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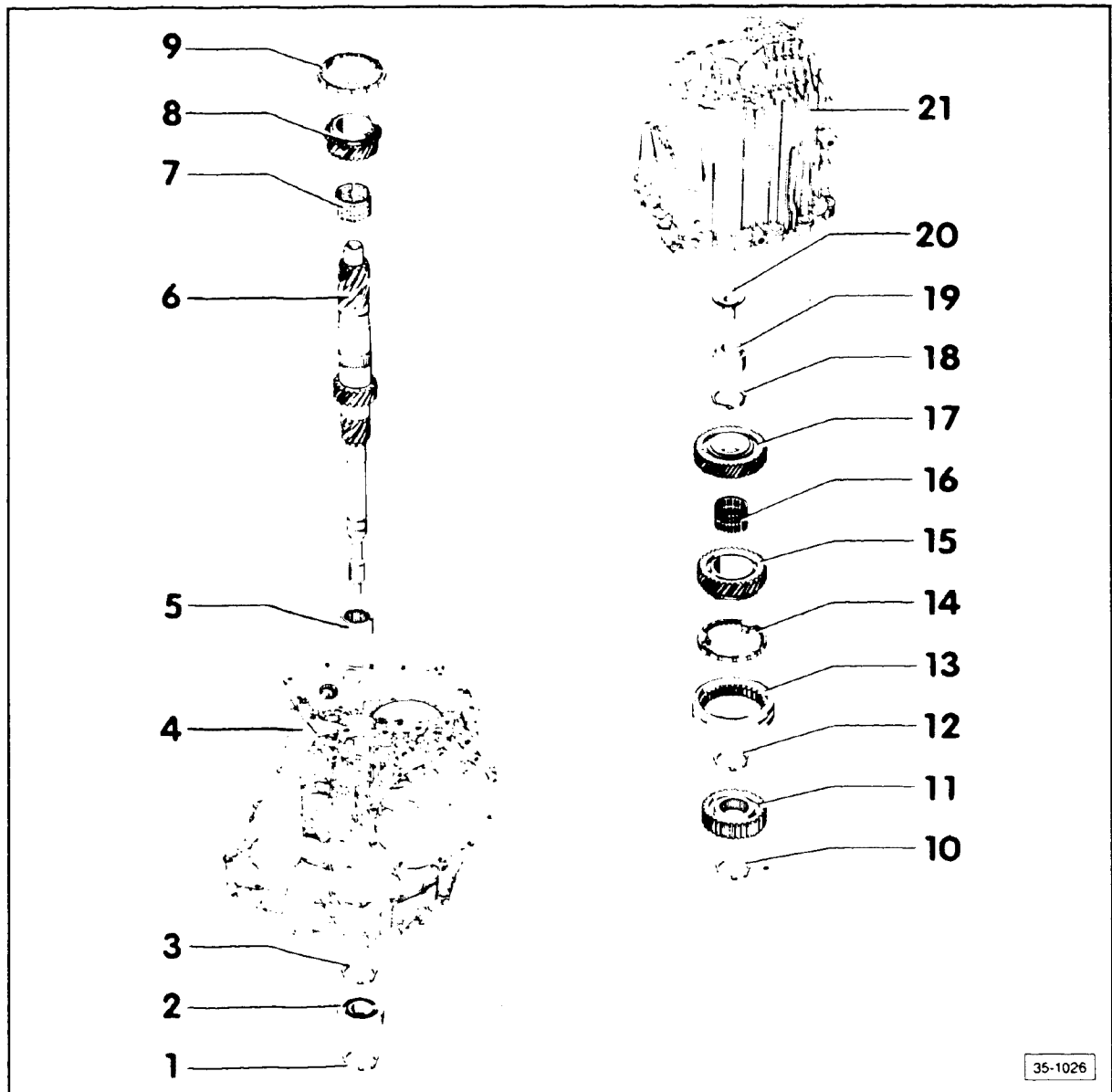
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Transmission

- * ■ modifications 35.35

* NEW INFORMATION since last filming

Manual Transmission – Case, Gears, Shafts



Note

When installing new gears or main shaft, note technical data, see Repair Group 00 - code letters, application, ratios, filling capacities.

Since circlips of varying size and thickness are used, the individual circlips must be identified (identify with numbers as in Fig. 11). Thickness of the individual circlip is re-determined if a component directly affected is being replaced.

1 — Circlip

- determining thickness, page 35.24
- when reusing ball bearings and main shaft, measure circlip with micrometer and use circlip of same thickness

2 — Main shaft ball bearing

removing/installing, Fig. 3

3 — Circlip

- determining thickness, page 35.24
- when reusing ball bearings and main shaft, measure circlip with micrometer and use circlip of same thickness

4 — Final drive housing

5 — Main shaft needle bearing

- removing, Fig. 1
- installing, Fig. 2

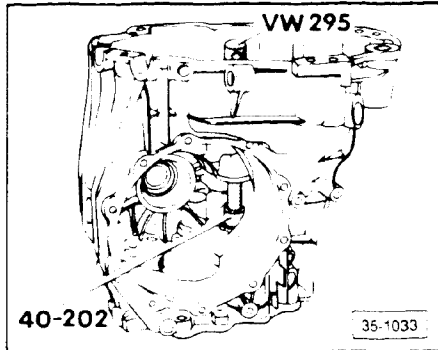
6 — Main shaft

adjusting, page 35.24

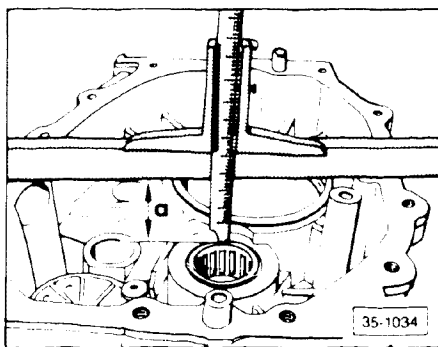
Manual Transmission – Case, Gears, Shafts

- 7 — **3rd gear needle bearing**
- 8 — **3rd gear**
 - spring, assembling, Fig. 4
- 9 — **3rd gear synchronizer ring**
 - checking for wear, Fig. 5
- 10 — **Circlip**
 - locating selecting, Fig. 11 (no. 3)
- 11 — **3rd/4th gear synchronizer hub**
 - high collar faces 3rd gear
 - removing, Fig. 12
 - installing, Fig. 13
- 12 — **Circlip**
 - redetermine thickness when replacing the synchronizer hub
 - installing, Fig. 10
 - locating selecting, Fig. 11 (no. 4)
- 13 — **3rd/4th gear operating sleeve**
 - installed position, Fig. 6
- 14 — **4th gear synchronizer ring**
 - checking for wear, Fig. 5
- 15 — **4th gear**
 - spring, assembling, Fig. 4
- 16 — **4th gear needle bearing**
- 17 — **5th gear**
 - removing, Fig. 7
 - installing, Fig. 8
- 18 — **Circlip**
 - redetermine thickness when replacing 5th gear
 - installing, Fig. 10
 - locating selecting, Fig. 11 (no. 5)
- 19 — **Main shaft needle bearing**
 - always replace
 - removing, Fig. 9
 - drive in 214 mm (measured from housing mating surface) with **VW 416 b**
 - See also "Transmission modifications" on page 35.36.
- 20 — **Plastic sleeve**
 - always replace
- 21 — **Gear carrier housing**

Manual Transmission – Case, Gears, Shafts

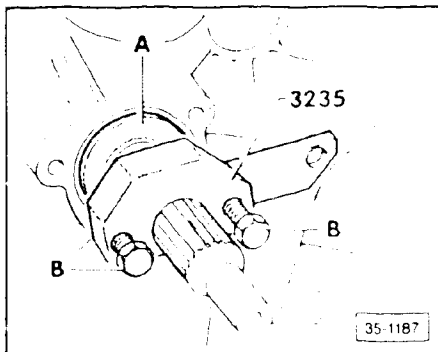


► Fig. 1 Main shaft needle bearing, removing



► Fig. 2 Needle bearing, installing

- press in with 40-202
- measure from lower edge of straightedge to upper edge of needle bearing
 - dimension **a** = 35 mm



► Fig. 3 Ball bearing, installing in housing

- install main shaft, output shaft, and shift mechanism complete
- install circlip on main shaft
- install ball bearing on main shaft, up to stop
- position thrust washer (**A**) of press 3235, onto ball bearing
- brace flange of press 3235 as shown, and tighten both bolts (**B**)

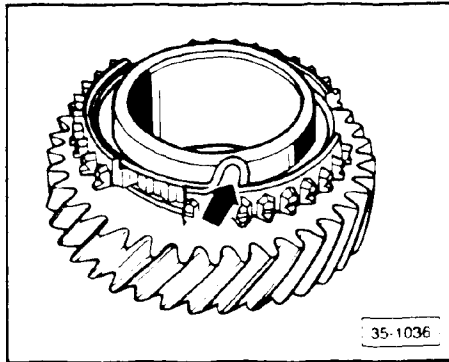
CAUTION

Bolts (**B**) must be tightened alternately and evenly (i.e. 1/2 turn at a time), or ball bearing could tilt and become damaged.

Note

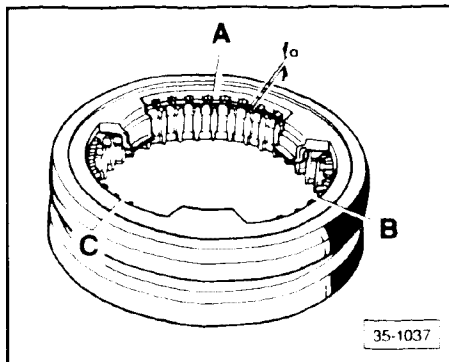
Installation position of ball bearing: open side of plastic cage points towards guide sleeve.

Manual Transmission – Case, Gears, Shafts



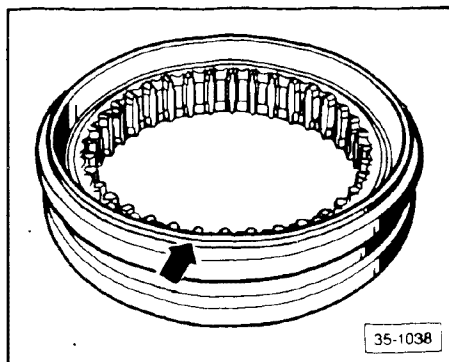
► Fig. 4 Spring, installing in gear

- assemble spring (**arrow**) in gear by installing angled end of spring in bore



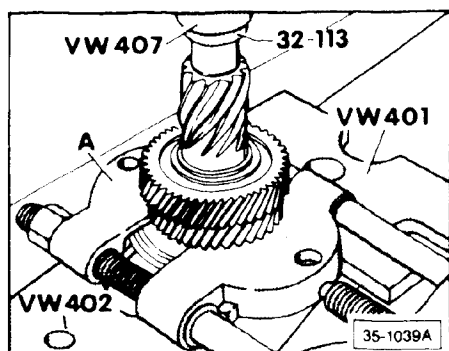
► Fig. 5 Synchronizer ring, checking for wear

- press synchronizer ring into operating sleeve and measure gap **a** with a feeler gage in positions **A**, **B**, and **C**
- add measured values and divide by 3
 - value obtained must not be less than 0.5 mm



► Fig. 6 3rd/4th gear operating sleeve, installing

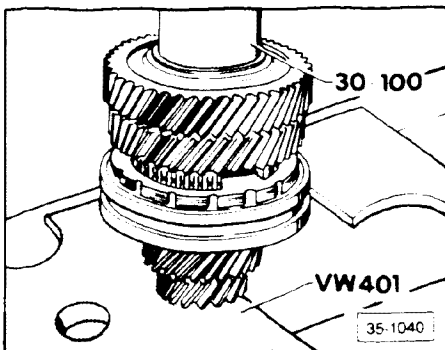
- recessed side (**arrow**) faces 3rd gear



► Fig. 7 5th gear, removing

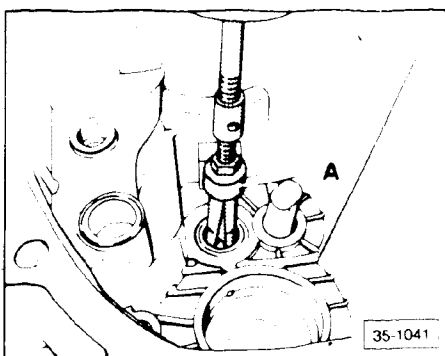
- use 12-75 mm separating device. A (e.g. Kukko 17/2)

Manual Transmission – Case, Gears, Shafts



► Fig. 8 5th gear, installing

- the higher collar faces reverse gear
- the oil traps face 4th gear



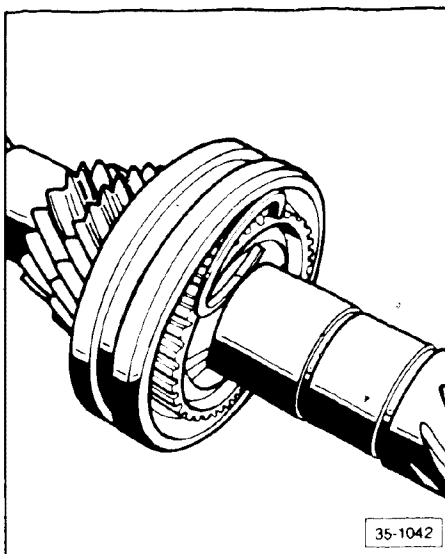
► Fig. 9 Main shaft needle bearing, removing

- use 23.5 mm - 30 mm puller, **A**
(e.g. **Kukko 21/4**) along with slide hammer **VW 771**

Note

Drive in 214 mm (measured from housing mating surface) with **VW 416b**.

See also "Transmission modifications" on page 35.36.

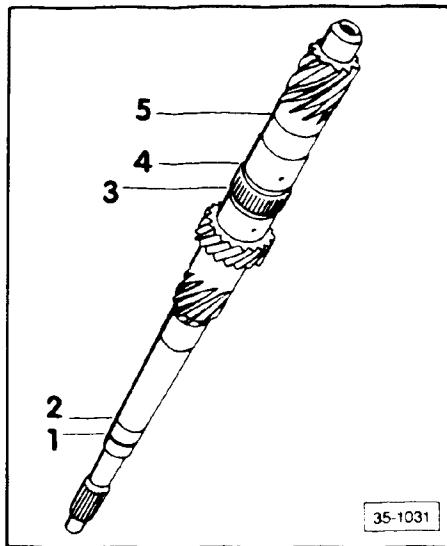


► Fig. 10 4th gear circlip, installing

- determine the thickest circlip that can be used, and install
 - 5th gear circlip is determined in same manner

Note

For listing of available circlips, see Fig. 11.



► Fig. 11 Circlips, locating/selecting

- thickness of circlips 1, 2, 4, and 5 must be determined
- thickness of circlip 3 is always the same
- determine thickness of circlips 1 and 2
 - see page 35.24 — Main shaft, adjusting

Circlip 3 (annealing color: brown)

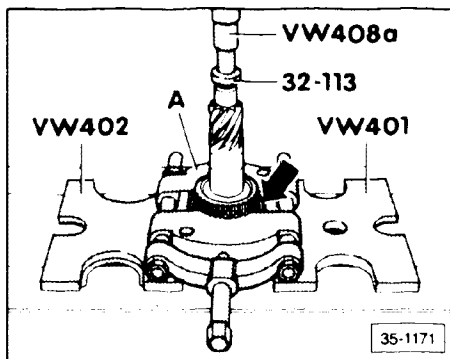
Thickness of circlip (mm)	Part number
2.00	N 902 945.01

Circlip 4 (annealing color: blue)

Thickness of circlip (mm)	Part number
1.90	N 902 944.01
1.93	N 902 944.02
1.96	N 902 944.03
1.99	N 902 944.04
2.02	N 902 944.05
2.05	N 902 944.06

Circlip 5

Thickness of circlip (mm)	Part number
1.90	N 902 942.02
1.93	N 902 942.03
1.96	N 902 942.04
1.99	N 902 942.05
2.02	N 902 942.06

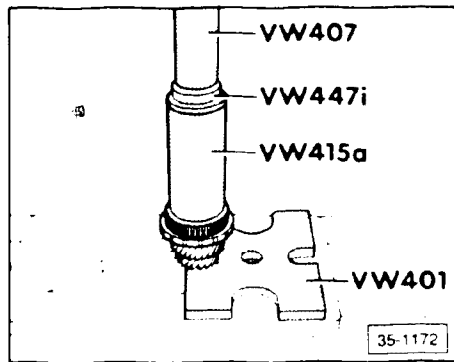


► Fig. 12 3rd/4th gear synchronizer hub, removing

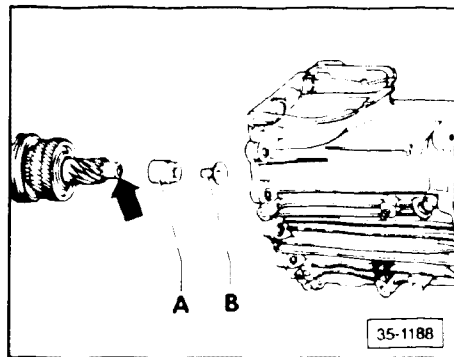
- use 22-115 mm separating device, A (e.g. Kukko 17/2)

Note

Before installing separating device (A), press 3rd gear synchronizer ring (arrow) toward 3rd gear.



► Fig. 13 3rd/4th gear synchronizer hub, installing



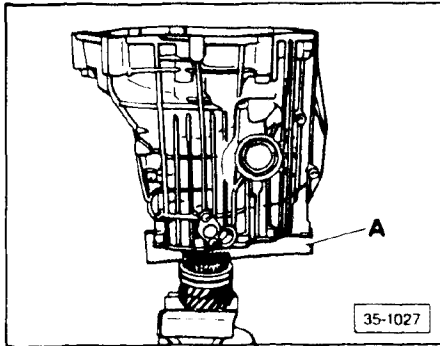
► Fig. 14 Plastic sleeve, installing

For main shafts with oil passages (**arrow**):

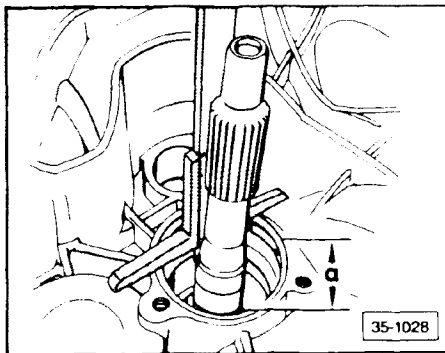
- install needle bearing (**A**) and plastic sleeve (**B**)

Manual Transmission – Case, Gears, Shafts

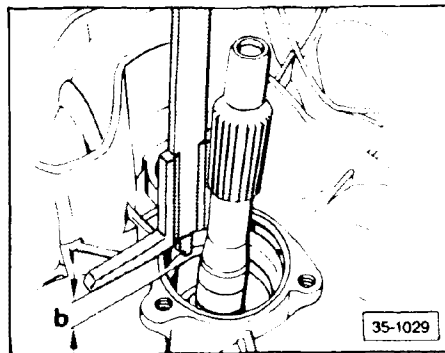
Main shaft, adjusting



- tighten main shaft in vise equipped with jaw covers
- place spacer gage (A = 3167) on 3rd gear and install housing on A via main shaft



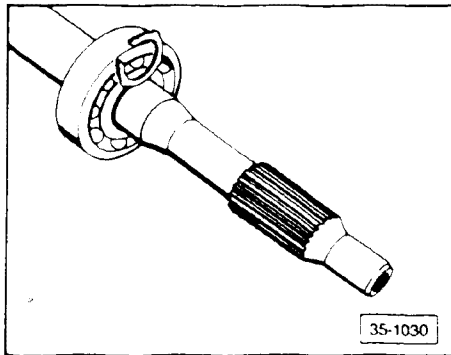
- place depth gage on housing and measure to the lower recess of the main shaft
 - dimension a = 28.5 mm



- place depth gage on housing and measure to contact surface of ball bearing
 - dimension b = 26.8 mm
- determine thickness of lower circlip
 - dimension x:
 - $x = a - b$
 - $x = 28.5 \text{ mm} - 26.8 \text{ mm} = 1.70 \text{ mm}$
- determine thickness of circlip according to table

Measurement result (mm)	Thickness (mm)	Part number
1.64-1.71	1.69	N 902941.05
1.72-1.79	1.77	N 902941.06
1.80-1.87	1.85	N 902941.07
1.88-1.95	1.93	N 902941.08
1.96-2.03	2.01	N 902941.09
2.04-2.11	2.09	N 902941.10
2.12-2.19	2.17	N 902941.11
2.20-2.27	2.25	N 902941.12
2.28-2.35	2.33	N 902941.13

Manual Transmission – Case, Gears, Shafts



- install circlip and ball bearing on main shaft with press tube **30-100**
 - determine the thickest circlip that can be installed

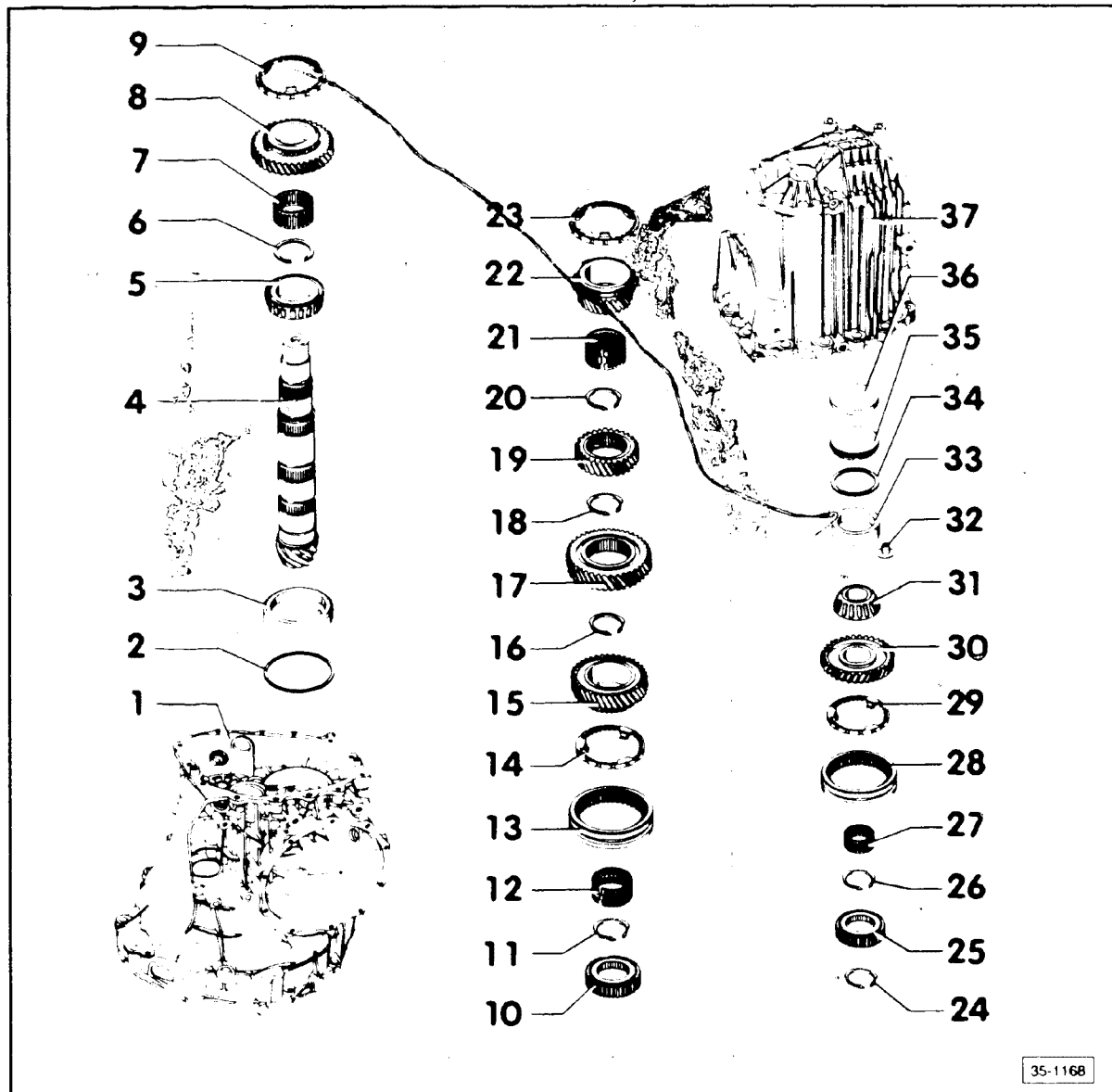
Note

The following circlips are available:

Thickness (mm)	Part number
1.69	N 902941.05
1.77	N 902941.06
1.85	N 902941.07
1.93	N 902941.08
2.01	N 902941.09
2.09	N 902941.10
2.17	N 902941.11
2.25	N 902941.12
2.33	N 902941.13

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Manual Transmission – Case, Gears, Shafts



CAUTION

When replacing taper roller bearings, determine the installation position before removing the pinion with the hollow shaft (actual measurement). See Repair Group 39 — Determining installation position of the pinion.

Do not damage seal lips between taper roller bearings.

Note

Before installing new gear or ring gear pinion set — note technical data — see Repair Group 00.

Since circlips of varying size and thickness are being used, the individual circlips must be identified (identify with numbers as in Fig. 20). Thickness of the individual circlip is re-determined if a component directly affected is being replaced.

1 — Final drive housing

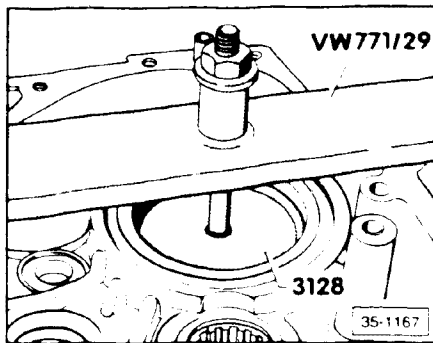
2 — Shim S3

adjustment overview, see Repair Group 39

Manual Transmission – Case, Gears, Shafts

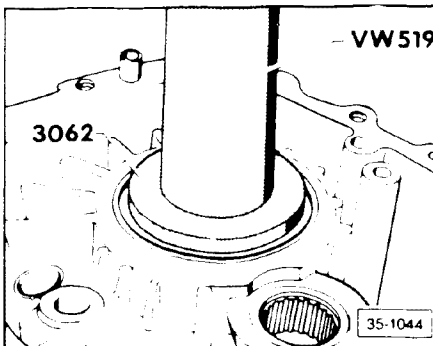
- 3 — **Double taper roller bearing outer race**
 - removing, Fig. 1
 - installing, Fig. 2
- 4 — **Pinion**
 - matched with ring gear (ring gear pinion set)
 - when replacing ring gear pinion set, pinion is to be adjusted with hollow shaft and ring gear. See Repair Group 39 — Pinion, adjusting Ring gear, adjusting
- 5 — **Double taper roller bearing inner race**
 - removing, Fig. 3
 - installing, Fig. 4
- 6 — **Circlip**
 - installing, Fig. 19
 - locating selecting, Fig. 20 (no. 1)
- 7 — **1st gear needle bearing**
- 8 — **1st gear**
 - spring, assembling, Fig. 5
- 9 — **1st gear synchronizer ring**
 - checking for wear, Fig. 6
- 10 — **1st/2nd gear synchronizer hub**
 - high collar faces 2nd gear
 - press off together with 1st gear. Use thrust plates **VW 401** and **VW 402**
 - press on with **VW 415A** and **VW 519**
- 11 — **Circlip**
 - installing, Fig. 19
 - locating selecting, Fig. 20 (no. 2)
- 12 — **2nd gear needle bearing**
- 13 — **1st/2nd gear operating sleeve**
 - installing, Fig. 7
- 14 — **2nd gear synchronizer ring**
 - checking for wear, Fig. 6
- 15 — **2nd gear**
 - spring, assembling, Fig. 5
- 16 — **Circlip**
 - locating selecting, Fig. 20 (no. 3)
- 17 — **3rd gear**
 - groove faces 4th gear
 - removing, Fig. 8
 - installing, Fig. 9
- 18 — **Circlip**
 - installing, Fig. 19
 - locating selecting, Fig. 20 (no. 4)
- 19 — **4th gear**
 - collar faces 3rd gear
 - removing, Fig. 10
 - installing, Fig. 11
- 20 — **Circlip**
 - installing, Fig. 19
 - locating selecting, Fig. 20 (no. 5)
- 21 — **5th gear needle bearing**
- 22 — **5th gear**
 - spring, assembling, Fig. 5
- 23 — **5th gear synchronizer ring**
 - checking for wear, Fig. 6
- 24 — **Circlip**
 - locating selecting, Fig. 20 (no. 6)
- 25 — **5th/reverse gear synchronizer hub**
 - high collar faces 5th gear
 - press off with 5th gear, Fig. 12
 - press on using **2010**
- 26 — **Circlip**
 - installing, Fig. 19
 - locating selecting, Fig. 20 (no. 7)
- 27 — **Reverse gear needle bearing**
- 28 — **5th/reverse gear operating sleeve**
 - installed position, Fig. 15
- 29 — **Reverse gear synchronizer ring**
 - checking for wear, Fig. 6
- 30 — **Reverse gear**
 - spring, assembling, Fig. 5
- 31 — **Taper roller bearing inner race**
 - removing, Fig. 13
 - installing, Fig. 14
- 32 — **Locking bushing for taper roller bearing outer race**
 - removing, Fig. 16
 - reinstallation not necessary once outer race is replaced (bushing required only during production)
- 33 — **Taper roller bearing outer race**
 - removing, Fig. 17
 - installing, Fig. 18
- 34 — **Shim S4**
 - adjustment overview, see Repair Group 39
- 35 — **Pressure plate**
- 36 — **Washer**
 - compensates for length, depending on temperature (heat)
 - to remove, drill hole in washer and pry out with sheet metal screw

Manual Transmission – Case, Gears, Shafts

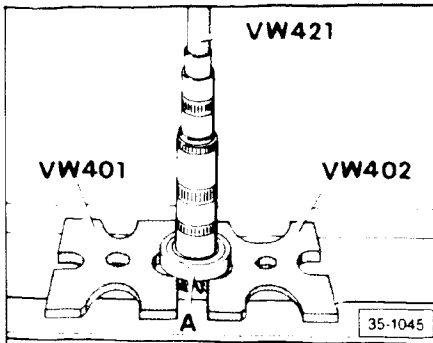


► Fig. 1 Double taper roller bearing outer race, removing

- place pressure piece from puller 3128 under outer race
- position support bridge VW 771/29 and install a bolt on transmission housing
 - when tightening bolt, outer race is pulled out of housing



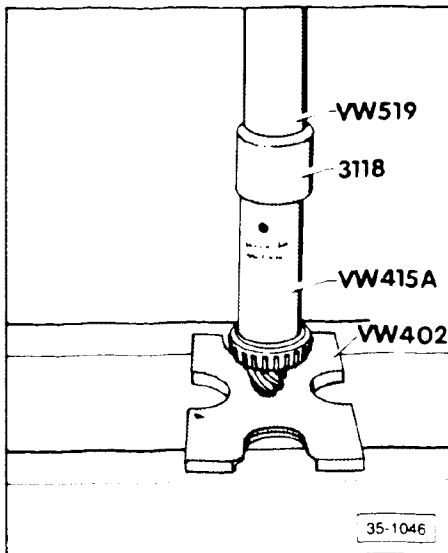
► Fig. 2 Double taper roller bearing outer race, installing



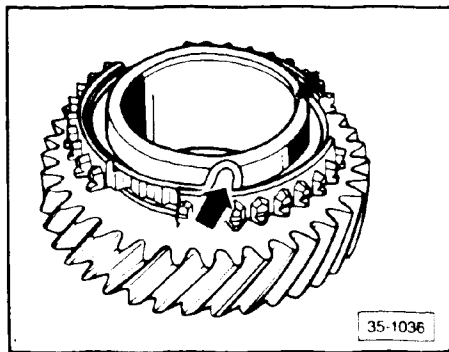
► Fig. 3 Double taper roller bearing inner race, removing

- outer race A must be installed to remove inner race

Manual Transmission – Case, Gears, Shafts

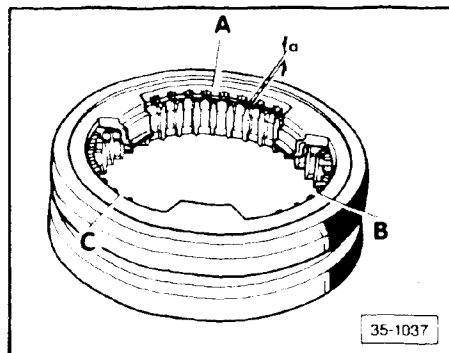


► Fig. 4 Double taper roller bearing inner race, installing



► Fig. 5 Spring, installing in gear

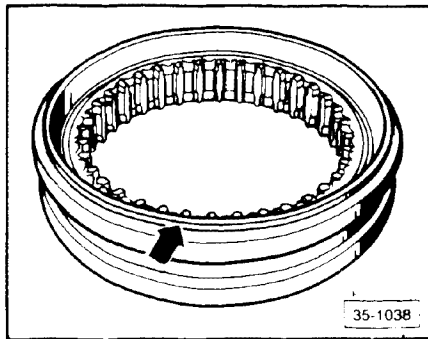
- assemble spring (arrow) in gear by installing angled end of spring in bore



► Fig. 6 Synchronizer ring, checking for wear

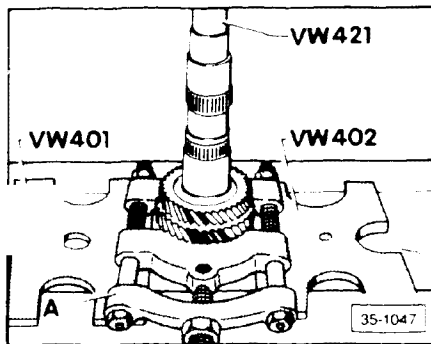
- press synchronizer ring into operating sleeve and measure gap **A** with a feeler gage in positions **A**, **B**, and **C**
- add values obtained and divide by 3
 - the measured value must not be less than 0.5 mm

Manual Transmission – Case, Gears, Shafts



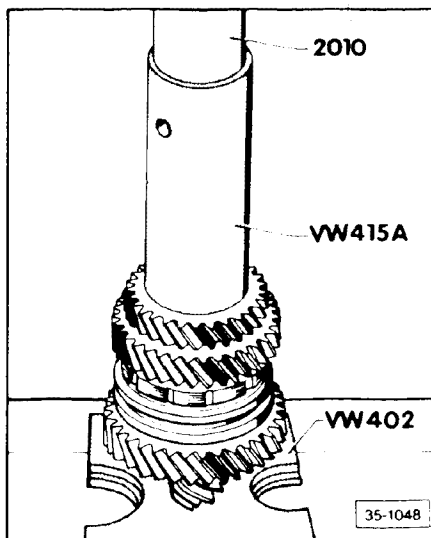
► Fig. 7 1st/2nd gear operating sleeve, installing

- recessed side (arrow) faces 1st gear



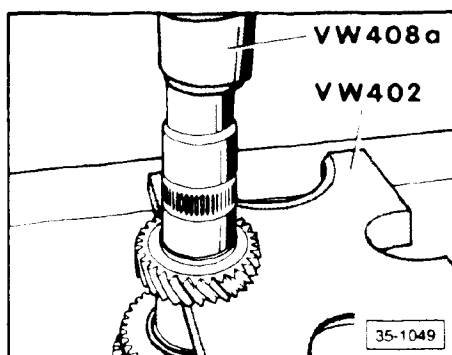
► Fig. 8 3rd gear, removing

- use 22-115 mm separating device, A (e.g. Kukko 17/2)
- remove 3rd gear and 2nd gear together

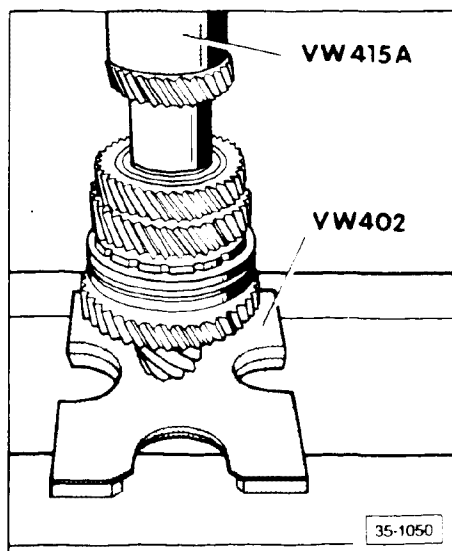


► Fig. 9 3rd gear, installing

- installation position: groove faces 4th gear

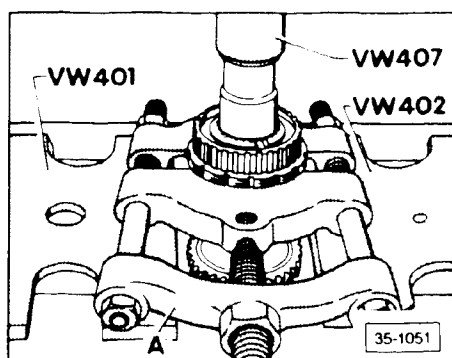


► Fig. 10 4th gear, removing



► Fig. 11 4th gear, installing

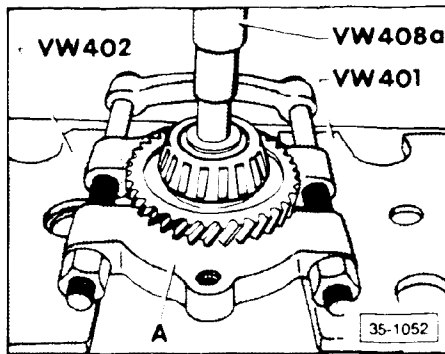
- collar faces 3rd gear



► Fig. 12 Synchronizer hub, removing

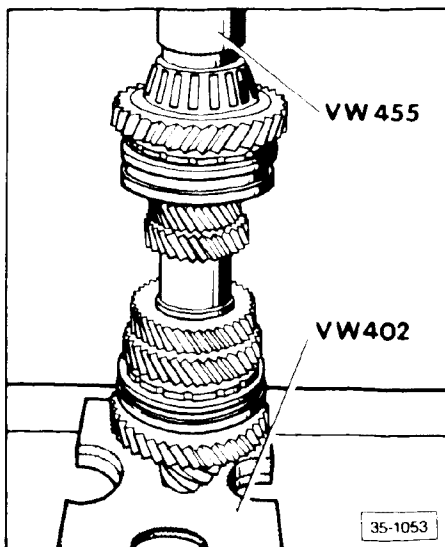
- remove synchronizer hub with 5th gear
 - use 22-115 mm separating device, A (e.g. Kukko 17/2)

Manual Transmission – Case, Gears, Shafts

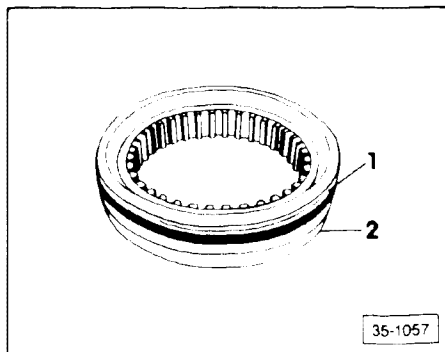


► Fig. 13 Taper roller bearing inner race, removing

- remove inner race with reverse gear
- use 22-115 mm separating device, A (e.g. Kukko 17/2)



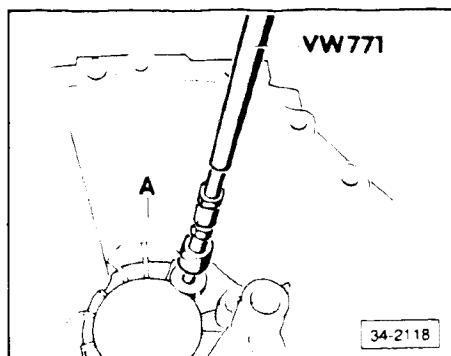
► Fig. 14 Taper roller bearing inner race, installing



► Fig. 15 5th/reverse gear operating sleeve, installing

- diagonal (1) faces reverse gear
- recessed side (2) faces 5th gear

Manual Transmission – Case, Gears, Shafts

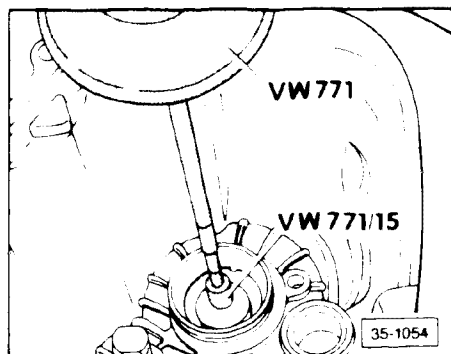


► Fig. 16 Locking bushing for taper roller bearing outer race, removing

- use 12-16 mm puller A (e.g. US 1010 or Kukko 21/1)

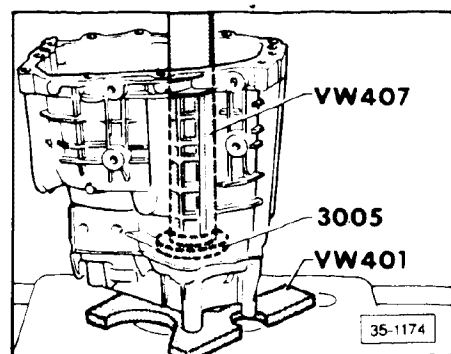
Note

Bushing reinstallation not necessary once outer race is replaced. (Bushing required only during production.)



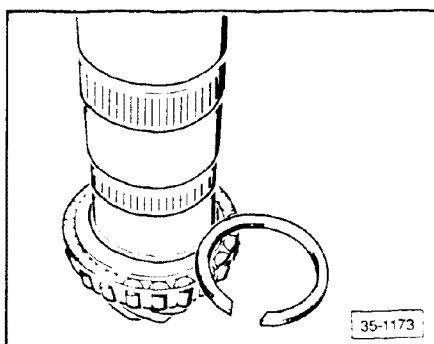
► Fig. 17 Taper roller bearing outer race, removing

- fabricate the following removal device:
 - M10 stud (length = 50 mm) reduced to M8 diameter
- thread stud into pressure plate
- remove pressure plate and outer race from housing with slide hammer



► Fig. 18 Taper roller bearing outer race, installing

Manual Transmission – Case, Gears, Shafts

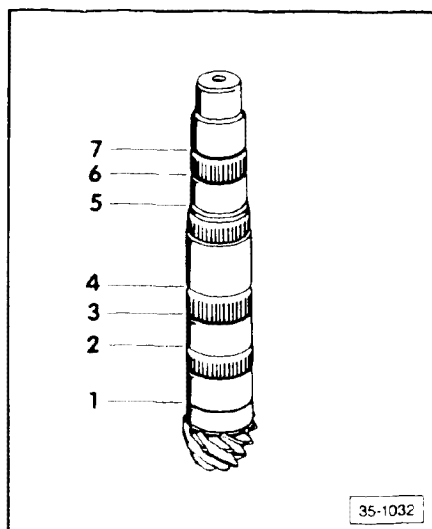


► Fig. 19 Taper roller bearing circlip, installing

- determine the thickest circlip that can be used, and install
 - synchronizer hub circlips and 3rd 4th gear circlip are determined in same manner as taper roller bearing circlip

Note

For listing of available circlips, see Fig. 20.



► Fig. 20 Circlips, locating/selecting

- determine thickness of circlips 1, 2, 4, 5, and 7
 - thickness of circlips 3 and 6 is always constant (see table)

Circlip 1

Thickness of circlip (mm)	Part number
2.00	N 902 950.01
2.02	N 902 950.02
2.04	N 902 950.03
2.06	N 902 950.04
2.08	N 902 950.05
2.10	N 902 950.06

Circlip 2 (annealing color: blue)

Thickness of circlip (mm)	Part number
1.90	N 902 947.01
1.93	N 902 947.02
1.96	N 902 947.03
1.99	N 902 947.04
2.02	N 902 947.05

Circlip 3 (annealing color: blue)

Thickness of circlip (mm)	Part number
2.50	N 902 947.06

Note

See also "Transmission modifications" on page 35.36.

Manual Transmission – Case, Gears, Shafts

Note

See also "Transmission modifications" on page 35.36.

Circlip 4

Thickness of circlip (mm)	Part number
1.90	N 902 946.02
1.93	N 902 946.03
1.96	N 902 946.04
1.99	N 902 946.05
2.02	N 902 946.06

Circlip 5

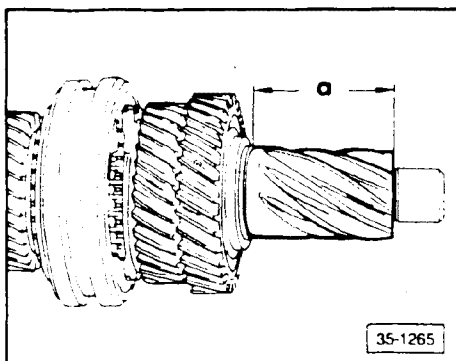
Thickness of circlip (mm)	Part number
1.87	N 902 952.01
1.90	N 902 952.02
1.93	N 902 952.03
1.96	N 902 952.04

Circlip 6 (annealing color: brown)

Thickness of circlip (mm)	Part number
2.00	N 902 945.01

Circlip 7 (annealing color: blue)

Thickness of circlip (mm)	Part number
1.90	N 902 944.01
1.93	N 902 944.02
1.96	N 902 944.03
1.99	N 902 944.04
2.02	N 902 944.05
2.05	N 902 944.06

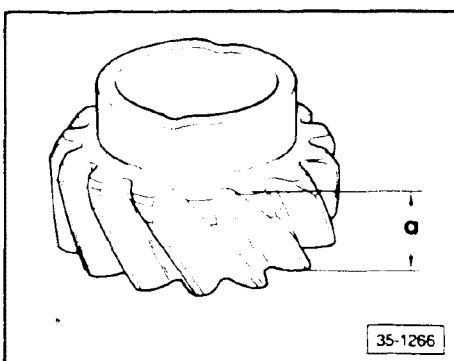


Transmission modifications

Reverse gear

Beginning with transmission date 20 08 0, the reverse gear teeth on the main shaft and those of the reverse gear have been lengthened as follows:

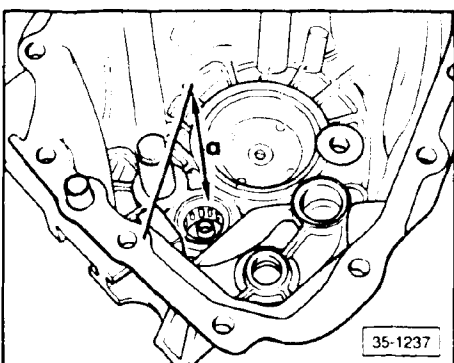
- dimension **a** = current: 54.50 mm
New: 56.50 mm



- dimension **a** = current: 18.3 mm
New: 19.7 mm

Note

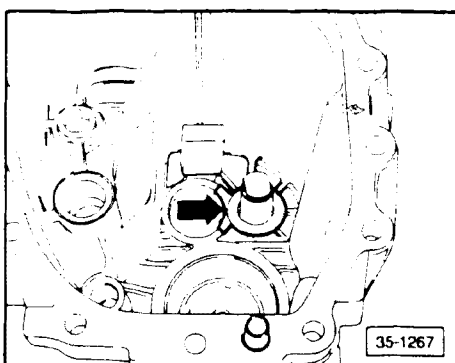
The new mainshaft can be installed in earlier transmissions (before 20 08 0) but the needle bearing must be installed 2.0 mm deeper (see Mainshaft needle bearing installation on this page).



Main shaft needle bearing installation

Beginning with transmission date 20 08 0, the main shaft needle bearing in the final drive housing is installed 2.0 mm deeper.

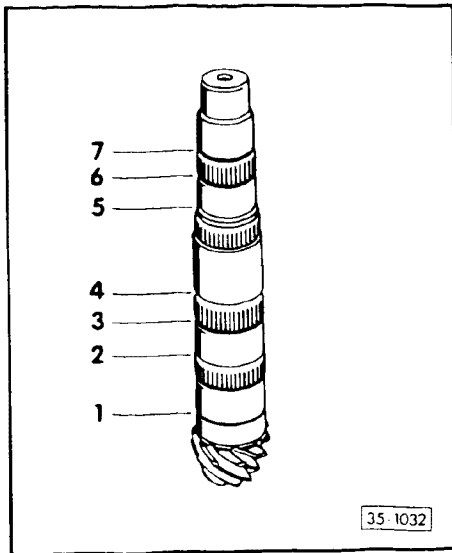
- dimension **a** = current: 214 mm
New: 216 mm



The final drive housing is slightly milled-out in the reverse gear area (**arrow**).

Note

The new reverse gear can only be installed in transmissions that have the revised housing and main shaft.



Pinion shaft circlips revised

Beginning with transmission date 03 04 0, the circlip sizes are revised as follows:

Circlip 1

Thickness of circlip (mm)	Part number
2.00	N 902 950.01
2.03	N 902 950.08
2.06	N 902 950.04
2.09	N 902 950.09
2.12	N 902 950.10
2.15	N 902 950.11

Circlip 4

Thickness of circlip (mm)	Part number
1.90	N 902 946.02
1.94	N 902 946.09
1.98	N 902 946.10
2.02	N 902 946.06
2.06	N 902 946.11

Circlip 5

Thickness of circlip (mm)	Part number
1.86	N 902 952.07
1.90	N 902 952.02
1.94	N 902 952.08
1.98	N 902 952.09

Note

The circlips **2, 3, 6** and **7** remain unchanged.

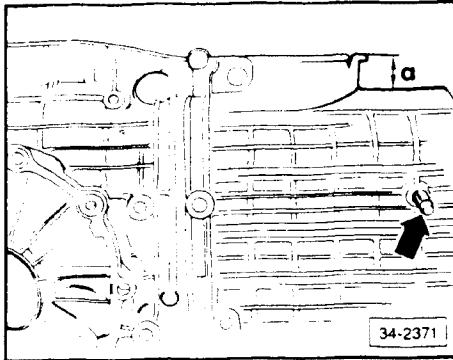
New circlips can be installed in all current transmissions.

Current circlips will be deleted when supplies are used up.

Tensioning cable mounting

Beginning with transmission date 20 08 0, the tensioning cable mount on the transmission was changed.

- dimension **a** = current: 23.5 mm
New: 31.5 mm



Beginning in 9:90 a mounting hole in the housing replaces the previously used mounting stud (**arrow**). The tensioning cable bracket is then provided with a mounting stud.

Note

Change the cable bracket when installing a new transmission.