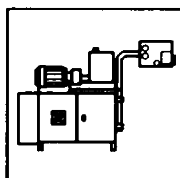
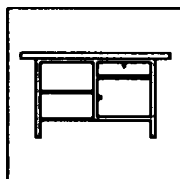
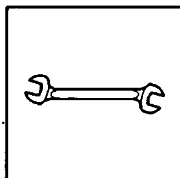


S
e
r
v
i
c
e

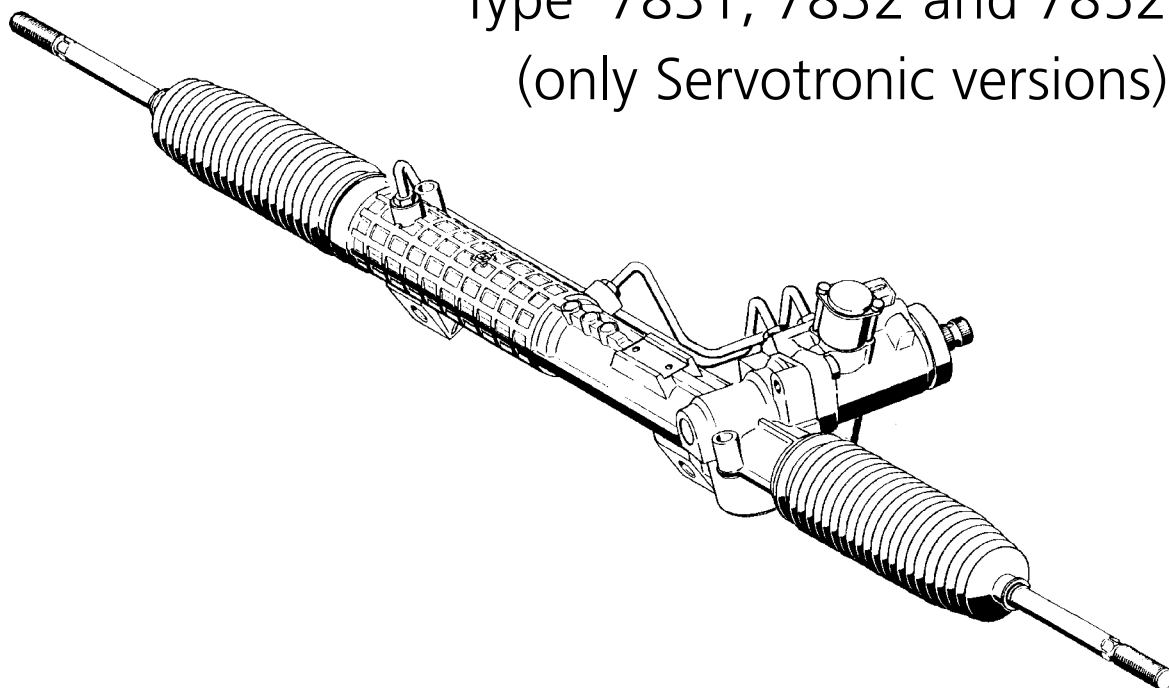


ZF Lenksysteme

Repair

ZF Rack and Pinion Power Steering Gear

Type 7831, 7832 and 7852
(only Servotronic versions)



ZF Lenksysteme GmbH
D-73522 Schwaebisch Gmuend
Telephone (07171) 31-0 Fax (07171) 31-4396

	Seite
I. Documentation for "D" and "A" (safety) parts	2
II. Disassembly	3
III. Examining the individual parts	13
IV. Assembly	16
V. Functional test	34
VI. Trouble shooting	38
VII. Tightening torques	40
VIII. Special tools	41
IX. Key to numbers in figures	46
X. Sectional drawings	48
XI. Exploded drawings	50
Inspection report	60



Attention:

For preparing these repair instructions, versions were selected that comprise a maximum number of different parts.

It may, thus, well be that less parts than described herein are required for the version to be repaired.

The spare parts list associated to the steering gear shall always be authoritative for the number of parts to be fitted and their respective installation positions.

~~ZF-Rack and Pinion Power Steering Gears with Servotronic~~ I. Documentation for "D" and "A" (safety) parts

To enable a successful certification to DIN/VDA, a documentation must be established and maintained for the "D" and the "A" (safety) parts.

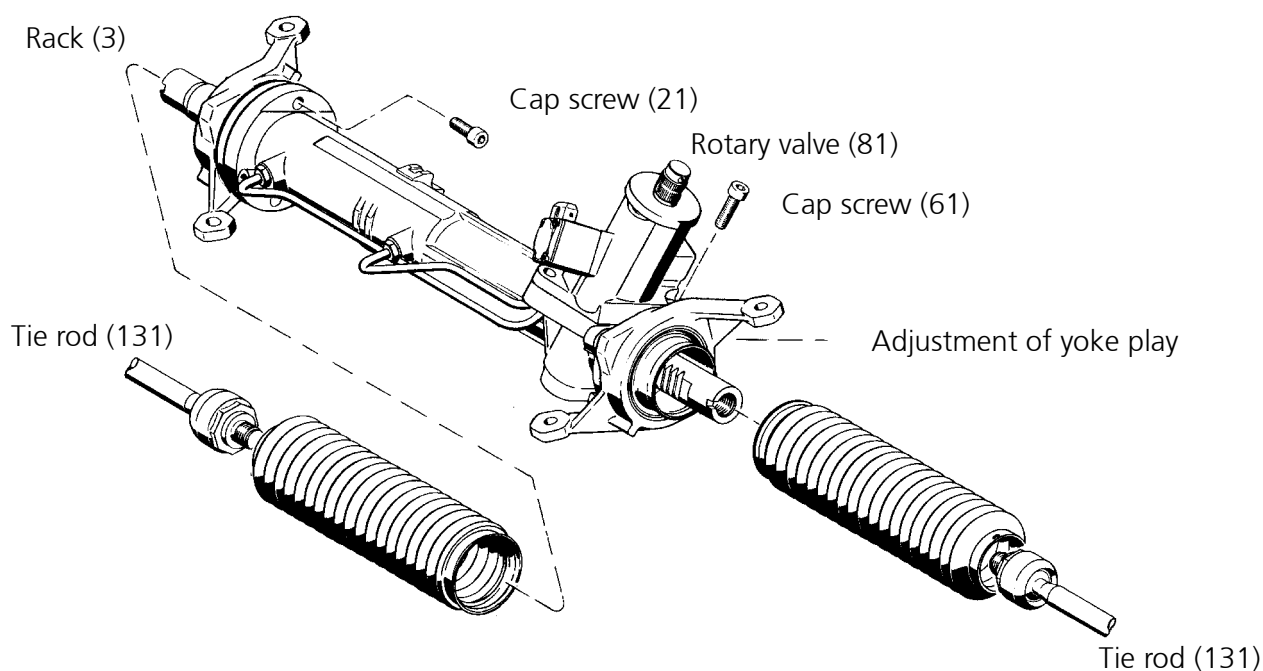
This means that during repair, the implementation of the repair work listed herein after must be put down (e.g., entry in the inspection report) and that the document in question must be kept.

This also applies to:

Tightening torques: Cap screw (21)
Cap screw (61)
Tie rod (131)

Adjustment: Yoke play

Crack test: Rack (3)
Rotary valve (81)



II. Disassembly

1	Removing the tie rods (131)	4
2	Removing the pipes (100, 101 and 102)	5
3	Removing the yoke (30)	5
4	Removing and disassembling the rotary valve (81)	6
5	Removing the rack (3)	8
6	Disassembling the housing (1)	10
7	Disassembling the valve housing (59)	12



Attention:

To guarantee a safe functioning of the steering gear, absolute cleanliness must be the top priority during disassembly and storage of the parts. During disassembly, by no means use any force, for this may cause damages to sealing ring seats, sealing surfaces, etc., and such damages may, as a consequence, cause the steering gear to fail in part or totally.

Note:

- The numbers in brackets, for instance (131), refer to the numbers in figures used in Chapter IX. and in the spare parts list.
- The numbers in square brackets, e.g. [1], refer to the special tools listed in Chapter VIII..

1 ZF-Rack and Pinion Power Steering Gears with Servotronic

Clamp the steering gear in an appropriate clamping fixture or a commercially available vice (soft jaws to be used).

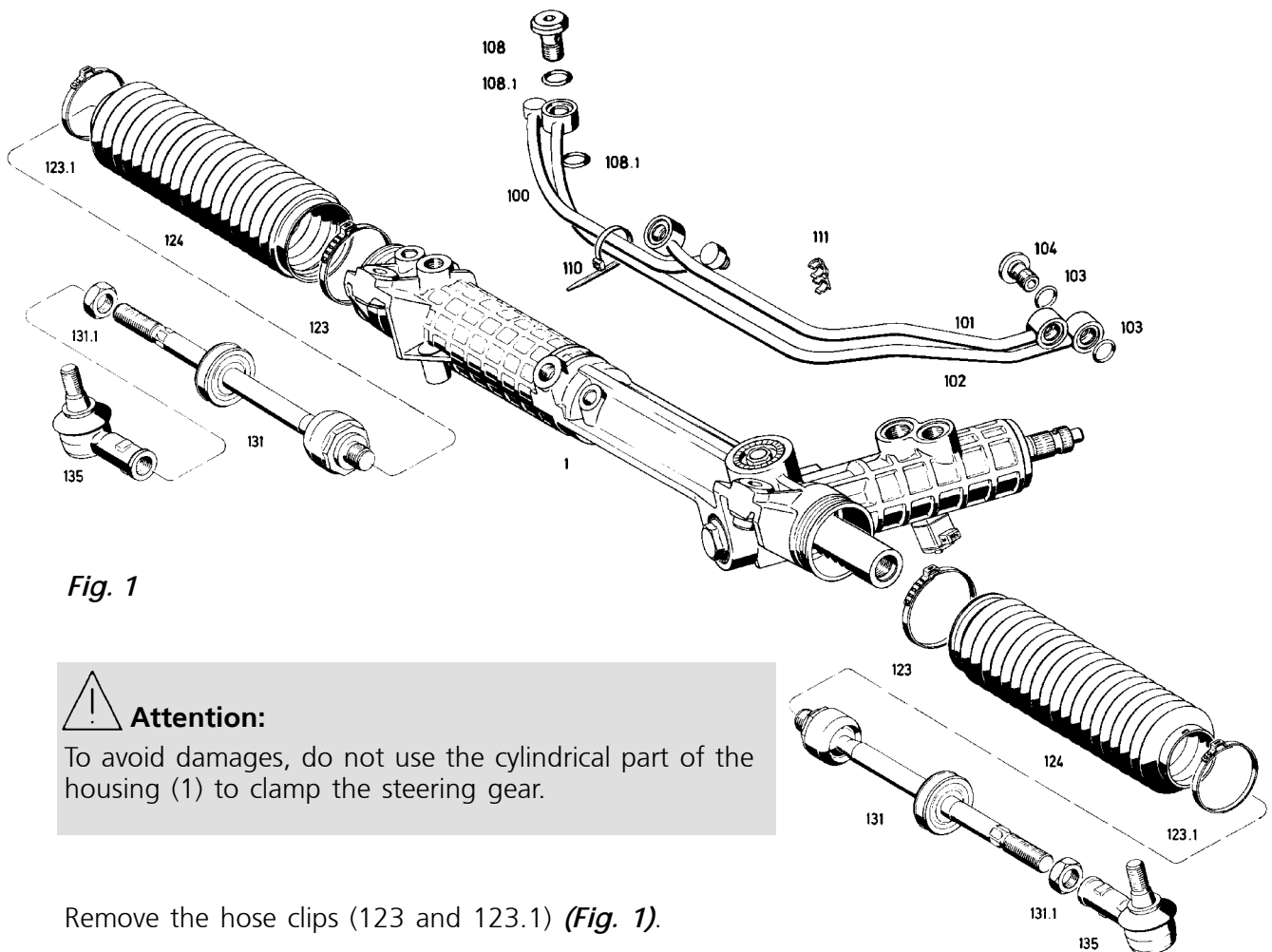


Fig. 1



Attention:

To avoid damages, do not use the cylindrical part of the housing (1) to clamp the steering gear.

Remove the hose clips (123 and 123.1) (**Fig. 1**).

Push back the bellows (124).

Support the rack (3) at the spanner flat or clamp the teeth of the rack (3) in a vice (use soft jaws) and, with the help of tool [1], screw the tie rods (131) out. Remove the tab washer (29) if there is one.



Attention:

When you have a version with spanner flats at the rack (3), never remove the tie rods (131) without supporting the rack as otherwise the teeth and the bearings of the rack (3) and of the rotary valve (81) may be damaged.

If the rack (3) has no spanner flats, then a supporting of the rack is not necessary.

1.1 Additionally, for versions with lever (124.1)

Remove the hose clamp (123.2) (*Fig. 2*).

Push the lever (124.1) off to the side and pull of the O-rings (124.2 and 124.3).

Remove the bellows (124.4), the cup spring (3.1) and the stop ring (41).

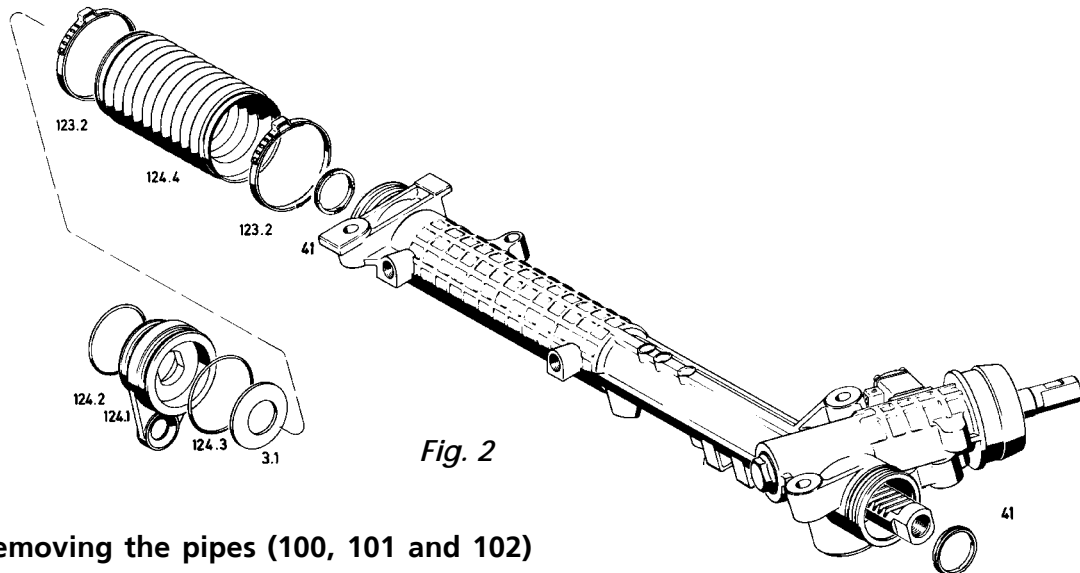


Fig. 2

2 Removing the pipes (100, 101 and 102)

Remove the cable clip (110) and the retainer (111) (*Fig. 1*).

Screw the union screws (104) and the damper valve (108) out.

Remove the pipes (100, 101 and 102).

Remove the O-rings (103) and the sealing washers (108.1).

3 Removing the yoke (30)

3.1 Version with cover (34)

Mark the position of the cover (34) relative to the housing (1).

Screw the hexagon screws (35) out and remove the cover (34) (*Fig. 3*).

Pull out the spacing washer/washer (33) and the compression spring (32).

Remove the yoke (30).

Remove the O-ring (31) and the insert foil (30.1) from the yoke (30).

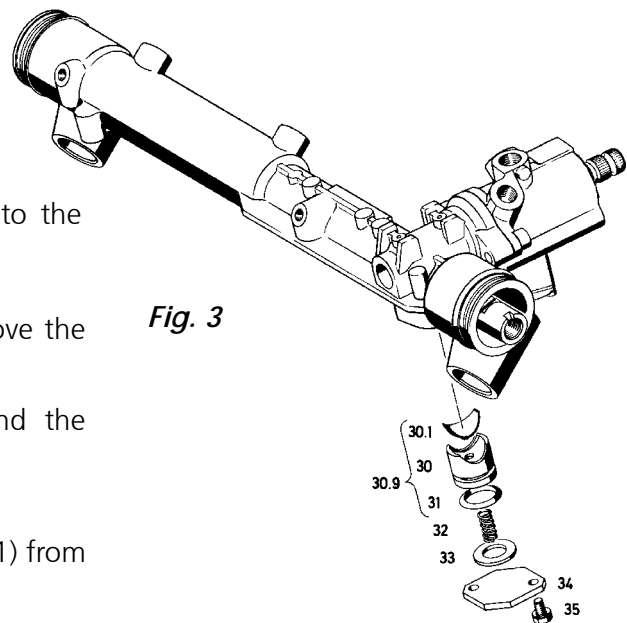


Fig. 3

Note:

It is also possible to push the yoke (30) out from inside after the housing (1) was disassembled.

4.3 Versions with valve housing (59)

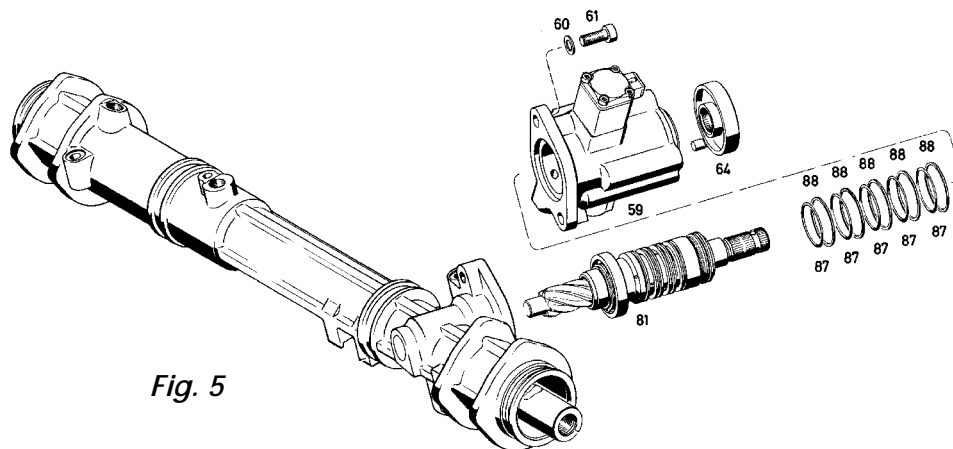


Fig. 5

Screw out the cap screws (61) with washers (60) (*Fig. 5*).

Lift the valve housing (59) off.

Clamp the input shaft stub of the rotary valve (81) into a vice and make sure soft jaws are used.

Drive the rotary valve (81) out by knocking on the housing (1) with a plastic tip hammer.

4.4 Versions without valve housing (59)

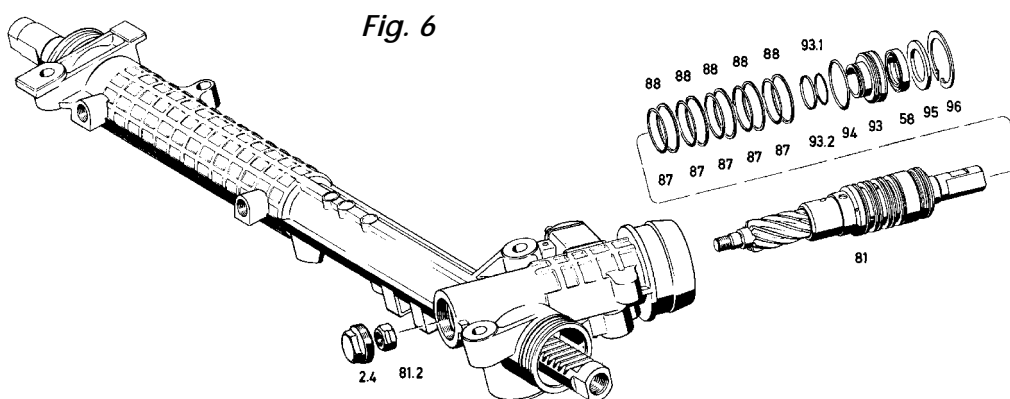


Fig. 6

Remove the plug (2.4) (*Fig. 6*).

Screw out the locking nut (81.2).

Unsnap the retaining ring (96).

ZF-Rack and Pinion Power Steering Gears with Servotronic

Put on tool [15] (Fig. 7).

Press out the rotary valve (81) complete with the bush (93).

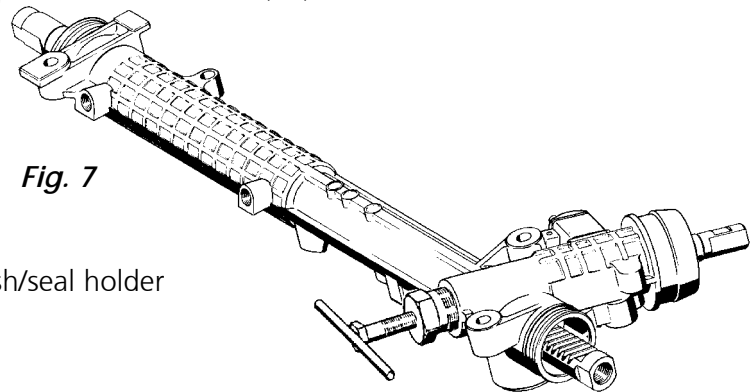


Fig. 7

Slip off the washer (95) and the bush/seal holder (93).

Remove the sealing ring (93.2).

Remove the O-rings (93.1 and 94) (see Fig. 6).

Remove the shaft seal (58) from the bush (93).

4.5 Versions with/without valve housing (59)

Pull the O-rings (87) and the sealing rings (88) off the rotary valve (81) (Fig 6).

A further disassembly of the rotary valve (81) is not permissible as a proper reassembly can only be carried out using an expensive and complicated specific assembly fixture.

5 Removing the rack (3)

5.1 Versions without silent blocs (119 and 119.1)

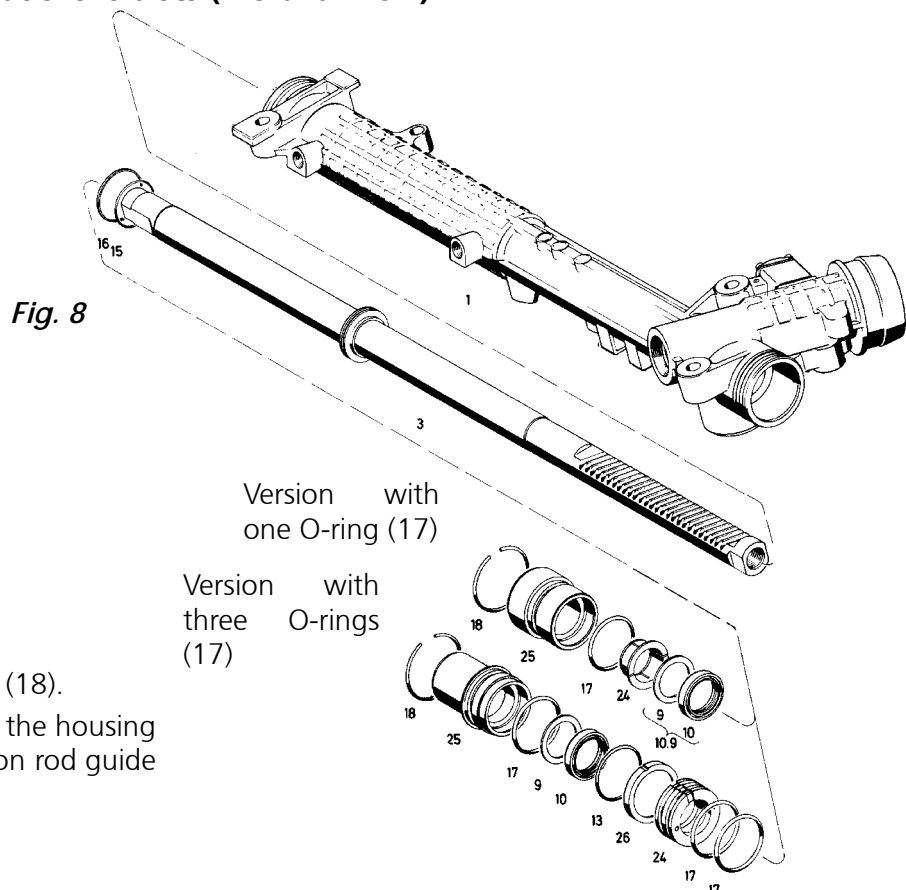


Fig. 8

Unsnap the snap ring (18).

Pull the rack (3) out of the housing (1) along with the piston rod guide (25) (Fig. 8).

Slip the piston rod guide (25) off the rack (3).

Remove the bearing bush (24), the seal (10), the washer (26) - if any - and the washer (9).

Pull the O-ring (17) off the piston rod guide (25).

Remove the O-ring (15) and the sealing ring (16) from the rack (3).

Additionally, for versions with three O-rings (17):

Remove the two additional O-rings (17) (see Fig. 8).

5.2 Versions with silent blocs (119 and 119.1)

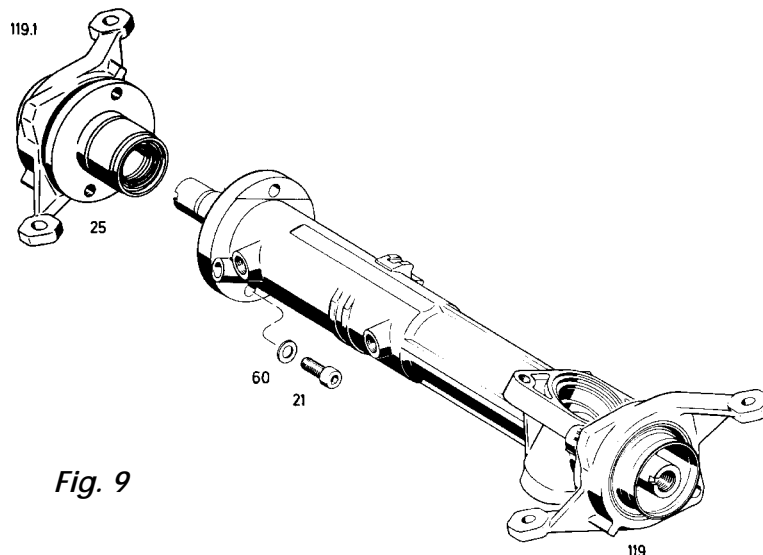


Fig. 9

Mark the position of the piston rod guide (25) relative to the housing (1).

Screw out the cap screws (21) with washers (60) (Fig. 9).

Take off the silent bloc (119.1) with the piston rod guide (25).

For the removal of the bearing bush (24), the O-ring (15) and the sealing ring (16), please refer to Item 5.1.

Note:

A removal of silent bloc (119) or a dismantling of silent bloc (119.1) from the piston rod guide (25) is not permissible as a reassembly in accordance with all drawing specifications requires a complicated and expensive fixture.

If the silent bloc (119 or 119.1) has to be replaced, the steering gear can be repaired at the manufacturer's plant, only.

6 ZF-Rack and Pinion Power Steering Gears with Servotronic

6.1 Versions with valve housing (59)

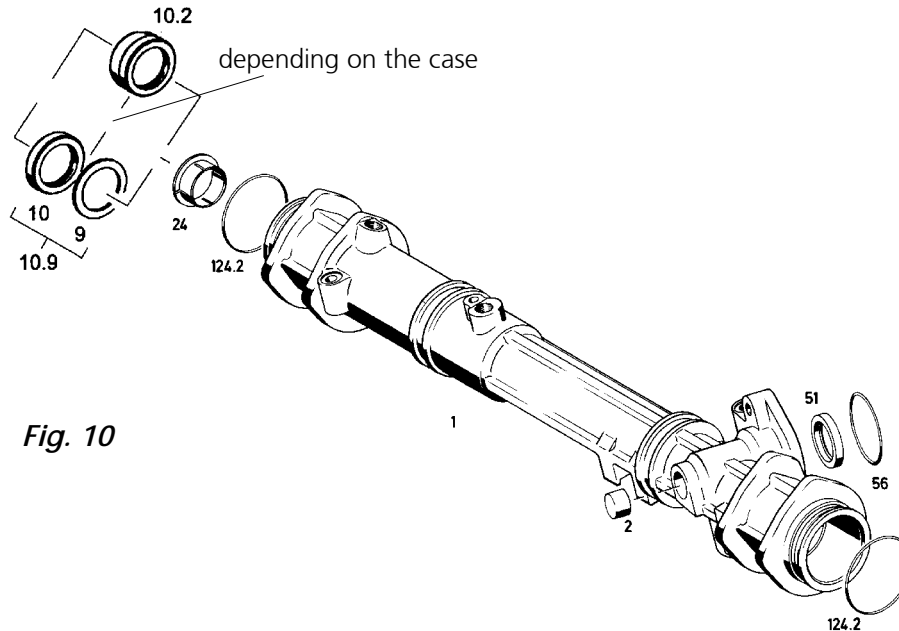


Fig. 10

Remove the O-rings (124.2) (**Fig. 10**).

Remove the shaft seal (51) from the housing (1).

Remove the O-ring (56).

Using a suitable mandrel, press the bearing bush (24), the washer (9) and the seals (10, 10.2 and 10.9) out towards the cylinder chamber.

If any wear is found on the journal of the rotary valve (81), measure the pressing-in depth (dimension X) of the needle bush (2) and put it down in writing (**Fig. 11**).

Using an appropriate mandrel, press the needle bush (2) out.

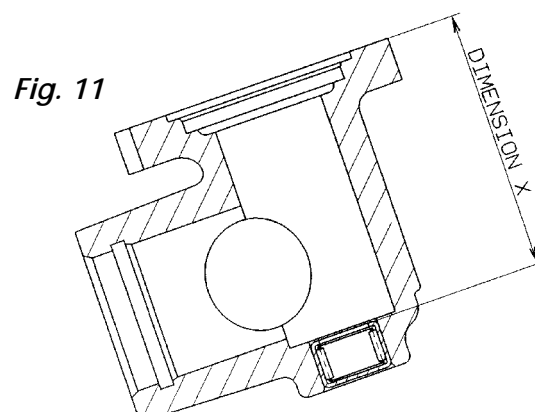


Fig. 11

6.2 Versions without valve housing (59)

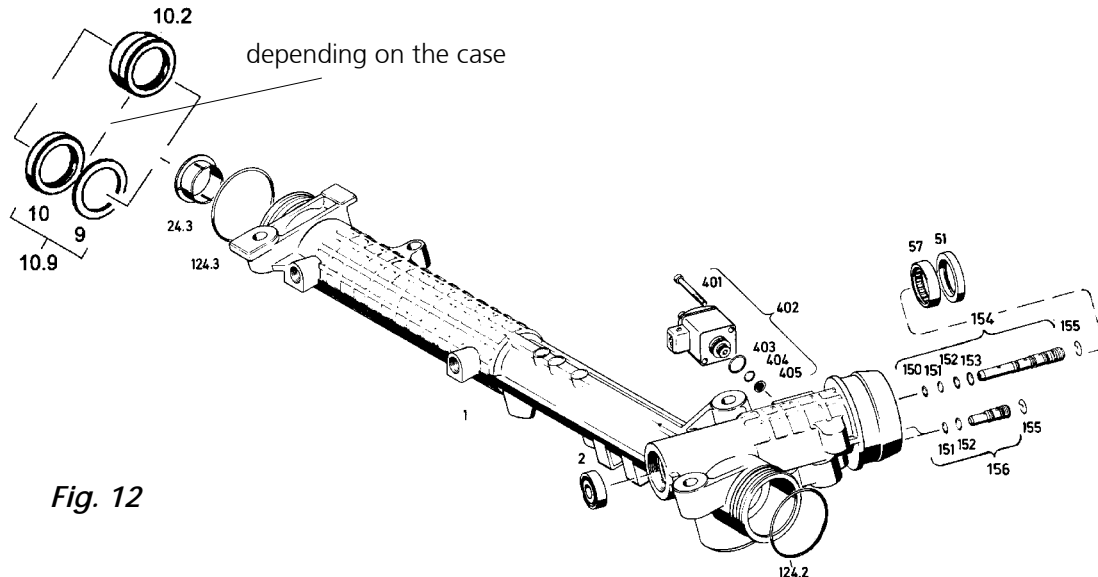


Fig. 12

Mark the installed position of the transducer (402).

6.2.1 Cornered transducer housing (402):

Unscrew the two diagonally opposed unsealed cap screws (401) (Fig. 12).

6.2.2 Round transducer housing (402):

Unscrew the two cap screws (401).

6.2.3 Cornered and round transducer housing (402)

Pull off the transducer (402) (Fig. 12).

Remove the oil screen (405) and the O-rings (403 and 404).

Unsnap the 3 snap rings (155).

Pull out the cut-off valve (154) and the two check valves (156) using a screw (M4).

Disassemble the O-rings (150, 151, 152 and 153).

Using tools [2] and [3], pull the roller bearing (57), the ball bearing (2) and the shaft seal (51) out of the housing (1).

7 ZF-Back and Pinion Power Steering Gears with Servotronic

Mark the installed position of the transducer (402) (*Fig. 13*).

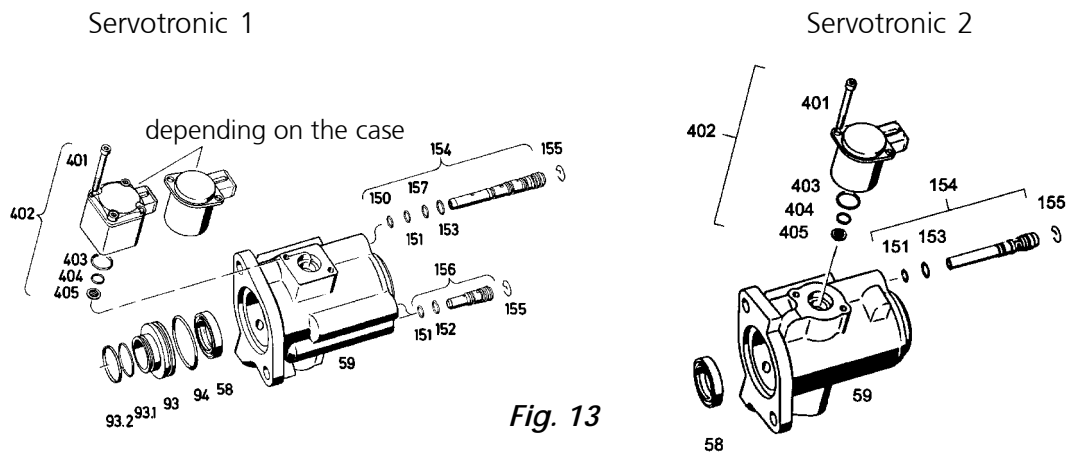


Fig. 13

7.1 Cornered transducer housing (402):

Unscrew the two diagonally opposed unsealed cap screws (401) (*Fig. 13*).

7.2 Round transducer housing (402):

Unscrew the two cap screws (401).

7.3 Cornered and round transducer housing (402)

Pull off the transducer (402).

Remove the oil screen (405) and the O-rings (403 and 404).

Unsnap the 3 snap rings (155).

Pull out the cut-off valve (154) and the two check valves (156) using a screw (M4).

Disassemble the O-rings (150, 151, 152 and 153).

Using tools [2] and [3], pull out the shaft seal (58) and the seal holder/bush (93).

Remove the sealing elements (93.1 and 93.2).

III. Examining the Individual Parts

- Examine and appraise all parts for wear, corrosion, damages caused by heavy pressure or other defects and decide whether the parts can be reused.
- Repolish or grind the sealing ring contact surfaces and the sealing surfaces with emery cloth.
- To avoid any swelling, make sure that sealing rings and other rubber parts do not come into contact with chlorinated hydrocarbons.
- Use new parts in accordance with the associated spare parts list.



Attention:

This checking calls for expert knowledge and conscientiousness, for the fitter has to decide on his own authority whether the parts must be replaced or not.

In addition, the following has to be inspected:

1 Rotary valve (81)

- contact surfaces of the shaft seals
- pressed-on ball bearing

Note:

If wear or damage is found, replace the complete rotary valve (81).

- contact surface of the needle sleeve or the roller sleeve

Note:

If wear or damage is found, replace the needle sleeve or the roller sleeve pertaining to the rotary valve.

- teeth

Carry out a crack test: with an appropriate testing method, e.g. the ferro-flux method, check the component lengthwise and crosswise for cracks. The fluid jet must be directed in a way to prevent any wetting of the valve and, in consequence, any ingress of iron particles in the valve bores.



Attention:

Parts with cracks must be scrapped.

Avoid excessive current intensities as this might cause damages to the inner parts of the rotary valve (81).

2 ZF-Rack and Pinion Power Steering Gears with Servotronic

- contact surfaces of the sealing rings
- a wear of up to 0.1 mm in the area of the sealing ring race and of up to 0.2 mm in the diameter is permissible.
- threads
- mounting face
- sealing ring seat
- roller sleeve seat
- bores for transducer fitment

3 Housing (1)

- check the shaft seal seat for rubber rests
- threads

Note:

If material had been peened, it may become necessary to recut the thread.

- check the sealing ring seats and the recesses for damages
- contact surfaces of the piston (14)
- a wear of up to 0.025 mm in the central area and of up to 0.05 mm in the diameter is permissible.
- contact surface of the yoke (30)
- silent bearing (1.4)
- bores for transducer fitment

4 Rack (3)

- force fit of the piston
- crack detection:
lengthwise and crosswise, using an appropriate method, e.g. ferro-flux testing



Attention:

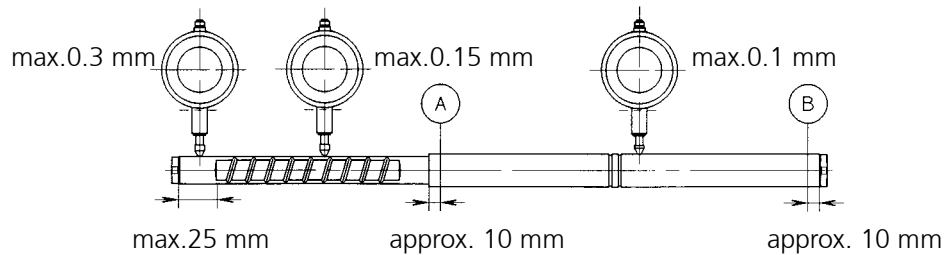
Parts with cracks must be scrapped.

- threads
- teeth

- eccentricity of the rack (3):

support the rack (3) on prisms in positions A and B and measure its concentricity.

Maximum permissible concentricity error: see illustration below:



- check the contact surfaces for scoring and corrosion pits

The rack (3) and the piston (14) may be reworked by polishing with an emery paper having a grain of 320.

Mirror finish polishing with grain 500 emery paper is also permissible.

5 Yoke (30)

- contact surface
- sealing ring seats

6 Piston rod guide/bearing bush (25)

- sealing ring seats

7 Transducer (402)

- impurities in the oil feed bore
- check the resistance
- specified value: $7.5 \pm 0.4 \Omega$ (room temperature: 20°C)

8 Pipes (100, 101 and 102)

- sealing ring seats
- threads

ZF-Assembly Pinion Power Steering Gears with Servotronic

1	Pre-assembling the housing (1)	17
2	Fitting the rack (3) and the piston rod guide (25)	20
3	Pre-assembling the valve housing (59)	23
4	Pre-assembling and fitting the rotary valve (81)	25
5	Fitting the yoke (30) and adjusting the yoke play	28
6	Fitting the pipes (100, 101 and 102)	31
7	Fitting the tie rods (131) and the bellows (124)	32



Attention:

To guarantee a safe functioning of the steering gear, absolute cleanliness must be the top priority during assembly. By no means use any force during assembly, for this may cause damages for instance to sealing ring seats and sealing surfaces, and such damages may, as a consequence, cause the steering gear to fail in part or totally.

Note:

- Prior to assembling the steering gear, all parts must be cleaned thoroughly. Before mounting it again, each part must be checked for wear or other defects (cf. Chapter II.), and oiled.
- As a rule, sealing elements must be replaced by new parts and fitted in an oiled condition.
- To remove rests of paint and damages, the front faces of the housings and covers must be ground with emery cloth.
- Use DEA Spectron FO 20 or an equivalent calcium complex grease of consistency class 2 to fill the space between the sealing lip and the dust lip of shaft seals as well as the space on rack seals with lubrication groove.
- The measuring and adjustment tools used for repair must be checked for their precision at regular intervals.
- The tightening torques specified apply to a manual tightening using a torque wrench.
- Prior to assembly, have a look at the spare parts list to see whether it specifies any tightening torques and pressing-in depths, or whether it contains any remarks regarding the installation position of special-purpose bolts or brackets etc... If it does not contain any such data, the values and/or descriptions given below shall apply.

1 Pre-assembling the housing (1)

Put the bearing bush (24), the washer (9) and the seals (10, 10.2 and 10.9) on tool (8) and press them into the housing (1). Fit the O-rings (124.2 and 56) to the housing (1) (**Fig. 14**).

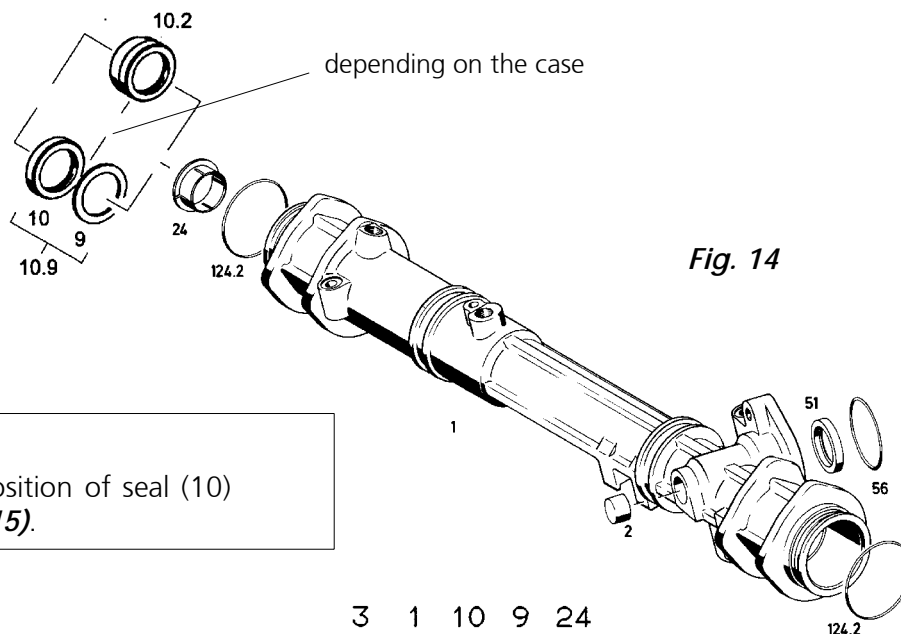


Fig. 14

Note:

Installed position of seal (10)
(see **Fig. 15**).

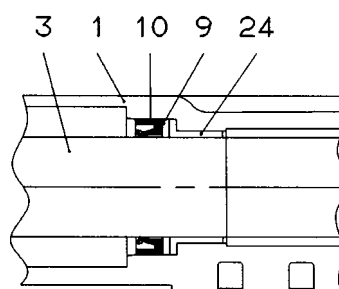


Fig. 15

If the needle sleeve/ball bearing (2) had been disassembled, grease a new needle sleeve/ball bearing (2) with grease (grease specification see spare parts list) and, using tool [4], press it into the housing (1) until the pressing-in depth (dimension X) is reached (**Fig. 16**).

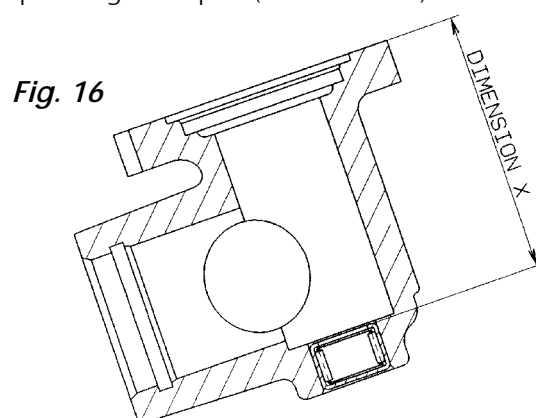


Fig. 16

1.1 Versions with valve housing (59)

Using tool [11], press the greased shaft seal (51) into the housing (1) until it is in perfect contact with the housing.

Note:

Installed position of the shaft seal (51) see **Fig. 17**.

ZF-Rack and Pinion Power Steering Gears with Servotronic

1.2 Versions Without Valve Housing (95)

Using tool [4], press the ball bearing (2) in until it is in perfect contact with the housing (1).

Using tool [11], press the roller bearing (57) and the shaft seal (51) into the housing (1) until they are in perfect contact with the housing (1) (**Fig. 18**).

Note:

Installed position of the shaft seal (51) *see Fig. 17*.

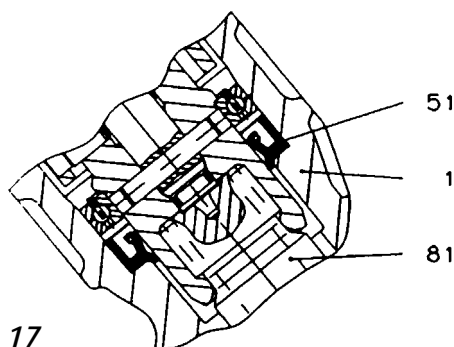


Fig. 17

1.2.1 Fitting the transducer (402)

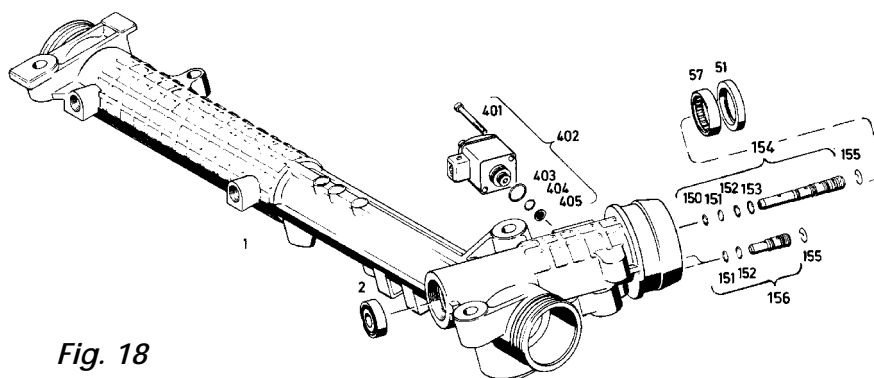


Fig. 18

Put the O-rings (403 and 404) on the transducer (402) (**Fig. 18**).

Put the oil screen (405) into place.

Put on the transducer (402) in the position as marked during disassembly.

- **Cornered transducer housing (402):**

Tighten the cap screws (401) (tightening torque: 2.9±0.15 Nm)

- **Round transducer housing (402):**

Tighten the cap screws (401) in the order indicated below.

Order	Screw No.	Tightening torque:
1.	①	0.5 Nm
2.	②	1.5 Nm
3.	①	2.9 Nm
4.	②	2.9 Nm

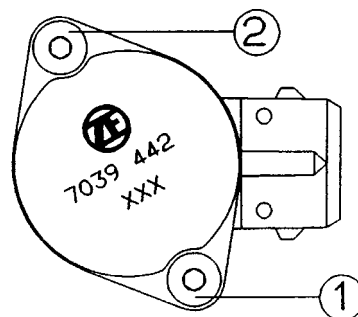


Fig. 19

1.2.2 Fitting the cut-off valve (154) and the check valves (156)

Servotronic 1:

Put the O-rings (150, 151, 152 and 153) on the cut-off valve (154) and the check valves (156) (Fig. 18).

Press the cut-off valve (154) and the check valves (156) into the bores until they are in perfect contact with the housing bores.

Snap in the snap rings (155).

Servotronic 2:

Put the O-rings (151 and 153) on the cut-off valve (154).

Press the cut-off valve (154) into the bore until it is in perfect contact with the housing bore.

Snap in the snap ring (155).

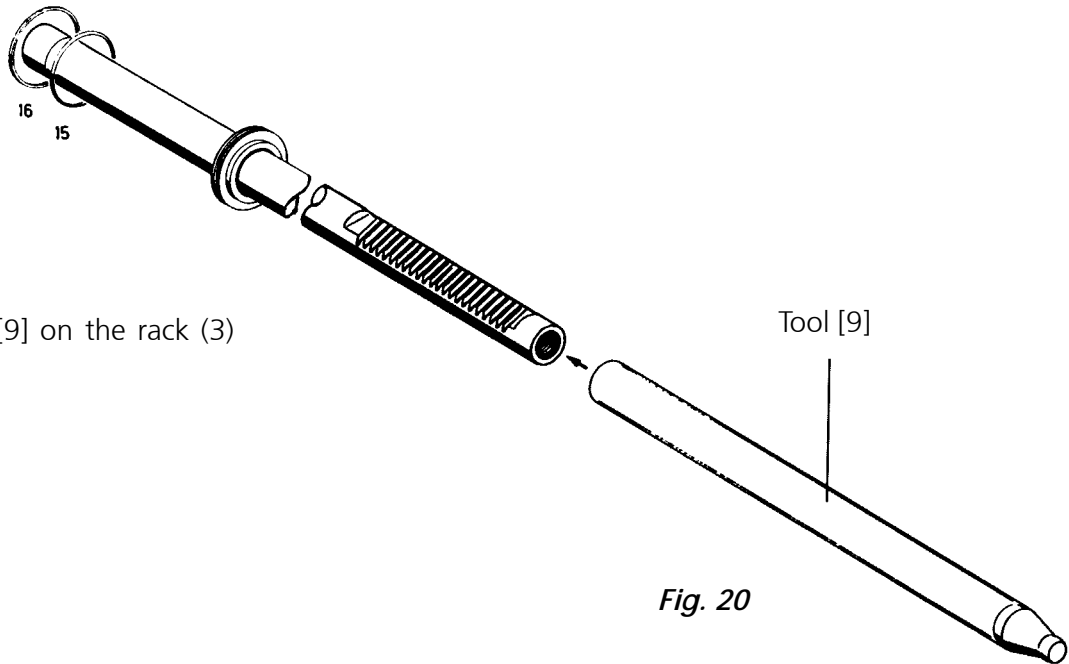
Pull back the cut-off valve (154) until it is in perfect contact with the snap ring (155).

2 Fitting the rack (3) and the piston rod guide (25)

ZF-Rack and Pinion Power Steering Gears with Servotronic

2.1 Fitting the rack (3)

Put the O-ring (15) and the sealing ring (16) on the piston of the rack (3) (*Fig. 20*).



Slip tool [9] on the rack (3)
(*Fig. 20*).

Fig. 20

Determine dimension „X“ (*see Fig. 21*).

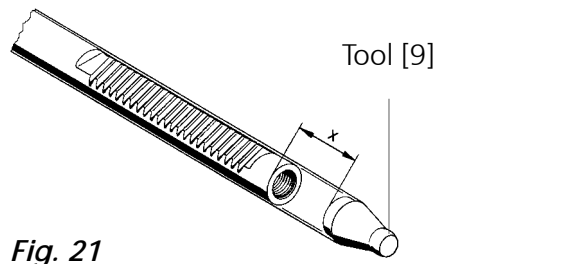


Fig. 21

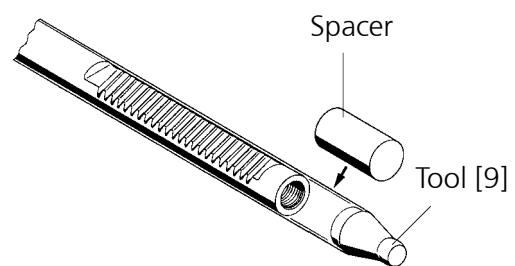


Fig. 22

Shorten the spacer of tool [9] to the dimension „X“ determined (*see Fig. 22*).

Fill the teeth of the rack (3) with grease (for the grease type please refer to the spare parts list). Put the spacer and tool [9] on the rack (3) as shown in **Fig. 23**.

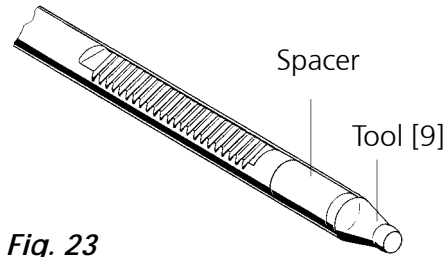


Fig. 23

Using tool [9], slide the rack (3) into the housing (1) without damaging any sealing elements (**Fig. 24**).

2.2 Fitting the piston rod guide (25)

2.2.1 Versions without silent blocs (119 and 119.1)

Using tool [8], fit the bearing bush (24), the washer (9) and the seal (10) into the piston rod guide (25) (**Fig. 24**).

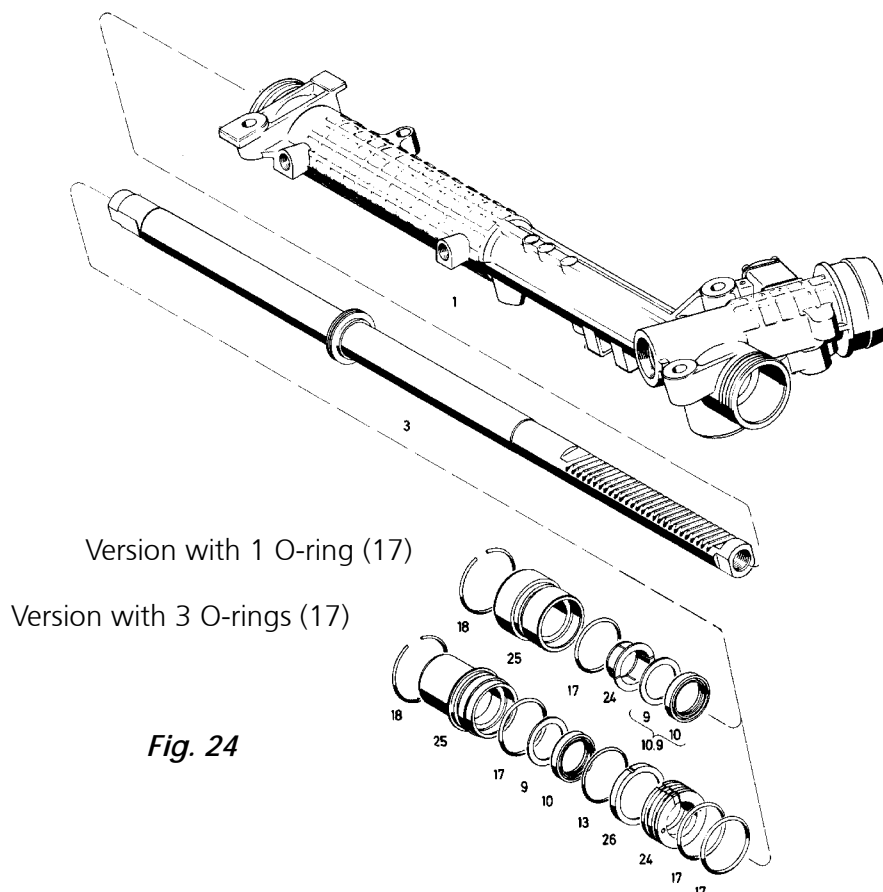


Fig. 24

ZF-Rack and Pinion Power Steering Gears with Servotronic

- Installed position of the seal (10 or 10.9): refer to *Fig. 25*.
- Depending on the version, instead of washer (9) and seal (10), seal (10.9) - seal and washer assembly - can be built in.

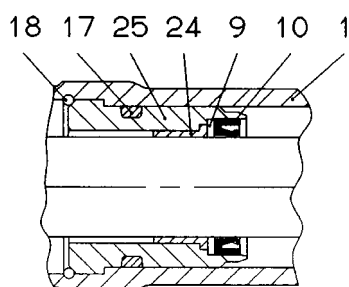


Fig. 25

Slide the greased O-ring (17) on the piston rod guide (25).

In addition, for versions with 3 O-rings:

Slide on the additional O-rings (17).

Without damaging any sealing elements, slide the pre-assembled piston rod guide (25) on the rack (3) and press it into the housing (1) until it is in perfect contact with the housing.

The snap ring (18) must be snapped in in such a way that one end of it is pointing towards the housing bore (if there is any).

Note:

Do not rotate the rack (3) to the stroke end positions without the tie rods (131) fitted to it, for otherwise the seals (10) will be damaged.



Attention:

Check the snap ring (18) for correct fit.

2.2.2 Versions with silent blocs (119 and 119.1)

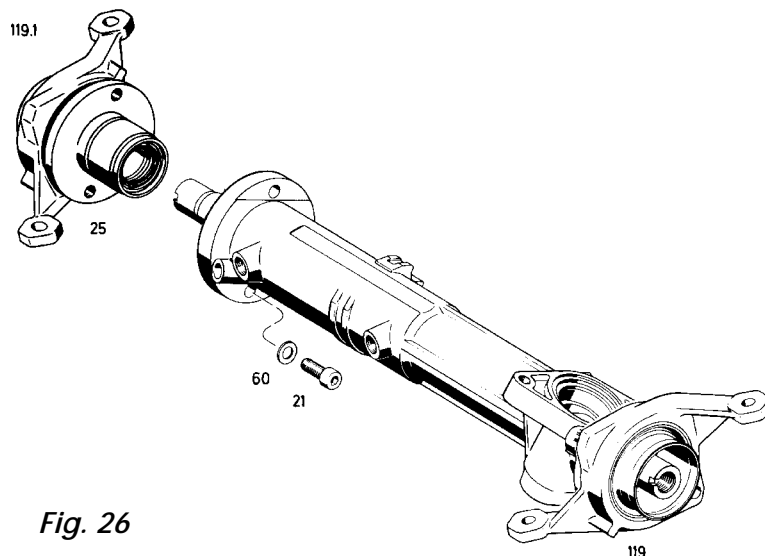


Fig. 26

Pre-assembly of the piston rod guide (25) - refer to para. 2.2.1.

Insert the silent bloc (119.1) along with the pre-assembled piston rod guide (25) (**Fig. 26**).

Check the position of the silent bloc (119.1) relative to the housing (1) and correct it if necessary.

Screw in the cap screws (21) with the washers (60).

Tightening torque: 17+3 Nm (M8)

3 Pre-assembling the valve housing (59)

Servotronic 1

Servotronic 2

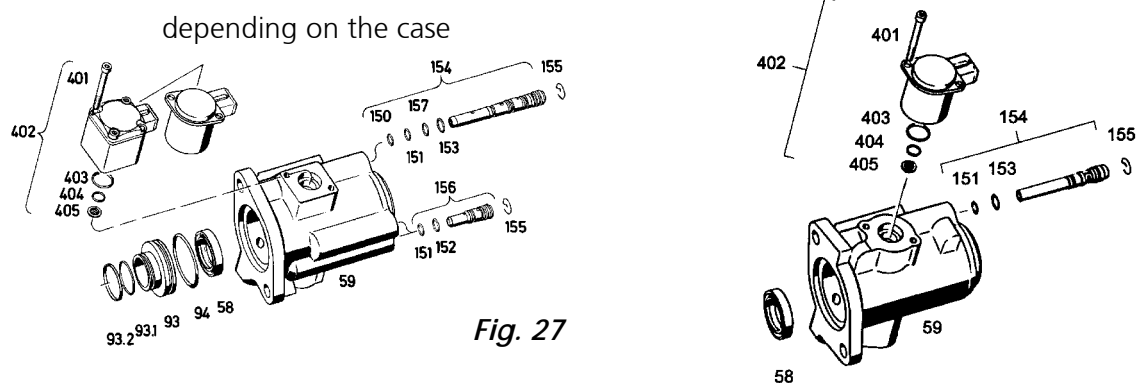


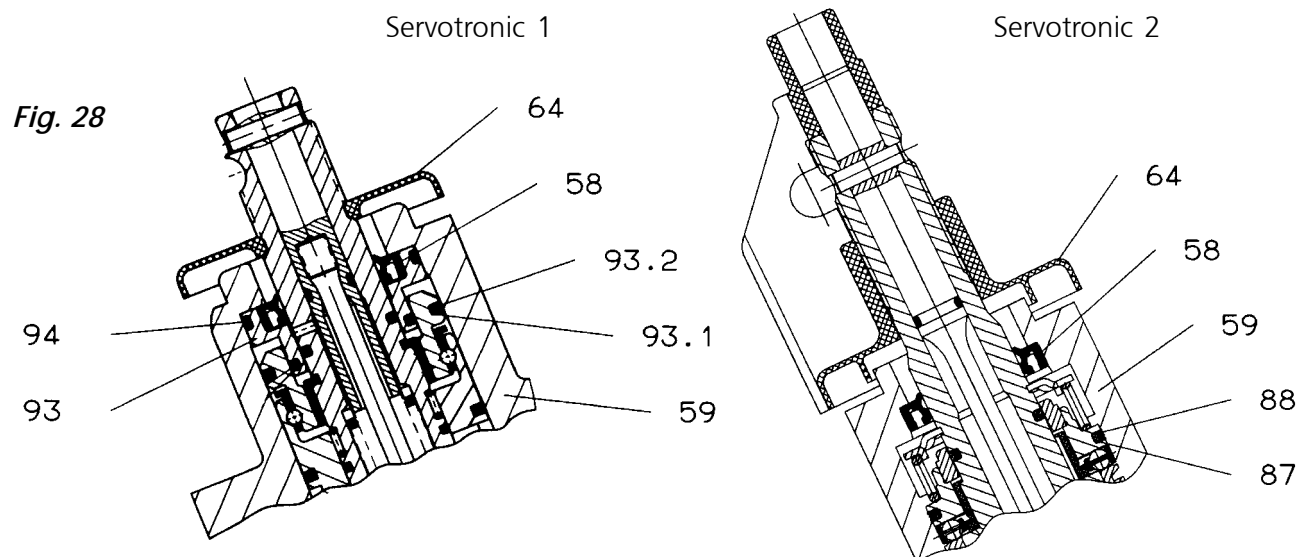
Fig. 27

On the shaft seal (58), fill the space between the sealing lip and the dust lip with grease (cf. the remarks at the beginning of Chapter III.).

Using tool [10], press the shaft seal (58) into the bush/seal holder (93) (**Fig. 27**).

ZF Rack and Pinion Power Steering Gears with Servotronic

Installed position of the shaft seal (58): *refer to Fig. 28.*



Fit the O-rings (93.1 and 94) and the sealing ring (94) (*Figs. 27/28*).

Press the bush/seal holder (93) into the valve housing (59) until it is in perfect contact with the valve housing.

Slide the O-rings (403 and 404) on the transducer (402).

Put the oil screen (405) into place.

Put the transducer (402) on in the position as marked during disassembly.

3.1 Cornered transducer housing (402)

Tighten the cap screws (401) (tightening torque: 2.9 ± 0.15 Nm).

3.2 Round transducer housing (402)

Tighten the cap screws (401) in the order indicated below.

Order	Screw No.	Tightening torque:
1.	1	0.5 Nm
2.	2	1.5 Nm
3.	1	2.9 Nm
4.	2	2.9 Nm

3.3 Fitting the cut-off valve (154) and the check valves (156)

- **Servotronic 1**

Put the O-rings (150, 151, 152 and 153) on the cut-off valve (154) and on the check valves (156).

Press the cut-off valve (154) and the check valves (156) into the bores until they are in perfect contact with the bores.
Snap in the snap rings (155).

- **Servotronic 2**

Put the O-rings (151 and 153) on the cut-off valve (154).

Press the cut-off valve (154) into the bore until it is in perfect contact with the bore.

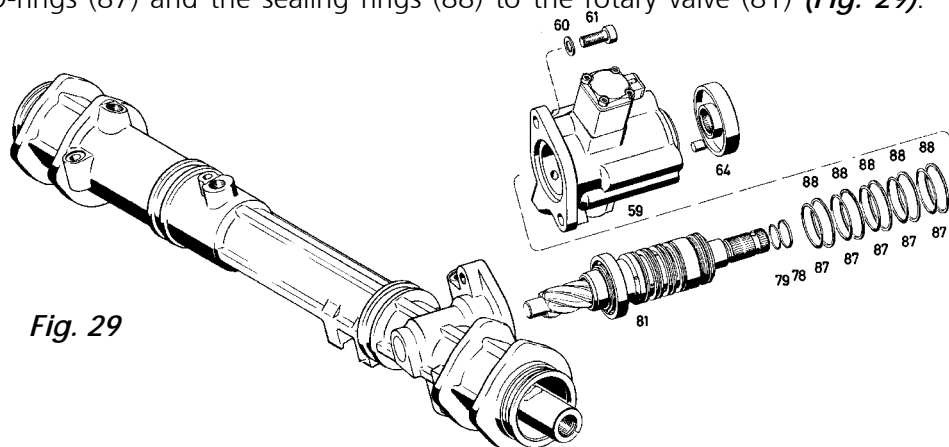
Snap in the snap ring (155).

Pull back the cut-off valve (154) until it is in perfect contact with the snap ring (155).

4 Pre-assembling and fitting the rotary valve (81)

4.1 Pre-assembling the rotary valve (81)

Fit the O-rings (87) and the sealing rings (88) to the rotary valve (81) (*Fig. 29*).



4.2 Fitting the rotary valve (81)

Have the rack (3) move out of the housing (1) until the checking dimension written down during disassembly is reached.

Coat the needle bush (2) and the pinion teeth with grease (grease specification: see spare parts list).

Slide the rotary valve (81) through the shaft seal (51) into the housing bore until the ball bearing is in perfect contact with the housing bore.

If necessary to assist this action, knock on the input shaft with a plastic tip hammer.

ZF-Rack and Pinion Power Steering Gears with Servotronic

Introduce the rotary valve (81) into the teeth of the rack (3) in such a way that the marks applied during disassembly are congruent.

4.3 Versions with valve housing (59)

Put tool [12] on the stub input shaft. Put the valve housing (59) into place.
Screw in the cap screws (61) with washers (60) and tighten them.

Tightening torques: 17+3 Nm (M8) for cap screw with surface protection
 23±2 Nm (M8) for cap screw without surface protection

4.4 Versions without valve housing (59)

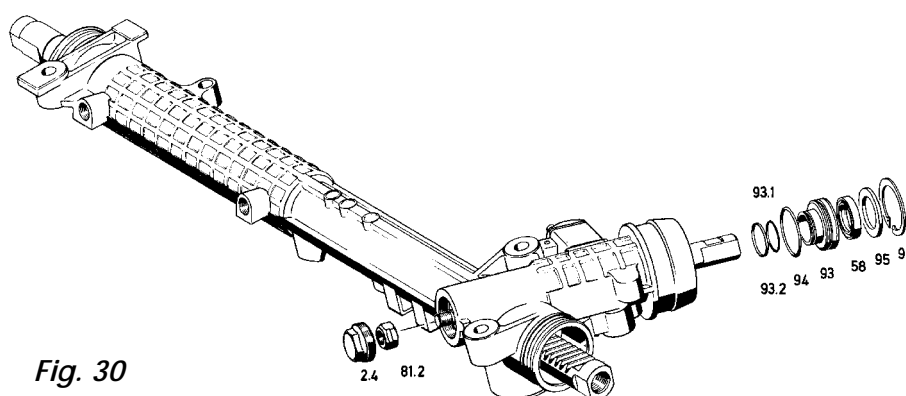


Fig. 30

Screw the locking nut (81.2) in **(Fig. 30)**.

Tightening torques: 22+4 Nm (M10)
 45+5 Nm (M14x1.5)

During screwing in, the rotary valve (81) must be held fast to prevent it from rotating.

Check for the following:

The locking nut (81.2) must be in perfect contact with the ball bearing (2).

Spread the thread of the plug (2.4) with a sealing compound (for the appropriate product please refer to the spare parts list).

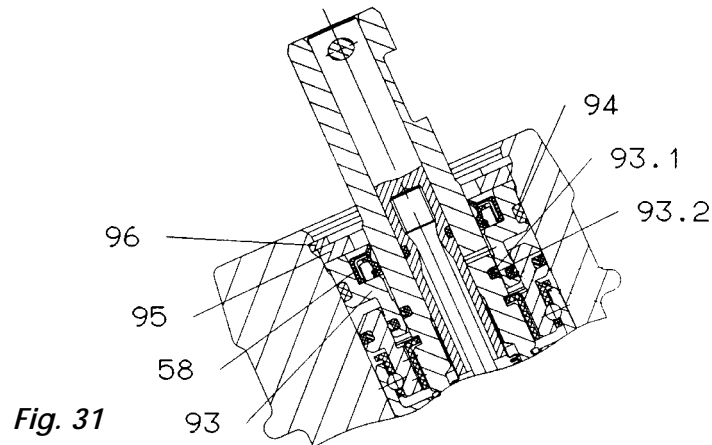
Fill the plug (2.4) with grease (to spare parts list).

Tightening torque: 30+5 Nm (M30x1.5/M35x1.5)
 70+5 Nm (M45x1.5)

If the plug (2.4) had originally been factory peened, it must be peened again. Shape, depth and number of peenings must be identical with the original peening.

On the shaft seal (58), fill the space between the sealing lip and the dust lip with grease (cf. the remarks at the beginning of Chapter III.).

Align the shaft seal (58) as shown in **Fig. 31** and, using tool [10], press it into the bush (93) until it is fitting snugly into the bush.



Mount the O-rings (93.1/94) and the sealing ring (93.2) onto the bush/seal holder (93).

Place tool [12] on the input shaft.

Using tool [13], press the bush/seal holder (93) in, however only to an extent enabling the retaining ring (96) to engage when the washer (95) is already fitted.

Insert the washer (95) and engage the retaining ring (96).



Attention:

Check the retaining ring (96) for correct fit.

4.5 For versions with protecting cap (64) in addition

Note:

Press the protecting cap (64) on only after the functional test to Chapter V. has been carried out.

Fill the protecting cap (64) with grease and press it on the rotary valve (81) in a way avoiding any contact with the housing (1) or the valve housing (59).

5ZF-Rack and Pinion Power Steering Gears with Servotronic

5.1 Versions with cover (34)

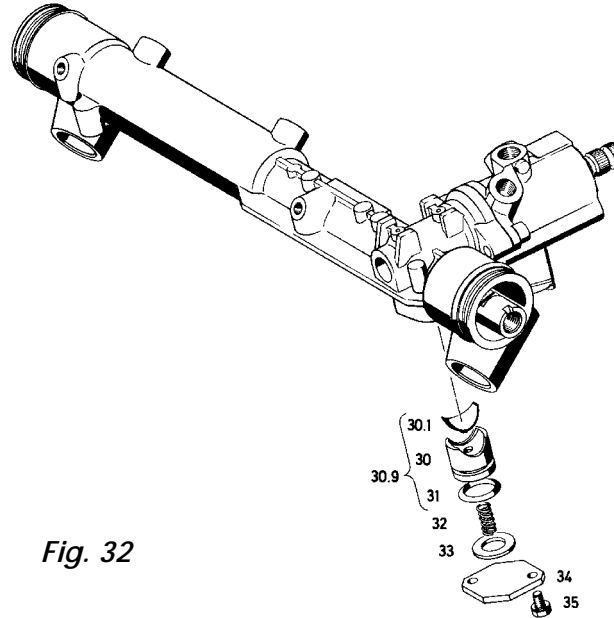


Fig. 32

Insert the yoke (30), with the insert foil (30.1) but without the O-rings (31), into the housing(1) (*Fig. 32*).

Place the compression spring (32) on the yoke (30).

Fit a commercially available dial gauge to tool [14].

By means of a gauging plate, set the dial gauge to zero.

Place tool [14] on the compression spring (32) and fasten it with 2 screws.

Using tool [7], rotate the rack (3) through the maximum permissible total stroke and, while doing so, read the maximum travel from the dial gauge.

Note:

Do not shift the rack (3) to the stroke end positions without the tie rods fitted to it, for otherwise the seals (10 and 10.2) may be damaged. For the maximum permissible rack stroke, please refer to the technical cover sheet of the spare parts list.

Reduce the value thus determined by the permissible play of 0.1...0.15 mm.

This value corresponds to the thickness of the spacing washer (33). Remove tool [14] and the yoke (30).

Fit the O-ring (31) to the yoke (30).

Fit the yoke (30) along with the insert foil (30.1) and the spacing washer (33) selected.
 Fit the greased compression spring (32) (grease specification: see spare parts list).
 Spread a thin coat of sealing compound (see spare parts list) on the sealing surface of the cover (34).
 Put the cover (34) on in the position as marked during disassembly.
 Fasten the cover (34) with hexagon screws (35).

Tightening torque: 7+1 Nm (M6)
 17+3 Nm (M8)

Check for the following:

There must not be any sticking of the steering gear when rotated through its total stroke.

5.2 Versions with adjusting screw (34)

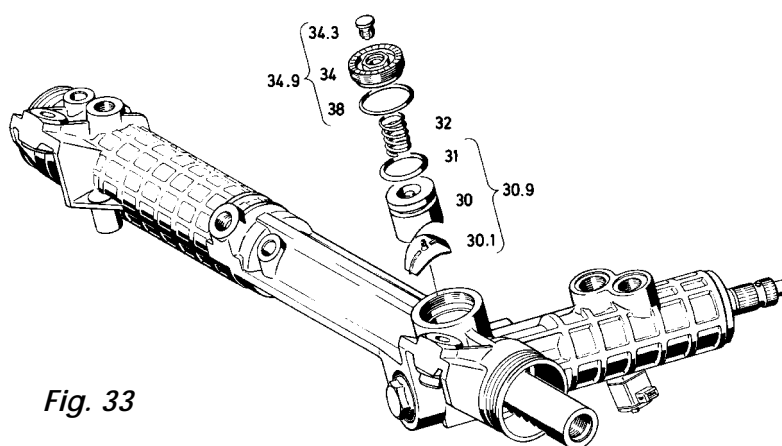


Fig. 33

Insert the O-ring (31) and the insert foil (30.1) into the yoke (30) (**Fig. 33**).

Insert the yoke (30) into the housing.

Fit the O-ring (38) and the greased compression spring (32) (grease specification see spare parts list).

Rotate the steering gear to mid-position.

Screw the adjusting screw (34) in until the insert foil (30.1) is in play-free contact with the rack (3) (screwing-in torque: 20 Nm).

Peen the adjusting screw (34) in such a way that only material is peened that had not yet been peened previously: see detail "V" of **Fig. 34**.

At the rotary valve (81), rotate the steering gear 6 times through the total stroke of the rack (3). Use tool [7] to this effect.

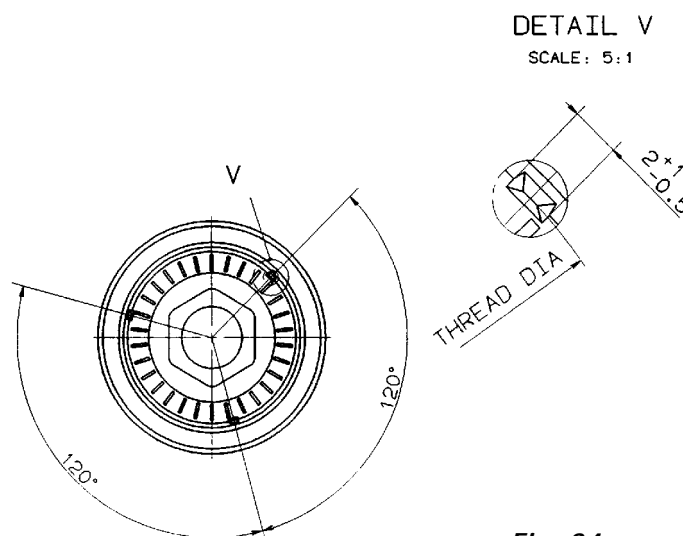


Fig. 34

ZF-Rack and Pinion Power Steering Gears with Servotronic

Do not shift the rack (3) to the stroke end positions without the tie rods fitted to it, for otherwise the seals (10 and 10.2) may be damaged. For the maximum permissible rack stroke, please refer to the technical cover sheet of the spare parts list.

Turn the adjusting screw (34) 5 graduation marks back (loosen it) and then screw it 1 graduation mark in again.

Rotate the steering gear to the mid-position so that the rack projection (relative to the steering lockstop) is equal at either side.

Fit tools [16], so that the rack stroke is restricted to 1...3 mm.

Fit tool [14] and a commercially available dial gauge.

Using tool [5], rotate the rotary valve (81) to the left and to the right (torque approx. 12 Nm) and measure the yoke play.

Specified value: 0.05...0.1 mm (if possible adjust to minimum dimension)

Adjust the yoke play by turning at the adjusting screw (34).

If the adjusting screw (34) is turned 1 graduation mark, this corresponds to a change of 0.05 mm in yoke play.

Without altering the yoke play setting, check the loosening torque at the adjusting screw (34).

Test value: 1.5 Nm minimum

Insert the plug (34.3).

Check for the following:

There must not be any sticking of the steering gear when rotated through its total stroke. Mark the definitive position of the adjusting screw (34) with marking ink (at any place on the circumference).

6 Fitting the pipes (100, 101 and 102)

6.1 Versions with union screws (104)

Fit the pipes (101 and 102) along with the O-rings (103) and the sealing washers (108.1) and the union screws (104) and the damper valves (108) (Fig. 35).

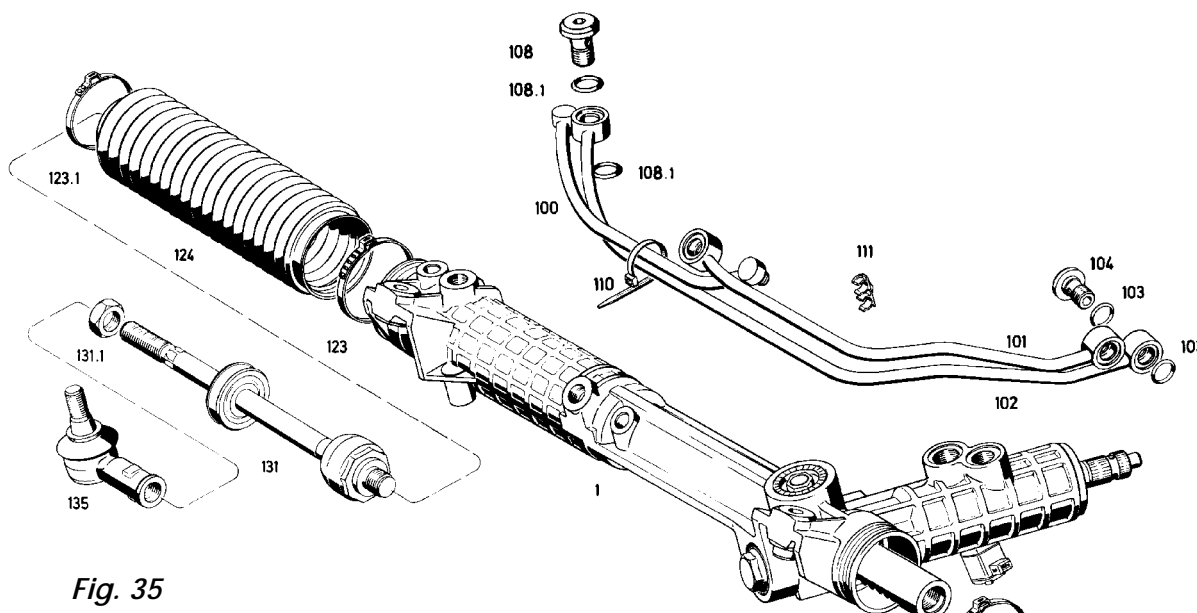


Fig. 35

Tightening torque:

Union screws (104): 20 ± 2 Nm (M10x1/M12x1.5)

Damper valve (108): 40 ± 4 Nm (M14x1.5)

Fit the cable clip (110) and the retainer (111).

6.2 Versions with cap nuts/cap screw

Fit the pipes (101 and 102) along with the O-rings (103).

Tightening torque: 10 ± 2 Nm (M12x1)

6.3 Fitting the pipe/compensating line (100)

Press the pipe/compensating line (100) connecting pieces into the bores.

If during first assembly at the manufacturer's plant the connecting pieces had been peened, the peening operation must be repeated following reassembly, with the peening shape, depth and number being identical to that of the first peening.

Fit the cable clip (110) and the retainer (111).

7 ZF-Rack and Pinion Power Steering Gears with Servotronic

Note:

Fit the tie rods (131) and the bellows (124) only after completion of the functional test to Chapter V.

7.1 Versions with additional lever (124.1):

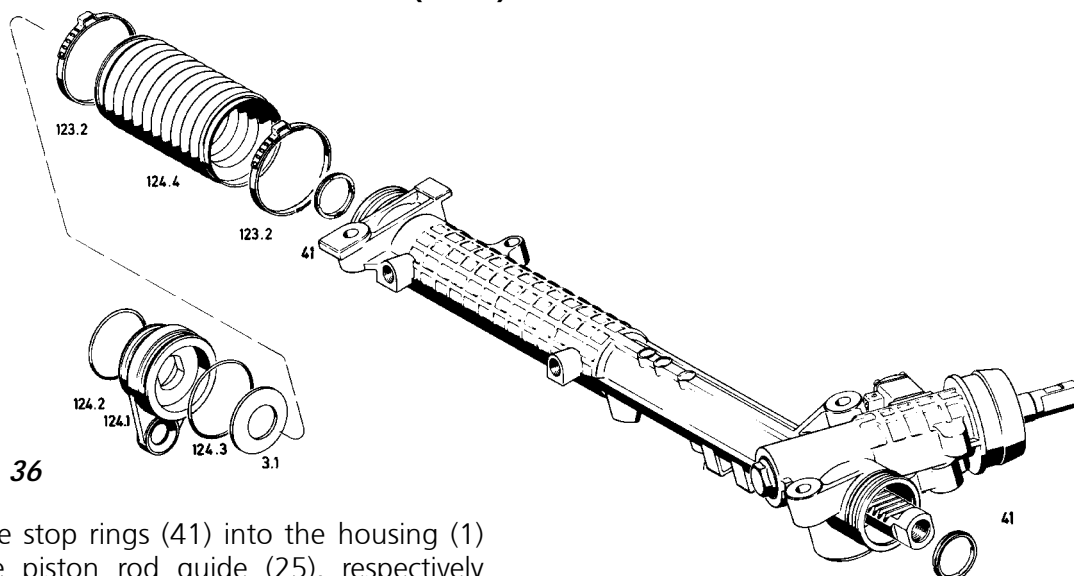


Fig. 36

Press the stop rings (41) into the housing (1) and the piston rod guide (25), respectively (Fig. 36).

Mount the O-rings (124.2 and 124.3) of the lever (124.1). Insert the cup spring (3.1) into the lever (124.1).

Installed position of the cup spring (3.1) (see Fig. 37).

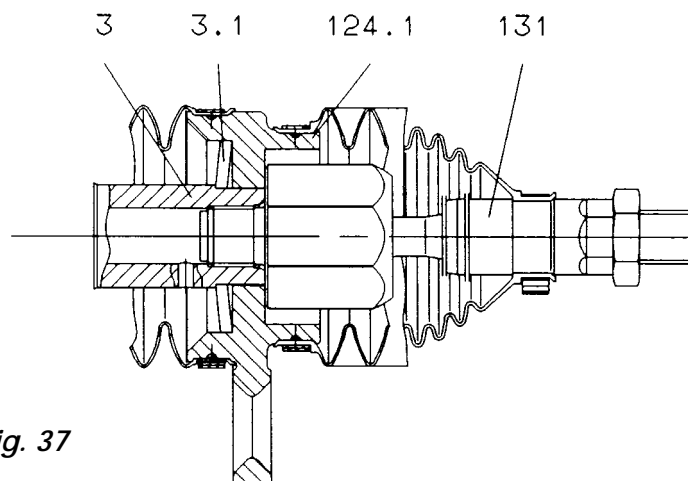


Fig. 37

As an assembly aid, spread the bearing surfaces of the bellows (124.4) with grease.

Fit the bellows (124.4) to the housing (1).

Put the lever (124.1) on the rack (3).

Fit and fasten the tie rods (131) as described below.

Mount the bellows (124.4) and secure it with hose clamps (123.2).

7.2 Mounting the bellows (124)

As an assembly aid, spread the bearing surfaces of the bellows (124) with grease.
Slide the bellows (124) onto the tie rod (131) (*Fig. 35*).

7.3 Versions without an additional tie rod (131) securing device

Using tool [1], screw the tie rod (131) in; at the same time support the rack (3) at its spanner flat.

If the rack (3) does not have a spanner flat, the rack teeth can also be clamped in a vice (with soft jaws) to serve the purpose of supporting the rack.

Tightening torques:	Types 7830/7831/7832:	80±8 Nm	(M14x1.5/M16x1.5)
	Type 7852:	100±10 Nm	(M14x1.5/M16x1.5)

7.4 Versions with locking collar

Screw the tie rod (131) in, using tool [1], and at the same time support the rack (3) at its spanner flat.

If the rack (3) does not have a spanner flat, the rack teeth can also be clamped in a vice (with soft jaws) to serve the purpose of supporting the rack.

Tightening torques:	Types 7830/7831/7832:	80±8 Nm	(M14x1.5/M16x1.5)
	Type 7852:	100±10Nm	(M14x1.5/M16x1.5)

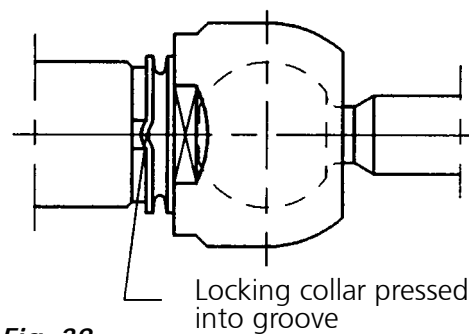


Fig. 38

Press the locking collar into the groove (*Fig. 38*).



Attention:

Material that had already been deformed during first peening may not be pressed into the groove again.

To avoid this, continue to screw the tied rod (131) in until an unpeened material can be pressed in.

7.5 Fastening the bellows (124)

Fasten the bellows (124) with the hose clips (123.1) (*Fig. 35*).

Functional Test Power Steering Gears with Servotronic

Attention:

To make sure its traffic safety remains unchanged, each steering gear must be subjected to a functional test on the test stand after repair. A steering gear may by no means be fitted to the vehicle again if it has not been function tested on the test stand. A checking for proper functioning during a test drive following repair alone is not permissible.

1 Preparing the steering gear for functional testing

Mount the completely assembled steering gear to the test stand.

Connect the pressure and return lines.

Attention:

Use lines and connections only that are authorized for the maximum pressure occurring on the test stand.

Connect tool [17] to the mains supply and to the transducer (402) (see Fig. 39).
For versions having a cable firmly cast on the transducer (402), use in addition tool [18].

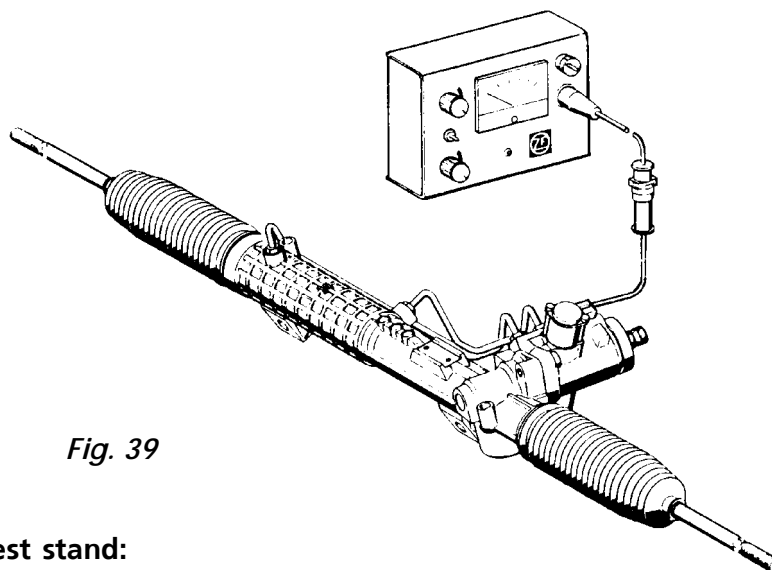


Fig. 39

Setting the test stand:

For the test stand setting values, please refer to the technical cover sheet of the spare parts list. If the list does not specify any values, the values given below shall apply:

Oil temperature: 50°C

Flow rate:

Type 7831: 7.0 dm³/min

Type 7832: 6.0 dm³/min

Type 7852: 7.5 dm³/min

Bleeding the steering system:

Switch the test stand on and actuate the steering gear several times to a position just before the end position.

Note:

Do not shift the rack (3) to the stroke end positions without the tie rods being fitted to it, as otherwise the seals (10 and 10.2) might be damaged. For the maximum permissible rack stroke, please refer to the technical cover sheet of the spare parts list.

2 Functional test

Note:

The testing sequences must be documented in the inspection report.

2.1 Testing for external leakage

While carrying out tests 2.2 to 2.8 described below, also check the steering gear for external leakage.

2.2 Testing the maximum pressure

Restrain the rack (3) in mid-position. To be able to do so, fit tools [16].

On tool [17], set a dial value of 0.65...0.85 (transducer closed).

By turning tool [5] in one direction of rotation, close the steering valve.

The pressure set at the test stand must then build up.

Implement the test in the other direction of rotation.

If maximum pressure is not attained, the leakage rate of the steering gear is too high.

2.3 Checking for leakage oil

Restrain the rack (3) in mid-position. To be able to do so, mount tools [16].

On tool [17], set a dial value of 0.65...0.85 (transducer closed).

Close the steering valve by turning tool [5] in one direction of rotation. Repeat the test in the other direction of rotation.

Maximum permissible leakage oil rate: 1 dm³/min

2.4 Checking the hydraulic centre and the functioning of the transducer

Restrain the rack (3) in mid-position. To be able to do so, mount tools [16].

In the technical cover sheet, look up the specified values for

Actuating torques M_t s (fast driving)

Actuating torques M_{tp} (parking)

as well as the respective pressures.

On tool [17], set a dial value of 0...0.1 (transducer open).

Close the steering valve by turning tool [5] until the required pressure is indicated, and measure the actuating torque M_{ts} (fast driving) to be applied to achieve this.

Implement the same test for the other turning direction.

Maximum permissible torque difference between LH and RH sides: 0.6 Nm.

On tool [17], set a dial value of 0.65...0.85 (transducer closed).

Close the steering valve by turning tool [5] until the required pressure is indicated, and measure the actuating torque M_{tp} (parking) to be applied to achieve this.

Implement the same test for the other turning direction.

Maximum permissible torque difference between LH and RH sides: 0.6 Nm.

2.5 Checking the self-centring of the valve

On tool [17], set a dial value of 0.65...0.85 (transducer closed).

Restrain the rack (3) in mid-position. To be able to do so, mount tools [16].

Close the steering valve by turning tool [5]. Maximum pressure is thus built up.

Next, using tool [5], rotate the steering valve in such a way that the pressure drops to flow pressure.

Using tool [5], allow a pressure corresponding to flow pressure + 10 bar to be built up.

Let tool [5] go and have a close look at the pressure. It must drop to flow pressure (maximum 0.5 bar higher) within 1 second.

Implement the same test also in the other direction of rotation.

Checking for hooking during initial steering:

On tool [17], set the dial value to 0...0.1 (transducer open).

No noticeable hooking (hydraulic hooking at initial steering) may be found when initial steering is done with tools [5] 3 times, each, alternately in the two directions of rotation until approx. 50 bar are reached.

2.6 Checking the rack (3) sliding force

Note:

During this test the bellows may not be fitted.

On tool [17], set a dial value of 0...0.1 (transducer open).

Using a spring balance, test the sliding force of the rack at a pulling speed of 10 mm/s and with the hydraulic system in operation.

Specified value: see the technical cover sheet

2.7 Checking the hydraulic steering limiters

Note:

Not all steering gears are fitted with hydraulic steering limiters. Therefore, look up in the technical cover sheet whether the steering gear in question is actually equipped with hydraulic steering limiters.

Fit the tie rods (131) or tools [19] at either side (see Fig. 40).

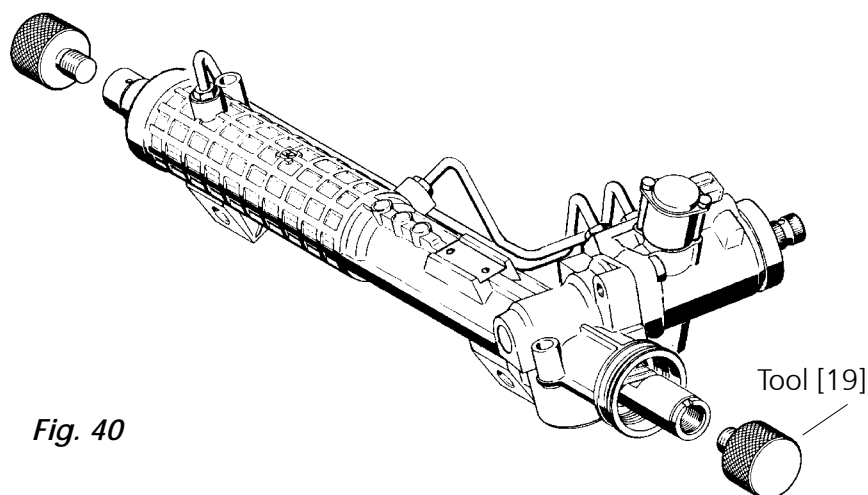


Fig. 40

Rotate the steering gear to one side until reaching the lockstop and close the steering valve by turning (approx. 100 N).

Read the pressure.

Specified value: < 40 bar

Implement the same test for the other direction of rotation, too.

2.8 Checking the external leakage of the steering gear at a stemmed return line pressure

On tool [17], set a dial value of 0...0.1 (transducer open).

At the test stand, set a return line pressure increased by 7 bar.

With the hydraulic system in operation and without any steering motion, test the steering gear for external leakage for a duration of 10 minutes.

2.9 Rotate the steering gear to the straight ahead position, i.e., the rack projection relative to the steering lockstop must be equal at either side.

Check the marks indicating the position of the rotary valve (81) relative to the housing (1) or the valve housing (59).

2.10 Fitting the tie rods (131), the bellows (124) and the protecting cap (64) - see Chapter IV., Assembly

2.11 Provide the steering gear with a repair index number

ZF Rack and Pinion Power Steering Gears with Servotronic VI. Trouble Shooting

Note:

- The ZF Rack and Pinion Power Steering Gear was developed for heavy duty applications. Its design is such that no failures will occur if maintenance is perfect and if it is operated under normal conditions.
- If, despite this, a failure should occur, the following hints will help to find and eliminate faults.

Fault	Cause	Remedial Action
stiff operation in both directions	O-ring (15) or sealing ring (16) defective	replace [1]
	sealing ring (88) defective	replace [1]
stiff operation in straight ahead driving position	wrong setting of yoke play	reset [2]
	eccentricity of rack (3)	check [3]
	too much sealing compound used when fitting the cover (34)	check [3]
stiff operation in one direction	sealing ring (88) defective	replace [1]
	hydraulic centre not correct	replace the rotary valve (81) [1]
play in the steering gear	wrong setting of yoke play	reset [2]
leakage	sealing elements (103 and 108.1) defective	replace [1]
	sealing elements (10, 10.2, 51 and 58) defective	replace [1]
stiff operation when vehicle is stationary	transducer (402) does not close (contamination)	check [1] replace [1]
	transducer (402) does not close (electr. defect)	check power supply voltage [1] check cable connection replace transducer (402) [1]
stiff operation during driving OK with vehicle stationary	transducer (402) opens too early	check control unit [4] replace control unit [5] check speedo signals [5]

Fault	Cause	Remedial Action
	cut-off valve (153) does not open or gets stuck	check [1] replace [1]
actuating forces LH/RH asymmetric	check valves (156) leaking	check [1] replace [1]
actuating forces change suddenly during driving	faulty speedo signals	check [5]

- [1] see Chapters II. and IV.
- [2] see Chapter IV.
- [3] see Chapter III.
- [4] see Servotronic Tester Operating Instructions
- [5] see vehicle manufacturer's instructions

ZF-Rack and Pinion Power Steering Gears with Servotronic

Note:

The values below are standard values and shall only apply if the technical cover sheet of the spare parts list does not specify any tightening torques.

Steering Component	Thread Size	Tightening torques
plug (2.4)	M30x1.5/M35x1.5 M45x1.5	30+5 Nm 70+5 Nm
cap screw (21)	M8	17+3 Nm
hexagon screw (35)	M6	7+1 Nm
male coupling (59.2 + 59.3)	M16x1.5	32+4 Nm
cap screw (61)	M8 M8	17+3 Nm (cap screw with surface protection) 23±2 Nm (cap screw without surface protection)
locking nut (81.2)	M10 M14x1.5	22+4 Nm 45+5 Nm
cap nut of pipes (100, 101 and 102)	M12x1	10+2 Nm
union screw (104)	M10x1/M12x1.5 M12x1 (internal hexagon)	20±2 Nm 30+3 Nm
damper valve (108)	M14x1.5	40±4 Nm
tie rod (131) Type 7831 7832	M14x1.5/M16x1.5	80±8 Nm
7852	M14x1.5/M16x1.5	100±10 Nm
cap screw (401) cornered transducer housing round transducer housing	M4 M4	2.9 Nm ±0.15 Nm see Chapter IV.

VIII. Special Tools

Note:

The following special tools refer to the production version and the design level of the ZF Rack and Pinion Power Steering Gear on the basis of which the complete Repair Instructions were prepared.

It may happen, therefore, that different tools are required for the actual steering gear to be repaired.

Tool [1]

Insert for tie rods (131)



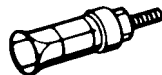
Tool [2]

Counter-support for extracting tool, tool [3]



Tool [3]

Extracting tool for shaft seal (51/58) roller bearing (57) ball bearing (2) and seal holder/bush (93)



Tool [4]

Mandrel for needle bush and ball bearing (2), respectively

- [1] needle bearing 12x18x12
- [2] needle bearing 13x19x12
- [3] ball bearing 12x28x8
- [4] ball bearing 15x42x13

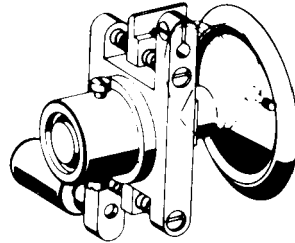


Ordering ref. for Steering Gear Type		
7831	7832	7852
up to 38 mm	7830 798 151	7852 798 154
exceedg 38 mm		
7421 798 351		
7409 798 201		
[3] 7831 798 052		
		[1] 7881 798 051
		[2] [4] 7844 7852 798 798 053 054

ZF-Rack and Pinion Power Steering Gears with Servotronic

Tool [5]

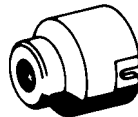
Torque meter
(without tool [6]
and without dial gauge)



Tool [6]

Insert for tool [5] and
[7], respectively

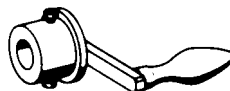
- ① with cylindrical serration
1x54
- ② with bore 17.5 mm
- ③ with bore 19 mm
- ④ with cylindrical serration
11/16" x 40



- ⑤ intermediate adapter for commercially
available torque wrench

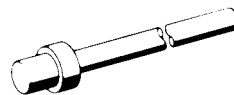
Tool [7]

Crank to rotate the steering
from lock to lock
(without tool [6])



Tool [8]

Mandrel for seal (10)



- ① seal 24x33x7
- ② seal 26x35x7
- ③ seal 28x38x7
- ④ seal 30x40x7

Ordering ref. for Steering Gear Type		
7831	7832	7852
7470 798 703		
① 8052 798 552		
② 7832 798 551		
	③ 7840 798 551	④ 7340 798 551
⑤ 7810 798 552		
7830 798 401		
① 7831 798 051	② 7832 798 052	③ 8052 798 054
		④ 7852 798 053

Tool [9]

Bush for rack



to be used with spacer



Tool [10]

Mandrel for shaft seal (58)

- [1] shaft seal 18x30x7/8
- [2] shaft seal 20x30x7/8
- [3] shaft seal 22x32x7/8



Tool [11]

Mandrel for shaft seal (51) and ball or roller bearing (57)

- [1] shaft seal 24x37x7
- [2] shaft seal 26x37x7
- [3] shaft seal 28x40x7
- [4] ball bearing 24x37x6
- [5] roller bearing 26x32x7,5
- [6] roller bearing 28x35x7,7



Ordering ref. for Steering Gear Type		
7831	7832	7852
23 7830 798 011	26 7832 798 009	28 7852 798 015
24 7831 798 004		30 7852 798 016
7830 798 012		
	[1] 8052 798 051	
	[2] 7832 798 051	
[3] 7633 798 051		[3] 7633 798 051
[1][4] 7844 798 052		
	[3] 8484 798 051	
	[2][5][6] 7418 798 051	

ZF-Rack and Pinion Power Steering Gears with Servotronic

Tool [12]

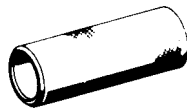
Advancing bush for shaft seal (58)

- ① shaft seal 18x30x7/8
- ② shaft seal 20x30x7/8
- ③ shaft seal 20x30x5/6



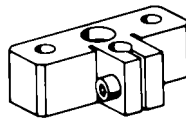
Tool [13]

Press-in sleeve for seal holder (93)



Tool [14]

Dial gauge bracket to measure the axial clearance - yoke (30)

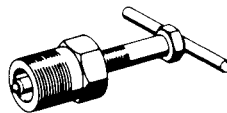


- ① screw spacing 42 mm
- ② housing 50 mm

Tool [15]

Tool for pressing out

- ① thread M30x1.5
- ② thread M35x1.5
- ③ thread M45x1.5

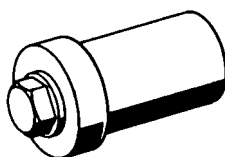


Ordering Ref. for Steering Gear Type		
7831	7832	7852
① 8052 798 003		
	② 7832 798 001	③ 7852 798 008
7428 798 054		
① 7830 798 701	② 7810 798 701	
① 7852 798 201		
	② 7852 798 202	
		③ 7852 798 203

Tool [16]

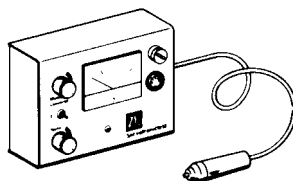
Restraining tool

- ① for rack (3) with M14x1.5
- ② for rack (3) with M16x1.5
- ③ for rack (3) with M18x1.5



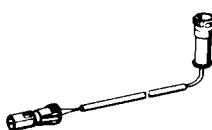
Tool [17]

ZF Servotronic Tester



Tool [18]

adapter cable
(only for versions with cable
firmly cast to the transducer)



Tool [19]

Lockstop for rack (3)
with M18x1.5



Ordering ref. for Steering Gear Type		
7831	7832	7852
① 7831 798 701		
		② 7852 798 703
	③ 7852 798 704	
7418 798 545		
7418 798 560		
7852 798 705		

ZF Rack and Pinion Power Steering Gears with Servotronic

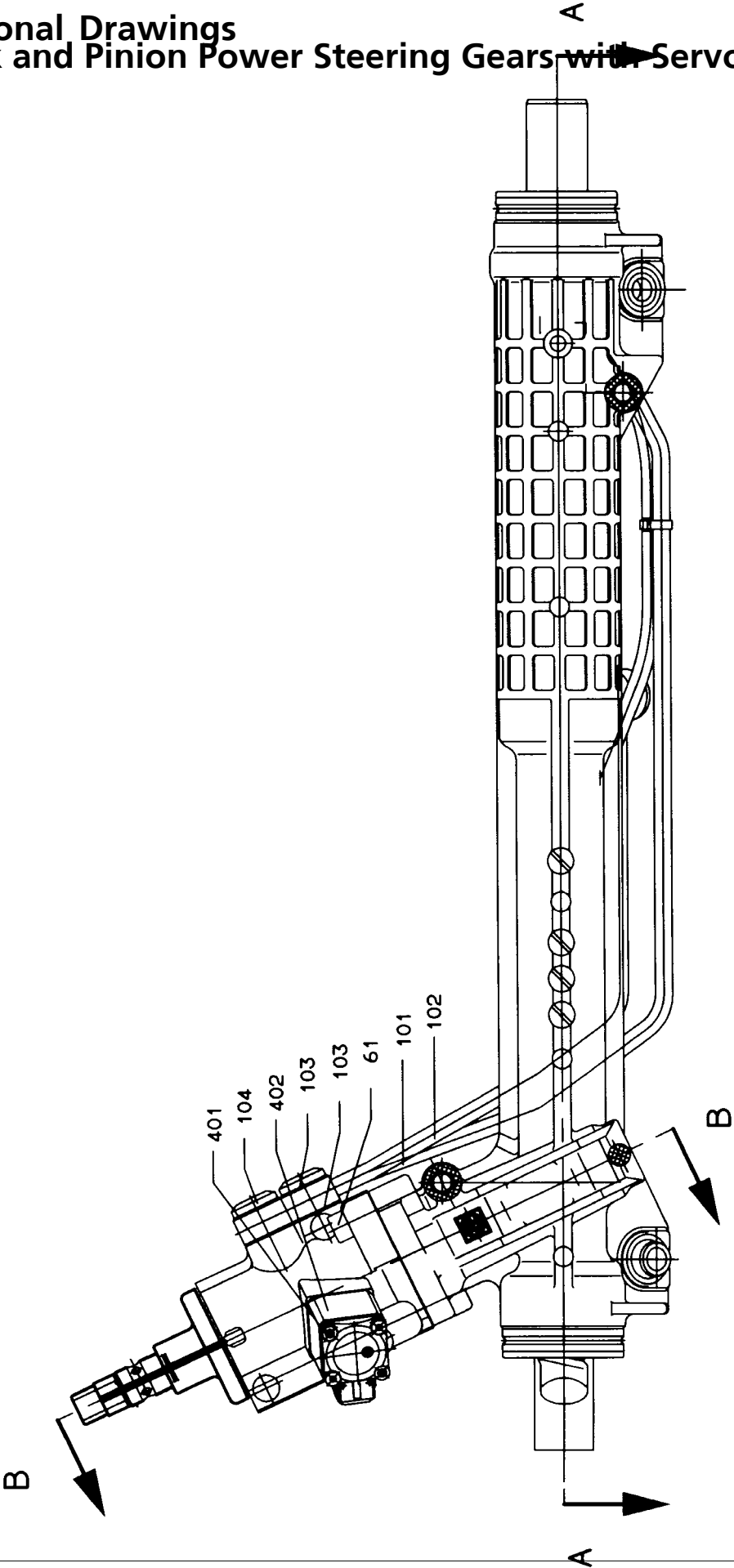
IX. Key to Numbers in Figures

1.0	Housing	40.1	Sealing ring
1.4	Bush/silent bearing/silent bush	41.0	Stop ring
1.8	Bush/threaded bolt	43.0	Stop ring
2.0	Needle bush/ball bearing/needle sleeve	51.0	Shaft seal
2.4	Plug	56.0	O-ring
3.0	Rack	57.0	Roller bearing
3.1	Cup spring	58.0	Shaft seal
5.0	Support ring	58.1	Shaft seal
9.0	Support shim/washer	59.0	Valve housing
10.0	Sealing ring/seal	59.2	Male coupling
10.9	Seal	59.3	Male coupling
13.0	O-ring	60.0	Washer
15.0	O-ring	61.0	Cap screw
16.0	Sealing ring	64.0	Protecting cap
17.0	O-ring	81.0	Rotary valve
18.0	Snap ring	81.2	Locking nut
21.0	Cap screw	81.4	O-ring
24.0	Bearing bush	81.5	Sealing ring
24.3	Bearing bush	87.0	O-ring
25.0	Piston rod guide	88.0	Sealing ring
25.9	Piston rod guide	93.0	Bush/seal holder
26.0	Washer/support shim	94.0	O-ring
29.0	Tab washer	95.0	Washer
30.0	Yoke	96.0	Retaining ring/O-ring
30.1	Insert foil	100.0	Compensating line
30.9	Yoke	101.0	Pipe
31.0	O-ring	102.0	Pipe
32.0	Compression spring	103.0	O-ring/sealing ring
33.0	Spacing washer	104.0	Union screw
34.0	Cover/adjusting screw	104.1	Union screw
34.3	Plug	108.0	Damper valve
35.0	Hexagon screw	108.1	Sealing washer
38.0	O-ring	110.0	Cable clip
40.0	Cap screw	119.0	Silent bloc
		119.1	Silent bloc

123.0	Hose clamp/hose clip
123.1	Hose clip/clip
124.0	Bellows
124.1	Lever
124.2	O-ring
124.3	O-ring
124.4	Bellows
131.0	Tie rod/axial joint
131.1	Hexagon nut
131.9	Tie rod
135.0	Ball joint
136.0	Ball joint
150.0	O-ring
151.0	O-ring
152.0	O-ring
153.0	O-ring
154.0	Cut-off valve
155.0	Snap ring
156.0	Check valve
157.0	O-ring
401.0	Cap screw
402.0	Transducer
403.0	O-ring
404.0	O-ring
405.0	Oil screen

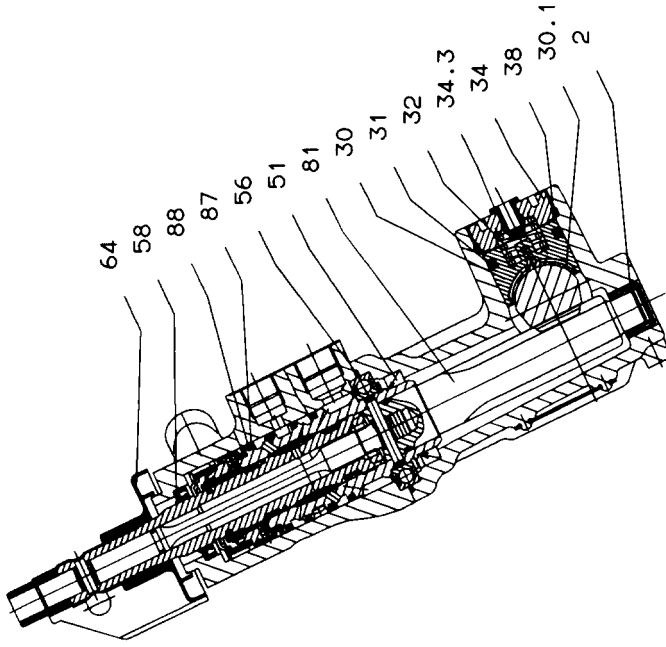
X. Sectional Drawings

ZF-Rack and Pinion Power Steering Gears with Servotronic



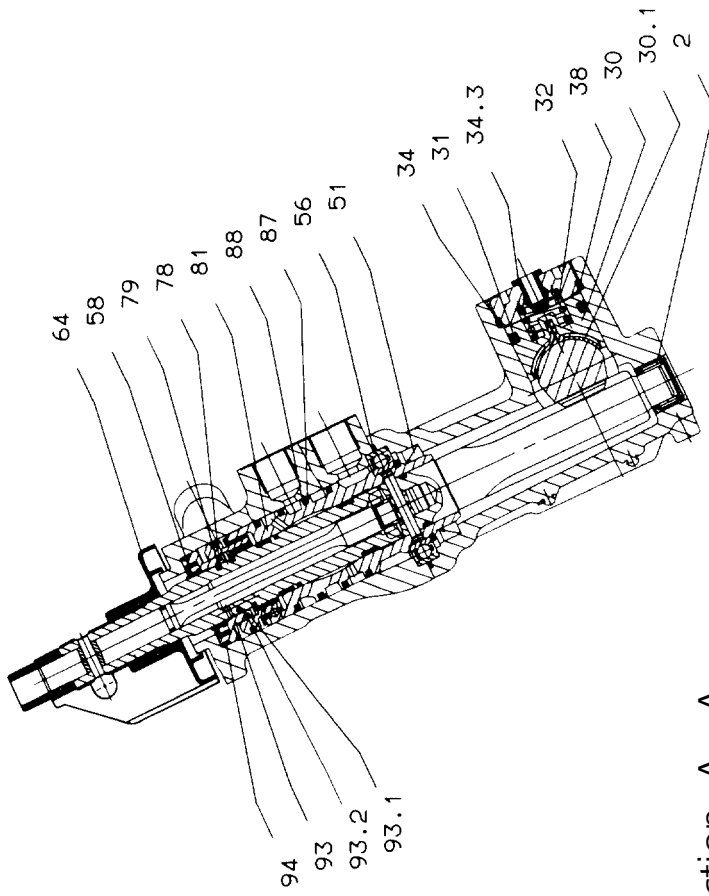
Servotronic 2

Section B - B

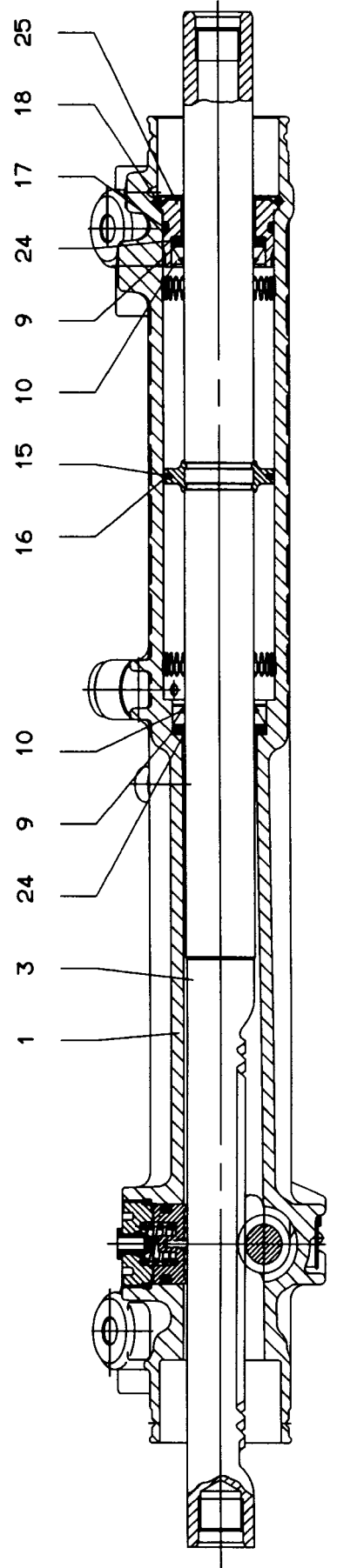


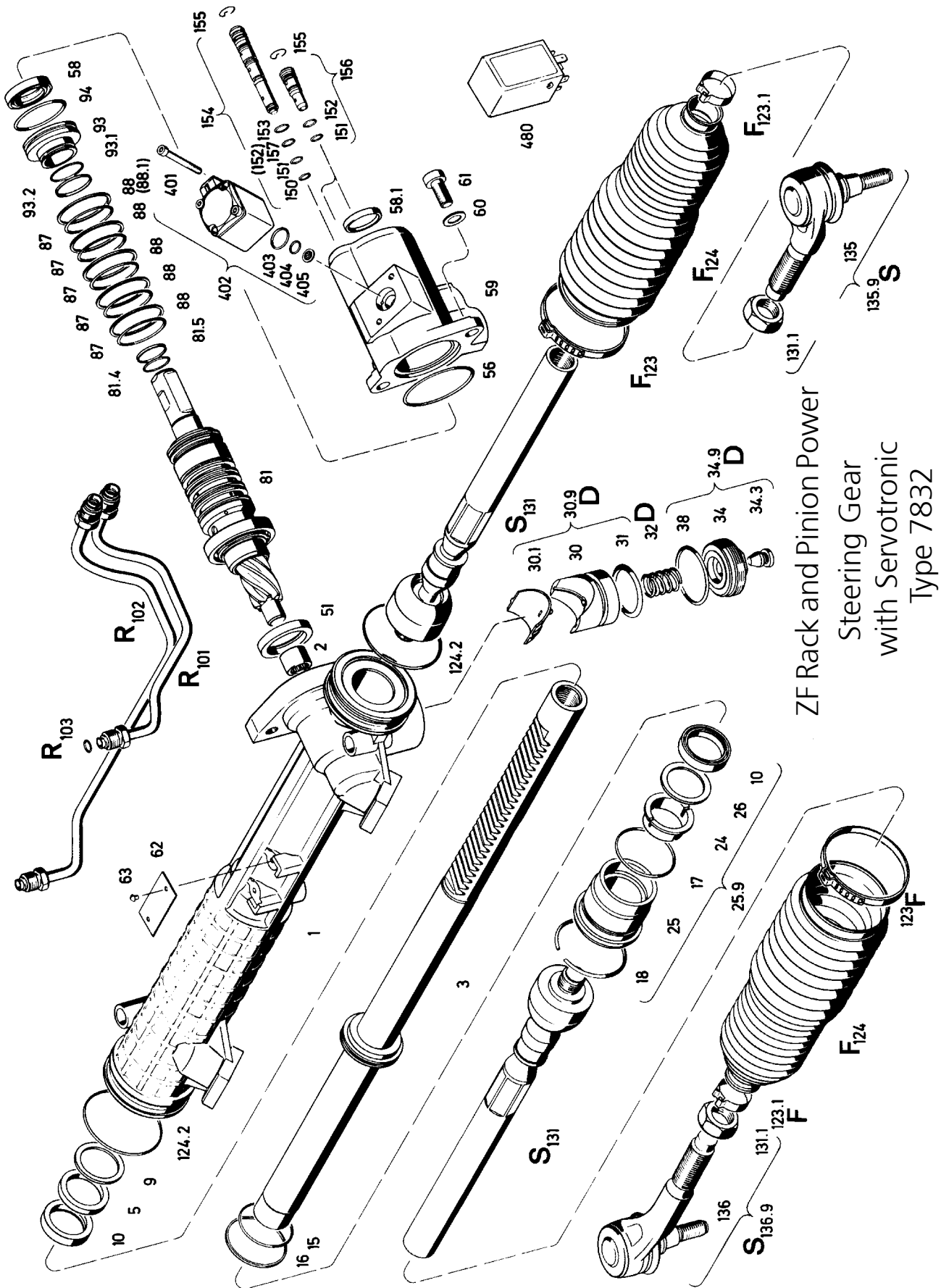
Servotronic 1

Section B - B



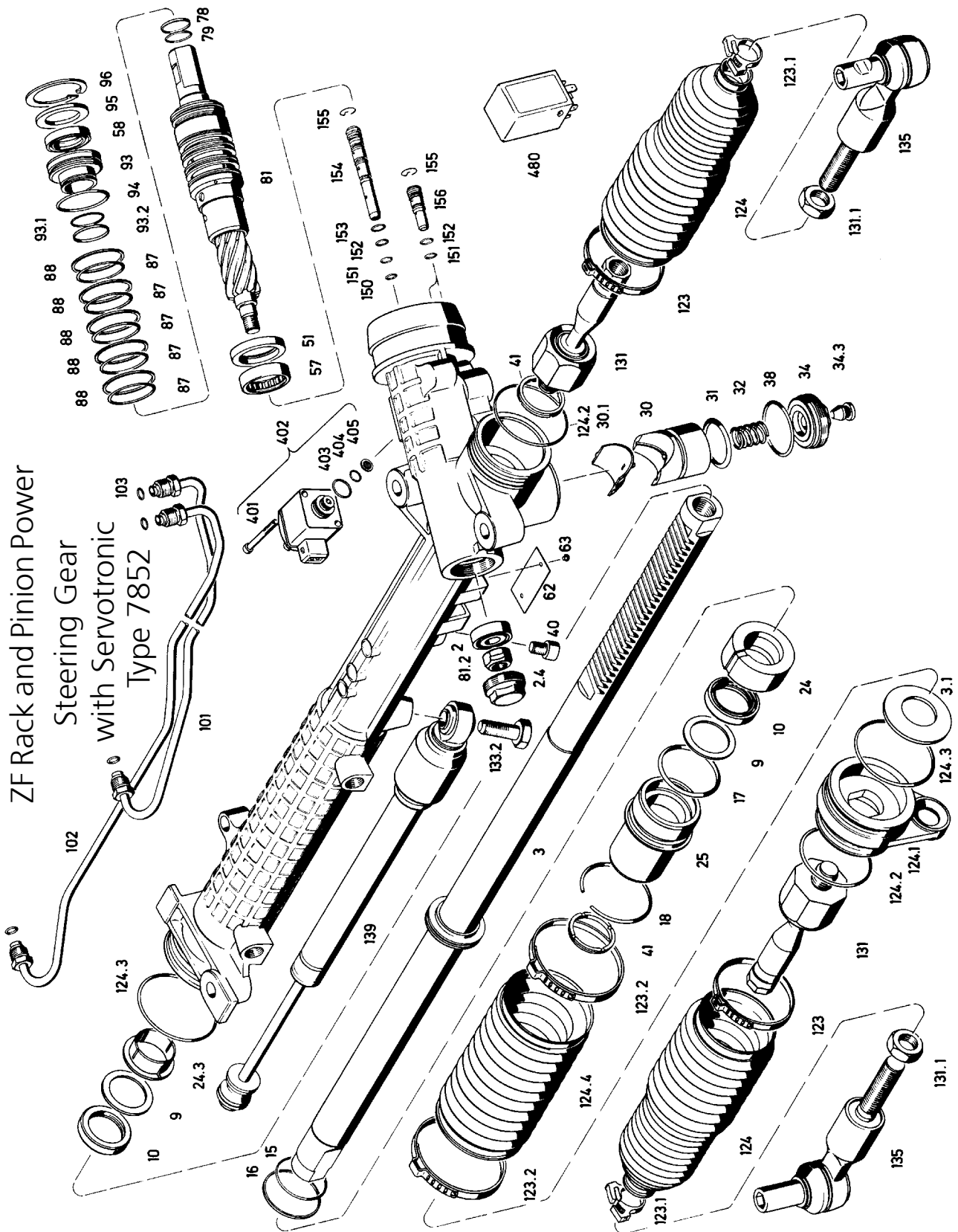
Section A - A

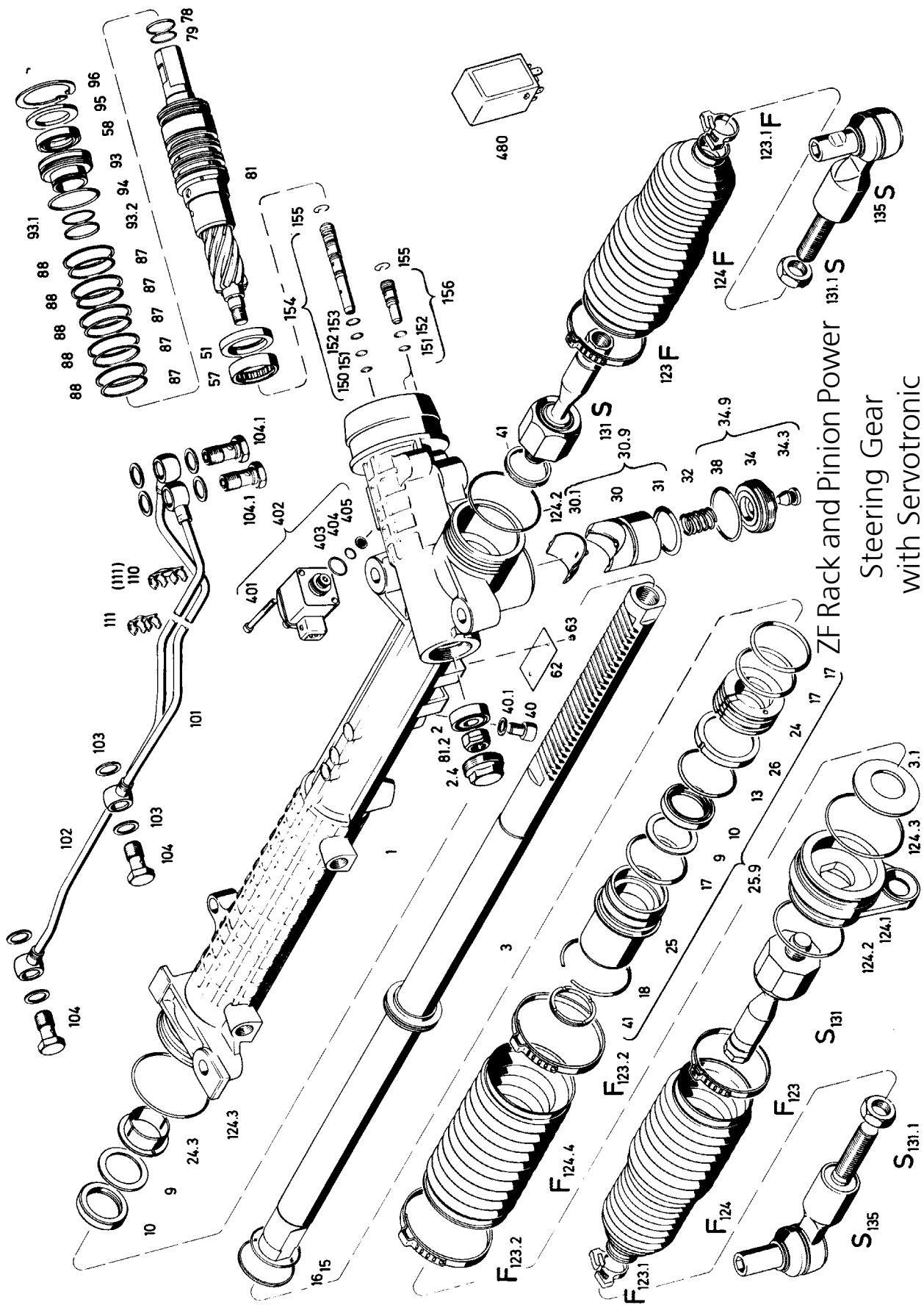




ZF Rack and Pinion Power
Steering Gear
with Servotronic
Type 7832

ZF-Rack and Pinion Power Steering Gears with Servotronic





ZF Rack and Pinion Power
Steering Gear
with Servotronic
Type 7852

ZF-Rack and Pinion Power Steering Gears with Servotronic

Repair Order No.: Date:

Parts List No.: Mfg. No.: Date of manufacture:

Documentation for "D" and "A" (safety) parts

- crack test carried out:

rack (3)	<input type="checkbox"/> yes
rotary valve (81)	<input type="checkbox"/> yes
- specified tightening torque applied:
 (specified values see repair instructions):

cap screw (21)	<input type="checkbox"/> yes
cap screw (61)	<input type="checkbox"/> yes
tie rod (131)	<input type="checkbox"/> yes
- yoke play set in accordance with the repair instructions: yes

Functional Test on the Test Stand

Setting values and specified values: see technical cover sheet or repair instructions

 Values the test stand was set at: maximum pressure bar flow rate dm³/min

- | | | LH | RH |
|---|---|----------------------------|----------------------------|
| ● maximum pressure | transducer closed | bar | bar |
| ● leakage oil | transducer closed | dm ³ /min | dm ³ /min |
| ● hydraulic centre and actuating torque, resp.: | | | |
| pressure: bar | transducer open (Mts) | Nm | Nm |
| pressure: bar | transducer closed (Mtp) | Nm | Nm |
| ● valve return to neutral o.k. | <input type="checkbox"/> yes | | |
| ● rack sliding force | N | | |
| ● steering limiters: | pressure | bar | bar |
| ● external leakproofness with stemmed-up return pressure: | o.k. <input type="checkbox"/> yes | | |
| ● marks for straight ahead position: | <input type="checkbox"/> checked <input type="checkbox"/> applied | | |
| ● steering gear finish assembled - tie rods (131), bellows (124), protecting cap (64) | <input type="checkbox"/> yes | | |
| ● repair code number applied: | <input type="checkbox"/> ja | | |

Inspected by:

Date: