

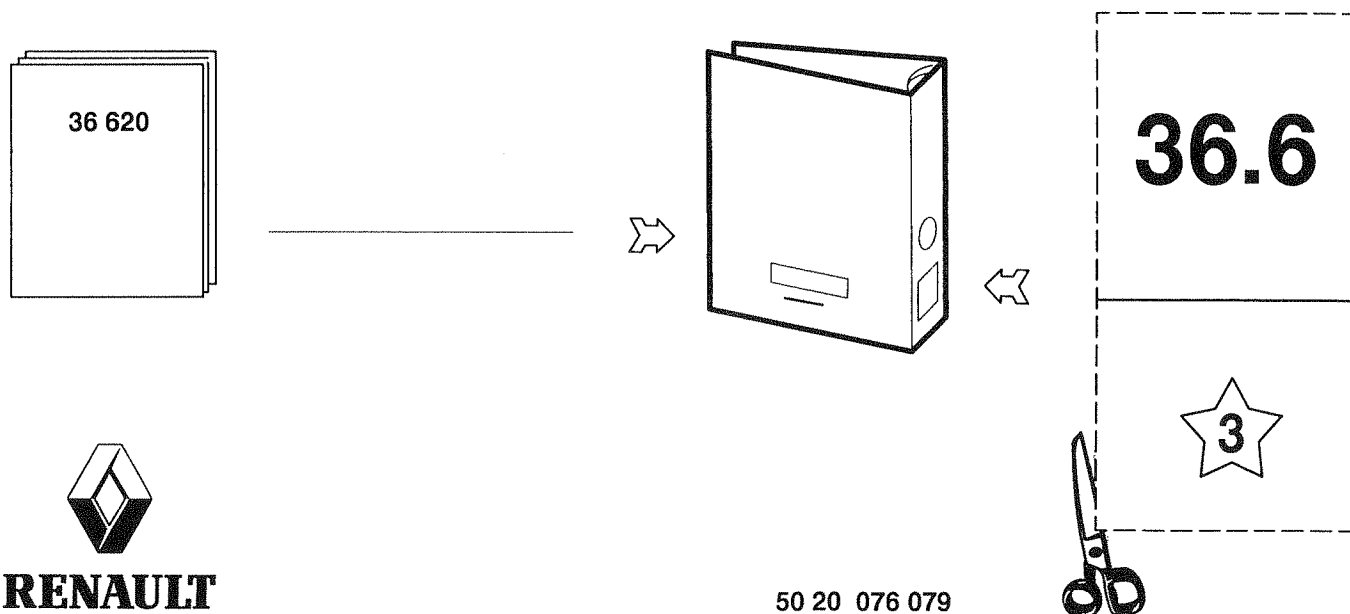
**36 620 – AN – 10.1998**

**POWER TAKE-OFF ZF NMV 221**

POWER TAKE-OFF	VEHICLES
ZF NMV 221	KERAX

**NOTE**

The above information may change in the course of time.  
Only the "Consult" section of the workshop manuals repertory in standard N° 10320 serves as reference.



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## SAFETY NOTICE

Companies who repair ZF units are responsible for their own work safety.

To avoid injury to personnel and damage to products, all safety regulations and legal requirements which apply to repair and maintenance work must be adhered to. Before starting work, mechanics must familiarize themselves with these regulations.

Personnel required to carry out repairs on ZF products must receive appropriate training in advance. It is the responsibility of each company to ensure that their repair staff is properly trained.

The following safety instructions appear in this manual:

### NOTE

Refers to special processes, techniques, data, use of auxiliary equipment, etc.

### CAUTION

This is used when incorrect, unprofessional working practices could damage the product.

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### DANGER

This is used when lack of care could lead to personal injury or death.

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## GENERAL INFORMATION

Read this manual carefully before starting any tests or repair work.

### CAUTION

Pictures, drawings and components do not always represent the original object, but are used to illustrate working procedures.

Pictures, drawings and components are not to scale and no information about size and weight should be inferred (even within a complete illustration).

Always follow the working steps as described in the text.

After completion of repair work and testing, skilled staff must satisfy themselves that the product is functioning correctly.

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### THREATS TO THE ENVIRONMENT !

Lubricants and cleaning agents must not be allowed to enter the soil, ground water or sewage system.

- Ask your local environment agency for safety information on the relevant products and adhere to their requirements.
  - Collect used oil in a suitably large container.
  - Dispose of used oil, dirty filters, lubricants and cleaning agents in accordance with environmental protection guidelines.
  - When working with lubricants and cleaning agents always refer to the manufacturer's instructions.
- 

### CAUTION

The transmission must NOT be hung on the input shaft NOR on the output flange.

In any cases of doubt always turn to the the relevant department within ZF After-Sales Services for advice.

After removing the transmission from the vehicle clean thoroughly before opening.

Pay particular attention to the corners and angles of housings and covers when cleaning.

Parts held on with Loctite can be slightly loosened if warmed with a hot air blower.

### CLEANING PARTS

Remove the old remains of gaskets on all gaskets. Carefully remove burrs or other similar patches of roughness using a oil-stone

Lube bores and grooves must be free of anti-corrosion agents and foreign matter, check that they can move without encountering any problems.

Carefully cover opened transmissions to prevent the entry of foreign matter..

### REUSING PARTS

Parts such as ball or roller bearings, multi-discs, thrust washers etc., must be inspected by a competent person, who should decide whether or not they can be re-used. Replace parts which are damaged or have suffered from excessive wear.

### GASKETS, LOCKING PLATES

Parts which cannot be removed without being damaged must always be replaced with new parts (e.g. gaskets and locking plates).

### SHAFT SEALS

Always change shaft seals with rough, ripped or hardened packing washers. Seal contact surfaces must be totally clean and in perfect condition.

### REWORKING

Rework may only be carried out on the seal contact surfaces using plunge-cut grinding, never use an emery cloth. Ensure that there are no traces of grinding traces or rifling from grinding.

If rework is needed on distance washers, shims etc. because of clearance settings, ensure that the reworked areas contain no face runout and have the same surface quality.

### TRANSMISSION ASSEMBLY

Find a clean site to assemble the transmission. Gaskets are installed without the use of sealing compound or grease. When measuring silicon-coated gaskets, take care not to include the **silicon layer in the measurement.**

During assembly, comply with all adjustment data, checking data and tightening torques in the Repair Manual.

## BEARINGS

If the bearings are filled while hot, these should be warmed up accordingly (e.g. in a heating cabinet). The temperature should be approx. 85 °C and may not exceed 120 °C. All bearings must be coated with transmission oil after assembly.

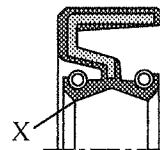
## SEALING

If a sealing agent\* is to be used for carrying out sealing, comply with the manufacturer's directions for use. Apply a thin layer of sealing agent to the surfaces and spread evenly. Do not allow sealing to enter oil ducts and bores. On oil-carrying ducts and bores wipe off the sealing agent on the surfaces to be sealed near apertures to ensure that no sealing agent penetrates the oil feeds when the surfaces are sealed.

## SHAFT SEALS

- Apply a light coat of sealing agent on outer edge of shaft seals with "steel surround".
- Never apply sealing agent** to shaft seals with "rubber surround" but apply a thin coat of Vaseline 8420 to the outer edge or wet with a lubricant, e.g. a water-soluble, concentrated washing-up liquid (e.g. Pril, Coin, Palmolive).
- Shaft seals with steel and rubber surrounds should be treated on the outer edge of the rubber surround as described above in section b).

- Duo shaft seals have two packing washers. The dust-proof packing washer (X) must face outwards.



- Fill the gap between the packing washers so it is 60% filled with grease (use a grease e.g. produced by Aral such as Aralub HL2 or by DEA such as Spectron FO 20).
- If possible heat shaft seal bores to between 40 and 50°C (this makes fitting easier). Press the seal shaft with mounting or faceplate onto the relevant installation depth plan.

## RETAINING AGENTS

Retaining agents\* may only be used in places as specified in the parts list. Always comply with manufacturer's directions for use when using retaining agents (e.g. Loctite). During assembly, comply with all adjustment data, checking data and tightening torques.

## TRANSMISSION OIL

After completing repairs, fill the transmission with transmission oil. For the procedure and approved oils, refer to the transmission operating manual and List of Lubricants TE-ML (refer to identification plate) which are available from any ZF After-Sales Service Point. After filling the transmission with oil, tighten the screw plugs at the oil filling point and the oil overflow to the specified torques.

\* refer to expendable material

Tightening torques for nuts and bolts, extract from ZFN 148

This Standard applies for bolts to DIN 912, DIN 931, DIN 933, DIN 960, DIN 961 and for nuts to DIN 934. This Standard contains data on tightening torques ( $M_A$ ) for bolts in strength categories 8.8, 10.9 and 12.9 and nuts in strength categories 8, 10 and 12.

Surface condition of bolts: heat-treated blackened finish and oiled or galvanized and oiled or galvanized, chrome-plated and oiled.

This Standard contains data on tightening torques ( $M_A$ ) for bolts in strength categories 8.8, 10.9 wrench.

**NOTE**

Divergent tightening torques are listed separately in the Repair Manual.

Metric coarse pitch thread			
Size	Tightening torque $M_A$ (Nm) for		
	8.8	10.9	12.9
Bolt	8	10	12
Nut	8	10	12
M 4	2,8	4,1	4,8
M 5	5,5	8,1	9,5
M 6	9,5	14	16,5
M 7	15	23	28
M 8	23	34	40
M 10	46	68	79
M 12	79	115	135
M 14	125	185	215
M 16	195	280	330
M 18	280	390	460
M 20	390	560	650
M 22	530	750	880
M 24	670	960	1100
M 27	1000	1400	1650
M 30	1350	1900	2250

Metric coarse pitch thread			
Size	Tightening torque $M_A$ (Nm) for		
	8.8	10.9	12.9
Bolt	8	10	12
Nut	8	10	12
M 8 x 1	24	36	43
M 9 x 1	36	53	62
M 10 x 1	52	76	89
M 10 x 1,25	49	72	84
M 12 x 1,25	87	125	150
M 12 x 1,5	83	122	145
M 14 x 1,5	135	200	235
M 16 x 1,5	205	300	360
M 18 x 1,5	310	440	520
M 18 x 2	290	420	490
M 20 x 1,5	430	620	720
M 22 x 1,5	580	820	960
M 24 x 1,5	760	1100	1250
M 24 x 2	730	1050	1200
M 27 x 1,5	1100	1600	1850
M 27 x 2	1050	1500	1800
M 30 x 1,5	1550	2200	2550
M 30 x 2	1500	2100	2500

**Screw plugs DIN 908, 910 and 7604**

The screw plug tightening torques  $M_A$  were determined according to DIN 7604, for screwing into steel, grey cast, and aluminium alloys.

**The values are based on experience, and are intended as reference values for the designer.**

The values for the tightening torque  $M_A$  shall also be used for screw plugs according to DIN 908 and DIN 910, as the thread geometries are almost identical.

General rule: Screw/bolt class 5, ZFN 148-1  
 Screw/bolt material: steel acc. to DIN 7604. Surface condition: as manufactured (without surface protection) and lightly oiled or galvanized, chromated and lightly oiled

**Union screws DIN 7643**

The tightening torques  $M_A$  were determined for screwing into steel, grey cast and aluminium alloys. The values are based on experience and are intended as reference values for the designer.

General rule: screw/bolt class 5, ZFN 148-1  
 Material 9SMnPb28K acc. to DIN 1651  
 Surface conditions: as manufactured (without surface protection) and lightly oiled or galvanized, chromated and lightly oiled

Screw plugs (DIN 908, 910, 7604)		
Dimensions	Tightening torque screwed into	
	steel/grey cast	Al alloy
M 8 x 1	20	10
M 10 x 1	25 / 30*	15 / 20*
M 12 x 1.5	35	25
M 14 x 1.5	35	25
M 16 x 1.5	40	30
M 18 x 1.5	50	35
M 20 x 1.5	55	45
M 22 x 1.5	60 / 80*	50 / 65*
M 24 x 1.5	70	60
M 26 x 1.5	80 / 105*	70 / 90*
M 27 x 2	80	70
M 30 x 1.5	100 / 130*	90 / 130*
M 30 x 2	95	85
M 33 x 2	120	110
M 36 x 1.5	130	115
M 38 x 1.5	140	120
M 42 x 1.5	150	130
M 42 x 2	145	125
M 45 x 1.5	160	140
M 45 x 2	150	130
M 48 x 1.5	170	145
M 48 x 2	160	135
M 52 x 1.5	180	150
M 60 x 2	195	165
M 64 x 2	205	175

Union screws (DIN7643)		
Pipe outer diameter	Thread	Tightening-torque $M_A$ in Nm
4 - 5	M 8 x 1	30
6	M 10 x 1	35
8	M 12 x 1.5	40
10	M 14 x 1.5	40
12	M 16 x 1.5	45
15	M 18 x 1.5	50
18	M 22 x 1.5	60
22	M 26 x 1.5	90
28	M 30 x 1.5	130
35	M 38 x 1.5	140

\* DIN 7604 Form C



Description ZF reference no.	Name	Approx. quantity	Application	Remarks
Grease 0750 199 001	For example: Spectron FO 20	2 grams 1 gram 2 grams	Needle bearing O-ring Threaded bush	Section 6 Section 3 Section 6
Anti-corrosion oil 0750 199 008	For example: Renolin MR 40 Z	0,50 ml	Pump ring gear	Section 6
Grease 0671 190 050	Olista Longtime 3EP		Clutch release fork	Section 2

**NOTE:** Inquire about the size of bundles that can be delivered before placing any orders!



Description	Dimension	Measuring device	Remarks
01. Axial play of idler gear	0.0 - 0.10 mm	Depth gauge	Set by using appropriate ring (increment: 0.1 mm).
02. Axial play of ball bearing, diameter 180 mm	0.0 - 0.10 mm	Depth gauge	Set by using appropriate ring (increment: 0.1 mm).
03. Axial play of helical gear (disc carrier)	0.0 - 0.10 mm	Depth gauge	Set by using appropriate ring (increment: 0.1 mm).
04. Axial play of pump	0.03 - 0.065 mm	Micrometer	Play is already set. Simply needs checking.
05. Axial play of mainshaft	0.0 - 0.10 mm	Depth gauge	Set by using appropriate shim (increment: 0.1 mm).
06. Axial play of countershaft	0.0 - 0.10 mm	Depth gauge	Set by using appropriate shim (increment: 0.1 mm).
07. Tightening torque M8x30 on bearing pin	23 Nm	Torque wrench	
08. Tightening torque M8x30 (pump housing)	23 Nm	Torque wrench	
09. Tightening torque M10x32 on cover (control housing)	46 Nm	Torque wrench	
10. Tightening torque M8x30 on cover (control housing)	23 Nm	Torque wrench	



Description	Dimension	Measuring device	Remarks
11. Tightening torque M12x85 (control housing)	79 Nm	Torque wrench	
12. Tightening torque M8x145 (control housing)	23 Nm	Torque wrench	
13. Tightening torque M8x105 (control housing)	23 Nm	Torque wrench	
14. Tightening torque of screw plug M12x1,5 (control housing)	25 Nm	Torque wrench	Use new sealing ring.
15. Tightening torque of screw plug M10x1 (control housing)	15 Nm	Torque wrench	Use new sealing ring.
16. Tightening torque M8x18 on retaining plate	23 Nm	Torque wrench	
17. Tightening torque M32x1,5 on output flange	360 Nm	Torque wrench	
18. Tightening torque M12x65 (clutch release fork)	115 Nm	Torque wrench	
19. Tightening torque hex screws on clutch housing	49 Nm	Torque wrench	



Description	Dimension	Measuring device	Remarks
20. Tightening torque M10x40 (bearing flange)	46 Nm	Torque wrench	
21. Tightening torque M8x30 (connection plate)	23 Nm	Torque wrench	
22. Tightening torque hex screws (shift mechanism)	23 Nm	Torque wrench	
23. Bearing seat temperature in clutch housing	approx. 60°C	Temperature probe pin	Do not exceed temperature
24. Bearing inner brace temperature (disc carrier)	approx. 60°C	Temperature probe pin	Do not exceed temperature
25. Bearing pin temperature (disc carrier)	approx. 60°C	Temperature probe pin	Do not exceed temperature



Part number	Where fitted	No. of turns	Wire Ø in mm	Spring outer Ø in mm	Untensioned length in mm
0732 040 222	Piston	16.5	1.4	9.6	46.6
0732 040 853	Output shaft	5.5	6.0	70/85	130.5
0732 042 486	Piston	16.5	2.5	16.0	74.4
0732 042 487	Piston	9.5	3.8	25.9	56.0

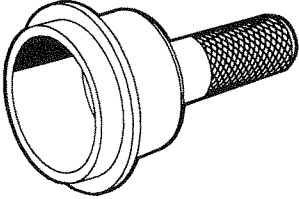
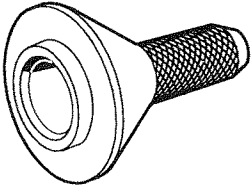
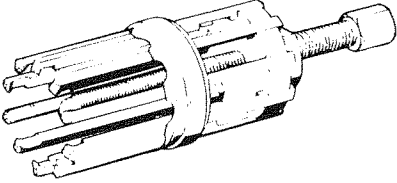
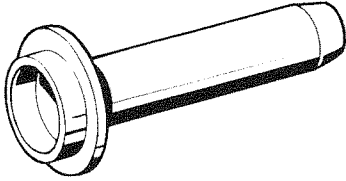
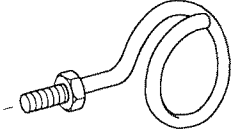
Fig. No.	Illustration	Order no.	Application	Qty.	Comments
1		<b>1X56 103 765</b>  <b>Drift</b> for radial seal on quill shaft		1	Section 3
2		<b>1X56 115 510</b>  <b>Drift</b> for radial seal in control housing		1	Section 5
3		<b>1X56 122 366</b>  <b>Rillex puller</b> for ball journal on quill shaft		1	Section 3
4		<b>1X56 122 407</b>  <b>Drift</b> for radial seal on bearing flange		1	Section 3
5		<b>1X56 136 564</b>  <b>Hook</b> for fastening clutch housing		2	Section 4

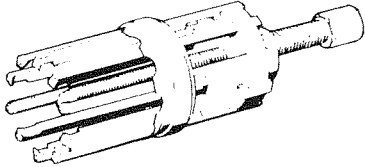
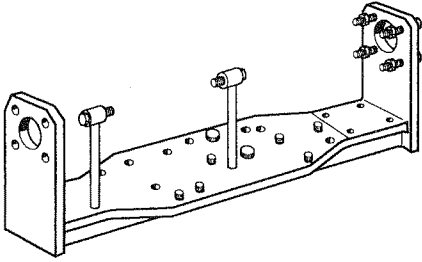
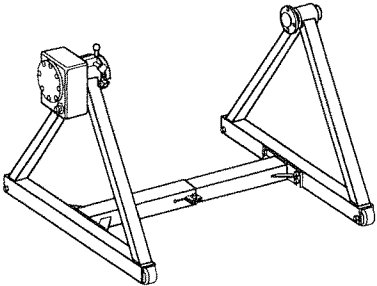
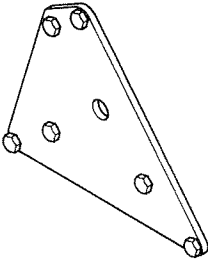
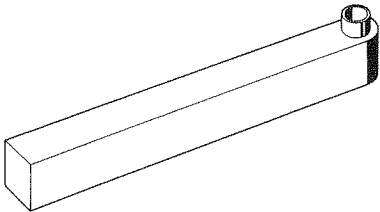
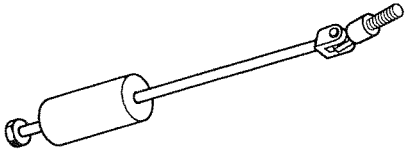
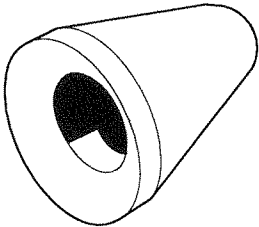
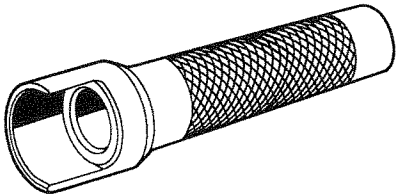
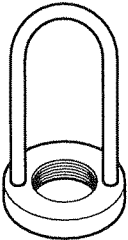
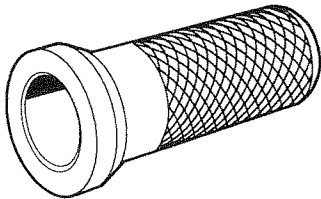
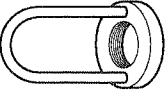
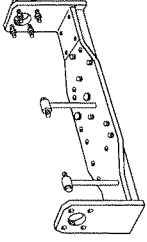
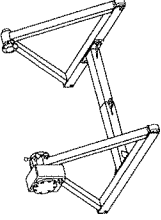
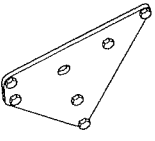

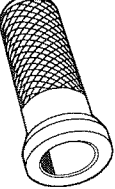
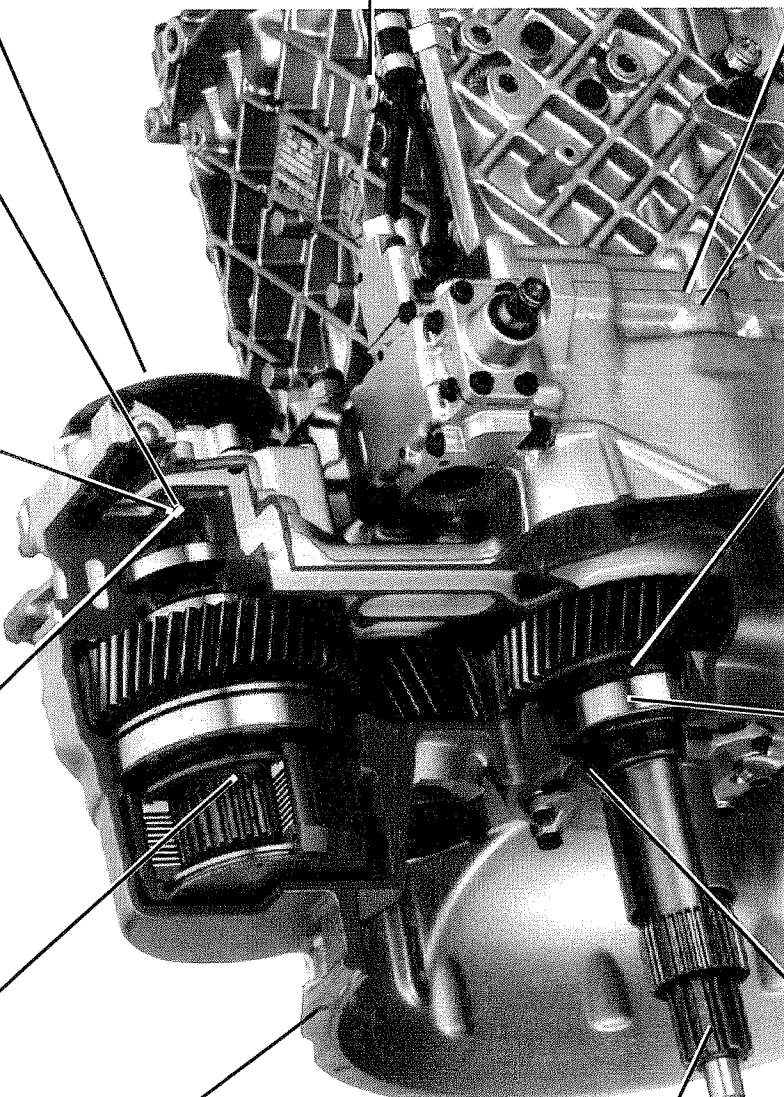
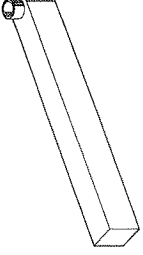
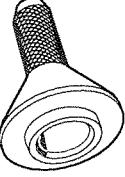
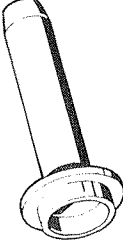

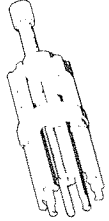
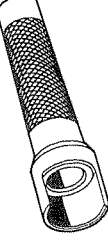
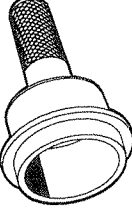
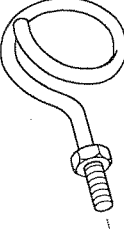
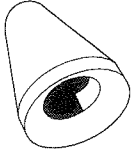
Fig. No.	Illustration	Order no.	Application	Qty.	Comments
6		<p><b>1X56 136 802</b></p> <p><b>Rillex puller</b> for ball journal in control housing</p>		1	Section 5
7		<p><b>1X56 136 998</b></p> <p><b>Adapter</b> for transmission swivel block 1X56 137 450</p>		1	
8		<p><b>1X56 137 450</b></p> <p><b>Transmission swivel block</b> for use with adapters 1X56 136 998 and 1X56 137 944</p>		1	
9		<p><b>1X56 137 944</b></p> <p><b>Adapter</b> for transmission swivel block 1X56 137 450</p>		1	
10		<p><b>1X56 138 063</b></p> <p><b>Extracting tool</b> for cylinder pins in clutch housing</p>		1	Section 4

Fig. No.	Illustration	Order no.	Application	Qty.	Comments
11		<b>In-house manufacture</b>  <b>Puller</b> for cylinder pins inside the clutch housing		1	Section 4
12		<b>1X56 138 064</b>  <b>Protective sleeve</b> for radial seal in ring gear		1	Section 3 Section 4
13		<b>1X56 138 143</b>  <b>Press tool</b> for holding down the guide ring and removing and fitting the retaining ring		1	Section 6
14		<b>1X56 138 144</b>  <b>Lifting attachment</b> for complete output shaft		1	Section 1
15		<b>1X56 138 145</b>  <b>Drift</b> for ball bearing on output shaft/control housing		1	Section 5





	1X56 138 144		1X56 136 998		1X56 137 450		1X56 137 944		In-house manufacture
	1X56 138 145								1X56 138 063
	1X56 115 510								1X56 122 407
	1X56 136 802								1X56 122 366
	1X56 138 143								1X56 103 765
			1X56 136 564				1X56 138 064		

REFERENCE ZF	REFERENCE RENAULT V I
1 X 56 103 765	50 00 26 <b>2351</b> + 50 00 26 <b>3016</b>
1 X 56 115 510	50 00 26 <b>2363</b> + 50 00 26 <b>3016</b>
1 X 56 122 366	Hydraulic press
1 X 56 122 407	50 00 26 <b>2351</b> + 50 00 26 <b>3016</b>
1 X 56 136 564	<b>FL 2457</b>
1 X 56 136 802	<b>0845</b>
1 X 56 136 998	50 00 26 <b>2203</b>
1 X 56 137 450	50 00 26 <b>1000</b>
1 X 56 137 944	50 00 26 <b>2203</b> + 50 00 26 <b>2413</b>
1 X 56 138 063	<b>FL 2454</b>
1 X 56 138 064	Adhesive tape type protection
1 X 56 138 143	<b>FL 2455</b>
1 X 56 138 144	Strap
1 X 56 138 145	50 00 26 <b>2363</b> + 50 00 26 <b>3016</b>

## TOOLS

**RENAULT V.I.** divide tools into 3 categories :

- **General-purpose tools** : Commercially available tools.
  - . **50 00 26 .... reference number** (possibility of purchasing through the Renault V.I. Spare Parts department).
  - . **4-figure reference number** (tools with Renault V.I. reference number, but available from the supplier).
  
- **Special tools** : Specially created tools, distributed by the RENAULT V.I. spare parts division.
  
- **Locally manufactured tools** : these tools are classified differently according to their degree of sophistication :
  - . **4-figure reference number** (represented by a drawing) : tools that are simple to make without need for special qualification.
  - . **50 00 26 .... reference number** (possibility of purchasing through the Renault V.I. Spare Parts department) : a certain skill is needed to make these tools.

**Three levels** (or echelons) determine their assignment :

- **LEVEL 1** : Tools for servicing and minor tasks.
- **LEVEL 2** : Tools for major repairs.
- **LEVEL 3** : Tools for refurbishment.

General-purpose tools				
Ref. Renault V.I.	Description	Category	Quantity	Pages
50 00 26 <b>0828</b>	Puller	2	1	4-1
50 00 26 <b>0829</b>	Puller	2	1	4-1
50 00 26 <b>1000</b>	Universal frame	2	1	16
50 00 26 <b>2351</b>	Set of pushers	1	1	3-2
50 00 26 <b>2363</b>	Set of pushers	2	1	5-4
<b>0845</b>	Puller	2	1	5-1

**Supplier's address**

**FACOM**

BP 99

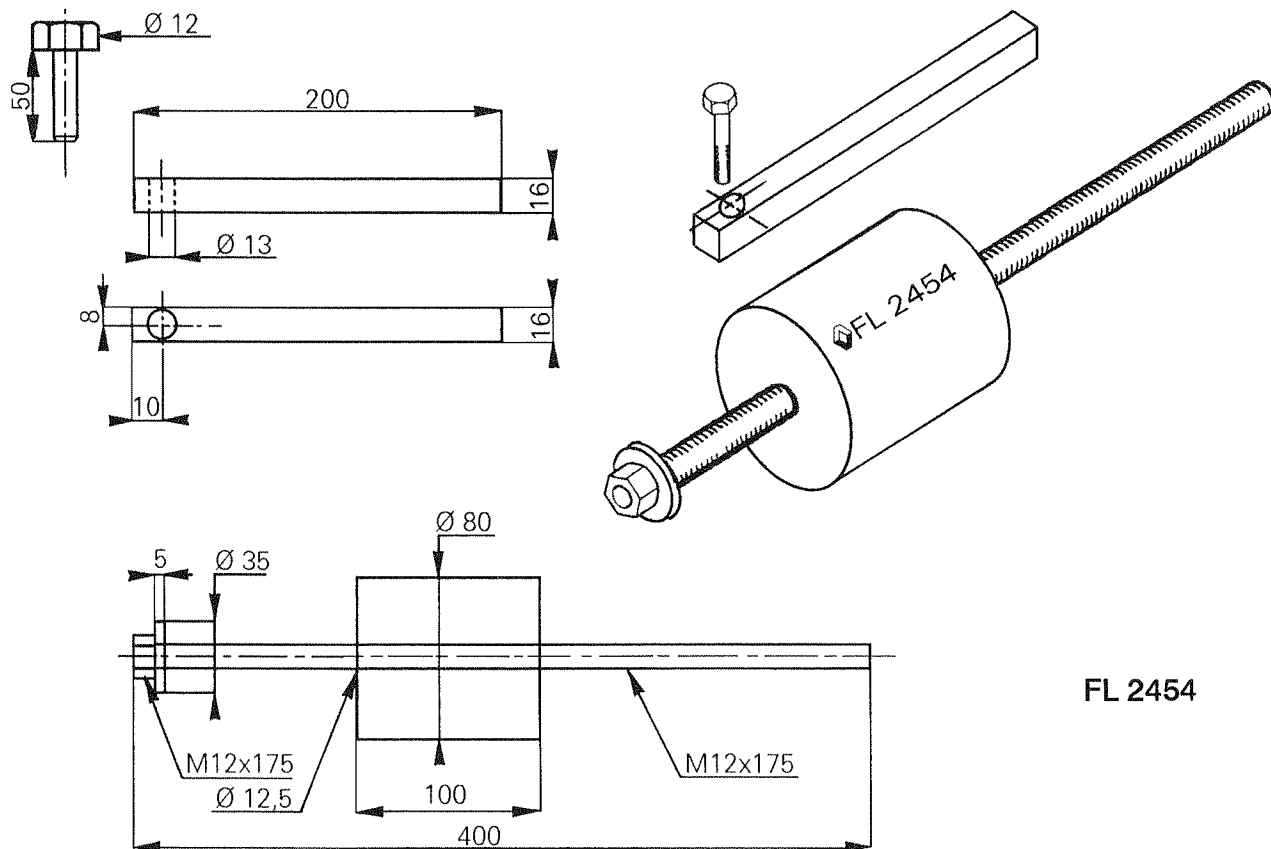
**91423 MORANGIS CEDEX**

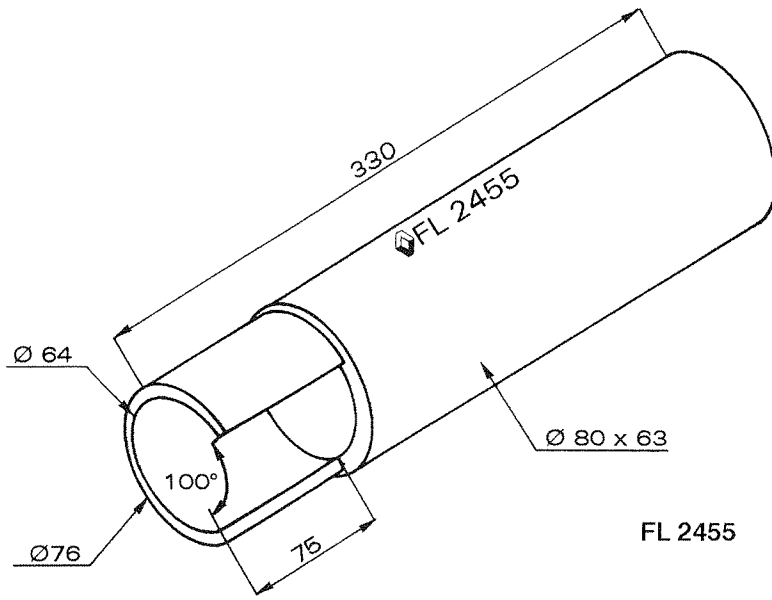
Tél. : 01 64 54 45 45

FAX : 01 69 09 60 93

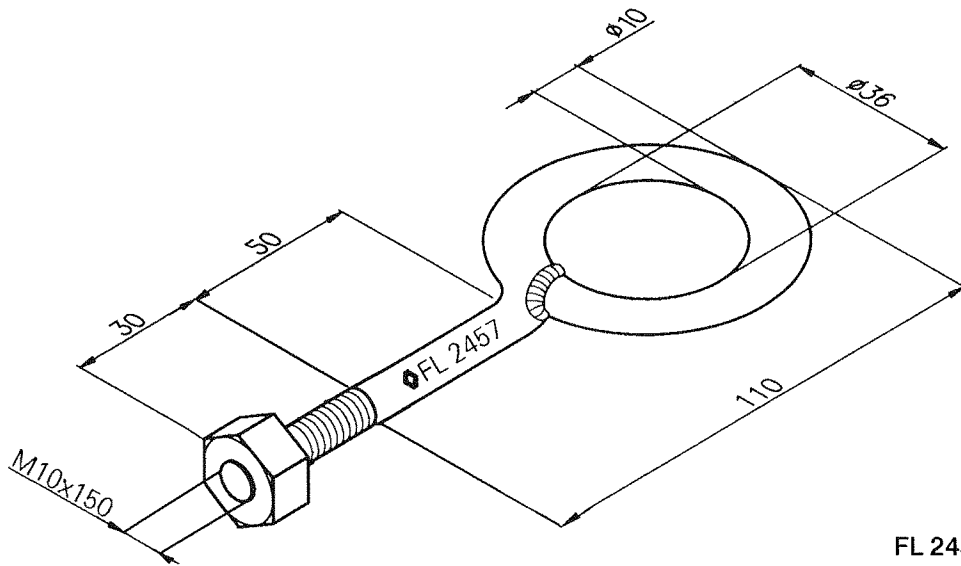
Special tools				
Ref. Renault V.I.	Description	Category	Quantity	Pages
50 00 26 2203	Support	2	1	16
50 00 26 2413	Support	2	1	16
50 00 26 3016	Handle	1	1	3-2

Locally manufactured tools				
Ref. Renault V.I.	Description	Category	Quantity	Pages
FL 2454	Puller	2	1	4-1
FL 2455	Pusher	2	1	6-1
FL 2457	Hook	2	2	4-1





FL 2455



FL 2457

## 1 Output flange, shift mechanism and output shaft

### General

**NOTE:** Markings for the ratio of the auxiliary output  $i = 0.98$  or  $i = 1.55$  (see arrow).

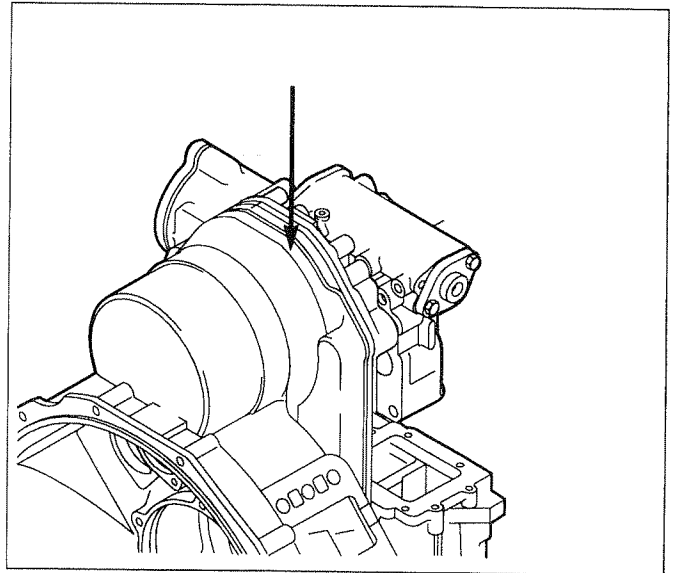
**NOTE:** Due to the larger idler gear, the following sequence should be noted for the fitting and removal procedure when the transmission is  $i = 1.55$ ;

### Removal

1. Clutch release fork removal (Section 2)
2. Quill shaft removal (Section 3)
3. Bearing pins removal and moving idler gear to one side (Section 7)
4. Shift mechanism removal (Section 1.2)
5. Removal of the output shaft, complete (Section 1.3)
6. Clutch housing removal (Section 4.1)
7. Idler gear removal (Section 7)

### Fitting

1. Inserting idler gear (Section 7)
2. Installing output shaft, complete (Section 1.3)
3. Assembling bearing pin (Section 7)
4. Fitting clutch housing (Section 4.3)
5. Installing quill shaft (Section 2)
6. Assembling clutch release fork (Section 2)
7. Fitting shift mechanism (Section 1.2)

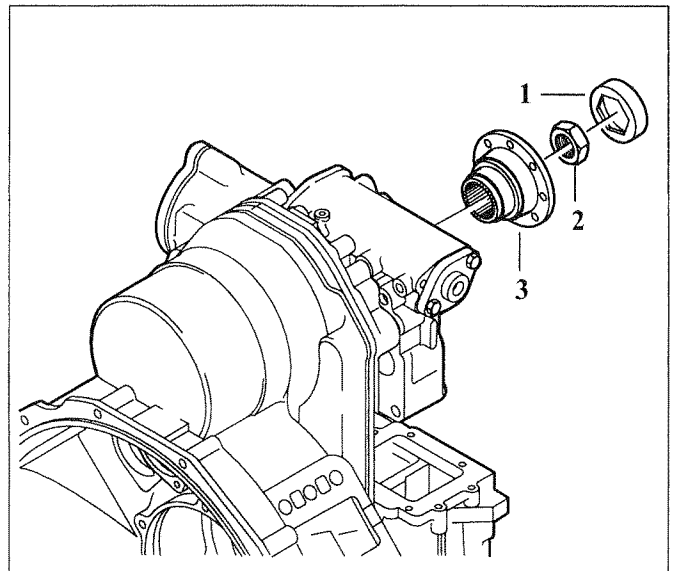


010338

## 1.1 Output flange

### Removal

- 1 Remove retaining plate (1) and unfasten and remove hex nut (2).
- 2 Pull output flange (3) out of output shaft.



010338

### Fitting

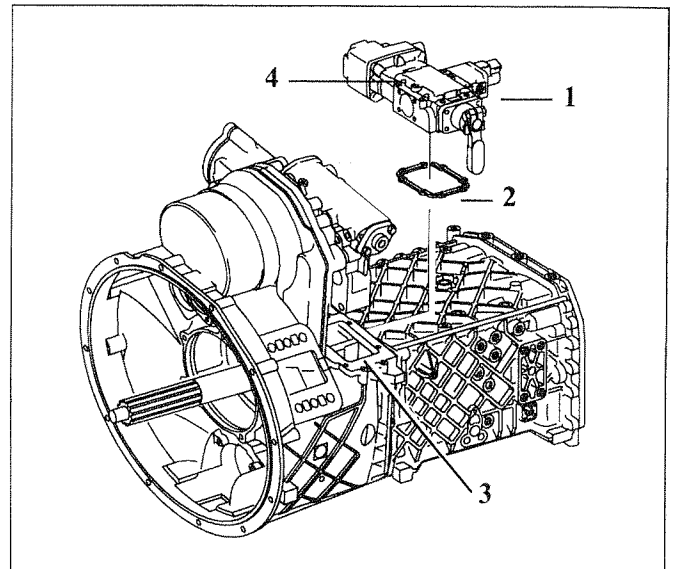
**NOTE:** before fitting the output flange, remove shift mechanism (see **Section 1.3**).

- 1 Place output flange (3) on output shaft and drive in.
- 2 Secure output flange so that it cannot turn. Insert hex nut (2) and screw in; tightening torque = 360 Nm.
- 3 Insert retaining plate (1) and peen twice.

**1.2 Shift mechanism**

**Removal**

- 1 Unfasten hex screws on shift housing (1).
- 2 Remove complete housing and gasket (2).

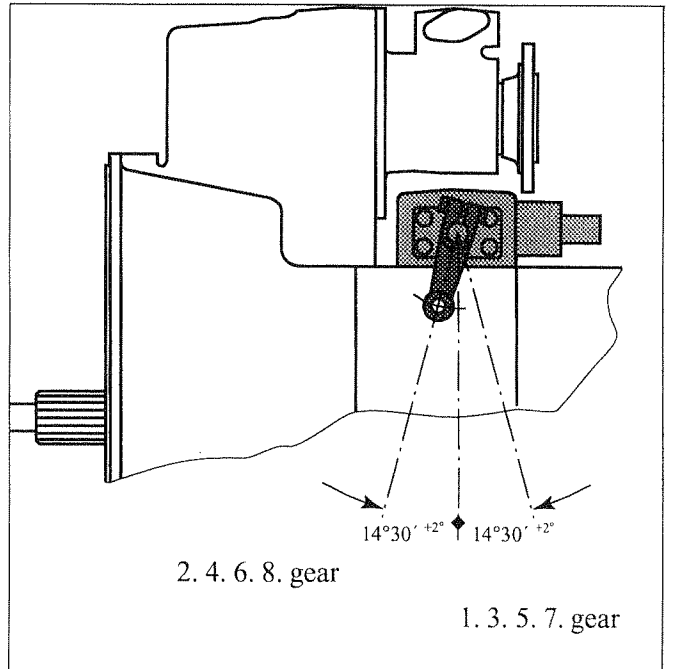


010496

**Fitting and adjusting**

**NOTE:** only fit shift mechanism once the complete output shaft has been fitted. (see Section 1.3).

- 1 Place new gasket (2) on clutch housing (3) and/or sealing faces.
- 2 Place hex screw (4) in shift housing. Screw cannot be assembled once shift mechanism is set up.
- 3 Add complete shift housing (1). Position bores in shift housing using gasket. Positioning between clutch housing, gasket and shift housing can be simplified by using threaded pins.
- 4 Shift through all gears. Excess shift travel must be felt in each gear. If the shift angle does not comply with the tolerances specified, it must be adjusted using an angle measuring device. Lastly tighten all hex screws.  
Tightening torque = 23 Nm.



010497

**CAUTION**

The shift turret housing must be positioned on the transmission housing so that the same play is attained (excess shift travel) on both sides and so that there is a shift angle of  $14^{\circ} 30' +2^{\circ}$  (see diagram).



## 1.3 Output shaft, complete

### Removal

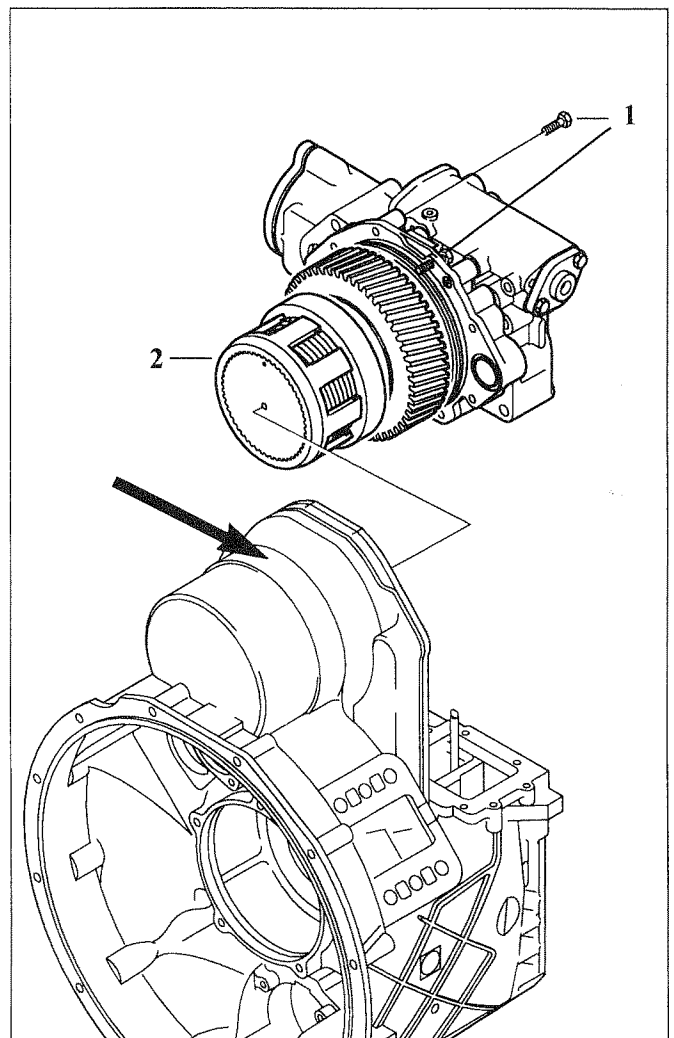
**NOTE:** the output shaft can only be removed once the shift mechanism has been removed (see Section 1.2).

**NOTE:** when the transmission is  $i = 1.55$ , take note of the order of the removal and fitting sequence.

- 1 Unfasten and remove screws (1).
- 2 Heat outside of the clutch housing around the bearing seat (see arrow).
- 3 Use crane and lifting attachment **1X56 138 144** to remove complete output shaft (2) from clutch housing.

### Installation

- 1 Heat outside of the clutch housing around the bearing seat to approx. 60 °C (see arrow).
- 2 Use crane and lifting attachment **1X56 138 144** to place complete output shaft (2) in clutch housing and tighten using hex screws (1); tightening torque = 23 Nm.



010498

**2 Clutch release fork**

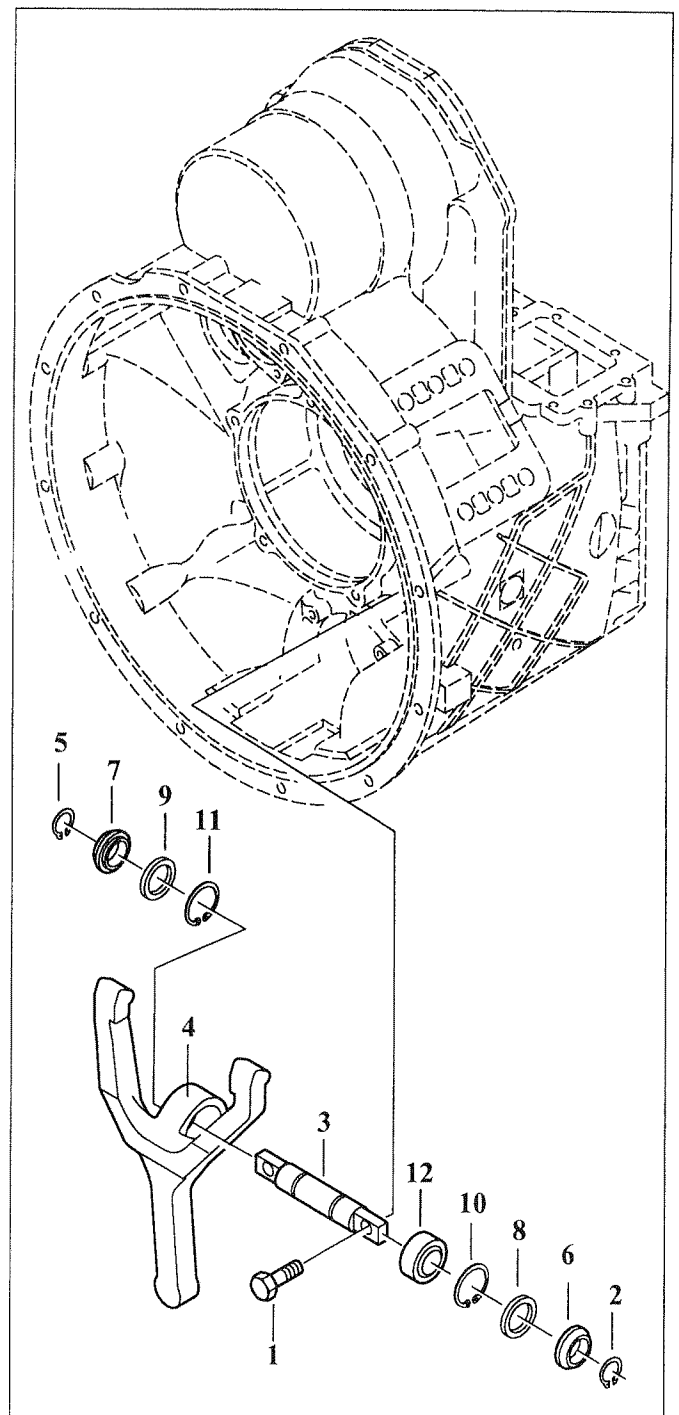
**Removal**

- 1 Unfasten hex screws (1) and remove with complete clutch release fork.
- 2 Remove circlip (2).
- 4 Drive pin (3) out of clutch release for (4) and remove circlip (5).
- 5 Remove sealing washers (6 and 7), sealing rings (8 and 9), circlips (10 and 11) and joint bearing (12) from clutch release fork.

**Installation**

**NOTE:** completed clutch release fork may only be fitted once the quill shaft has been installed (see **Section 3**).

- 1 Insert circlip (11) in clutch release fork (4), push joint bearing (12) firmly home with grease (Olista Longtime 3EP) and insert circlip (10).
- 2 Insert new sealing rings (8 and 9) and sealing washers (6 and 7).
- 3 Place circlip (5) on pin (3).
- 4 Press pin into clutch release fork.
- 5 Insert circlip (2).
- 6 Place completed clutch release fork in clutch housing with hex screws (1) and tighten; tightening torque = 115 Nm.



010341

3 Quill shaft

Removal and dismantling

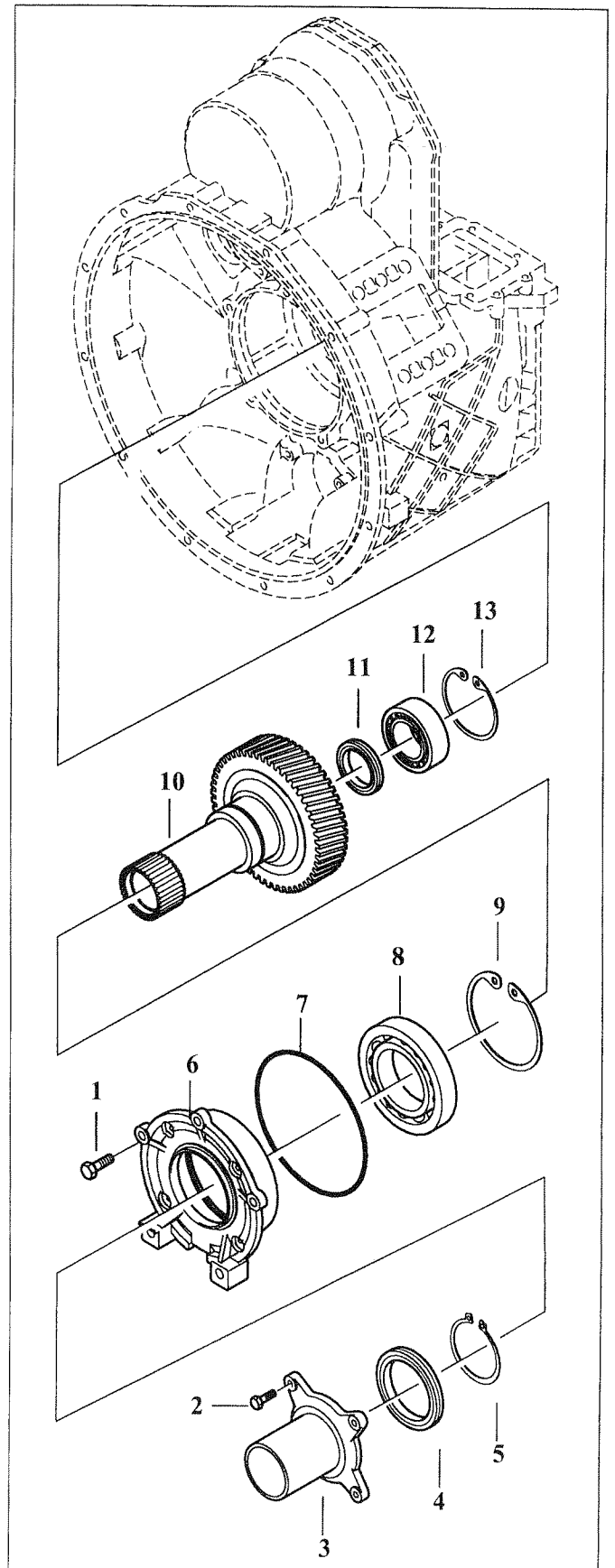
**NOTE:** the quill shaft can only be removed once the clutch release fork has been removed. (see Section 2).

- 1 Unfasten hex screws (1) and take complete quill shaft out of clutch housing.
- 2 Unfasten hex screws (2) and remove connection plate (3).
- 3 Remove radial seal (4) and circlip (5).

**CAUTION**

Sealing faces must not be damaged.

- 4 Remove bearing flange (6) from the quill shaft (10).
- 5 Take circlip (9) out of bearing flange and remove O-ring (7).
- 6 Use Rillex puller 1X56 122 366 to remove ball bearing (8) from bearing flange.
- 7 Take circlip (13) out of quill shaft and remove outer ring (12).
- 8 Use appropriate tool to remove radial seal (11) from quill shaft.



010342

**Assembly and installation**

**NOTE:** the quill shaft can only be inserted once the idler gear has been installed (see Section 7).

- 1 Use drift **1X56 122 407** to drive radial seal (11) firmly home into quill shaft (10).
- 2 Press outer ring (12) into quill shaft and insert circlip (13).
- 3 Place ball bearing (8) in bearing flange, insert circlip (9) and assembly O-ring (7) by using grease.
- 4 Use drift **1X56 122 407** to press preassembled bearing flange firmly home on quill shaft.
- 5 Insert circlip (5) into quill shaft.

**CAUTION**

**Sealing faces must not be damaged.**

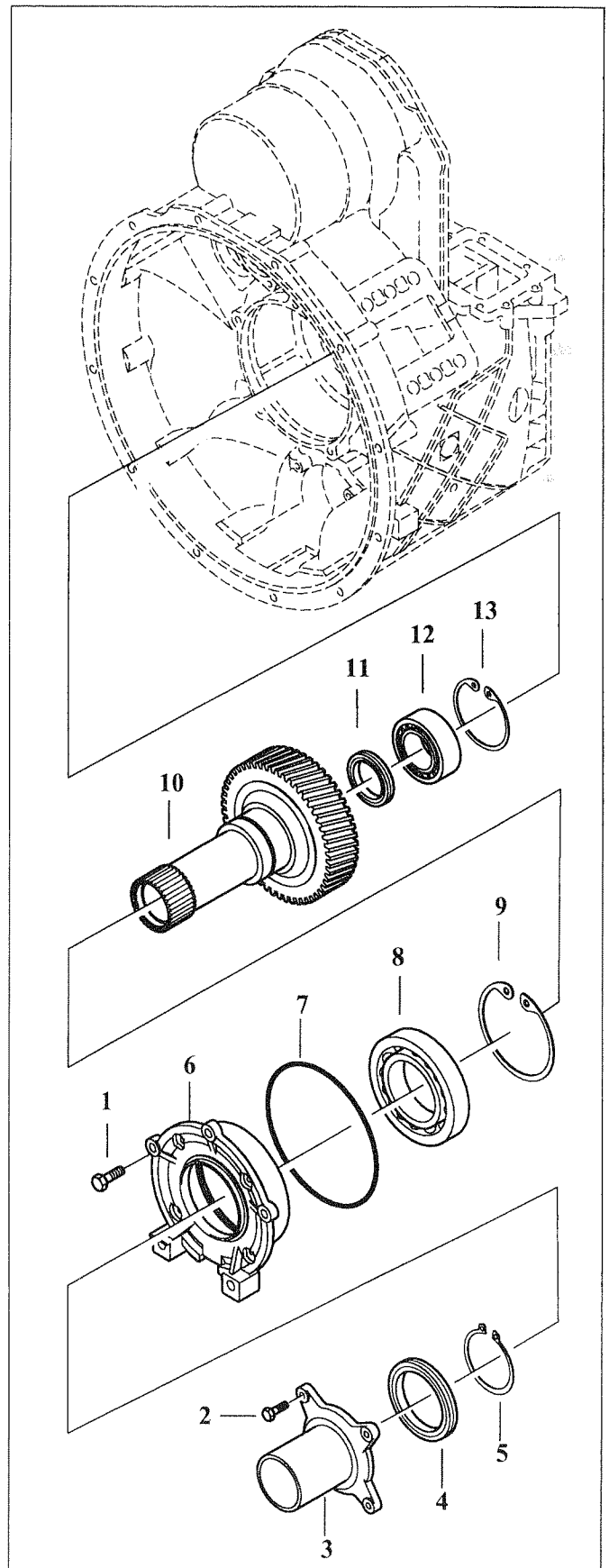
- 6 Use drift **1X56 103 765** to drive radial seal (4) into bearing flange.

**NOTE:** radial seal and bearing flange must be level.

- 7 Insert connection plate (3) and fasten hex screws (2); tightening torque = 23 Nm.

- 8 Place protective sleeve **1X56 138 064** on output shaft, insert completed quill shaft into clutch housing and tighten hex screws (1); tightening torque = 46 Nm.

**NOTE:** screw 2 stud bolts into clutch housing to assist with assembly.



4 Clutch housing

4.1 Removal of clutch housing

**NOTE:** the clutch housing can only be removed once the clutch shifter and quill shaft have been removed (see Sections 2 and 3).

- 1 Remove both inner and outer hex screws. Use extracting tool 1X56 138 063 to remove cylinder pin (1). Use in-house manufactured puller to remove cylinder pins on inside (see special tool, page 17, diagram 11).

**⚠ DANGER**

Exercise caution when attaching lifting tackle and cable.

- 2 Fit 2 hooks 1X56 136 564 on clutch housing so that they face one another.
- 3 Tighten the lifting tackle. Assembly suggestion: use four cylinder pins (1) to position the clutch housing on the central housing, i.e. the clutch housing must be level when it is lifted.
- 4 Use plastic hammer to hit the pockets (2) on the central housing and clutch housing.

**CAUTION**

Do not place assembly levers on sealing faces of housings and pry off.

- 5 Take off clutch housing and remove gasket (3).

**NOTE:** to disassemble bearing outer rings, heat bearing seats to approx. 60°C.

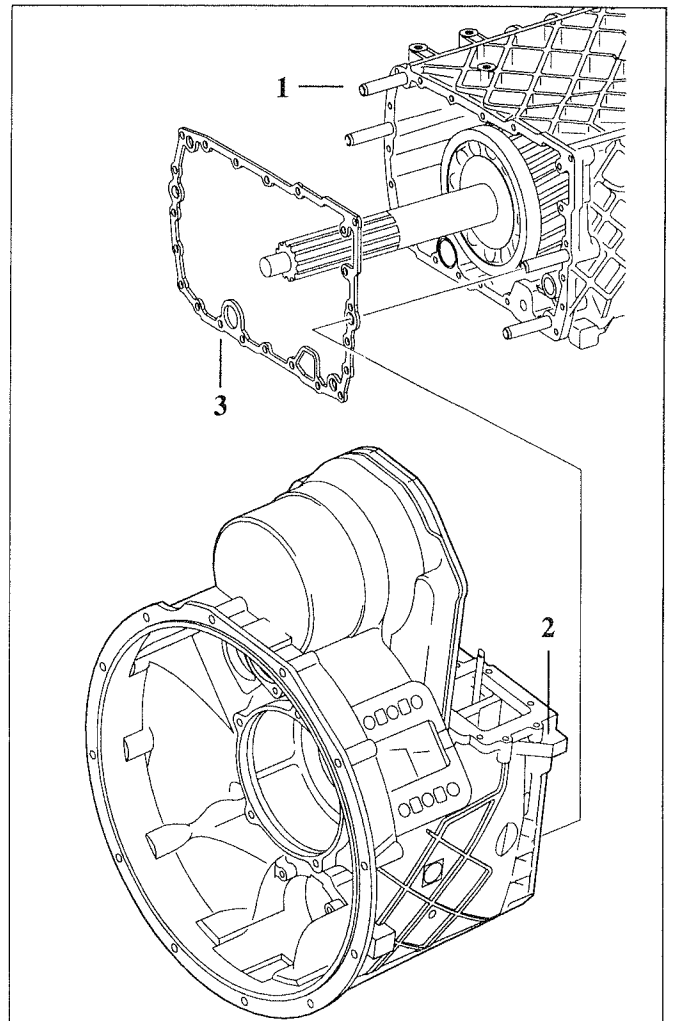
**⚠ DANGER**

Always wear protective gloves when handling heated parts.

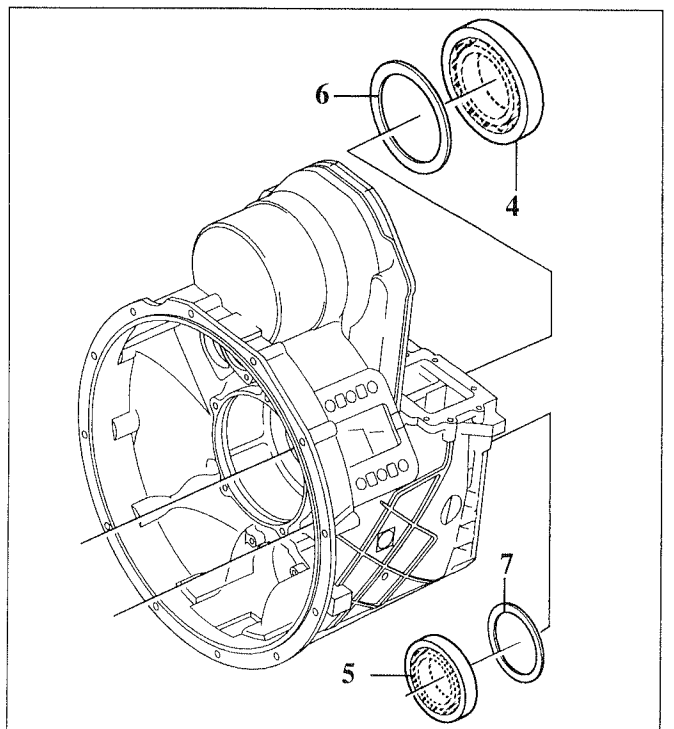
- 6 Use 2 standard pry bars to remove bearing outer rings (4 and 5) and shim washers (6 and 7) from clutch housing or use tool 50 00 26 0828 + 50 00 26 0829

**CAUTION**

You must place an appropriate spacer under the pry bars. Do not damage housing.



010499



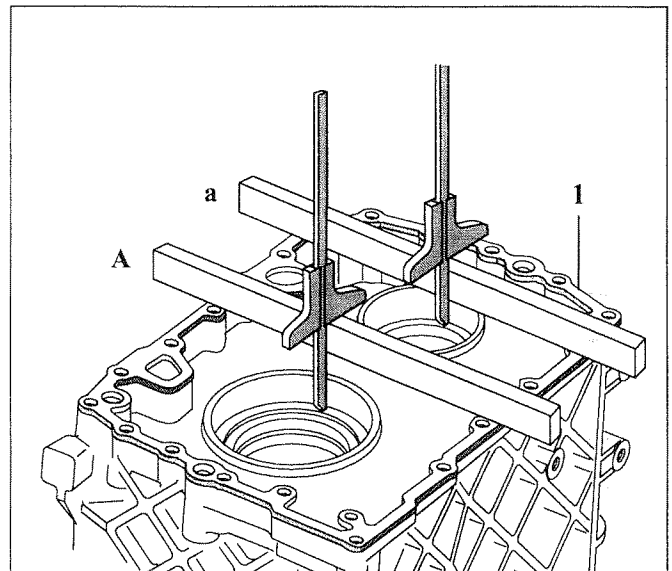
010500

**4.2 Measuring the clutch housing  
(mainshaft and countershaft)**

- 1 Place new gasket (1) and appropriate measuring strip on clutch housing.
- 2 Use depth gauge to measure from the measuring strip driven firmly home onto the shim washer to the clutch housing;  
 in mainshaft                      dimension "A"  
 in countershaft                    dimension "a".

**Example less measuring strip:**

Mainshaft                    "A"        = 129.00 mm  
 Countershaft                "a"        = 132.10 mm



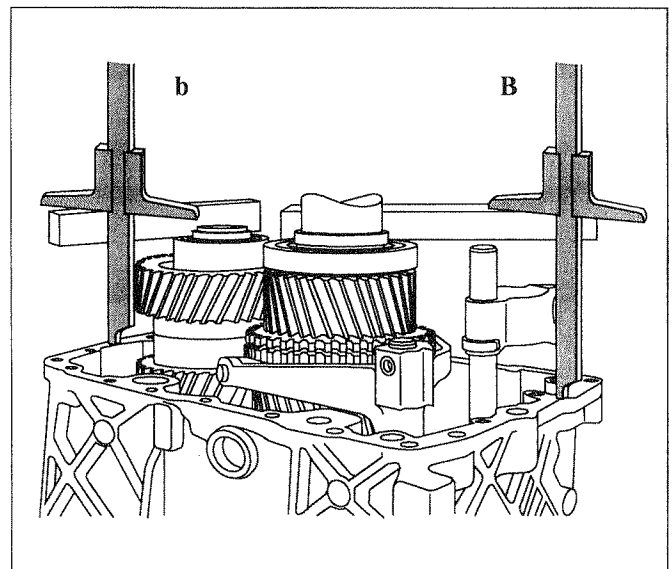
010501

- 3 Place outer bearing rings on mainshaft and countershaft and centre.
- NOTE:** perform measurements at several points, if necessary use the measuring strip to assist.

- 4 Use depth gauge to measure from front face of outer bearing ring to sealing face of central housing;  
 in mainshaft                      dimension "B"  
 in countershaft                    dimension "b"

**Example less measuring strip:**

Mainshaft                    "B"        = 127.80 mm  
 Countershaft                "b"        = 129.40 mm



010502

- 5 Calculate the differential dimension, "C" for mainshaft and "c" for countershaft.

**Mainshaft:**         $A - B = C$   
                            $129.00 - 127.8 = 1.2 \text{ mm}$   
 when the axial play permitted for the bearing is 0.0 to 0.1 mm, select a shim washer of 1.2 mm.

**Countershaft:**     $a - b = c$   
                            $132.1 - 129.4 = 2.7 \text{ mm}$   
 when the axial play permitted for the bearing is 0.0 to 0.1 mm, select a shim washer of 2.7 mm.

4.3 Fitting the clutch housing

**NOTE:** before the clutch housing can be fitted, when  $i = 0.98$ , the idler gear must be installed or when  $i = 1.55$ , it must be put into place (see Section 7).

- 1 Heat bearing seat in clutch housing to approx. 60°C, insert **newly** selected shim washers (6 and 7) and drive outer bearing rings (4 and 5) firmly home .
- 2 Place new gasket (3) on central housing (sealing face) and position.

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**⚠ DANGER**  
**Exercise caution when attaching lifting tackle and cable.**

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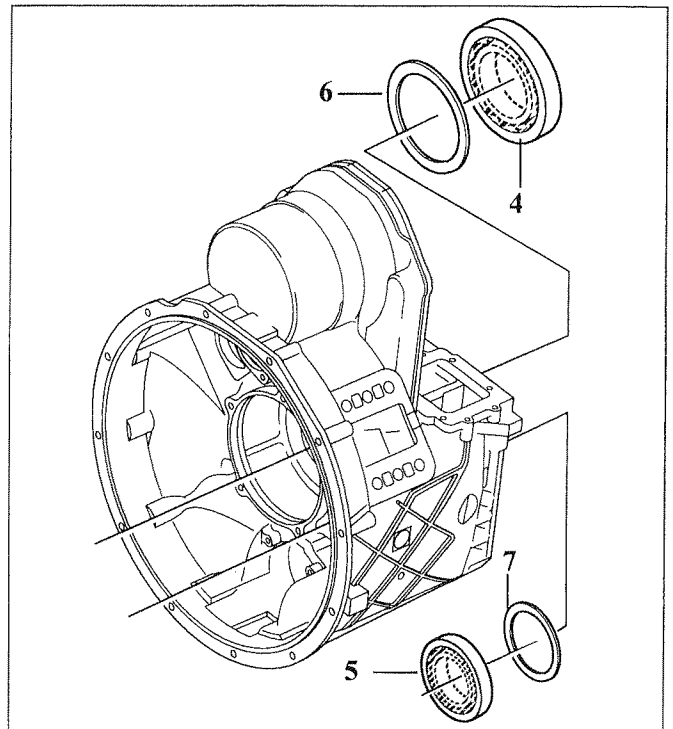
- 3 Use hook **1X56 136 564** to place clutch housing evenly on central housing.

**NOTE:** if the quill shaft has already been assembled, slide protective sleeve **1X56 138 064** onto output shaft.

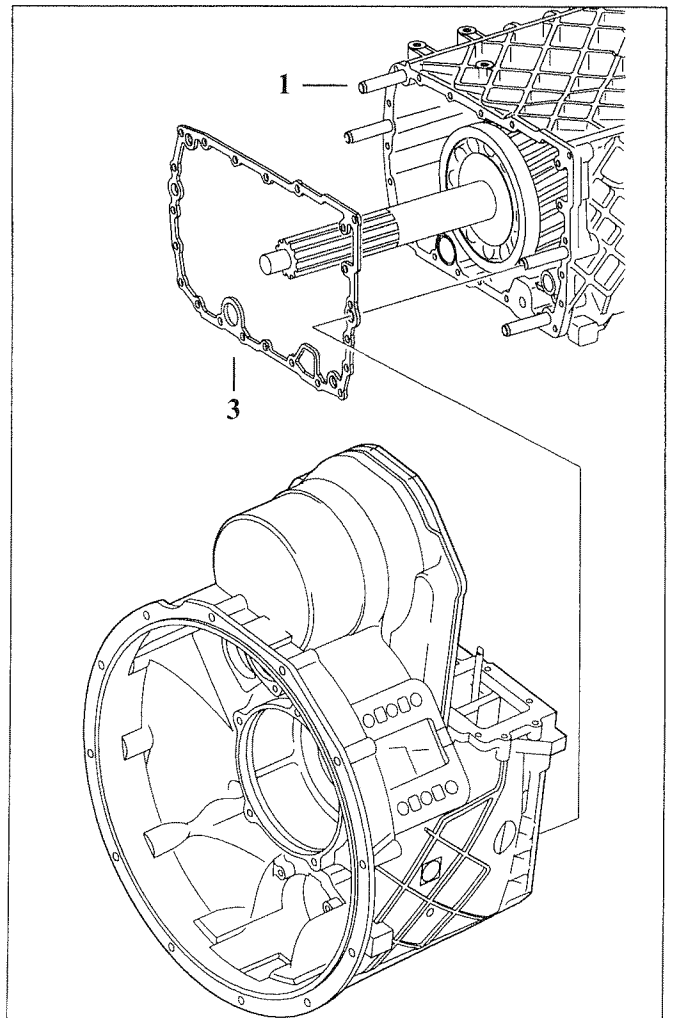
**CAUTION**  
**The end of the spray tube must engage in funnel and selector rails in the bores of the clutch housing.**

**NOTE:** position all cylinder pins (1) between clutch housing and central housing at the same time. If necessary push driver of selector rails in until clutch housing is fastened.

- 4 Screw in the inner and outer hex screws on the clutch housing. Turn output shaft several times to centre the bearing rollers; tightening torque = 49 Nm.
- 5 Remove hook **1X56 136 564** and protective sleeve **1X56 138 064**.



010500

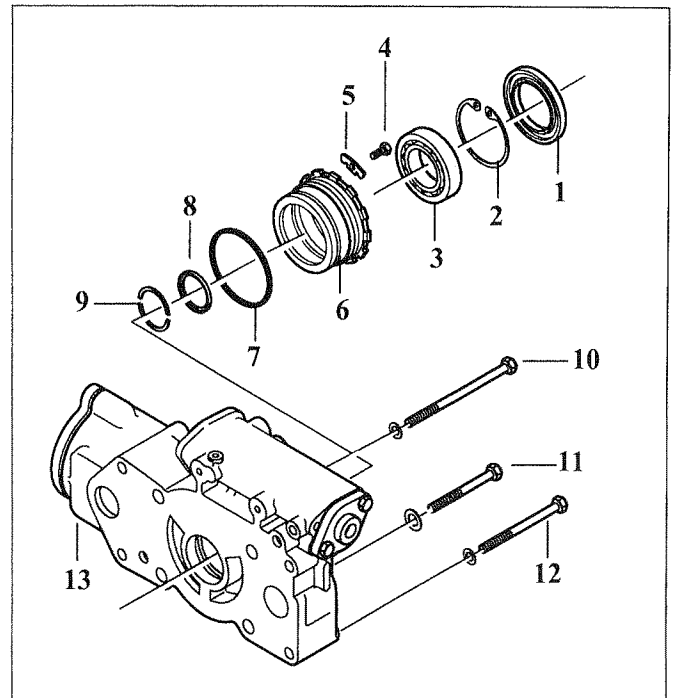


010499

**5 Control housing**

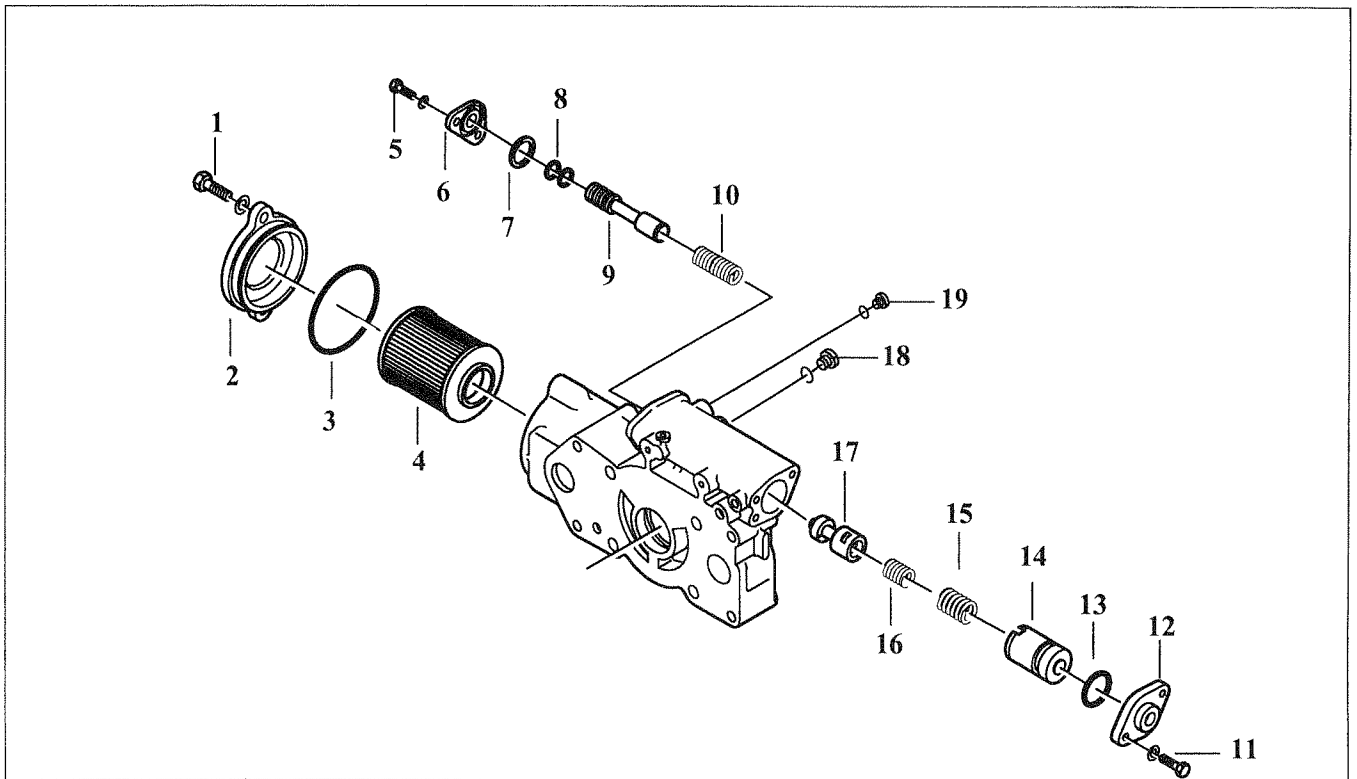
**Removal**

- 1 Remove radial seal (1) and sealing ring (2) from control housing (13).
- 2 Use Rillex puller **1X56 136 802** to pull ball bearing (3) out of control housing.
- 3 Unfasten hex screw (4) and remove with retaining plate (5).
- 4 Use open-end wrench to unfasten threaded bush (6) and unscrew, remove O-ring (7).
- 5 Remove ring (8) and split ring (9) from output shaft.
- 6 Unfasten hex screws (10, 11 and 12) and remove control housing from output shaft.



010503

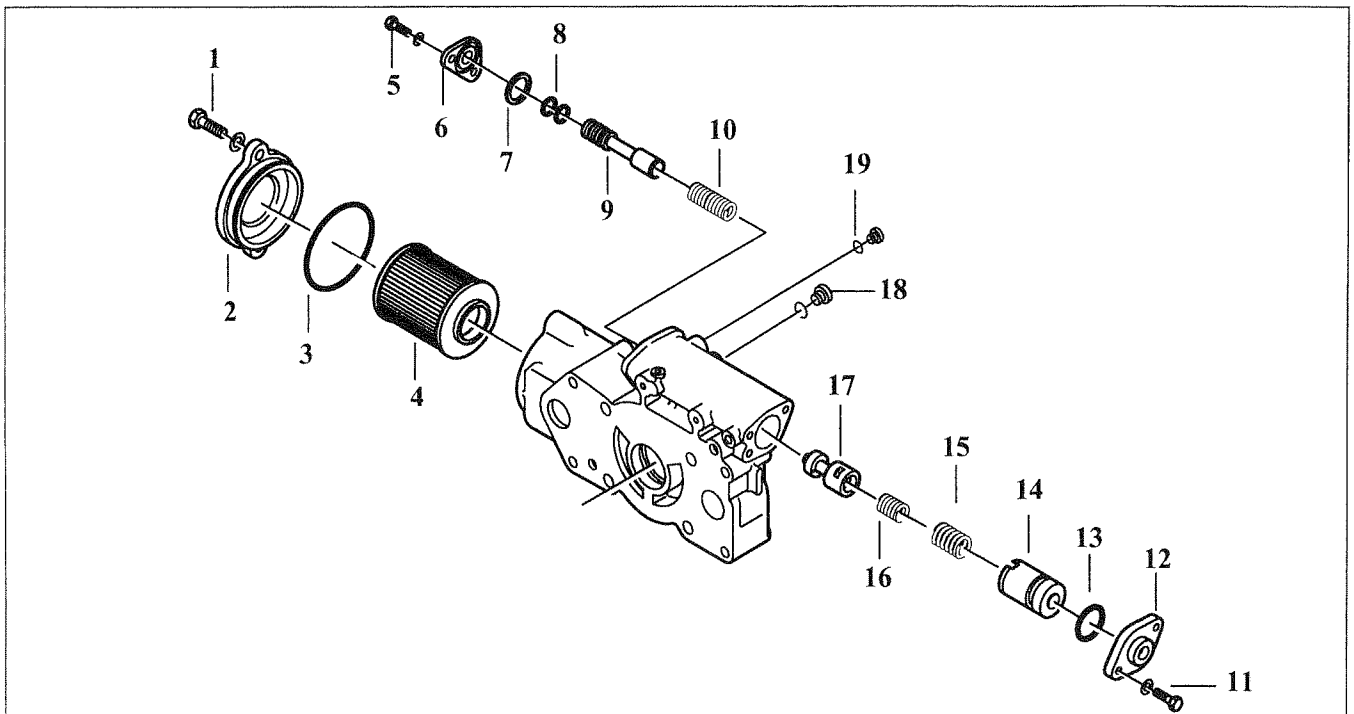




010339

### Dismantling

- 1 Unfasten hex screws (1), remove cover (2), O-ring (3) and filter (4).
- 2 Unfasten hex screws (5) and remove cover (6) and O-ring (7).
- 3 Pull piston (9) and spring (10) out of bore and remove O-ring (8).
- 4 Unfasten hex screws (11) and remove cover (12) and O-ring (13).
- 5 Remove pistons (14 and 17) and springs (15 and 16).
- 6 Unfasten screw plugs (18 and 19) and remove.



010339

**Assembly**

- 1 Place O-rings (8) on piston (9) with grease and insert piston and spring (10) into control housing.
- 2 Place O-ring (7) in cover (6) with grease and screw on cover using hex screws (5); tightening torque = 23 Nm.
- 3 Screw in screw plugs;
 

Tightening torque M12x1,5	(18) = 25 Nm
Tightening torque M10x1	(19) = 15 Nm

**II If the recess (21) is visible, piston (17) is not assembled correctly (see II, arrow). Repeat steps 4 and 5.**

**CAUTION**

**Check that the bore (20) is clear.**

- 4 Insert piston (17) in control housing by carefully screwing it in.

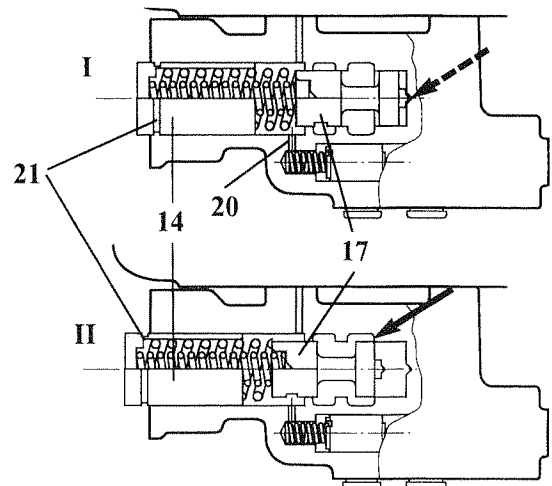
**CAUTION**

**You must feel piston (17) reach its limit stop (see I, arrow).**

- 5 Place piston (14) and springs (15 and 16) in control housing.

**CAUTION**

**I If piston (17) is assembled correctly, piston (14) may protrude approx. 7 mm when in slack position. Recess (21) on piston is not visible.**



010504

- 6 Place O-ring (13) in cover (12) with grease and screw on with hex screws (11); tightening torque = 23 Nm.
- 7 Insert filter (4) into control housing.
- 8 Insert O-ring (3) in cover (2) with grease and screw on with hex screws (1); tightening torque = 46 Nm.

## Fitting

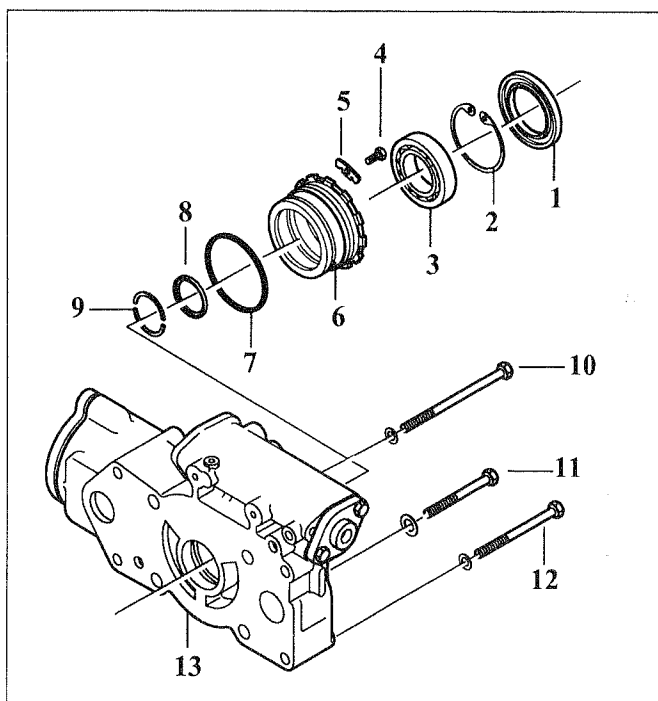
- 1 Place preassembled control housing on output shaft and screw in screws (10, 11 and 12) and tighten;  
tightening torque = 79 Nm.

**NOTE:** housing is fastened with 2 cylinder pins on the pump housing.

- 2 Place split ring (9) and ring (8) on output shaft with grease.
- 3 Place O-ring (7) on threaded bush with grease.
- 4 Apply grease to threaded bush and use open-end wrench to screw firmly home into control housing.
- 5 Screw on retaining plate (5) using hex screw (4);  
tightening torque = 23 Nm.

**NOTE:** by turning the retaining plate and by using the 4 screw-on bores there are 8 possible ways of gaining the exact positioning.

- 6 Pull control housing and pump housing in the output direction firmly home to the split ring. Use wedges or suitably manufactured supports to fasten the housings.
- 7 Use drift **1X56 138 145** to drive ball bearing (3) onto output shaft.
- 8 Insert circlip (2) and use drift **1X56 115 510** to drive radial seal (1) firmly home.



010503

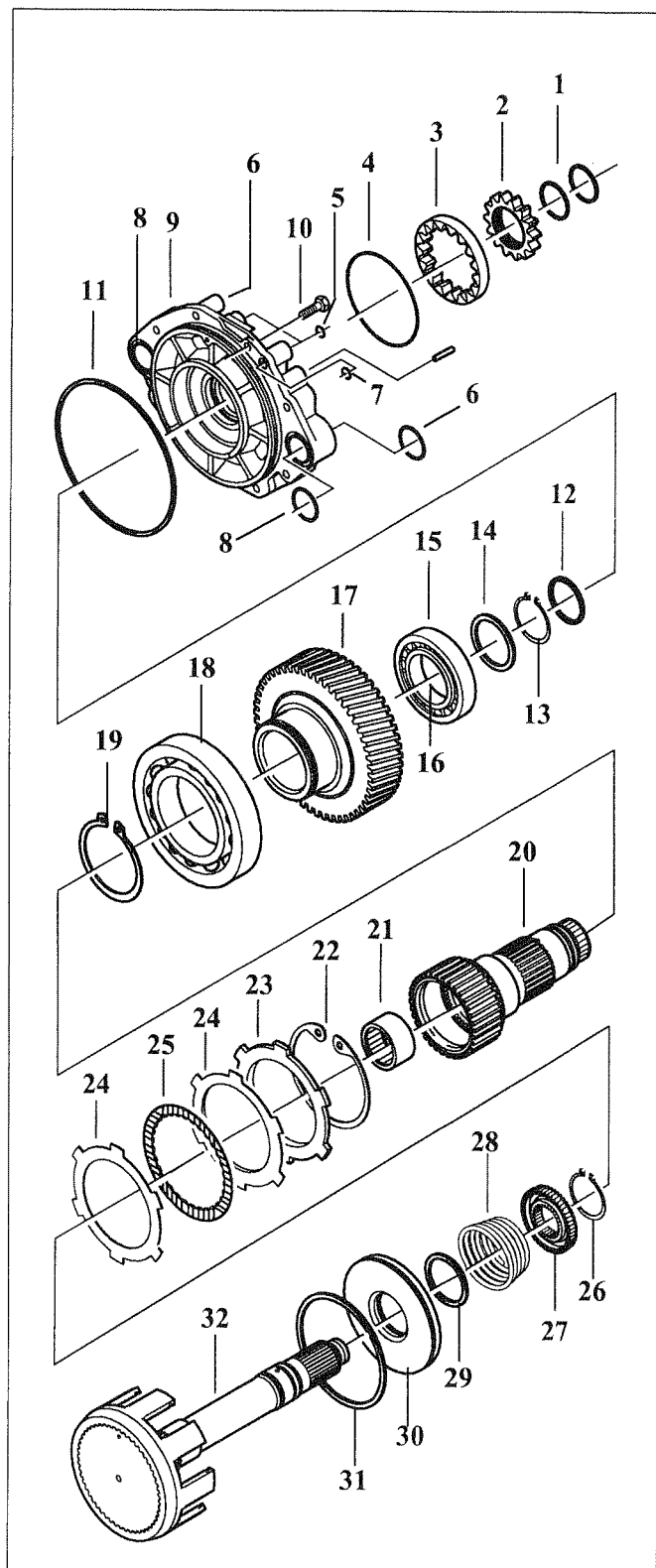
**6 Output shaft**

**Dismantling**

- 1 Remove pump gear (2) and pump ring gear (3) from pump housing (9).
- 2 Take pump housing off disc carrier (20), remove all O-rings (4, 5, 6, 7, 8 and 11) and M8x30 screw (10).
- 3 Press outer bearing ring (15) out of pump housing.
- 4 Pull disc carrier (20) off output shaft (32).
- 5 Remove rectangular ring (12), circlip (13) and washer (14) from disc carrier.
- 6 Use puller to pull inner bearing ring (19) off disc carrier.
- 7 Remove circlip (19), remove helical gear (17) and ball bearing (18) and push ball bearing off helical gear.
- 8 Pull needle bearing (21) off disc carrier.
- 9 Remove circlip (22), take end shim (23) off output shaft with all the outer discs (24) and inner discs (25).

**⚠ DANGER**  
**Spring is under great amount of pressure.**

- 10 Use tool **1X56 138 143**, press guide ring (27) and spring (28) under the press, force downwards and remove circlip (26) and carefully relieve spring.
- 11 Take circlip (26), guide ring (27), spring (28), piston (30) and rectangular ring (1) off output shaft.
- 12 Remove lipped sealing rings (29 and 31) from piston.



010580

## Assembly

- 1 Insert rectangular ring (1) in output shaft (32).
- 2 Insert new lipped sealing rings (31 and 29) with grease into the correct position in piston (30).

### CAUTION

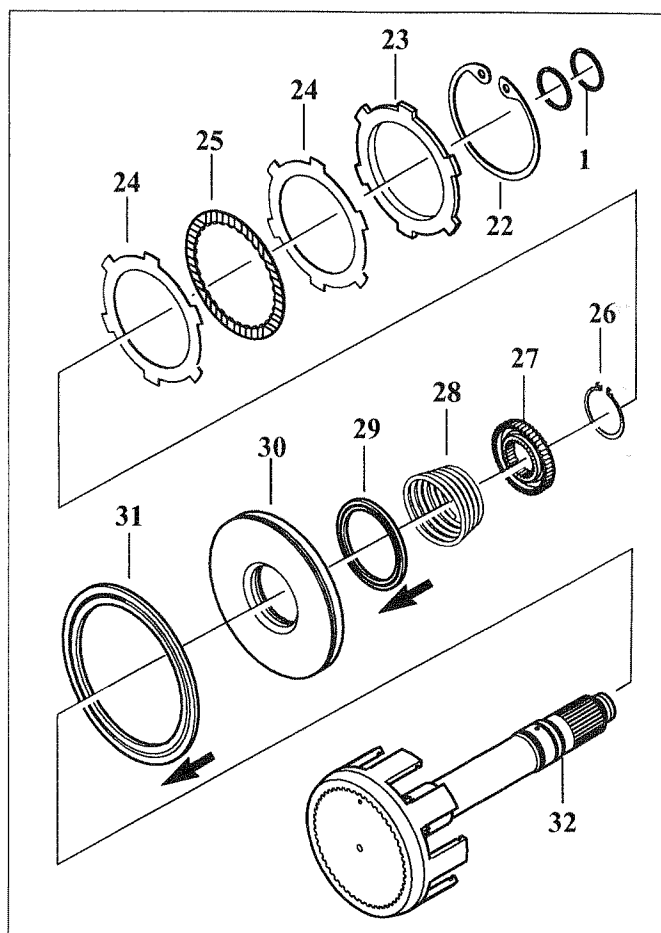
**Groove on lipped sealing rings must face the same direction as the arrow in diagram.**

- 3 Place piston in the correct position on output shaft.
- 4 Insert spring (28), guide ring (27) and circlip (26).
- 5 Use tool 1X56 138 143, place guide ring and spring under press, force downwards and insert circlip.
- 6 Firstly place outer discs (24) on output shaft and then inner discs (25).

**NOTE:** 9 outer discs and 9 inner discs must be inserted in turn.

- 7 Add end shim (23) and insert circlip (22).
- 8 Centre inner discs to one another on output shaft and align.

**NOTE:** if you use in-house manufactured wedges, the aligned discs can be pushed upwards against the circlip which means that it is easier to assemble the disc carrier.



010336

- 9 Insert needle bearing (12) with grease firmly home into disc carrier (20).
- 10 Press ball bearing (18) onto helical gear, ensuring that its thread is facing the output shaft (see arrow) and insert corresponding circlip (19). Take note of the permitted axial play of 0.0 to 0.1 mm.
- 11 Press helical gear and bearing firmly home onto disc carrier.

**⚠ DANGER**

**Always wear protective gloves when handling heated parts.**

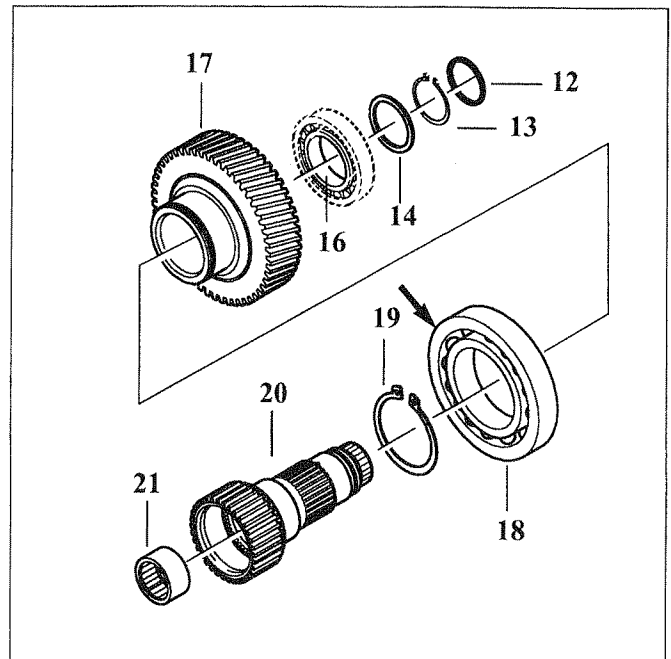
- 12 Heat inner bearing ring (16) to approx. 60 °C and place on disc carrier.
- 13 Insert washer (14), appropriate circlip (13) and rectangular ring (12). Take note of the permitted axial play of 0.0 to 0.1 mm.
- 14 Place partially assembled disc carrier on output shaft and remove wedges.

**NOTE:** check whether all discs can move. Disc play is 4 - 5 mm.

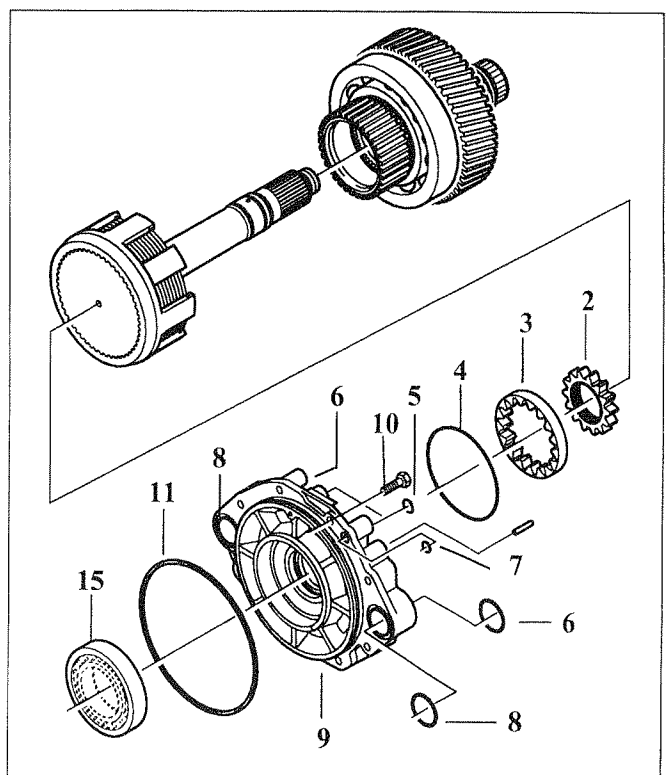
- 15 Press outer bearing ring (15) into pump housing.
- 16 Insert O-rings (11, 8 and 7) with grease into pump housing.
- 17 Place pump housing over disc carrier.
- 18 Insert M8x30 screw (10). This screw cannot be assembled once the control housing has been assembled.
- 19 Insert O-rings (6, 5 and 4) with grease on the output side onto the pump housing.
- 20 Insert pump ring gear (3) and pump gear (2) with anti-corrosion oil in pump housing. Check that axial play is 0.03 - 0.065 mm.

**CAUTION**

- Markings on pump ring gear and pump gear must face output.
- Do not assemble gears if they are dry.



010581



010538

7 Idler gear

Removal

**NOTE:** the idler gear can only be removed once the clutch release fork, quill shaft and clutch housing have been removed (see Sections 2, 3 and 4).

- 1 Unfasten screws (1) and remove.

**NOTE:** heat clutch housing around the bearing pins.

- 2 Pull bearing pin (2) out of the clutch housing.  
Use tool 50 00 26 **0829**.  
Use a threaded rod diameter : 18 x 150 mm,  
length : 350 mm.

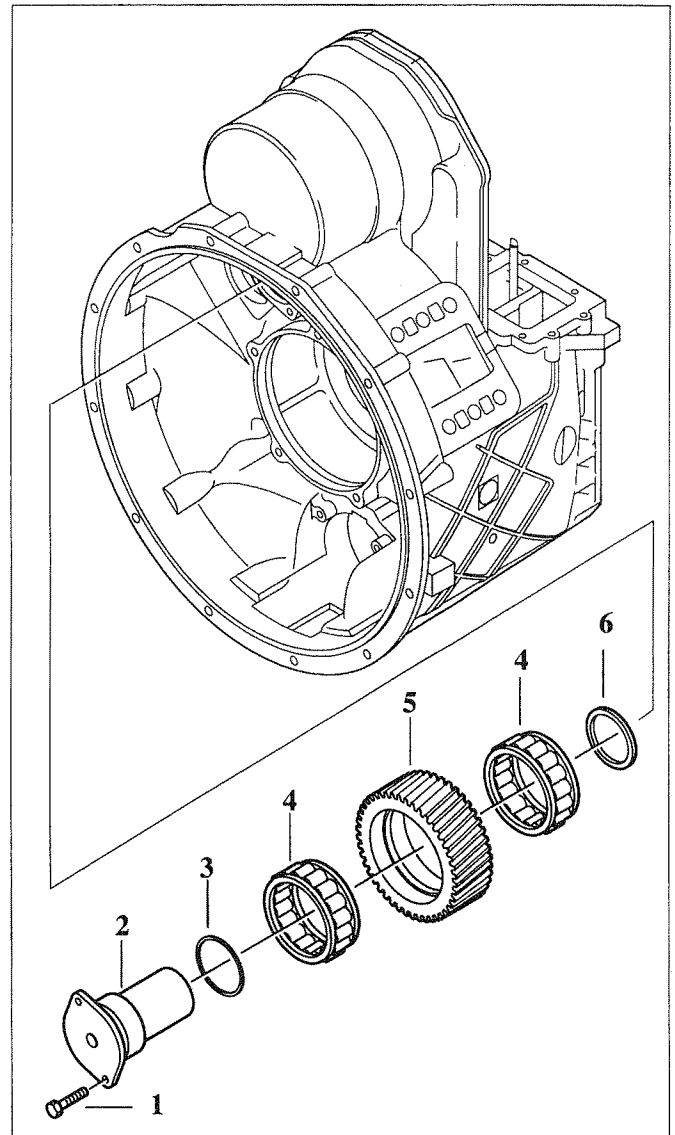
**CAUTION**

**Bearing pin sits very firmly, do not damage it when removing clutch housing.**

- 3 Remove O-ring (3) from bearing pin.
- 4 Take idler gear (5), 2 bearings (4) and ring (6) out of clutch housing.

**NOTE:** if the ratio is  $i = 1.55$ , release idler gear (5) in transmission sideways and lastly remove output shaft and only then may you remove idler gear with bearing and ring.

- 5 Take bearing (4) off idler gear.

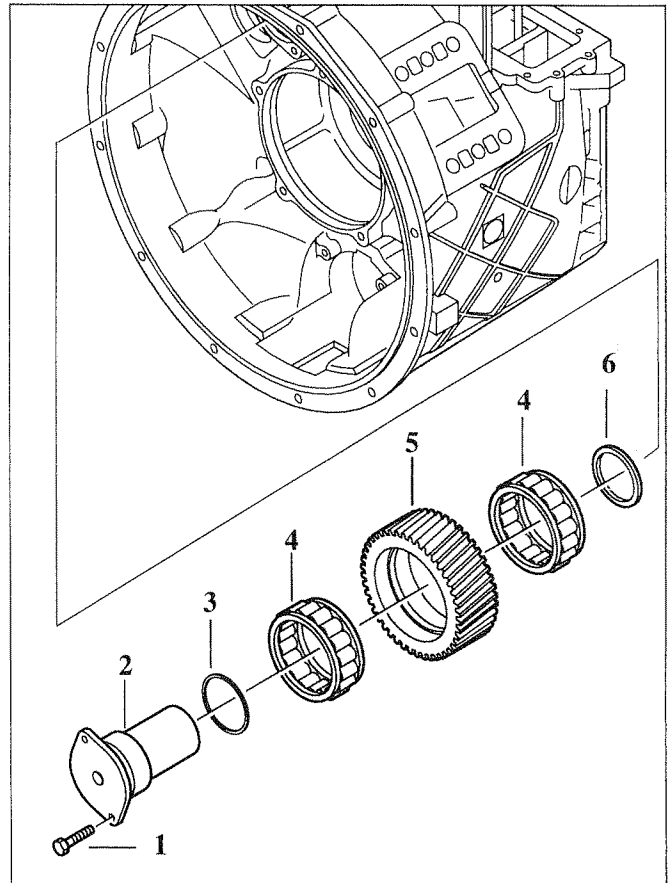


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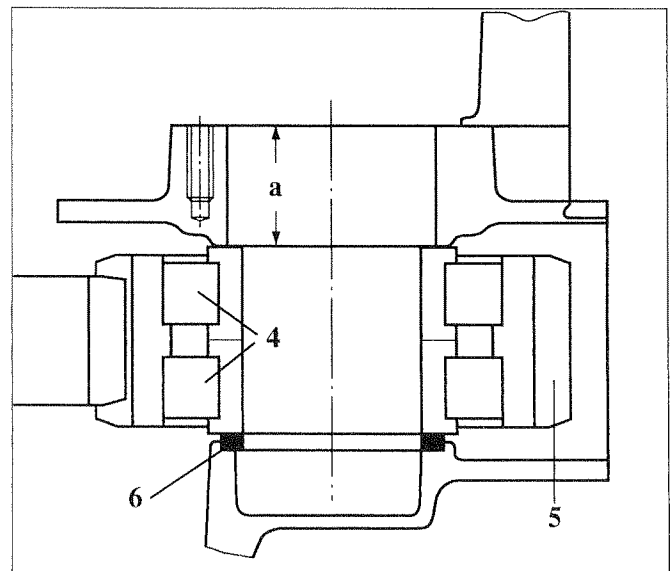
**Installation**

**NOTE:** before fitting the clutch housing, completely assemble idler gear if ratio is  $i = 0.98$ .  
 If ratio is  $i = 1.55$ , only insert the idler gear. Only insert bearing pin once the output shaft has been installed (see **Section 1.3**).

- 1 Insert bearing (4) in idler gear (5).
- 2 Place ring (6) in clutch housing.
- 3 Place idler gear with bearing in clutch housing.
- 4 Use depth gauge to measure from housing to inner bearing ring (dimension "a").



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5 Measure dimension “b” on bearing pin (2).

**Example:**

Dimension “a” on housing when ring inserted is 6.2 mm long = 43.9 mm

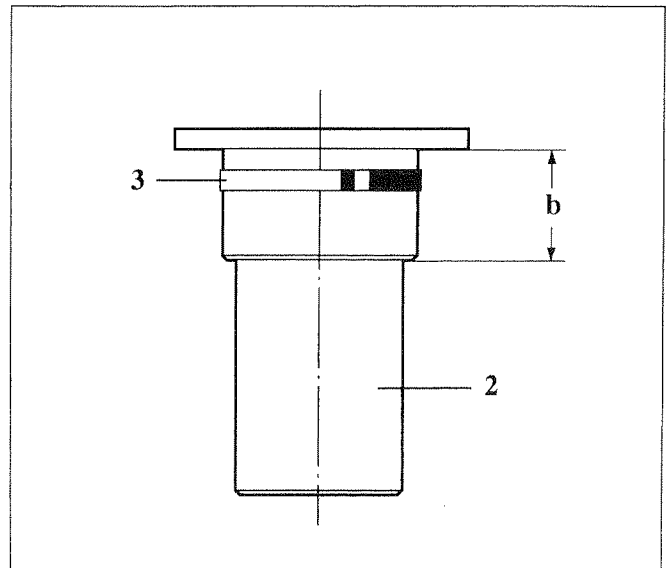
minus dimension “b” on bearing pin = 43.7 mm  
 difference = 0.2 mm

When the permitted play is 0.0 to 0.1 mm, a ring of 6.4 mm should be inserted.

6 Place O-ring (3) with grease on bearing pin.

7 Heat housing and bearing to approx. 60 °C.

8 Push bearing pin firmly home, fasten and tighten with 2 hex screws (1);  
 tightening torque = 23 Nm.



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