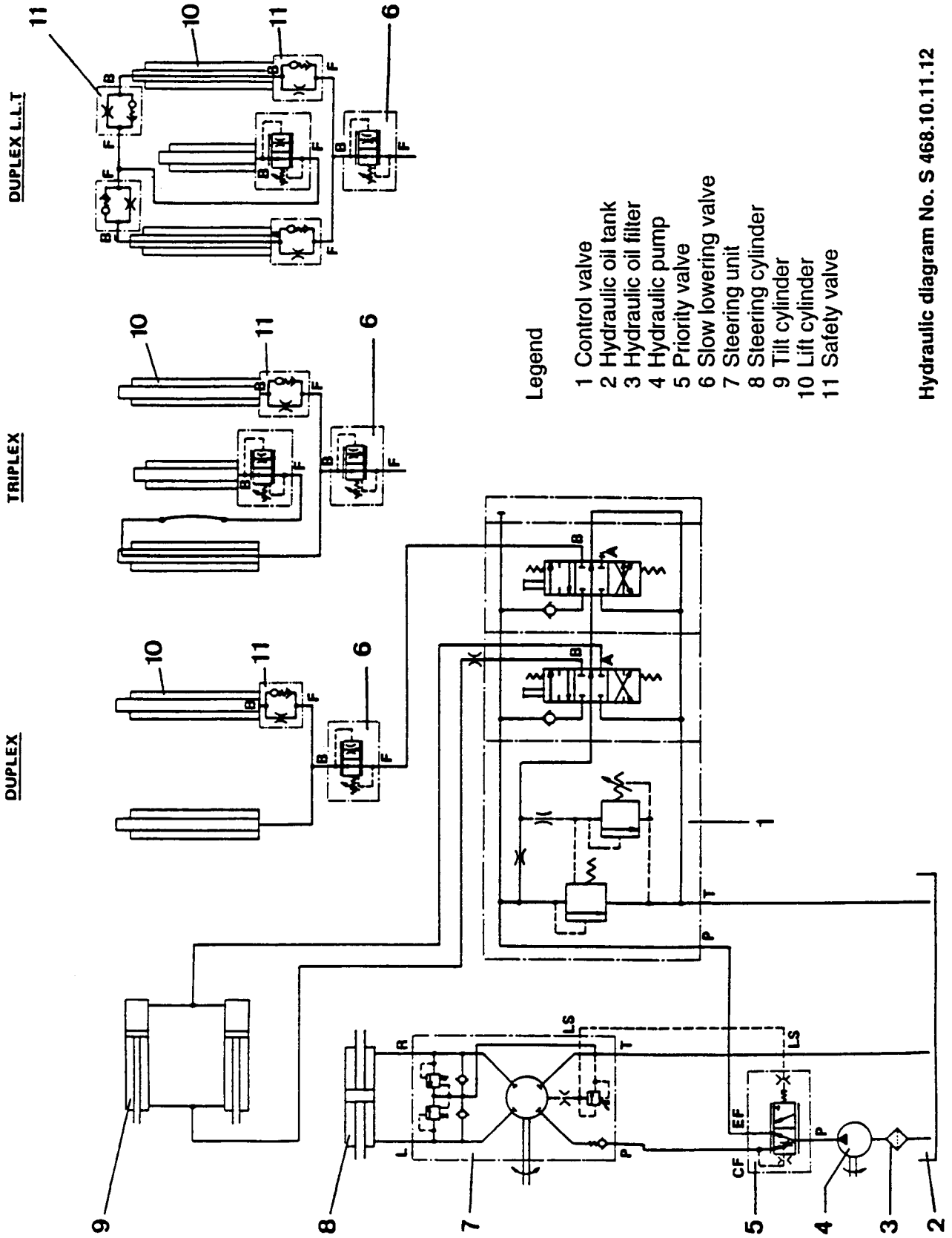


Figure 10-6

* Applies to the M15 models from serial numbers 717111004000 (Diesel) and 717117004000 (LPG)

Priority valve

The priority valve controlling the priority flow is mounted on the transmission with screws.
It is a hydraulic control element whose function is to supply oil to the hydrostatic power steering via a hydraulic priority circuit.

The hydraulic lines must be connected to the priority valve with the following torques.

CF = *80 Nm*
EF = *80 Nm*
P = *80 Nm*
LS = *45 Nm*

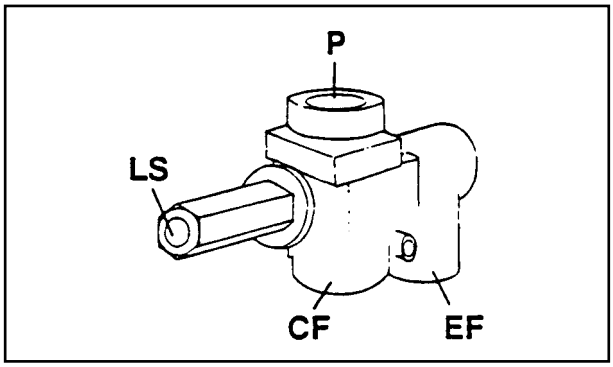


Figure 10-7

Disassembly of the priority valve

If dirt has entered into the hydraulic circuit, it can impair the proper operation of the priority valve. If the movement of the spool (3) in the valve housing is reduced, hard steering will result.

1 = Plug
2 = Ring
3 = Spool
4 = Pressurising spring
5 = Plug for LS port
6 = Valve housing

- Remove plug (1) and the plug at the LS port (5).
- Remove the spool.
- Clean all parts and then blow out with compressed air.

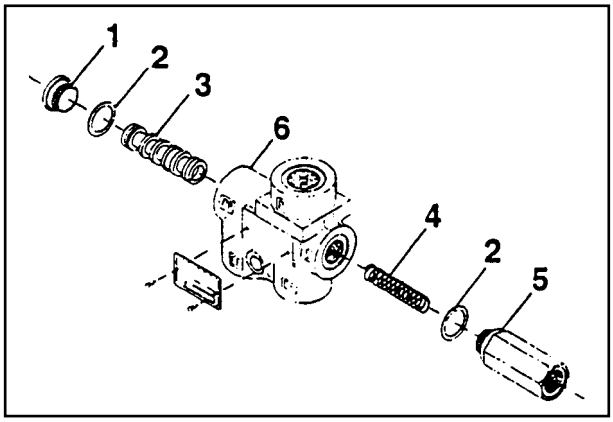


Figure 10-8

Assembly of the priority valve

Assembly all parts in the reverse order of disassembly.
Observe the torque of **50 Nm** for the plugs (1 and 5).

ATTENTION
The LS swivel connector must be removed after each servicing in order to be able to purge the hydraulic circuit. Then torque it to 45 Nm.

Control valve with pilot control

Method of operation

If a spool is moved only slightly, the oil entering via port "P" flows with negligible pressure back to the tank via the return line opening (6).
Moving the spool further reduces the size of the return line opening and the hydraulic oil, whose quantity depends on the position of the spool, flows to the cylinders.
When a cylinder reaches the end of stroke and the pump pressure reaches the pressure setting of the pressure-relief valve, the latter is activated and the oil returns to the hydraulic oil tank.

Control valve with pilot control (4)

The control valve in the way valve prevents the mast from tilting forward inadvertently.
Tilting forward is only possible when pressure is increased via port "A3". This unlocks the valve hydraulically, allowing the oil in the chambers ahead of the tilt cylinders to return to the hydraulic oil tank via port "B3".

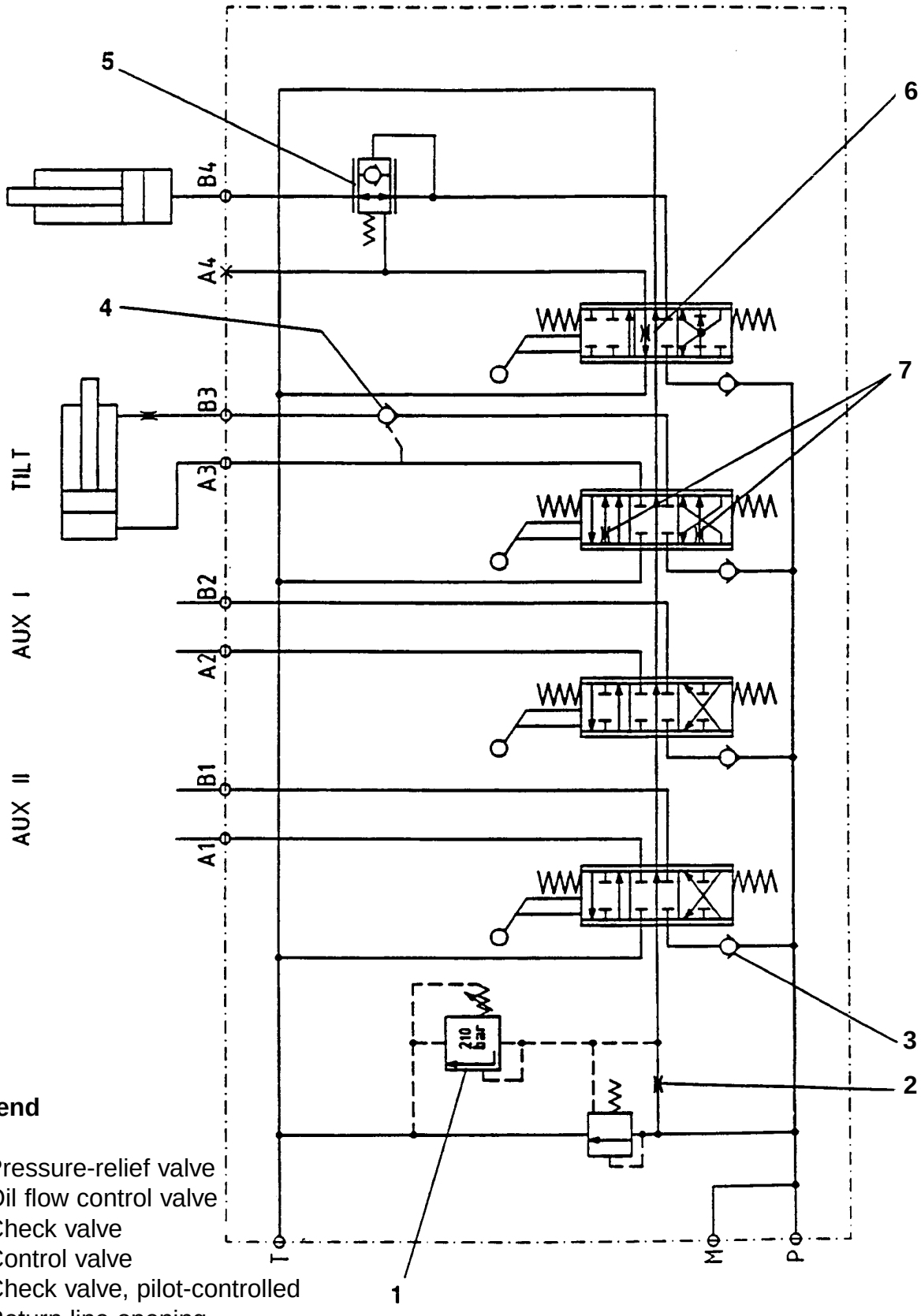
Check valve (5)

The check valve installed in the way valve prevents the load from lowering inadvertently when the spool is in the neutral position.

Tilt cylinder circuit

When the engine is idling (780 RPM), pump output is approx. 10 l/min with the valve in the neutral position.
If the tilt valve is operated fully in either direction, engine speed is reduced and a small amount of oil continues to flow through one of the 2 openings (7) to the hydraulic oil tank. This prevents the engine from stalling.

hydraulic diagram
Control valve with pilot control



Legend

1 Pressure-relief valve
2 Oil flow control valve
3 Check valve
4 Control valve
5 Check valve, pilot-controlled
6 Return line opening

Lifting/lowering function

1) Lifting

If the spool (1) is moved down, the oil from the pump first flows via the spool to the check valve (2).
From there the oil goes via control valve (3) to port "B" and then finally to the lift cylinder.
At the same time, spring (4) is compressed by the plunger (F).

2) Neutral point

When the lift function is no longer required :
- the spool (1) returns to the neutral position (see illustration),
- the check valve (2) is pressed into the valve seat by the spring (5),
- the control valve (3) is by pressed into the valve seat by the force of spring (7) and the pressure in chamber (9) applied through opening (8).

No oil can flow now. This increases the tightness of the system and reduces internal oil leakage.

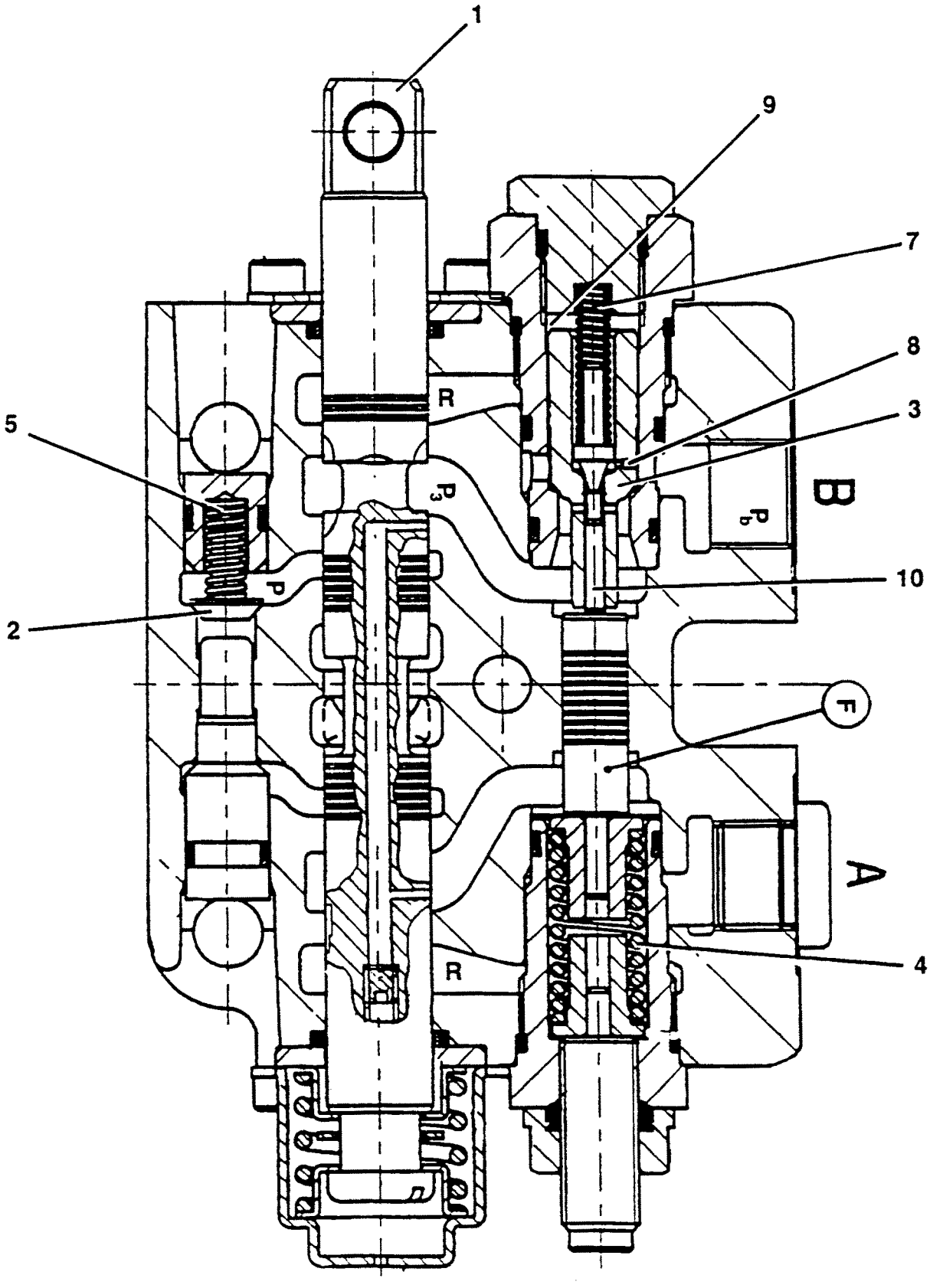
3) Lowering

If the spool is moved up :
- the pressure at P3 is reduced through the oil return to the hydraulic tank,
- plunger F applies pressure to pin (10) of the control valve via the spring (4),
- simultaneously the oil flows out of chamber (9), which allows valve (3) to open slowly, permitting the oil in the cylinders to return to the hydraulic oil tank (R).

Legend

1 Spool
2 Check valve
3 Pilot-controlled valve
4 Spring
5 Spring
7 Spring
8 Opening
9 Chamber
10 Pin

Cross section of lifting valve



Tilting back function

If the spool (1) is moved down, the oil from the pump first flows to the check valve (2), then it flows via the spool to the control valve (3). This valve opens due to the pressure, allowing hydraulic oil to flow to port B (cylinder oil supply). The return oil flows through A now and depending on the position of the spool (1) the oil flows back to the hydraulic oil tank.

At the neutral point, the load pressure is added to the force of the spring (5) and it causes the valve (3) to remain closed (anti-tilt device).

The check valve (2) is also pushed back into the valve seat by the force of the spring (4).

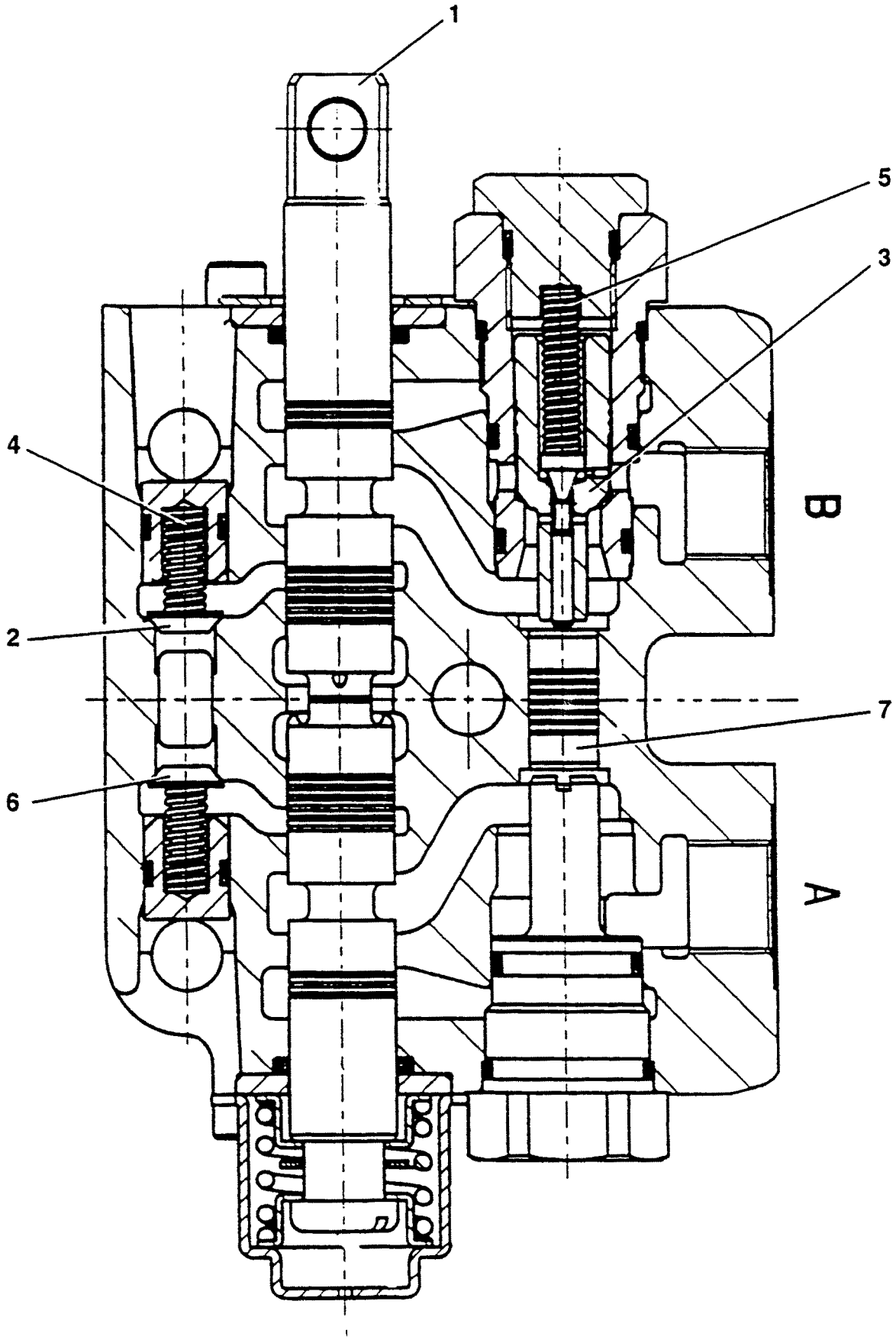
Tilting forward

When the spool (1) is moved up :
- the check valve (6) is actuated so that the oil can flow via the spool to port "A",
- the piston (7) is operated, which in turn moves the control valve (3) allowing the oil to return to the hydraulic oil tank (same control principle as for lifting).

Legend

1 Spool
2 Check valve
3 Control valve, pilot-controlled
4 Spring
5 Spring
6 Check valve
7 Piston

Cross section ot tilting valve



Hydraulic diagram

* Applies to M15 models from serial number 717111004000 (Diesel) and 717117004000 (LPG)

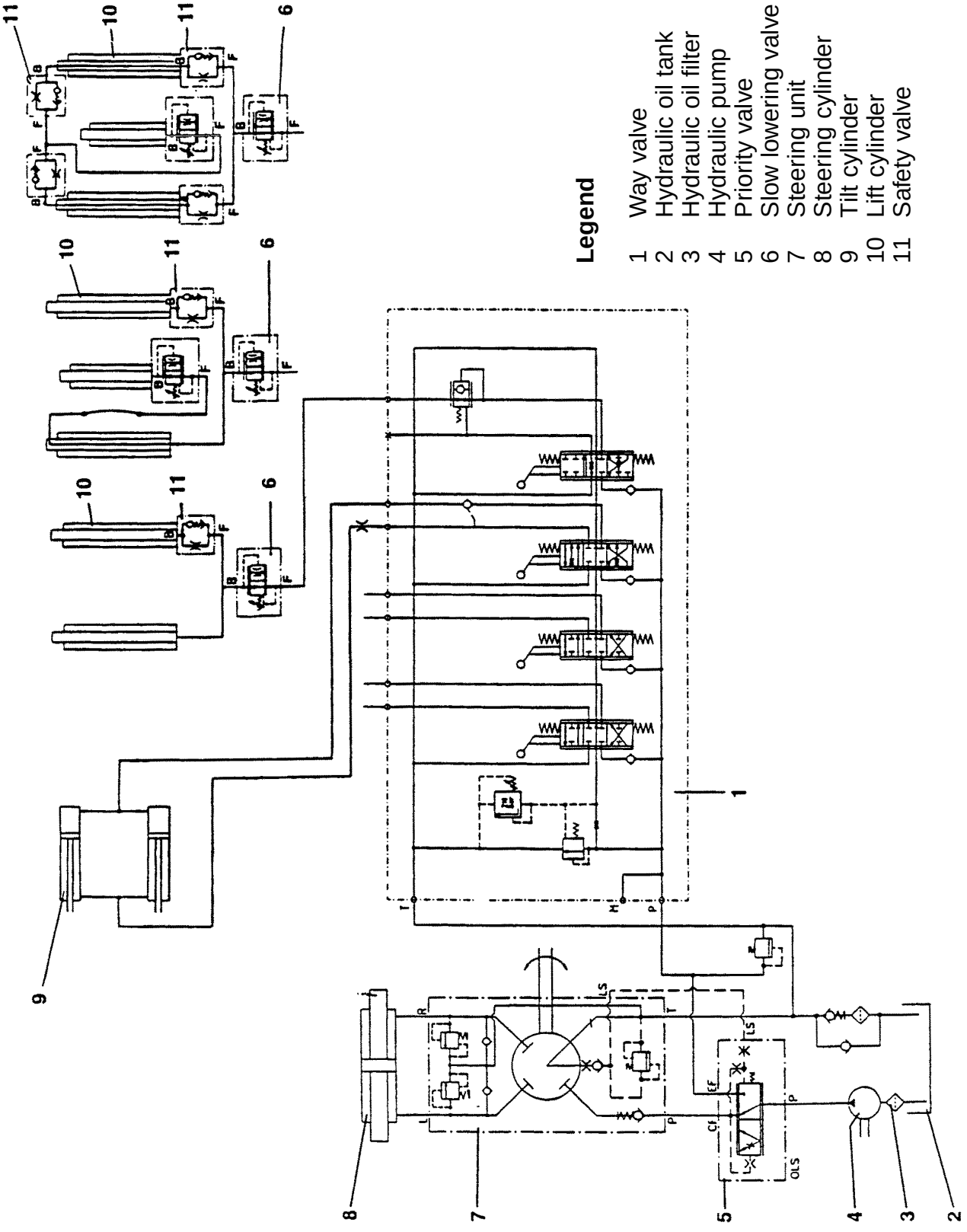


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Important :

Unless shown otherwise, all dimensions are in millimetres.

Symbols used in this section :

 : Exhaust

 : Inlet

 : Production dimension

 : Repair dimension

Technical data for maintenance

Assembly group 15	**Applies to :**
Diesel engine	
Make : PEUGEOT Model : XUD9	
Cubic displacement ccm	1905
Power KW / (HP to DIN) 70020 Maximum speed : RPM	39.8 (54) 2900
Bore : mm	83
Stroke : mm	88
Firing order	1 - 3 - 4 - 2
Direction of rotation seen from flywheel	anti-clockwise
Coolant capacity : l	8
Coolant capacity engine only : l	4.8
Oil capacity with the filter change : l	5.2
Fuel injection pump / Roto-Diesel - Lucas	DPC R 8443 B 900 A
Set value	indicated on pump
Injectors / Roto-Diesel	RDNOSDC 6751
Injection pressure : bar	115 ± 5
Compression ratio	23.5 to 1
Max. torque : Nm / RPM	120 / 2200
Engine dry weight with flywheel, alternator and starter : kg	136

Technical data for maintenance

Assembly group 15 **Diesel Engine**	**Applies to :** **XUD9**
Idle speed : RPM	780 ± 25
Max. no-load speed : RPM	2900
Fuel	Diesel
Fuel tank capacity : l	16
Electrical system	12 V
Starter	12 V
Alternator	12 V 55 A
Valve gear	belt drive
Compression : bar (engine at operating temperature)	Min : 18 - Normal : 25 to 30 max. deviation between cylinders : 5 bar
Max. coolant temperature	105°C
Thermoswitch	105°C + thermistor
Thermostat	opens at : 81°C fully open at : 93°C
Fuel consumption per kW/h at speed n = 2900 RPM ± 5 %	262 g/kW/h 4/4 full load 322 g/kW/h 1/2 half load

Engine removal

The engine and transmission must be separated after their removal from the chassis.

1. Remove the two brake cylinder screws at the pedal mount.
2. Unscrew the two M12x36 pedal screws at the intermediate piece between engine and transmission, and remove the pedal.
3. Loosen the lower coolant hose clamp at the engine block.
4. Remove the coolant hose.
5. Remove the starter.
6. Unscrew the 4 transmission mounting screws (M8x14) from the connecting plate for flywheel and transmission through the starter mounting opening.
7. Block up the transmission.
8. Remove the 8 M10x40 screws at the transmission with an articulated wrench.
9. Attach a lifting gear at the engine lifting eyes ans separate the negine from the transmission.
10. Installation is the reverse of removal.

Cylinder head

- Cylinder head height **h** is measured with the camshaft in place fitted with two bearing caps.

  h is measured on the oil seal lip contact diameter (the largest diameter).
  h nominal : 157.40 to 157.75 mm

- Maximum permissible bow : **0.07 mm** (the camshaft must turn freely).

- Maximum permissible gasket face machining : **0.4 mm** in relation to the measured h nominal.

- Cylinder heads machined undersize are stamped **R** in area (**a**).

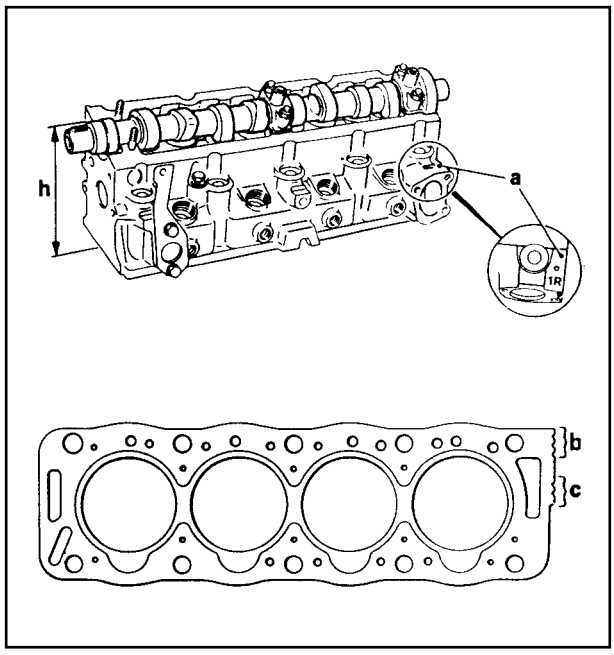


Figure 11-1

- After machining a gasket face, the following operations must be carried out :
  - Valve seat machining to re-establish correct recess.
  - Replacement of the swirl chambers by repair dimension chambers and correction of their protrusion.
  - Fitting of **0.4 mm** thick compensation washers under the valve springs.

- Cylinder heads with oversize camshaft bearings (+ 0.5) are stamped 1 in area (**a**).

Cylinder head gasket

Thickness identification : **(b)**

Engine	Identification **(c)**	Identification **(b)**	Thickness
XUD9..	No notch	2 notches	1.61 mm

	●		⊗
	→I 10/86	I→ 10/86	
1 mini	112.2	112.2	
Ø a 0 0.015	8.005	8.005	7.985
Ø b ± 0.1	36	38,5	33
α	120°	90°	90°

● : Areas **(x)** and **(y)** can be ground 0.2 mm maximum.

⊗ : No grinding of the valve shaft or valve plate.

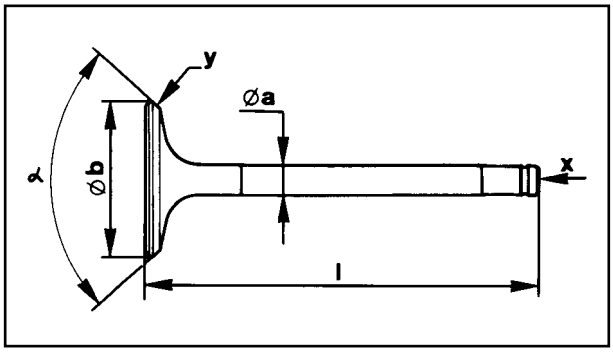


Figure 11-2

Valve recess

	●		⊗	
c	0.5	1.05	0.9	1.45

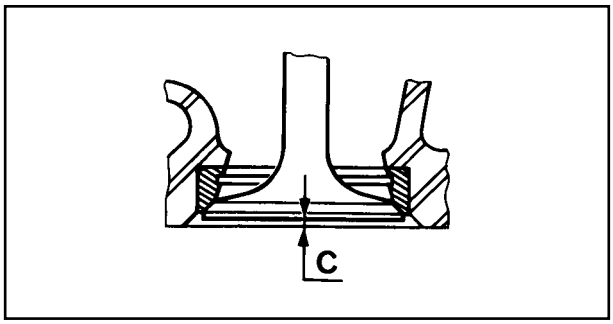


Figure 11-3

Valve springs

	Inner spring	Outer spring
Ø d	19.5	29
P1 : daN e1	8.5 38.4	18 42.4
P1 : daN e2	23.7 29.3	45 33.3

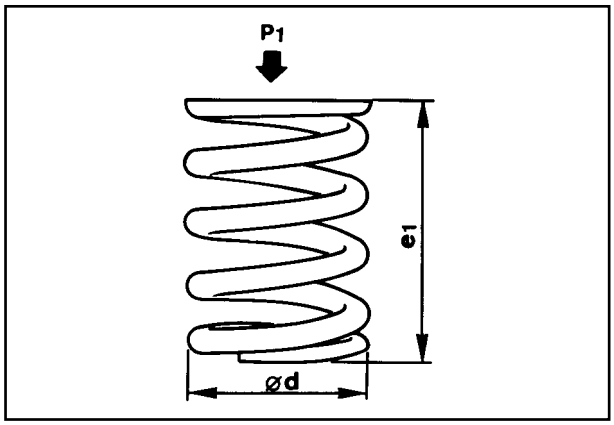


Figure 11-4

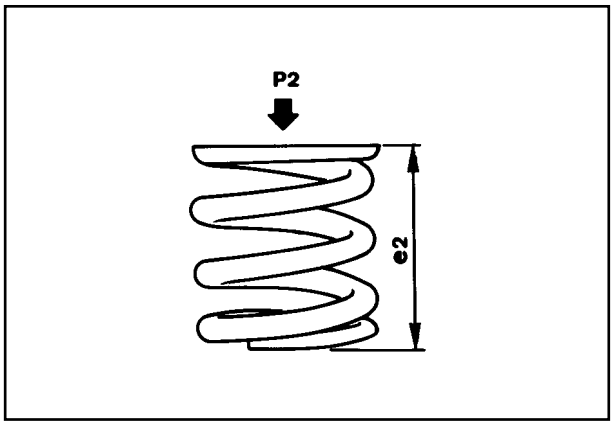


Figure 11-5

Valve guides

	Ø f	Ø g	h	j	Ø k
Tolerance	0 -0.011	+0.032 0	± 0.25	± 0.50	0 +0.2
⊢→ 0	14.02 14.13	13.981 14.051	52.00	36.50	8.02
⌐‾ 1	14.29	14.211			
⌐‾ 2	14.59	14.511			

ϕ **k** is obtained by grinding after fitting in the cylinder head.

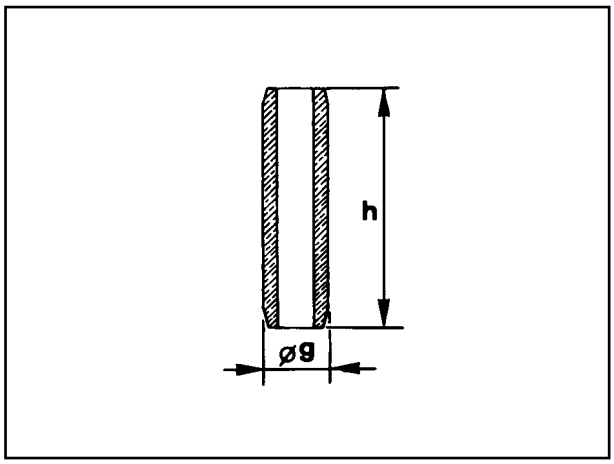


Figure 11-6

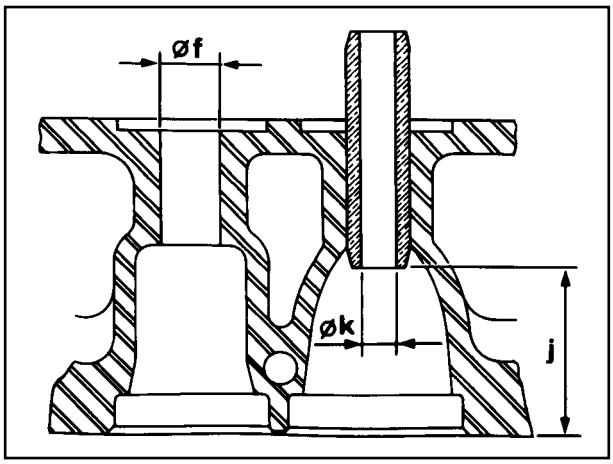


Figure 11-7

Valve seats

●						
	Ø a		Ø b		c	d
	→I 10.86	I→ 10.86	→I 10.86	I→ 10.86		
Tolerance	+0.137 +0.112	0 -0.025	± 0.025		0 -0.1	± 0.15
⊢→ 0	39 39.2	40.161 40.361	39 39.2	40 40.2	6.25 6.45	8.267 8.467
1	39.3	40.461	39.3	40.3	6.45	8.467
2	39.5	40.661	39.5	40.5	6.45	8.467

⊗				
	Ø a	Ø b	c	d
Tolerance	0 -0.025	± 0.025	0 -0.1	± 0.15
⊢→ 0	34.137 34.337	34 34.2	6.05 6.25	8.15 8.35
1	34.437	34.3	6.25	8.35
2	34.637	34.5	6.25	8.35

Grund the valve seats after installation in the cylinder.

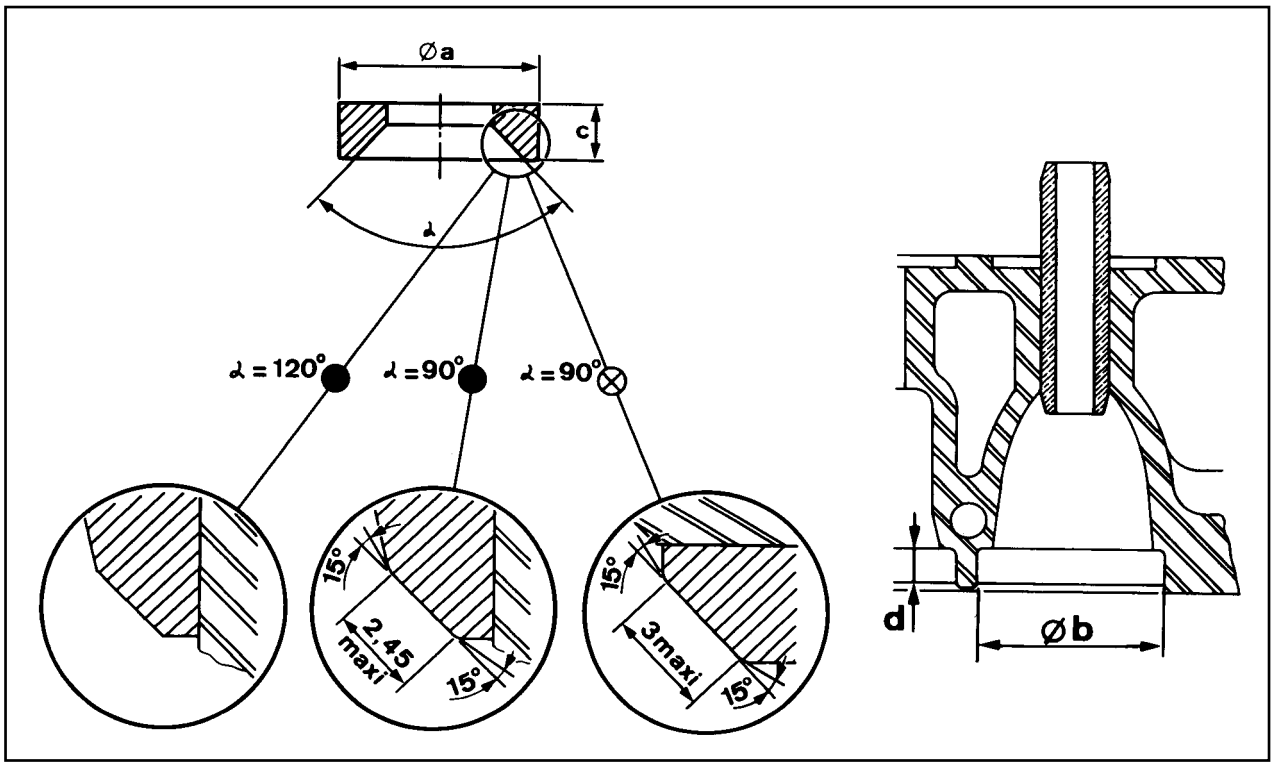


Figure 11-8

Swirl Chambers

	Ø e	Ø f	g	h
Tolerance	+0.099 -0.060	+0.039 +0	+0.020 -0.025	+0.02 -0.04
⊢→ 0	32.05 32.25	32 32.2	4 4.1	3.9 4
⌐‾ 1	32.45	32.4	4.2	4.1
⌐‾ 2	32.65	32.6	4.3	4.2

The protrusion j must be between 0 and 0.03 mm
Dimension j is obtained by machining faces (x) and (y).

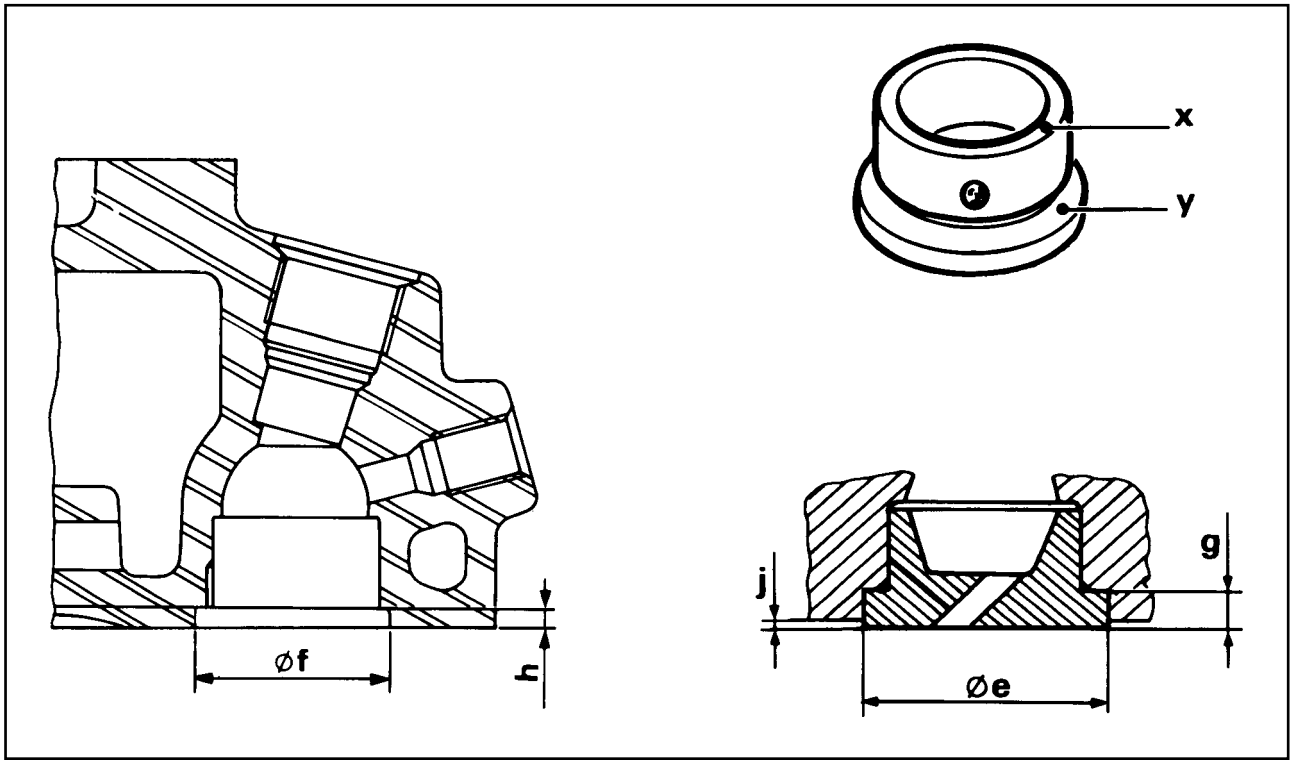


Figure 11-9

		Cylinder Ø a Tolerance : -0/+0.018	Piston Ø b Tolerance : ± 0.009
	Identification (x)	XUD9..	XUD9..
⟼ 0	None	83	82.93
	A1	83.03	82.96
1	R1	83.20	83.13
2	R2	83.50	83.43
3	R3	83.80	83.73

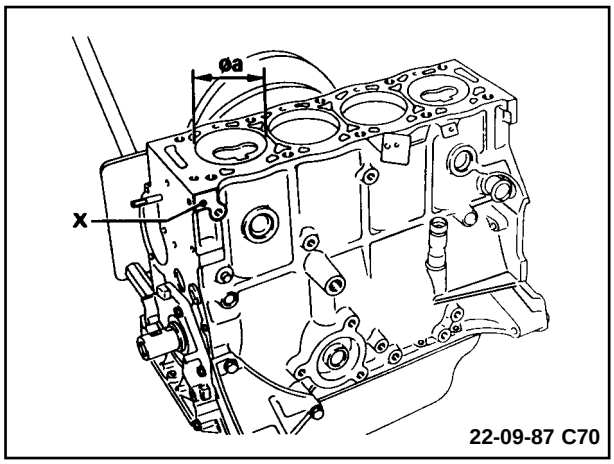


Figure 11-10

NOTE
Piston diameter b must be measured at dimension c.

c	25.00

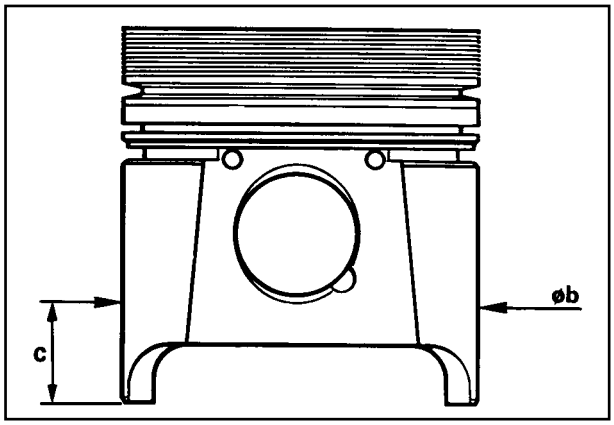


Figure 11-11

Crankshaft

Crankshaft pins and journals

	Ø a	b	Ø c	d
Tolerance	-0 -0.016	± 0.003	-0 -0.019	± 0.003
⊢→ 0	50.00	1.827	60.00	1.842
⌐ 1	49.70	1.977	59.70	1.992

- The repair dimension identification (**X**) is stamped on the cylinder block and pistons.

Gudgeon pin

ϕ	25

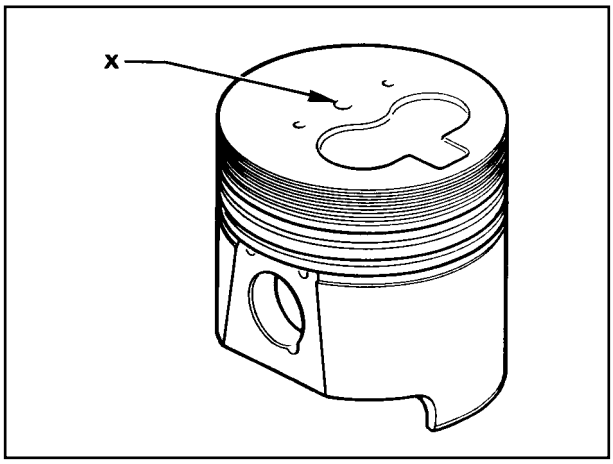


Figure 11-12

NOTE
Big end and main bearing shells 1 can be identified by white paint (1) on the edge of the shell.

End float

End float must be between **0.07** and **0.32**.

	Journal No. 2 (End float setting)	Half shell thickness
	e	f
Tolerance	+0.05 0	± 0.025
⊢→ 0	26.60	2.305
⌐ 1	26.80	2.405
⌐ 2	26.90	2.455
⌐ 3	27.00	2.505

Oil seal contact surface

Dimension	Ø g Tolerance -0 -0.087
⊢→ 0	90.00
⌐ 1	89.80

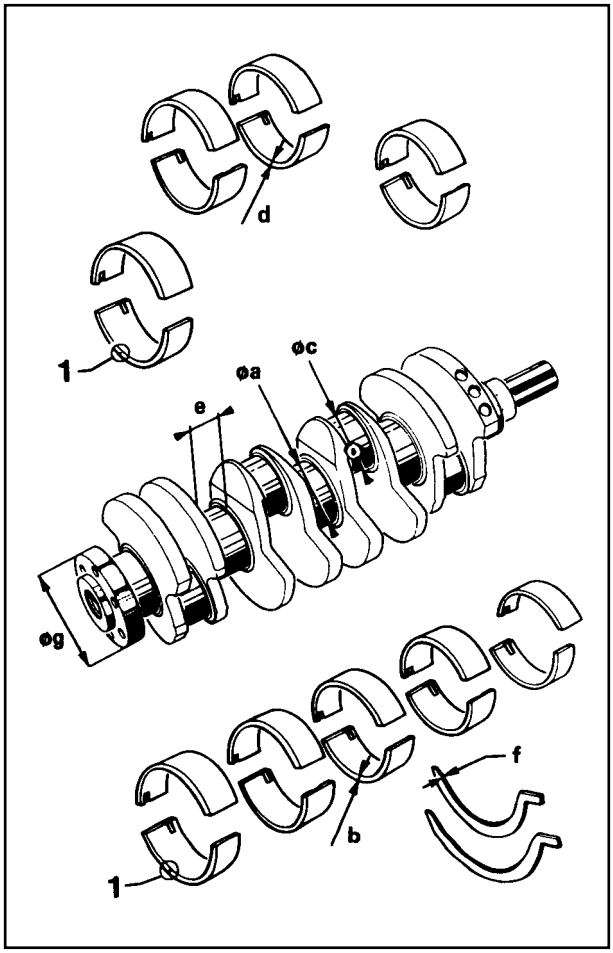


Figure 11-13

NOTE
Big end and main bearing shells 1 can be identified by white paint (1) on the edge of the shell.

End float

End float must be between **0.07** and **0.32**.

	Journal No. 2 (End float setting)	Half shell thickness
	e	f
Tolerance	+0.05 0	± 0.025
⊢→ 0	26.60	2.305
⌐ 1	26.80	2.405
⌐ 2	26.90	2.455
⌐ 3	27.00	2.505

Oil seal contact surface

Dimension	ϕ g Tolerance -0 -0.087
⊢→ 0	90.00
⌐ 1	89.80

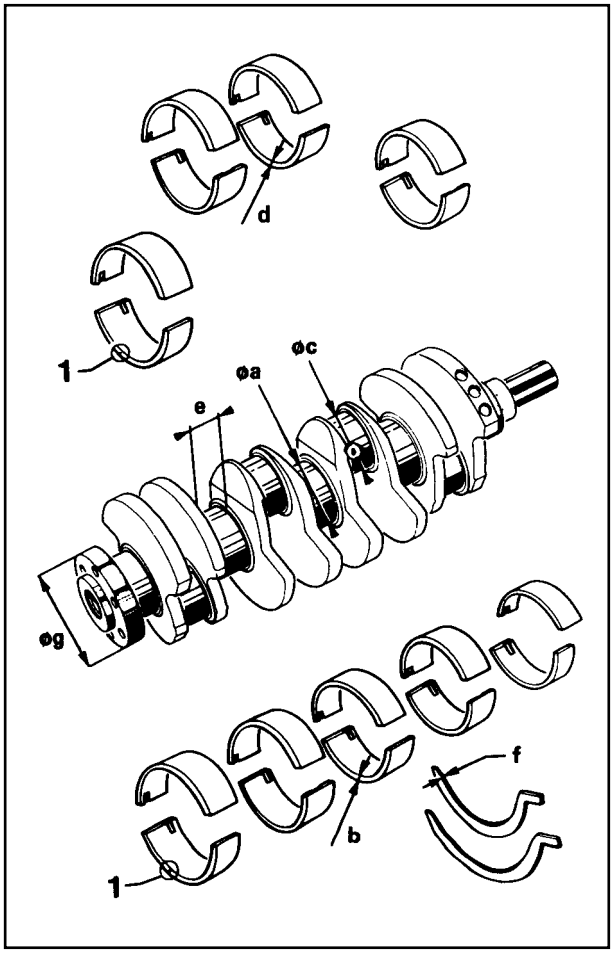


Figure 11-13

Special tools I, (-).0110

DZ - Feeler gauge, 2 mm thick
GY - Support for dial indicator on cylinder head
H - Support for dial indicator on gasket face

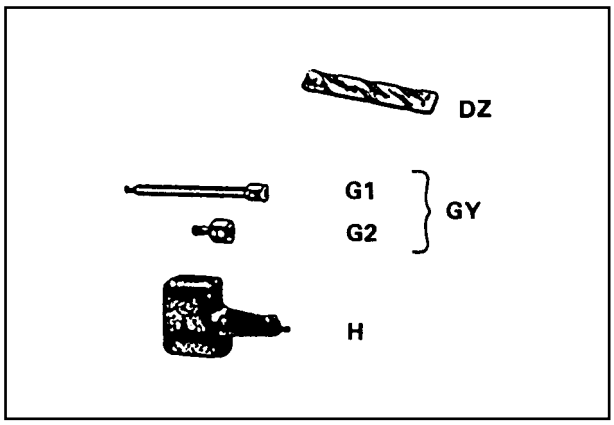


Figure 11-14

II, (-).0117

EZ - Crankshaft turning spanner
F - Dial gauge
AAZ - Support tool kit for
AB - Knurled nut injection pump
AC - Support Roto-Diesel-Lucas
AD - Plunger DPC

AK - Dial indicator support and extension for BOSCH pump
N - Engine positioning rod
AM - Tools for timing Roto-Diesel-Lucas DPC injection pump

(-) Complete service tool kit for the adjusting of the 2 types of injection pump.
Ref STILL & SAXBY : **5454483**

(-).0504

A1-A2 - Dial gauge support

(-).0164

- Injection pipe spanner

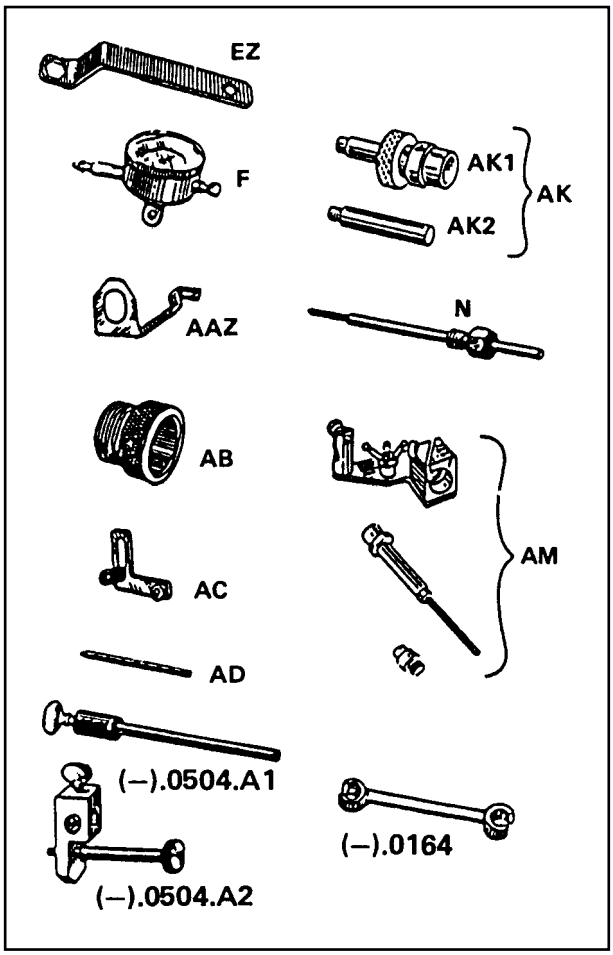


Figure 11-15

III, (-).0153

A1 - Universal tool for fitting No. 1 main bearing with side seals
A2 - Set of shims 0.15 mm thick
C-D-E - Oil seal fitting plugs
N - TDC setting rod for flywheel

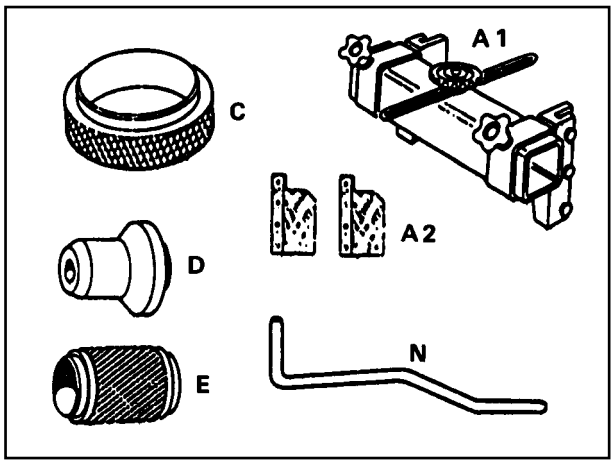


Figure 11-16

IV, (-).0149

- Spanner for screwed injector carriers

0016901900

- Clutch plate centralising mandrel

(-).1504

- Dial gauge with mounting eye

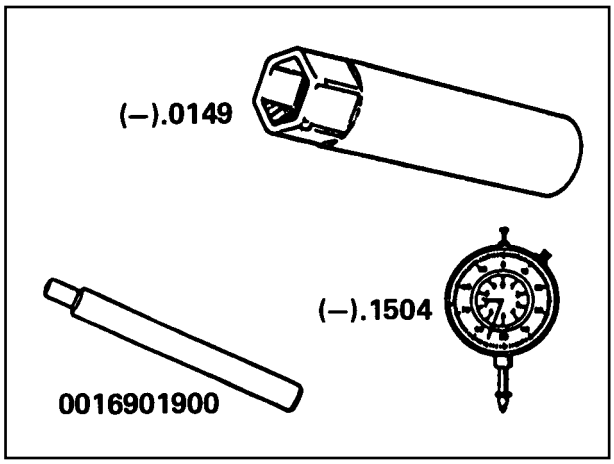


Figure 11-17

V, Makeshift tools
0.0149

- Cylinder head separating levers

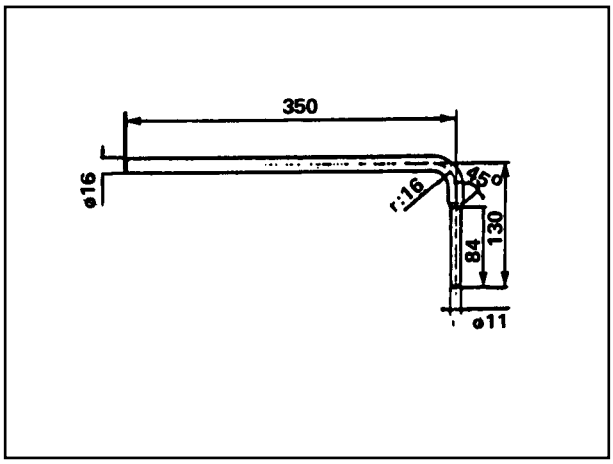


Figure 11-18

I Stripping the engine

- Mount the engine on the DESVIL stand, Part No. 175/3.

- Lock the flywheel with a tool e.g. FACOM D86.

- Remove :
  - Expansion chamber (1) at exhaust
  - Exhaust (2) and inlet manifold (3) manifolds
  - Coolant manifold (8) and its metal pipe

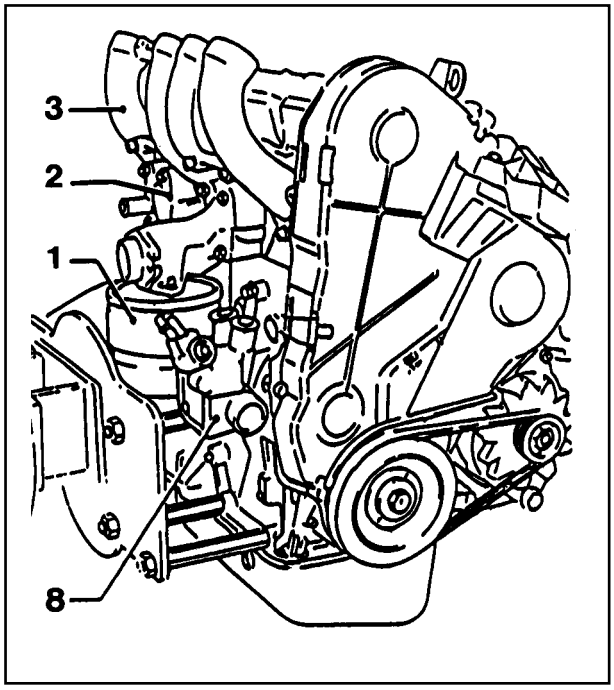


Figure 11-19

II

- Remove :
  - Pulley (9)
  - Alternator and drivebelt
  - Oil filter (10)
  - Fast idle control (15)
  - Injector pipes (12)
  - Glow plug leads
  - Crankcase breather pipes oil filter/filter pipe assembly (13)
  - Oil pressure switch (14)
  - Engine mounting (16)

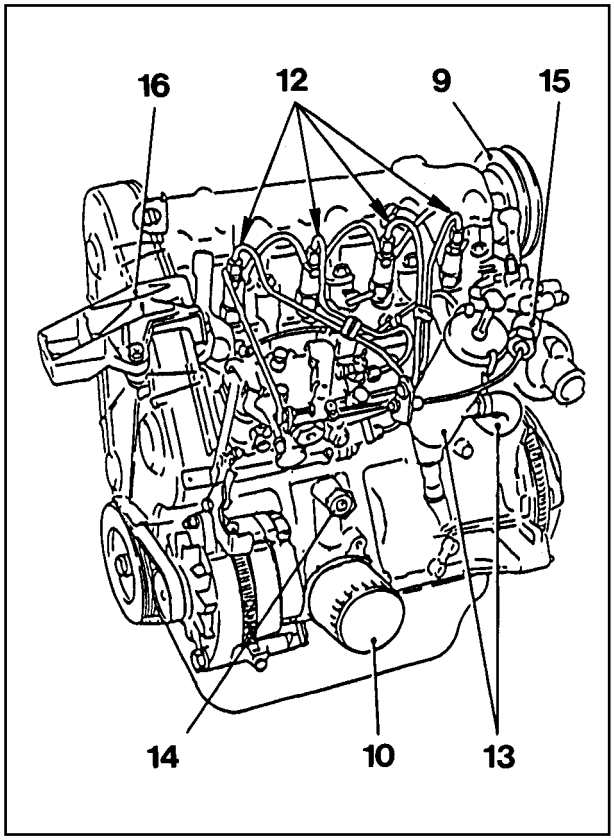


Figure 11-20

III

- Remove :
  - Thermostat housing cover (17)
  - Thermostat housing (18)
  - Fuel injectors (19) using spanner (-) .0149 and retrieve the copper washer (20) and the flame trap washer (21).
  - Glow plugs (22)

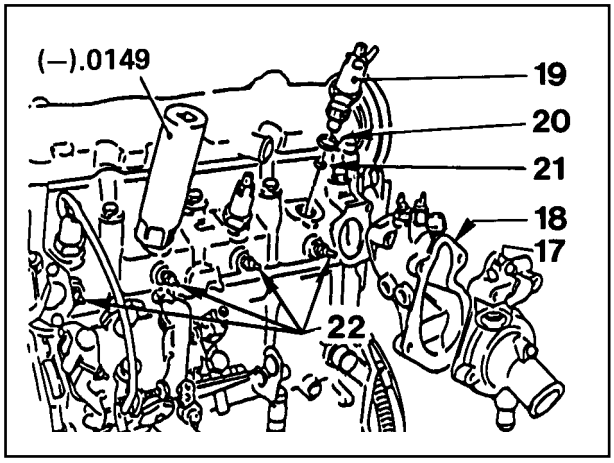


Figure 11-21

I

- Remove :
  - Bolt (1) and the pulley
  - Clutch
  - Flywheel
  - Flywheel locking tool

Removing the timing belt

- Remove the covers (2), (3) and (4) in that order.

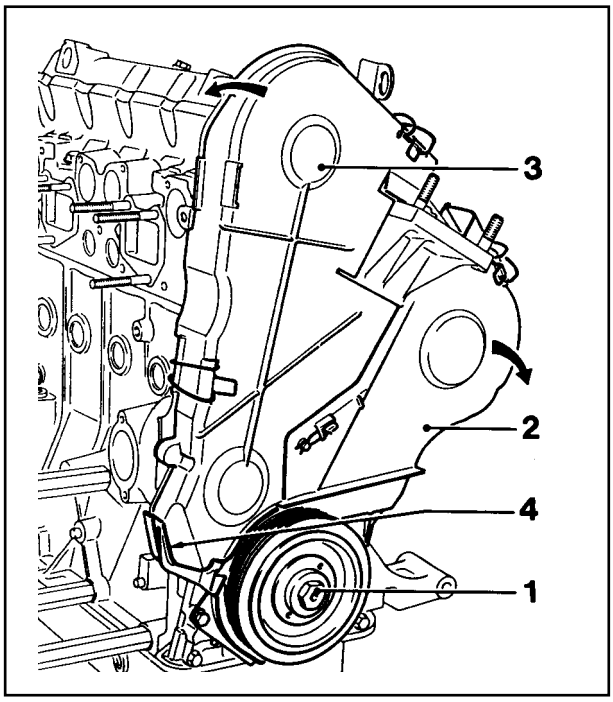


Figure 11-22

II

- Remove the rubber spacer (5).

- Refit the bolt (1) and the washer.

- Turn the crankshaft to the setting point of the camshaft gears (6) and injection pump (7).

- Lock in the adjustment position :
  - The camshaft gear (6) with an M8x125x40 bolt.
  - The injection pump gear (7) with an M8x125x35 bolt.

IMPORTANT
These locking bolts must be only finger tight.

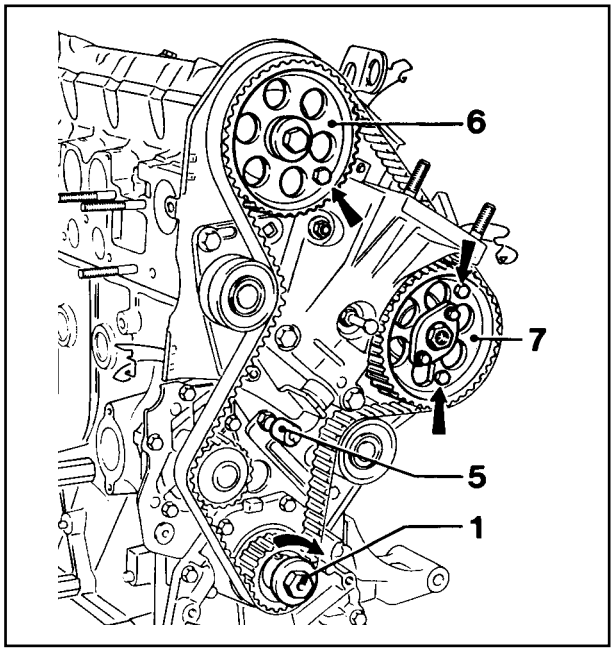


Figure 11-23

III

- Slacken the nut (8) and the bolt (9), securing the tensioning roller bracket (10).

- Turn the tensioning roller bracket square (a) to compress the spring (11).

- Re-tighten the bolt (9).

- Remove :
  - Toothed belt
  - Gears from the camshaft (6), the injection pump (7) and the crankshaft (12) and remove the keys.
  - Roller tensioner (10) and remove the plunger (13) and the spring (11)
  - Lifting eye (14)*
  - Engine mounting (15)
  - Fixed guide roller (16)
  - Coolant pump (17)
  - Plate (18)

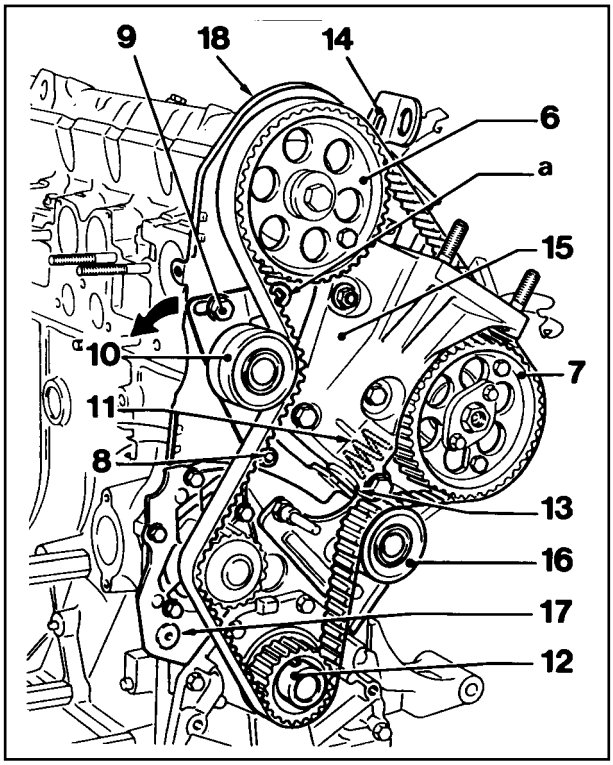


Figure 11-24

* depending on model

IV Removing the injection pump

- Remove :
  • the injection pump (19)
  • the bracket (19).

NOTE
If the injection pump needs to be checked, entrust this to a BOSCH or ROTO DIESEL - LUCAS distributor.

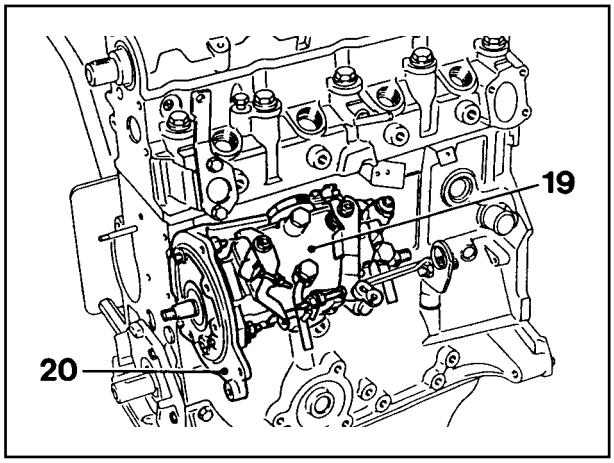


Figure 11-25

I Removing the cylinder head

- Remove the cylinder head cover.

- Progressively slacken the cylinder head bolts, working in a spiral from the outside.

- Release the cylinder head using levers 0.0149.

- Remove the cylinder head and gasket.

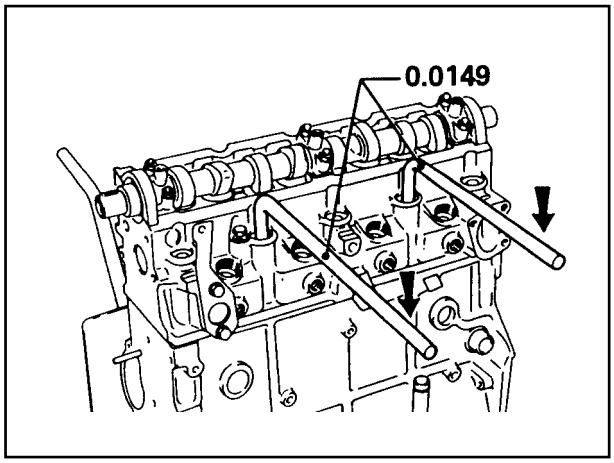


Figure 11-26

II Removing the oil pump

- Remove :
  • the sump and its seal.
  • The bolts (1), (2) and (3).
  • The seal carrier plate (4).

WARNING
The bolt (1) is special as it centres the pump (5).

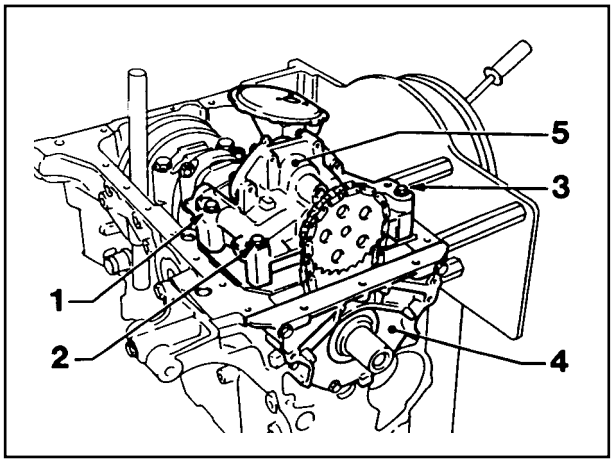


Figure 11-27

III

- Lift the oil pump (5) to free it from its centering pin.

- Remove :
  • Spacer (6) (according to engine type)
  • Pump (5) / drive chain / crankshaft sprocket (7) assembly.

- Remove the key and the centering pin.

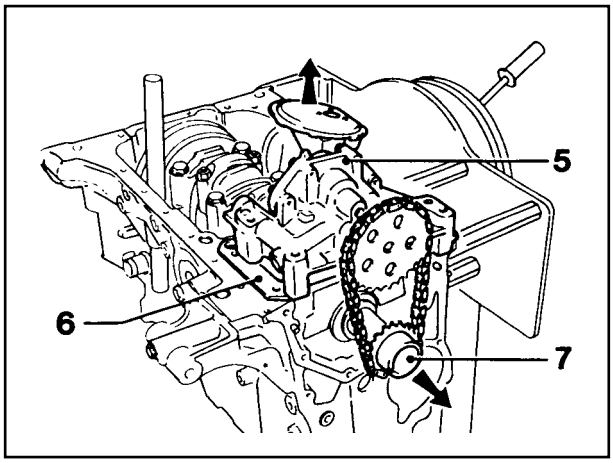


Figure 11-28

IV Removing the crankshaft and piston

- Remove :
  - Big end caps (8) after marking them
  - Main bearing caps (9) (cast-in marks)
  - With No. 2 cap, remove the end float washers.

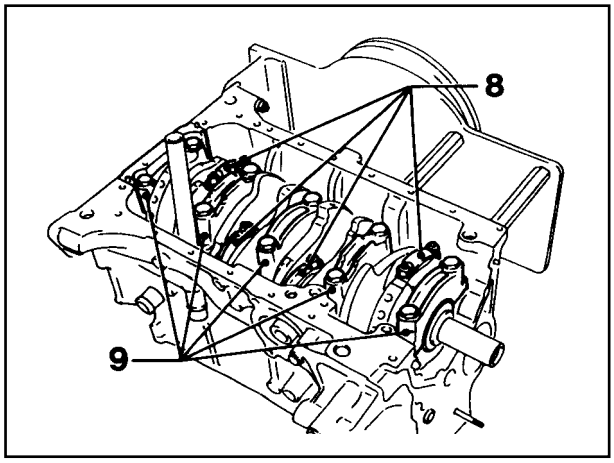


Figure 11-29

V

- Remove :
  - Oil seal (10)
  - End float washers (11)
  - Crankshaft
  - Main bearing shells
  - Piston/connecting rod assemblies.

- Remove the gudgeon pin circlips and separate the pistons from the connecting rods.

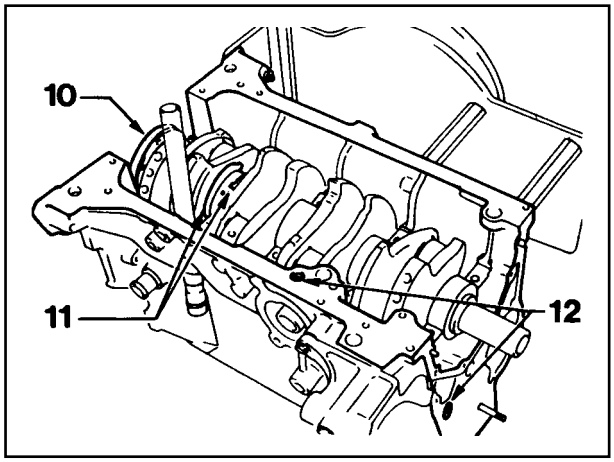


Figure 11-30

VI

- Remove :
  - The plugs (12) from the oil passages.

- Thoroughly clean out all oil passages.

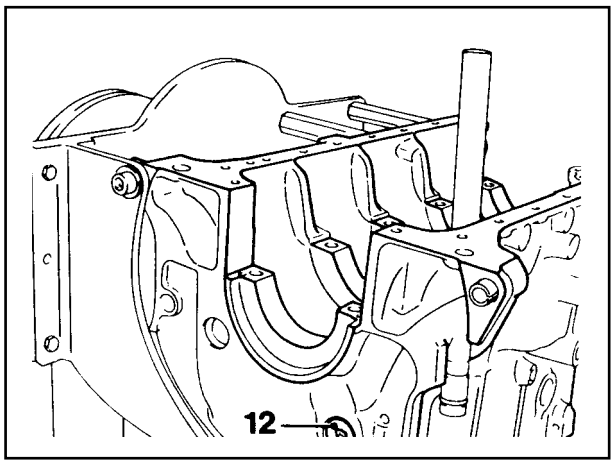


Figure 11-31

I

- Progressively slacken the camshaft bearing caps (1).

- Remove :
  - Bearing caps (1) (cast-in marking)
  - Oil seals (2)
  - Camshaft (3)
  - Tappets (4)
  - Adjustment shims (5).

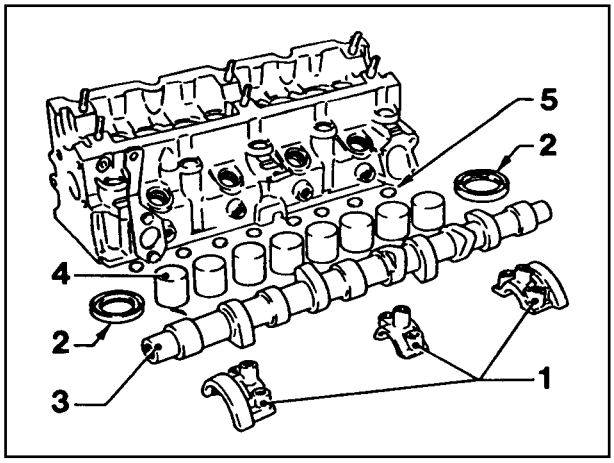


Figure 11-32

II

- Remove :
  - The eight valves, using a valve lifter.
  - The swirl chambers by drifting them out from the injectors orifices.

- Clean the cylinder head, using DECAPLOC 88 stripper for the sealing surfaces.

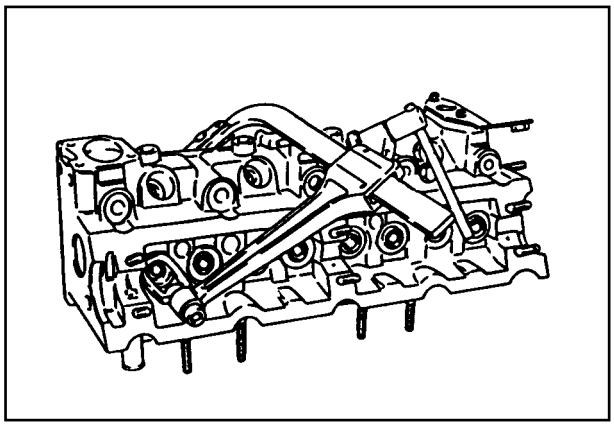


Figure 11-33

III

- Check the cylinder head seal contact for bow. Maximum bow : 0.07 mm.

- Check the condition of :
  - Valve seats and guides*
  - Valves*
  - Valve springs*
  - Swirl chambers
  - Camshaft
  - Camshaft bearings
  - Tapped holes

* **IMPORTANT**
When checking, machining or replacing these parts, do not exceed the tolerance limits.

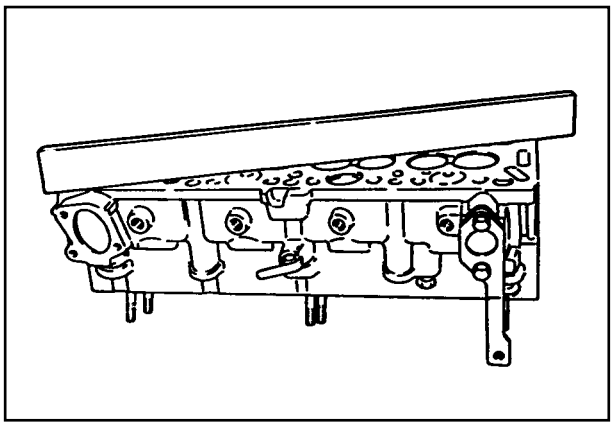


Figure 11-34

IV

- Check the protrusion of the swirl chambers (A)
  Protrusion : 0 to 0.03 mm

- Achieve this dimension by machining faces (a) and (b).

- Check the valve recess (B) :
  ⊗ 0.9 to 1.45
  ● 0.5 to 1.05

- Achieve these dimensions by machining the valve seats.

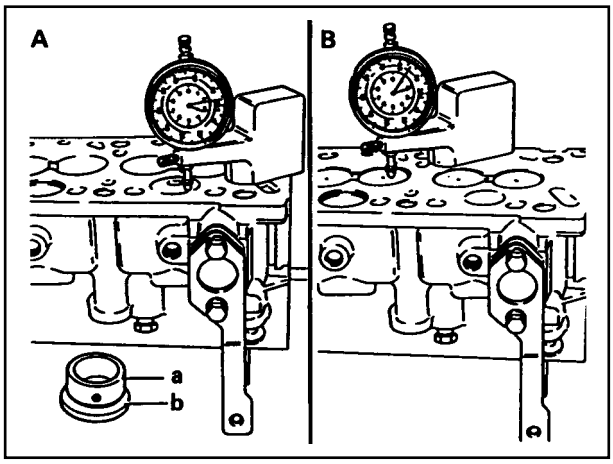


Figure 11-35

V

- Lap in the valves.

- Refit the valves.

IMPORTANT
If the cylinder head has been machined, fit shims under the valve springs.

- Fit a basic shim 2.425 mm thick to each valve stem and check that they project over the spring cup (6).

- If they are not, grind the top of the spring cup (6).

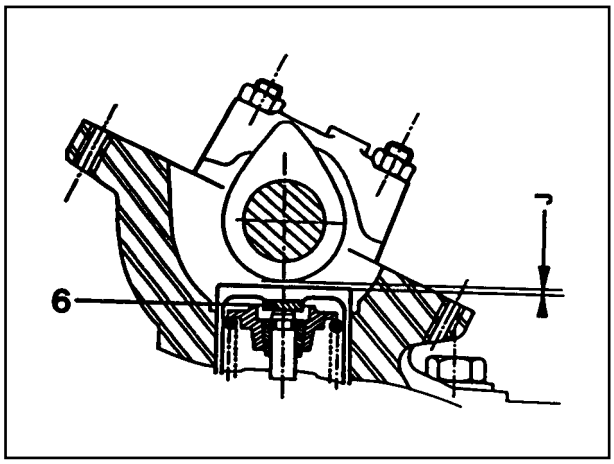


Figure 11-36

VI

- Refit the tappets.

- Oil the camshaft bearings.

- Fit the camshaft, with the DIST marking at the timing gear end.

- Progressively tighten the bearing caps to 1.75 mm (13 lbf ft) (cast-in markings).

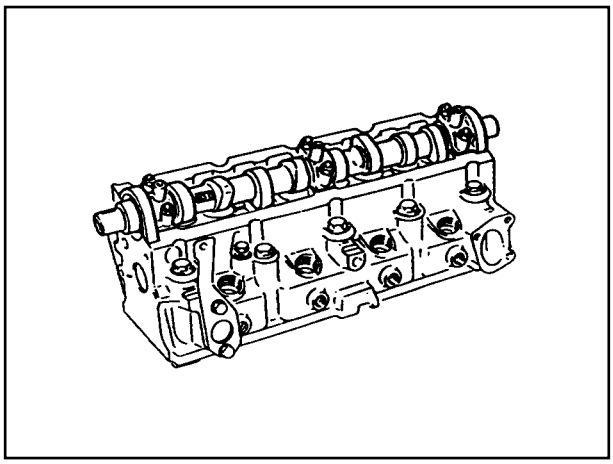


Figure 11-37

I Fitting the crankshaft

- Fit into the cylinder block :
  - the oil gallery plugs previously coated with threadlock LOCTITE
  - the grooved main bearing shells.

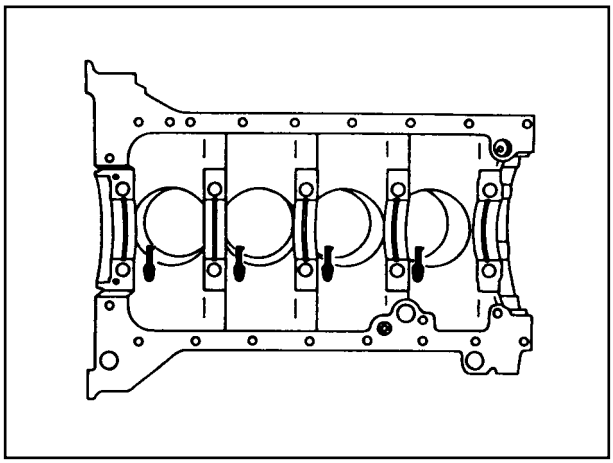


Figure 11-38

II

- Install :
  - Crankshaft
  - Nos. 3, 4 and 5 main bearing caps
  - The two end float half-washers (1), with the anti-friction faces towards the crankshaft.

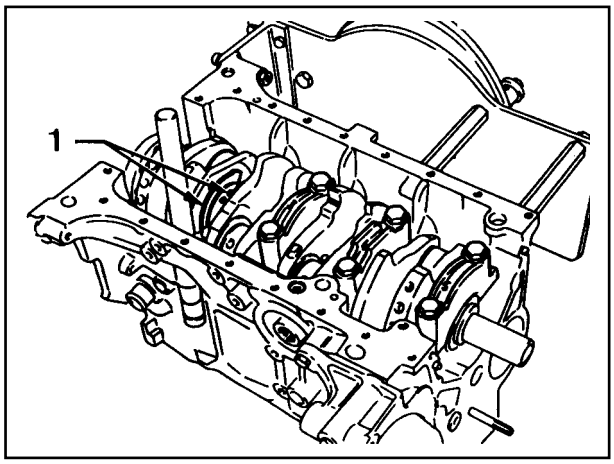


Figure 11-39

III

- Fit the No. 2 main bearing cap (2) with its two end float half-washers ; their anti-friction faces towards the crankshaft.

- Apply a thin coat of FORMETANCH sealant to the ends (a) of the bearings.

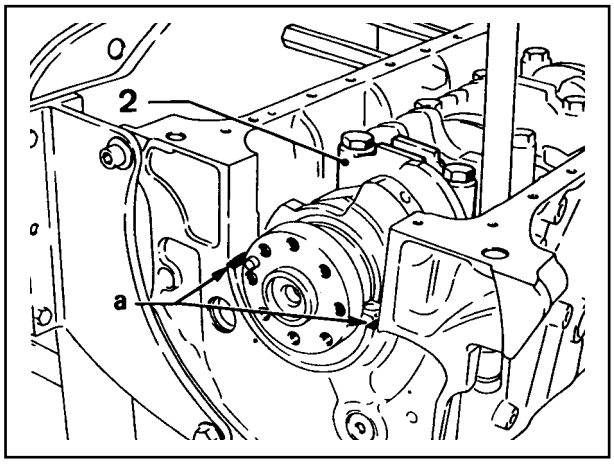


Figure 11-40

IV

- Fit two new side seals (3) to No. 1 main bearing cap.

- Using a bolt and washer (5), attach tool (-).0153 A1 fitted with shims A2 to No. 1 main bearing cap (4).

- Adjust the height (x) of the shims.

- Oil the shims and the housing.

WARNING
To avoid stretching the side seals, fit the cap as follows :

- Insert it in its housing at 45°.
- Straighten it and lower it carefully.
- Tighten the two bearing cap bolts (6) to 70 Nm (52 lbf ft).
- Withdraw the tool horizontally.

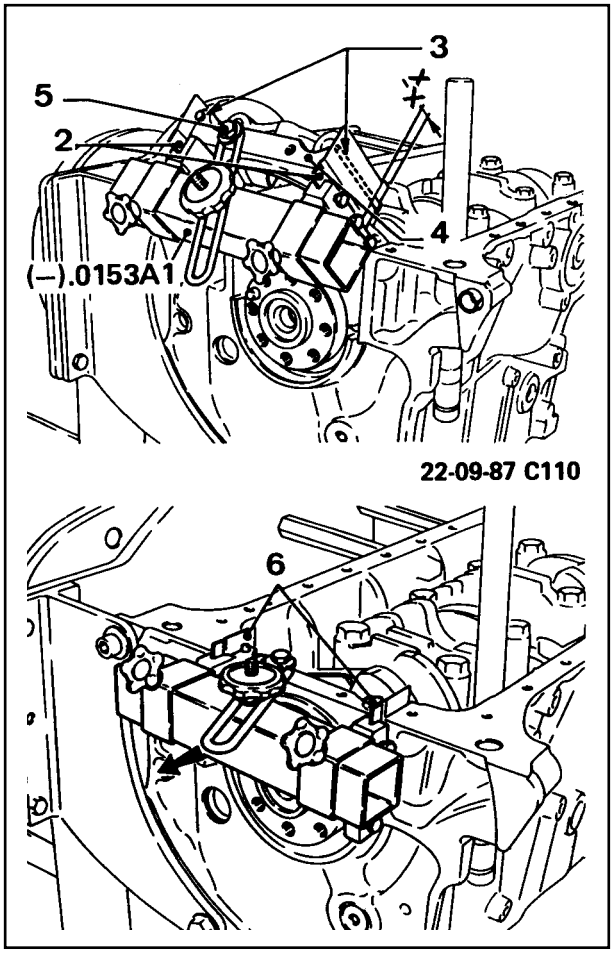


Figure 11-41

V

- Using gauge (-).0110 D2, cut off the side seals so that they protrude 2 mm.

- Tighten the bearing cap bolts to 70 Nm (52 lbf ft).

- Check that the crankshaft rotates without tight spots.

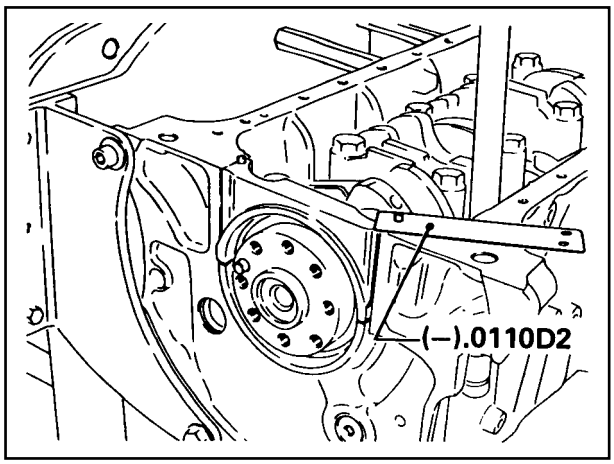


Figure 11-42

I Checking crankshaft end float

- Fit the dial gauge, using tools (-).0110 G1, (-).0504 A1 and A2.

- End float must be between 0.07 and 0.32 mm.

NOTE
For choice of half-washer thickness, do not exceed tolerance limits.

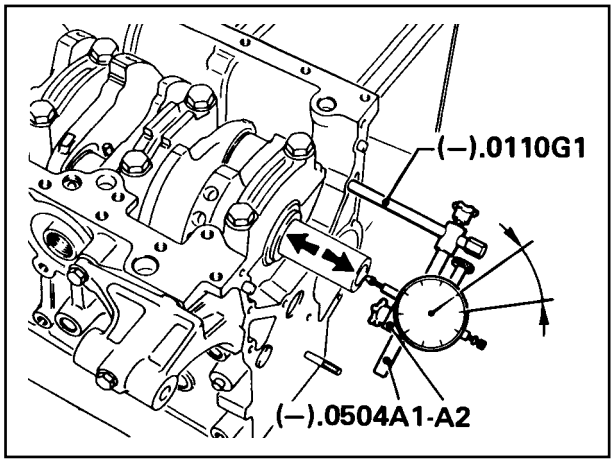


Figure 11-43

II Fitting the pistons and connecting rods

- Assemble the connecting rods and pistons with the bearing shell tab recess (a) on the same side as the piston crown recess (b).

Fit the piston rings :

NOTE
The marked face of the tapered ring (centre piston ring) must show towards the combustion chamber.

- Use special pliers for the assembly.

(1) - Scaper ring
(2) - Tapered ring (compression ring)
(3) - Domed chrome ring (compression ring).

- Space the tapered ring (2) and domed ring (3) gaps at 120° in relation to the scraper ring gap (c).

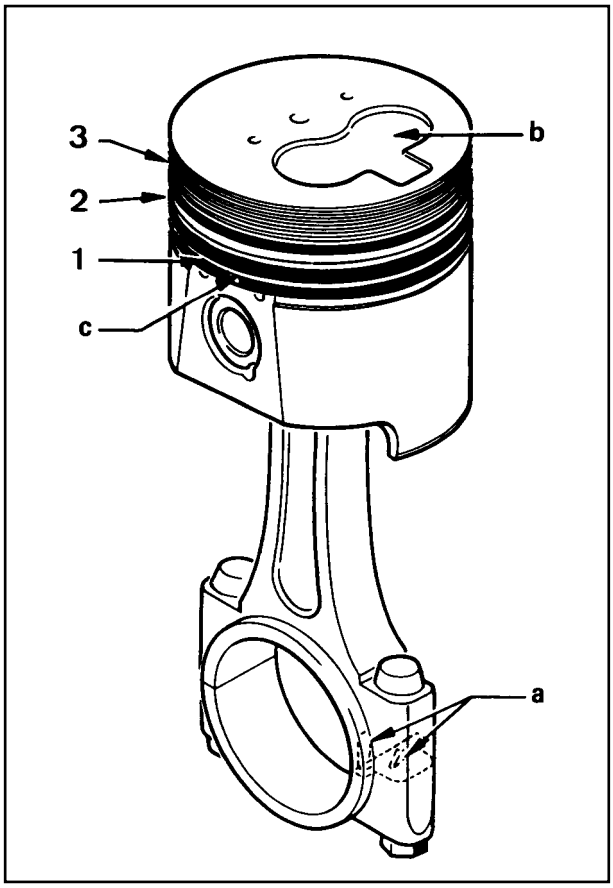


Figure 11-44

- Oil the piston and moderately tighten the piston ring clamp (4).

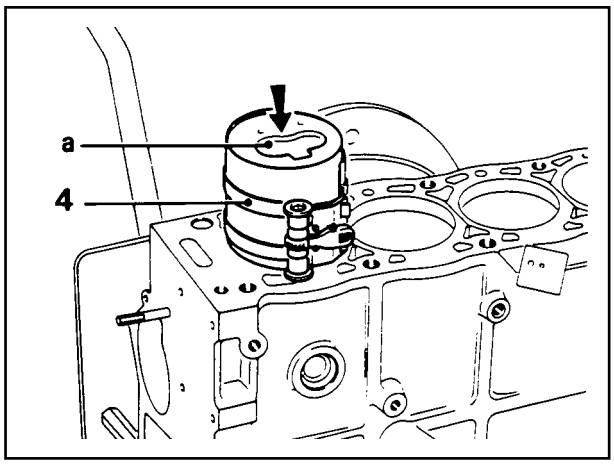


Figure 11-45

IV

- Remove the big end caps.

- Rit the pistons in the bores, observing the markings made at removal and with the piston crown recess (a) on the oil filter side of the block.

- Fit the big end caps and tighten the nuts to 50 Nm (37 lbf ft).

NOTE
In the choice of bearing shell thickness, do not exceed the tolerance limits.

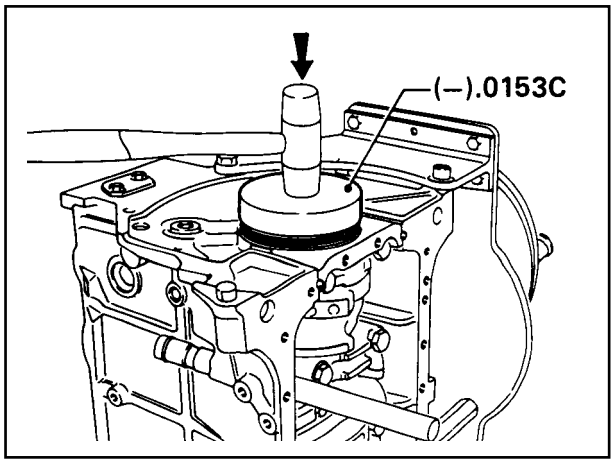


Figure 11-46

- Position a new oil seal on tool (-).0153 C.

- Fit the seal by tapping it fully home with a mallet.

- Withdraw the tool with a twisting movement.

- Check that the visible lip of the seal is towards the outside.

V Installing the oil pump

- Install in the following order :
  - Centering pin (5) to the cylinder block
  - Key (6)
  - Oil pump (7) / drive chain / sprocket (8) assembly
  - "L"-shaped spacer at (9).

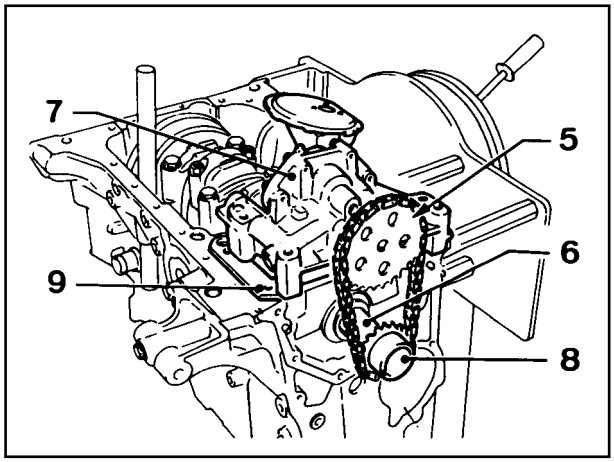


Figure 11-47

I

WARNING
The bolt (1) is special : It serves to centre the pump.

- Tighten the bolts (1), (2) and (3) to 20 Nm (15 lbf ft).
- Fit the seal carrier plate with a new seal (4) and tighten the bolts to 15 Nm (11 lbf ft).
- Put a new oil seal on tool (-).0153 D.
- Fit the seal by tapping it fully home with a mallet.
- Apply SILICONE CLASS 1 jointing paste at (a).

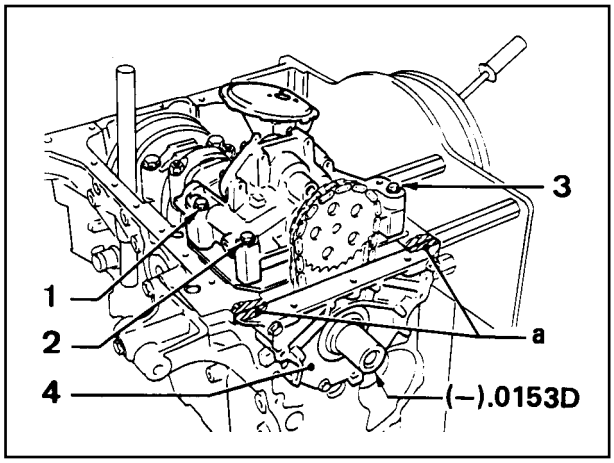


Figure 11-48

- Fit the sump (5) with a new gasket.
- Tighten the bolts to 20 Nm (15 lbf ft).

NOTE
The bolts at (b) have socket heads.

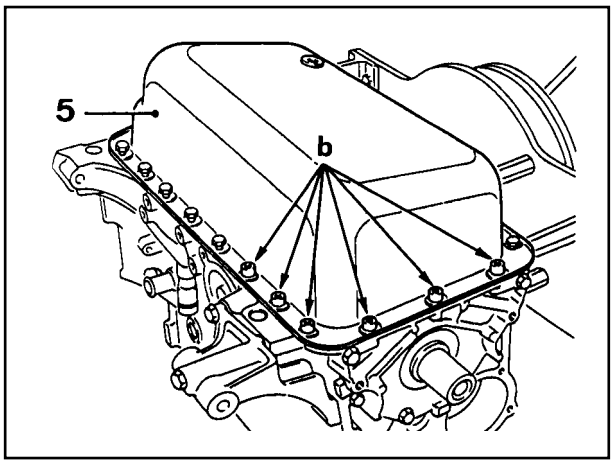


Figure 11-49

II

- Fit the flywheel and fit the bolts coated with threadlock LOCTITE.
- Fit a FACOM D86 type locking tool.

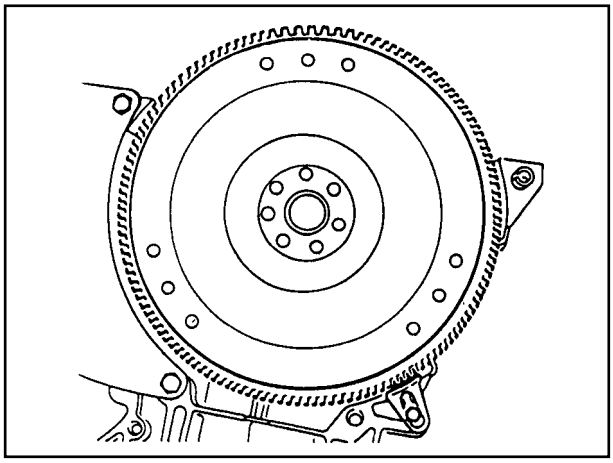


Figure 11-50

III Cylinder head gasket selection

- Mount the dial gauge on support (-).0110 H and zero it on a alignment plate.
- Turn the crankshaft and measure the projection of each piston at TDC.
- Note the maximum projection (d).
- Select a cylinder head gasket of suitable thickness.

Projection (d)	Thickness identification
$0.77 \leq d$	2 notches
$d > 0.77$	3 notches

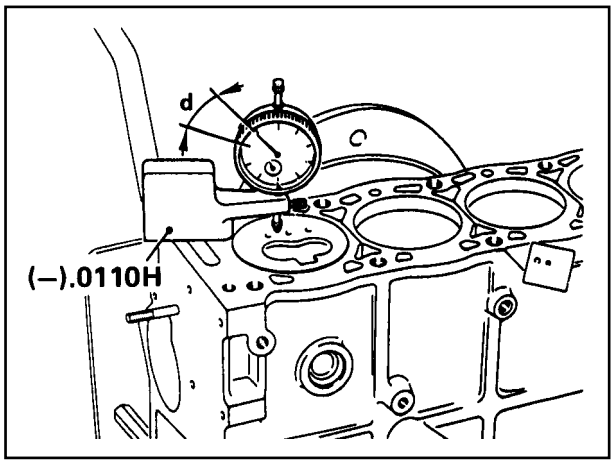


Figure 11-51

IV Installing the cylinder head

- Turn the crankshaft to position the pistons at mid stroke with the damper pulley key (6) at 9 o'clock.
- Clean the tapped holes in the cylinder block (12x150 thread).
- Install :
  - Centering pin (7)
  - Head gasket, dry
  - Cylinder head
- At the cylinder head bolts :
  - Carefully brush the threads.
  - Coat the bolt threads and the washer contact faces with MOLYKOTE G RAPID.

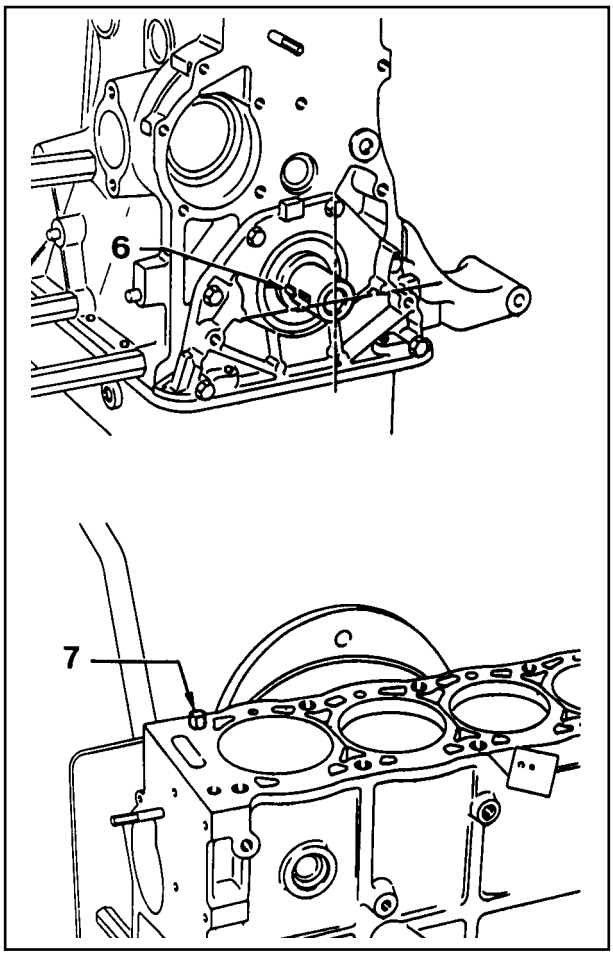


Figure 11-52

I Tightening the cylinder head bolts

- Insert the bolts with new washers.

METHOD 1 FOR BOLTS "A"

In the order shown :
- pre-tighten to 30 Nm (22 lbf ft)
- tighten to 60 Nm (44 lbf ft)
- bolt by bolt, slacken a quarter turn, then re-tighten to 60 Nm (44 lbf ft)

METHOD 2 FOR BOLTS "B"

In the order shown :
- pre-tighten to 30 Nm (22 lbf ft)
- tighten to 70 Nm (52 lbf ft)
- tighten a further 120° using a spanner of type FACOM D360.

IMPORTANT
For re-tightening operations refer to the notes at the end of this section.

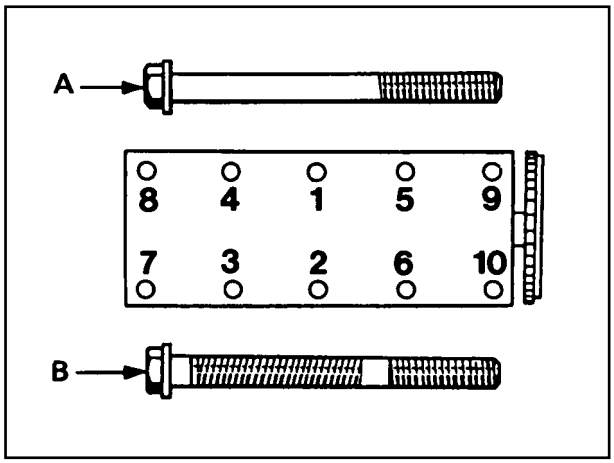


Figure 11-53a

II Valve clearance adjustment

- Fit the camshaft sprocket (1).

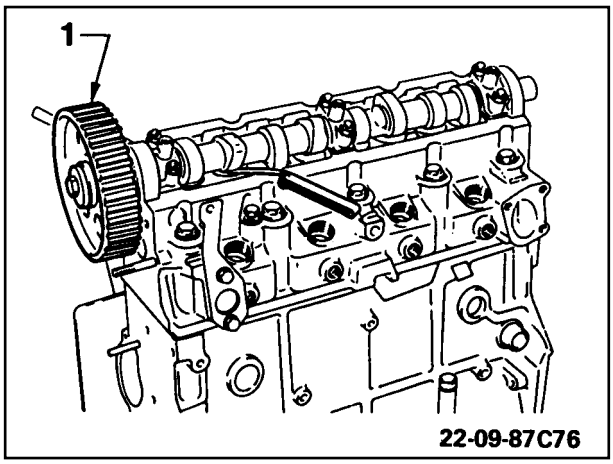


Figure 11-54b

- Running clearance
  Inlet ..... 0.15 mm
  Exhaust ..... 0.30 mm
  Tolerance ..... ± 0.04 mm

Set "on the rock"	4	4	1	1
Check	1 2	1 3	4 3	4 2

- Record the clearances.

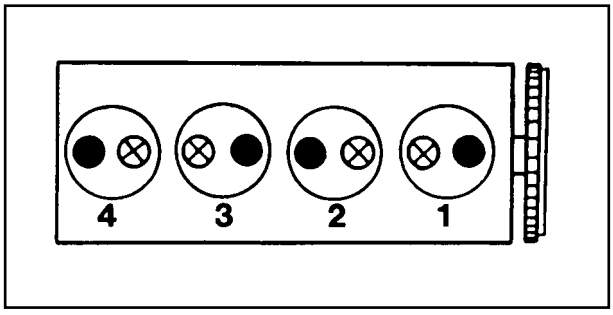


Figure 11-55

III

- Remove :
  - Camshaft sprocket (1)
  - Camshaft bearing caps (2)
  - Camshaft (3)
  - Tappets (4)
  - Shims (5)

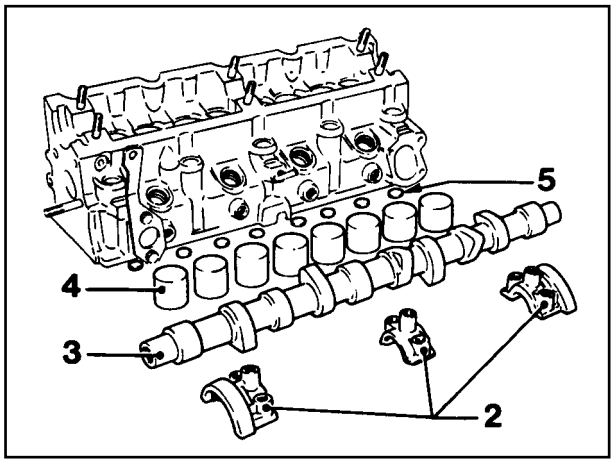


Figure 11-55

- Determine the shim thickness to be fitted for each valve.

- Example

	1
Specified clearance	0.15
Clearance measured	0.25
Difference	+ 0.10
Shim fitted	2.425*
Shim to be fitted	2.50
Clearance obtained	0.175

* Basic shim

IV

- Install :
  - Shims with the determined thickness
  - Tappets

- Apply :
  - a thin coat of FORMETANCH sealant to each end of the bearing housing at (a)
  - MOLYKOTE G. RAPID to the bearing surfaces on the camshaft

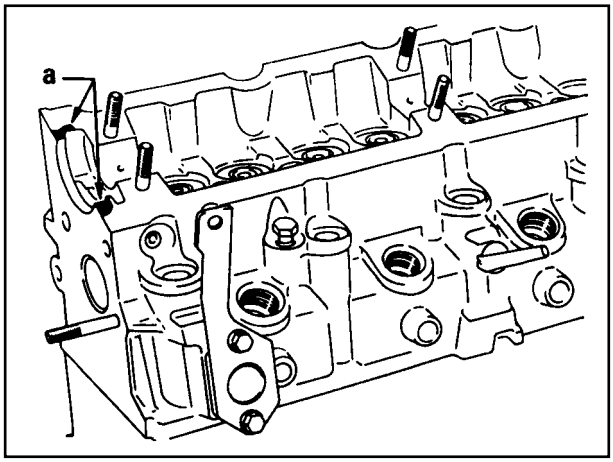


Figure 11-56

- Install :
  - Camshaft (3) with the DIST marking at the timing gear end.
  - Camshaft bearing caps (2) (cast in markings).
- Progressively tighten the bearing caps to 17.5 Nm (13 lbf ft).

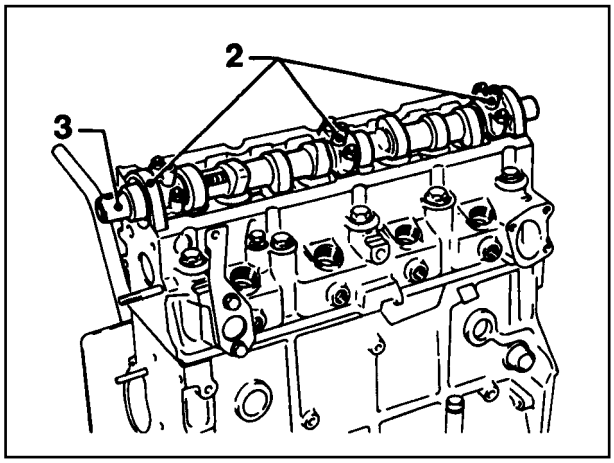


Figure 11-57

I

- Fit a new oil seal to tool (-).0153 E on the side where the inner flange is the farthest away.

- Fit the two camshaft oil seals, using a camshaft sprocket or pulley mounting bolt.

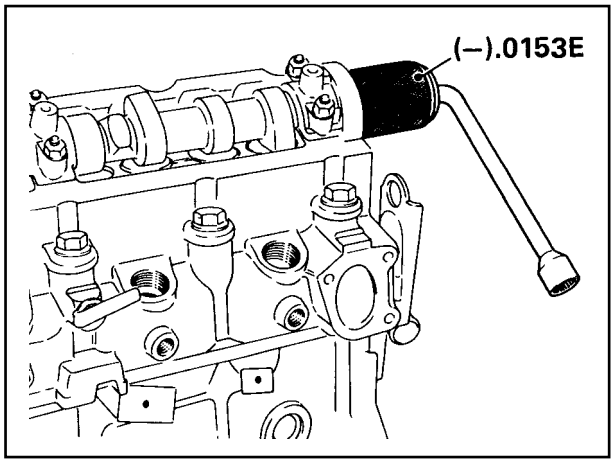


Figure 11-58

II Installing the timing belt

- Install :
  • Pump bracket (1)
  • Injection pump (2)

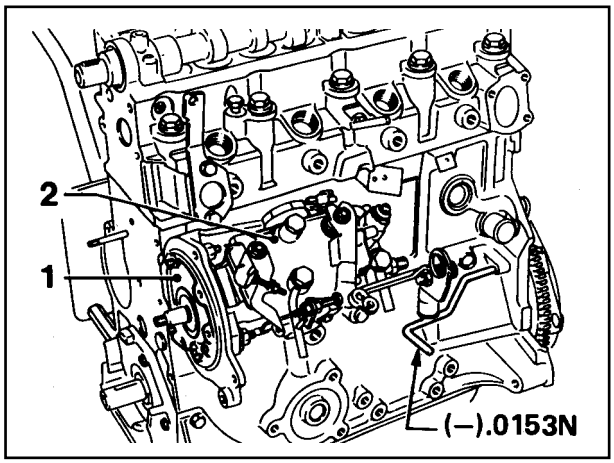


Figure 11-59

III

- Install :
  • Plate (3)
  • Camshaft sprocket (4) and the injection pump sprocket (5).

- Tighten the sprockets with bolts (7), (8) and (9) finger tight.

- Tighten :
  • The bolt of sprocket (4) to 40 Nm (30 lbf ft).
  • The nut of sprocket (5) to 50 Nm (37 lbf ft).

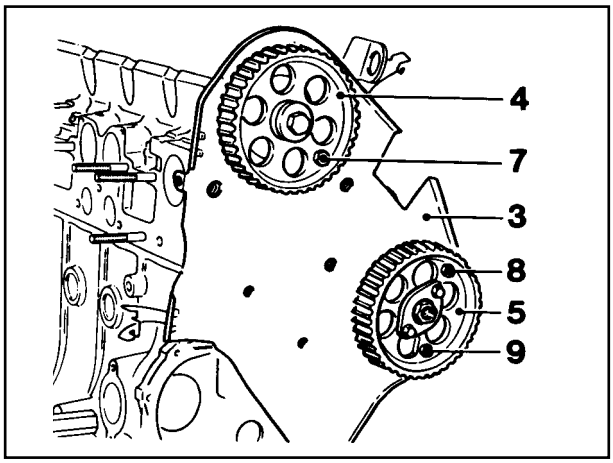


Figure 11-60

IV

- Turn the crankshaft in the running direction and lock the flywheel with tool (-) .0153 N (figure II).

- Install :
  - Coolant pump (10) with a new joint and tighten the bolts to 15 Nm (11 lbf ft).
  - Fixed guide roller (11).
  - Key (12) and the crankshaft sprocket (13).
  - Engine mounting (14) ; coat the bolts with threadlock LOCTITE and tighten them to 20 Nm (15 lbf ft).
  - Spring (15) and plunger (16), then the tensioning roller (17).

- Immobilise the roller (17), with the plunger pressed in.

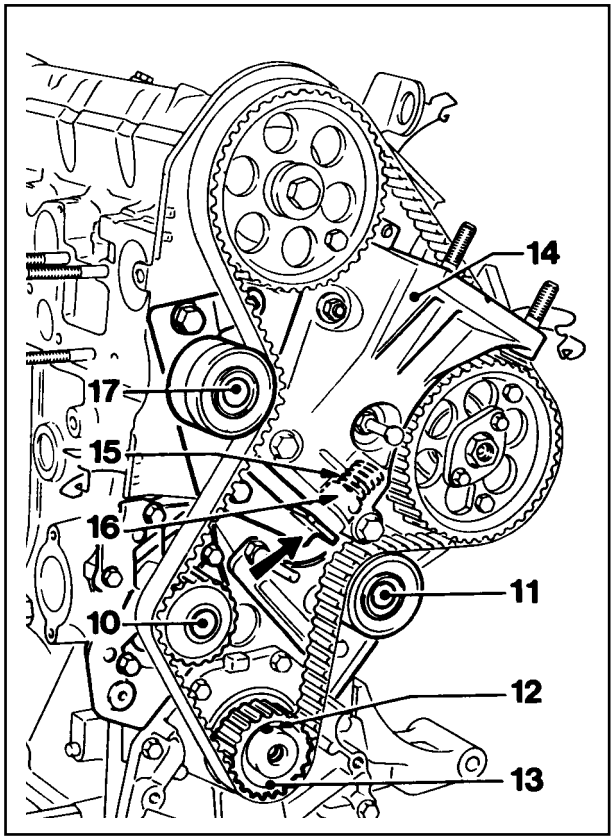


Figure 11-61

- Fit a new timing belt, with the runs taut, in the following order :
  - crankshaft sprocket
  - fixed guide roller
  - injection pump sprocket
  - camshaft sprocket
  - tensioning roller
  - coolant pump sprocket.

V

- Slacken the bolt (18) and the nut (19) to release the tensioning roller.

- Re-tighten the bolt (18) then the nut (19) when the belt is tensioned.

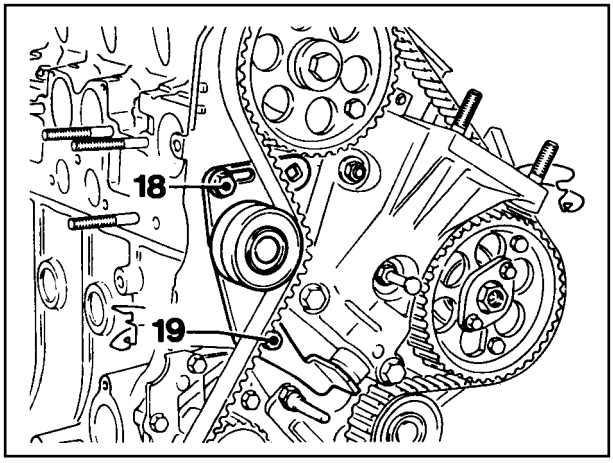


Figure 11-62

I Checking the valve timing

- Remove the four setting devices.
- Fit the bolt (1) and washer (2).
- Turn the crankshaft two revolutions.
- Refit the setting tool (-).0153 N and the three setting bolts.

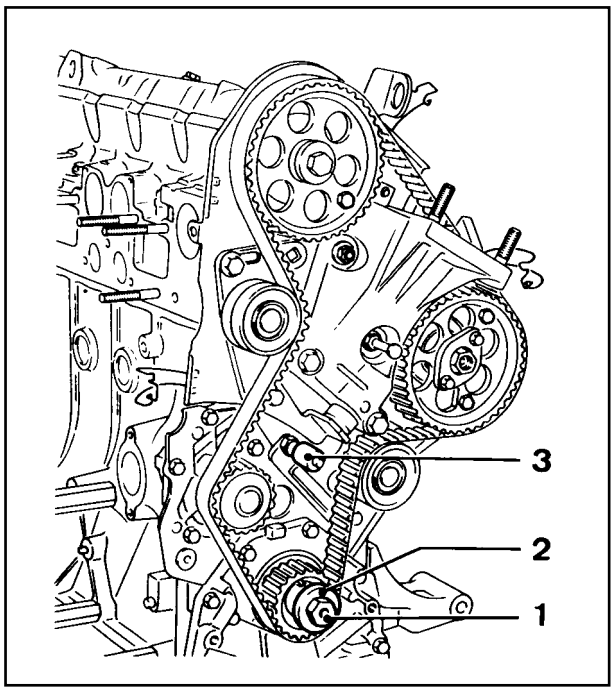


Figure 11-63

IMPORTANT
If it is possible to fit any one of the setting devices, repeat the belt fitting operation from the start.

- Slacken the tensioning roller and re-tighten the bolt, then the nut to 17.5 Nm (13 lbf ft).
- Remove the four setting devices.
- Fit in the following order :
  • rubber spacer (3)
  • covers (4), (5) and (6)
  • key and crankshaft pulley (7).

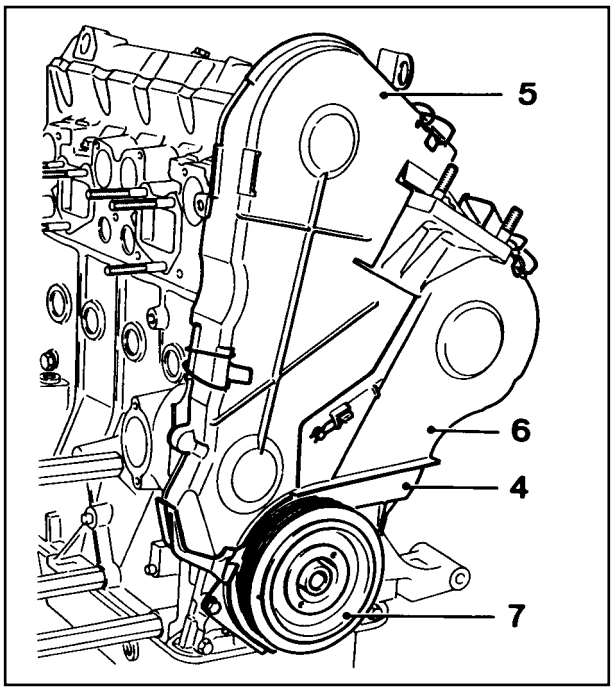


Figure 11-64

II Fitting the crankshaft pulley and dumper

- Lock the flywheel with a FACOM D86-type tool.

- Brush and degrease :
  • the threads of bolt (1)
  • the bearing faces of the washer (2) and the head of bolt (1).

- Fit the bolt (1), coated with threadlock LOCTITE FRENETANCH, and the washer (2) and pretighten to 40 Nm (30 lbf ft).

- Tighten a further 60°, that is, one flat.

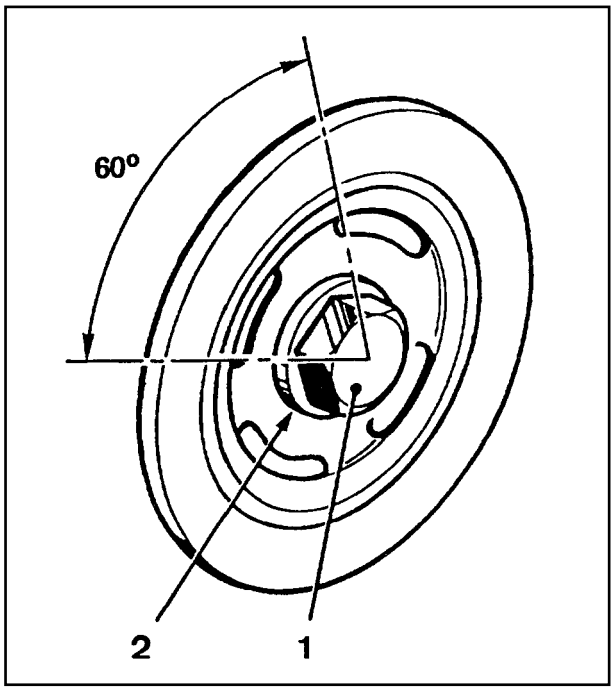


Figure 11-66

III Timing the injection pump

A ROTO DIESEL-LUCAS injection pump

- Timing at TDC.

- Use for :
  • ROTO DIESEL - LUCAS pump with inspection plug at (b) and timing value shown at (c).

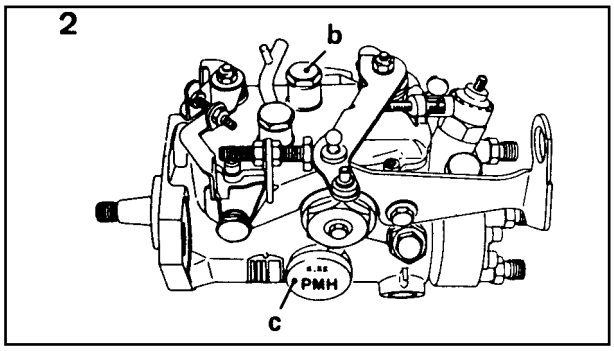


Figure 11-66

1. Preparing the injection pump

- Turn the crankshaft with spanner (-).0119 EZ to the point where No. 1 exhaust valve starts to open.

- Remove the inspection plug.

- Swing the pump to the full retard position away from the engine.

- Use tool assembly (-).0017 AM.

- Fit the rod (1).

- Attach the support (2) and the dial indicator (-).1504 fitted with the flat (3).

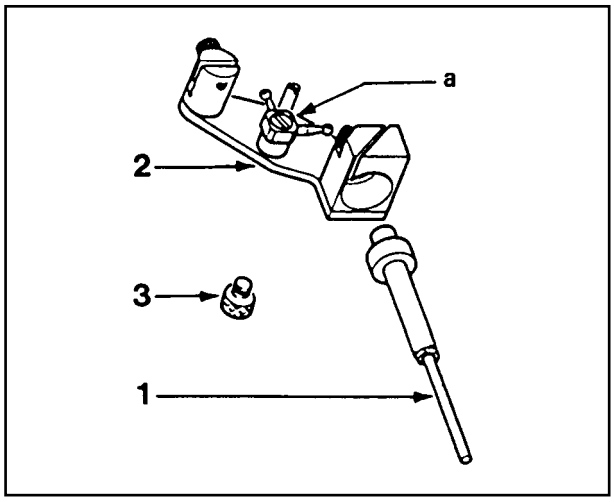


Figure 11-67

- Hold the bell crank (a) against the rod and zero the dial indicator (rod in contact with the pump).

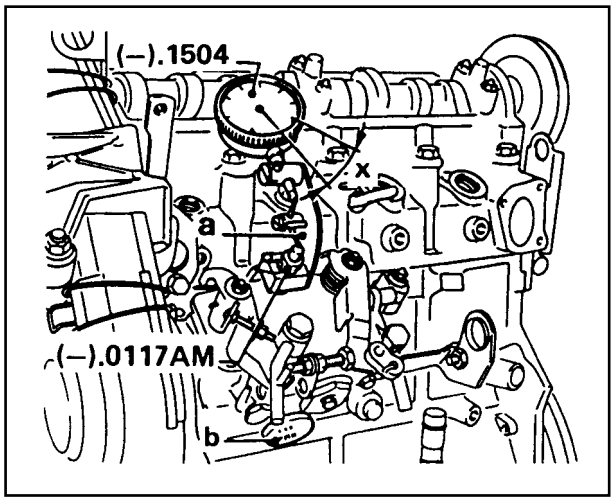


Figure 11-68

2. Timing the injection pump

- Turn the crankshaft to position the valves of No. 1 cylinder "on the rock" (TDC No. 4 cylinder).

- Set the flywheel with tool (-).0153 N.

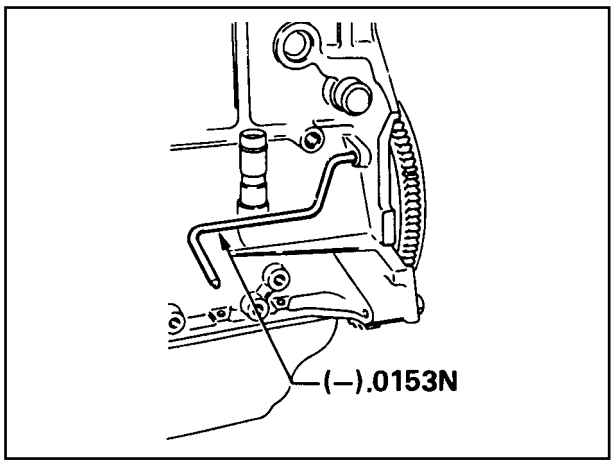


Figure 11-69

- Slowly turn the pump in the advance direction (towards the engine) to obtain the reading X engraved on the capsule (b).

- Tighten the pump mountings.

I Checking the injection pump timing

- Remove the rod (-).0153 N.

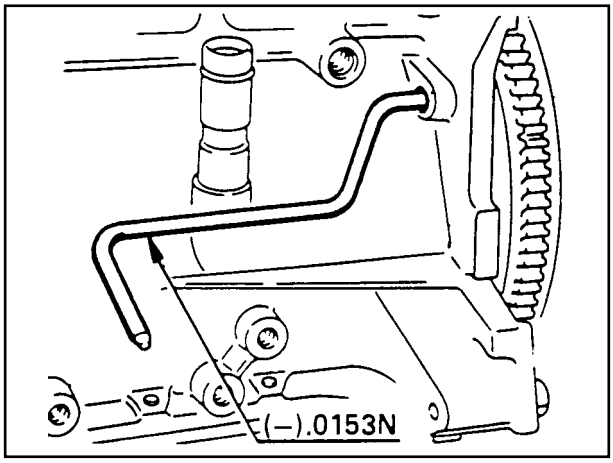


Figure 11-70

- Turn the crankshaft a quarter turn in the opposite direction to running.

- Turn the crankshaft slowly in the running direction and fit the rod at TDC.

- In this position, the dial indicator mounted on the pump should read :
  • value X shown on the pump ± 0.04 mm.

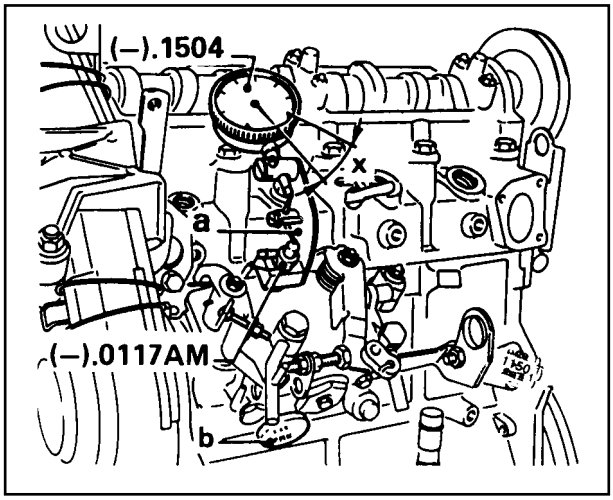


Figure 11-71

B BOSCH injection pump

1. Preparing the injection pump

- Turn the crankshaft with spanner (-).0119 EZ to the point where No. 1 exhaust valve starts to open.

- Remove the inspection plug.

- Swing the pump to the full retard position away from the engine.

- Fit the dial gauge (-).0117 F using support (-).0117 AK1 and plunger (-).0117 AK2.

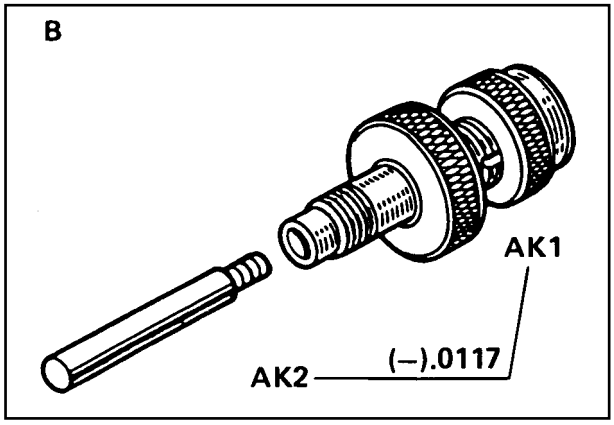


Figure 11-72

- Turn the crankshaft to locate bottom dead centre on the pump.

- Zero the dial gauge.

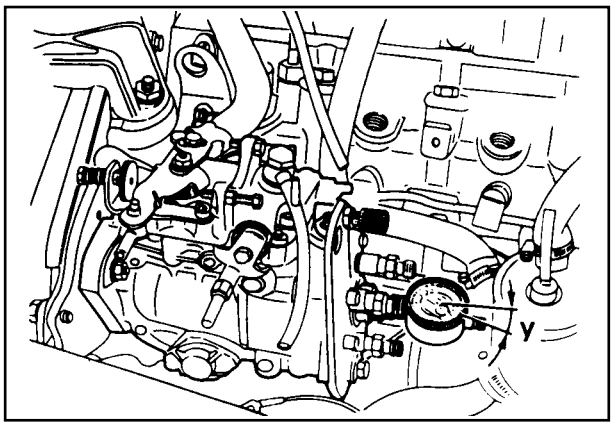


Figure 11-73

2. Timing the pump

- Turn the crankshaft to position the valves of No. 1 cylinder "on the rock" (TDC No. 4 cylinder).

- Set the flywheel with tool (-).0153 N.

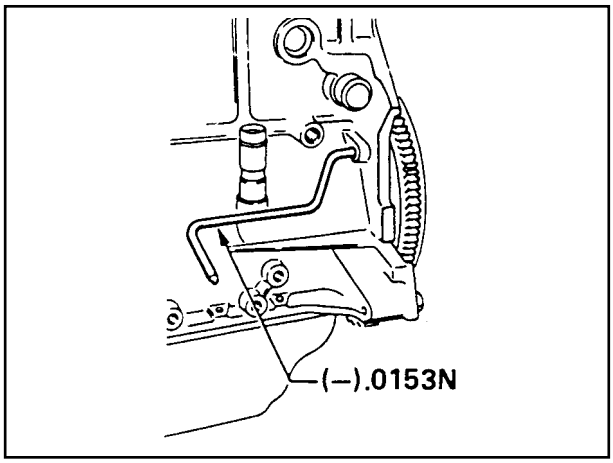


Figure 11-74

- Slowly turn the pump in the advance direction (towards the engine) to the point where the dial indicator shows a reading 0.90 after bottom dead centre.

- Tighten pump mountings.

I Checking the injection pump timing

- Remove the rod (-).0153 N.

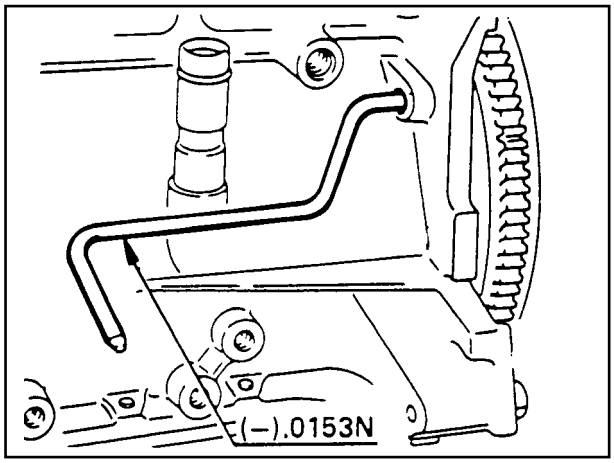


Figure 11-75

- Turn the crankshaft a quarter turn in the opposite direction of running.
- Turn the crankshaft slowly in the running direction and fit the rod at TDC.
- In this position, the dial indicator mounted on the pump should read :
- Piston lift value 0.90.

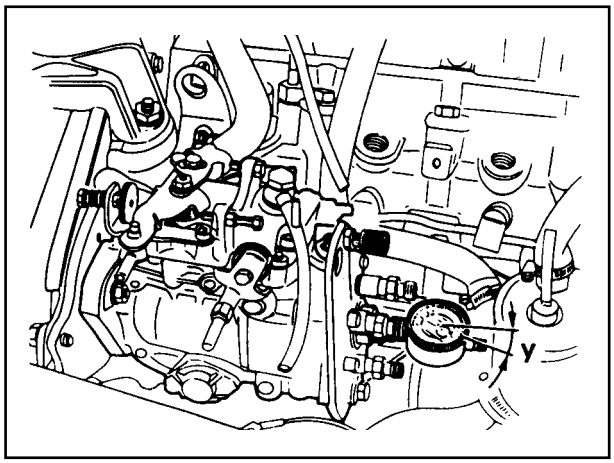


Figure 11-76

I Reassembling the engine

- Install :
  - New heat-resistant washers (1), convex surface upwards.
  - New copper washers (2).
  - Injectors (3) and tighten to 90 Nm (66 lbf ft).
  - Pre-heat plugs (4) and tighten them to 22 Nm (16 lbf ft).

NOTE
The injectors must be checked before refitting.

- Thermostat housing (5) and its cover (6), fitted with a new thermostat.
- Cylinder head cover (7), and tighten to 10 Nm (7 lbf ft).
- Pulley (8) and tighten to 35 Nm (26 lbf ft).

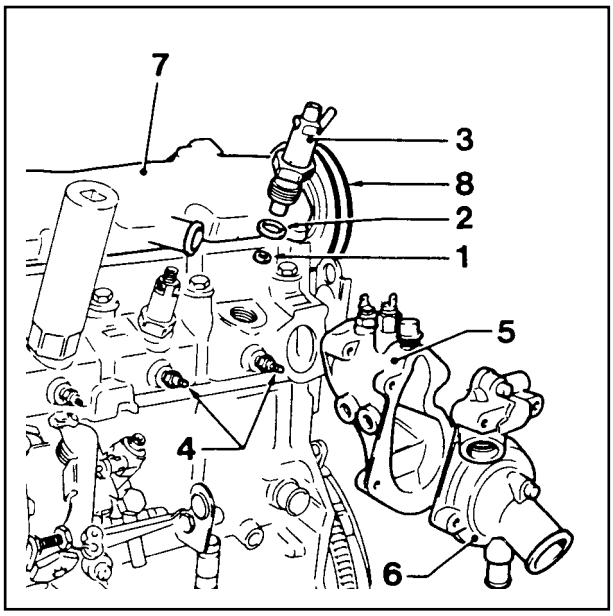


Figure 11-77

II

- Install :
  - Leads of pre-heat plugs.
  - Breather pipe assembly, with the oil filler tube and the oil separator.
  - Accelerated idle control cable coated with CLASS 1 SILICONE compound on the threaded part.
  - Oil pressure switch, and tighten to 27.5 Nm (20 lbf ft).
  - Oil filter cartridge.
  - Alternator and drivebelt
    New belt tension :
    72 SEEM units (60 daN/run).

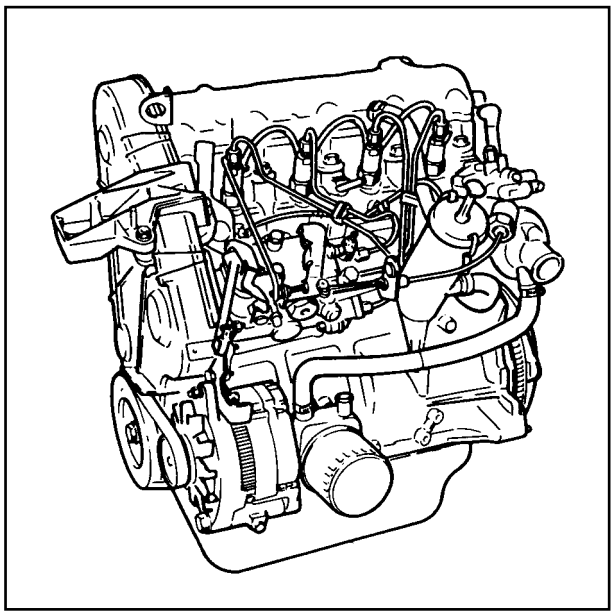


Figure 11-78

III

- Install :
  - Water inlet housing and its metal pipe.
  - Engine bracket (9) and tighten to 45 Nm (33 lbf ft).
  - Exhaust manifold with new seals.
  - Expansion chamber (wide part on the water inlet housing side).
  - Inlet manifold.

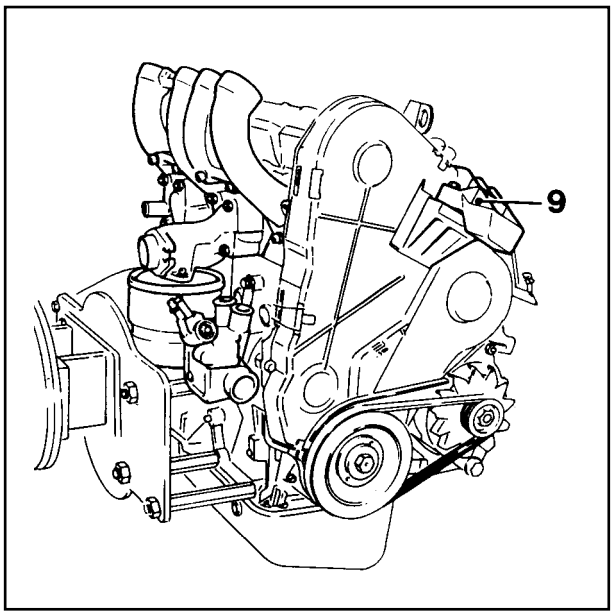


Figure 11-79

- Remove the engine from the DESVIL support.

I Installation activities

- Replace the coolant hoses and hose clips.
- Check the condition of the radiator (scaling, leaks, damage).
- Check the operation of the cooling fan motor.
- Check the coolant filter cap for leaks and pressure setting.
- Replace the air cleaner and fuel filter elements.
- Oil bath air cleaner : thoroughly clean the casing and filter element, and fill to level with engine oil.
- Add engine oil.
- Adjust the controls.
- Fill and bleed the cooling system.
- Warm up the engine.
- Check that the cooling fan starts.
- Adjust the idling speed.

Re-tightening the cylinder head bolts

Bolts A

- Run the engine for 10 minutes at maximal speed.
- Allow the engine to cool for 2 hours 30 minutes with the bonnet open.
- Release the cooling system pressure.
- Bolt by bolt, in the order shown :
  - Slacken a quarter turn.
  - Re-tighten to 70 Nm (52 lbf ft).
  - Repeat these operations.

Bolts B

No re-tightening of the cylinder head bolts.

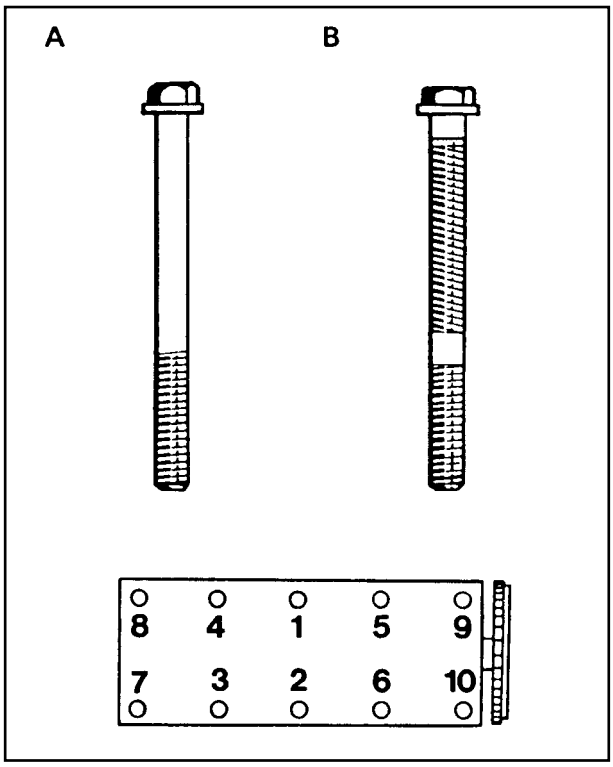


Figure 11-80

Tightening torques (in m.daN)

- Glow plugs 2,2
- Oil seal carrier, timing sprocket end 1,5
- Sump to block 2
- Big ends 5
- Camshaft bearing caps 1,75
- Main bearings caps 7
- Cylinder head cover 1
- Injectors 9
- Clutch mechanism 2,5
- Camshaft sprocket 4
- Injection pump sprocket 5
- Coolant pump 1,5
- Oil pump 2
- Crankshaft pulley ..... 4 + 60°
- Exhauster pulley 3,5
- Timing belt tensioner 1,5
- Oil cooler 6,5

- Cylinder head bolts	Bolts A	Bolts B
- pre-tightening	3	3
- tightening	6	7
- slackening	1/4 tour	None
- re-tightening	7	+120°

- Flywheel 5

Cooling system *

The improvements to the cooling system are as follows :
- Stronger shaped hoses
- Pressure setting in the cooling circuit increased from 0.8 to 1 bar.
- Baffle plate omitted

Method of operation of cooling system

Cooling air flows from the Diesel engine to the radiator. The pressure increases with the temperature, and at 1 bar the valve in the radiator cap (1) opens the way for the water and the gas to flow to the expansion reservoir (2) (venting). A breather opening in the expansion reservoir cap allows the gases to escape.
When the temperature drops, the pressure drops and the water in the expansion reservoir flows back into the radiator. A second valve in the radiator cap is now operated, allowing the coolant to return into the cooling circuit.

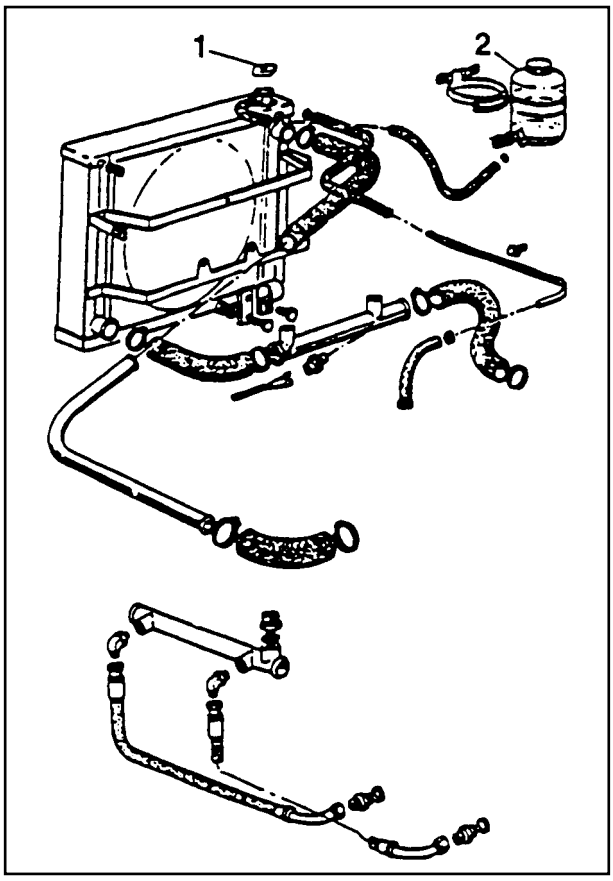


Figure 11-81

* Applies to new M15 from serial number 717111004000 (Diesel)

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Technical data for maintenance

Assembly group 15	
LPG engine	**Applies to :**
Make : RENAULT Model : C1J 768	
Cubic displacement ccm	1397
Power KW / (HP to DIN) Maximum speed : RPM	34 (47) 2900 ± 50
Bore : mm	76
Stroke : mm	77
Firing order	1 - 3 - 4 - 2
Direction of rotation seen from flywheel	anti-clockwise
Coolant capacity : l	8
Oil capacity with filter change : l	3.5
Ignition Timing value	Electronic RE 204 Not applicable
Spark plugs	Bosch : W 8 DC AC : C42CXLS Champion : N 281 YC EYQUEM : C 52 LS
Fuel	GPL S126A
Max. torque : Nm/RPM	10.6 2700
Compression ratio	9.25 : 1
Engine dry weight with flywheel : kg	100
Valve clearance	cold warm Inlet 0.15 0.18 Outlet 0.20 0.25

Technical data for maintenance

Assemby group 15 **LPG engine**	**Applies to :** **C1 J768**
Idle speed : RPM	780 ± 25
Max. no-load speed : RPM	2900 ± 100
Fuel	LPG bottle 11 kg
Electrical system	12 V
Starter	12 V
Alternator	12 V / 60 A integrated regulator
Compression (engine cold) : bar	12 to 15 (min 10)
Operating temperature	95°C
Coolant temperature	95°C
Max. coolant temperature	110°C
Valve gear	chain driven
Fuel consumption (standard truck)	1.6
Oil pressure (engine at 80°C) : bar	Idle : 0.7 min 2900 RPM : 3.5 min

LPG engine

Engine identification

The engine is identified by a plate riveted to the cylinder block. The shape of this plate is determined by the amount of space available.

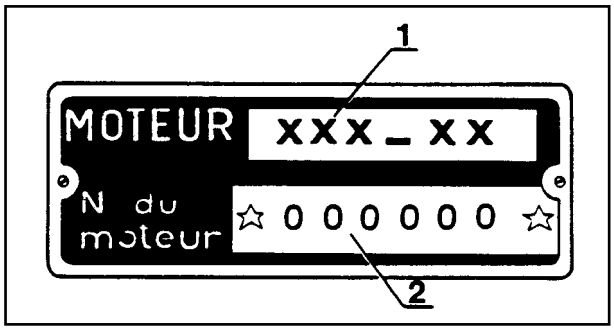


Figure 11-82

1st model

This shows :

1 Type number followed by the engine suffix
2 The manufacturer's number

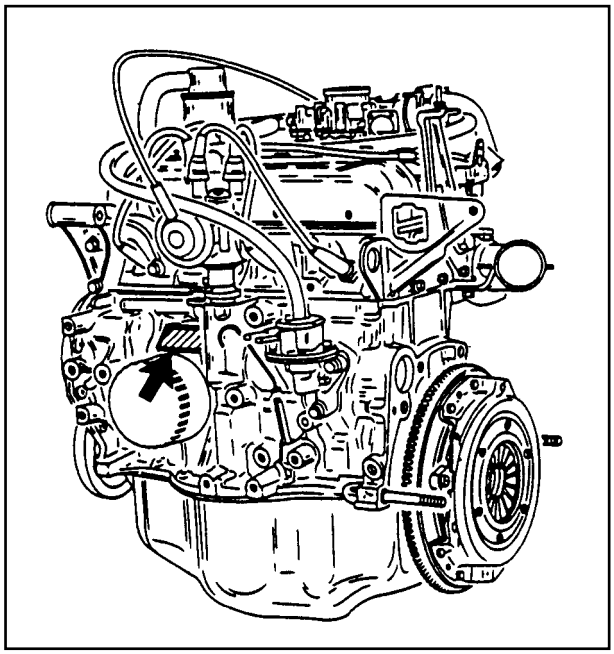


Figure 11-83

2nd and 3rd models :

These show :

At A : Engine type.
At B : Engine type approval letter.
At C : R.N.U.R identification.
At D : Engine suffix.
At E : The engine manufacturer's number (preceded by suffix reminder).

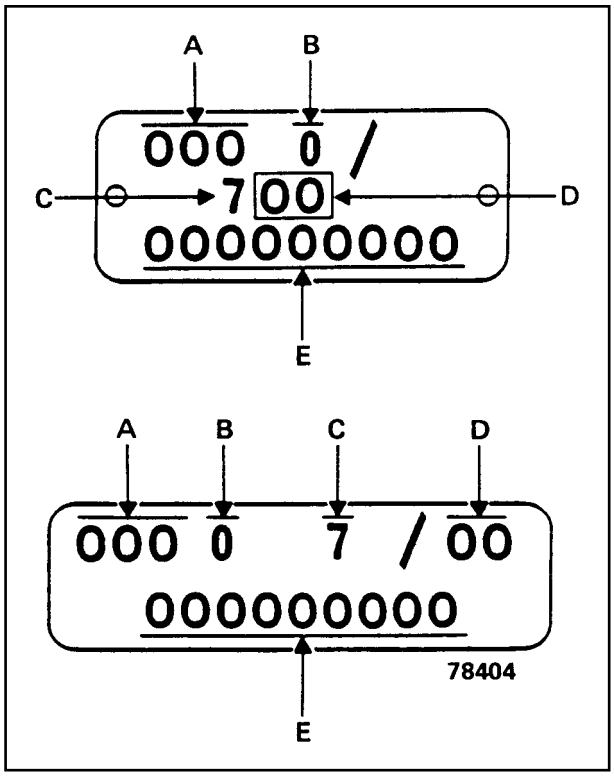


Figure 11-84

Tightening, retightening

Tightening

Torque tighten the bolts in the correct sequence as shown.

Perform :

- Rocker arm adjustment,
- Filling and bleeding of the cooling system,
- Filling the engine with oil.

Run the engine for 20 minutes. After the engine has been shut off for 2 1/2 hours, retighten the cylinder head :

- Loosen bolt No. 1 half a turn and tighten it to the specified torque.

- Repeat the above on all the other bolts in the correct sequence.

- Adjust the rocker arm clearances.

If this operation is used, the cylinder head bolts no longer have to be retightened after 500 miles (1000 km), for the cases mentioned in the note page 11-44.

Retightening

- Use the torque wrench.

- Loosen bolt No. 1 half a turn and retighten it.

Carry out the above on the other bolts, in the correct sequence.

- Adjust the valve clearance.

Removing the Renault LPG engine

NOTE

This activity does not apply for the diesel engine (lack of space).

1. Disconnect the battery.
2. Remove the bonnet (refer to Group 02).
3. Remove the engine compartment cover (refer to Group 02).
4. Disconnect the cable harness for the engine auxiliary units.
5. Unscrew and remove the brake master cylinder bracket on the pedal mount.
6. Unscrew the pedal mount.
7. Remove the starter.
8. Disconnect the vaporizer hoses on the engine.
9. Disconnect the carburetor control cable at the carburetor.
10. Loosen the clamp on the lower coolant hose at the engine block and disconnect the hose.
11. Using a hoist and lifting gear, hook the engine to the lifting eyes.
12. Remove the TDC sensor mounted on the top of the flywheel housing.
13. Loosen the four M8x14 transmission bolts at the connecting plate for the flywheel and torque converter through the opening of the removed TDC sensor.
14. Remove the eight M10x40 bolts on the gearbox side with a flexible head spanner.
15. Pull the engine back and lift it out of the chassis.
16. Installation is the reverse of removal.

Lubricating system

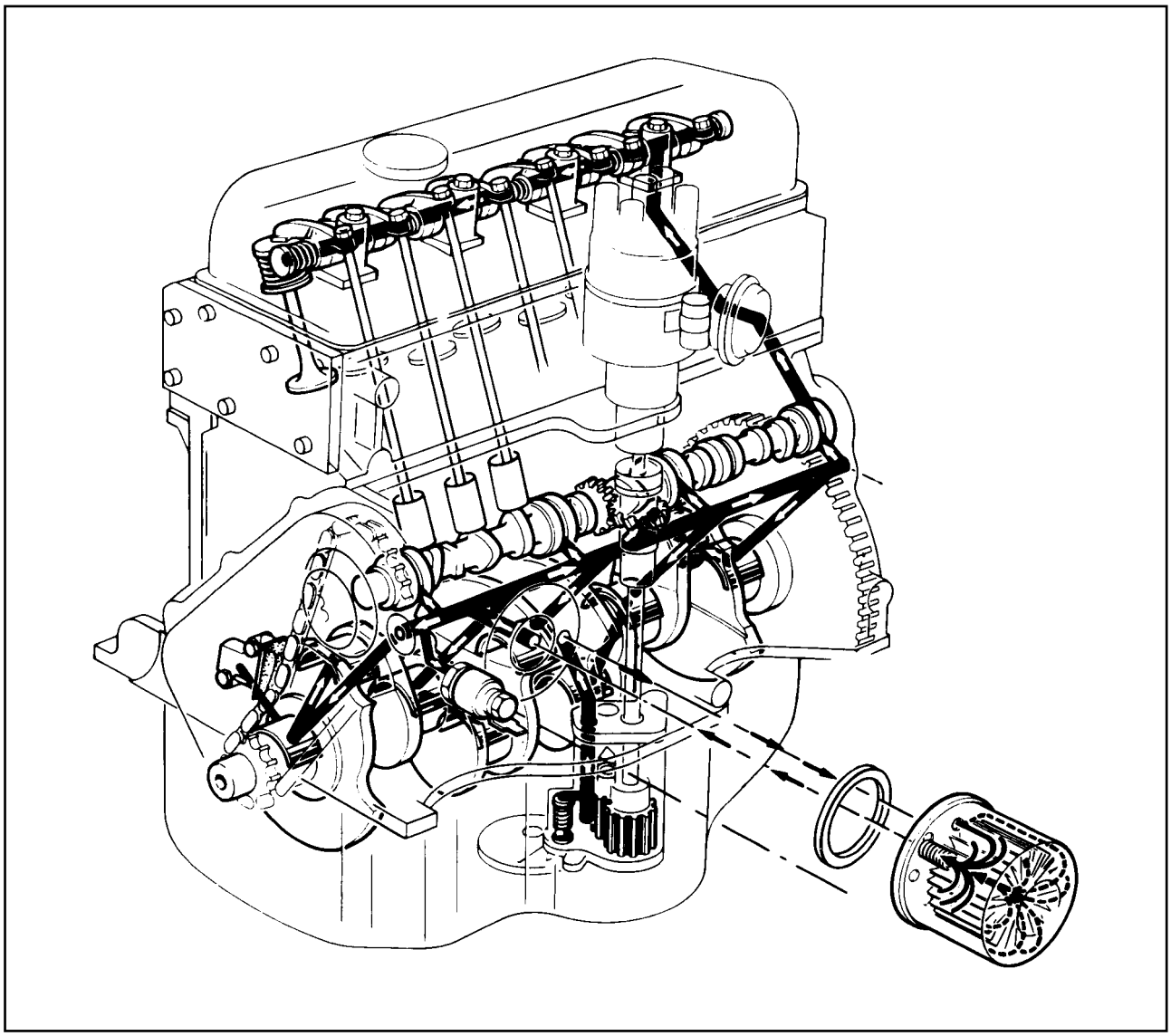


Figure 11-85

Cylinder head

Removal, Installation, Replacing the gaskets

Cleaning the cylinder head and cylinder block

Aluminium parts must not be scraped.

Use Magnus "Magstrip" liquid or "Decaploc 88" to dissolve any part of the gasket remaining stuck.

- Brush the liquid onto the area to be cleaned ; wait about 10 minutes, then lift off with a piece of wood.

Gloves must be worn for this operation.

Take great care when cleaning the gasket faces on the cylinder head and cylinder block to prevent any foreign matter entering the oil inlets which supply oil under pressure to the rocker assembly (oil passages in cylinder block and cylinder head).

Failure to respects this advice may result in the calibrated orifices for lubrication of the rocker shaft assembly becoming blocked and the cams and rocker arm pads wearing rapidly.

- Use a syringe to suck up any oil remaining in the cylinder head bolt holes.

This is necessary in order to obtain precise torque tightening of the bolts.

Checking the liner protrusion

Check the liner protrusion (see chapter on liners and pistons) using thrust plate Mot. 252-01 and dial gauge support Mot. 251-01.

Protrusion less seal : 0.02 to 0.09 mm.

Check the liner - cylinder block assembly dimensions (see respective section) if the protrusion is incorrect.

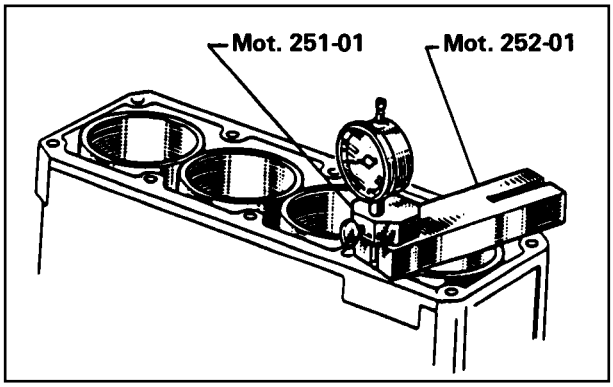


Figure 11-86

Removal

Remove :

- Auxiliary units on the cylinder head.
- Withdraw the pushrods and lay them out in order.

Unscrew and remove all the cylinder head bolts except bolt A wich passes through the location pin near the distributor. Leave this bolt in until the head gasket is unstuck.

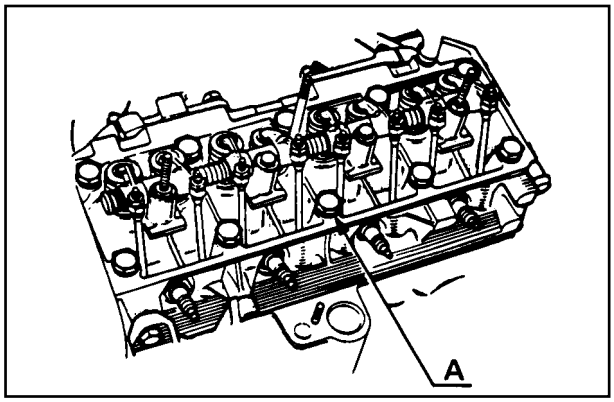


Figure 11-87

Checking the sealing face for truth

- Use a straight edge and a set of feeler gauges to check if bow is present.

Maximum bow (X) = 0.05 mm.

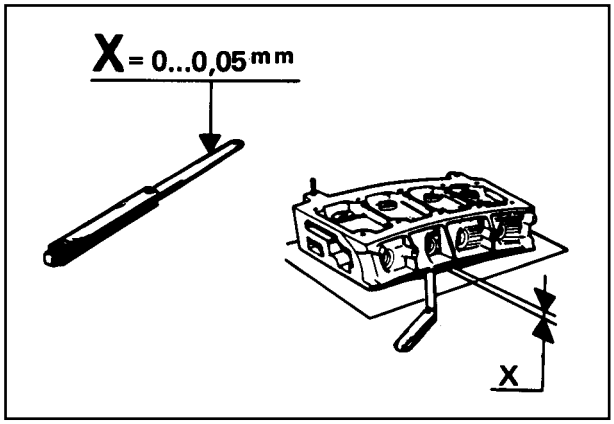


Figure 11-88

The cylinder head gasket must not be lifted as the gasket adheres to the head, block and liners. Any attempt to lift the head would break the watertight seal at the bottom of the liners and allow foreign objects to enter the sump.

The cylinder head must be pivoted round the locating pin (bolt still in position) in order to loosen it from the block.

- Tap each end of the cylinder head on the side with a plastic hammer to loosen it.

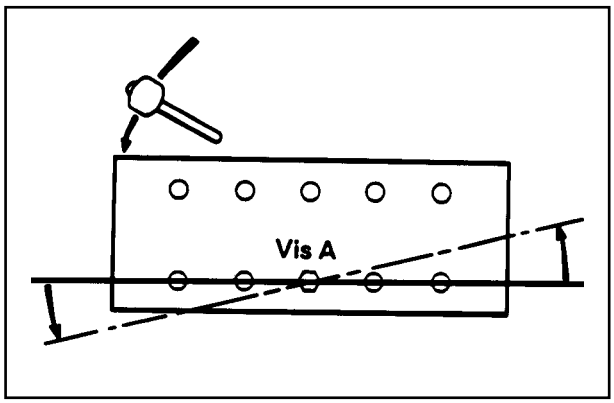


Figure 11-89

- Remove bolt A.

- Remove the cylinder head.

Fit the liner clamp Mot. 521-01.

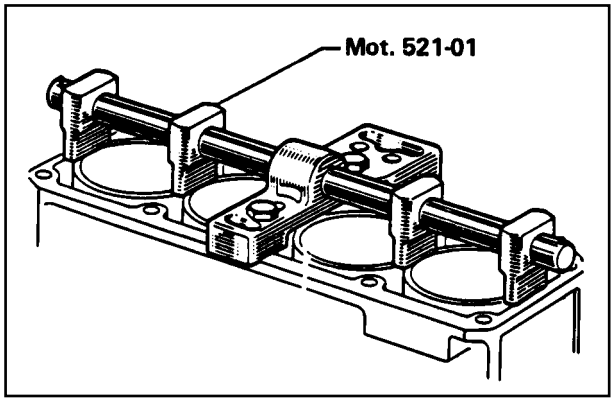


Figure 11-90

Installation

Special points concerning installation :

Check the condition of :

- An unworn centre should be apparent. The top ends of the pushrods.

G - adjusting screw
T - tappet
Z - contact-free centre

- The tappets should also have an unworn centre.

T - pushrod
Z - contact-free centre
P - tappet

If this is not the case, the concerned parts must be changed.

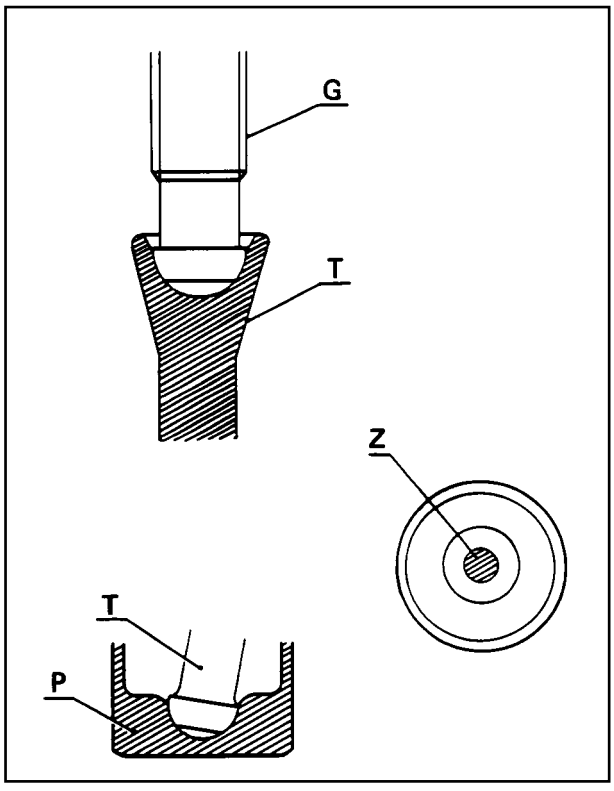


Figure 11-91

- Remove the liner holding device.

- Insert the gasket locators Mot. 104.

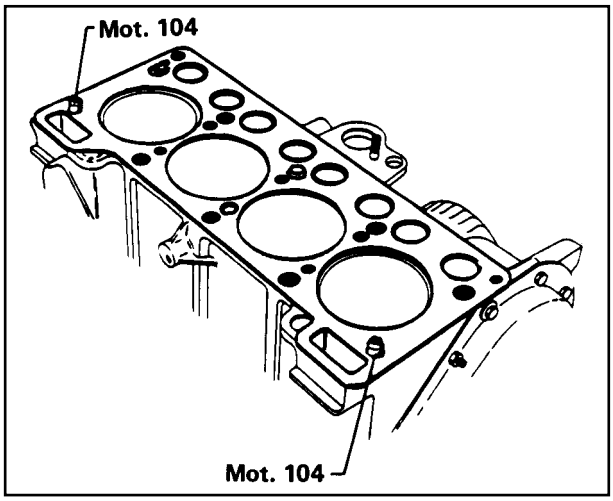


Figure 11-92

- Fit the cylinder head gasket dry with the "HAUT-TOP" marking uppermost.

Once the gasket is in place it must not be lifted as the adhesive varnish head cannot be reused.

It this is done, nevertheless, because the cylinder head is misaligned, the gasket must be thrown away and another gasket used.

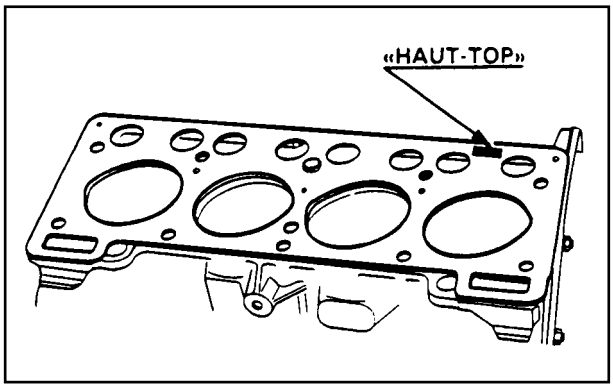


Figure 11-93

- Position the cylinder head with rocker arm assembly.

Tightening sequence

- Fit two cylinder head bolts and tighten tighly to prevent cylinder head from moving.
- Remove the locating pins.
- Fit the remaining bolts.
- Torque tighten all the bolts in the correct order shown.

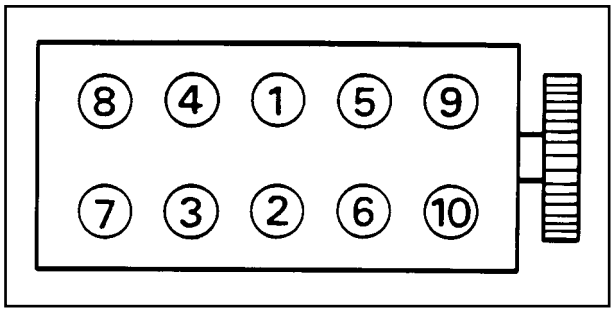


Figure 11-94

NOTE
The cylinder head has to be retorqued in the following cases :

- after each removal of the cylinder head
- on replacement engines.

After all these activities the valve clearance must be set.

Torques

Cylinder head	Rocker arms			
Cold or warm (daN.m)	Inlet		Outlet	
	Cold	Warm	Cold	Warm
5.5 to 6.5	0.15	0.18	0.20	0.25
Cold 6 to 6.5	0.20		0.25	

Cylinder head

Replacing

Special tools required :

Mot. 320	Valve retaining plate
Mot. 330-01	Cylinder head support for fitting to adjustable stand
Mot. 382	Valve spring compressor
FACOM U43LA	Valve spring compressor

- Remove the cylinder head (see chapter "Changing the gaskets").
- Place the cylinder head on support Mot. 330-01 (which can be fitted to the adjustable stand or bench stand).
- Remove the cylinder head attaching parts.

Removal

All types of engines except 840.CJ.C7K.

- Push the valves down using thrust plate Mot. 320.

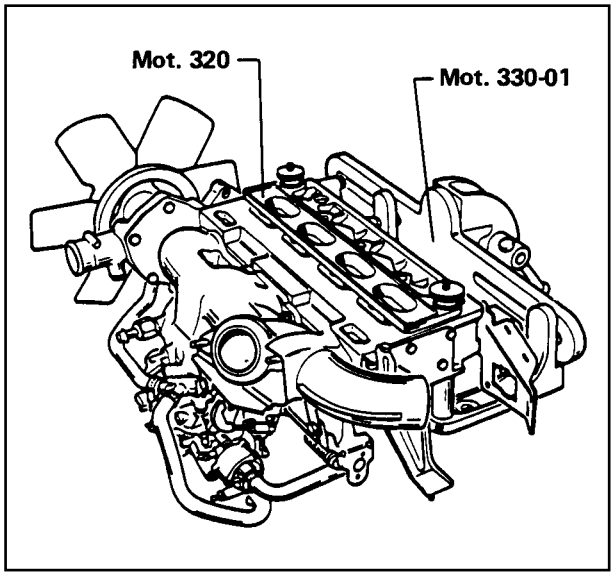


Figure 11-95

- Compress the valve springs using compressor Mot. 382.

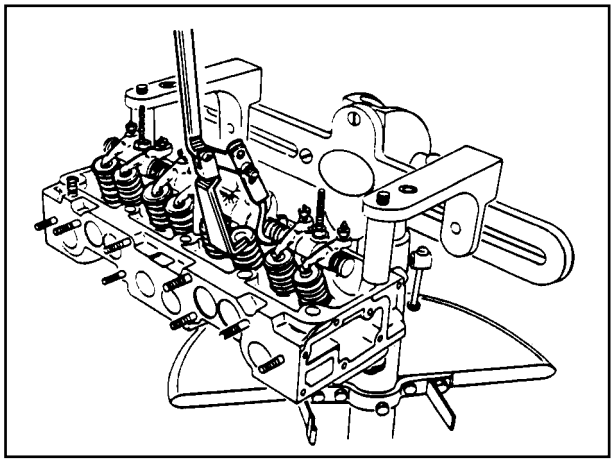


Figure 11-96

- Remove the half-collets, top-cups, springs and base washers.

- Lay all the parts out in order.

- Remove the rocker arm assembly and the thrust plate Mot. 320.

All types of engines

Use a tool of the FACOM U43LA type.

(First of all the rocker shaft assembly must be removed).

- Compress the valve springs using compressor FACOM U43LA.

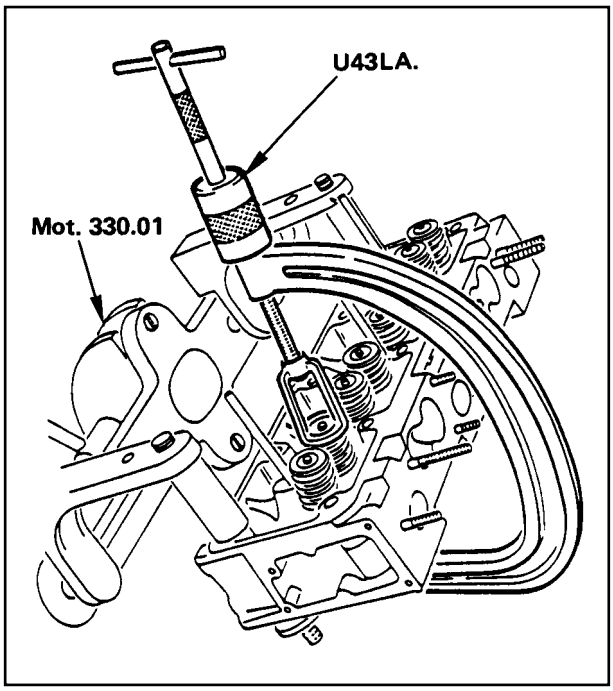


Figure 11-97

- Remove the half-collets, top cups, springs, base washers and valves.

- Lay all the parts out in order.

Installation

- Fit the new, cleaned cylinder head on the support Mot. 330-01.

- Insert the new valves and grind them lightly onto their respective seats.

It is essential to clean the cylinder head and the valves (having marked their position) after the valve grinding operation.

- Refit the valves in their respective positions.

Fit thrust plate Mot. 320 if spring compressor Mot. 382 is to be used.

Assemble in the correct order and install :
- base washers (4)
- springs (3) closest coil downwards towards cylinder head
- and cups (2) at the top

- Use tool Mot. 382 or FACOM U43LA (depending on the model) to compress the springs.

- Fit the half-collets (1).

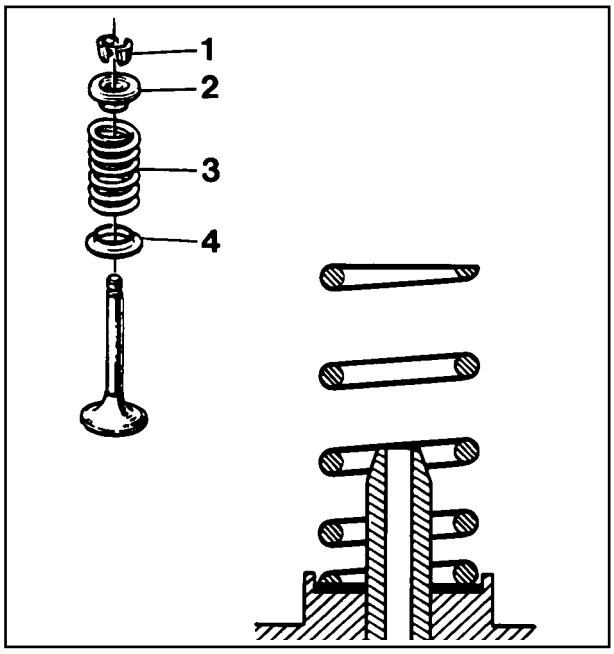


Figure 11-98

Identifying the half-collets

1st type of installation :

The valve stems are retained by half-collets A for the inlet, and half-collets B for the exhaust.

2nd type of installation :

The inlet and exhaust valve stems are provided with identical half-collets B.

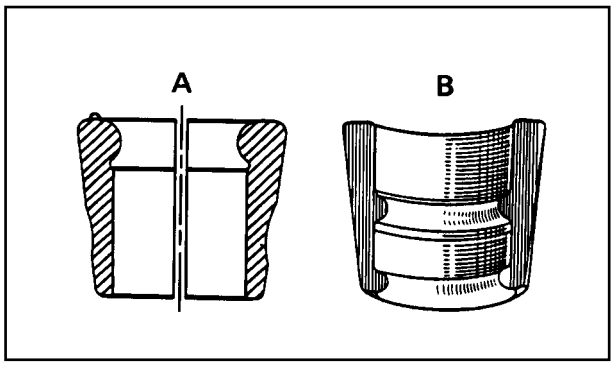


Figure 11-99

- Remove thrust plate Mot. 320.

- Refit the rocker shaft assembly.

- Refit the cylinder head attaching parts.

Refit the cylinder head (see chapter "Changing the gasket").

Cylinder head
Rocker shaft assembly

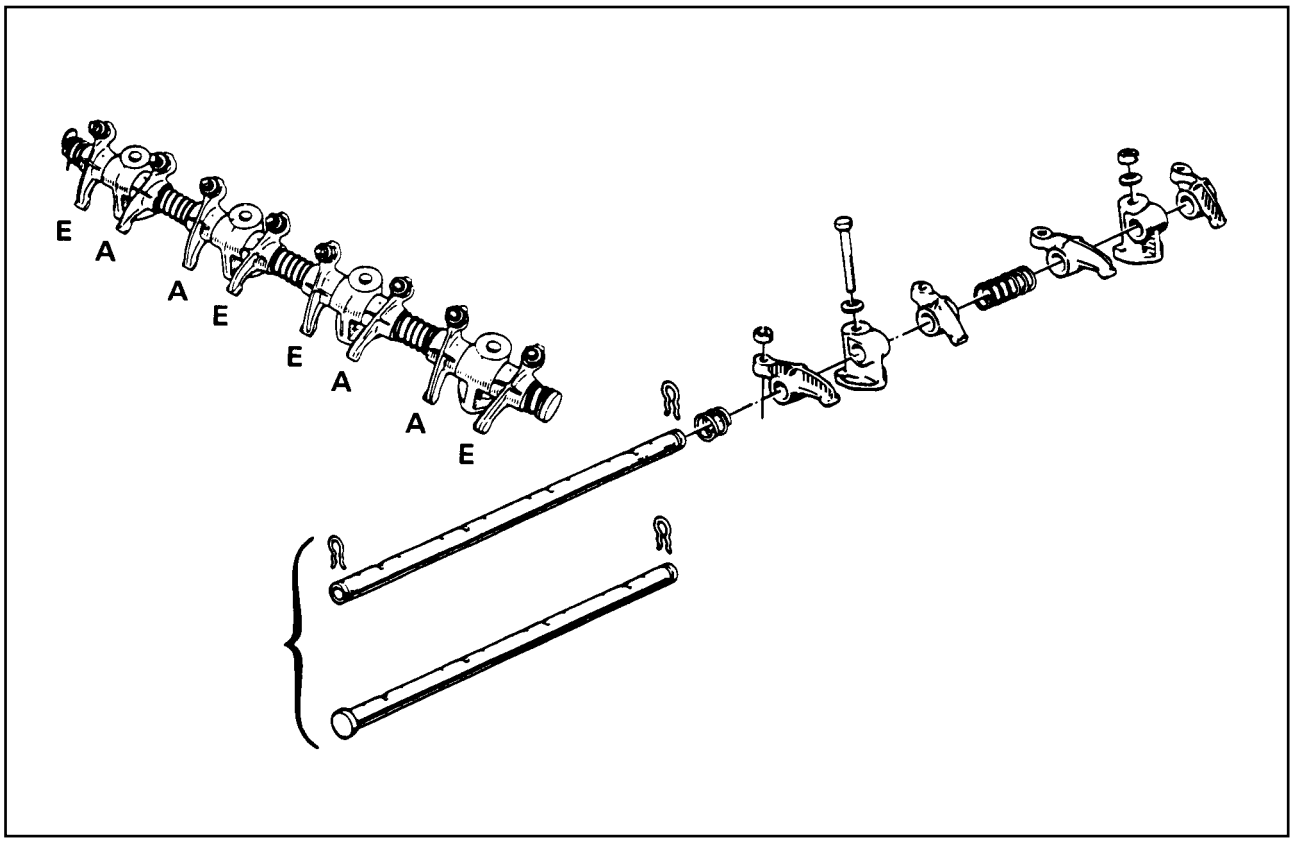


Figure 11-100

The inlet rocker arms (A) and exhaust rocker arms (E) are different.

The plugs at each end of the rocker shaft are press-fitted and must not be dismantled.

Some engines are equipped with drilled inlet and exhaust rocker arms.

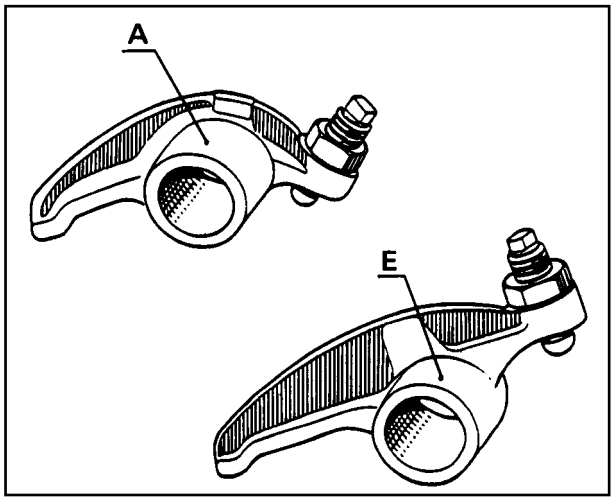


Figure 11-

The Parts Department only supplies drilled inlet and exhaust rocker arms as service parts.

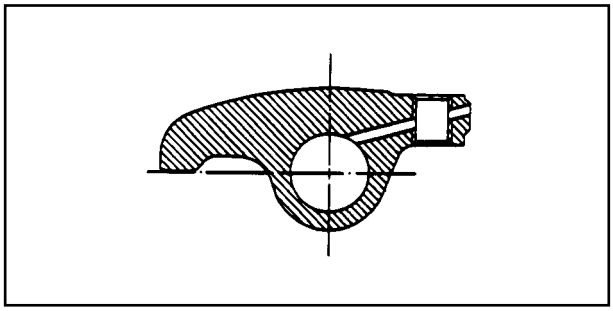


Figure 11-102

1st method of installation :

The oil is supplied by pillar (A) at the clutch end between the bolt and the bore.

The four rocker shaft pillars are identical.

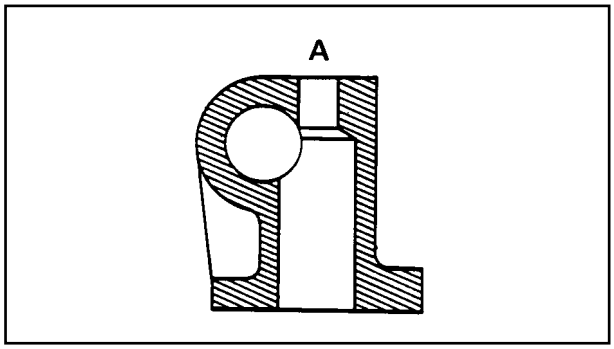


Figure 11-103

2nd method of installation :

Only the pillar (C) at the clutch end has an oil hole (B) for supplying oil to the rocker shaft assembly.

Under no circumstances should the pillars be mixed up when reassembling since the others (D) are not drilled and no oil can pass through them.

The Parts Department will only supply pattern (C) pillar as a service part. This pillar is provided with an oil feed hole and may be mounted instead of pillars (A) or (D).

Fit the parts to the rocker shaft in their correct order.

The lubrication holes in the rocker shaft must face towards the pushrods. The support fixing bolts must be aligned with those in the rocker shaft.

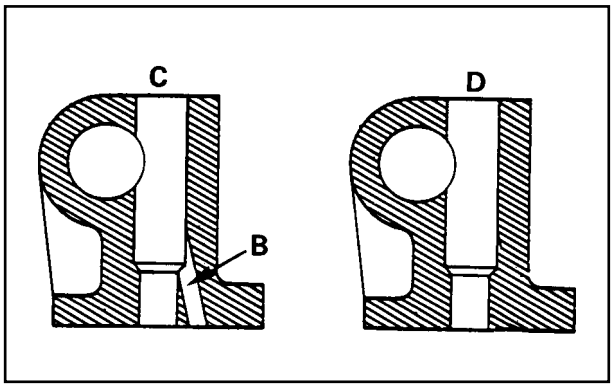


Figure 11-104

Cylinder head

Recutting valve seats

This operation can be performed with the NEWAY valve seat cutting tool kit (see MR 500).

NEWAY-cutters	Tools
Reference	Description
230	Cutter for recutting valve seat face angles (90° and 120°)
212 ou 213	Valve seat width reducing cutter
150-7	Valve seat cutter pilot for 7 mm Ø valves
150-8	Valve seat cutter pilot for 8 mm Ø valves
503-T	Drive wrench

NOTE
The above tools are available from :
Société CERGYDIS
Immeuble le Président
14, Chaussée Jules César
95520 OSNY
Tél. : 01.30.38.52.10

- Insert the correct pilot in the valve guide.

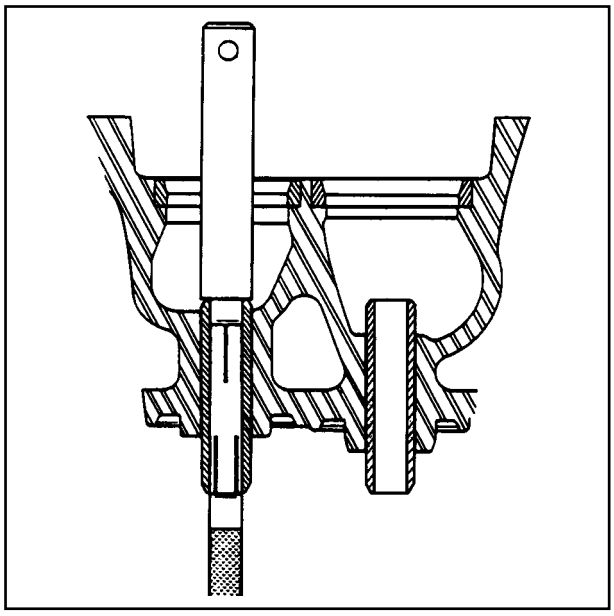


Figure 11-105

- Select a cutter to match the diameter and angle of seat to be recut.

- Adjust the position of the blades to suit seat diameter (Allen key No. 240).

- Slip the cutter over the pilot ; do not let it fall onto the seat.

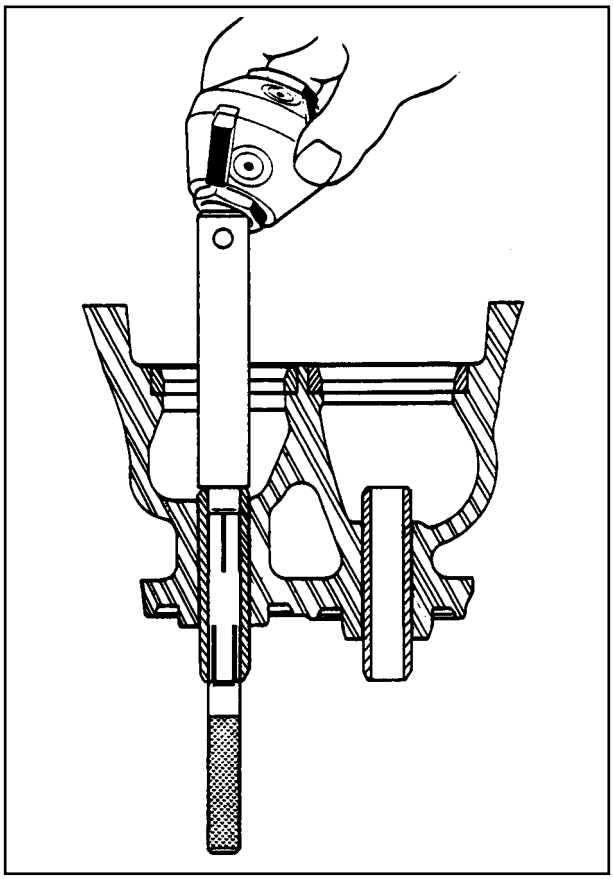


Figure 11-106

- Fit the "T"-handle No. 503 T for cutters.

- Rotate the "T"-handle and press lightly.

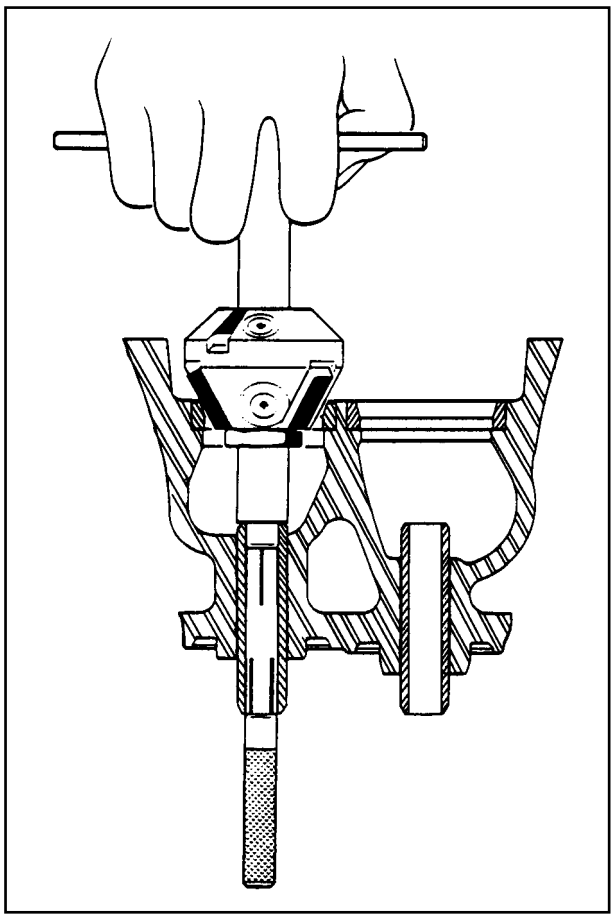


Figure 11-107

Once a good seat has been obtained, make cuts at (2) and (3) to obtain the width X as indicated in the "Technical data" chapter.

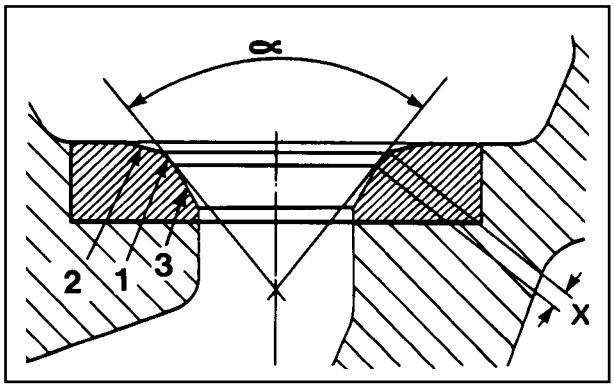


Figure 11-108

- Clean the cylinder head carefully.

Cylinder block

Changing the camshaft bearing bushes

All types except 840-30 and C7K.

This operation is performed when the camshaft has been removed. There is only one detachable camshaft bush on these engines (at flywheel end). Drive the old bush in towards the inside of the engine.

- Lift up the edges and collapse it to remove it.

When fitting the new bush, note :

- The position of the oil slots :
  • 8x4 mm slot to top,
  • 6x4 mm slot to bottom.

- The position of the longitudinal slit (arrow).

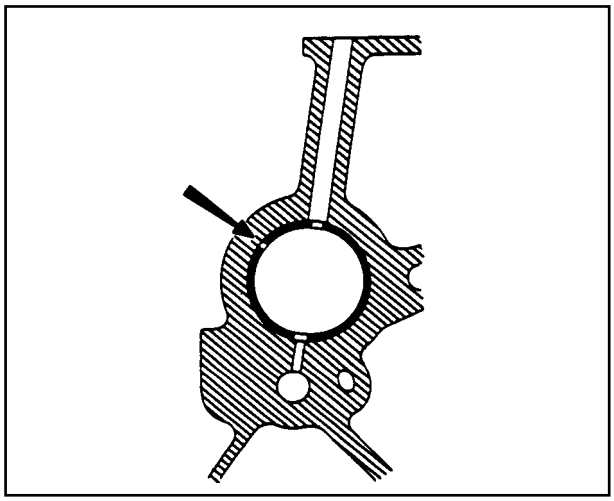


Figure 11-109

- Dimension B = 14.5 mm recessed from the block face.

- Use a makeshift tool (dimensions in mm).

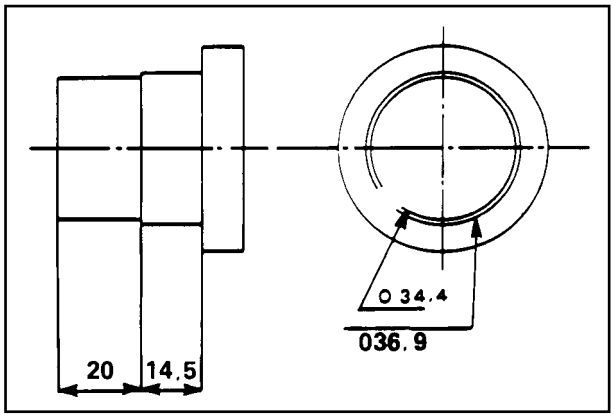


Figure 11-110

No reaming is necessary once the new bush is in position.

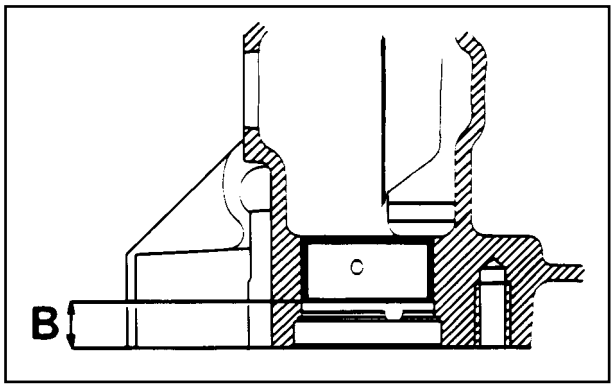


Figure 11-111

- Remove the camshaft plug (5) by giving it a smart tap in the centre. Use mandrel (A) to drive out :

- Bushes (1), (2), (3) towards the inside of the block - collapse them to remove them.

- Bush (4) must be tapped from the inside outwards.

- Drill out both plugs in the tappet housing.

- Clean the cylinder block.

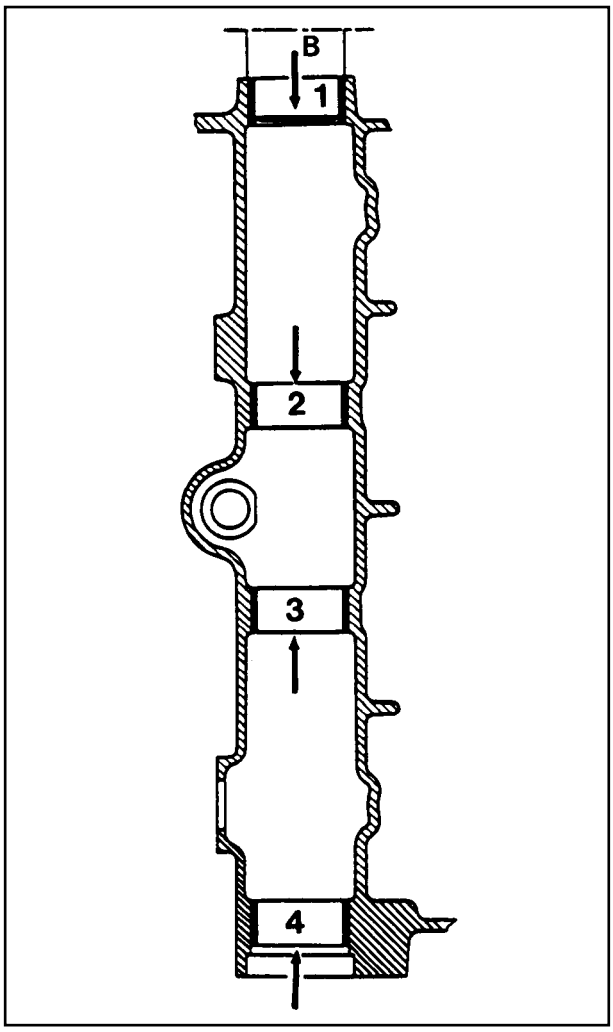


Figure 11-112

The inside bushes (2) and (3) are smaller than the outside bushes (1) and (4).

Using mandrel (B), fit the new bushes as follows (in the arrowed direction) :

- Inner bush (2) : the end (end opposite the bush) should be 17.5 mm proud of the block outside face for correct bush location,

- The inner bush (3) : the end of the mandrel (end opposite the brush) must be flush with the block outside face for correct bush location,

- The outer bush (1) : this should be flush with the outside face of the block,

- The outer bush (4) : this should be recessed 13 mm from the block outside face.

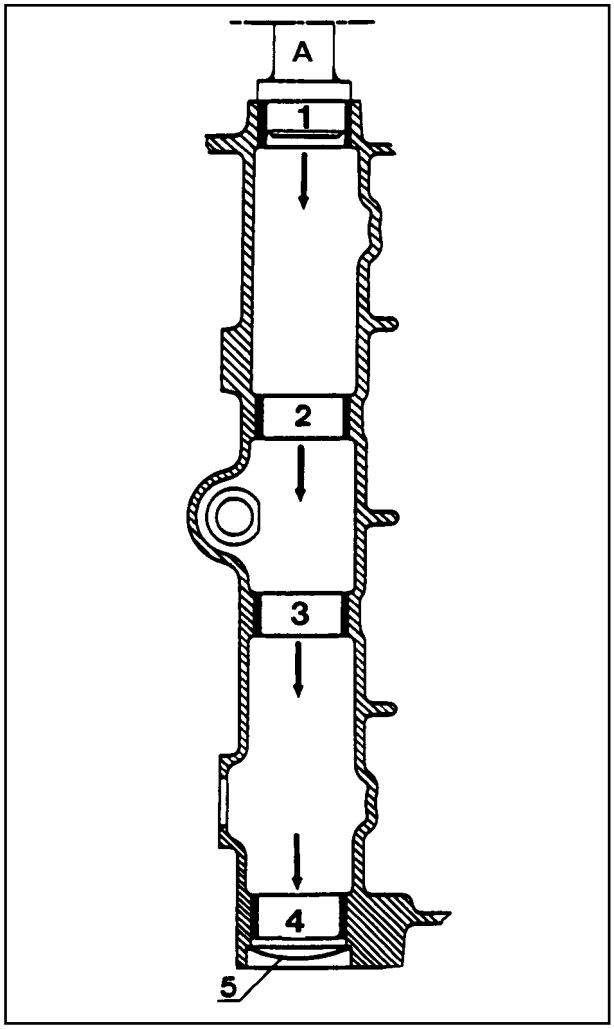


Figure 11-113

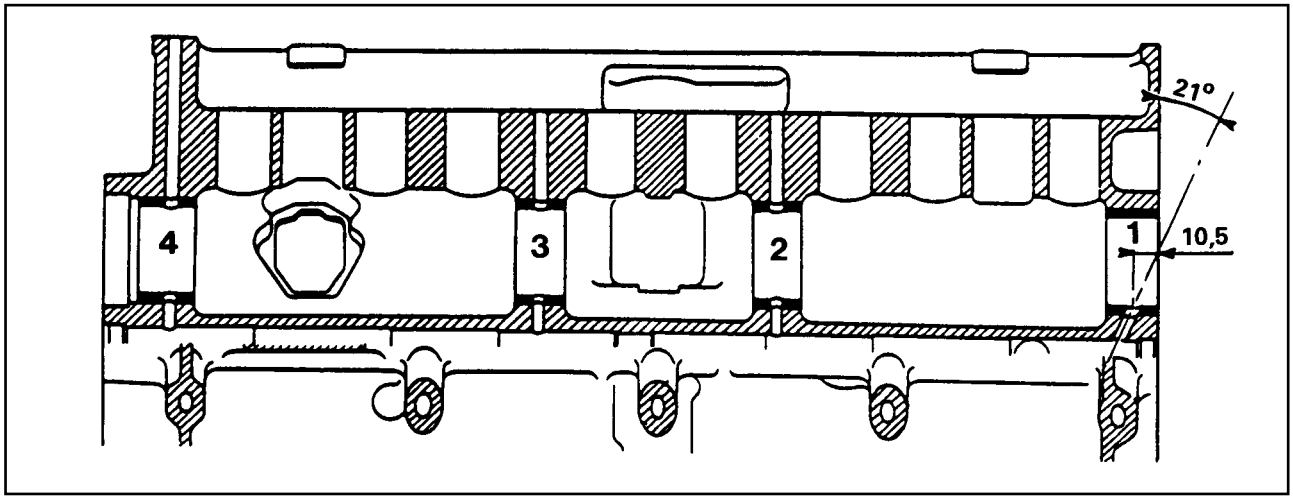


Figure 11-114

- Drill the oil holes in the bushes :

a) Bushes 2, 3 and 4
   - one 5 mm hole at the top,
   - one 3 mm hole at the bottom.

b) Bush 1
   - one 4 mm hole at the bottom in line with the other 3 bottom oil holes.

- Fit the 5 main bearing caps on the block.

- Ream the bushes out :
  diameter 38 mm +0.025/-0

- Surface finish should not be more than 3 microns.

Use the camshaft as a reference centreline :

- The centre of the camshaft is determined by the following dimensions :
  E = 128 mm ± 0.05
  F = 81 mm ± 0.05

- The camshaft bush bores are reamed to a finished size of :
  58.731 mm +0.019/0

Check

- Out-of-parallel of camshaft with line bores :
  max. 0.05 mm

- Bush bores :
  a checking bar of :
  38 mm $^{-0.005}_{-0.015}$
  should turn in all four bushes.

- Coat with SCELBLOC loctite and insert a new core plug (5) in the end, convex face outwards.

- Give it a smart blow in the centre to spread it.

- Fit the 2 Plugs in the tappet housing and peen them over.

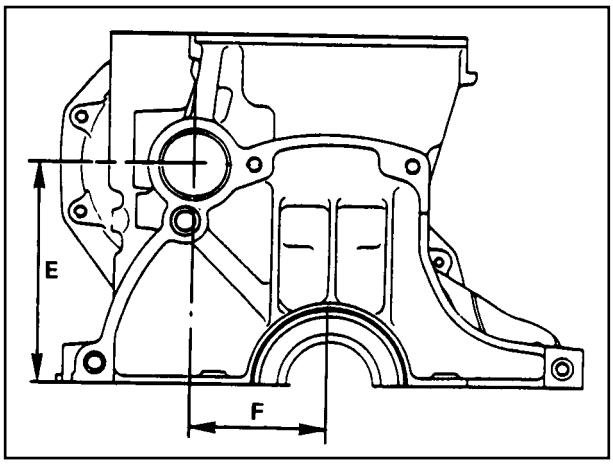


Figure 11-115

Oil filter connector

1st type : cylindrical threaded union 19 mm dia. 1.587 pitch

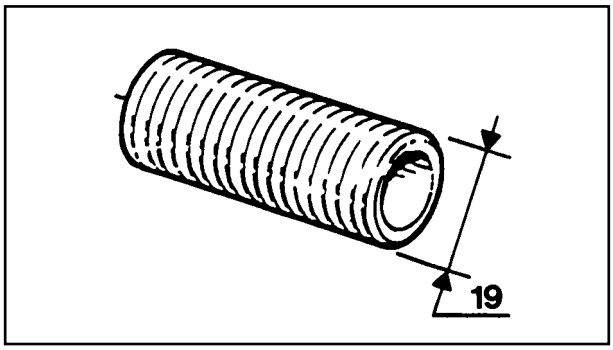


Figure 11-116

2nd type : stepped threaded union
19 mm dia. 1.587 pitch (cylinder block end)
20 mm dia. 1.50 pitch (oil filter end)

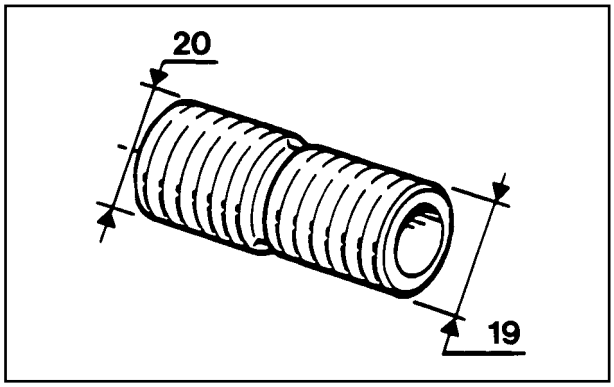


Figure 11-117

3rd type : cylindrical threaded union
20 mm dia. 1.50 pitch

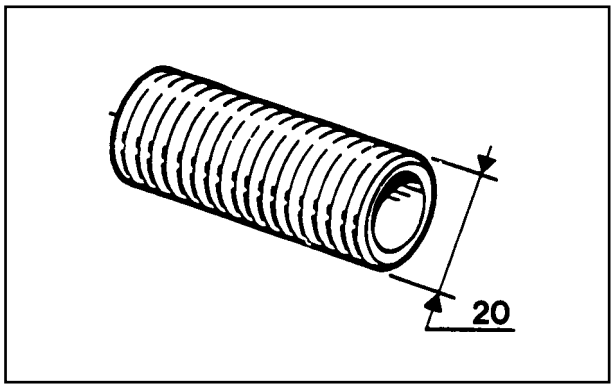


Figure 11-118

- The filter stamped with 20x1,50 must be fitted on 20x1,50 threaded union with a metric pitch.

- Visual inspection of the filter.

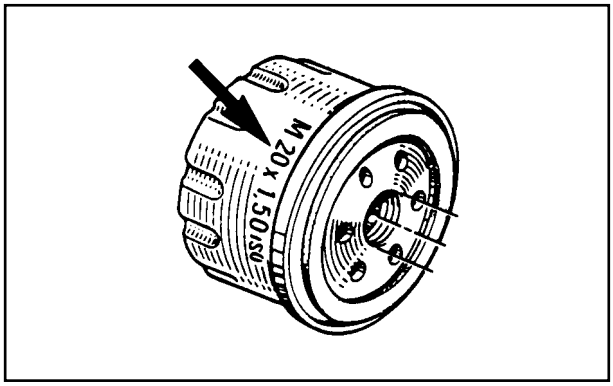


Figure 11-119

ATTENTION
It is possible to fit a 20x1.50 oil filter on a 19x1.587 threaded union by mistake. In such a case, the oil filter will loosen as a result of vibrations. Furthermore, there is an abnormal clearance between the assembly and the engine block.

NOTE
Engines fitted with a 20x1.50 oil filter are marked by a label affixed to the rocker cover.

Cylinder block

Plugs for the main oil passages

Special tools :

Mot. 111 Inserting punch

Material

Loctite SCELBLOC Fixing and sealing resin

- Coat the aluminium plugs with resin and sealant.
- Fit the aluminium plugs (1) and (2) for the main oil passages in position.
- Fix them using tool Mot. 111.

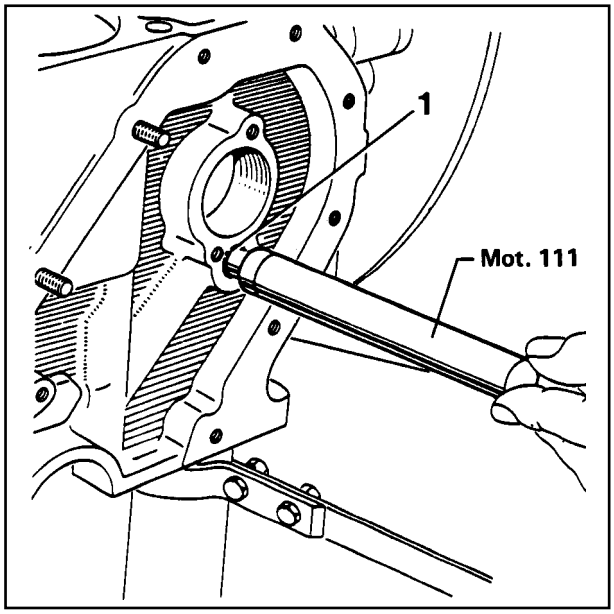


Figure 11-120

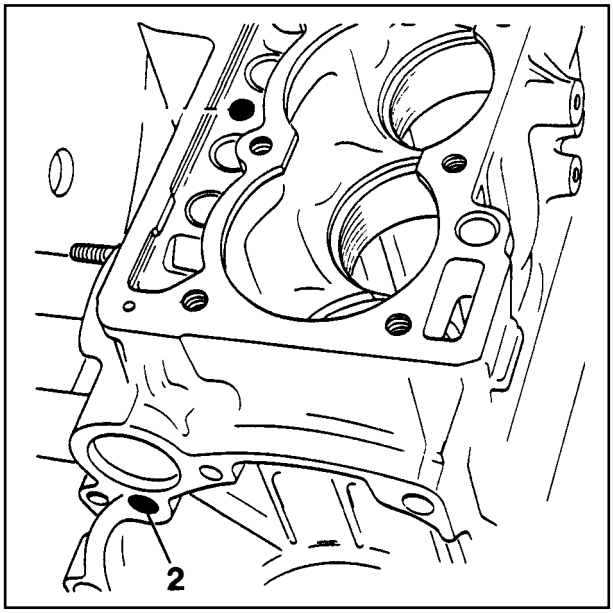


Figure 11-121

Replacing liners and pistons

Special tools :

Mot. 251-01	Clock gauge support for liner protrusion check
Mot. 252-01	Thrust plate for Mot. 251-01
Mot. 521-01	Liner clamp
Mot. 567	Rocker arm adjusting tool
Mot. 574-13	Gudgeon pin mounting tool
Mot. 792-01	Engine support for fitting to Desvil stand

The tools listed below can still be used but are no longer available from the Parts Department.

Mot. 217-01 Mot. 218 Mot. 459 Mot. 655	Tool for fitting pistons in liners*
Mot. 851	Clamp for fitting pistons in liners*

* These are replaced by a FACOM 750 TB type clamp for all engine types.

Tightening torques (daNm)

Cylinder head bolts : see "Cylinder head" chapter (tightening-retightening)

Big end cap nuts : 4 - 4.5

Materials

CAF 4/60 THIXO	Sealing paste for sump and timing gear cover
Magnus MAGSTRIP or DECAPLOC 88	Cleaning aluminium seal faces
MOLYKOTE M 55 plus	grease for inserting gudgeon pins

Drain :

- Cooling system
- Oil from sump

- Fasten the engine to the support Mot. 792-01.

Remove :

- Cylinder head (see "Cylinder head" chapter)

- Sump (remove the bolts and turn the crankshaft so that the pistons of No. 1 and No. 4 cylinders are on BDC).

Mark the connecting rods :

No. 1 at the flywheel end on the side opposite the camshaft.

- Unscrew the big-end cap nuts.

- Remove the big-end caps and the bearing shells.

- Take out the liner, piston and connecting rod assembly group.

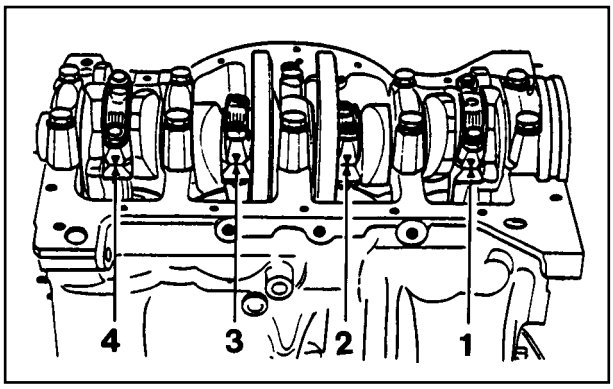


Figure 11-122

Cleaning

The gasket face on aluminium parts must never be scraped.

- Brush on Magnus "Magstrip" or "Decaploc 88" liquid to dissolve any gasket particles still remaining.

- Apply the product to the section to be cleaned, wait for approximately 10 minutes then remove the remnants with a piece of wood.

Gloves should be worn for this operation.

Avoid any spots dropping on the paintwork.

Great care must be taken with this operation to prevent foreign objects from entering the passages supplying pressure-fed oil to the rocker shaft (channels in cylinder head and block).

If the above advice is disregarded, rocker arm jet holes may become blocked, which will lead to rapid cam wear and rocker arm pad wear.

- Using a syringe, suck up any oil remaining in the cylinder head bolt holes.

This is necessary to obtain correct bolt tightening.

Clean :
- The inside of the cylinder block
- Liner base seal location
- Crankshaft

Preparation

Check the condition of :

- Oil pump
- Cylinder head : check the gasket face on the latter for truth, recut the valve seats and regring if necessary.

The components supplied in the liner and piston kit are matched.

- Mark the parts in each box in lots A to D to retain the matching.

- Dissolve the anti-rust film ; never scrape the parts off.

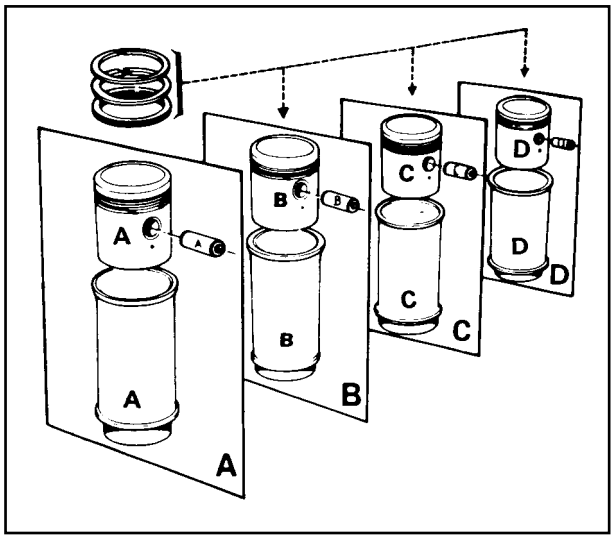


Figure 11-123

Liner protrusion

The above engines are fitted with Excelnyl liner base seals.

- Select a blue base seal first and fit one to each liner.

There are three thicknesses of Excelnyl liner base seals :

Colour code	Excelnyl
Blue	0.08 mm
Red	0.10 mm
Green	0.12 mm

- Place each liner in the cylinder block.

- Press down with your hand to make sure that liner and seal are seating.

- Check line protrusion above the cylinder block face using thrust plate Mot. 252-01 and clock gauge Mot. 251-01.

The correct protrusion should be between 0.04 mm and 0.12 mm.

If not, use red or green seals instead of the blue ones.

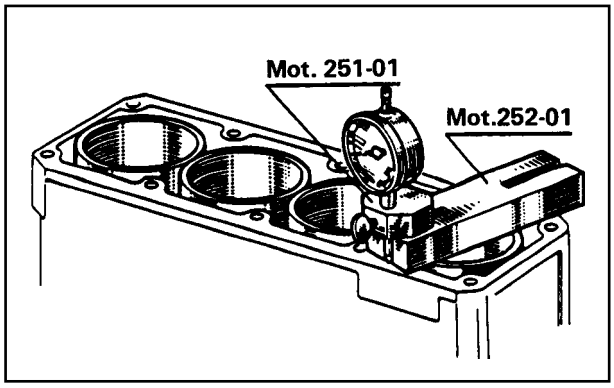


Figure 11-124

These engines are fitted with an O-ring at the base of each liner.

These O-ring act as coolant seals only.

The liners rest directly on the cylinder block and the correct protrusion is obtained by close tolerance machining dimensions for the cylinder block and liners.

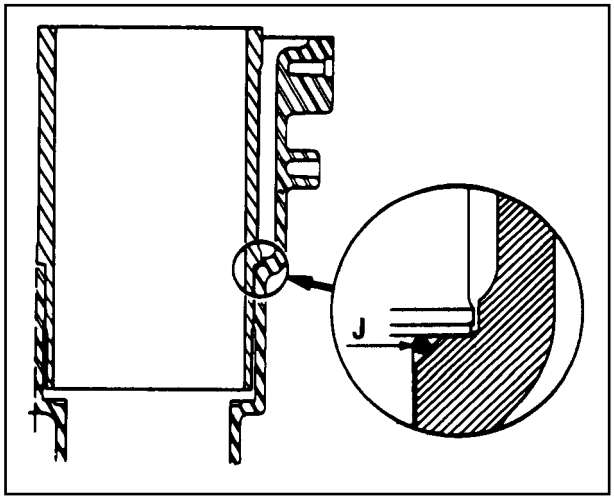


Figure 11-125

Protrusion (X) should be checked as follows :

- Place the liner WITHOUT its O-ring (J) in the cylinder block.
- Check protrusion (X) using thrust plate Mot. 252-01 and clock gauge Mot. 251-01. It should be between 0.02 and 0.09 mm.

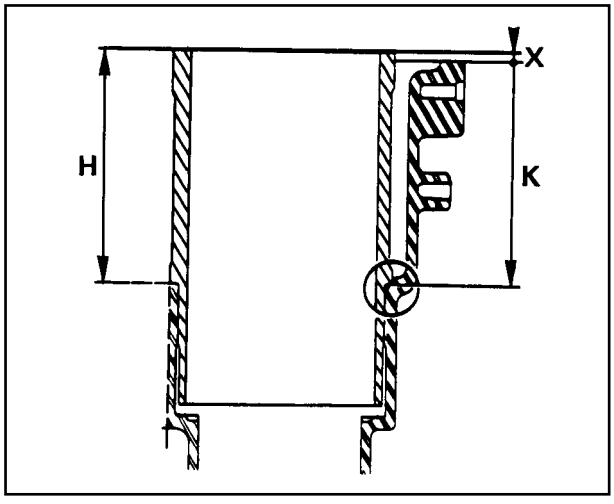


Figure 11-126

Position the liners so that :

- The difference between two adjacent liners does not exceed 0.04 mm (within the permitted tolerance).
- Protrusion may be stepped downwards from No. 1 cylinder to No. 4 cylinder or vice versa.

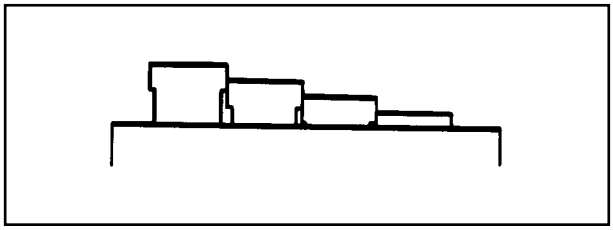


Figure 11-127

Once the correct protrusions have been obtained, refit assemblies A, B, C and D together. Then number the liners, pistons and gudgeon pins 1 to 4 (No. 1 at flywheel end) so that they match their connecting rods.

If incorrect protrusion is found, check with a new set of liners to determine whether the cylinder block or liners are at fault.

The Drawing Office dimensions are given below purely as a guide :

- Liner height (H) between top face and bottom locating face H = 95.005 to 95.035 mm,
- Cylinder block height (K) between top face and liner locating face K = 94.945 to 94.985 mm.

Mounting the gudgeon pins

All types of engine except 840-30 and C7K.

Gudgeons pins are a press-fit in their small ends and free-turning in their pistons. Use tooling kit Mot. 574-13 containing :

- Gudgeon pins (A) followed by a suffix,
- Collars marked (B) followed by a suffix,
- Locating mandrels marked (C) followed by a suffix,
- A supporting block marked D,
- A set of extractors E for removing the gudgeon pins.

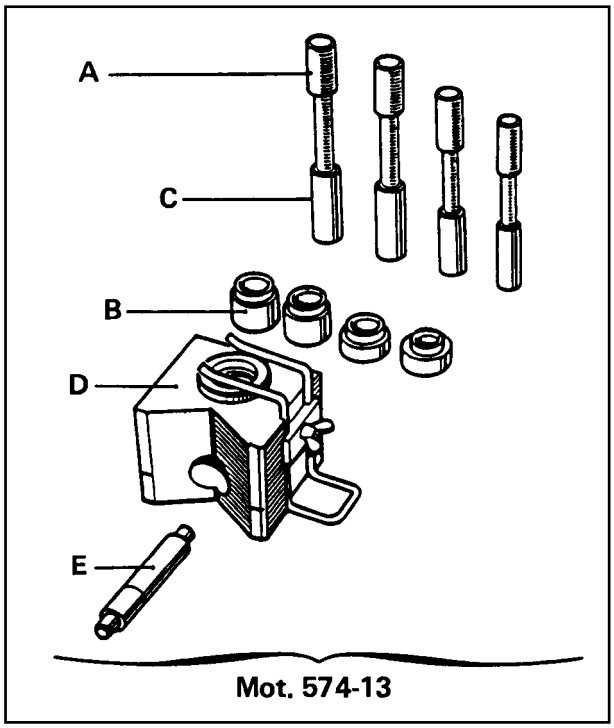


Figure 11-128

Required tools

Inner Ø gudgeon pin (mm)	Outer Ø gudgeon pin (mm)	Tool Mot. 574-13		
		Pin	Collar	Locating tool
12	20	A3	B5	C5

Extracting the gudgeon pin

- Lay the piston in the "V" in the support with the gudgeon pin bore in line with the clearance hole (the support has 2 grooves (T) to facilitate alignment).

- Press out the gudgeon pin with the extracting mandrel (E).

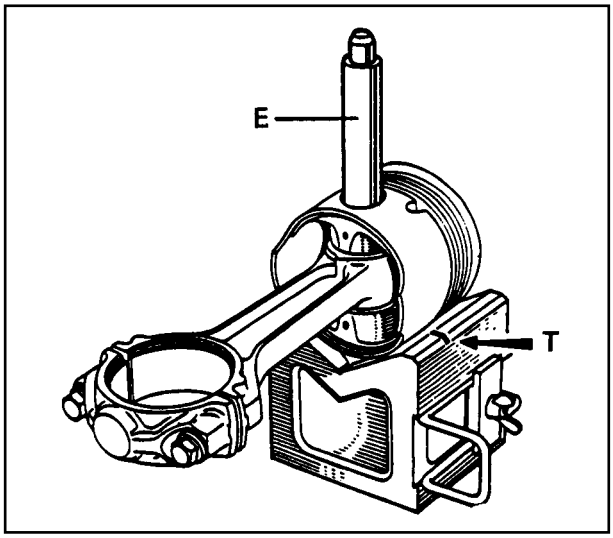


Figure 11-129

Preparing the connecting rods

Check :

- The connecting rods for twist and out-of-square,
- Mating of the big-ends caps to their rods (deburr if necessary to obtain good cap seating).
- Use a 1500 W hotplate (refer to MR 500 **).
- Space the small ends out round the hot-plate.
- Make sure that they are lying flat for maximum heat transfer.
- Place a small piece of cored tinman's solder with a melting point of about 250°C on each small end at (a) to act as a temperature guide.
- Heat each small end until the solder is seen to melt.

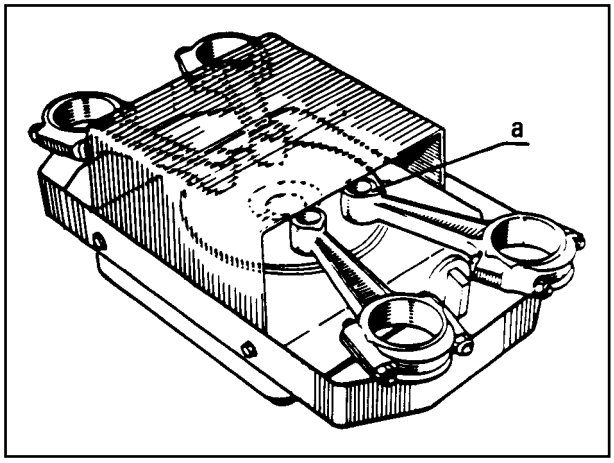


Figure 11-130

Preparing the gudgeon pins

- Check that each gudgeon pin rotates freely in its piston.

Fitting the gudgeon pins

- Fit gudgeon pin 1 to inserting mandrel (do not tighten as the gudgeon pin must be free to move between mandrel A and guide C).

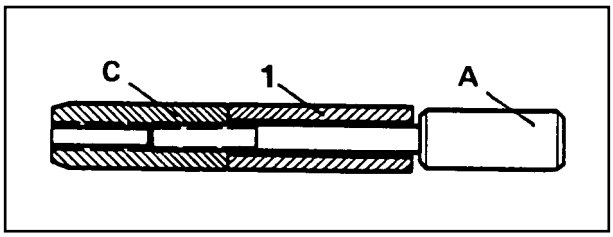


Figure 11-131

- Coat the parts with Molykote M55 plus.

Each piston crown is marked with an arrow which must point towards the flywheel ; spotfacing (F) must face the other end.

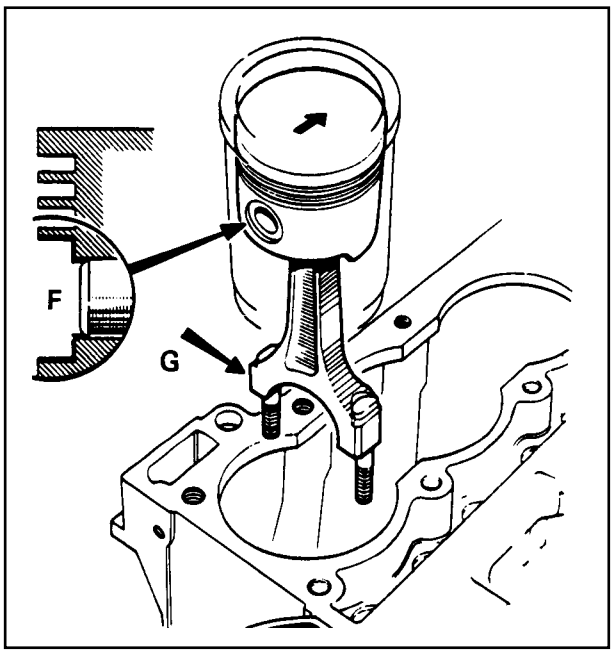


Figure 11-132

Proceed as follows to assemble a piston and connecting rod :

- Fit a thrust pad (B) corresponding to the gudgeon pin diameter on the support and clamp the piston to it with the clip.
  The spotfacing F on the piston must rest on the pad.
- Big-end mark (G) made on dismantling must face the side away from the camshaft.

The following operations must be carried out rapidly so that head loss is kept to a minimum.

As soon as the drop of solder reaches melting point (becomes a droplet) :

- Wipe off solder.
- Insert the locating guide in the piston.
- Fit the connecting rod to the piston with their marks in line.
- Press the gudgeon pin in quickly until the guide butts up against the bottom of the support.

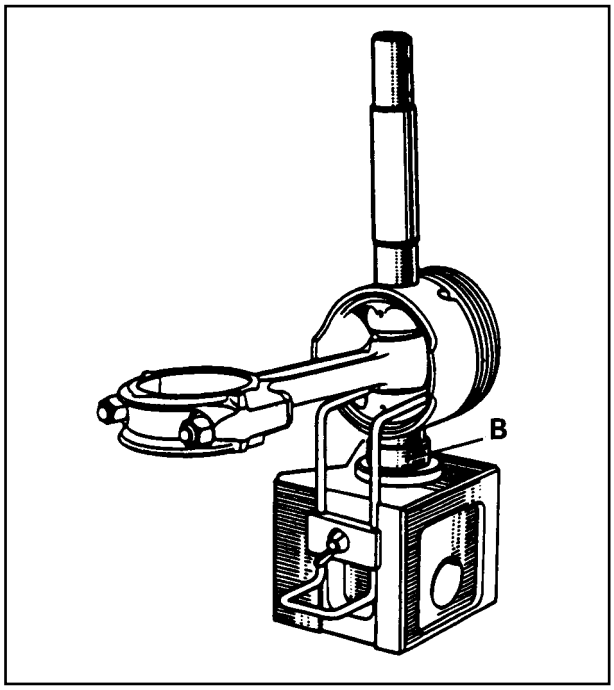


Figure 11-133

- After a few seconds, remove the connecting rod and piston assembly from the support, unscrew the guide and remove the inserting mandrel.
- Check that the gudgeon pin is recessed in the piston skirt on both sides in any position of the connecting rod in the piston.

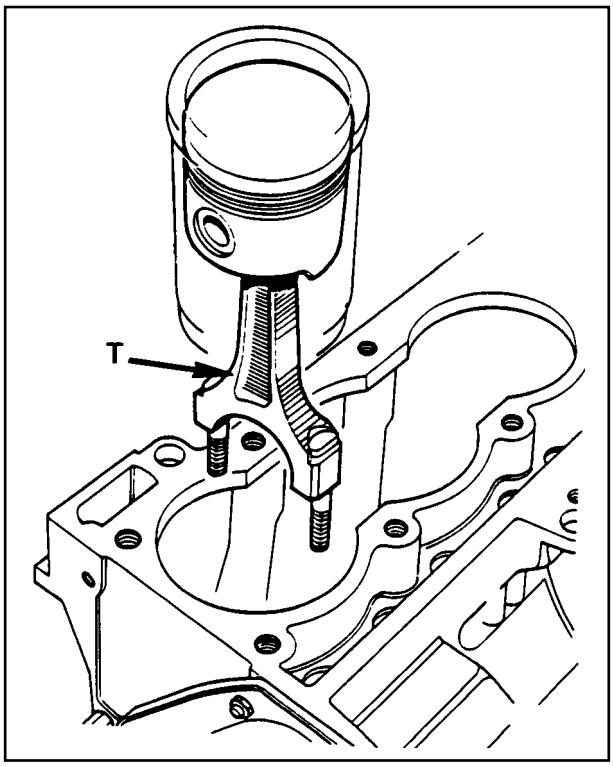


Figure 11-134

Fit to the piston :

- Oil scraper ring (3),
- Taper compression ring (mark uppermost) (2),
- Top compression ring (1).

The piston rings are supplied pre-gapped and this must not be altered.

- Lubricate the rings and space them with their gaps at 120° to each other opposite a plain portion of each groove.

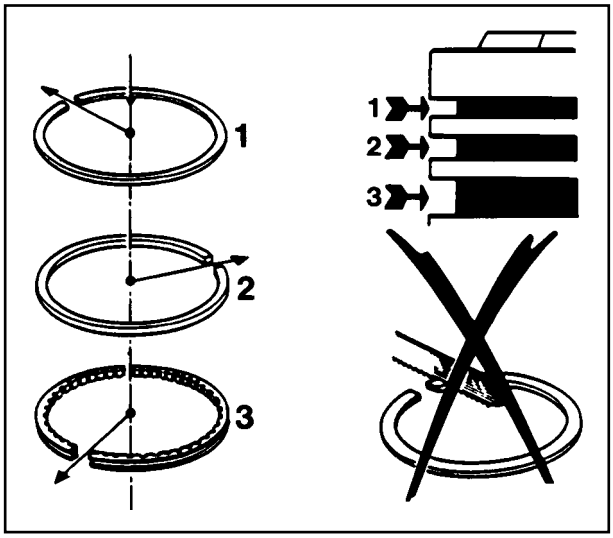


Figure 11-135

Lubricate the pistons.

- Fit the connecting rod-piston-assemblies in their respective liners using sleeve :
  - Mot. 655.

The universal piston rings compressor Mot. 851 or a tool of the FACOM 750 TB type may also be used for this operation.

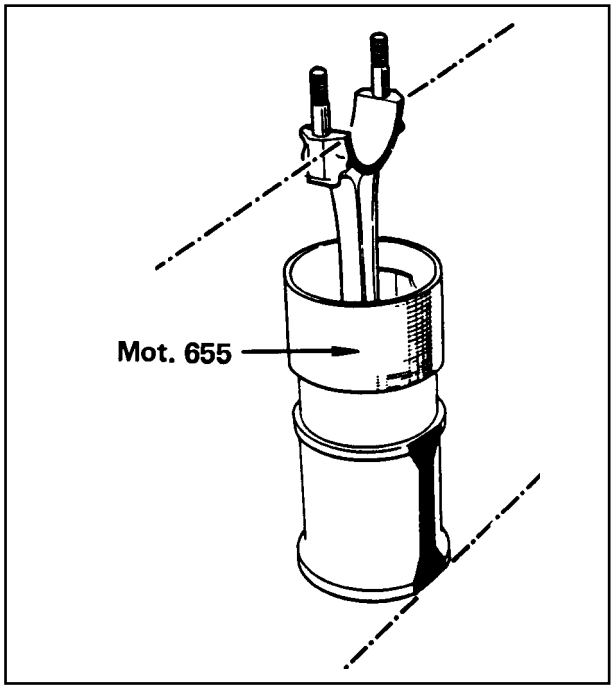


Figure 11-136

The machined sides of the big-end must be parallel to the flat on the top of the liner.

Remember to fit each liner with its selected base seal (no twist) before inserting the liner, piston and connecting rod assemblies.

- Fit the shell bearings to the connecting rods.

- Insert the liner-piston-connecting rod assemblies in the cylinder block.

Make sure that they are in correct bores and in the right position :

- No. 1 at the flywheel end
- Number marked on connecting rod big-end on the side away from the camshaft.
- Arrow on piston pointing to the flywheel.

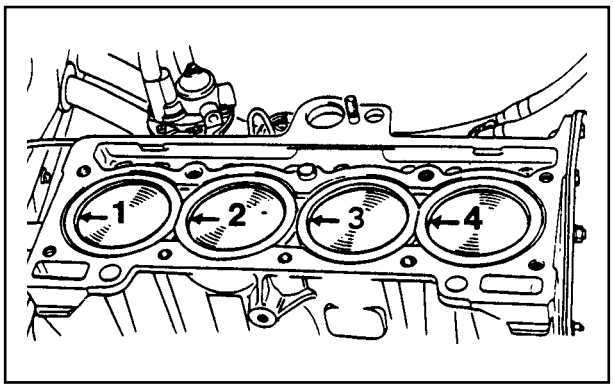


Figure 11-137

- Fit liner clamp Mot. 512-01 in position.

- Lubricate the crankpin and draw the connecting rods down.

- Fit the big-end caps complete with their bearing shells making sure that they are correctly matched.

- Screw on and torque tighten the big-end cap nuts.

- Check that the assembly revolves freely.

Install :

- Oil pump,
- Sump (see "Sump" chapter),
- Cylinder head, adjust the rocker arm clearances,
- Ignition distributor, adjust the initial advance if necessary.

Perform :

- Fill the recommended oil.

Replacing the camshaft

Special tools

Mot. 131-02 or Mot. 259-01	Main bearing oil seal inserting tool - flywheel end
Mot. 761	Timing chain fitting and removing tool
Mot. 792-01	Engine support for fitting to Desvil stand

The tool listed below may still be used but is no longer available from the Parts Department.

Mot. 49	Sprocket extractor (FACOM U35P type)

Tightening torques (daNm) :

Main bearing cap bolts ..... 5.5 to 6.5
Flywheel bolts..... 5
Converter fixing bolts :
TA 4139 ..... 6.5 to 7
TA MB1..... 4.5 to 5
Big-end cap nuts 4.5
Camshaft sprocket bolt..... 3
Crankshaft pulley bolts :
- Crankshaft drilled to 34 mm - 40 mm bolts 8
- Crankshaft drilled to 39 mm - 45 mm bolts 11

Materials :

CAF 4/60 THIXO : sealing paste for sump and timing cover.

Loctite FRENETANCH (bolt locking and sealing resin allowing unscrewing) :
crankshaft pulley fixing bolt and sealing of No. 1 bearing.

Loctite AUTOFORM : fixing engine flywheel to crankshaft.

Loctite FRENBLOC (locking and sealing resin) :
engine flywheel fixing bolt or converter plate.

- Fit the engine to support Mot. 792-01.

- Drain engine oil.

Removal

Remove :

- Drivebelts
- Crankshaft pulley : use locking sector Mot. 582 to prevent the flywheel from turning.

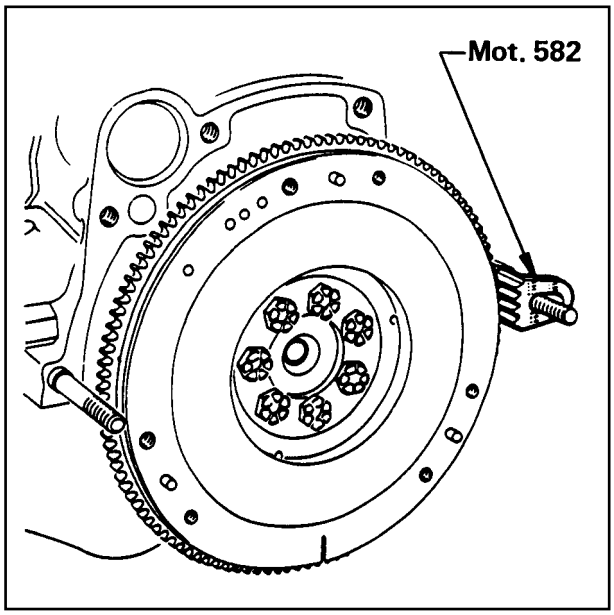


Figure 11-138

- Oil sump
- Oil pump
- Timing cover
- Timing gear (see chapter "Timing gear")
- Flywheel or converter driving plate
- Main bearing oil seal.

- Mark the connecting rods :

- No. 1 at the flywheel end and on the side opposite to the camshaft.

- Unscrew the big-end cap nuts.

- Remove the big-end caps and bearing shells.

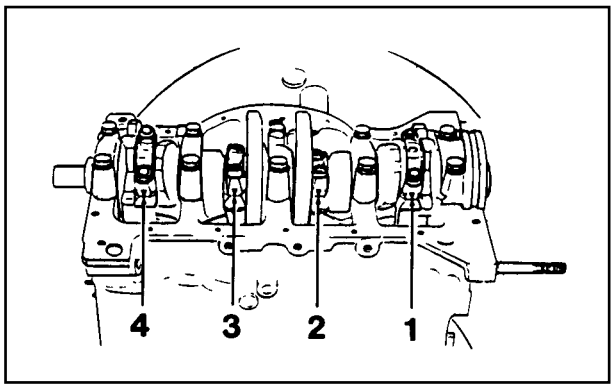


Figure 11-139

- Mark the main bearing caps in relation to the cylinder block.

- Unscrew the main bearing caps, remove them with their bearing shells.

- Lift out the crankshaft, thrust washers, main bearing shells and connecting rod shells.

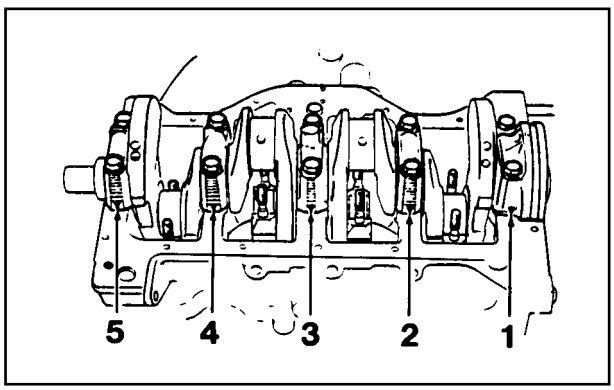


Figure 11-140

Refitting

Service crankshafts are supplied with the spigot bush already in position :

On vehicles with :
- automatic transmission
- or manual gearbox having a short clutch shaft.

The above bush must be extracted.

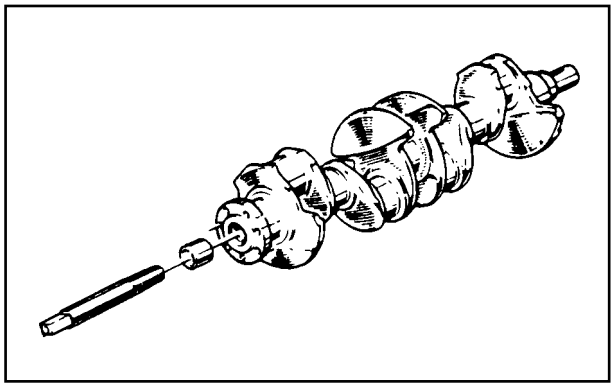


Figure 11-141

- Tap the bush with a 14 mm x 200 thread until it comes out.

- Clean the cylinder block joint face.

Fit :
- the new bearing shells to the connecting rods
- the new bearing shells to the main bearing journals.

These have oil holes :
- those for main bearing journals Nos. 1 and 3 are identical
- Those for main bearing journals Nos. 2, 4 and 5 are identical.

- Lubricate all bearing shells.

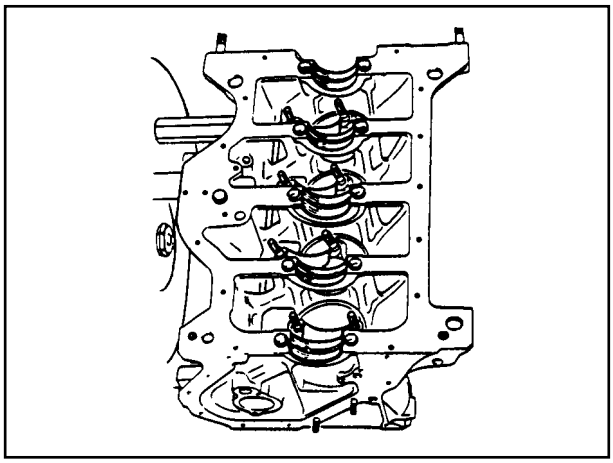


Figure 11-142

- Lubricate the crankshaft journals and lower th new crankshaft into the block.

- Insert the thrust washers, white-metalled face towards crankshaft.

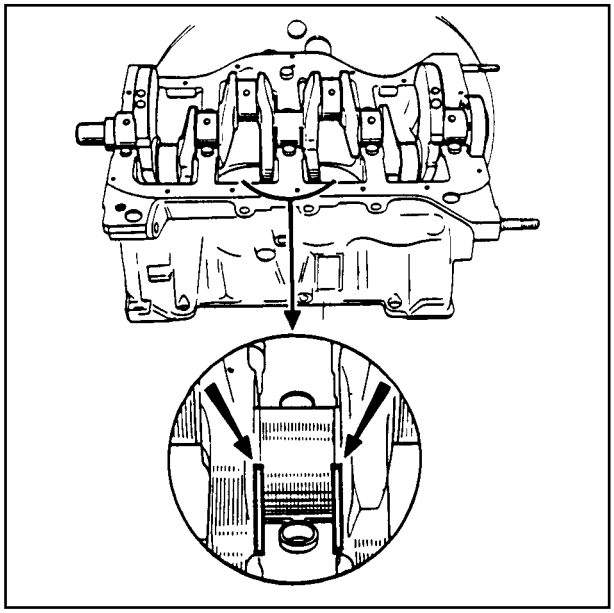


Figure 11-143

- Fit the shells to the main bearing caps ; they have no oil holes.

- Lubricate the bearing shells.

- Coat Loctite FRENETANCH on the bearing faces of No. 1 bearing cap.

- Fit the main bearing caps in their correct positions (marks made on dismantling).

- Torque tighten the main bearing caps to between 5.5 and 6.5 daNm.

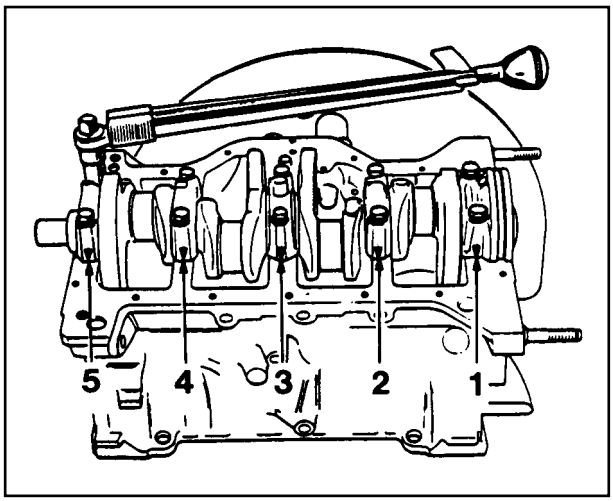


Figure 11-144

- Lock the crankshaft using locking sector Mot. 582.

- Tighten the bolts to the specified torque after fitting them with a few drops of Loctite FRENBLOC.

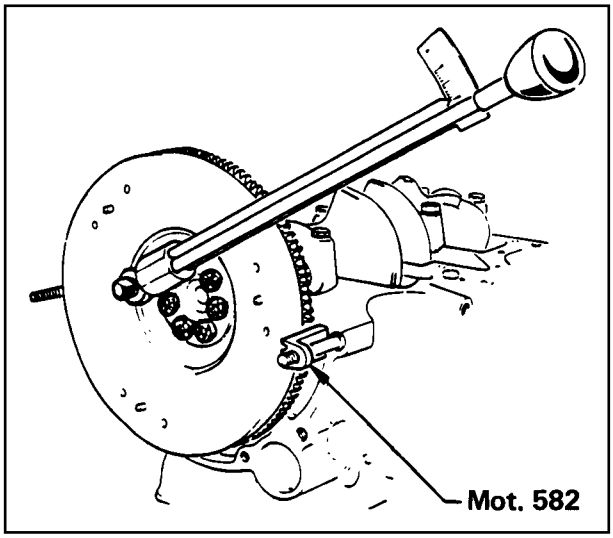


Figure 11-145

- Remove the locking sector.

- Check flywheel run-out using a clock gauge 0.06 mm max. ; 0.3 mm max. for converter drive plate.

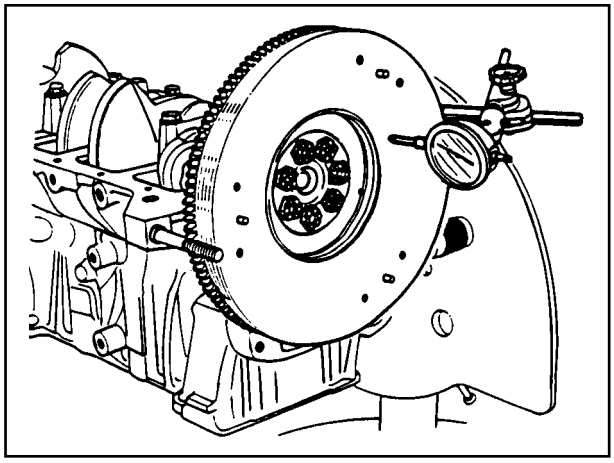


Figure 11-146

- Draw the connecting rods down onto the oiled crankpins.

- Fit the big-end caps with their bearing shells, making sure that they are matched correctly.

- Screw on and torque tighten the big-end cap nuts.

- Check that the assembly rotates freely.

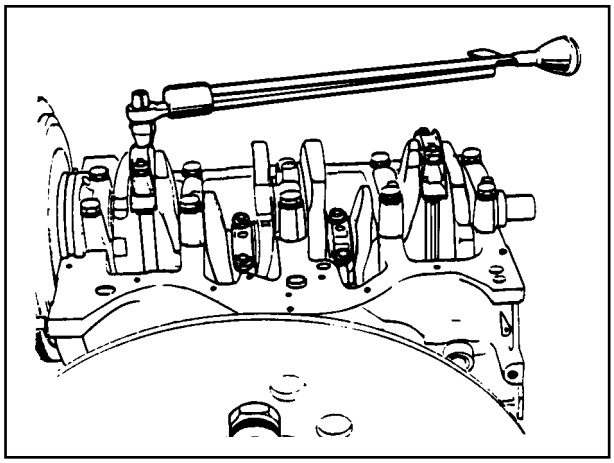


Figure 11-147

- Fit the oil pump - there is no gasket between the pump body and cylinder block.

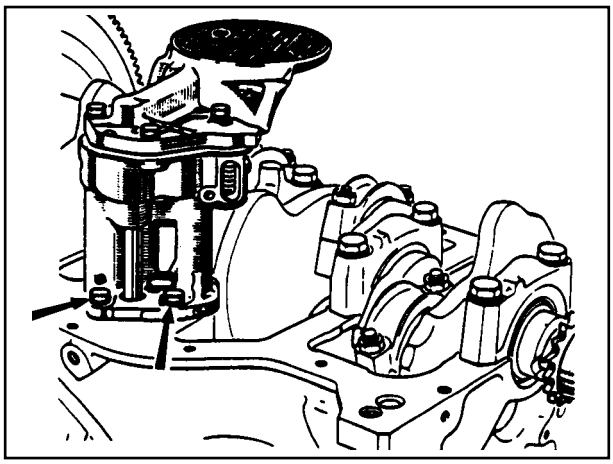


Figure 11-148

- Insert the key in the crankshaft nose and fit the sprocket ; the timing mark must face outwards.

Refit :

- Timing gear (see chapter "Timing gear")
- Timing cover and sump (see chapter "Sump and timing cover").

- Prevent the flywheel from turning using locking sector Mot. 582 and refit the crankshaft pulley on engines fitted with them.

- Centre the clutch disc.

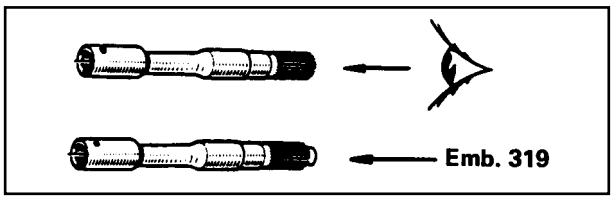


Figure 11-149

Use a primary shaft from a type 369-4 or 09 gearbox for the 840-30 C7K engines.

- Check that the crankshaft rotates freely.

- Fit a dial gauge at the end of the crankshaft.

- Check crankshaft end play :
  0.05 to 0.023 mm.

Change the thrust washers if the end play is incorrect.

They are available in different thicknesses.

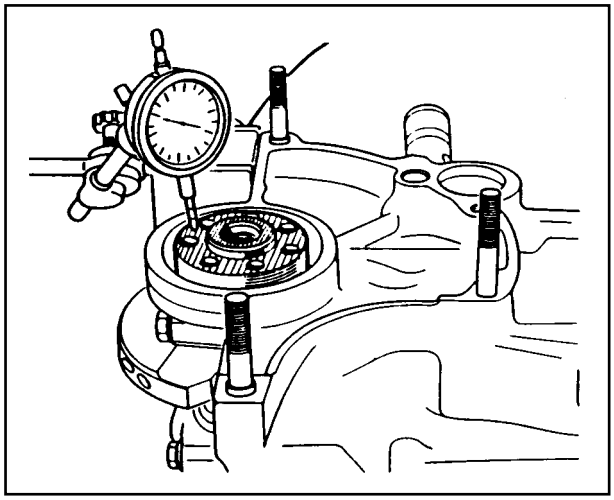


Figure 11-150

Fitting the oil seal

- Fit the main bearing oil seal : use inserting tool Mot. 131-02 for an oil seal of 90 mm diameter or Mot. 259-01 for an oil seal of 100 mm outer diameter.

- Take great care when fitting this seal as its lip is delicate.

- Place the seal on the tool.

- Lubricate the outer circumference of the seal.

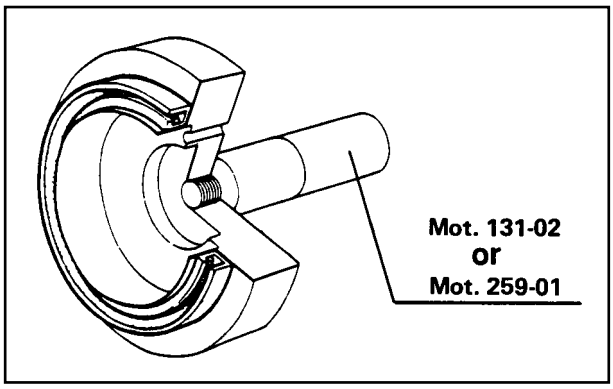


Figure 11-151

- Insert it by tapping the end of the tool lightly until the latter just contacts the block.

Re-used crankshaft

The new oil seal must be offset in relation to the original seal position by C = 2 mm approximately to prevent the lip running on the same surface as the old seal.

Use a spacer E = 2 mm thick to offset the position of the seal.

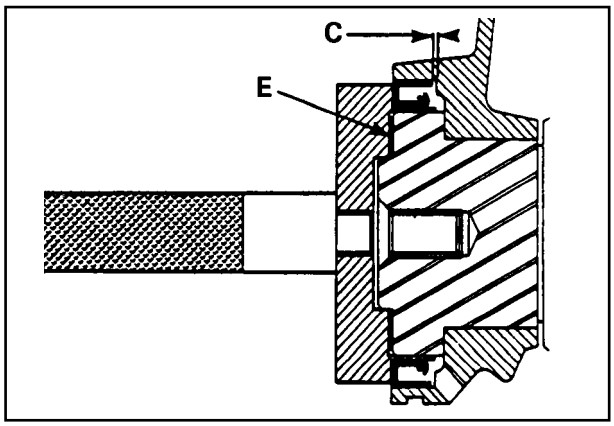


Figure 11-152

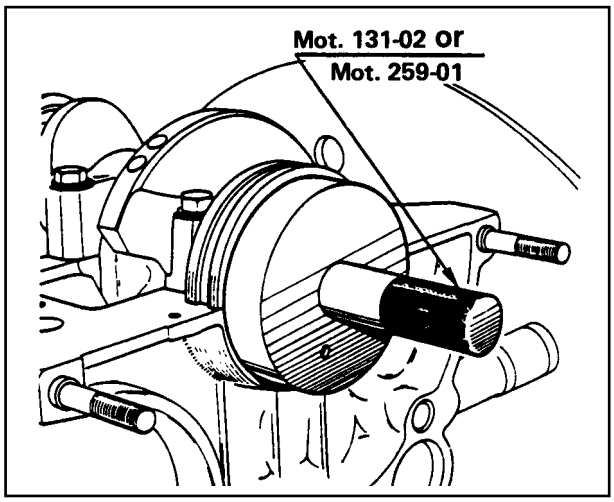


Figure 11-153

- Fit the flywheel or converter driving plate. (Smear the joint face with Loctite Autoform).

The flywheel bolts are of the self-locking type ; they must be changed at each dismantling.

Timing gear

Removal, refitting

Special tools

B. Vi. 28-01	Extractor with jaws 146 mm long, all types
B. Vi. 48	Set of 2 wide jaws all types
Mot. 500-03	Tool for extracting/inserting camshaft oil seal, all types
Mot. 521-01	Liner clamp
Mot. 567	Rocker arm adjusting tool
Mot. 233 or Mot. 443	Rocker arm adjusting tool
Mot. 582	Flywheel locking sector
Mot. 761	Timing chain fitting and removing tool
Mot. 792-01	Engine support for fitting to Desvil stand

The tool given below may still be used but is no longer available from the Parts Department.

Mot. 49	Sprocket extractor FACOM U35P

Tightening torques (daNm)

Camshaft sprocket fixing bolts all engine types except C1J Turbo 3
C1J Turbo 5
Crankshaft pulley fixing bolts :
- 40 mm long bolts 8
- 45 mm long bolts 11

Materials

CAF 4/60 THIXO : sealing paste for sump and timing gear cover.

Loctite FRENETANCH (bolt locking and sealing resin - allows unscrewing) :
crankshaft pulley fixing bolt.

- On disassembly of timing chain fix shoe with a wire (A).

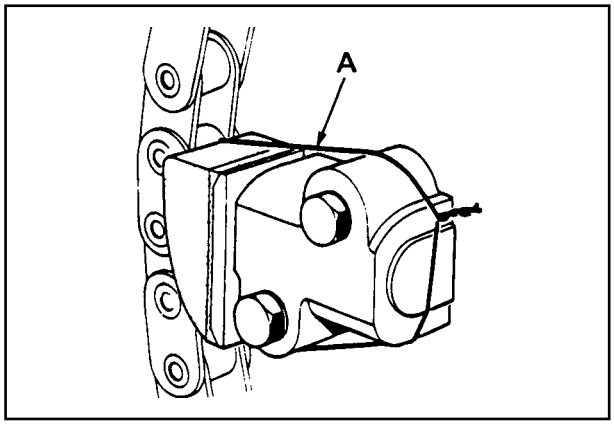


Figure 11-154

Mechanical chain tensioner

A spring bearing on the cylinder block exerts a load on the shoe which presses against the chain to keep it tensioned.

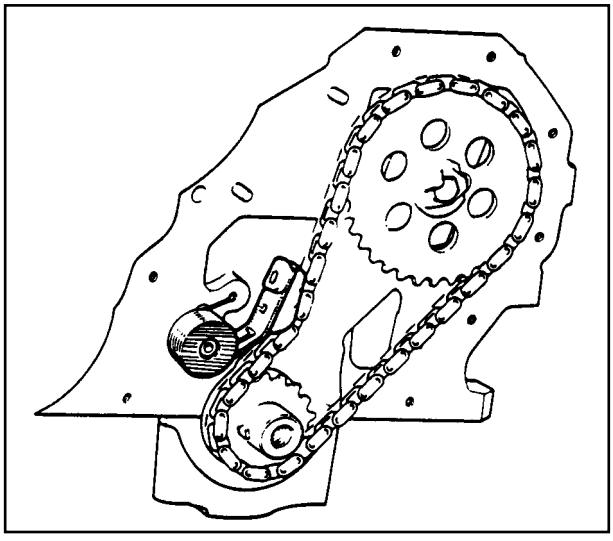


Figure 11-155

This tensioner consists of :

- Shoe (7) resting on the chain,
- Tensioning spring (6),
- Spindle (8) holding the assembly,
- Closing washer (5),
- Screw (9) and spring washer (10).

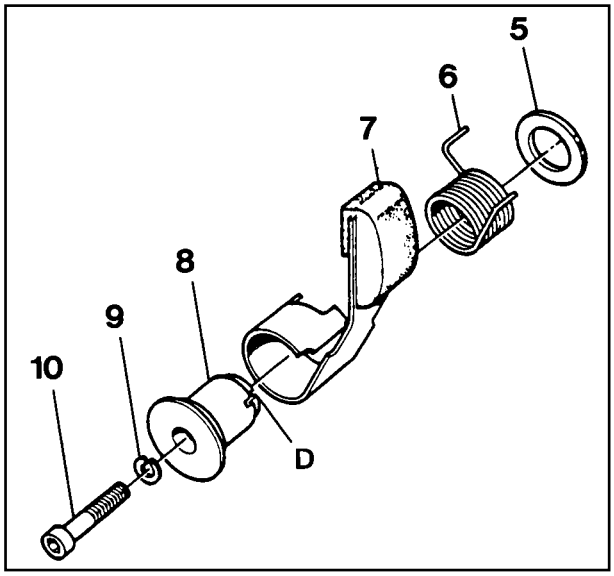


Figure 11-156

Tooling

This type of tensioner is fitted and removed more easily by making use of tool Mot. 761 which comprises :

- An assembly plate for putting the various components together.

- An tool to keep the tensioner compressed when the cylinder block is being fitted or removed.

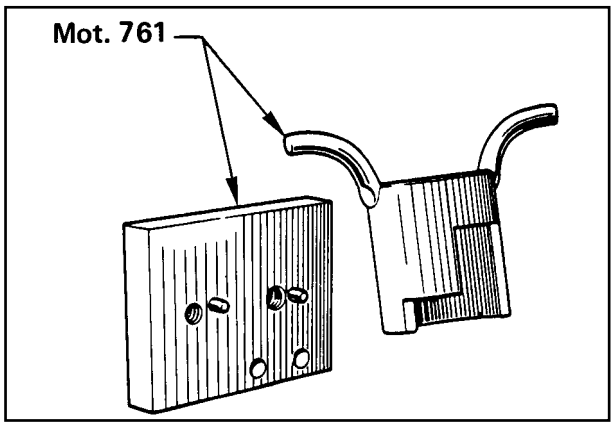


Figure 11-157

- Fit the engine to support Mot. 792-01.

- Drain the engine oil and coolant.

Remove :

- Sump,
- Crankshaft pulley (if fitted),
- Timing cover.

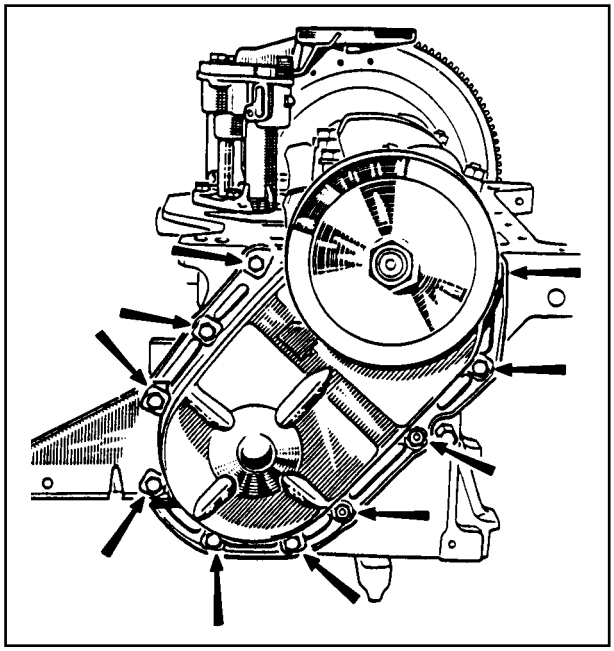


Figure 11-158

Clean the various sealing faces.

Removing the chain tensioner

CAUTION
There are two types of chain tensioners :

1) Hydraulic tensioner with automatic pre-setting
2) Mechanical tensioner.

Hydraulic tensioner with automatic setting

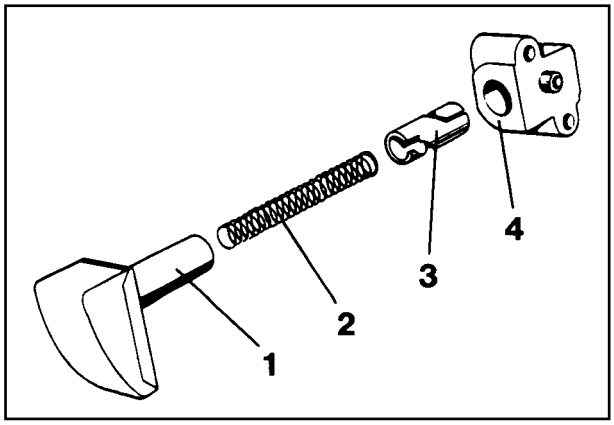


Figure 11-159

1 Steady shoe
2 Spring
3 Piston
4 Tensioner body

The helix keeps piston (3) locked when peg (e) in the shoe stem locates in slot (c) in the piston.

It is a few millimetres proud of shoe stem (1) when the parts are assembled.

The tensioner is set automatically owing to the pressure of piston (3) at the bottom of its location in body (4).

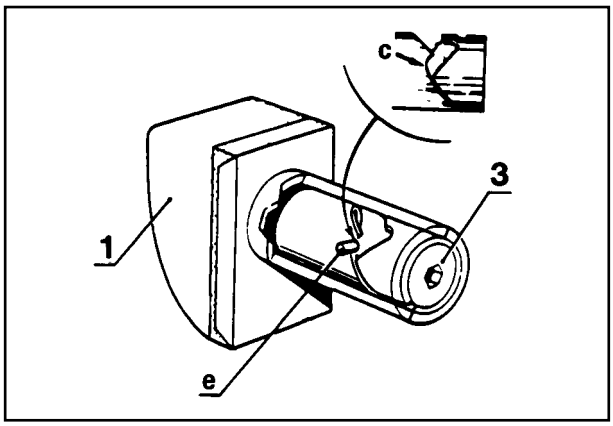


Figure 11-160

- Remove the tensioner and its support plate.

Adaptation of this type of tensioner

The following information is given as a guide :

This type of tensioner may only be fitted to a cylinder block with a camshaft oilbath.

The timing chain is lubricated by the oil return from the oilbath.

The following modifications must be made to the cylinder block :
- Oilpassage (A) feeding the hydraulic tensioner must be plugged,
- A 3 mm Ø peg (B) must be fitted to prevent the tensioner spindle from rotation.

The end of the spring is hooked into hole (C).

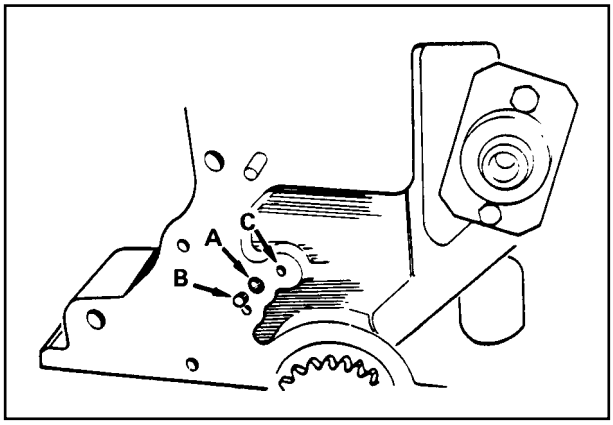


Figure 11-161

- With the chain tensioner assembled, tilt it as far as it will go and fit retainer Mot. 761.

- Remove the tensioner-retaining tool assembly.

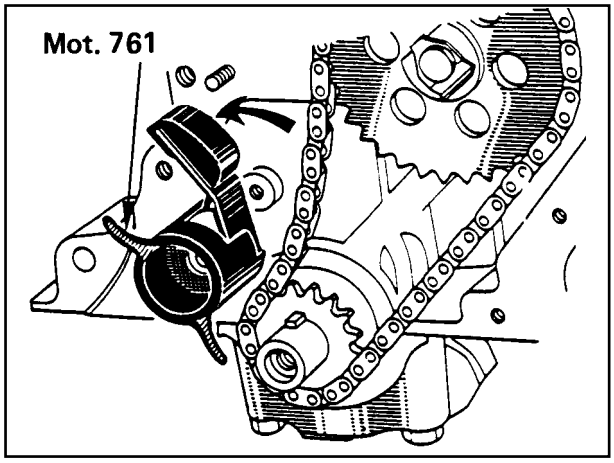


Figure 11-162

Use the assembly plate from mot. 761 to disconnect the tensioner from the retaining plate.

- Fit the assembly to this plate and remove the retaining tool by tilting the tensioner as far as it will go.

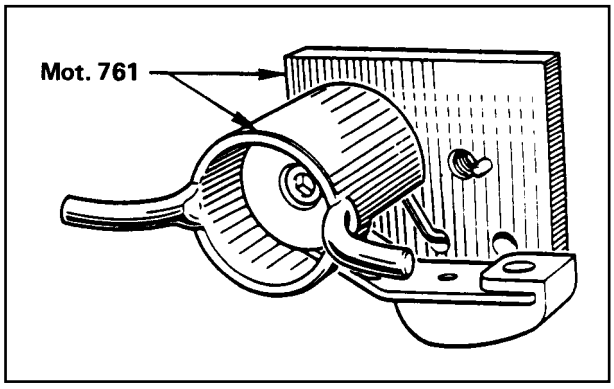


Figure 11-163

Removing the timing chain and sprockets

There are two types of timing chains :
- a single chain, and
- a duplex chain.

Single chain

Remove bolt (1), the washer, the camshaft sprocket (2) then the chain (3).

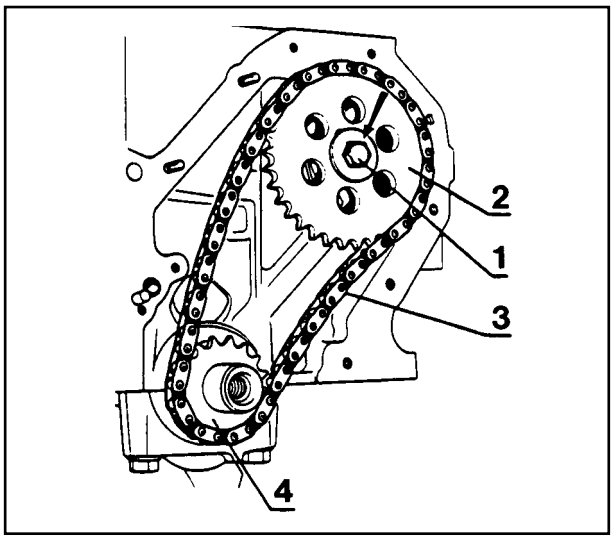


Figure 11-164

- Remove sprocket (4) using extractor Mot. 49 if required. Insert a bolt (V) with a deep centre between the crankshaft nose and the extractor screw.

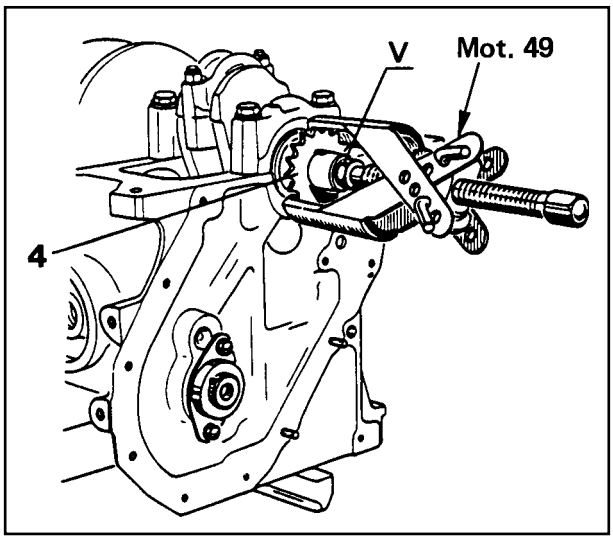


Figure 11-165

- Remove the key.

Duplex chain

The camshaft sprocket is fixed :
- either as a press-fit (non-drilled camshaft)
- or as a press-fit and held by a bolt and a washer (drilled camshaft).

When carrying out any operation requiring the timing gear (chain, sprockets) to be changed, without any work being necessary on the camshaft, make a 1st drilling of 6 mm dia. and 30 mm deep then a 2nd drilling of 6.75 mm dia. then tap to M8, pitch 1.25 mm.

This is to facilitate positioning of camshaft sprocket when refitting it.

- Use extractor Mot. 49 to withdraw the crankshaft sprocket and timing chain together. Inset a bolt (V) with a deep centre between the camshaft nose and the extractor screw (FACOM U20 type tool).

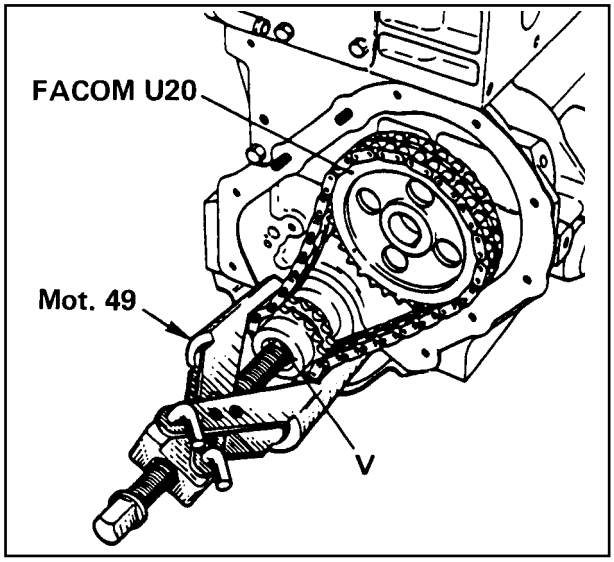


Figure 11-166

- Remove the key.

Replacing the camshaft

Special points :

If the camshaft has to be removed, it is advisable to remove the cylinder head, the distributor drive gear or the rotor drive gear and the tappets (see "Cylinder head" chapter).

Refer to the "Cylinder block chapter for replacing the camshaft bearing bush(es).

- Fit a new camshaft flange (B).

- Fit a new spacer using a piece of suitable tube until the former contacts the shoulder.

- After fitting the sprocket (timing mark facing outwards) and torque tightening it, check clearance (J) :

  J = 0.06 to 0.11 mm

Single chain

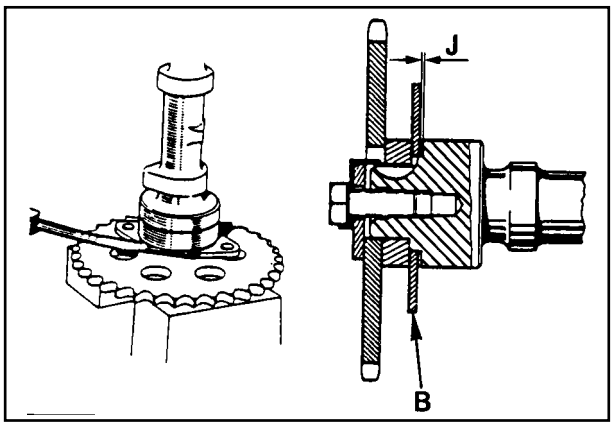


Figure 11-167

Duplex chain

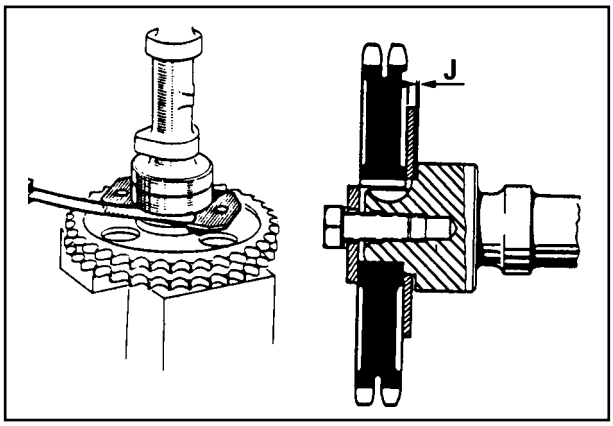


Figure 11-168

Lubricate the camshaft bearings.

- Fit the camshaft, crankshaft sprocket and timing chain assembly, paying attention to the timing gear timing.

- Tighten the flange bolts.

Refitting the timing gear
(without removing the camshaft)

Identifying the crankshaft sprockets :

1st type of assembly :

Engine with crankshaft pulley. The sprocket is flat and has no hub. With this type of assembly, the hub of the pulley holds the key and the crankshaft sprocket in position.

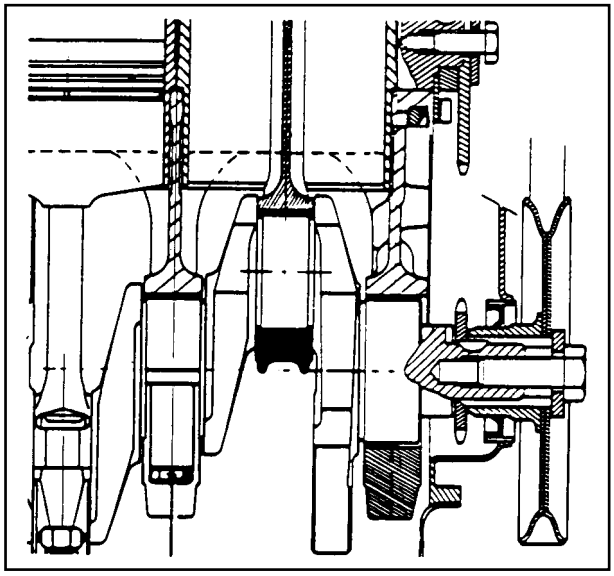


Figure 11-169

2nd type of assembly :

Engine without crankshaft pulley. the sprocket has an incorporated hub. This sprocket is a press-fit on crankshaft.

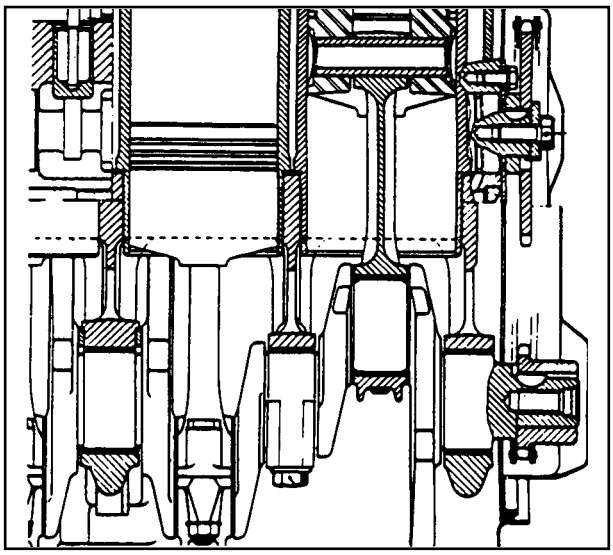


Figure 11-170

Refitting with single chain

- Insert the key and fit the crankshaft sprocket (timing mark facing outwards).

2nd type of assembly of crankshaft sprocket :

Use :
- A tube with an internal diameter of 25 mm
- A threaded rod screwed into the crankshaft
- A thick flat washer and nut

Screw up the nut so as to position the sprocket.

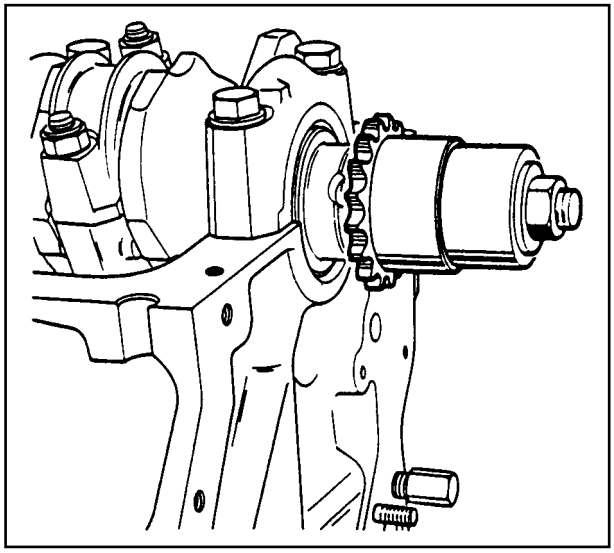


Figure 11-171

- Align the timing marks of the two sprockets with the centres of the crankshaft and the camshaft.

- Remove the camshaft sprocket without rotating the camshaft.

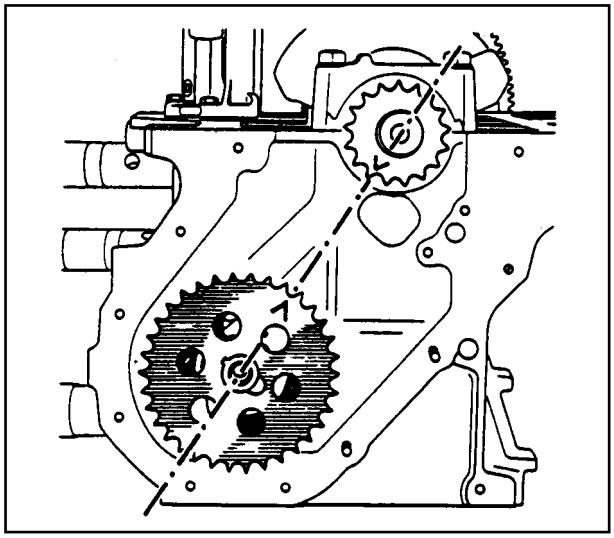


Figure 11-172

- Fit the timing chain (3) to the camshaft sprocket and the crankshaft sprocket.

- Refit camshaft sprocket (2) with all the timing marks still in line.

Timing position for all engine types

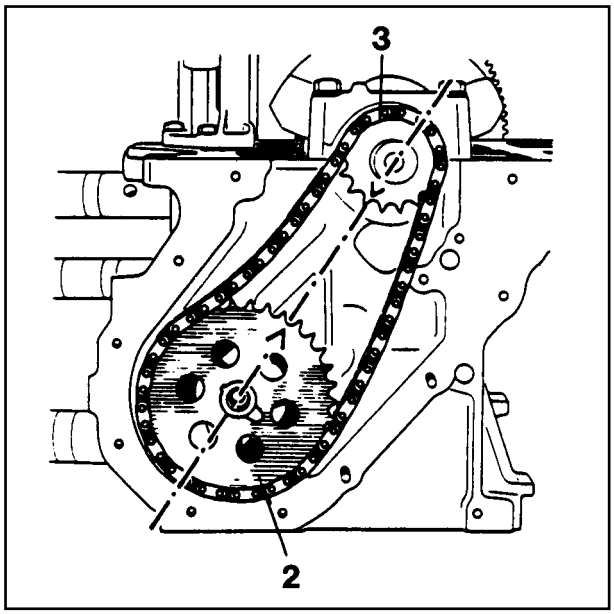


Figure 11-173

- Fit a new lockwasher and torque tighten the camshaft sprocket nut.

- Bend the tab over on the lockwasher.

Assembly with duplex timing chain (special feature)

The crankshaft and camshaft sprockets equipped with the chain are fitted at the same time.

- Insert on threaded rod into the camshaft. Gradually move the 2 sprockets closer, checking the position of the timing marks until the sprockets bear against one another.

- Remove the threaded rods from the sprockets. Fit the camshaft sprocket fixing bolt (coated with Loctite FRENBLOC) equipped with the washer and torque tighten.

Fitting the tensioner

Hydraulic tensioner with automatic setting.

- Fit filter (F) for the hydraulic tensioner.

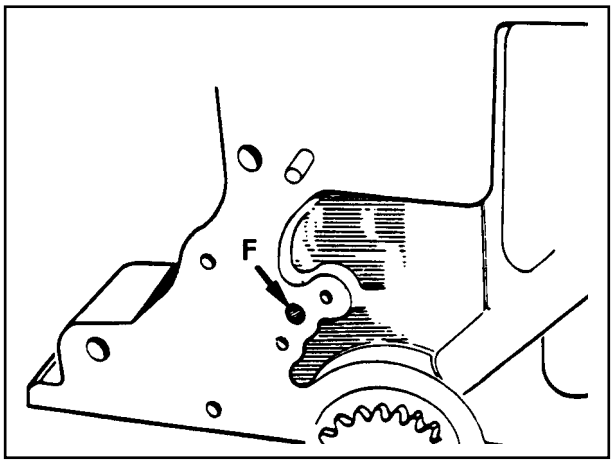


Figure 11-174

- Using a 3 mm male hexagon key, lock the piston in the shoe.

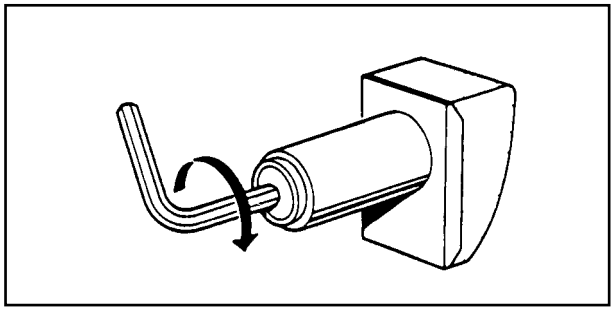


Figure 11-175

- Assemble the shoe stem in tensioner body.

- Insert a keep (2) about 2 mm thick between the tensioner body and shoe to prevent accidental setting during handling.

- Remove the plastic keep (new tensioner) or other keep (2) and press the shoe in until it contacts the bottom of the tensioner body.

- Release the shoe without interfering with spring action.

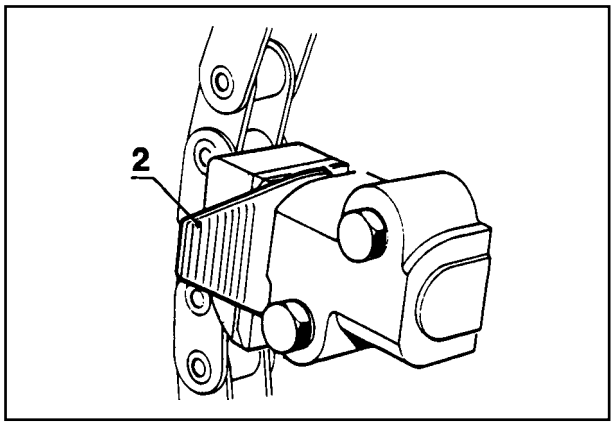


Figure 11-176

Mechanical tensioner

Use the assembly plate from tool Mot. 761 to assemble the chain tensioner components, if necessary.

- Fit the following to the plate :

- Washer (5)
- Shoe (7) fitted with spring (6) ; insert the end of the spring in the hole provided
- Tensioner spindle (8), plate peg in its slot in the spindle
- Fit screw (10) with its washer (9).

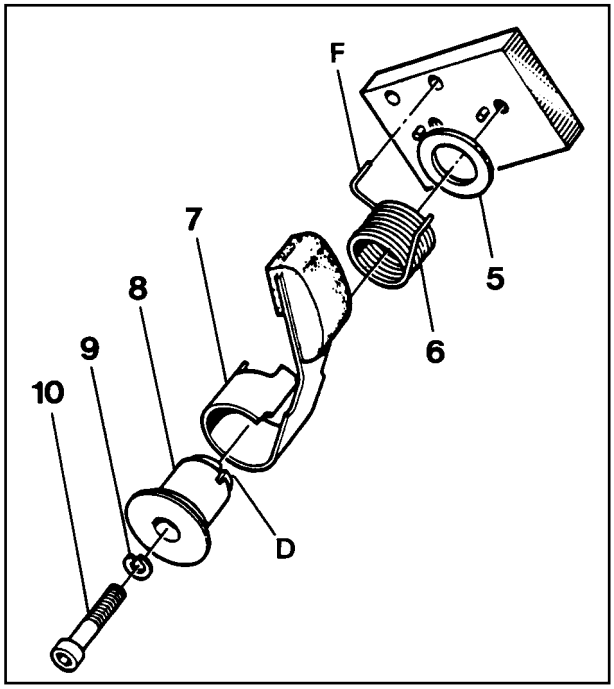


Figure 11-177

- With the chain tensioner assembled and mounted on the plate, tilt the tensioner as far as it will go and fit retainer Mot. 761.

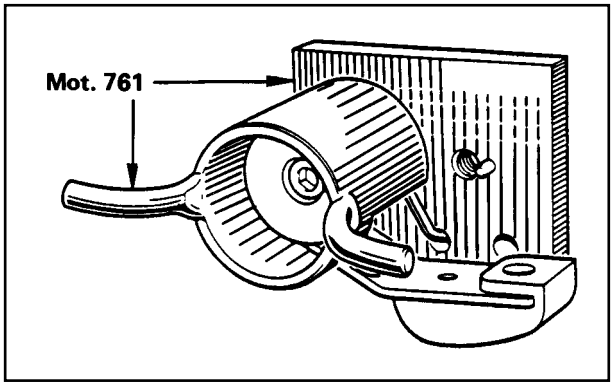


Figure 11-178

- Remove the tensioner-retaining tool assembly from the plate and transfer it to the cylinder block. Peg (B) should be in slot (D) in spindle (8) and spring tag (F) should be hooked into hole (C) in the cylinder block.

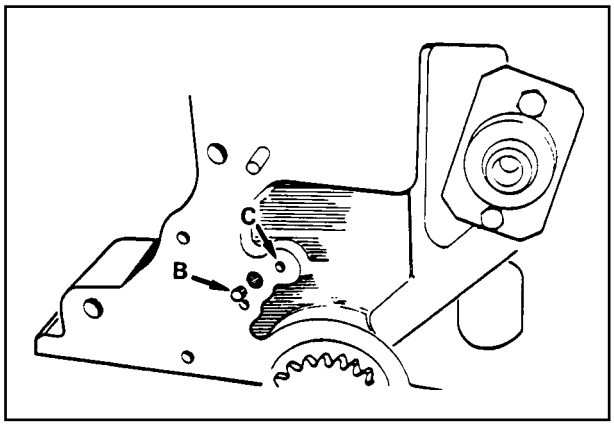


Figure 11-179

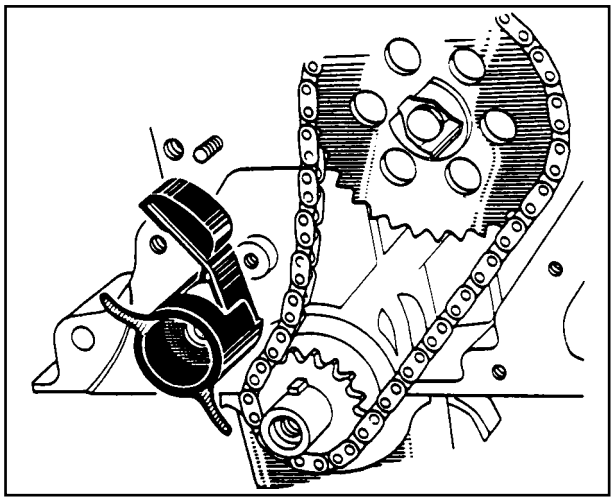


Figure 11-180

- Remove the retaining tool.

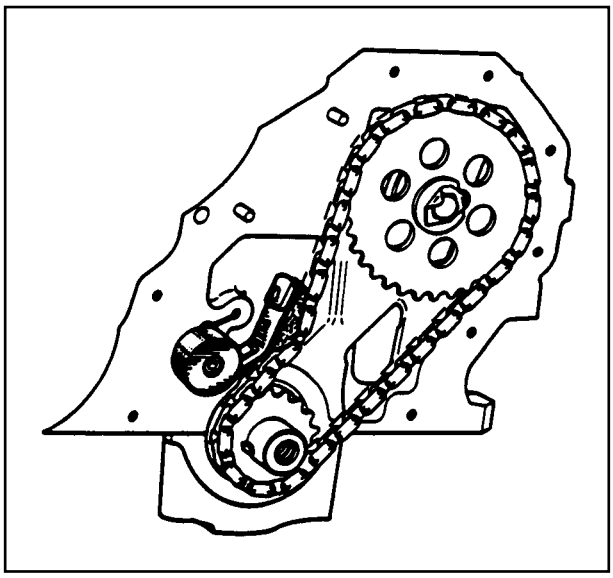


Figure 11-181

- Refit :

- Timing cover and sump (see chapter "Sump").
- Crankshaft pulley if applicable.

Insert the distributor drive gear :

- Turn the crankshaft so that No. 1 cylinder is on T.D.C (No. 4 cylinder valves on balance).
- Engage the distributor or rotor drive gear paying attention to its position (these gears no longer have any internal thread).

Adjusting the distributor drive mechanism

Thedriving slot must be right angles to the engine longitudinal centreline and the larger offset (D) facing the flywheel.

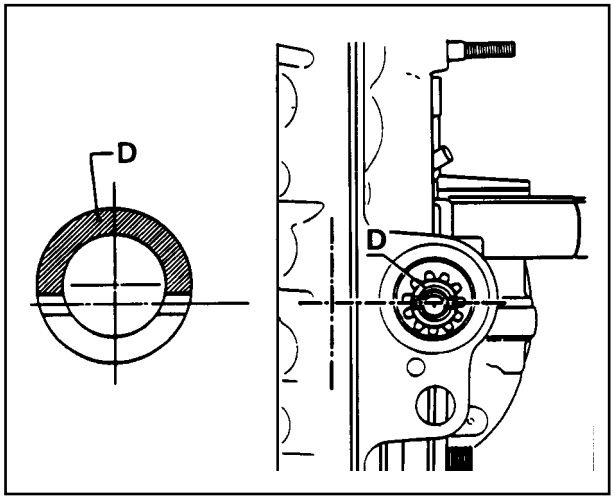


Figure 11-182

- Larger offset (D) facing the flywheel.
- The angle formed by the slot and a perpendicular drawn from the engine logitudinal centreline = 10°.

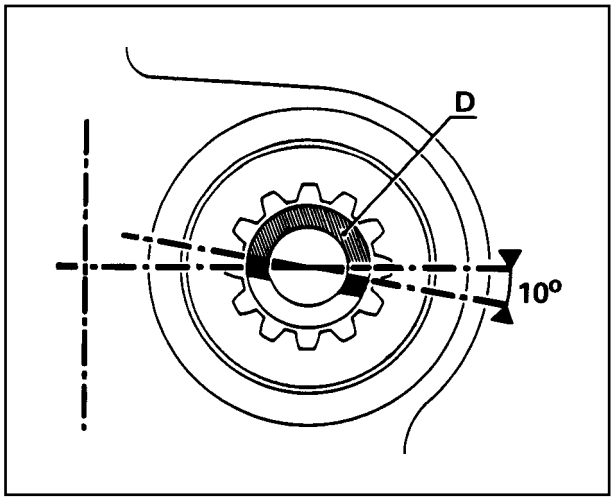


Figure 11-183

Camshaft oil seal

Replacing

Special tools required

Mot. 500-03	Oil seal inserting and extracting tool
Mot. 876	Camshaft bearing inserting and extracting tool

There are 3 possible types of assembly for camshaft oil seals.

1st type of assembly : without bearing

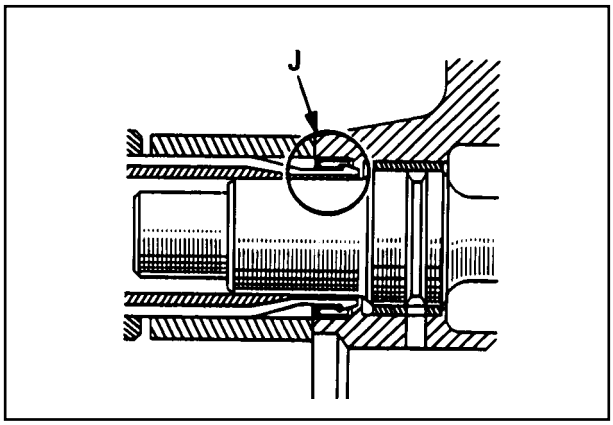


Figure 11-184

2nd type of assembly : inserted bearing

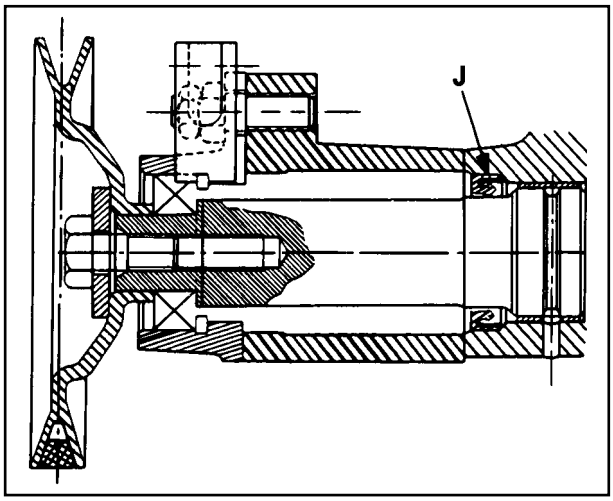


Figure 11-185

3rd type of assembly : integrated bearing

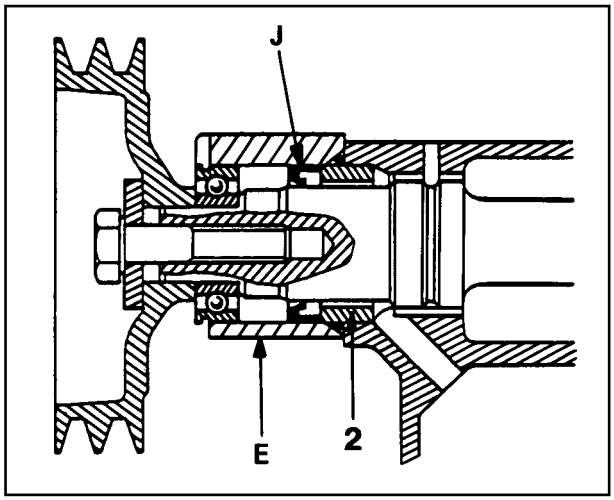


Figure 11-186

Removing the bearing

2nd type of assembly

Remove :

- Camshaft pulley
- Camshaft bearing fixing nuts (place a rag over the clutch - or converter casing - so that nuts and washers do not fall into it)
- Remove the bearing using the two M6x50 bolts with a 35 mm thread.

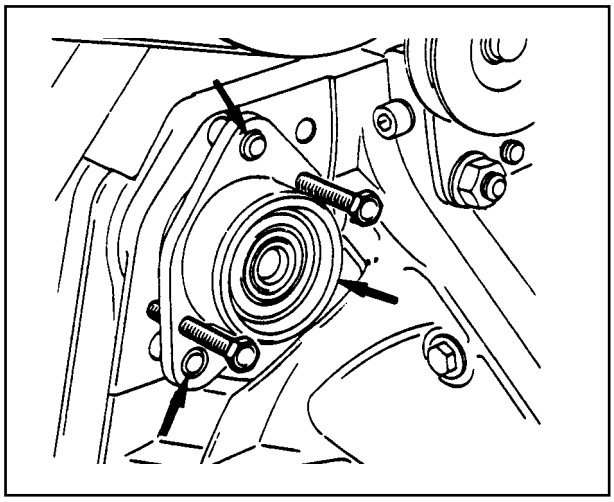


Figure 11-187

Special case of 3rd type of assembly

Since the seal is on the clutch or converter casing (E), do not push the extractor toll on completely.

Push-on tool Mot. 500-03 :

- Manual gearbox : approx. 30 mm
- Automatic transmission : approx. 50 mm

NOTE
With this type of assembly, since the length between the end of the camshaft and the seal is reduced, a 25 mm Ø spacer 45 mm long must be placed between the camshaft and the extractor bolt (V) of Mot. 500-03.

When the prongs of tool Mot. 500-03 have been passed behind the seal lip, bring the tool gently outwards so that the serrated ring (1) can slide, otherwise the prongs can catch under the spacer (2).

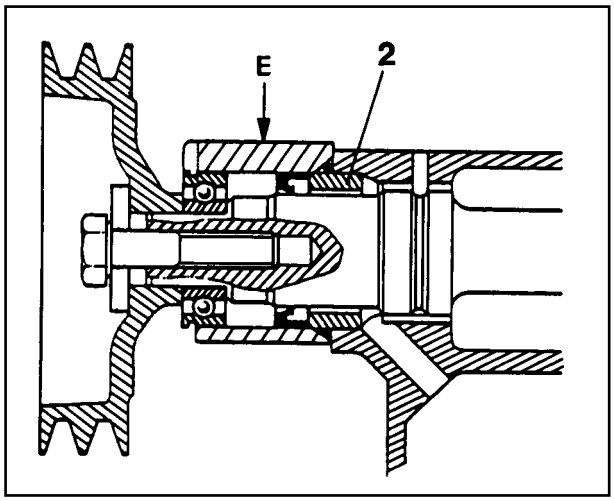


Figure 11-188

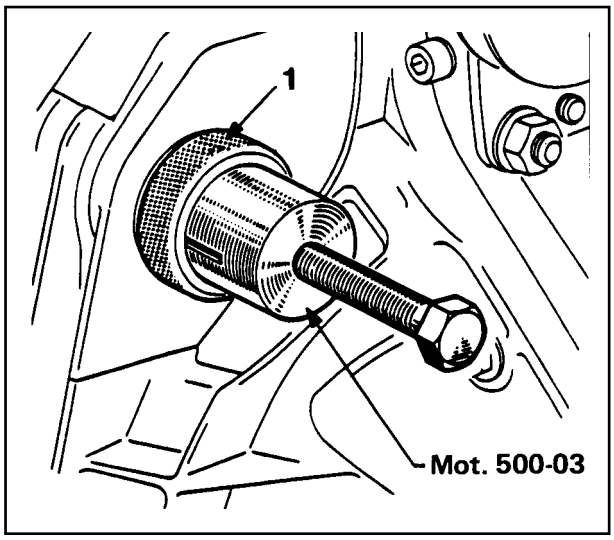


Figure 11-189

Fitting the new seal

- Fit the new seal on the end of inserting tool Mot. 500-03.
- Lubricate the seal.
- Place the tool equipped with the new seal on the camshaft.
- Using a 135 mm long threaded rod, the pulley washer and a nut, push on the assembly until the seal is in the position described below, with the mark in line with face (F) of the casing.

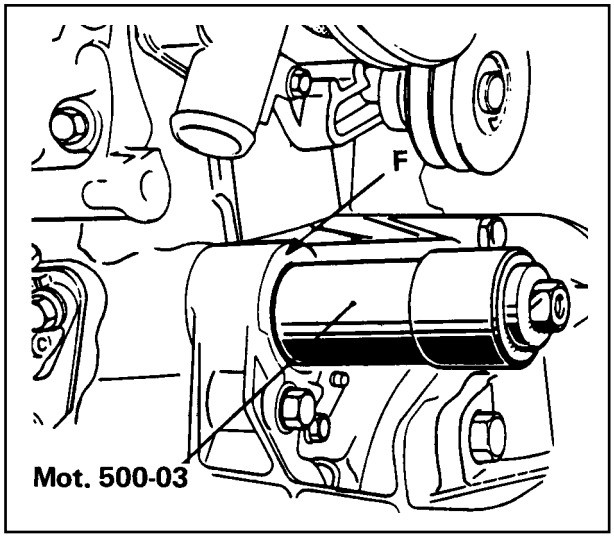


Figure 11-190

3rd type of assembly

Remove :

- the camshaft pulley,

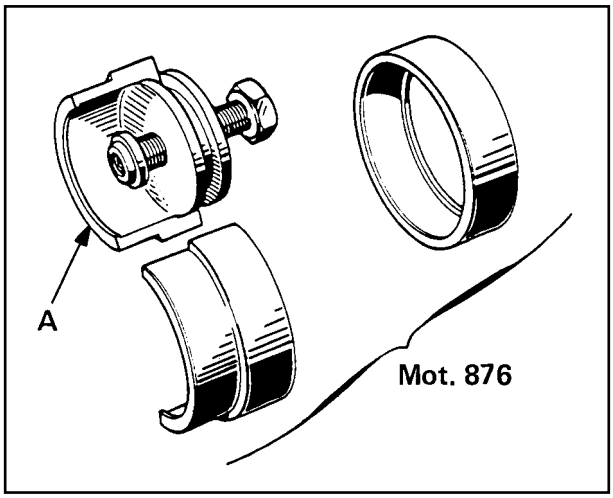


Figure 11-191

- the bearing (place small collar (A) of tool Mot. 876 in the bearing groove).

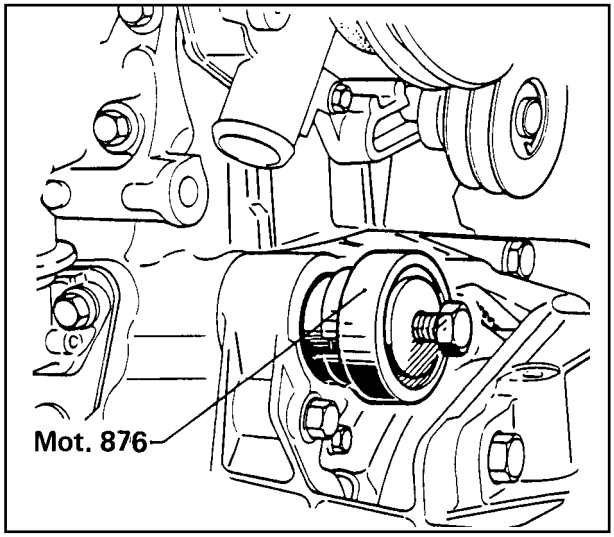


Figure 11-192

Removing the seal (J)

1st and 2nd types of assembly

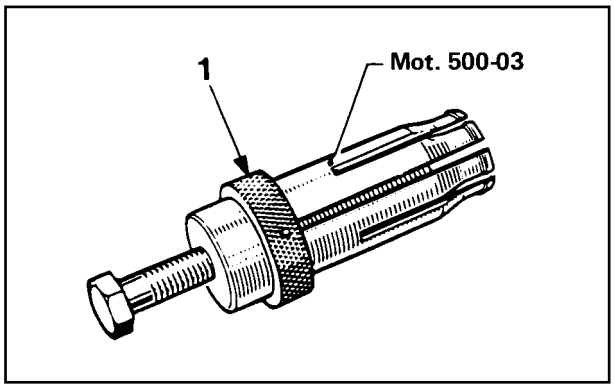


Figure 11-193

- Fit the extractor tool Mot. 500-03 and push it on completely so that the seal lip (L) passes behind the collar (C) of the tool.
- Push the serrated ring (1) ; ensure that the seal lip engages properly.
- Remove seal by screwing on tool bolt.

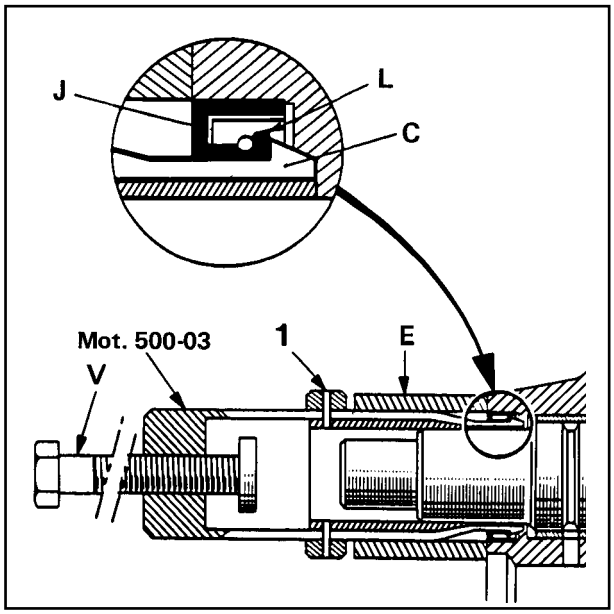


Figure 11-194

- Check that the seal spring is not still on the camshaft.

1st and 2nd types of assembly

Marks (A) - (B) - (C) and (D) are stamped, or are to be stamped, on tools Mot. 500-03.

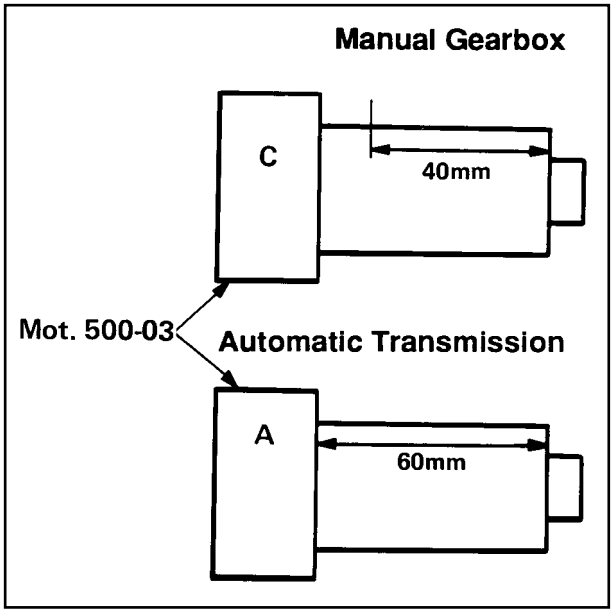


Figure 11-195

3rd type of assembly

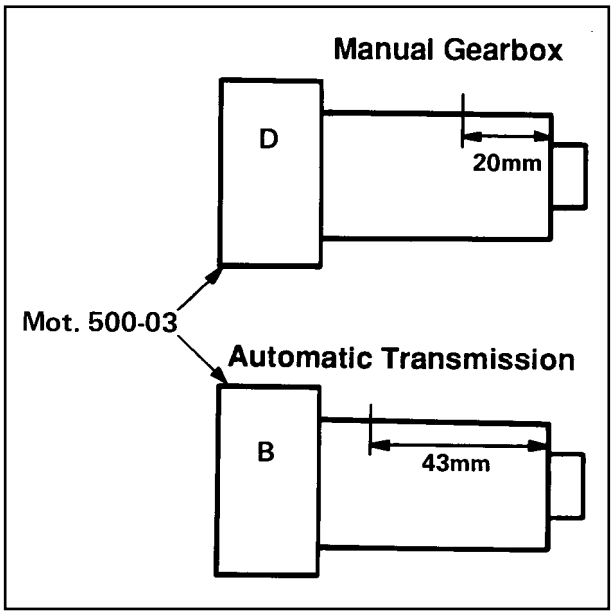


Figure 11-196

Fitting the bearing housing

2nd type of assembly

Insert the camshaft bearing using a tube, the bolt, the fixing plate and pulley.

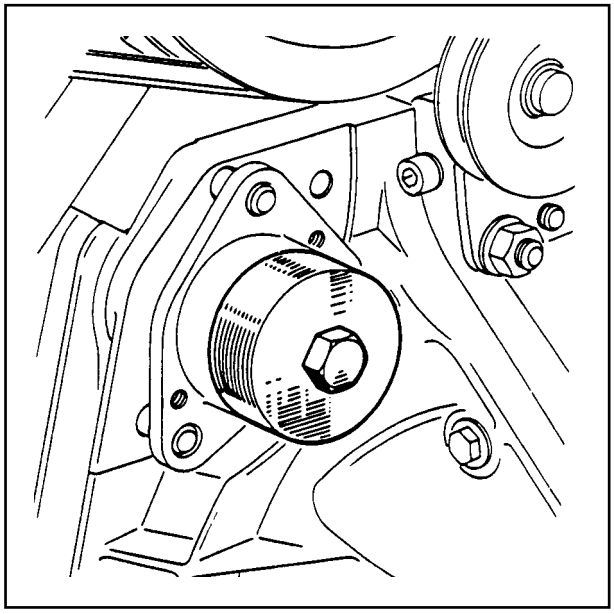


Figure 11-197

The pulley will position the bearing when it is tightened.

3rd type of assembly

This is the same as the 2nd type of assembly apart from the position of the bearing : groove (G) of the bearing should face the engine exterior.

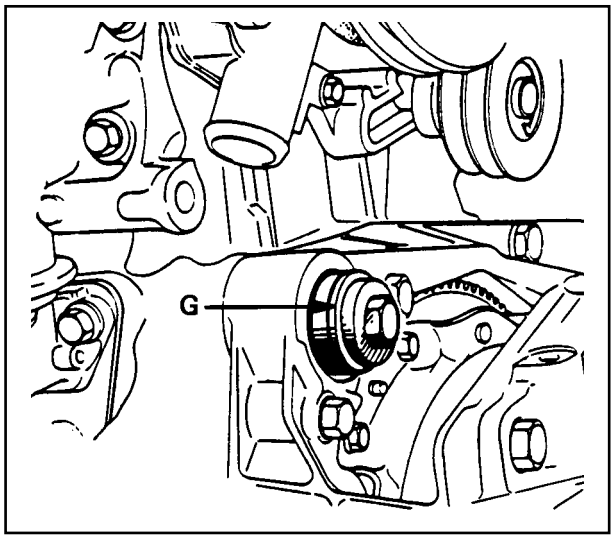


Figure 11-198

- Refit the pulley.

The belt tensions must be checked with tool Ele. 346-02 since their useful life depends on this.

Removal - Refitting - Overhauling

Material

CAF 4/60 THIXO : sump and timing cover (see "Sump" chapter)

Removal

- Drain the engine oil.
- Unscrew the sump bolts and remove the sump.
- Remove the gaskets and seals and clean the joint faces.
- Unscrew the 3 bolts and remove the oil pump.

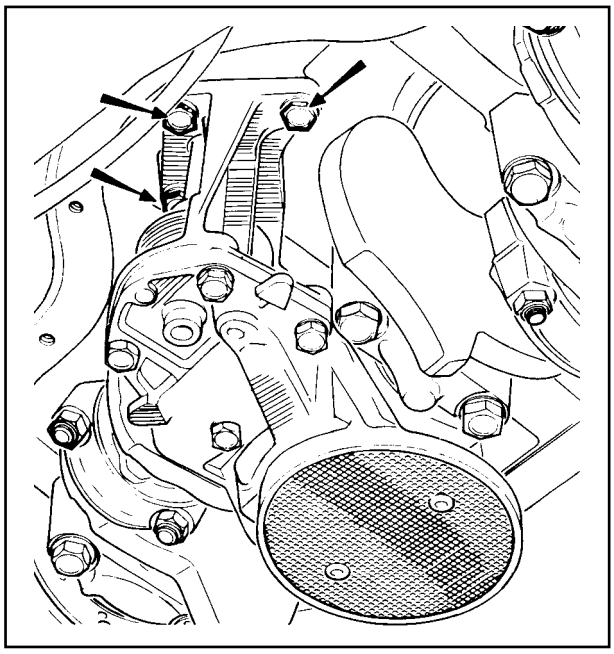


Figure 11-199

Overhauling

gear-type oil pump

- Unscrew the cover bolts : take care to prevent the ball seat, ball and pressure limiting spring from flying out. Remove the driven gear, driving gear and its shaft.

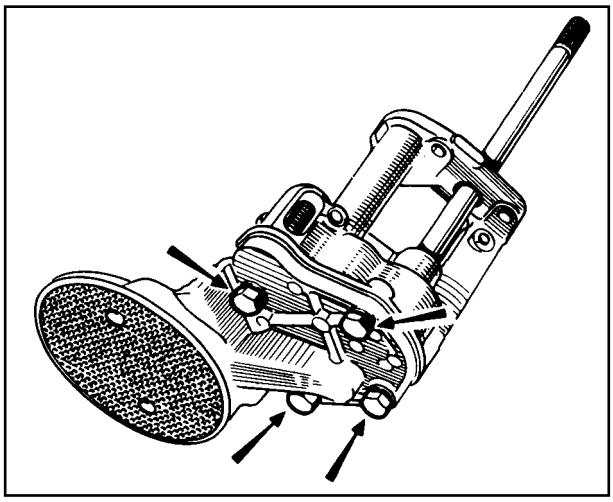


Figure 11-200

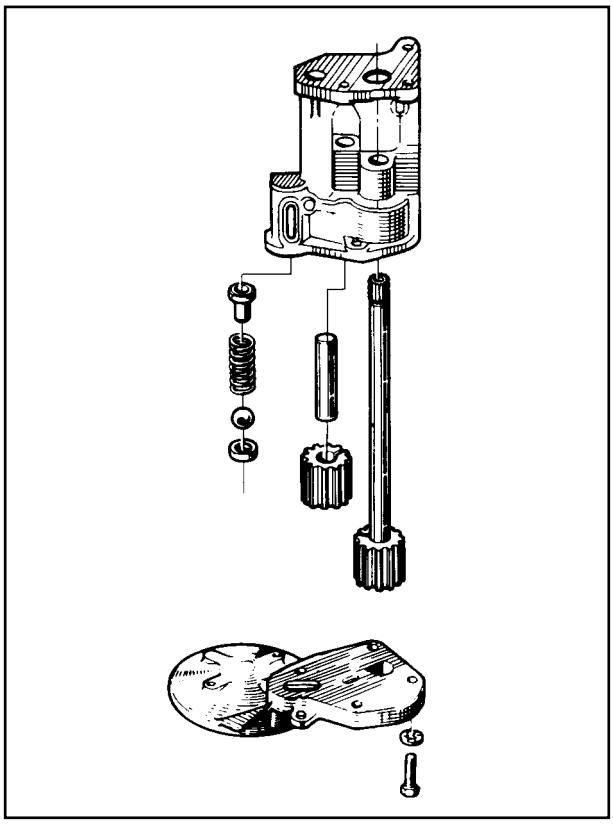


Figure 11-201

- Clean and check all the parts.

If the operating clearance between pump body and gears is more than 0.20 mm, replace the gears.

Oil pump with rotors

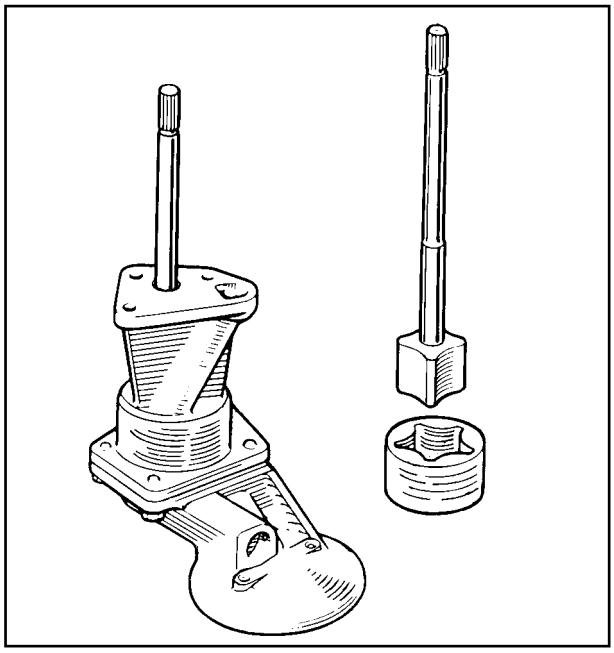


Figure 11-202

Check rotor clearances

Position 1

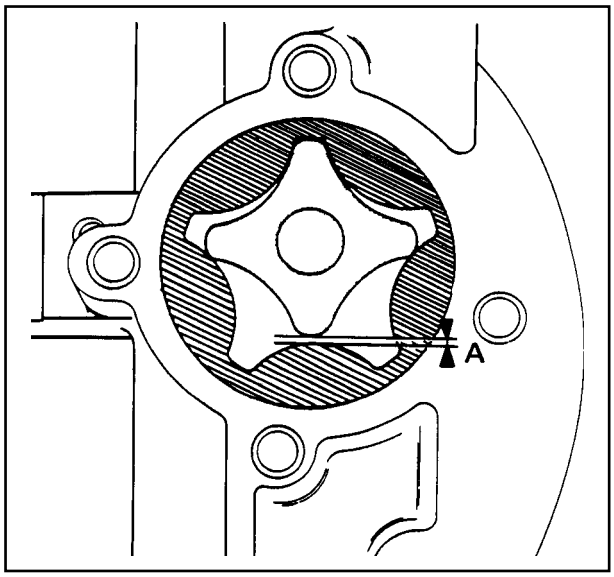


Figure 11-203

Dimension A : min. 0.04 mm
max. 0.29 mm

Position 2

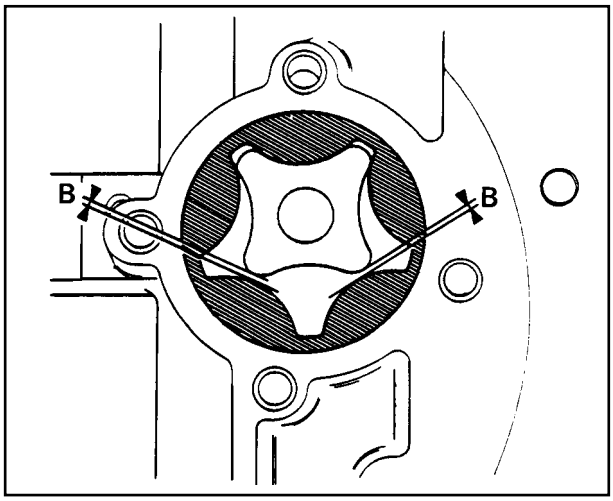


Figure 11-204

Dimension B : min. 0.02 mm
max. 0.14 mm

Both rotors must be changed if wear exceeds the above tolerances (the inside rotor is supplied with its drive shaft).

- Refit the pump in the reverse order to dismantling.

There is no seal between the oil pump and the cylinder block.

Assembly and adjustment

Special tools

Mot. 964 Timing cover centring tool

Material

CAF 4/60 THIXO : Sealing paste

Positioning of the timing cover on engines fitted with a crankshaft pulley

The 1st pattern timing cover must be located using tool Mot. 964.

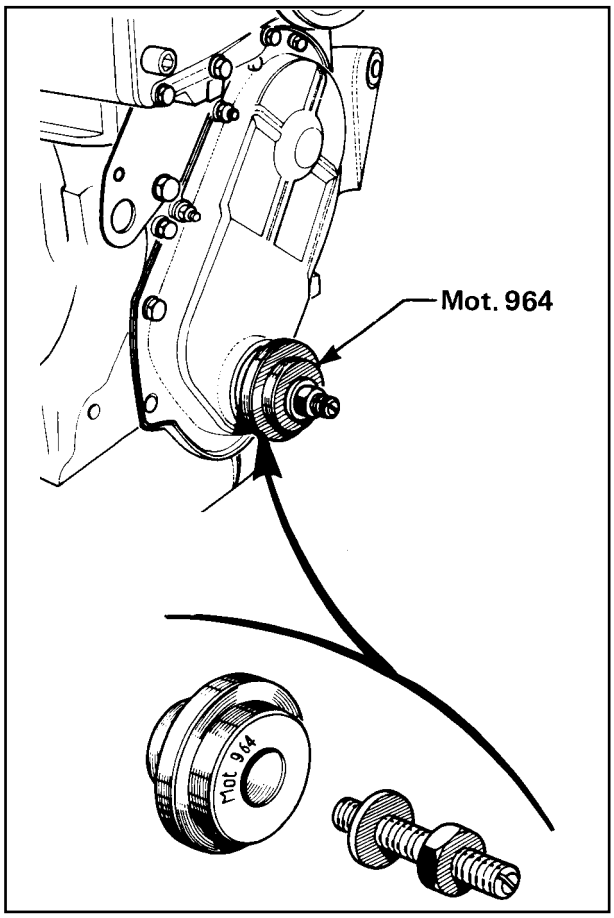


Figure 11-205

The 2nd pattern timing cover is located on the cylinder block by 2 dowels.

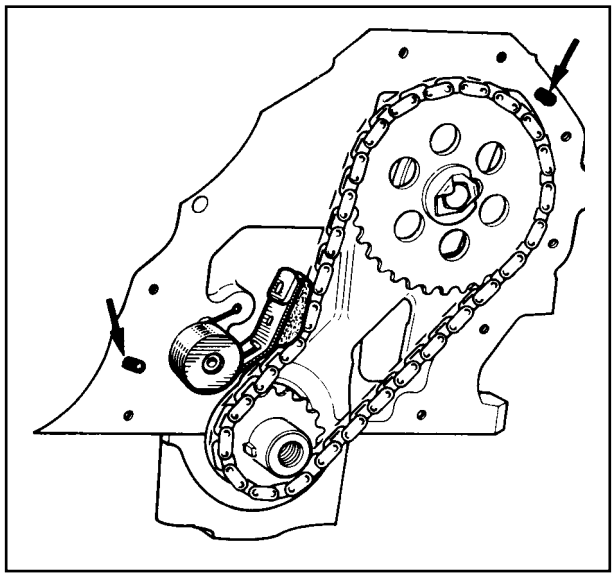


Figure 11-206

- Tighten the bolts without excess.
- Position the lip seal using tool Mot. 964.

Identifying sumps and timing covers

1st type

Must be assembled with cork gaskets.

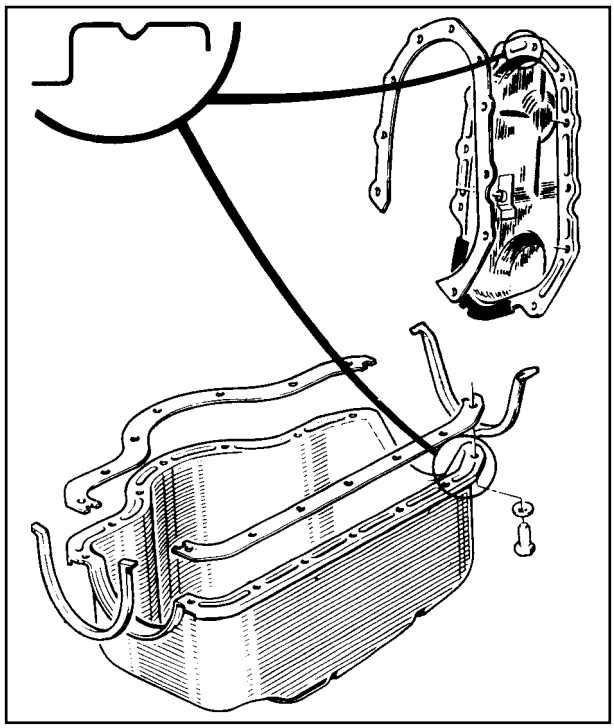


Figure 11-207

- Fit the rubber seals for the front and rear main bearings. The cork side gaskets must cover the ends of the rubber seals.

- Hold the cork gaskets in place using 4 dowels. Use CAF 4/60 THIXO paste at the ends of each gasket.

- Offer up the sump : tighten the bolts gradually and alternately taking care not to squash the gaskets.

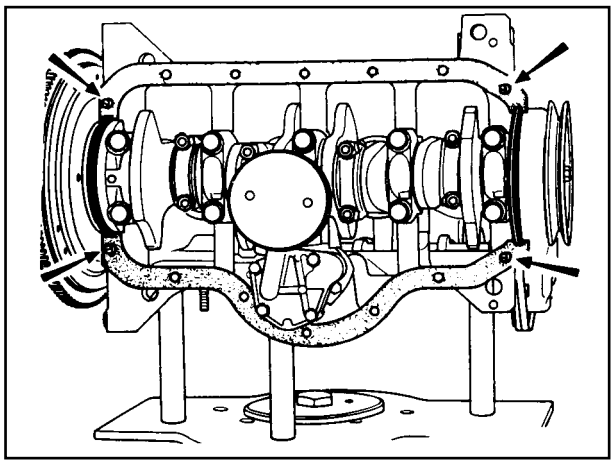


Figure 11-208

2nd type

Must be assembled with CAF 4/60 THIXO Silicon paste only.

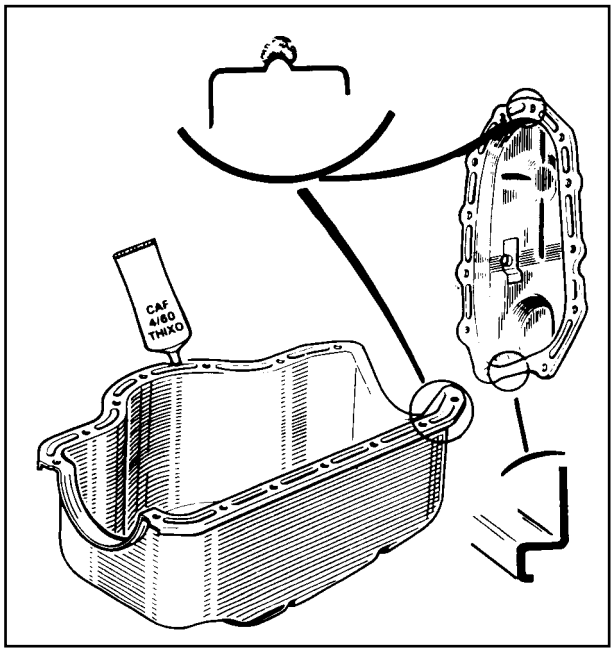


Figure 11-209

Application

It is essential to use CAF 4/60 THIXO since its properties provide good resistance to :

- Vibration
- High temperatures
- Oil and fuel
- Ageing

Use the following method to ensure good sealing of the joint faces of the casings :

- Clean the casings thoroughly (paste and oil).
- Wipe the timing cover, the movable gear and the oil pump to prevent any drips.
- Degrease (with a thinning agent) and dry the sealing faces of the casings and the cylinder block.
- Apply a 3 mm Ø strip of CAF 4/60 THIXO paste to the casings, placing a large amount at the four corners of the sump.

This product may be used in air for approximately 15 minutes.

CAUTION
An excess of sealing mastic at the sump cradle can block the flow of oil from the front bearing seal or the timing cover and cause damage.

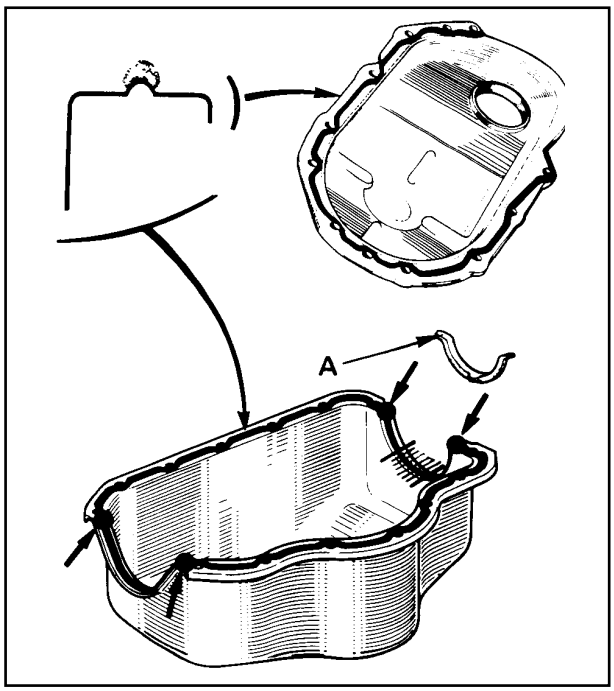


Figure 11-210

- Place a rubber seal Part No. 77 01 349 367 (A) in the No. 1 main bearing instead of the cork seal previously used.
  In this case do not put CAF 4/60 THIXO in the hatched area (approximately 7 cm).

- Place four centring rods (B) on the cylinder block (6 mm dia. bolt pitch 100 with a cut head ; make a slot for a screwdriver to position it).

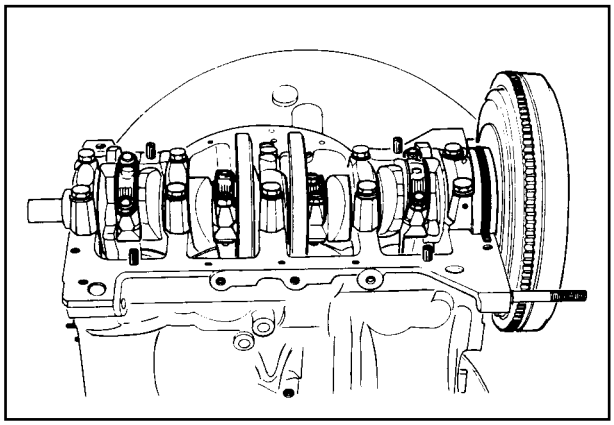


Figure 11-211

- Make sure that no oil runs just before the casing is replaced. Otherwise degrease again. DO NOT WIPE.

- If the strip of mastic has been pushed out of place before the casing is positioned, it should be replaced at this location.

Check that the casing is airtight after the assembly has been allowed to dry for one hour (see chapter on "Engine sealing").

Fault diagnosis

Special tools

Mot. 1014 Pressure gauge

Materials

Gas leak detector : 1000 bubbles (AIR LIQUIDE)
MOUSS MM2 (LUBRO oils) or equivalent (These products are supplied in 400 ml aerosol).

Searching for oil leaks to the exterior is facilitated by putting the interior of the engine under pressure and spraying a "gas leak detector" product over the area of the engine where the leak is suspected.

This test may be carried out with the engine removed or mounted in the vehicle.

Connection

On the oil rebreathing circuit :
(enables you to check the entire area of the engine which is not under oil pressure).

Examples of connection :

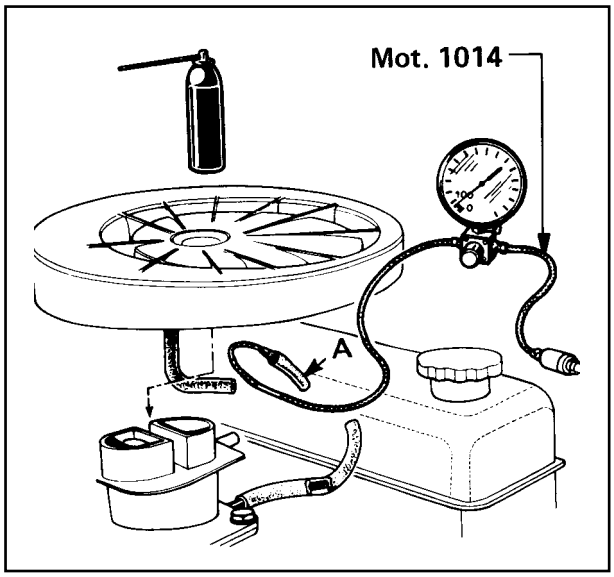


Figure 11-212

- Pressure gauge Mot. 1014 with end fitting (A) enabling it to be fitted to the vapour rebreathing circuit.

Method :

NEVER EXCEED A PRESSURE OF 80 MILLIBARS.

Above this pressure, the lip seals turn over.

- Completely unscrew the relief valve screw of pressure gauge Mot. 1014 before connecting it to the rebreathing circuit.

- Very slowly, increase the pressure to 80 millibars and check :

  • the sealing of the filler cap and the dipstick ;
  • whether there are any air leaks in the air inlet circuit (rebreathing circuit not blocked).

- Spray the gas-detecting product liberally over the area where the leak is suspected and look to see whether soap bubbles are formed.

NOTE
- In some cases it may be necessary to remove surrounding parts, for example the engine flywheel protective panel.
- This operation may also be performed on an engine which has been removed from the vehicle.
- If this operation is performed after repair work has been done, wait for the sealing paste to dry and only perform the operation for a few seconds otherwise this paste will be damaged.

Returning to Parts Department

Preparing the old engine for return to the parts department

The engine must be clean and the sump empty of oil.

The following must be left on the engine or must be packed in with it :

- dipstick and guide
- flywheel or converter driving plate
- clutch disc and mechanism
- fuel pump and plunger
- water pump and pulley
- crankshaft pulley
- rocker cover
- spark plugs
- oil pressure switch and thermal switch
- timing cover
- oil filter

Remember to remove :

- all hoses
- the belt or belts

The old engine must be fastened to the wooden base in exactly the same way as the new engine :

- plastic plugs in position, covers in position
- the whole assembly covered with the cardboard cover.

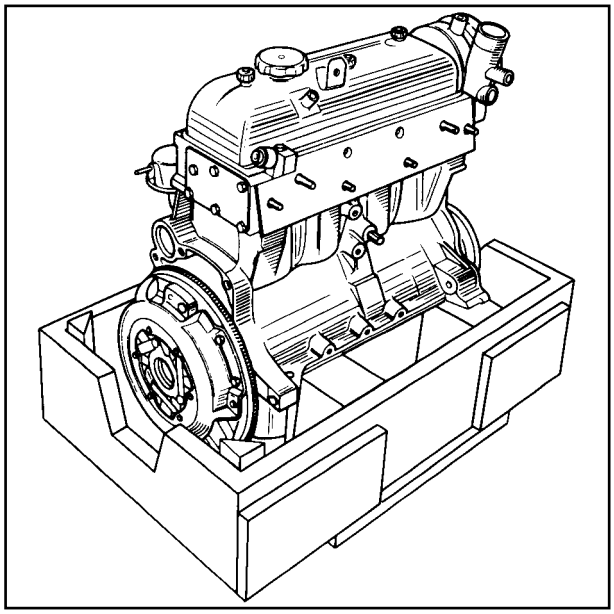
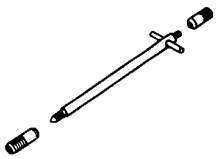
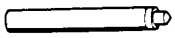
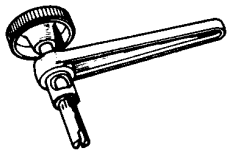
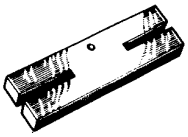
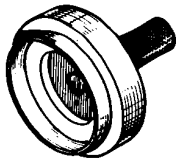
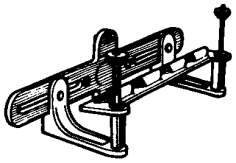
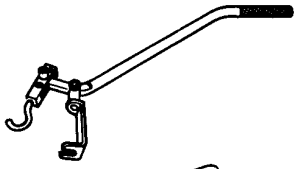
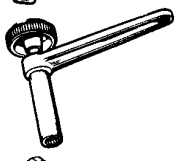
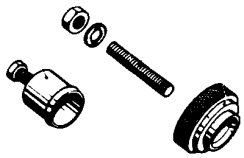
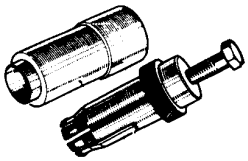
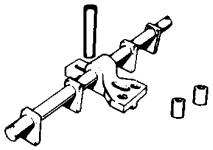
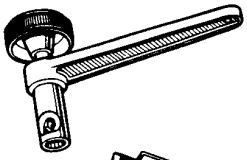
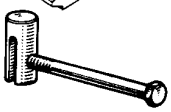
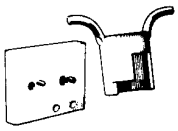
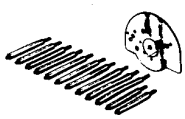
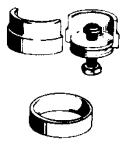
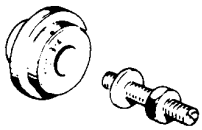
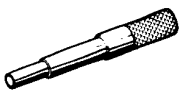
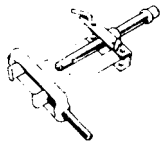
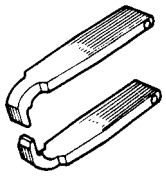


Figure 11-213

Special tools

	Engineering reference	Part number	Name
	Mot. 104	00 01 309 900	Cylinder head locating tool
	Mot. 111	00 01 320 300	Riveting bolt
	Mot. 233	00 00 023 300	Rocker arm adjuster
	Mot. 251-01	00 00 251 101	Dial gauge support
	Mot. 252-01	00 00 025 201	Pressure plate for liner protrusion
	Mot. 259-01	00 00 025 901	Mandrel for installing crankshaft seal, flywheel end
	Mot. 320	00 00 032 000	Valve holding plate (used with Mot. 382)
	Mot. 330-01	00 00 033 001	Cylinder head retainer on DESVIL stand
	Mot. 382	00 00 038 200	Valve spring compressor
	Mot. 443	00 00 044 300	Rocker arm adjuster
	Mot. 457	00 00 045 700	Timing cover oil seal extractor

Engineering reference	Part number	Name
 Mot. 500-03	00 00 050 003	Camshaft seal extracting and fitting tool
 Mot. 521-01	00 00 052 101	Liner retaining device
 Mot. 567	00 00 056 700	Rocker arm adjuster
 Mot. 574-13	00 00 057 407	Gudgeon pin inserting and extracting tool
 Mot. 582	00 00 058 200	Locking sector for flywheel
 Mot. 720	00 00 072 000	Cylinder head locating tool
 Mot. 761	00 00 076 100	Fitting and removing tool for timing chain mechanical tensioner
 Mot. 792-01	00 00 079 200	Engine support for fitting to DESVIL stand
 Mot. 876	00 00 087 600	Camshaft bearing extractor (5th bearing)
 Mot. 964	00 00 096 400	Timing gear cover seal positioning and centring tool
 Emb. 319	00 00 031 900	Clutch disc locating mandrel

	Engineering reference	Part number	Name
	B.Vi. 28-01	00 01 227 301	Bearing extractor with jaws 146 mm long
	B.Vi. 48	00 01 330 300	Set of 2 jaws with wide opening (addition to B.Vi. 28-01)

Vendor's No.	Vendor	Designation
U 20	Facom	Extractor
U43 LA	Facom	Valve lifter
Nr. 230	Neway	Valve seat cutter
Nr. 212	Neway	Cutter to reduce bearing seat
Nr. 213	Neway	Cutter to reduce bearing seat
Nr. 150-7	Neway	Valve seat cutter pilot Ø 7 mm
Nr. 150-8	Neway	Valve seat cutter pilot Ø 8 mm
Nr. 100-8 T	Neway	Drive wrench
Nr. 503-T	Neway	Drive wrench

Mixer

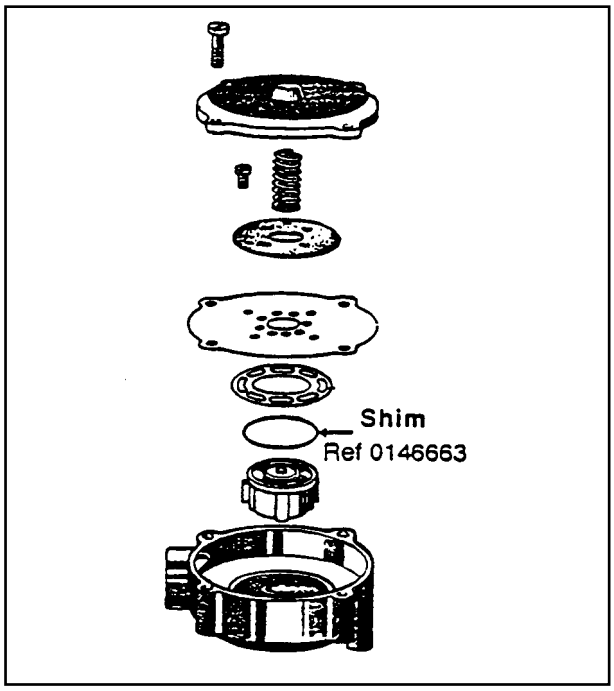


Figure 11-214

Fuel supply setting

For a correct CO rate setting, the height of the nozzle under the diaphragm will often have to be reshimmed. Plastic shims are available (ref. 0146663) to obtain the best possible setting for this.

Before replacing the mixer, we would like a full adjustment to be carried out at the same time as an analysis of the exhaust gases.

If it is not possible to adjust the CO rate, this often means that the nozzle height is incorrect.

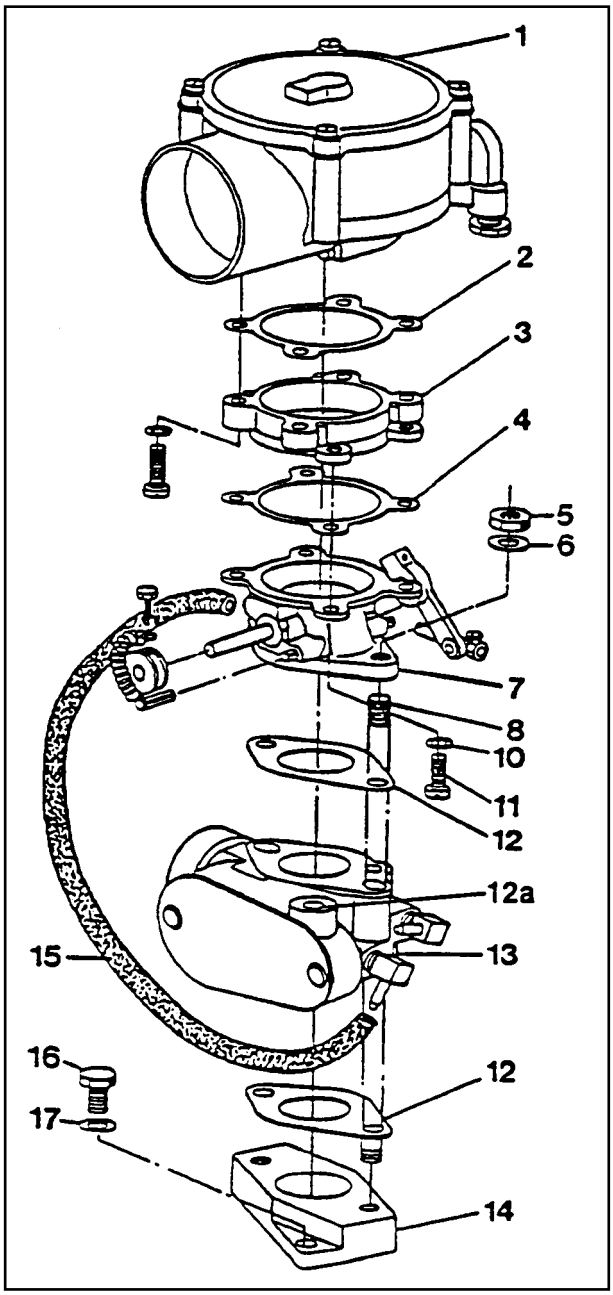


Figure 11-215

1	Housing	11	Screw
2	Seal	12	Seal
3	Flange	12a	Adjusting screw for maximum rpm
4	Seal	13	Converter
5	Nut	14	Flange
6	Washer	15	Hose
7	Nozzle	16	Screw
8	Pin	17	Washer
10	Washer		

Converter JB

Legend

1 Screw
2 Cover assy, secondary
3 Diaphragm assy, secondary
4 screw
5 Seal
6 Pin
7 Gasket, primary regulator
8 Gasket
9 Diaphragm assy, primary
10 Pin, primary valve
11 Screw

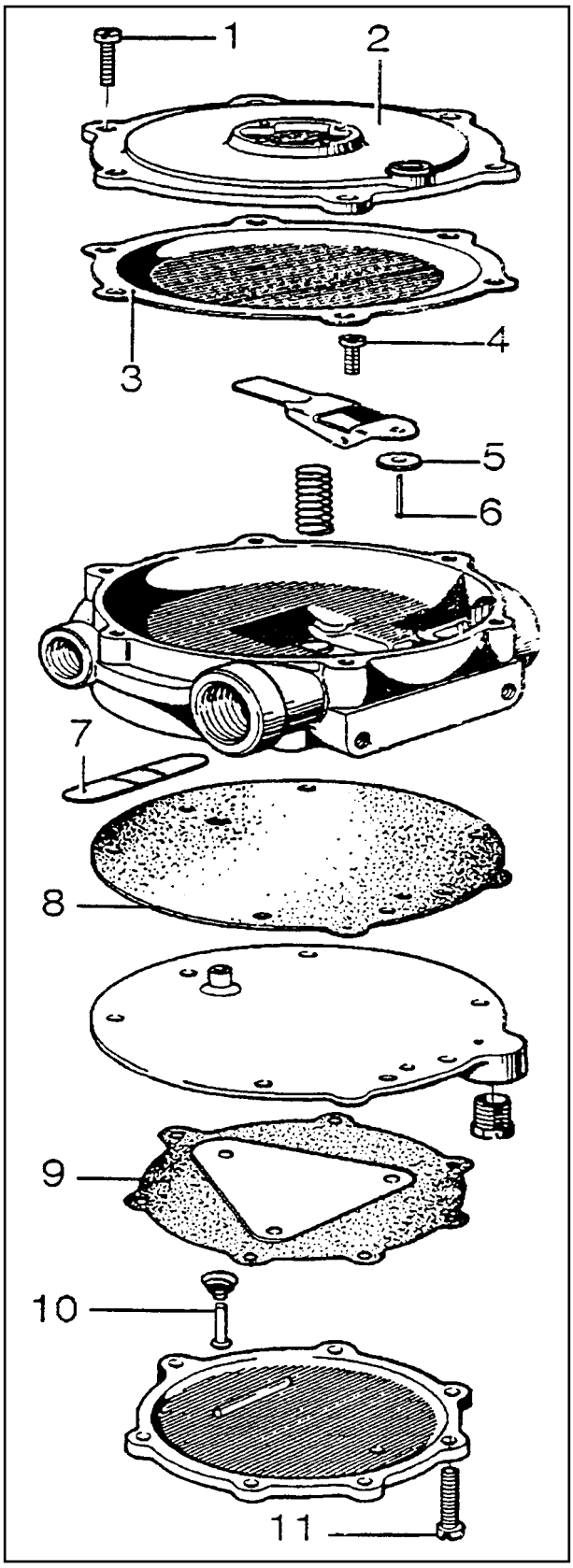


Figure 11-216

Disassembly - assembly

- Pull the diaphragm and link sideways to clear the lever slot.

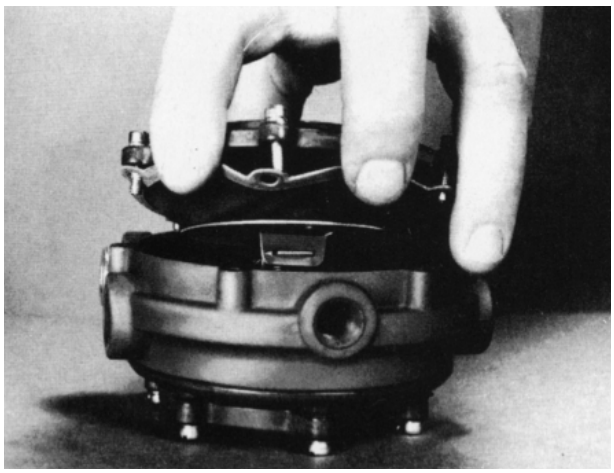


Figure 11-217

Remove secondary regulator cover and diaphragm assembly (3) from converter body.

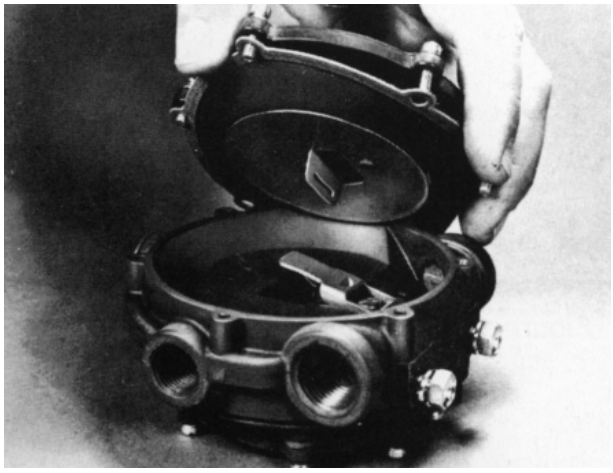


Figure 11-218

Remove screw (4) holding secondary lever from converter body.

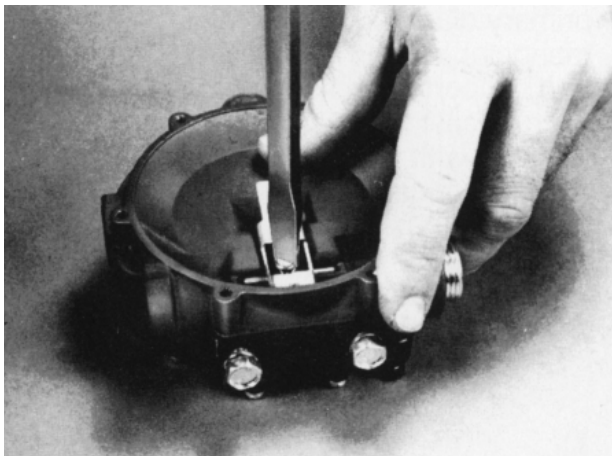


Figure 11-219

Remove secondary lever assembly and spring. A tab is provided on the underside of the lever to prevent the spring from slipping out under the lever.

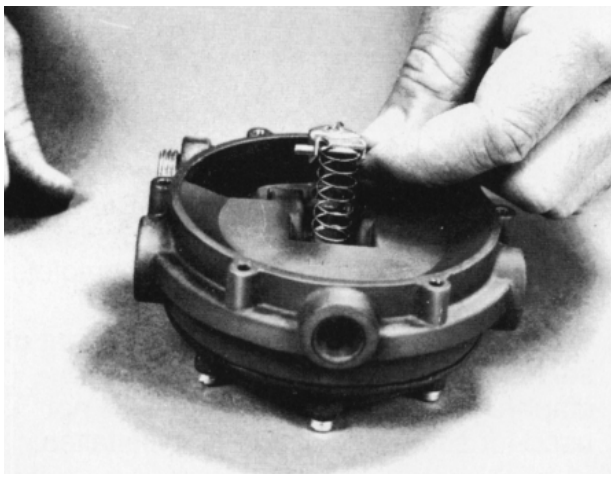


Figure 11-220

Remove screws (5) and lift cover off converter body.

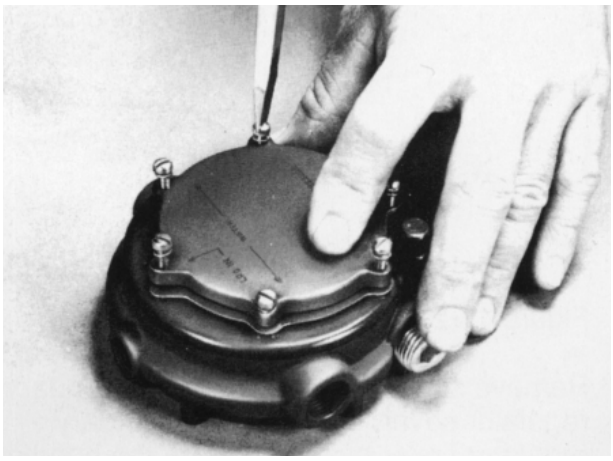


Figure 11-221

Remove the primary regulator cover and primary diaphragm assembly (6). A triangular lever is riveted to the diaphragm and supported on its upper side by a fulcrum cast in the cover. The diaphragm together with this triangular lever rocks on the fulcrum cast to depress the valve pin (7).

The point indicated in the illustration is the sensing port of pressure regulation.



Figure 11-222

The repair kit contains all the necessary wearing parts. Installation of the complete kit should be made only at time of overhauling the unit or if it has been out of service for some time. Gaskets and diaphragms deteriorate if the unit is not used for some time after being installed.

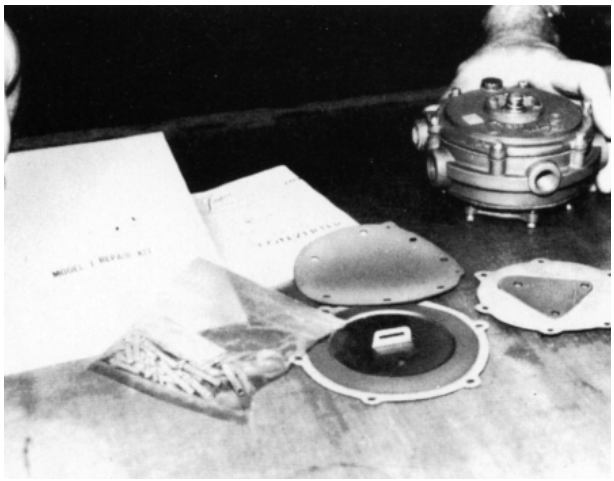


Figure 11-223

Remove screws (1) holding the secondary regulator cover. Loosen the secondary regulator cover by tapping with the handle of the screwdriver.

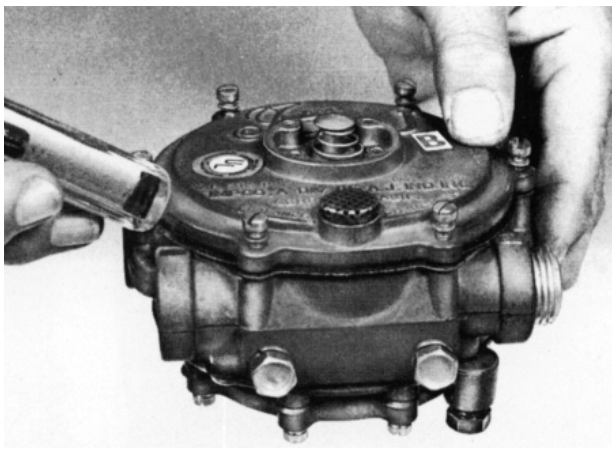


Figure 11-224

Remove the secondary diaphragm assembly by lifting it off in direction of the LP gas inlet. This will enable the diaphragm link to be disengaged from the lever guide.

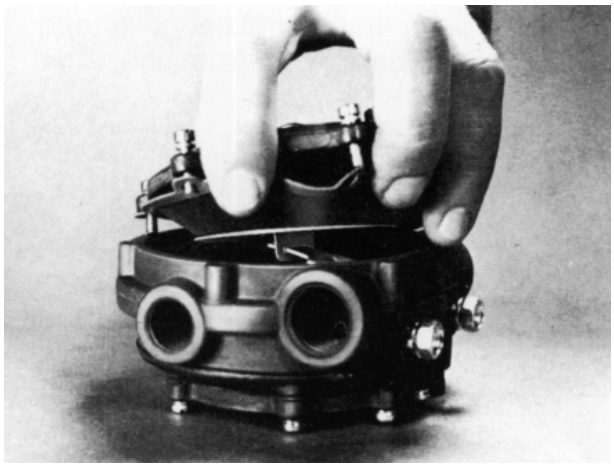


Figure 11-225

Remove the primary valve and primary regulator spring. The primary valve is operated by the valve pin moving in the bore of the converter body cover plate. It isolates the primary diaphragm (6) from contact with liquid gas and thus prevents stiffening of the diaphragm or icing.

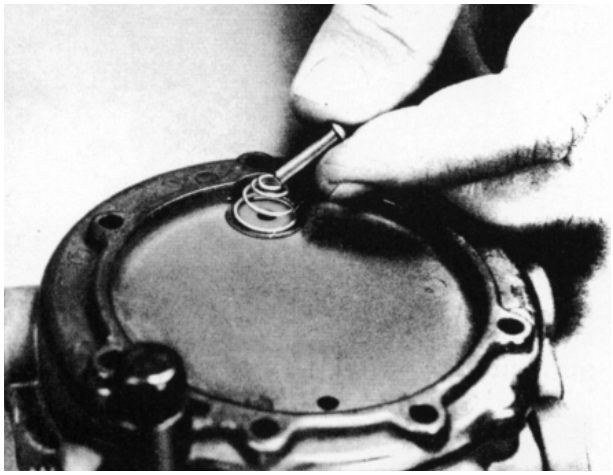


Figure 11-226

Remove the converter body cover plate and gasket (8). Liquid fuel is vaporized in the vaporizer labyrinth by absorbing heat from the engine cooling water. The gerrated chamber on outside is the vaporizing chamber, in which the flat gasket (9) for the primary regulator valve is located.

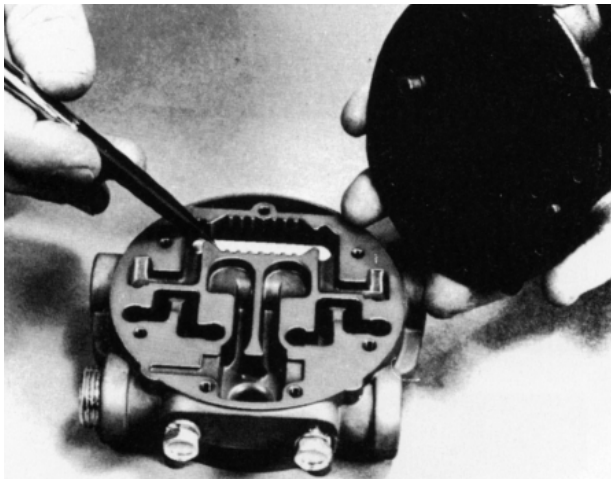


Figure 11-227

Remove gasket (8) from converter body cover plate.

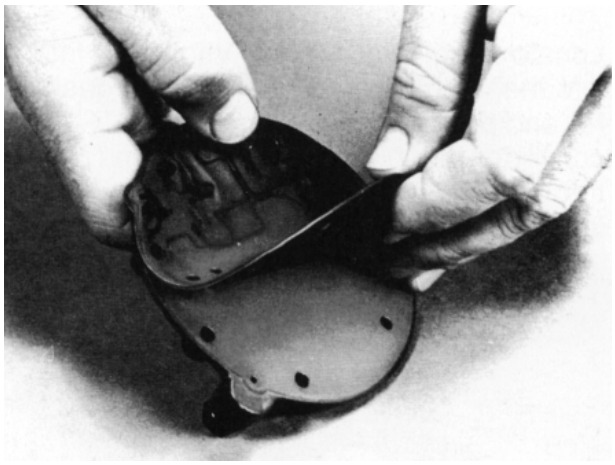


Figure 11-228

A viton seat for the primary regulator valve (9) is bonded to the back of the gasket (7).

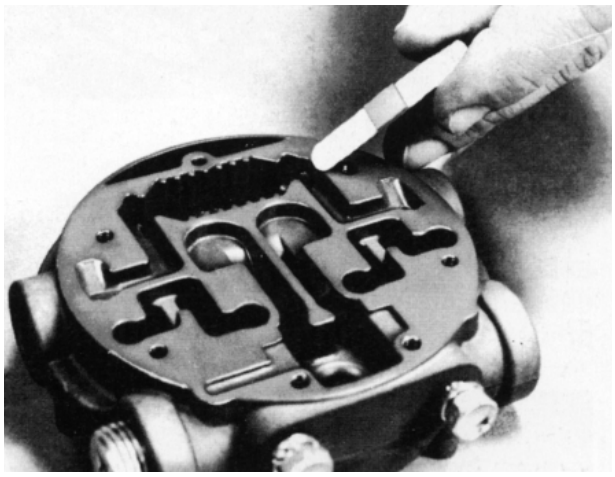


Figure 11-229

Assembly

Locate the gasket (9) with Viton seat fitting into the vaporizer labyrinth. Locate gasket (8) and position the cover plate on converter body, insert the valve pin (7) through the primary regulator spring and locate it in the bore of the cover plate.



Figure 11-230

Fit the primary regulator cover with the fulcrum cast and primary diaphragm assembly on the cover plate. The fulcrum cast and triangular lever must face towards primary valve.



Figure 11-231

Secure the primary regulator cover on the converter body by tightening the screws (5) in diagonally opposed sequence. The connecting positions for L.P. gas inlet, water inlet and outlet and primary regulator cover. Below the marking for the primary pressure test plug is an atmospheric vent bore for the primary diaphragm.

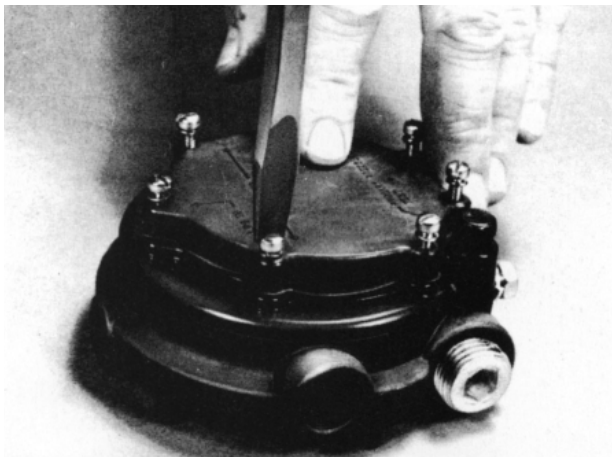


Figure 11-232

If necessary, replace the sealing ring (10) and pin (11).

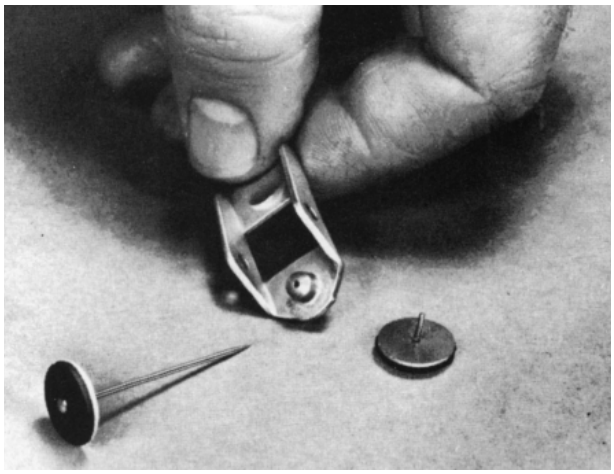


Figure 11-233

First insert sealing ring (10) in pin (11) and then draw the complete pin through the bore of the lever so that the sealing ring comes to be seated on the lever sealing face. However, the sealing ring should have enough freedom of movement to fit to the surface in the body bore and to seal the bore.

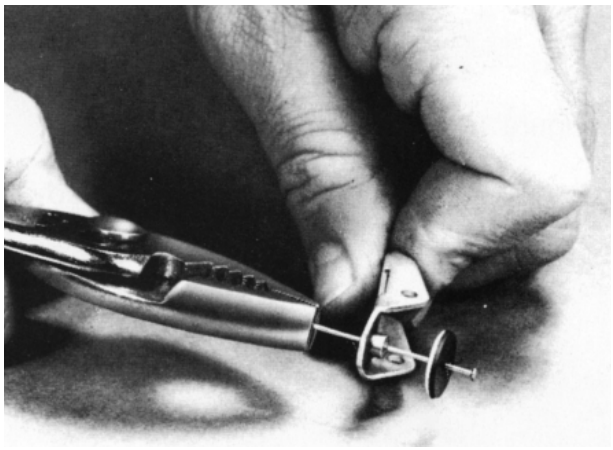


Figure 11-234

Bend pin (11) to retain the sealing ring (10) in position on the lever and cut off the excess length of the pin. The completed assembly should be as illustrated.

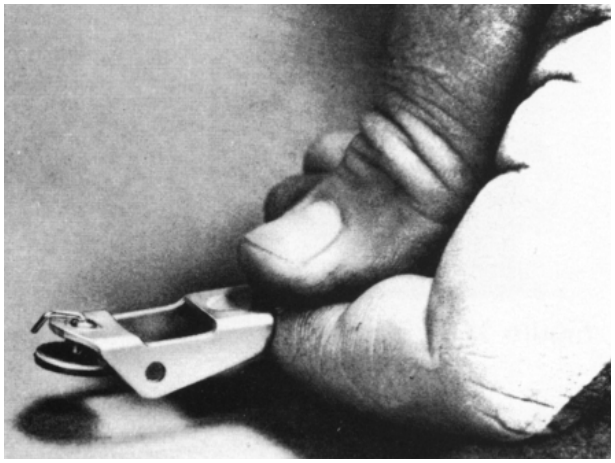


Figure 11-235

Locate the spring in the regulator body. Insert the guide pin through the bores in the regulator lever assembly.

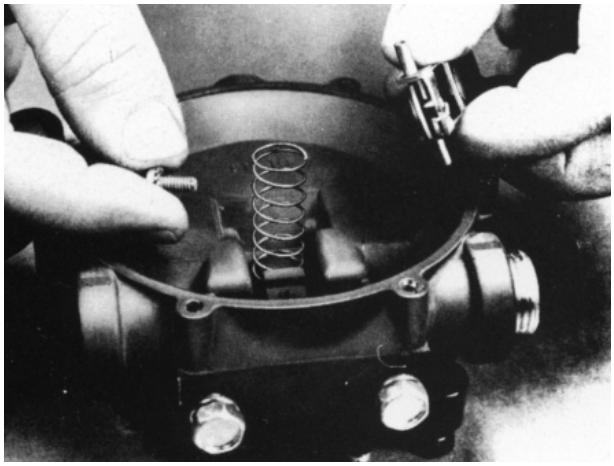


Figure 11-236

Secure the spring on the underside of regulator lever by the tabs provided.

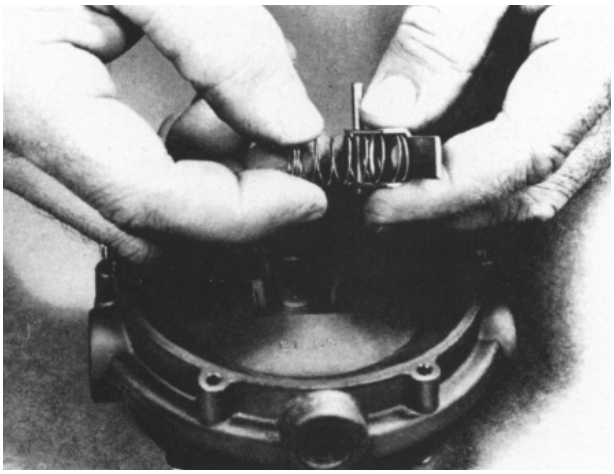


Figure 11-237

Install the secondary regulator lever assembly with the fulcrum pin in the groove of the body. Tighten screw (4) to secure the lever assembly in the body.

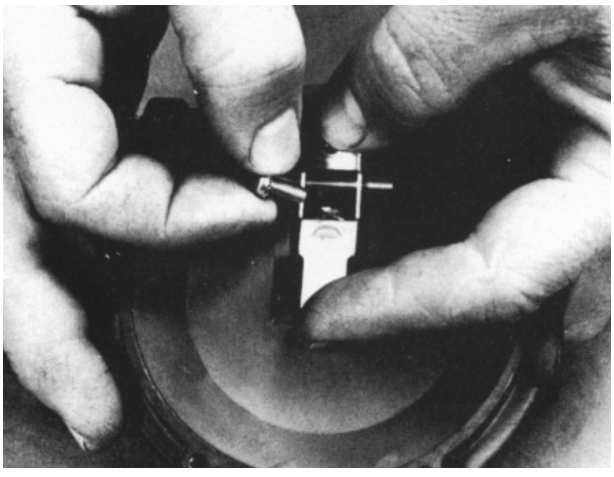


Figure 11-238

Pull the secondary diaphragm assembly (2) sideways into the regulator lever slot and position it on the body.

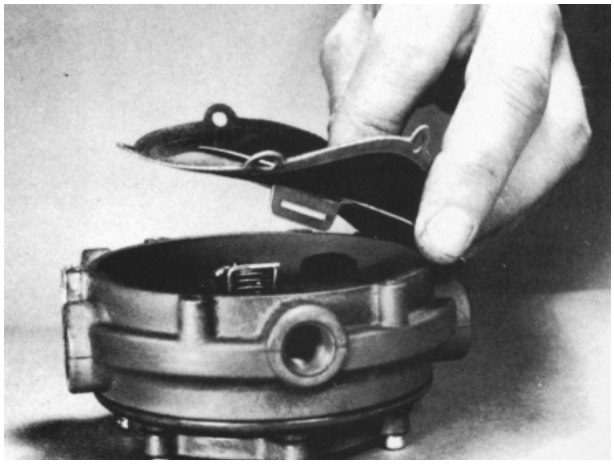


Figure 11-239

Place the secondary cover on the body and secure it with the screws, tightening in diagonally opposed sequence.

NOTE
Use only brass water hose fittings in the vaporizer in order to avoid electrolytic corrosion. Sealing tape (Teflon) must be used with elbows for gas and water connections. Gas fittings have taper threads (NPT), entailing the risk of the cast housings cracking if the fittings are screwed in too tightly. Therefore connections must be made tight with sealing tape rather than tightening with excessive force.

Inspect all L.P. gas connections for leaks with soap suds.

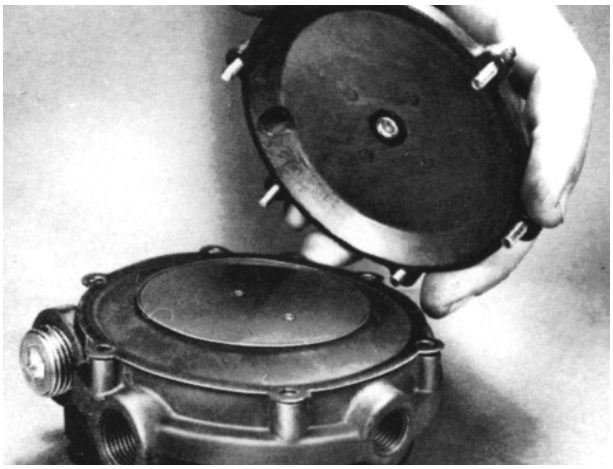


Figure 11-240

Ignition

Fault finding

Test conditions	Test		
	Clearance of rpm sensor to flywheel (gauge) 1 mm ± 0,5	Not OK	Renew receiver
	OK		
Plug (A) and (B) connected, coil removed, at starter rpm	Test lamp connected to (8) and (9) (disconnected. Lamp must flash at starter rpm.	Not OK	Replace module
	OK		
Coil removed, ignition off	Resistance measured with Ohmmeter at secondary end of ignition coil between (7) and (12) 2000 to 12000 Ω	Not OK	Renew ignition coil
	OK		
Coil removed, ignition off	Primary resistance of ignition coil between (6) and (7) is Reading : 0.4 to 0.8 Ω	Not OK	Renew ignition coil
	OK		
Plug (A) disconnected ignition off	Check insulation of rpm sensor between (2) and (3) Reading > 20 KΩ	Not OK	Repair wiring or rpm sensor
	OK		
	Not high voltage : Replace module		

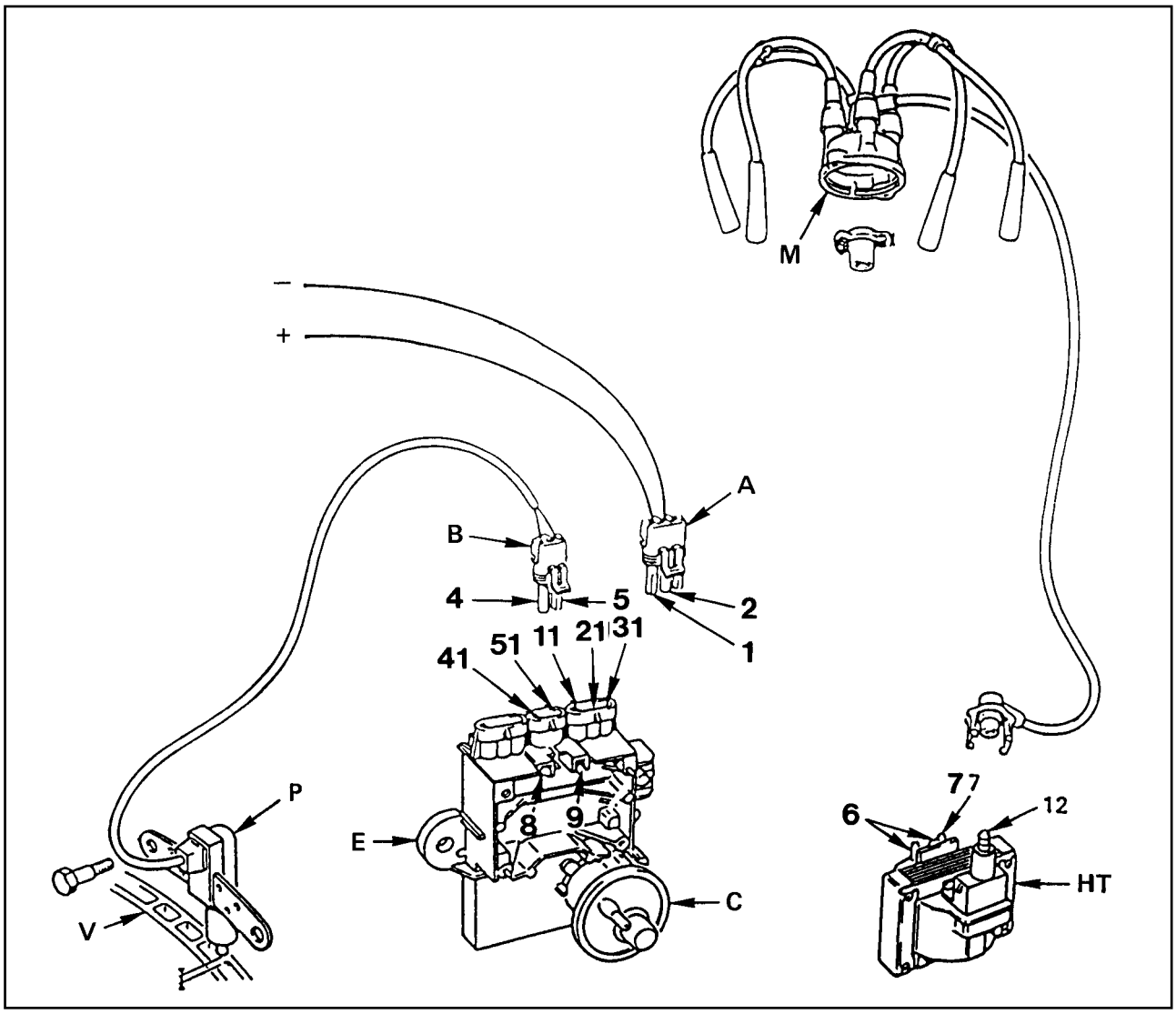


Figure 11-241

Item	Description
1	Power supply (+)
2	Ground
4	RPM sensor coil
5	RPM sensor coil
6	Coil terminal (+) Terminal for suppressor condenser
7	Coil terminal
8	Coil terminal (+)
9	Coil terminal (-)
11	Module input (+)
12	Secondary winding contact input

Item	Description
21	Module ground
31	RPM output
41	RPM sensor signal
51	RPM sensor signal
M	Distributor cap
HT	Ignition coil
C	Vacuum unit
E	Electronic processor or module
P	Hall rpm sensor
V	Flywheel

NOTE
Terminals 8 and 11 are connected directly in the housing.

1 Flywheel

The flywheel has 44 evenly spaced teeth of which two are omitted after each half circumference to give an exact reference point for the 90° position before TDC and BDC. This leaves a total of 40 teeth.

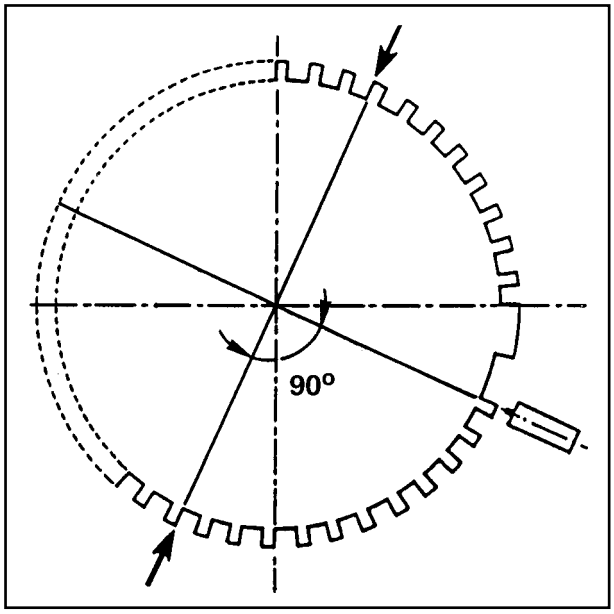


Figure 11-242

2 Hall RPM sensor (P)

It determines

- the position of TDC and BDC,

- engine speed.

It is nonadjustable (preset on its mounting bracket).

It must be fastened on the clutch housing using the stepped screw.

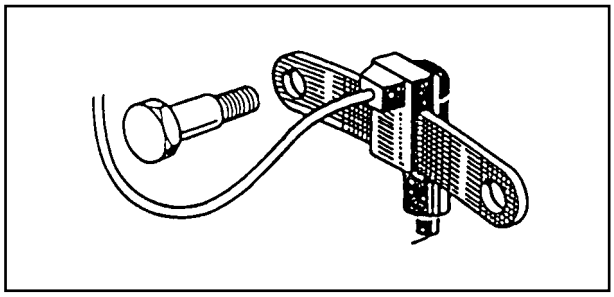


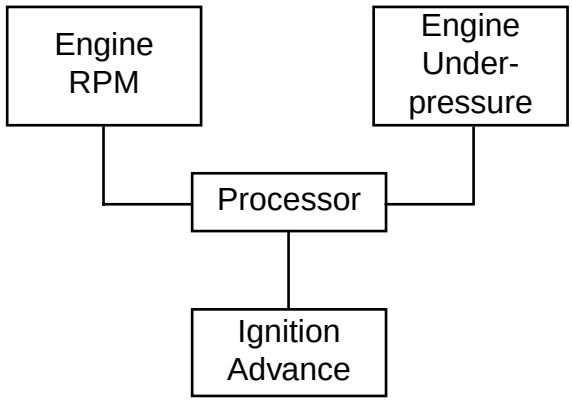
Figure 11-243

3 Vacuum unit

This unit is identical with the conventional vacuum unit having the same appearance ; however, its internal method of operation is different.

4 Processor

The electronic system determines the ignition advance dependent on the engine speed and the underpressure.



5 Ignition coil

The coil is independent of the processor so that it can be replaced.

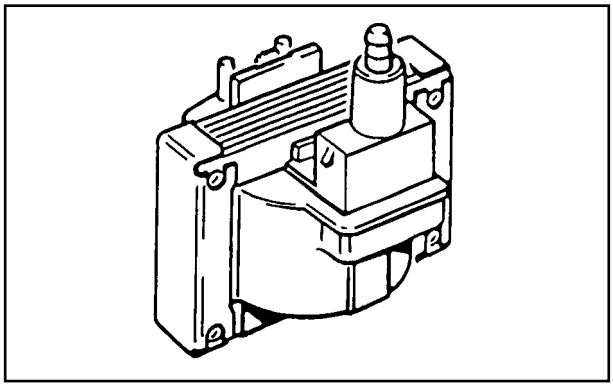


Figure 11-244

Distributor

The distributor has only the function of distributing the high tension voltage to the plugs in the order of ignition. It is adjustable.

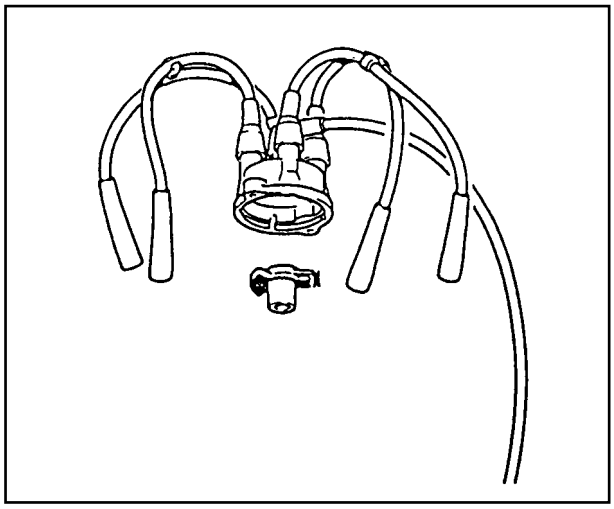


Figure 11-245

Test

The curves for advanced ignition and underpressure adjustment can be tested but not adjusted (this could indicate a fault in the electronic processor).

Instruments

Identical to those used for our range of trucks :

- Voltmeter
- Ohmmeter
- Test lamp
- Stroboscopic lamp
- Diagnostic unit (with connections identical to those vehicles not provided with a diagnostic connector and with the "Electronics" button depressed).

IMPORTANT
Precautions :

- Do not apply high tension voltage to the electronic processor.

- Do not apply the coil primary and secondary windings to ground.

No ignition

Sight check :

- Spark plugs
- Spark plug leads
- Ignition distributor
- High voltage lead

Check the condition of pins (A) and (B) ; disconnect and reconnect the plug several times. Clean the cable terminals, if required, and whenever replacing components.

Preliminary test

Check whether the voltage between terminal 6 (ignition coil power supply positive terminal and output lead of suppressor condenser) and ground (ignition on) is above 9.5 volts.

Test condition	Measurement		Diagnosis
Plug (A) pulled off Ignition on Starter running	(+) voltage at module terminal (1) and vehicle ground (voltmeter) > 9.5 V	Not OK	- Check battery voltage - Charge battery - Check module power supply lead
	OK		
Plug (A) disconnected Ignition off	Ground plug terminal (2) and vehicle ground Ohmmeter 0 Ω	Not OK	- Check module ground lead
	OK		
Plug (A) disconnected Ignition off	Ignition coil power supply (6) and (11) Ohmmeter 0 Ω	Not OK	- Replace electronic module
	OK		
Plug (A) connected Ignition on	At block terminal (A) point (6) and vehicle ground (voltmeter) > 9.5 V	Not OK	Move assembly (A). If still not OK check leads between coil terminals and contacts. If then still not OK, replace (A).
	OK		
Plug (B) disconnected Ignition off	Resistance of Hall sender at points (4) and (5) 200 Ω ± 50 Ω	Not OK	Replace Hall sender

Starting is difficult, but not malfunctions when engine is running

Inspect visually or use an instrument :

- Plugs
- Ignition leads
- Ignition distributor
- Ignition coil

Check high voltage at starter speed :

- Remove high voltage lead at distributor cap
- Hold ignition lead 2 cm from engine block

WARNING
Do not apply high voltage to the electronic module

Test condition	**Measurement**		**Diagnosis**
Operate starter	High voltage arcs equal	Not OK	Check module power supply : > 9.5 V Check battery voltage Check battery
	OK		OK
	Check : Mixer, mechanical condition, engine, basic adjustment		Check resistance of Hall sender between points (4) and (5) Ohmmeter : 200 Ω ± 50 Ω Replace if not OK
			OK
			Check clearance of Hall sender to flywheel 1 mm ± 0.5 Replace if not OK
			OK
			Clean the pickup end of sender
			OK
			Replace Hall sender

Check the mechanical condition of the vaccum unit

- Runt the engine at maximal speed.
- Remove the vacuum hose at the vacuum unit

Engine speed decreases	NO	Check condition of vaccum hose
YES		OK
Vaccum unit OK		Replace electronic module

Engine pollutant emission values

The values shown correspond to test bench operation.
Real values on the truck may be slightly different depending on the use, engine load, fuel type and general operating conditions.

Diesel Engine
Fuel : CEC- RF 03
Engine adjusted for a maximum speed of 2800 RPM (13 mode tests)

in g / kW . h

HC	CO	CO2	Particles
0,23	1,43	2,40	0,415

* These values cannot be adjusted and cannot (in the French network) be checked.

"GAZ" Engine
Fuel : GPL
Engine adjusted for a maximum speed of 2900 RPM.

	in ppm	in % vol	in % vol
Idle speed 750 RPM	HC	CO	CO2
	170	0,9	11,6

NOTE : 0,01 % is equivalent to 100 ppm.

Cooling system*

The improvements to the cooling system are as follows :
- Stronger shaped hoses
- Pressure setting in the cooling circuit increased from 0.8 to 1 bar.
- Baffle plate omitted

Method of operation of cooling system

The radiator cap (1) is completely tight and when the coolant temperature increases, the pressure increases and the coolant flows into the expansion reservoir (2). When the pressure in the expansion reservoir reaches 1 bar, the valve in the expansion reservoir cap responds and allows the pressure to drop again.

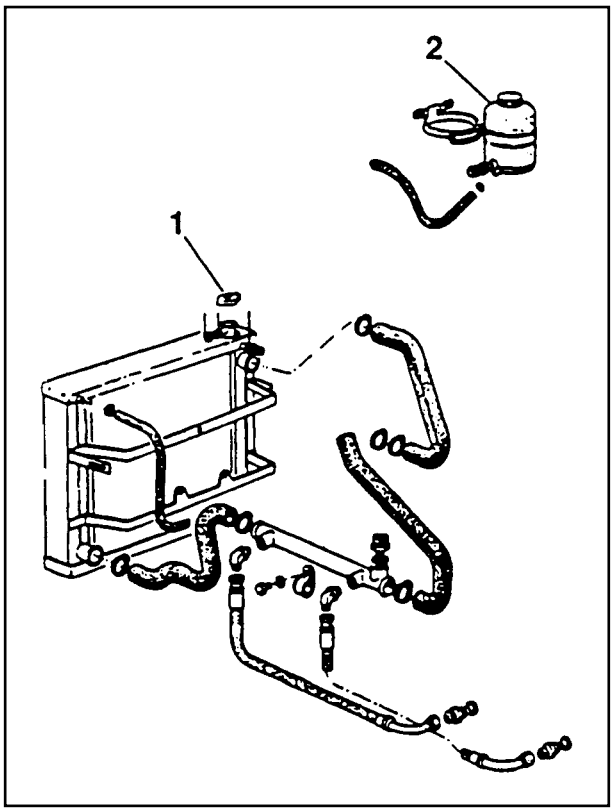


Figure 11-246

* Applies to new M15 from serial number 717117004000 (LPG)

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Telescopic mast 20-4
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Triplex mast 20-9
Chain adjustment 20-12
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Mast types

All three mast types are clearview masts. The mast uprights (channels) are a "I"-beams. The fork carriage and mast uprights are guided by rollers which can also take up side loadings. For this reason the previously used side thrust rollers are not fitted.

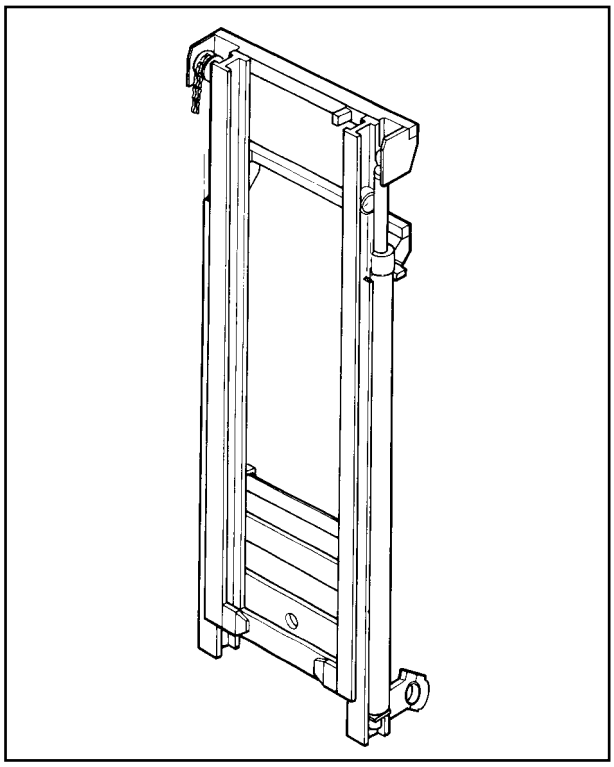


Figure 20-1

Telescopic mast

When lifting, the inside uprights are higher than the load. With low ceilings the inner mast height of lift must be taken into account (low free lift of 150 mm without increasing the built height).

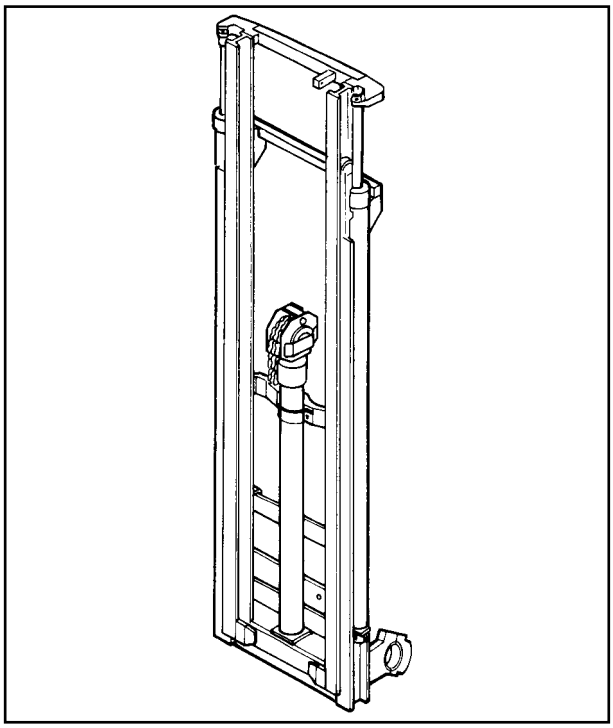


Figure 20-2

NiHo (Full free lift)

When lifting, the extending mast is never higher than the load. With low ceilings the inner mast lift does not need to be taken into account.

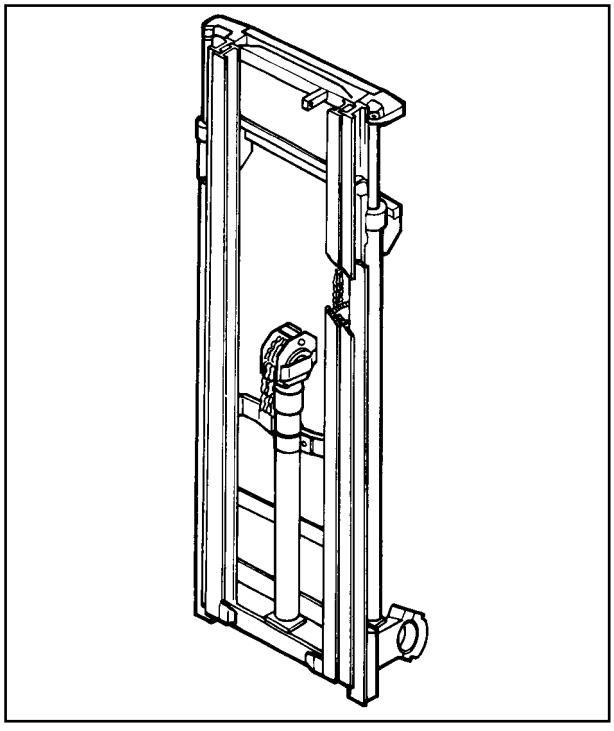


Figure 20-3

Triplex mast

Same as the NiHo mast except that it is higher without extending the built height. With low ceilings the inner mast lift need not be taken into account.

Removing the mast

1. Remove the forks or attachments (if fitted).
2. Block up the truck so that the removal can be performed with absolute safety.
3. Put the mast vertical and secure the top of the mast to a hoist.
4. Disconnect the lift cylinder hoses.
5. Pull out the tilt cylinder pins at the mast support.
6. Remove the mast support bolts and mark the left and right support halves.
7. Remove the mast to the front.

Installing the mast

For the installation of the mast, perform the above steps in the reverse order. Make sure that the friction discs are fitted on the pins. Also take care not ot interchange the left and right support halves.

IMPORTANT
Torque the mast support bolts to 19.6 mkg.

NOTE
To reduce roller wear, lubricate all mast channels regulary with grease F.

Telescopic mast
Mast hydraulic circuit

The oil enters the lowering valve (2) under presure where it is distributed by a tee to the two outer cylinders.

The right-hand lift cylinder is provided with an automatic line safety valve (1) which prevents the load from lowering too fast if a line breaks.

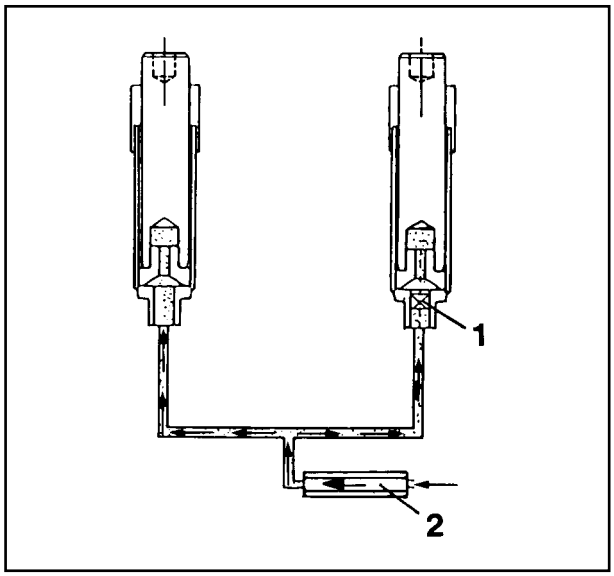


Figure 20-4

1 Line safety valve (for installation see related section)
2 Beake lowering valve

Telescopic mast

Load chain adjustment

The load chains are adjusted at the chain tensioners (1).

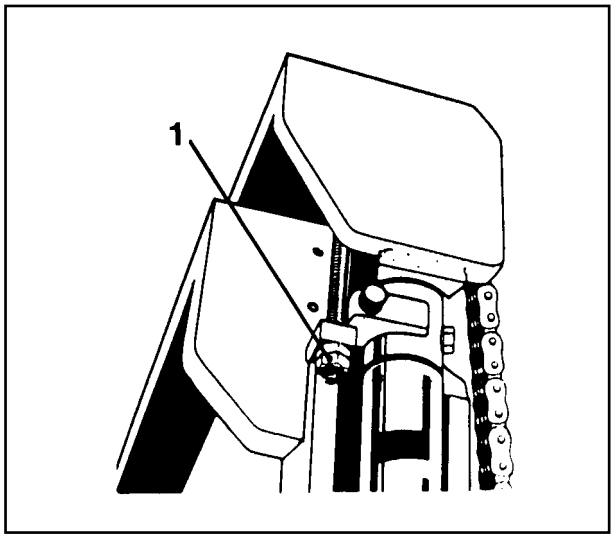


Figure 20-5

When the lift cylinder is fully extended (the stop is located between lift cylinder and piston), the centre of the top fork carriage rollers must be at least 35 mm below the top edge of the inner upright.

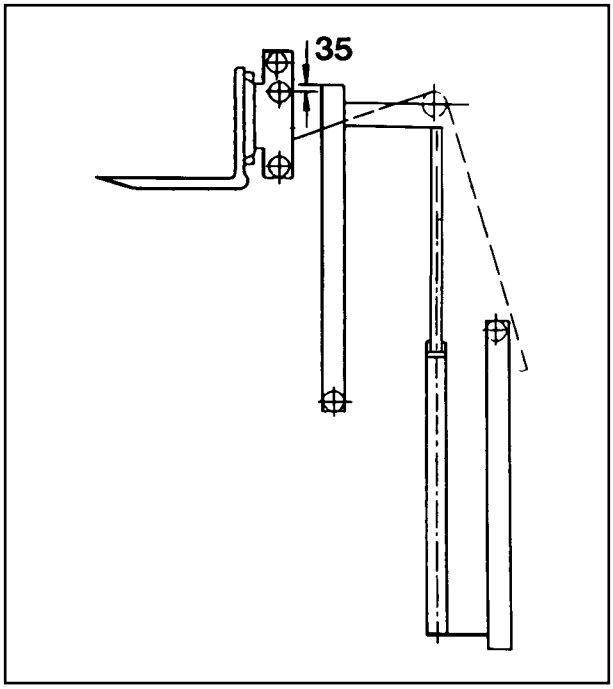


Figure 20-6

It is not allowed to compensate tyre wear by adjusting the chains.

CAUTION
Also make sure that the minimum distance for the fork carriage run-out stop is maintained (see the section on run-out stop).

IMPORTANT
The condition of the load chains and their stretch (3 % max.) must be checked as required by accident prevention regulations.

Telescopic mast

Method of operation

The two outer cylinders are located in the "I"-beams of the outer upright.

They have a common hydraulic oil supply line.

The two pistons are attached at the top to the croos member of the inner mast.

When pressure oil flows to the two cylinders, both pistons are extended simultaneously, lifting the moveable inner mast up.

The end stop is fitted between the cylinder and piston.

The load chains are attached to the outer upright. From there they are lead over pulleys to the inner mast. At the other end they are connected to the fork carriage.

Consequently, the mast is raised at a 1 : 2 ratio in relation to the fork carriage.

A lowering brake valve in the fixed pipes limits the maximum lowering rate to 0.60 m per second.

The intermediate cylinder possesses a line safety valve (safety in case a hose or pipe breaks).

The run-out stop prevents the fork carriage from jumping out and falling to the ground.

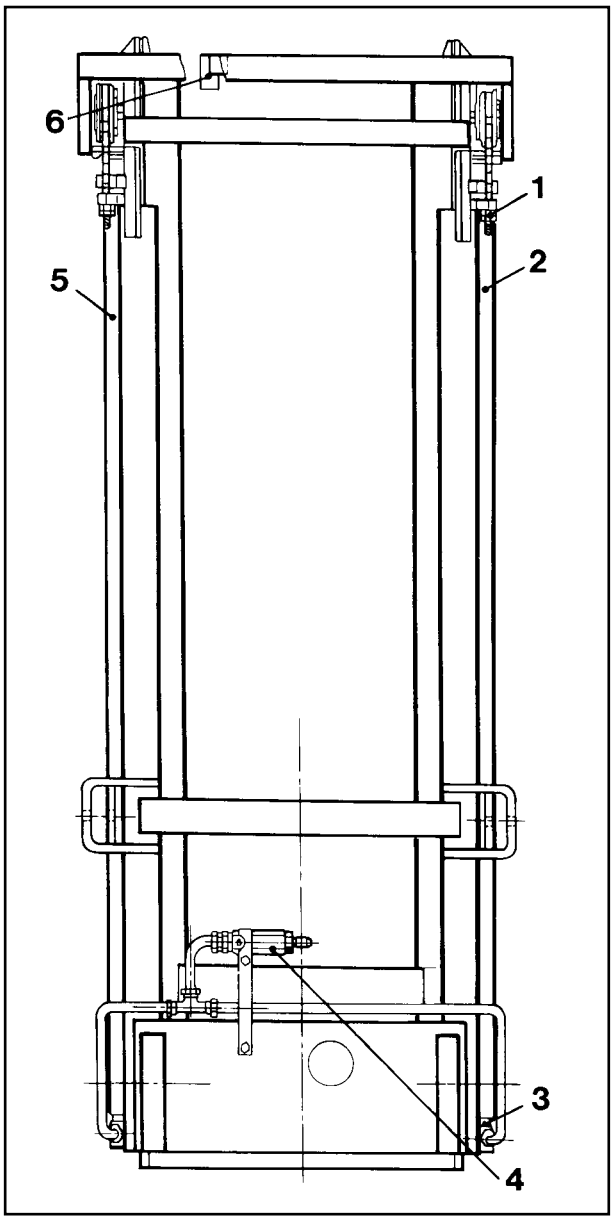


Figure 20-7

1 Chain tensioner
2 Right lift cylinder
3 Line safety valve
4 Lowering brake valve
5 Left lift cylinder
6 Run-out stop

NiHo mast

Hydraulic circuit in the mast

A gear pump supplies pressure oil to the lowering brake valve. From there it is distributed through a tee to the lateral lift cylinders. The oil from the two lateral lift cylinders goes to the intermediate cylinder through an additional connection.

By using different pistons with different cross sections the intermediate cylinder is extended first. When this cylinder has reached the end stop, both outer cylinders begin to extend at the same rate.

- Lift procedure I
  only raises the fork carriage for free lift (without raising the moveable masts).

- Lift procedure II
  performs the telescopic extension of the moveable mast.

The line safety valves integrated in the outer cylinders prevent the masts from lowering too fast if a hose or pipe beaks.

NOTE
NiHo masts up to a maximum build height of 2330 mm only have a line safety valve in the right-hand outer cylinder. From an overall height of 2390 mm and up the same valve is also installed in the left-hand outer cylinder.

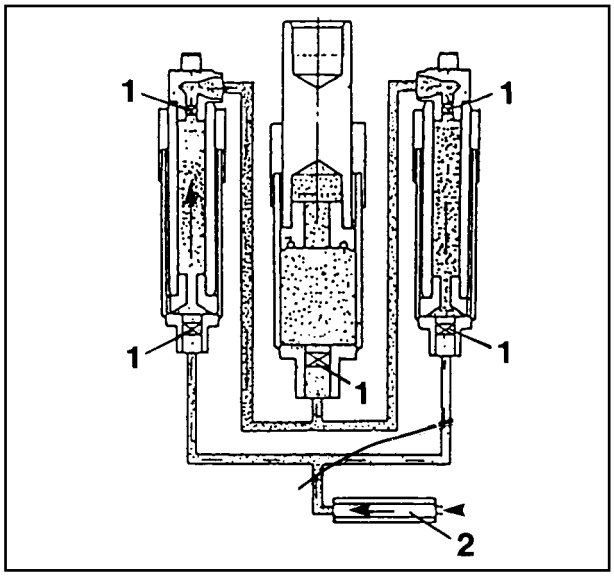


Figure 20-8

1 Line safety valve (for assembly see the related section)
2 Lowering brake valve

NiHo mast

Method of operation

This mast is provided with 3 lift cylinders.

The intermediate cylinder with half the length is mounted in the moveable inner mast. The centre lift chain is attached to the inner mast behind the chain roller and at the other end to the fork carriage.

The arrangement of the intermediate cylinder, which extends inside the inner mast, permits the large free lift, i.e. the great maximum reach height of the forks, without exceeding the built height of the mast.

The two outer cylinders are integrated into the channels of the outer mast. The pistons of these cylinders are connected to the intermediate mast. When the cylinders are supplied with pressure oil, the intermediate cylinder extends first for it has a piston with a different effective cross section.

Subsequently, the two outer cylinders are extended simultaneously, lifting the inner mast.

Two lowering brakes installed in the fixed lines and a third in the intermediate cylinder limit the maximum lowering rate to 0.60 m per second.

The outer cylinders are provided with line safety valves at the top and bottom.

The run-out stop prevents the fork carriage from jumping out and falling down when it has reached the maximum lift height.

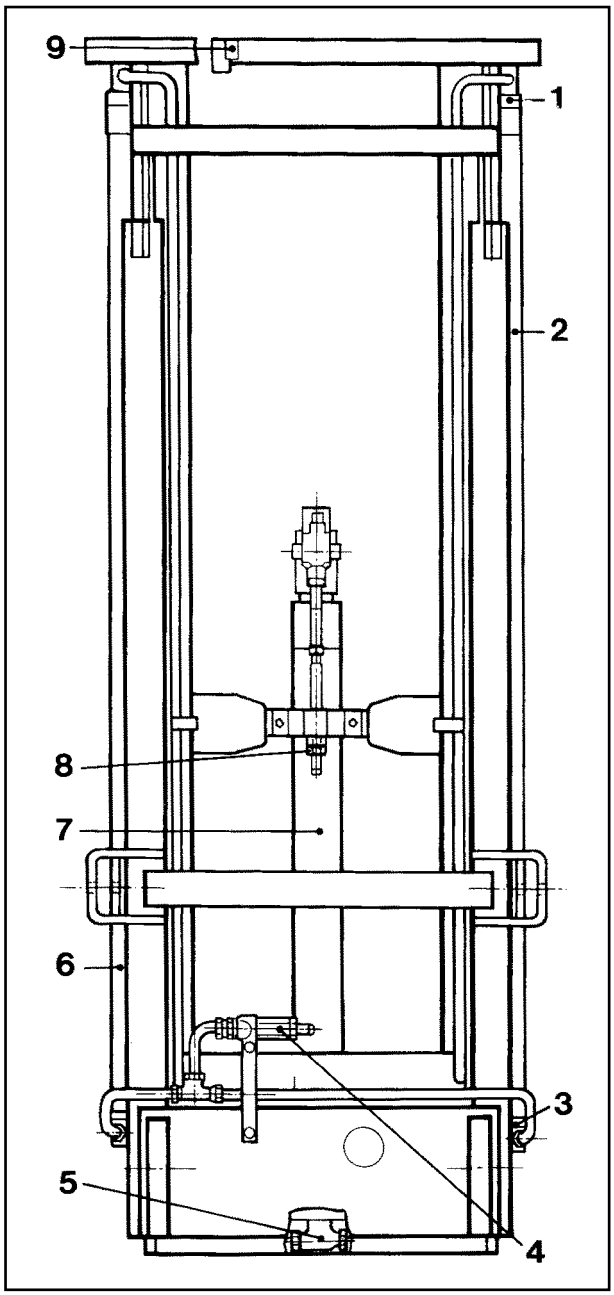


Figure 20-9

1 Line safety valve in the adapter
2 Right lift cylinder
3 Line safety valve in cylinder bottom end
4 Lowering brake valve
5 Line safety valve in cylinder bottom end
6 Left lift cylinder
7 Intermediate cylinder
8 Chain tensioner
9 Run-out stop

NiHo mast

Adjusting the load chain

With the lift cylinder is fully extended, adjust the load chains (2) at the chain tensioner until the centre of the top fork carriage roller is at least 35 mm below the top edge of the inner mast beam (the stop is located between the lift cylinder and piston).

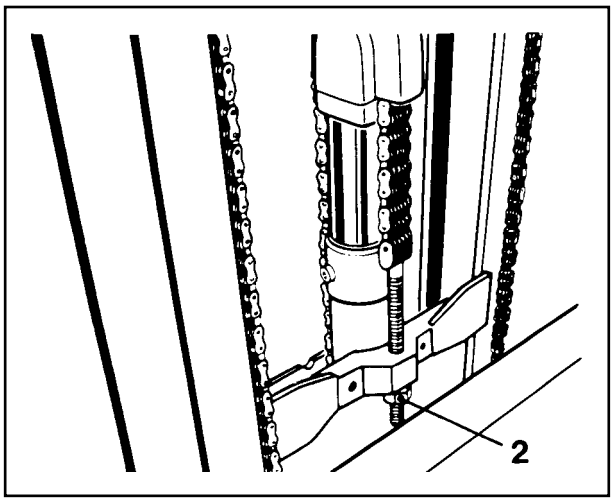


Figure 20-10

Play between fork carriage and inner mast : min. 2 mm.

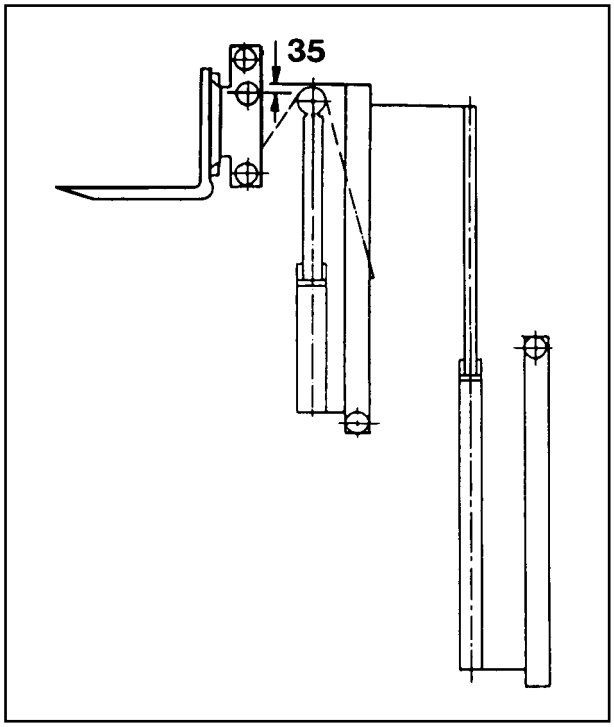


Figure 20-11

Never compensate type wear by adjusting the chains.

CAUTION
Also make sure that the minimum distance for the fork carriage run-out stop is maintained (see the section on run-out stop).

IMPORTANT
The condition of the load chains and their stretch (3 % max.) must be checked as required by accident prevention regulations.

Triplex mast

Method of operation

This mast is provided with 3 lift cylinders.

The intermediate cylinder with half the length is mounted in the moveable inner mast. The centre lift chain is attached to the inner mast behind the chain roller and at the other end to the fork carriage.

The arrangement of the intermediate cylinder, which extends inside the inner mast, permits the large free lift, i.e. the great maximum reach height of the forks, without exceeding the built height of the mast.

The two outer cylinders are integrated into the channels of the outer mast. The pistons of these cylinders are connected to the moveable intermediate mast. The load chains are located behind the intermediate mast. They are attached to the top end of the outer mast and to the bottom of the intermediate mast at the other end.

When the cylinders are supplied with pressure oil, the intermediate cylinder extends firts for it has a piston with a different effective cross-section.
Subsequently, the two outer cylinders are extended simultaneously, lifting the intermediate and inner mast. The former lifts the inner mast at a ratio of 1 : 2 by means of the chains.

A lowering brake (4) installed in the fixed line limits the maximum lowering rate to 0.60 m per second.

The right-hand outer cylinder is provided with a line safety valve.

The run-out stop prevents the fork carriage from jumping out and falling down when it has reached the maximum lift height.

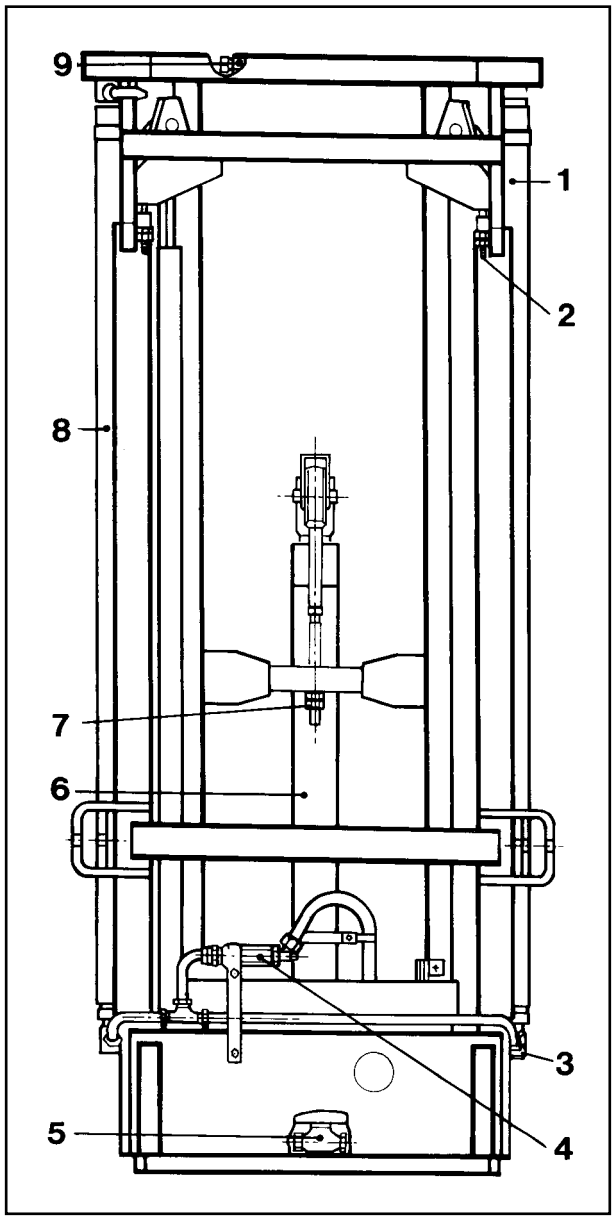


Figure 20-12

1 Right-hand cylinder
2 Chain tensioner
3 Line safety valve in bottom of cylinder
4 Brake lowering valve
5 Line safety valve in bottom of cylinder
6 Intermediate cylinder
7 Chain tensioner
8 Left-hand lift cylinder
9 Run-out stop

Triplex mast

Hydraulic circuit in the mast

A gear pump supplies pressure oil to the lowering brake valve. From there it is distributed through a tee to the lateral lift cylinders.

The right cylinder has a solid piston, the left one a tubular piston with a hose through which the oil goes to the intermediate cylinder.

By using pistons with different cross-sections, the intermediate cylinder is extended first. After this cylinder has reached its end stop, the two outer cylinders begin to extend at the same rate.

- Lift procedure I
  only raises the fork carriage to free lift (without raising the moveable masts).

- Lift procedure II
  performs the telescopic extension of the moveable masts.

The line safety valve integrated in the outer cylinder prevents the masts from lowering too fast if a hose or pipe breaks.

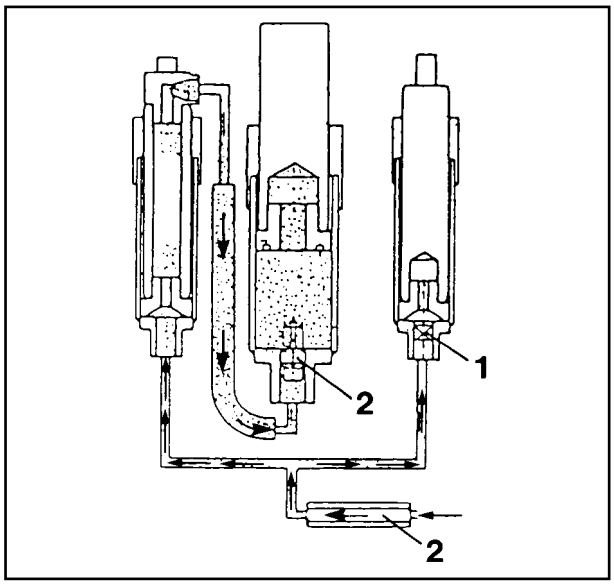


Figure 20-13

1 Line safety valve (for assembly see the respective section)
2 Break lowering valve

Triplex mast

Adjusting the load chains

Outer chains

The outer chains are retightend evenly at the chain tensioners (3) until the 3 mast channels are flush.

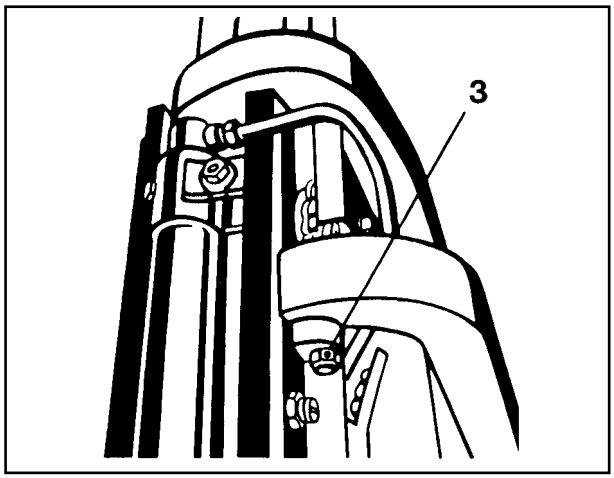


Figure 20-14

Intermediate chain

The chain is retightened at chain tensioner (2) at the intermediate cylinder.

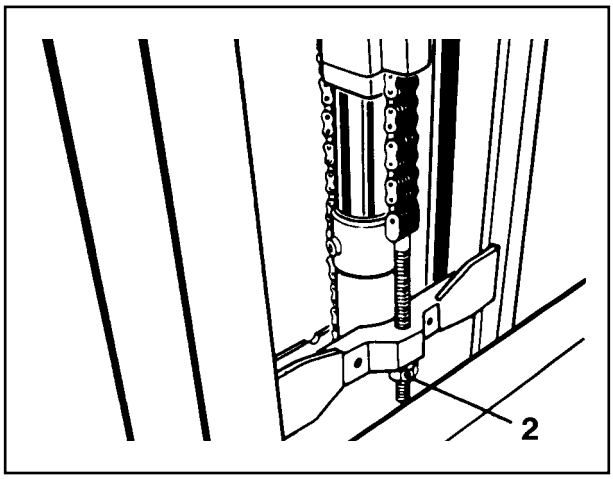


Figure 20-15

With the piston in cylinder I extended as far as possible (the stop is between the cylinder and piston), the centre of the top fork carriage roller must be 35 mm below the intermediate mast channel. The clearance between fork carriage stop and the intermediate mast must be 2 mm.

Never compensate type wear be retightening the chains.

CAUTION
Also make that the minimum distance to the fork carriage run-out stop is maintained (see the section on run-out stop).

IMPORTANT
The condition of the load chains and their stretch (3 % max.) must be checked as required by accident prevention regulations.

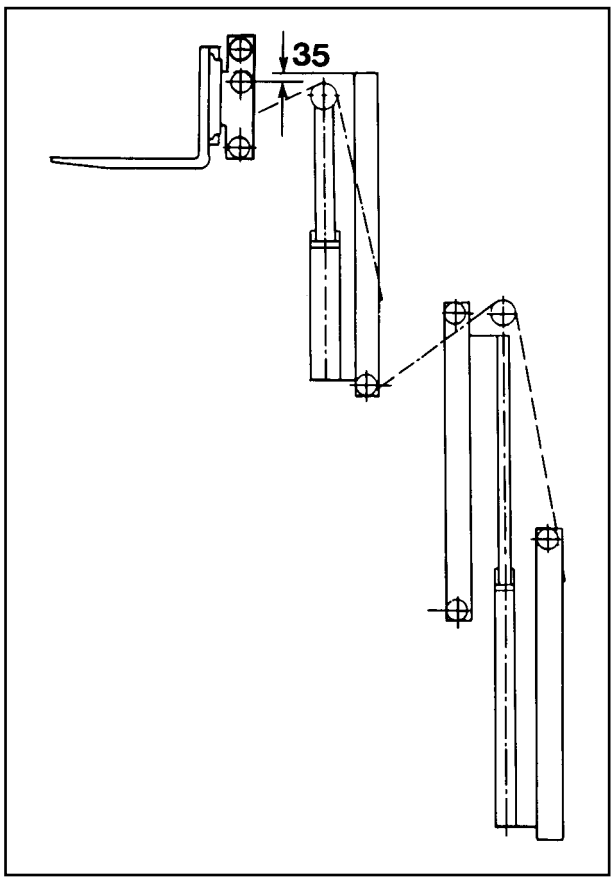


Figure 20-16

Adjusting the chain

Run-out stop (prevents the fork carriage from running out of channels)

When adjusting the chains, make sure that the piston in the lift cylinder is extended as far as the end stop when the mast is raised fully.

IMPORTANT
When the mast is raised fully, there must be a clearance of 2 mm minimum between the driver (4) and stop (5) (clearance of 2 mm minimum between the two parts of the stops).

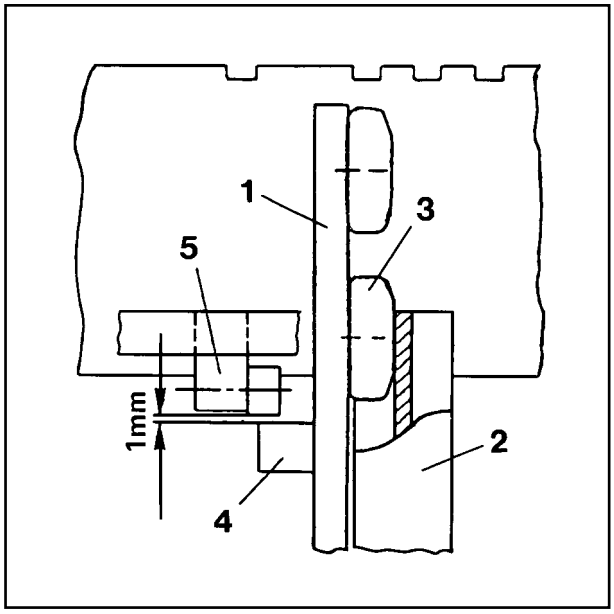


Figure 20-17

1 Fork carriage
2 Mast channel (inner mast)
3 Support roller
4 Drive (on fork carriage)
5 Run-out stop (on cross member of inner mast)

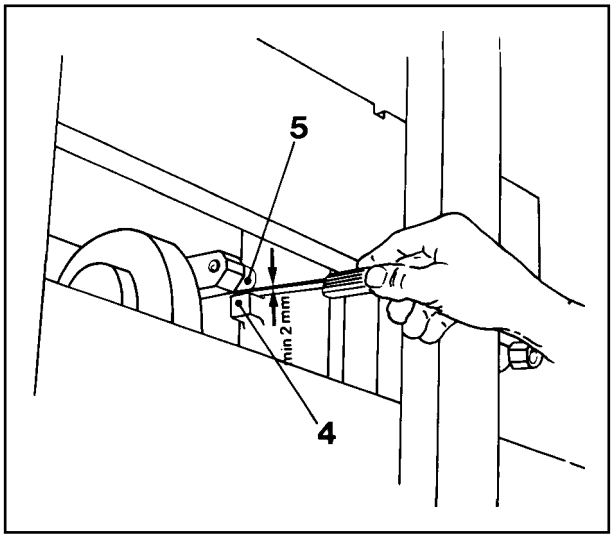


Figure 20-18

Rollers

Assembly

Roller Ø	Dim "A" over	up to
75.2	-	75.9
75.7	75.9	76.4
76.2	76.4	76.9
76.7	76.9	-

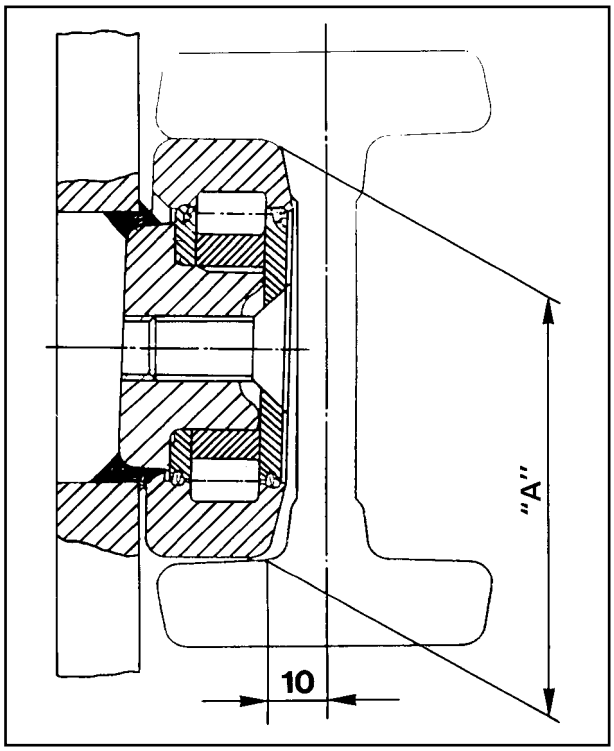


Figure 20-19

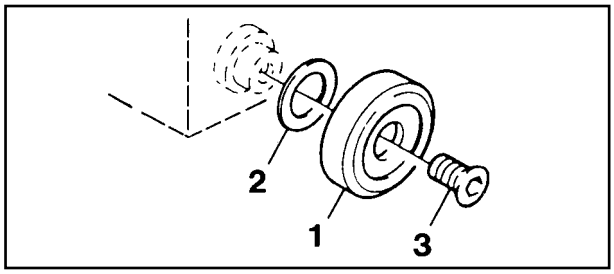


Figure 20-20

1 Roller (see Parts Catalogue)
2 Shim (see Parts Catalogue)
3 Recessed screw secured with Loctite 242 (ID No. 519 899)

Torque
MA = 60 ± 6 Nm (6 ± 0.6 mkg)

Admissible lateral play

Fork carriage - inner mast

Min. 0.2 mm max. 0.5 mm at closest point, at any point max. 1.3 mm.

Inner mast - intermediate mast - outer mast

Top roller : min. 0.5 mm, max. 0.8 mm (in assembly position) at closest point, at any point max. 1.3 mm

Bottom roller : min. 0.2 mm, max. 0.5 mm at closest point, at any point max. 1.3 mm

NOTE
The roller bearings are filled with line soap grease in the factory so that regreasing is nor required. Do not disassemble the rollers as this could damage the thrust washer retaining rings.

Rollers

Checks
(see the figures below)

- Raise the fork carriage.
- Place a wooden beam under the forks.
- Fully lower the forks. The fork carriage will tilt back and the rollers will contact the rear area of the channels.

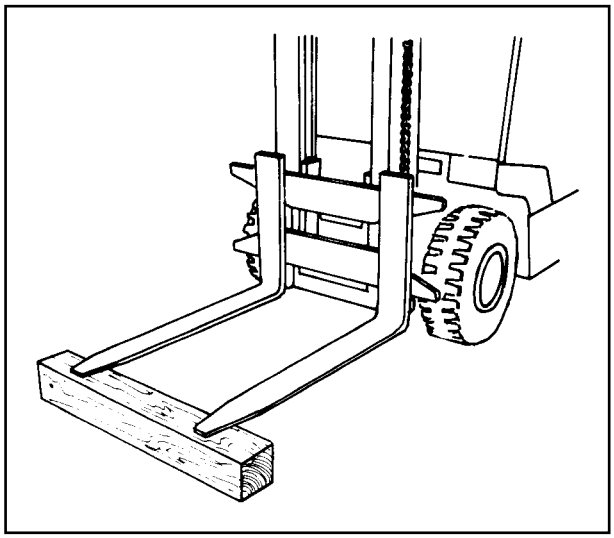


Figure 20-21

- Measure the gap between the rollers and the channel with a feeler gauge.

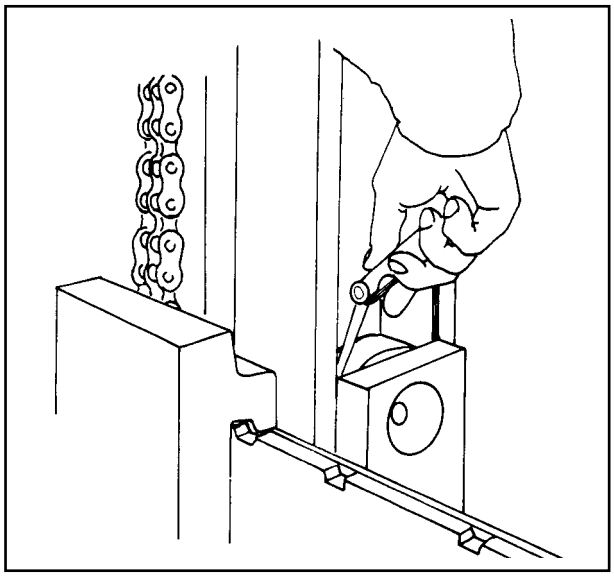


Figure 20-22

- Gap "X" maximum allowed = 0.5 mm

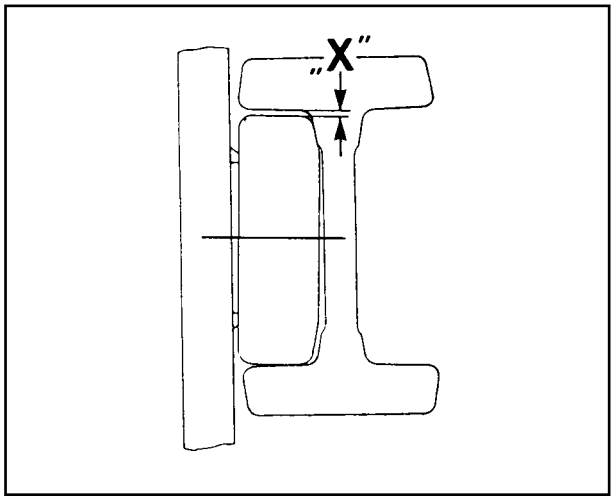


Figure 20-23

NOTE
Prior to this check, check the lateral clearance of the fork carriage.

Lift cylinder

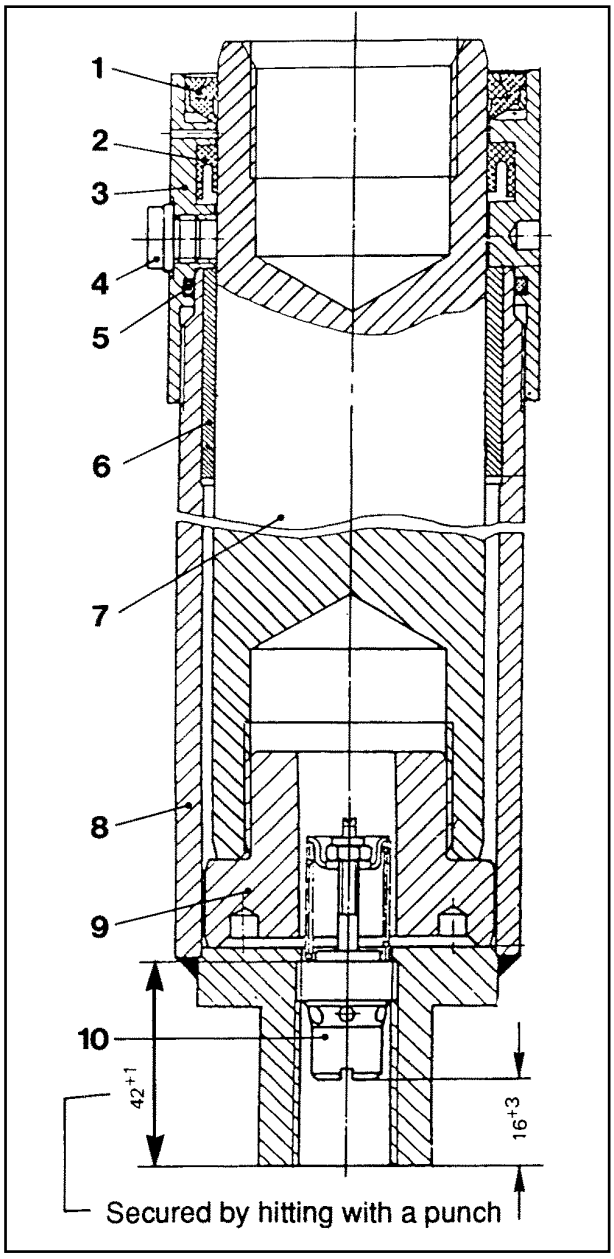


Figure 20-24

1 Wiper
2 Grooved sealing ring
3 Cylinder head
4 Bleeder screw
5 O-Ring
6 Guide bushing
7 Piston
8 Cylinder tube
9 Piston
10 Lowering brake (triplex mast)
Torque to 20 ± 2 Nm
(the NiHo mast has a line safety valve at this point)

Lift cylinder

Description

The lift cylinder is a single-acting lift cylinder with plunger. The cylinder tube and bottom are welded together. The cylinder head is screwed onto the cylinder tube and secured with Loctite 242.

An O-Ring is used to seal the cylinder tube and cylinder head and a grooved ring seals the plunger and cylinder head.

A piston head screwed into the plunger and secured with Loctite 242, serves as stoke end stop. The safety valve at the bottom of the piston can be a brake lowering valve or a line safety valve.

Dismantling the lift cylinder

- Remove the fitting and catch the oil in a container.

- Remove the chain guard, raise the fork carriage, take off the chain by lifting it and then the fork carriage.

- Remove the lift cylinder clamp.

- Lift the cylinder and remove it.

- Clamp the cylinder tube in a vise (clamp at the cylinder bottom, not at the tube, else the tube may go out of true).

- Unscrew the cylinder head with sickle spanner B 68-75 to DIN 1810. If the cylinder head cannot be moved, preheat it with a flame.

- Draw the cylinder head out of the cylinder tube.

- Remove the chain roller at the piston.

- Clamp the clevis into a vise. Remove the piston head with sickle spanner B 58-62 to DIN 1810. For this drill a 5 mm blind hole at any point on the circumference of the piston head. If no sickle spanner is available, use another type of spanner at the head end.

- Screw off the cylinder head and fit new seals. Check that the guide bushing shows no traces of wear.

Installation of the cylinder is in the reverse order of removal.

NOTE
Secure the cylinder head with Loctite 242, also the cylinder head and the bearing fork for the chain roller. Apply 3 drops of Loctite at 3 places so that the glue will be distributed over the entire circumference.

Lift cylinder

1 Wiper
2 Grooved sealing ring
3 Cylinder head
4 Bleeder screw
5 O-Ring
6 Guide bushing
7 Piston
8 Cylinder tube
9 Securing ring for piston stroke (optional)
10 Lowering brake (triplex mast)
11 Line safety valve

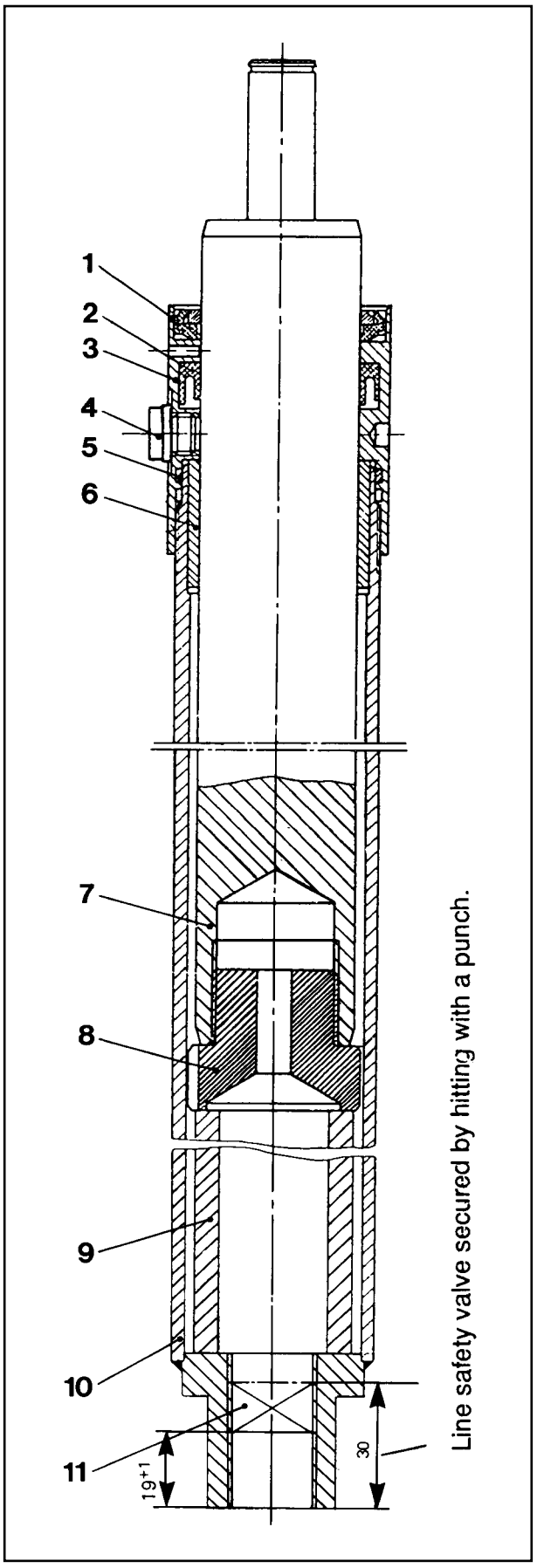


Figure 20-16

Removing the outer cylinders

- Raise the mast to maximum height and block it securely.
- Remove the snap ring at the top piston mounting (cross member of plunger).
- Disconnect the rear hydraulic line and unscrew the fitting.
- Remove the fastening clamp.
- Open the lift valve by moving the lift control lever forward. The piston will retract ; push down with a screwdriver, if required.
- Lift the cylinder and remove.
- Clamp the cylinder into a vise, not at the tubing but at the cylinder bottom so that the tubing does not go out of true.
- Unscrew the cylinder head with sickle spanner B 52-55 to DIN 1810. If the cylinder head cannot be moved, heat it with a flame.
- Draw the piston out of the cylinder tube.
- Unscrew the piston head from the piston. Renew the cylinder head seals. Check that the guide bushing does not show any traces of wear.
- To remove the piston head, use sickle spanner A 40-42 to DIN 1810 or drill a blind hole 4 mm at any point at the circumference of the piston head and remove the head with sickle spanner B 40-42 to DIN 1810.

Installation is in the reverse order of removal.

NOTE
Secure the cylinder head and piston head with Loctite 242. Apply 3 drops of Loctite at 3 places so that the glue will be distributed over the entire circumference.

Lowering brake valve

This valve (in the valve bottom) is used to achieve a uniform lowering speed independent of the load so that the forks do not lower too fast in case of a hydraulic line break.

Method of operation

When the load lowers, the oil flowing through the valve causes it to move to the control position and form a ring throttle in the control spool. The throttling effect can be preset with the preliminary tension of the spring (its length can be modified optionally).

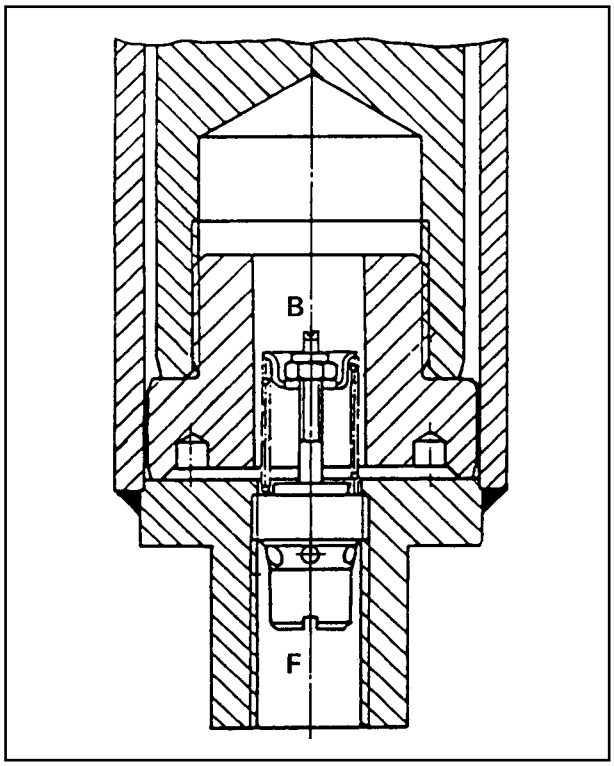


Figure 20-26

NOTA
The maximum admissible lowering speed (with a load corresponding to the rated capacity of the truck) is 0.6 m per second.

Lifting, oil flow from F to B

The arrow shows the direction of flow when the resistance is minimal. Oil flow can take place because the throttle is lifted up from its regulating position (flow not restricted).

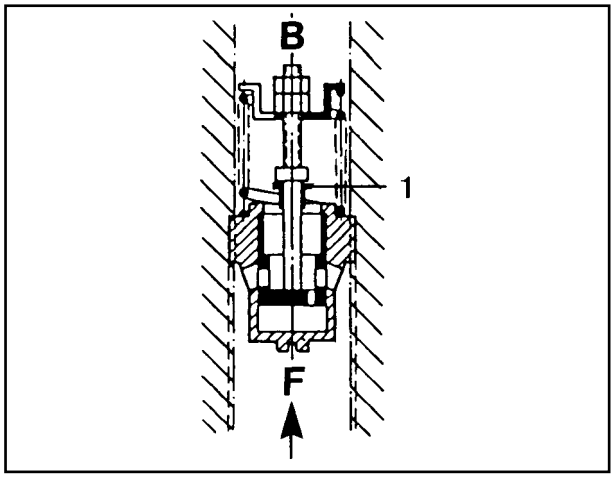


Figure 20-27

1 Moveable throttle in non-restricted position

Lowering, oil flow from B to F

The oil flow rate is constant over a wide range due to the pressure balance which results automatically between the oil pressure inside the valve and the pressure exerted by the control piston spring.

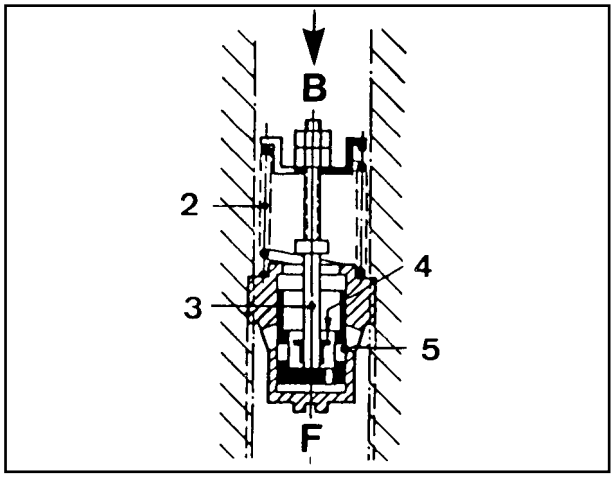


Figure 20-28

2 Control piston spring
3 Control piston
4 Throttle in regulating position
5 Forcing cone

Line safety valve

The illustration shows the position of the valve in the lower part of the outer cylinder. The valve must be tightened firmly.

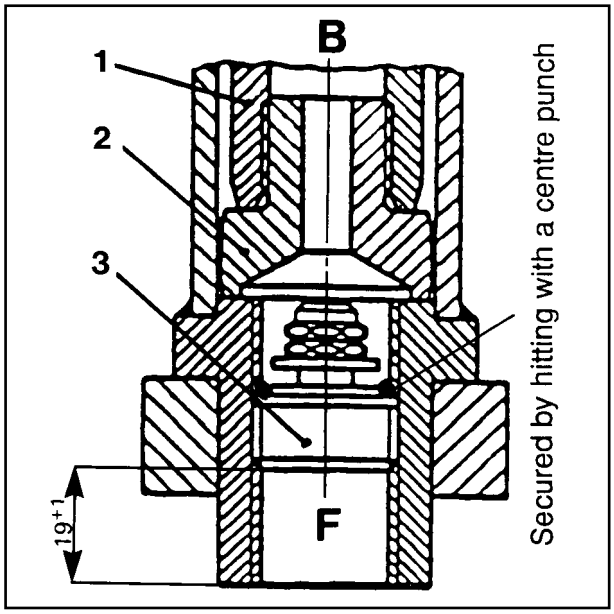


Figure 20-29

1 Piston
2 Piston head
3 Line safety valve

Function

The function of the line safety valve is to prevent an uncontrollable rapid lowering of the load in case of a break in the hydraulic line. The valve installed is a plate valve whose closing element is lifted from the valve seat by a spring when in the normal position. The flow cross section is variable.

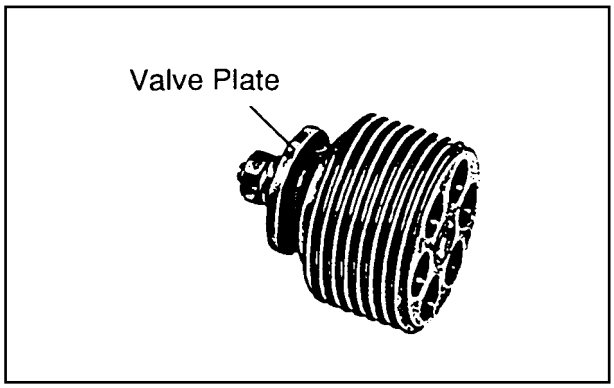


Figure 20-30

The flow resistance and the back pressure effect at the valve plate in the direction of flow from B to F (actuating direction) are normally lower than the pressure of the spring so that the valve remains open. If a line breaks, the pressure of the oil flow from B to F caused by the load will exceed the force at the spring and the valve will close instantly. The plate has a small hole whose size depends on the load. This hole allows oil to flow from B to F so that the load can slowly lower to the ground.

The illustration below shows the position of the line safety valve in the outer cylinder of a NiHo mast.

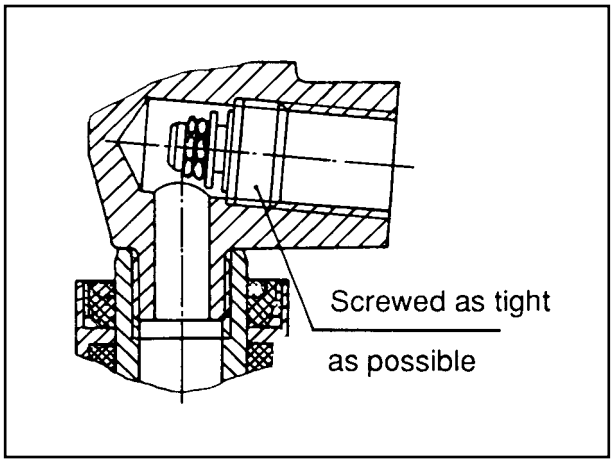


Figure 20-31

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Installation of rubber boot 25-3

Tilt cylinder

Assembly

Check all parts for wear and clean them thoroughly.

NOTE
Piston (2) and hexagonal nut (14) are secured with Loctite 242.
Torque for the nut : MA = 130 + 10 Nm

- Fit grooved seal (10) onto piston (9) and grease lightly.

- Insert the piston and piston rod into the cylinders.

- Renew the seals on the cylinder head (8) and grease lightly.

- Insert the cylinder head (8) into the tubing.

NOTE
The cut-out in the cylinder head must point to the connection hole.

- Fit locking ring (10).

- Screw on the eye bolt and secure.

IMPORTANT
Ensure the thread depth is as marked at removal.

Wrap the hydraulic fitting with PTFE tape before screwing it in.

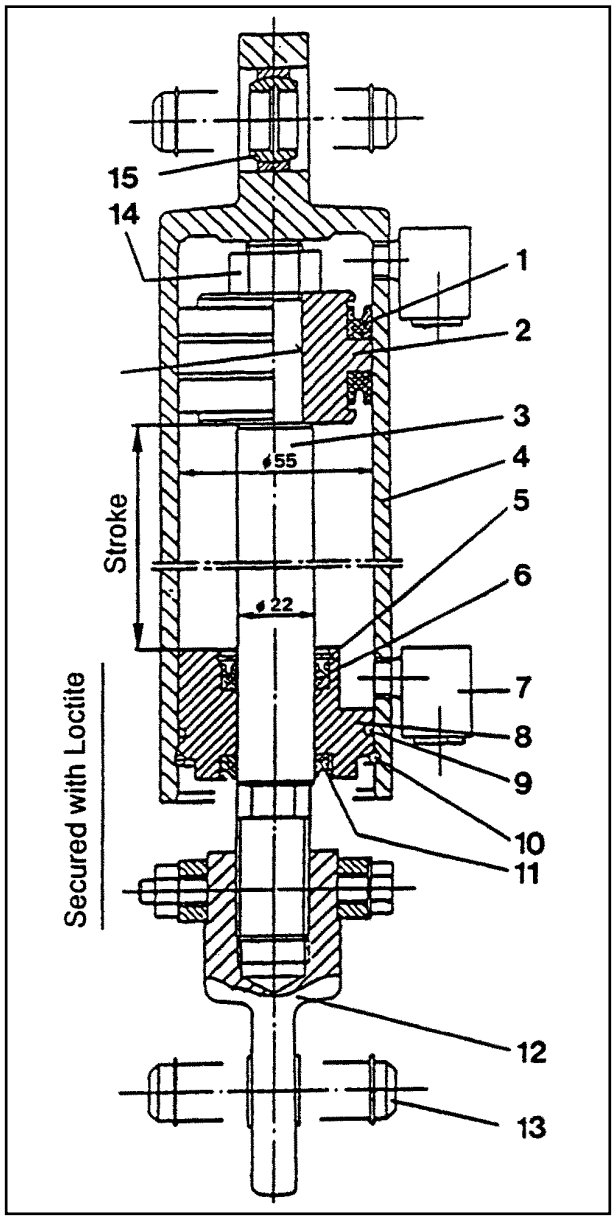


Figure 25-1

1 Grooved seal
2 Piston
3 Piston rod
4 Cylinder tube
5 Snap ring
6 Grooved seal
7 Fitting
8 Cylinder head
9 O-Ring
10 Lock washer
11 Wiper
12 Eye bolt for tilt cylinder
13 Pin
14 Hexagon nut
15 Friction bearing

Removal

- Clamp the cylinder at cylinder base into a vise.

- Loosen the top fitting (7) - the thread protrudes into the oil chamber.

- Drive in the cylinder head (8) slightly with a drift.

- Press in the circlip (10) through the small opening in the cylinder with a drift and screw it out with a screwdriver (see figure).

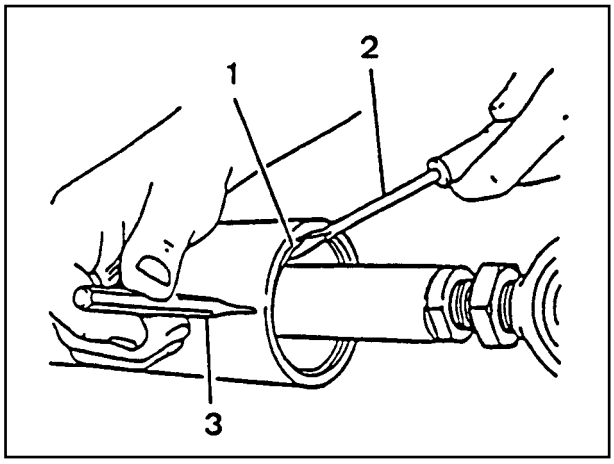


Figure 25-2

1 Circlip
2 Screwdriver
3 Drift

- Pull the cylinder head (8) out of the cylinder barrel by pulling at the piston rod.

- Clamp the piston rod into a vise fitted with protective jaws.

- Remove the eyebolts (12) on the new cylinder.

ATTENTION
Note how far the eyebolts are screwed in and do not exceed this depth during assembly, otherwise the tilt angle can change.

- Remove the cylinder head and seals.

- Remove the seal (1) from the piston (2).

Installation of rubber boot*

The two tilt cylinders are protected against dust by a rubber boot (1). The boots are mounted on the frame on one side and on the mast on the other side.

* Applies to new M15 model from serial numbers
717111004000 (Diesel) and
71711700400 (LPG)

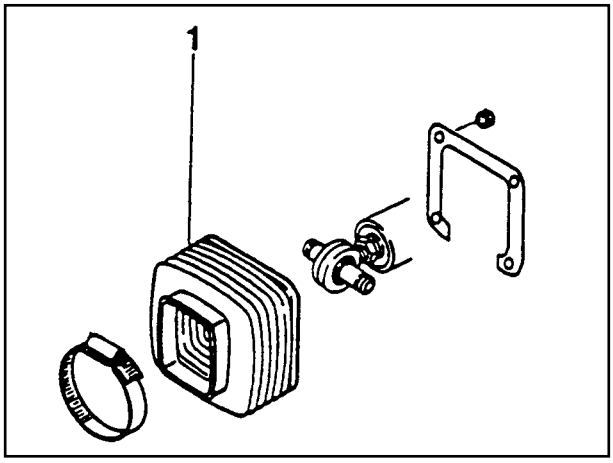


Figure 25-3