

E. Removal and Installation of Gear Train, including Disassembly and Reassembly

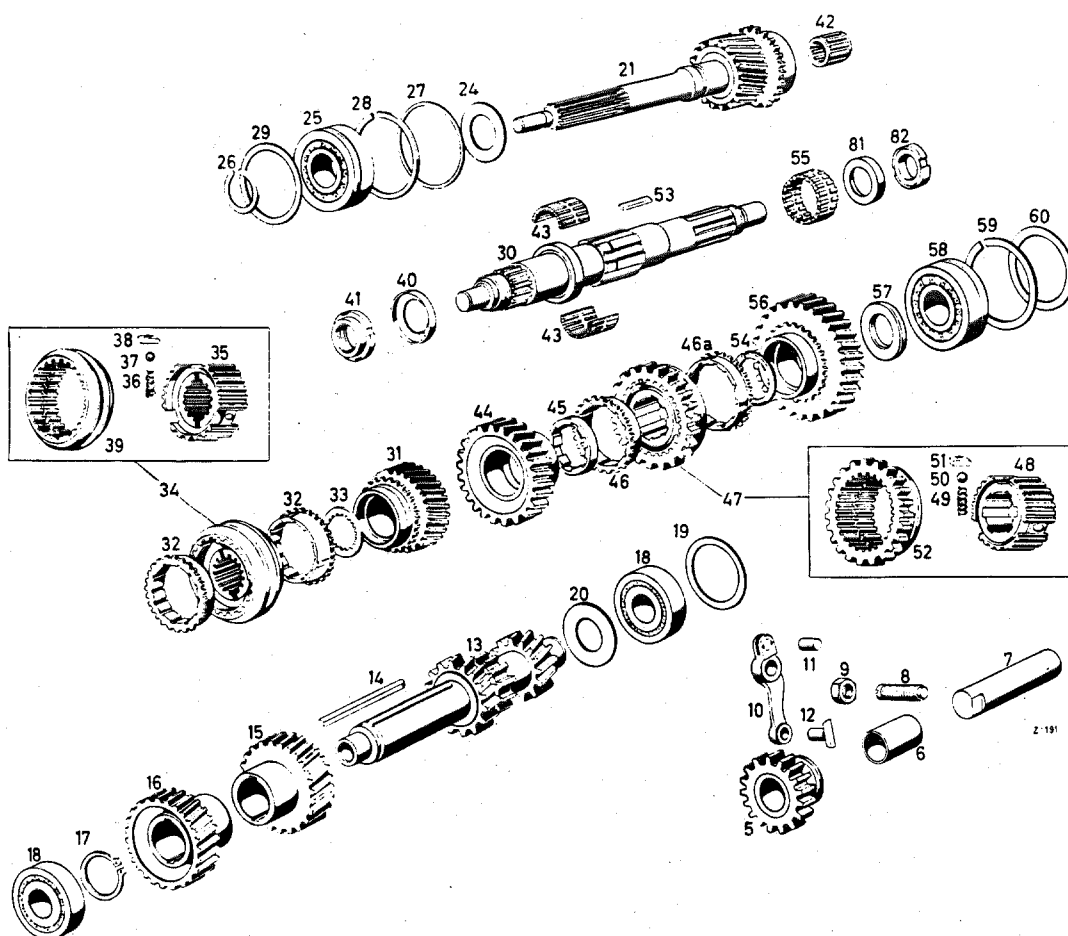


Fig. 26 — 4/25

- | | | |
|----------------------------|---|---|
| 5 Reverse idling gear | 26 Snap ring | 44 Helical gear (2nd speed) |
| 6 Bushing | 27 Spacer ring | 45 Stop ring |
| 7 Reverse idling shaft | 28 Snap ring | 46 Synchronizing ring |
| 8 Threaded pin | 29 Shim | 46a Synchronizing ring |
| 9 Hexagon nut | 30 Main shaft | 47 Synchronizing unit (1st and 2nd speed) |
| 10 Relay lever | 31 Helical gear (3rd speed) | 48 Synchronizing unit |
| 11 Dowel pin | 32 Synchronizing ring | 49 Pressure spring |
| 12 Shifting claw | 33 Thrust washer | 50 Steel ball |
| 13 Countershaft | 34 Synchronizing unit (3rd and 4th speed) | 51 Follower |
| 14 Woodruff key | 35 Synchronizing unit (4th speed) | 52 Sliding sleeve |
| 15 Countergear (3rd speed) | 36 Pressure spring | 53 Key |
| 16 Countershaft drive gear | 37 Steel ball | 54 Thrust washer |
| 17 Snap ring | 38 Follower | 55 Roller cage |
| 18 Annular grooved bearing | 39 Sliding sleeve | 56 Helical gear (1st speed) |
| 19 Shim | 40 Locking plate | 57 Thrust washer |
| 20 Protective washer | 41 Grooved nut | 58 Annular grooved bearing |
| 21 Drive shaft | 42 Roller cage | 59 Snap ring |
| 24 Oil slinger plate | 43 Roller cage, split | 60 Shim |
| 25 Annular grooved bearing | | |

Removal:

56. Perform the operations necessary to remove the transmission case top, front, and rear covers as well as the clutch housing, as outlined in Sections A—E.
57. Remove the small snap ring in front of the annular grooved bearing on the drive shaft by means of Snap Ring Pliers 136 589 00 37 (Fig. 26 — 4/26).

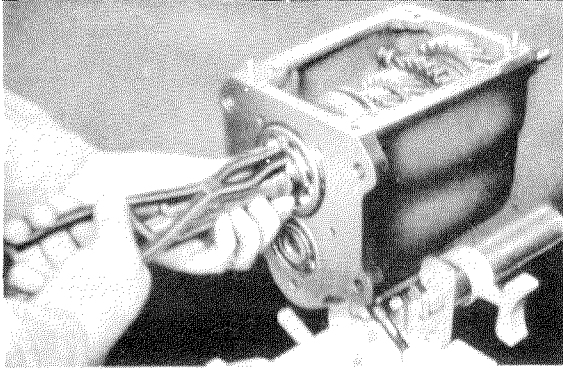


Fig. 26 — 4/26

58. Use a plastic hammer to tap the main shaft toward the front to the point where the annular grooved bearing can be caught by the two removing levers at the large snap ring and can be forced forward (Fig. 26 — 4/27).

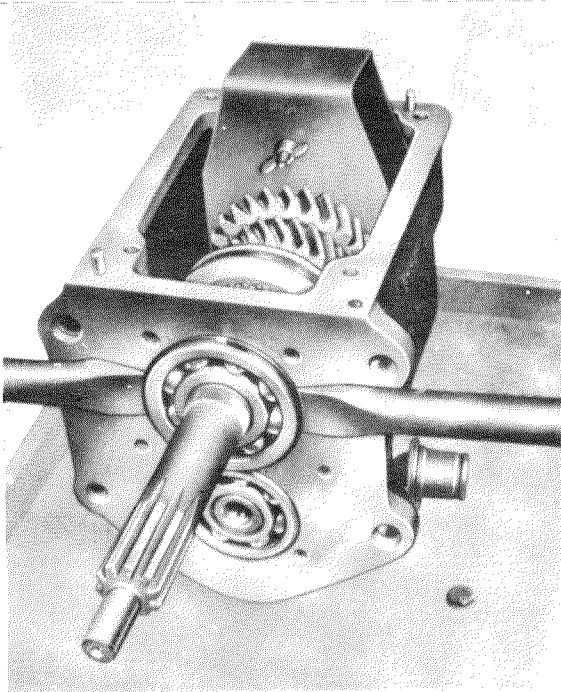


Fig. 26 — 4/27

Pull off the annular grooved bearing by means of Puller 136 589 02 33 (Fig. 26 — 4/28). Pay attention to the spacer ring behind the snap ring!

Alternatively, first tap the drive shaft toward the rear and then tap the main shaft toward the front until the annular grooved bearing can be pulled off by means of the puller.

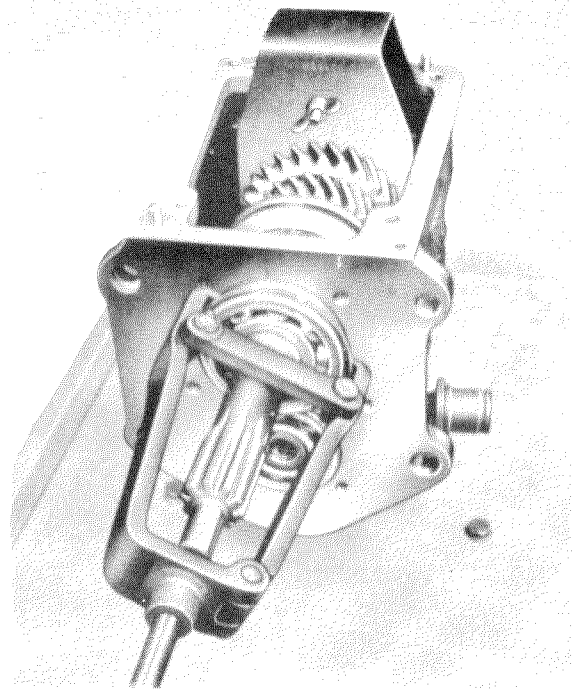


Fig. 26 — 4/28

59. Tap the drive shaft toward the rear by means of a plastic hammer until the snap ring of the rear annular grooved bearing on the main shaft can be caught and then pulled off by means of Puller 136 589 02 33 (Fig. 26 — 4/29).

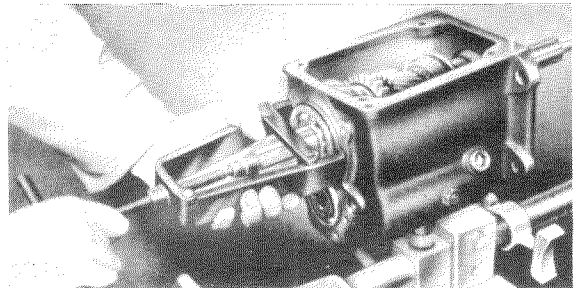


Fig. 26 — 4/29

60. After pulling off the rear annular grooved bearing, slide Fitting Sleeve 198 589 02 61 over the free end of the main shaft and use

the grooved nut to screw the sleeve against the 1st speed gear on the main shaft (Fig. 26 — 4/30).

Note: This is necessary in order to prevent any axial displacement of the 1st speed gear on the main shaft.

Then remove Retaining Clamp 136 589 14 61; its task has now been taken over by Fitting Sleeve 198 589 02 61.

61. Pull the rear annular grooved bearing off the countershaft, using Puller 187 589 06 33 (Fig. 26 — 4/30).

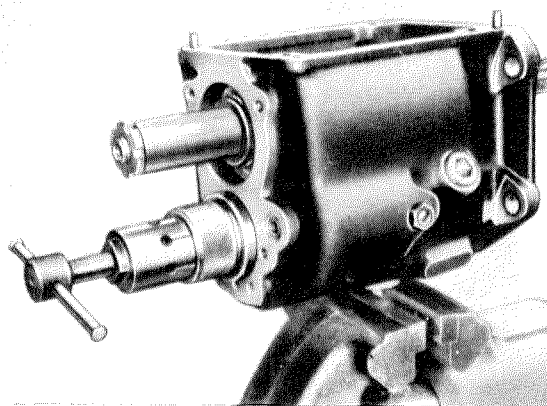


Fig. 26 — 4/30

62. If the puller is not available, lift both drive and main shaft (Fig. 26 — 4/31).

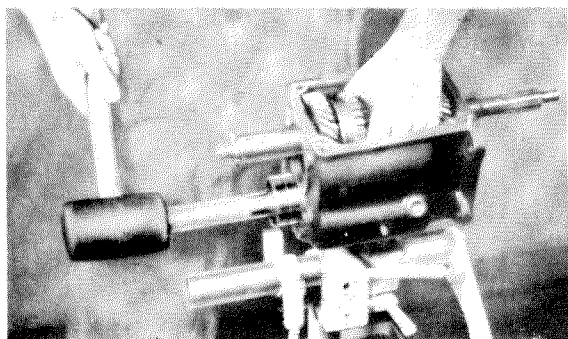


Fig. 26 — 4/31

Then use Drift 136 589 06 39 to drive the countershaft, together with front bearing, toward the rear until the countershaft drops down into the transmission case.

63. Remove the drive shaft toward the front and the main shaft upward at an angle (Fig. 26 — 4/32).

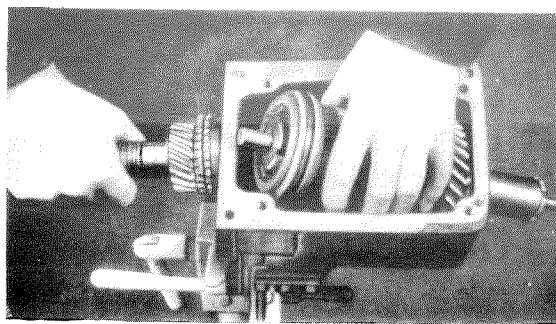


Fig. 26 — 4/32

Remove the roller cage from the rear end of the drive shaft and remove the 4th speed synchronizing ring from the 3rd and 4th speed synchronizing unit.

64. Install Retaining Tool 136 589 11 61 on the countershaft in such a way that the 2nd speed gear is supported against the transmission case wall (Fig. 26 — 4/33).

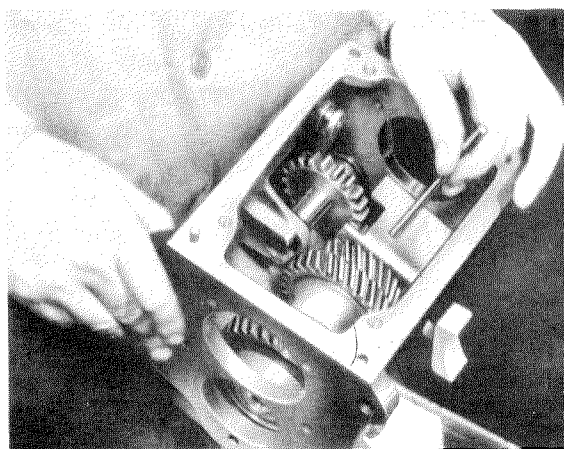


Fig. 26 — 4/33

65. Use the two Removing Levers 136 589 00 35 to press the rear annular grooved bearing off the countershaft (Fig. 26 — 4/34).

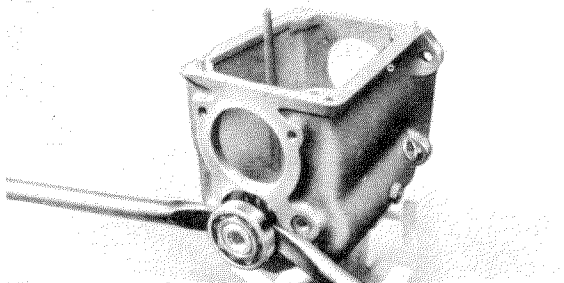


Fig. 26 — 4/34

66. Remove the countershaft from the transmission case upward.
67. Unscrew the threaded pin and hexagon nut for the reverse idling shaft. Then use Puller 136 589 27 33 to pull out the reverse idling shaft toward the rear and remove the reverse idling gear (Fig. 26 — 4/35).

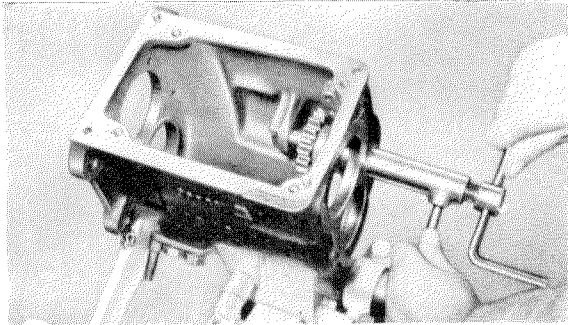


Fig. 26 — 4/35

68. Remove the relay lever and shifting claw for the reverse idling gear.

Disassembly:

Countershaft:

69. Press the front annular grooved bearing off the countershaft, using Removing Levers 136 589 00 35.
70. Remove the snap ring from the countershaft. If necessary, press off the two countergears (drive gear and 3rd speed gear) from the countershaft (Fig. 26 — 4/36).

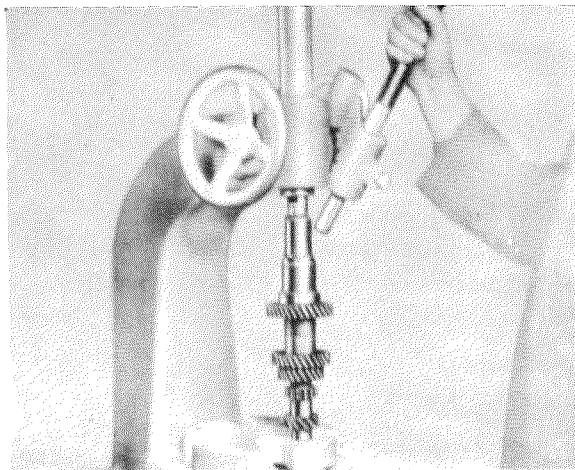


Fig. 26 — 4/36

Main Shaft:

71. Remove Fitting Sleeve 198 589 02 61 after removing the grooved nut. Remove 1st speed gear together with synchronizing ring, roller cage, and thrust washer (Fig. 26 — 4/37).

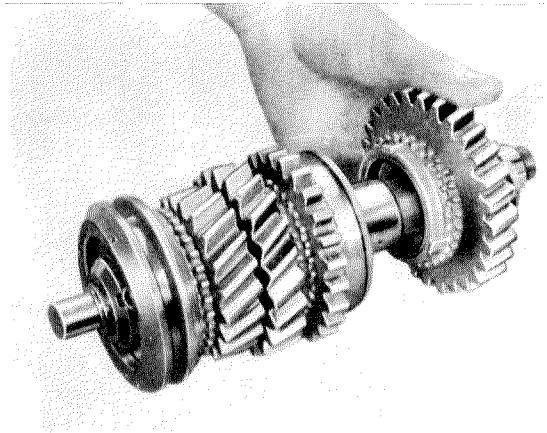


Fig. 26 — 4/37

72. Remove the 1st and 2nd speed synchronizing unit (which is also the reverse idling gear), synchronizing ring, thrust washer, and key (Fig. 26 — 4/38).

Note: When disassembling the gear train, always mark the synchronizing rings in relation to the appropriate side of the speed gears, since the synchronizing cones in the course of time have adapted themselves to one another.

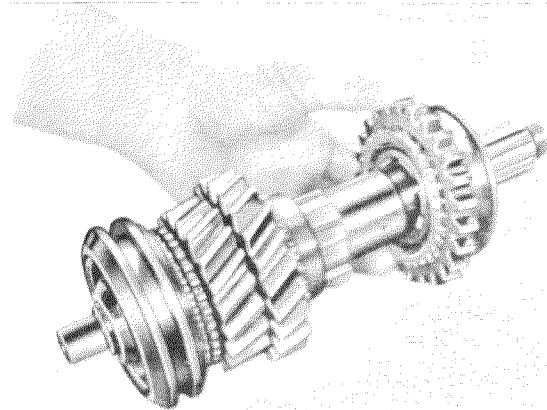


Fig. 26 — 4/38

73. Turn the stop ring for the 2nd speed gear in such a way that the splines on the main shaft and on the stop ring (1) are indexed (Fig. 26 — 4/39).

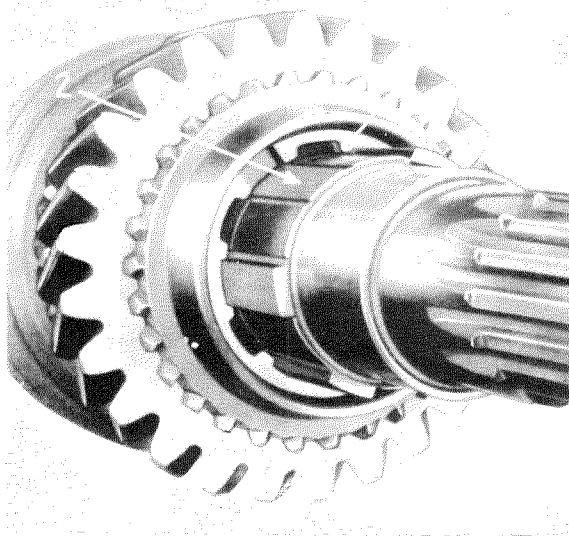


Fig. 26 — 4/39

- 1 Splines on stop ring
- 2 Splineways on main shaft

74. Remove 2nd speed gear, together with stop ring and split roller cage (Fig. 26 — 4/40).

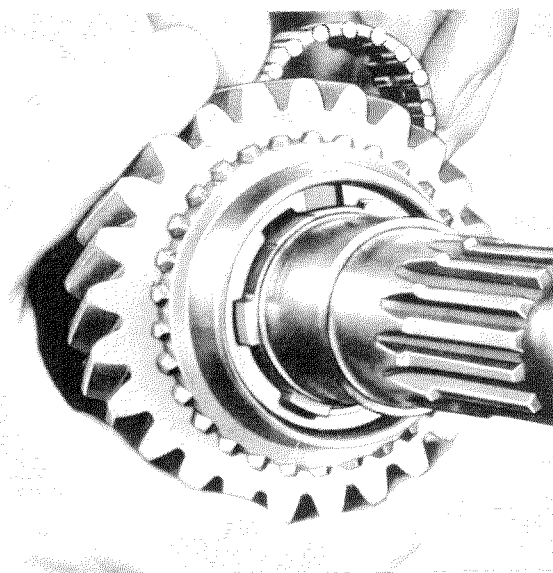


Fig. 26 — 4/40

75. Clamp Retaining Wrench 187 589 00 31 in a vise. Install the three-way flange in the retaining wrench and insert the main shaft in the three-way flange. Remove the locking plate from the main shaft and unscrew the grooved nut, using Pin Wrench 120 589 04 07 (Fig. 26 — 4/41).

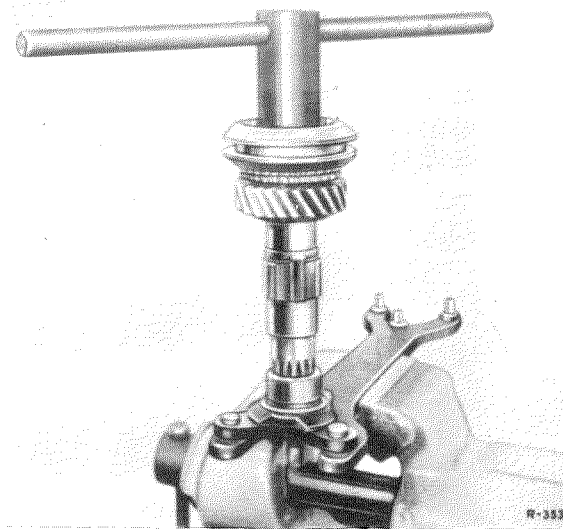


Fig. 26 — 4/41

76. Remove the 3rd and 4th speed synchronizing unit together with synchronizing ring, thrust washer, and 3rd speed gear.

Synchronizing Units

77. In order to disassemble the synchronizing units, insert the synchronizing ring and press the synchronizing unit and followers out of the sliding sleeve with the help of the synchronizing ring (Fig. 26 — 4/42).

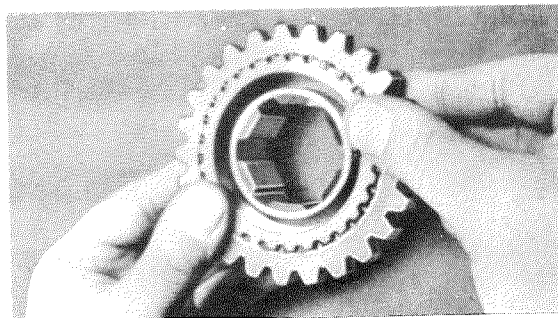


Fig. 26 — 4/42

Note: Since the steel balls drop out in the process, it is advisable to wrap the synchronizing unit in a cloth to catch the steel balls.

Reassembly

Synchronizing Units

78. Install the followers and springs in the synchronizing unit and insert the synchronizing unit in the sliding sleeve (Fig. 26 — 4/43).

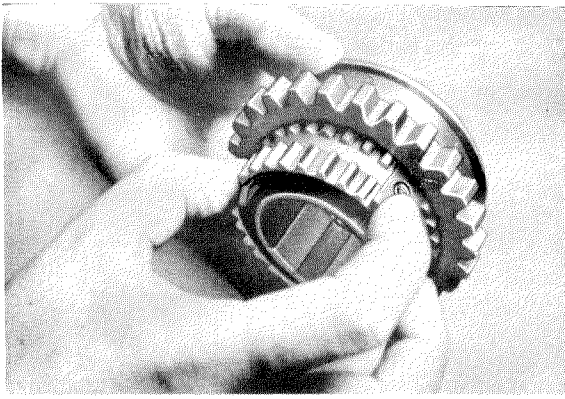


Fig. 26 — 4/43

79. Push followers forward one at a time, insert a ball, and push the follower back again (Fig. 26 — 4/44 and Fig. 26 — 4/45).

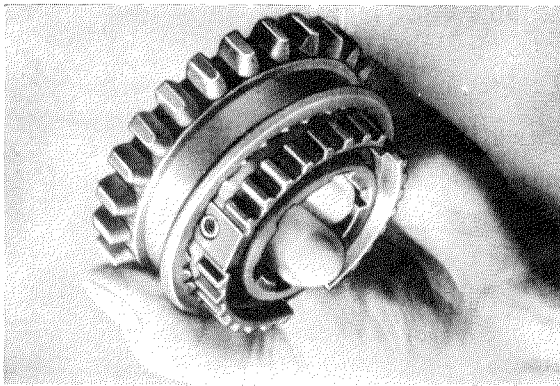


Fig. 26 — 4/44

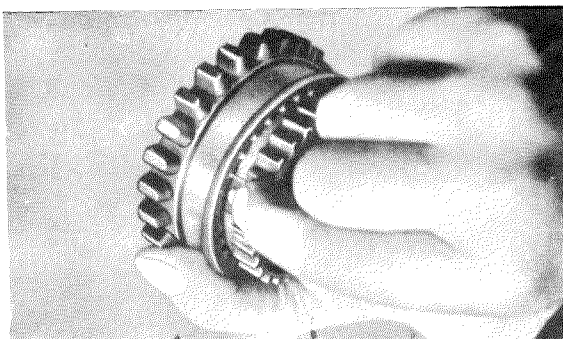


Fig. 26 — 4/45

80. Install the 1st and 2nd speed synchronizing unit in such a way that the long hub side of

the synchronizing unit is opposite the guide groove in the sliding sleeve (Fig. 26 — 4/46).

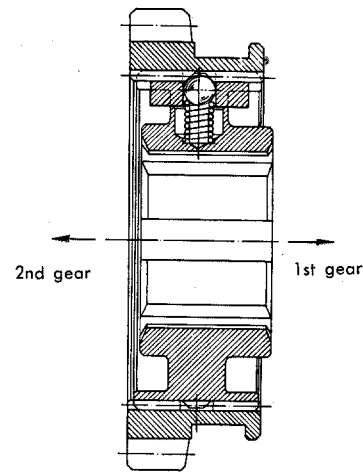


Fig. 26 — 4/46

81. Install the 3rd and 4th speed synchronizing unit in such a way that the broad hub side and the 3 grooves in the sliding sleeve are opposite each other (Fig. 26 — 4/47).

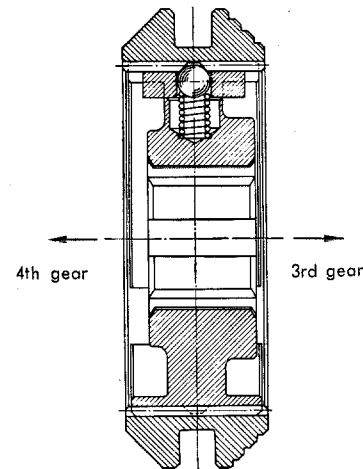


Fig. 26 — 4/47

82. After assembly check whether the sliding sleeve disengages under an axial thrust of 7—11 kg.

Countershaft

83. Fit the key in the countershaft.
84. Press the two countergears (3rd speed gear and drive gear) onto the countershaft with the two high collars facing one another (Fig. 26 — 4/48).

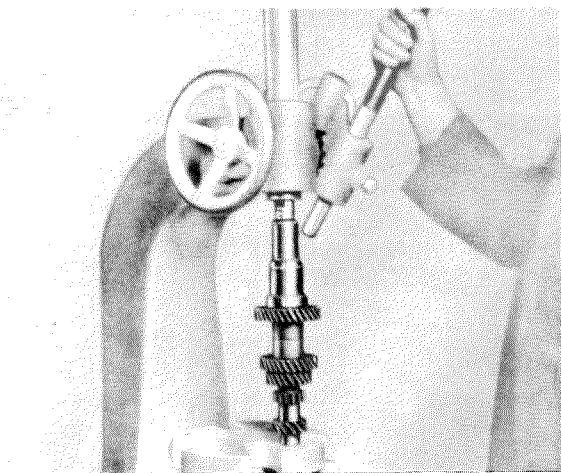


Fig. 26 — 4/48

When pressing on the gears, make sure that no stock is scraped off! Before the 3rd speed countergear comes to rest against the 2nd speed countergear, check whether any stock has been scraped off. If necessary, remove the material and make sure that the faces of the collars are absolutely clean. Then press the countergears on until they rest against one another.

85. Install the snap ring.

Main Shaft

86. Clamp Retaining Wrench 187 589 00 31 in a vise and install the three-way flange in the retaining wrench.

87. Insert the main shaft in the three-way flange.

88. Slide the 3rd speed gear onto the shaft with the synchronizing cone pointing upward and insert the thrust washer.

89. Install the synchronizing ring (8.4 mm nose width) on top of the 3rd speed gear and slide the synchronizing unit onto the shaft with the grooved side down (see Fig. 26 — 4/47). Pay attention to the markings made on removal.

90. Install the locking plate and the grooved nut and firmly tighten the nut using Wrench 120 589 04 07 (Fig. 26 — 4/49). Do not yet lock the grooved nut.

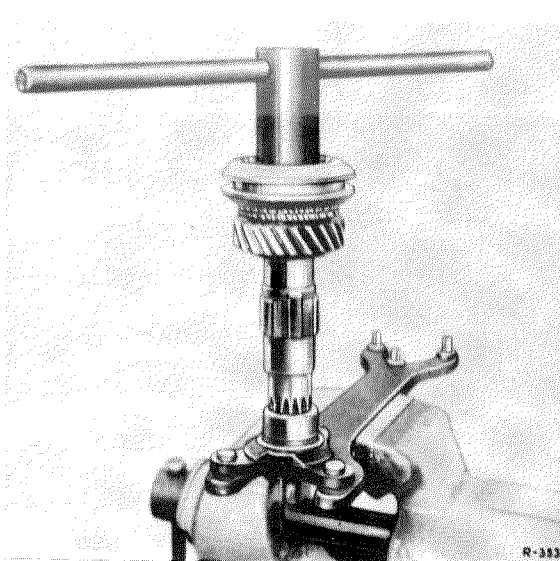


Fig. 26 — 4/49

Note: The 3rd speed gear must still be able to turn easily.

91. Then pull the main shaft out of the three-way flange, turn the main shaft over, with the drive shaft centering journal pointing downward, and either reinstall it in the three-way flange or clamp it in a vise, using copper or lead jaw covers.

92. Measure the end play between the 3rd speed gear and the shaft collar (Fig. 26 — 4/50). Set dial gage to 1 mm beforehand!

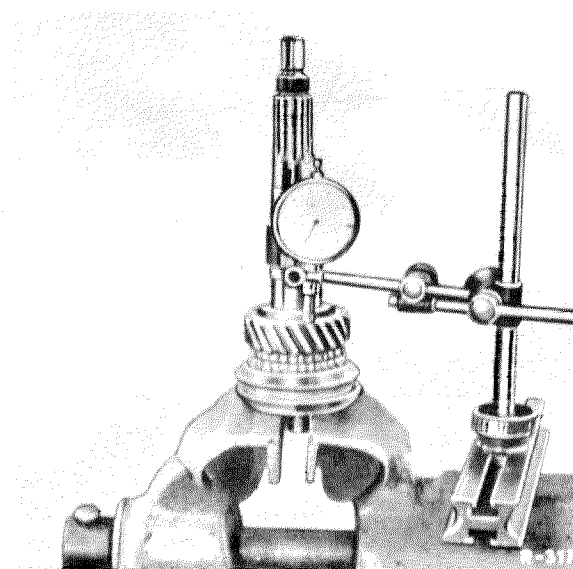


Fig. 26 — 4/50

The end play must be 0.10—0.18 mm. Thrust washers of different thicknesses are not available.

If the end play is less than 0.10 mm, the front of the 3rd speed gear must be ground down. If the end play is more than 0.18 mm, the 3rd speed gear must be replaced.

93. Turn over the main shaft, tighten the grooved nut to a torque of 12 mkg and then tap down the grooved nut locking plate at all four points.

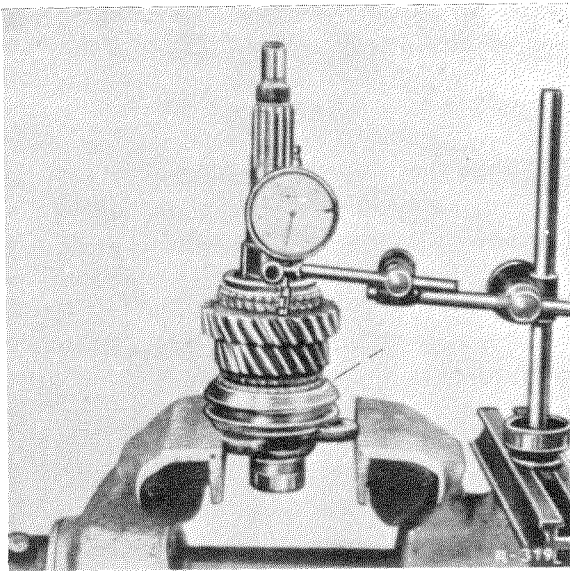


Fig. 26 — 4/51

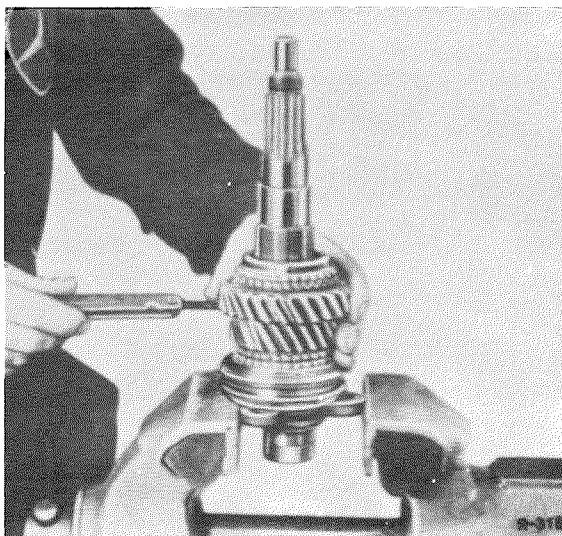


Fig. 26 — 4/51 a

94. Again turn the main shaft over, slide the 2nd speed gear over the shaft and install the stop ring.

95. Measure the end play between the 2nd speed gear and the shaft collar with a dial gage or a feeler gage (Figs. 26 — 4/51 and 26 — 4/51 a).

The end play must be 0.10—0.18 mm and can be adjusted by installing the appropriate stop ring.

Stop rings are available in thicknesses between 7.90 and 8.10 mm at intervals of 0.05 mm.

96. Remove the 2nd speed gear together with stop ring. Install the split roller cage on the shaft, slide the 2nd speed gear over the shaft and the split roller cage and install the stop ring in front of it.

97. Turn the stop ring in such a way that the splines of the stop ring and the splineways (2) of the main shaft index (Fig. 26 — 4/52).

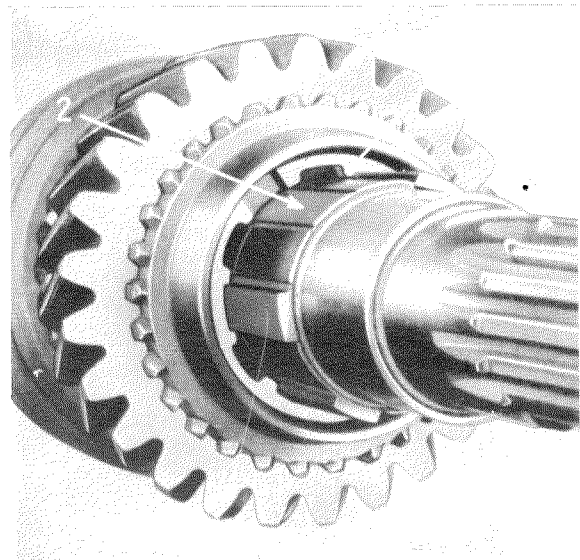


Fig. 26 — 4/52

1 Spline of stop ring
2 Splineway of main shaft

98. Slide the 1st speed gear thrust washer with spline onto the main shaft, spline downward. Then install the 1st speed gear with the synchronizing cone downward. Install the rear thrust washer with the shouldered face upward and measure the end play of the 1st speed gear (Fig. 26 — 4/53).

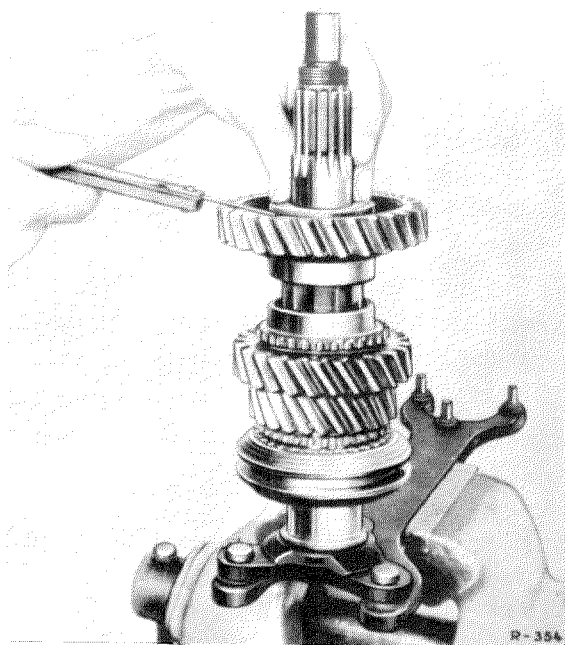


Fig. 26 — 4/53

Note: The prescribed end play of 0.10—0.18 mm is obtained by using an appropriate thrust washer. Only splined washers are replaced. The thrust washers are available in thicknesses from 4.40—4.60 mm at intervals of 0.05 mm.

99. Remove rear thrust washer and 1st speed gear. Insert the key between the two splines of the thrust washer and the stop ring and measure the axial clearance of the key by means of a tolerance feeler band (Fig. 26 — 4/54).

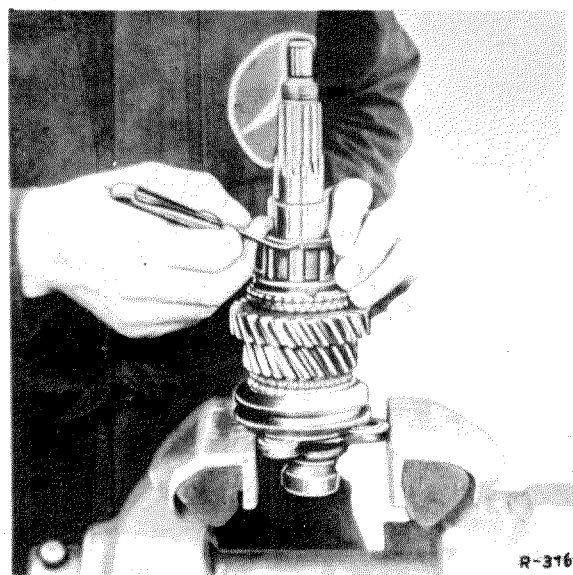


Fig. 26 — 4/54

The minimum axial clearance is 0.1 mm.

Note: When measuring the clearance, the clearance between the 2nd speed gear and the stop ring must be taken into account!

100. Remove the thrust washer and key and fit the key into the synchronizing unit. The key can only be fitted into two opposite splines which are cut slightly deeper.
101. Put the synchronizing ring with a nose width of 8.4 mm on the synchronizing cone of the 2nd speed gear and install the key. Then slide the synchronizing unit, with the guide groove for the shift fork facing upward (see Fig. 26 — 4/46), over the key; remember that only the deep-cut spline will fit over the key.
102. Slide the thrust washer together with the roller cage on the main shaft. Spline and key must index. Put the synchronizing ring with the 10 mm nose width on the synchronizing unit. Install the 1st speed gear and the rear thrust washer, shouldered face upward.
103. Slide Fitting Sleeve 198 589 02 61 or a short pipe length (31 × 40 × 62) over the shaft and screw down with the grooved nut in order to hold the 1st speed gear in position.

Note: If a suitable gage is available, the functioning of the various gears should be checked before reassembly (Fig. 26—4/55).

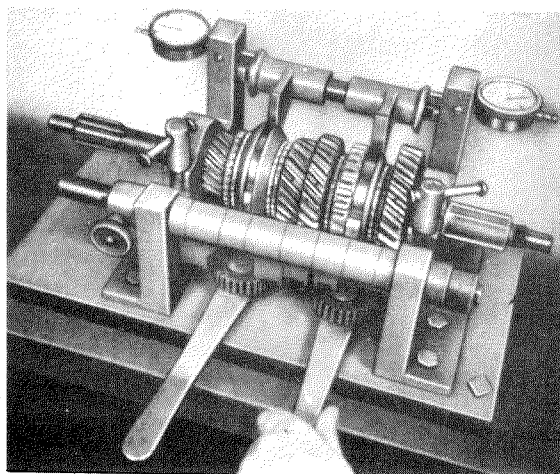


Fig. 26 — 4/55

Until the individual synchronizing units come to rest against the opposite cone of the speed gear, the travel is 0.8—1.3 mm (1st to 4th gear).

Any deviation in the 4th gear can be adjusted by the large thrust washer between the 1st speed gear and the annular grooved bearing. These thrust washers are available in thicknesses from 3.80—4.50 mm at intervals of 0.1 mm.

Supplementary Note Concerning Main Shaft Reassembly

On recent models the 3rd speed gear is provided with roller bearings in the same way as the 1st and 2nd speed gears: For reassembly only the procedure outlined in Paragraph 88 has been modified. First slide the two roller cages onto the main shaft and then install the 3rd speed gear, synchronizing cone upward (Fig. 26—4/55a).

Then install the thrust washer. For the rest, the procedure is the same as outlined above.

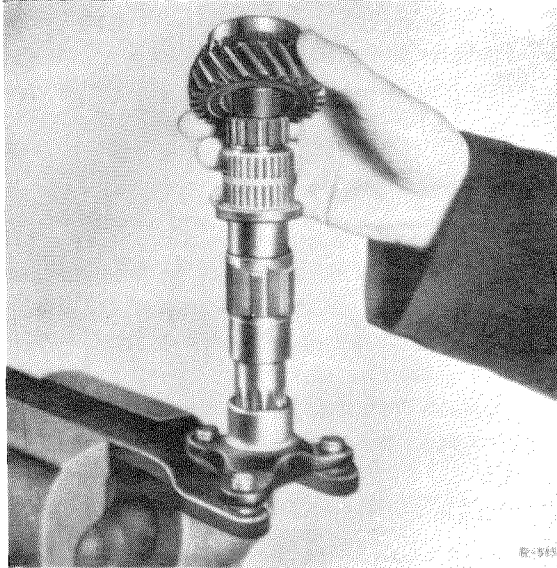


Fig. 26 — 4/55a

Note: The 3rd speed gear with roller bearing can be installed subsequently only if both the main shaft and the 3rd speed gear are replaced, since the dimensions of these two parts have been modified.

Installation:

104. Install the relay lever for the reverse gear in the housing together with shifting claw.
105. Insert the reverse idling shaft in the case, making sure that the reverse idling gear is slid on with the guide groove toward the rear in such a way that the shifting claw of the relay lever engages the guide groove of the reverse idling gear (Fig. 26—4/56).

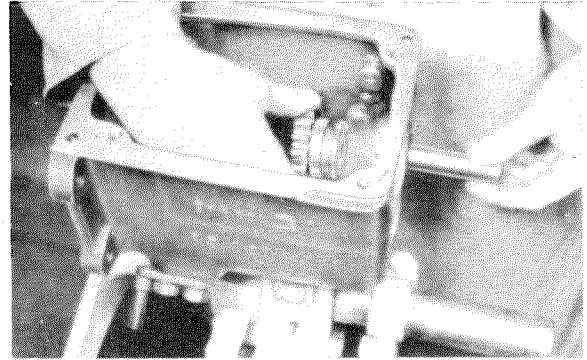


Fig. 26 — 4/56

106. Lock the reverse idling shaft by means of the threaded pin and tighten the hexagon nut of the threaded pin.
107. Press the front annular grooved bearing onto the countershaft and install the countershaft from above in the transmission case.
108. Slide the protective washer onto the rear end of the countershaft.
109. Install the main shaft from above and push the roller cage into the drive shaft bore. Put the synchronizing ring for the 4th speed gear on the drive shaft and insert the drive shaft from the front (Fig. 26—4/57).

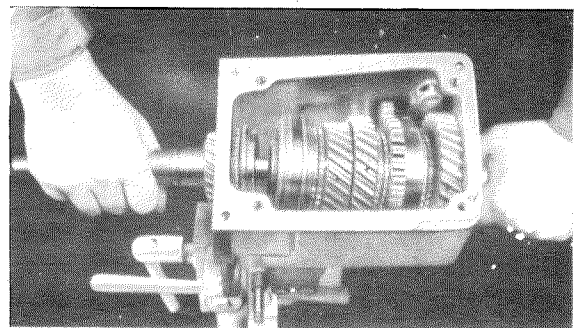


Fig. 26 — 4/57

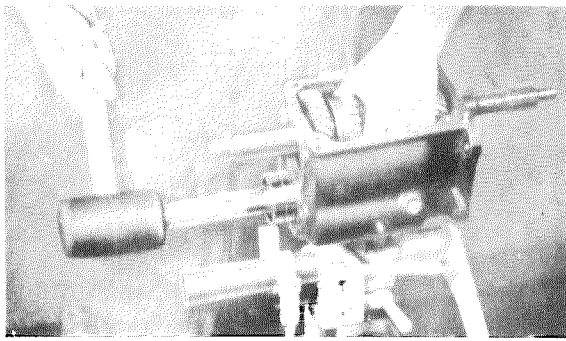


Fig. 26 — 4/58

110. Lift both drive shaft and main shaft and drive the countershaft into the transmission case with Drift 136 589 06 39 (Fig. 26 — 4/58).
111. Slide the oil slinger plate onto the drive shaft; use Installing Arbor 136 589 07 39 to drive the annular grooved bearing together with Cover Plate 6306 ZN DIN 625 (snap ring toward the front), and the spacer ring onto the drive shaft and at the same time into the transmission case.
112. Use Snap Ring Pliers 136 589 00 37 to install the small snap ring in the groove of the drive shaft. The snap ring must be firmly seated on the shaft. Re-shape loose snap rings (Fig. 26 — 4/59), if for some reason a new snap ring should not be available.

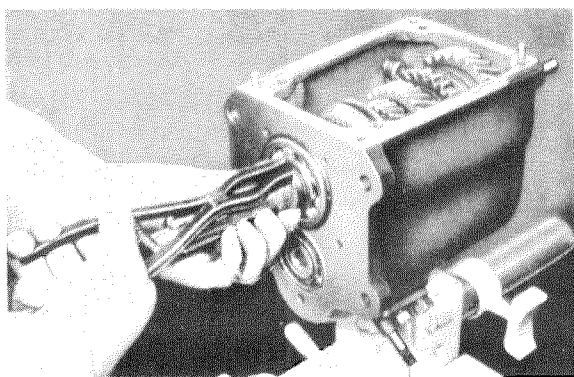


Fig. 26 — 4/59

113. Perform the operations necessary to install the transmission case front cover and the clutch housing as outlined in Sections B and C.
114. Install Retaining Clamp 136 589 14 61 in the short gear section of the 1st and 2nd speed gears in such a way that the speed gears are pushed toward the synchronizing unit in order to prevent the key from slipping out of the groove of the stop ring or the thrust washer (Fig. 26 — 4/60).

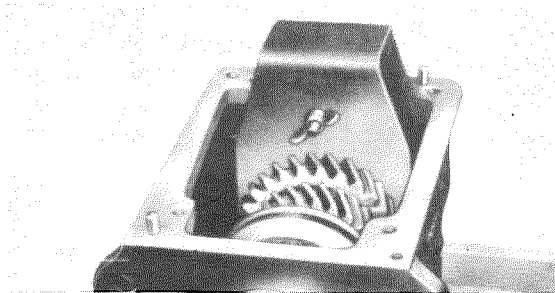


Fig. 26 — 4/60

115. Remove Fitting Sleeve 198 589 02 61, slide on Rear Annular Grooved Bearing 6306 N marked X (see Job No. 26 — 5) and drive it into the transmission case, snap ring toward the rear, using Fixture 136 589 07 39.
116. Perform the operations necessary to install the transmission case rear cover as outlined in Section D, Paragraphs 49 — 54.
117. Fill in 1.4 liters transmission fluid Type A.
Note: For this purpose it is advisable to unscrew the oil level check plug at the transmission case and to fill in transmission oil until it runs out at the check bore.
The previous conical plug at the transmission case for draining the oil has been replaced by a shouldered plug (Part No. 186 997 01 32) together with Sealing Ring A 24 × 30 DIN 7603 AL 99 F 8.
118. Perform the operations necessary to install the transmission case top cover as outlined in Section A.