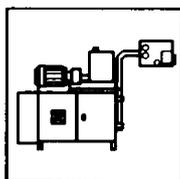
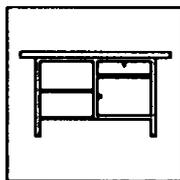
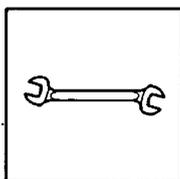


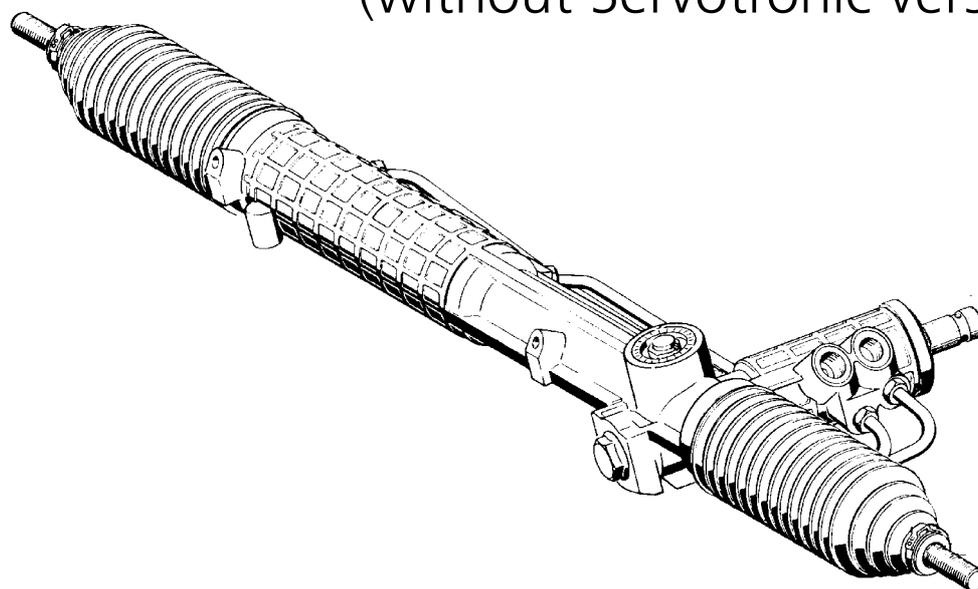
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Repair

ZF Rack and Pinion Power Steering Gear

Type 7830, 7831, 7832 and 7852
(without Servotronic versions)



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 **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 here in 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.

Note:

These instructions do **not** apply to the following versions:

7831 955 123	7831 974 139
7831 955 124	7831 974 140
7831 955 125	7831 974 141
7831 955 126	7831 974 142

Although according to the type plate these steering gear versions are Type 7831 9.. ... steerings, their design is that of Type 7891, and therefore the above mentioned versions 7831 9.. ... have to be repaired in accordance with the descriptions of the repair instructions of ZF Rack and Pinion Power Steering Type 7891.



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I. Disassembly

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 VIII. and in the spare parts list.
- The numbers in square brackets, e.g. [1], refer to the special tools listed in Chapter VII..

1 Removing the tie rods (131)

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

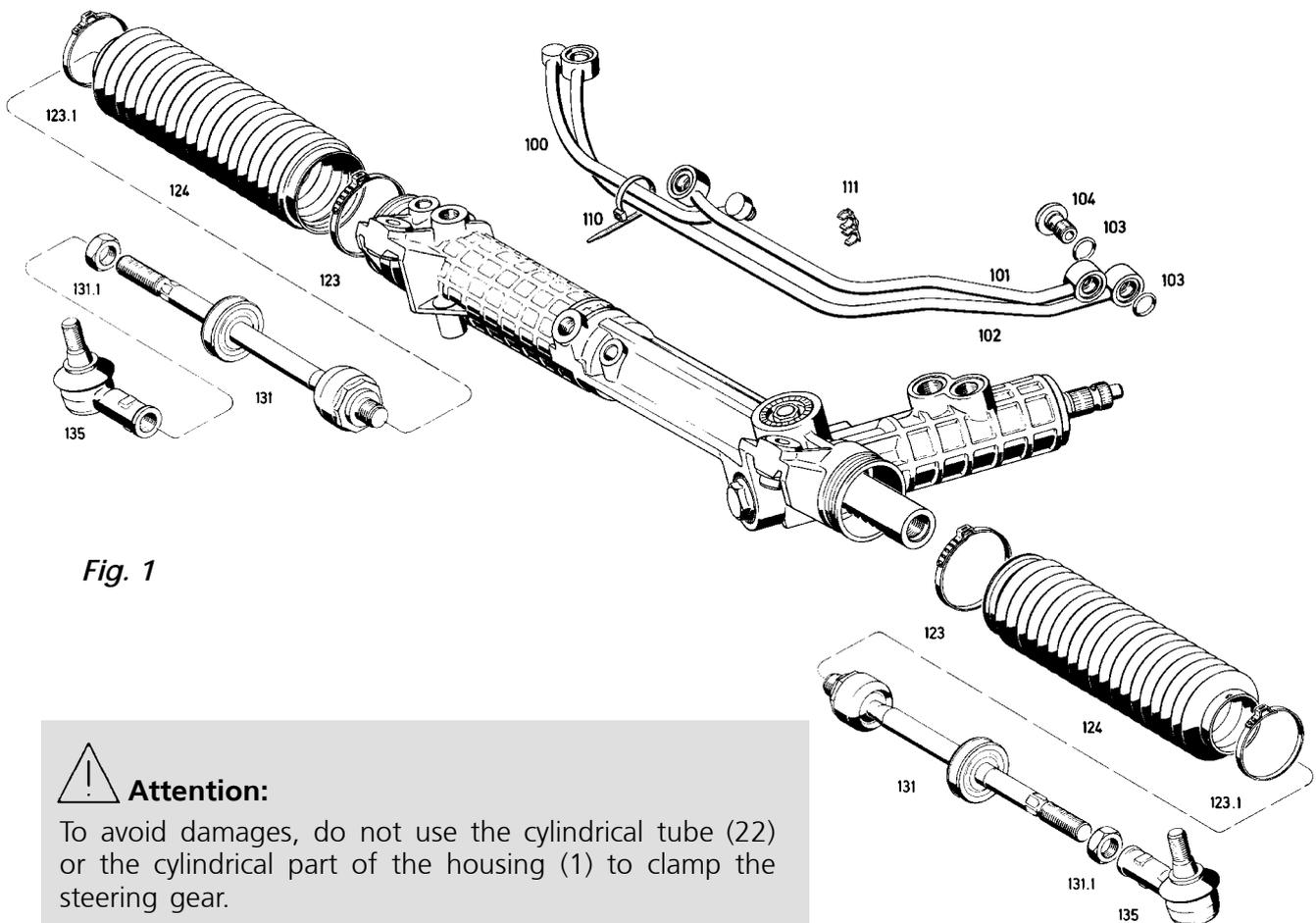


Fig. 1

Attention:

To avoid damages, do not use the cylindrical tube (22) or the cylindrical part of the housing (1) to clamp the steering gear.

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

Pushing 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.

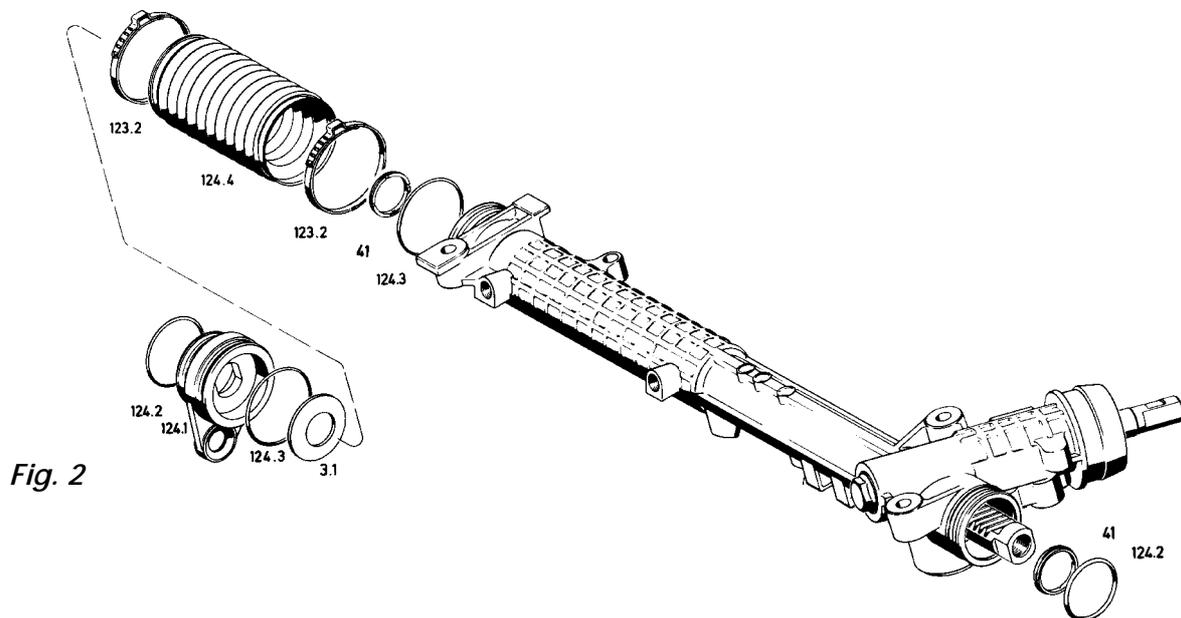
If the rack (3) has no spanner flats, then a supporting of the rack is not necessary.

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 off the O-rings (124.2 und 124.3).

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



2 Removing the pipes (100, 101 and 102)

Remove the cable clip (110) and the retainer (11) (*Fig. 1*).

Screw the union screws (104) out.

Remove the pipes (100, 101 and 102).

Remove the O-rings (103).

3 Removing the yoke (30)

3.1 Version with cover (34)

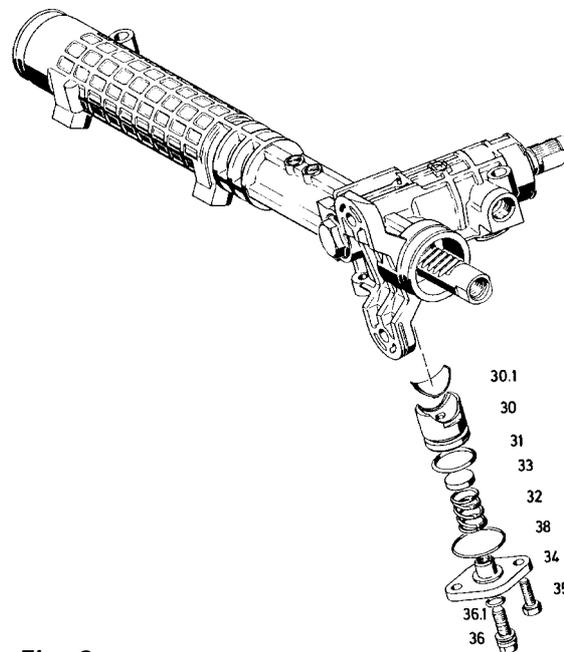


Fig. 3

3.1.1 For versions with additional adjusting screw (36):

Screw the adjusting screw (36) out and remove the O-ring (36.1) (*Fig. 3*).

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

Screw the hexagon screws (35) out and remove the cover (34) with O-ring (38).

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).

Note:

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

3.2 Versions with adjusting screw (34)

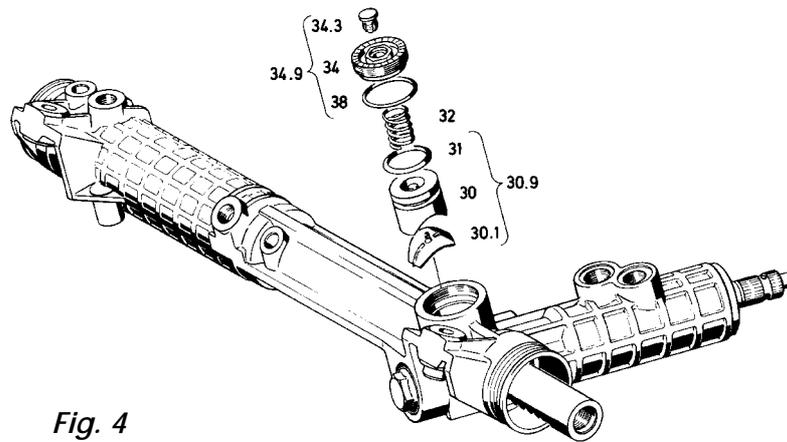


Fig. 4

Remove the plug (34.3) (Fig. 4).

Using a drill with 5 mm, remove the peened material of the adjusting screw (34) by boring until the peening depth is reached.

Remove the chips.

Screw the adjusting screw (34) out (using a hexagon insert if possible) and remove the O-ring (38).

For the version with additional O-ring (34.4):

Remove the O-ring (34.4).

Remove the compression spring (32) and the yoke (30) with insert foil (30.1).

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

4 Removing and disassembling the rotary valve (81)

4.1 For versions with additional protecting cap (64):

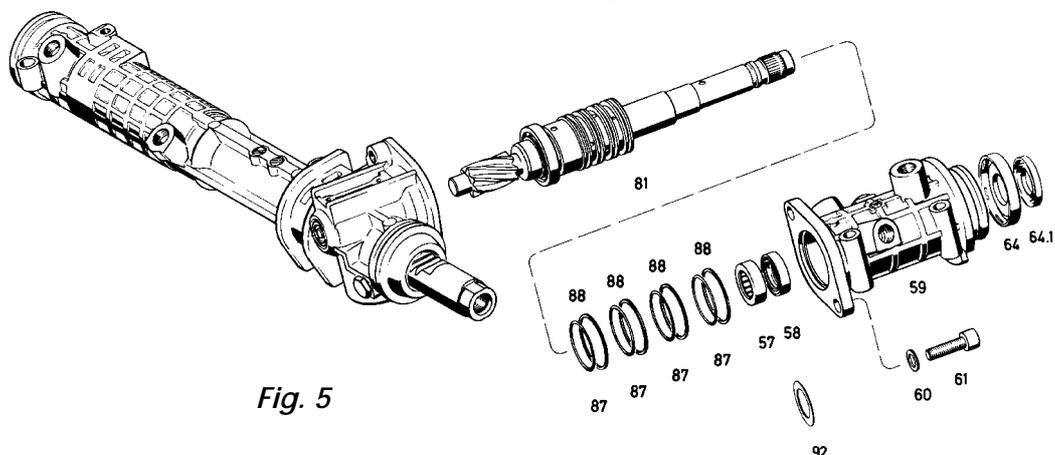


Fig. 5

For versions with additional support shim (92)

Remove the protecting caps (64 and 64.1) (Fig. 5).

4.2 Rotate the rack (3) to the straight ahead position, in other words, relative to the steering lockstop the length of projection of the rack ends must be equal at either side.

Measure the distance dimension - end of rack (3) to steering lockstop - and write it down, as it will serve as a checking dimension for reassembly.

Mark the position of the rotary valve (81) relative to the valve housing (59) / the housing (1).

4.3 Versions with valve housing (59)

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

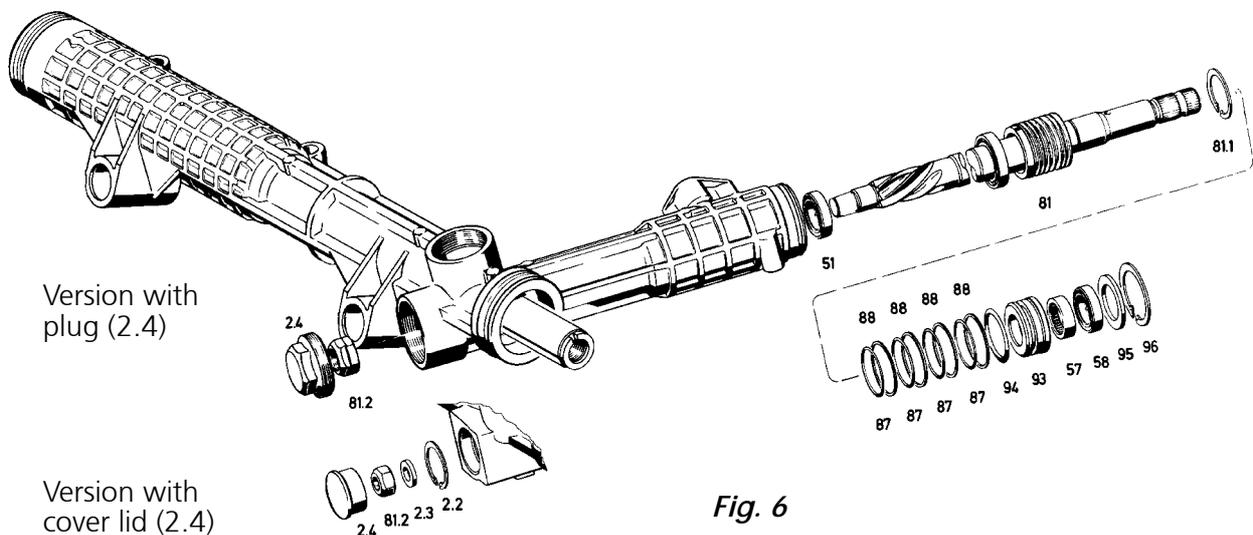
Lift the valve housing (59) off.

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.

Remove the support shim (92) if there is one.

Pull out the shaft seal (58) and the roller bearing/needlesleeve using tools [2] and [3].

4.4 Versions without valve housing (59)



Screw out the plug (2.4)/remove the cover lid (2.4) by pushing it off to the side (*Fig. 6*).

Screw out the locking screw/locking nut (81.2) and remove the washer (2.3).

Unsnap the retaining rings (2.2, 81.1 and 96).

For a version with additional roller bearing (53):

Using tools [2] and [3], pull out the roller bearing (53) along with the shaft seal (51).

4.4.1 For versions with cover lid (2.4)

Clamp the input shaft stub of the rotary valve (81) in a vice, making sure soft jaws are used. Drive the rotary valve (81) out along with the bush (93) by knocking on the housing (1) with a plastic tip hammer.

4.4.2 For versions with plug (2.4)

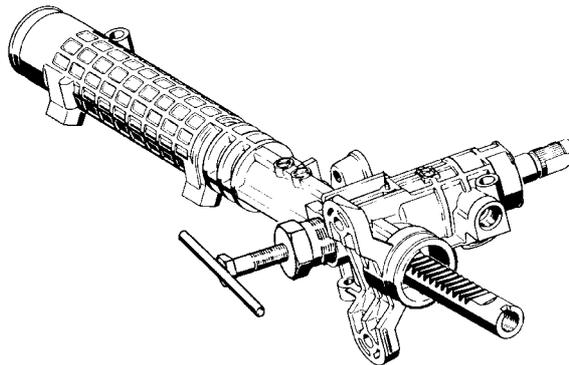


Fig. 7

Put on tool [22] *as shown in Fig. 7*.

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

4.4.3 Slip off the washer (95) and the bush (93).

Remove the O-ring (94) (*Fig. 6*).

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

Using tools [2] and [3], pull the roller bearing/needle sleeve (57) out of the bush (93).

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

Note:

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

5 Removing the cylindrical tube (22)

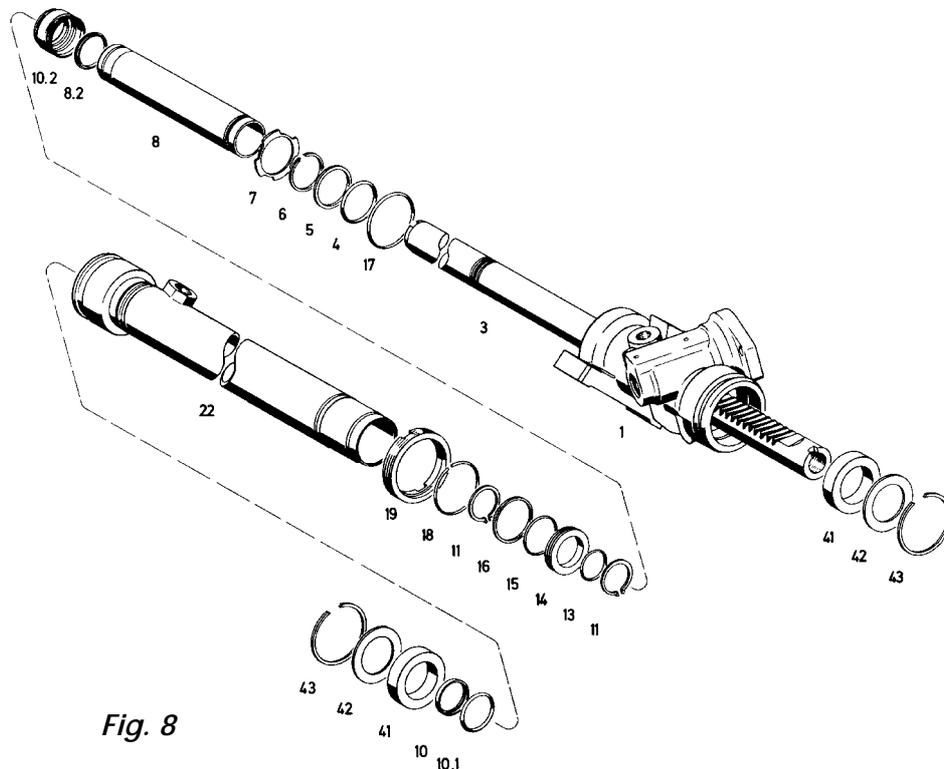


Fig. 8

Mark the position of the cylindrical tube (22) relative to the housing (1).

Using tool [4], screw out the threaded ring (19) (**Fig. 8**).

Pull the cylindrical tube (22) along with the rack (3) out of the housing (1).

Unsnap the snap ring (18) without leaving any scratches on the cylindrical tube (22).

Remove the threaded ring (19) and the O-rings (17).

6 Removing the rack (3)

6.1 Versions with cylindrical tube (22)

Pull the rack (3) and the spacer tube (8) out of the cylindrical tube (22) (**Fig. 8**).

Unsnap the retaining rings (11) without leaving any scratches on the rack (3).

For versions with additional support ring (12):

Remove the support rings (12) without leaving any scratches on the rack (3).

Remove the piston (14) and the sealing components (13, 15 and 16).

Pull the spacer tube (8) off the rack (3).

Version without guide ring (9) (**Fig. 8**)

Pull off the tension spring of seal (10.2).

Pull seal (10.2) and support ring (8.2) off the spacer tube (8).

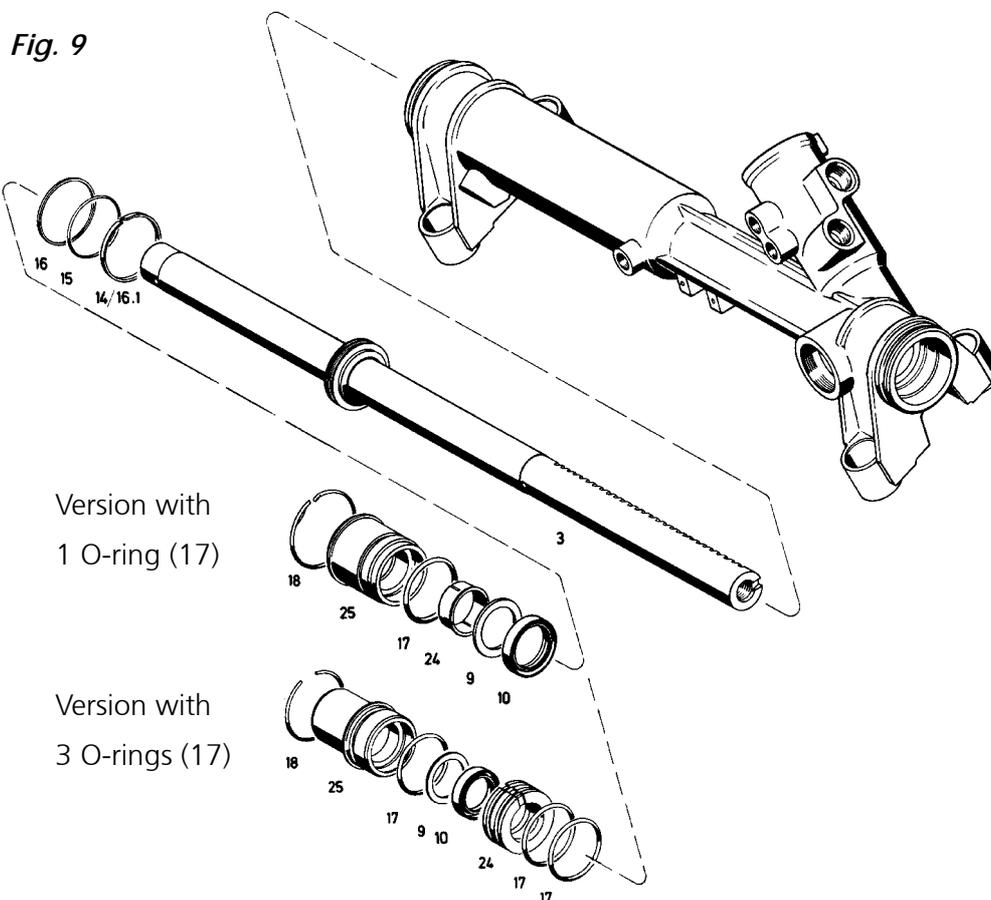
Version with guide ring (9)

Remove the guide ring (9) and the seal (10).

Unsnap the snap ring (43), remove the washer(42) and press the buffer (41) out of the cylindrical tube (22).

Remove the sealing ring (10) and the O-ring (10.1).

6.2 Versions without cylindrical tube (22)



Unsnap the snap ring (18).

Pull the rack (3) out of the housing (1) along with the piston rod guide (25) (**Fig. 9**).

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 guide ring (14 or 16.1), the O-ring (15) and the sealing ring (16) from the rack.

For versions with 3 additional O-rings (17):

Remove the 2 additional O-rings (17) (*see Fig. 9*).

6.3 Versions with silent blocs (119 and 119.1)

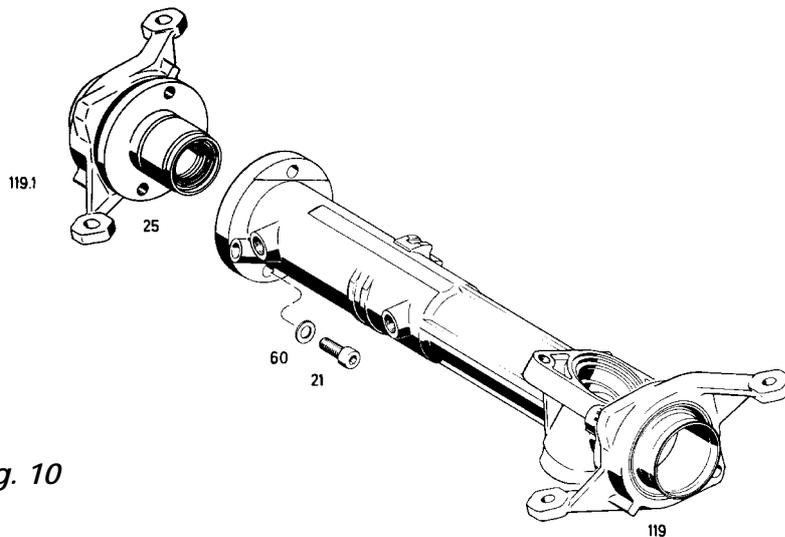


Fig. 10

Mark the position of the silent bloc (119.1) relative to the housing (1).

Screw the cylinder screws (21) with washers (60) out (**Fig. 10**).

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

For the removal of the bearing bush (24) please refer to Item 6.2.

Note:

A dismantling of silent bloc (119) or a removal of silent bloc (119.1) from the piston rod guide 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.

7 Disassembling the housing (1)

7.1 Remove the bearing bush (24)

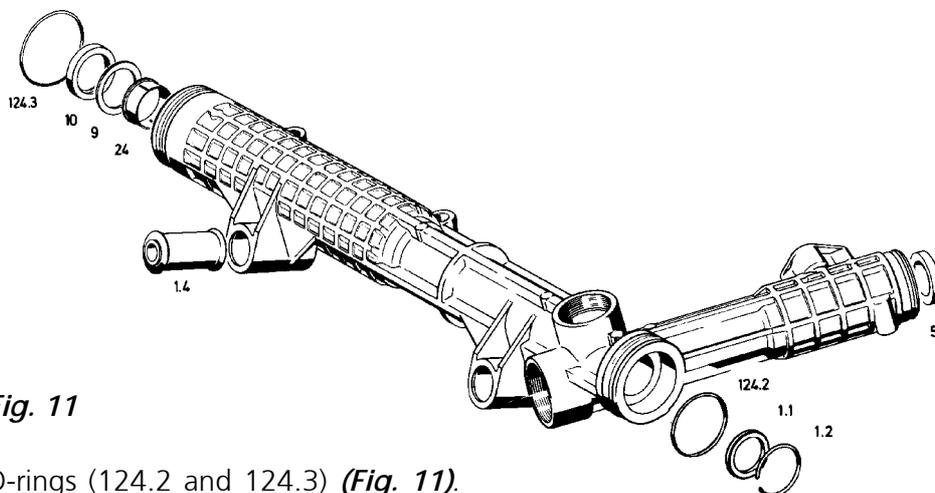


Fig. 11

Remove O-rings (124.2 and 124.3) (**Fig. 11**).

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

Using a suitable mandrel, press the bearing bush (24), the washer (9) and the seal (10) out towards the cylinder chamber (**Fig. 11**).

Press the silent bearing (1.4) out.

Unsnap the snap ring (1.2) and remove the stop ring (1.1).

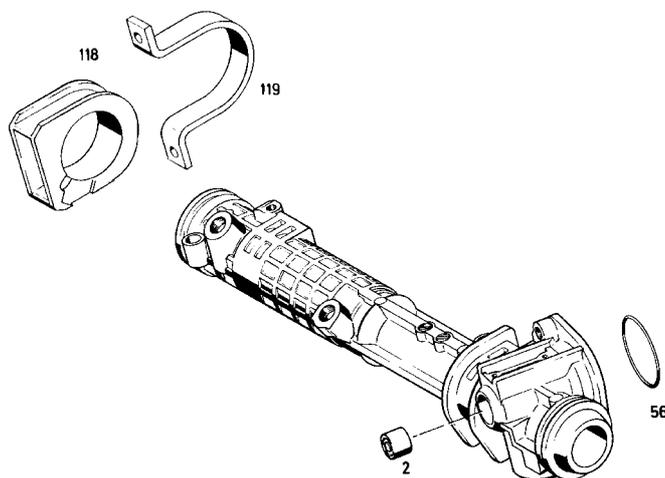


Fig. 12

Remove the O-ring (56) (**Fig. 12**).

Mark the positions of the rubber part (118) and of the clamp (129).

Remove both parts.

7.2 For versions without plug / protection cover (2.4)

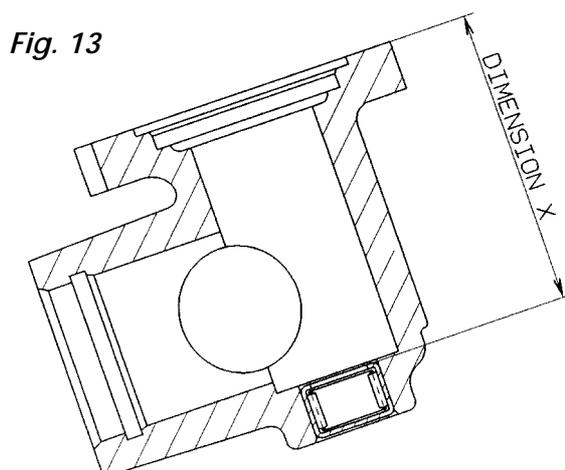


Fig. 13

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 write it down (**Fig. 12/13**).

Press the needle bush (2) out, using an appropriate mandrel.

7.3 For versions with plug / protection cover (2.4)

If any wear is found on the journal of the rotary valve (81), press the ball bearing (2) out along with the washer (2.3), using an appropriate mandrel (*Fig. 14*).

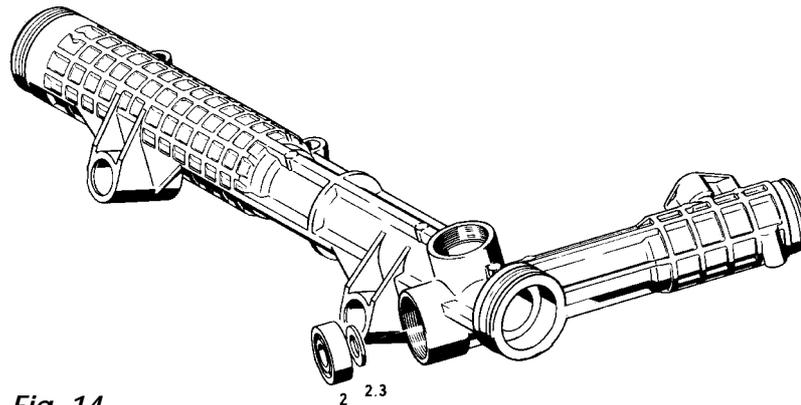


Fig. 14

II. 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 spare parts list.

Attention:

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

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 Valve housing (59)

- 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

3 Housing (1) and cylindrical tube (22), respectively

- check the shaft seal seat for rubber rests
- threads

Note:

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

- check sealing ring seats and 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)

4 Rack (3)

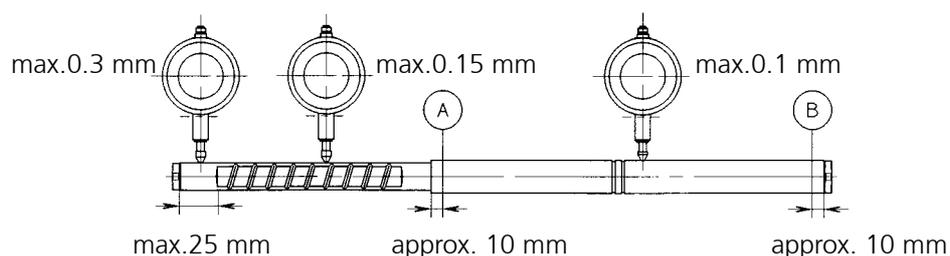
- force fit of piston (14)
- crack detection:
lengthwise and crosswise using an appropriate method, e.g. ferro-flux testing



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 surface 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 or finer. 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 Cylindrical tube (22)

- check the sealing ring seats and recesses for damages
- contact surface of piston

8 Pipes (100, 101 and 102)

- sealing ring seats
- threads

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7	Pre-assembling the valve housing (59)	27
8	Pre-assembling and fitting the rotary valve (81)	28
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10	Fitting the pipes (100, 101 and 102)	36
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III. Assembly



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.

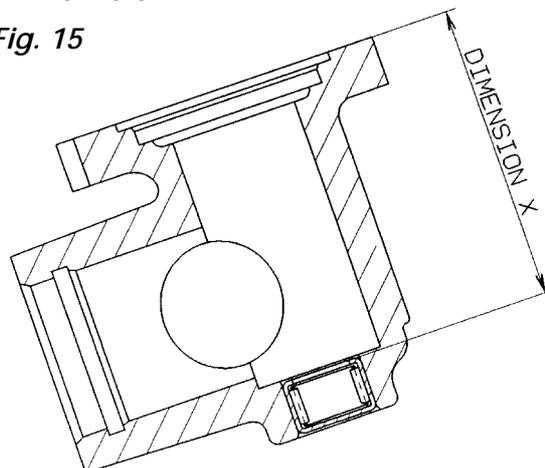
Note:

- 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, seals, shaft seals and O-rings 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 grease 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)

1.1 For versions without plug/protection cover (2.4)

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 [5], press it into the housing (1) until the pressing-in depth (dimension X) is reached (*Fig. 15*).

1.2 For versions with washer (2.3)

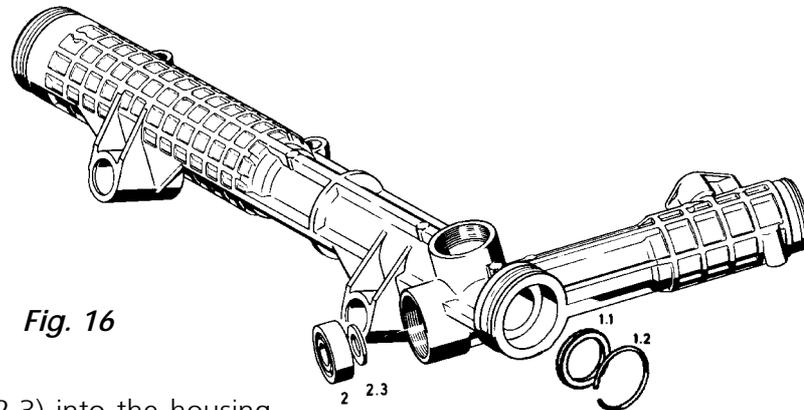


Fig. 16

Insert the washer (2.3) into the housing.

Press the ball bearing (2) in until it is in perfect contact with the housing.

Use tool [5] (*Fig. 16*).

1.3 For versions with additional stop ring (1.1 or 41):

Press the stop ring (1.1 or 41) in. Snap the snap ring (1.2) in.

2 Pre-assembling the spacer tube (8) and the rack (3)

2.1 Mount the spacer tube (8)

Versions without guide ring (9)

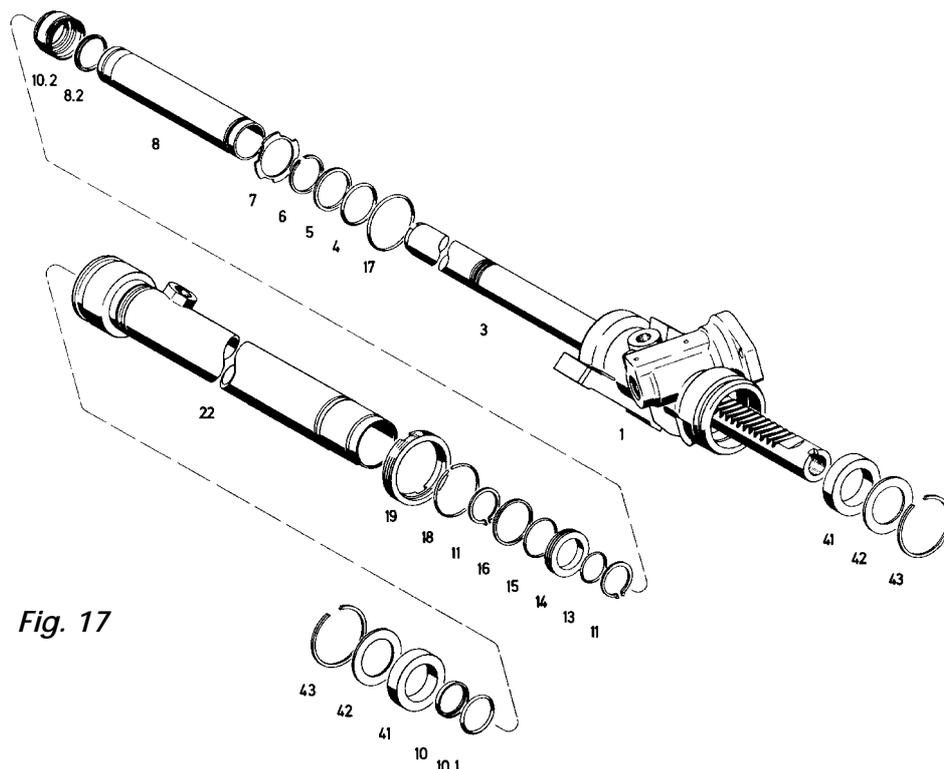


Fig. 17

Clamp the toothed part of the rack (3) in the vice in a vertical position (make sure soft jaws are used).

Fit the support ring (8.2) into the recess of the spacer tube (8) (*Fig. 17*).

Press the seal (10.2) onto the greased spacer tube (8) until it is in perfect contact with the spacer tube.

Put tool [14] on the end of the rack.

To protect the sealing lip of the seal (10.2), stick an adhesive tape (sellotape, scotch tape or similar) to the rack recesses.

Introduce the tool [21] into the seal (10.2) until it is in perfect contact with the support ring (8.2).

Note:

The sealing lip is thus momentarily widened to such an extent that it can be fitted without being damaged.

Cautiously (preferably in a turning motion) slip the spacer tube (8) onto the rack (3).

Make sure no fragments of the adhesive tape are left in the seal (10.2).

Remove the adhesive tape from the rack (3).

Versions with guide ring (9)

Clamp the toothed part of the rack (3) into the vice in a vertical position (make sure soft jaws are used).

Slip the tool [10] over the rack (3) and put it on the vice.

Slip the spacer tube (8) onto the rack (3) in such a way that the larger diameter is pointing upward.

Place the guide ring (9) in the spacer tube (8) as shown in *Fig. 18*.

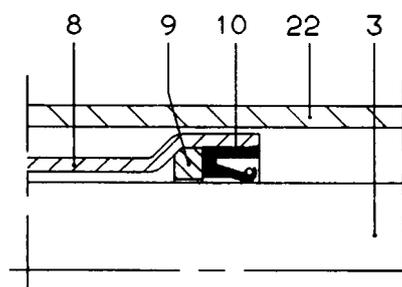


Fig. 18

Cover the recesses on the rack with adhesive tape.

Using tool [11], slip the seal (10) across the recesses and press it into the spacer tube (8).

2.2 Assembling the piston (14)

Mount the O-ring (15) and the sealing ring (16) to the piston (14) (*Figs. 19/20*).

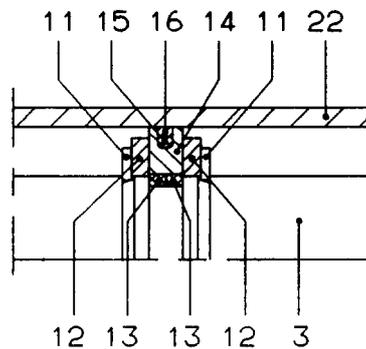


Fig. 19

Snap the rear retaining ring (11) in and mount the O-ring (13).

Slip the piston (14) onto the rack (3) until it is in contact with the rear retaining ring (11).

Snap the second retaining ring (11) in.

For versions with additional support ring (12):

Mount the support rings (12) as shown in *Fig. 19*.

Note:

If the mounting of the retaining rings (11) or that of the support rings (12) caused scratches on the rack (3), such scratches must be removed by repolishing.

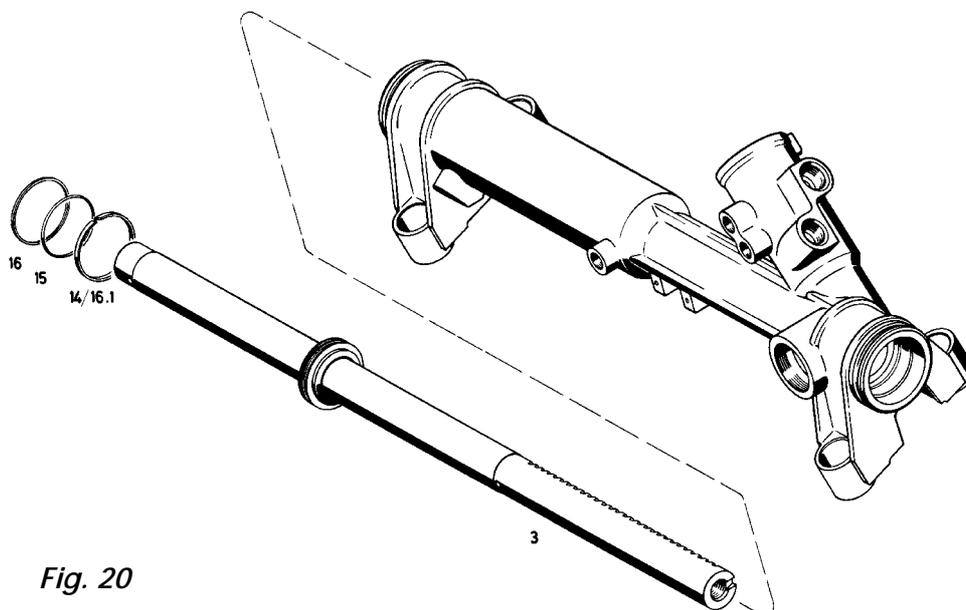


Fig. 20



Attention:

Make sure the retaining rings (11) are completely engaged. There may be no radial play at the groove base as, thereby, the retaining rings (11) might be pressed out, thus making it impossible to move the steering gear.

Make sure the seal (10) is then perfectly round again and fitting snugly to the sealing surface. Insert the buffer (41) and the washer (42) and secure them with the snap ring (43).

4 Mounting the cylindrical tube (22) to the rack (3)

Introduce the tool [12] into the thread at the rack end. Slip the cylindrical tube (22) over the piston (14), taking care not to damage any sealing elements.

5 Fitting the cylindrical tube (22) to the housing (1)

Fill the teeth of the rack (3) with grease (for a convenient grease, refer to the spare parts list).

Insert the O-ring (17) into the housing (1).

Insert the rack (3), with the cylindrical tube (22) fitted to it, into the housing (1).

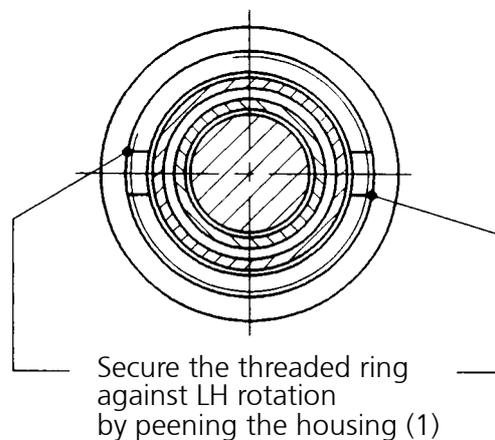
Screw the threaded ring (19) into the housing (1) in such a way that the position of the cylindrical tube (22) relative to the housing (1) (that had been marked during disassembly) is attained.

Tighten with tool [4].

Tightening torques:	Type 7830:			90+10 Nm (M45x1.5)
	Type 7832:	Snap ring	2.5 mm	120+10 Nm (M56x1.5)
		Snap ring	3.5 mm	150+10 Nm (M56x1.5)
	Type 7852:			140+10 Nm (M68x1.5)

Secure the threaded ring (19) against a rotation to the left by peening (see Fig. 23) the housing (1).

Fig. 23



Note:

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

6 Finish assembling the housing (1) and mounting the rack (3)

Note:

For versions without cylindrical tube (22) only.

Mount the O-ring (15) and the sealing ring (16) to the piston (14) of the rack (3) (see Fig. 20).

For versions with additional guide ring (14 or 16.1):

Mount the additional guide ring (14 or 16.1) (see Fig. 20).

Put the bearing bush (24), the washer (9) and the seal (10) on tool [13] and press these parts into the housing (1) (Fig. 24).

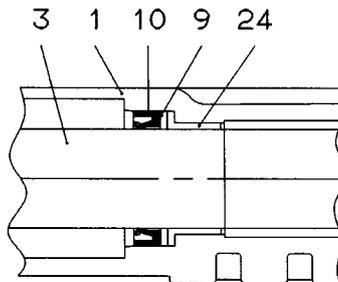


Fig. 24

Note:

Alignment of seal (10) (see Fig. 24).

Slip tool [15] on the rack (30) (see Fig. 25).

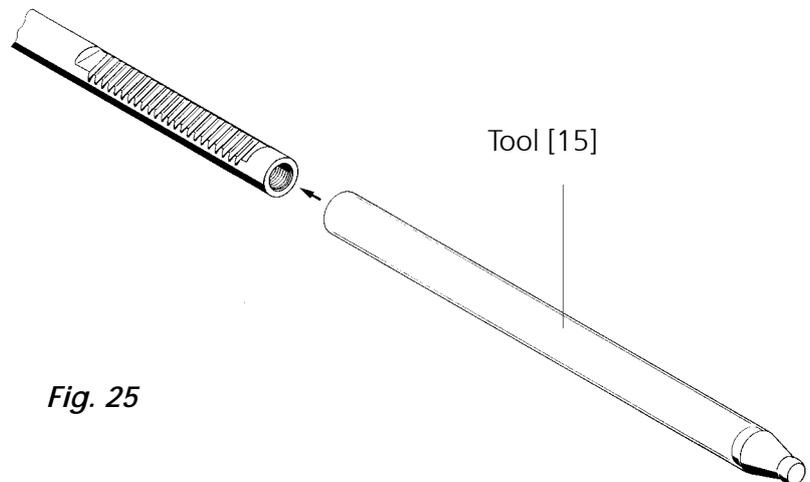


Fig. 25

Determine dimension „X“ (see Fig. 26).

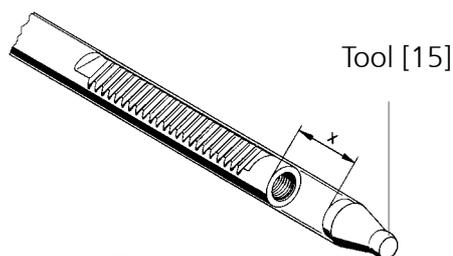


Fig. 26

Shorten the spacer of tool [15] to the determined dimension „X“ (see *Fig. 27*).

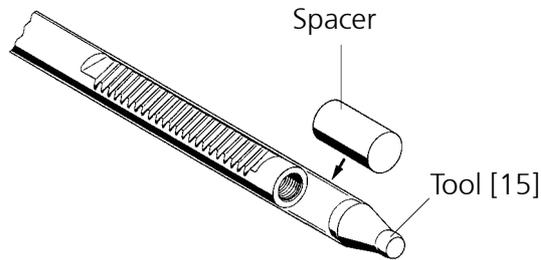


Fig. 27

Fill the teeth of the rack (3) with grease (grease specification: see spare parts list).

Put the spacer and tool [15] on the rack (3) as shown in *Fig. 28*.

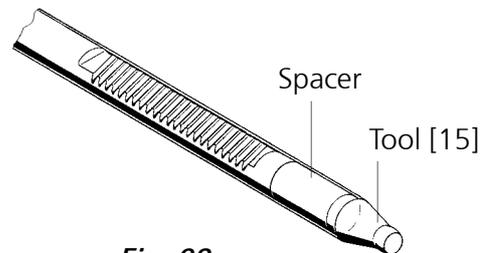


Fig. 28

With tool [15], insert the rack (3) into the housing (1), taking care not to damage any sealing elements (*Fig. 30*).

Remove tool [15] and the spacer.

With tool [13], fit the bearing bush (24), the washer (9) and the seal (10) into the piston rod guide (25).

Note:

- Alignment of seal (10 or 10.9) see *Fig. 29*.
- Depending on the version, instead of washer (9) and seal (10), seal (10.9) - seal and washer assembly - can be installed.

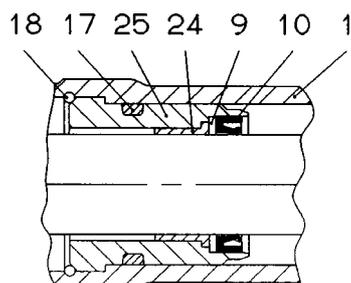


Fig. 29

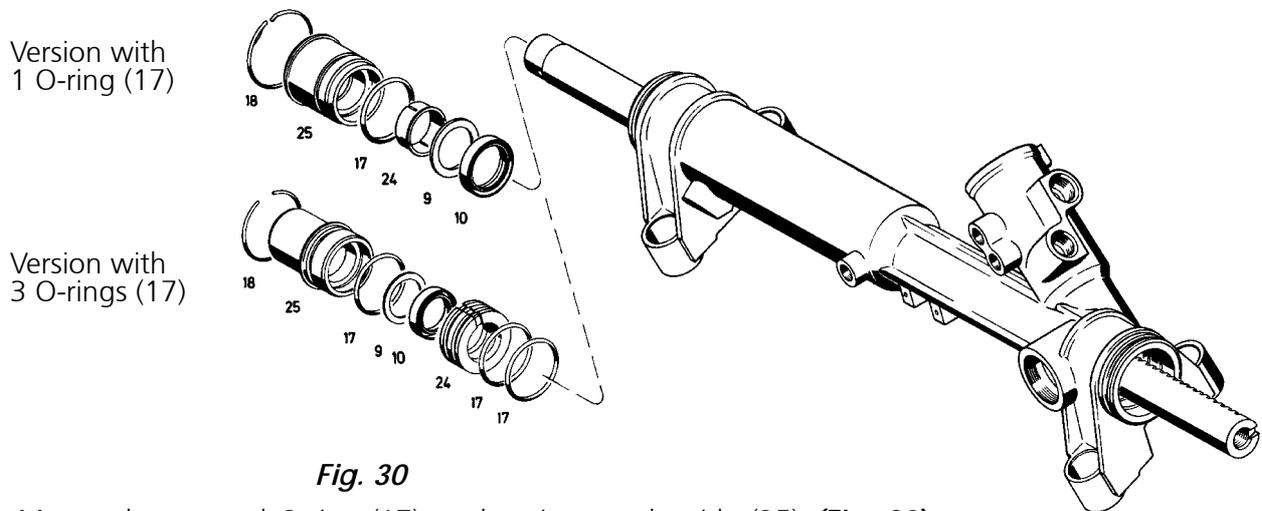


Fig. 30

Mount the greased O-ring (17) to the piston rod guide (25) (**Fig. 30**).

For versions with 3 additional O-rings (17):

Mount the additional O-rings (17).

Taking care not to damage any sealing elements, slip the pre-assembled piston rod guide (25) on the rack (3) and press it into the housing (1) until it is in contact with the shoulder in the housing.

Engage the snap ring (18) in such a way that one end of the snap ring (18) is pointing towards the housing bore (if existing).

 **Attention:**
Check whether the snap ring (18) fits well.

For versions with silent blocs (119 and 119.1)

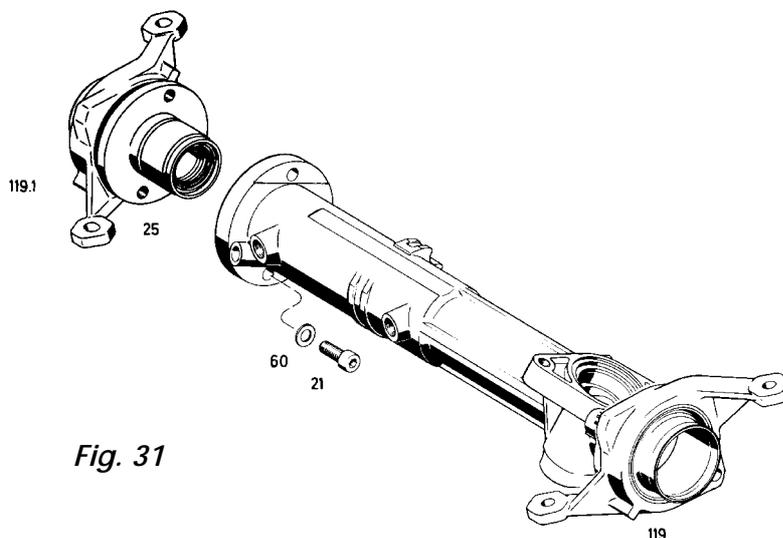


Fig. 31

Introduce the silent bloc (119.1) along with the pre-assembled piston rod guide (25) (**Fig. 31**).

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

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

Tightening torque: 17+3 Nm (M8)

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.

7 Pre-assembling the valve housing (59)

Fill the space between the sealing lip and the dust lip with grease (cf. remarks at the beginning of Chapter III.).

Using tool [16], press the shaft seal (58) into the valve housing (59) (*Fig. 32*).

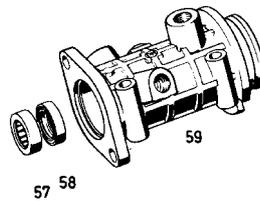


Fig. 32

Alignment of shaft seal (58) see *Fig. 33*.

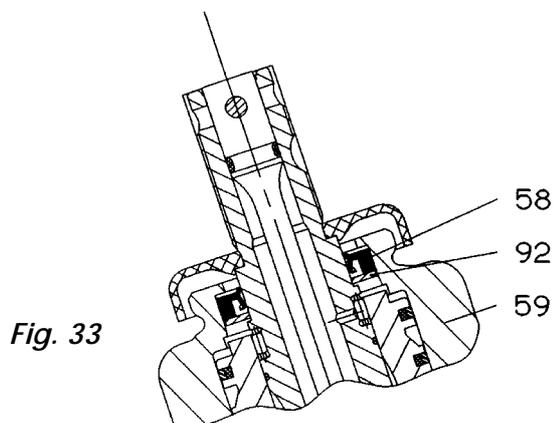


Fig. 33

Using tool [16], press the roller bearing/needle sleeve (57) in until it is in perfect contact with the valve housing.

Note:

If the roller bearing or the needle sleeve (57) had been peened originally, the peening operation following the pressing-in operation must be carried out in exactly the same way as the original peening.

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

8.1 Pre-assembling the rotary valve (81)

Mount the O-rings (87) and the sealing rings (88) to the rotary valve (81) (*Fig. 34*).

Engage the retaining ring (81.1).

Using tool [17], press the shaft seal (51) into the housing (1) until it is in perfect contact with the housing.

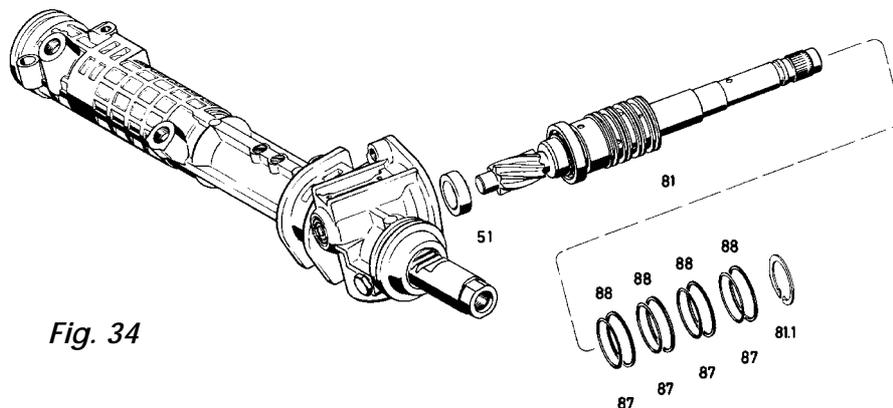


Fig. 34

Alignment of shaft seal (51) see *Fig. 35*.

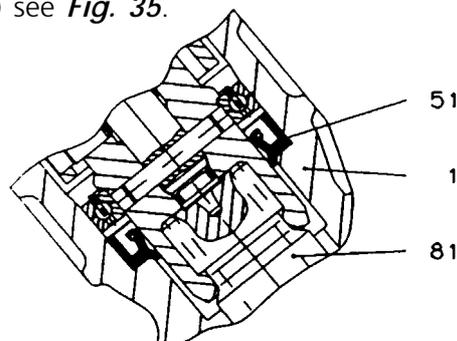


Fig. 35

For a version with additional roller bearing (53):

Using tool [17], press the shaft seal (51) into the housing (1) until it is in perfect contact with the housing (**Fig. 36**).

Grease the roller bearing (53) and, using tool [17], press it in until it is in perfect contact with the housing.

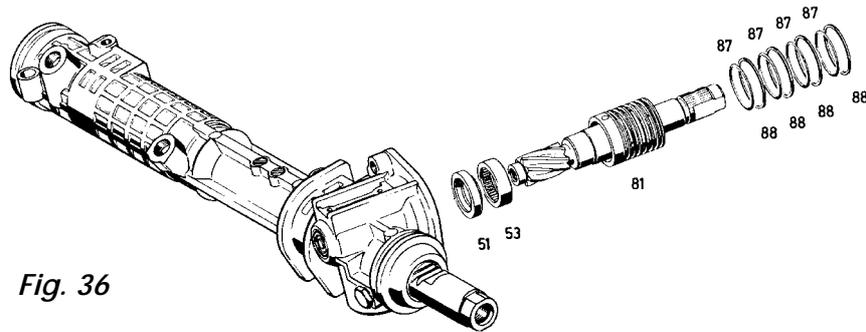


Fig. 36

8.2 Fitting the rotary valve (81)

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

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 it is in perfect contact with the housing bore.

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

Note:

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

8.3 For versions with valve housing (59)

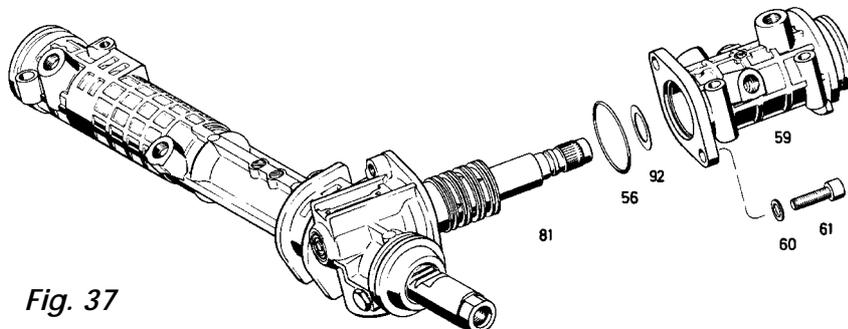


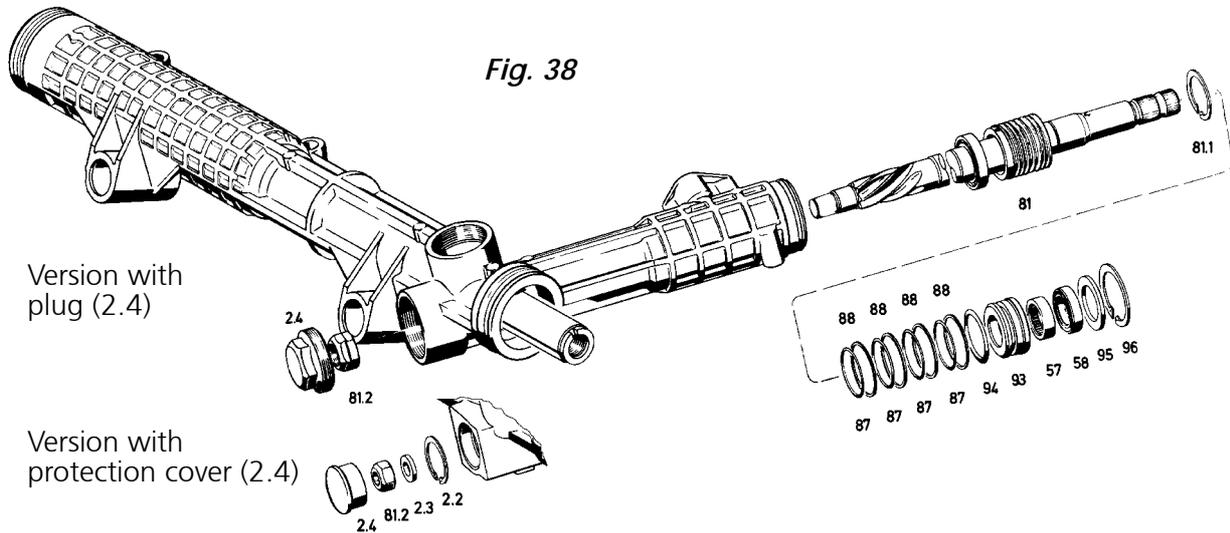
Fig. 37

Mount the O-ring (56) (**Fig. 37**). Put the support shim (92) into place. Put tool [18] on the stub input shaft. Put the valve housing (59) into place.

Screw the cylinder screws (61) with washers (60) in and tighten them.

Tightening torques: 7+1 Nm (M6)
 17+3 Nm (M8) for cylinder screws with surface protection
 23±2 Nm (M8) for cylinder screws without surface protection

8.4 For versions without valve housing (59)



8.4.1 Engage the retaining ring (2.2), put the washer (2.3) on and screw the locking screw/locking nut (81.2) in (Fig. 38).

Tightening torques: 35+4 Nm (M8) - locking screw
 22+4 Nm (M10) - locking nut
 45+5 Nm (M14x1.5) - locking nut

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

Check:

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

8.4.2 Versions with plug (2.4)

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)
 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.

8.4.3 Versions with protection cover (2.4)

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

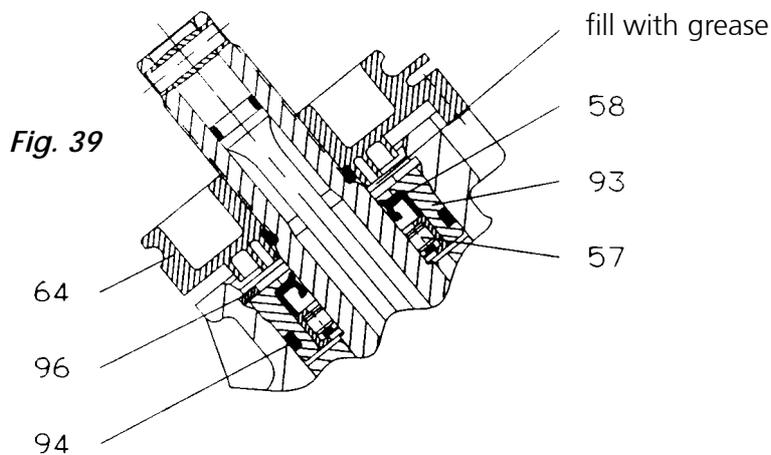
Press the protection cover (2.4) on (Fig. 38).

8.4.4 Pre-assemble and fit the bush (93)

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

Align the shaft seal (58) as shown in **Fig. 39** and, using tool [16], press it into bush (93) until it is fitting snugly into the bush.

Using tool [6], press the roller bearing (57) into the bush (93) until the front face of the bush is flush with the rollerbearing.



Mount the O-ring (94) on the bush (93).

Place tool [18] on the input shaft.

Using tool [19], press the bush (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 whether the retaining ring (96) fits well.

8.5 For versions with additional protecting cap (64)

Note:
Press the protecting cap (64) on only after the functional test, Chapter IV., has been carried out.

Fill the protecting cap (64) with grease (*see Fig. 39*) and press it on the rotary valve (81) in a way avoiding any contact with the housing (1) or the valve housing (59).

9 Fitting the yoke (30) and adjusting the yoke play

9.1 Versions with cover (34)

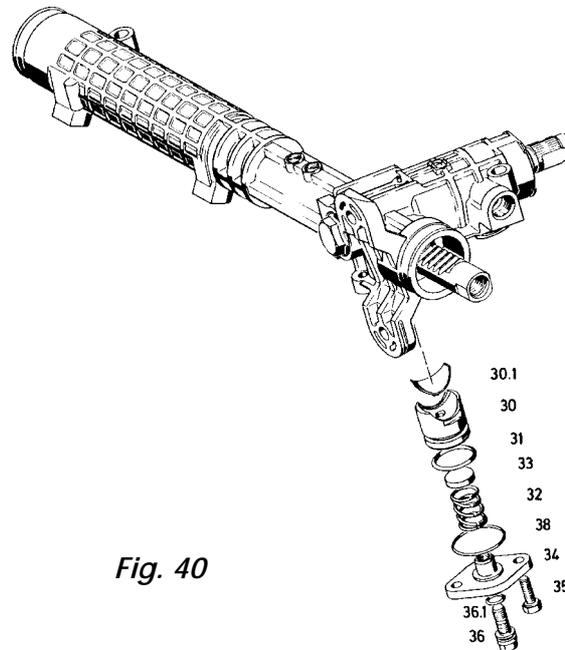


Fig. 40

9.1.1 Versions without adjusting screw (36)

Insert the yoke (30) with the insert foil (30.1), but without the O-rings (31), in the housing (1) (*Fig. 40*).

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

Fit a commercially available dial gauge to tool [20].

By means of a gauging plate, set tool [20] to zero.

Place tool [20] on the compression spring (32) and fasten it with 2 screws.

Using tool [9], rotate the rack (3) through the maximum permissible total stroke and, in 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) to be inserted.

Remove tool [20] and the yoke (30).

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

Fit the yoke (30) with the insert foil (30.1), as well as 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 the hexagon screws (35).

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

Check:

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

9.1.2 Version with adjusting screw (36)

Insert the yoke (30), with the insert foil (30.1) and the O-ring (31) fitted, into the housing (1) (*Fig. 40*).

Put the washer (33) and the greased compression spring (32) on (grease specification see spare parts list).

Insert the O-ring (38) and fasten the cover (34) with the hexagon screws (35).

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

Screw the adjusting screw (36), with the O-ring (36.1) fitted, into the cover (34).

If a new insert foil (30.1) is used in addition
Using tool [8], fit a commercially available torque wrench to the input shaft. Screw in the adjusting screw (36) until a lock to lock turning torque of 8...10 Nm is attained at the input shaft.

Then, using tool [9], rotate the input shaft 6 times through the total stroke at a rotating velocity of approx. 1.3 turns/second.

Screw the adjusting screw (36) 1/4 turn out.

Adjusting the play of the yoke
Rotate the steering gear from lock to lock at the input shaft and screw the adjusting screw (36) in until the rack displacement is braked.

Next, screw the adjusting screw (36) approx. 30° back.

Check:

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

9.2 Versions with adjusting screw (34)

9.2.1 Versions with measuring bore in the adjusting screw (34)

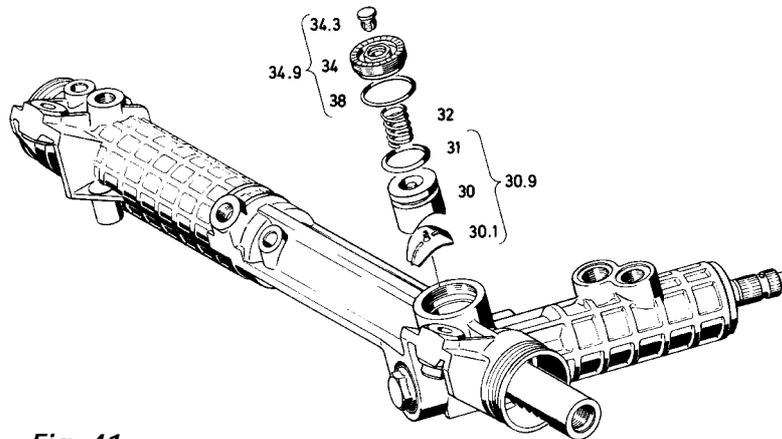


Fig. 41

Insert the O-ring (31) and the insert foil (30.1) into the yoke (30) (**Fig. 41**).

Insert the yoke (30) into the housing.

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

Rotate the steering gear to mid-position.

For a version with additional O-ring (34.4):

Insert O-ring (34.4).

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. 42**.

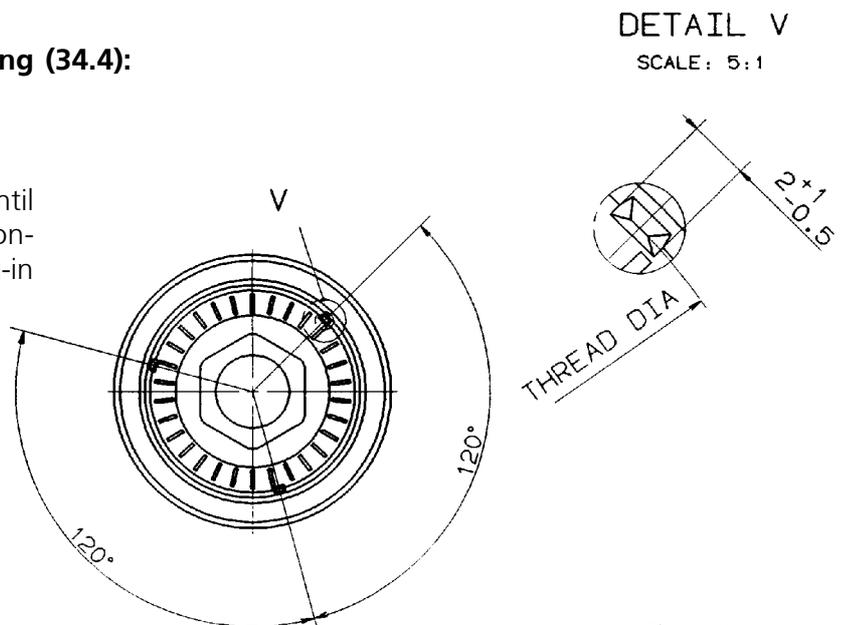


Fig. 42

At the rotary valve (81), rotate the steering gear 6 times through the total stroke of the rack (3). Use tool [9] to this effect.

Note:

Do not shift the rack (3) to the stroke end positions without the tie rods fitted to it for otherwise, 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.

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

Fit tools [23] to restrict the rack stroke to 1...3 mm.

Fit tool [20] and a commercially available dial gauge.

Using tool [9], rotate the rotary valve (81) to the left and to the right (torque approx. 12 Nm) and measure the yoke play.

Specified value: 0.1 mm maximum

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 in yoke play of 0.05 mm.

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:

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).

9.2.2 Version without measuring bore in the adjusting screw (34)

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

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

Mount the yoke (30) and insert the greased compression spring (32) (grease specification see spare parts list).

Screw a new adjusting screw (34) in with 20 Nm minimum until the insert foil (30.1) is in play-free contact with the rack (3), and determine the screwing-in torque to be applied.

Tighten the adjusting screw (34) by applying the screwing-in torque determined +10 Nm.

Turn the adjusting screw (34) approx. 1 turn back.

At the rotary valve (81), rotate the rack (3) several times through the total stroke and, in doing so, continue to screw in the adjusting screw (34) until the rotation torque increases. Use tool [9] to rotate the rack.

Turn the adjusting screw (34) 2 graduation marks back.

Rotate the steering gear through the total stroke without damaging the seals (10).

Check:

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).

10 Fitting the pipes (100, 101 and 102)

10.1 Versions with union screws (104)

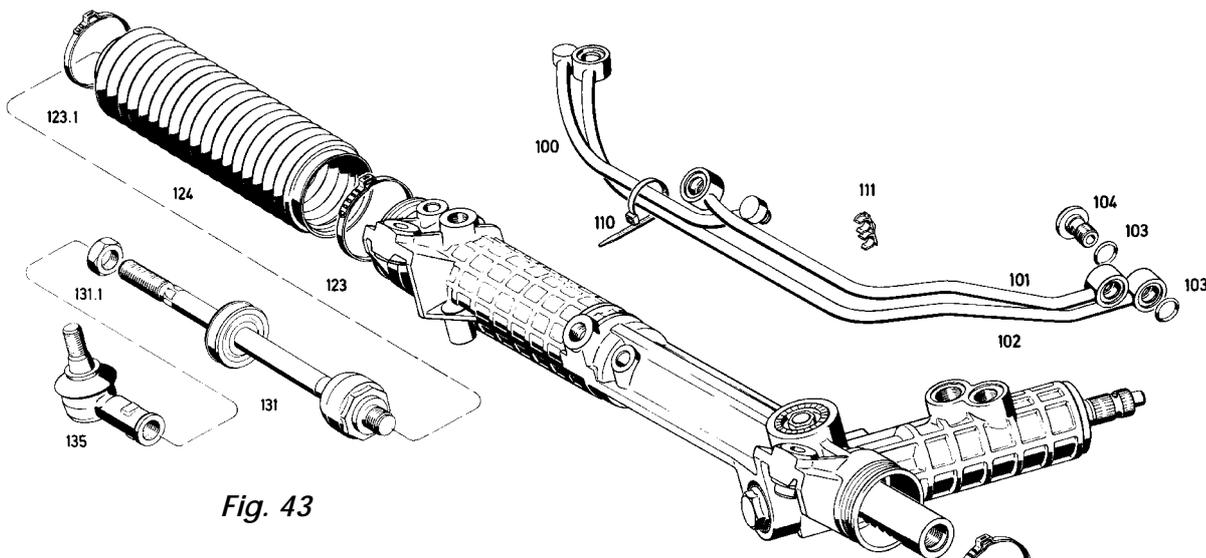
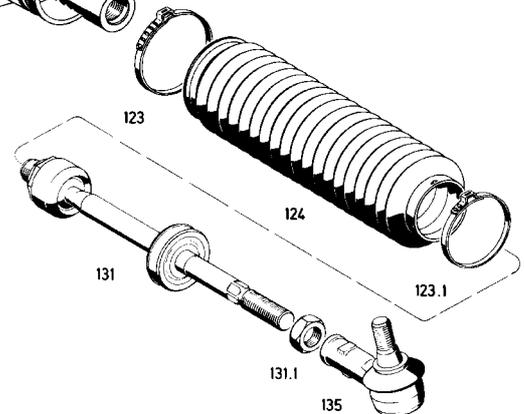


Fig. 43

Fit the pipes (101 and 102) along with the O-rings (103) and the union screws (104) (Fig. 43).

Tightening torque: 20 ± 2 Nm (M10x1/M12x1.5)

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



10.2 Versions with cap nuts/cap screws

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

Tightening torque: 10 ± 2 Nm (M12x1)

10.3 Fitting the pipe/compensating line (100)

For versions with an additional O-ring (100.2):

Mount the O-ring (100.2).

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).

11 Fitting the tie rods (131) and the bellows (124)

Note:

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

11.1 For versions with additional lever (124.1):

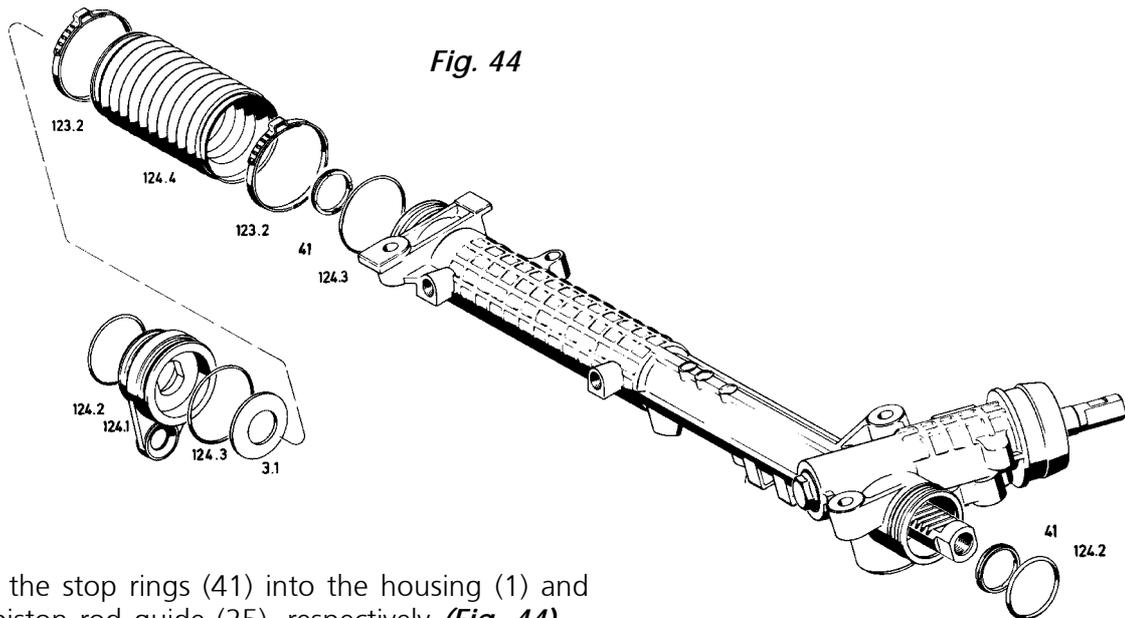


Fig. 44

Press the stop rings (41) into the housing (1) and the piston rod guide (25), respectively (**Fig. 44**).

Mount the O-rings (124.2 and 124.3).

Insert the cup spring (3.1) into the lever (124.1).

Position of cup spring (3.1) (**see Fig. 45**).

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).

Secure the bellows (124.4) with hose clamps (123.2).

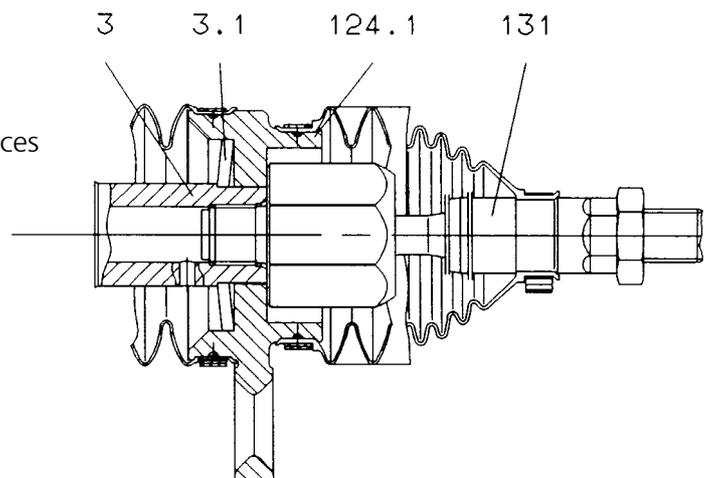


Fig. 45

11.2 Assembling the bellows (124)

As an assembly aid, spread the bearing surfaces of the bellows (124) with grease.
Slip the bellows (124) onto the tie rod (131) (*Fig. 43*).
Fit the O-rings (124.4) to the housing.

11.3 Versions without an additional tie rod (131) safety 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±10Nm	(M14x1.5/M16x1.5)

11.4 Versions with tab washer (29)

Fit the tab washer (29) to the tie rod (131).

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

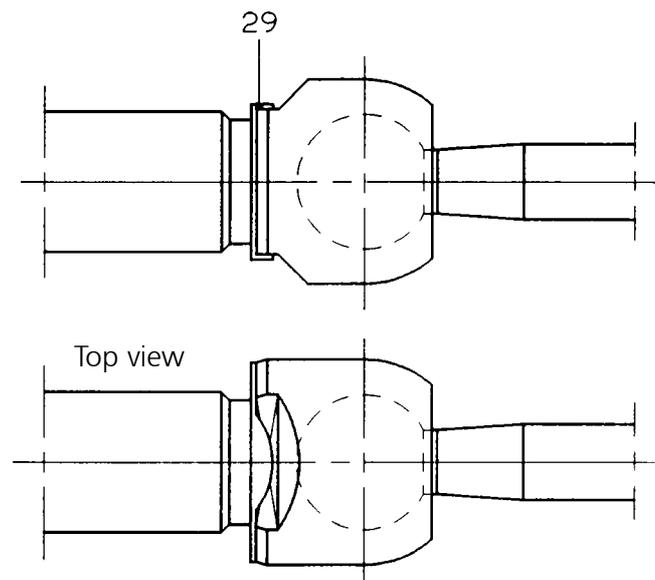


Fig. 46

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)

At both spanner flats, bend the tab washer (29) at right angles (*Fig. 46*).

11.5 Versions with locking collar

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±10Nm	(M14x1.5/M16x1.5)

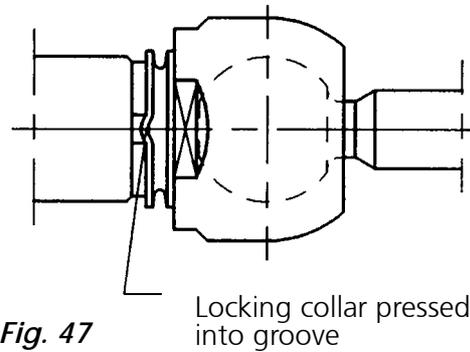


Fig. 47

Locking collar pressed into groove

Press the locking collar into the groove (**Fig. 47**).



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 tie rod (131) in until an unpeened material can be pressed in.

11.6 Peened version

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

If the rack (3) does not have a spanner flat, the teeth of the rack 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)

By peening, secure the tie rod (131) against rotation.

The number, shape and depth of peening(s) to be identical to that of the original peening.

11.7 Fastening the bellows (124)

Fasten the bellows (124) with the hose clips (123.1) (**Fig. 43**).

11.8 Fitting the rubber part (118) and the clamp (119) at the positions marked during disassembly.

IV. Functional Test

**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.

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 7830: 4.5 dm³/min

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, for 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 2.6 described below, also check the steering gear for external leakage.

2.2 Checking for maximum pressure

Restrain the rack (3) in mid-position. To be able to do so, mount tools [23].

By turning tool [9] in one direction of rotation, close the steering valve.

The pressure set at the test stand must now 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 [23].

By turning tool [9] in one direction of rotation, close the steering valve. Repeat the test in the other direction of rotation.

Maximum permissible leakage oil rate: 1 dm³/min

0.5 dm³/min for versions with a maximum pressure of 150 bar

2.4 Checking the hydraulic centre

Restrain the rack (3) in mid-position. To be able to do so, mount tools [23].

Close the steering valve by turning tools [7] and [8] in one direction until the pressure gauge shows 50 bar (100 bar for versions with maximum pressure 150 bar), and measure the torque to be applied to achieve this.

Implement the same test for the other turning direction.

Maximum permissible torque difference between LH and RH side: 0.6 Nm

2.5 Checking the self-centring of the valve

Restrain the rack (3) in mid-position. To be able to do so, mount tools [23].

Close the steering valve by turning tools [7] and [8] in one direction. Maximum pressure is thus built up.

Then, slowly let the tools go and allow a pump pressure of 10 bar above flow pressure to be built up. The valve must then return to neutral position, in other words, the oil pressure must drop to flow pressure within one second.

Implement this test in the other turning direction, too.

Checking for hooking during initial steering:

No noticeable hooking (hydraulic hooking at initial steering) may be found when initial steering is done with tools [7] and [8] 3 times, each, in the two directions of rotation alternatingly until approx. 50 bar are reached.

2.6 Checking the rack (3) sliding force

Note:

During this test, the bellows may not be fitted.

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 technical cover sheet

2.7 Checking the external leakage of the steering gear at a stemmed returnline pressure

At the test stand, set a return line pressure that is 7 bar higher than the return line pressure.

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

2.8 Providing the steering gear with a repair index number

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

V. 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 [1]
stiff operation in one direction	sealing ring (88) defective	replace [1]
	hydraulic centre not correct	replace [1]
play in the steering gear	wrong setting of yoke play	reset [2]
oil leakage	O-rings (103) defective	replace [1]
	sealing elements (10, 10.2, 51 and 58) defective	replace [1]

[1] see Chapters I. and III.

[2] see Chapter III.

[3] see Chapter II.

VI. Tightening Torques

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/protection cover (2.4)	M30x1.5 M45x1.5	30+5 Nm 70+5 Nm
threaded ring (19) Type 7830 Type 7832	M45x1.5 snap ring 2.5 mm M56x1,5 snap ring 3.5 mm M56x1.5	90+10 Nm 120+10 Nm 150+10 Nm
Type 7852	M68x1.5	140+10 Nm
cylinder screw (21)	M8	17+3 Nm
hexagon screw (35)	M6 M8	7+1 Nm 17+3 Nm
cylinder screw (61)	M6 M8 M8	7+1 Nm 17+3 Nm (cylinder screw with surface protection) 23±2 Nm (cylinder screw without surface protection)
locking screw (81.2)	M8	35+4 Nm
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	20±2 Nm
tie rod (131) Type 7830 7831 7832 7852	M14x1.5/M16x1.5 M14x1.5/M16x1.5	80±8 Nm 100±10 Nm

VII. 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 steering gear to be repaired.

Tool [1]

Insert for tie rods (131)



Tool [2]

Counter-support for internal extracting tool, tool [3]



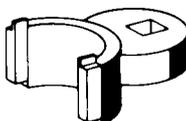
Tool [3]

Extracting tool for shaft seal (51/58), ball or roller bearing (53) and roller bearing (57)



Tool [4]

Slotted nut insert for threaded ring (19)



Ordering ref. for steering gear Type			
7830	7831	7832	7852
up to clamping diameter 38 mm 7830 798 151 in excess of clamping diameter 38 mm 7852 798 154			
	7421 798 351		7421 798 351
	7409 798 201		7409 798 201
36 7830 798 153		47 7842 798 151	55 7852 798 151
40 7830 798 152			
37 7830 798 154			

Tool [5]

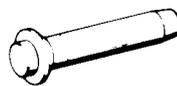
Mandrel for needle bush and ball bearing (2), respectively

- [1] Needle bush 11,11x17,46x12,7
- [2] Needle bush 12x18x12
- [3] Needle bush 13x19x12
- [4] Ball bearing 12x28x8
- [5] Ball bearing 15x42x13



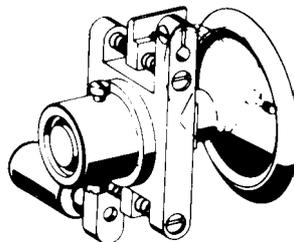
Tool [6]

Mandrel for roller bearing and bearing ring (57), respectively



Tool [7]

Torque meter (without tool [8] and without dial gauge)



Ordering ref. for steering gear Type			
7830	7831	7832	7852
[1] 7830 798 054	[4] 7831 798 052		
[2] 7881 798 051		[2] 7881 798 051	
		[3] 7844 798 053	[5] 7852 798 054
	7831 798 053		7831 798 053
		7633 798 051	
7470 798 703			

Tool [8]

Insert for tool [7] and [9]



- [1] with cylindrical serration
- [2] with bore 17.5 mm
- [3] with bore 17.6 mm
- [4] with bore 19 mm
- [5] with cylindrical serration
1 1/16" x 40 teeth
- [6] with serration 18,45x36

Tool [9]

Crank to rotate the steering from lock to lock



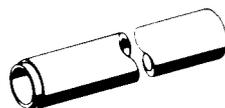
Tool [10]

Supporting ring for spacer tube (8)



Tool [11]

Press-in sleeve for seal (10)



- [1] Seal 26x35x7
- [2] Seal 28x38x7

Ordering ref. for steering gear Type			
7830	7831	7832	7852
[3] 7846 798 551	[2] 7832 798 551	[1] 8052 798 552	
		[4] 7840 798 551	[5] 7340 798 551
		[1] 8052 798 552	[2] 7832 798 551
[6] 7832 798 552			
7830 798 401			
		7842 798 351	7852 798 351
		[1] 7842 798 001	[2] 7852 798 001

Tool [12]

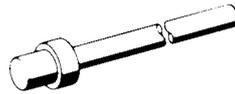
Guide bolt for advancing the rack



Tool [13]

Mandrel for seal (10)

- ① Seal 22x31x6,5
- ② Seal 24x33x7
- ③ Seal 26x35x7
- ④ Seal 28x38x7
- ⑤ Seal 30x40x7



Tool [14]

Advancing bush for spacer tube (8)



Tool [15]

Bush for rack



To be used with spacer



Ordering ref. for steering gear Type			
7830	7831	7832	7852
7830 798 052			
① 7830 798 055	② 7831 798 051	③ 7832 798 052	④ 8052 798 054
			⑤ 7852 798 053
7830 798 003			
22 7830 798 010	23 7830 798 011	26 7832 798 009	28 7852 798 015
23 7830 798 011	24 7831 798 004		30 7852 798 016
7830 798 012			

Tool [16]

Mandrel for shaft seal (58)

- ① Shaft seal 18x30x7/8
- ② Shaft seal 20x30x7/8
- ③ Shaft seal 22x32x7/8



Tool [17]

Mandrel for shaft seal (51) and ball or roller bearing (53)

- 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



Tool [18]

Advancing bush for shaft seal (58)

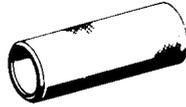
- ① Shaft seal 18x30x7/8
- ② Shaft seal 20x30x7/8
- ③ Shaft seal 20x30x5/6



Ordering ref. for steering gear Type			
7830	7831	7832	7852
② 7832 798 051	③ 7633 798 051	① 8052 798 051	
		② 7832 798 051	③ 7633 798 051
			② 7832 798 051
② 7418 798 051	① ④ 7844 798 052	② ⑤ ⑥ 7418 798 051	
		① 7844 798 052	
		③ 8484 798 051	
② 7830 798 001	① 8052 798 003		
		② 7832 798 001	③ 7852 798 008

Tool [19]

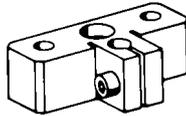
Press-in sleeve for bush (93)



Tool [20]

Dial gauge bracket for measuring the axial clearance - yoke (30)

- ① Screw spacing 48 mm
- ② Screw spacing 42 mm
- ③ Housing 50 mm



Tool [21]

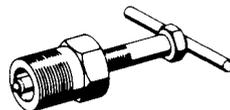
Mandrel for expanding seal (10.2)



Tool [22]

Tool for pressing out

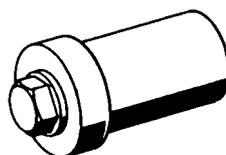
- ① thread M30x1.5
- ② thread M35x1.5
- ③ thread M45x1.5



Tool [23]

Restraining tool

- ① Rack (3) with M14x1,5
- ② Rack (3) with M16x1,5
- ③ Rack (3) with M18x1,5



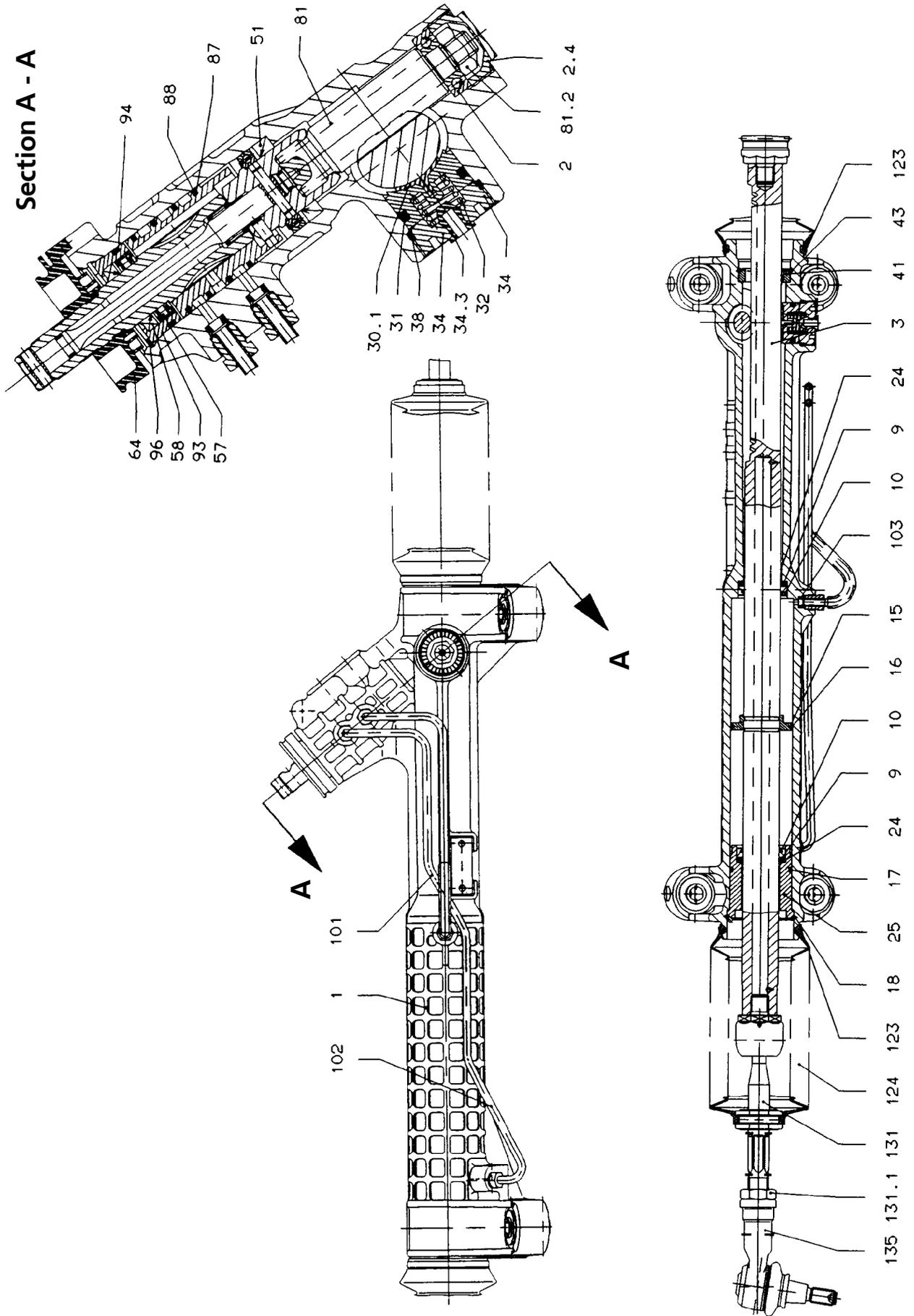
Ordering ref. for steering gear Type			
7830	7831	7832	7852
	7404 798 001		7428 798 054
		① 7832 798 701	
② 7830 798 701			③ 7810 798 701
7830 798 053			7852 798 051
① 7852 798 201			
			② 7852 798 202
			③ 7852 798 203
① 7831 798 701			
			② 7852 798 703
			③ 7852 798 704

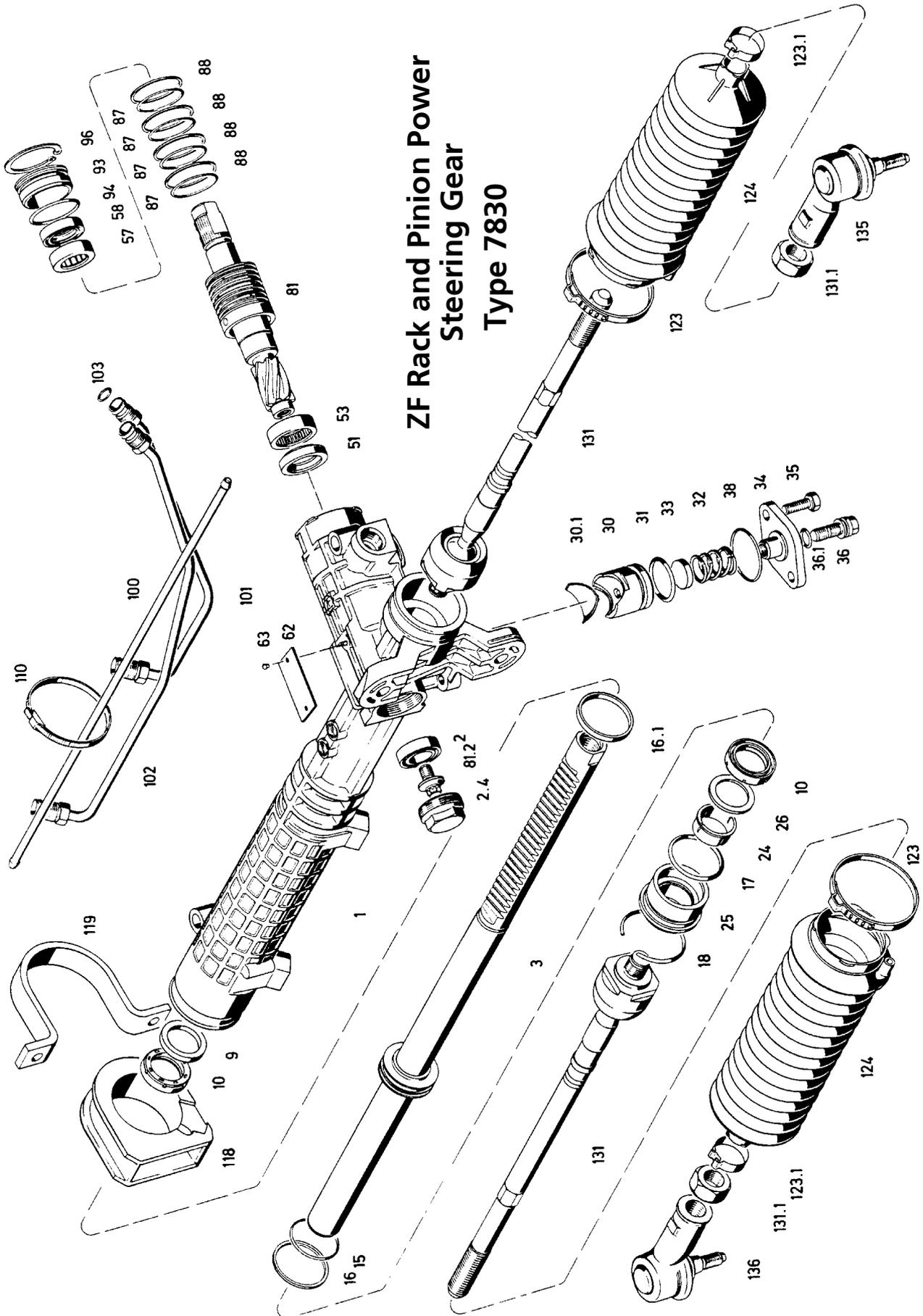
VIII. Key to Numbers in Figures

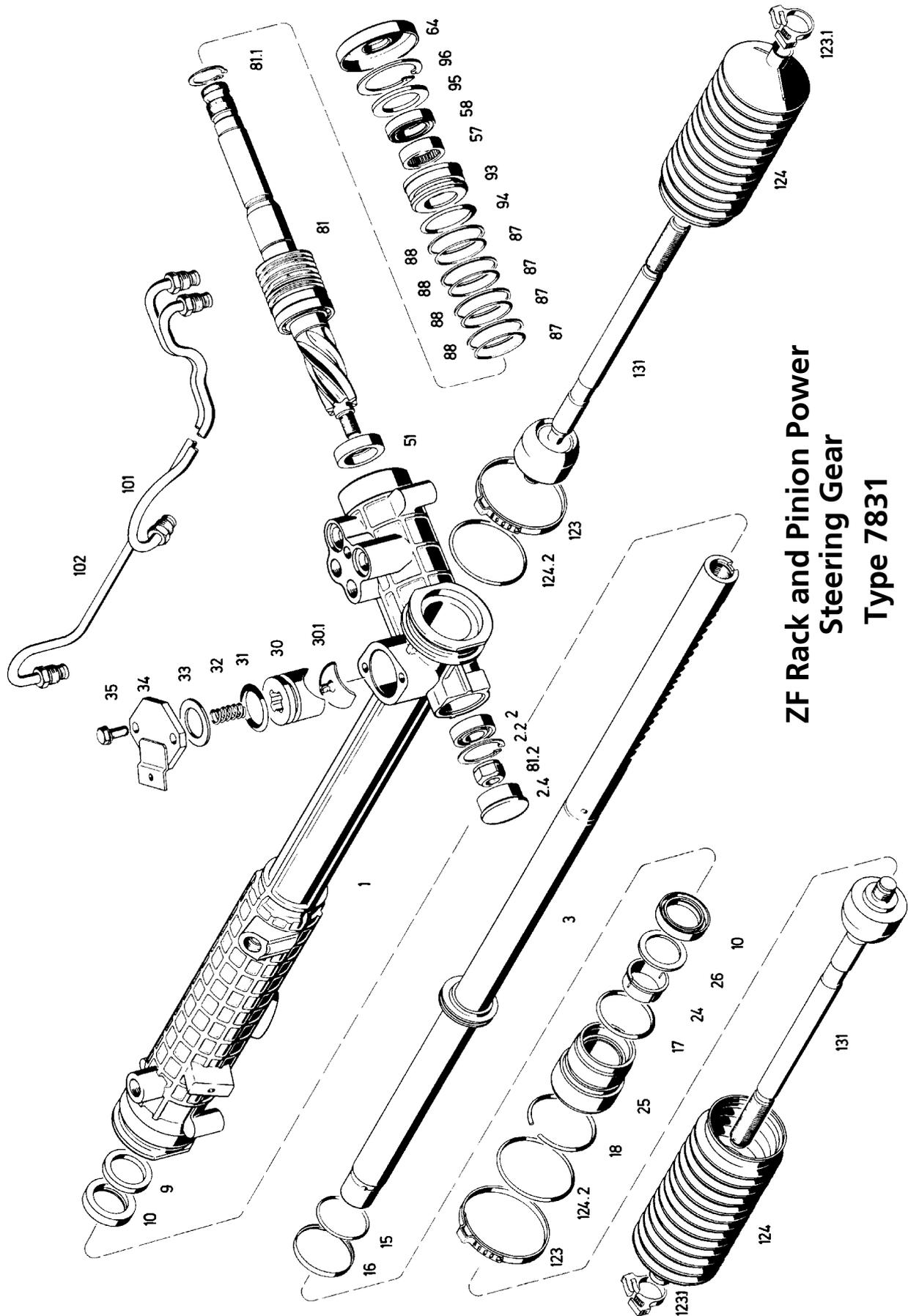
1.0	Housing	21.0	Cylinder screw
1.1	Stop ring	22.0	Cylindrical tube
1.2	Snap ring	24.0	Bearing bush
1.4	Bush/silent bearing/silent bush	25.0	Piston rod guide/ bearing bush
1.8	Bush	26.0	Washer
2.0	Needle bush/ball bearing	29.0	Tab washer
2.2	Retaining ring	30.0	Yoke
2.3	Washer	30.1	Insert foil
2.4	Plug/protection cover	31.0	O-ring
3.0	Rack	32.0	Compression spring
3.1	Cup spring	33.0	Washer/spacing washer
4.0	O-ring	34.0	Cover/adjusting screw
5.0	Spacer ring	34.3	Plug
6.0	Snap ring	34.4	O-ring
7.0	Washer	35.0	Hexagon screw
8.0	Spacer tube	36.0	Adjusting screw
8.2	Support ring	36.1	O-ring
9.0	Support ring/guide ring/washer/ support shim	38.0	O-ring
10.0	Sealing ring/seal/U-Ring	41.0	Buffer/stop ring
10.1	O-ring	42.0	Washer
10.2	Seal	43.0	Snap ring
10.9	Seal	51.0	Shaft seal
11.0	Retaining ring	53.0	Roller bearing
12.0	Support ring	56.0	O-ring
13.0	O-ring	57.0	Roller bearing/needle sleeve/ roller sleeve
14.0	Piston/guide ring	58.0	Shaft seal
15.0	O-ring	59.0	Valve housing
16.0	Sealing ring/piston ring	60.0	Washer
16.1	Guide ring	61.0	Cylinder screw
17.0	O-ring	64.0	Protecting cap
18.0	Snap ring	64.1	Protecting cap
19.0	Threaded ring		

81.0	Rotary valve
81.1	Retaining ring
81.2	Locking screw/ locking nut/collar nut
87.0	O-ring
88.0	Sealing ring
92.0	Support shim
93.0	Bush
94.0	O-ring
95.0	Washer
96.0	Retaining ring
100.0	Compensating line/ pipe
101.0	Pipe
102.0	Pipe
103.0	O-ring
104.0	Union screw
110.0	Cable clip
118.0	Rubber part
119.0	Silent bloc/clamp
119.1	Silent bloc/clamp
123.0	Hose clamp/hose clamp/ hose clip
123.1	Hose clamp/hose clamp/ clip
123.2	Hose clamp
124.0	Bellows
124.1	Lever
124.2	Seal/O-ring
124.3	O-ring
124.4	Bellows
131.0	Tie rod
131.1	Hexagon nut
135.0	Ball joint
136.0	Ball joint

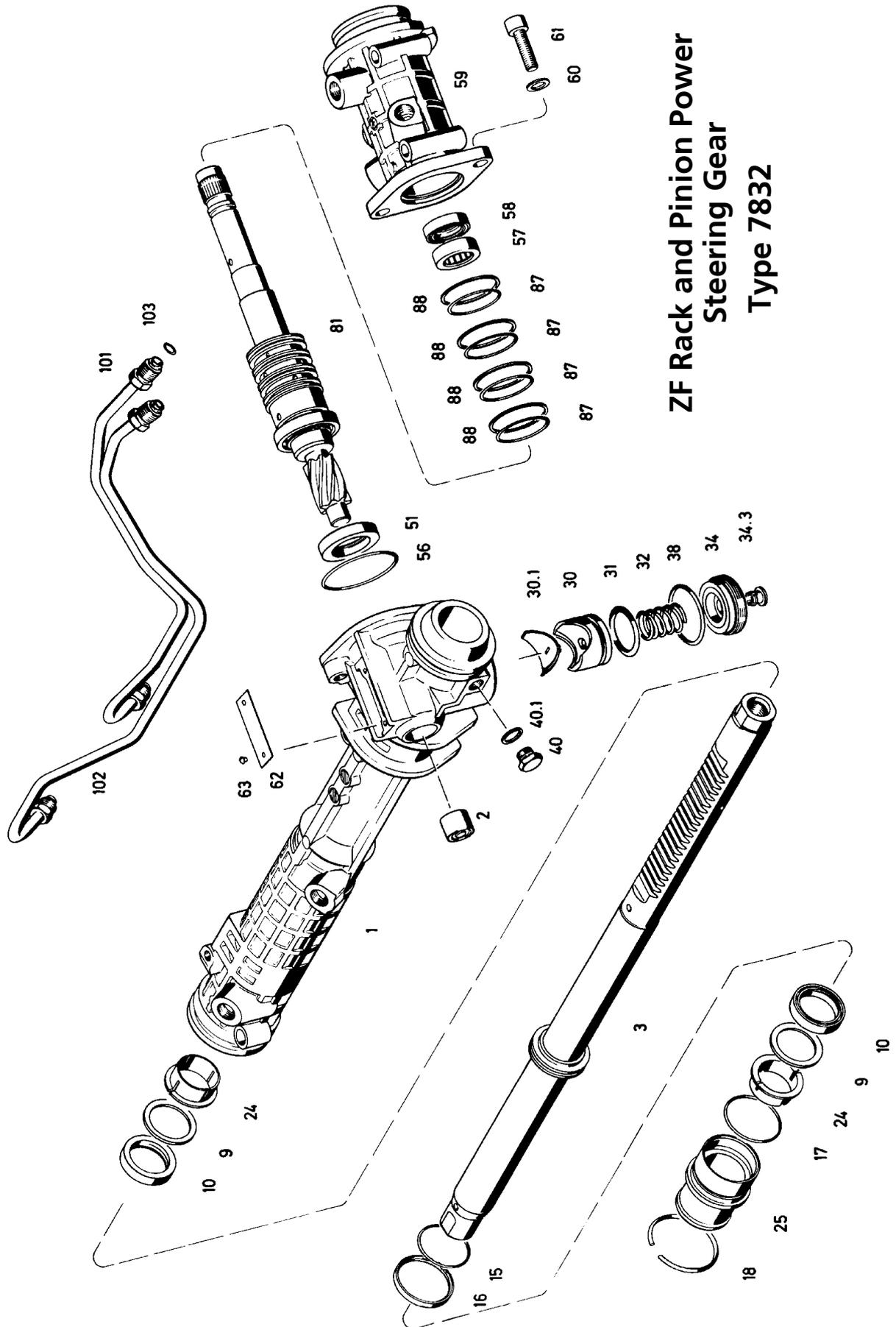
IX. Sectional Drawings



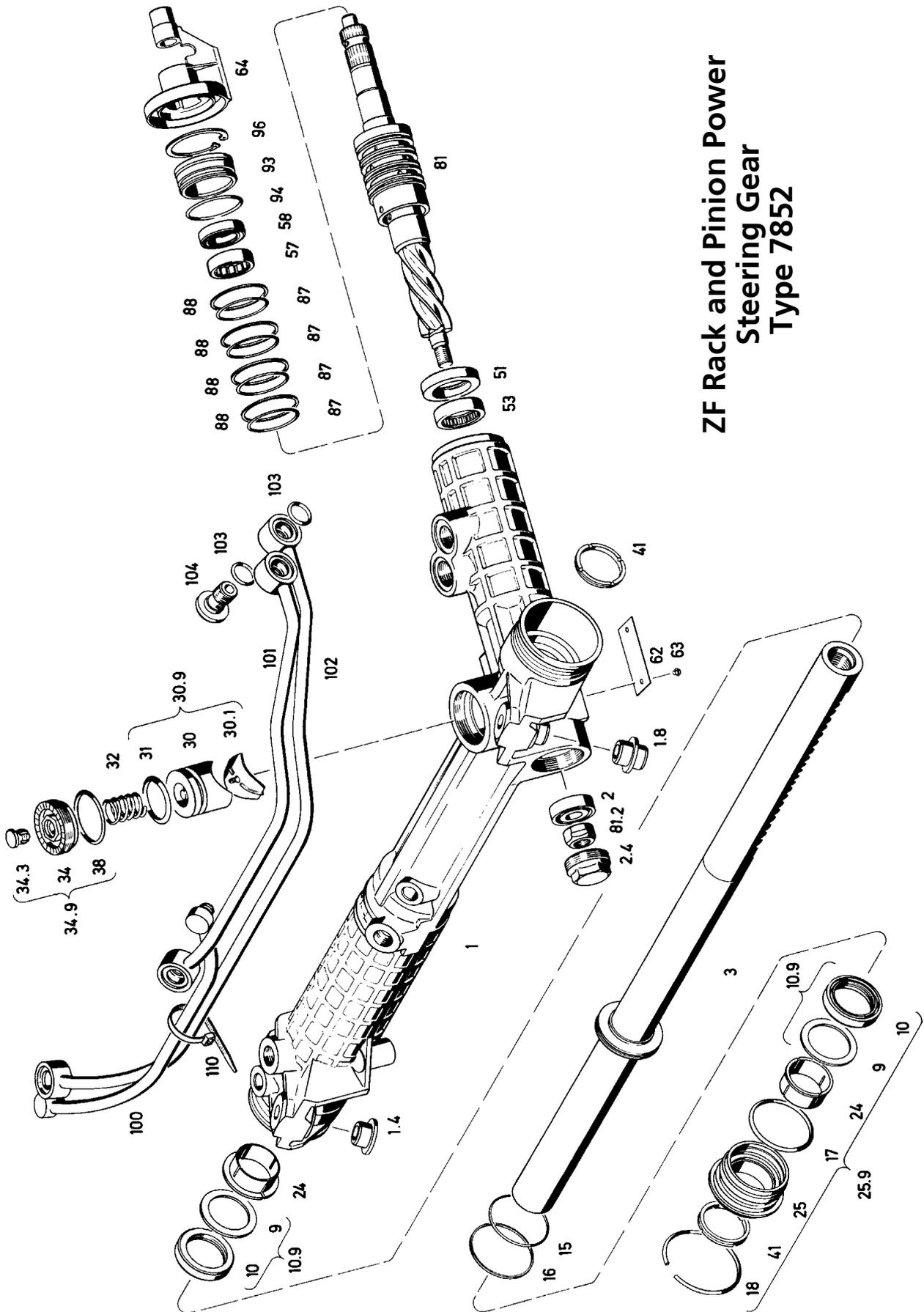




**ZF Rack and Pinion Power
Steering Gear
Type 7831**



**ZF Rack and Pinion Power
Steering Gear
Type 7832**



**ZF Rack and Pinion Power
Steering Gear
Type 7852**

