

D. Removal, Installation and Adjustment of Gear Train

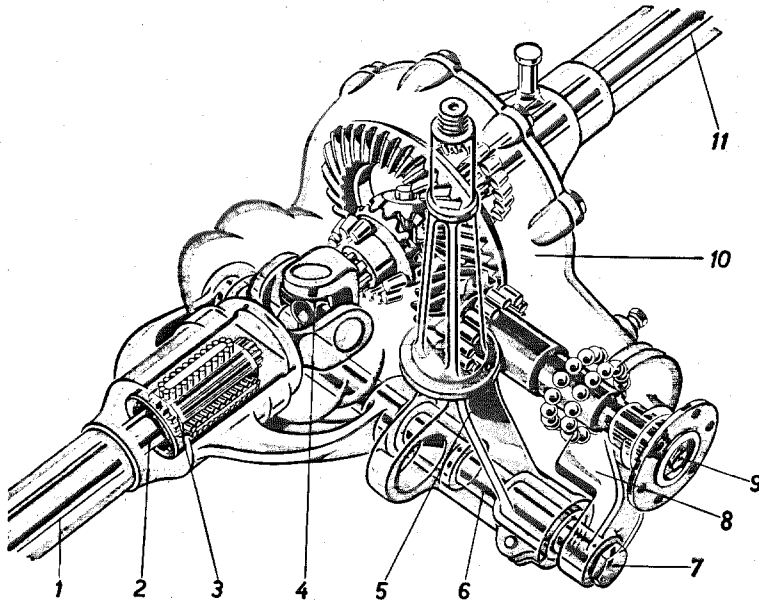


Fig. 35 — 4/20

- 1 Right axle tube
- 2 Right rear axle shaft
- 3 Sliding sleeve
- 4 Slip coupling with universal joint spider
- 5 Support for rear axle suspension
- 6 Connecting pin
- 7 Hexagon screw for connecting pin
- 8 Cover with eye for connecting pin
- 9 Drive pinion shaft
- 10 Rear axle housing
- 11 Left axle tube

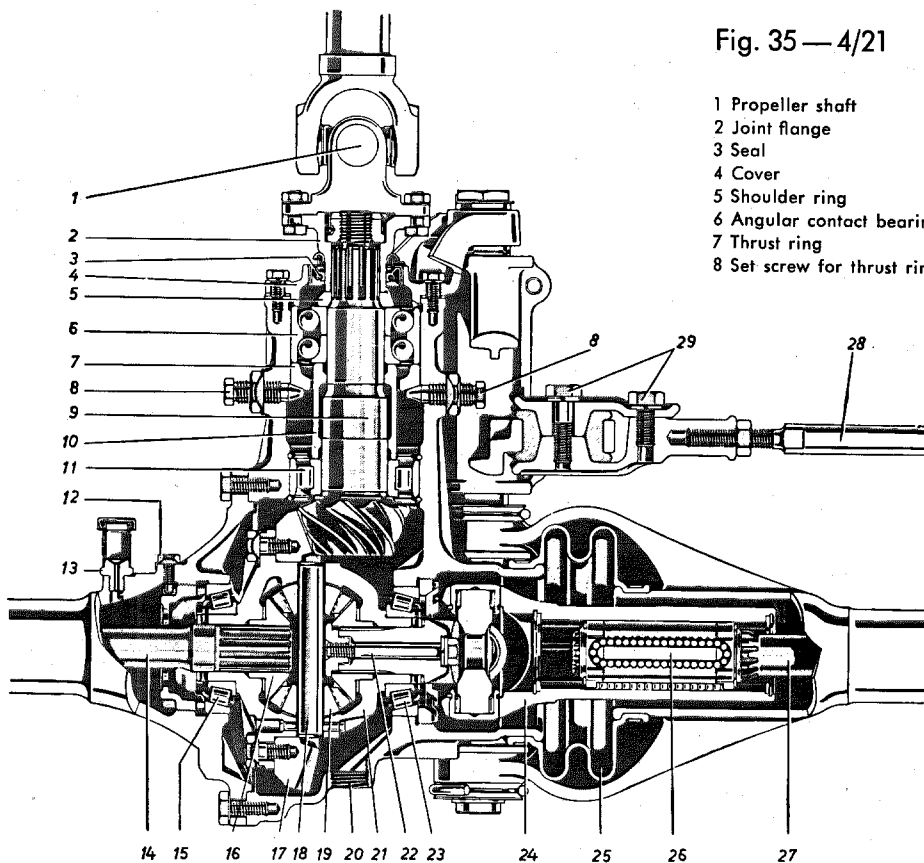


Fig. 35 — 4/21

- 1 Propeller shaft
- 2 Joint flange
- 3 Seal
- 4 Cover
- 5 Shoulder ring
- 6 Angular contact bearing
- 7 Thrust ring
- 8 Set screw for thrust ring

- 9 Drive pinion shaft
- 10 Spacer sleeve
- 11 Cylindrical roller bearing
- 12 Lock screw for threaded ring
- 13 Bleed screw for left axle tube
- 14 Left rear axle shaft
- 15 Taper roller bearing

- 16 Differential side gear, left
- 17 Ring gear
- 18 Differential pinion shaft
- 19 Differential pinion gear
- 20 Oil filler plug
- 21 Differential housing
- 22 Clamping screw

- 23 Taper roller bearing
- 24 Slip coupling
- 25 Rubber cuff
- 26 Sliding sleeve
- 27 Right rear axle shaft
- 28 Cross strut with link
- 29 Fixing screw for cross strut

Disassembly:

60. Remove the right rear axle shaft (see Paras. 1—6).
61. Remove the right axle tube (see Paras. 35—42).
62. Hold the left rear axle shaft and the flange of the drive pinion shaft, in order to loosen the clamping screw (22). Then unscrew the clamping screw (22) which fixes the slip coupling (24) to the right differential side gear and take out the slip coupling with compensating washer (Figs. 35—4/21 and 35—4/22).

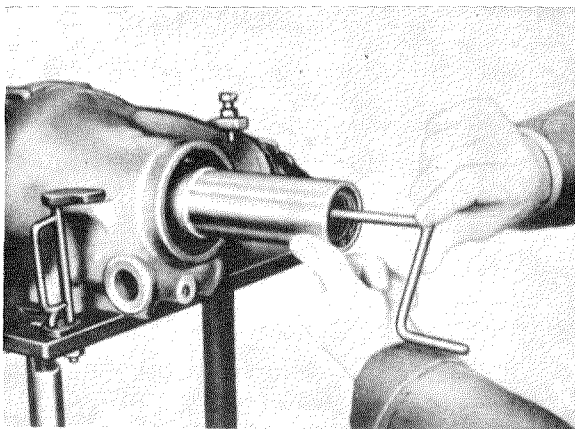


Fig. 35—4/22

63. Remove the left rear axle shaft (see Paras. 1—6). Then unscrew the left axle tube from the rear axle housing and take out the differential housing with ring gear.
64. Press the seal (2) out of the left axle tube with a screwdriver (Fig. 35—4/23).
Unscrew the bleed screw (13) and the lock screw (12) for the threaded ring (see Fig. 35—4/21).
Use Pin Wrench 180 589 02 07 on the threaded ring to press out the outer race of the taper roller bearing (15) (see Fig. 35—4/21).

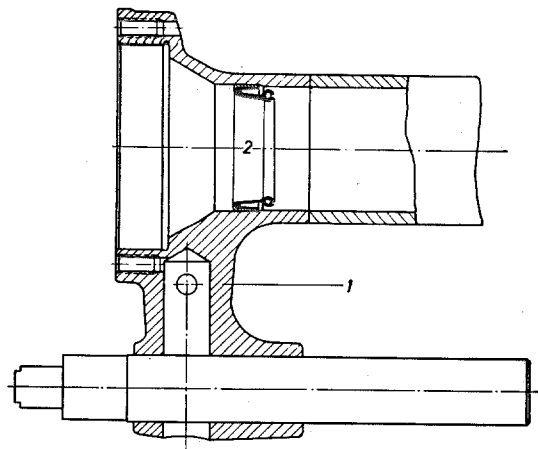


Fig. 35—4/23

1 Axle tube
2 Seal

65. Set up the rear axle housing on the assembly stand for the rear axle:

Note: The assembly stand for rear axle housings (according to Drawing BE 9891 a) with Assembly Plate BE 11 175 a, can be made in the workshop with the drawing as a guide. If necessary, the rear axle housing can also be disassembled on a shop bench.

66. Unlock the two set screws (8) for the thrust ring of the angular contact bearing and back out the two screws.

Unscrew the hexagon screws at the cover (4) of the rear axle housing. Then pull out the drive pinion shaft (9), together with the joint flange (2), the cover (4), the seal (3), the angular contact bearing (6), the spacer sleeve (10) and the cylindrical roller bearing (11) (see Fig. 35—4/21).

67. After tapping up the locking plate (4), unscrew the two hexagon screws for the lock (3) of the threaded ring in the rear axle housing and screw out the threaded ring (2) (Fig. 35—4/24). Use Pin Wrench 180 589 00 07 for the threaded ring. Then press out the outer race of the taper roller bearing toward the inside (Fig. 35—4/24).
68. Remove the two snap rings (15) for the outer race of the cylindrical roller bearing (2) and drive out the race with Assembly Arbor 120 589 00 39 (see Fig. 35—4/26).

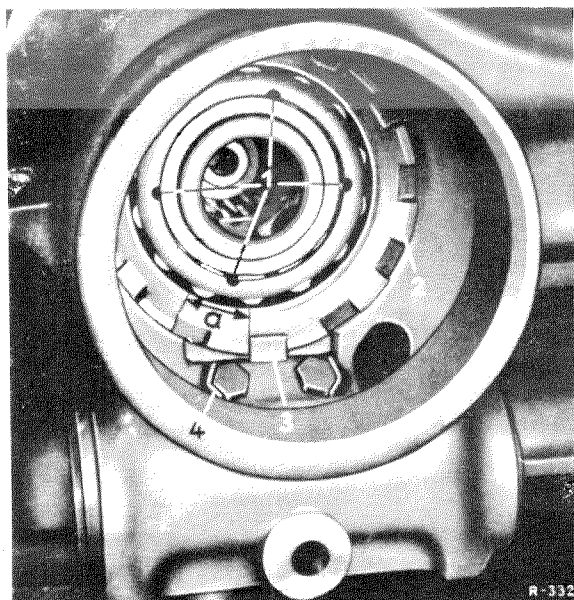


Fig. 35 — 4/24

- 1 The 4 recesses in the roller cage for Special Pin Wrench 180 589 14 07
- 2 Threaded ring
- 3 Lock
- 4 Locking plate
- a = one notch

Reassembly:

69. Insert the snap ring (2) in the rear axle housing. Make sure that it is properly positioned in the annular groove!

The hook of the snap ring must rest in the cast groove in the housing (Fig. 35 — 4/25).

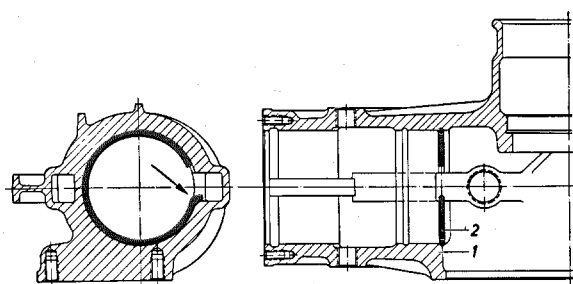


Fig. 35 — 4/25

- 1 Rear axle housing
- 2 Snap ring

70. Press in the outer race of the cylindrical roller bearing (2) with Assembly Arbor 120 589 00 39 and insert the front snap ring (15). Make sure it is properly positioned in the annular groove! (Fig. 35 — 4/26).

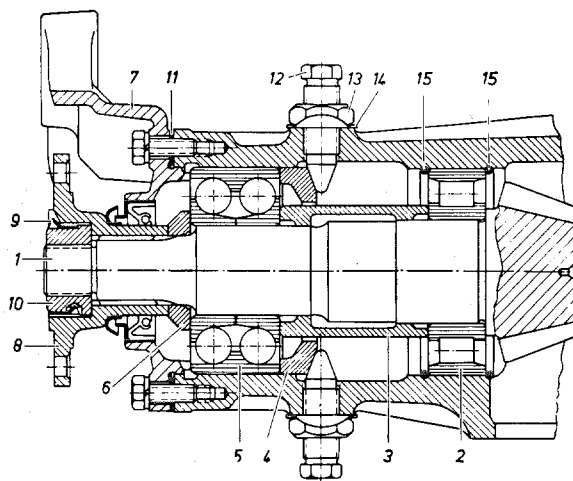


Fig. 35 — 4/26

- 1 Drive pinion shaft
- 2 Cylindrical roller bearing
- 3 Spacer sleeve
- 4 Thrust ring
- 5 Angular contact bearing
- 6 Shoulder ring
- 7 Cover with pressed-in seal
- 8 Joint flange
- 9 Lock
- 10 Grooved nut
- 11 Shim
- 12 Set screw for thrust ring
- 13 Hexagon nut
- 14 Locking plate
- 15 Snap ring

71. Screw the two set screws (12) about half-way in so that when the fitted drive pinion shaft is slid into the rear axle housing, the thrust ring (4) butts against the set screws (12).

72. Place a shim (11) (no specified thickness) on the cover (7) of the rear axle housing and slide the drive pinion shaft, which is fitted ready for installation, into the rear axle housing.

Screw up the cover (7). Screw in the two set screws (12), a few turns at a time at each screw, until they lie firmly against the thrust ring (4) (Fig. 35 — 4/26).

The tightening torque for the two set screws is 2.5 mkg.

73. Screw the right threaded ring three threads into the rear axle housing. Then use Assembly Arbor 180 589 00 39 to press in the outer race of the taper roller bearing (23) until it lies against the threaded ring (see Fig. 35 — 4/21).

Adjustment of Pinion Drive:

74. When a new gear train is being installed in the rear axle housing, the specified distances between the individual gears and the

specified amount of backlash must be obtained by adjustment. The installation dimensions are stamped on the rear face of the ring gear, the first figures indicating the clearances between the gears and the second figures indicating the amount of backlash required (Fig. 35 — 4/27).

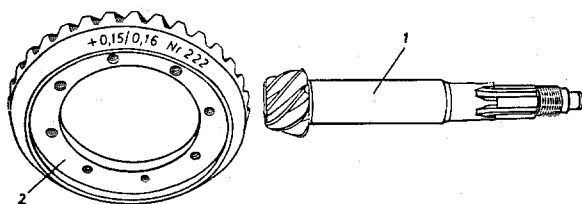


Fig. 35 — 4/27

1 Drive pinion shaft
2 Ring gear

Clearance dimension	= +0.15 mm
Backlash	= 0.16 mm
Gear train	No. 122

The two dimensions given ensure optimum meshing and operation of the gear train.

75. In order to set the front edge of the drive pinion and the center line of the ring gear to the exact clearance, place the measuring disk (4) (108.00 mm diameter) on Adjusting Device (1) 180 589 01 23 and set it to zero. To do this, screw the adjusting screw (3) of the device either in or out, to the point where the measuring disk (4) can just be turned to and fro with ease. Then lock the adjusting screw with the lock nut (2). No light gap must be visible between the two surfaces (Fig. 35 — 4/28).

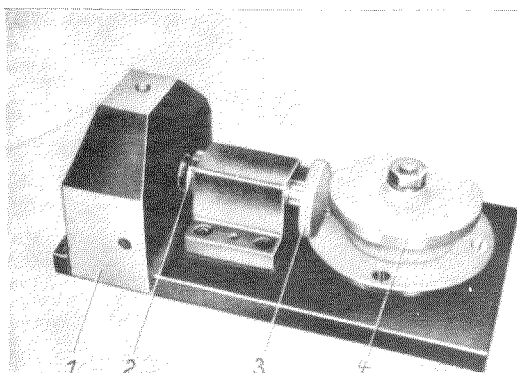


Fig. 35 — 4/28

1 Adjusting Device 180 589 01 23
2 Lock nut
3 Adjusting screw
4 Measuring disk

76. Now replace the measuring disk by the strap (5) with Dial Gage Holder 180 589 00 23 and a Dial Gage 000 589 14 21 and place in Adjusting Device 180 589 01 23. Clamp the dial gage in position under an initial tension of 1 mm. By turning the dial gage holder to and fro, establish the highest point of the face of the adjusting screw and set the dial gage to zero by moving the scale (Fig. 35 — 4/29).

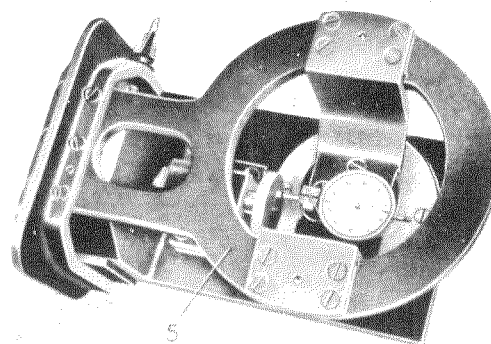


Fig. 35 — 4/29

Strap 180 589 00 23

77. Put the strap with dial gage holder and the dial gage in the rear axle housing (Fig. 35 — 4/30).

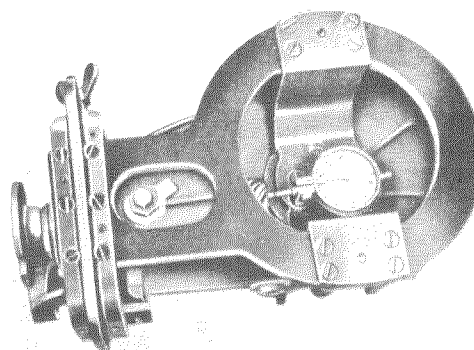


Fig. 35 — 4/30

Note: Recently the adjusting tools described in Paras. 75 — 77, i. e. the

Adjusting Device	180 589 01 23
with Measuring Disk	108 mm diameter
and Strap with Dial Gage Holder	180 589 00 23

have been replaced by the following adjusting tools:

Adjusting Device	136 589 02 23
Strap	180 589 05 23
and Measuring disk	108 mm diameter
	180 589 06 23.

If Adjusting Device 136 589 02 23 for adjusting the twin-jointed rear axle is already available, it does not need to be re-ordered (Fig. 35 — 4/28 a).

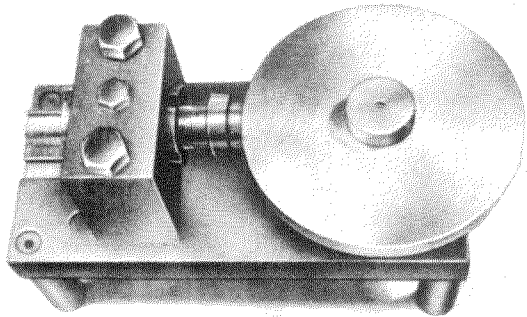


Fig. 35 — 4/28 a

Adjusting Device 136 589 02 23
Measuring Disk 180 589 06 23 108 mm diameter

Adjustment with these tools is done in the same way as described above but with the difference that when the dial gage is adjusted, the strap does not need to be bolted to Adjusting Device 136 589 02 23 (Fig. 35 — 4/29 a).

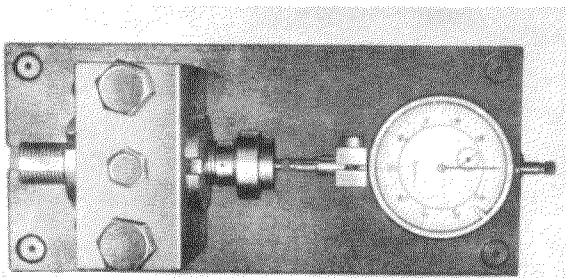


Fig. 35 — 4/29 a

Adjusting Device 136 589 02 23
and dial gage

After the dial gage has been adjusted, the dial gage is placed in the Strap 180 589 05 23 and then the strap, together with the dial gage, is put into the rear axle housing.

78. Adjust to the specified clearance between drive pinion shaft and ring gear (the clearance specified by the works and stamped on the ring gear) by selecting an appropriate compensating washer (11) for insertion between the rear axle housing and the cover (7) (see Fig. 35 — 4/26).

When the dial gage is read off, the original initial tension of 1 mm must be taken into account!

Example 1:

Clearance stamped on ring gear: +0.15 mm (see Fig. 35 — 4/27).

In accordance with the initial tension of 1 mm, the dial gage must show 1.15 mm after the adjustment. (For the + measurement, the pointer of the dial turns in a clockwise direction.)

Example 2:

Clearance stamped on ring gear: —0.15 mm.

In accordance with the initial tension of 1 mm, the dial gage must show 0.85 mm after the adjustment. (For the measurement, the pointer of the dial turns in an anti-clockwise direction).

For setting to the clearance required, compensating washers are available in a range from 1.0 to 2.0 mm, in steps of 0.1 mm. Compensating washers 2.05 mm thick are also available.

If necessary, a compensating washer should be ground to the appropriate thickness.

The tolerance for this setting is 0 to 0.02 mm.

79. Screw the threaded ring right home into the left axle tube (see Fig. 35 — 4/31). Then press in the outer race of the taper roller bearing, using Assembly Arbor 180 589 04 39.
80. Put the differential housing (21) into the rear axle housing and screw the left axle tube to the rear axle housing (see Fig. 35 — 4/21).
81. Use Pin Wrench 180 589 02 07 to tighten the threaded ring in the left axle tube to the point where there is no further play between the drive pinion and the ring gear. Then turn the threaded ring back 2—3 notches.

Note: The notches (1) of the threaded ring are visible through the bore for the locking screw (Fig. 35 — 4/31).

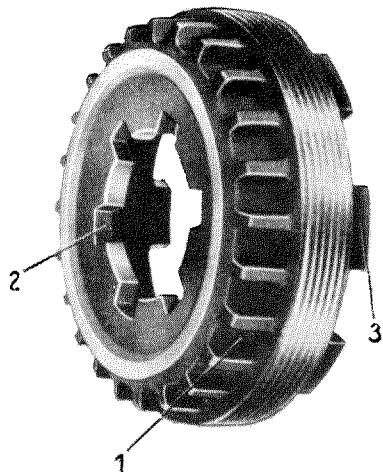


Fig. 35 — 4/31

- 1 Notches for the locking screw
- 2 Spaces for Pin Wrench 180 589 02 07
- 3 Contact surface for outer race of bearing

Pin Wrench 180 589 02 07 can only be inserted in the axle tube **before** the seal has been put in the axle tube.

82. Use a torque wrench and Pin Wrench 180 589 00 07 to tighten the right threaded ring in the rear axle housing to 4.0 mkg.
 83. Mount Measuring Gage 180 589 01 21 for measuring the backlash (Fig. 35 — 4/32).
 84. Fix the stop bracket (1) to the rear axle housing.
 85. Insert the holder (2) with dial gage in the bore of the differential housing and clamp it in position.
 86. Adjust the holder in such a way that the feeler of the dial gage points to the diameter of 176 mm marked on the stop bracket (1).
- Note:** This is necessary because the backlash reading is in respect of a diameter of 176 mm.
87. Clamp the drive pinion shaft to the joint flange with a screw (3) (see Fig. 35 — 4/32).

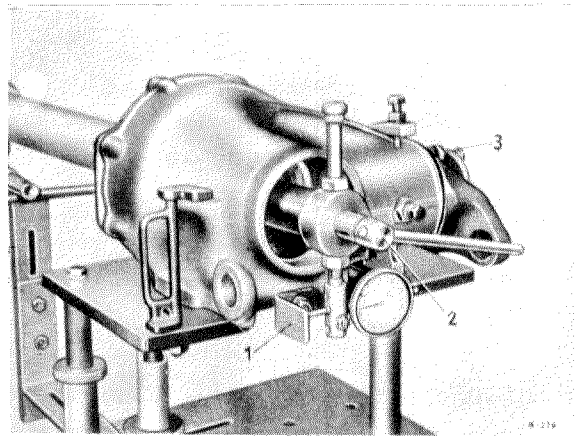


Fig. 35 — 4/32

- 1 Stop bracket
- 2 Holder with dial gage
- 3 Screw

88. Now make the adjustment by screwing the two threaded rings in or out as required until the backlash indicated on the ring gear is obtained. For the left threaded ring, use Pin Wrench 180 589 02 07, and for the right threaded ring, Pin Wrench 180 589 00 07.

Measurements should be taken at four points on the circumference of the ring gear. The true measurement is the one obtained where the play is smallest.

89. Remove the measuring gage after the adjustment of the backlash has been made.
90. **In order to check the accuracy of the adjustment, it is absolutely necessary to take a wear pattern impression on the flanks of the teeth.**

Note: If the adjusting device for the gear train is not available, the adjustment must be made by means of the wear pattern impression alone. But adjusting by means of the wear pattern impression requires considerable expert knowledge and great experience.

91. In order to take the wear pattern impression, remove the left axle tube again and take out the differential housing.
92. Apply a layer of oil-diluted blue dye to both sides of about 5 of the ring gear teeth. Put the differential housing in position once more and screw on the left axle tube again.

93. Use a crank to turn the joint flange and when turning, brake the ring gear at the same time. Once more remove the differential housing, check the wear pattern impression and if necessary, correct the adjustment.

The following diagrams show the wear pattern impressions for correct and incorrect meshing.

Wear Pattern Impressions on Ring Gear under Load

(Ring gear braked)

Correct meshing

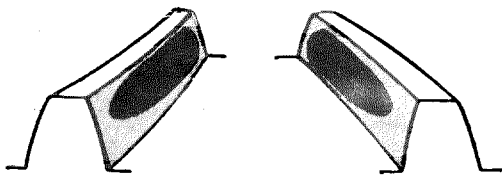


Fig. 35 — 4/33

As a rule, such an ideal wear pattern impression will not be obtained in practice. It is, however, important to ensure that the outer edge of the tooth flank is not touched at any point.

Contact at addendum (incorrect)

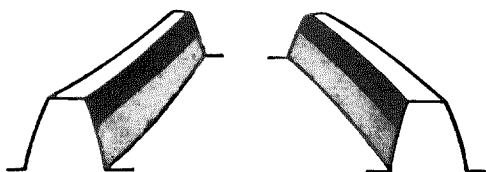


Fig. 35 — 4/34

Remedy:

Decrease the fitting clearance of the drive pinion and at the same time increase the fitting clearance of the ring gear in order to obtain the correct amount of backlash.

Contact at dedendum (incorrect)

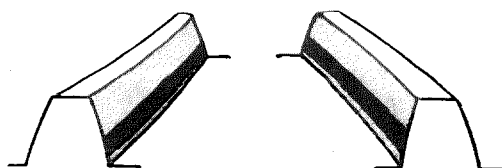


Fig. 35 — 4/35

Remedy:

Increase the fitting clearance of the drive pinion and at the same time decrease the fitting clearance of the ring gear in order to obtain the correct amount of backlash.

If in spite of the gear train being correctly adjusted, it is impossible to obtain a satisfactory wear pattern impression, the fault must lie in the rear axle housing or in the left axle tube.

In this case, the parts in question must be replaced.

94. After adjusting the pinion drive, loosen the drive pinion shaft (1), pull the drive pinion shaft out a little, apply sealing compound to the compensating washer (11) and slide the drive pinion shaft (1) finally into the rear axle housing and tighten up the cover (7) (Fig. 35 — 4/36).

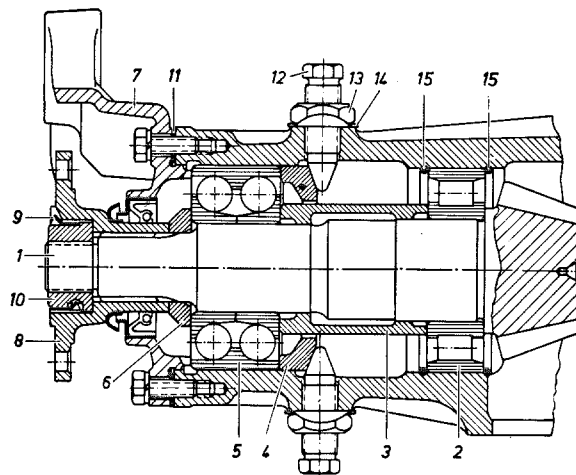


Fig. 35 — 4/36

- | | |
|------------------------------|------------------------------|
| 1 Drive pinion shaft | 8 Joint flange |
| 2 Cylindrical roller bearing | 9 Lock |
| 3 Spacer sleeve | 10 Grooved nut |
| 4 Thrust ring | 11 Compensating shim |
| 5 Angular contact bearing | 12 Set screw for thrust ring |
| 6 Shoulder ring | 13 Hexagon nut |
| 7 Cover with pressed-in seal | 14 Locking plate |
| | 15 Snap ring |

95. Remove the set screws (12) once more and coat them with sealing compound. Push on new locking plates and again screw in the set screws, a few turns at a time on each one, and tighten to a torque of 2.5 mkg.

Lock the set screws (12) with the hexagon nuts (13) and tap over the locking plates (Fig. 34 — 4/36).

96. Remove the left axle tube once more and coat the sealing surface of the flange with sealing compound. Re-install the axle tube and tighten up.
97. In order to adjust the taper roller bearing properly, insert Special Pin Wrench 180 589 14 07 in the four recesses (1) in the roller cage of the right taper roller bearing (Fig. 35 — 4/37 and Fig. 35 — 4/38).

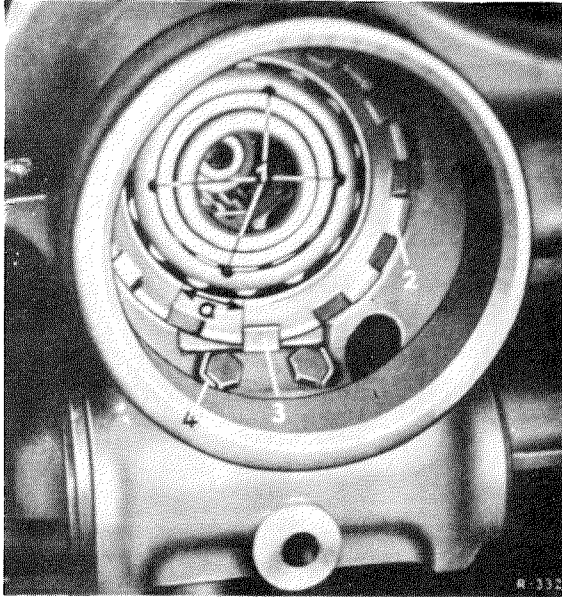


Fig. 35 — 4/37

- 1 The four recesses in the roller cage for Special Pin Wrench 180 589 14 07
- 2 Threaded ring
- 3 Lock
- 4 Locking plate
- a = one notch

Then, with the aid of Special Pin Wrench ([1] in Fig. 35 — 4/38) 180 589 14 07, screw the threaded ring in or out as required until the roller cage can be turned with a torque of 50—80 cmkg.

98. For measuring this torque, put a torque wrench with a range of 0—160 cmkg on Special Pin Wrench 180 589 14 07 (Fig. 35 — 4/38).

Note: It is important that the drive pinion should be continuously turned while the adjustment is taking place and that the inner race should be given a tap or two so that the taper rollers can settle into place properly without any of them being tilted.

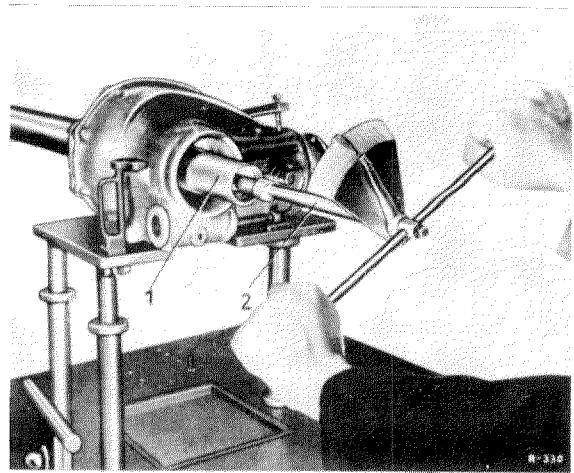


Fig. 35 — 4/38

- 1 Special Pin Wrench 180 589 14 07
- 2 Torque wrench 0—160 cmkg with $\frac{1}{4}$ " square drive

The Special Pin Wrench 180 589 14 07 is made in the form of a combination wrench so that the threaded ring can be moved and the torque necessary to move the roller cage can be measured at the same time.

99. After the specified torque value has been obtained, tighten the threaded ring $\frac{3}{4}$ to 1 notch (see Fig. 35 — 4/37).

Note: It should be noted that turning the threaded ring one notch corresponds to the lower torque value mentioned above. i. e., at a torque of 50 cmkg = 0.5 mkg the threaded ring must be turned one notch and at a torque of 80 cmkg = 0.8 mkg, it must be turned $\frac{3}{4}$ of a notch.

This degree of tightening corresponds to an axial movement of the threaded ring of 0.09 to 0.12 mm, the thread dimensions being M 90 \times 1.5.

100. If a taper roller bearing with the four recesses in the cage is not available or if Special Pin Wrench 180 589 14 07 is not available, tighten the right threaded ring to a torque of 4.0 mkg, using Pin Wrench 180 589 00 07.

Note: This new method of adjusting the taper roller bearing must be applied with the utmost care in order to ensure the long life of the taper roller bearings.

This method of adjustment by tightening the right threaded ring to a torque of 4.0 mkg must only be used in emergencies.

101. Lock the right threaded ring with a lock wedge. Five types of this lock wedge are available, the offset of the nose being different in each.

Fix the lock wedge, together with a locking plate, with two hexagon screws and lock the hexagon screws by bending over the locking plate (4) (see Fig. 35 — 4/37).

102. Lock the left threaded ring by screwing in the lock screw (12) into the axle tube and tap over the locking plate (see Fig. 35 — 4/21).

103. Check the backlash again. A departure from the specified backlash of ± 0.02 mm is permissible. **If the backlash has to be corrected, the taper roller bearing must again be adjusted in accordance with paras. 97 to 102.**

Attach the slip coupling (24) with the clamping screw (22) to the right differential (21) (see Fig. 35 — 4/21 and Fig. 35 — 4/39).

104. When tightening up the clamping screw, put in the left rear axle shaft and hold the rear axle shaft and the joint flange steady.

Caution! Make sure that the correct compensating shim is used (see Job No. 35—4, Paras. 122—123).

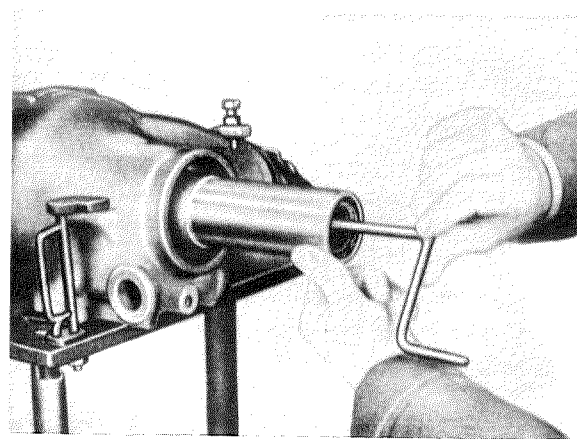


Fig. 35 — 4/39

105. Install the bleed screw (13) in the left axle tube (see Fig. 35 — 4/21). Use Installing Arbor 180 589 03 39 to press or drive a new seal into the axle tube as far as the collar (see Fig. 35 — 4/23).

106. Install the right axle tube (see Paras. 43—59).

107. Install the left and right rear axle shafts (see Paras. 19—26).

108. Put 2.25 liters of Hypoid Oil SAE 90 into the rear axle.