Workshop Manual

928

DR. ING. h. c. F. PORSCHE Aktiengesellschaft

The Workshop Manual is only for the internal use of the Porsche Dealer Organization.

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General

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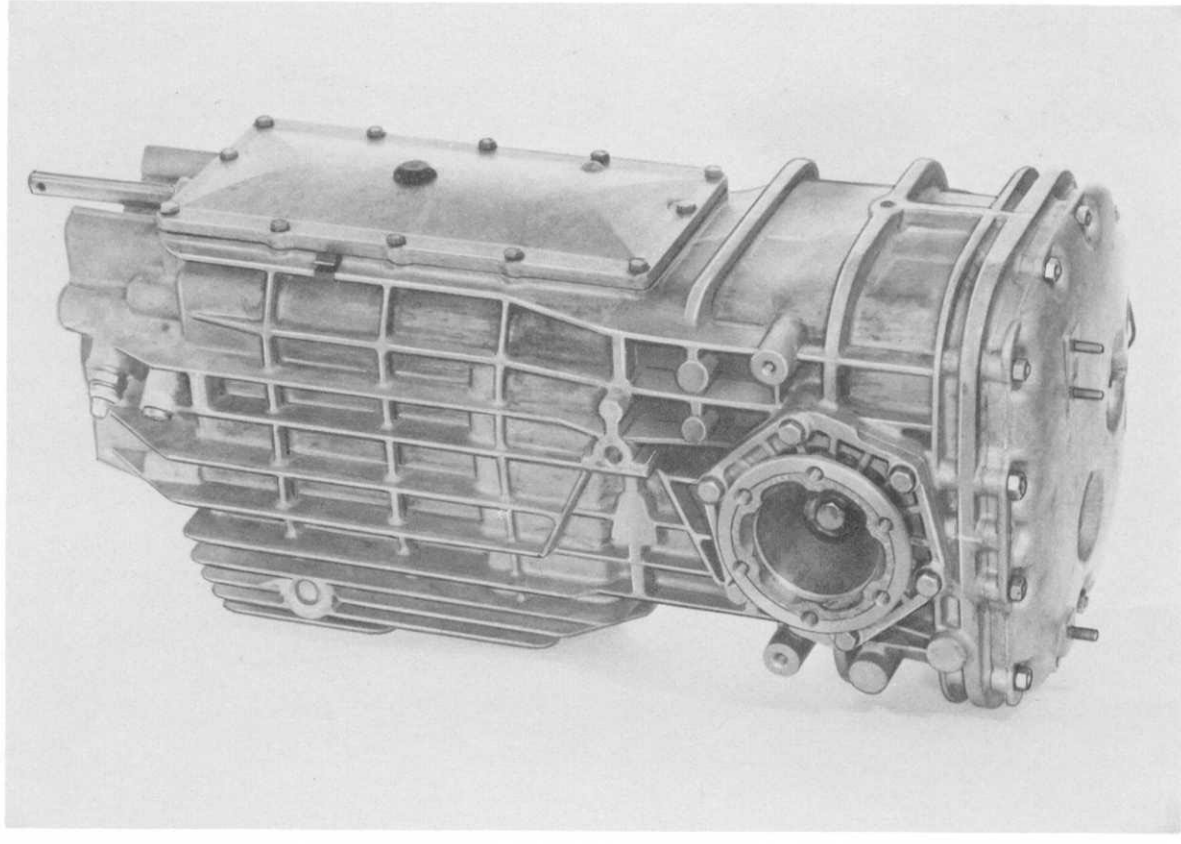
Differential / Transaxle System

PSD diagnosis / Troubleshooting: beginning with supplement 35, pages see voume III.

Printed in Germany - XXXV, 1996

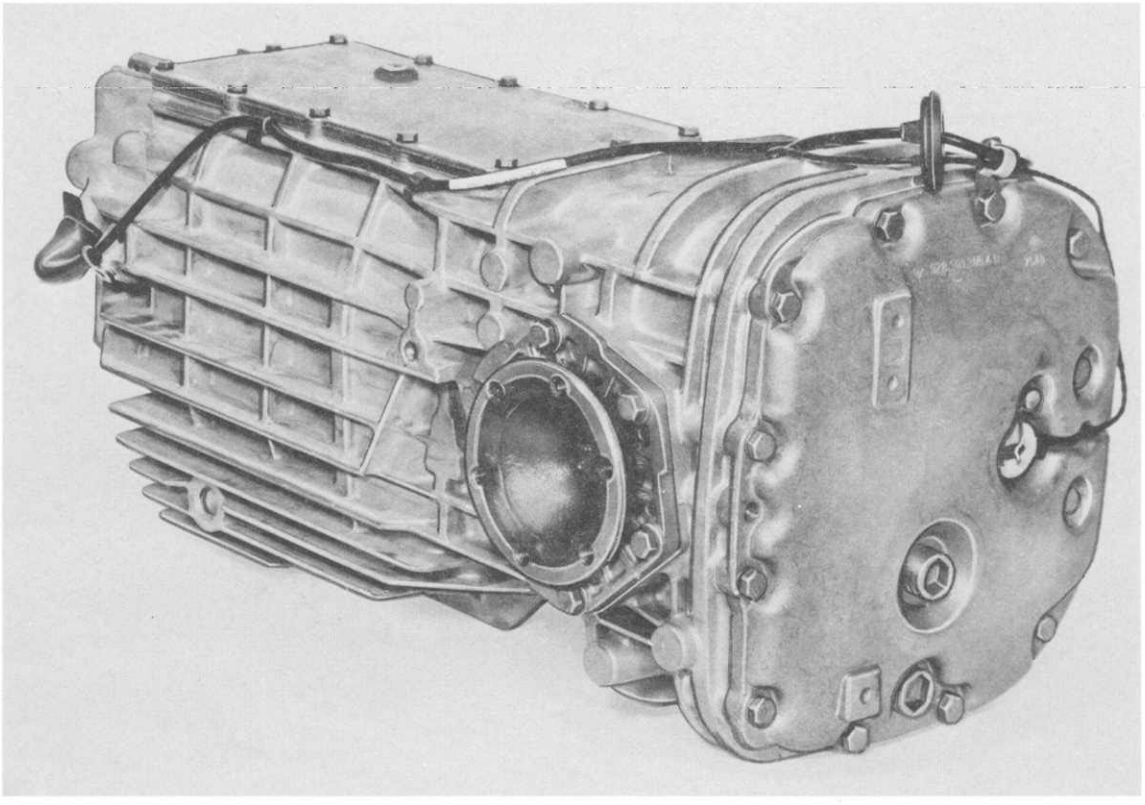
FIVE SPEED MANUAL TRANSMISSION / TYPE G 28.03



This transmission was installed worldwide in 928 cars up to June 13, 1980.

FIVE SPEED MANUAL TRANSMISSION / TYPE G 28.05

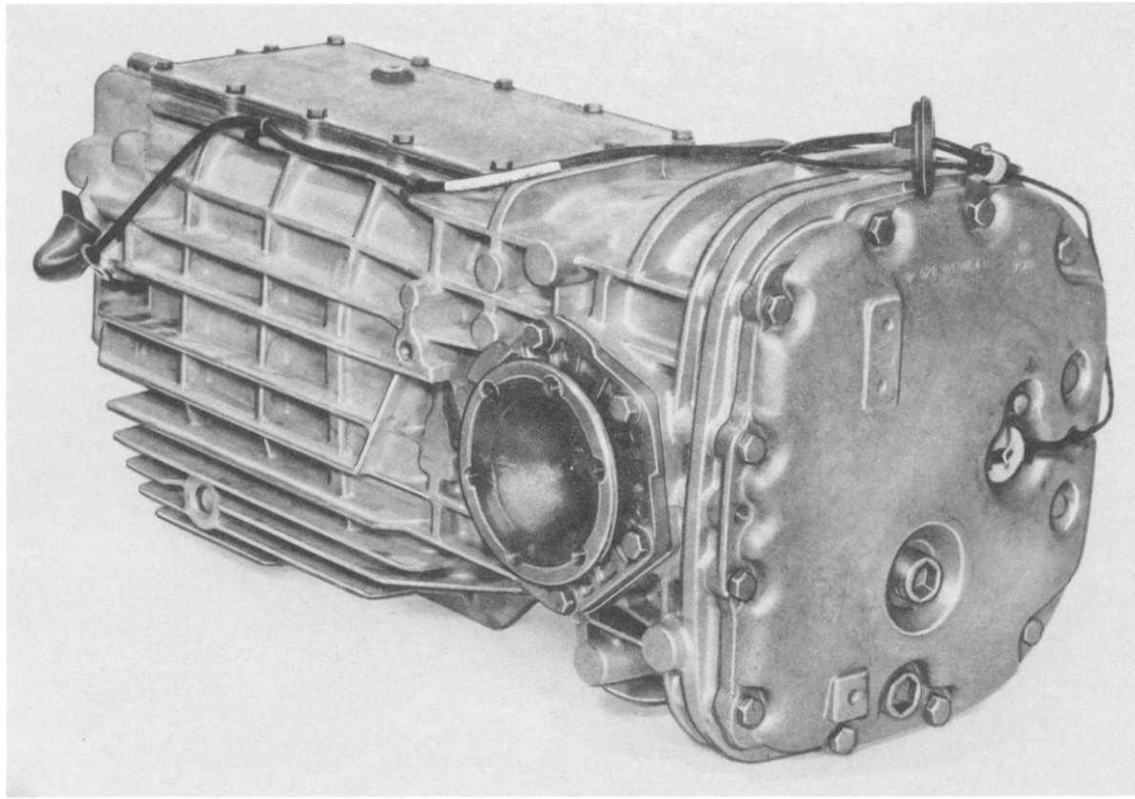
Installed in 928 cars beginning with 1981 models (June 1980)



This transmission is similar in design and repairing procedures to transmission type G 28.03, but has the following modifications.

1. Transmission moved forward by 30 mm.
2. Drive shaft longer.
3. Transmission case with modified ribs and hexagon head bolts instead of studs for the rear transmission cover.
4. Split needle bearings for loose gears.
5. Light alloy selector forks.
6. Modified pinion/ring gear (R = 70.70 mm).

FIVE SPEED MANUAL TRANSMISSION / TYPE G 28.08



Transmission Type	Installed In
G 28.08	928 S – 1983 Model

This transmission is similar in design and repairing procedures to transmission type G 28.05, but the ratios are different (see page 30 - 06).

TORQUE SPECIFICATIONS FOR MANUAL TRANSMISSION, GEAR SHIFT, CENTRAL TUBE

Location	Description	Threads/Pitch	Material	Torque Nm (ftlb)
Central tube/transmission	Bolt	M 10 x 1.5	10.9	58 (42)
Pinion bearing assembly	Nut	M 42 x 1.5	15CrNi6	280 (202)
Bearing cap/ transmission case	Bolt	M 8 x 1.25	10.9	30 (22)
Plug/locks	Plug	M 12 x 1.5	5.8	19 (14)
Upper cover/ transmission case	Bolt	M 6 x 1	8.8 12.9	9 (7) 16 (12)
Reverse gear deflector/ upper cover	Bolt	M 6 x 1	8.8	9 (7)
Ring gear	Bolt	M 12 x 1.25	12.9	165 (119)
Side cover/ transmission case	Bolt	M 8 x 1.25	8.8	22 (16)
Rear cover/ transmission case	Nut	M 8 x 1.25	8.8	22 (16)
Oil filler and drain plugs	Plug	M 24 x 1.5		22 (16)
Clamping sleeve/ drive shaft	Bolt	M 10 x 1.5	8.8 12.9	48 (35) 80 (58)
Backup light switch	Switch	M 18 x 1.5		22 (16)
Joint flange/ transmission outlet	Bolt	M 10 x 1.5	8.8	43 (31)
Bearing/internal selector rod	Bolt	M 8 x 1.25	8.8	15 (11)
Transmission mount/ transmission case	Bolt	M 12 x 1.5	8.8	85 (61)

Location	Description	Threads/Pitch	Material	Torque Nm (ftlb)
Central tube/ clutch housing	Bolt	M 10 x 1.5	8.8	43 (31)
Selector rod/ bearing assy. (selector rod coupling)	Bolt	M 8 x 1.25		25 (18)
Ball socket/ guide tube	Nut	BM 10		25 (18)
Guide tube bracket to body or central tube	Nut	M 6 x 1		9 (7)

General data	Manual transmission type G 28.03 and 28.05				
Design	Direct transmission with countershaft				
Ratios *	Z_1	Z_2	i_Z $Z_2 : Z_1$	i_{Vor} 32 : 23	$i_Z\ i_{Vor}$
1st gear	17	44	2.5882	1.3913	3.6010
2nd gear	22	39	1.7727	1.3913	2.4664
3rd gear	26	34	1.3077	1.3913	1.8194
4th gear	29	28	0.9655	1.3913	1.3433
5th gear	direct	direct	1.0000	direct	1.0000
Reserve gear	$\frac{22}{(30)}$	$\frac{(30)}{50}$	2.2727	1.3913	3.1620
Final drive	Drive pinion without hypoid offset				
Final drive ratio	12 : 33 i = 2.7500 up to Jan. 13, 1981 11 : 30 i = 2.7272 since Jan. 14, 1981				
Transmission oil	Multigrade gear lube SAE 75 W 90 API Classification GL 5 (or MIL-L-2105 B)				
Oil capacity	approx. 3.8 liters				

* Z_1 = Number of teeth on first gear meshed for selected gear

Z_2 = Number of teeth on second gear meshed for selected gear

i_Z = Gear ratio

i_{Vor} = Countershaft ratio

General Data	Manual Transmission Type G 28.08				
Design	Direct transmission with countershaft				
Ratios *	Z_1	Z_2	i_Z $Z_2 : Z_1$	i_{Vor} 33 : 20	$i_Z\ i_{Vor}$
1st gear	17	44	2.5882	1.650	4.2705
2nd gear	22	38	1.7272	1.650	2.8498
3rd gear	26	32	1.2307	1.650	2.0306
4th gear	29	27	0.9310	1.650	1.5361
5th gear	direct	direct	1.0000	direct	1.0000
Reverse gear	$\frac{22}{(30)}$	$\frac{(30)}{50}$	2.2727	1.650	3.7499
Final drive	Drive pinion without hypoid offset				
Final drive ratio	15 : 34 i = 2.2666				
Transmission oil	Multigrade gear lube SAE 75 W 90 API Classification GL 5 (or MIL-L 2105 B)				
Oil capacity	approx. 3.8 liters				

* Z_1 = Number of teeth on first gear meshed for selected gear

Z_2 = Number of teeth on second gear meshed for selected gear

i_Z = Gear ratio

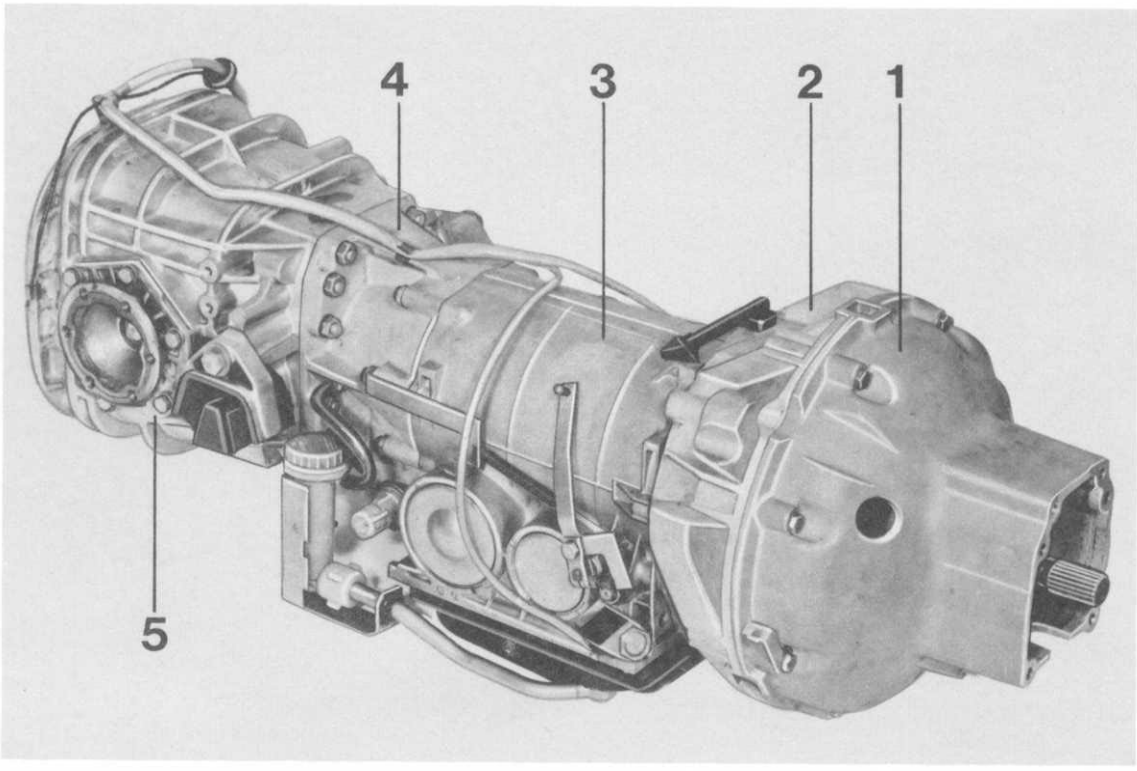
i_{Vor} = Countershaft ratio

General Data		Clutch
Design		Double disc, dry clutch with diaphragm springs, pulled version, engine end arrangement, hydraulically operated
Pressure plate	1978/1979 models	MFZ 2/215 KS ph (200 mm dia.; as spare part after depletion of stocks)
	from 1980 models	MFZ 2/200 KS ph
Spring pressure	1978/1979 models	5000 to 5700 N (1124 to 1281 lb)
	from 1980 models	5400 to 5900 N (1214 to 1326 lb)
	from 1984 models	5600 to 6200 N
Clutch disc (flywheel end)		200 mm dia.
Clutch disc (clutch end)		200 mm dia.

TORQUE SPECIFICATIONS FOR CLUTCH

Location	Description	Threads	Material	Torque Nm (ftlb)
Starter ring/interm. plate	Bolt	M 7 x 1	8.8	14 (10)
Guide tube/clutch housing	Bolt	M 6 x 1	8.8	9 (6.5)
Clutch slave cylinder	Bolt	M 8 x 1.25	8.8	22 (16)
Clamp/input shafts	Bolt	M 10 x 1.5	8.8	48 (35)
			12.9	80 (58)
Clutch housing/central tube	Bolt	M 10 x 1.5	8.8	43 (31)
Engine/clutch housing	Bolt	M 12 x 1.5	8.8	77 (56)
Clutch housing/cover	Bolt	M 8 x 1.25	8.8	22 (16)
Clutch/flywheel	Bolt	M 8 x 1.25	8.8	22 (16)
Ball stud/clutch housing	Ball stud	M 6		10 (7)
		M 8		23 (17)
Flywheel/crankshaft	Bolt	M 10 x 1.25		90 + 5 (70 + 4)

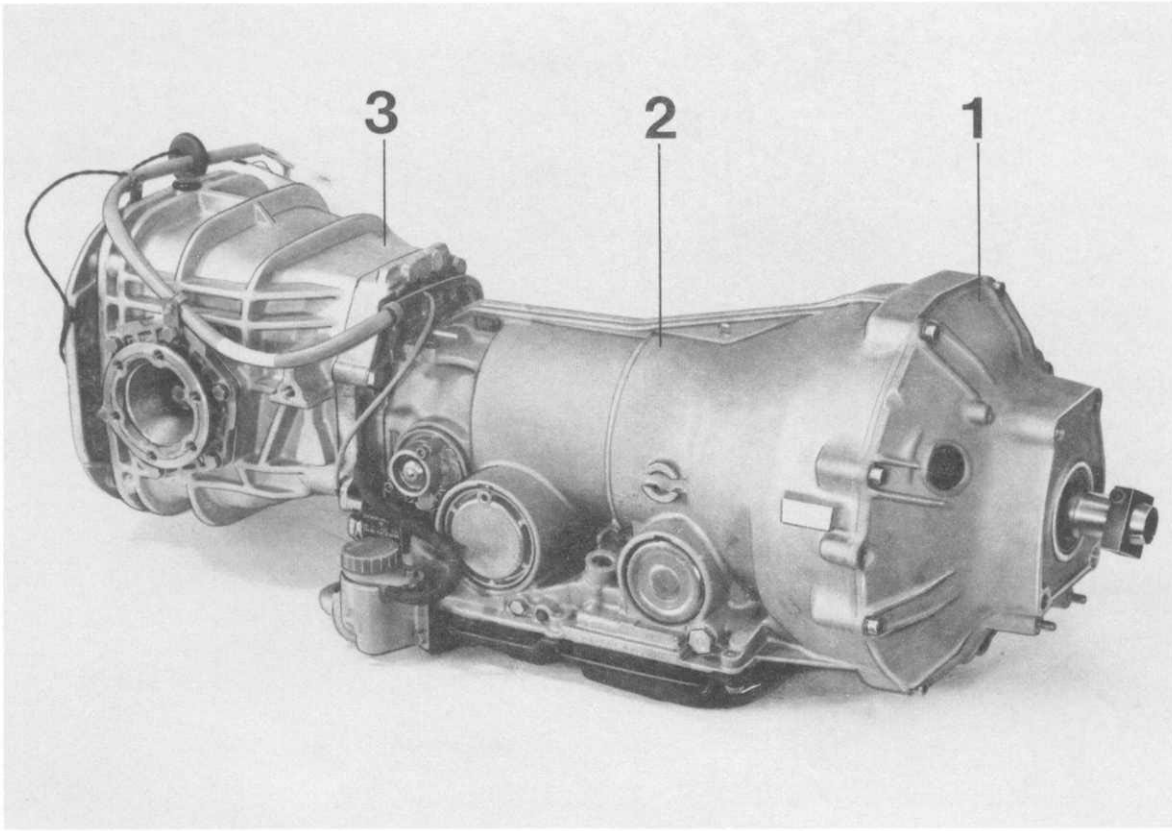
THREE SPEED AUTOMATIC TRANSMISSION



1 – Front converter housing
2 – Rear converter housing
3 – Automatic transmission
4 – Rear transmission case
5 – Final drive

Transm. Type	Installed In
A 22.01	928 – from 1980 models
A 22.02	928 – 1978/1979 models

FOUR SPEED AUTOMATIC TRANSMISSION



1 – Front converter housing

2 – Automatic transmission

3 – Final drive

Transmission Type	Installed In
A 28.01	928 S – standard from 1983 models

TORQUE SPECIFICATIONS FOR AUTOMATIC TRANSMISSION
(Central Tube and Final Drive)

Location	Description	Threads	Material	Torque Nm (ftlb)
Ring gear/flywheel	Bolt	M 8 x 1.25	12.9	32 . . . 39 (23 . . . 28)
Drive plate/flange	Bolt	M 10 x 1.25	10.9	54 . . . 64 (39 . . . 46)
Engine/clutch housing	Bolt	M 12 x 1.5	8.8	70 . . . 83 (51 . . . 60)
Clutch housing/cover	Bolt	M 8 x 1.25	8.8	19 . . . 23 (14 . . . 17)
Cover plate/cover	Bolt	M 8 x 1.25	8.8	19 . . . 23 (14 . . . 17)
Clutch housing/ central tube	Bolt	M 10 x 1.5	8.8	39 . . . 46 (28 . . . 33)
Central tube/ transmission	Bolt	M 10 x 1.5	10.9	54 . . . 64 (39 . . . 46)
Flange/central shaft	Bolt	M 10 x 1.5	12.9	80 (58)
Bolt/double clamp	Bolt	M 10 x 1.5	12.9	80 (58)
Final drive housing/ transmission case	Nut	M 10 x 1.5	8	39 . . . 46 (28 . . . 33)
Ring gear	Bolt	M 12 x 1.25	12.9	150 . . . 180 (110 . . . 131)
Side bearing cover/ final drive housing	Bolt	M 8 x 1.25	8.8	19 . . . 23 (14 . . . 17)
Joint flange/differential	Bolt	M 10 x 1.5	8.8	39 . . . 46 (28 . . . 33)
Rear cover/ final drive housing	Nut	M 8 x 1.25	8	19 . . . 23 (14 . . . 17)

TORQUE SPECIFICATIONS FOR AUTOMATIC TRANSMISSION
(Central Tube and Final Drive)

Location	Description	Threads	Material	Torque Nm (ftlb)
Bearing assembly/ rear transmission case	Bolt	M 8 x 1.25	10.9	27 . . . 32 (20 . . . 23)
Pinion/output shaft Transmission without fixed governor (see page 39 - 24 a)	Nut	M 26 x 1.5	L 35 V	200 . . . 240 (145 . . . 174)
Pinion/output shaft Transmission with fixed governor (see page 39 - 24 a)	Nut	M 26 x 1.5	L 35 V	280 (202)

General Data	Automatic Transmission Type A 22.01 and A 22.02
Design	Fully automatic, 3-speed, planetary gear transmission
Ratios 1st gear 2nd gear 3rd gear (D) Reverse (R)	 2.306 1.460 1.000 1.836
Final drive	Pinion without hypoid offset
Final drive ratio	12/33 2.750
Stall speed	2350 ± 200 rpm – 1978/1979 mod. 2470 ± 200 rpm – from 1980 models
Converter ratio	2.00
Final drive oil capacity	Approx. 2 liters/2.1 US qt of hypoid gear lube API classification GL 5 (MIL-L 2105 B) SAE 90
Automatic transmission and converter oil capacity	Approx. 6 liters/6.3 US qt total oil capacity. Approx. 5.5 liters/5.8 US qt oil change capacity including converter; ATF Dexron B

General data	Automatic transmission Type A 28.01
Design	Fully automatic four speed planetary gear transmission
Ratios: 1st gear 2nd gear 3rd gear 4th gear Reverse gear	 3.6760 2.4120 1.4360 1.0000 5.1390
Final drive	Drive pinion without hypoid offset
Final drive ratio	15 : 33 i = 2.2000
Stall speed	2200 . . . 2600 rpm
Converter ratio	i = 2.12
Oil capacity – final drive	approx. 3 liters of hypoid gear lube SAE 90 APL Classification GL 5 (MIL-L-2105 B)
Oil capacity – automatic transmission + converter	approx. 8 liters total initial amount; approx. 6.2 liters for change including torque converter; ATF Dexron B sperm whale oil free

Clutch operation

Checking clutch free travel

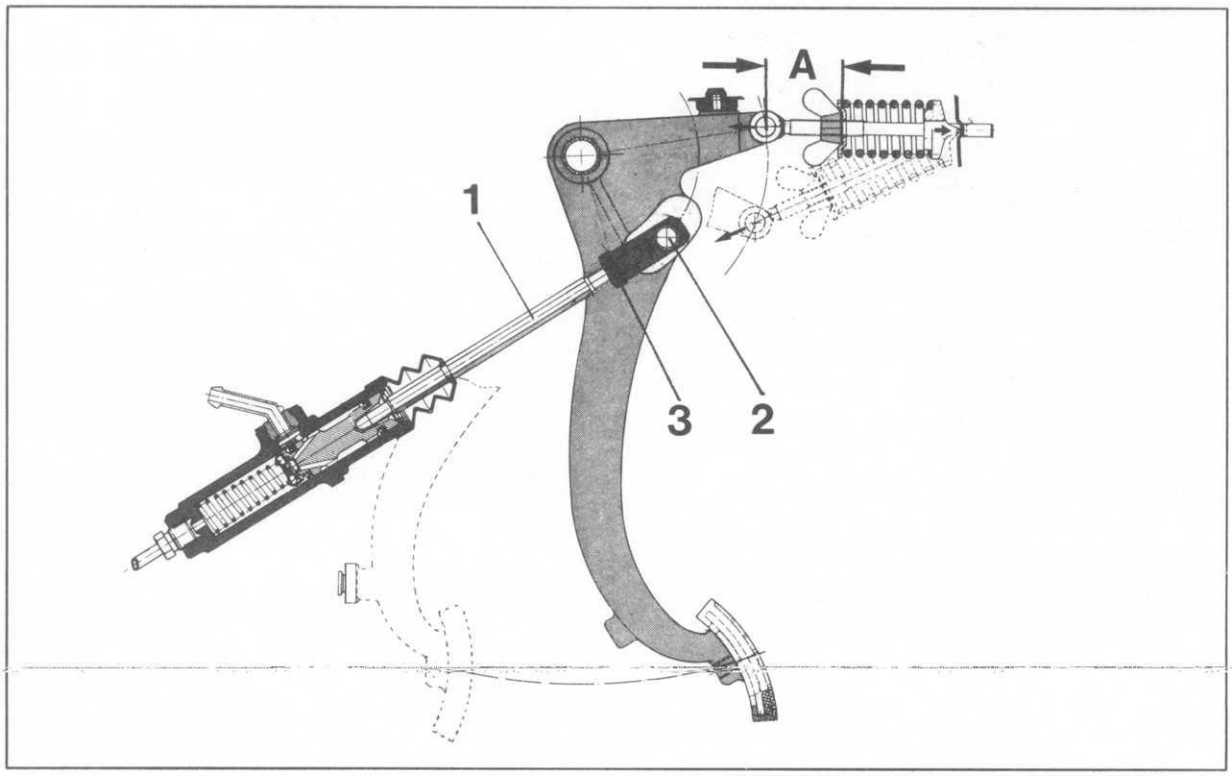
Due to the fact that the clutch is fitted with an automatic hydraulic adjuster, the clutch free travel cannot be checked at the clutch pedal. To ensure proper operation of the clutch, however, the pushrod must be adjusted correctly.

Adjusting the pushrod

Adjust for zero clearance with the pushrod (1) disengaged to allow the pushrod to be pushed over the pin (2) without any load being present. Then preload the pushrod by rotating by one turn and lock with nut (3).

Adjusting the clutch spring

To boost foot pressure, a boost spring is fitted to reduce the pedal force required. To achieve this effect, the boost spring must be preloaded sufficiently.
When measuring from the inside of the spring cup to the center of the mounting pin, dimension A must be 43 mm for vehicles up to MY '91 and 21 mm for vehicles as of MY '92 with the clutch engaged (clutch pedal at end stop).
If required, correct setting by rotating the wing nut or the hexagon nut, respectively.



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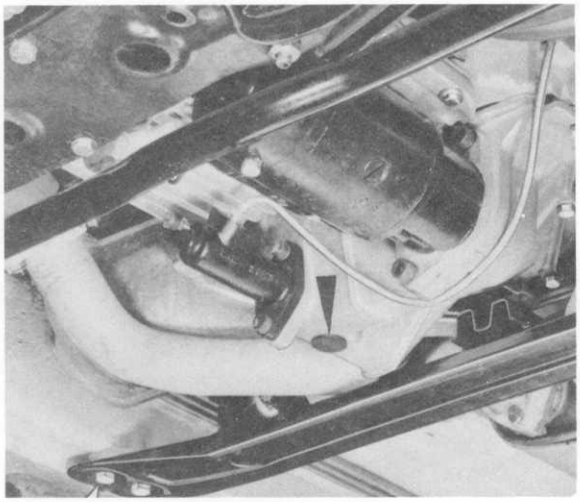
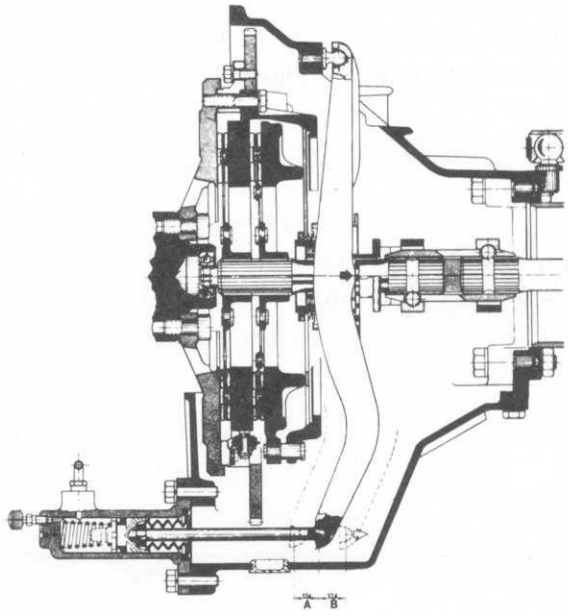
CHECKING WEAR OF CLUTCH DISCS

The amount of clutch disc wear will not be indicated at the clutch pedal because of the automatic hydraulic clutch adjustment.

Check for wear according to the following procedures.

1. Remove plug from inspection hole.





A = Wear travel of clutch 17.4 mm
B = Operating travel 17.4 mm

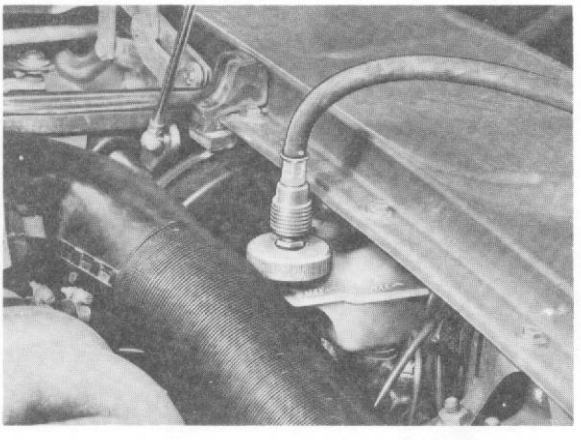
2. Visually inspect position of release lever.
   The wear limit has been reached for cars up to and including 1982 models when front edge of lever just appears in inspection hole.
   Beginning with 1983 models there were changes in starter installation and inspection hole location.
   The wear limit has been reached when front edge of lever reaches end of inspection hole.

BLEEDING CLUTCH

General Information

An electric bleeder is recommended for fast and accurate bleeding.

1. Fill tank to upper edge with brake fluid. Remove strainer. Connect bleeder.



2. Turn on bleeder and open bleeder screw on clutch slave cylinder until escaping fluid is without air bubbles. Depress clutch pedal several times during this step.

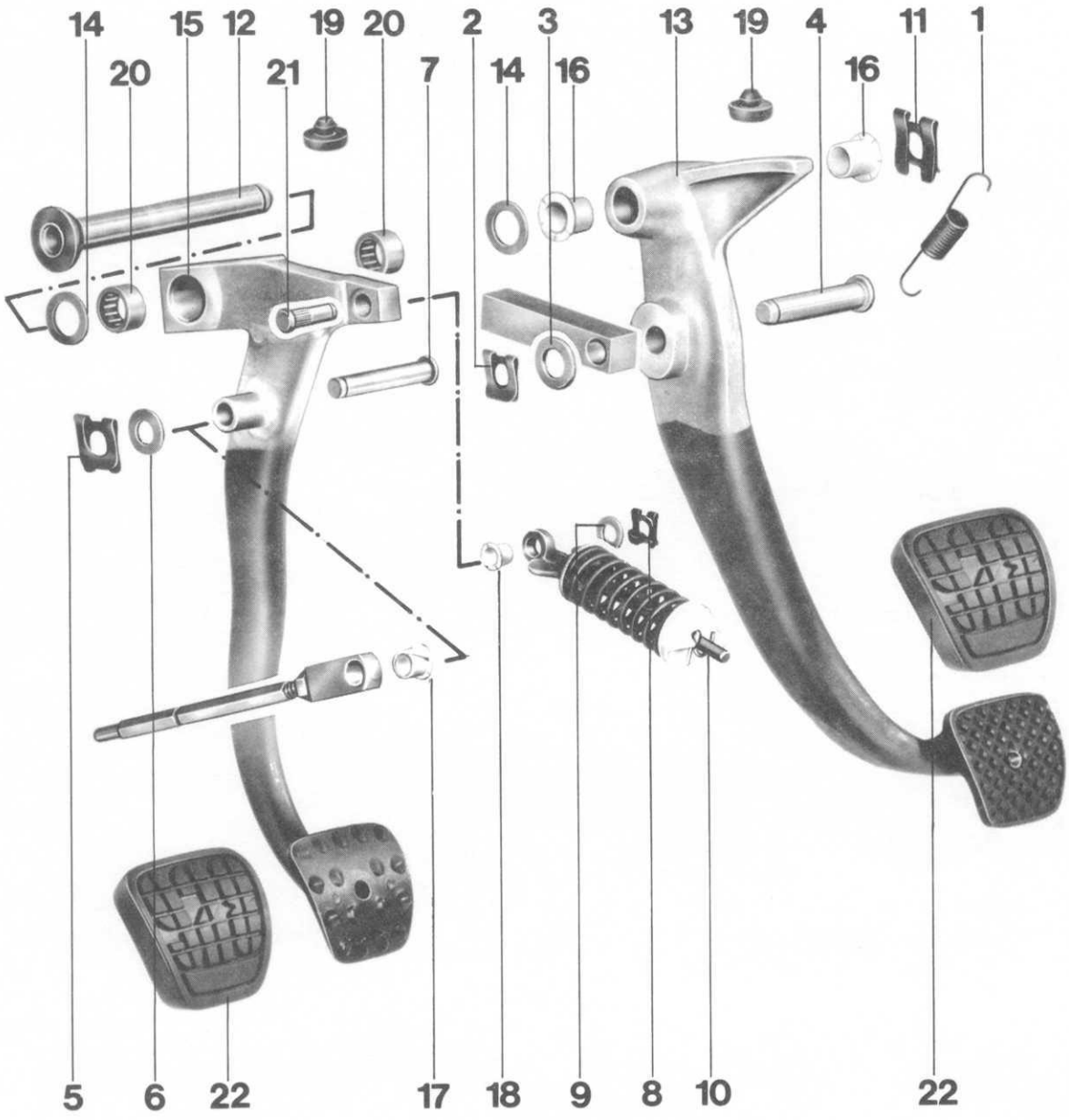
3. If necessary (air still in system/operating travel too small), unscrew slave cylinder on clutch housing. Press push rod into slave cylinder against stop and release again slowly (bleeder switched off/tank not filled to edge). This will force back remaining air into the clutch line or master cylinder/tank.

4. Install slave cylinder and repeat bleeding procedures.

Note

Never operate clutch pedal as long as slave cylinder is removed.

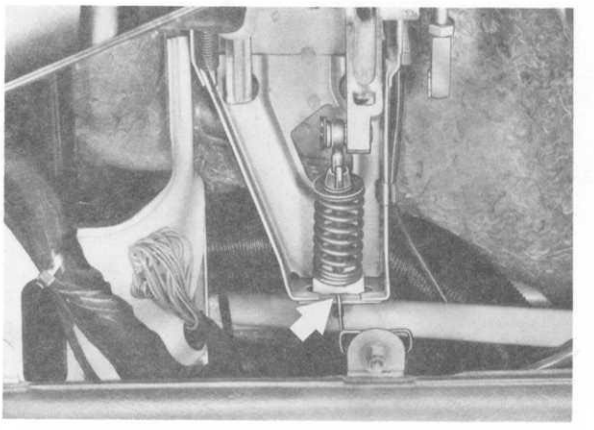
REMOVING AND INSTALLING CLUTCH PEDAL



No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
1	Return spring	1		Position correctly	The return spring (from 1982 models on) can also be used in older cars
2	Retainer	1		Replace if necessary	
3	Washer	1			
4	Shaft	1		Coat with multi-purpose grease	
5	Retainer	1		Replace if necessary	
6	Washer	1			
7	Shaft	1		Coat with multi-purpose grease	
8	Retainer	1		Replace if necessary	
9	Washer	1			
10	Guide rod/ clutch power spring assy.	1	Insert assembly wire (see page 30 - 2 e)		
11	Retainer	1		Replace if necessary	
12	Bearing shaft	1		Install with multi-purpose grease. Can only be pushed in fully when surfaces on bearing shaft and console are aligned.	
13	Brake pedal	1			Spacers (pedal adjustment) are available

No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
14	Washer 1 mm thick LHD cars after 1982 models (altered clutch pedal)	2		In cars with one 2 mm thick washer (between two pedals) two 1 mm thick washers may be installed (see page 30 - 2 b)	
	Washer 2 mm thick between two pedals	(1)			
15	Clutch pedal	1			Spacers (pedal adjustment) are available
16	Bushing	2		Replace if necessary	
17	Bushing	1		Replace if necessary	
18	Bushing	1		Replace if necessary	
19	Stop (pad)	2		Replace if necessary	
20	Needle bearing	2		Press in flush, pack with all-purpose grease	
21	Shaft	1	Press out, using a suitable sleeve for support	Press in against stop	
22	Pedal rubber cover	2		Replace if necessary	

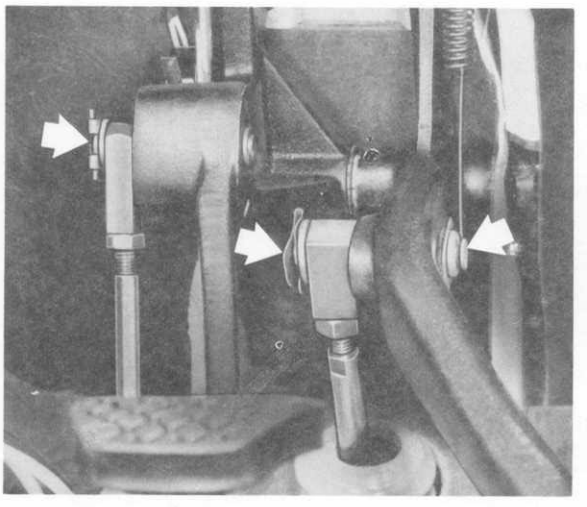
REMOVING AND INSTALLING CLUTCH PEDAL



Removing

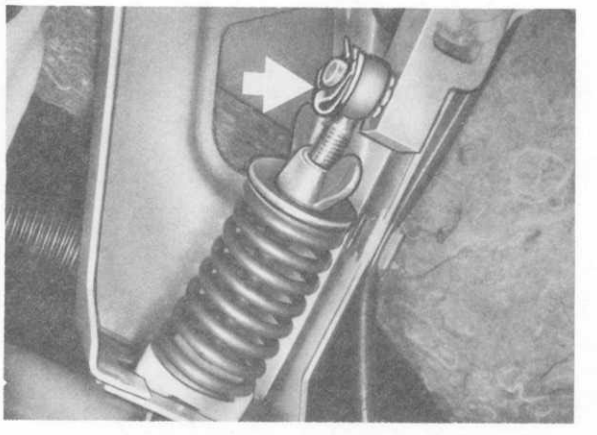
1. Move seat back and steering wheel up to make procedures easier. Remove shelf if applicable.

2. Disconnect return spring on brake pedal. Remove shafts for brake and clutch push rods.



3. The guide rod for clutch power spring has an assembly bore. Operate clutch pedal far enough (press down) until bore has cleared the bearing. Insert 3 mm dia. wire through bore (in this position) to take spring force off of pedal.

4. Remove complete clutch power spring/guide rod. This requires removing the retainer, pressing guide rod off clutch pedal and taking the assembly out of console.



5. Remove brake and clutch pedals after sliding out the bearing shaft.

Installing

1. Check needle bearing, bearing shaft, retainers, stops, all sleeves and shafts, replacing if necessary. Coat all bearing and sliding surfaces with a multi-purpose grease.

2. Install pedals.

   Note:

   Bearing shaft can only be pushed in fully, if surfaces on bearing shaft and console are aligned.

3. Place complete clutch power spring/guide rod in console and mount on clutch lever.

4. Take assembly wire out of guide rod and move clutch pedal to final stop.

5. Mount clutch and brake push rod on pedals. Connect return spring for brake pedal. Check push rod play, correcting if necessary.
   See pages 30 - 1 and 46 - 9.

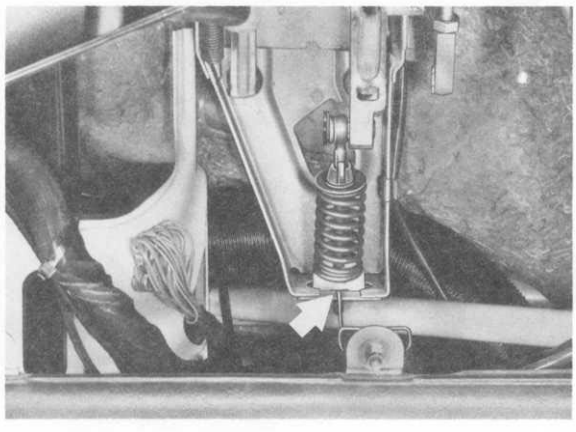
REMOVING AND INSTALLING CLUTCH SPRING

Removing

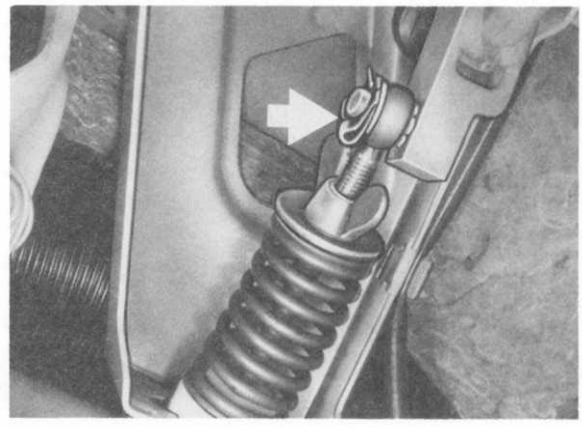
1. Move seat back and steering wheel up to make procedures easier.
   Remove tray if applicable.

2. Remove shaft for clutch push rod.

3. The guide rod for clutch power spring has an assembly bore. Operate clutch pedal enough (press down) until bore has cleared the bearing. Insert 3 mm dia. wire through bore in this position.



4. Remove complete clutch power spring/guide rod. This requires removing the retainer, pressing guide rod off of clutch pedal and taking out of console.

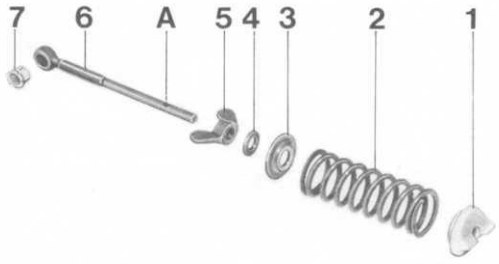


5. Release clutch power spring by turning winged nut as far as possible.

6. Remove piece of wire and take parts off of guide rod.

Installing

1. Slide clutch power spring and pertinent parts on to guide rod. Insert piece of wire.



A Assembly bore

1 Bearing

2 Clutch power spring

3 Spring retainer

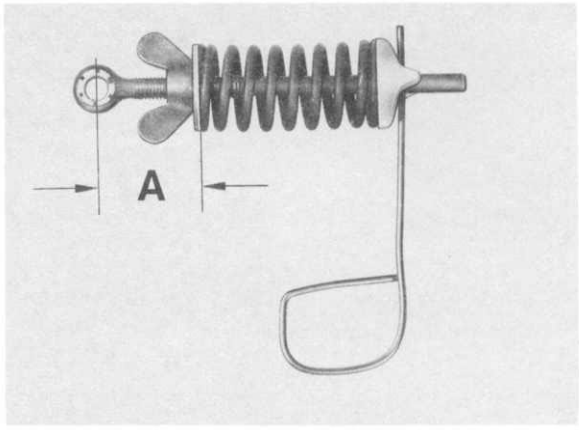
4 Washer

5 Winged nut

6 Guide rod

7 Bearing sleeve

2. Adjust clutch power spring. Distance A between inside of spring retainer and center of bearing shaft should be 43 mm*. If necessary, correct by turning the winged nut.



3. Install adjusted complete part in car and mount on clutch pedal.

4. Take piece of wire out of guide rod and adjust clutch pedal to final position.

5. Mount clutch push rod on pedal. Check push rod adjustment and correct if required.

* As of MY '92, dimension A is 21 mm. At the same time, the parts listed under item 1 have been modified.

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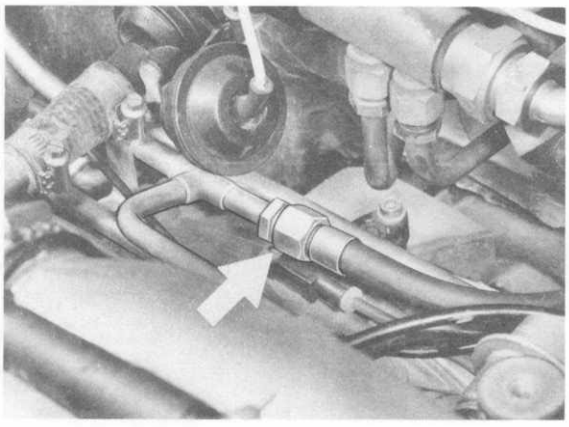
REMOVING AND INSTALLING CLUTCH

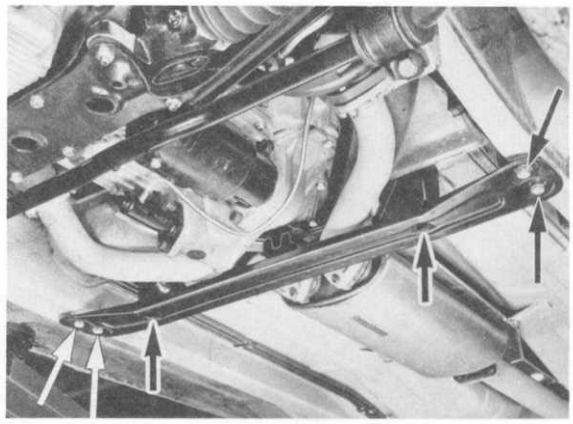
Removing

1. Disconnect ground strap at battery.

2. Jobs required additionally beginning with 1984 models:
   Remove TDC sensor on clutch housing by taking off air cleaner, loosening screw and pulling TDC sensor out of clutch housing.
   On cars with LH-Jetronic pull speed/ reference mark sensor for electronic ignition out of crankcase upper section while turning back and forth, after loosening the screw.



3. Remove lower body brace, if applicable.

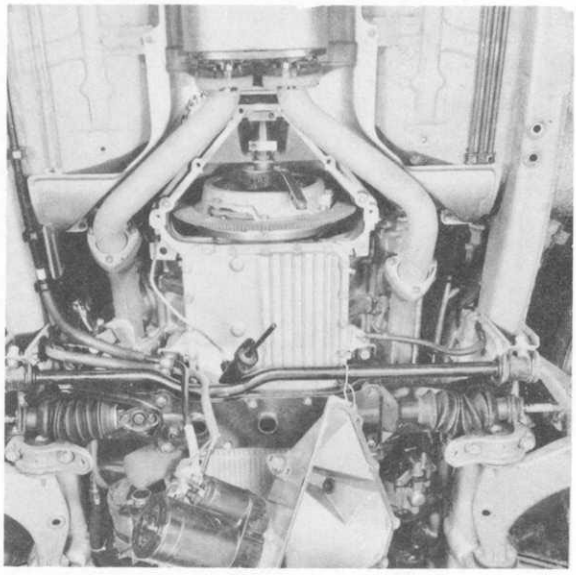


4. Unscrew clutch slave cylinder, remove clamp on clutch hose holder and take out cylinder with line connected.

Note:

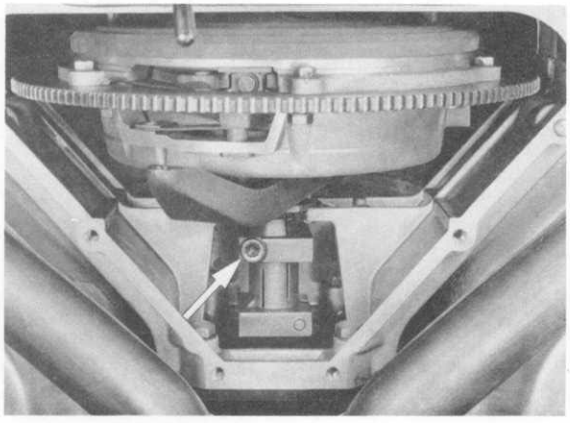
Clutch must not be operated as long as slave cylinder is removed.

5. a) Before 1983 Models
Remove cover for clutch housing with starter and suspend from stabilizer. If applicable, also remove converter (modified shape).

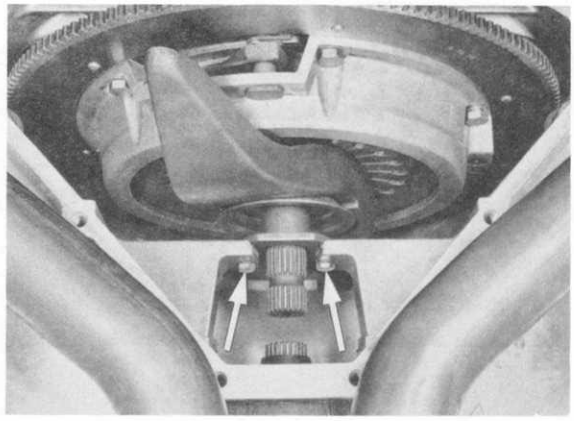


5. b) Since 1983 Models
(Modified Starter Installation)
Remove starter or loosen starter and suspend it from car.
Take off clutch housing cover.
If applicable, also remove catalytic converter.

6. Remove coupling screws and push back coupling on central shaft II. In case of long coupling, remove plug from central tube to unscrew rear bolt.

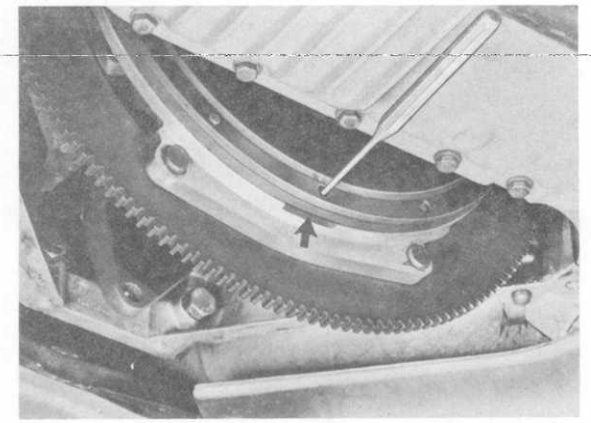


7. Remove release bearing sleeve mounting bolts and push sleeve toward flywheel.



8. Mark position of pressure plate, intermediate plate and flywheel in relation to each other for installation later.
For dowel pin centered clutches drive the cylindrical pins in direction of pressure plate with a punch far enough so that they are beyond the centering bore of the flywheel. Check visually at opening of intermediate plate (arrow).

Beginning with 1984 models one of the three centering pins is stepped (6 mm dia. in area of intermediate ring/pressure plate and 8 mm dia. in flywheel).
Consequently the intermediate ring can only be installed in a certain position to the flywheel (see intermediate ring on page 30 - 16 a).
Remove stepped centering pin (large bore in flywheel) completely.
This is only possible in direction of the flywheel.
Drive the other two centering pins in direction of pressure plate as described above, until they are beyond the centering bore of the flywheel (do not remove completely).

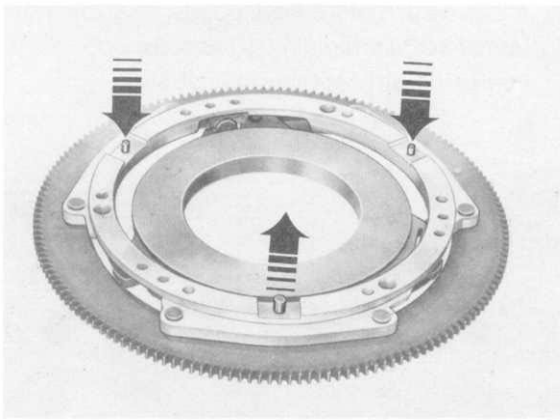


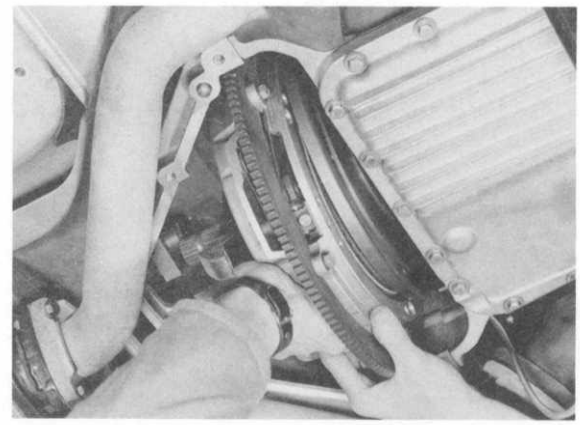
Note:

The pressure plate remains pre-loaded and removal will be easier by using 4 mm thick wire brackets (locally made) underneath the bolt heads before loosening the mounting bolts (less force required/brackets bevelled). In addition, it will not be necessary to unscrew the mounting bolts in steps of 1 to 1 1/2 turns.
Also refer to point 6 on page 30 - 6 and point 2 on page 30 - 17.

Beginning with 1984 models

10. Push back entire clutch (pressure plate, intermediate ring with starter gear ring, both clutch discs, release lever, release bearing sleeve, central shaft I) and remove downward.





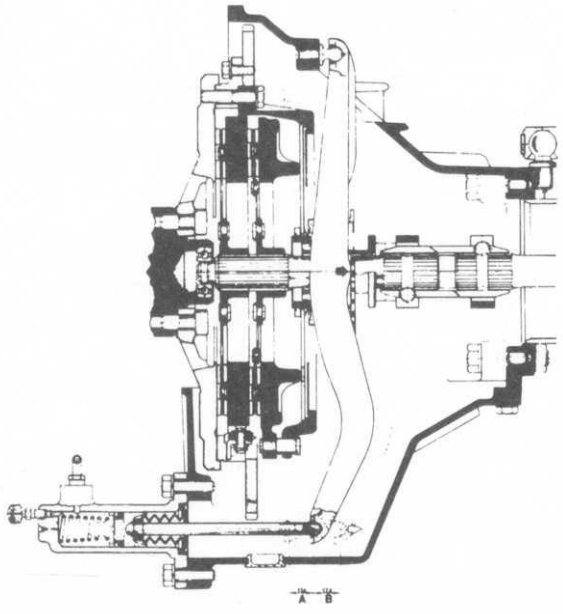
9. Unscrew the clutch mounting bolts one after the other by 1 to 1 1/2 turns until pressure is removed from the pressure plate. Disconnect release lever at ball stud, by pushing the release lever down toward the flywheel. Now remove the mounting bolts.

Installing

1. Check and, if necessary, replace clutch parts prior to installation. Also refer to "Disassembling and Assembling Clutch", "Clutch Control Ball Stud Versions" and "Checking Discs, Pressure Plate and Intermediate Plate".

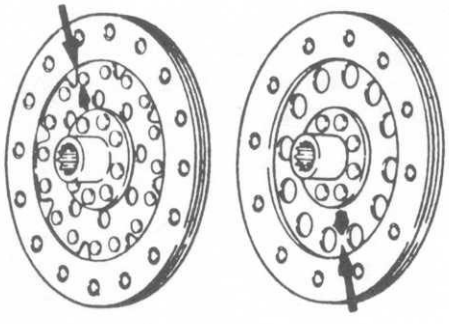
2. Prior to installation push intermediate ring at the three adjusting elements in direction of the release bearing. If applicable, pre-load clutch pressure plate (see page 30 - 17).

3. Assemble clutch (hubs of discs face release bearing, correct location of centering pins from intermediate ring for dowel pin centered clutches – see page 30 - 18). Guide clutch into clutch housing and center discs with drive shaft in grooved ball bearings of crankshaft.



Note:

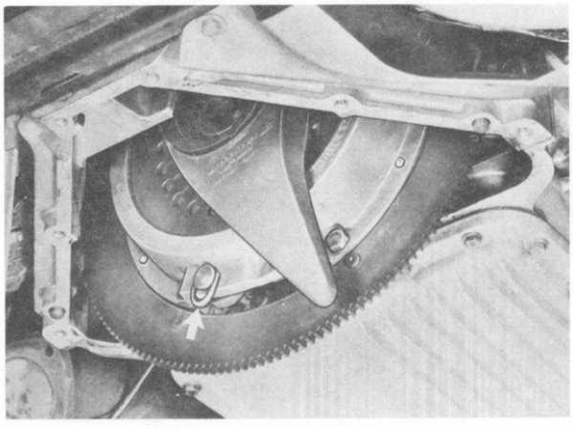
The discs are different. Disc I (sometimes marked with white paint dot) is between flywheel and intermediate ring. Disc II (larger liner springs or longer hub) is between pressure plate and intermediate ring (see page 30 - 14).
When installing discs on short central shaft make sure residual unbalance sides (yellow arrow/black side) are offset 180° opposite each other.



4. Note marks when installing pressure plate, intermediate ring and flywheel.
Guide centering pins of a dowel pin centered clutch into the flywheel.
Beginning with 1984 models guide in far enough that correct position of intermediate ring (missing centering pin) to flywheel (large bore) is given.
Insert mounting bolts.

5. On cars from 1984 models on align stepped centering pin with centering bore in intermediate ring and drive it in from the flywheel side.

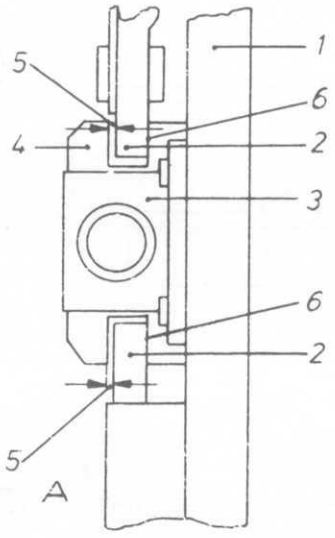
6. Screw in clutch mounting bolts uniformly until the clutch is held tight.
Make sure that central shaft I moves easily.
Then remove the clips from underneath the pressure plate bolt heads. If applicable (since 1984 models), drive stepped centering pin further against stop.



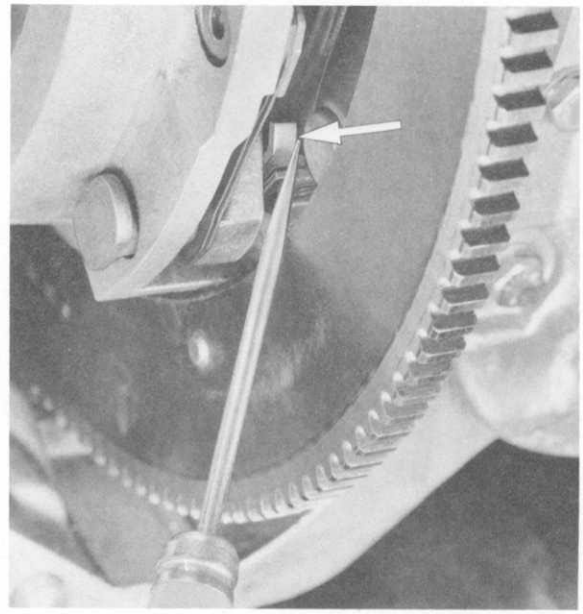
Note:

Differences in tolerances could make it difficult to guide in the dowel pin-centered clutch. Should this apply, position the centering pins as for removal in point 8. Guide in clutch and insert mounting bolts. Drive in centering pins after they have been aligned with the flywheel bores (reposition pressure plate for this purpose). After tightening the mounting bolts, drive in centering pins until they are flush with the pressure plate.

7. The forks of the stop brackets must rest on the stop of the intermediate plate on the flywheel end on both sides. This will produce a gap of 0.7 to 1.0 mm or 1.2 to 1.5 mm (see sketch). Push back the 3 forks of the stop brackets uniformly on both sides with a screwdriver (in direction of pressure plate). This alone will guarantee proper function of the clutch and stop brackets.



1 – Intermediate ring housing
2 – Intermediate ring stop
3 – Adjusting element
4 – Fork
5 – Gap of 0.7 to 1.0 mm or 1.2 to 1.5 mm
6 – Position of fork on stop
A – Release bearing side
S – Flywheel side



8. Mount release bearing sleeve.

9. Connect release lever at ball stud. Place ball stud and ball socket opposite each other and press down release lever toward the rear until the lever engages.

10. First mount coupling on central shaft I. Center bores of coupling on shafts accurately. Install cover for clutch bell housing and slave cylinder.

Note:

Location of slave cylinder piston rod can be checked through inspection hole.

11. Install lower body brace, if applicable, positioning correctly. Protruding support plate on lower body brace must face forward to cover for clutch bell housing.

REMOVING AND INSTALLING SINGLE-DISK CLUTCH

'87 MODELS ONWARD

ENGINE TYPE M 28 .41

Removing

1. Detach ground lead from battery.

2. Remove complete lower engine guard.

3. Unbolt clutch actuating cylinder, disconnect clutch hose holder from oil pan and allow cylinder to dangle with line connected.

Note:

Never depress the clutch with actuating cylinder disconnected.

4. Unbolt starter motor, withdraw and leave on bracket.

5. Unbolt exhaust flanges on left and right manifolds and detach air injector.

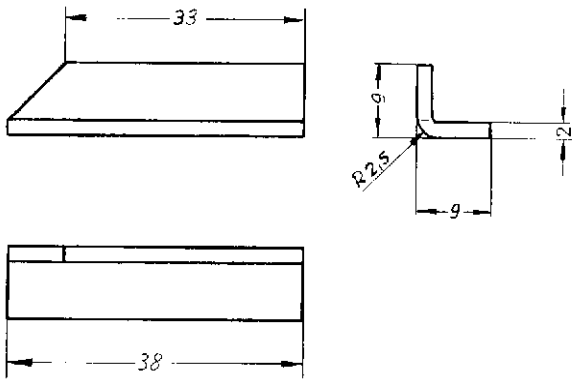
6. Remove cover from clutch housing.

7. Remove clamping sleeve cap screws and push sleeve back along central shaft II. If long clamping sleeve is fitted, remove plug in central tube to permit removal of the rear screw.

8. Remove securing screws for guide tube and push guide tube toward flywheel.

9. Disengage release lever from ball joint by pressing lever down toward flywheel.

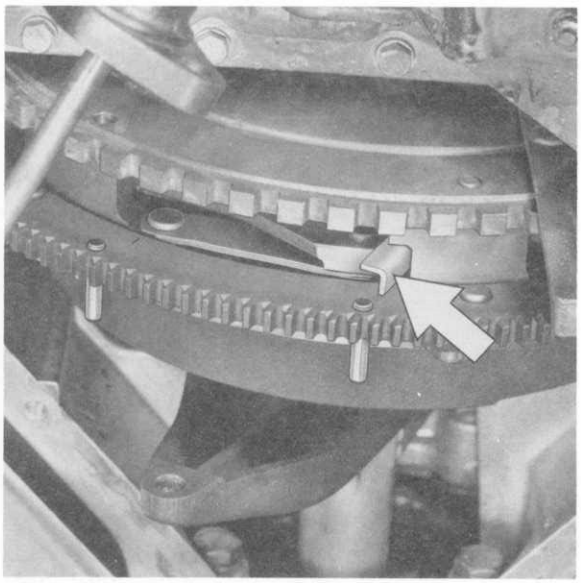
10. Fabricate three sheet-metal angles (2 mm thick), if no angles are installed.



Note:

These improvised angles are used to tension and position the genuine Porsche spare parts.

11. Insert angle in notch of pressure plate and slacken mounting bolts. Drive centering pins out of flywheel toward pressure plate.



12. Remove mounting bolts uniformly one after the other and remove pressure plate from bottom, complete with release lever, guide tube, driven plate and central shaft 1.

Note

1. The straight pins for the TDC sensor must point downward to permit removal of the complete clutch (risk of damage).

2. Lubricant "Optimoly HT" has been replaced by "Optimoly Olista Longtime 3EP". To be used on clamping sleeve, drive shaft, clutch release lever, guide tube and clutch release bearing.

3. As of Model '93, engine type **M 28.49.928 GTS**, the clutch release bearing is fitted with a plastic guide sleeve. Guide tube and guide sleeve are fitted without grease and **must not be greased either** when repairs are made in this area.

Installing

1. Install pre-loaded pressure plate with driven plate in clutch housing, center drive plate with central shaft 1 in deep-groove ball bearing of crankshaft and tighten mounting bolts 1 to 1/2 turns.

2. Fit guide tube. Make sure that the guide tube is seated correctly in the corresponding cutout in the clutch bell housing and that the entire contact surface of guide tube and clutch bell housing is in contact.

3. Engage release lever by placing ball and socket opposite each other and pressing release lever down and back until it is felt to engage.

4. Attach calmping sleeve to central shaft 1 first. Align holes of clamping sleeve on shafts.

5. Uniformly tighten mounting bolts of presure plate. Tightening torque 22 Nm (16 ftlb) remove angles (3 of).

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6. Check centering pins. Using a depth gauge, measure from the rear of the flywheel (engine side) through the bore to the centering pin (approx. 4 mm).

7. Insert slave cylinder into clutch bell housing and tighten cover. Then fit slave cylinder into place.

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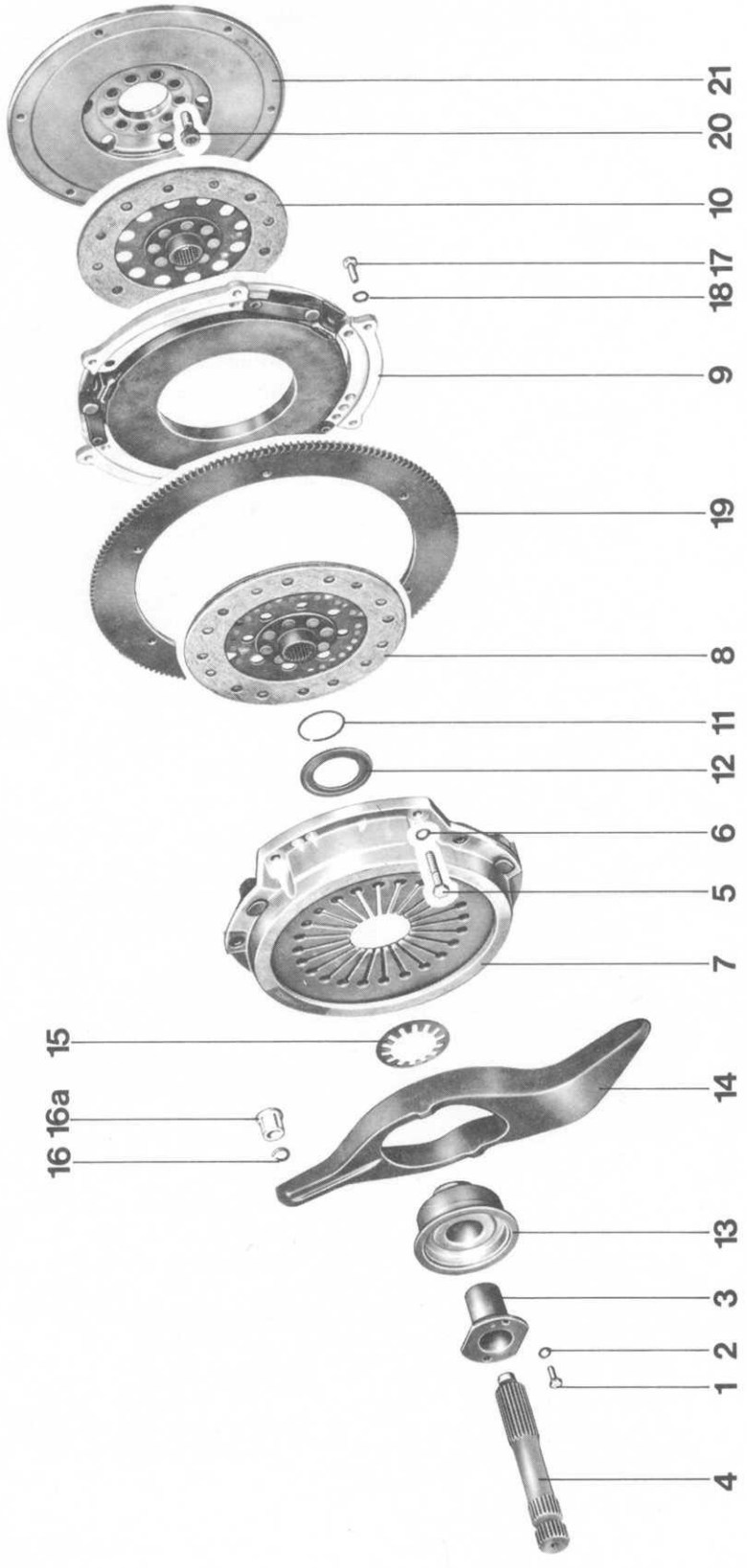
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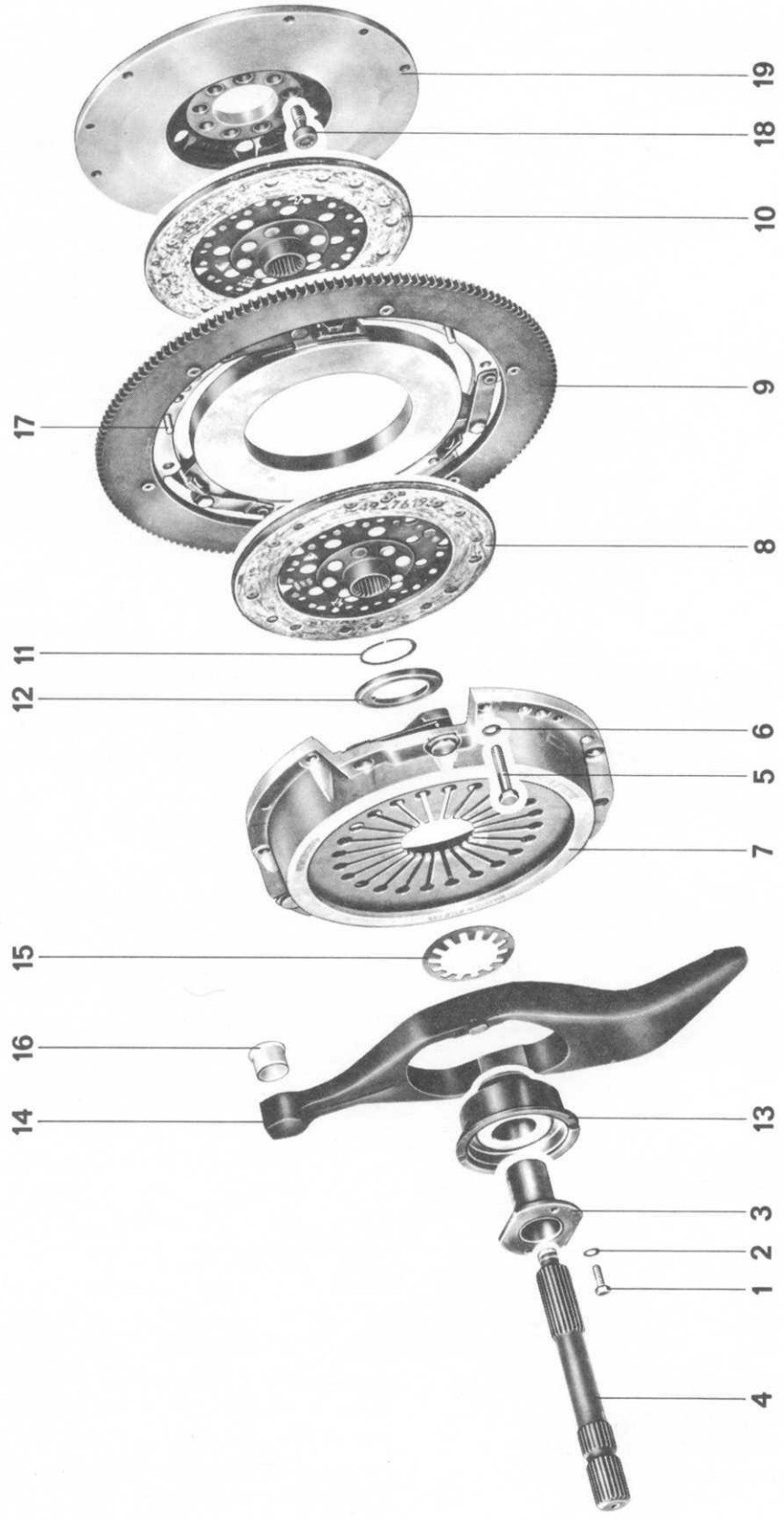
No.	Description	Qty.	Note When: Removing	Note When: Installing	Special Instructions
1	Bolt	2		Tighten to specified torque	
2	Washer	2		Replace if necessary	
3	Guide tube	1		Coat sliding surface for release bearing with MoS_2	
4	Short drive shaft	1		Thin coat of Optimoly HT on splines (use hard brush)	page 30 - 9
5	Bolt	6	Loosen one after the other by 1 to 1 1/2 turns	Screw in uniformly to specified torque. Then remove assembly clip	
6	Washer	6		Replace if necessary	
X 7	Pressure plate	1	See note	Check for wear. Lubricate pre-load washer in area no. 12 and no. 15 with Optimoly HT	
8	Clutch disc II (spring-loaded, 0.85 – 1.15 mm)	1		Inspect; thin coat of Optimoly HT on splines, watch position to no. 10	Hub length: 20 mm page 30 - 9
X 9	Intermediate ring	1	See note	Prior to installing push on 3 adjusting elements toward release bearing	
10	Clutch disc I (not spring-loaded/ or slight spring load, 0 – 0.4 mm)	1		Inspect; thin coat of Optimoly HT on splines; watch position to no. 8	Hub length: 20 mm page 30 - 9
11	Snap ring	1		Important! Install snap ring so that gap is between retainer (turning lock) on release bearing or offset to groove in new version release bearing	

No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
12	Thrust washer	1		Position correctly	
13	Release bearing	1		Don't wash, only wipe dry. Coat sliding surfaces for guide tube with MoS_2 and in release lever with a white lubricating paste	Note correct combination with release lever
14	Release lever	1		Coat bearing surface for slave cyl. piston rod with white solid lubricating paste and cams for release bearing with MoS_2.	Note correct combination with release bearing and ball stud
15	Washer	1		Position correctly	
16	Snap ring	1		Position correctly	Only for initial version
16A	Ball socket bushing	1		Position correctly. Coat with solid white paste (AOS 1260006). Press in with VW 421	For modified or present version
17	Bolt	6			
18	Washer	6		Replace if necessary	
X19	Starter ring	1	See note	After installing give teeth light coat of Optimoly HT	
20	Bolt	9		Torque: 90 + 5 Nm (65 + 4 ftlb)	
X21	Flywheel with centering collar	1	See note		

Note

The parts marked with a "X" in the chart have been balanced together in manufacturing and must therefore be marked when removing, to guarantee installation in same position later.

Insofar as central shaft I (928.421.235.16) is installed (only possible as from certain chassis numbers/replaces 928.423.235.13 after depletion of stocks). Identification: dull silver, when splines of clutch discs and central shaft I are not coated with Optimoly HT but instead with Optimoly Olista Longtime 3 EP.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No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
1	Bolt	2		Tighten to specified torque	
2	Washer	2		Replace if necessary	
3	Guide tube	1		Coat sliding surface for release bearing with MoS_2	See page 30 - 13
4	Central shaft I	1		Lubricate splines with grease depending on version	See page 30 - 13 and 30 - 16 a
5	Bolt	6	Loosen one after the other and by 1 to 1 1/2 turns	Screw in uniformly and tighten to specified torque. Then remove clip	
6	Washer	6		Replace if necessary	
X7	Pressure plate with three centering bores	1	See note	Check for wear. Give preload washer light coat of Optimoly HT in area of no. 12 and no. 15	
8	Clutch disc II (spring-loaded)	1		Inspect. Lubricate splines acc. central shaft I. Watch position to no. 10	See page 30 - 13 and 30 - 16 a
X9	Intermediate ring with riveted starter ring	1	See note	Prior to installation push three adjusting elements toward release bearing. Thin coat of Optimoly HT on spline of starter ring after installation	See page 30 - 13
10	Clutch disc I (spring-loaded)	1		Inspect. Lubricate splines acc. central shaft I. Watch position to no. 8	See page 30 - 13 and 30 - 16 a

No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
11	Snap ring	1		Important! Install snap ring so that gap is between retainer (turning lock) on release bearing or on new release bearings offset to groove in release bearing	
12	Thrust washer	1		Position correctly	
13	Release bearing	1		Don't wash, only wipe dry. Coat sliding surfaces for guide tube with MoS_2 and sliding surface in release lever with solid white paste	
14	Release lever	1		Coat bearing surface for slave cylinder piston rod with solid white paste	Coat contact areas for release bearing with MoS_2
15	Washer	1		Position correctly	
16	Ball socket bushing	1		Position correctly. Coat with solid white paste (AOS 1260006). Press in with VW 421	
17	Centering pin	3		Straighten or replace damaged pins. Protrusion beyond bearing surface of intermediate ring on flywheel 3.5 – 0.5 mm. Must have tight fit	
18	Bolt	9		Torque: 90 + 5 Nm (65 + 4 ftlb)	
X19	Flywheel with centering bores	1			

Note

Parts in table marked with "X" were balanced together in manufacturing and must therefore be marked prior to removing for installation in same position later (also refer to procedures).

CHANGES ON CLUTCH/ INSTRUCTIONS FOR REPLACEMENTS

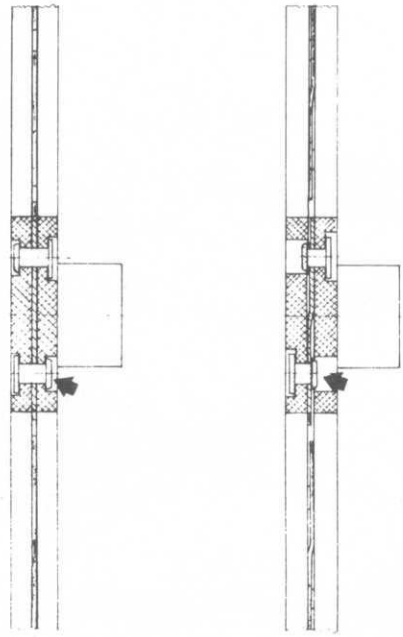
Clutch discs with symmetric liner springs and a longer hub were introduced as from December, 1980 in standard production to improve engaging behavior.
In conjunction with this changes were also necessary on the clutch intermediate ring, central shaft I and release bearing tube.
From 1984 models on cars have a separate test connection to check the ignition timing. This changed the dowel pin centering of the clutch in such a manner that the intermediate ring can now only be installed in correct position to the flywheel.

Survey of Changed Parts

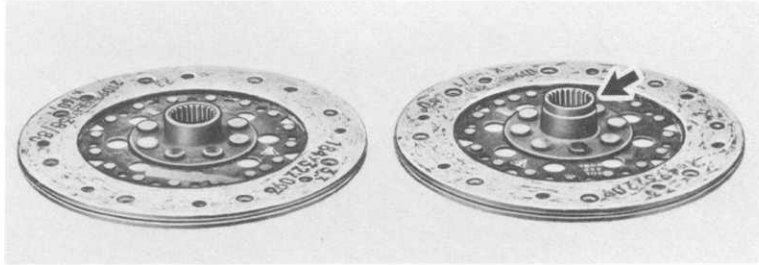
Description	Up to Dec., 1980	Changed/Presently
Clutch disc I (front)	928.116.011.23	928.116.011.27 or 928.116.011.33
Clutch disc II (rear)	928.116.011.24	928.116.011.28 or 928.116.011.34
Intermediate ring	928.116.033.17	928.116.033.22 since 1984 mod. 928.116.033.26
Central shaft	928.421.235.12	928.421.235.13 or 928.421.235.16
Release bearing tube	928.116.087.11	928.116.087.13

CROSS REFERENCE OF ORIGINAL AND CHANGED / PRESENT PARTS

Part Description	Original Version	Changed/Present Version
1. Clutch disc I (front)	928.116.011.23 Liners riveted tight on both sides with each rivet. Without gap between liners. Slight liner spring load (0.0 . . . 0.4 mm) Hub length: 20 mm	928.116.011.27 or 928.116.011.33 Liners riveted alternately with only every second rivet. Gap between liners. Liner spring load (0.5 . . . 0.8 mm) Hub length: 20 mm



2. Clutch disc II (rear)	928.116.011.24 Liner springs with each 2 spring plates (0.85 . . . 1.15 mm) Hub length: 20 mm	928.116.011.28 or 928.116.011.34 Liner springs with each 1 spring plate (0.5 . . . 0.8 mm) Hub length: 29 mm N o t e : Disc with a hub length of 25 mm were used a short time. They also belong to new version.

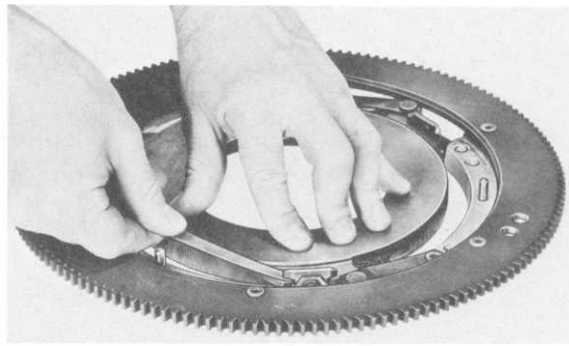


Part Description	Original Version	Changed/Present Version
3. Intermediate ring	928.116.033.17 Travel: 0.7 . . . 1.0 mm Label 3059 008 001	928.116.033.22 Travel: 1.2 . . . 1.5 mm Label 3059 008 101 since '84 models 928.116.033.26 (modified dowel pin centering, page 30 - 16 a)

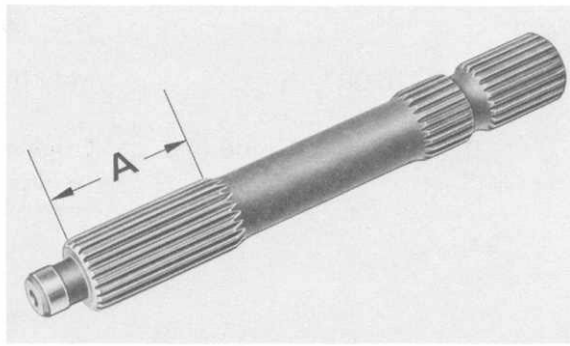
Note:
If the label is missing, the travel could be determined as follows.

Press down clutch ring from starter ring side against stop.
Determine gap distance on guide with a feeler gauge blade.

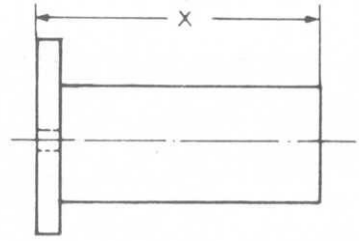
New version – at least 1.2 mm
Old version – at least 1.0 mm



4. Short drive shaft	928.421.235.12 Tooth distance "A" 51 mm	928.421.235.13 (gray/black) or 928.421.235.16 (dull silver) Spline distance "A" 56 mm



5. Guide tube	928.116.087.11 Total length distance "X" 50 mm	928.116.087.13 Total length distance "X" 49 mm



Replacement Procedures:

Intermediate ring, central shaft and release bearing tube are no longer available in the original version.

Clutch discs I and II are still available in original version for the diameter and dowel pin centered clutch.

Parts of the modified/present and original version may not be installed together in one car. See remarks for exceptions.
Check chart below when repairing clutches with modified/present clutch parts (dowel pin centered clutch).

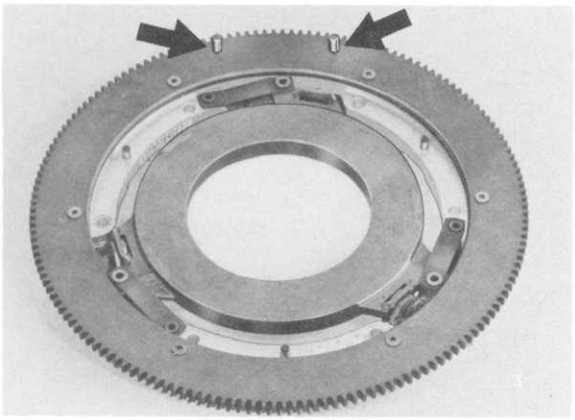
Part Description	Part Number	Version
Clutch disc I	928.116.011.27 or 928.116.011.33	Modified (see remarks) Present
Intermediate ring	928.116.033.22 or 928.116.033.26	Modified Since 1984 models (see remarks)
Clutch disc II	928.116.011.28 or 928.116.011.34	Modified (see remarks) Present
Central shaft I	(928.421.235.12) 928.421.235.13 or 928.421.235.16	Original version Modified version Present version (see remarks)
Release bearing tube	928.116.087.13 or 928.116.087.11 modified	Modified/present Original version (see remarks)

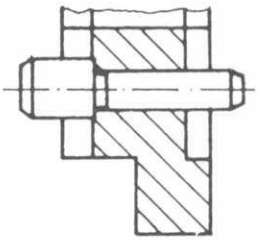
Remarks:

Clutch Discs I and II
Modified clutch discs I, 928.116.011.27, and II,
928.116.011.28, were replaced with clutch discs,
928.116.011.33 and 928.116.011.34 (different liner grade).
Identification: color of liners.
Clutch discs 928.116.011.27 and 928.116.011.28 will not be available after depletion of stocks.
Clutch discs with different type liners should not be installed together in one car.

Intermediate Ring

Beginning with 1984 models there is a separate test connection, which is connected with a TDC sensor, for checking the ignition timing. The TDC sensor signal is triggered by two cylindrical pins which are pressed in the gear ring of the clutch intermediate ring. This makes precise positioning between the intermediate ring and flywheel necessary.
This position is guaranteed, in that one of the three centering pins in the intermediate ring has two different diameters on each end, namely 6 mm and 8 mm. A centering bore in the flywheel now has a 8 mm diameter. Consequently the intermediate ring can only be mounted in one position.





Central Shaft I

The first version of central shaft 928.421.235.12 (no longer available) was sometimes installed together with new clutch parts.
The modified central shaft 928.421.235.13 was replaced with central shaft 928.421.235.16 (hard nicle-plated/same size) as from June of 1983. Central shaft 928.421.235.13 will no longer be available after depletion of stocks.
Axial movement of clutch discs on central shaft I is better after long operating time when using the hard nickle-plated version in conjunction with the specified lubricant.

Identification: 928.421.235.13 gray/black
928.421.235.16 dull silver

Lubricant specifications for splines (central shaft I and clutch discs):

928.423.235.12 and 928.423.235.13	very thin coat of Optimoly HT
928.423.235.16	coat of Optimoly Olista Longtime 3 EP (Part No. 000.043.024.00)

Release Bearing Sleeve

When repairing clutch, the old release bearing sleeve 928.116.087.11 with a total length of 50 mm can be ground off to a length of 49 mm.

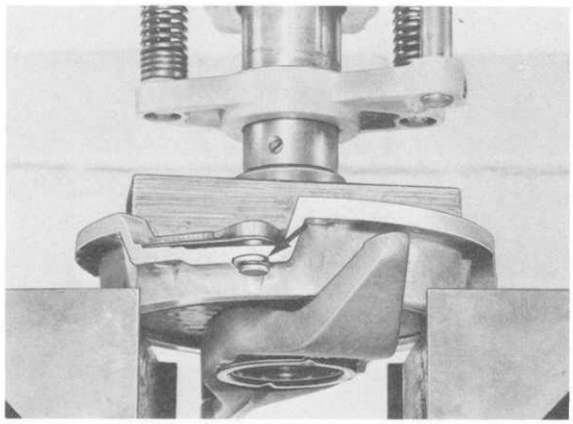
DISASSEMBLING AND ASSEMBLING CLUTCH

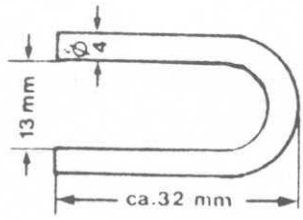
Differences in tolerances could make it necessary to preload the clutch to be able to install the release bearing and release lever.

Disassembling

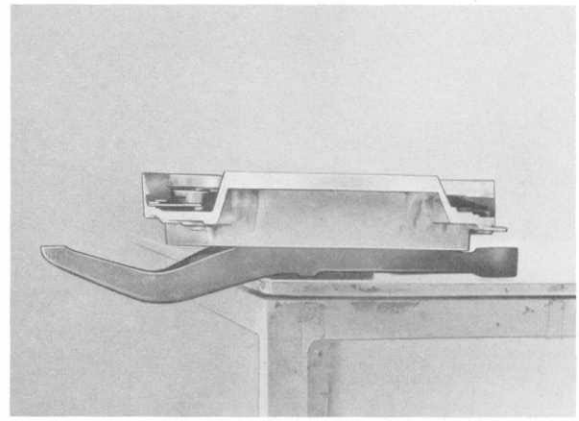
1. Pry the pressure plate off of the intermediate plate uniformly (if a dowel pin-centered clutch).

2. Place pressure plate in a press so that, when preloading, the release lever can be moved out downward without interference. Preload pressure plate carefully until 4 mm thick locally made wire tool can be slid underneath heads of mounting bolts.





3. Place pressure plate and release lever on a workbench. Press down on thrust washer and remove snap ring of release bearing. Bent section of release lever should project over workbench so that pressure plate and thrust washer can move downward and make the snap ring accessible.



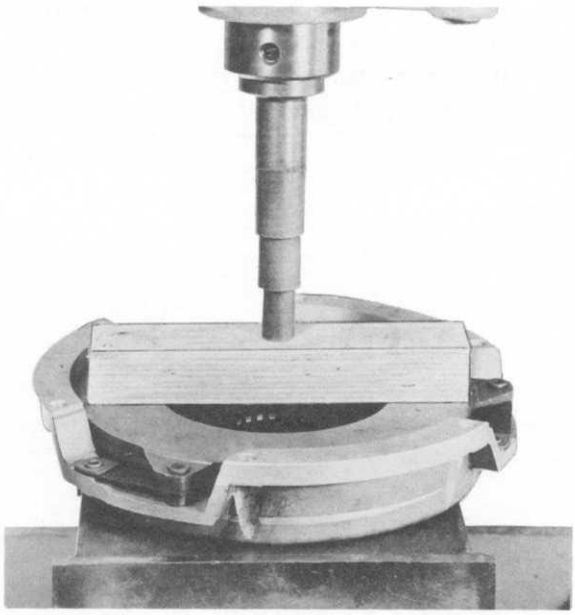
Assembling

1. Install diameter-centered or dowel pin-centered pressure plates and intermediate plates only with the matching flywheel.
See page 30 - 7 for flywheel of diameter-centered clutch.
See page 30 - 10 for flywheel of dowel pin-centered clutch.

2. Inspect parts of clutch and, if necessary, replace (also refer to page 30 - 23/24). Also slide 4 mm thick locally made wire tool underneath bolt heads of new version pressure plate. Place this pressure plate on a level plate in a press for preloading. Bearing surface on pressure plate must not scrape on pressure plate housing while pressing together.

Note

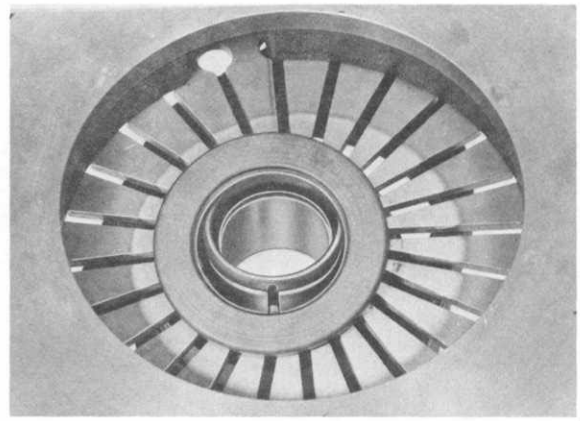
Don't forget to remove wire clip after installation of clutch.



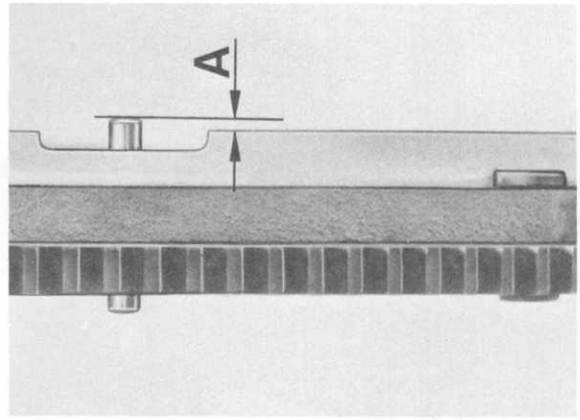
3. Inspect ball socket bushing (snap ring) in release lever. If necessary, install a new ball socket bushing and press in against stop with Special Tool VW 421. Vent hole in release lever must not be covered, otherwise ball socket bushing would spring back when air can't escape.

4. Lubricate bearing surface of release bearing in release lever as well as both sides of preload washer for pressure plate in area of release bearing with Optimoly HT. Mount release bearing with washer and release lever on pressure plate. Gap of circlip should be between retainer on release bearing or offset to groove in release bearing when bearing has an opening.

* Only applicable for the two 6 mm diameter centering pins of cars beginning with 1984 models, since the stepped 6/8 mm diameter pin is removed for installation and removal. Distance A could also not be reached.



5. Check position of centering pins of a dowel pin-centered clutch, correcting if necessary. Protrusion of pins over bearing surface of intermediate plate on flywheel: 3.5 – 0.5 mm (distance A).*



6. Push intermediate plate in direction of release bearing on the three adjusting elements.

7. Assemble clutch, observing the following points:

   a) Yellow arrows on discs are mounted 180° opposite (residual unbalance).

   b) White mark on disc (without spring-loaded liner) faces flywheel.

   c) Hubs of discs face release bearing.

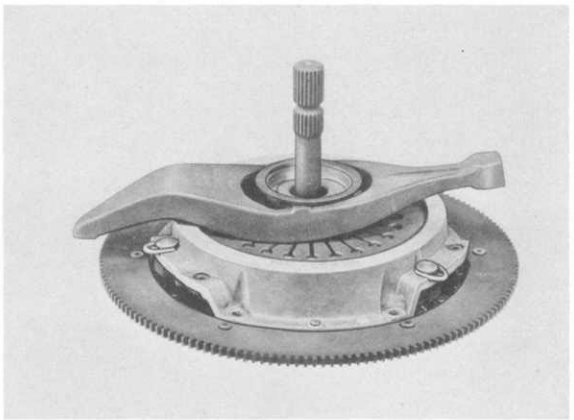
d) Transfer residual unbalance mark of discs (yellow arrows) to engine side of same (facilitates assembly work).

e) Mark pressure plate before installing; drive pressure plate of dowel pin centered clutch on to centering pins or into intermediate plate with a plastic hammer far enough, so that the drive plate located between both can still be moved with short drive shaft (central shaft I).

f) Pressure plate and intermediate plate are also marked with dots of white paint (residual unbalance/heavy side), which are mounted offset 180° (opposite). This must be considered when replacing one or both parts.

g) Recheck protrusion of centering pins on flywheel (3.5 – 0.5 mm), correcting if necessary.

h) Lubricate parts to specifications (see table); however lubricate the starter ring after installation of the clutch. Don't forget to lubricate guide tube for the release bearing.



CLUTCH LINKAGE VERSIONS

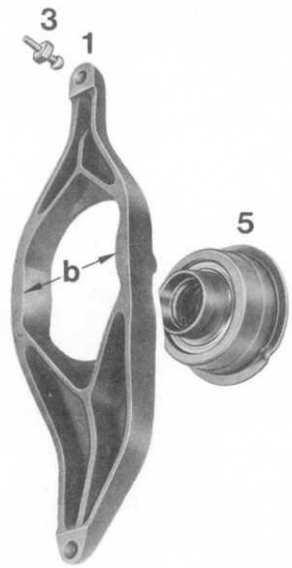
The following modifications have been made to the clutch linkages since the beginning of production.

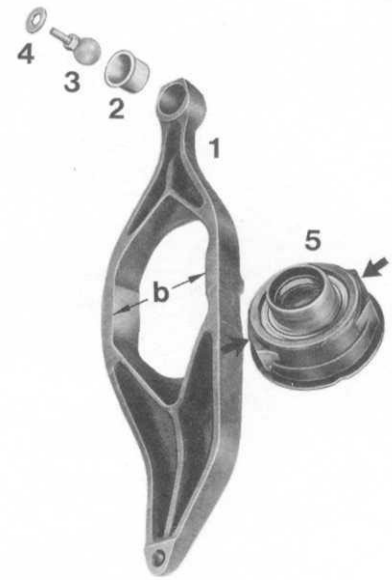
– Ball stud (no. 3) for release lever changed from 10 mm dia. to 19 mm dia.

– Release lever fitted with plastic bushing (no. 2) to take ball stud.

– Release bearing (no. 5) with vulcanized rubber pads to suppress noise and prevent turning.

Part Description	Original Version *	Modified/Present Version
1 Release lever	b = small width	b = large width
2 Bushing	––– (snap ring)	Available
3 Ball stud (see page 30 - 21)	10 mm dia.	19 mm dia.
4 Washer	–––	Available. Ball socket bushing not available for version 2 (see page 30 - 21)
5 Release bearing	Without turning lock	With vulcanized rubber pads as turning locks (won't fit in release lever of original version)





* Parts no longer available. When replacing all parts of either the original or present version must be installed.

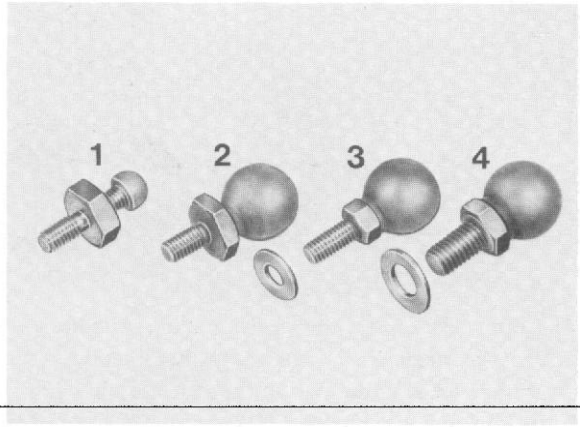
BALL STUD VERSIONS

1 – Original version with 10 mm ball diameter. M 6 threads (originally this version was without threads, also refer to "Replacing Ball Stud").

2 – Modified version, 19 mm ball diameter, M 6 threads without washer (was used briefly in standard production).

3 – Modified version, 19 mm ball diameter, M 6 threads with washer.

4 – Present version, 19 mm ball diameter, M 8 threads with washer.



REPLACING BALL STUD

1. Unscrew ball stud after removing clutch (air cleaner removed).

Note

Ball studs are locked with Loctite so that removal must be done carefully and perhaps turning back and forth several times will be necessary.
Heat a removed clutch housing (up to about 250 °C/480 °F) to facilitate removal of the ball stud.

2. Clean threads with, for example, Loctite Cleaner 0706 prior to screwing in a new ball stud (19 mm dia. instead of 10 mm dia.). Spread a thin coat of Loctite 270 on thread flanks. Screw ball stud version 3 with washer in clutch housing. After depletion of stocks version 3 will no longer be available. Then use ball stud version 4 with washer (tap M 8 threads in clutch housing).

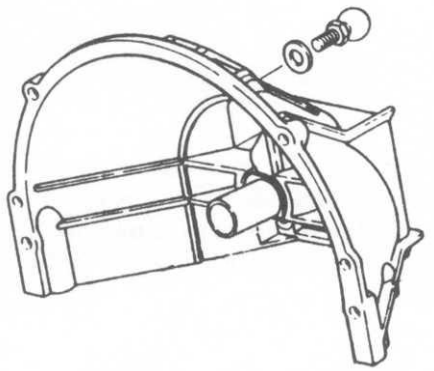
The ball stud in cars prior to Chassis Number

928 820 0491

is not screwed, but pressed in. On these cars the replacement of the ball stud will require installing a M 6 threaded insert in the bore, e. g. Helicoil.

For ball stud version 4 (after depletion of version 3 stocks) the clutch housing has 8 mm threads (without a threaded insert).

These jobs can only be performed after removal of the clutch housing.



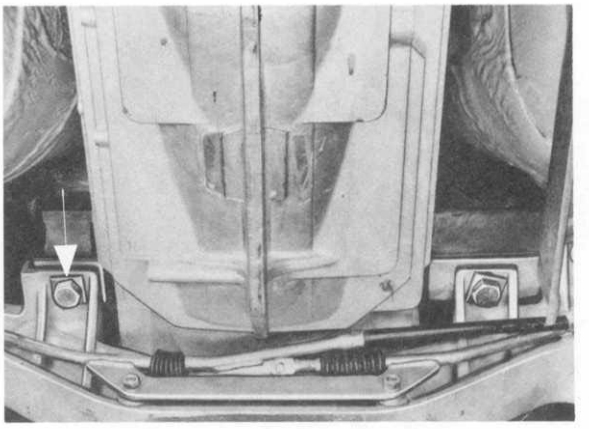
REMOVING AND INSTALLING CLUTCH HOUSING

Removing

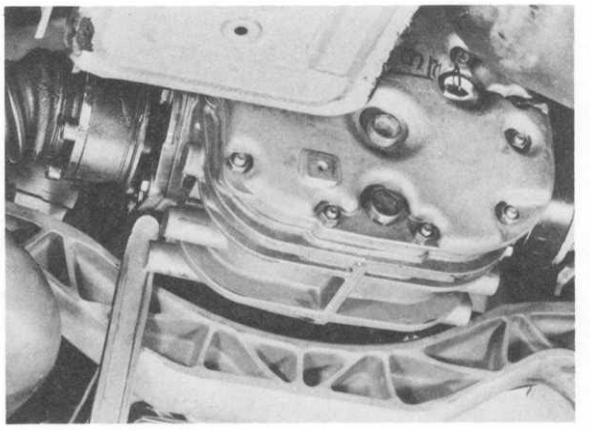
1. Remove front exhaust lines.

2. With clutch removed unscrew mounting bolts for central tube to clutch housing and clutch housing to engine.

3. Remove both mounting bolts of transmission mounts on rear axle cross member.



4. Apply tire iron on transmission and rear axle cross member. Push back transmission and central tube far enough so that the clutch housing can be removed.



Installing

Installation in reverse order.
Watch specified torque.

CHECKING CLUTCH DISCS

1. Inspect splines. Clutch discs must slide easily on short drive shaft. Slight radial play is designed in and is not important.

2. Inspect rivets. Replace clutch disc when in doubt.

3. Inspect clutch linings. If clutch linings are covered with oil, burnt, damaged or worn locally, install a new clutch discs.

4. Check lining thickness of clutch discs. Measure distance from lining to highest point (rivet) on all four linings. Replace clutch discs when less than 0.3 mm.

Note:

See page 30 - 14 for former version clutch discs.

Since clutch discs will be subject to different degrees of wear in operation, the lining thickness will vary. On unsprung disc the flywheel end lining between the flywheel and intermediate plate (white dot of paint) will be considerably thinner.

5. Check clutch discs with lining for lateral runout. Max. permissible lateral runout at 190 mm dia.: 0.4 mm.

CHECKING CLUTCH PRESSURE PLATE

Clutch pressure plates have not been designed to permit overhauling or repairing. Checking is limited to dry cleaning and removing of dust with compressed air and emery cloth as well as a thorough visual inspection.

1. Clean clutch. Clean bearing surface of pressure plate with emery cloth, if necessary. Then blow out entire mechanism thoroughly with compressed air.

2. Check tips of diaphragm springs for traces of wear from clutch release bearing. Scoring to a depth of 0.3 mm is not significant.

3. Inspect bearing surface of pressure plate for cracks, burnt spots and wear. Check deflection with a steel ruler. Pressure plates with up to 0.3 mm deflection inward (measured with a feeler gauge blade) can still be used.

4. Inspect spring connections between pressure plate and cover for cracks. Check tightness of rivets. Replace pressure plates with damaged or loose rivets.

CHECKING CLUTCH INTERMEDIATE PLATE

Clutch intermediate plates have not been designed to permit overhauling or repairing. Checking is limited to dry cleaning and removing of dust with compressed air and emery cloth as well as a thorough visual inspection.

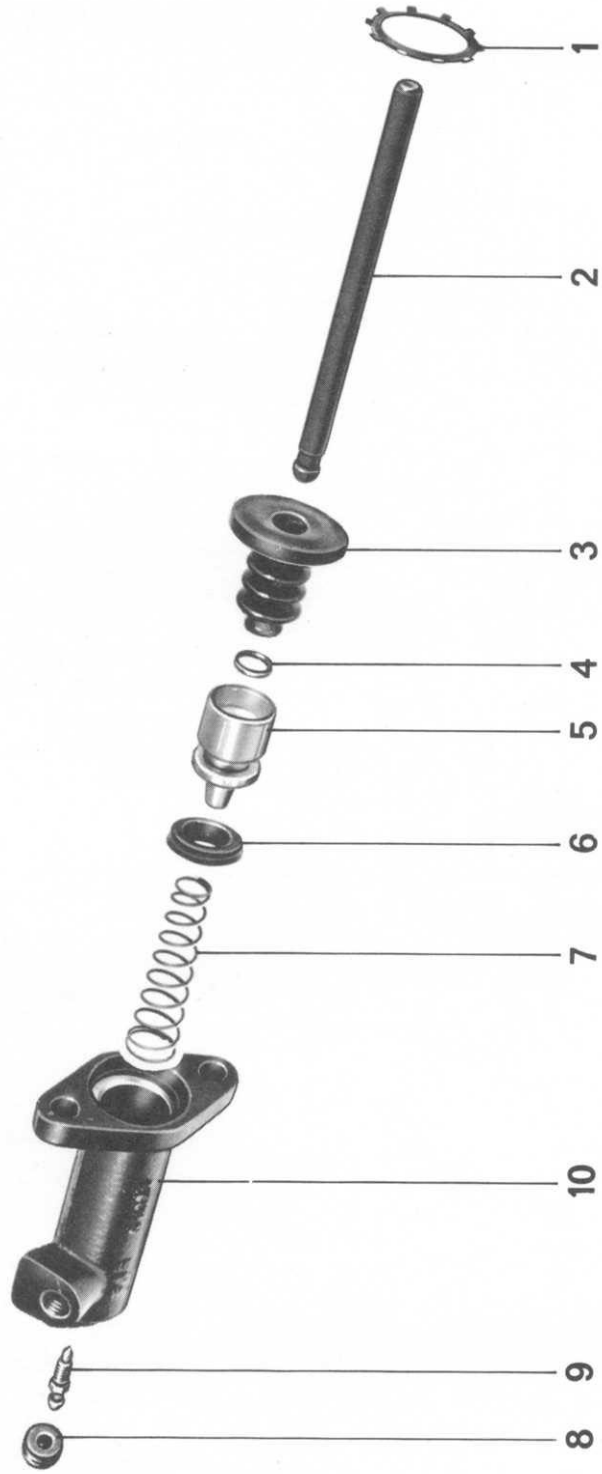
1. Clean intermediate plate. Clean bearing surfaces with emery cloth when necessary. Polish out burnt spots. Blow out entire mechanism with compressed air.

2. Check bearing surfaces for cracks, burnt spots and wear. Check deflection with a steel ruler. Intermediate plates with up to 0.3 mm deflection inward (measured with a feeler gauge blade) can still be used.

3. Inspect spring connection between intermediate plate and intermediate plate housing for cracks. Inspect rivets for tight fit and adjusting elements for damage, replacing intermediate plate if necessary.

4. Check tight fit of centering pins in intermediate plate of dowel pin centered clutch. Straighten or replace bent or damaged centering pins.

OVERHAULING CLUTCH SLAVE CYLINDER



No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
1	Circlip	1		Replace, concave side faces in, make sure of proper fit	
2	Push rod	1			
3	Rubber cover	1		Replace	
4	Retaining ring	1			
5	Piston	1			
6	Dust cover	1		Replace, coat very slightly with brake cylinder paste	
7	Spring	1		Position correctly	
8	Dust cap	1			
9	Bleeder screw	1			
10	Clutch slave cylinder	1		Clean thoroughly with gasoline. Apply a very thin coat of brake cylinder paste to cylinder bore	

Checking clutch disc for wear

Clutch disc is removed

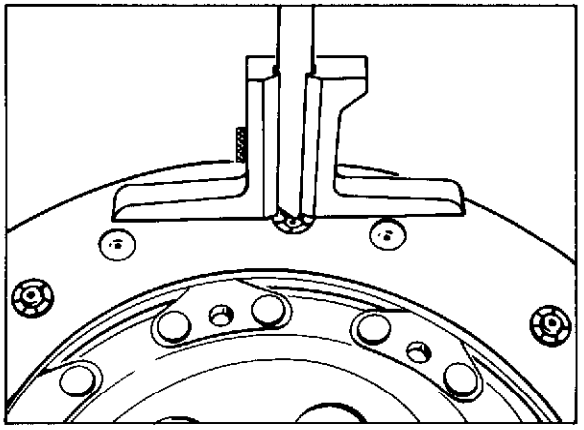
Checking:

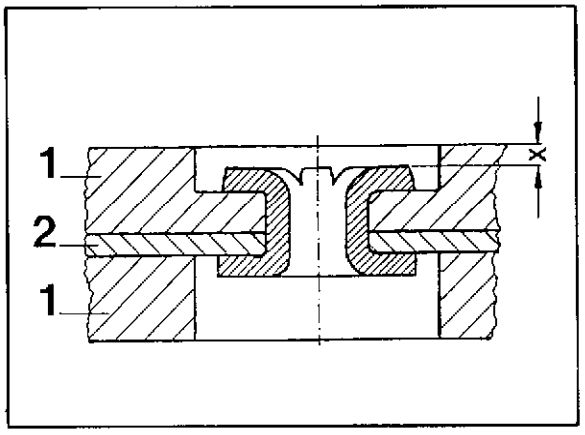
Using a depth gauge, check thickness of lining to rivet head (dimension X).

Note

Measure only on flared rived head side.

Dimension X is approx. 1.4 mm for new clutch discs.
If **dimension X** is down to **0.3 mm**, the clutch disc is worn and must be replaced.
Please note that **lining wear is not linear** over the entire life of the clutch.
Wear decreases considerably as the clutch mileage increases.





1 - Lining
2 - Clutch disc/lining spring

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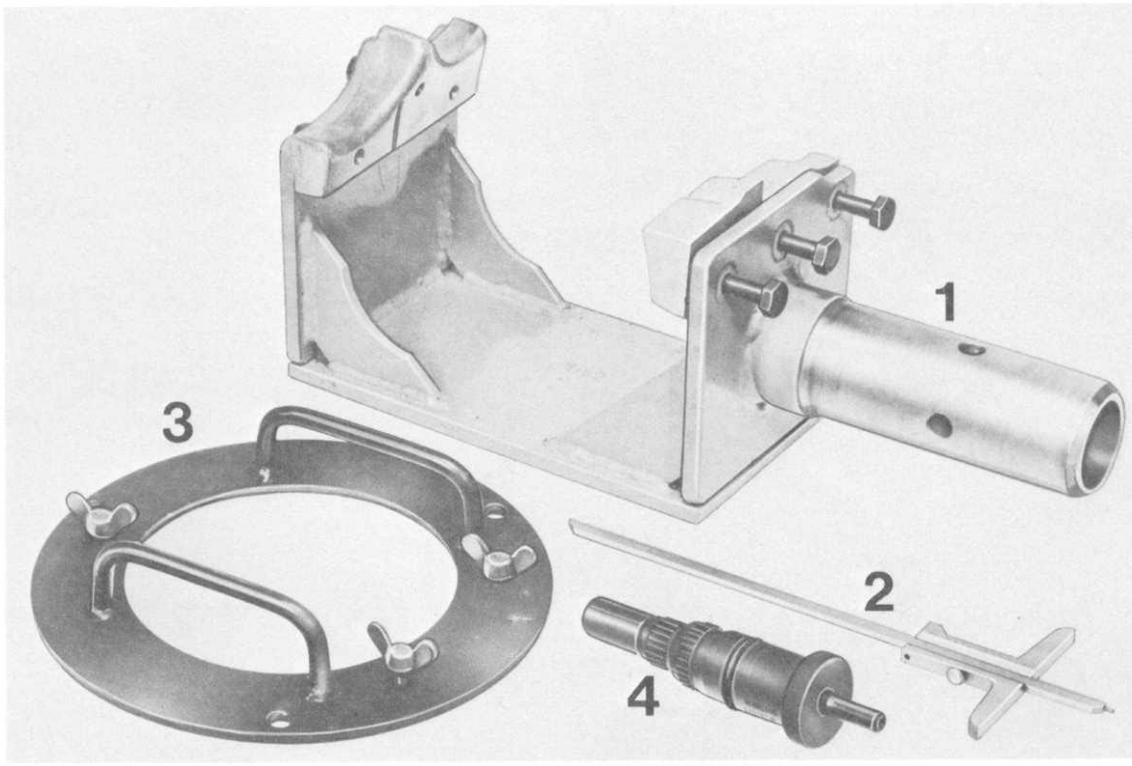
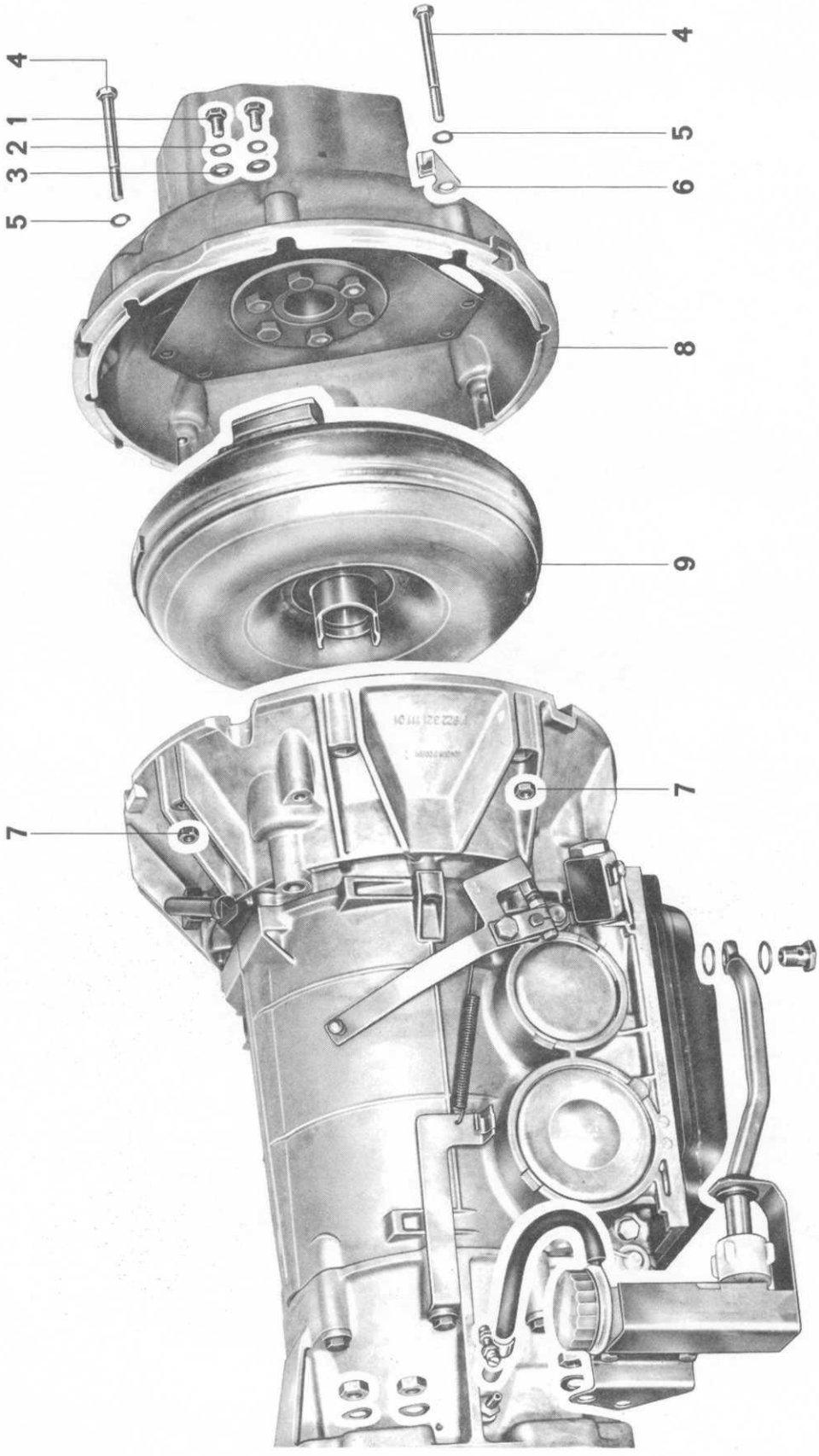
TOOLS



No.	Description	Special Tool	Remarks
1	Transmission holder	9162	
2	Depth gauge	---	Standard tool
3	Grip plate	9301	
4	Mandrel	9310	


4
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7

No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
1	Bolt	6		Tighten to specified torque	
2	Washer	6			
3	Washer	6			
4	Bolt	8		Tighten to specified torque	
5	Washer	8			
6	Vacuum line holder	1			
7	Nut	8			
8	Front converter housing	1			
9	Torque converter	1	Remove upward carefully with Special Tool 9301	Replace when wear is excessive or ATF has metal particles. Lubricate input flange and shaft/bearing journals with a multi-purpose grease containing MoS_2. Place transmission upright and run in carefully with Special Tool 9301.	

REMOVING AND INSTALLING TORQUE CONVERTER

Removing

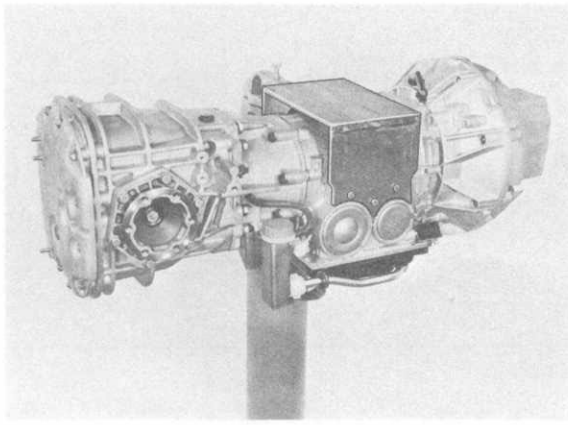
1. Remove transmission.

2. Take off control pressure lever.

Note

Be careful not to place any force on lever shaft when loosening or tightening the mounting bolt, to prevent damage to shaft in transmission. Always counterhold with a wrench when loosening or tightening (see page 37 - 14).

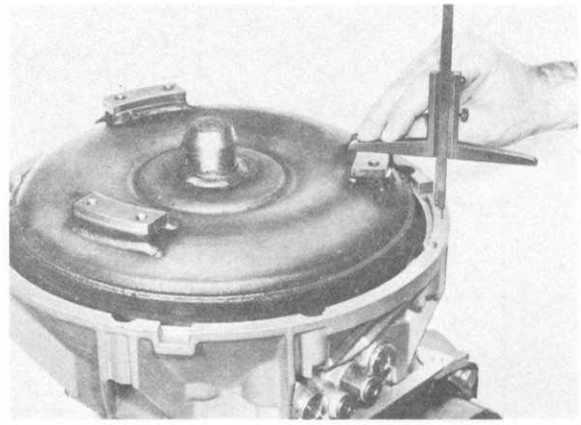
3. Install transmission in assembly stand with Special Tool 9162.



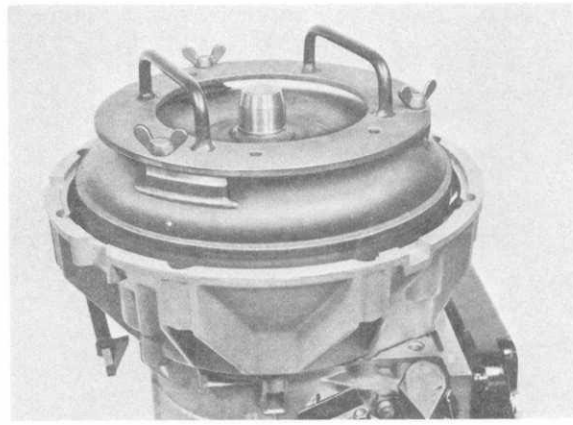
4. Position transmission upright and remove converter mounting bolts through openings in converter housing.

5. Remove front converter housing.

6. Note installed depth of converter (about 49 mm) for reinstalling.



7. Mount Special Tool 9301 on torque converter and lift out converter carefully.

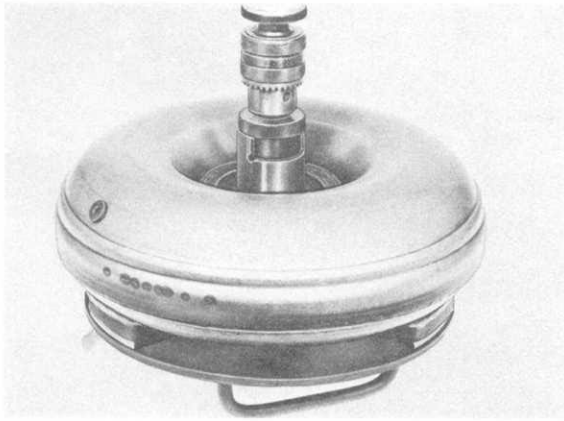


Installing

Note

If ATF contains clutch plate/brake band facing particles, clean inside of torque converter with Special Tool 9310 (flushing mandrel). Fill converter with about 1 liter/quart of kerosene, install flushing mandrel and turn same with a drill running at slow speed. Repeat these procedures twice and let the fluid drain through the drain plug.

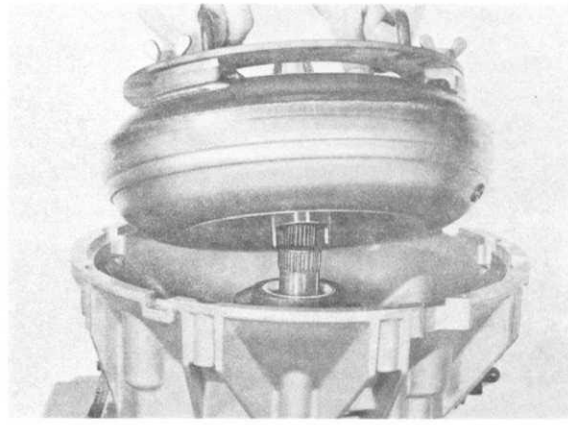
If there are metal particles in oil sump of transmission, torque converter will have to be replaced.



1. Mount Special Tool 9301 on converter.

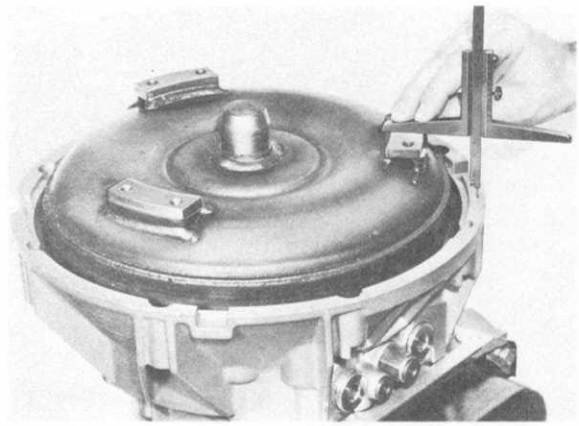
2. Lubricate input flange and bearing journal of converter with a multi-purpose grease containing MoS_2 additives.

3. Place transmission upright. Position drive dog on converter input flange opposite impeller for engagement.



4. Run in conveter carefully, turning it back and forth slightly. Also be careful not to damage seal while running in converter.

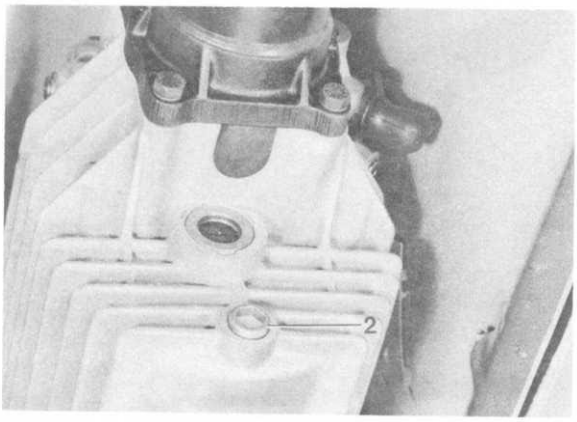
5. Measure installed depth (about 49 mm) of converter, to make sure that converter is positioned correctly. Install front converter housing.

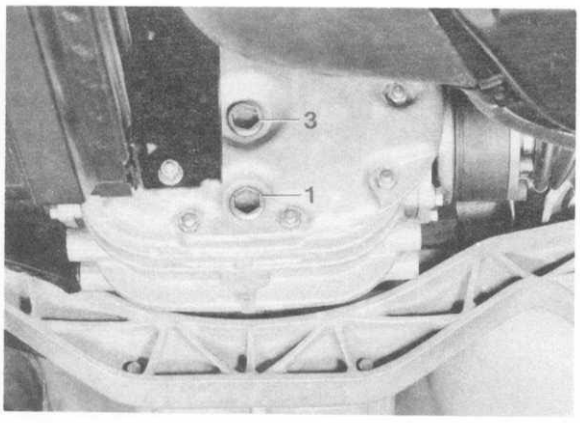


CHANGING TRANSMISSION OIL

Filling capacity approx. 3.8 liters/8 US pints of hypoid oil SAE 90, MIL-L-2105 B; API Classification GL 5

1. Drain oil when transmission has reached operating temperature. Oil has to be drained from transmission and differential separately.





2. Clean filler plug, drain plug for manual transmission and also magnetic drain plug for differential, and tighten them to torque of 1.9 to 2.3 mkg (14 to 17 ft lb).

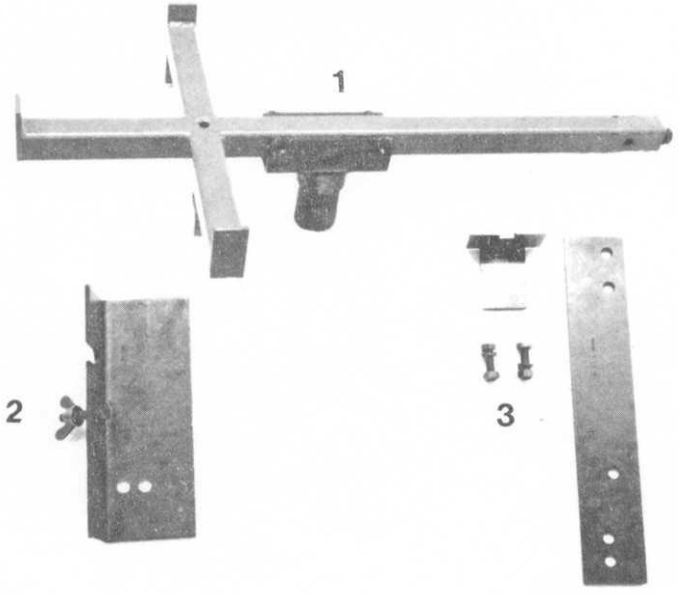
3. Add transmission oil with car on level surface until oil flows out of filler plug opening (approx. 3.8 1/8 US pints).

1 - Drain plug

2 - Magnetic drain plug

3 - Filler plug

TOOLS



No.	Description	Special Tool	Remarks
1	Transmission support	US 618	
2	Support bracket	US 618/2	
3	Support bracket	US 618/4	

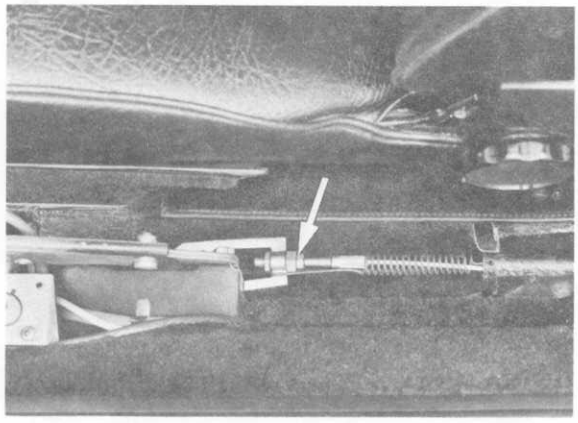
REMOVING AND INSTALLING TRANSMISSION

Removing

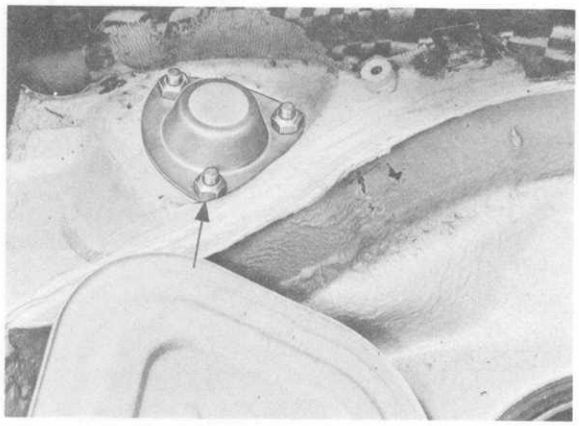
1. Disconnect ground strap at battery.

2. Loosen rear wheels. Engage 5th gear.

3. Loosen parking brake cable at connector. Unscrew locknut and pull out cable toward rear (only for cars with welded battery console).

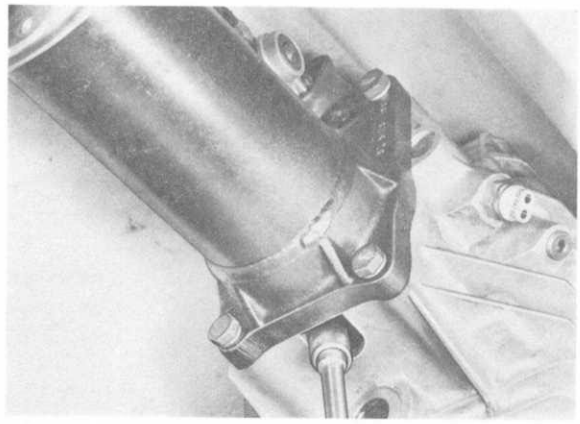


4. Remove nuts on spring struts in luggage compartment.



5. Remove battery (only for cars with bolted battery console).

6. Turn one rear wheel (holding wheel on opposite side) to position coupling bolt between input shaft and drive shaft, and remove bolt.

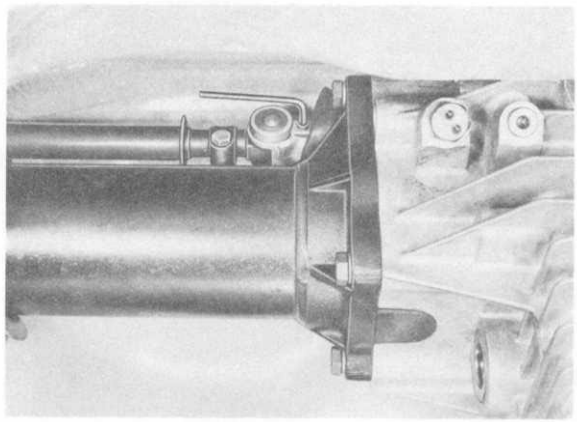


7. Move shift lever to neutral and remove rear wheels.

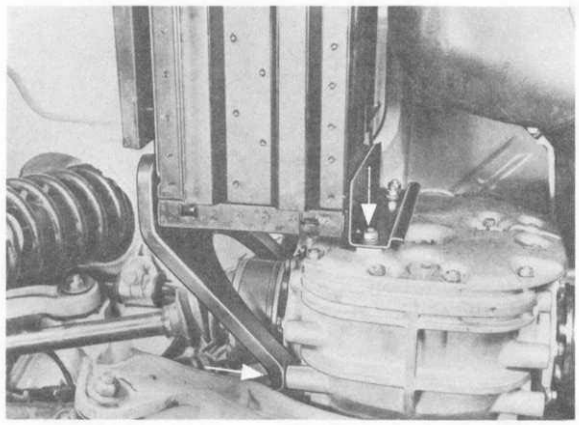
8. Detach brake calipers and suspend on wire so that brake hoses are without tension.

9. Remove exhaust assembly after catalytic converter and remove heat shield.

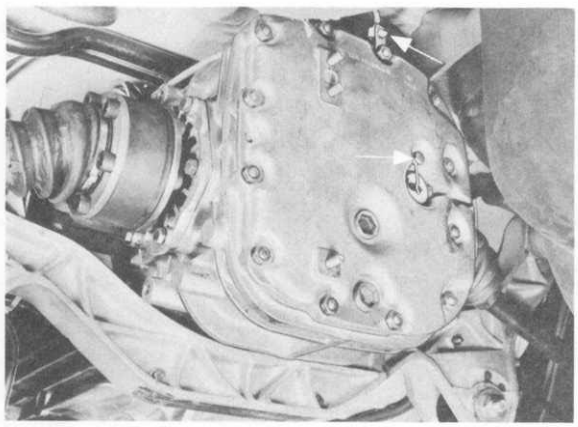
10. After stripping back the dust cover, remove set screw from shift rod coupling. Detach shift rod by pushing it off of main shift rod.



11. Remove battery console (only for cars with bolted battery console).



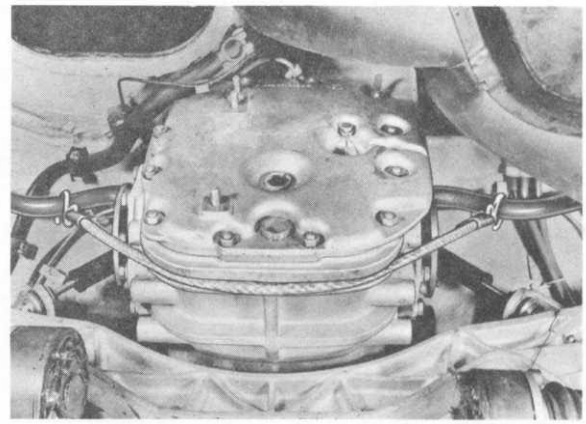
12. Pull off wires on backup lights. Remove pulse transmitter for speedometer and both wires from mounting clips.



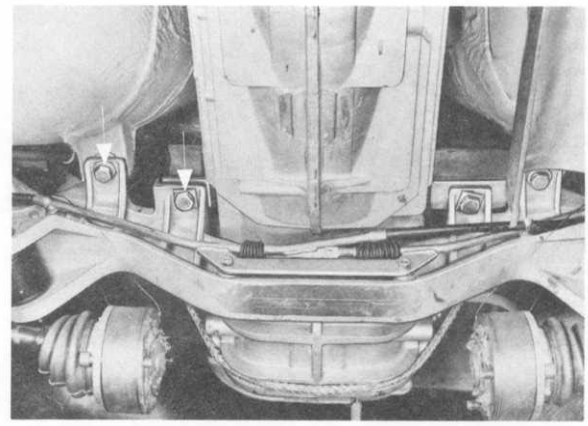
13. Detach axle shafts at transmission end and suspend from rear axle cross member in horizontal position.

14. Disconnect stabilizer bar at lower control arm.

15. Support transmission with special tool US 8031 attached to stabilizer bar.



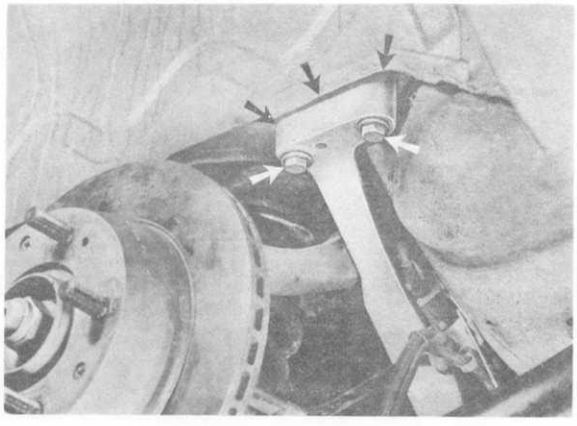
16. Remove both bolts of transmission mounts on rear axle cross member as well as 2 bolts between rear axle cross member and frame.



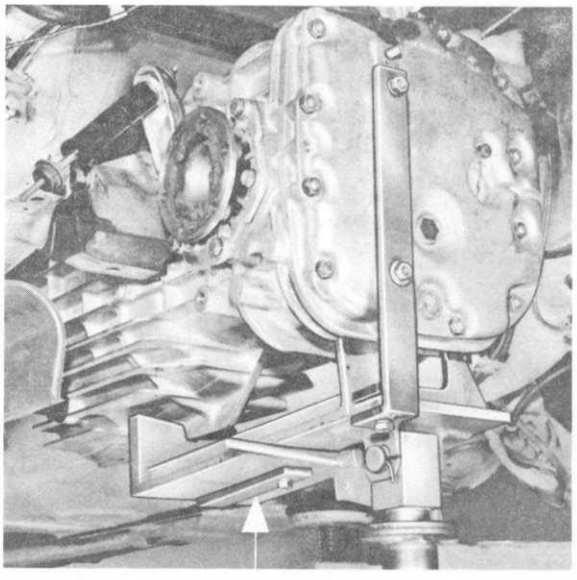
Note

To improve the insulating effect of transmission mounts, (since March of 1980) the gap between the transmission mounts and rear axle cross member is measured during assembly and eliminated by installing shims.
For this reason the shims must be marked for installation later.

17. Place floor crane underneath rear axle cross member. Mark position of rear axle cross member. Remove last 4 bolts on rear axle cross member. Tilt rear axle carefully, making sure that spring struts or control arms do not twist. Support rear axle in tilted position to keep the entire weight off of the lower control arm link pins.

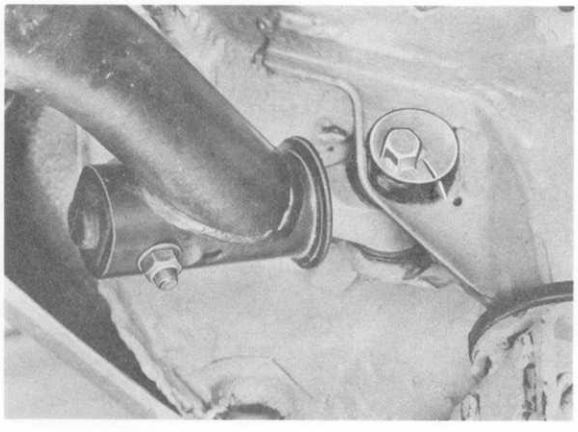


18. Mount transmission support/bracket on transmission. Remove 6 bolts between central tube and transmission, as well as Special Tool US 8029. Pull back transmission to one side and lower.



Note

Entire rear axle assembly of cars with a welded battery console must be removed. Mark toe eccentric for installation later and remove eccentric bolts.



Installing

1. Install the marked spacers or spacers of determined thickness between the transmission mounts and rear axle cross member (see page 34 - 8 a).

2. Watch marks of toe eccentric and cross member to body when installing the rear axle.

3. Adjust parking brake (see page 46 - 8).

4. Observe the specified torque values.

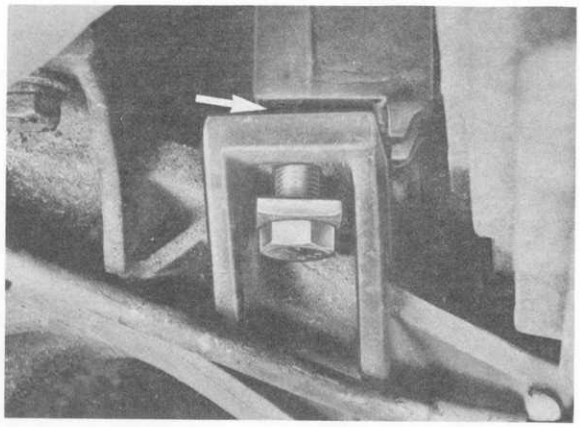
ADJUSTING TRANSMISSION SUSPENSION

To prevent stress in transmission suspension and to provide good insulation, transmission mounts have to be adjusted.

1. Install transmission and rear axle. Tighten transmission mount to transmission case bolts to specified torque.

2. Screw in cross member to transmission mount bolts several turns.

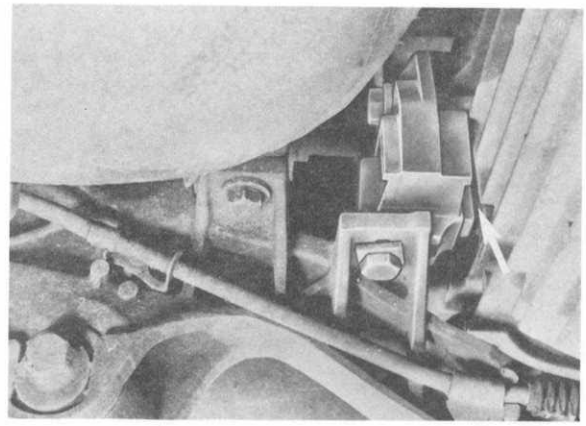
3. Lift transmission at center of case enough so that there is a gap between both transmission mounts and the cross member. Measure this gap on both sides and take up difference with shims.

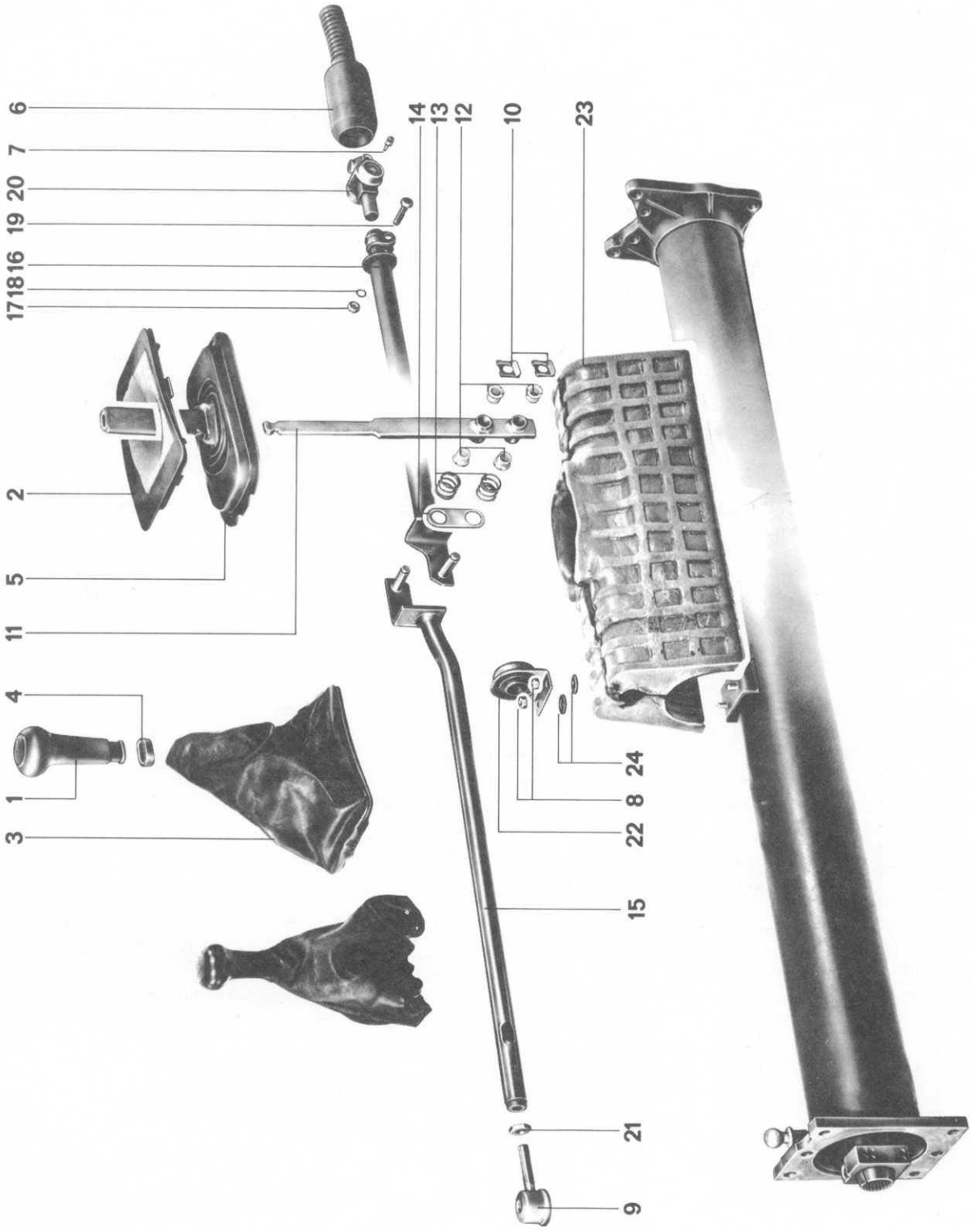


4. Place shims of determined thickness between the transmission mount and cross member, lower transmission and tighten transmission mount to cross member bolts to specified torque.

Note

There must be at least 1 mm clearance between transmission case and side stop on transmission mount after tightening the mounting bolts.

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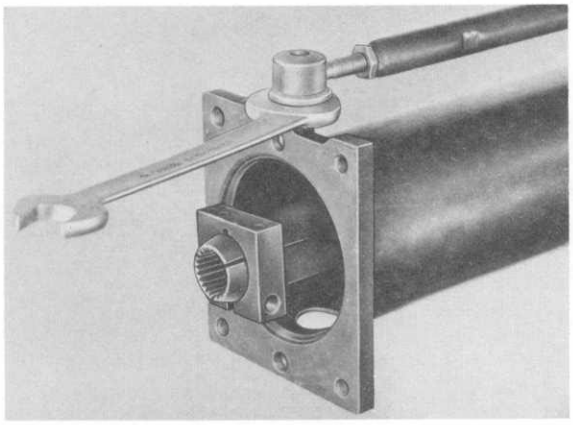
No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
1	Shift knob	1	Pull off of selector lever together with leather cover and frame	Install with glycerine/gasoline mixed 1 to 1	Other version with leather cover no. 3 (pulled over)
2	Frame	1	Disengage retainers in center console	Position correctly	
3	Leather cover	1			
4	Rubber ring	1			Not for one piece version (shift knob with leather cover pulled over)
5	Sleeve	1			
6	Dust cover	1			
7	Screw	1		Self-locking, replace if necessary	2 versions: self-locking (polyamide plug); not self-locking use Loctite 270
8	Locknut	2		Replace if necessary	
9	Ball socket	1	Lift off with fork wrench. Readjust shift if locknuts are loosened or ball socket is turned in relation to guide tube	Slight play between ball socket and ball head because of noise	
10	Circlip	2		Replace if necessary	
11	Selector lever	1		Welded seam on bushings on left side looking forward	
12	Plastic bearing	4		Replace if necessary. Insert with white paste (AOS 1260006)	
13	Spring	2			

No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
14	Friction plate	1		Lubricate with white paste (AOS 1260006)	
15	Guide rod	1		In neutral shift lever must be inclined toward rear by $2.5 \pm 2^{\circ}$. Adjust by turning ball socket. Lubricate all bushings with white paste (AOS 1260006)	
16	Shift rod	1			
17	Nut	1		First adjust shift lever lateral angle and then tighten nut to specified torque.	
18	Lockwasher	1		Replace, if necessary	
19	Bolt	1			
20	Shift rod coupling	1		Push in shift rod flush. Adjust shift lever cross angle.	
21	Nut	1		Align ball socket and shift lever prior to tightening	
22	Guide rod bracket	1			Mounted to body or on central tube
23	Insulation	1		Held on central tube with tape. Use tire paste, e.g. Contifix, to facilitate.	
24	Washer	2		Replace, if necessary	

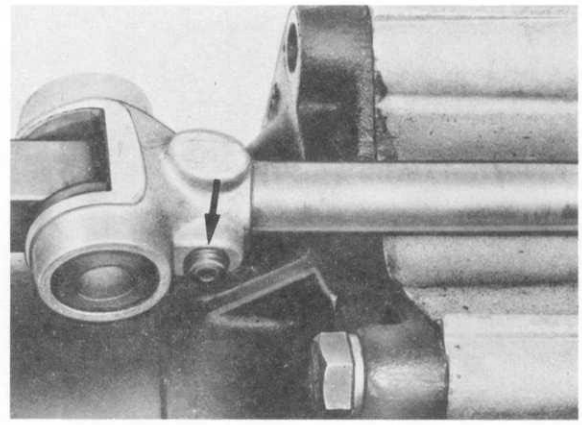
DISASSEMBLING AND ASSEMBLING SELECTOR LINKAGE

Disassembling

Pry ball socket off of ball head. Disconnect bracket, in so far as it is mounted on the frame tunnel, to remove the central tube (see "Removing and Installing Central Tube").



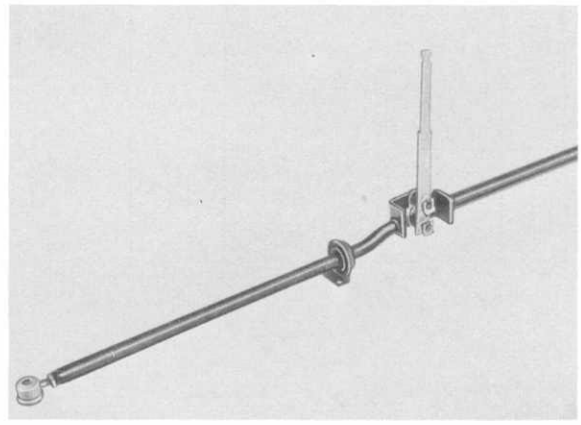
2. Mount bearing unit (selector rod coupling) on interior selector rod of transmission with tapered bolt. If applicable, use Loctite No. 270 (see page 34 - 8 d).



3. Assemble guide tube with bracket (guide tube bearing) and ball socket. Assemble selector lever, selector rod and guide tube, lubricating all bearing surfaces with white paste (AOS 1260006). Don't tighten locknut for ball socket or selector rod to bearing unit (selector rod coupling) mounting bolt at this point.

Assembling

1. Place transmission on a workbench and apply a piece of wood underneath rear end so that transmission is approximately horizontal. Bolt on central tube with 2 bolts and support from underneath with an universal transmission lift.

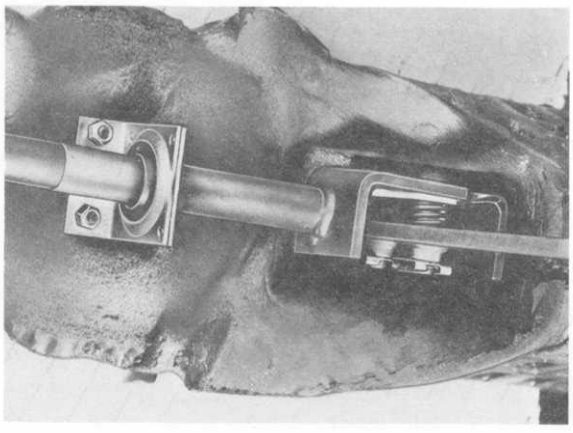


4. Adjust shift to guarantee correct shift travel. Keep to the order of selector lever axial and then lateral inclination.

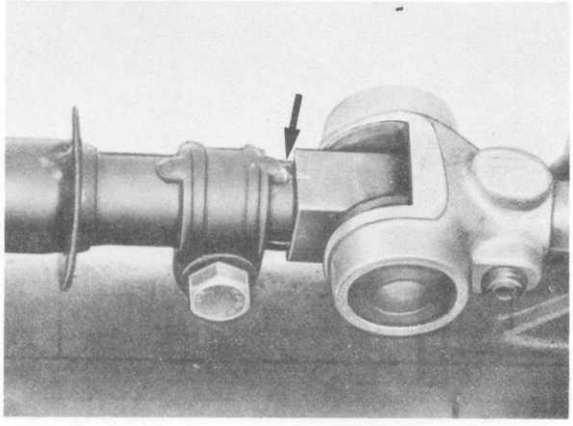
   The adjustment differs according to the mounting of the bracket. It is bolted on the central tube or body.

Bracket Mounted on Central Tube (Present Version)

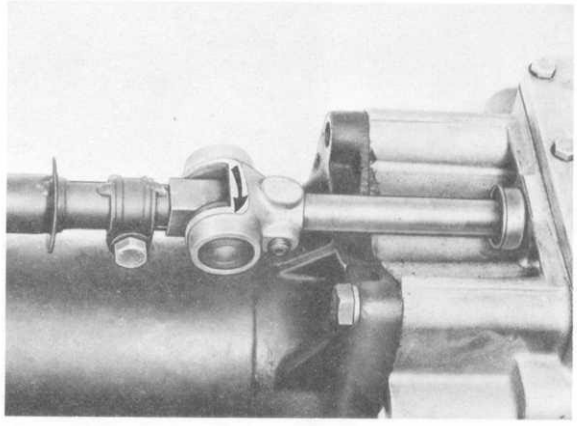
a) Place insulation sheet on central tube and mount bracket (guide tube mount) on the central tube.

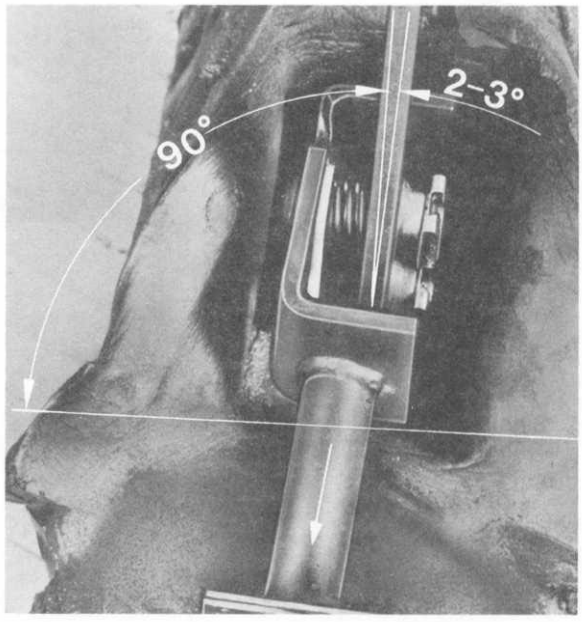


b) With transmission in neutral position push selector rod on to bearing unit (selector rod coupling) against the stop.



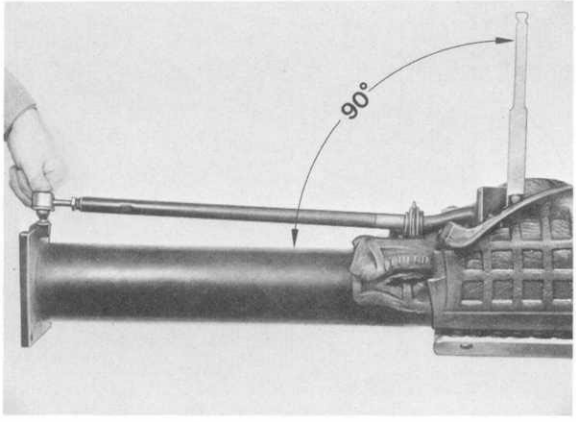
c) Adjust selector lever lateral inclination. With transmission in neutral position turn bearing unit anticlockwise against stop and hold. Turn selector rod with selector lever until the selector lever is inclined to the left by 2 to 3°. Clamp selector rod flush with the bearing unit in this position (arrow = forward direction).



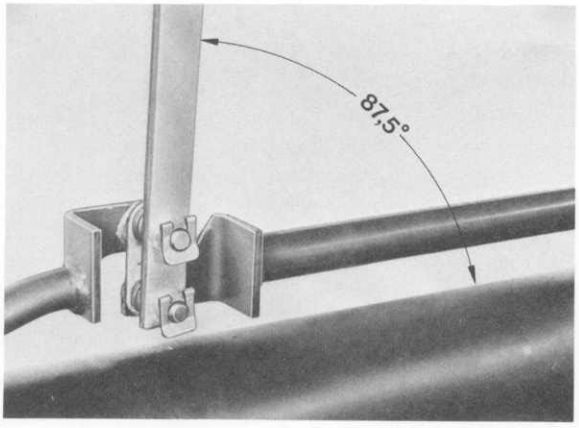


d) Adjust shift lever longitudinal inclination to $87,5 \pm 2^{o}$ ($2,5 \pm 2^{o}$ toward rear). First center the shift lever in neutral, since there is play in the interior shift rod of the transmission as well as in the shift rod coupling by design.

Turn ball socket until the shift lever is upright (90^{o}) with the ball socket mounted on the ball stud.



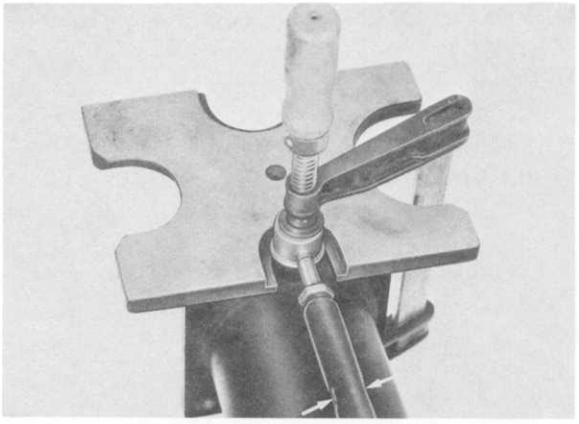
e) From this position unscrew the ball socket about 2 turns (lengthening the guide rod) and mount on central tube (plastic hammer). The shift lever longitudinal inclination should be $87,5 \pm 2^{o}$ after compensation for the design play. If necessary, turn the ball socket accordingly.



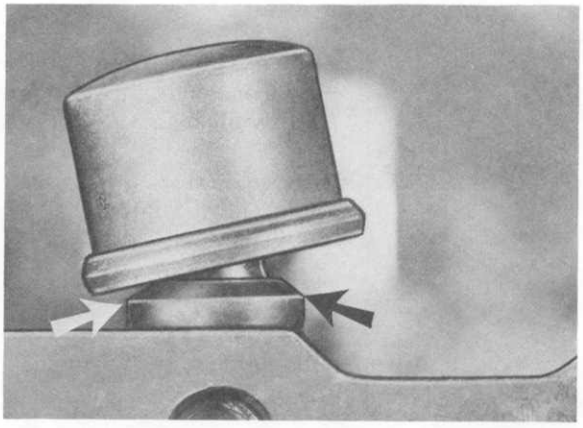
f) To exclude shift problems or damage to the ball socket, hold guide rod in correct position to the ball socket while tightening the locknut (ball socket horizontal, shift lever with guide rod on stop of reverse or 1st gear lock).

Horizontal Ball Socket Position:
Slide special tool VW 402 between central tube flange and ball socket, and hold ball socket with a clamp. Don't apply excessive force.

Guide Rod Position:
Apply open-end wrench on surface (arrow) of guide rod provided for this purpose. Use openend wrench to turn shift lever with guide rod counterclockwise against stop in neutral in 2nd - 3rd plane and hold tight while tightening locknuts.
Watch torque value.



g) In neutral position turn shift lever against left and right stops, making sure ball socket does not rest on collar of ball stud. If there is no gap (clearance) on one side, the guide rod had been turned while tightening the locknut. In this case unscrew the locknut again and repeat point f) carefully.



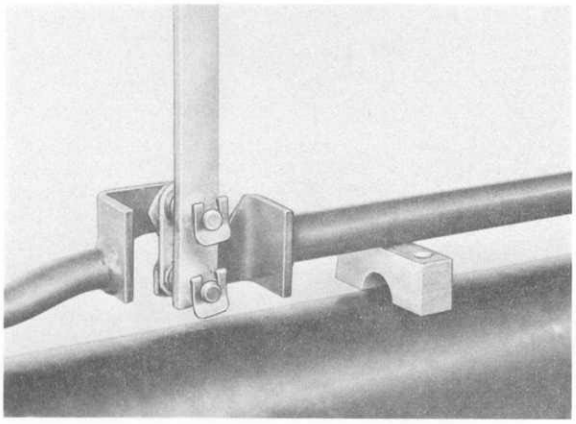
Guide Rod Bracket Mounted on Body

a) Adjusting procedures are identical with those for bracket version mounted on the central tube except for the following points.

b) Point a) omitted.

c) After point b) separate special tool VW 40-204 or 40-204 A due to missing mounting of guide rod bracket and apply section of special tool without pin close to the shift lever with the radius on the central tube.

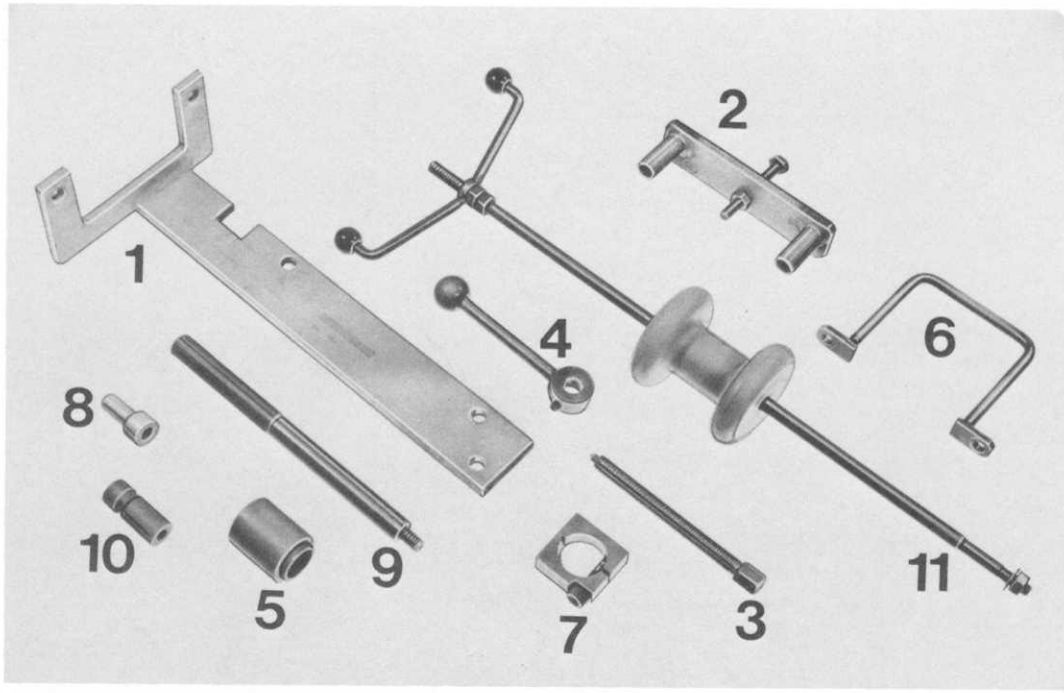
Some other support could also be used. Requirement: shift rod approximately parallel to central tube. This is equal to a distance of about 25 to 30 mm.



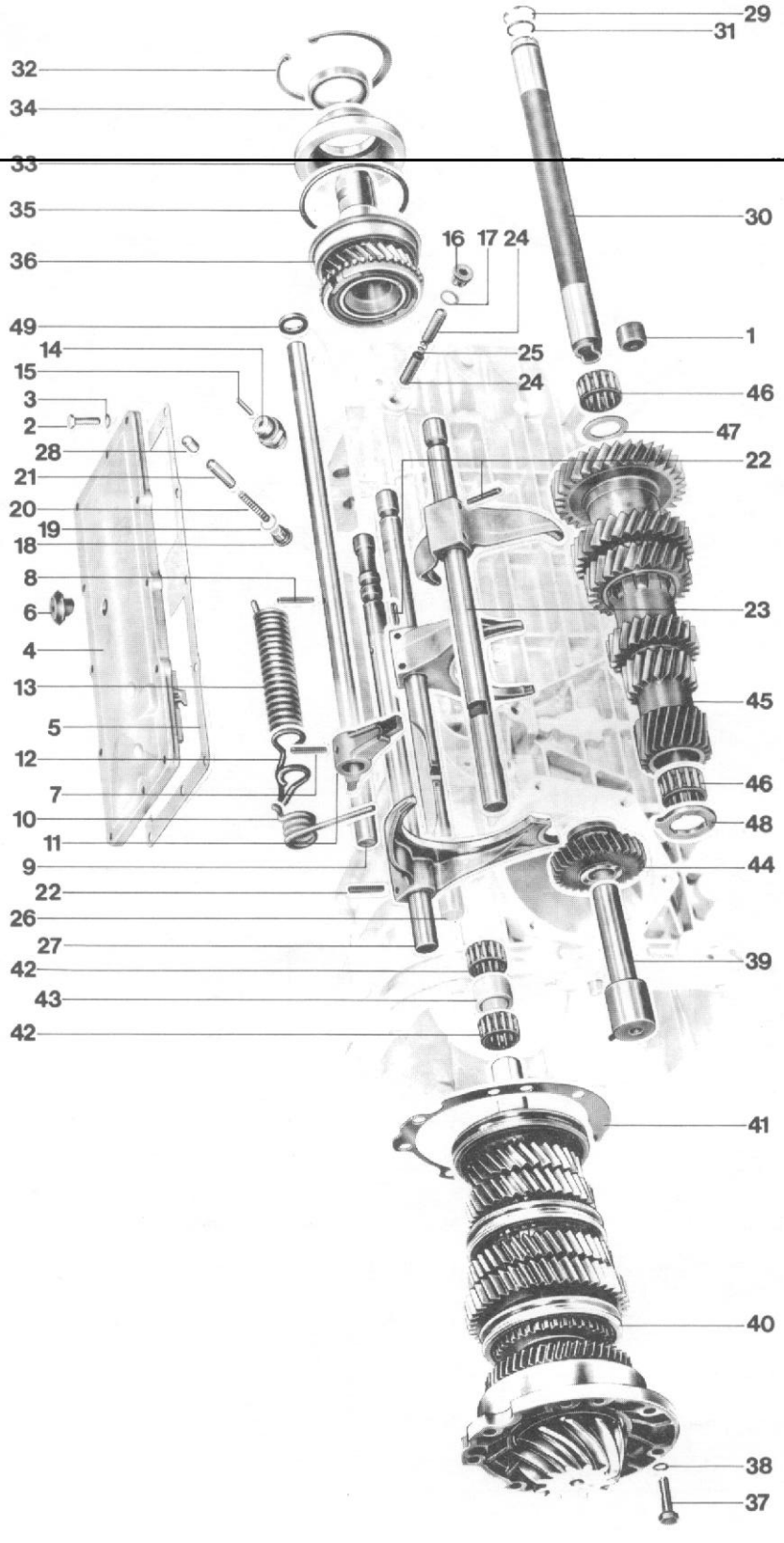
d) Leave support underneath the shift rod during the entire adjusting procedures. Due to the missing bracket hold the shift linkage to keep it from sliding off of the support.
It could be necessary to center out the shift linkage more often.

e) Place insulation sheet on central tube after adjusting.

TOOLS



No.	Description	Special Tool	Remarks
1	Support	9149	
2	Extractor	9148	
3	Spindle	US 1078	
4	Operating lever	9155	
5	Press tool	P 263	
6	Holder	9144	
7	Coupling	–	Spare part
8	Arbor	US 8050/9	
9	Pin	US 8050	
10	Puller, input shaft	9140	
11	Slide hammer	VW 771	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No.	Description	Qty.	Note When: Removing	Note When: Installing	Special Instructions
1	Plug (magnetic)	1		Torque: 22 Nm (16 ftlb)	
2	Bolt M 6 x 22 – 8.8 M 6 x 22 – 12.9	12		 Torque: 9 Nm (7 ftlb) Torque: 16 Nm (12 ftlb)	
3	Washer	12			Plain washers are used instead of these washers for transm. with reverse gear lock
4	Case cover	1			
5	Gasket	1			
6	Vent	1			
7	Roll pin	1	Engage 5th gear and drive out		
8	Split pin	1	First drive out roll pin no. 7		
9	Internal selector rod	1		Position correctly, depression for set screw must face left	
10	Spring				Only for transm. with reverse gear lock
11	Shift finger	1			
12	U-spring	1		Convex side faces down	
13	Lockout spring	1			
14	Backup light switch	1			
15	Plunger	1		Stepped end faces switch	
16	Plug	1		Torque: 19 Nm (14 ftlb)	
17	Seal	1		Replace	

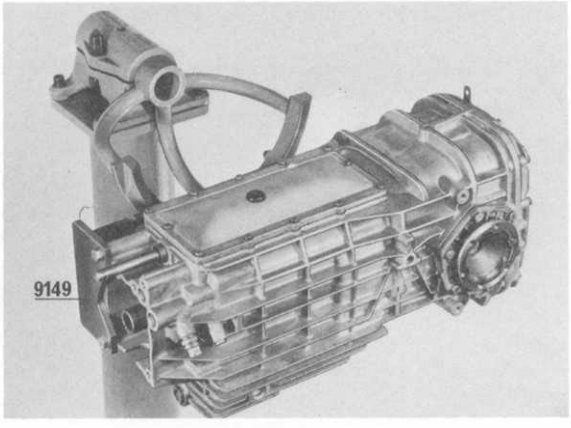
No.	Description	Qty.	Note When: Removing	Note When: Installing	Special Instructions
18	Plug	1		Torque: 19 Nm (14 ftlb)	
19	Seal	1		Replace	
20	Spring	1			
21	Locking sleeve	1			
22	Clamping sleeve	6			
23	Selector rod (with selector fork for 4th and 5th gears)	1	Remove toward rear		
24	Locking sleeve	2			
25	Spring	1			
26	Selector rod (with selector fork for 2nd and 3rd gears)	1	Remove toward rear		
27	Selector rod (with selector fork for 1st and reverse gears)	1	Remove toward rear		
28	Detent	1			
29	Circlip	1			
30	Countershaft	1			
31	O-ring	1		Replace, coat with transmission oil	
32	Circlip	1			
33	Bearing cap	1	Pull out by turning and pulling		
34	Seal	1			
35	O-ring	1		Replace, coat with transmission oil	
36	Input shaft	1	Pull out with special tools 9140 and 9148, but first lower cluster gear	Drive in with piece of suitable pipe	

No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
37	Bolt	7		Torque: 30 Nm (22 ftlb)	
38	Lock washer	7 *		Hollow side faces bearing cover	
39	Reverse shaft	1	Turn and remove bearing unit with VW 771		
40	Pinion shaft assy.	1	Press out with 9148 and P 263	Insert with 9144	
41	Shim	X	Note quantity and thickness for installation later	If necessary, determine again. Position correctly	
42	Needle cage	2			
43	Thrust washer	1			
44	Reverse gear wheel	1			
45	Cluster gear	1			
46	Needle cage	2			
47	Washer	1			
48	Thrust washer	1		Torsional lock faces case opening, stick on case with a little grease	
49	Seal	1		Drive in with special tool US 8050/9	

DISASSEMBLING AND ASSEMBLING MANUAL TRANSMISSION

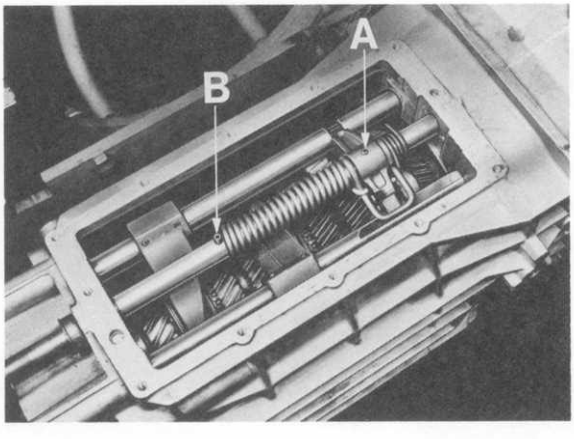
Disassembling

1. Mount transmission on assembly stand with special tool 9149 and drain transmission oil.

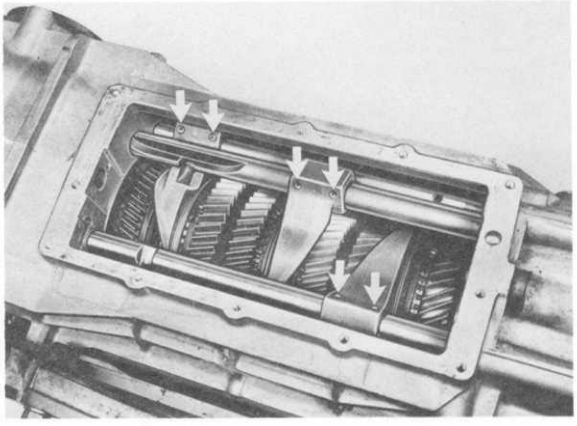


2. Remove differential (see page 39 - 1).

3. Engage 5th gear, drive out roll pin (A) for shift finger and only then (when spring is relaxed) split pin (B) for spring support.
Disassembling order is important, since otherwise the accelerated split pin (B) could cause injury.



4. Drive out split pins for selector forks and remove selector rods toward rear (toward differential).



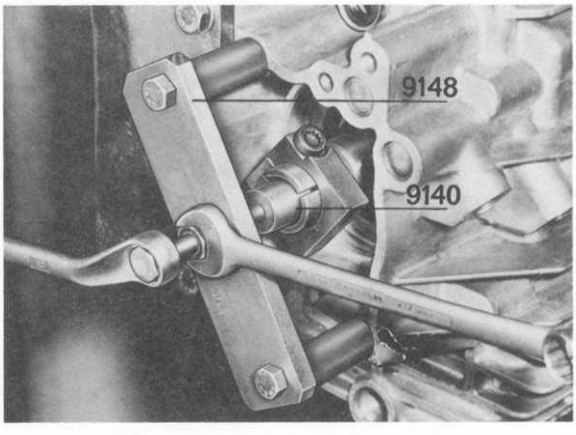
5. Remove circlip for countershaft and take out countershaft.

6. Remove circlip for input shaft.

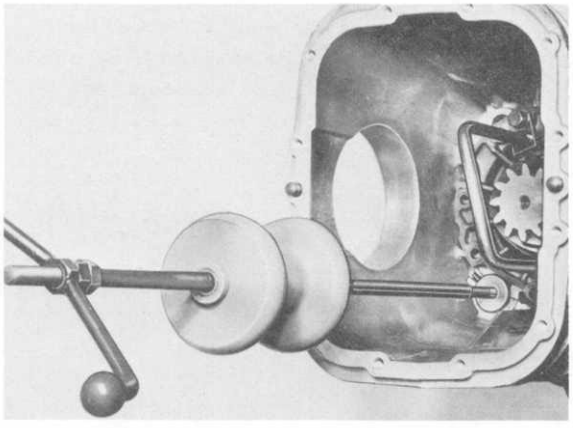
7. Remove bearing cover by turning and pulling. Remove O-ring and pull out input shaft with special tools 9140 and 9148.

Note

Always first remove the countershaft and lower cluster gear to bottom of transmission.



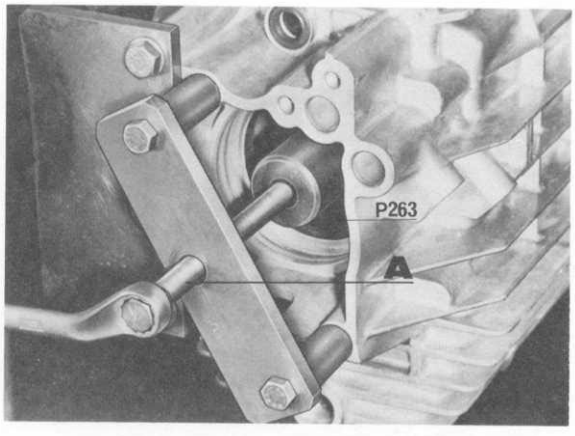
8. Remove pinion shaft mounting bolts, mount special tool 9144 on the bearing unit and turn this unit until reverse shaft can be removed with special tool VW 771.



Note

Reverse shafts without threads are driven out from the inside with a suitable mandrel after removal of the pinion shaft.

9. Press out pinion shaft with special tools 9148 and P 263.



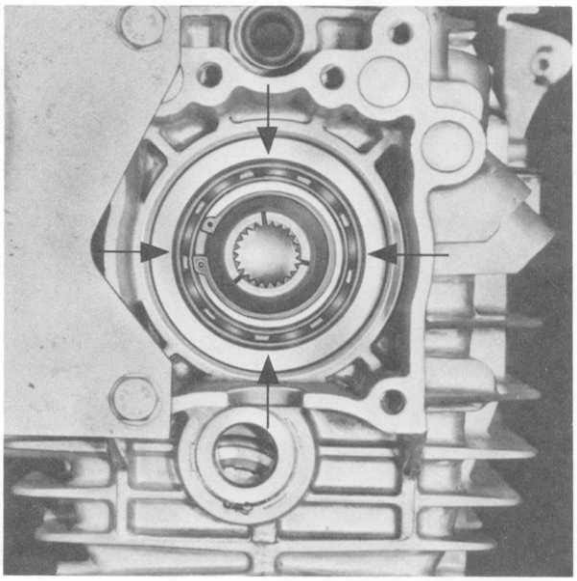
A – US 1078 or 40 - 19

Assembling

1. Stick thrust washer for cluster gear on case with a little grease.

2. Place assembled cluster gear in case.

3. Drive in assembled input shaft without synchromesh parts over outer race of grooved ball bearing against stop with a suitable piece of pipe or mandrel, applied alternately.



4. Insert O-ring for bearing cover and lubricate lightly with oil.

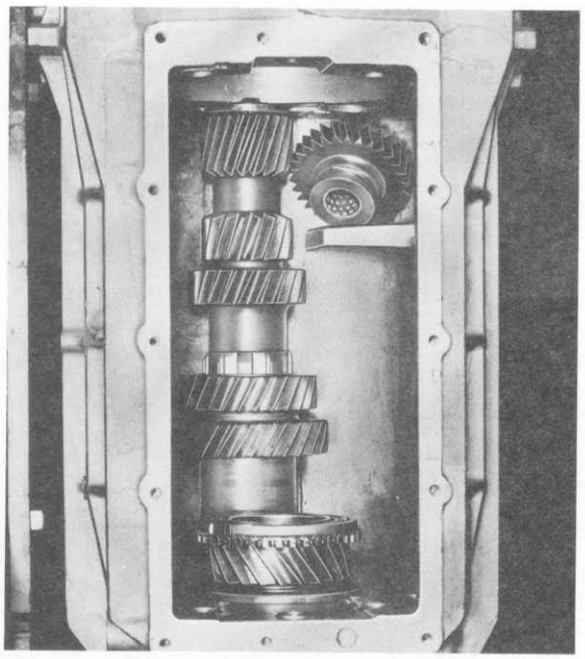
5. Install bearing cover and circlip.

6. Swing transmission on assembly stand so that input shaft faces down.

7. Insert needle cage and thrust washer in input shaft.

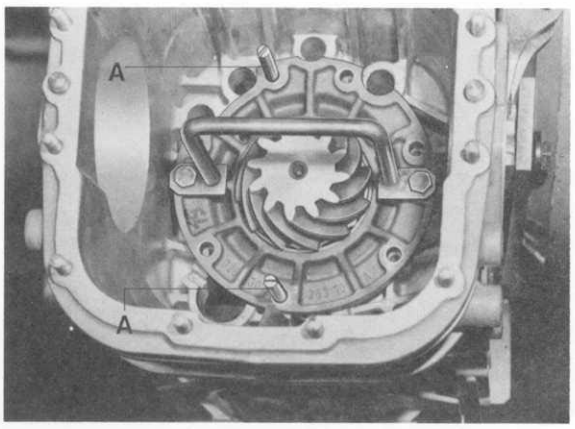
8. Place synchromesh parts for 5th gear on clutch unit.

9. Place reverse gear wheel in case as shown in figure.



10. Screw centering pins (locally made) for installation of pinion shaft in case and install shims S_3 of determined thickness and quantity.

11. Mount special tool 9144 on pinion shaft bearing cover and guide in pinion shaft carefully. Watch out especially for the 5th gear synchromesh parts and reverse gear wheel.

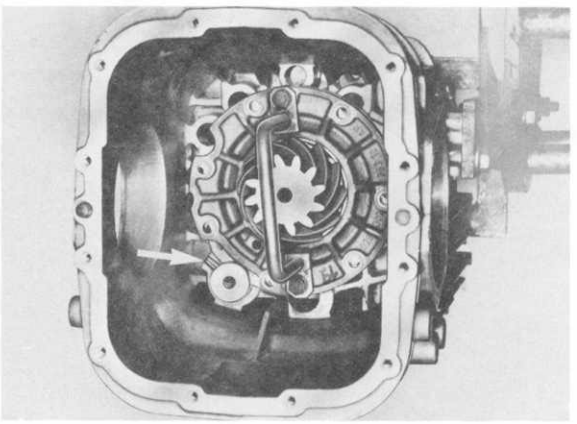


A – Centering pins (locally made)

Note:

Engage 4th gear to prevent operating sleeve for 4th and 5th gears from slipping.

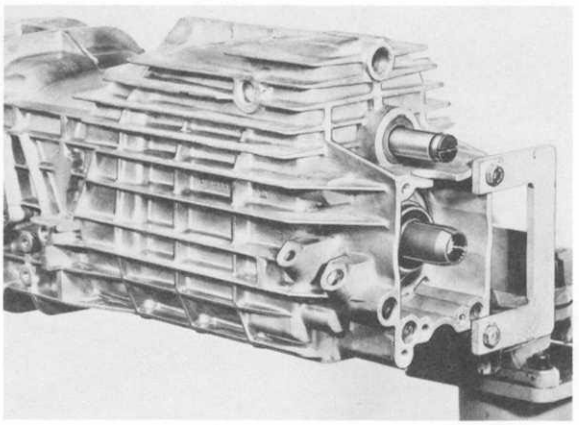
12. Position reverse gear wheel correctly with a suitable screwdriver, unscrew centering pins for bearing unit and turn latter together with the shims until the reverse shaft can be installed.



13. Turn bearing unit with shims S_3 to installed position, remove special tool 9144 and torque mounting bolts to 30 Nm (22 ftlb).

14. Measure distance "Z" between input shaft and pinion shaft (see page 35 - 15).

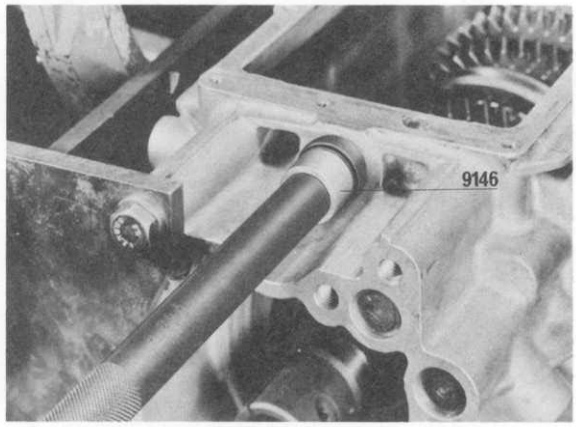
15. Move countershaft to installed position and install shaft with O-ring, which is given a light coat of oil. Install snap ring.



Note:

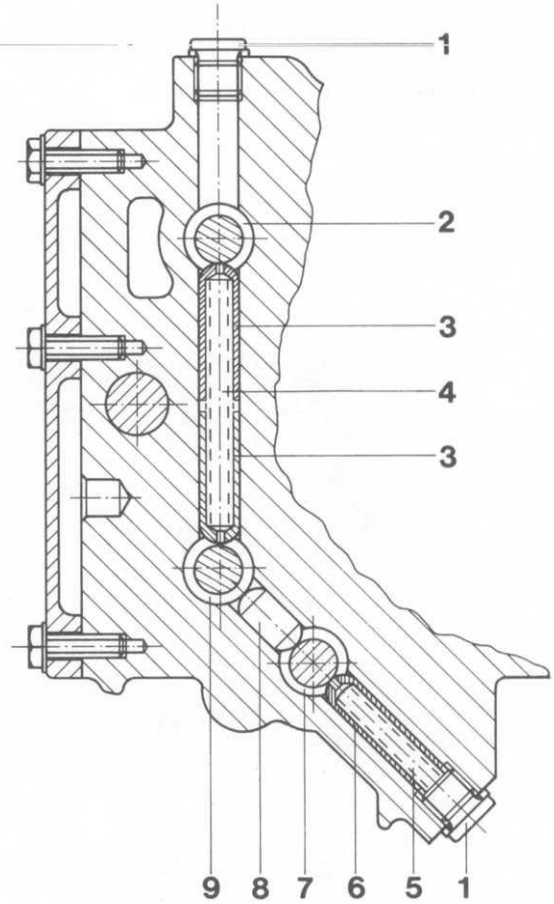
Assembly can be made easier by turning transmission in the assembly stand until the cluster gear falls into its installed position under its own weight.

16. Drive in seal for internal selector rod with Special Tool US 8050/9.



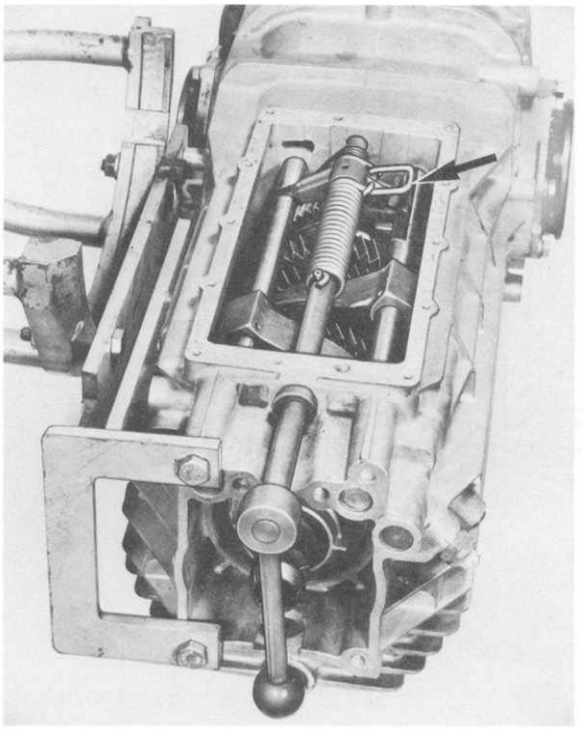
17. Engage neutral.

18. Install selector rods, selector forks and shift interlock components.

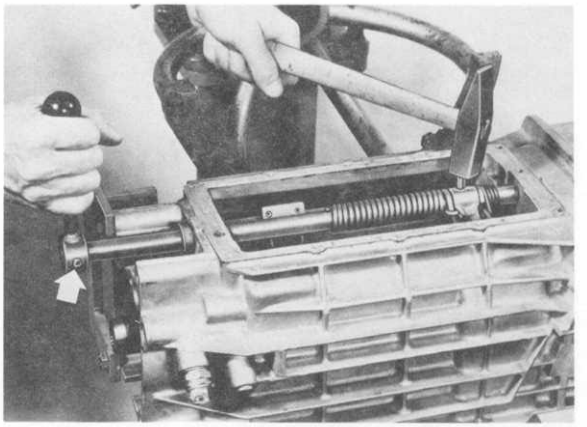


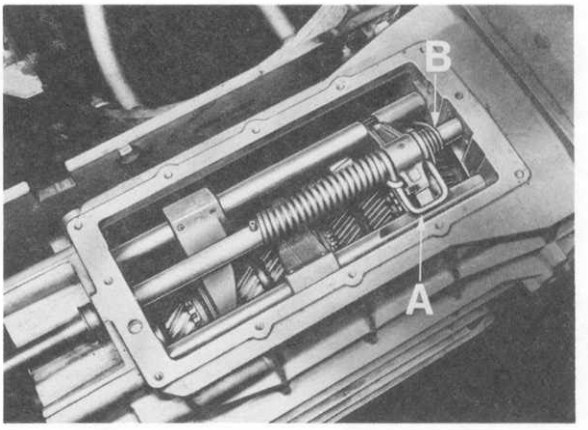
1 – Plug
2 – Selector rod, 4th and 5th gear
3 – Detent plunger
4 – Spring
5 – Spring
6 – Detent plunger
7 – Selector rod, 1st and reverse gear
8 – Interlock pin
9 – Selector rod, 2nd and 3rd gear

19. Install internal selector rod with shift finger and springs as shown in figure. Concave surface of spring faces down to selector rod.



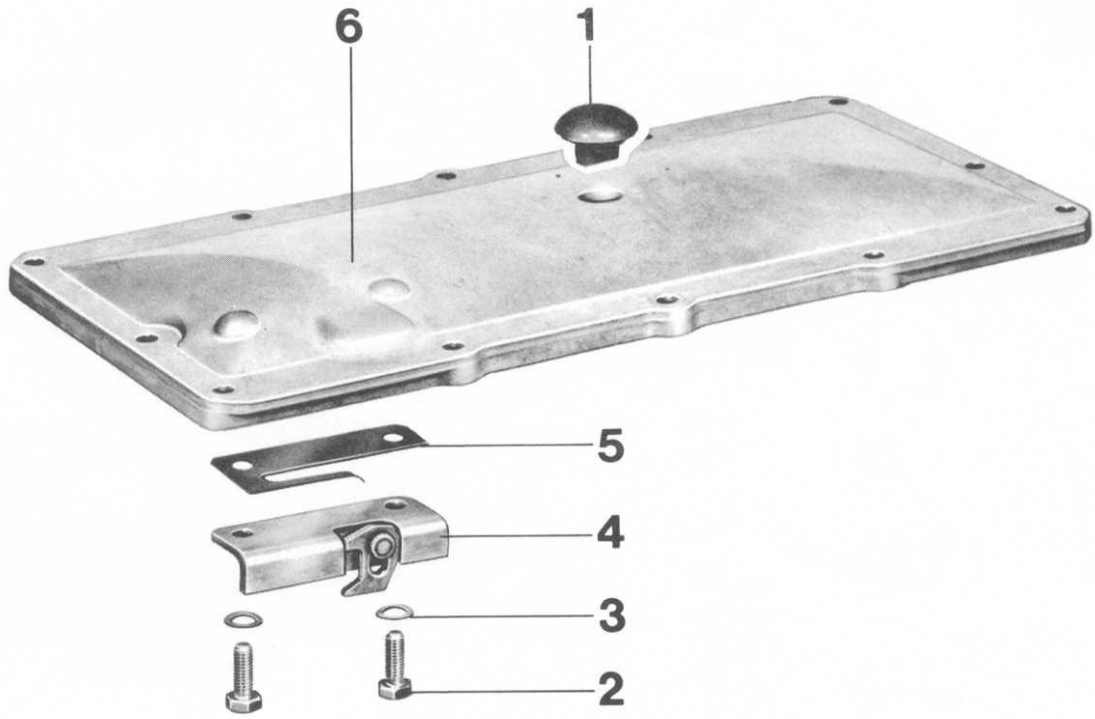
20. Turn internal selector rod 180° with Special Tool 9155 and install pin for shift finger. The torsion spring will be under tension in this position and cavity for pointed screw in internal selector rod faces left (looking forward).





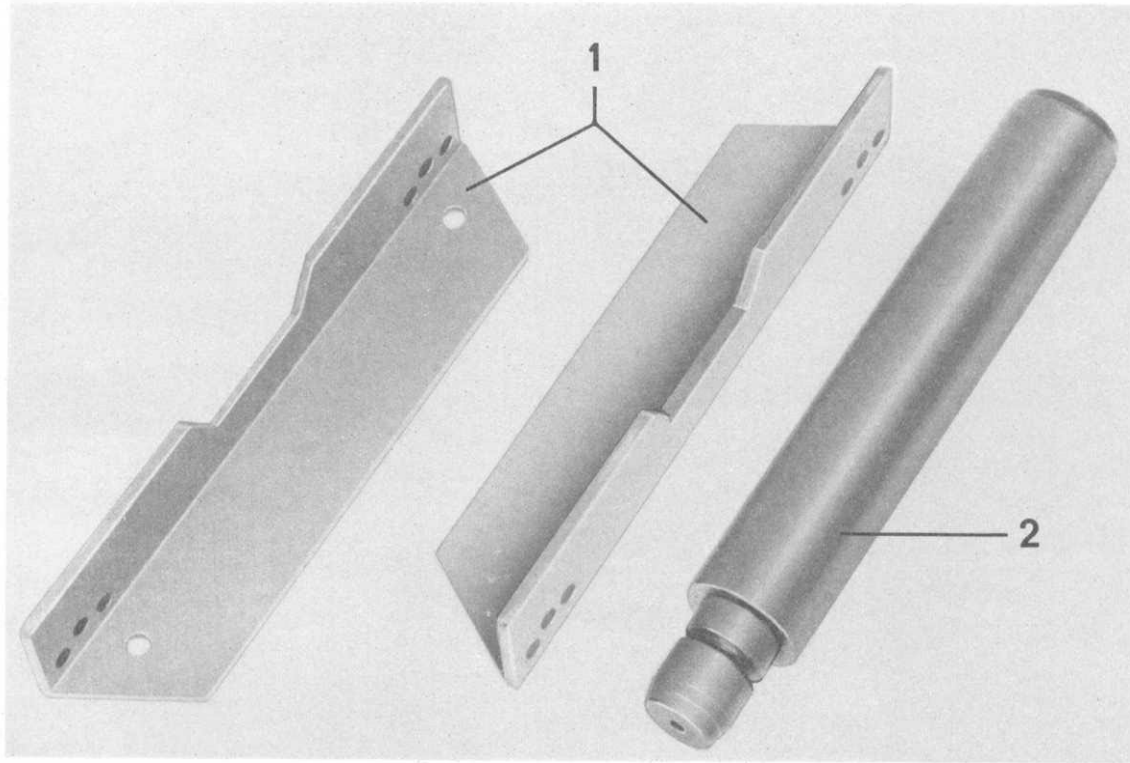
A – Spring (concave surface faces down)
B – Spring (only for transmissions with reverse gear shift lock)

21. Check by shifting through all gears with Special Tool 9155.

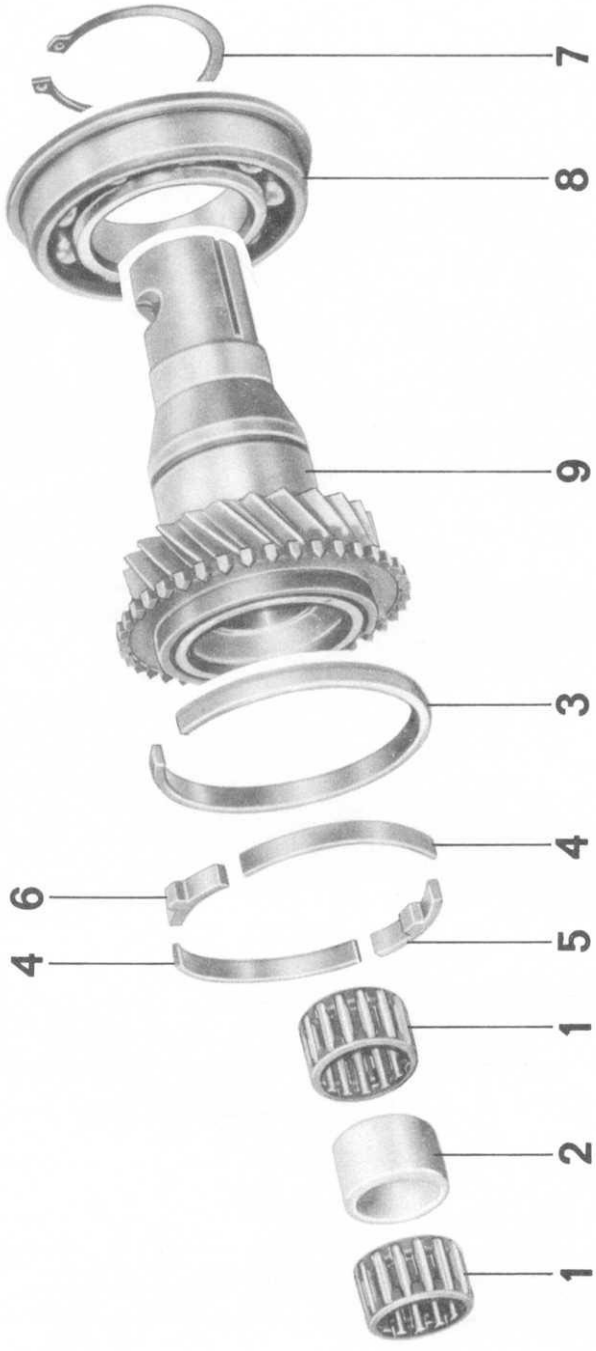


No.	Description	Qty.	Note When: Removing	Note When: Installing	Special Instructions
1	Vent	1			
2	Bolt	2		Torque: 9 Nm	
3	Washer	2			
4	Gear lock	1		Check locking pawl for easy movement	
5	Leaf spring	1		Position correctly	
6	Case cover	1			

TOOLS



No.	Description	Special Tool	Remarks
1	Support rail	VW 457	
2	Mandrel	VW 407	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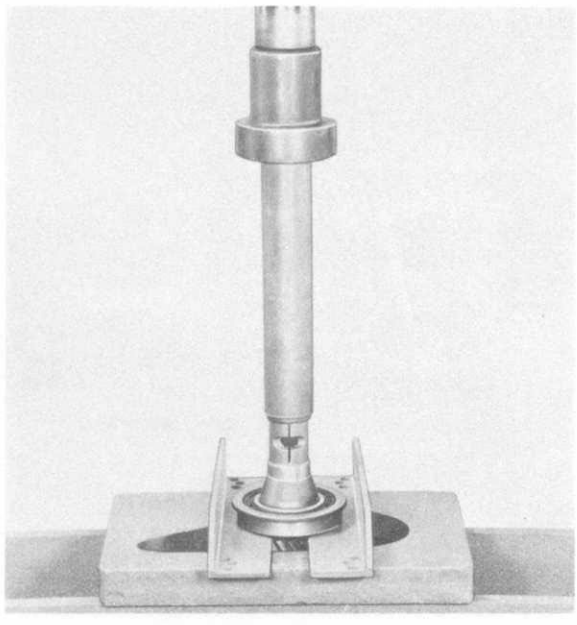
No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
1	Needle bearing	2			
2	Spacer	1			
3	Synchronizer ring	1			
4	Shift band	2			
5	Stop	1			
6	Thrust block	1			
7	Circlip	1			
8	Ball bearing	1	Press off with VW 457 and VW 407	Heat to approx. 100° C/212° F and drive on	
9	Input shaft				

DISASSEMBLING AND ASSEMBLING INPUT SHAFT

Disassembling

1. Remove circlip.
2. Press off ball bearing with a pertinent mandrel (e.g. VW 407) and Special Tool VW 457.



Assembling

Heat ball bearing to approx. 100° C/212° F and drive on.

Modification from Transm. No. 118 1093

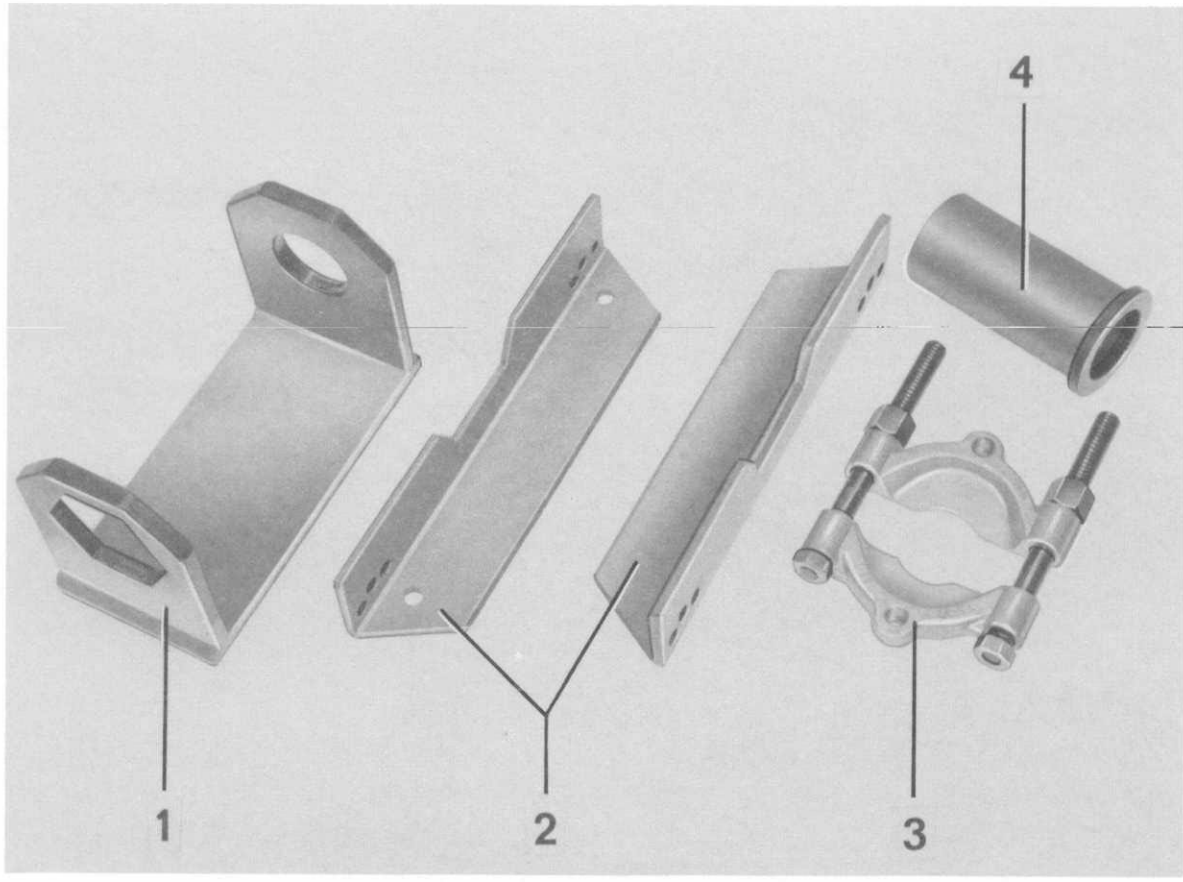
A new input shaft with modified clutch body and a new synchronizer ring for 5th gear are installed from Transmission No. 118 1093.

This modification has changed distance "Z" and the calculation of distance "X" (see pages 35 - 11 and 35 - 15).

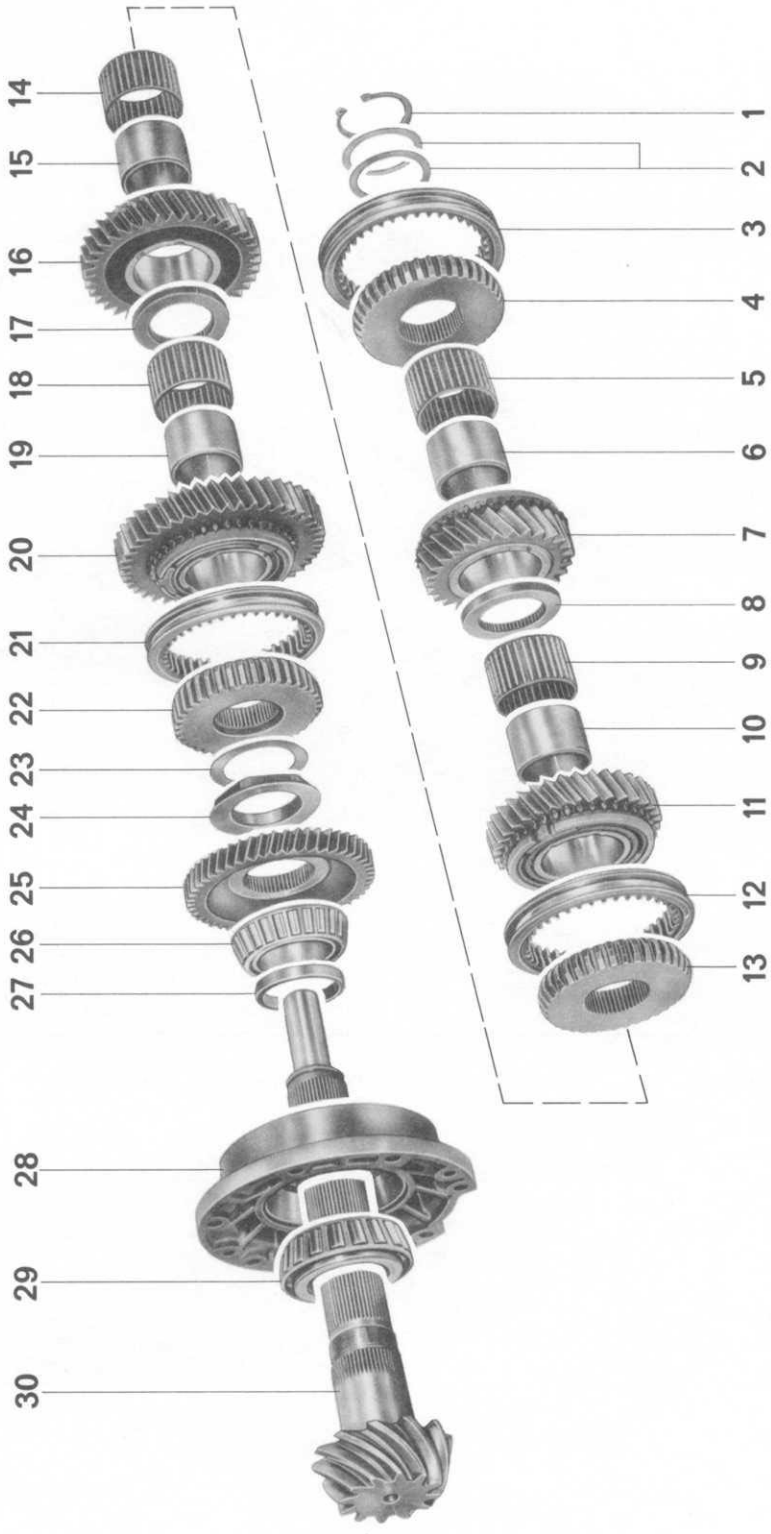
Note

Old and new parts must not be installed together when repairing.

TOOLS



No.	Description	Special Tool	Remarks
1	Retainer	9142	
2	Support rail	VW 457	
3	Separator	US 1103	
4	Wrench	9143	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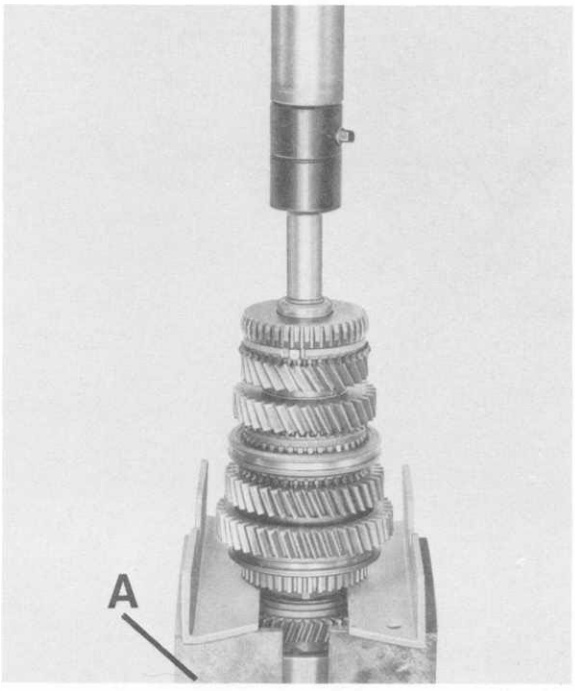
No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
1	Circlip	1		Replace, if necessary	
2	Shim (distance y)	X	Note number and thickness for reassembly	If necessary, remeasure thickness	
3	Shift sleeve	1			
4	Hub	1			
5	Needle bearing	1	Mark for reassembly	Install with same gear	
6	Inner race	1	Mark for reassembly	Heat to approx. 100° C/212° F, install with same needle bearing and gear	
7	Gear, 4th speed	1		Check synchronization, replace in pairs only	
8	Thrust washer	1			
9	Needle bearing	1	Mark for reassembly	Install with same gear	
10	Inner race	1	Mark for reassembly	Heat to approx. 100° C/212° F, install with same needle bearing and gear	
11	Gear, 3rd speed	1		Check synchronization, replace in pairs only	
12	Shift sleeve	1			
13	Hub	1			
14	Needle bearing	1	Mark for reassembly	Install with same gear	
15	Inner race	1	Mark for reassembly	Heat to approx. 100° C/212° F, install with same needle bearing and gear	
16	Gear, 2nd speed	1		Check synchronization, replace in pairs only	
17	Thrust washer	1			

No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
18	Needle cage	1	Mark for reassembly	Install with same gear	
19	Inner race	1	Mark for reassembly	Heat to approx. 100 °C/212 °F, install with same needle bearing and gear	
20	Gear, 1st speed	1		Check synchronization, replace in pairs only	
21	Shift sleeve	1			
22	Guide sleeve	1		Flat surface on side flank faces 1st gear	
23	Shim (distance X)	X	Note quantity and thickness for reassembly	If necessary, remeasure thickness	
24	Lock nut	1		Tighten to specified torque, lock by staking	
25	Reverse gear	1		Cavity faces lock nut	
26	Tapered roller bearing inner race	1	Press off together with bearing cover	Heat to approx. 100 °C/212 °F and drive on	
27	Shim	1			
28	Bearing cover	1	Press off	Replace only complete with tapered roller bearing and shim	
29	Tapered roller bearing inner race	1	Press off with a suitable separator	Heat to approx. 100 °C/212 °F and drive on	
30	Pinion shaft	1		Adjust if necessary. Note pair number	

DISASSEMBLING AND ASSEMBLING PINION SHAFT

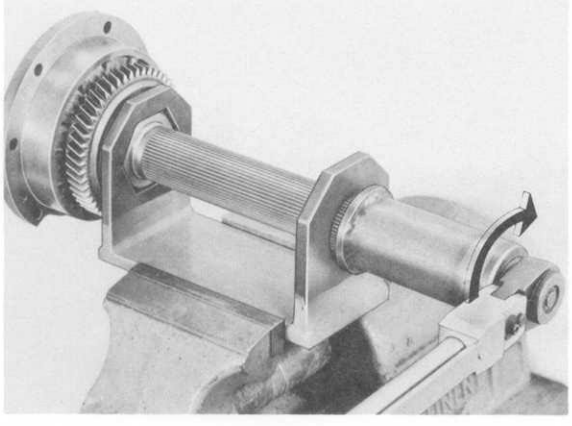
Disassembling

1. Press gears and inner races off of pinion shaft with special tool VW 457 and a suitable support.

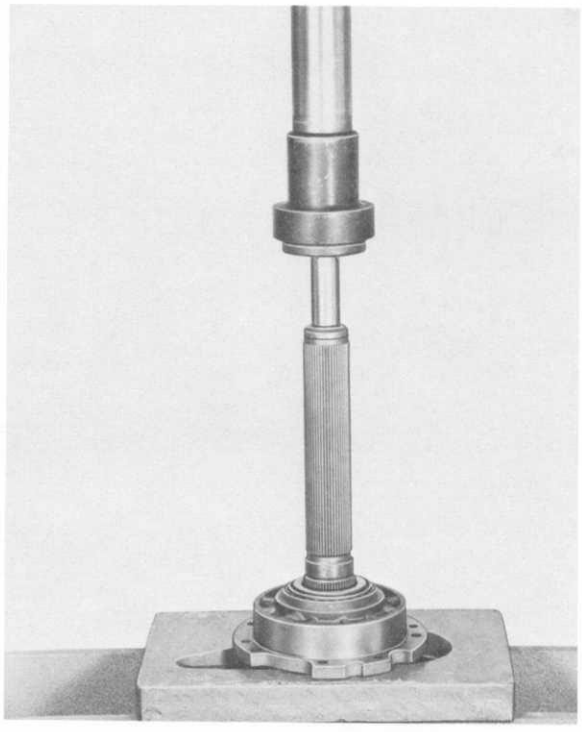


A – Standard U-steel (U 200) approx. 260 mm long

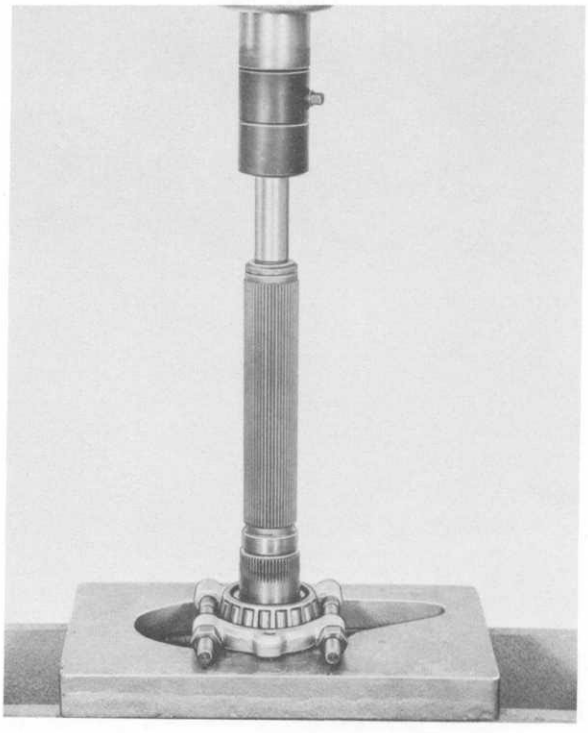
2. Unscrew lock nut with special tools 9142 and 9143.



3. Press off bearing cover with a suitable press tool.

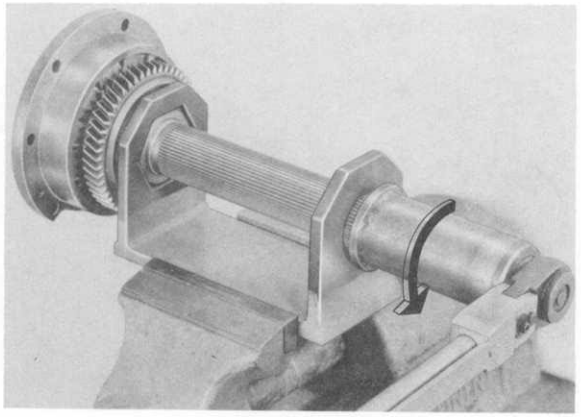


4. Press off large tapered roller bearing inner race with a suitable seperator.



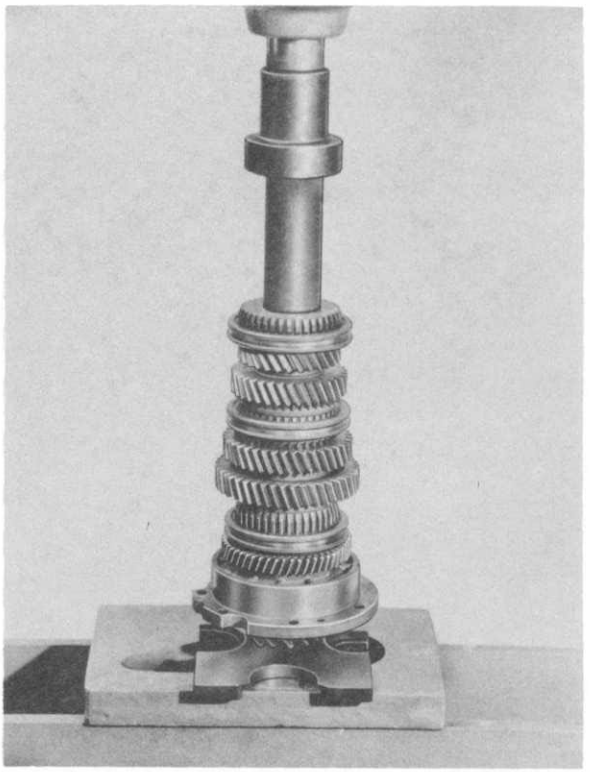
Assembling

1. Tighten lock nut to specified torque with Special Tools 9142 and 9143.



2. Lock lock nut by staking collar.

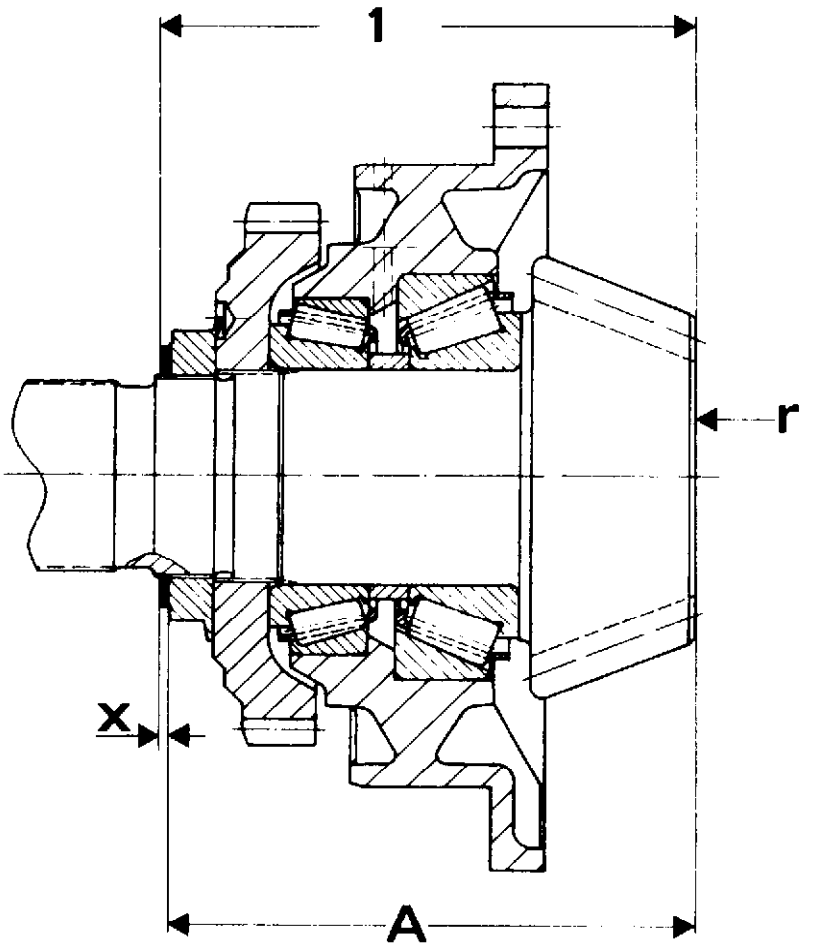
3. Press assembled gear set together with an appropriate piece of pipe (e.g. VW 519). Approx. 5 tons of pressure.



DETERMINING SHIM THICKNESS "X" OF PINION SHAFT LOCK NUT

Note

To guarantee perfect running of spur gears from pinion shaft and countershaft, shims must be used on the pinion shaft.



A – Distance from pinion head to bearing surface of lock nut

B – Distance A + r (pinion shaft deviation)

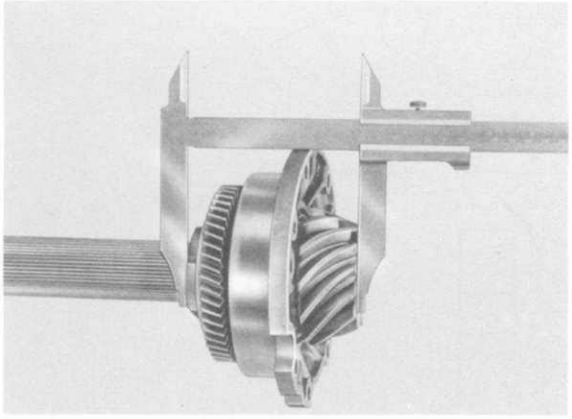
r – Pinion shaft deviation (e. g. N 12)

1 – Design specification

Transmission Type G 28.03	108.85 mm up to transm. no. 118 1092
	108.70 mm from transm. no. 118 1093
Transmission Type G 28.05	110.70 mm from transm. no. 110 5001

Measuring Procedures

1. Measure distance "A" with a sliding calipers.



2. Work out distance "B"
   B = A + r

3. Work out distance "X"
   (Type G 28.03 up to Transm. No. 118 1092)
   X = 108.85 – B

4. Work out distance "X"
   (Type G 28.03 from Transm. No. 118 1093)
   X = 108.70 – B

5. Work out distance "X"
   (Type G 28.05 from Transm. No. 110 5001)
   X = 110.70 – B

Example (Type G 28.03 up to Transm. No. 118 1092)

Distance "A" = 106.90
Distance "B" = A + r

	A	= 106.90 mm
+	r	= 0.12 mm
		107.02 mm

Distance "X" = 108.85 – B

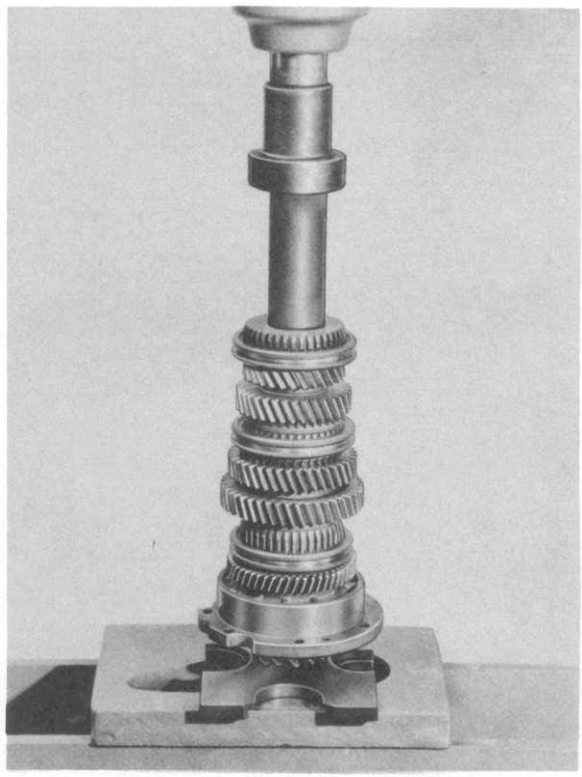
	108.85 mm
–	107.02 mm
	1.83 mm

DETERMINING SHIM THICKNESS "Y" AT GEAR SET END

Note

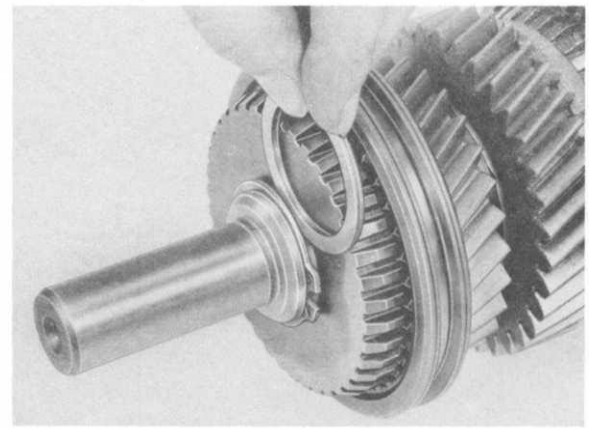
Since a circlip on the pinion shaft prevents axial movement, gear set must be adjusted to take up all play between gear set and circlip.

1. Press assembled gear set together with an appropriate piece of pipe (e.g. VW 519). Approx. 5 tons of pressure.



2. Install new circlip in groove.

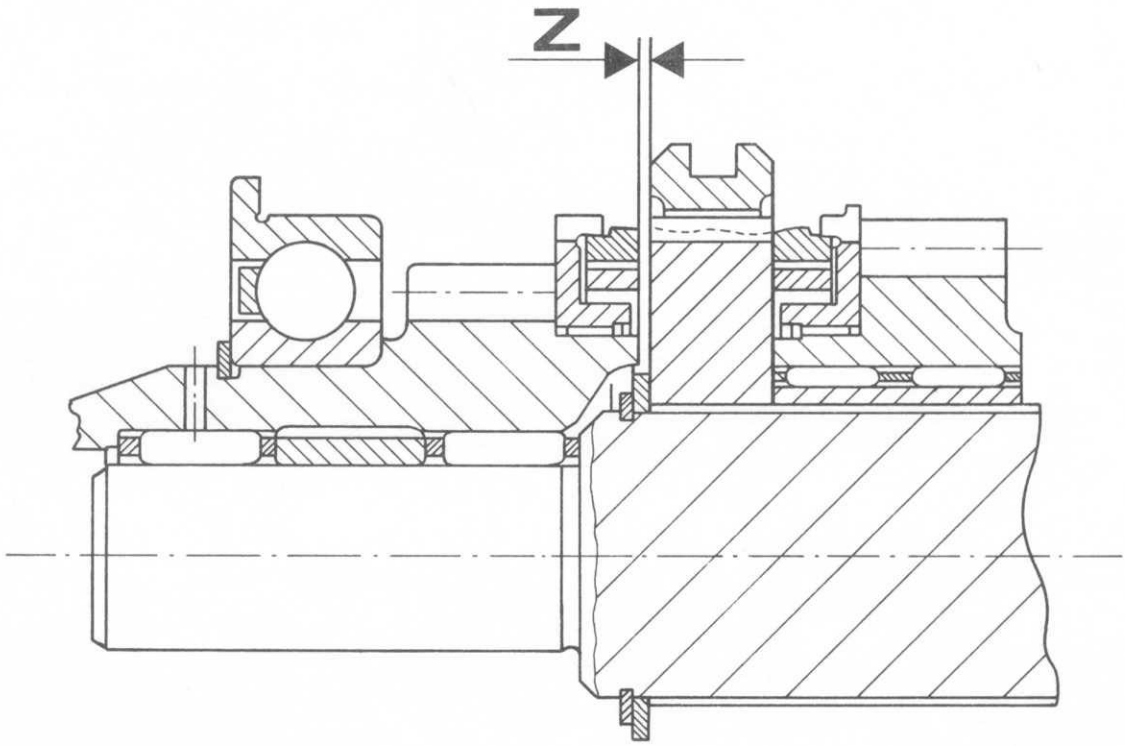
3. Install a shim with maximum thickness "Y" to take up all play.



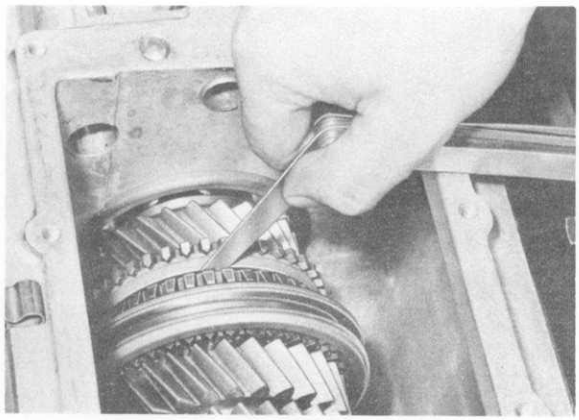
MEASURING DISTANCE "Z" BETWEEN INPUT SHAFT AND PINION SHAFT

Since the new Porsche synchronizing system does not employ circlips, it is important to make sure that distance "Z" is maintained between end face of input shaft and 4th/5th speed hub on pinion shaft.

Distance "Z" 0.2 to 0.3 mm up to transm. no. 118 1092
0.4 to 0.6 mm from transm. no. 118 1093



1. Measure distance "Z" between input shaft and hub with a feeler gage.



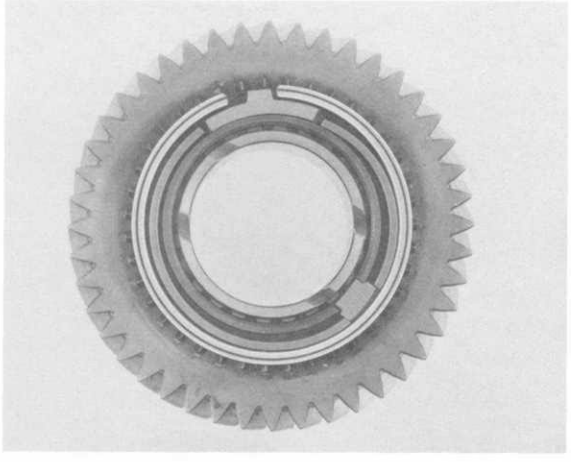
Note

Do not measure distance between synchronizer ring and shift sleeve or clutch body and shift sleeve.

2. If distance "Z" is not 0.2 to 0.3 mm or 0.4 to 0.6 mm, disassemble pinion shaft again and correct shim thickness "X". Of course, it will also be necessary to redetermine shim thickness "Y" on end of pinion shaft.

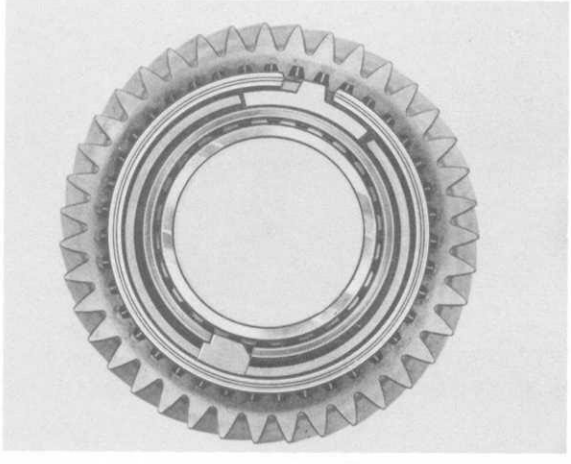
DISASSEMBLING AND ASSEMBLING SYNCHRONIZERS

The transmission of the 928 is equipped with modified Porsche synchronization for all forward speeds. One of the changes is the omission of circlips, which previously were used to keep the synchronizing ring thrust blocks and shift bands from moving axially. In the new system this is accomplished by a shift sleeve with beveled flanks.



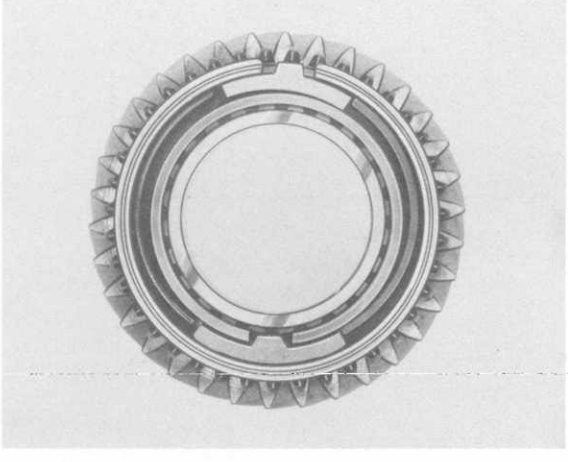
1st Gear

Synchronizer ring:	1 groove on face
Thrust block:	2 bevelled flanks
Shift band:	Asymmetrical shift band
Stop:	Two straight flanks
Installation Note:	Short side of shift band must be to right of thrust block



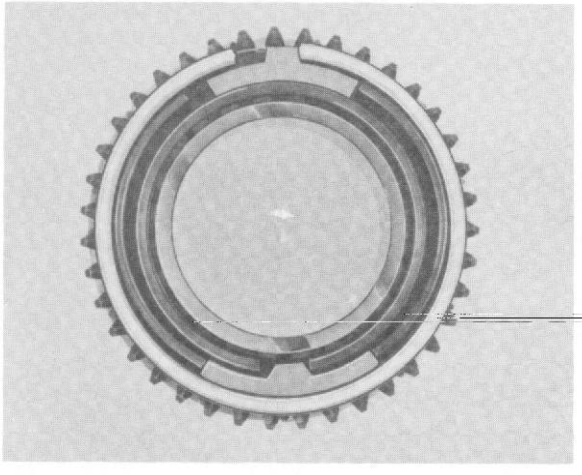
2nd Gear

Synchronizer ring:	2 grooves on face or red dot
Thrust block:	2 bevelled flanks
Shift band:	Symmetrical shift band
Stop:	1 straight, 1 bevelled flank
Installation Note:	Bevelled side of stop must face to right as seen from top view



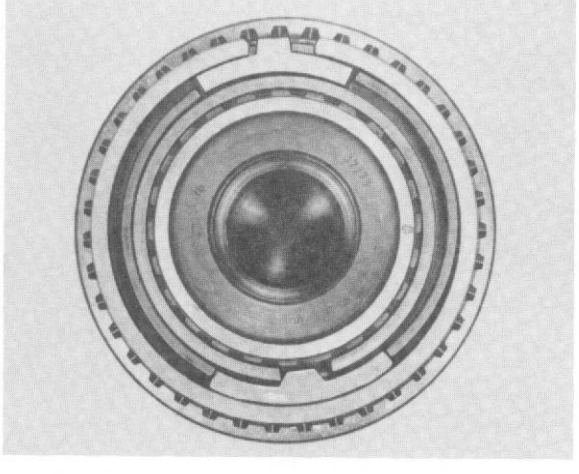
3rd Gear

Synchronizer ring:	2 grooves on face or red dot
Thrust block:	2 bevelled flanks
Shift band:	2 separate shift bands
Stop:	Bevelled flanks



4th Gear:

Synchronizer ring:	No grooves
Thrust block:	2 bevelled flanks
Shift band:	2 separate shift bands
Stop:	Bevelled flanks
Note:	See below

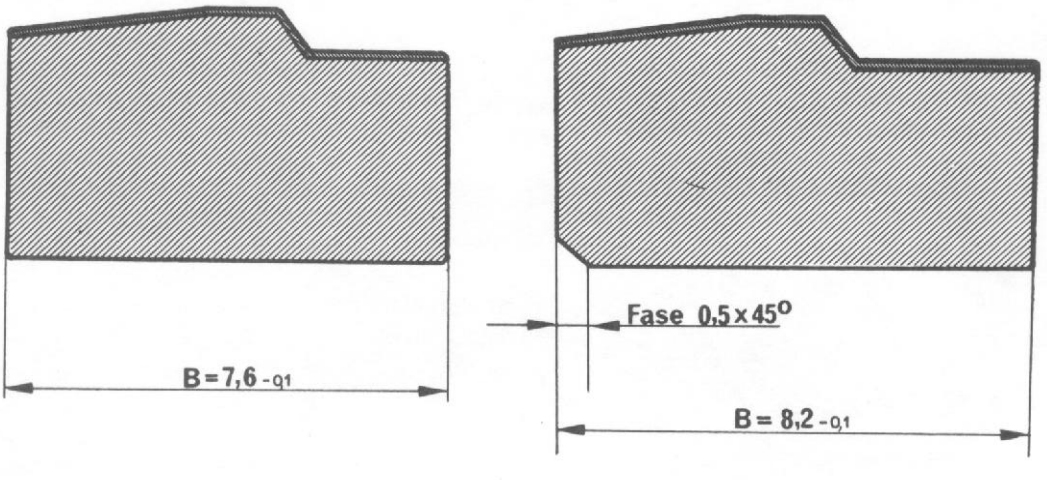


5th Gear:

Synchronizer ring:	No grooves
Thrust block:	2 bevelled flanks
Shift band:	2 separate shift bands
Stop:	Bevelled flanks
Note:	See below

Fifth gear synchronizer ring is identical with fourth gear synchronizer ring up to Transmission No. 118 1092.

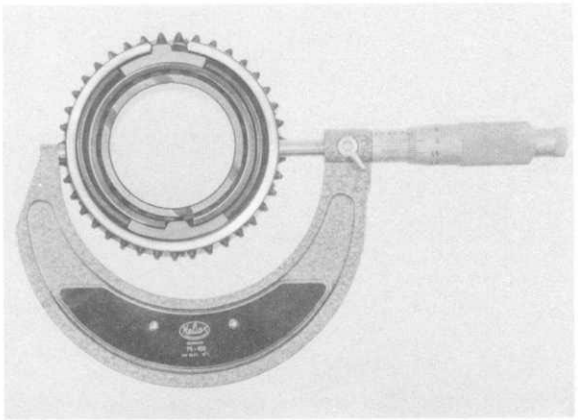
Fifth gear synchronizer ring cannot be used on 4th gear wheel beginning with Transmission No. 118 1093.



CHECKING SYNCHRONIZATION

Check installed diameter of synchronization rings to guarantee perfect synchronization.

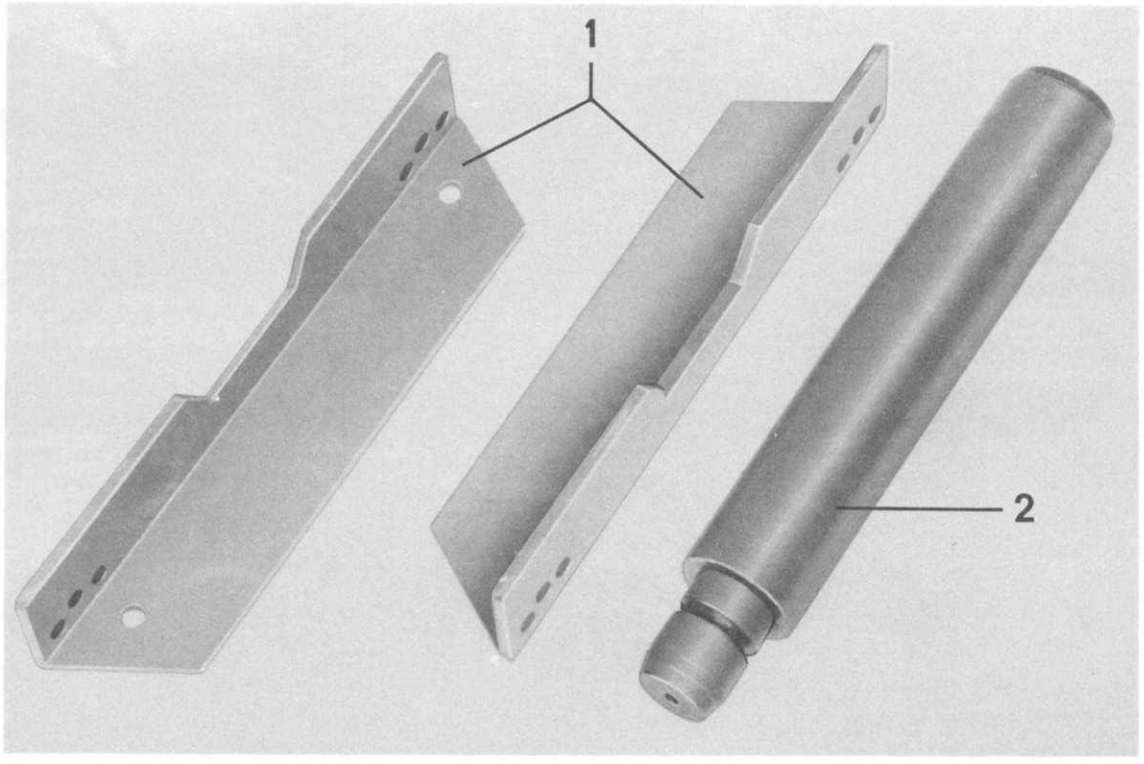
Check installed diameter of installed synchronization ring with a micrometer. Micrometer must be applied at highest point of synchronization ring.



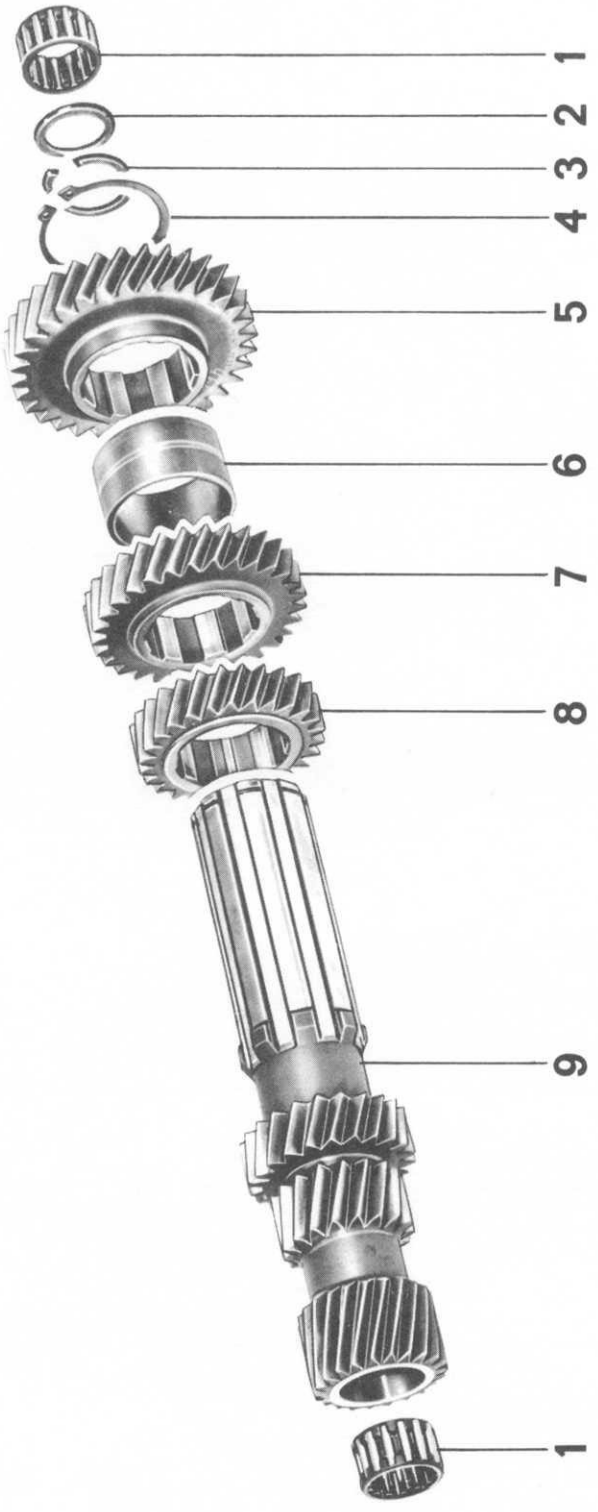
Installed Diameter:

1st through 5th speed = $86,0 \pm 0,24$ mm

TOOLS



No.	Description	Special Tool	Remarks
1	Support rail	VW 457	
2	Mandrel	VW 407	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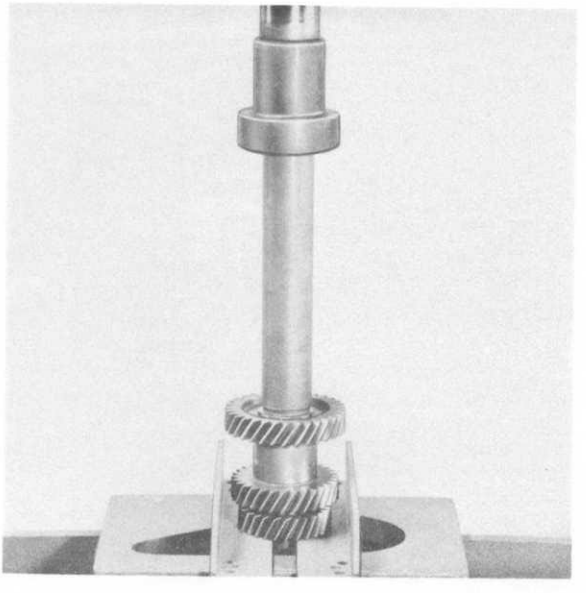
No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
1	Needle bearing	2			
2	Washer	1			Only for transm. type 28.05
3	Circlip	1			
4	Circlip	1			
5	5th gear	1	Press off with VW 407 and VW 457	Replace only in pairs (with input shaft), large shoulder faces spacer	
6	Spacer	1			
7	4th gear	1	Press off with VW 407 and VW 457	Replace only in pairs, large shoulder faces 3rd gear	
8	3rd gear	1	Press off with VW 407 and VW 457	Replace only in pairs, small shoulder faces stop	
9	Countershaft hub	1			

DISASSEMBLING AND ASSEMBLING COUNTERSHAFT HUB/GEARS

Disassembling

1. Remove circlip.

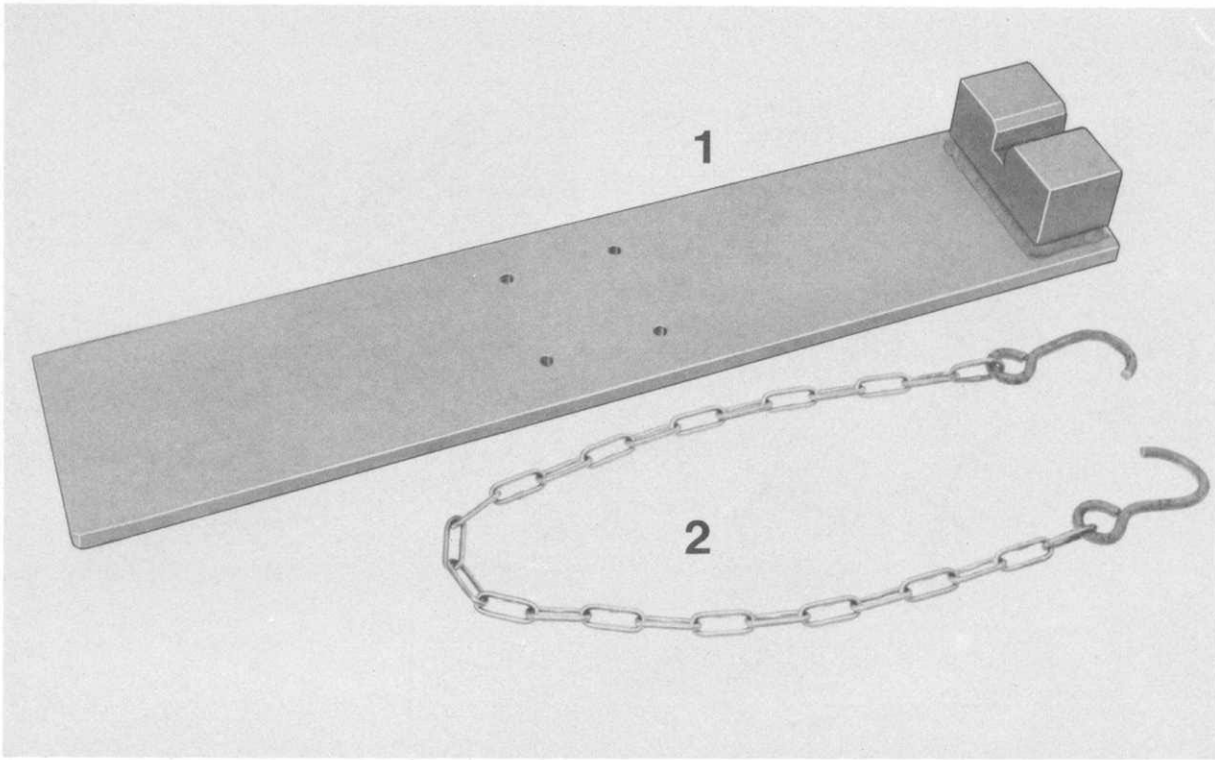
2. Press off gears (3rd, 4th and 5th) with a suitable mandrel (e.g. VW 407) and Special Tool VW 457



Assembling

Heat gear to approx. 100° C/212° F and install to correct position.

TOOLS



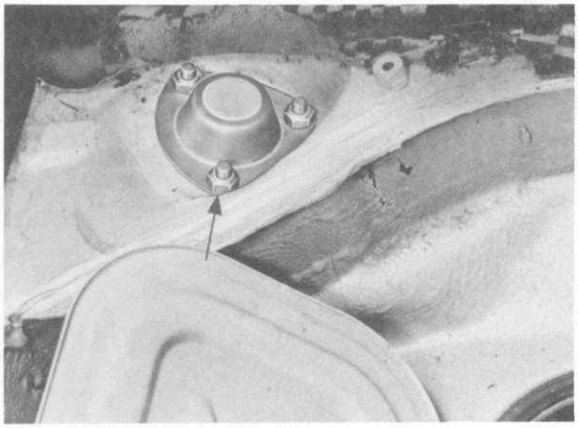
No.	Description	Special Tool	Remarks
1	Removal plate	9163	
2	Chain	9164	

REMOVING AND INSTALLING AUTOMATIC TRANSMISSION

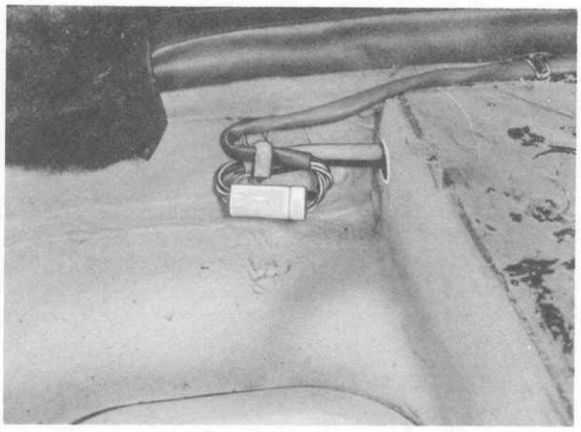
Removing

1. Remove battery.

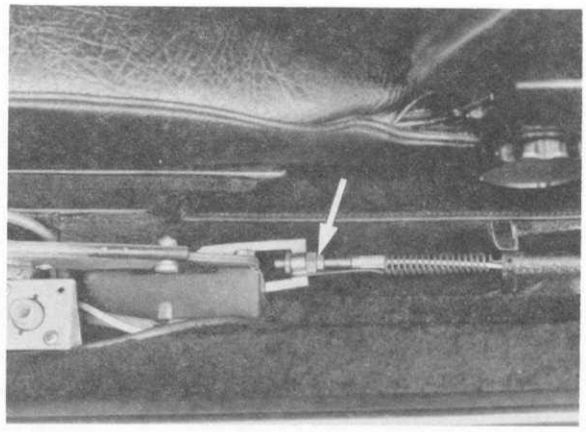
2. Unscrew self-locking hexagon nuts from spring struts in trunk.



3. Disconnect multiple plug in spare wheel well and pull out toward rear.

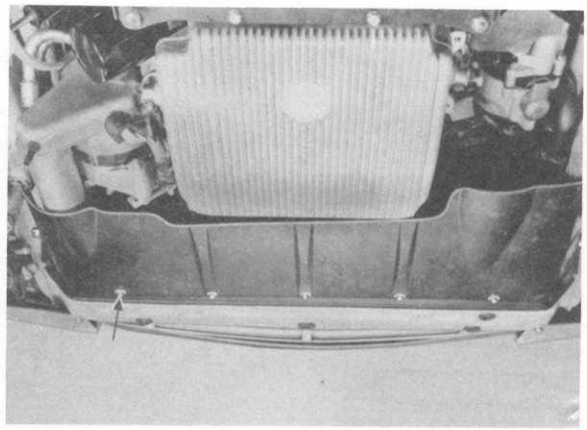


4. Detach parking brake cable and lock.

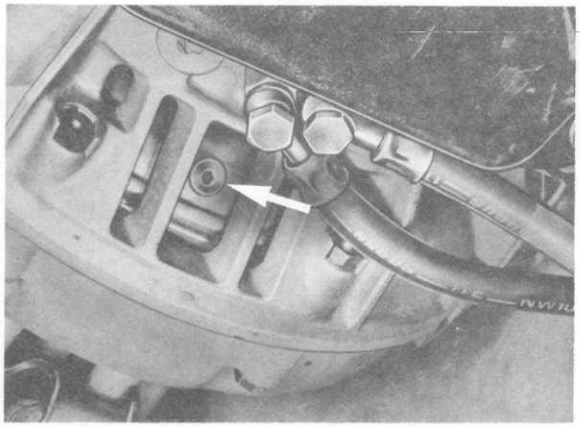


5. Remove rear wheels.

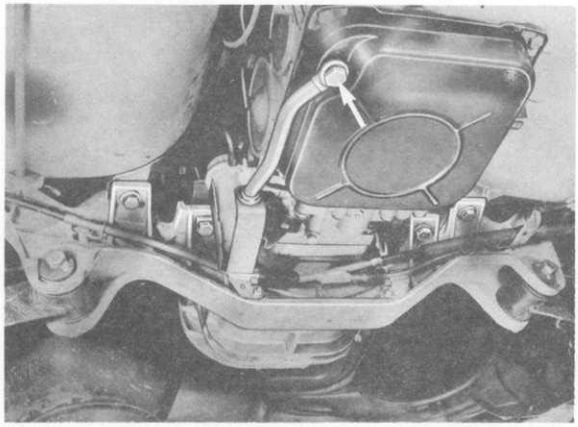
6. Unscrew air duct.



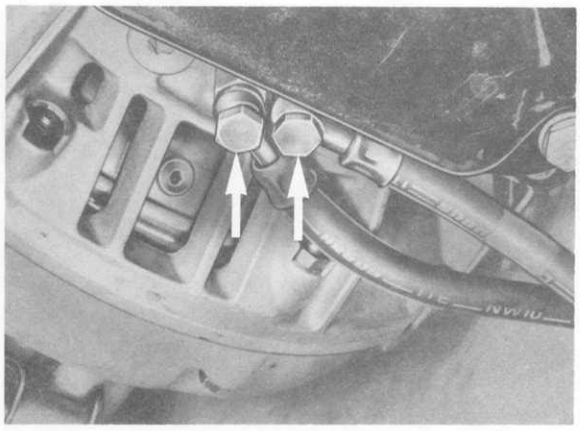
7. Turn crankshaft until converter drain plug can be seen. Now unscrew drain plug and drain ATF.



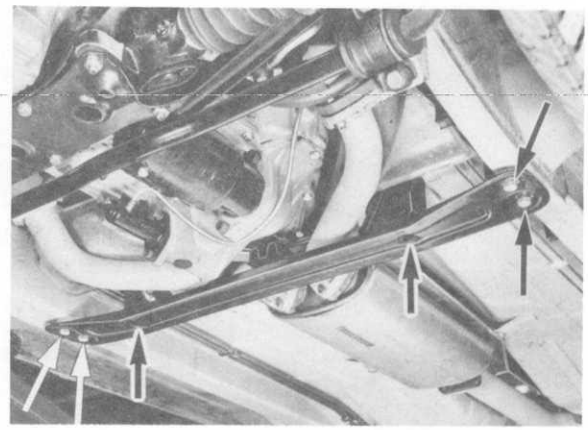
8. Unscrew oil filler tube from oil pan and drain ATF.



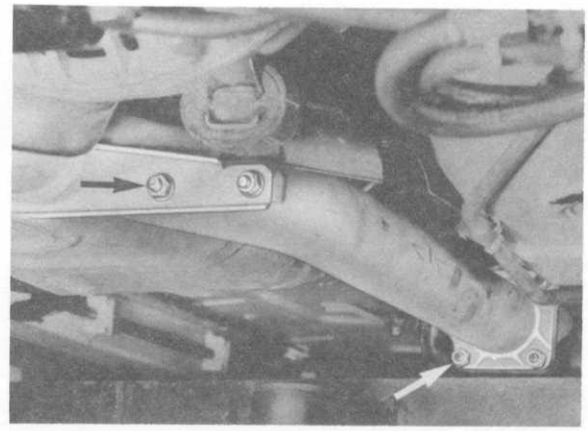
9. Unscrew feed and return lines for ATF cooler.

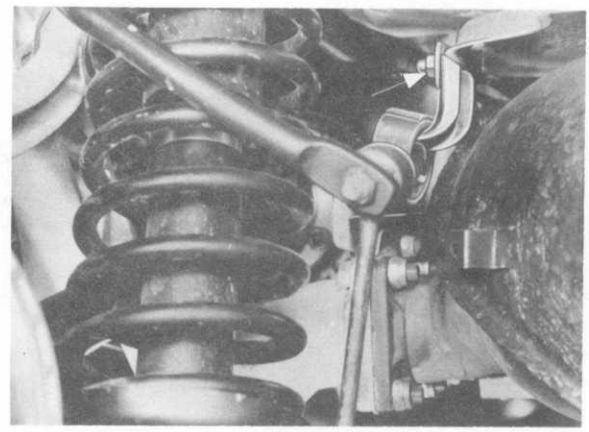


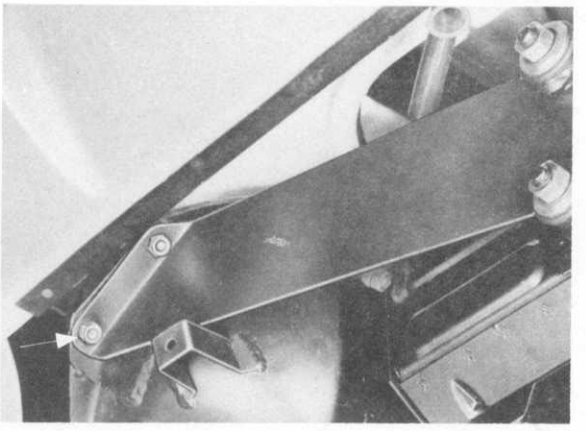
10. Remove cross member.



11. Remove exhaust system from primary muffler.



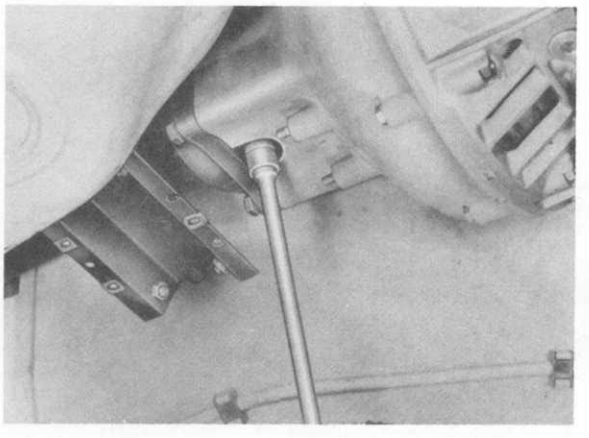




12. Remove exhaust system guards.

13. Remove battery console.

14. Remove rubber cap from sight hole in central pipe and turn crankshaft to position double clamp that capscrew can be removed.

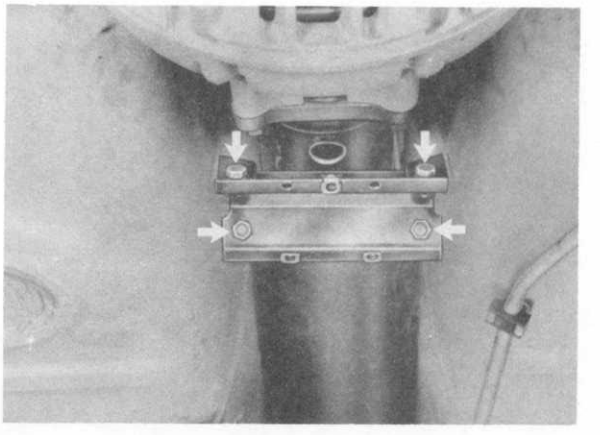


15. Detach brake calipers and suspend that brake hoses are without tension.

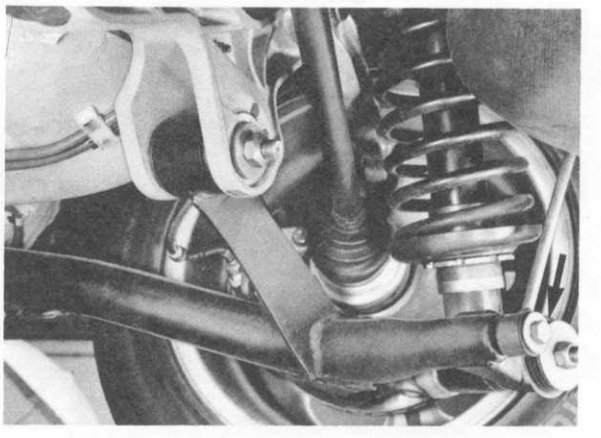
16. Detach axle shafts from transmission and suspend in horizontal position.

17. Detach holder for parking brake cable and pull out cable toward rear.

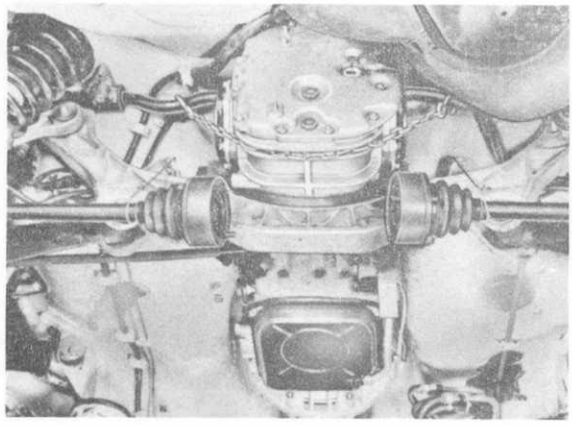
18. Remove rear reinforcement plate.



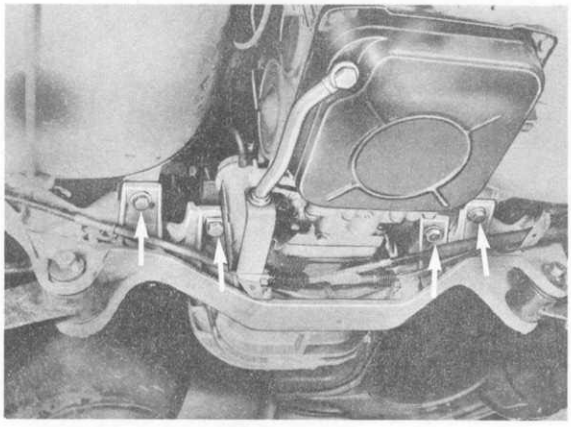
19. Detach stabilizer from lower control arm.



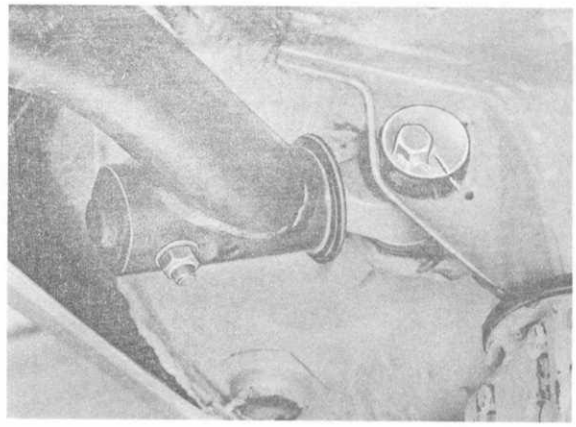
20. Support transmission on stabilizer bar with Special Tool 9164.



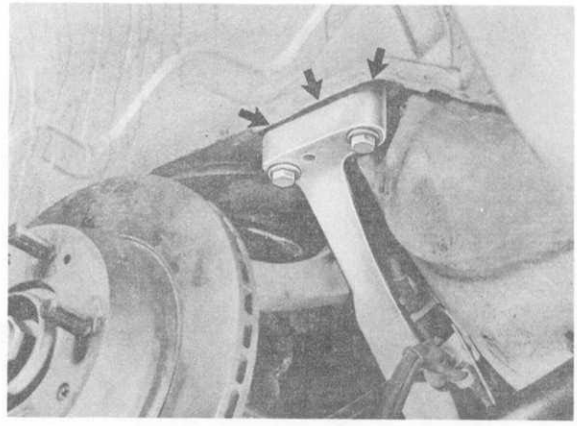
21. Remove two bolts from transmission mounts and two bolts holding rear axle cross member to frame.



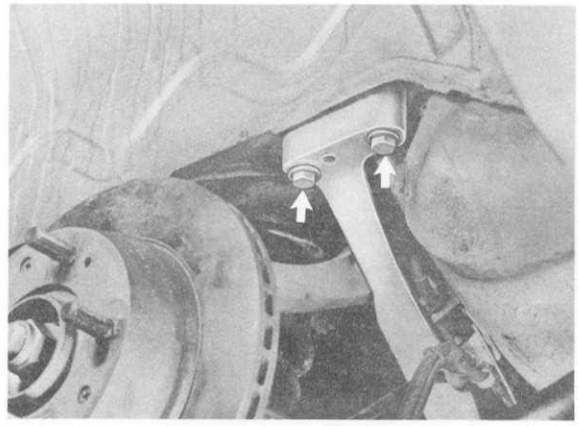
22. Mark position of toe eccentric bolts for reinstallation and remove eccentric bolts.



23. Mark position of rear axle cross member for reinstallation.



24. Place jack underneath rear axle cross member and remove mounting bolts from cross member.



25. Lower rear axle carefully and be careful that spring struts, cross member and bearing brackets do not tilt.

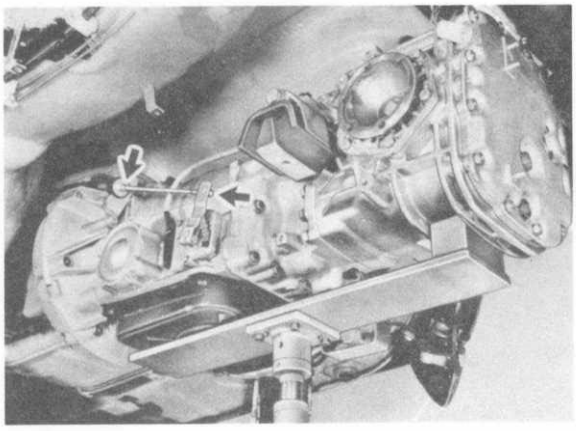
Note

A second person is required for removal of rear axle.

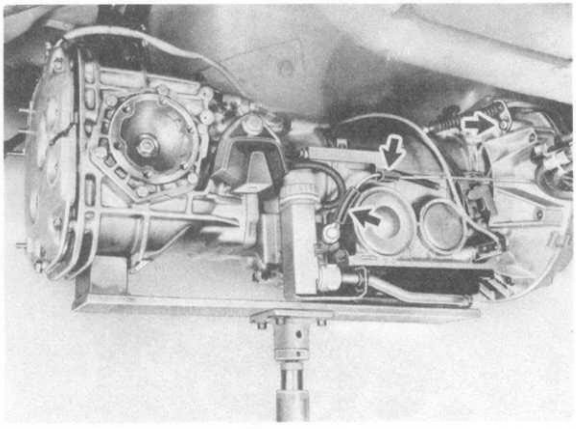
26. Mount Special Tool 9163 on universal transmission lift and place underneath transmission.

27. Lift transmission and detach Special Tool 9164.

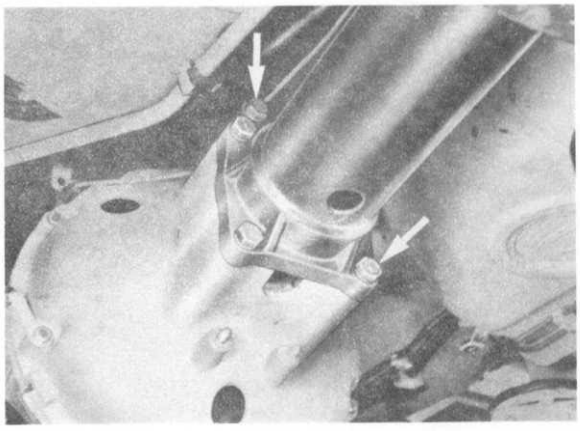
28. Lower transmission a little, detach selector lever cable and disconnect cable sleeve.



29. Pull off vacuum line from vacuum modulator and press out of holders. Detach transmission cable and remove holder for guide tube.

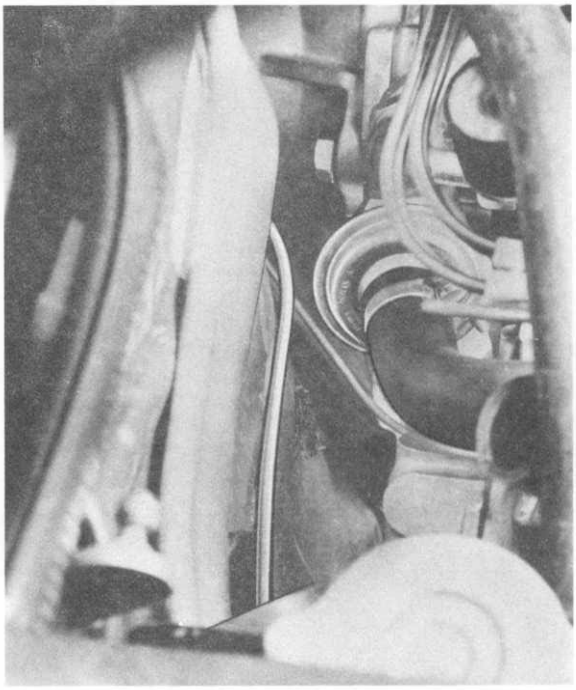


30. Remove six bolts of central tube. This requires lowering transmission as fas as possible.



Note

When lowering transmission, be careful that check valve for air injection does not damage brake line.

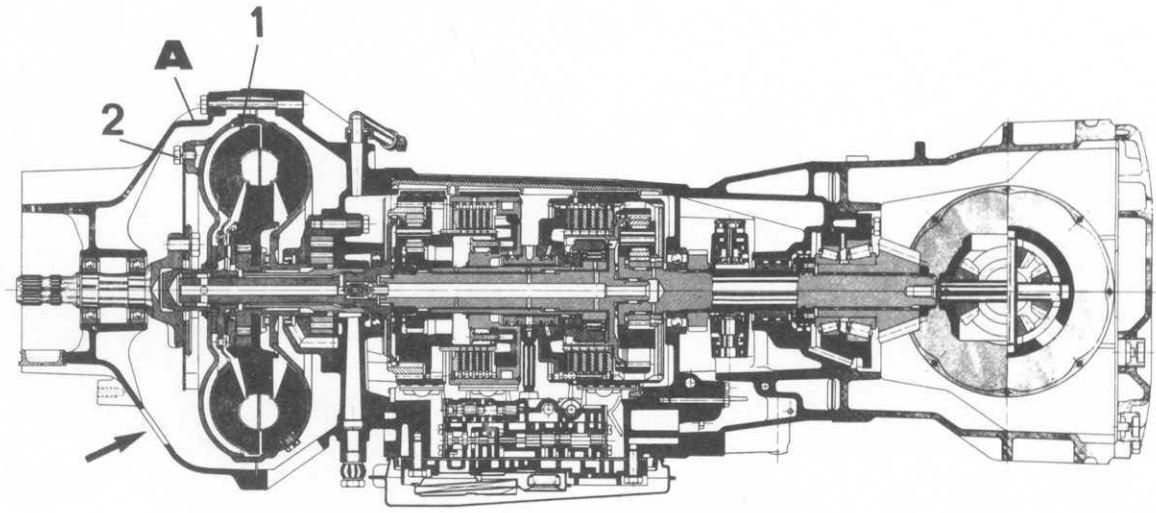


31. Pull transmission out of coupling splines and lower carefully.

FRONT CONVERTER HOUSING, EXCHANGING

Note

Before installing new automatic transmission/final drive assembly into vehicle, front converter housings must be exchanged between new and old units. This is to maintain factory adjustment between drive shaft coupling and transmission input shaft.



Perform following steps:

1. Loosen 6 bolts (2) attaching drive plate to torque converter (1) through opening (arrow).

2. Remove 8 bolts holding front converter housing (A).

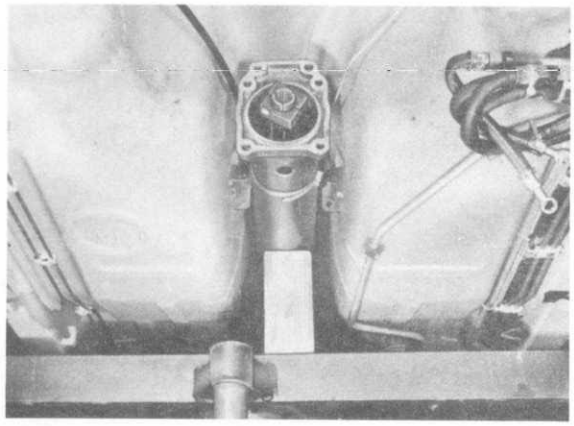
3. Exchange front converter housings only.

4. Tighten converter housing bolts to 1.9 - 2.3 mkg (14 - 17 ft lb).

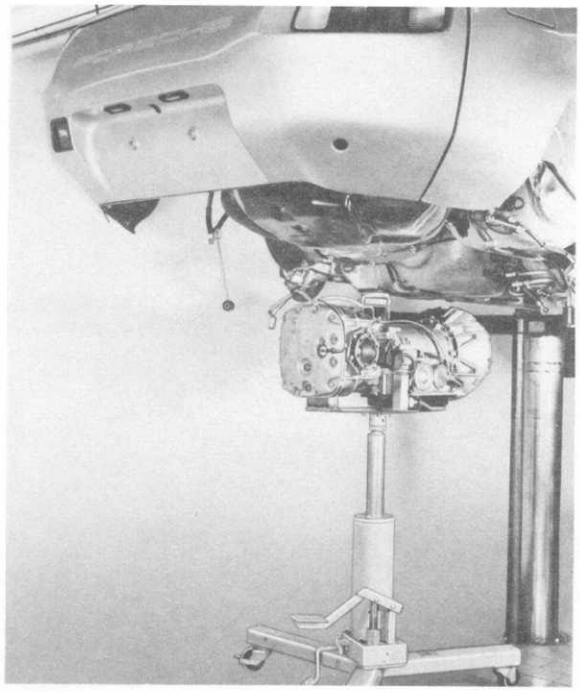
5. Tighten drive plate bolts to 3.2 - 3.9 mkg (23 - 28 ft lb).

Installing

1. Move central tube to installed position with a suitable piece of wood. Install rear reinforcement plate for car lifts without a center pillar.



2. Lift transmission with universal transmission lift and Special Tool 9163, and push it into splines of coupling.



3. Install accessible bolts on central tube and tighten hand tight.

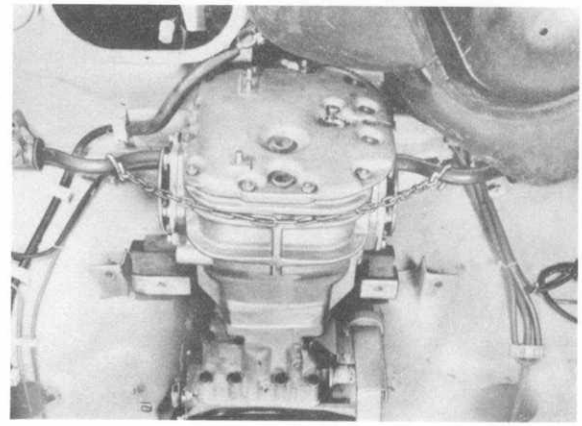
4. Lift transmission and remove piece of wood from central tube.

5. Lower transmission until all bolts can be installed on central tube flange.

6. Tighten six mounting bolts to specified torque.

7. Lift transmission again so that selector lever and transmission cables can be installed without tension.

8. Lift transmission and hold in installed position with Special Tool 9164.

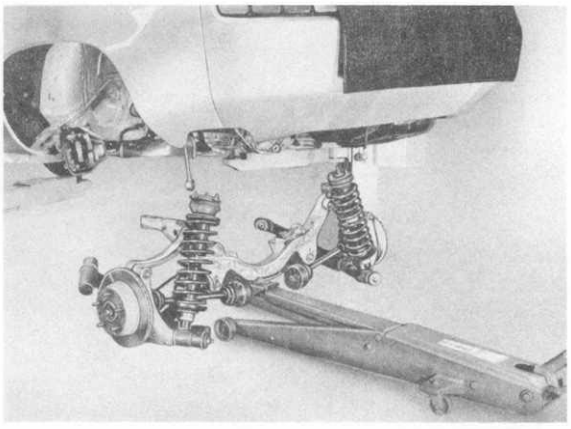


9. Push up wire harness through opening in spare wheel well and install rubber grommet.

10. Lower universal transmission lift.

11. Position rear axle and tighten all bolts except for the two transmission mount bolts.

Note:
A second person is required to install rear axle.



12. Lift transmission and detach Special Tool 9164.

13. Mount transmission on cross member and tighten all bolts to specified torque.

Note:
Watch marks for correct reinstallation.

REMOVING AND INSTALLING SELECTOR LEVER CABLE

Removing

Note

To remove the selector lever cable it will be necessary to remove muffler and rear shield. Further the rear axle has to be removed up to the control arm mountings and lowered (see page 37 - 2, "Removing and Installing Transmission").

1. Unscrew ground strap of battery.

2. Remove selector lever grip and take off rubber cover.

3. Remove cover frame (see page 37 - 10 a).

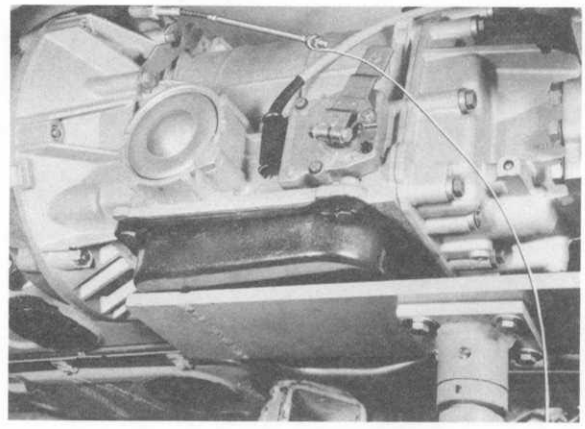
4. Pull bulb holder carrier out of retaining clips.

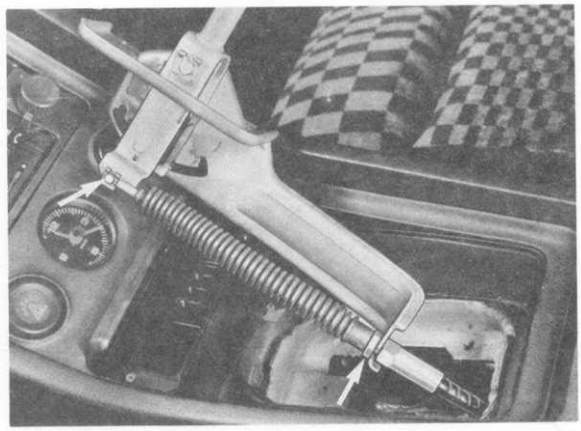
5. Mark location of selector lever base for reinstallation and remove mounting screws.

6. Disconnect selector lever cable at transmission and detach cable sleeve at holder.

7. Take off ball head, hexagon nut and mounting parts.

8. Mount wire on cable and pull out selector lever base by applying a jerk forwards. Lower central tube and transmission slightly for this purpose.





9. Remove cable circlip from selector lever and detach cable sleeve at selector lever base.

Installing

1. Attach cable sleeve on selector lever base, tightening the hexagon nut carefully.

2. Push cable on to selector lever pin and install circlip.

3. Mount wire, pulled forward during removal, on cable and pull cable toward rear.

Note

Selector lever cable must be routed underneath a metal tab, which is mounted on converter housing with a hexagon screw.

4. Install selector lever base (watching mark) and tighten the mounting screws.

5. Install cover frame and place selector lever at "N".

Note

If light opening of gate and letter "N" are not exactly opposite each other in cover frame, remove cover frame again and reposition selector lever base in slots.

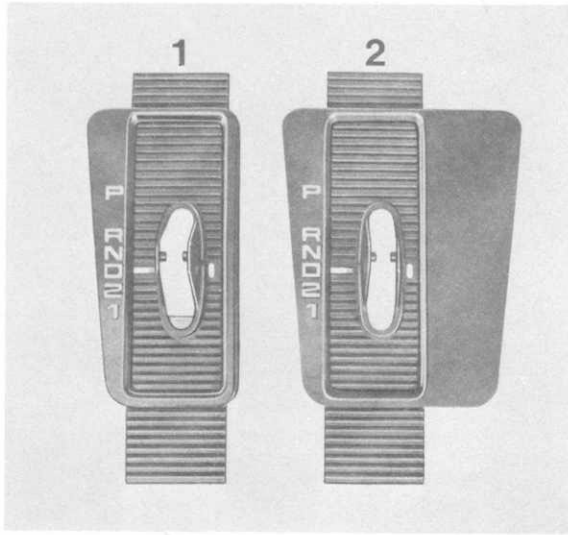
6. Adjust selector lever cable and check adjustment (see pages 37 - 11 to 37 - 12).

REMOVING AND INSTALLING SELECTOR LEVER COVER FRAME

Note

At the beginning of standard production cover frames without locks were used. These frames can be pried out of the center console with a suitable screwdriver.

Removal of the new version with locks, on the other hand, requires unlocking both locking bars.

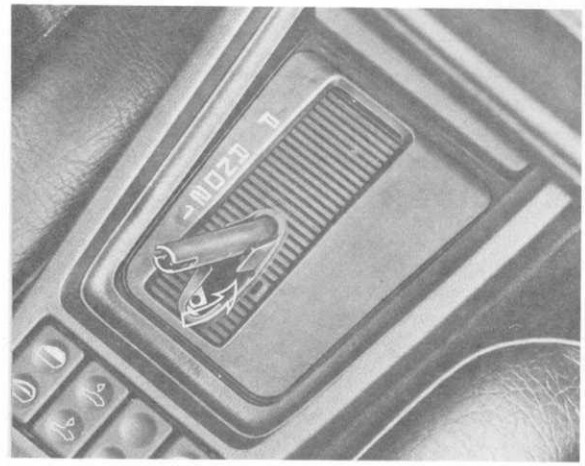


1 - Cover frame without lock (old version)
2 - Cover frame with lock (new version)

Removing

1. Remove selector lever handle and take off rubber cover.

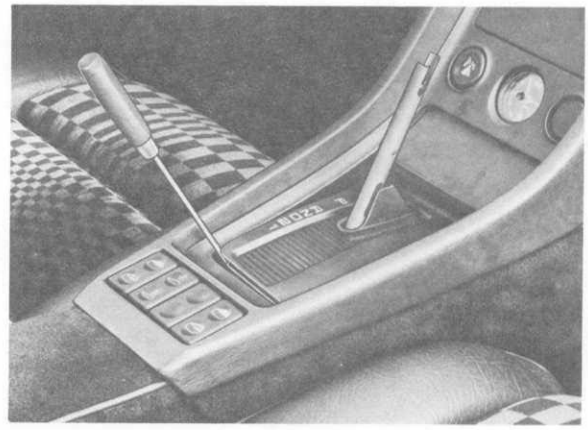
2. Move selector lever to position "1" and push rear locking bar forward against stop with a suitable tool (e. g. scribe).



3. Move selector lever to position "R", disconnect gate and push forward as far as possible.

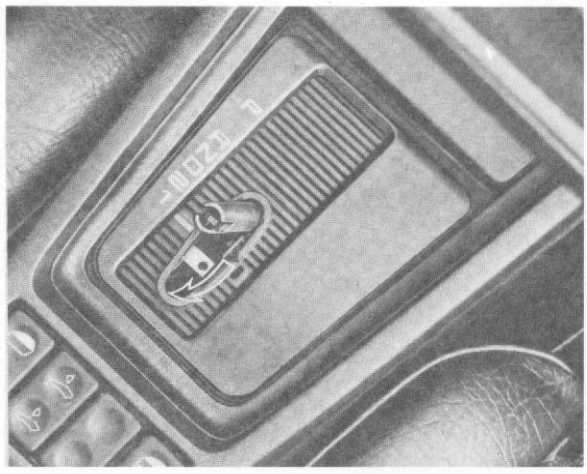
4. Push front locking bar forward against stop with a suitable tool (e. g. scribe).

5. Move selector lever to position "P" and press out cover frame carefully with a suitable screwdriver applied at the left rear corner.



6. Move selector lever to position "N" and remove frame inclined toward rear.

Installing



1. Move selector lever to position "2".

2. Push gate in frame forward all the way.

3. Install cover frame in correct position and move selector lever to position "P".

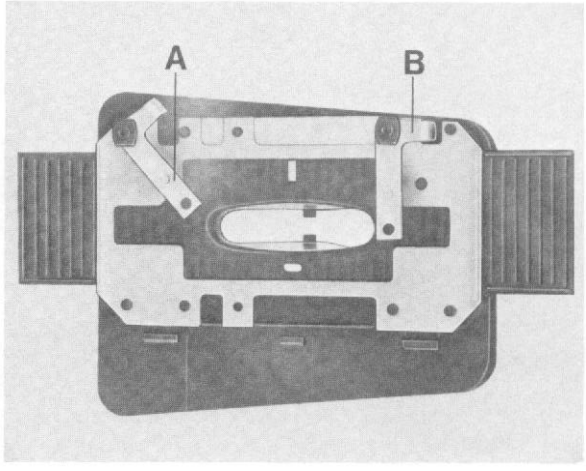
4. Push cover frame forward and move right side to correct installed position (this is done by lifting left rear corner slightly and pushing down on right side).

5. Push down on left rear corner until frame fits in center console correctly.

6. Move selector lever between "R" and "P", connect gate on selector lever and push forward.

7. Push front locking bar toward rear until it engages.

8. Move selector lever to position "2" and push rear locking bar toward rear until it engages.

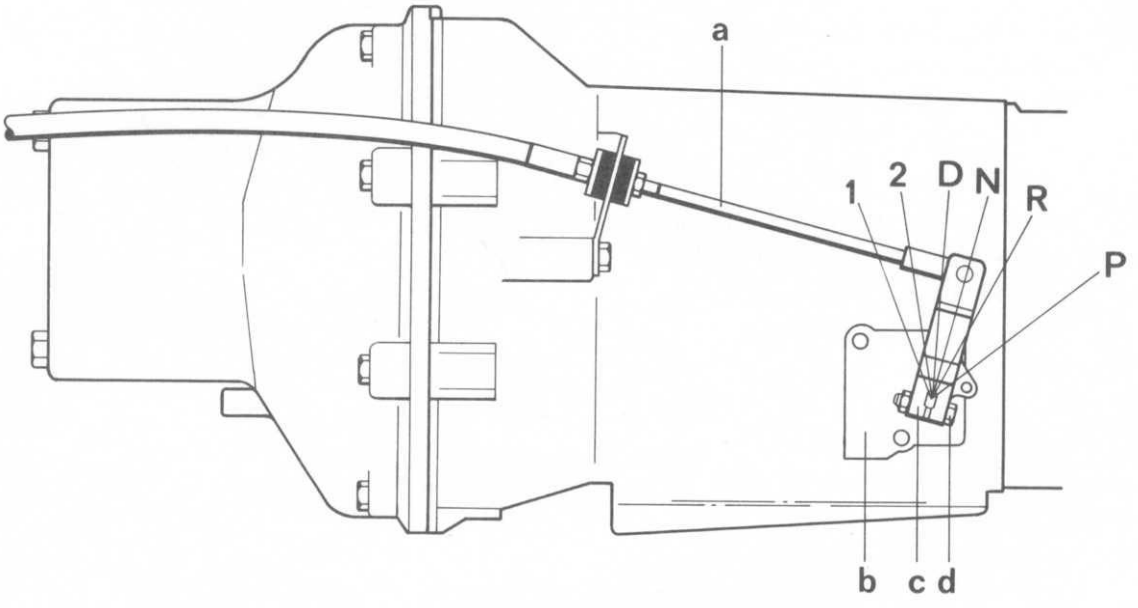


A - Locked
B - Unlocked

9. Attach gate in selector lever, install rubber cover in correct position and install selector lever handle.

10. Move selector lever in and out of all positions and make sure that cover frame fits correctly.

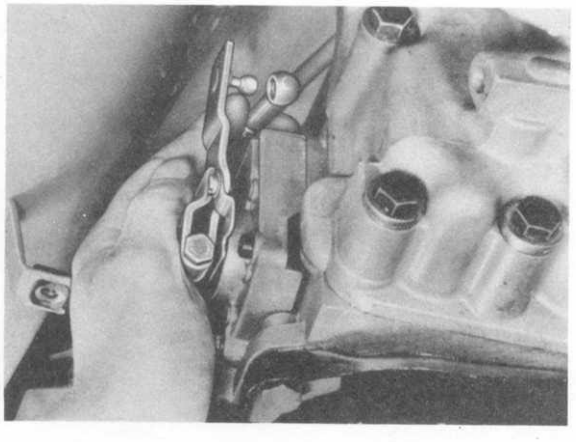
ADJUSTING SELECTOR CABLE



1. Place selector lever in N.

2. Detach cable from operating lever (on trans.).

3. Place selector operating lever (on trans.) in N position.



4. Adjust cable so that ball socket attaches to operating lever without tension.

CHECKING SELECTOR CABLE AND BACKUP LIGHT SWITCH OPERATION

Note
Correct adjustment of selector lever and selector cable is absolutely necessary for proper operation of transmission.

1. Place selector lever in N. Apply parking and foot brakes. Start engine and idle at about 1000 - 1200 rpm.

2. Move lever to R. Engine speed must drop as gear engages. Backup lights must light.

3. Move lever to P. Engine speed should increase as reverse gear disengages.

4. Move lever to R. Engine speed must drop as gear engages.

5. Move lever to N. Engine speed should increase as reverse gear disengages.

6. Move lever to D. Engine speed should drop as gear engages.

7. Move lever to P. Turn off engine.

8. Adjust selector cable if necessary.

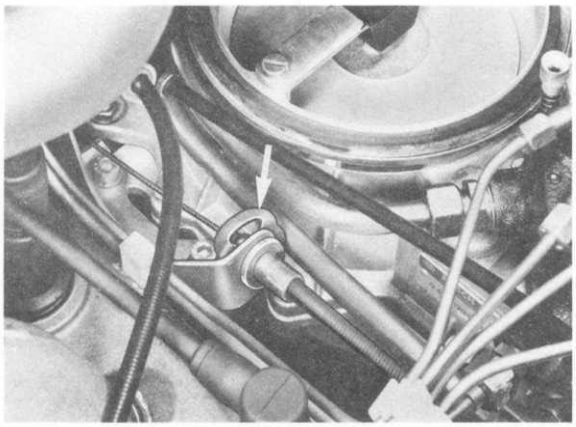
REMOVING AND INSTALLING ACCELERATOR CABLE

Removing

1. Detach cable at transmission lever. Unscrew ball socket and locknut. Pull off rubber grommet.

2. Detach cable at throttle valve lever.

3. Remove circlip for cable sleeve and pull cable out forward, being careful not to bend cable.



Installing

Adjust cable (see page 37 - 14).

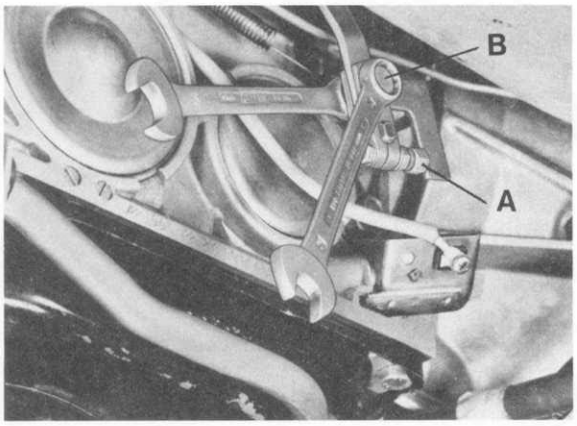
ADJUSTING THROTTLE PRESSURE CABLE

1. Detach cable at trans. lever.

2. Adjust lever with adjusting bolt A after loosening clamping bolt B so that cable can be attached without tension or free play.

Caution

If clamping bolt B is loosened for adjustments, under no circumstances should bolt be tightened against stop inside transmission (damages operating lever). Use second wrench.



A - adjusting bolt
B - clamping bolt

Note

Ball socket of cable must be screwed on threads approx. 6 mm (1/4 in.).

When cable is adjusted correctly, trans. lever travel will be approx. 33 mm (1 5/16 in.) as accelerator pedal is depressed from idle to full throttle (not kickdown).

CHECKING NEUTRAL/PARK STARTING SWITCH

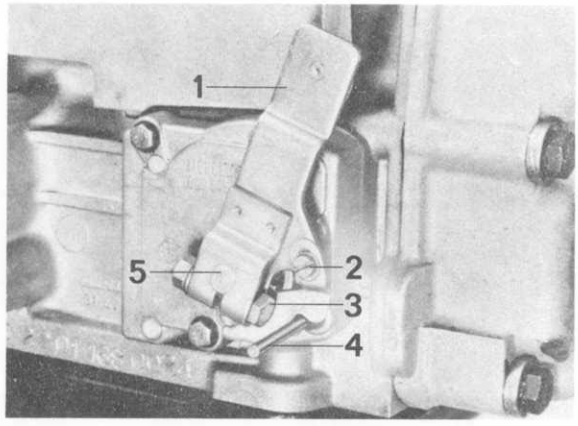
Starter should only operate in P or N positions with properly adjusted switch.

ADJUSTING NEUTRAL/PARK STARTING SWITCH

1. Move selector lever to position N.

2. Loosen adjusting screw.

3. Insert 4 mm dia. pin from US 8030 tool set through drive dog into locating hole in case.



1 = operating lever
2 = adjusting screw
3 = clamping bolt
4 = locating pin (from US 8030 tool set)
5 = shaft

4. Tighten adjusting screw. Remove locating pin.

5. Check whether engine can be started with selector lever in N or P positions.

REMOVING NEUTRAL/PARK STARTING SWITCH

1. Place selector lever in N position.

2. Disconnect electrical plug.

3. Remove clamping bolt 3 and pull operating lever 1 (with attached driving dog) off shaft 5.

4. Remove switch mounting bolts and withdraw switch.

INSTALLING NEUTRAL/PARK STARTING SWITCH

1. Install switch and mounting bolts for same.

2. Place operating lever 1 (with attached driving dog) onto shaft 5.

3. Insert lugs of driving dog into switch.

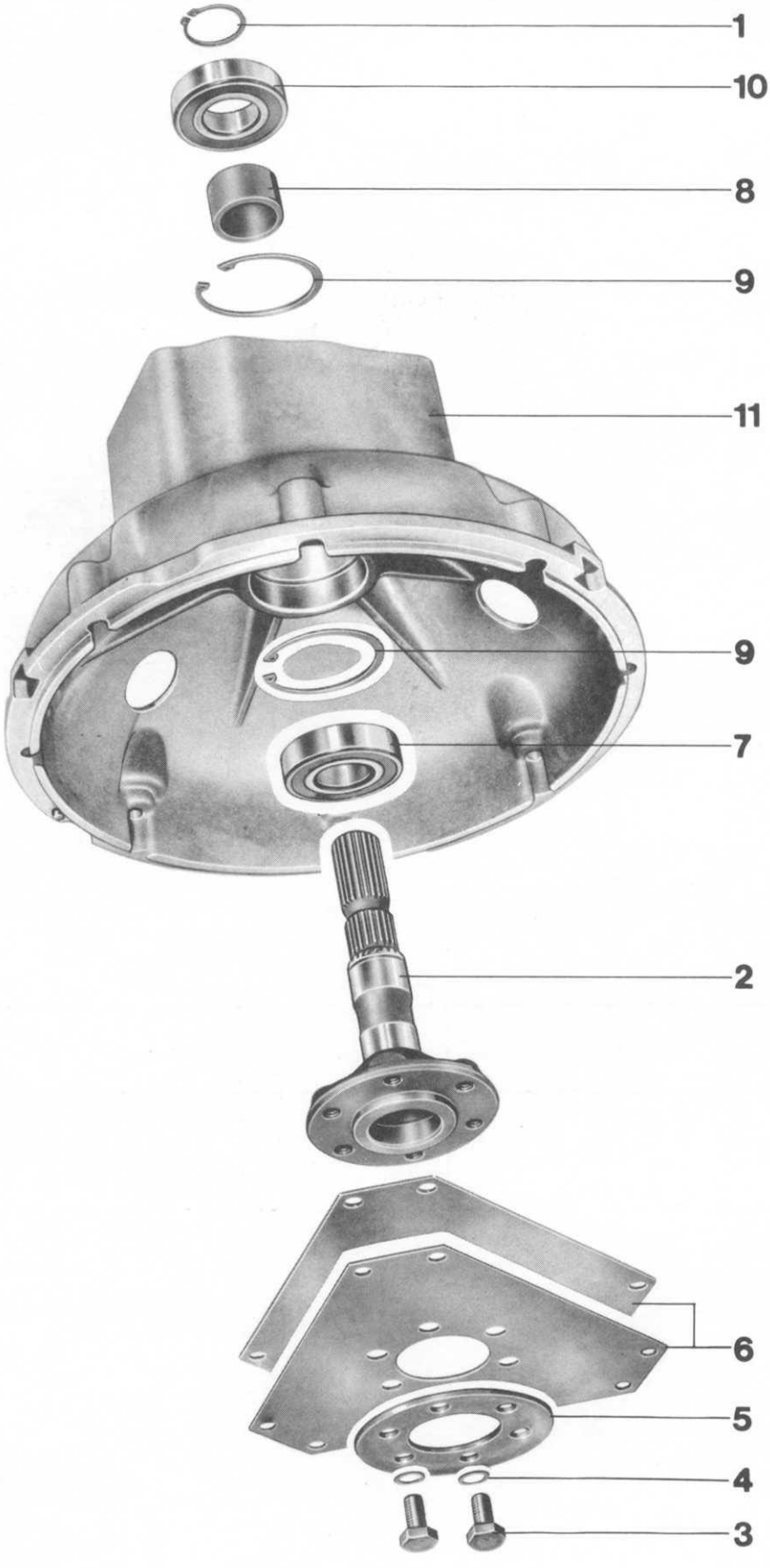
4. Insert clamping bolt 3 into operating lever 1 and tighten nut.

5. Connect electrical plug.

6. Adjust switch.

TOOLS

No.	Description	Special Tool	Remarks
1	Take-up rail	VW 457	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No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
1	Circlip	1			
2	Input flange	1			If replaced, readjust connection between fly-wheel and drive plate (page 39 - 51)
3	Bolt	6		Torque: 54 – 64 Nm (39 – 46 ftlb)	
4	Lockwasher	6		Replace. Position correctly	
5	Lockplate	1			
6	Drive plate	2			See below
7	Grooved ball bearing	1	Press from output flange with VW 457	Replace. Install in heated housing together with output flange	
8	Spacer	1			
9	Circlip	1			
10	Grooved ball bearing	1	Drive out with suitable mandrel	Replace. Heat housing to approx. 120 °C and press in with a suitable piece of pipe. Support input flange	
11	Front converter housing	1			If replaced, readjust connection between fly-wheel and drive plate (page 39 - 51)

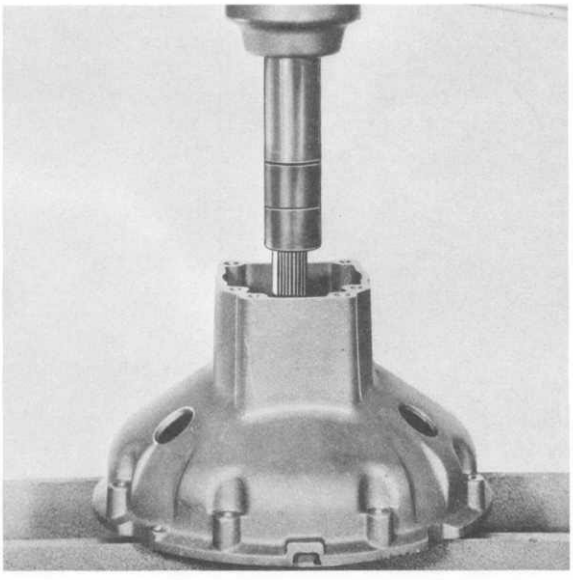
Note

Two drive plates (each 1.5 mm thick) have replaced the single drive plate (2.0 mm thick).
In conjunction with this change the input flange (Pos. 2) also had to be modified.
Since spare parts of former version are no longer available, when repairing cars with only one drive plate they must be changed to the new version.

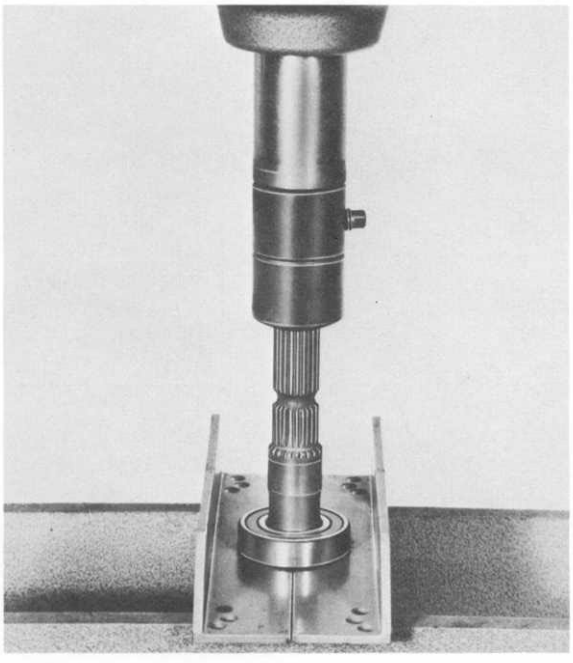
DISASSEMBLING AND ASSEMBLING FRONT CONVERTER HOUSING

Disassembling

1. Remove circlip and press out drive flange.



2. Press grooved ball bearing off of drive flange with Special Tool VW 457.



Assembling

1. Install both circlips in converter housing.

2. Press grooved ball bearing on drive flange against shoulder with a suitable piece of pipe applied on bearing inner race.

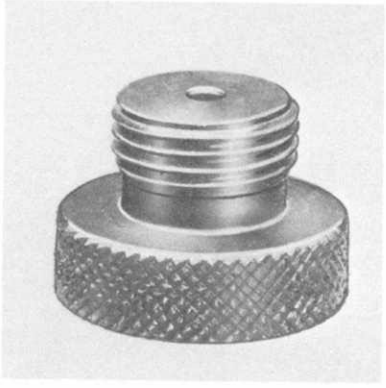
3. Heat converter housing to about 120° C/248° F and press in drive flange with grooved ball bearing against circlip.

4. Install spacer and press in front grooved ball bearing against circlip with a suitable piece of pipe applied on inner race.

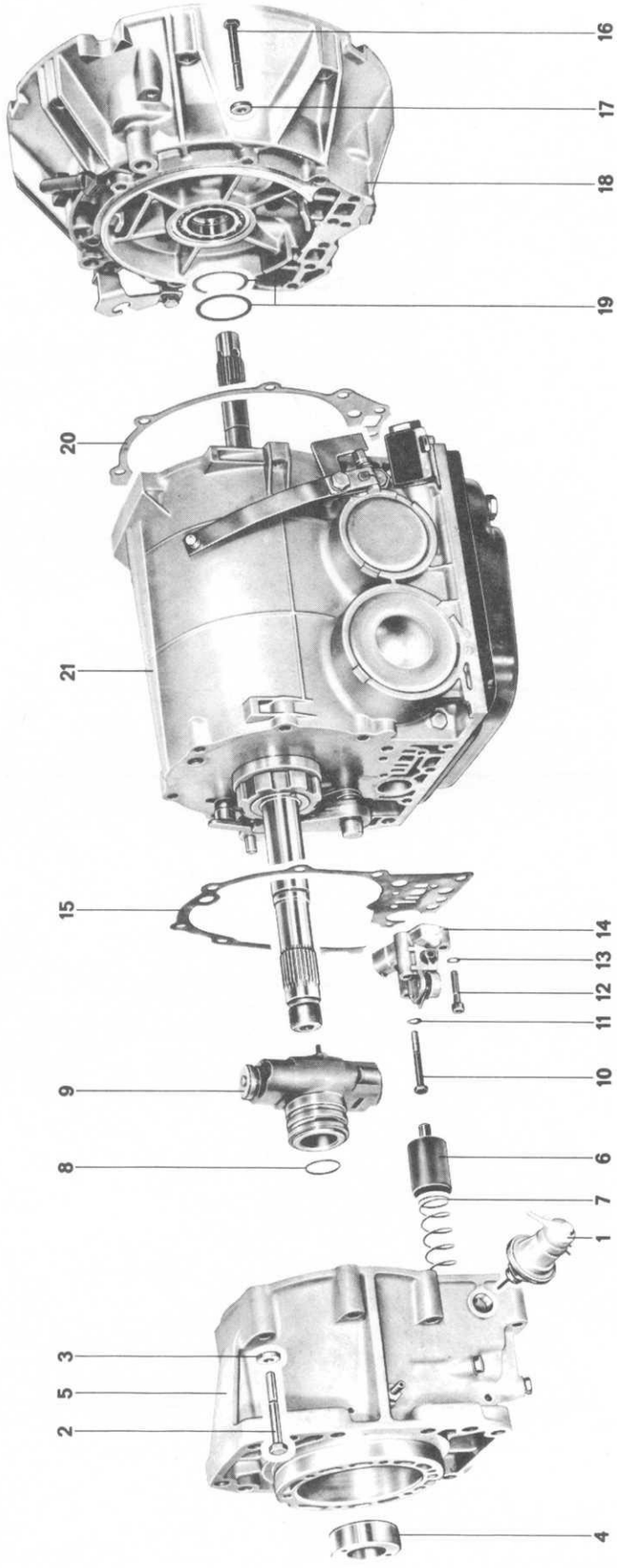
Note

To prevent the drive flange from moving out while pressing in the bearing, it must be supported from underneath with a suitable thrust pad.

TOOLS



No.	Description	Special Tool	Remarks
1	Knurled head bolt	9303	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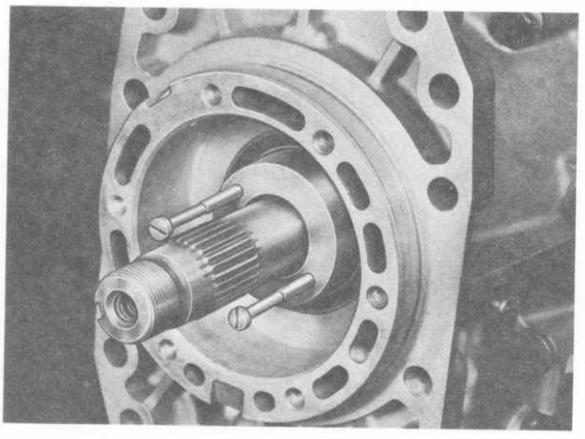
No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
1	Vacuum box	1		Check length of pressure pin with 9303 install with Omnifit Rapid Red M. Coat threads with Hyloma	
2	Bolt	10		Tighten to specified torque	
3	Washer	10			
4	Race	1	Pull out with 2 approx. 60 mm long bolts		
5	Final drive housing	1			
6	Piston	1			
7	Spring	1			
8	O-ring	1		Replace. Coat with ATF	
9	Centrifugal governor	1			
10	Bolt	2		Tighten to specified torque	
11	Washer	2			
12	Screw	1		Tighten to specified torque	
13	Washer	1			
14	Modulation pressure valve housing	1	Do not loosen or maladjust adjusting screw for bimetal spring	Check valve for easy movement after tightening mounting screws	

No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
15	Gasket	1		Replace	
16	Bolt	11		Tighten to specified torque	
17	Washer	11			
18	Rear converter housing	1	Must face up in assembly stand. Loosen by applying light knocks with a plastic hammer and remove		
19	Shim	X	Note thickness for reinstallation	Determine thickness again, if necessary	
20	Gasket	1			
21	Automatic transmission	1			

REMOVING AND INSTALLING FINAL DRIVE HOUSING AND REAR CONVERTER HOUSING

Removing

1. Pull out race with two approx. 60 mm long bolts and take off final drive housing.



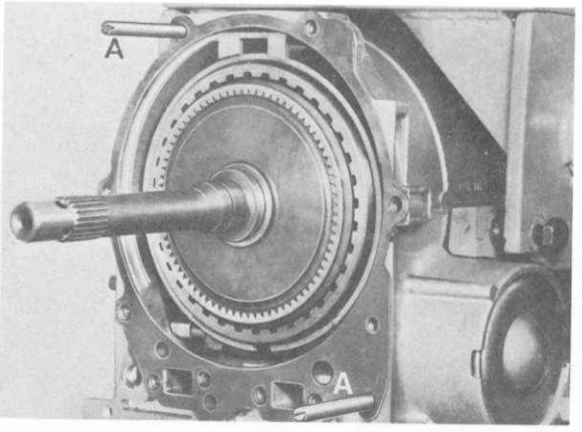
2. Turn transmission in assembly stand until converter housing faces up.

3. Remove converter housing mounting bolts and take off housing by applying light knocks with a plastic hammer.

Installing

1. Install the number of shims noted while removing or the shims calculated for the axial play on the input shaft.

2. Screw two staybolts in transmission case and install gasket.



A - Staybolts

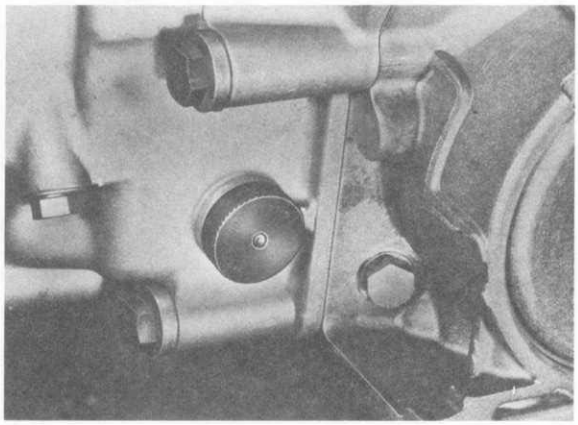
3. Align piston ring on input shaft that its gap is flush with the groove.

4. Install converter housing and tighten mounting bolts to the specified torque.

Note

Use a sealant (e. g. Hylomar SQ 32 M) on the lower seven bolts. This sealant remains permanently elastic within a high temperature range. It is available from Marston Ölchemie GmbH in 5352 Zülpich.

5. Determine pressure pin for vacuum box by screwing Special Tool 9303 in housing and tightening slightly. Insert pressure pin and press it in against stop. Pressure pin should be flush with face of special tool. If not, install a different pressure pin. For this reason pressure pins are available in three different lengths, which are identified by colors.



6. Install the determined pressure pin in the vacuum box with Omnifit Rapid Red M.

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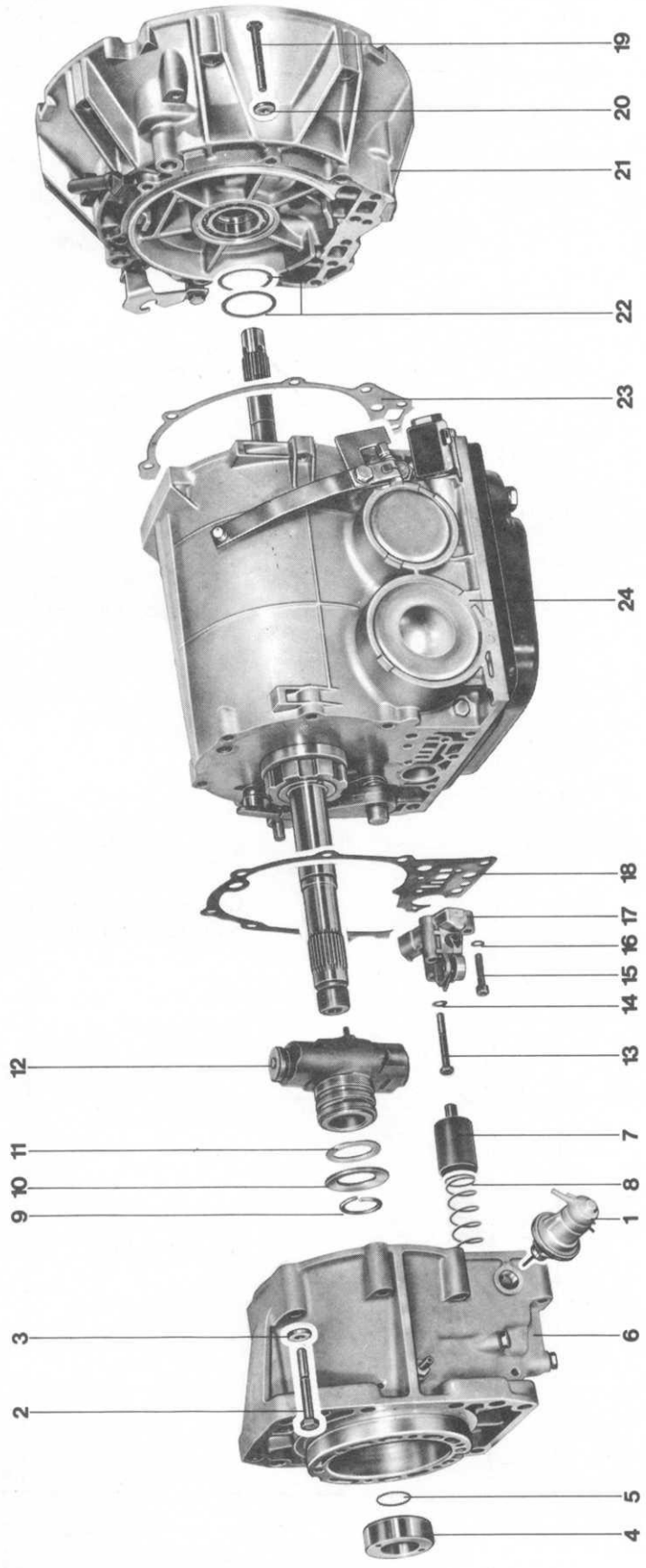
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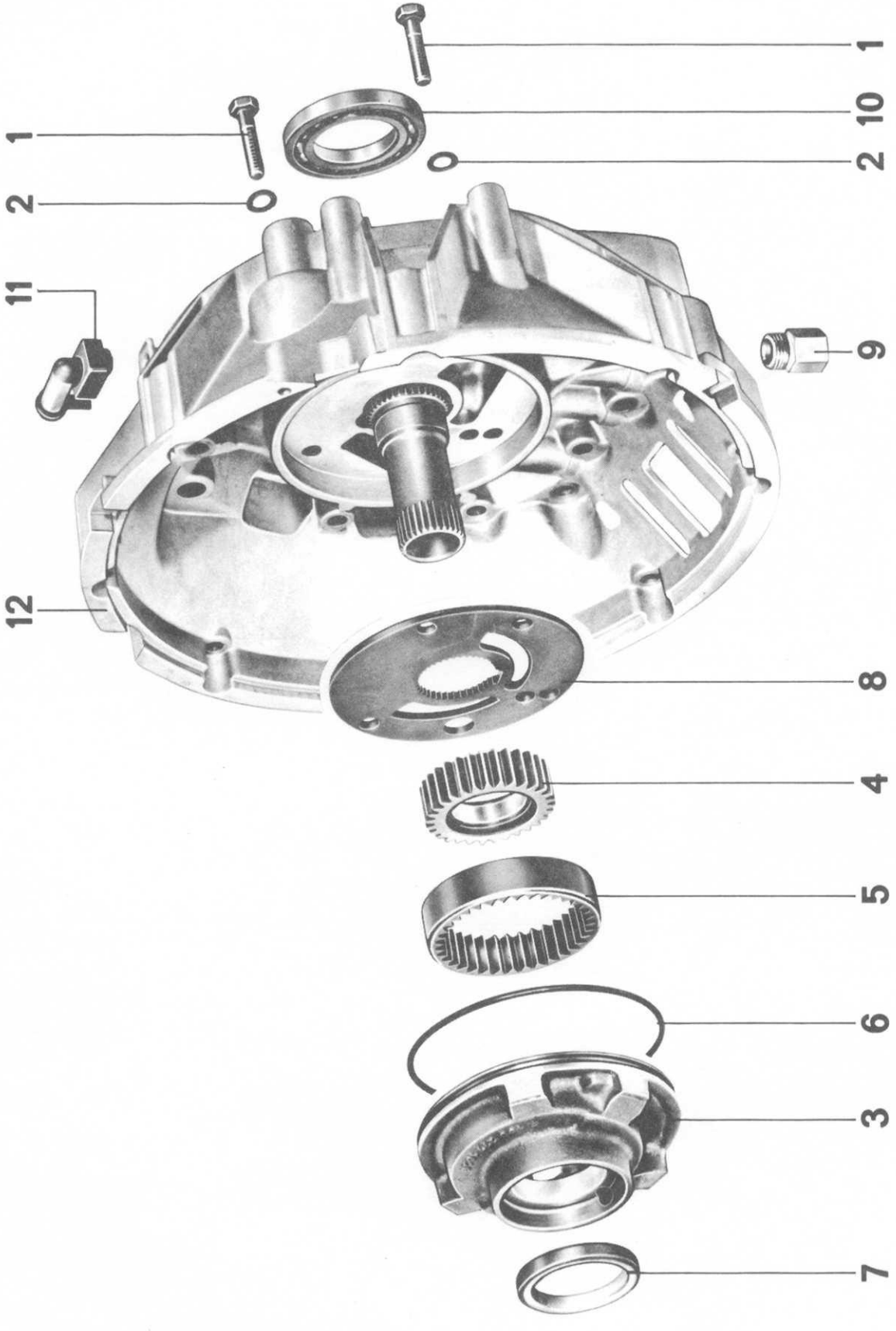
No.	Description	Qty.	Note When: Removing	Note When: Installing	Special Instructions
1	Vacuum modulator	1		Check length of pressure pin with special tool 9303 and paste with Omnifit Rapid Red M. Coat threads with non-hardening sealant	
2	Bolt	10		Torque: 27 to 32 Nm (20 to 23 ftlb)	
3	Washer	10			
4	Thrust ring	1	Pull out with two approx. 60 mm long bolts		
5	O-ring	1		Replace, coat with ATF	
6	Rear transm. case	1			
7	Piston	1			
8	Spring	1			
9	Support ring	1			
10	Diaphragm spring	1		Concave side faces centrifugal governor	
11	Spacer	1			
12	Centrifugal governor	1			
13	Bolt	2		Torque: 7.0 Nm (5 ftlb)	
14	Washer	2			
15	Bolt	1		Torque: 7.0 Nm (5 ftlb)	
16	Washer	1			

No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
17	Modulation pressure valve housing	1	Bimetal spring adjusting screw must not be unscrewed or maladjusted	Check valve for easy movement after tightening mounting bolts	
18	Gasket	1			
19	Bolt	11		Torque: 27 to 32 Nm (20 to 23 ftlb)	
20	Washer	11			
21	Rear converter housing	1	Must face up in assembly stand. Loosen with light taps from a plastic hammer and remove		
22	Shims	X	Note thickness for installation later	Redetermine thickness if necessary	
23	Gasket	1		Replace	
24	Automatic transmission	1			

Refer to pages 37 - 25/26 for instructions on removing and installing.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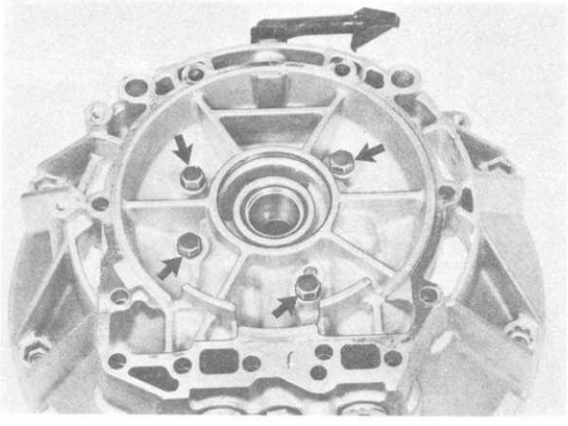
No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
1	Bolt	4		Tighten to specified torque	
2	Washer	4			
3	Pump housing with liner	1	Drive out with two bolts		
4	Drive gear	1		Install with ATF	
5	Gear	1		Install with ATF; chamfered outer edge faces pump housing	
6	O-ring	1		Replace, coat with ATF	
7	Seal	1	Drive out with suitable screw-driver	Replace, drive in flush with suitable thrust pad	
8	Intermediate plate	1			
9	Threaded plug	1			
10	Ball bearing	1	Heat converter housing to 120° C/ 248° F and remove	Drive in against stop with suitable thrust pad	
11	Breather	1			
12	Rear converter housing	1			

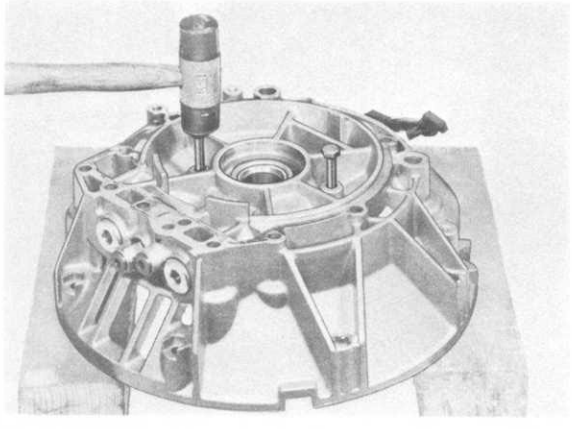
DISASSEMBLING AND ASSEMBLING REAR CONVERTER HOUSING

Disassembling

1. Remove ATF pump mounting bolts.

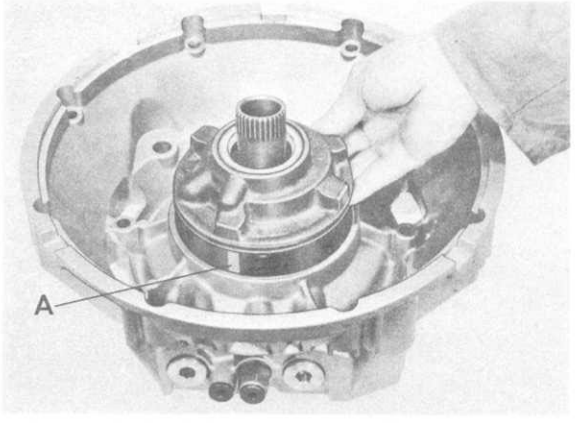


2. Screw in two approx. 50 mm long bolts opposite each other and drive out pump by lightly tapping on bolts.



Assembling

Insert ATF pump in converter housing carefully and tighten mounting bolts to specified torque.

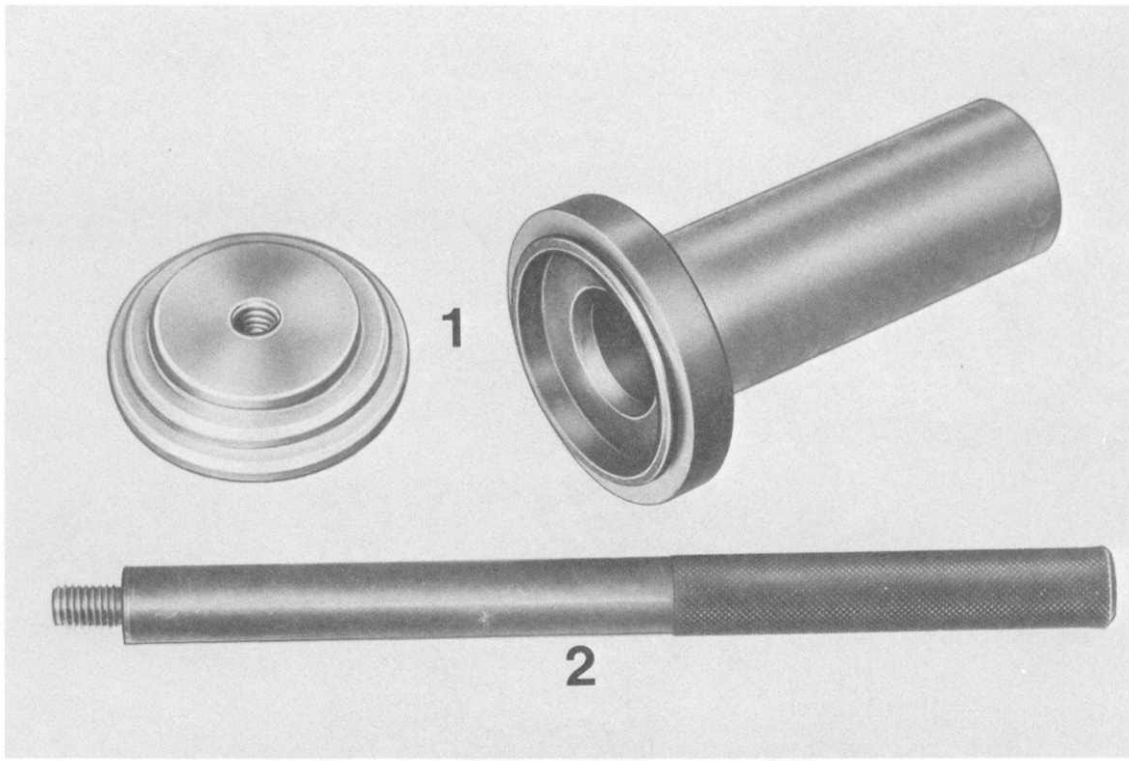


A - Studs

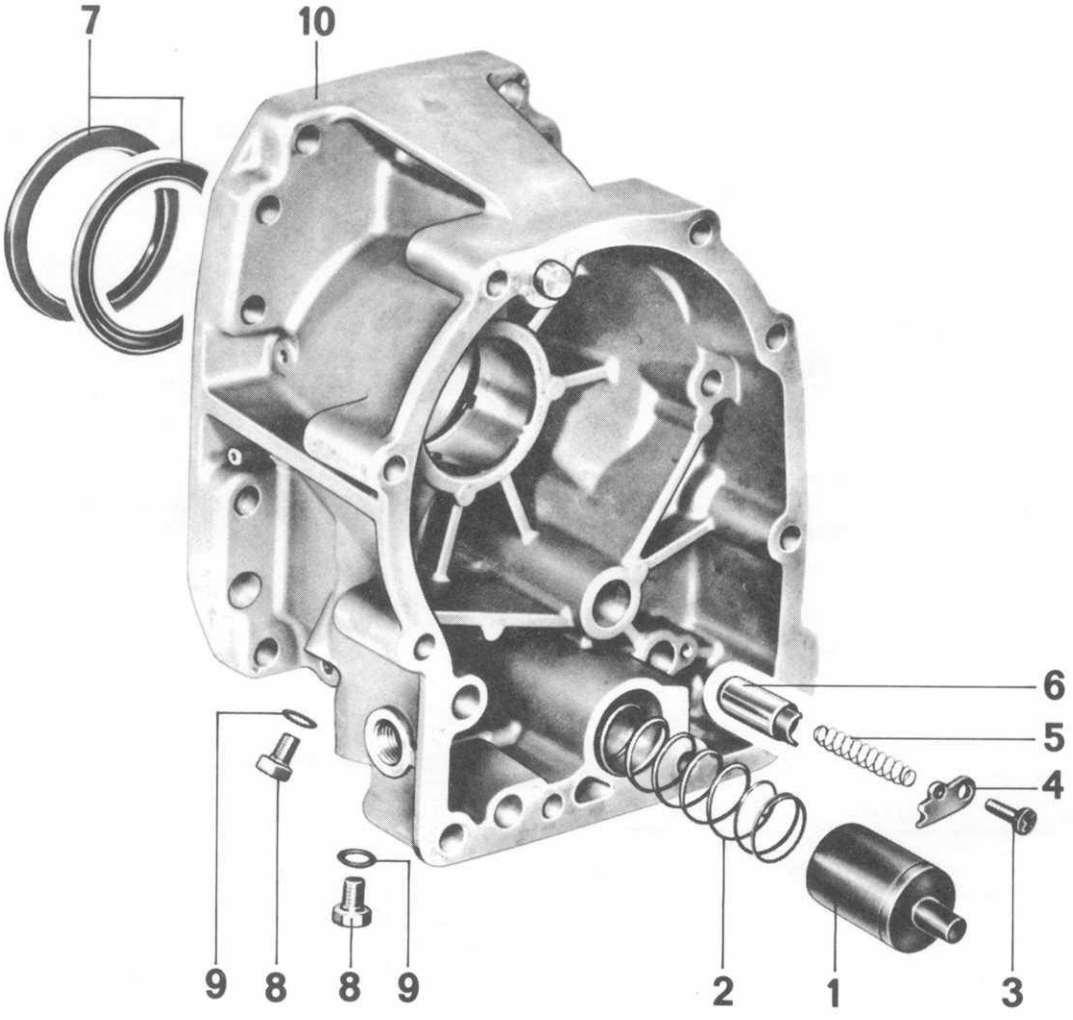
Note

Screw two studs in pump housing to facilitate installation.

TOOLS



No.	Description	Special Tool	Remarks
1	Thrust tool	9180	Consisting of thrust pad and thrust sleeve
2	Mandrel	P 254	



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No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
1	Pressure piston	1		Position correctly	
2	Spring	1			
3	Bolt	1		Tighten to specified torque	
4	Holder	1			
5	Spring	1			
6	Piston	1			
7	Seal	2	Drive out from inside to outside with suitable screwdriver	Drive in to correct position with 9180 and P 254	
8	Plug	2		Tighten to specified torque	
9	Seal	2		Replace	
10	Housing	1			

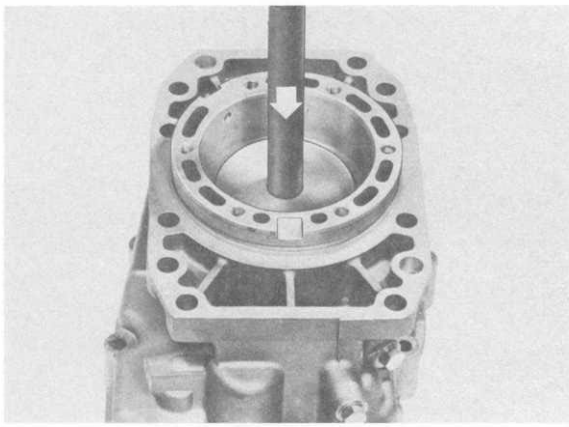
DISASSEMBLING AND ASSEMBLING FINAL DRIVE HOUSING

Disassembling

Drive out seals from inside to outside with a suitable screwdriver.

Assembling

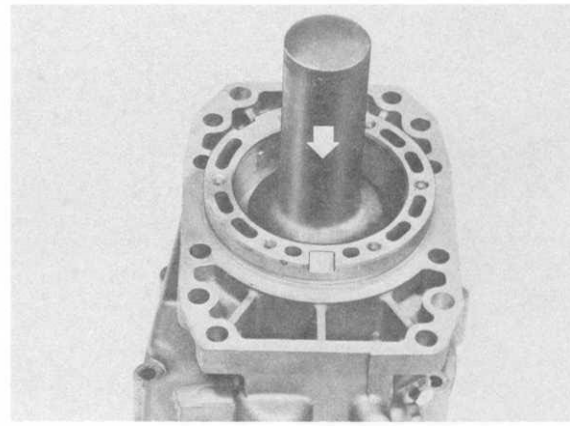
1. Drive in inner seal to correct position with Special Tools 9180 and P 254.



Note

Install seal that its sealing lip faces the automatic transmission.

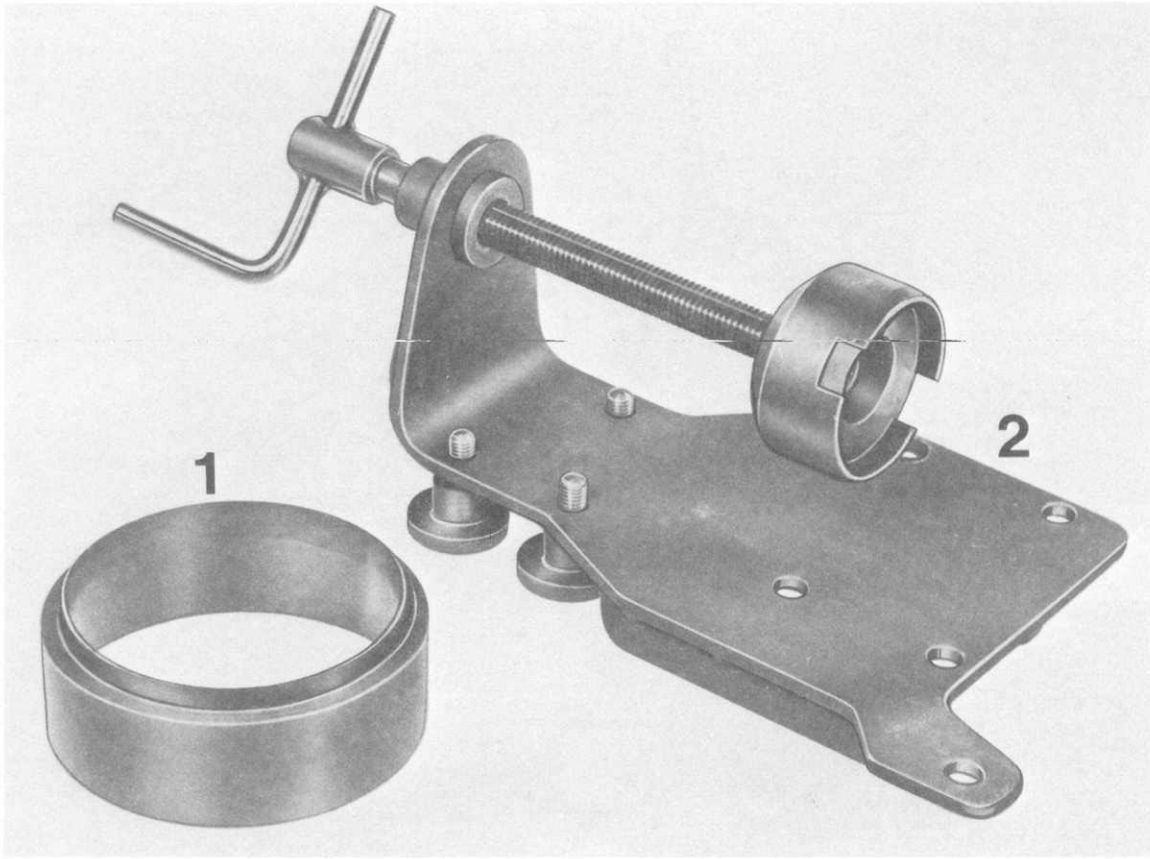
2. Drive in outer seal to correct position with Special Tool 9180.



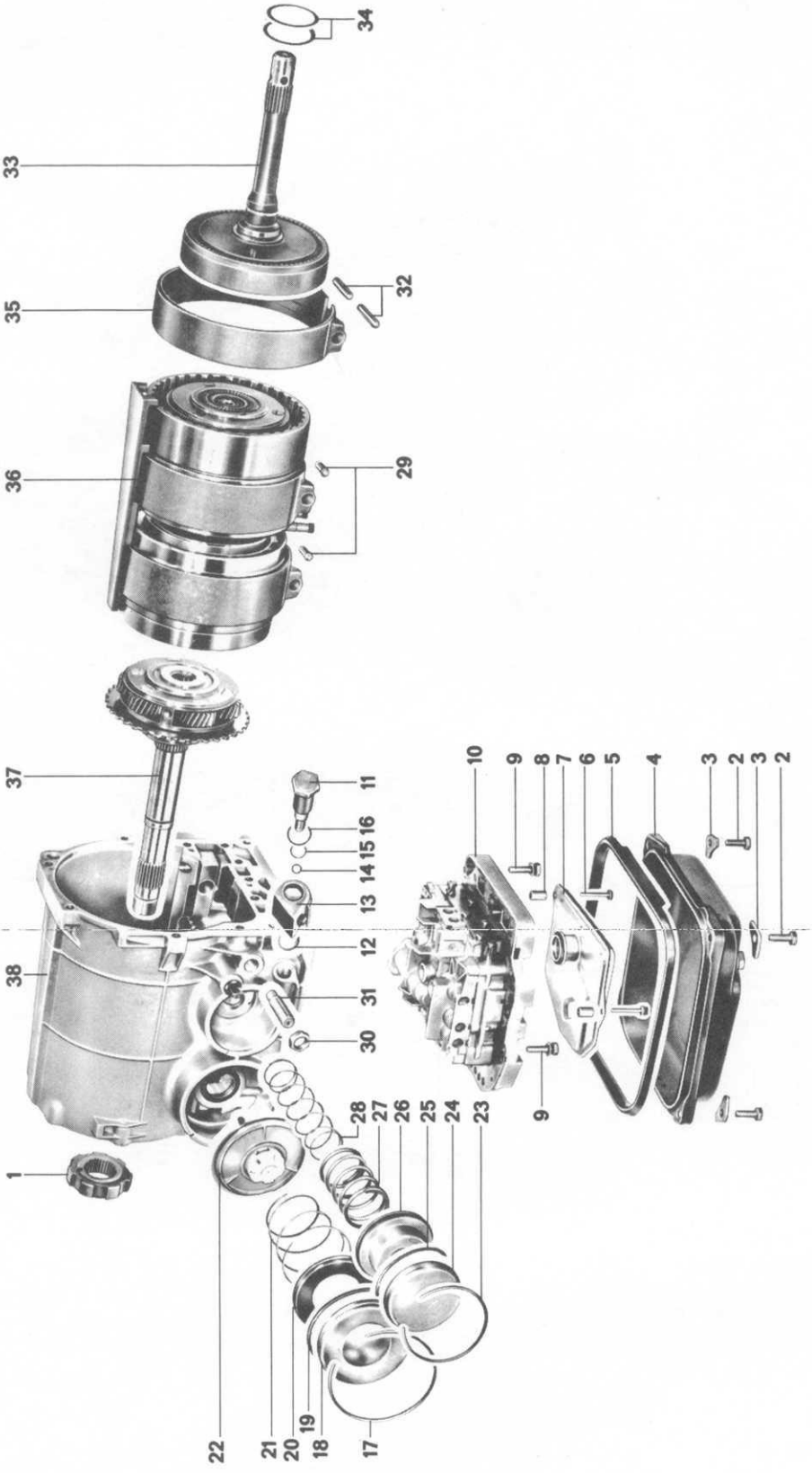
Note

Install seal that its sealing lip faces the final drive.

TOOLS



No.	Description	Special Tool	Remarks
1	Assembly sleeve	9305	
2	Assembly tool	9304	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No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
1	Parking lock gear	1			
2	Bolt	4		Tighten to specified torque	
3	Lockplate	4			
4	Oil pan	1			
5	Gasket	1		Replace, if necessary	
6	Screw and washer	2		Tighten to specified torque	
7	Oil filter	1		Replace, every 40.000 km/25,000 mi.	
8	Spacer	2			
9	Bolt	11		Tighten to specified torque	
10	Valve body housing	1			Page 38 - 21
11	Kickdown solenoid	1			
12	Seal	1		Replace	
13	Housing	1			
14	O-ring	1		Replace	
15	O-ring	1		Replace	
16	O-ring	1		Replace	
17	Snap ring	1			
18	Cover	1			
19	O-ring	1		Replace, apply light coat of ATF	
20	Guide	1			

No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
21	Spring	1			
22	Piston	1	Use 9305	Use 9305	
23	Snap ring	1	Preload piston with 9304	Preload piston with 9304	
24	Cover	1			
25	O-ring	1		Replace	
26	Piston and seal	1			
27	Spring	1			
28	Spring	1			
29	Pin	2	Mark for reinstallation	Redetermine length, if necessary	
30	Nut	1			
31	Adjusting screw	1		Replace	
32	Pin	2			
33	Input shaft	1			
34	Shim	X	Note quantity and thickness for reinstallation	Redetermine thickness, if necessary	
35	Brake band B 3	1			
36	Gear set with brake bands B 1, B 2 and brake band guide	1			
37	Output shaft	1			
38	Transmission case	1			

DISASSEMBLING AND ASSEMBLING TRANSMISSION

Disassembling

Absolute cleanliness is very important when working on an open transmission. Perfect transmission function requires that there be no dirt on transmission parts, command valves or in oil circuits. Consequently disassembled parts must be washed thoroughly, oil bores flushed and dried.
Never use gasoline to wash rubber seals, which would be damaged. Only use alcohol for cleaning.

Also make sure that wool rags are not used on parts, because even minute contamination (e. g. lint) could lead to disturbances.

1. Detach final drive and remove bearing assembly with drive pinion (see page 39 - 22).

2. Remove final drive housing, centrifugal governor and modulation pressure valve housing (see page 37 - 21).

Note

It is essential to first take off the vacuum box for modulation pressure prior to removing the final drive housing.

3. Pull parking lock gear off of output shaft.

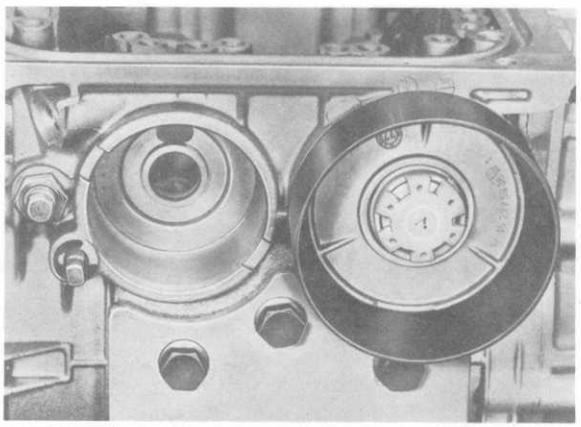
4. Remove front converter housing and torque converter (see page 32 - 1).

5. Remove valve body (see page 38 - 21).

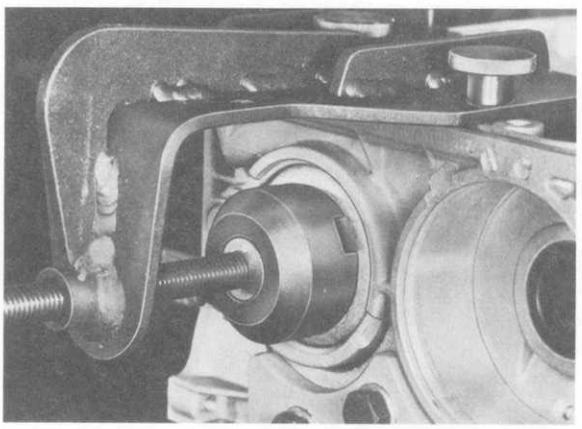
6. Remove solenoid valve.

7. Remove snap ring for cover of brake band B 2 piston and take off cover.

8. Install Special Tool 9305 and press out piston carefully.



9. Attach Special Tool 9304 for cover of brake band B 1 piston. Preload piston and remove snap ring.



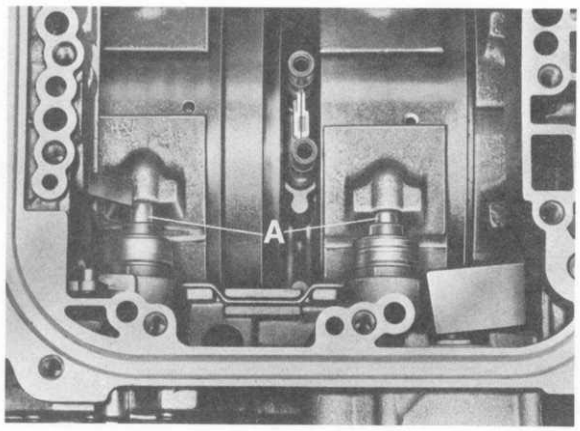
10. Release and unscrew special tool.

11. Remove cover, piston and springs of brake band B 1.

12. Remove pressure pins for B 1 and B 2.

Note

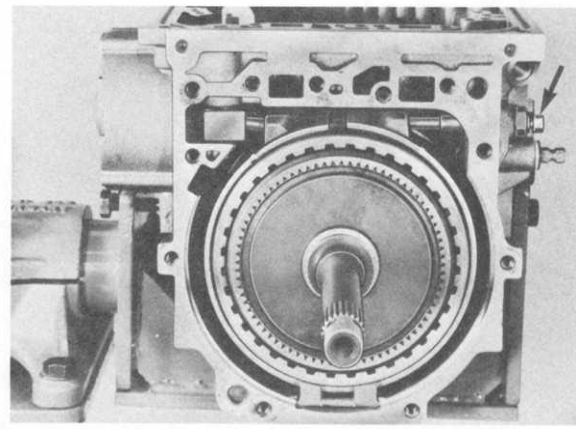
Mark pressure pins for reinstallation.



A - Pressure pins

13. Swing transmission in assembly stand to horizontal position.

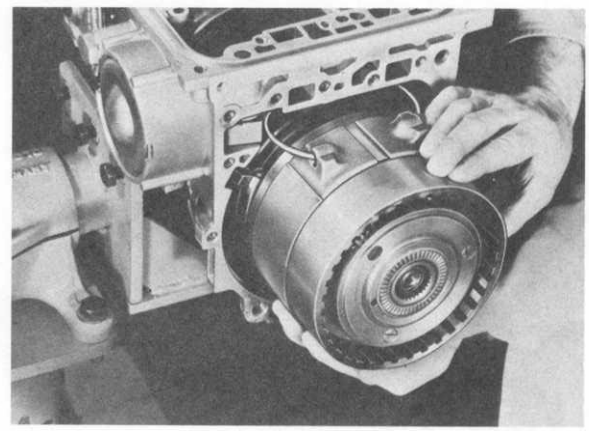
14. Remove adjusting screw B 3 and take out both pressure pins.



15. Remove brake band B 3 forward.

16. Pull input shaft out of gear assembly.

17. Hold brake band B 1 on the drum with a snap ring from cover of brake band B 2 piston and remove gear assembly with brake bands.



18. Drive out output shaft with a plastic hammer.

Assembling

Use specified ATF on bearings and moving parts when assembling the transmission.

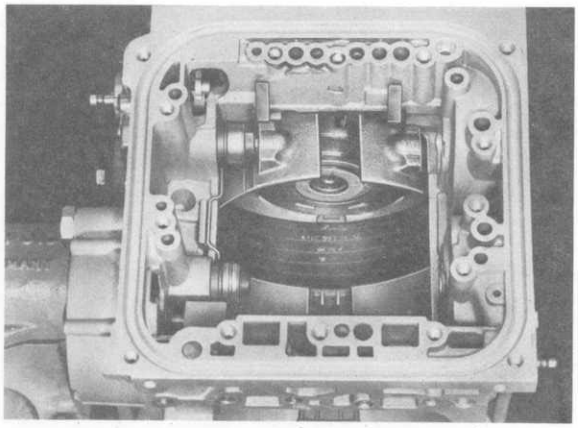
1. Install output shaft with ball bearings in transmission case and drive in with a plastic hammer.

2. Install parking lock gear.

3. Attach final drive housing with centrifugal governor, modulation pressure valve housing and pressure piston (see page 37 - 21).

4. Install the shims (either those noted while disassembling or those of redetermined thickness) with the bearing assembly and tighten drive pinion nut to specified torque (see pages 39 - 23 and 39 - 29).

5. Install brake band B 2 (steel band with radial groove liner) and brake band guide in transmission case.



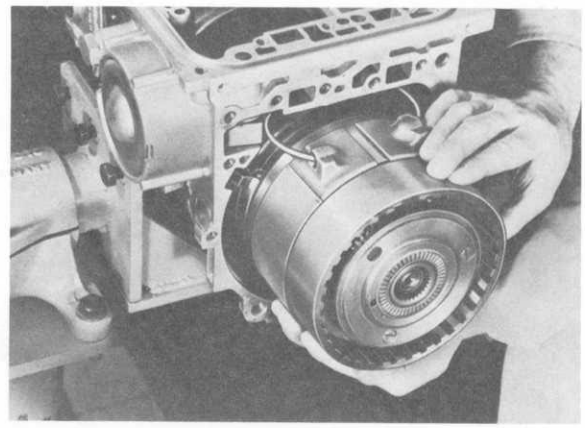
6. Lubricate and install radial bearing.

7. Hold brake band B 1 (steel band with smooth liner) on brake band drum with the snap ring for piston of brake band B 2.

8. Install gear assembly with brake band B 1, guiding the support lever for the oil distribution sleeve into groove of transmission case.

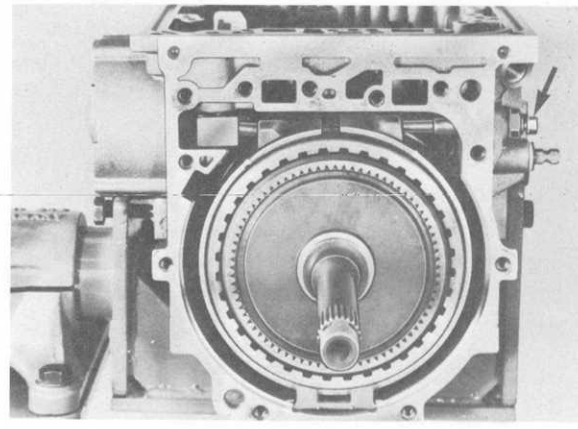
Note

When guiding gear assembly into the transmission case, make sure that segment spline of sun gear on the output shaft meshes correctly in drum of brake band B 2.



9. Install input shaft in gear assembly.

10. Install brake band B 3 (thick steel band with radial groove liner) in transmission case from front. Insert both pressure pins in brake band and screw new adjusting screw coated with a sealant in transmission case so far, until brake band is held.

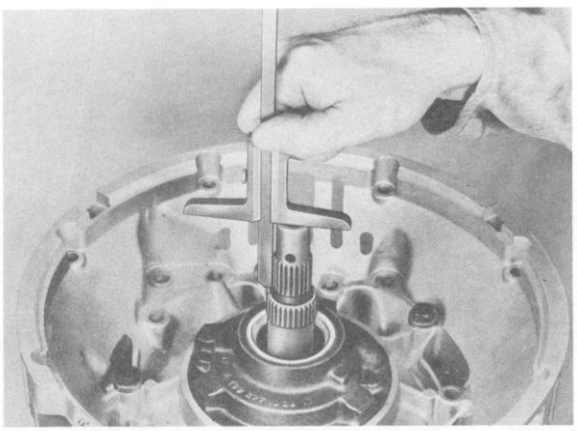


11. Turn transmission until input shaft faces up.

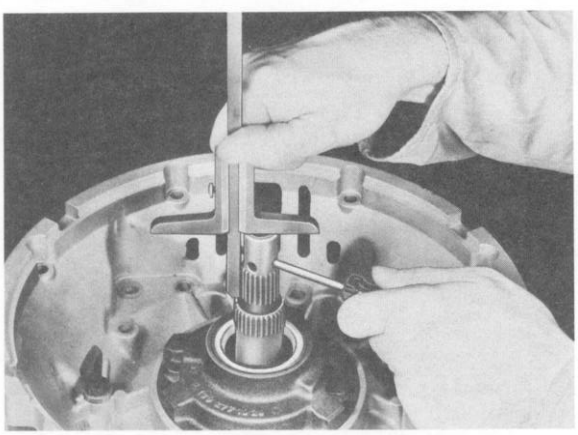
12. Measure axial play of gear assembly. It should be 0.4 to 0.6 mm.

    Install rear converter housing with gasket and tighten four mounting bolts to specified torque.

    Check distance from upper edge of input shaft to upper edge of stator shaft with a depth gauge. This distance is "A".



    Pull up input shaft against the stop and repeat measurement. This distance is "B".



    Axial play will be the difference between "A" and "B".

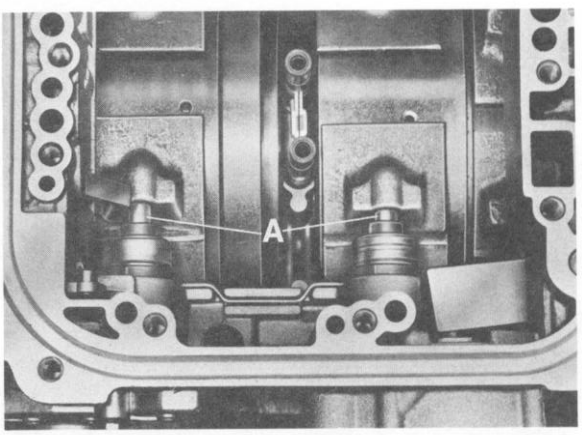
    Adjust axial play to 0.4...0.6 mm by using shims of pertinent thickness on the input shaft.

Note

Prior to checking the axial play of the gear assembly, it will be essential to adjust the bearing assembly and tighten the drive pinion nut to specified torque.

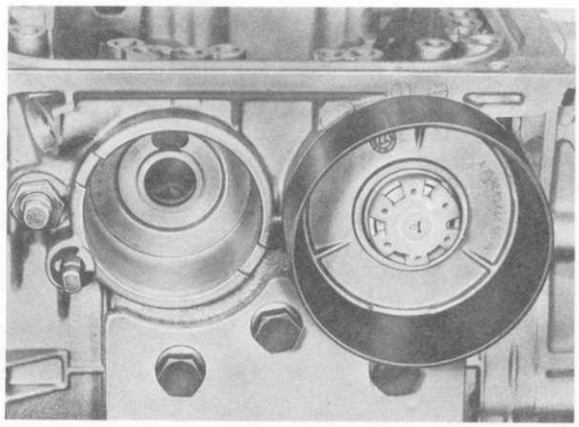
13. Attach rear converter housing (see page 37 - 21).

14. Install pressure pins for B 1 and B 2.



A - Pressure pins

15. Install piston of brake band B 2 by guiding brake band piston into transmission case with Special Tool 9305 and making sure that the pressure pin has proper fit in bore of brake band B 2.



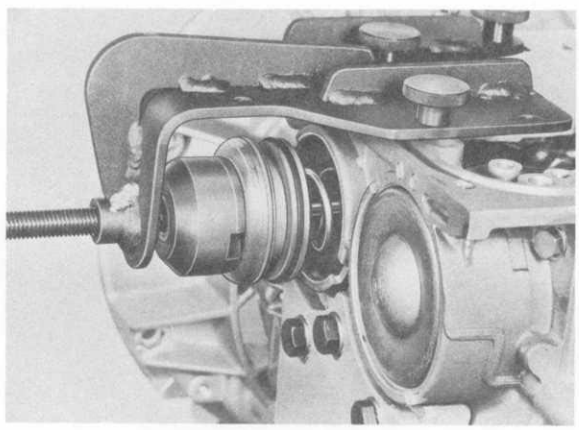
16. Use a new O-ring on cover of B 2 brake band piston and install with a spring.

Note

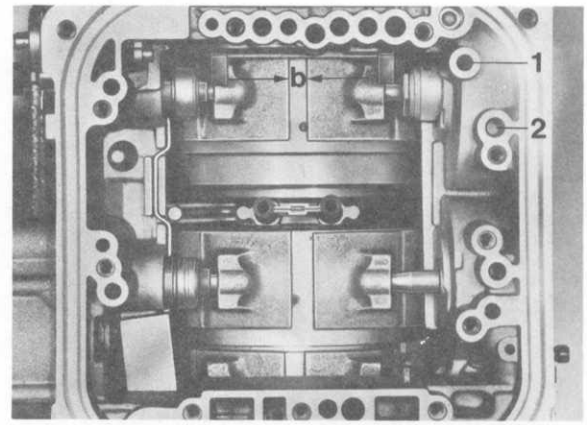
Apply a light coat of ATF on O-ring.

17. Install snap ring for cover.

18. Install piston and cover of brake band B 1 with Special Tool 9304.

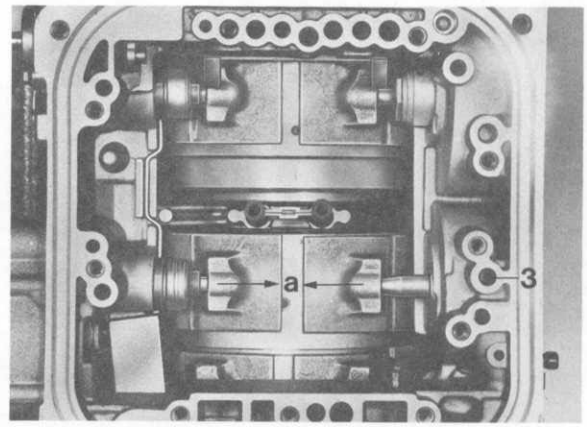


19. Measure distance of dead travel for pistons of brake bands B 1 and B 2. This is done by moving piston of brake band B 2 into lift position with air pressure supplied through lift pressure bore and checking distance "b". Then move the brake band piston into shift position with air pressure supplied through the shift pressure bore and recheck distance "b". The difference of both distances is dead travel "L".



1 - Lift pressure - bore B 2
2 - Shift pressure - bore B 2

Check distance "a" while springs hold the piston of brake band B 1 in lift position. Then move this piston to shift position with air pressure supplied through shift pressure bore B 1 and re-check distance "a". The difference will be dead travel "L".



3 - Shift pressure - bore B 1

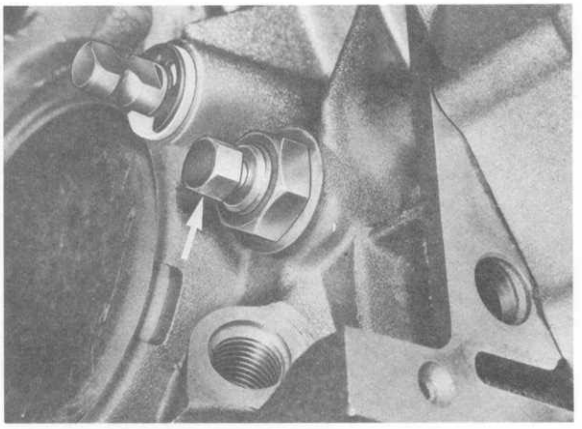
Dead travel "L" of pistons in brake bands B 1 and B 2 should be 3.0 to 4.0 mm.

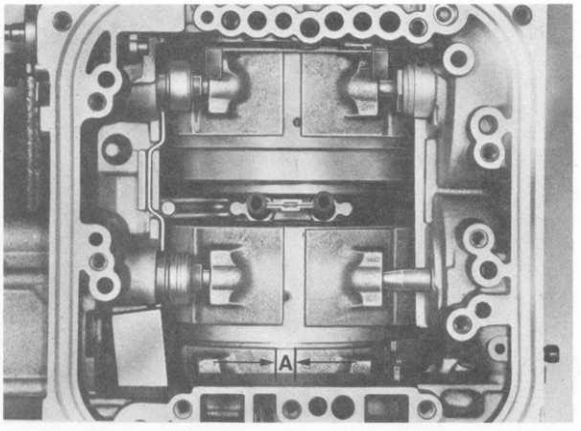
Note

Dead travel "L" excessive - use longer pressure pin.
Dead travel "L" insufficient - use shorter pressure pin.

20. Adjust brake band B 3.

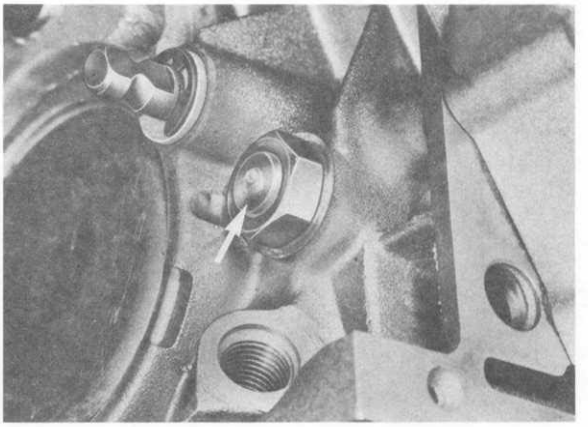
Screw in the adjusting screw after loosening the counternut and tighten to 5 Nm (0.5 kpm). Check gap "A" on brake band.

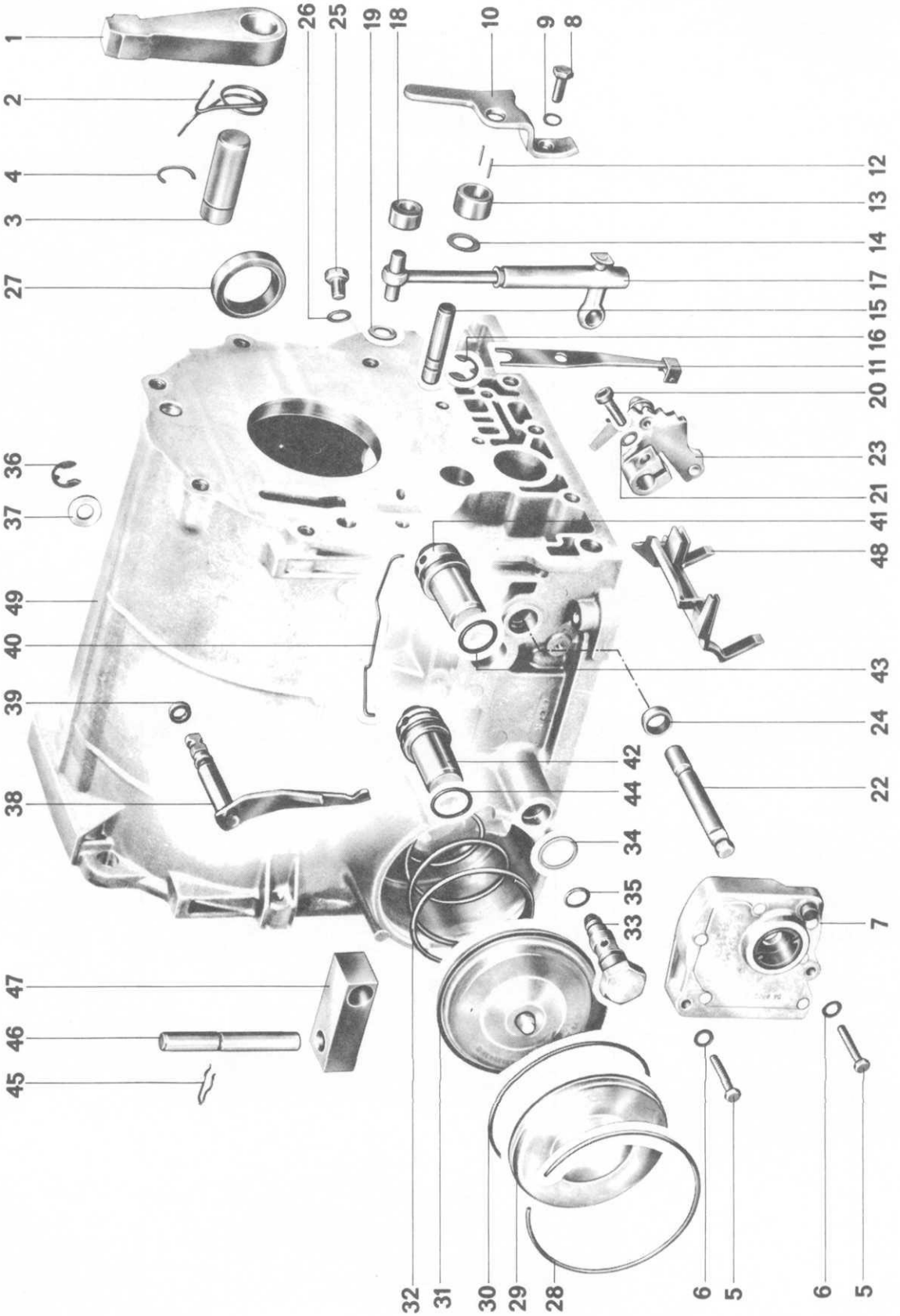




Unscrew adjusting screw by 1 3/4 turns and recheck gap "A". The difference between both distances is the dead travel, which should be at least 3 mm.

Hold the adjusting screw to prevent maladjustment. Tighten counternut and grind off head of adjusting screw.

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No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
1	Pawl	1			
2	Spring	1			
3	Pin	1			
4	Circlip	1			
5	Bolt	2		Tighten to specified torque	
6	Washer	2			
7	Anti-restart and backup light switch	1		Adjust	Page 37 - 15
8	Bolt	1		Tighten to specified torque	
9	Washer	1			
10	Holder	1	Remove together with leaf spring and roller running on needle bearing		
11	Leaf spring	1			
12	Needle	X			
13	Roller	1			
14	Washer	1			
15	Pin	1			
16	Lockwasher	1			
17	Linkage	1			
18	Roller	1			
19	Washer	1			

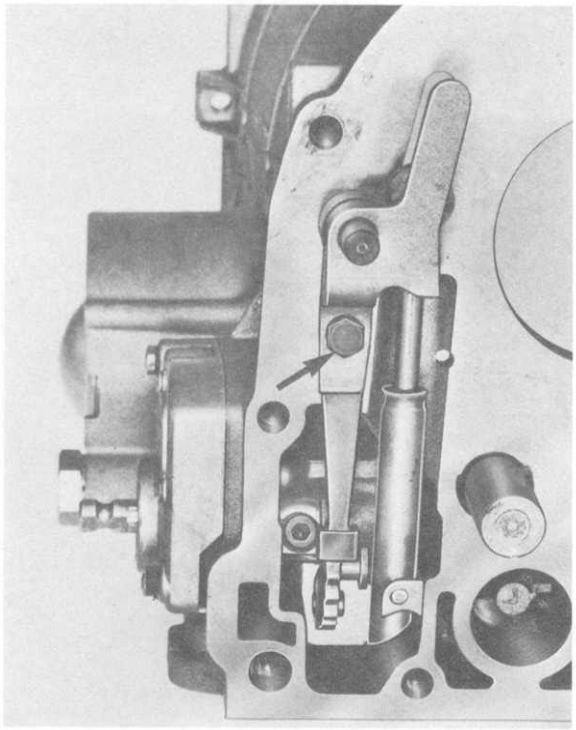
No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
20	Screw	1		Tighten to specified torque	
21	Washer	1			
22	Shaft	1			
23	Catch plate	1			
24	Seal	1	Lever out with suitable screw-driver	Drive in with suitable tool	
25	Plug	1		Tighten to specified torque	
26	Seal	1		Replace	
27	Seal	1	Drive out with suitable screw-driver	Drive in to correct position with suitable tool; lip faces out	
28	Snap ring	1			
29	Cover	1			
30	Seal	1		Replace, coat with ATF	
31	Piston	1		Coat seal with ATF	
32	Spring	1			
33	Fast charging valve for reverse gear	1			
34	Seal	1		Replace	
35	Seal	1		Replace, coat with ATF	
36	Circlip	1			
37	Washer	1			
38	Lever	1			

No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
39	Seal	1		Replace, coat with ATF and position correctly	
40	Spring retainer	1			
41	Pressure unit B 2	1		Do not mix up with pressure unit B 1	
42	Pressure unit B 1 (identified by a groove all around)	1		Do not mix up with pressure unit B 2	
43	Seal	1		Replace, coat with ATF	
44	Seal	1		Replace, coat with ATF	
45	Spring	1			
46	Pin	1	Remove downward		
47	Lever	1			
48	Brake band guide	1			
49	Case	1			

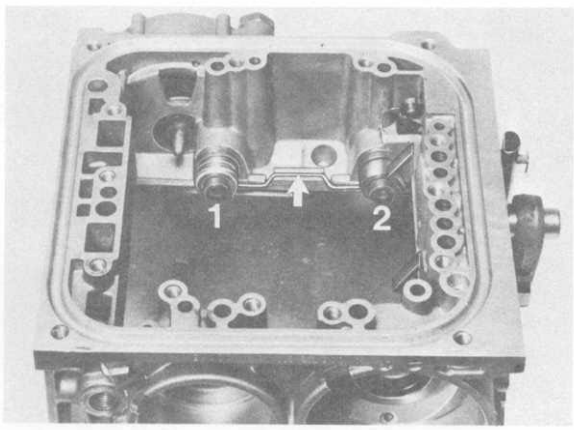
DISASSEMBLING AND ASSEMBLING TRANSMISSION CASE

Disassembling

1. Unscrew holder and remove with leaf spring and roller running on needles.

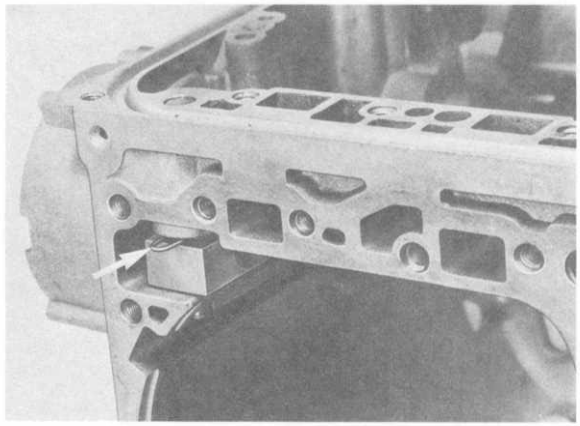


2. Remove lock for pressure units B 1 and B 2, and remove both pressure units.



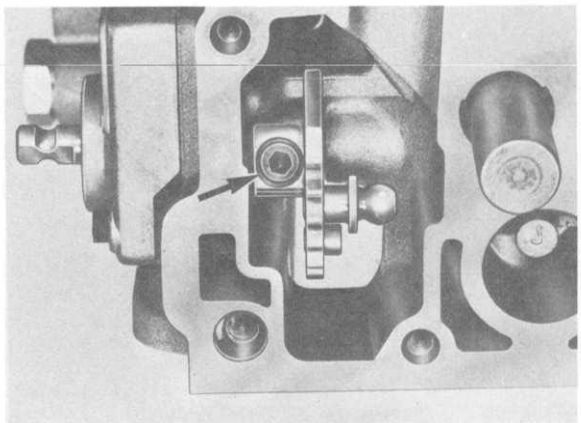
1 - Pressure unit B 1
2 - Pressure unit B 2

3. Pull out spring for bearing pin from lever of brake band B 3 and drive out pin downward.

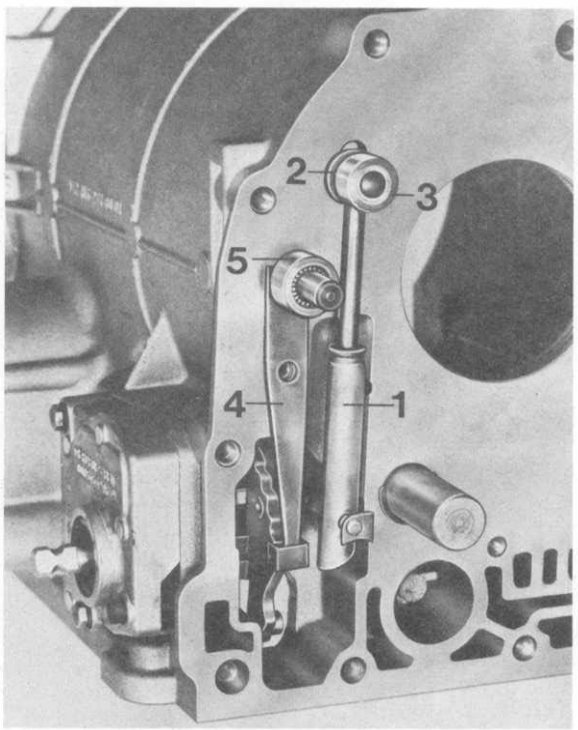


Assembling

1. Install catch plate in housing. Guide shaft into spline of catch plate and tighten holding screw to specified torque.



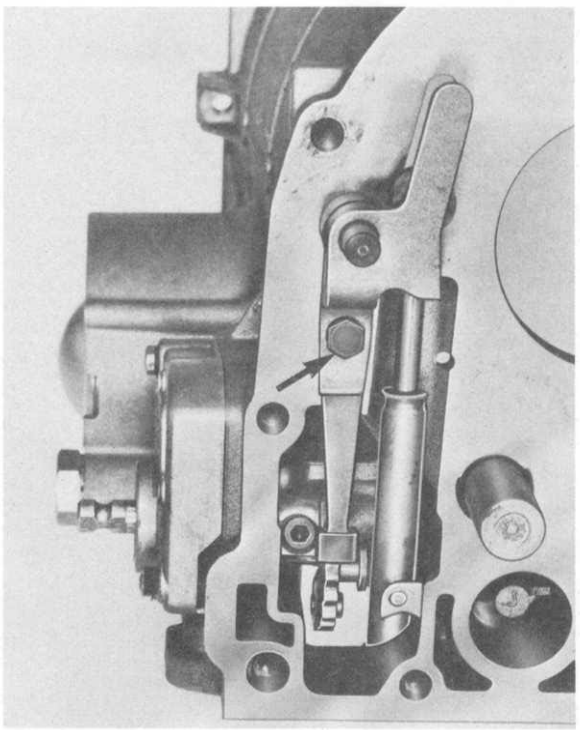
2. Install linkage with washer and roller.



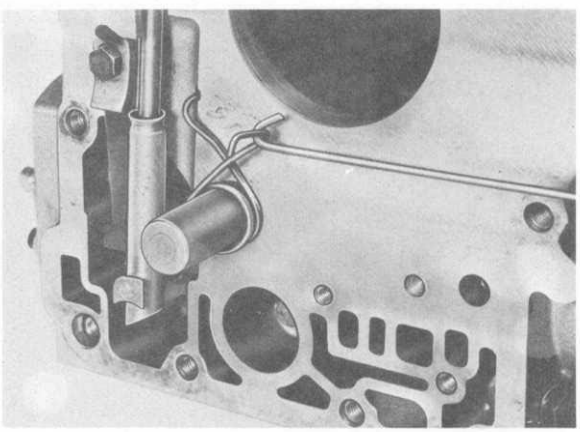
1 - Linkage
2 - Washer
3 - Roller
4 - Leaf spring
5 - Roller on needles

3. Install leaf spring and roller running on needles.

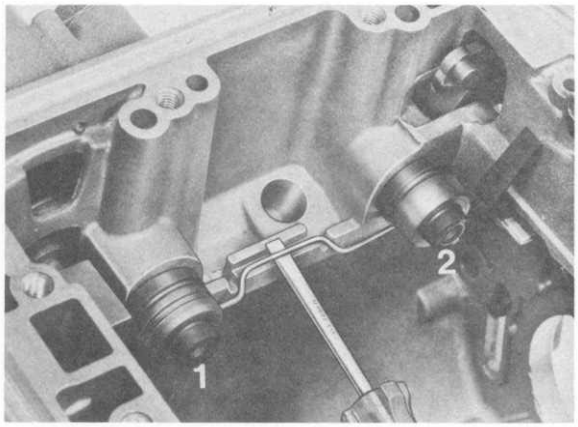
4. Install holder and tighten bolt to specified torque.



5. Push spring on to bearing pin and attach in transmission case. Tension spring with a scribe or suitable wire hook and slide on the parking lock pawl.



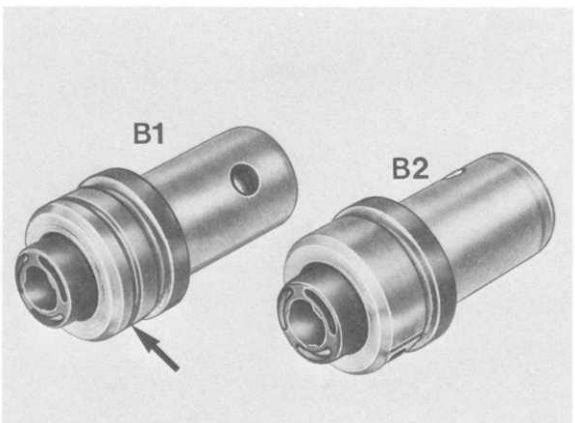
6. Install pressure units B 1 and B 2 in correct position and secure with lock.



1 - Pressure unit B 1
2 - Pressure unit B 2

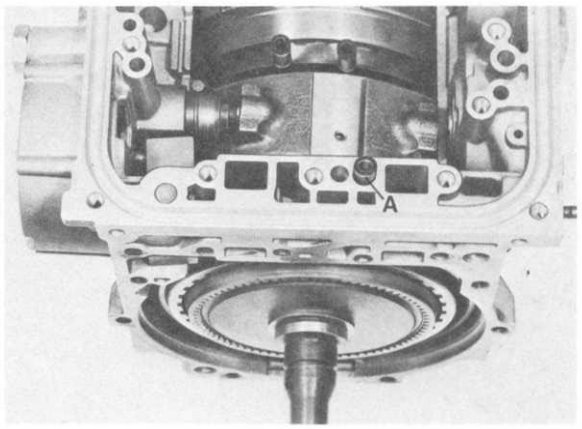
Note

Pressure units B 1 and B 2 have different designs and therefore must not be mixed up. For identification B 1 pressure unit has a groove running all around.



Note

A rubber insert is installed as from May 7, 1979 to eliminate hydraulic noise in the lubricating circuit. This rubber insert can be service installed in transmission without one.

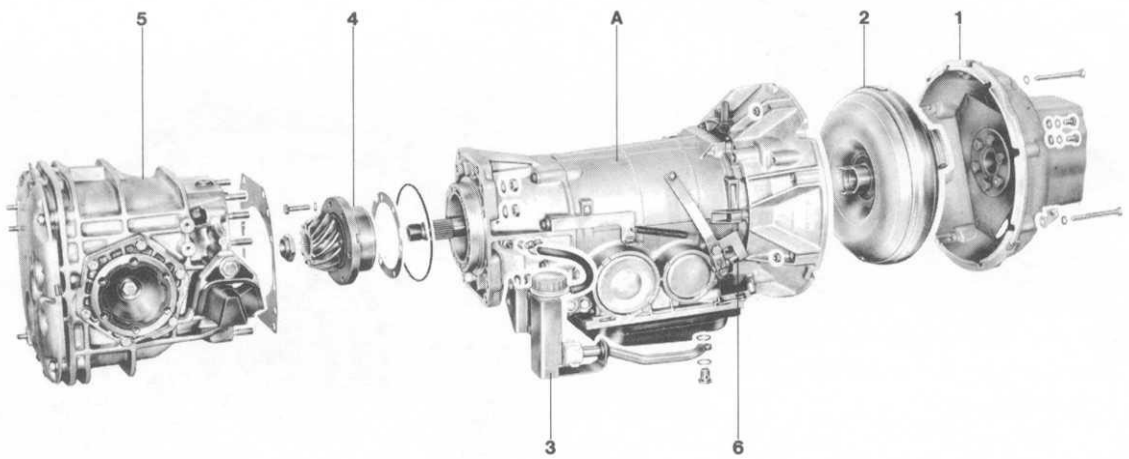


A - Rubber insert

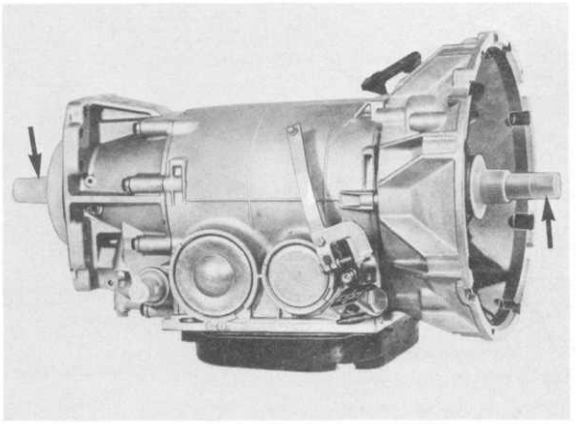
INSTALLING AUTOMATIC TRANSMISSION SECTION

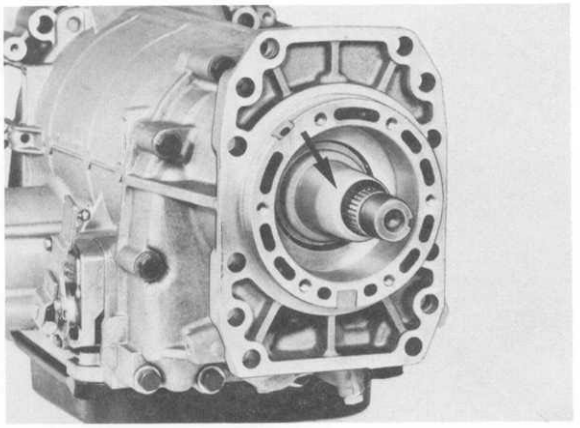
If transmission (A) section is installed, the following parts must be transferred from the defective transmission to the new transmission.

1 – Front converter housing with mounting parts
2 – Torque converter
3 – ATF tank
4 – Bearing assembly with drive pinion and mounting parts (replace O-ring)
5 – Final drive
6 – Adjusting nut



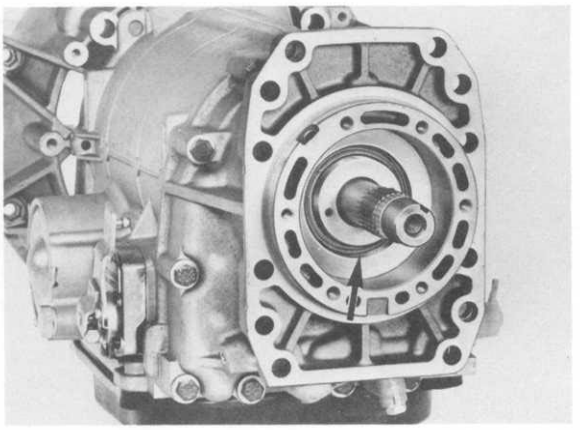
1. Take transmission section out of crate and remove protective caps.



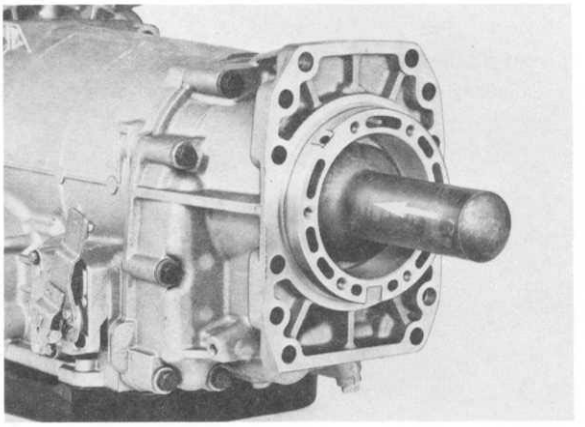


Note:

The outer seal between the transmission case and final drive is missing on transmission section for manufacturing reasons.

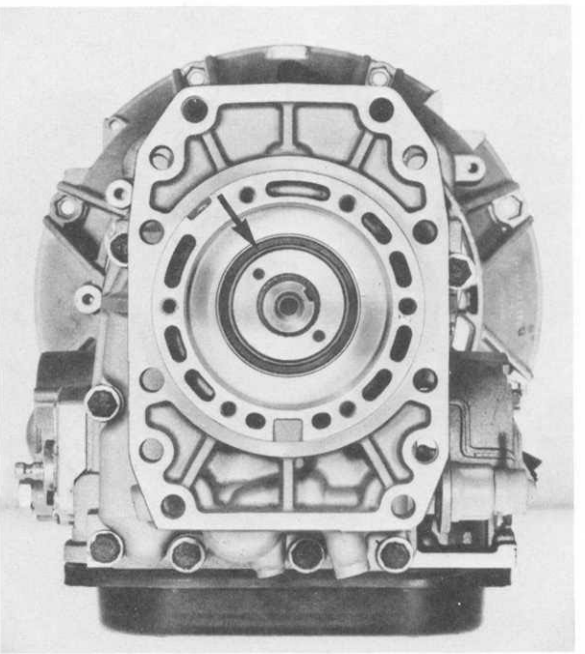


2. Drive in outer seal to correct position with Special Tool 9180 (also refer to page 37 - 34).



Note:

The outer seal must be installed so that its sealing lip and spring supporting the sealing lip face the final drive.

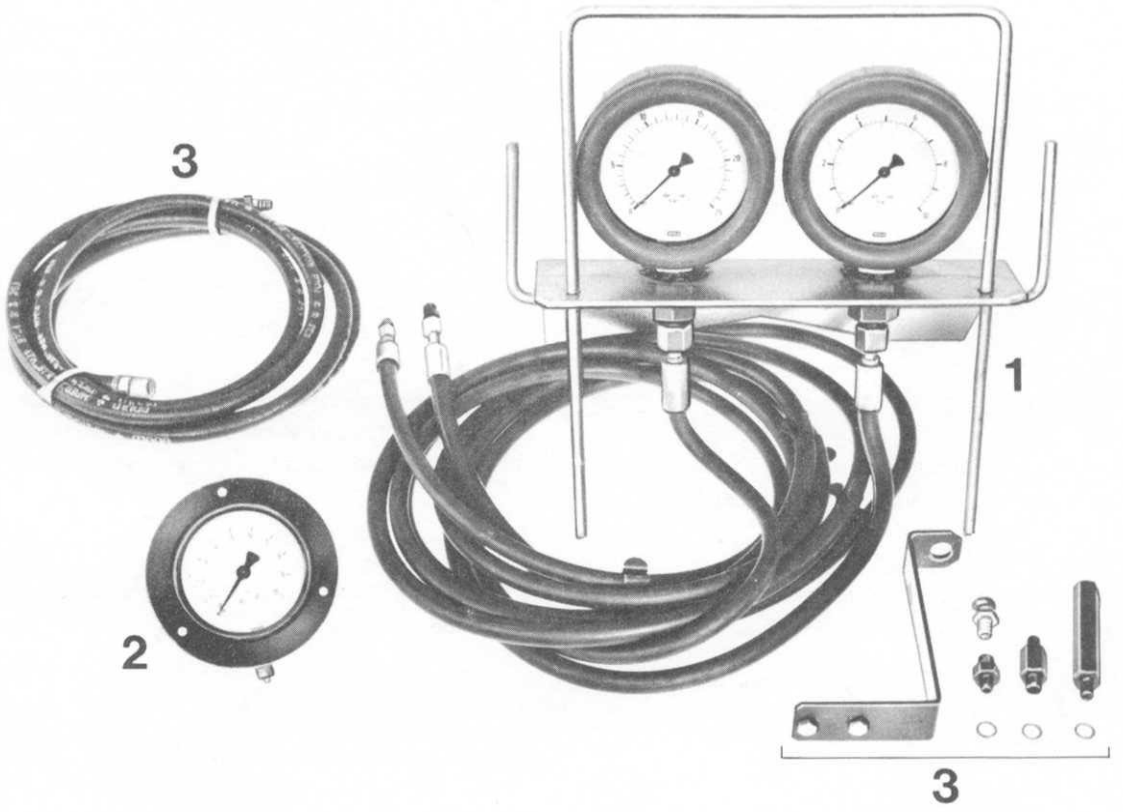


3. Install torque converter and front converter housing (see page 32 - 1).

4. Redetermine thickness of shims for bearing assembly and install bearing assembly (see pages 39 - 24 and 39 - 29).

5. Adjust drive pinion and ring gear (see page 39 - 31).

TOOLS



No.	Description	Special Tool	Remarks
1	Gauge set	US 1090	
2	Gauge and coupling	VW 1318	or P 378
3	Hose, adapters and bracket	US 8030	

CHECKING TRANSMISSION OPERATION

Prior to making repairs on an automatic transmission, troubleshoot transmission as instructed below and with help from the following tests.

A - General Checks

B - Transmission Fluid Level

C - Stall Test

D - Test Drive

E - Pressure Test

Important

All jobs, which require that engine runs, should only be carried out with selector lever in "N" or "P" and parking brake applied.

Exceptions: Tests, which require briefly a different selector lever position.

A - General Checks

Following jobs must be performed prior to any testing of transmission, and if defects are found, they must be eliminated before continuing with other work on transmission.

1. Check engine tuning (ignition timing, idle and transition).

2. Check for external damage, e.g. leaks on transmission (ATF) or final drive (hypoid oil) and missing or loose mounting bolts.

B - Transmission Fluid Level

The specified fluid level is extremely important for proper operation of automatic transmission, so that following test must be carried out with great care.

Checking ATF Level

Also check appearance and odor of ATF. Burnt friction linings cause a burnt odor. Contaminated oil could cause failure in valve body.

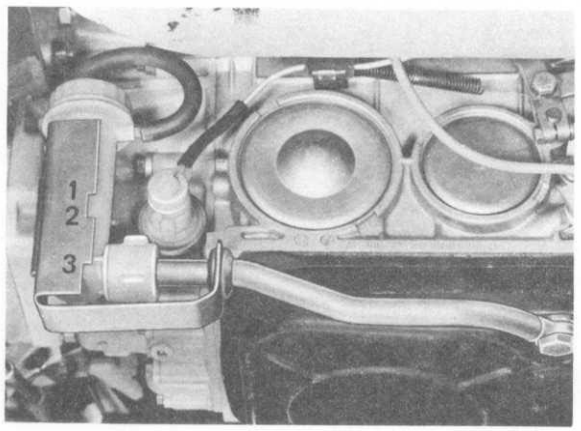
In this case transmission must be removed and repaired or replaced.

Test is carried out at engine idle speed, parking brake applied and selector lever at "N". Car must be on level surface.

Let engine run at idle speed 1 to 2 minutes before checking fluid level, so that torque converter will be full.

ATF level can be checked on a cold or warm transmission. However, the level will be more accurate on a cold transmission (20° - 30°C/ 68° - 86° F ATF temperature). An ATF temperature of 80° C/176° F can only be guesstimated.

ATF level in transmission will change with fluid temperature. Max. and min. marks on transparent tank are in reference to an ATF temperature of 80° C/176° F. When ATF temperature is 20 to 30° C/68 - 86° F, the ATF level will be 30 mm/ 1 3/16 in. below minimum mark (see figure). The amount of ATF between min. and max. marks is 0.2 liters/6.75 fluid ounces.



1 = max. at 80° C/176° F ATF temperature
2 = min. at 80° C/176° F ATF temperature
3 = max. at 20 to 30° C/68 - 86° F ATF-temperature

Add ATF to correct level. Cleanliness is essential!

If ATF level is too low, oil pump will draw in air, which can be heard. ATF will foam and cause incorrect readings when checking ATF level. Stop engine until ATF foam disappears (approx. 2 minutes). Add ATF and recheck ATF level.

Excessive ATF must be drained or drawn off, since otherwise transmission components would splash excessively and raise the temperature too much, until finally foamed oil is forced out through vent. This condition could damage transmission on a longterm basis.

After correcting ATF level to specifications, operate brake pedal, leave selector lever in each position (R - N - D - N - R) several seconds and then return it to "N", so that working pistons of power parts are filled with ATF. Recheck and, if necessary, correct ATF level.

C - Stall Speed

This check provides information on operation of engine, converter and transmission. It is applied, when top speed cannot be reached or acceleration is insufficient.

Note

During this check all the engine power is converted into heat in the converter, which is why this check must not last longer than 5 seconds.

Rear wheels must not be permitted to turn for this check.

Also engine must be at operating temperature and develop its full power.

Extra equipment, e.g. compressor for air conditioning, must be turned off.

Check must not be made with car's tachometer.

1. Connect tachometer that it can be read from driver's seat.
2. Run engine at about 2000 rpm approx. 2 minutes prior to testing.
3. Apply parking brake all the way and depress brake pedal with left foot.

4. Position selector lever at "D", floor accelerator pedal with right foot and check whether specified stall speed is reached.

Stall speed must be 2400 $\pm$ 200 rpm.

Note

If stall speed drops by approx. 400 to 700 rpm below specified value, one-way clutch in torque converter is slipping.

If stall speed is faster than specified value by about 300 rpm, slip is in transmission.

If stall speed is correct and top speed is still not reached, one-way clutch is locking in both directions or has seized. This will usually be noticed during fast highway driving by ATF leaking through the vent.

The stall speed will drop by approx. 125 rpm for each 1000 meters/3900 feet altitude above sea level because of a drop in engine power.

Even excessively high outside temperatures could cause stall speed to drop slightly below the minimum value.

D - Test Drive

Vehicle should be driven in all gear ranges and under all possible road conditions. Do not test drive if there is obvious mechanical damage.

Shift points in km/h (mph)

Selector lever position "D"		Upshift	Downshift
Accelerator pedal position		km/h (mph)	km/h (mph)
Part throttle	1-2-1	26 - 33 (16 - 21)	16 - 23 (10 - 14)
	2-3-2	42 - 48 (26 - 30)	32 - 37 (20 - 23)
Full throttle	1-2-1	97 - 105 (60 - 65)	45 - 52 (28 - 32)
	2-3-2	150 - 158 (93 - 98)	57 - 85 (35 - 53)
Kickdown	1-2-1		57 - 78 (36 - 48)
	2-3-2		122 - 133 (76 - 83)

1. Note shift points and compare to chart above. Shifts should be smooth. Shifts should take place quickly and without lag in power transmission.

2. Listen for any sign of engine speedup between shifts. Speedup between shifts indicates slipping brake bands or clutches.

3. After road test check transmission for fluid leaks.

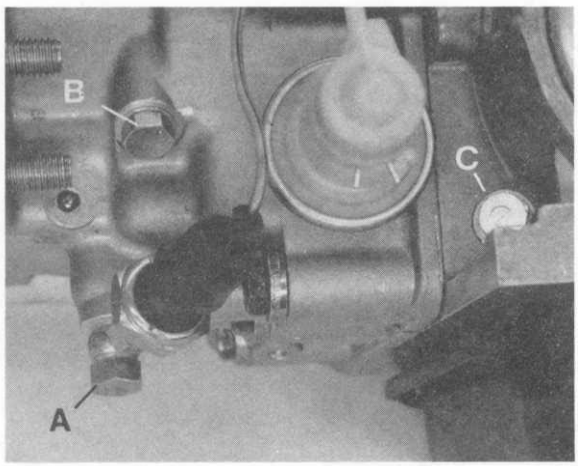
Note

All specified speeds are approximate.

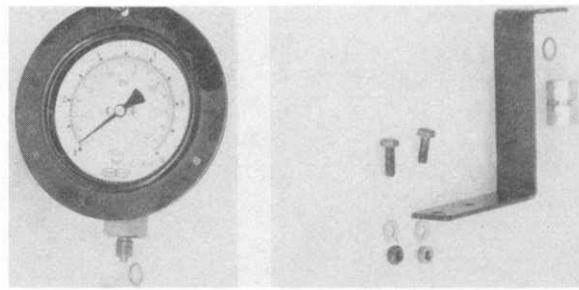
E - Pressure Test

Note

This test will locate defects in ATF circuit (internal leakage, wear, sticking control valves, dirt in ATF system).



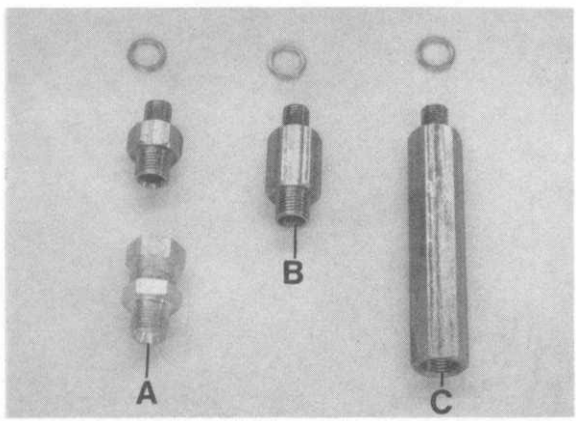
a = main pressure
b = governor pressure
c = modulator pressure



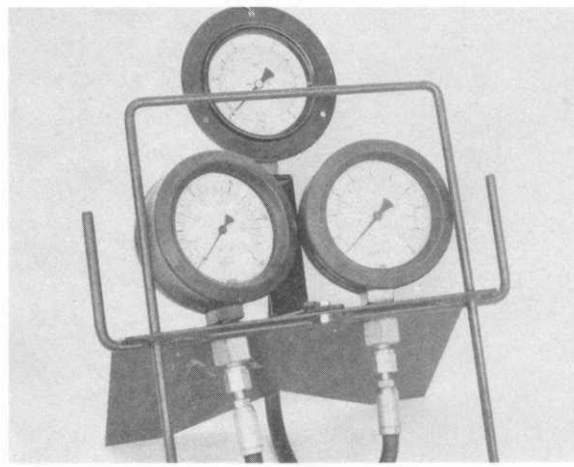
Gauge and coupling from VW 1318 plus bracket and parts from US 8030.

Note

After removing gauges, install plugs with new seals.



Hose adapters for pressure gauges (from US 8030)



Third gauge setup with US 1090

Work sequence

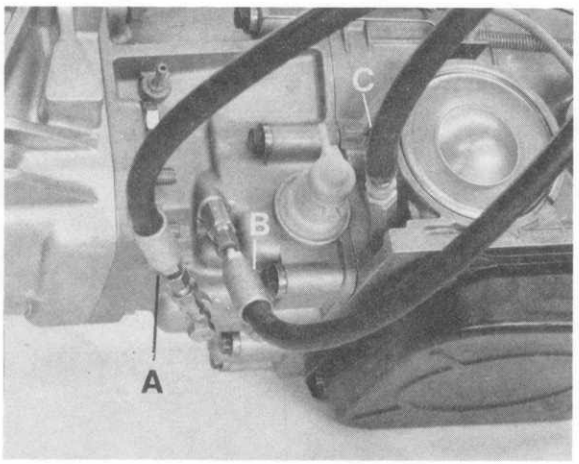
1. Connect gauge with 0 - 25 bar (0 - 350 psi) range to main pressure gauge connection a.

2. Connect gauge with 0 - 10 bar (0 - 140 psi) range to governor pressure gauge connection b.

3. Connect gauge with 0 - 10 bar (0 - 140 psi) range to modulator pressure gauge connection c.

Note

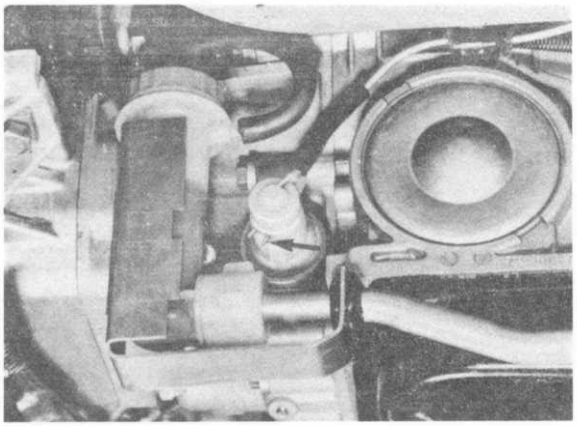
Pressure gauge set is set up in footwell of front passenger seat. Hoses are routed through window of right door.

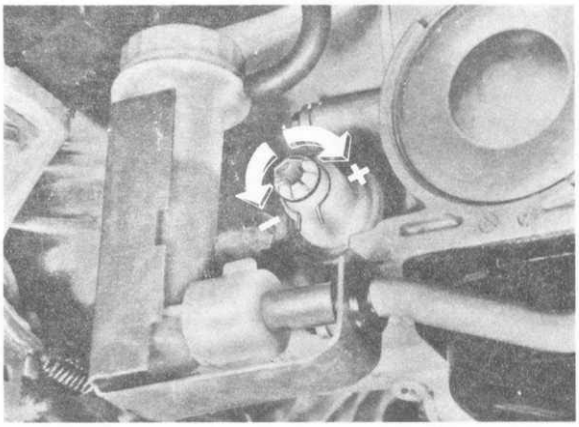


Hose adapters installed

Note

Before any other pressures are checked, modulator pressure must be measured at full throttle in "D" range at 88 km/h (55 mph) with vacuum line connected (see page 38 - 9). Adjust if necessary. Correct modulator pressure automatically affects main pressure.





Checking Modulator Pressure

1. Compress circlip (arrow) and remove cover.
2. If inside of cover is wet with ATF, replace modulator.
3. Adjust if necessary.

Checking Main Pressure

Not adjustable, modulator pressure automatically affects main pressure.

Checking Governor Pressure

Not adjustable.

Adjusting Modulator Pressure

1. Compress circlip and remove vacuum modulator cover.
2. Slightly pull adjusting key out and turn screw.
3. After adjusting, push key into nearest slot. One turn of setting screw results in 0.2 bar (2.8 psi) pressure change.

Note

Changing modulator pressure also changes shift points.

Replacing Vacuum Modulator

1. Pull off vacuum hose.
2. Compress circlip and remove cover.
3. Remove modulator using 22 mm open end wrench.
4. When installing, apply non-hardening sealing compound to threads.

Nominal Pressures in Bar (PSI)

Test for	Transm. Type A 22.01 (1980)	Transm. Type A 22.02 (1978, 1979)	Testing Conditions
Modulator pressure	3.1 - 3.15 (44 - 45)	3.1 - 3.15 (44 - 45)	Full throttle in range "D" (3rd gear) with connected vacuum line. Transmission temperature below 90° C/194° F.
	4.6 - 4.9 (65 - 70)	4.6 - 4.9 (65 - 70)	Measured on stationary car at stall speed in range "D", vacuum line disconnected.
Main pressure	10.0 - 11.6 (145-168)	10.5 - 11.2 (149 - 159)	Measured on stationary car at stall speed in range "D", vacuum line disconnected.
	19.2 - 20.3 (278 - 294)	18.5 - 19.6 (263 - 279)	Measured on stationary car at stall speed in range "R", vacuum line disconnected.
	5.5 - 5.9 (80 - 86)	5.2 - 5.6 (74 - 80)	Full throttle in range "D" (3rd gear) at approx. 100 km/h, vacuum line connected.
Governor pressure	0.5-0.6 (7-9) 1.5-1.7 (21-24) 2.1-2.2 (30-31) 2.5-2.6 (36-37) 3.1-3.3 (44-47) 3.9-4.1 (55-58)	0.5-0.6 (7-9) 1.5-1.7 (21-24) 2.1-2.2 (30-31) 2.5-2.6 (36-37) 3.1-3.3 (44-47) 3.9-4.1 (55-58)	20 km/h (12 mph) 50 km/h (31 mph) 75 km/h (47 mph) 100 km/h (62 mph) 130 km/h (81 mph) 160 km/h (99 mph) } Vacuum line

TROUBLESHOOTING AUTOMATIC TRANSMISSION

Note: If transmission oil is black and smells burnt or there is an unusual large amount of metal burrs in oil pan, either repair or replace transmission.

Conditions and Correction

Condition: Transmission slips in all selector lever positions

Correction:

1. Check modulating pressure, adjusting if necessary. If not adjustable, check movement of modulating pressure control valve. Clean modulating pressure safety valve in shift valve housing upper section.
2. Check whether vacuum line from intake branch to vacuum box is plugged. If yes, replace.
3. Check operating pressure. If too low or not available:
   a) Disassemble and clean shift valve housing, and service operating pressure control valve.
   b) Remove and inspect primary pump, replacing if necessary.

Condition: Transmission grabs or car vibrates when moving off

Correction:

1. Check modulating pressure, adjusting if necessary.
2. Pull off vacuum line from vacuum box, checking whether ATF or fuel escapes.
   a) If ATF, replace vacuum box.
   b) If fuel, check fuel injection system and repair.

Condition: 1st gear slips

Correction:

1. Check easy movement of control valve B 1, replacing shift valve housing if necessary.
2. Remove and install brake band piston B 1, check seal and replace if necessary.
3. Replace brake band B 1 and pressure part for B 1. Check easy movement of vent valves in support flange K 1, replacing support flange if necessary.

Condition: Transmission slips during 1st/2nd shift or in 2nd and 3rd gear

Correction:

1. Check modulating and operating pressures, adjusting if necessary.
2. Replace shift valve housing, also replacing sealing bushings on plug tubes.
3. Repair clutches K 1 and K 2 depending on findings. Visually inspect oil distribution sleeve, replacing if necessary.

Condition: Transmission slips in 3rd gear

Correction:

1. Remove shift valve housing, check sealing bushings on plug tubes and replace same if necessary.
2. Repair clutch K 2 depending on findings. Visually inspect oil distribution sleeve, replacing if necessary.

Condition:	Transmission slips when moving off in 1st and 2nd gear, or moving off not possible in forward gear. Reverse gear is still good
	Brake band B 2 seriously worn or broken
Correction:	Adjust brake band B 2 by installing a longer pressure pin. Replace brake band, if seriously worn or broken.

Condition:	Transmission slips in all gears
	No or insufficient modulating pressure
Correction:	1. Check modulating pressure, adjusting if possible. 2. Remove and service modulating pressure control valve. 3. Check and clean modulating pressure safety valve in shift valve housing upper section.

Condition:	After installation, transmission has no power flow or fails after a brief time of operation
	Torque converter not installed according to instructions. Drive dogs do not engage accurately in drive gear of primary pump. Follow-up damage: Drive dogs of torque converter and primary pumps will be destroyed.
Correction:	Install torque converter according to instructions.

Condition:	No power flow in all selector lever positions for a brief period immediately after starting engine (especially when car had not been used for a while)
	Torque converter drains partially via leaky or defective lubricating ring or valve in input shaft.
Correction:	1. Check lubricating ring on input shaft, replacing if necessary.
	2. Checking ball valve in input shaft, replacing input shaft if necessary.
	3. Check and clean lubricating pressure valve in shift valve housing.

Condition:	No power flow in reverse gear
Correction:	1. Remove shift valve housing, check brake band B 3 and adjustment.
	2. Remove brake band piston B 3 and check seal.
	3. Replace one-way clutch in gear set.

Condition:	Strong jolt when engaging selector lever in "D"
Correction:	1. Adjust idle speed and CO level to specifications.
	2. Check modulating and operating pressures, correcting modulating pressure if necessary.
	3. Check vacuum line and connections for leaks.
	4. Check whether pressure acceptance piston in rear transmission case moves easily and is installed correctly.
	5. Check whether feed bore for pressure acceptance piston in rear transmission case is plugged.
Note:	If there is a hard engagement jolt when quickly shifting back and forth between "N" and "D" several times, there is no fault. The pressure pick-up requires a running time of approx. 2 seconds. If this time is given, the engagement jolt will also be correct.

Condition: Strong jolts when changing gears

Correction:
1. Check modulating and operating pressures, adjusting modulating pressure if necessary. If operating pressure is too high, replace shift valve housing.
2. Check vacuum line and connections for leaks.
3. Service control valve for converter adaptation.

Condition: Strong jolt in downshift from 3rd to 2nd gear

Correction:
1. Replace seal on release end of B 2.
2. Replace brake band piston B 2.

Condition: No upshifts

Correction:
1. Check governor pressure. If there is no governor pressure reading, continue with point 1. If governor pressure is correct, continue with point 2.
2. Disassemble, clean and service centrifugal governor.
3. Disassemble and clean shift valve housing, replacing if necessary (use new sealing bushings on plug tubes).

Condition: No upshift on cold transmission, upshifts okay after short distance

Correction:
1. Replace shift valve housing (use new sealing bushings on plug tubes).

Condition: Upshifts only in upper speed range of gears

Correction:

1. Check and adjust control pressure cable.
2. Check governor pressure and replace centrifugal governor, if governor pressure is too low.
3. Service control pressure valve.

Condition: Upshifts only in lower speed range of gears

Correction:

1. Tighten bolt for control pressure lever on transmission. Then check control pressure cable, adjusting if necessary.
2. Check full throttle stop. Move accelerator pedal to kickdown and check whether throttle is against full throttle stop, adjusting if necessary.
3. Check governor pressure and replace centrifugal governor, if governor pressure is too high.

Condition: No kickdown downshifts

Correction:

1. Check voltage at solenoid valve. If necessary, check wire connections against current flow diagram.
2. Remove solenoid valve. Connect removed valve to power supply and check function, replacing if necessary.
3. Tighten control pressure lever bolt on transmission. Then check control pressure, adjusting if necessary.
4. Check movement of kickdown control valve in shift valve housing upper section, replacing shift valve housing if necessary.

Condition: No brake shifts from 3rd to 2nd and 2nd to 1st

Correction:
1. Adjust control pressure cable.
2. Service brake shift piston, replacing shift valve housing if necessary.

Condition: Automatic, unwanted downshifts outside of partial throttle downshift range, without operation of kickdown switch

Correction:
1. Remove kickdown solenoid valve. Check O-ring on solenoid valve for damage.
2. Check whether kickdown switch sticks in pressed position, replacing if necessary.
3. Check whether solenoid valve sticks in open position, replacing solenoid valve if necessary.
4. Check movement of control pressure valve, cleaning shift valve housing and servicing valve if necessary, or replacing shift valve housing.

Condition: Poor acceleration when moving off

Correction:
1. Check stall speed.
2. If stall speed drops below specified value by approx. 400 to 700 rpm, one-way clutch in converter is slipping. Replace torque converter.

Condition: Transmission does not make upshifts

Correction:
1. Check governor pressure and when not correct, clean and service centrifugal governor. If correct, continue with point 2.
2. Service master valve in shift valve housing, replacing shift valve housing if necessary.

Condition:	Parking lock does not engage
Correction:	Check adjustment of selector lever cable, correcting if necessary.

Condition:	Selector lever cannot be engaged in "R" and "P" a) With engine running b) With engine stopped
Correction:	1. a) Disassemble, clean and service centrifugal governor. 2. b) Service blocking piston in rear transmission case.

Condition:	Engine cannot be started with selector lever in "P" or "N"
Correction:	1. Adjust selector lever cable and starter interlock switch. 2. Replace starter interlock and backup light switch.

Condition:	Invisible oil loss (leak cannot be seen on outside) Diaphragm in vacuum box defective. ATF drawn in by engine via vacuum line.
Correction:	Replace vacuum box.

Condition:	Sudden thick smoke caused by defective vacuum box
Correction:	Replace vacuum box.

Condition:	ATF lost between torque converter and primary pump
Correction:	1. Install and tighten drain plug for torque converter, using a new seal. Coat threads with Hyloma. If still leaking ATF, continue with points 2 and 3. 2. Replace radial seal and O-ring of primary pump, checking O-ring groove in primary pump for porous spots. Replace primary pump, if necessary. 3. Apply a good coat of Hyloma to threads of bottom mounting bolts.

Condition:	Oil leak behind starter interlock and backup light switch
Correction:	Replace O-ring on pressure part B 2.

Condition:	2nd gear loud
Correction:	Replace rear planet gear set.

Condition:	Whining noise only when changing gears with full load
Correction:	Replace oil filter.

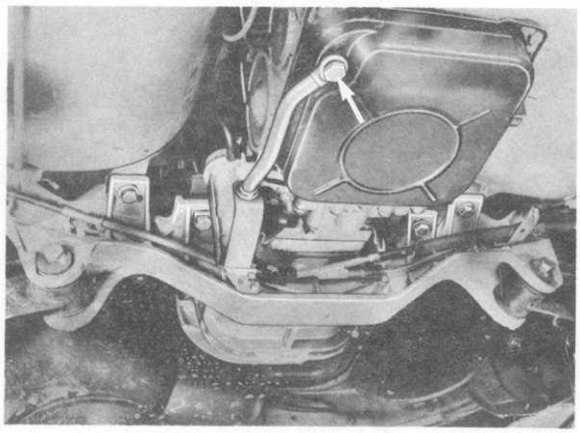
Condition:	Whining noise, which increases in loudness as engine speed rises
Correction:	Check primary pump, replacing if necessary.

REMOVING AND INSTALLING SHIFT VALVE HOUSING

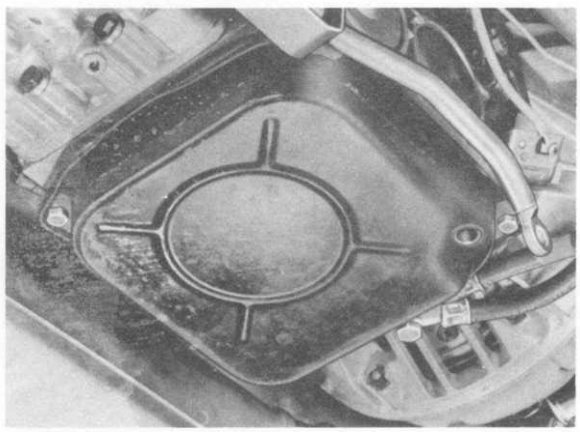
Removing

1. Move selector lever to "P".

2. Unscrew oil filler tube from oil pan and let ATF drain.



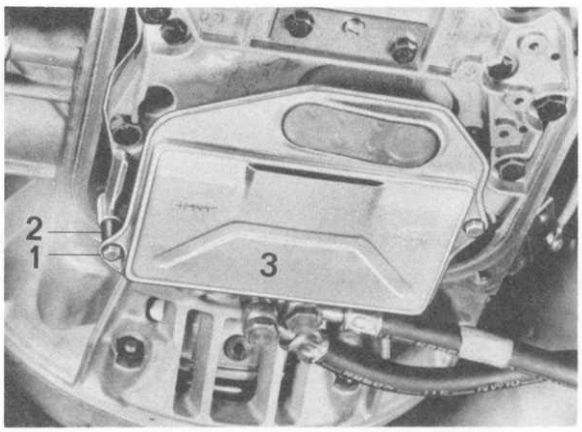
3. Unscrew oil filler tube coupling and turn out filler tube.



4. Unscrew oil pan mounting bolts and remove oil pan with gasket.

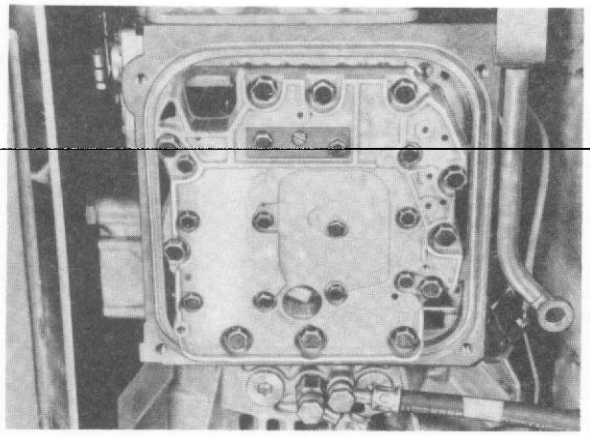
Note:
If ATF smells burnt and there is metal abrasion in oil pan, sludge or an unusual large amount of burrs, it is not sufficient to only replace shift valve housing. The entire transmission and torque converter will have to be replaced. Further oil lines and oil cooler will have to be flushed clean thoroughly.

5. Remove oil filter.



1 - Mounting bolts
2 - Spacer
3 - Oil filter

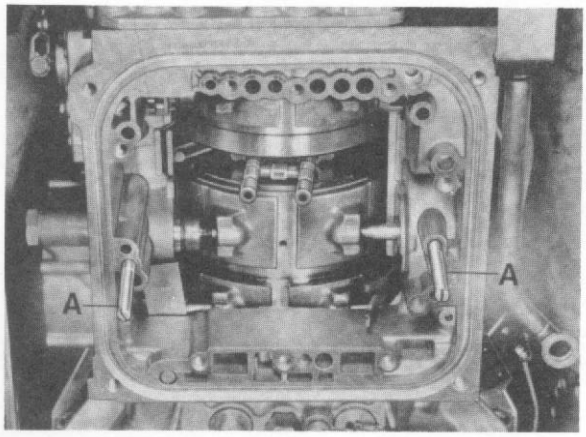
6. Unscrew mounting bolts of shift valve housing and remove shift valve housing.



7. Remove plug tubes with sealing bushings and pull off sealing bushings from plug tubes.

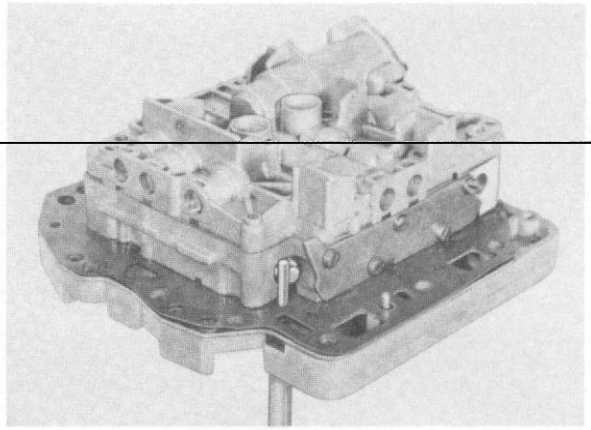
Installing

1. Fit new sealing bushings on both ends of plug tubes and install tubes in transmission. Screw two locally made centering pins in transmission case.

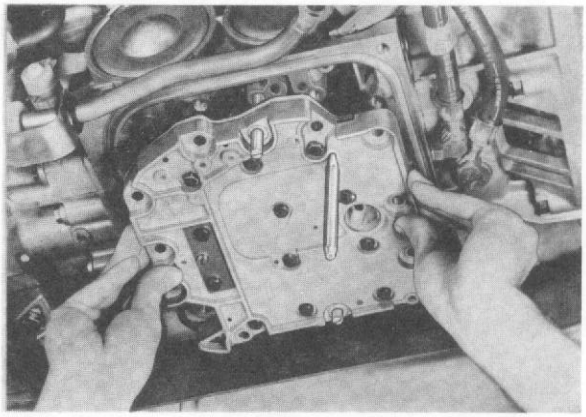


A - Centering pins

2. Install locating pin (suitable punch) for control pressure valve in shift valve housing.



3. Guide in shift valve housing carefully. Make sure in particular that range valve engages correctly in catch plate.



4. Install mounting bolts with spring washers and tighten to specified torque.

5. Remove locating pin for control pressure valve.

6. Install oil filter.

7. Install oil pan with gasket and tighten mounting bolts to specified torque.

8. Screw oil filler tube on oil pan and tighten coupling nut.

9. Add ATF as specified.

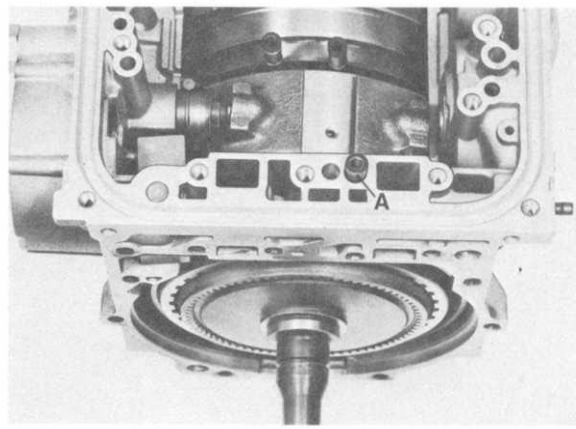
10. Check shifts during test drive.

11. Check ATF level while warm.

12. Tighten bolts on oil pan to specified torque.

Note

As from May 7, 1979 a rubber insert is installed to eliminate hydraulic noise in the lubricating circuit.
Rubber inserts can be service installed in a transmission without one.



A - Rubber insert

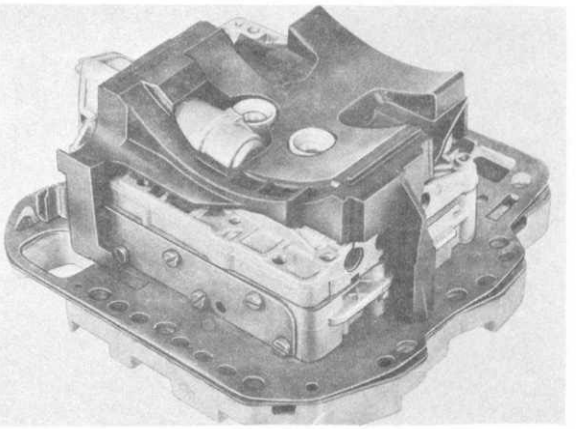
MODIFICATIONS ON SHIFT VALVE HOUSING

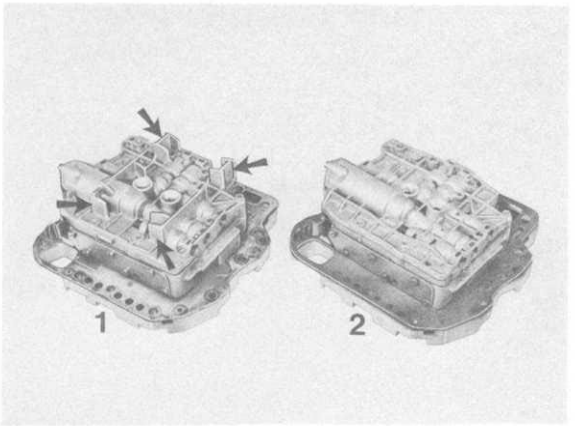
Note

The shift valve housing has an additional plastic brake band holder from transmission numbers

169 0626 A 22.01 Europe, Rest of World
and 169 3254 A 22.02 USA, Japan.

The cast brake band holders have been omitted on these housings.





1 - Old version with cast brake band holders (arrow)
2 - New version (install only with plastic brake band holder)

Only the new version will be available after depletion of old version shift valve housing stocks. Old and new version shift valve housings are interchangeable, however the new version (without cast brake band holders) will always require installation of the plastic brake band holders.

TOOLS

No.	Description	Special Tool	Remarks
	Filler		Standard, e.g. Dresser-Wayne Model 3009

REPLACING ATF AND FILTER

ATF Capacity:

Initial filling: approx. 6.0 liters/6.3 US.qt
ATF change: approx. 5.5 liters/5.7 US.qt

Type of ATF:

ATF Dexron ® or Dexron II ®

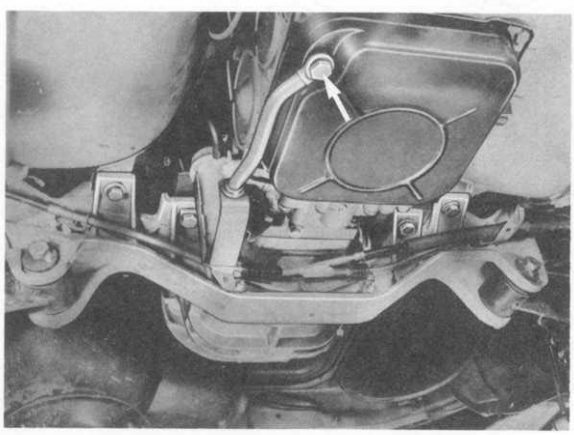
ATF and filter must be replaced every 48,000 km/30,000 miles.

Note:

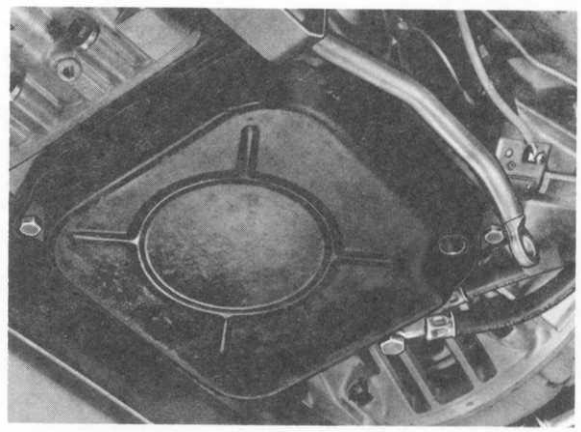
ATF (not filter) should be replaced more often, if car is subjected to severe operating conditions (trailer hauling etc.).

Car must be on level surface when replacing ATF. Also have transmission at operating temperature and engine stopped.

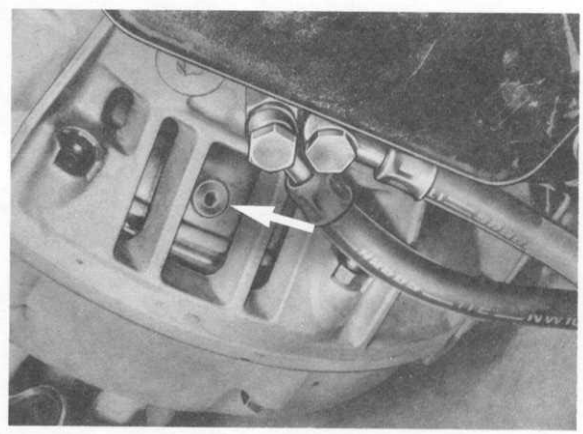
Unscrew oil filler tube from oil pan and let ATF drain.



Unscrew filler tube coupling nut and turn out filler tube.



Turn crankshaft until converter drain plug can be seen and removed.



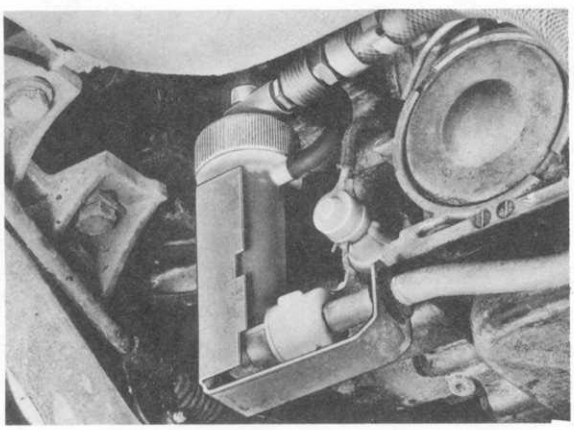
Remove transmission oil pan and replace oil filter when ATF stops draining from transmission and torque converter.

Install oil pan with gasket and tighten mounting bolts to 7.0 Nm/5 ftlb torque.

Install converter drain plug with a new seal.

Adding ATF

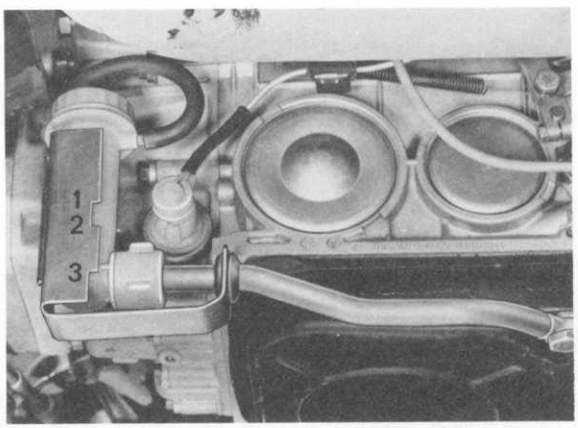
First add a large amount (approx. 4 liters/4 US.qt) of ATF with the engine stopped. Start engine with selector lever in "P" and let engine run at idle speed. Observe ATF level in tank and add remaining ATF immediately.



Operate brake pedal and leave selector lever in each position several seconds. Then recheck ATF level.

Note:

ATF level in transmission will change with any change in ATF temperature. Max. and min. marks on tank are in reference to an ATF temperature of 80 °C/176 °F. At a temperature of 20 to 30 °C/ 68 to 86 °F, on the other hand, the maximum ATF level will be approx. 30 mm below the min. mark (see figure). This information is important for replacing ATF, which normally takes place at this temperature.



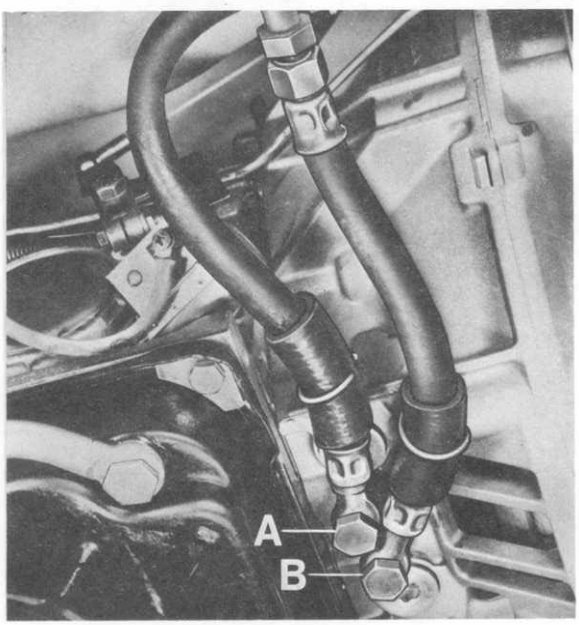
1 = Max. at 80 °C/176 °F ATF temperature
2 = Max. at 80 °C/176 °F ATF temperature
3 = Max. at 20 to 30 °C/68 to 86 °F ATF temperature

FLUSHING ATF COOLER AND LINES

Note

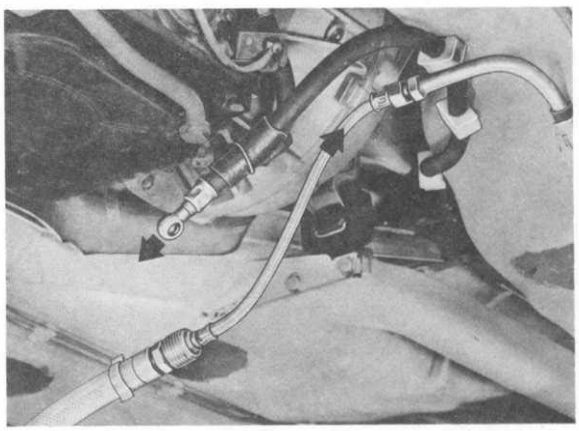
If ATF smells burnt and there are metal particles or sludge in oil pan, it is not sufficient to only replace the valve body or transmission. The ATF cooler and lines will also have to be flushed with ATF.

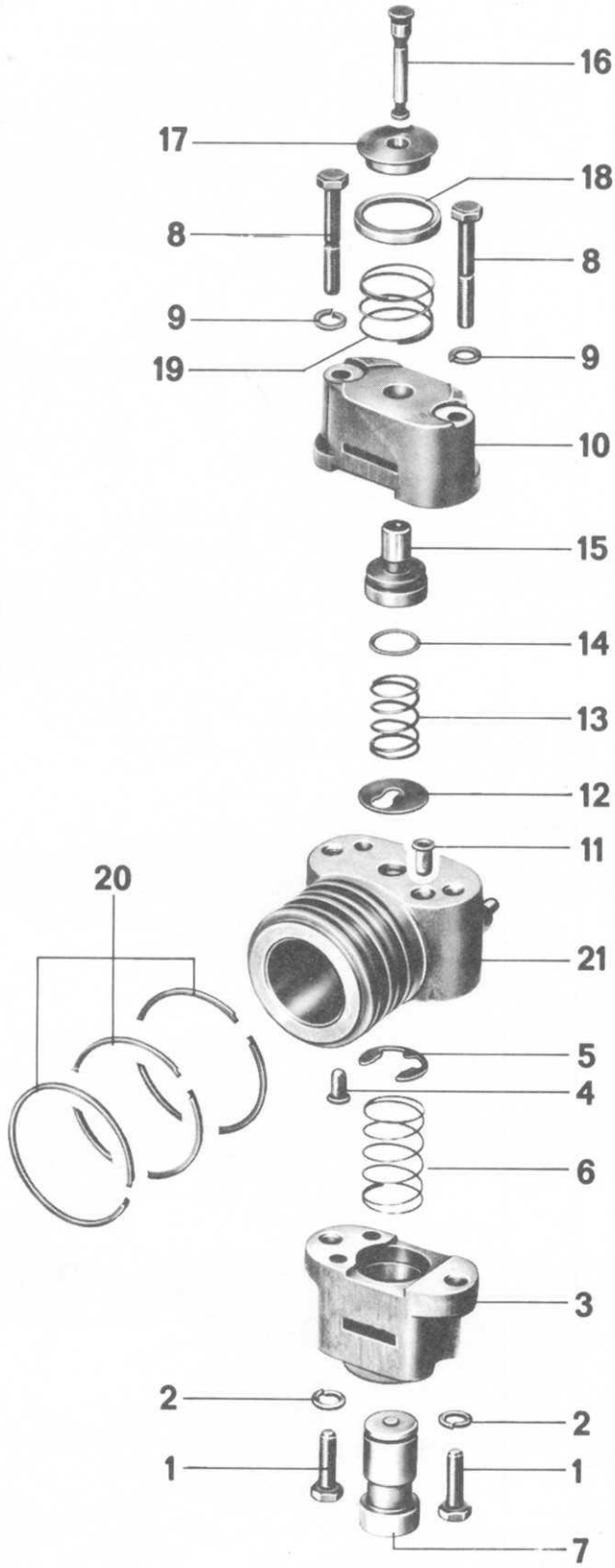
1. Detach feed and return lines at converter housing and take off short hose from return line.



A – To cooler inlet (bottom connection)
B – From cooler outlet (top connection)

2. Attach extra hose from ATF charger (see Workshop Equipment Group of Special Tool Catalog) on return line and flush cooler as well as lines with the charger.

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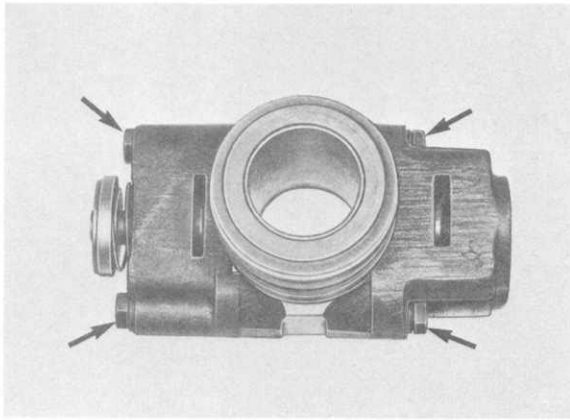
No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
1	Bolt	2		Tighten to specified torque	
2	Lockwasher	2		Replace, if necessary	
3	Valve body	1		Position correctly on flange	
4	Filter screen	1			
5	Circlip	1			
6	Spring	1			
7	Shift valve	1		Check for easy movement and damage	
8	Bolt	2		Tighten to specified torque	
9	Lockwasher	2		Replace, if necessary	
10	Governor housing	1		Position correctly on flange	
11	Filter screen	1			
12	Spring retainer	1		Position correctly	
13	Spring	1			
14	Shim	X	Note quantity and thickness for reinstalling		
15	Governor valve	1		Check for easy movement and damage	

No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
16	Pin	1			
17	Centrifugal weight	1			
18	Guide ring	1			
19	Spring	1			
20	Oil seal	3	Detach and remove carefully		
21	Flange	1			

DISASSEMBLING AND ASSEMBLING CENTRIFUGAL GOVERNOR

Disassembling

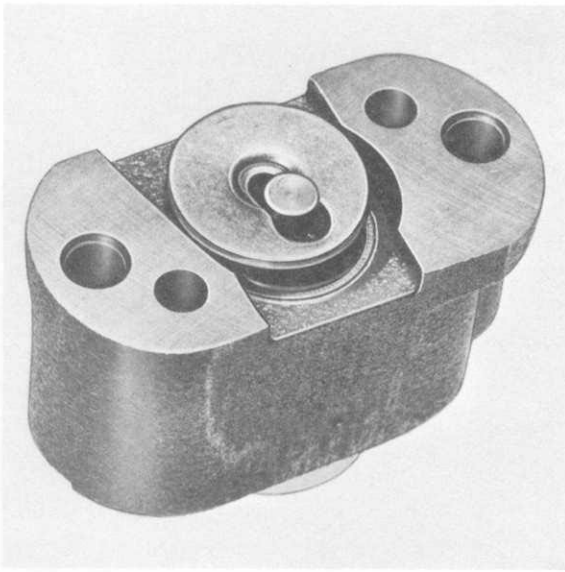
1. Unscrew bolts and remove valve body as well as governor housing from flange.



Note

Be careful not to damage filter screen in flange when taking off housing.

2. Press off spring retainer. Remove centrifugal weight with valve and springs.

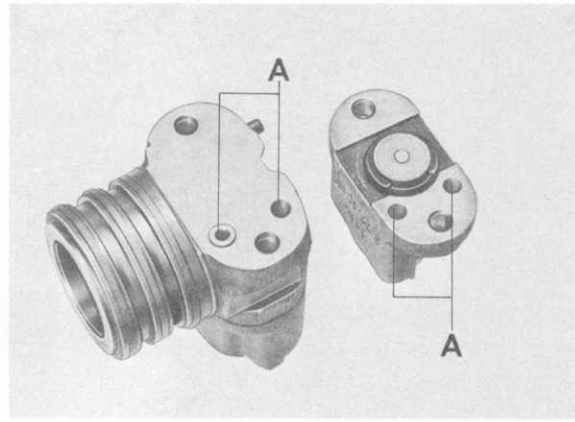


Assembling

Note

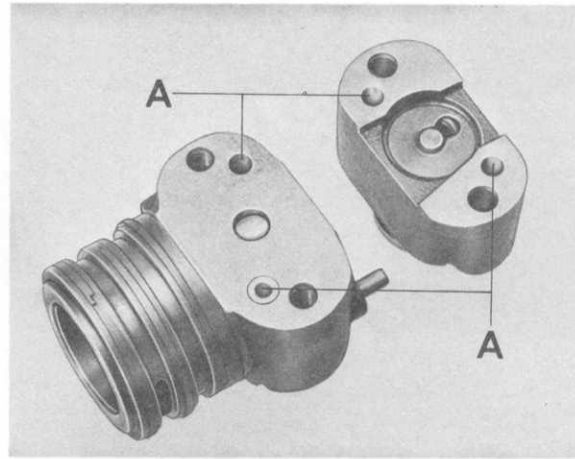
Clean all parts in clean gasoline thoroughly. Check shift valve and governor valve for damage and easy movement in their bores.

1. Place filter screen in seat provided for this purpose in oil bore and install valve body on flange that oil outlet slot faces oil seals and oil bores align.



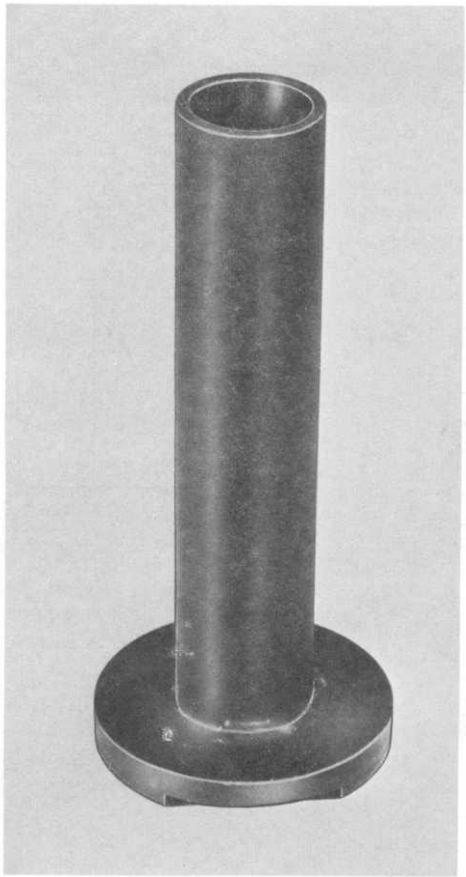
A - Oil bores

2. Place filter screen in seat provided for this purpose in oil bore and install governor housing that oil outlet slot faces oil seals and oil bores align.

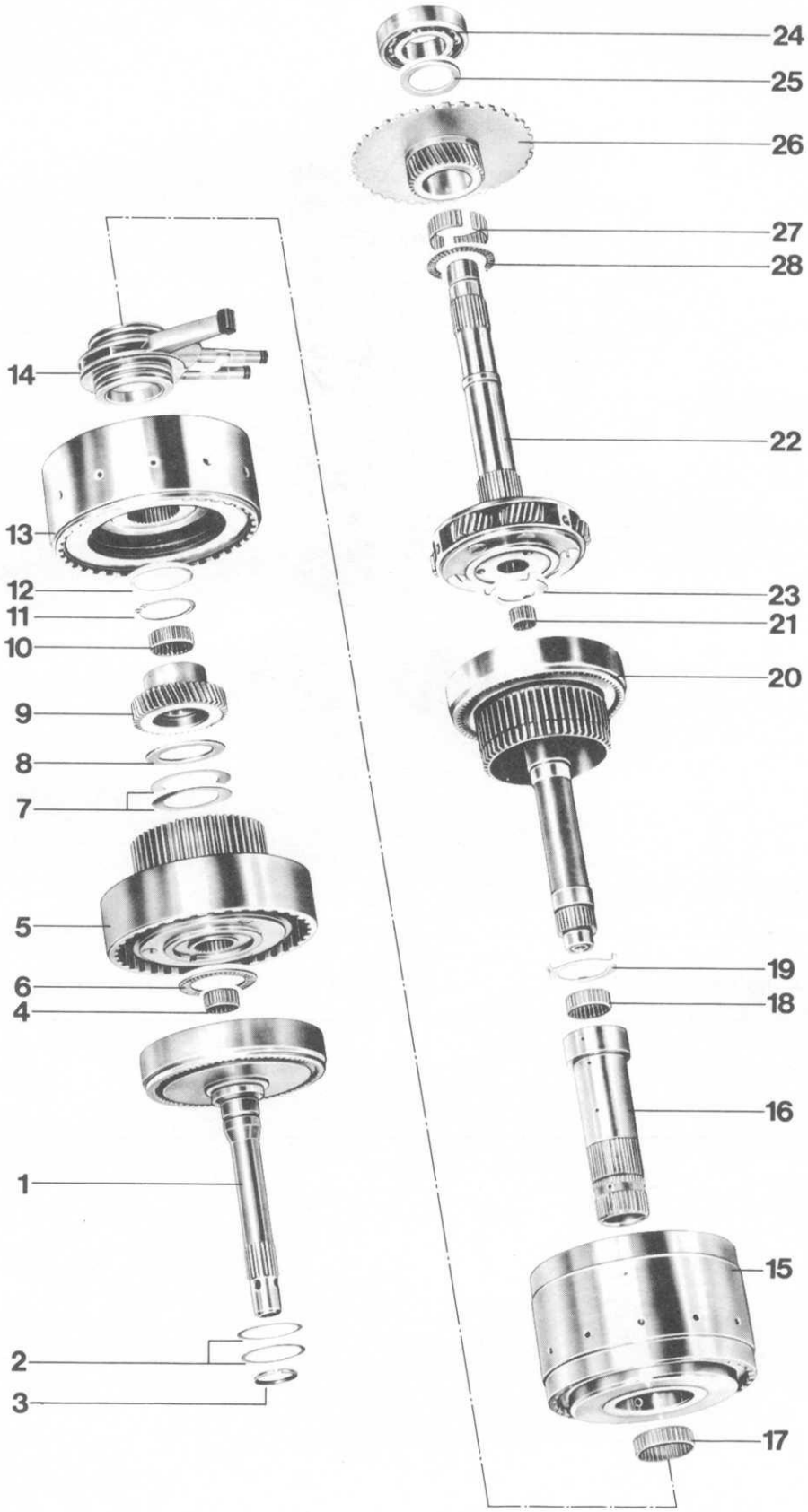


A - Oil bores

TOOLS



No.	Description	Special Tool	Remarks
1	Assembly tool	9307	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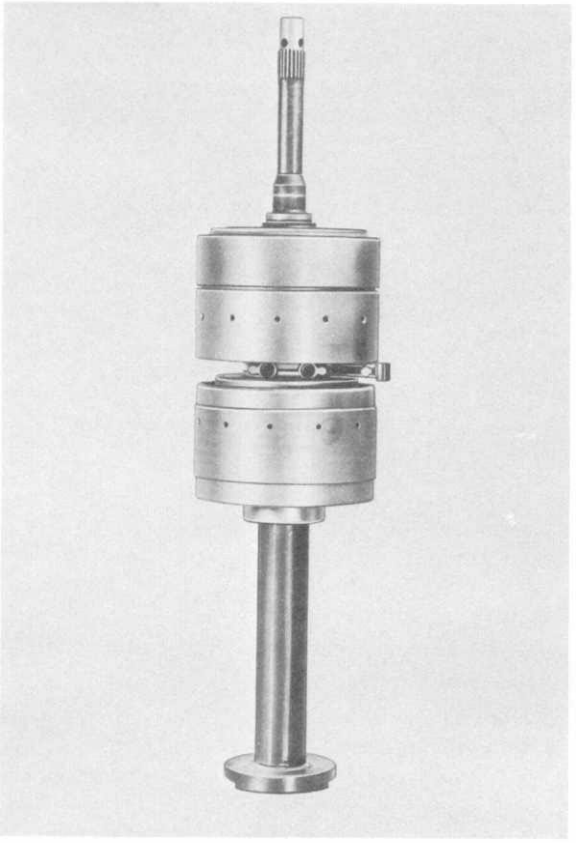
No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
1	Input shaft	1			
2	Shim	X	Note quantity and thickness for reinstalling	Redetermine thickness, if necessary	
3	Lubricating pressure ring	1			
4	Radial bearing	1			
5	Planet gear carrier	1			
6	Axial bearing	1			
7	Shim	X	Note quantity and thickness for reinstalling	Redetermine thickness, if necessary	
8	Axial bearing	1			
9	Sun gear	1			
10	Radial bearing	1			
11	Circlip	1			
12	Shim	X	Note quantity and thickness for reinstalling	Redetermine thickness, if necessary	
13	Clutch K 1	1			
14	Oil distribution sleeve	1		Position correctly	
15	Clutch K 2	1			
16	Hollow shaft	1			
17	Radial bearing	1			
18	Radial bearing	1			
19	Thrust washer	1			
20	Intermediate shaft	1			

No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
21	Radial bearing	1			
22	Output shaft	1			
23	Thrust washer	1			An aramide plastic washer without turning lock is installed instead of metal thrust washer betw. rear planet set and intermediate shaft for transm type A 22.04 as well as for type 22.01 from 1981 models
24	Ball bearing	1			
25	Thrust washer	1			
26	Sun gear	1			
27	Split needle bearing	1			
28	Axial bearing	1			

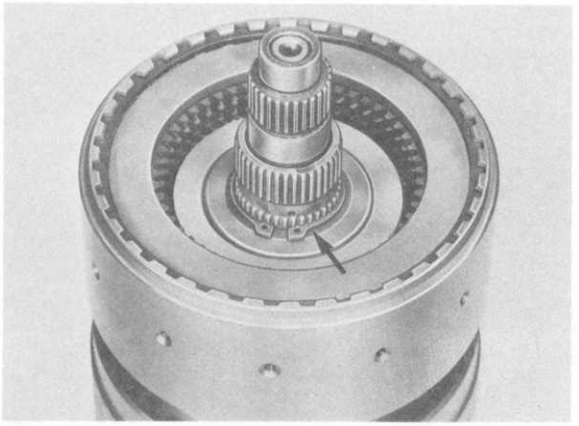
DISASSEMBLING AND ASSEMBLING GEAR ASSEMBLY

Disassembling

1. Slide Special Tool 9307 on to the output shaft and position the entire gear assembly upright carefully.

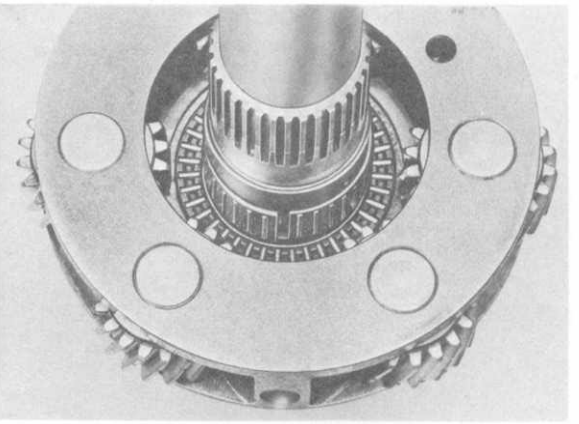


2. Remove snap ring and take off clutch K 1 and shims.



Assembling

1. Lubricate and install axial bearing and split needle bearing.



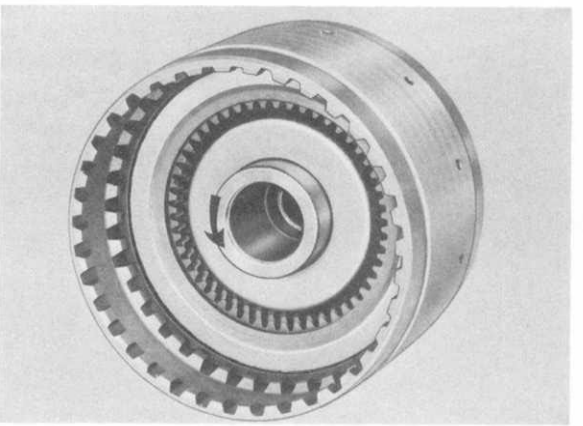
2. Install sun gear and thrust washer.

Note

Coated side of thrust washer faces sun gear.

3. Heat ball bearing to about 120° C and press on with a suitable piece of pipe.

4. Install hollow shaft in one-way clutch that shaft turns in direction of arrow.

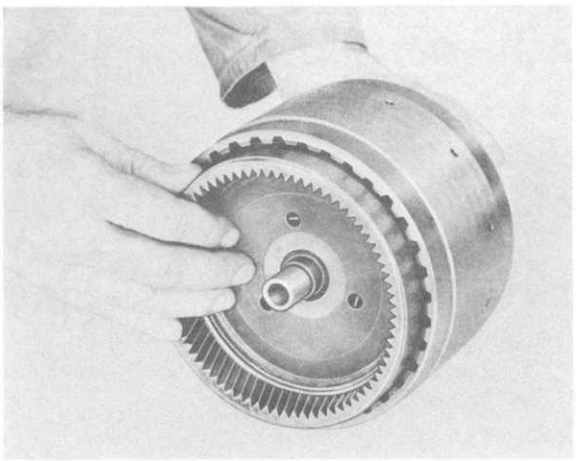


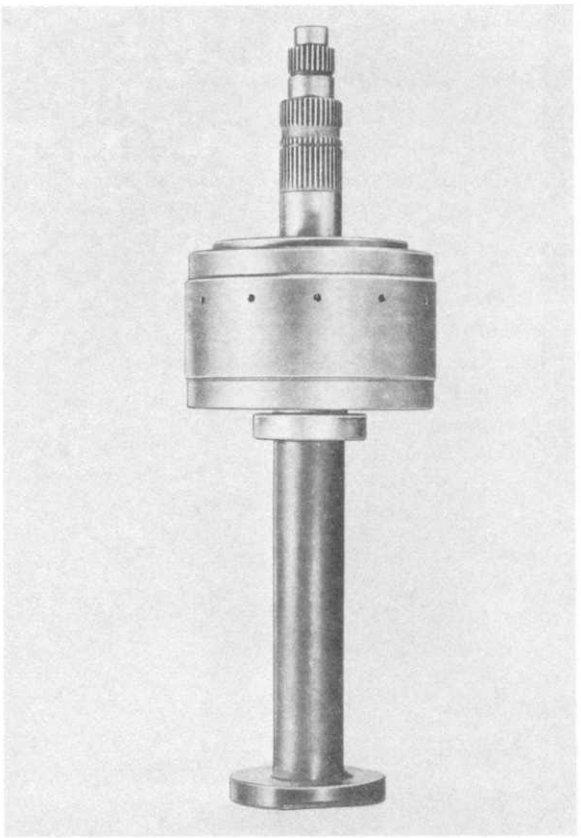
Note

After installation of hollow shaft it must lock when turned in opposite direction of arrow.

5. Lubricate thrust washer and needle bearing slightly and slide them on the intermediate shaft.

6. Install intermediate shaft in clutch K 2, turning slightly that spline of inner plate carrier engages in inner plates.



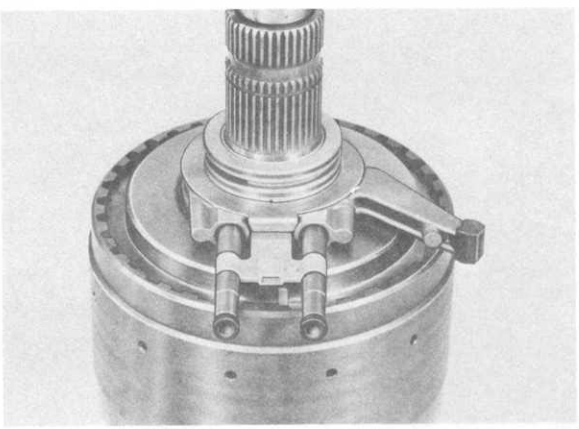


9. Install radial bearing between hollow shaft and support flange.

10. Install oil distribution sleeve in support flange K 2 so far carefully, that both oil seals engage in support flange.

7. Install output shaft with needle bearing in brake band drum.

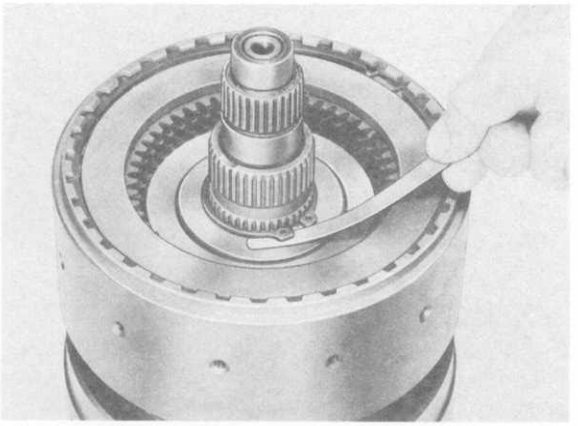
8. Install Special Tool 9307 on output shaft and position preassembled gear assembly upright carefully.



11. Install clutch K 1 carefully, making sure that oil seals engage properly.

12. Check axial play of hollow shaft.

Install circlip without shims and check play with a feeler gauge.

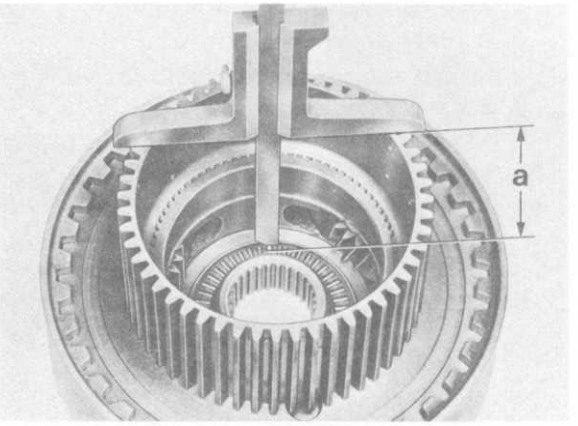


Install shims to adjust play to specified value of 0.3 to 0.4 mm.

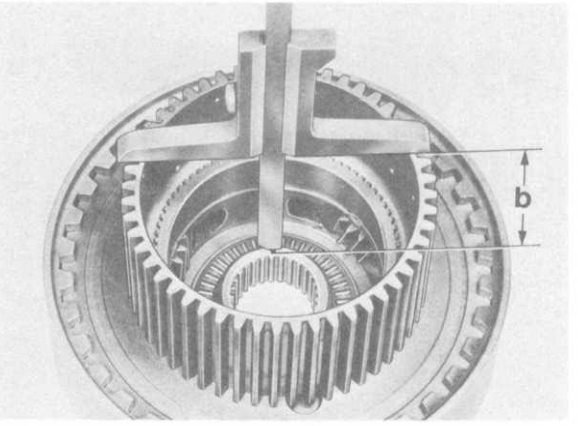
13. Check axial play of sun gear.

Lubricate and install axial bearing in planet gear carrier.

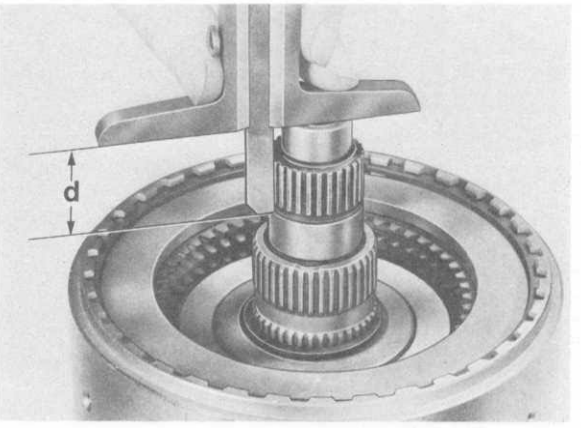
Measure distance "a" from face of inner plate carrier to roller of axial bearing with a depth gauge.



Measure distance "b" from face of inner plate carrier to shoulder of planet gear carrier.

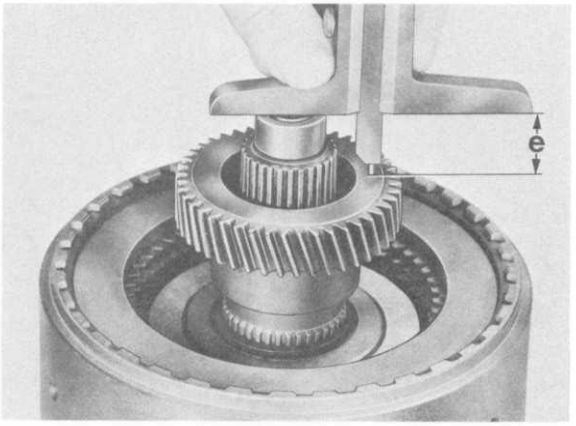


Measure distance "d" from face of intermediate shaft to shoulder of intermediate shaft.



Install sun gear and needle bearing.

Measure distance "e" from face of intermediate shaft to face of sun gear.



Calculate play:
Distance "a" - "b" = "c"
Distance "d" - "e" = "f"
Distance "c" - "f" = play

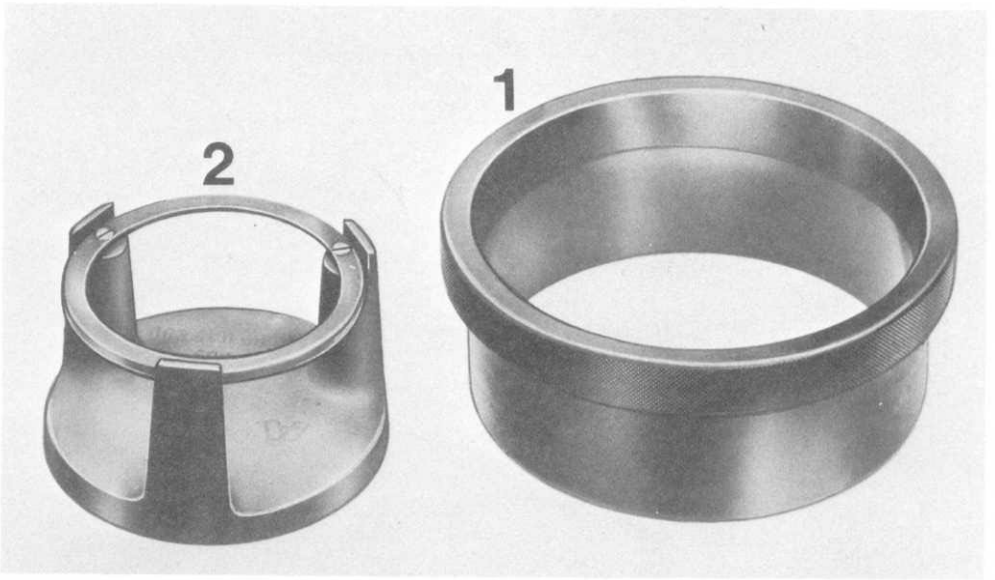
Adjust play to specified value of 0.2 to 0.3 mm by installing shims underneath the axial bearing.

14. Install planet gear carrier, turning it back and forth to have inner plate carrier engage in spline of plates.

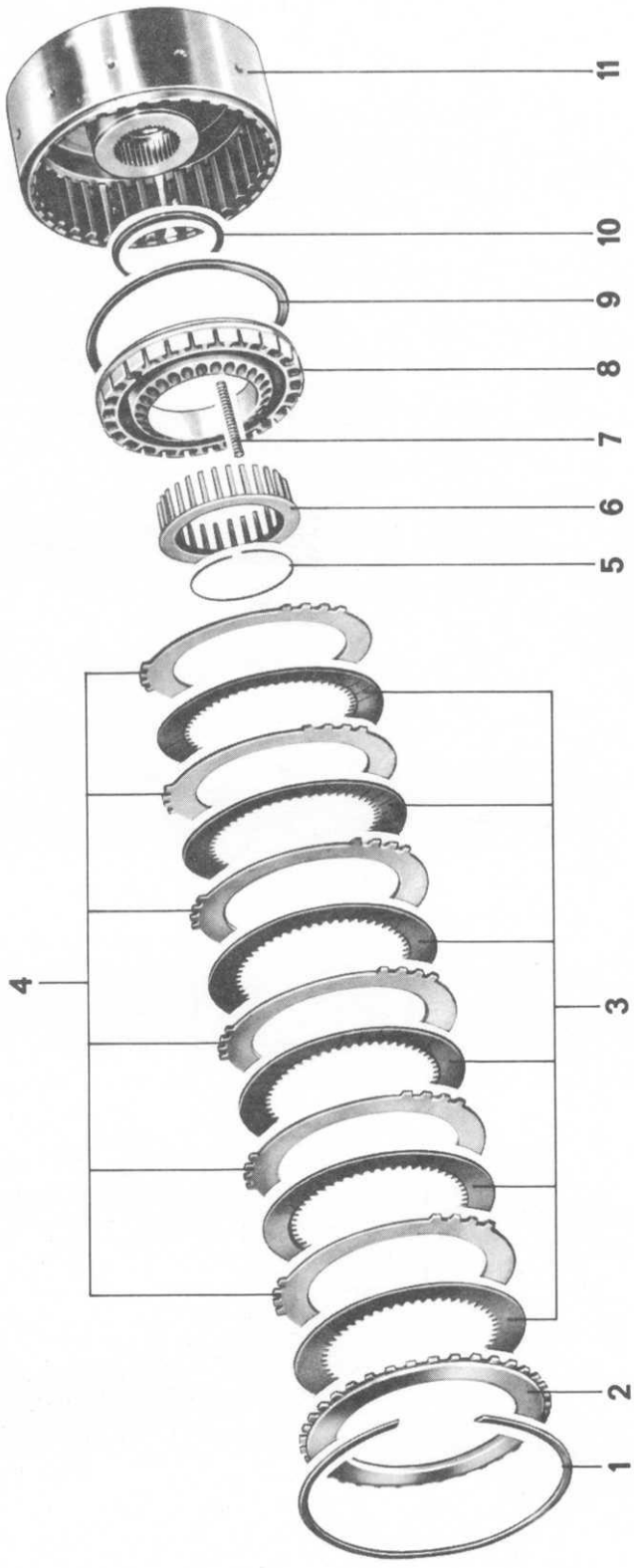
15. Install radial bearing and input shaft.

16. Install and attach lubricating pressure ring in groove of input shaft.

TOOLS



No.	Description	Special Tool	Remarks
1	Assembly sleeve	9308	
2	Assembly tool	9309	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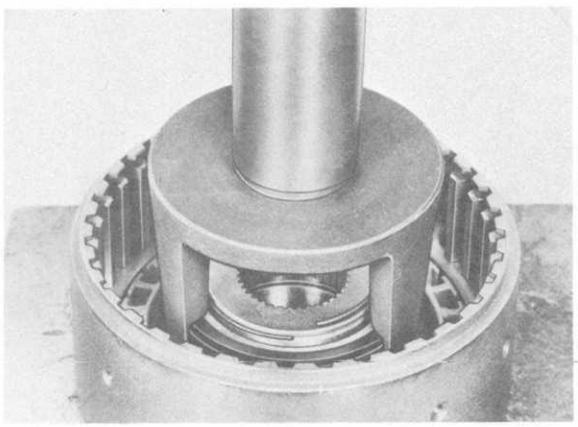
No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
1	Snap ring (corrugated)	1		Do not mix up with snap ring of K 2 (different spring force)	
2	Outer plate (5.0 mm thick)	1		Shouldered side faces snap ring	
3	Inner plate	6		Dip in ATF bath prior to installation	
4	Outer plate (optionally 3.0 or 3.5 mm thick)	6			
5	Snap ring	1			
6	Spring retainer	1			
7	Spring	X	Note quantity for reinstalling	Install same quantity as removed	
8	Piston	1	Pull out with two pointed pliers	Coat piston and lip seals with ATF and press in carefully with 9308	
9	Seal	1		Replace. Sealing lip faces support flange	
10	Seal	1		Replace. Sealing lip faces bottom of support flange	
11	Support flange	1			

DISASSEMBLING AND ASSEMBLING CLUTCH K 1

Disassembling

1. Install Special Tool 9309 on spring retainer that pressure ring has an uniform fit. Press down the spring retainer in a press far enough, that snap ring is clear and can be removed.



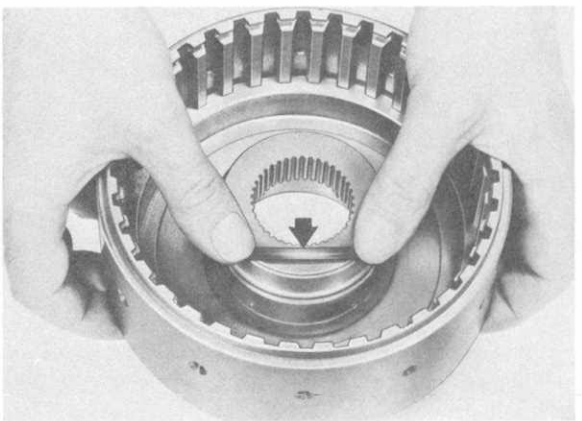
2. Release press carefully and remove spring retainer and springs.

Note

The quantity of springs for the clutch pistons will vary. If new springs are required, the same quantity must be used again.

Assembling

1. Install lipped seal carefully that it is positioned correctly in the groove and its lip faces down (in direction of arrow).



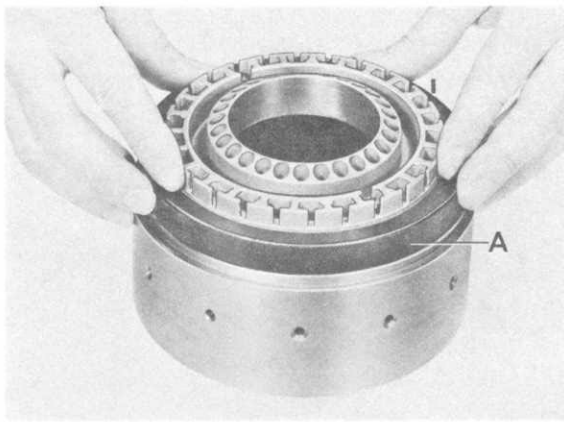
Note

Never use sharp edged tools to install seals.

2. Insert Special Tool 9309 in support flange.

3. Install lipped seal for piston that its sealing lip faces down to bottom of support flange.

4. Give piston and seal a light coat of ATF and press in against bottom of housing without tilting.



A - Special Tool 9308

Note

Don' t force in piston to prevent damaging the seals.

5. Assemble plates according to exploded view and install assembly in clutch drum.

Note

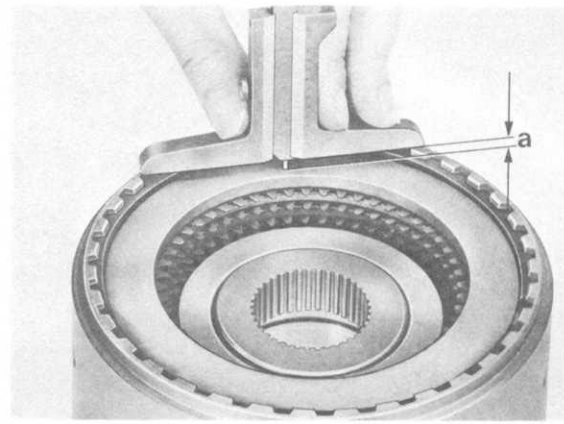
New (coated) plates must be dipped briefly in ATF prior to installation.

6. Install wavy snapring in groove and press it into groove with a suitable tool.

Note

The wavy snap rings of clutches K 1 and K2 have different spring forces, for which reason they must not be mixed up.

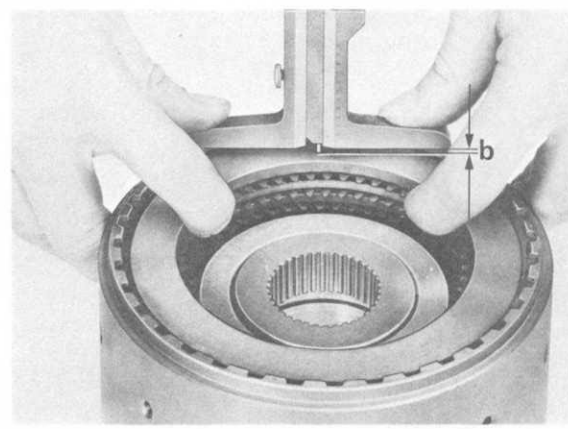
7. Check clutch play "L", which should be 1.0 ± 0.2 mm. Measure distance "a" from upper edge of clutch drum to plate assembly with a depth gauge.



Note

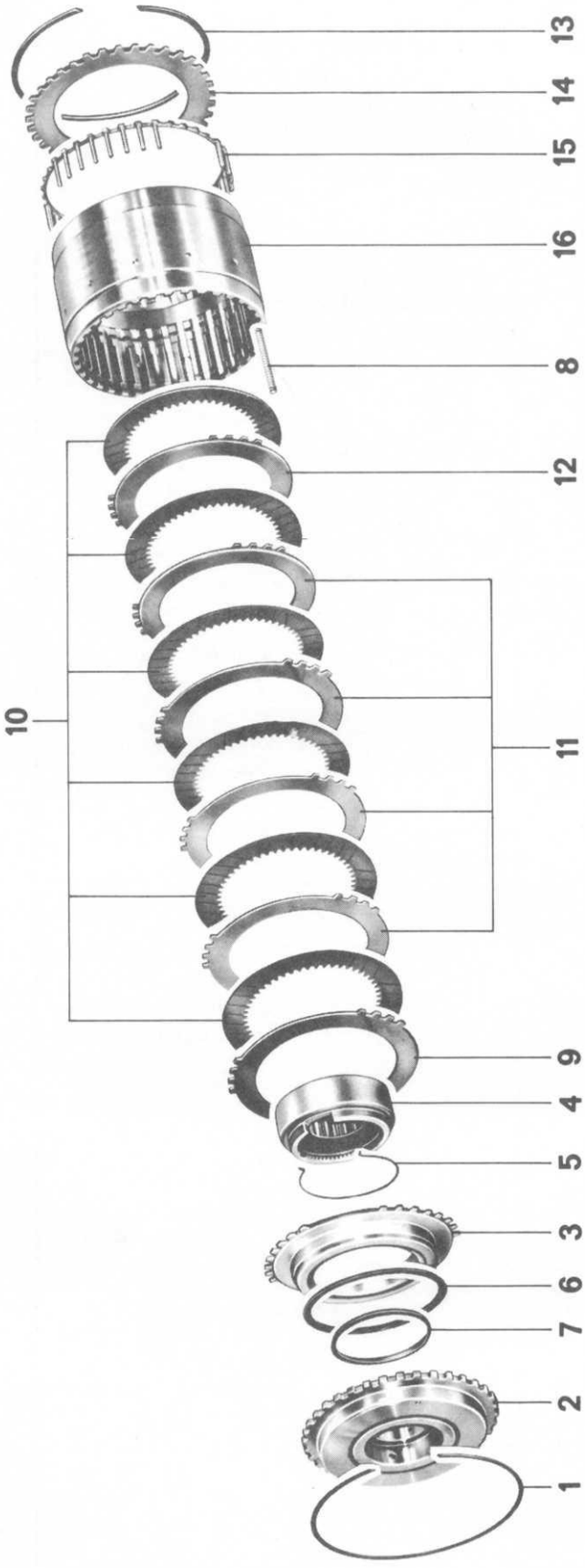
When measuring distance "a" have tip of depth gauge just touch the plate assembly without pressure.

Press up outer plates all the way and measure distance "b" from upper edge of clutch drum to plate assembly. Clutch play "L" is a - b.



Note

The play can be adjusted with the outer plates, which are available 3.0 and 3.5 mm thick.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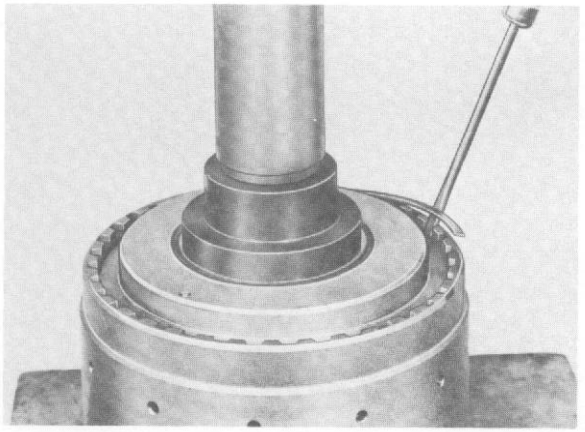
No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
1	Snap ring (flat)	1	Press down support flange slightly with a press and suitable thrust pad		
2	Support flange	1	Remove with piston from brake band drum		
3	Piston	1			
4	One-way clutch outer race	1	Remove snap ring with pointed pliers by squeezing together		
5	Snap ring	1			
6	Lipped seal	1		Replace. Sealing lip faces support flange	
7	Lipped seal	1		Replace. Sealing lip faces down	
8	Spring	X	Note quantity for reinstalling	Install same quantity as removed	
9	Outer plate (2.0 mm thick)	1			
10	Inner plate	6		Dip in ATF bath prior to installation	
11	Outer plate (optionally 3.0 or 3.5 mm thick)	4			
12	Outer plate (optionally 4.5 or 5.0 mm thick)	1		Shouldered side faces corrugated snap ring	
13	Snap ring (corrugated)	1		Don't mix up with snap ring of K 1 (different spring force)	

No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
14	Outer plate (5.0 mm thick)	1		Shouldered side faces corrugated snap ring	
15	Guide ring	1			
16	Brake band drum	1			

DISASSEMBLING AND ASSEMBLING CLUTCH K 2

Disassembling

1. Remove flat snap ring with a suitable tool, while pressing the support flange down slightly in a press with a suitable thrust pad (e.g. VW 511).



2. Take support flange and piston out of brake band drum.

Note

Support flange and piston must be held together to prevent the piston from falling out.

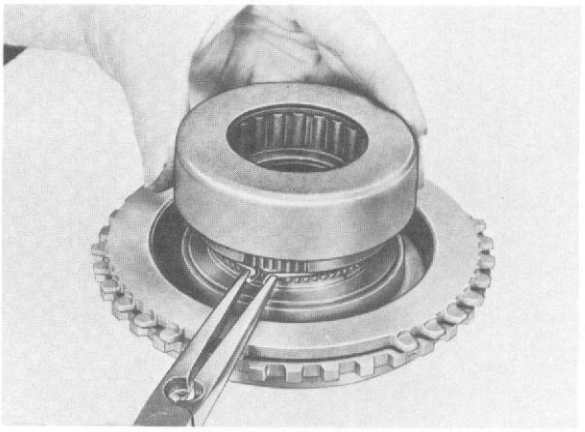
3. Remove all springs and plates from the brake band drum.

Note

The quantity of springs for clutch pistons will vary. If new springs are required, the same quantity as removed must be installed.

4. Remove corrugated snap ring and outer plate as well as guide ring for springs.

5. Squeeze snap ring together with a pointed pliers and remove one-way clutch outer race.



Assembling

1. Install guide ring for springs and outer plate that shouldered side faces snap ring.

2. Install corrugated snap ring.

Note

The corrugated snap rings of clutches K 1 and K 2 are different in spring force, for which reason they must not be mixed up.

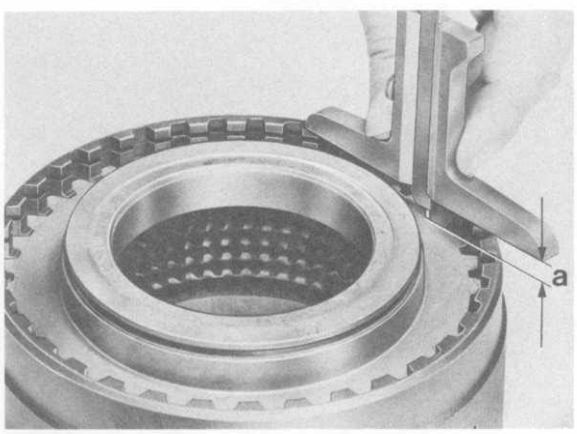
3. Assemble plates according to explosion view drawing and install assembly in outer plate carrier.

Note

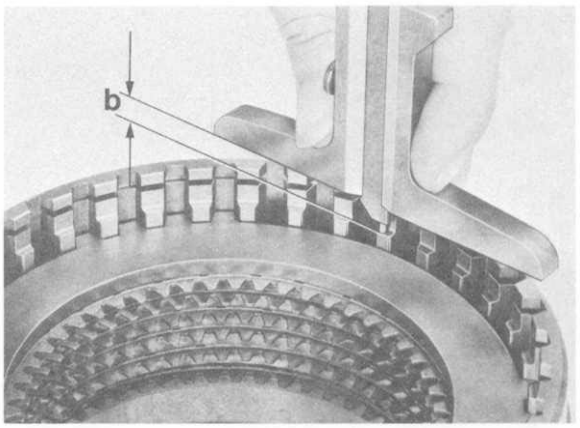
New coated plates must be dipped briefly in an ATF bath prior to installation.

4. Check clutch play "L", which should be $1.0^{+}_{-}0.2$ mm.

Place clutch piston on plate assembly and measure distance "a" from upper edge of outer plate carrier to clutch body with a depth gauge.



Measure distance "b" from upper edge of outer plate carrier to bearing surface of support flange with a depth gauge.

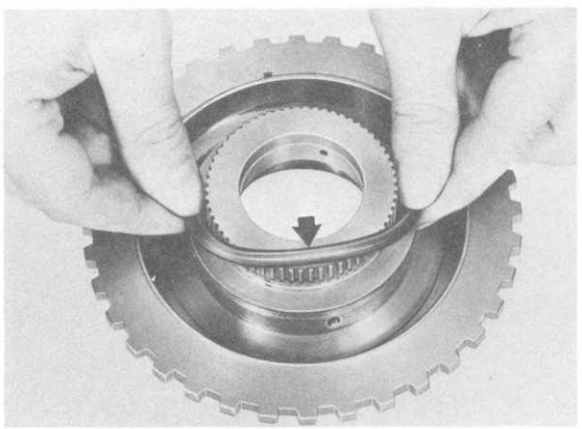


Clutch play "L" is a - b.

If applicable, adjust play by selecting outer plates of pertinent thickness.

5. Place all springs on guide pin.

6. Install seal carefully that it fits properly in the groove and its sealing lip faces down (in direction of arrow).

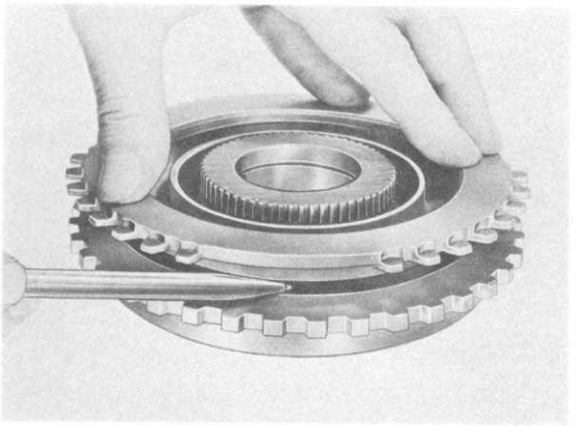


Note

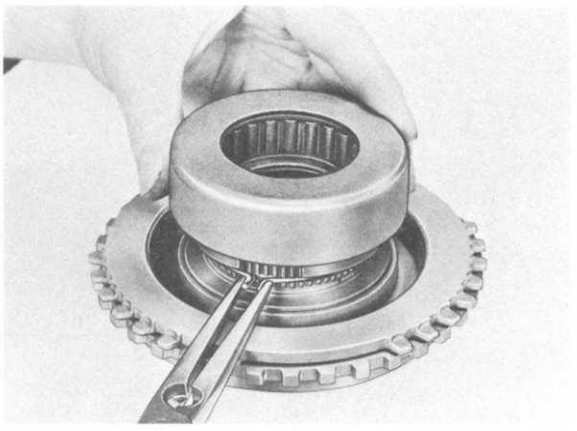
Never use sharp edged tools to install seals.

7. Install seal for piston so that its sealing lip faces down.

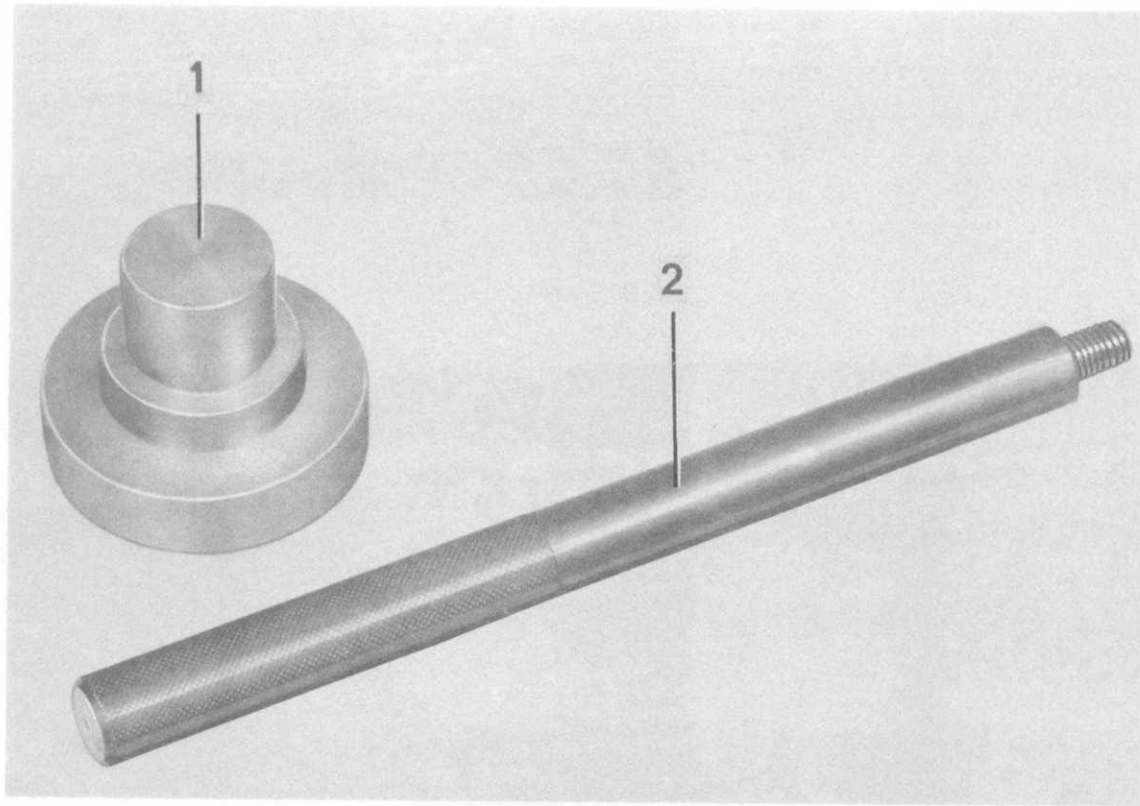
8. Apply a light coat of ATF to seals and install piston in support flange, pressing the sealing lip into the support flange with a pencil or ball point pen and moving in the piston carefully without tilting.



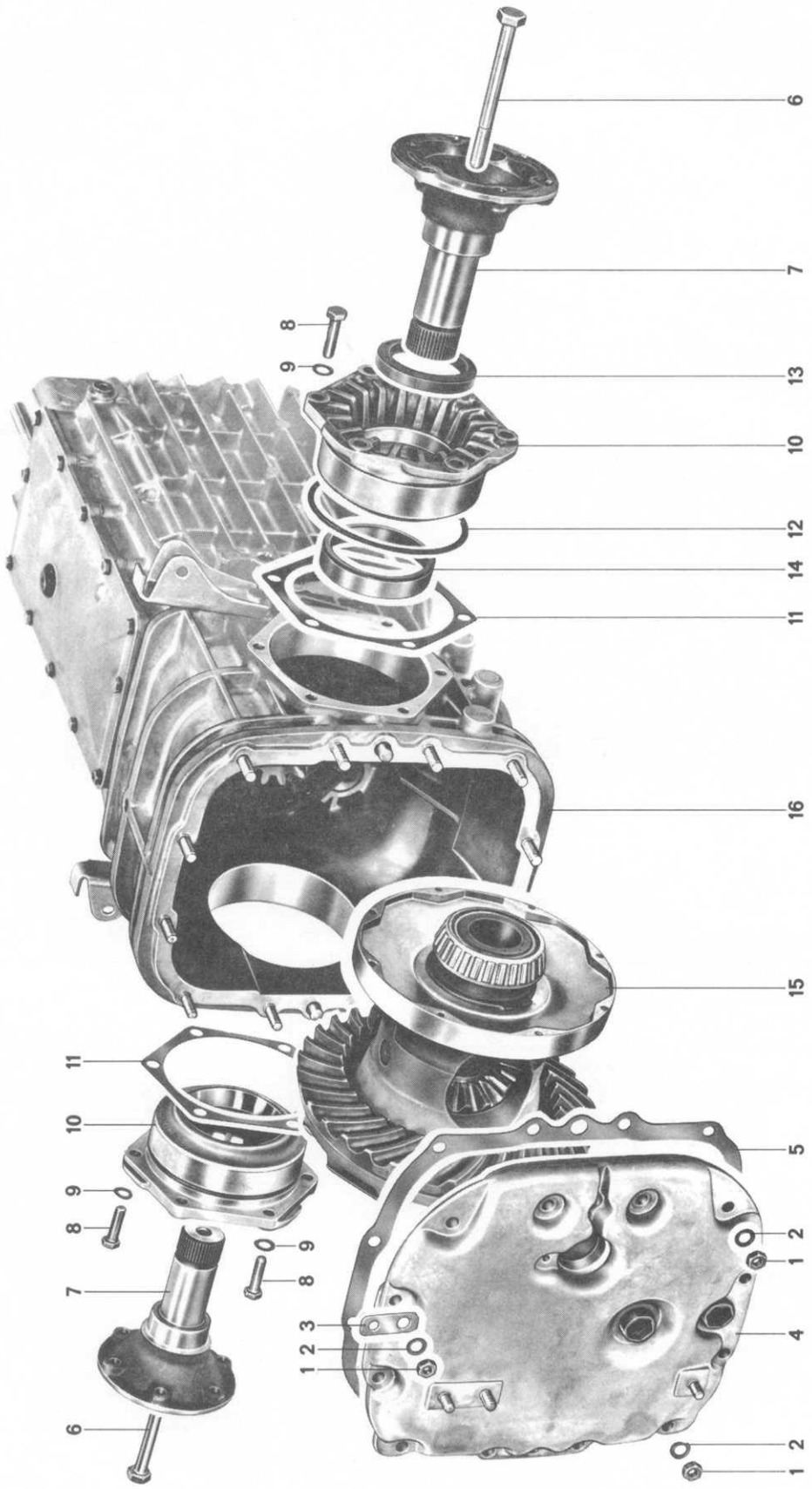
9. Install snap ring in groove of support flange, squeeze together with a needle-nose pliers and insert one-way clutch outer race.



TOOLS



No.	Description	Special Tool	Remarks
1	Mandred	US 8050/10	
2	Pin	US 8050	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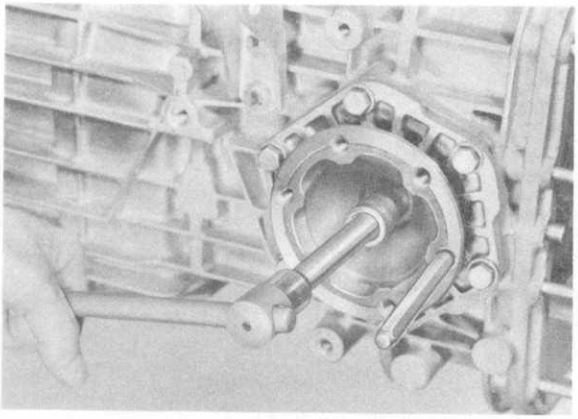
No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
1	Nut	12		Tighten to specified torque	
2	Washer	12		Replace if necessary	
3	Holder	1			
4	Rear cover	1			
5	Gasket	1		Replace	
6	Bolt	2		Tighten to specified torque	
7	Axle flange	2			
8	Bolt	12		Tighten to specified torque	
9	Washer	12		Replace if necessary	
10	Side cover	2	Mark for reassembly	Must be installed on same side	
11	Shim	X	Note number and thickness for reassembly on each side	Determine again, if necessary	
12	O-Ring	2		Replace, coat slightly with transmission oil	
13	Oil seal	2	Press out with suitable screwdriver	Drive in with US 8050/10	
14	Tapered roller bearing outer race	2	Mark for reassembly	Install in same side cover, heat side cover to approx. 100° C/212° F and drive in with a suitable mandrel	
15	Differential	1		Adjust, if necessary	
16	Case	1			

REMOVING AND INSTALLING DIFFERENTIAL

Removing

1. Drain transmission oil.

2. Unscrew axle flange bolt and remove axle flange.

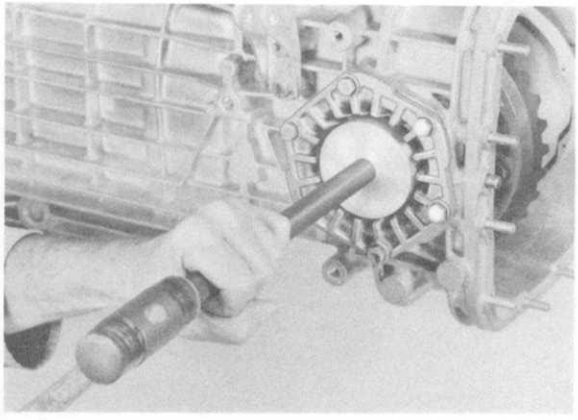


Note

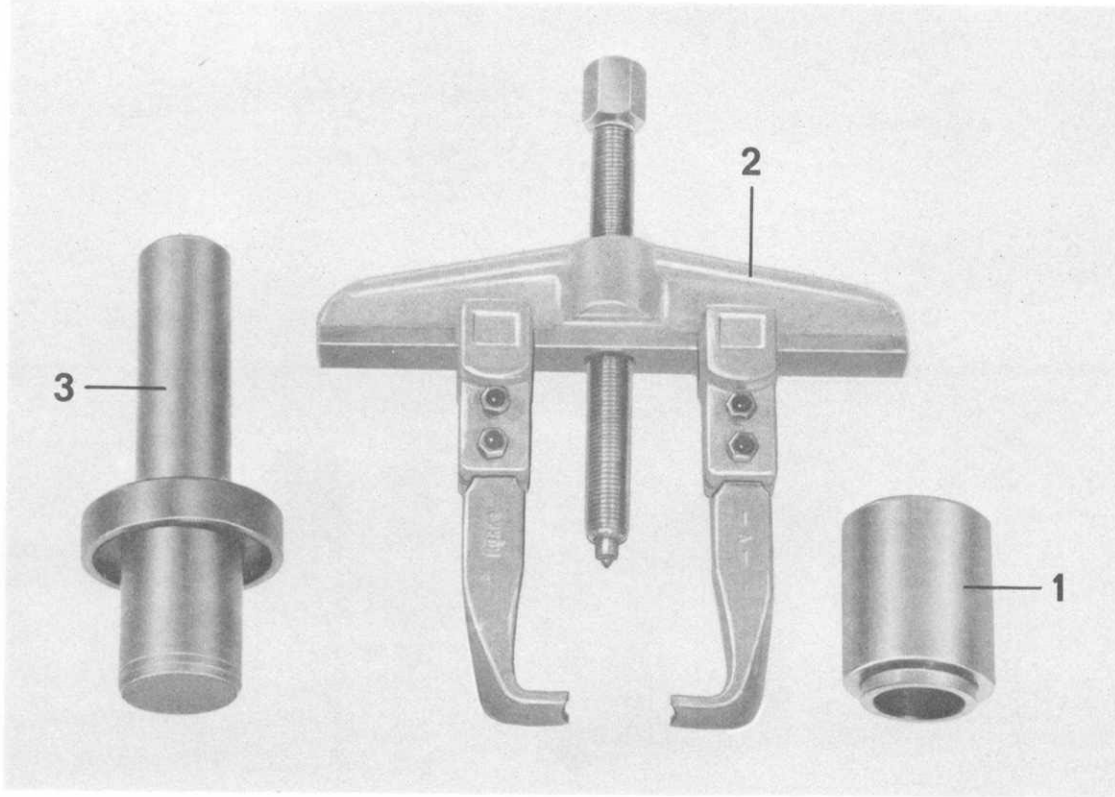
Preload of the tapered roller bearings could cause tension on the case when tightening bolts for the side covers, which later could impair installation of the rear cover. Consequently the rear cover should be installed before tightening the bolts.

Installing

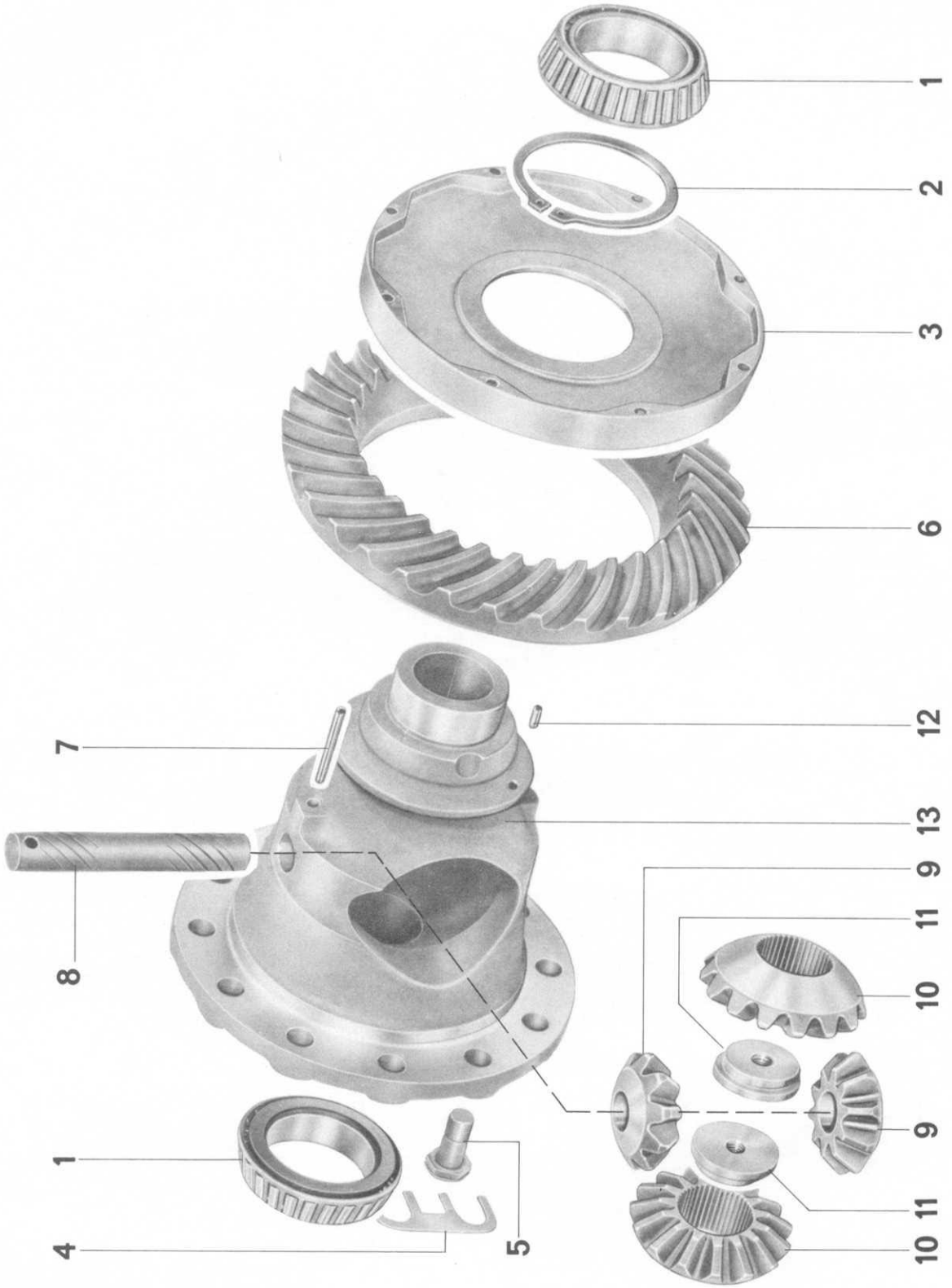
Drive in axle flange seal with US 8050/10.



TOOLS



No.	Description	Special Tool	Remarks
1	Mandrel	P 263	
2	Extractor	US 1078	
3	Drift	P 264 b	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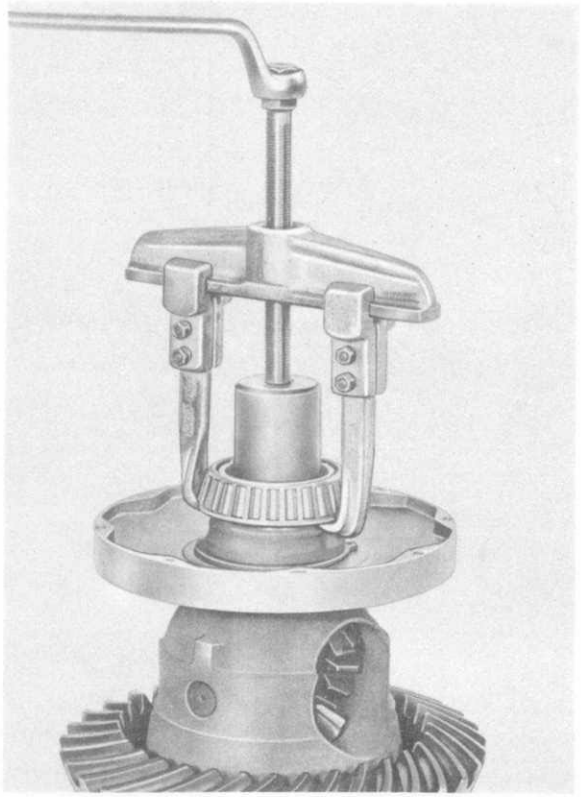
No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
1	Tapered roller bearing inner race	2	Pull off with US 1078 and P 263	Drive on with P 264 b	
2	Circlip	1			
3	Magnet carrier plate	1			
4	Lockplate	6		Replace	
5	Bolt	12		Threads must be dry and greaseless. Tighten to specified torque	
6	Ring gear	1		Heat to approx. 100° C/212° F. Tapped holes for ring gear bolts must be dry and greaseless. Note pair number. Adjust if necessary	
7	Roll pin	1			
8	Differential gear shaft	1			
9	Small differential gear	2		Coat thrust surface with MoS_2 paste. Replace only in pairs	
10	Large differential gear	2		Coat thrust surface with MoS_2 paste. Replace only in pairs	
11	Axle flange nut	2			
12	Split pin	1			
13	Differential housing	1			

DISASSEMBLING AND ASSEMBLING DIFFERENTIAL

Disassembling

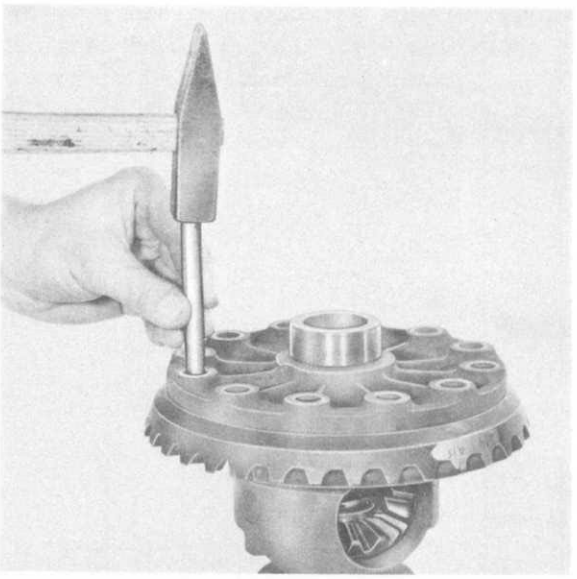
1. Pull off tapered roller bearing inner race with an extractor US 1078 and Special Tool P 263.



Note

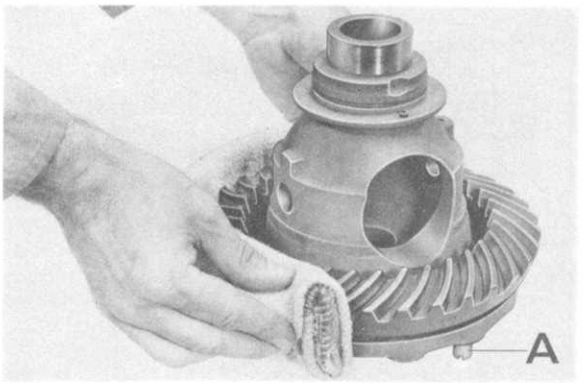
Claws of both legs might have to be machined.

2. Drive ring gear from housing with a suitable mandrel.



Assembling

1. Heat ring gear to approx. 100° C/212° F and install. Use local manufactured centering pins as guides.

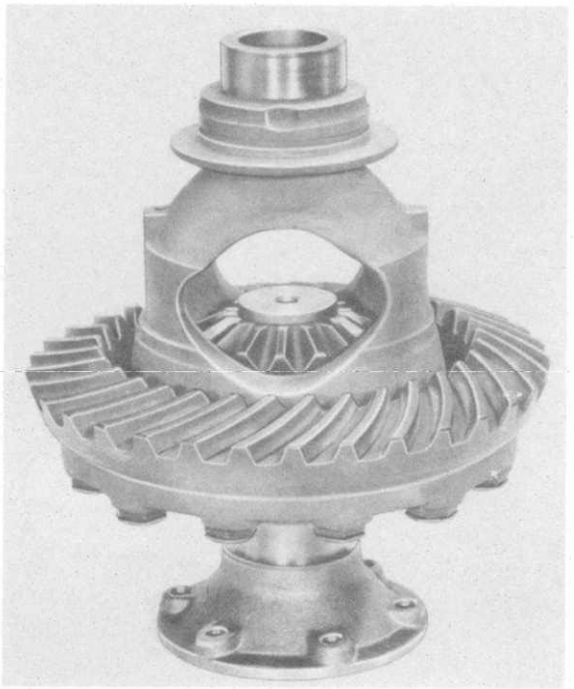


A - Centering pins (local manufacture)

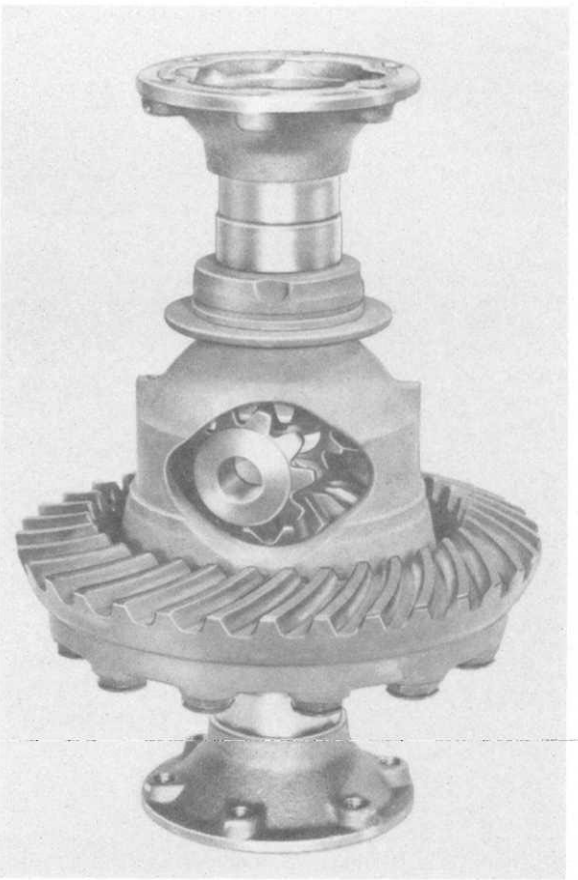
2. Tighten ring gear bolts to specified torque. Slide lockplate into bolt head groove. Squeeze lockplate ends together with pliers. Bend lockplate ends down over side of bolt head.

3. Coat oval surface of differential gears with MoS_2 paste.

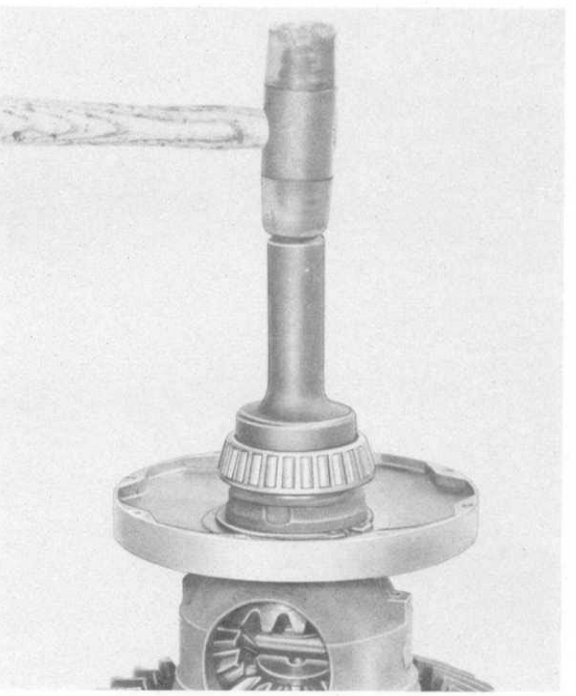
4. Install large differential gears with press-fit threaded plates through opening in differential case and hold with joint flanges.



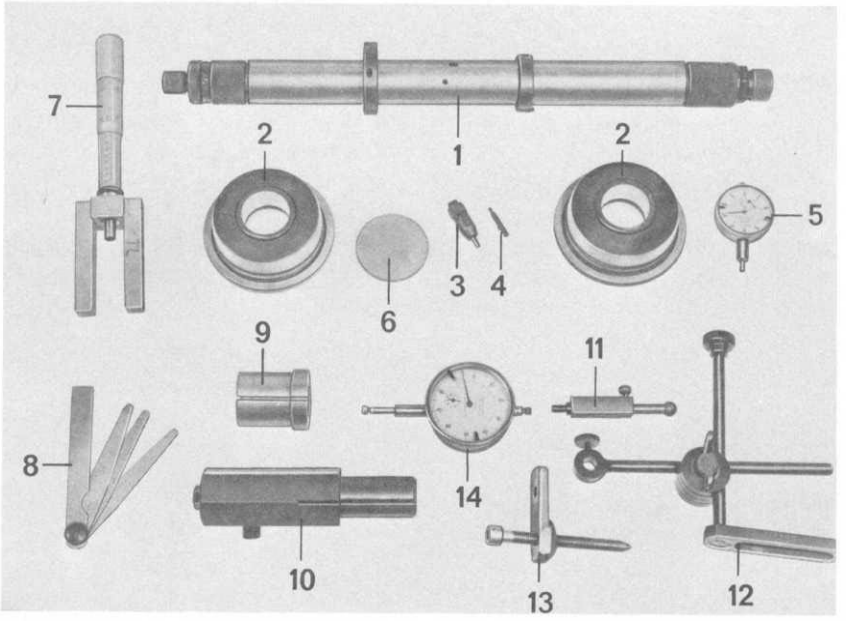
5. Install small differential gears between large differential gears and turn, until bores of gears are aligned with bores in case.



6. Drive on taper roller bearing inner race with P 264 b.



TOOLS

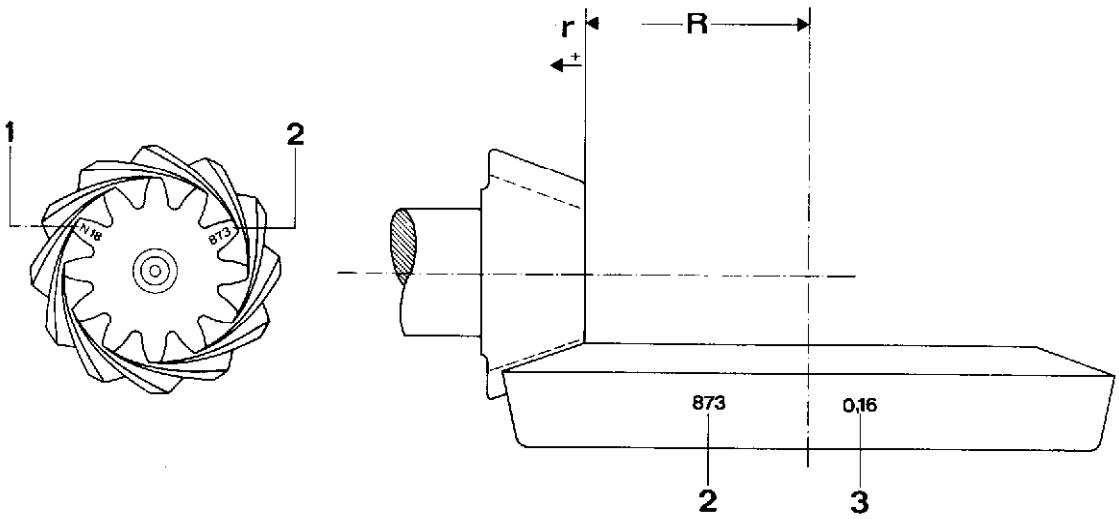


No.	Description	Special Tool	Remarks
1	Universal gauge	VW 385/1	
2	Centering discs	VW 385/4	
3	Gauge plunger	VW 385/14	
4	Dial gauge extension (20 mm)	9150	
5	Dial gauge	-	Standard, 3 mm range
6	Gauge plate	VW 385/17	
7	Master gauge	VW 385/30	
8	Feeler gauge	-	Standard, 0,05 - 1,0 mm
9	Clamping sleeve	9145	
10	Adjusting device	VW 521/4	
11	Adjustable lever	VW 388	
12	Universal dial gauge holder	VW 387	
13	Holder	-	Local manufacture
14	Dial gauge	-	Standard

ADJUSTING DRIVE PINION AND RING GEAR

Note

Careful adjustment of the drive pinion and ring gear is important to guarantee a long service life and quiet running for the final drive. This is why drive pinions and ring gears are matched during production and checked on special testing machines for the most favorable surface appearance and low noise levels in both directions of rotation. The position of quietest running is determined by moving the drive pinion in an axial direction, keeping the ring gear within specified backlash tolerances. The deviation "r" from the design distance "R" is measured and inscribed on the face of the drive pinion. Ring gears and drive pinions are designed in such a manner that deviation "r" is always added to design distance "R"; is always given with a + sign.



R = Design distance (G 28.03 = 72.70 mm/G 28.05 = 70.70 mm)
r = Deviation from R given in 1/100 mm
1 = Deviation r
2 = Pair code
3 = Backlash

Recommended Sequence of Adjusting Drive Pinion and Ring Gear

When it becomes necessary to adjust the drive pinion and ring gear, it would be in the interest of economical procedures to keep to the following sequence.

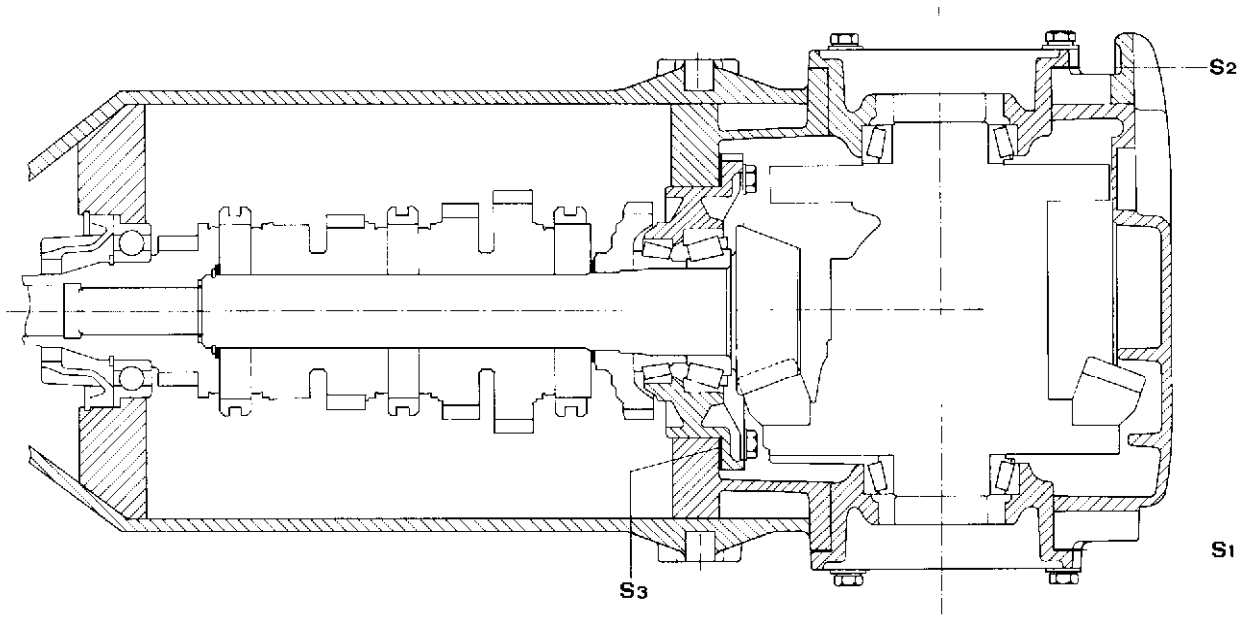
1. Determine the total shim thickness "Stot." (S_1 plus S_2) for the specified pre-load of the taper roller bearing/differential.

2. Determine shim thickness "S_3".

3. Divide total shim thickness "S tot." in S_1 and S_2 so that there is the specified amount of backlash between the ring gear and drive pinion.

The goal of adjustments is to relocate the point of optimal quiet running as was determined in the special testing machine during production.

Perfect results require absolute care and cleanliness during all assembly and measuring operations.



Location of Shims

S_1 = Shim for ring gear
S_2 = Shim for ring gear
S_3 = Shim for drive pinion

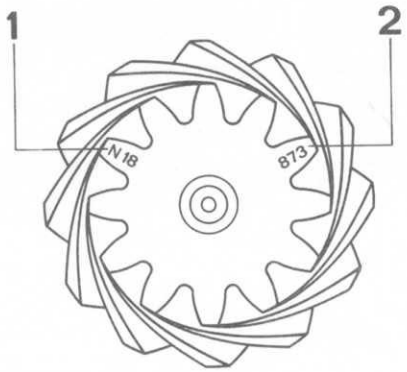
The drive pinion and ring gear only have to be adjusted when jobs on the final drive require the replacement of parts having direct influence on the adjustment. Refer to the following table to avoid unnecessary adjustments!

Adjust: / Replaced Part	Ring Gear ($S_1 + S_2$)	Drive Pinion Deviation "r" (S_3)
Transmission case	X	X
Side transmission cover	X	
Bearing bracket with taper roller bearing for drive pinion	X	X
Drive pinion/ring gear	X	X
Differential case	X	
Taper roller bearing for differential	X	

ADJUSTING PINION

Distance "E" must be calculated from the given design distance "R" + deviation "r" inscribed on face of pinion.

"R" for Type G 28.03 = 72.70 mm
"R" for Type G 28.05 = 70.70 mm



1 = Deviation "r" in 1/100 mm
2 = Pair code

Example:

Deviation "r" on face of pinion is N 18.

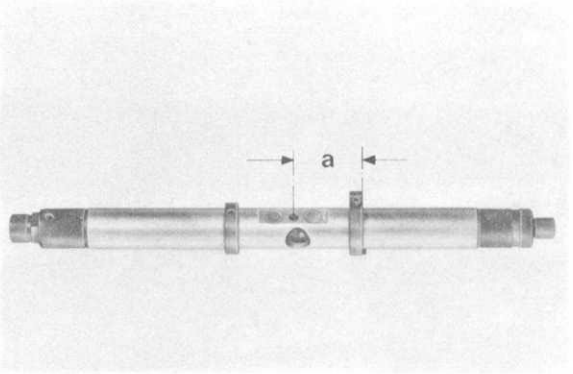
R = Design distance		72.70 mm
r = Deviation	+	0.18 mm
E = Adjusting distance		72.88 mm

1. Install input shaft, **without circlip.**

2. Install pinion without shims S3 and tighten all bearing retaining plate bolts to specified torque.

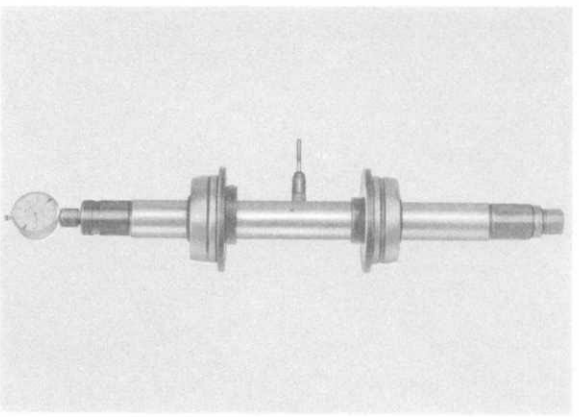
3. Install one side cover without O-ring and secure with two bolts.

4. Set adjusting ring of universal master gauge VW 385/1 at distance "a".



a = 60 mm

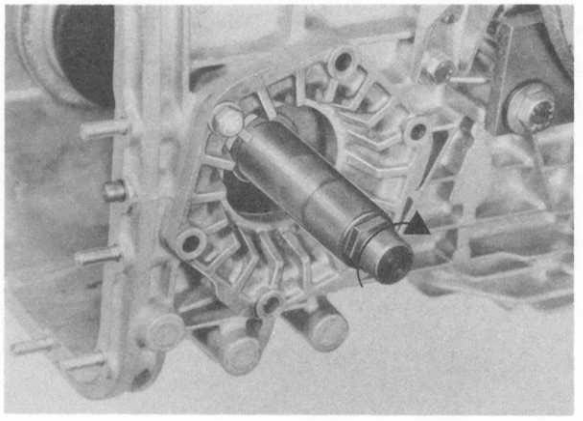
5. Install centering discs VW 385/4 on universal master gauge and attach gauge plunger VW 385/14 with dial gauge extension 9150 (20 mm).



6. Insert universal gauge in case.

7. Install second side cover without O-ring and secure with two bolts.

8. Use spindle to move centering disc of universal gauge out so that the universal gauge can just barely be turned by hand.

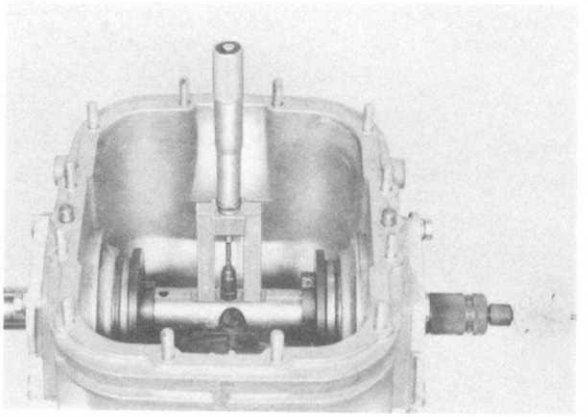


9. Set master gauge VW 385/30 at adjusting distance E (E = R + r)

Example:

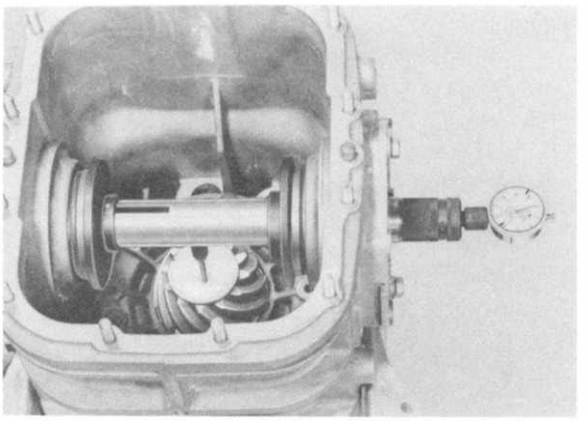
R = 72.70 mm
r = + 0.18 mm
E = 72.88 mm (adjustment of master gauge)

10. Install master gauge and set dial gauge (3 mm range) at zero with 1 mm pre-load.



11. Install gauge plate VW 385/17 on pinion head.

12. Turn universal gauge carefully until dial gauge extension is perpendicular to face of pinion head. At this moment dial gauge needle will reach its point of reversal and dial gauge should be read.



Note

The measured value will always deviate from the set distance "E" counterclockwise (small dial gauge) needle positioned between 0 and 1), i.e. when dial gauge is set with 1 mm pre-load the value deviating from 1 must be used as shim thickness S_3.

For this measurement the dial gauge must be read anticlockwise (red range).

13. Insert a shim with thickness S_3 equalling the determined deviation between the bearing cap and transmission case. Round off to the nearest 0.05 mm (e.g. 0.22 mm becomes 0.25 mm).

14. After installation of shims with the determined thickness,recheck adjusting distance "E".

Note

In the interest of economical procedures the countershaft should be installed in the case before assembly of the drive pinion with determined shims S_3.

ADJUSTING RING GEAR (Stot.)

Note

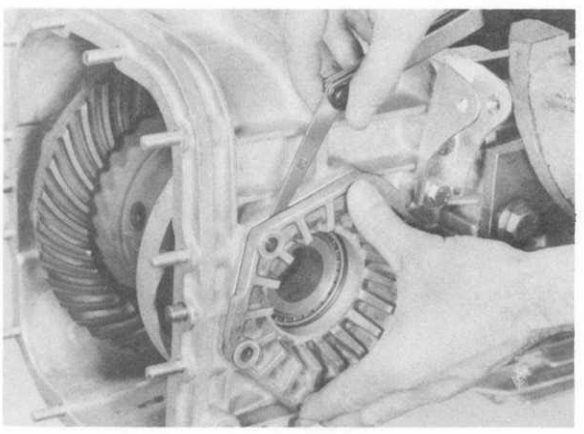
The drive pinion must not be installed for this adjustment.

1. Install differential with ring gear in case.

2. Install side transmission cover (ring gear end) without shims and tighten all bolts to specified torque.

3. Guide in second side transmission cover without shims carefully.

4. Check gap between transmission case and side transmission cover with a feeler gauge.



5. Calculate shim thickness "Stot.".

Stot. = gap - 0.30 mm (bearing pre-load)

Example:	
Gap	1.25 mm
Bearing pre-load	- 0.30 mm
Stot.	0.95 mm

ADJUSTING BACKLASH

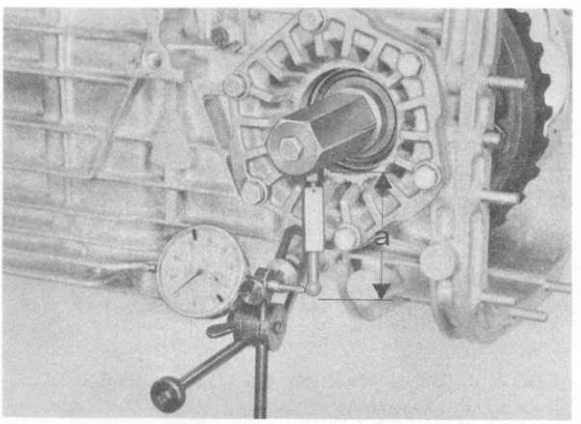
1. Install pinion with shims S_3 determined for pinion adjustment and tighten bearing retaining plate bolts to specified torque.

2. Place differential in case.

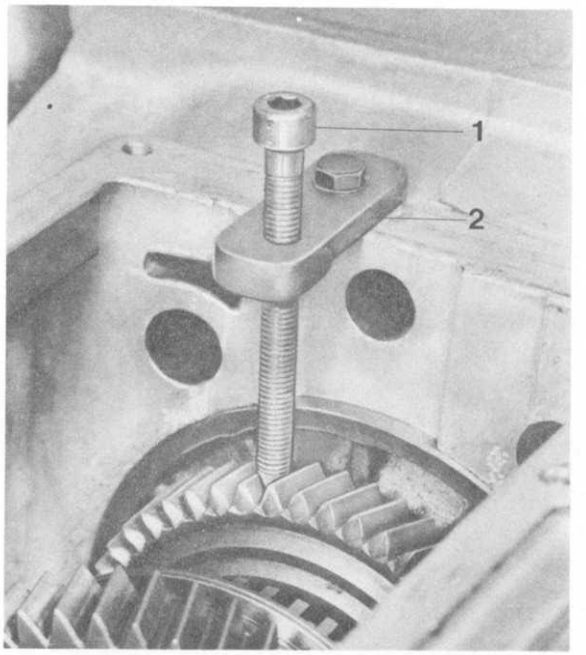
3. Install side cover, placing determined shim "Stotal" on ring gear end, and tighten all bolts to specified torque.

4. Turn differential in both directions several times to settle tapered roller bearings.

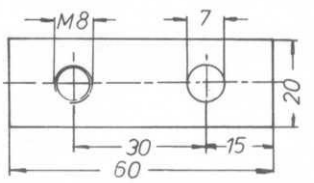
5. Install gauges, setting adjustable lever VW 388 to distance "a" = 80 mm.



6. Engine 5th and reverse gears, and hold pinion with local manufactured tool on reverse gear. This is done by tightening a screw with a ground point between two teeth.



1 - Screw M 8 x 80 (ground point)
2 - Flat iron 60 x 20 x 6 mm



Note

When shift rods are installed the engagement of two gears will require removal of detent plunger for 1st and reverse gear shift rod.

7. Turn ring gear to stop by hand and set dial gauge at zero.

8. Turn back ring gear and read amount of backlash (e.g. 0.88 mm).

DETERMINING THICKNESS OF SHIMS S_1 AND S_2

Note

The measured backlash must be brought to the value specified by the pinion/ring gear manufacturer by dividing "Stotal".

Specifications:
Getrag pinion/ring gear = 0.15 to 0.20 mm
Hurth pinion/ring gear = 0.20 to 0.25 mm

The specified backlash is inscribed on the ring gear.

S_1 = Stotal
- measured backlash
+ specified backlash (inscribed on ring gear)
X 0.66 (lift constant)

Example:

Stotal	0.95 mm
- measured backlash	0.88 mm
	0.07 mm
+ specified backlash (e.g. 0.20 mm)	0.20 mm
	0.27 mm
X (lift constant)	0.66
S_1 =	0.18 mm

S_2 = Stotal - S_1

Example:

Stotal	0.95 mm
S_1	- 0.18 mm
S_2 =	0.77 mm

1. Remove side cover and divide shims "Stotal" to give the shim thicknesses determined for S_1 and S_2.

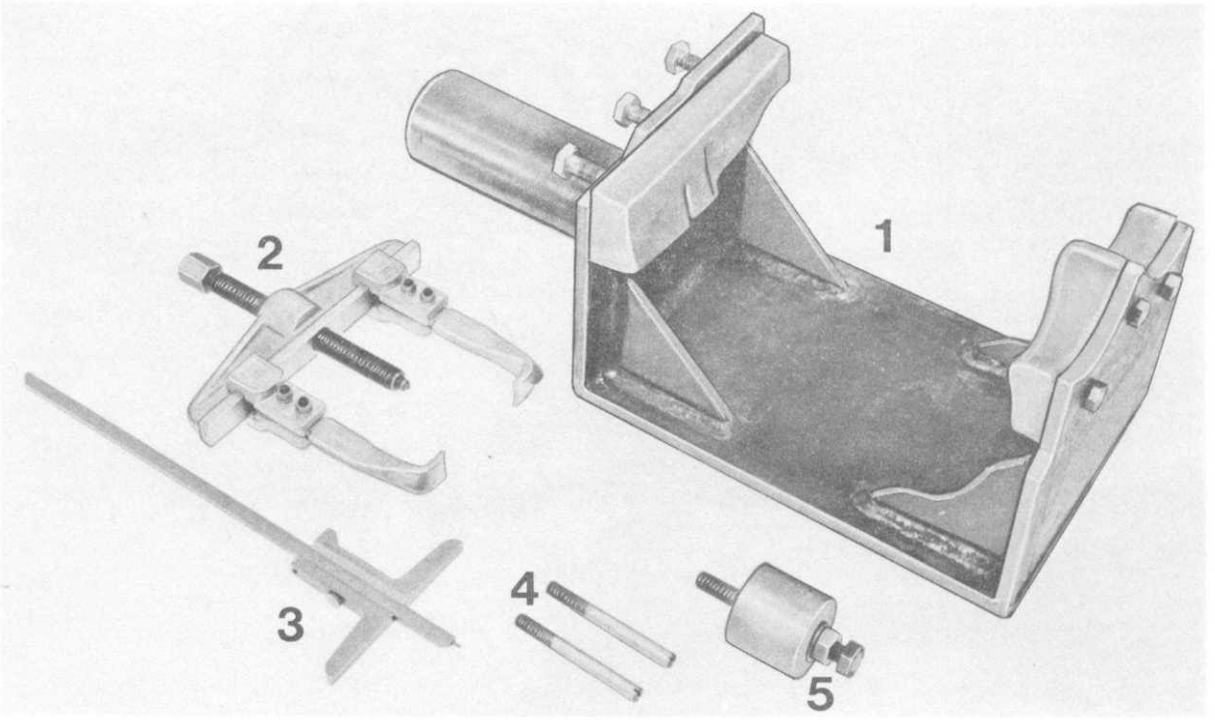
Note

In the interest of economical procedures the shift rods and shift forks should be installed prior to the assembly of the differential with determined shims S_1 and S_2.

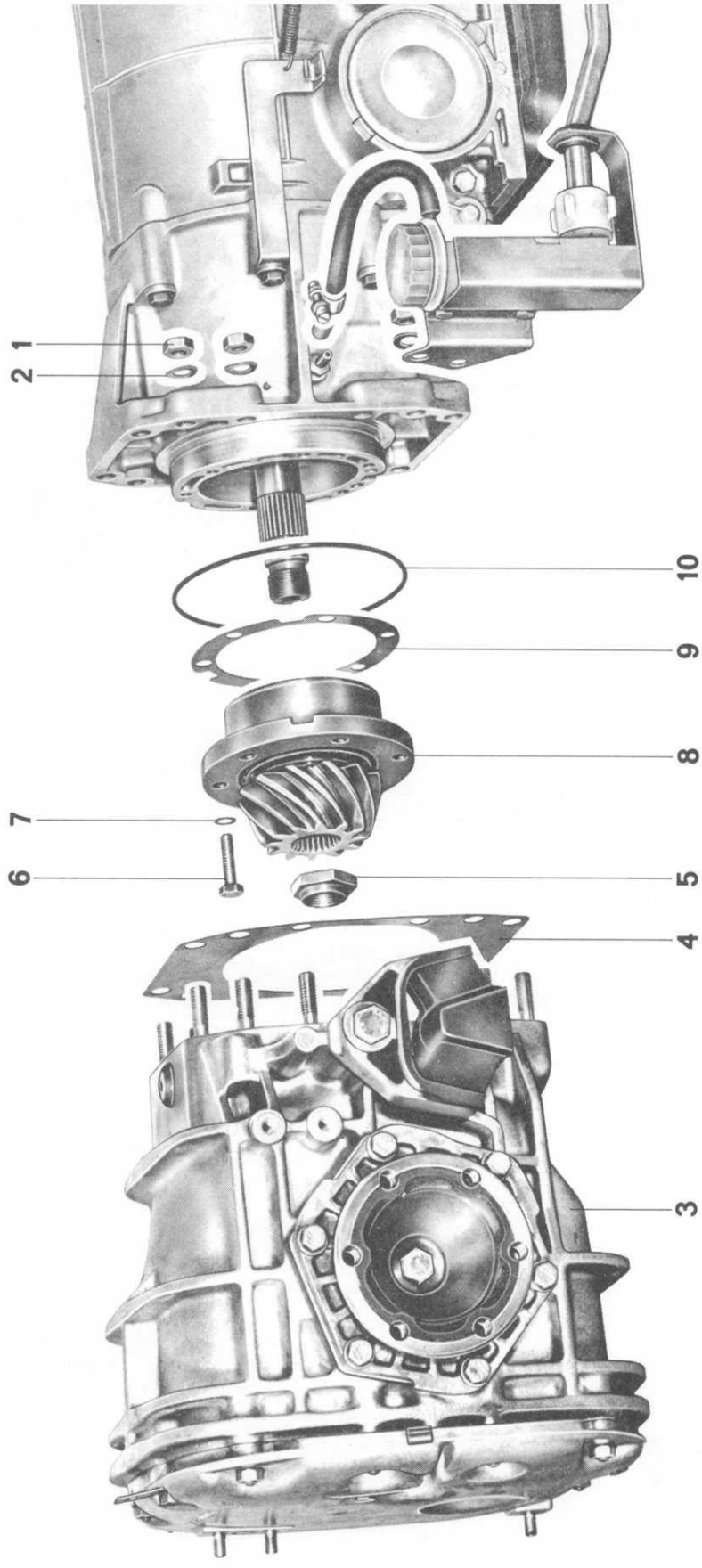
2. Measure backlash and, if necessary, change shims S_1 and S_2 again until specified backlash is reached.

3. Check backlash at four places by turning ring gear 90° each time. The four measurements must not deviate from each other by more than 0.05 mm.

TOOLS



No.	Description	Special Tool	Remarks
1	Transmission holder	9162	
2	Puller	US 1078	
3	Depth gauge	---	Standard
4	Centering pins	---	Made locally
5	Installer	---	Made locally (steel pipe 45 x 5 x 40 mm with welded cover and 11 mm dia. bore)



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No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
1	Nut	12		Torque: 39 . . . 46 Nm (28 . . . 33 ftlb)	
2	Washer	12			
3	Final drive	1			
4	Shim S_3	X	Note quantity and thickness of shims for installation later	Redetermine thickness if necessary	
5	Nut	1	Engage parking lock	Engage parking lock and tighten to specified torque. Lock collar of nut	See page 39 - 24a
6	Bolt	6		Torque: 27 . . . 32 Nm (20 . . . 23 ftlb)	
7	Circlip	6		Position correctly. Hollow side faces flange	
8	Bearing assembly with drive pinion	1	Pull out with a suitable puller	Press in with locally made tool	
9	Shim	X	Note quantity and thickness of shims for installation later	Redetermine thickness if necessary	
10	O-ring	1		Replace, coat with ATF. Make sure that fit is correct when installing final drive	

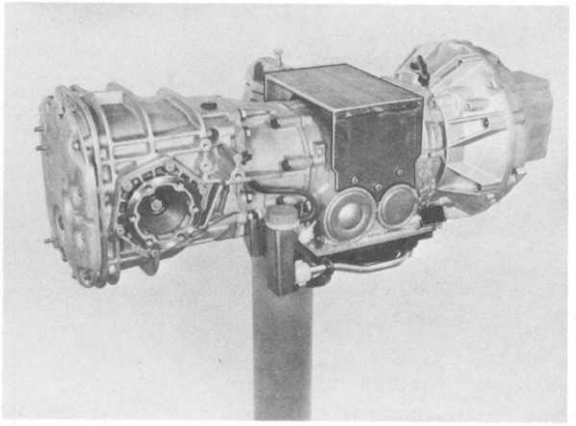
REMOVING AND INSTALLING FINAL DRIVE FOR AUTOMATIC TRANSMISSION

Removing

1. Remove transmission and take off control pressure lever.

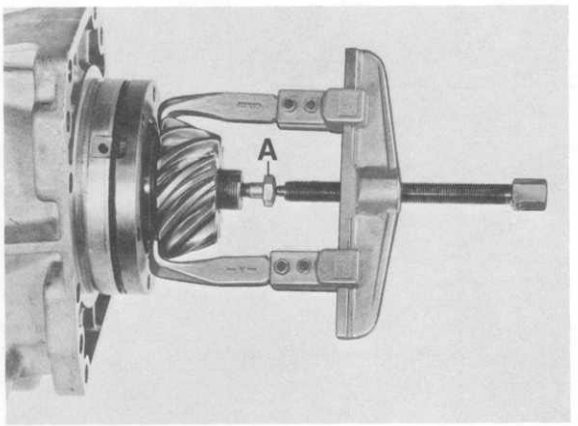
Note
Be careful not to place any force on lever shaft when loosening or tightening the mounting screw, to prevent damage to shaft in transmission. Always counterhold with a wrench when loosening or tightening (see page 37 - 14).

2. Mount transmission on assembly stand with Special Tool 9162 and drain oil from final drive.



3. Engage parking lock and remove collared nut.

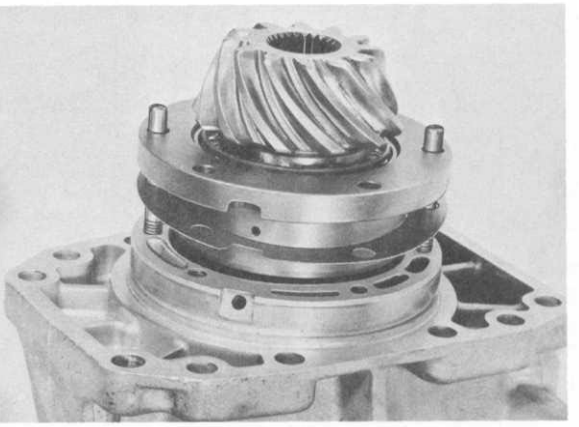
4. Pull out bearing assembly with a suitable puller (e. g. US 1078).



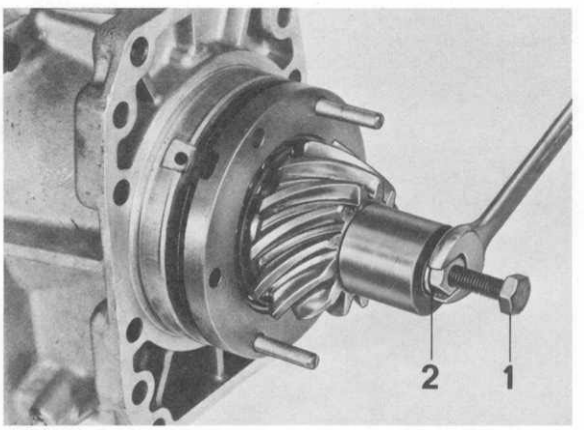
A – M 10 x 30 bolt with centering hole

Installing

1. Install the shims noted before removal or shims of newly determined thickness on output shaft together with bearing assembly.



2. Press in bearing assembly with locally made tool.



1 – Bolt from Special Tool 9148
2 – Washer

Note

Use locally made centering pins to facilitate installation.

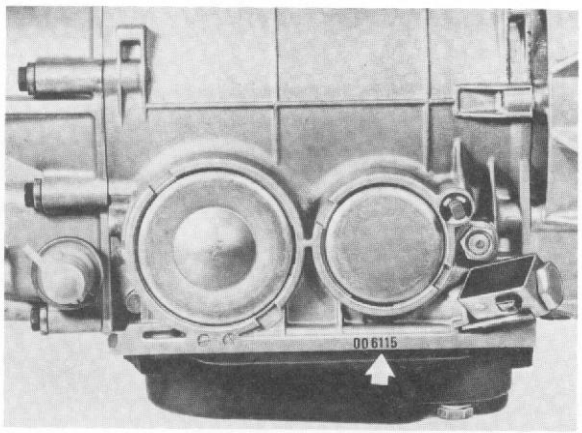
3. Engage parking lock and tighten collar nut as follows:
   Transmission Type A 22.02
   (without fixed governor)
   200 . . . 240 Nm (145 . . . 175 ftlb)

   Transmission Type A 22.01
   up to DB Mfg. No. 5797
   (without fixed governor)
   200 . . . 240 Nm (145 . . . 175 ftlb)

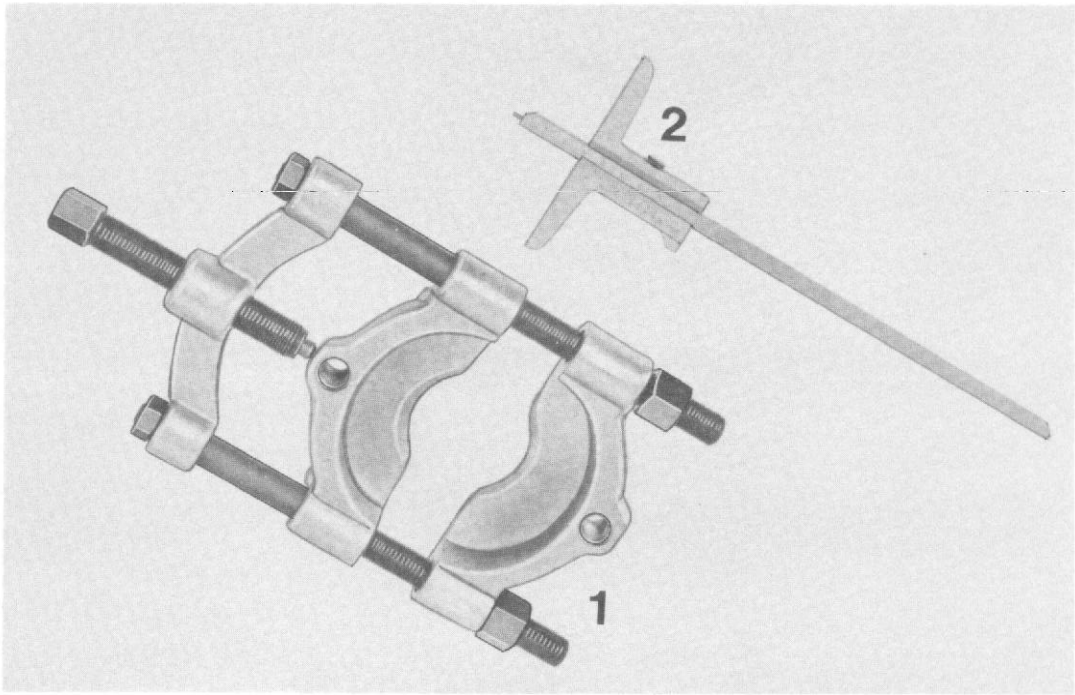
   Transmission Type A 22.01
   from DB Mfg. No. 5798
   (with fixed governor)
   280 Nm (200 ftlb)

Note:

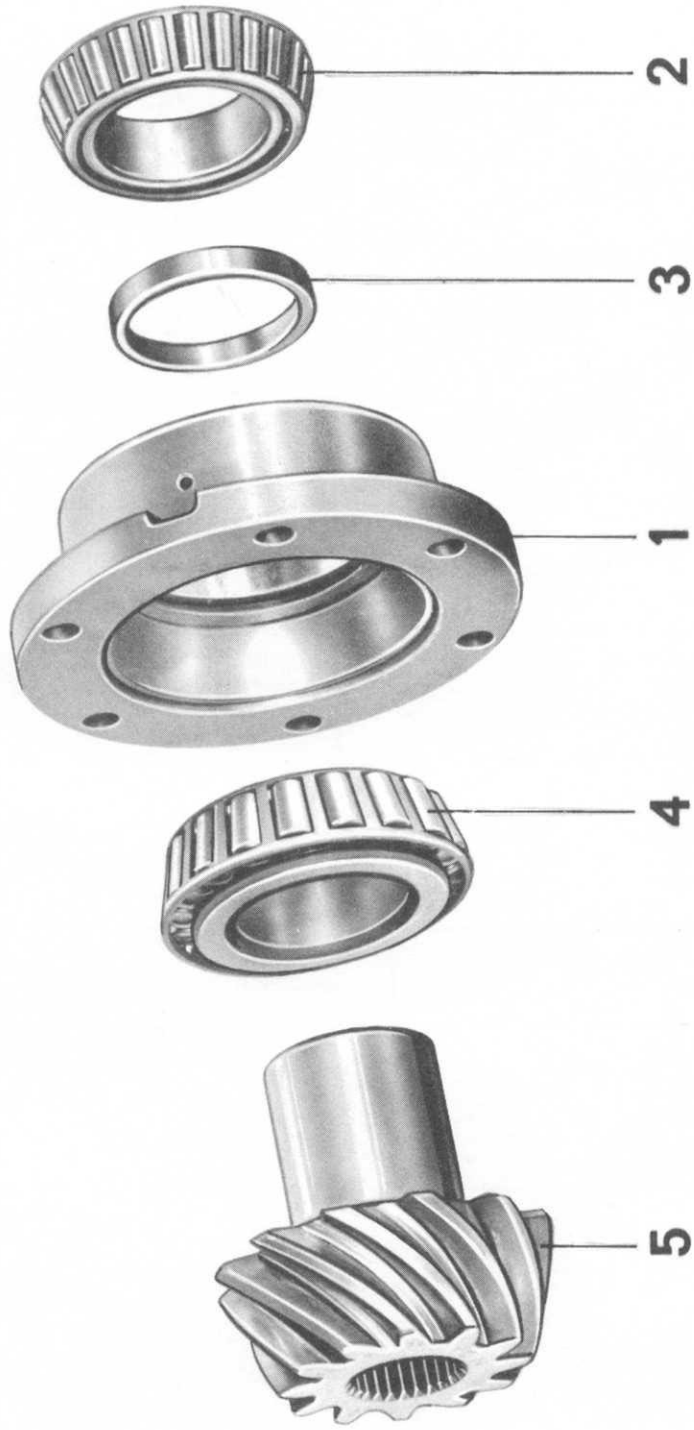
The DB manufacturing number is stamped on the right side of the transmission case, above the ATF sump.



TOOLS



No.	Description	Special Tool	Remarks
1	Separator	US 1103	
2	Depth gauge	---	Standard

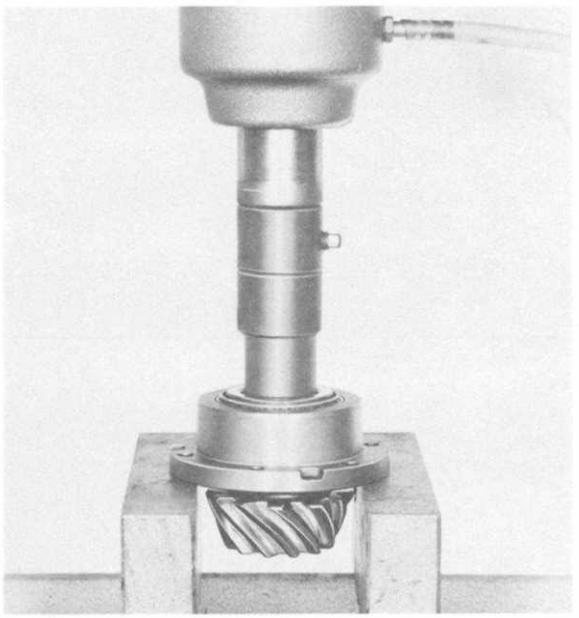

2
3
1
4
5

No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
1	Bearing flange	1		For replacements only available as complete part (positions 1...4)	
2	Bearing inner race	1		Heat to approx. 120° C/248° F and drive on	
3	Adjusting ring	X			
4	Bearing inner race	1		Heat to approx. 100° C/212° F and drive on	
5	Pinion	1	Press out with VW 516	Note pair number	

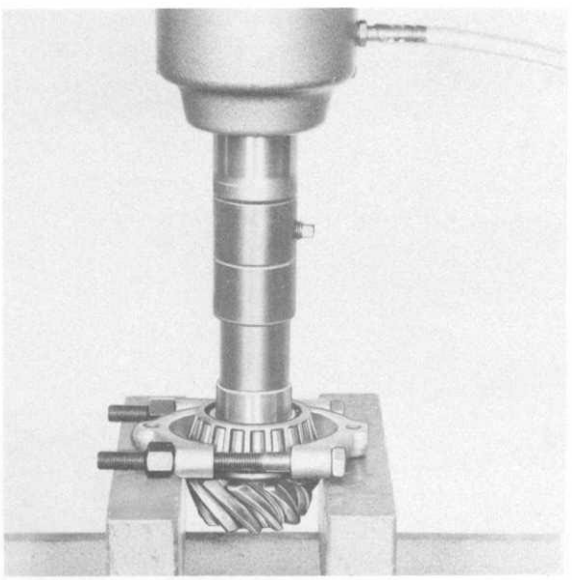
DISASSEMBLING AND ASSEMBLING BEARING ASSEMBLY FOR AUTOMATIC TRANSMISSION

Disassembling

1. Press out pinion with VW 516.



2. Press off tapered roller bearing inner race with a special tool separator US 1103.



Assembling

Note

Bearing flange is only available as a complete unit (with tapered roller bearings and adjusting ring) for replacements.

1. Heat tapered roller bearing inner race to approx. 100° C/212° F and drive on.

2. Press on assembled bearing with VW 415 a, approx. 5 tons force.

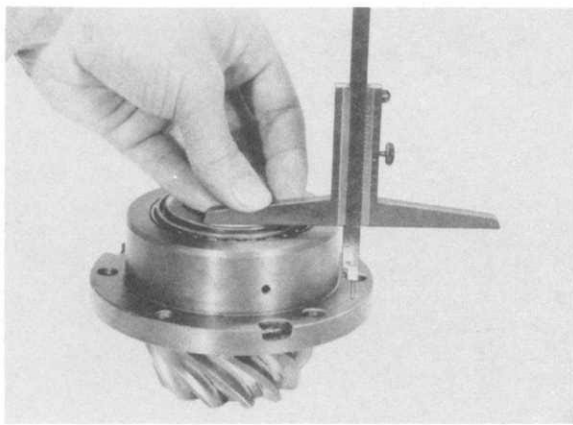
3. If necessary, determine thickness of shims for bearing assembly.

Determining Thickness of Shims for Bearing Assembly

Note

The adjustment of bearing assembly is important for axial play of automatic transmission. Consequently the thickness of shims has to be determined again after repairing or replacing a bearing assembly.

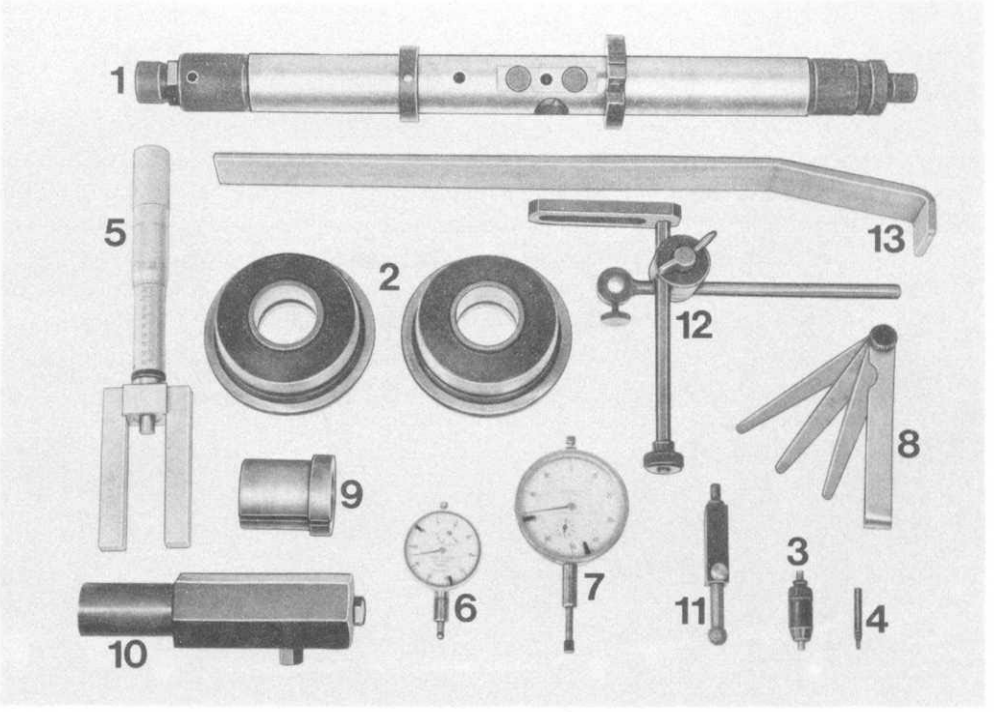
Use a depth gauge to measure distance from taper roller bearing surface to bearing flange surface (e.g. 34.55 mm). Since the design calls for a distance of only 34 ± 0.05 mm, a shim 0.55 mm thick has to be used.



Example

34.55 mm actual distance (measured on bearing assembly)
- 34.00 mm nominal distance (designed distance)
0.55 mm thickness of shims

TOOLS

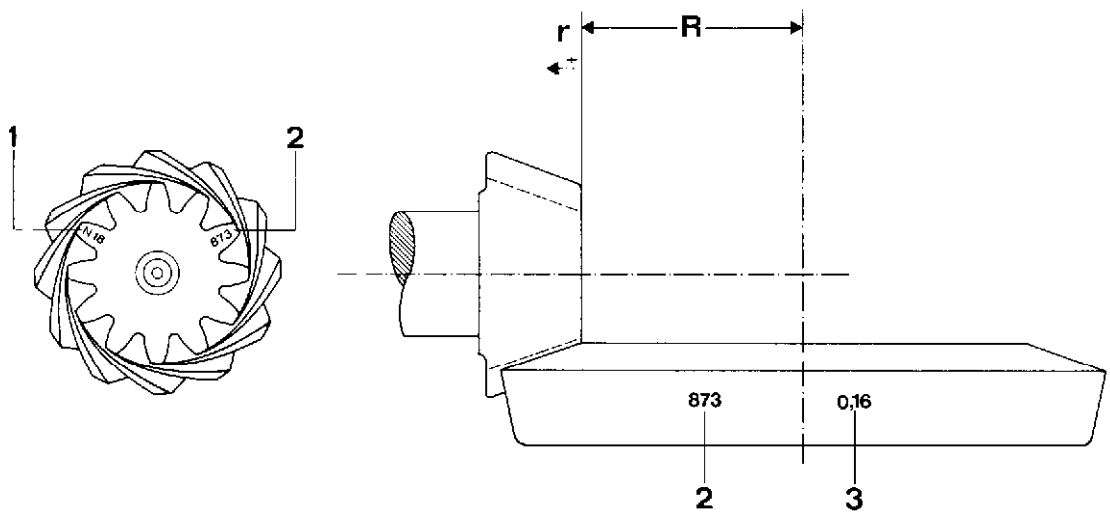


No.	Description	Special Tool	Remarks
1	Measuring bar	VW 385/1	
2	Centering rings	VW 385/4	
3	Plunger	VW 385/14	
4	Dial gauge extension (25 mm)	9168	
5	Master micrometer	VW 385/30	
6	Dial gauge		Standard, 3 mm range
7	Dial gauge		Standard, 10 mm range
8	Feeler gauge		Standard, 0.05 to 1.0 mm
9	Sleeve	9145	
10	Clamping arbor	VW 521/4	
11	Adjustable lever	VW 388	
12	Dial gauge holder	VW 387	
13	Lever		Made locally

ADJUSTING PINION AND RING GEAR

General Information

Accurate adjustments of the pinion and ring gear are immensely important for the service life and smooth running of the final drive. This is why pinions and ring gears are paired during manufacture and checked in special machines for tooth pattern and quietness in both directions of rotation. The position of smoothest running is determined by moving the pinion in an axial direction, whereby the ring gear is lifted out of the no-play meshing position far enough so that the backlash will be kept within specified tolerances. Deviation "r" from the designed distance "R" is measured and recorded on face of pinion. Ring gears and pinions are designed so that deviation "r" is always added to "R", i.e. is preceded by a + sign.



R = Design distance 72.70 mm
r = Deviation from R in 1/100 mm
1 = Deviation r
2 = Pair number
3 = Backlash

Recommended Sequence for Adjustment of Pinion/Ring Gear

If drive pinion and ring gear have to be adjusted, the following sequence of procedures would be most economical.

1. Determine total shim thickness "Sges" (S_1 plus S_2) for specified preload of taper roller bearing/differential.
2. Determine shim thickness "S_3".
3. Divide total shim thickness "Sges" into S_1 and S_2, so that specified backlash is between ring gear and drive pinion.

Objective of adjustments must be to regain the maximum degree of quiet running, as had been determined by the special testing machine in manufacturing.

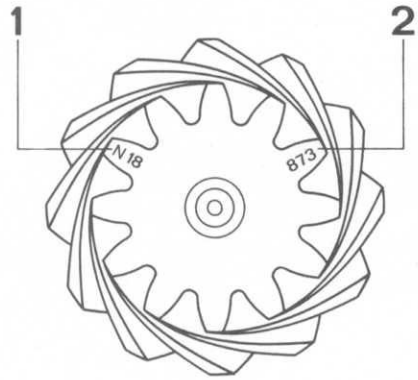
Absolute cleanliness is essential for all assembly jobs and testing procedures to guarantee perfect results.

After working on the final drive it will only be necessary to adjust the pinion and ring gear, if parts had been replaced which have direct influence on said adjustment. The following chart will help in avoiding unnecessary adjustments!

Adjust: / Part Replaced	Ring Gear (S_1 + S_2)	Drive Pinion deviation "r" (S_3)
Transm. case (automatic) or rear transmission case	X	X
Bearing assembly for pinion	X	X
Final drive case	X	X
Side transmission cover	X	
Pinion/ring gear	X	X
Differential case	X	
Taper roller bearing for differential	X	

ADJUSTING PINION

Adjusting distance "E" is calculated from known design distance "R" = 72.70 mm + deviation "r", which is located on face of drive pinion.



1 = Deviation "r" in 1/100 mm
2 = Pair number

Note

The design of the drive pinion will not allow use of the 5 mm thick Special Tool VW 385/17, normally applied for adjustments.

Since Special Tool VW 385/30 includes this 5 mm distance, it is important to add 5 mm to adjusting distance "E".

Example:

N 18 is the deviation "r" on face of pinion.

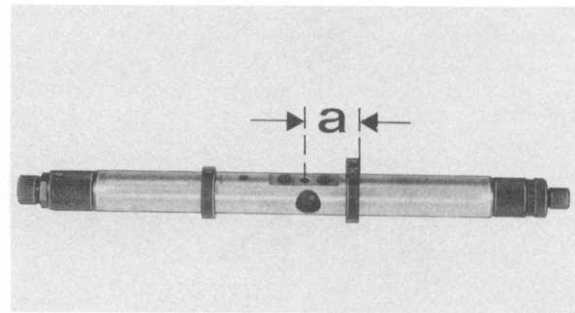
R = design distance		72.70 mm
r = deviation	+	0.18 mm
E = adjusting distance		72.88 mm
Missing special tool	+	5.00 mm
Adjustment of master gauge		77.88 mm

1. Install bearing assembly with shims and tighten collared nut to specified torque.

2. Install final drive case (without shims) and tighten all hexagon nuts to specified torque.

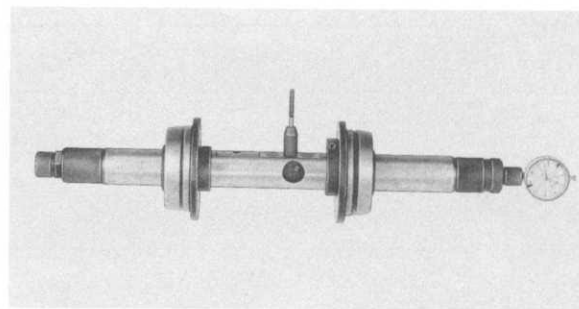
3. Install one side bearing cover without O-ring and secure with two bolts.

4. Adjust setring of Special Tool VW 385/1 to distance "a".



a = 41 mm

5. Slide Special Tools VW 385/4 on to 385/1. Install Special Tool VW 385/14 with (25 mm) dial gauge extension 9168.



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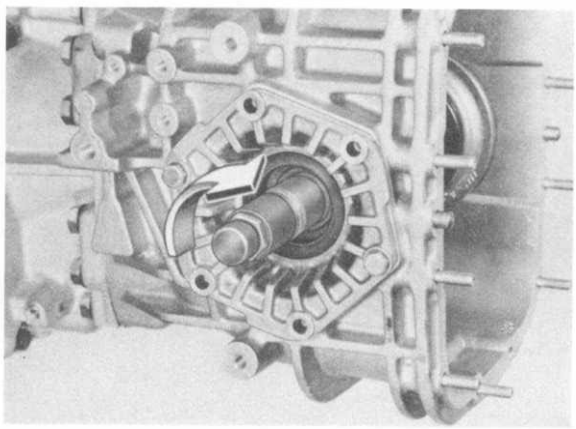
6. Turn pinion so that surface of pinion nut is vertical.

7. Insert measuring bar into case.

8. Install second side cover without O-ring and secure with two bolts.

9. Pull out centering ring of measuring bar with the spindle so that measuring bar can still just be turned by hand.

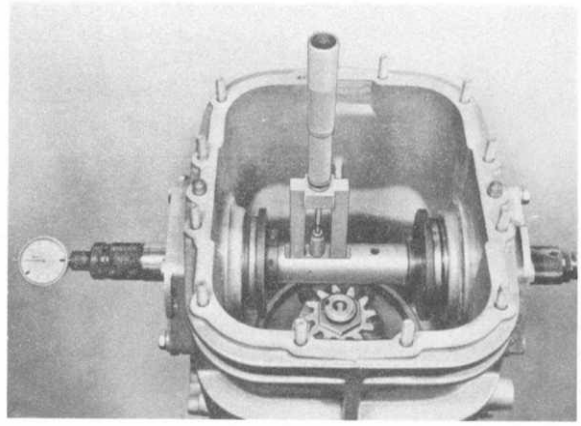


10. Set Special Tool VW 385/30 to adjusting distance "E" + 5 mm (for missing Special Tool VW 385/17).

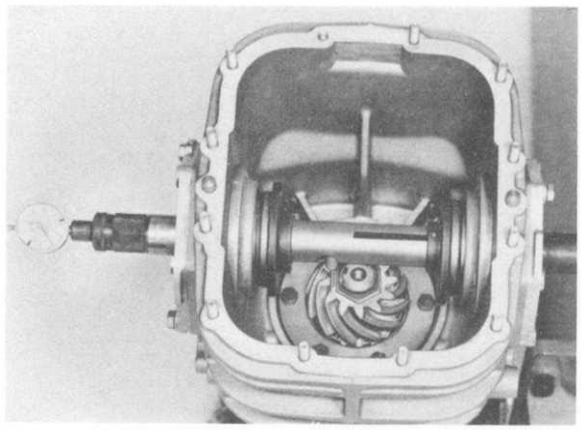
Example:

R	=	72.70 mm	
r	=	+ 0.18 mm	
E	=	72.88 mm	
		+ 5.00 mm	
		77.88 mm	adjustment of measuring bar

11. Install measuring bar and set (3 mm range) dial gauge at zero with 1 mm preload.



12. Turn measuring bar carefully until dial gauge extension is vertical to face of pinion head. At this moment dial gauge needle will reach its point of reverse direction, when dial gauge must be read.



Note

The measured value will always deviate from the set distance in clockwise direction (small needle of dial gauge will be between 1 and 2), i.e. when adjusting the dial gauge with 1 mm preload the value deviating from 1 is added as shim thickness S_3.

Example:

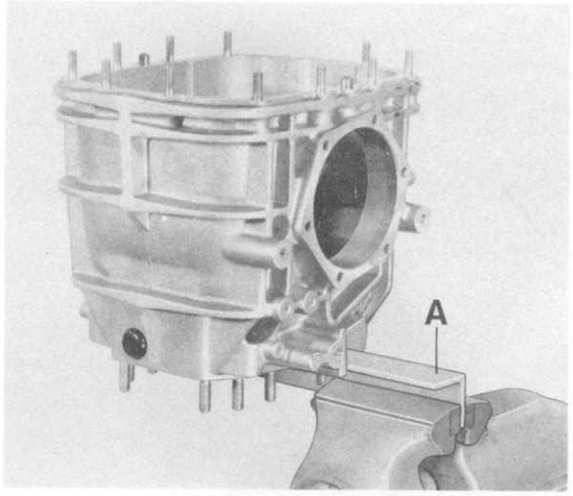
If small needle of dial gauge is between 1 and 2, and large needle points to 0.40 mm, use 0.40 mm as shim thickness S_3 (with 1 mm dial gauge preload).

13. Install the determined shim thickness S_3 between transmission case and final drive housing.

14. Recheck distance after installation of shims with determined thickness. A deviation of $\pm$ 0.03 mm is permissible.

ADJUSTING RING GEAR (S_{total})

1. Clamp final drive housing in a vise, using a suitable fixture.



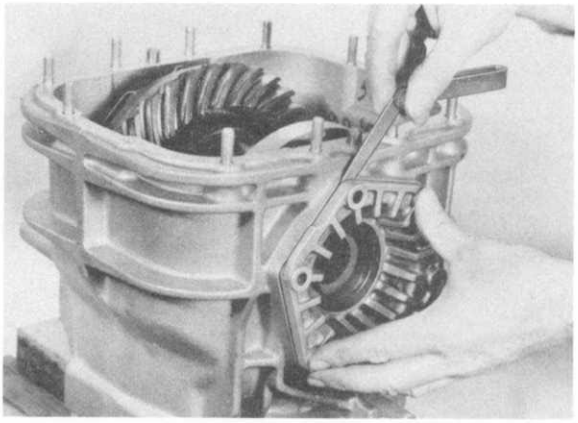
A - angle iron bar

2. Install differential with ring gear in housing.

3. Install side cover (ring gear end) without shims and tighten all bolts to specified torque.

4. Guide in second side cover without shims carefully.

5. Check gap between transmission case and side cover with a feeler gauge.



6. Calculate shim thickness S_{total}

S_{total} = gap - 0.30 mm (bearing preload)

Example:

Gap		1.25 mm
Bearing preload	-	0.30 mm
		0.95 mm

ADJUSTING BACKLASH

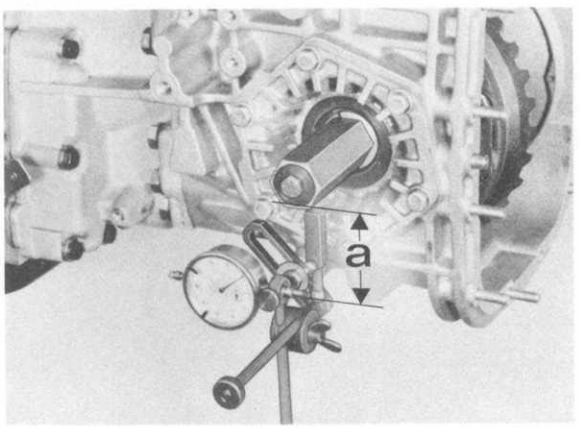
1. Place shims determined for pinion adjustment between transmission case and final drive housing. Install final drive housing and tighten all mounting bolts to specified torque.

2. Install differential in housing.

3. Install side cover, using total shim thickness "S_{total}" as determined on ring gear end and tighten all bolts to specified torque.

4. Turn differential in both directions several times, to settle tapered roller bearings.

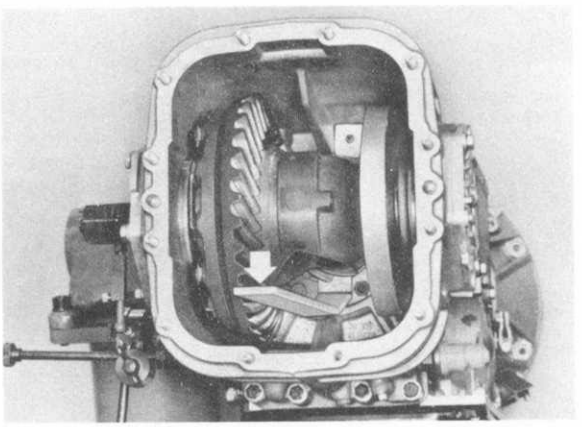
5. Install measuring tools. Set Special Tool VW 388 to distance "a" = 80 mm.

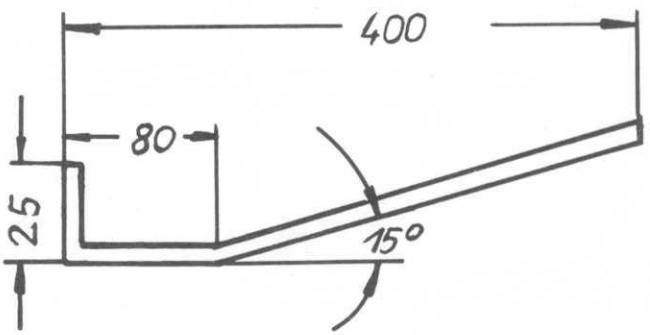


6. Engange parking lock.

7. Turn ring gear carefully by hand against stop and set dial gauge to zero.

8. Hold pinion with locally made lever and turn back ring gear carefully. Read and note amount of backlash.





Lever made locally from flat iron 30 x 5 mm

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DETERMINATION OF SHIMS S_1 AND S_2

Measured backlash must be brought to value specified by manufacturer of pinion/ring gear by splitting total shim thickness Sges.

Specified Value:
Getrag pinion/ring gear = 0.15 to 0.20 mm
Hurth pinion/ring gear = 0.20 to 0.25 mm

Backlash is stamped on ring gear.

Determining Shim Thickness S_1 (Ring Gear End)

S_1 = Sges (total shim thickness)
- measured backlash
+ backlash inscribed on ring gear

Example:

Sges	0.95 mm
- measured backlash	0.88 mm
	0.07 mm
+ inscribed backlash (e.g. 0.20 mm)	0.20 mm
S_1	0.27 mm

Determining Shim Thickness S_2 (Opposite Ring Gear)

S_2 = Sges - S_1

Example:

Sges	0.95 mm
S_1	- 0.27 mm
	0.68 mm

Note

The change in backlash by splitting shims S_1 and S_2 is only an example and does not have to be made strict according to procedures.

1. Remove side transmission cover and split total shim thickness Sges, that it gives the determined shim thicknesses S_1 and S_2.

Note

When tightening nuts for side transmission covers, always remember that there is a certain amount of backlash. Never let the drive pinion and ring gear clamp.

2. Measure backlash and, if necessary, change shims S_1 and S_2 again until specified play is reached.

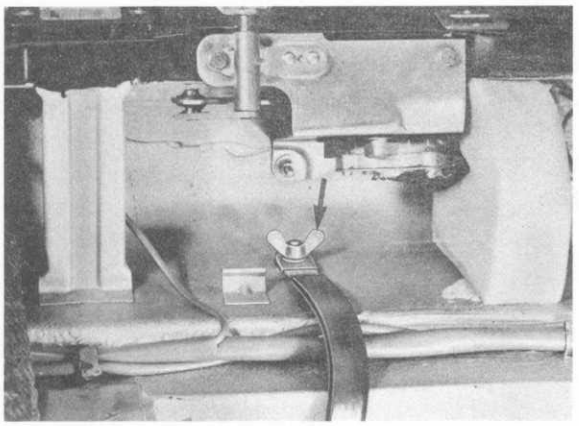
3. Check backlash at four places on periphery, turning ring gear by 90° each time. Measurements must not deviate from each other by more than 0.05 mm.

1 = Automatic transmission
2 = Central tube
3 = Drive plate housing

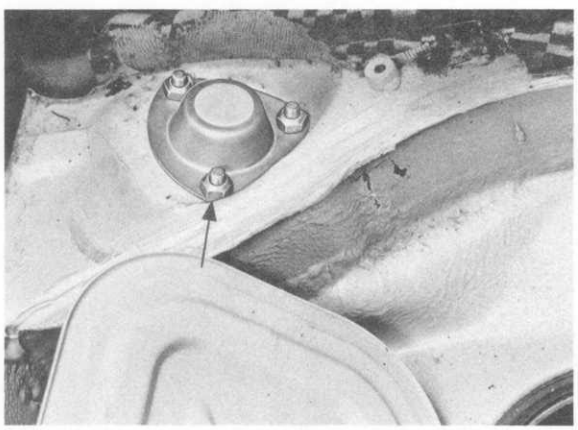
REMOVING AND INSTALLING CENTRAL TUBE (AUTOMATIC TRANSMISSION)

Removing

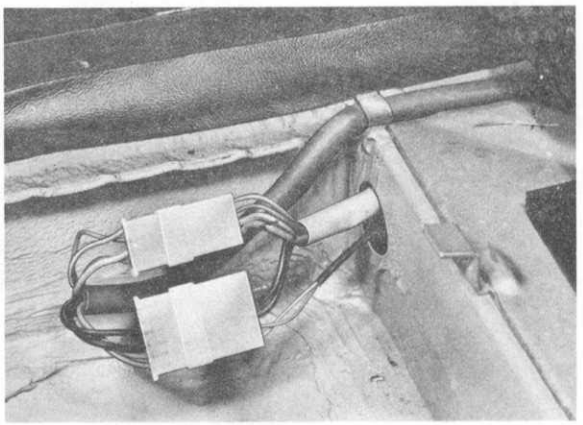
1. Remove battery ground strap.



2. Remove self-locking nuts from spring struts in trunk.



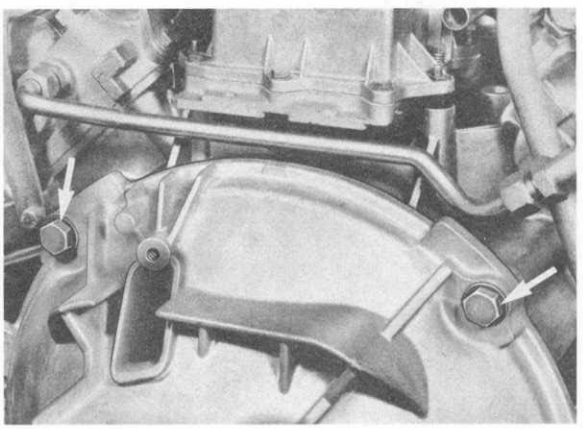
3. Disconnect multiple plugs in spare wheel well and pull out downward.



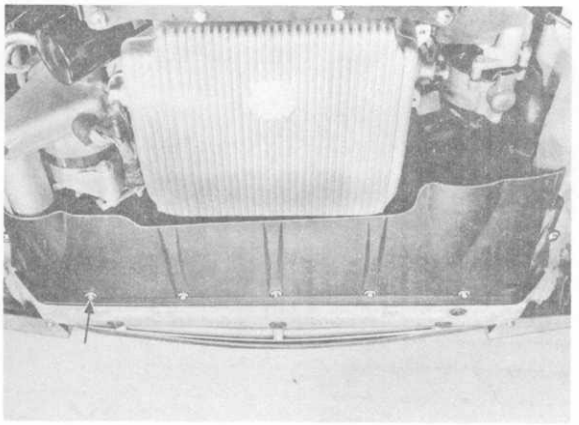
4. Detach parking brake cable at fastener.

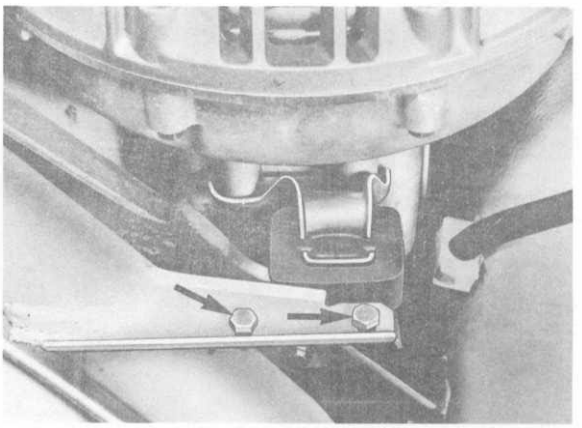
5. Remove air cleaner.

6. Remove upper mounting screws of drive plate housing.



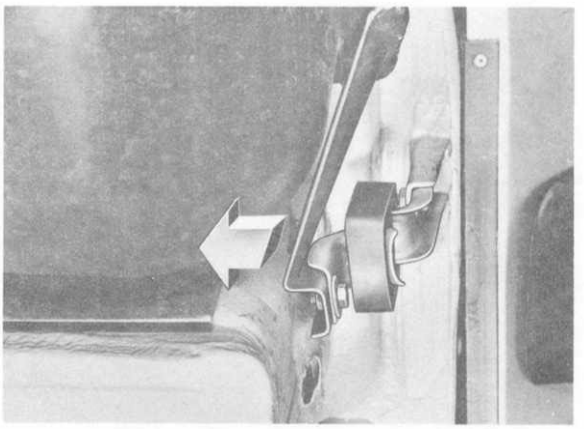
7. Remove splash shield.

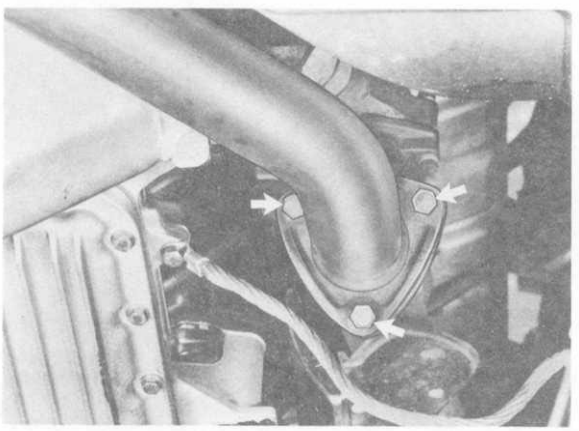


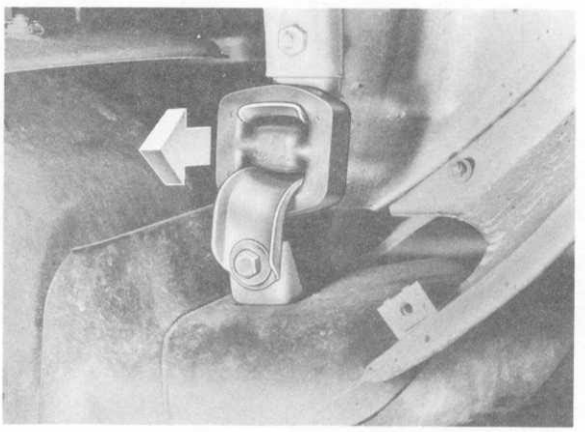


8. Remove lower body brace.

9. Remove entire exhaust system, by removing bolts on exhaust manifold and holder, and then pulling exhaust system out of rubber holder.





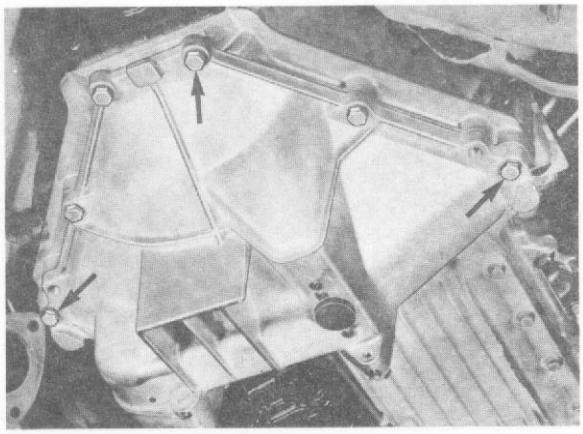


Note

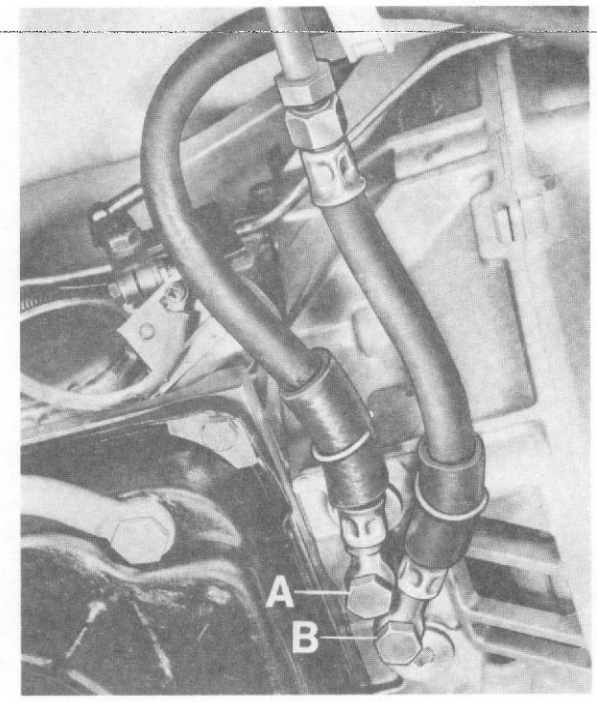
Two people will be required to remove and install a complete exhaust system.

10. Remove exhaust system heat shields.

11. Remove cover for drive plate housing together with starter and detach stabilizer bar.

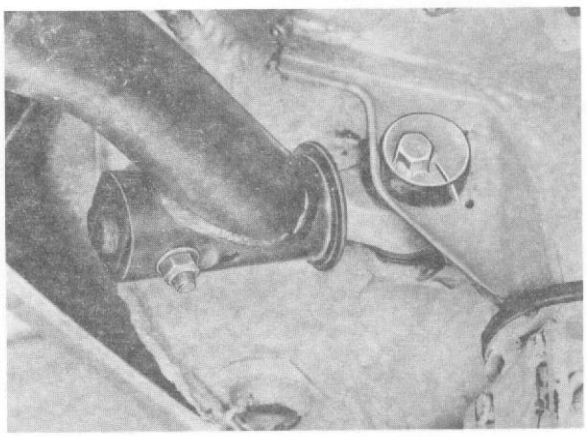


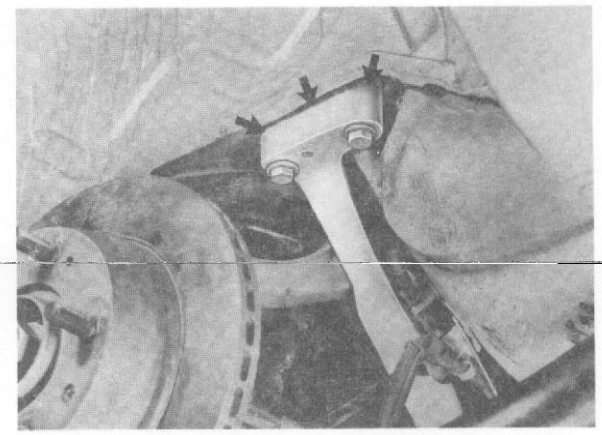
12. Detach feed and return lines for ATF cooler and plug bores in converter housing.



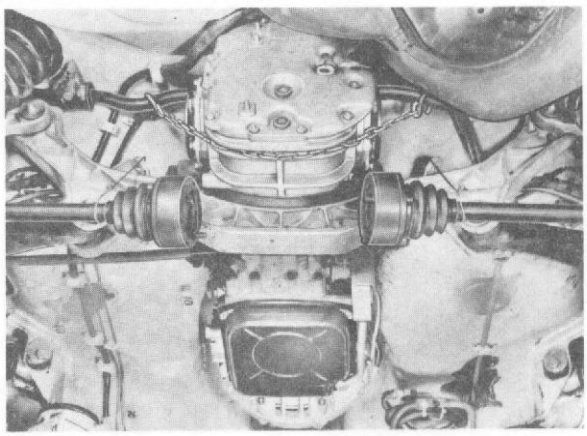
A - To cooler inlet (bottom connection)
B - From cooler outlet (top connection)

13. Mark location of toe eccentric bolts and rear axle cross member for reinstallation.





14. Support transmission on stabilizer bar with chain US 8031 and remove rear axle.



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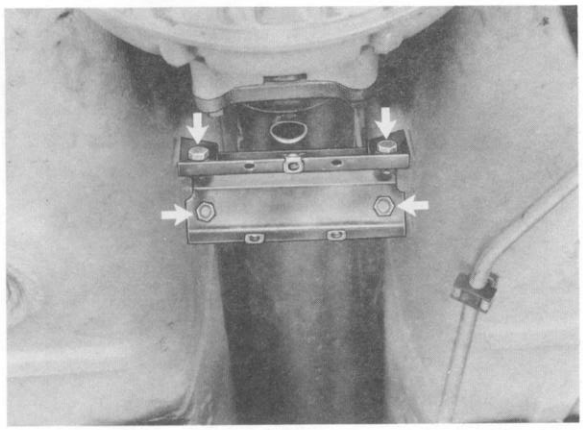
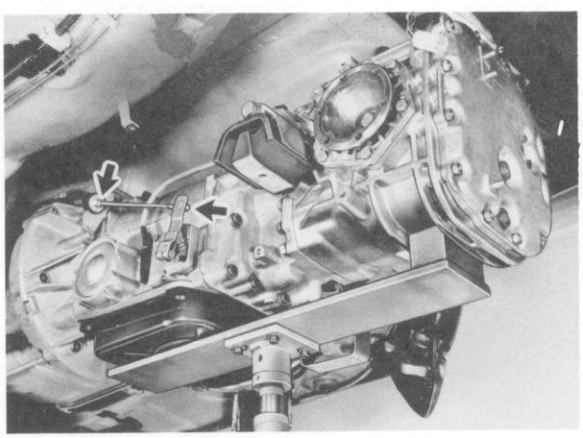
15. Remove rear reinforcement plate.



16. Bolt transmission plate 9163 on universal transmission jack and place underneath transmission.

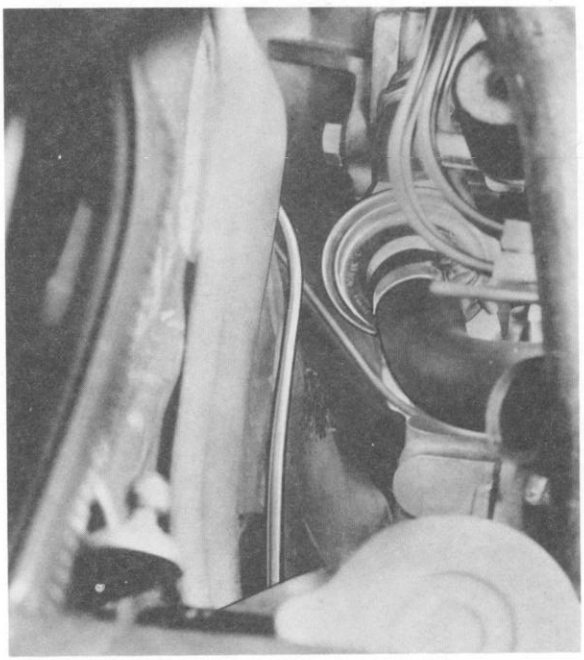
17. Lift transmission and detach holding chain.

18. Lower transmission only so far, that selector lever cable and cable sleeve on holder can be detached.

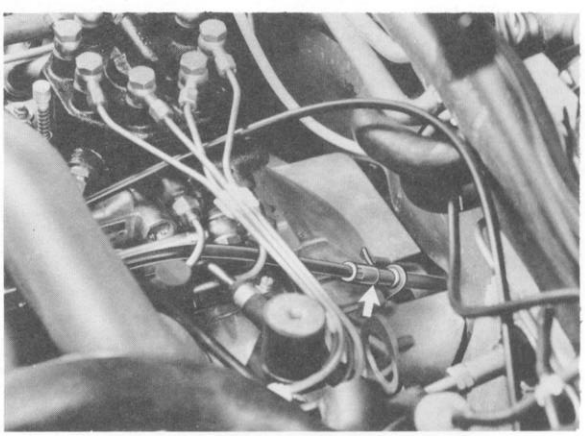


Note

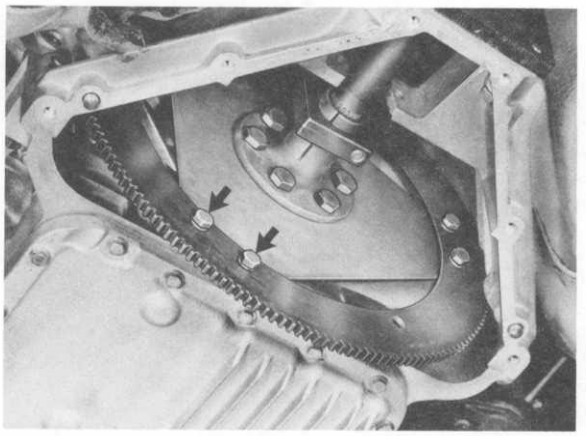
When lowering transmission, it is important to be careful that the engine check valve for air injection does not damage the brake line.



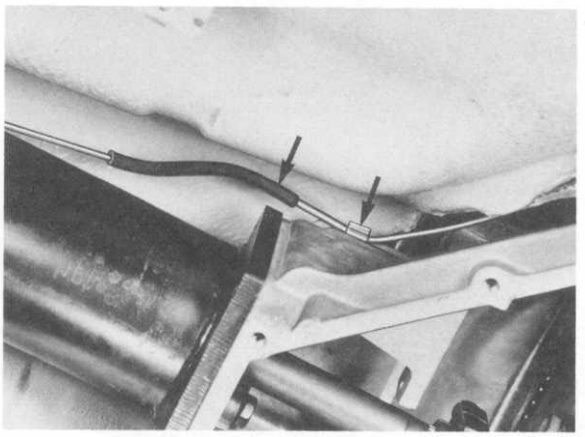
19. Detach control pressure cable. Unscrew ball head and locknut. Pull off rubber grommet and pull out cable from engine compartment. Be careful not to bend cable.



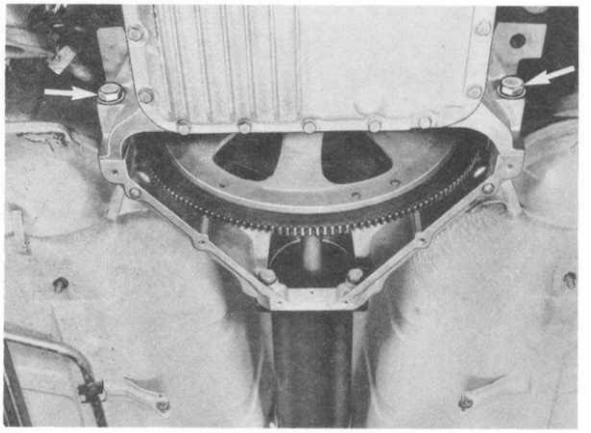
20. Screw out pan-head screw for clamping sleeve and mounting bolts for driver plate



21. Press out vacuum line from retaining clips and pull of hose.



22. Unscrew lower monting screws for clutch housing



23. Pull back central tube with transmission slightly and lower with universal transmission jack.

Note

Two persons will be required to remove central tube.

Istalling

Note

To avoid placing the driver plate of the flywheel under strain, start by tightening the six driver plate bolts and only tighten the pan-head screw of the clamping sleeve afterwards.

1. Note specified tightening torque values.

2. Adjust selector lever and control pressure cables.

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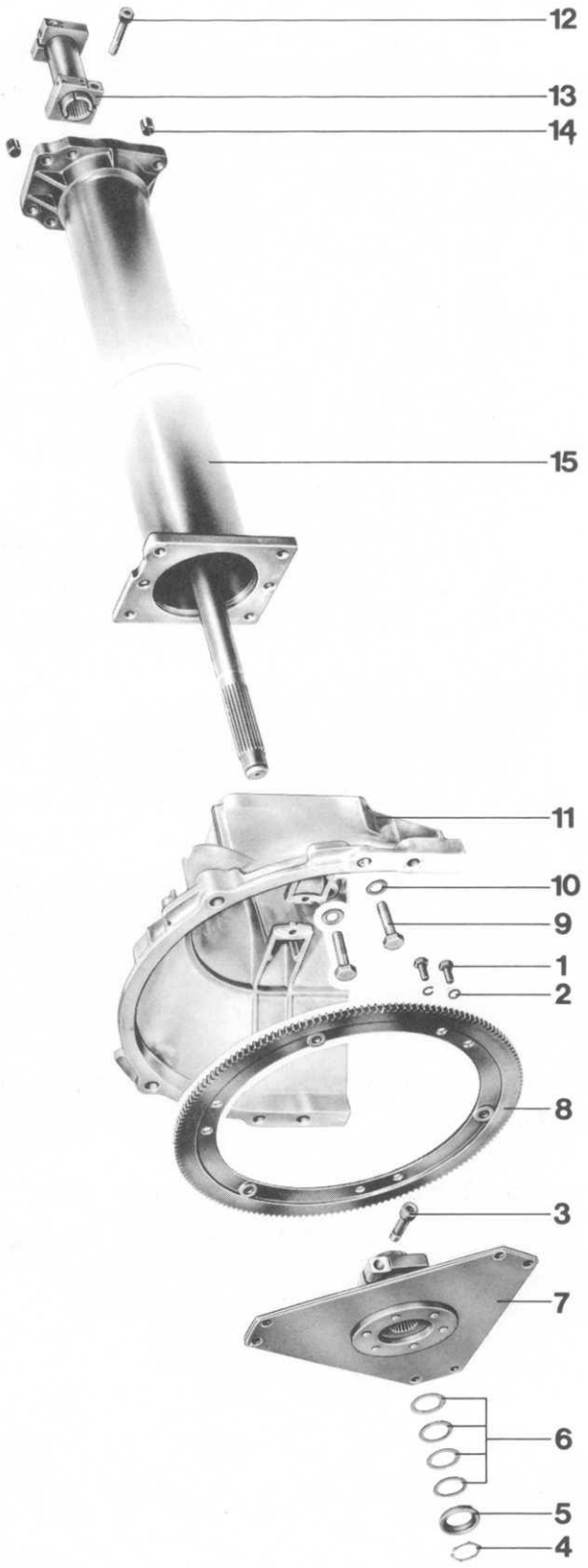
DISASSEMBLING AND ASSEMBLING CENTRAL TUBE (AUTOMATIC TRANSMISSION)



No.	Description	Qty.	Note when Removing	Note when Installing
1	Bolt	9		Torque: 32...39 Nm (24 ftlb...29 ftlb)
2	Lockwasher	9		Replace
3	Pan head screw	1		Torque: 80 Nm (59 ftlb)
4	Circlip*	1		Replace if necessary
5	Bushing*	1		
6	Shim*	X		
7	Driver plate	1		
8	Starter ring gear	1		
9	Bolt	4		Torque: 39...46 Nm (29 ftlb...34 ftlb)
10	Washer	4		
11	Drive plate housing	1		
12	Pan head screw	1		Torque: 80 Nm (59 ftlb)
13	Coupling	1		
14	Dowel sleeve	2		
15	Central tube	1		Check, replacing if necessary

Note

* Parts are deleted as of MY '85. Adjustment of the driver plate is no longer required (also refer to page 39 - 138, Vol. III).

The ring gear can only be replaced if the central tube has been removed.

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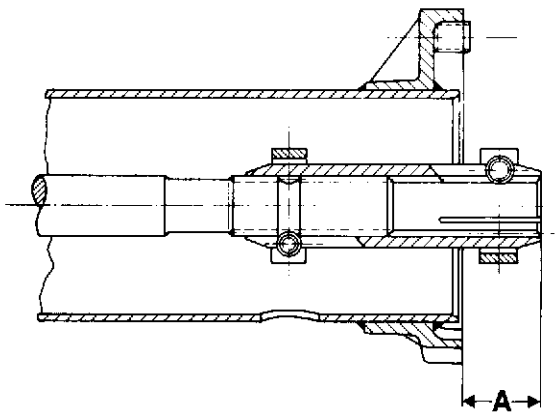
Checking Drive Shaft

Since the position of the drive shaft is important to proper operation, the coupling must protrude by 36 ± 0.5 mm.



A = 36 ± 0.5 mm

The amount of protrusion can be corrected by tapping with a plastic hammer against face of drive shaft.

Check for easy movement of drive shaft bearings by turning shaft by hand. Shaft must turn easily and without binding at any point.

Note

If bearings or shaft are damaged, replace entire central tube with shaft and bearings. There are no plans for replacement of individual parts.

Modification on Coupling

Note

At the beginning of standard production, manufacturing methods made it necessary to build about 120 transmissions without an undercut at the end of the spline on the drive shaft for the torque converter. This meant that 4.5 mm had to ground off of the face of the coupling.

The distance A = 36 $\pm$ 0.5 mm as mentioned on page 39 - 49 must not be applied to the shortened coupling.

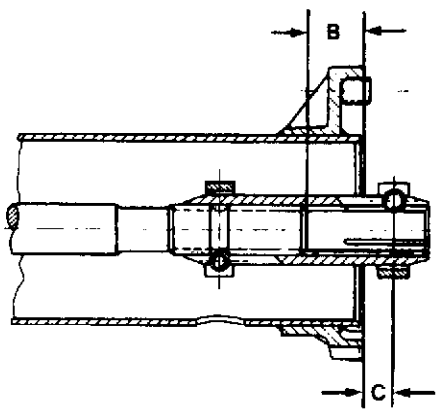
Total length of coupling = 130.00 mm
Total length of shortened coupling = 125.50 mm

When installed shortened end faces torque converter.

When using the shortened coupling, procedures for measuring the drive shaft are as follows.

1. Measuring without coupling:
   Distance "B" must be 30 $\pm$ 0.5 mm

2. Measuring with coupling:
   Distance "C" must be 17 $\pm$ 0.5 mm.



Distance B = 30 $\pm$ 0.5 mm
Distance C = 17 $\pm$ 0.5 mm

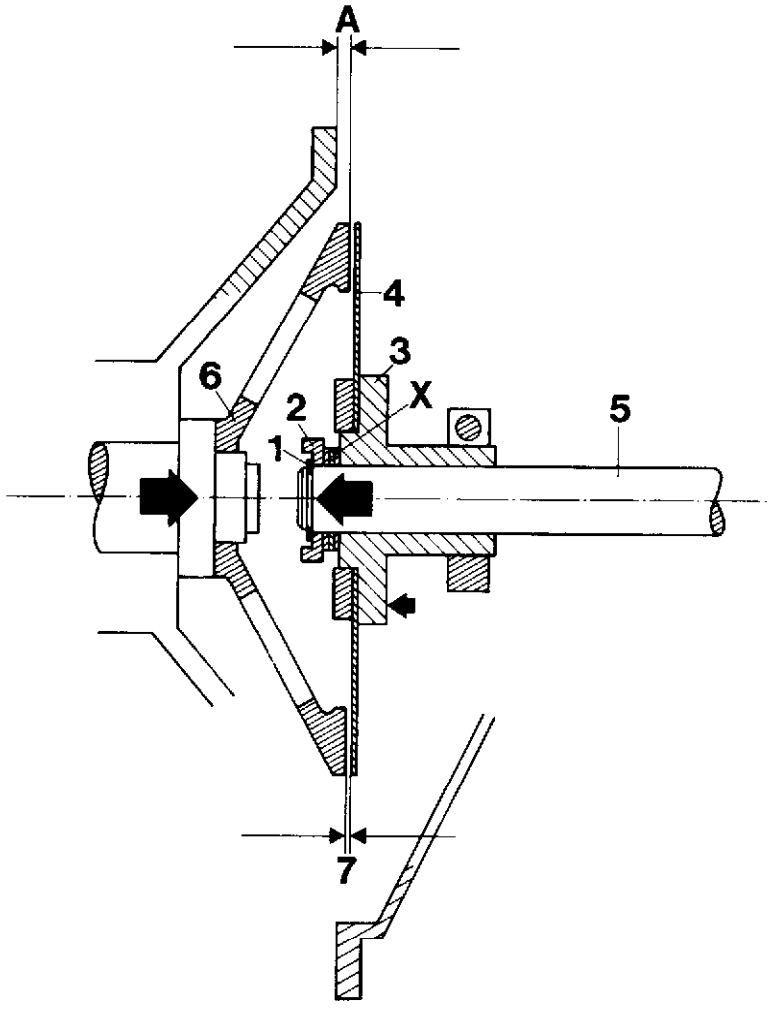
Note

The distances 30 $\pm$ 0.5 mm and 17 $\pm$ 0.5 mm apply to all couplings.

The protrusion can be corrected slightly with light taps from a plastic hammer against the face of the drive shaft.

Adjusting Drive Plate

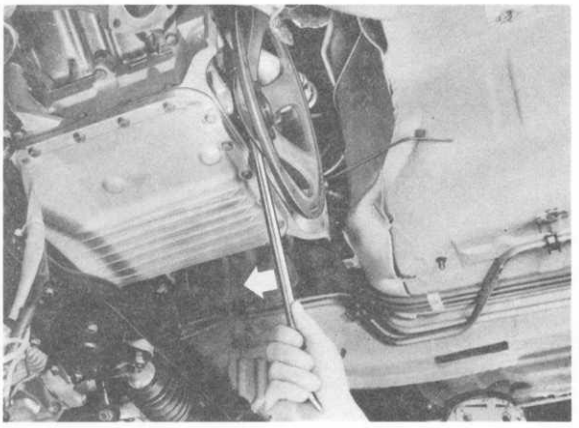
To prevent axial loads on crankshaft and consequently additional loads on crankshaft thrust bearings, the connections between flywheel and drive plate (distance X) must be checked and adjusted after replacement of engine, central tube, coupling, front converter housing or drive shaft for converter.



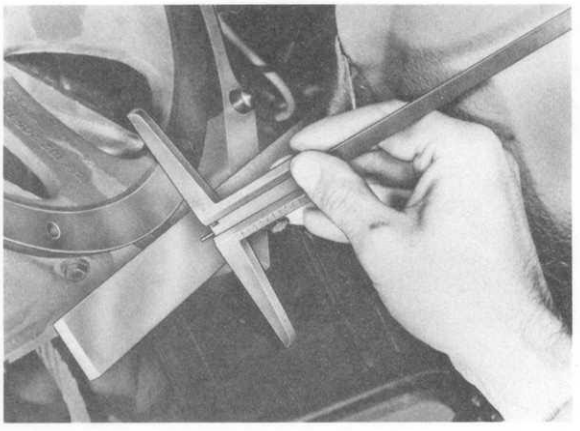
1 = Circlip
2 = Bushing
3 = Coupling flange
4 = Drive plate
5 = Drive shaft
6 = Engine flywheel
7 = Pre-load 0.3 + 0.2 mm
A = Distance A, engine flange/flywheel mating surface
X = Shim thickness (must be determined again)

Determining Distance X

1. Crankshaft must contact thrust bearing in direction of transmission. Pry flywheel with a lever until end play of crankshaft is eliminated.



2. Determine distance A, by using a ruler and measuring distance from engine flange to flywheel mating surface.



Note

Remember thickness of ruler when measuring.

Example:

Measured value	6.7 mm
Ruler thickness	+ 5.5 mm
Distance A	12.2 mm

3. Push coupling on to drive shaft and mount transmission on central tube. Tighten bolts to specified torque.

4. Screw in coupling screws by hand (finger tight).

5. Push drive flange with bushing, but without shims, on to drive shaft and install circlip.

6. Use a suitable lever and push drive shaft on drive flange far enough forward so that drive shaft rests on screws on shaft groove.

7. Tighten screws for coupling to specified torque.

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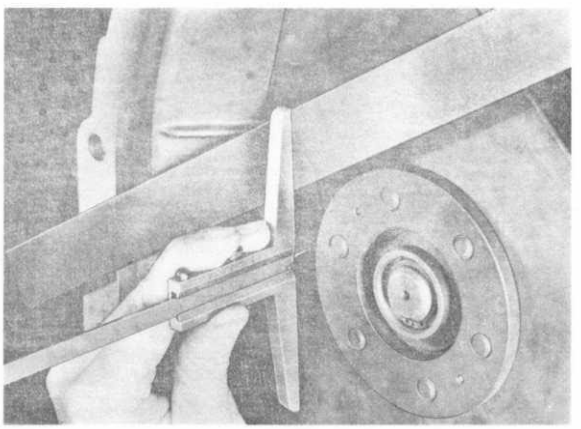
8. Push drive flange forward against stop on circlip and tighten screw to specified torque.

9. Determine distance B. Use ruler and measure distance from drive plate housing to drive plate bearing surface (as far in as possible).



Determining Distance X

X = A - B + 0.5 mm pre-load

A =		12.2 mm
B =	-	7.4 mm
		4.8 mm
Preload =	+	0.3 mm
X =		5.1 mm

Install shim having thickness X (in example 5.3 mm).

Shims are available in thicknesses of 0.2 mm, 0.5 mm and 1.0 mm.

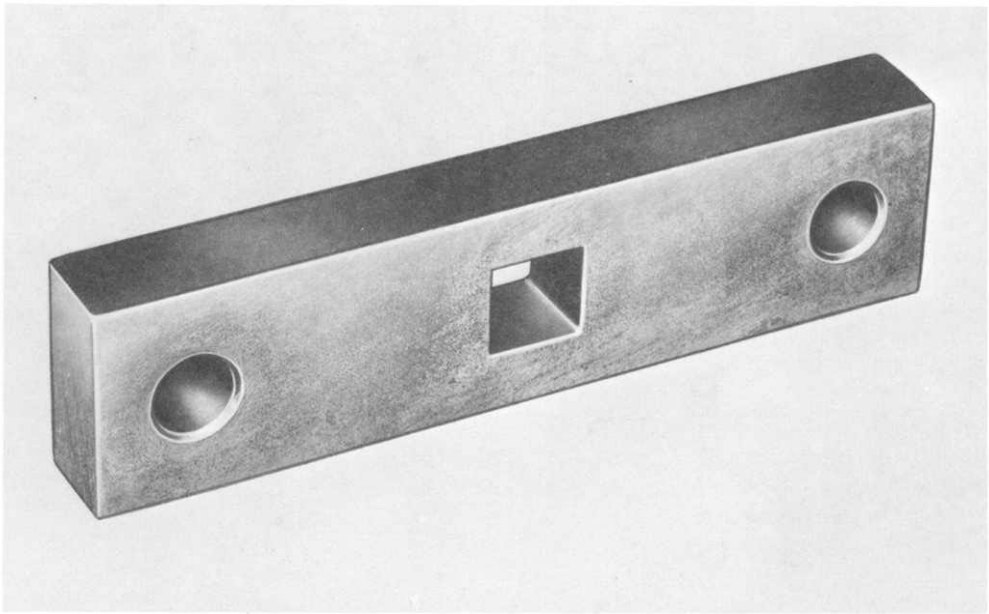
Note

Remember thickness of ruler used for measuring.

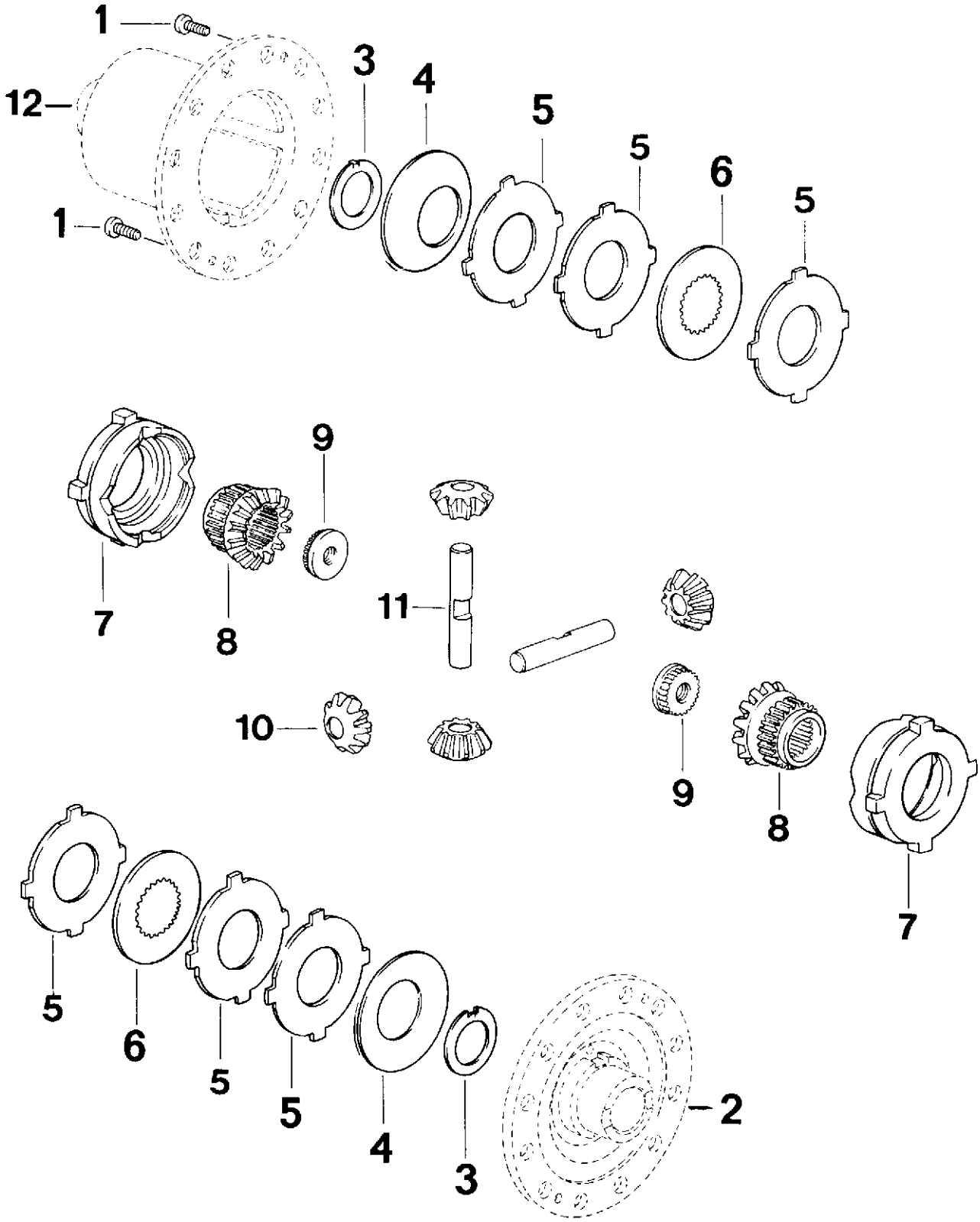
Example:

Measured value		12.9 mm
Ruler thickness	-	5.5 mm
Distance B		7.4 mm

TOOLS



No.	Description	Special Tool	Remarks
1	Connector	---	Local manufacture. Connector of joint flange can be made of 30 x 15 x 120 mm flat steel and must have a 1/2" square opening in the middle.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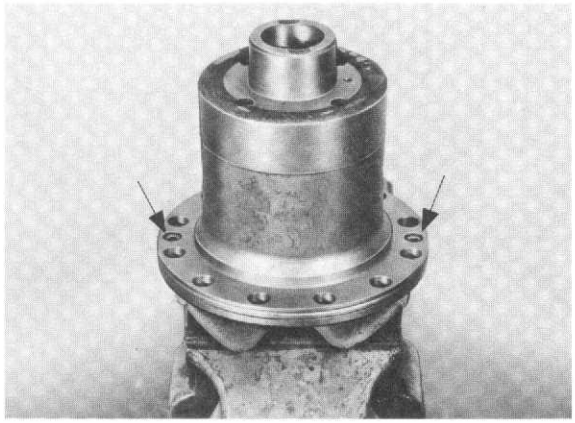
No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
1	Bolt	2		Torque: 14 Nm (10 ftlb)	
2	Housing cover	1			
3	Thrust washer	2		Position correctly	
4	Spring retainer	2		Position correctly	
5	Outer plate	6			
6	Inner plate (molybdenum coated)	2			
7	Thrust ring	2			
8	Differential gear	2			
9	Splined nut	2	Press out of differential gear	Press in to correct position	
10	Differential pinion	4			
11	Differential shaft	2			
12	Differential housing	1			

DISASSEMBLING AND ASSEMBLING LIMITED SLIP DIFFERENTIAL

Disassembling

1. Take off ring gear.

2. Loosen screws on housing flange and remove cover.



3. Remove all inner parts.

Note

Note order of installed plates in order to have same locking ratio when reassembled.

Assembling

1. Check all parts for wear or damage and replace, if necessary.

   a) Differential housing:
   Check guide grooves for outer plates and thrust rings for wear.

   b) Thrust rings:
   Guide tabs and bearing surfaces must not be worn seriously or scored. In addition, they must move easily in differential housing.

   c) Differential gears:
   Bearing surfaces for thrust washers must not be worn and inner plates must move easily on splines of differential gears.

   d) Plates:
   Check inner and outer plates for wear. Guide tabs of outer plates and splines of inner plates must not be seriously worn.

2. Lubricate all sliding surfaces of plates, thrust rings and differential shafts with SAE 90 hypoid gear lube prior to installation.

3. Install thrust washers so that holding tabs engage in bore of housing or housing cover. Applying grease to the washers to hold them in position will facilitate installation.

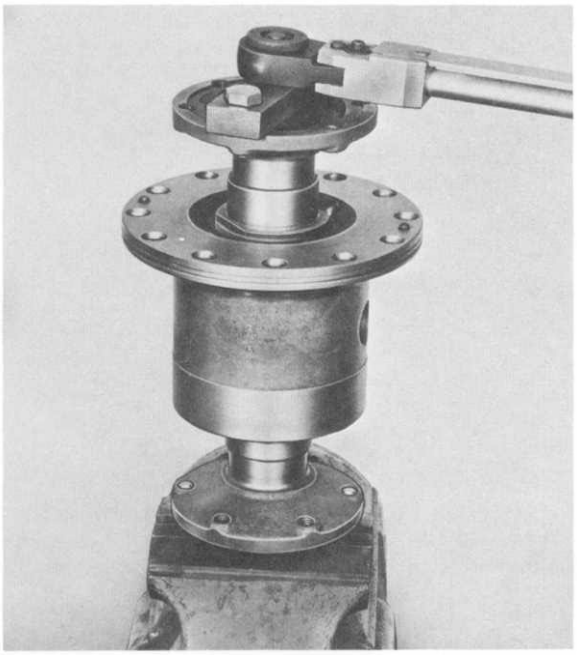
4. Install other parts as shown in exploded drawing.

It is essential that plates be installed in correct order and position to reach the same locking ratio.

Note

Diaphragm springs must be installed so that concave sides face in toward plate assembly.

5. Check torque slip with one differential gear held tight and one driven. This requires clamping a flange with two bolts in a vise and installing the differential. Install a second flange with the local manufactured connector and turn the differential with a torque wrench. A torque of 5 to 20 Nm (4 to 14 ftlb) must be reached.



Note

If the specified torque cannot be reached, a change can be made by installing pertinent outer plates. Outer plates are available in thicknesses of 1.9, 2.0 and 2.1 mm.

If the thickest outer plates are installed and the specified torque is still not reached, all plates are worn and must be replaced.

REMOVING AND INSTALLING CENTRAL TUBE (Manual Transmission)

REMOVING AND INSTALLING INSTRUCTIONS

Removing

1. Remove exhaust assembly with heat shields.

2. Remove rear axle.

Note

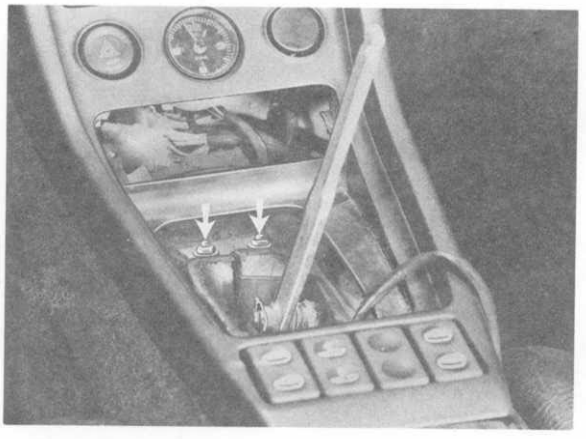
Let rear axle of cars with a bolted battery console hang down on the trailing links and support same (tie up).

3. Remove transmission (see page 34 - 3).

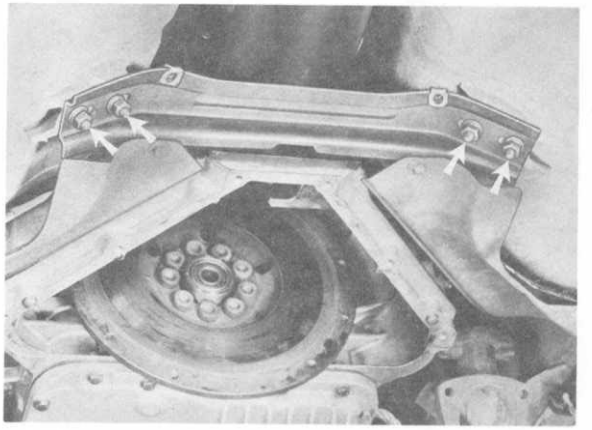
4. Remove clutch (see page 30 - 3).

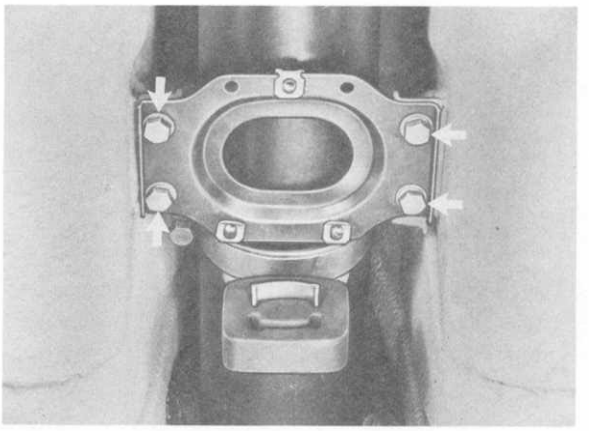
5. Remove shift lever.

6. Remove ashtray and unscrew guide tube mount from body (only for cars manufactured up to August 7, 1978).

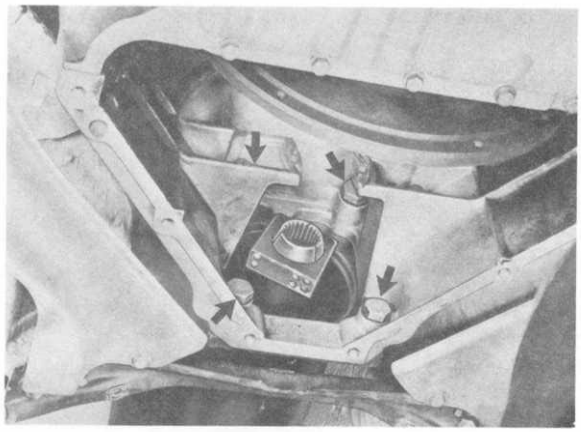


7. Remove front and rear reinforcement plates.





8. Support central tube from underneath and remove clutch bell housing/central tube mounting bolts.



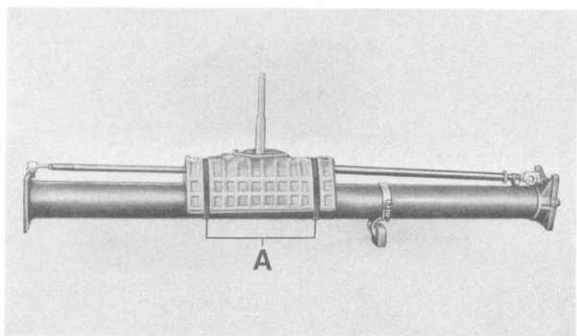
4. Tighten all mounting bolts to specified torque.

Installing

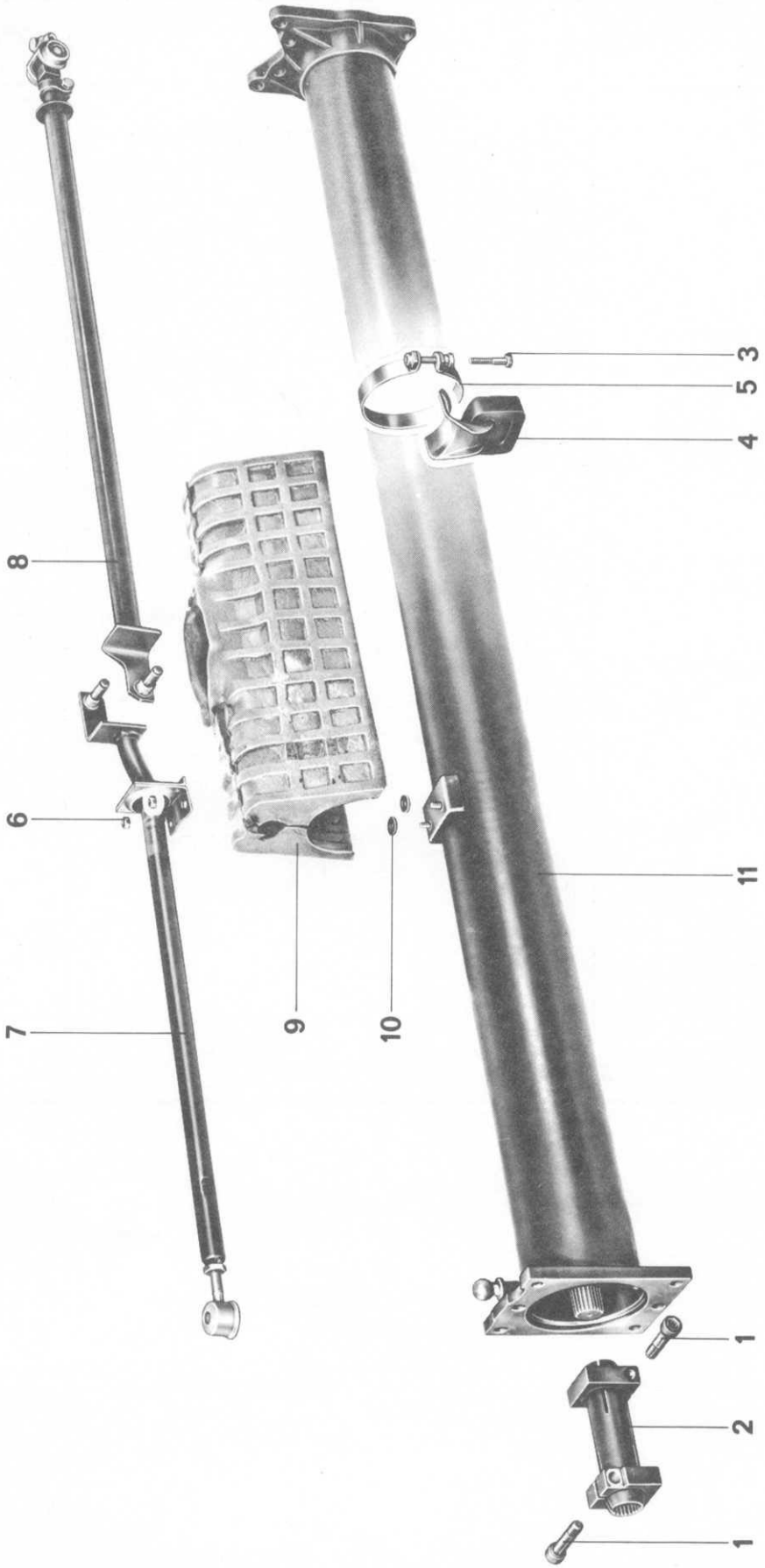
1. Adjust selector linkage, if necessary.

2. Brush a thin coat of Optimoly HT paste on spline of central shaft.

3. Wrap strips of tape around insulation sheet and coat bearing surfaces on body with Contifix grease to facilitate installation.



A - Tape strips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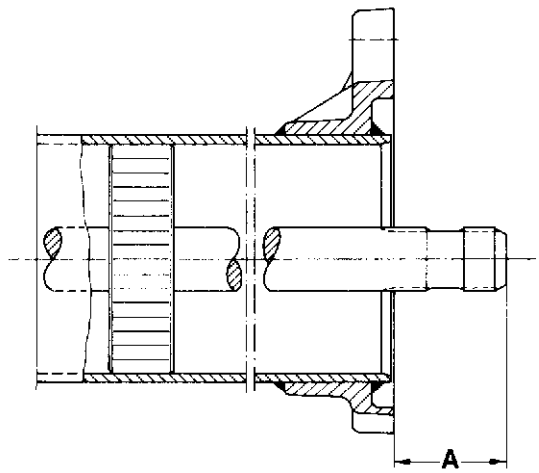
No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
1	Bolt	2		Tighten to 80 Nm (8.0 kpm)	
2	Double clamp	1			
3	Bolt	1			
4	Hook with rubber mount	1			
5	Strap	1	Mark position for installing later		
6	Nut	2			Not for cars produced up to 7.8.78
7	Guide tube with mount and angle joint	1	Pry off angle joint with suitable open-end wrench	Coat ball shell and ball head of ball joint white lube paste and drive on carefully	On cars produced up to 7.8.78 mount of guide tube is on body
8	Selector rod	1			
9	Insulation sheet	1		Wrap strips of tape around and coat bearing surfaces to body with Contifix grease	
10	Rubber washer	2			Not for cars produced up to 7.8.78
11	Central tube	1		Check, replacing if necessary	

Checking Drive Shaft

Since the position of the drive shaft is important to guarantee proper operation, the drive shaft must protrude by 46.85 - 0.5 mm.



A = 46,85 - 0,5 mm

The amount of protrusion can be correctly slightly by tapping with a plastic hammer against face of drive shaft.

Check easy movement of drive shaft bearings by turning shaft by hand. Shaft must turn easily and without restriction at any point.

Note

If bearings or shaft are damaged, replace entire drive tube with shaft and bearings. There are no plans for replacement of separate parts.

Max. permissible runout for central shaft: 0,8 mm.

The procedures described for repairing the 5-speed manual transmission

Type G 28 '85 models onward

are arranged by repair groups and 200-series page numbers.

To keep the documents in correct order, please file all pages with 200-series page numbers behind the yellow Marker Sheet.

For example:

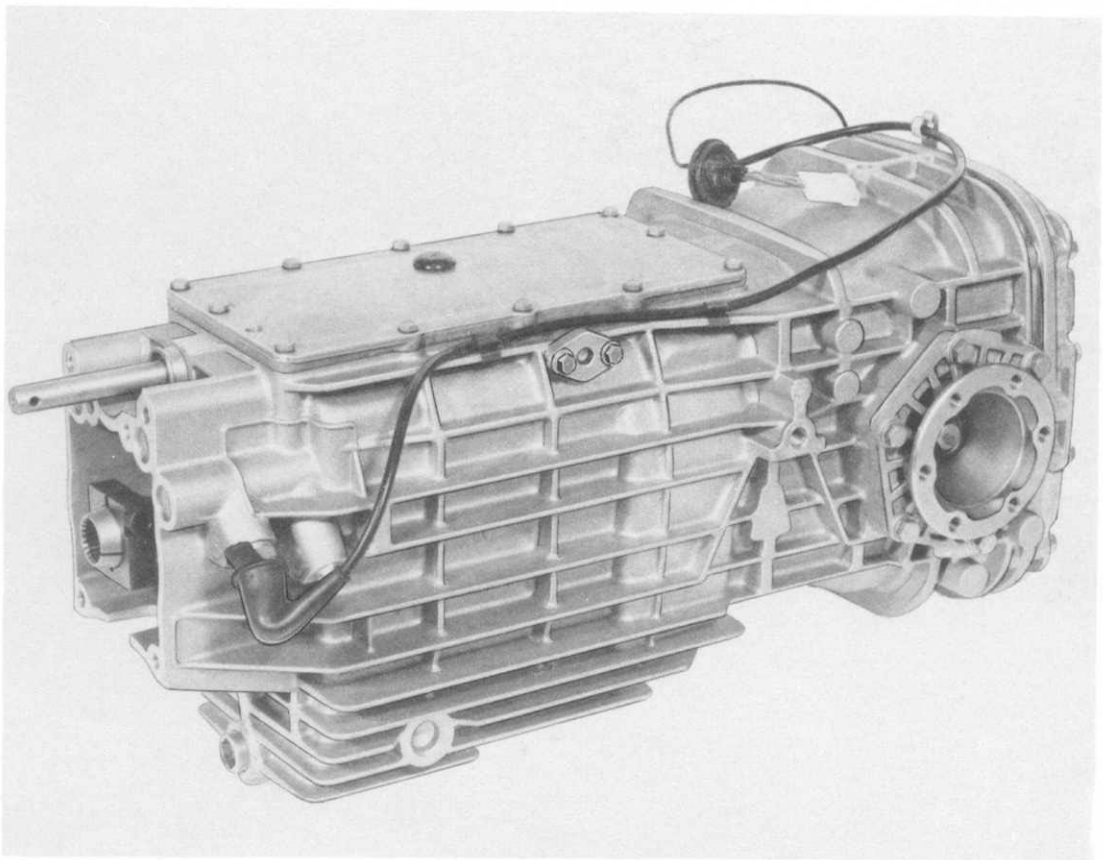
30 - 0201.....

34 - 201.....

35 - 201.....

39 - 201.....

5-speed manual gearbox type G 28



Type	Key number	Equipment	installed in	model
G 28/10	-	5 Speed	928 S Eur./R.o.W.	1985/86
G 28/11	-	5 Speed	928 S USA	1985/86
G 28/12	-	5 Speed	928 S 4 Eur./R.o.W.	1987/88
G 28/13	-	5 Speed	928 S 4 USA/Japan	1987/88
G 28/55*	-	5 Speed	928 S 4 Clubsport 928 S4, 928 GT (worldwide)	1988 1989/90/91
G 28/57	-	5 Speed	928 GTS (worldwide)	1992/93

* Model '88 / 89 standard with limited slip differential (40%).
As of Model '90 standard with controlled limited slip differential (PSD).

Printed in Germany – XXXI, 1993

General Data	Manual transmission Type G 28/10/12/55					Manual transmission Type G 28/11/13				
Design	Direct transmission with layshaft									
Ratios*	Z_1	Z_2	i_Z $Z_2:Z_1$	i_{lay} 32:22	$i_Z \times i_{lay}$	Z_1	Z_2	i_Z $Z_2:Z_1$	i_{lay} 33:21	$i_z \times i_{lay}$
1st gear	17	44	2,5882	1,4545	3,7645	17	44	2,5882	1,5714	4,0672
2nd gear	22	38	1,7272	1,4545	2,5122	22	38	1,7272	1,5714	2,7142
3rd gear	26	32	1,2307	1,4545	1,7900	26	32	1,2307	1,5714	1,9339
4th gear	29	27	0,9310	1,4545	1,3541	29	27	0,9310	1,5714	1,4629
5th gear	direct		1,0000	direct	1,0000	direct		1,0000	direct	1,0000
Reverse gear	22 (30)	(30) 50	2,2727	1,4545	3,3056	22 (30)	(30) 50	2,2727	1,5714	3,5714
Final drive	Drive pinion without hypoid displacement									
Final drive ratio	11:30 i = 2,7272 (G28/10/55) 11:29 i = 2,6363 (G28/12)					15:33 i = 2,200				
Transmission oil	Multigrade gear lube SAE 75 W 90 API - Classification GL 5 (or MIL L 2105 B)									
Oil capacities	85 models and earlier = approx. 3,8 liters 86 models onward = approx. 4,5 liters									

* Z_1 = Number of teeth on first gear wheel in the load path of the gear concerned

Z_2 = Number of teeth on second gear in the load path of the gear concerned

i_Z = Gear ratio

i_{lay} = Layshaft ratio

General Data	Manual transmission Type G 28.57				
Type	Direct transmission with countershaft				
Ratios*	Z_1	Z_2	iz Z_2:Z1	i_{coun} 35:24	iz x i_{coun}
1st gear	17	44	2.5882	1.4583	3.7745
2nd gear	22	38	1.7272	1.4583	2.5188
3rd gear	26	32	1.2307	1.4583	1.7948
4th gear	29	27	0.9310	1.4583	1.3577
5th gear	direct		1.0000	direct	1.0000
Reverse	22 (30)	(30) 50	2.2727	1.4583	3.3143
Final drive	Bevel gear without hypoid offset				
Final drive ratio	11:30 i = 2.7272				
Transmission oil	Multigrade transmission oil SAE 75 W 90 API classification GL 5 (or MIL L 2105 B)				
Capacity	approx. 4.8 l				

* Z_1 = No. of teeth of first gearwheel in power flow of respective gear

Z_2 = No. of teeth of second gearwheel in power flow of respective gear

iz = Transmission ratio of gear

i_{coun} = Countershaft

TORQUE SPECIFICATIONS FOR MANUAL TRANSMISSION G28.10/11

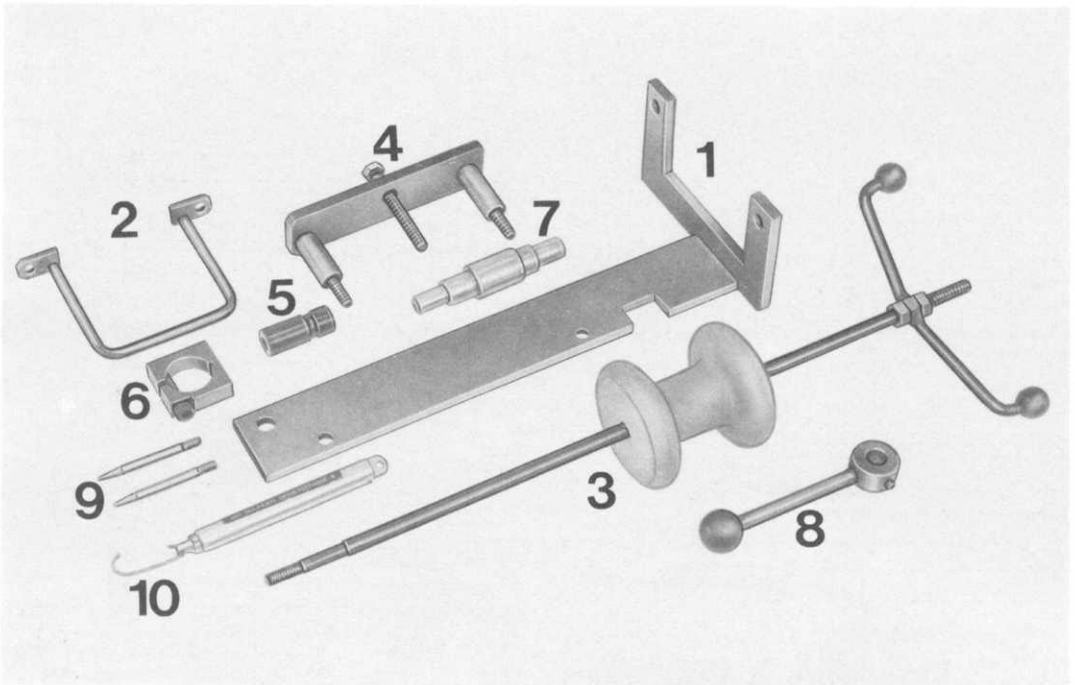
Location	Designation	Thread/ lead	Material	Torque (Nm)
Oil filler and drain plug	*Threaded plug	M 24 x 1.5 M 22 x 1.5	-	22
Transmission output flange	Hex bolt	M 10 x 1,5	8.8	43
End cover to transmission housing	Hex bolt	M 8 x 1,25	8.8	22
Side cover to transmission housing	Hex bolt	M 8 x 1,25	8.8	22
Top cover to transmission housing	Hex bolt	M 6 x 1	8.8	9
Reverse gear stop to top cover	Hex bolt	M 6 x 1	8.8	9
Guide sleeve transmission housing	Hex bolt	M 6 x 1	8.8	10
Back-up light switch to housing	Back-up light switch	M 18 x 1.5	-	22
Plug to transmission housing	Plug	M 12 x 1.5	5.8	19
Selector fork to selector rod	Hex bolt	M 8 x 1,25	8.8	25

*Bolts with sealing rings from 86 models onward

Torque specification for manual transmission

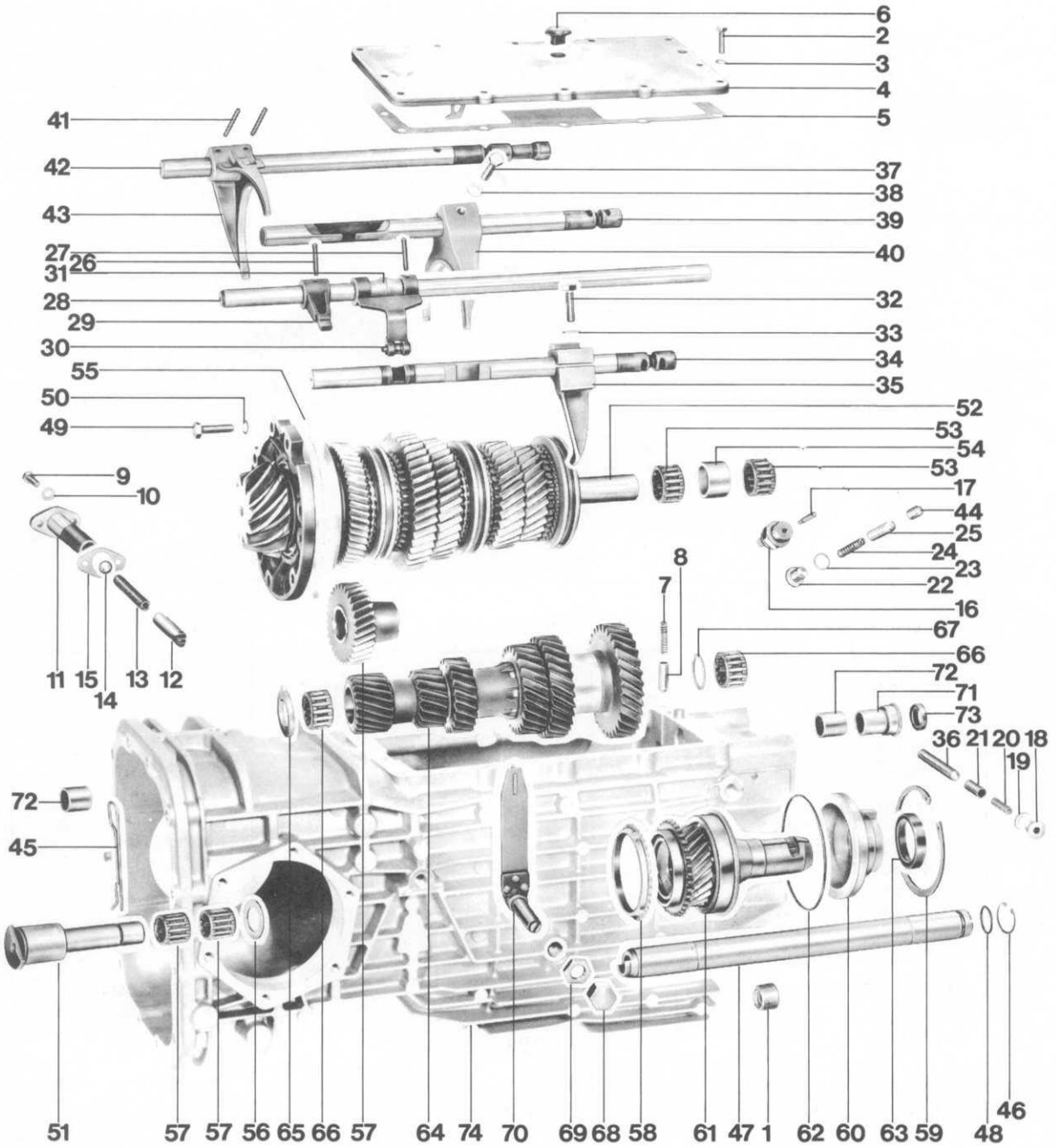
Location	Description	Threads/ Pitch	class	Torque Nm (ftlb)
Cap and hexagon - nut on stud for preselector spring	Nut	M 14 x 1	-	50 (36)
Drive pinion bearing unit/ transmission case	Bolt-	M 8 x 1,25	10.9	30 (22)
Lock nut on drive pinion	Nut-	M 32 x 1,5	-	300 (217)
Ring gear/ differential housing-	Bolt-	M 12 x 1,25	12.9	165 (119)

TOOLS



No.	Description	Special Tool	Remarks
1	Holding plate	9149	
2	Bracket	9144	
3	Impact tool	VW 771	
4	Extractor	9148	
5	Extractor	9140	
6	Clamping sleeve	-	Spare part
7	Driver	9223	
8	Operating lever	9155	
9	Centering pins	9321	
10	Spring scale	-	Standard, 0...50 N

DISASSEMBLING AND ASSEMBLING TRANSMISSION



No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
1	Drain plug (magnetic plug)	1		Torque: 22 Nm (16 ftlb)	
2	Bolt	12		Torque: 9 Nm (7 ftlb)	
3	Washer	12			
4	Case cover	1			
5	Gasket	1		Replace	
6	Vent	1			
7	Spring	1			
8	Locking sleeve	1		Lubricate thoroughly	
9	Bolt	2		Torque: 10 Nm (7 ftlb)	
10	Washer	2			
11	Guide sleeve	1			
12	Lockpin	1		Position correctly	
13	Spring	1			
14	Ball	1			
15	Gasket	1		Replace	
16	Backup light switch	1		Torque: 22 Nm (16 ftlb)	
17	Plunger	1		Stepped end faces switch	
18	Plug	1		Torque: 19 Nm (14 ftlb)	
19	Gasket	1		Replace	

No.	Description	Qty.	Note When Removing	Note When Installing	Special Instructions
20	Spring	1			
21	Locking sleeve	1		Lubricate thoroughly	
22	Plug	1		Torque: 19 Nm (14 ftlb)	
23	Gasket	1		Replace	
24	Spring	1			
25	Locking sleeve	1		Lubricate thoroughly	
26	Pin	1	Engage 5th gear and drive out, counterholding shift rod with suitable tool.	Counterhold shift rod with suitable tool.	
27	Key	1	Engage 4th gear and drive out, counterholding shift rod with suitable tool.	Counterhold shift rod with suitable tool.	
28	Interior shift rod	1		Position correctly, cavity for pointed screw must face left.	
29	Shift arm	1			
30	Preselector lever	1			
31	Shift cam	1			
32	Bolt	1		Torque: 25 Nm (18 ftlb)	

No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
33	Washer	1			
34	Shift rod (4th and 5th gears)	1	Pull out toward rear		
35	Shift fork (4th and 5th gears)	1		Adjust	
36	Lock (long)	1		Lubricate thoroughly	
37	Bolt	1		Torque: 25 Nm (18 ftlb)	
38	Washer	1			
39	Shift rod (2nd and 3rd gears)	1	Pull out toward rear		
40	Shift fork (2nd and 3rd gears)	1		Adjust	
41	Lock	2			
42	Shift rod (1st and reverse gears)	1	Pull out toward rear		
43	Shift fork (1st and reverse gears)	2			
44	Lock (short)	1		Install with grease	
45	Clamp	1			
46	Circlip	1			
47	Countershaft	1			
48	O-ring	1		Replace, lubricate with light coat of oil	
49	Bolt	7		Torque: 30 Nm (22 ftlb)	

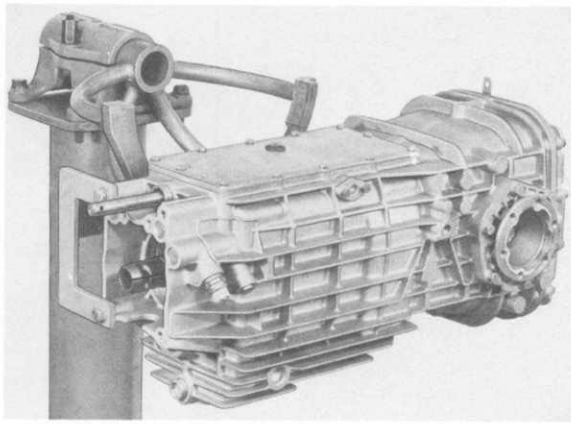
No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
50	Lock washer	7		Hollow side faces bearing cap	
51	Reverse idler shaft	1	Turn bearing assembly and remove with VW 771		
52	Drive pinion	1	Remove with 9144	Install with 9144	
53	Needle cage	2			
54	Thrust ring	1			
55	Shim	X	Note number and thickness for reassembly	If necessary, determine again	
56	Thrust washer	1			
57	Needle cage	2			
58	Synchromesh ring	1	Mark for reassembly	Check for wear; mount on same gear	
59	Circlip	1			
60	Bearing cap	1	Pull out together with input shaft		
61	Input shaft	1	Pull out with 9140 and 9148		

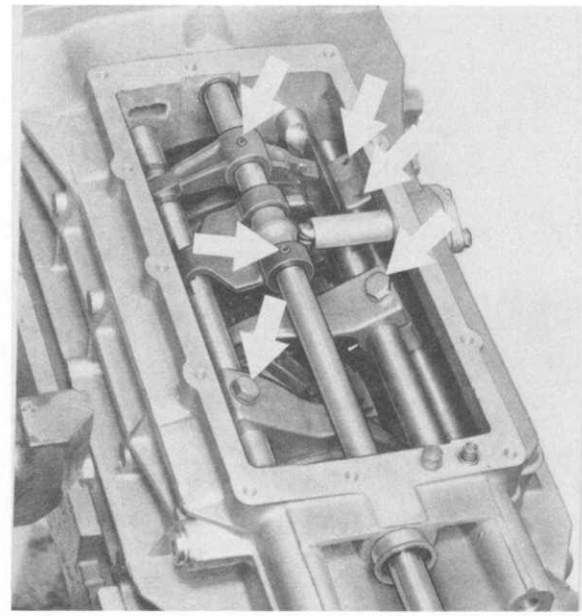
No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
62	O - ring	1		Replace, lubricate with light coat of oil	
63	Seal	1			
64	Countershaft	1			
65	Thrust washer	1		Turning lock faces case opening; stick on case with a little grease	
66	Needle cage	2			
67	Washer	1			
68	Cap nut	1		Torque: 50 Nm (36 ftlb)	
69	Nut	1		Torque: 50 Nm (36 ftlb)	
70	Preselector spring with stud	1			
71	Take-up sleeve	1		Drive in with 9223	
72	Bearing	2	Drive out with suitable mandrel	Drive in with 9223	
73	Seal	1		Drive in with 9223	
74	Transmission case	1			

DISASSEMBLING AND ASSEMBLING TRANSMISSION

Disassembling

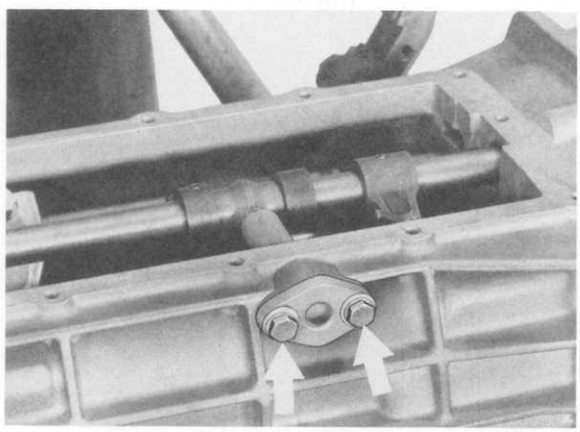
1. Mount transmission on assembly stand with Special Tool 9149 and drain oil.





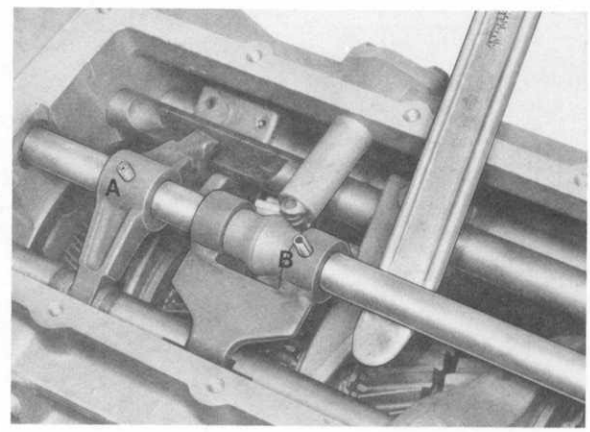
2. Remove differential (see page 39 - 201).

3. Remove shift rods, shift forks and locks.

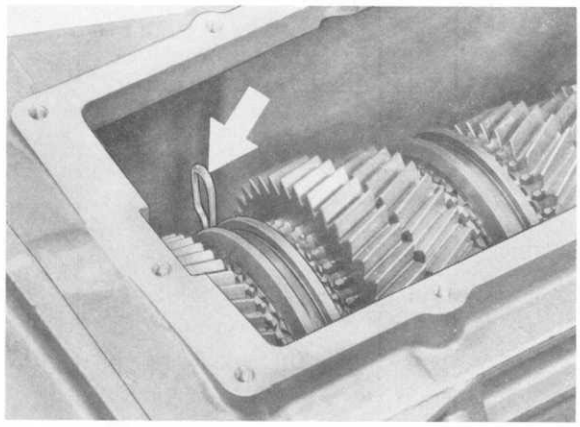


Note

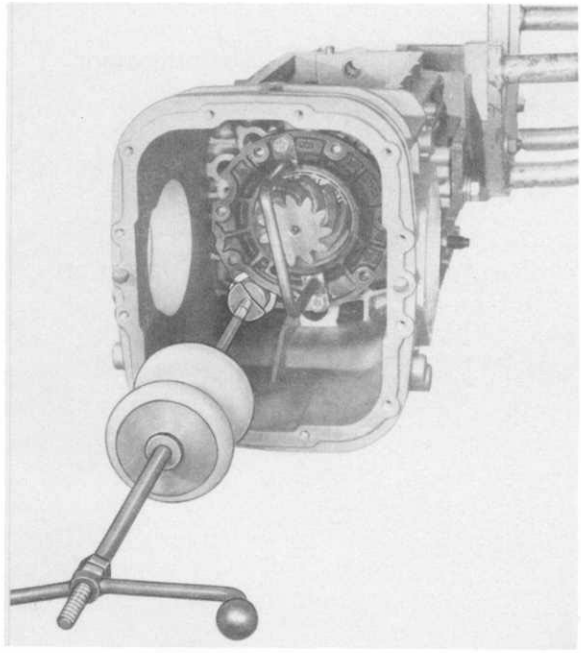
Always counterhold on interior shift rod with a suitable tool when driving out pins and keys.



4. Pull out clamp for reverse gear with a suitable pliers.



5. Unscrew drive pinion mounting bolts, mount Special Tool on bearing assembly and turn until reverse gear shaft can be removed with Special Tool VW 771.

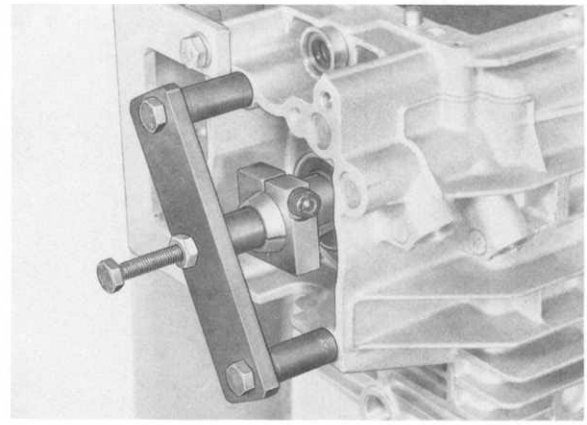


6. Remove circlip for input shaft.

7. Pull out input shaft and bearing cap with Special Tools 9140 and 9148

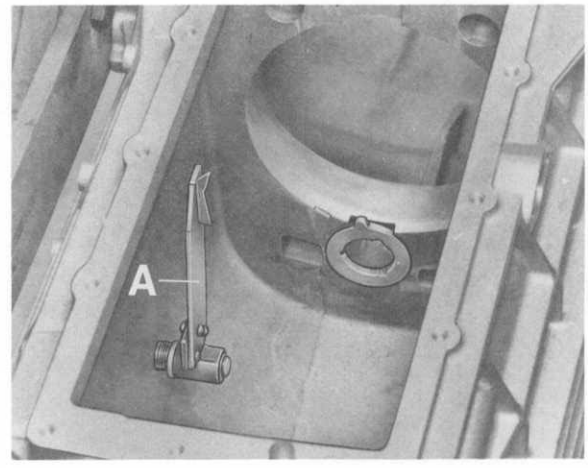
Note

Always first remove countershaft and lower countershaft to bottom of transmission.



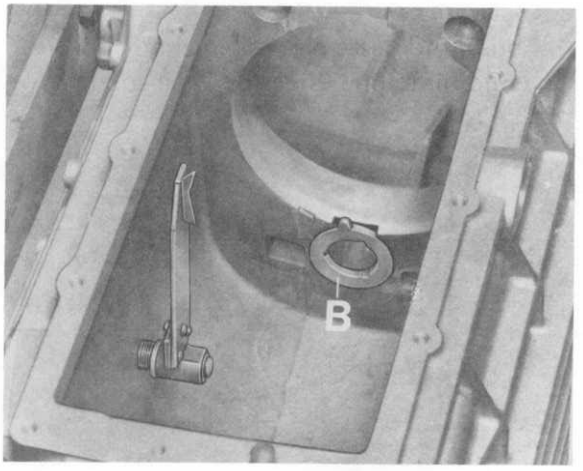
Assembling

1. Screw in preselector spring with stud from inside to outside.



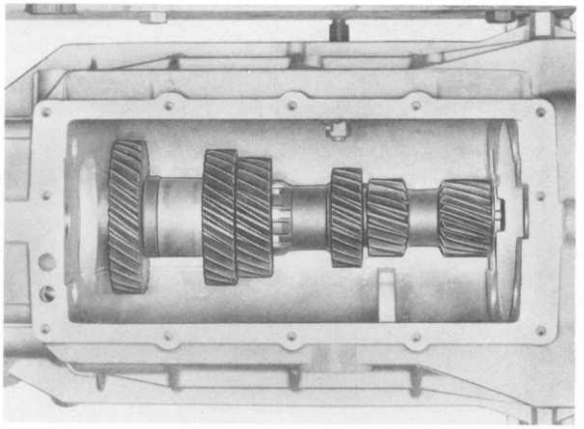
A = Preselector spring

2. Stick thrust washer for countershaft in case with a little grease.

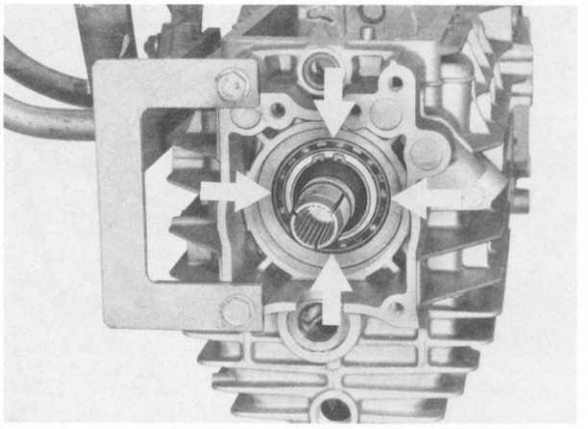


B = Thrust washer

3. Place complete countershaft in case.



4. Drive in complete input shaft over bearing outer race against stop alternately with a piece of suitable pipe or a mandrel.



5. Insert O-ring for bearing cap and lubricate with a light coat of oil.

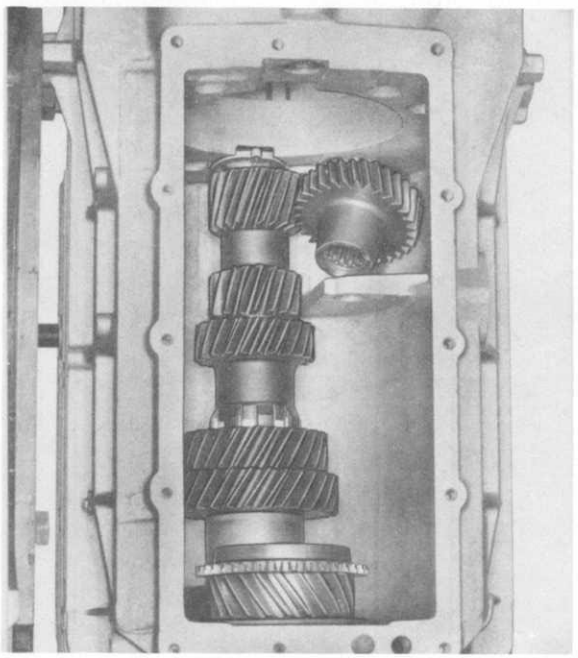
6. Mount bearing cap and circlip.

7. Swing transmission on assembly stand to have input shaft face down.

8. Install needle cages and thrust ring in input shaft.

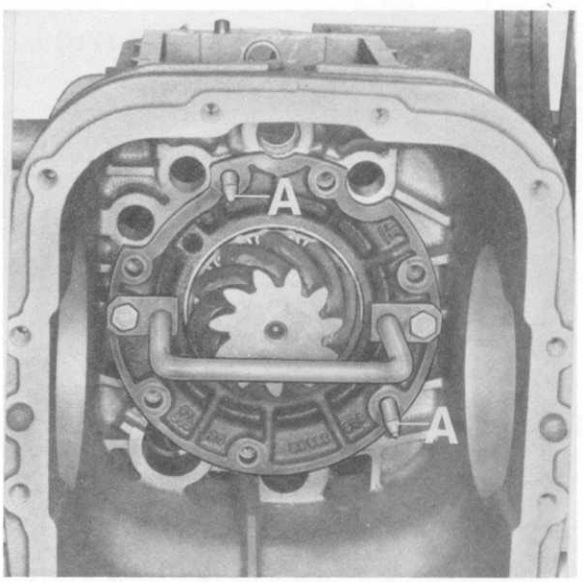
9. Place synchromesh ring for 5th gear on clutch body.

10. Place reverse gear and needle cages in case as shown in the picture.



11. Screw centering pins, Special Tools 9321, in case for installation of drive pinion and install shims S_3.

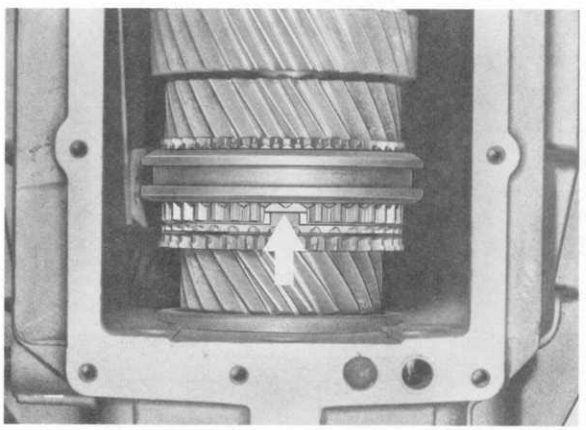
12. Mount Special Tool 9144 on drive pinion bearing cap and move in drive pinion carefully (with 4th gear engaged). Check that reverse gear is positioned correctly.



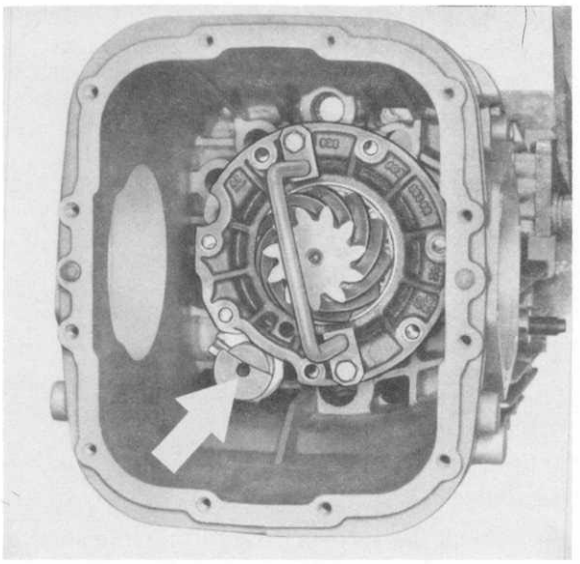
A = Special Tool 9321

Note

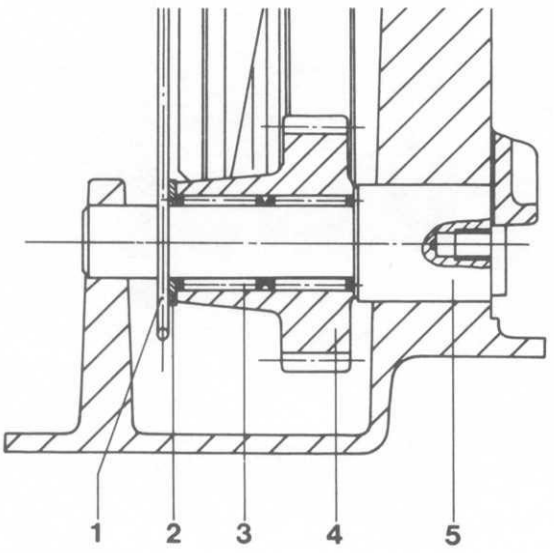
When installing the drive pinion make sure that pins of synchromesh ring (5th gear) engage in openings of guide sleeve.



13. Move reverse gear to correct installed position with a suitable tool, remove centering pins 9321 for bearing assembly and turn latter together with shims until the reverse gear shaft can be mounted.

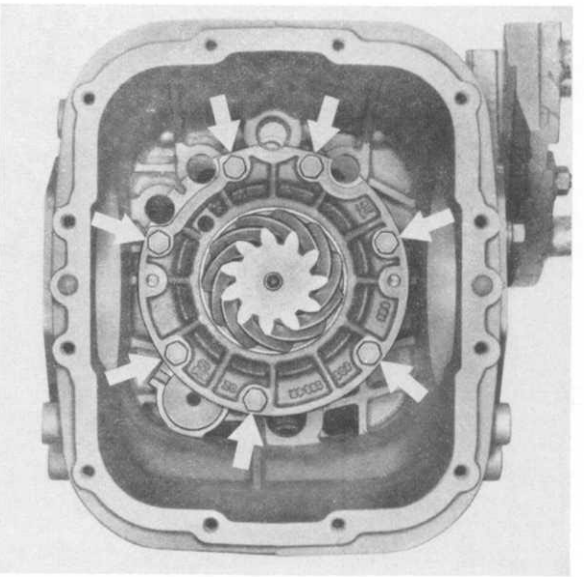


14. Drive in reverse gear shaft only far enough that thrust washer can be installed. Then drive in reverse gear shaft to correct installed position and install clamp.



1 = Clamp
2 = Thrust washer

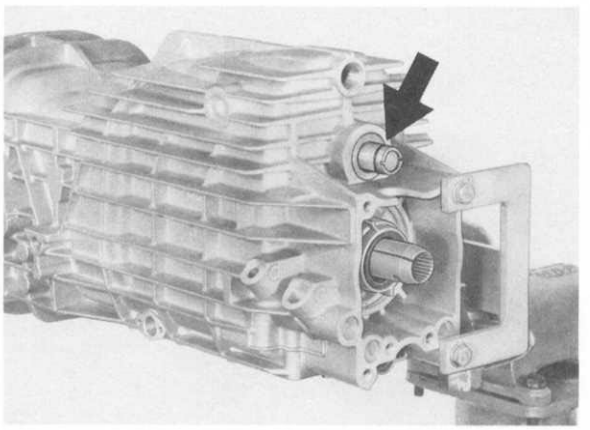
15. Turn bearing assembly and shims S_3 to installed position, tighten mounting bolts to torque of 30 Nm and remove Special Tool 9144.



16. Move countershaft to correct installed position and install shaft with O-ring (O-ring coated lightly with oil).

Note

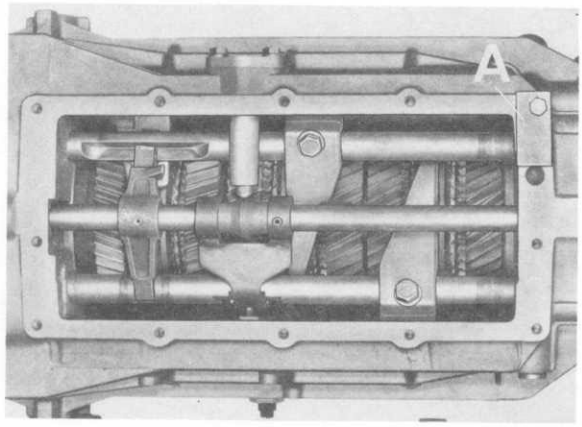
Facilitate installation by turning transmission on assembly stand until countershaft falls into correct installed position on its own weight.

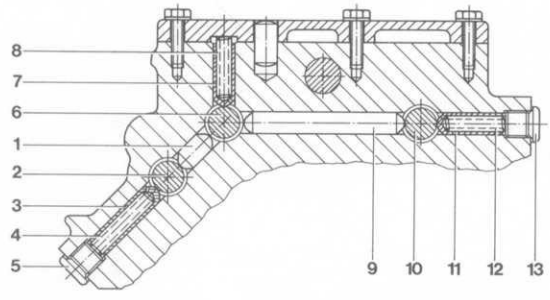


17. Install circlip.

18. Turn on idle.

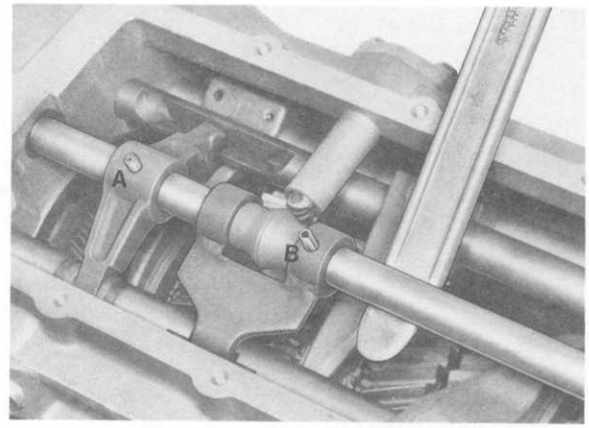
19. Install shift rods, shift forks and locks.





1 - Lock (short)
2 - Shift rods (1st and reverse gears)
3 - Locking sleeve (long)
4 - Spring (long)
5 - Plug
6 - Shift rod (2nd and 3rd gears)
7 - Locking sleeve (short)
8 - Spring
9 - Lock (long)
10 - Shift rod (4th and 5th gears)
11 - Locking sleeve (short)
12 - Spring (short)
13 - Plug

20. Mount interior shift rod with preselector lever and shift arm, counterholding on shift rod with a suitable tool.

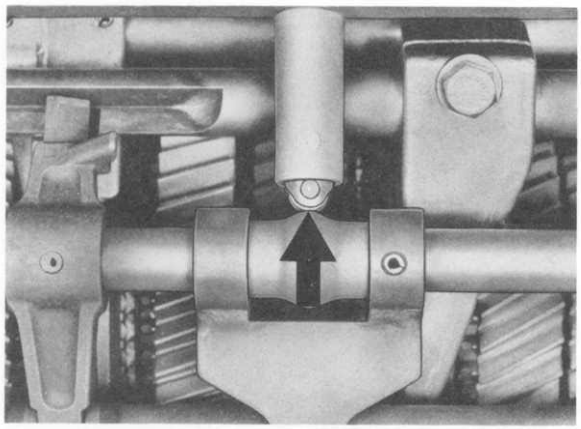


A = Pin
B = Key

Note

Cavity for pointed screw in interior shift rod must face left (in forward direction).

21. Install lockpin in correct position.



22. Adjust preselector spring and shift forks (see page 34 - 215).

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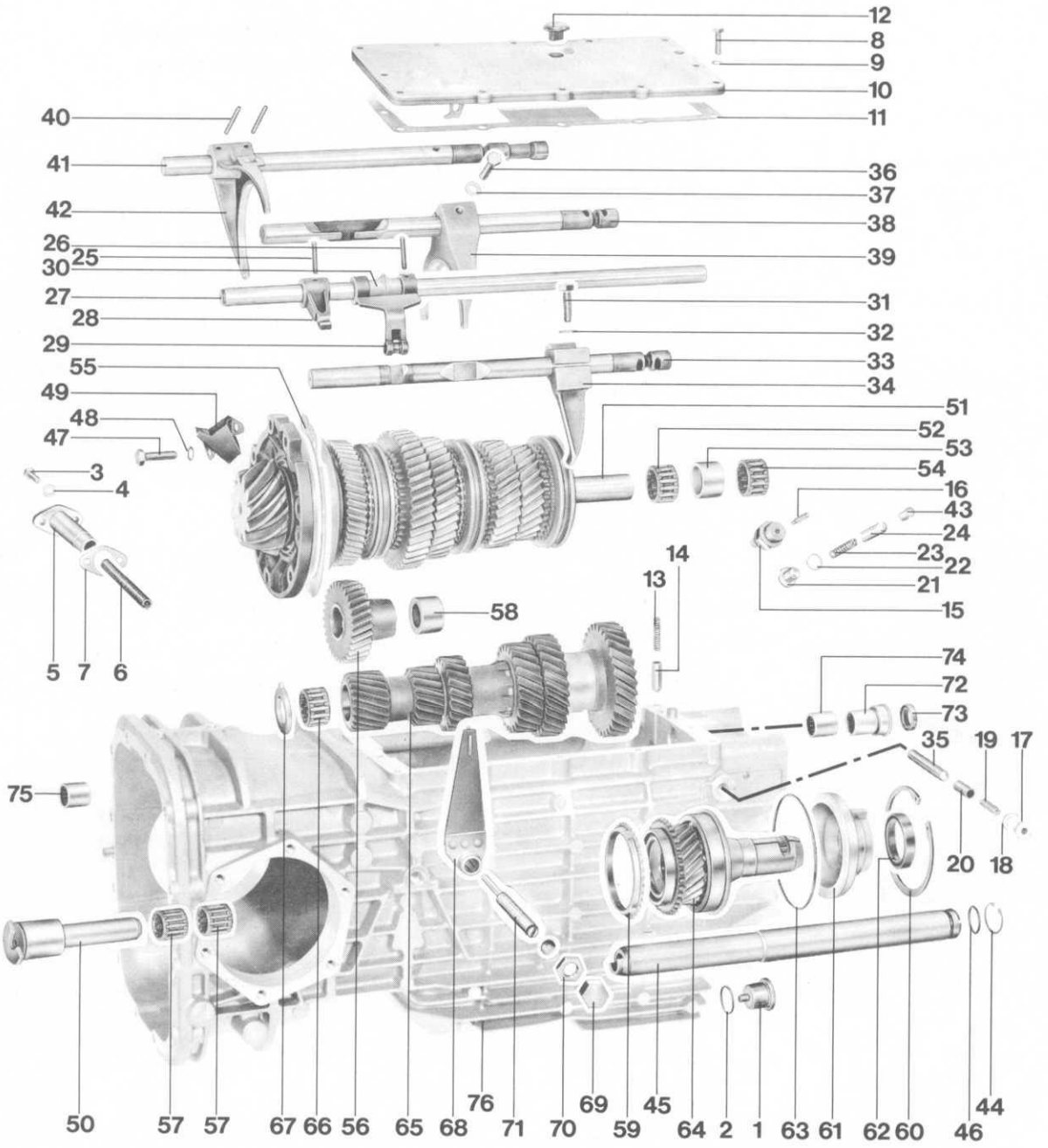
DISASSEMBLING AND ASSEMBLING MANUAL TRANSMISSION ('87 MODELS ONWARD)



No.	Description	Qty.	Note when: Removing	Note when: Installing
1	Threaded plug (with magnet)	1		Clean, tightening torque 22 Nm (16 ftlb)
2	Sealing ring	1		Replace
3	Hex bolt	2		Tightening torque: 10 Nm (7 ftlb)
4	Washer	2		
5	Guide sleeve	1		
6	Compression spring	1		
7	Gasket	1		Replace
8	Hex bolt	12		Tightening torque: 9 Nm (6.6 ftlb)
9	Spring washer	12		
10	Case cover	1		
11	Gasket	1		Replace
12	Breather*	1		
13	Compression spring	1		
14	Locking sleeve	1		Oil well
15	Back-up light switch	1		Tightening torque: 22 Nm (16 ftlb)
16	Tappet	1		Offset side toward switch
17	Threaded plug	1		Tightening torque: 19 Nm (13.9 ftlb)
18	Sealing ring	1		Replace
19	Compression spring	1		
20	Locking sleeve	1		Oil well

* Transmission housing fitted with new breather as of MY '92 (refer to page 34 - 214m)

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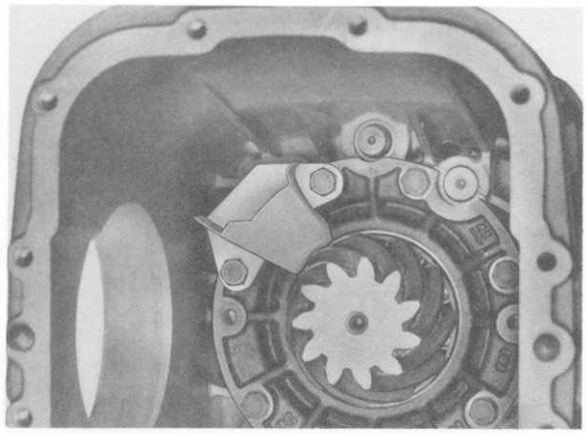
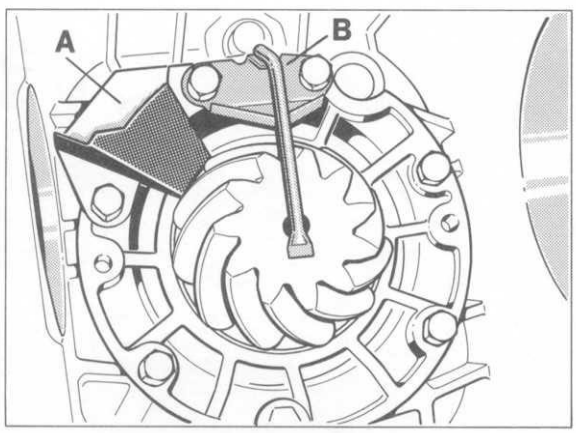
Note

Once the selector rodas are in position, secure the oil funnel at mounding holes "A".



Modification as of MY '92

As of MY '92, an oil catcher spray tube is fitted in addition to the oil catcher cone.



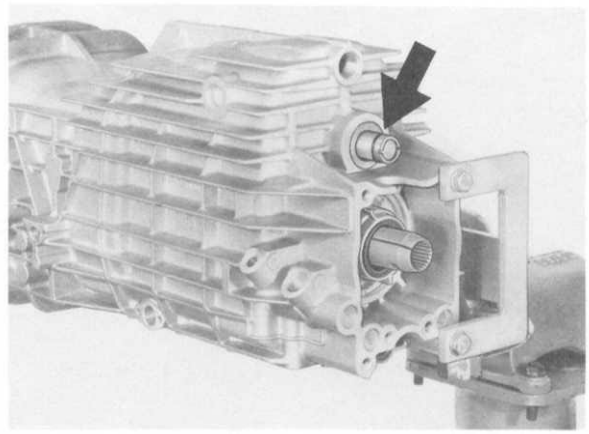
1338-34

A = Oil catcher cone
B = Oil catcher spray tube

14. Place layshaft in installation position and install axle with O-ring (lightly oil O-Ring).

Note

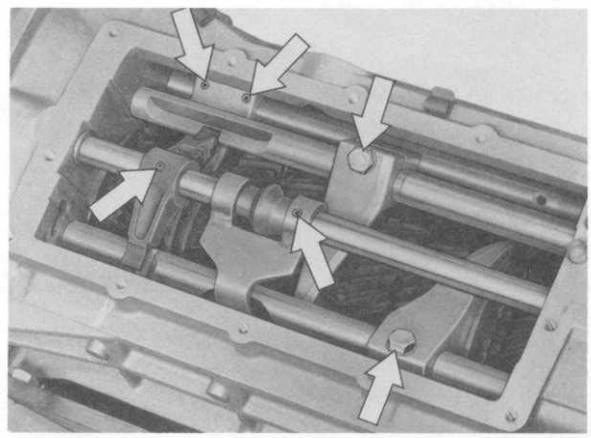
to faciliatate assembly, turn the transmission on the support until the weight of the layshaft causes ist to fall into the installation position.



15. Install circlip.

16. Select neutral.

17. Install preselect spring, selector rods, selector forks and detente.



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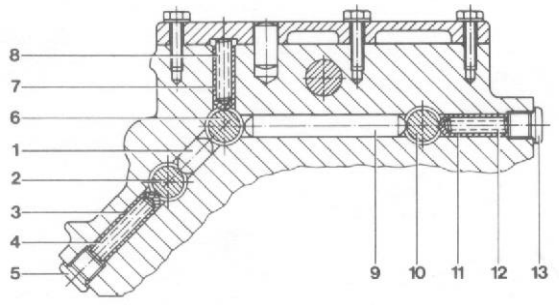
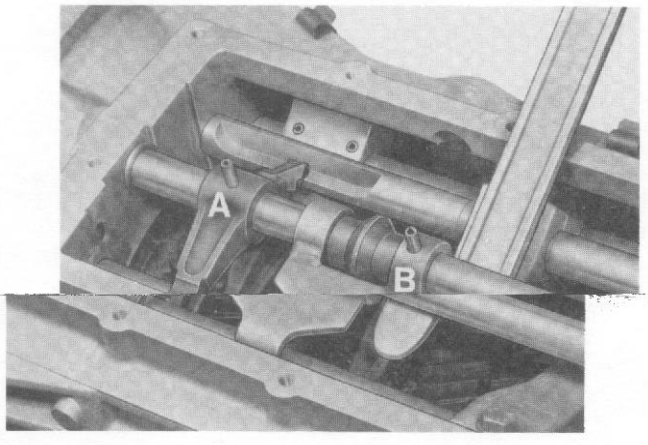


1 - Lock, short
2 - Selector rod, 1st and reverse gear
3 - Locking sleeve, long
4 - Compression spring, long
5 - Threaded plug
6 - Selector rod, 2nd and 3rd gear
7 - Locking sleeve, short
8 - Compression spring
9 - Lock, long
10 - Selector rod, 4th and 5th gear
11 - Locking sleeve, short
12 - Compression spring, short
13 - Threaded plug

18. Install internal selector arm with preselect lever and selector finger. Hold selector rod with a suitable tool.



A = Tensioning pin
B = Tensioning sleeve

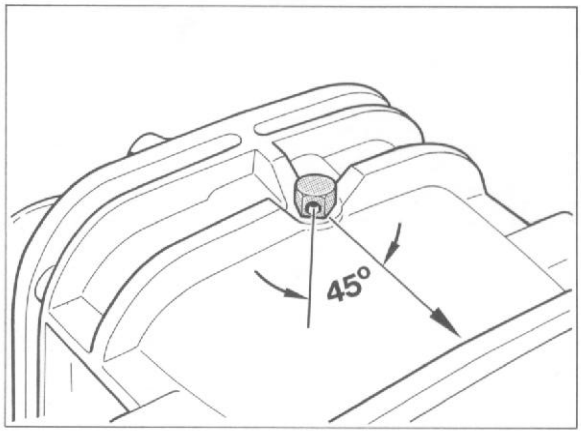
Note:

The blind hole for the tapered bolt in the internal selector arm must face left (as viewed in the forward direction of travel).

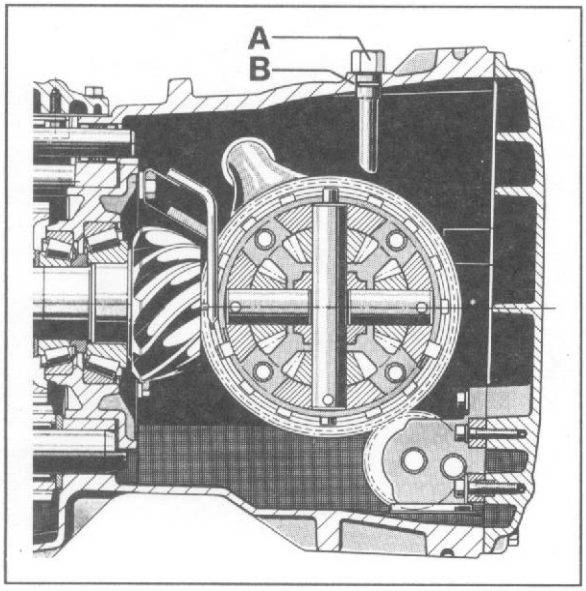
19. Adjust preselect spring and selector forks (see Page 34 - 215)

Modifications as of Model Year '92

The transmission breather in the upper transmission cover has been deleted. The new breather is located in the transmission housing and is sealed with an O-ring.



1334-34



1335-34

A = Breather
B = O-ring (apply a thin coat of transm. oil)

Note

Observing correct position, push breather into the housing until it is seated against the stop. The breather bore must then point forward at an angle of 45 deg. to the direction of travel.

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No.	Description	Qty.	Note When: Removing	Installing
21	Threaded plug	1		Tightening torque: 19Nm (13.9 ftlb)
22	Sealing ring	1		replace
23	Compression spring	1		
24	Locking sleeve	1		Oil well
25	Tensioning pin	1	Select 5th gear and drive out. Hold selector rod with suitable tool while driving out.	Hold selector rod with suitable tool.
26	Tensioning sleeve	1	Select 4th gear and drive out. Hold selector rod with suitable tool while driving out.	Hold selector rod with suitable tool.
27	Internal selector arm	1		Blind hole for taper bolt must point to left.
28	Selector finger	1		
29	Preselect lever	1		
30	Selector cam	1		
31	Hex bolt	1		Tightening torque: 25 Nm (18 ftlb)
32	Spring washer	1		
33	Selector rod (4th and 5th gear)	1		Withdraw toward rear
34	Selector fork (4th and 5th gear)	1		Adjust
35	Lock (long)	1		Oil well

No.	Description	Qty.	Note When: Removing	Installing
36	Hex bolt	1		Tightening torque: 25 Nm (18 ftlb)
37	Spring washer	1		
38	Selector rod (2nd and 3rd gear)	1		Withdraw toward rear
39	Selector fork (2nd and 3rd gear)	1		Adjust
40	Tensioning sleeve	2		
41	Selector rod (1st and reverse gear)	1		Withdraw toward rear
42	Selector fork (1st and reverse gear)	1		
43	Lock (short)	1		Grease before installing
44	Circlip	1		
45	Layshaft	1		
46	O-ring	1		Replace, oil lightly
47	Hex bolt	7		Tightening torque: 30 Nm (22 ftlb)
48	Locking washer	7		Hollow side toward bearing cover
49	Oil funnel	7		Note installation position
50	Reversing shaft	1	Turn bearing assembly and remove with VW 771	
51	Drive pinion	1	Remove with Special Tool 9144	Install with Special Tool 9144

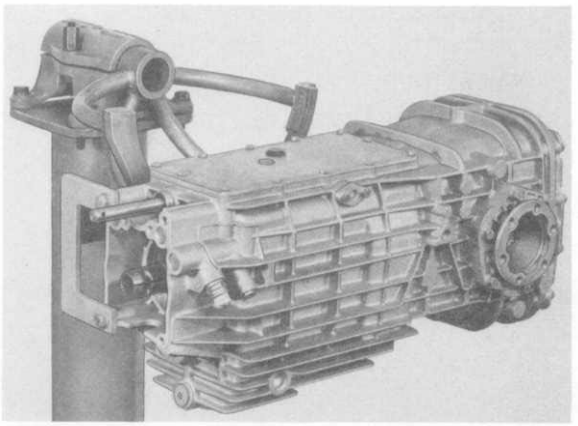
No.	Description	Qty.	Note When: Removing	Installing
52	Needle cage	1		
53	Thrust ring	1		
54	Needle bearing	1		
55	Shim "S_3"	X	Note number and thickness for reassembly	Recalculate if necessary
56	Reverse idler	1		
57	Needle cage	2		
58	Spacer	1		
59	Synchromesh ring	1	Mark for reassembly	Check for wear, install with original gear
60	Circlip	1		
61	Bearing cover	1	Withdraw with two flat pliers	
62	Sealing ring	1		Oil sealing lip
63	O-ring	1		Replace, oil lightly
64	Input shaft	1	Lower layshaft on to base of transmission and withdraw with Special Tools 9140 and 9148	
65	Layshaft	1		
66	Needle cage	1		
67	Thrust washer	1		Anti-twist lock toward recess in case, hold in place with blob of grease on case.

No.	Description	Qty.	Note When: Removing	Installing
68	Preselect spring	1		Adjust
69	Acorn nut	1		Tightening torque: 50 Nm (37 ftlb)
70	Hex nut	1		Tightening torque: 50 Nm (37 ftlb)
71	Stud bolt	1		
72	Locating sleeve	1		Press in with Special Tool 9223
73	Sealing ring	1		Press in with Special Tool 9223
74	Bearing	1	Drive out with suitable mandrel	Press in with Special Tool 9223
75	Bearing	1	Drive out with suitable mandrel	Press in with Special Tool 9223
76	Transmission case	1		

NOTES ON ASSEMBLING AND DISASSEMBLING

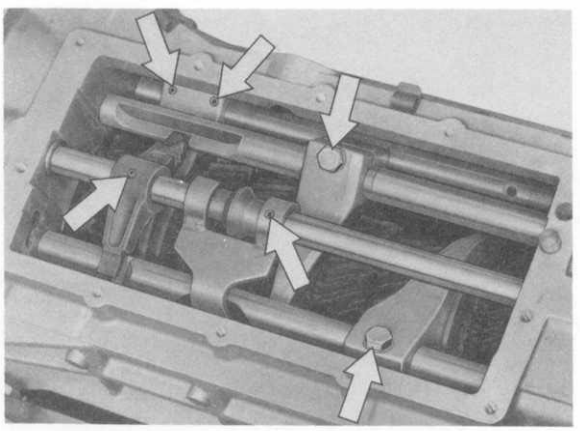
Disassembling

1. Secure transmission to assembly support with Special Tool 9149 and drain oil.



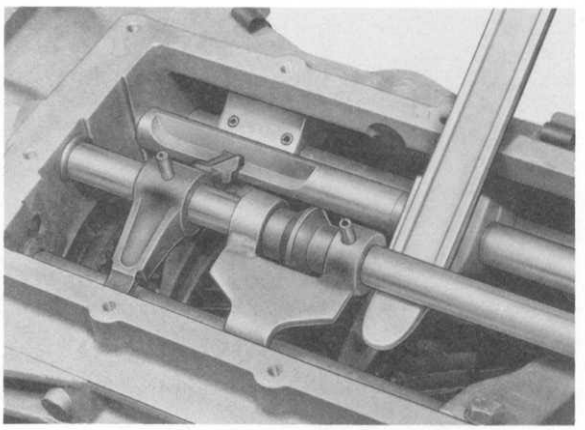
2. Installing differential, see page 39 - 201.

3. Remove selector rods, selector forks and detente.

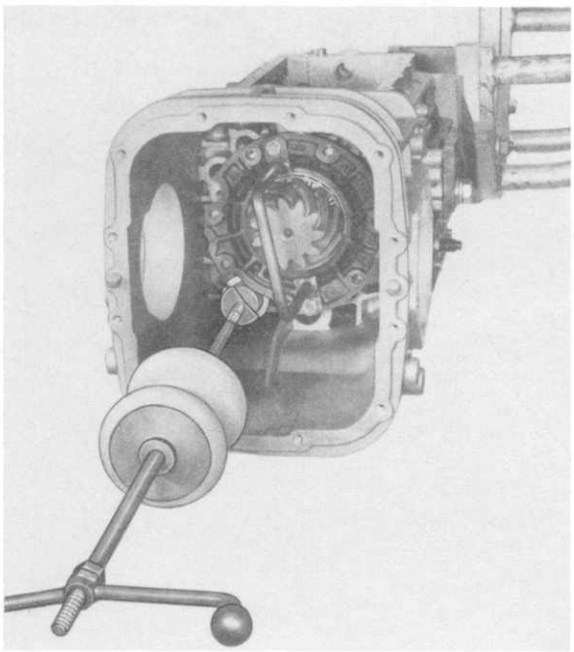


Note:

When driving out tensioning pin and tensioning sleeve, it is essential to hold internal selector arm with a suitable tool.



4. Remove mounting bolts for drive pinion, secure Special Tool 9144 to bearing assembly and turn the latter with shims "S_3" until the reverse idler shaft can be removed with Special Tool VW 771.



5. Remove circlip for bearing cover and remove cover with two suitable flat-nosed pliers.

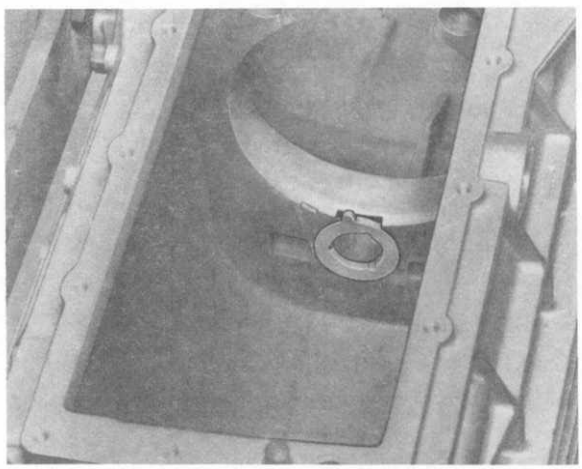
6. Withdraw drive pinion with Special Tools 9140 and 9148.

Note:

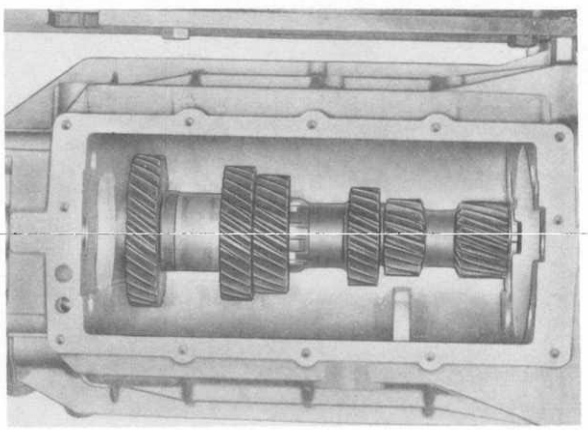
It is essential to remove the layshaft axle beforehand and lower layshaft to bottom of transmission.

Assembling:

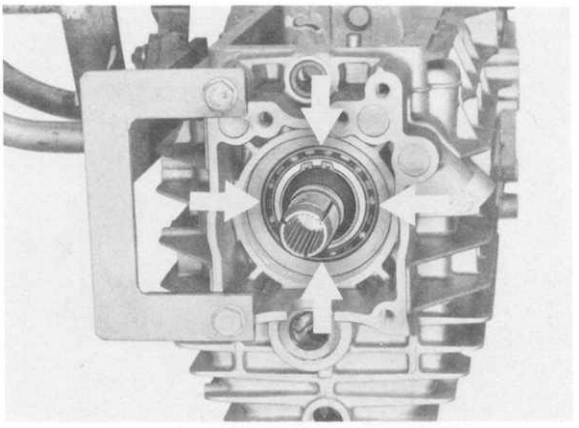
1. With a blob of grease, fix thrust washer for layshaft to case.



2. Place fully assembled layshaft in case.



3.Working on each side alternately, use a suitable piece of pipe or a mandrel to drive fully assembled input shaft over bearing outer race as far as it will go.



4.Insert O-ring for bearing cover, oil lightly.

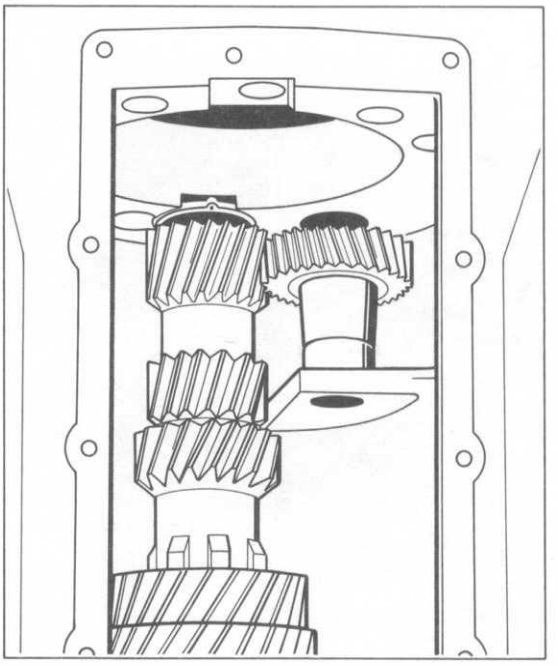
5.Install bearing cover and circlip.

6.Swivel transmission on support until input shaft points downward.

7.Install needle cage and thrust washer in input shaft.

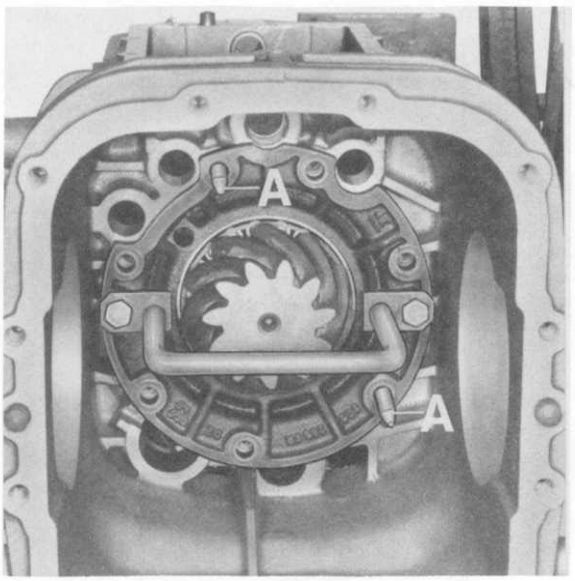
8.Place synchromesh ring for 5th gear on clutch body.

9.Place reverse idler with needle cages and spacer in case as illustrated.



10.Screw centering pins 9321 for installation of the drive pinion into case and place shims "S_3" in position.

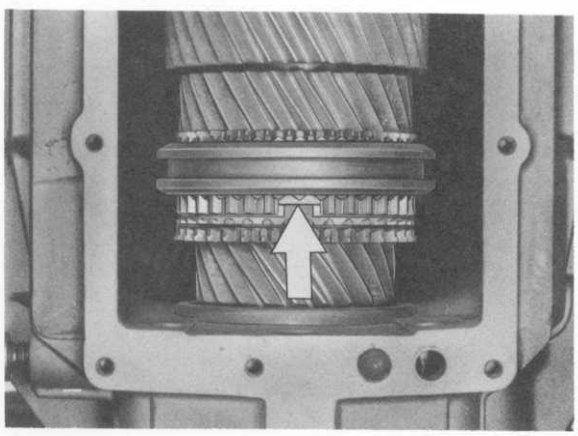
11. Attach Special Tool 9144 to drive-pinion bearing cover and carefully insert drive pinion (with 4th gear selected). Note position of reverse idler.



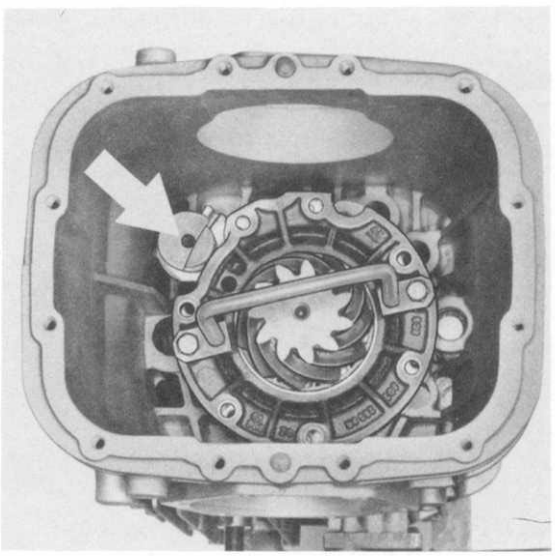
A = Special Tool 9321

Note:

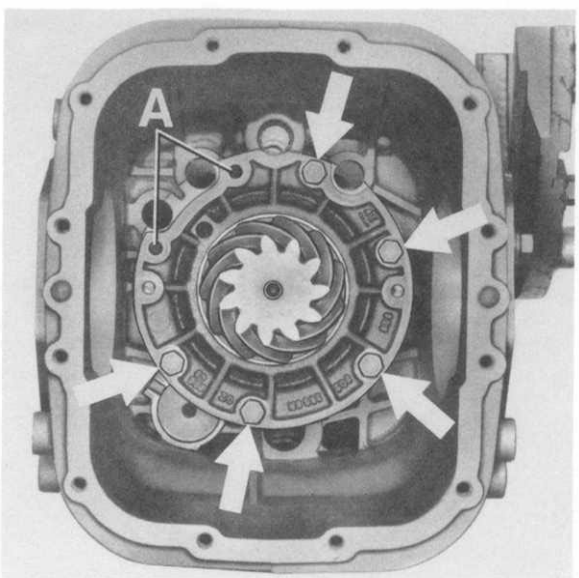
When installing drive pinion, it is essential to ensure that the dogs of the synchromesh ring (5th gear) engage the recesses of the guide sleeve.



12. With a suitable tool, move reverse idler to installation position, remove centering pins 9321 for bearing assembly and turn the latter with shims until the reverse idler shaft can be installed.



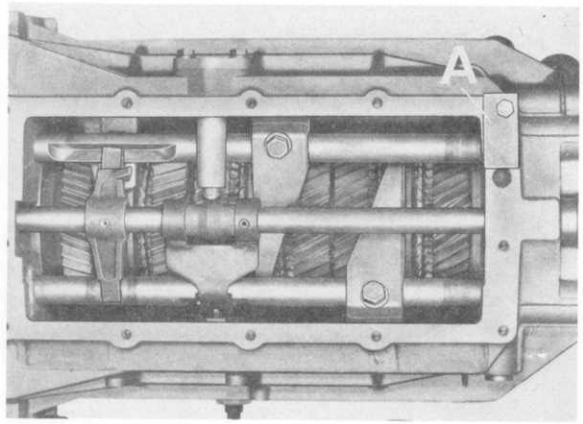
13. Turn bearing assembly with shims "S_3" to assembly position, tighten mounting bolts to 30 Nm (22 ftlb) and remove Special Tool 9144.



ADJUSTING SHIFT FORKS

Note

Insert locking sleeve and spring for no-play arrest of 2nd and 3rd gear rod and move to correct installed position with a locally manufactured holder.



A = Locally manufactured holder made of 10 x 20 x 45 mm flat steel, with 6,5 mm dia. mounting hole and 2.5 mm chamfer in area of locking sleeve.

1. Adjust operating sleeves with the shift forks that they are exactly in the middle between synchromesh rings in neutral position.

2. Tighten mounting bolts with torque of 25 Nm (18 ftlb).

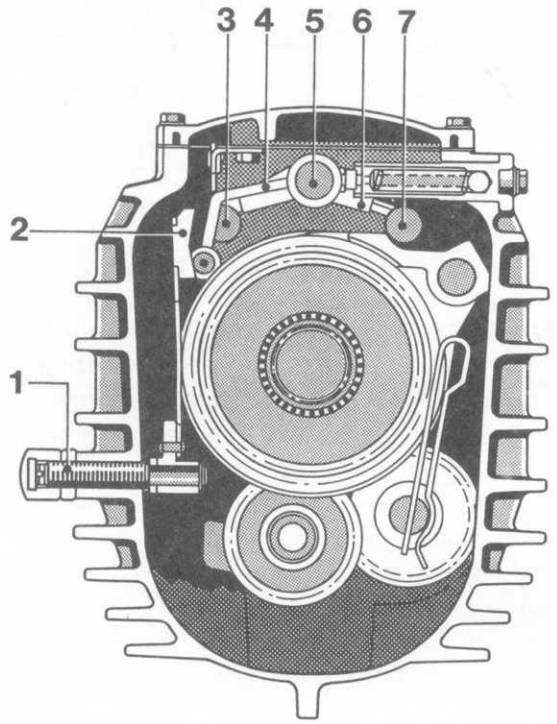
Note

Deviations in adjustments must be corrected after checking the shifting, since perfect synchronization depends on this.

ADJUSTING SHIFTS

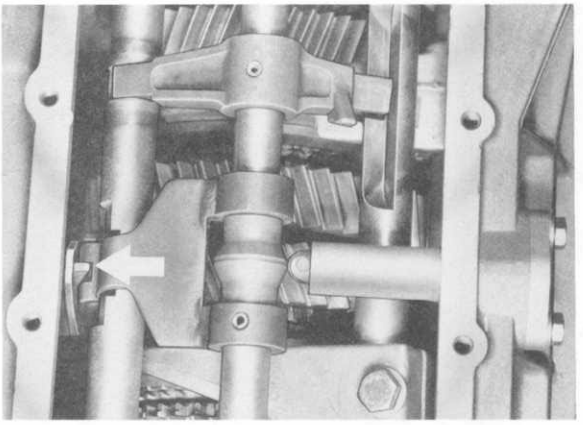
Note

Insert locking sleeve and spring for no-play arrest of 2nd and 3rd gear shift rod and move to correct installed position with a locally manufactured holder (see page 34 - 215).

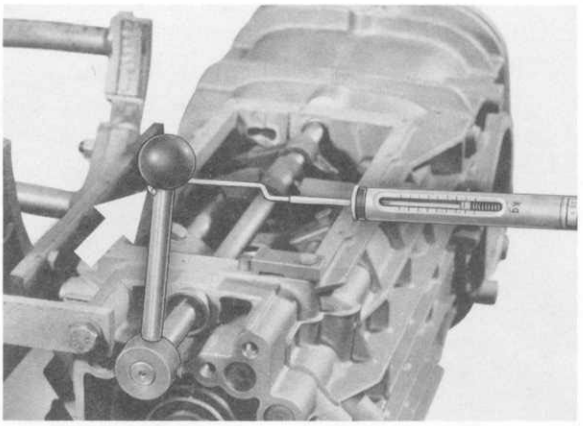


1 - Adjusting pin
2 - Preselector spring
3 - Shift rod, 4th and 5th gears
4 - Preselector lever
5 - Interior shift rod
6 - Shift arm
7 - Shift rod, 2nd and 3rd gears

1. Adjust preselector spring (2) with adjusting pin (1) enough that it just barely touches the roller of preselector lever (4). In this position shift arm (6) and preselector lever (4) will engage in openings of 4th and 5th gear shift rod.

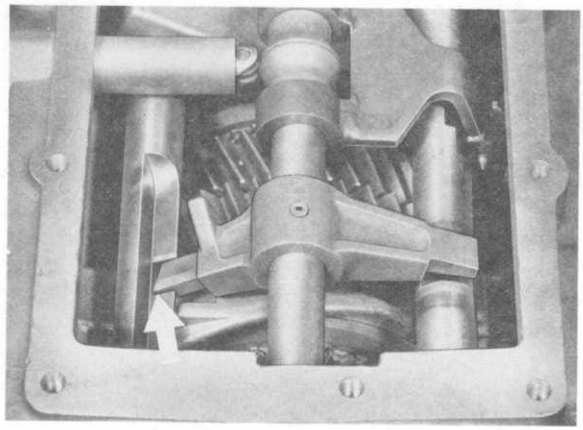


2. Measure force of preselector spring.
   Nominal value: 22 N.
   Mount Special Tool 9155 on interior shift rod, attach a conventional spring scale (0.....50 N) below ball, pull interior shift rod and shift arm into 2/3 shift plane and read spring force from spring scale.

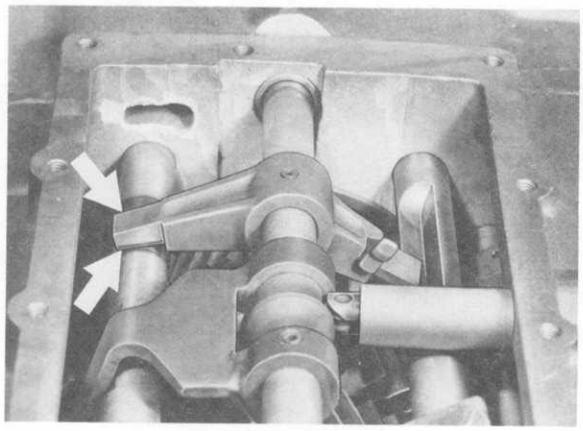


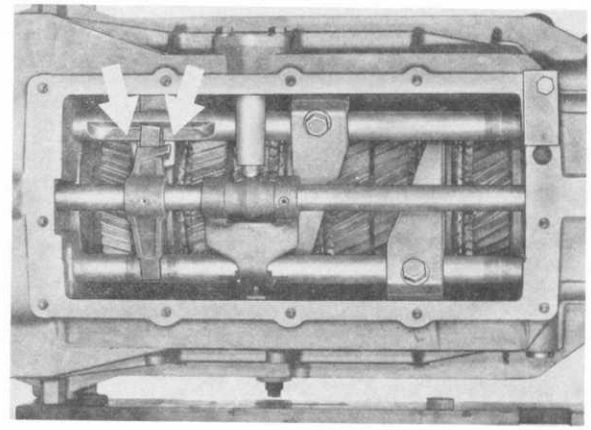
3. If necessary, adjust force of preselector spring to 22 N by turning the adjusting pin.

4. Move shift arm into 2/3 shift plane and adjust it by turning adjusting pin (approx. 1/2 turn clockwise or anticlockwise) that it does not protrude completely into opening of 2nd / 3rd gear shift rod.



5. Check by shifting in and out of all gears carefully with Special Tool 9155 (turning drive pinion if necessary) and note, whether shift arm has access to 4th/5th gear shift rod and 1st/reverse gear shift fork in 2/3 shift position as well as access to 2nd/3rd gear shift rod in 4/5 shift position





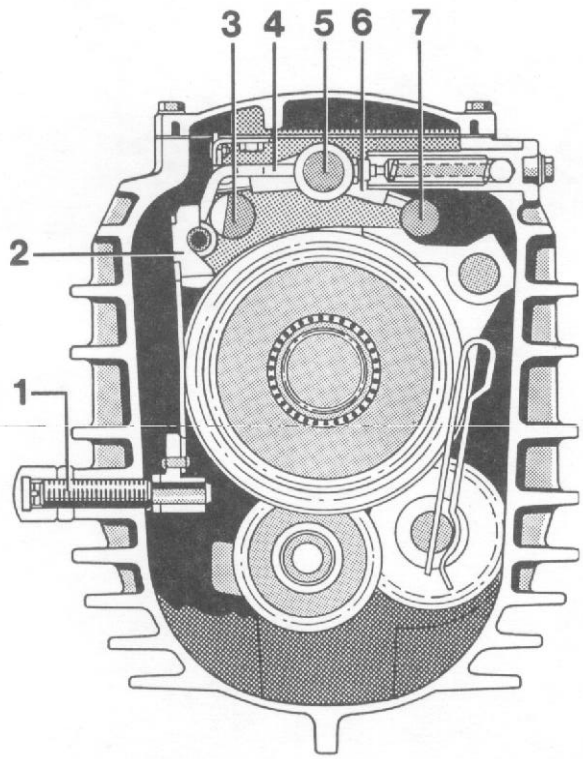
Note

Deviations must be corrected accurately after checking shifts, since perfect shifting depends on correct adjustment. Turning the adjusting pin (1) will change the force of preselector spring (2), so that turning the adjusting pin for corrections should be kept to a minimum (approx. 1/2 turn clockwise or anticlockwise).

ADJUSTING GEARSHIFT ('86 MODELS ONWARD)

Note:

To lock the 2nd and 3rd gear selector rod in its zero position, install locking sleeve and compression spring and bring to installation position with improvised holder (see page 34 - 215).



'86 Models

1 - Adjusting pin

2 - Preselect spring

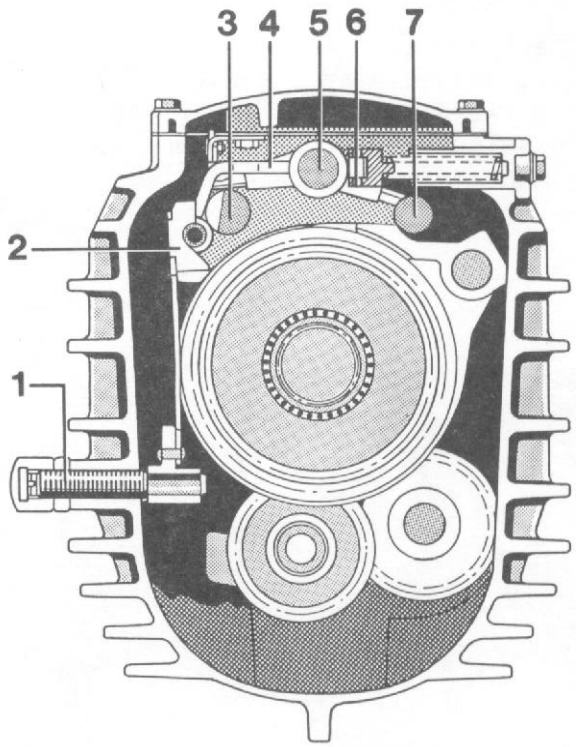
3 - Selector rod, 4th and 5th gear

4 - Preselect lever

5 - Internal selector arm

6 - Selector finger

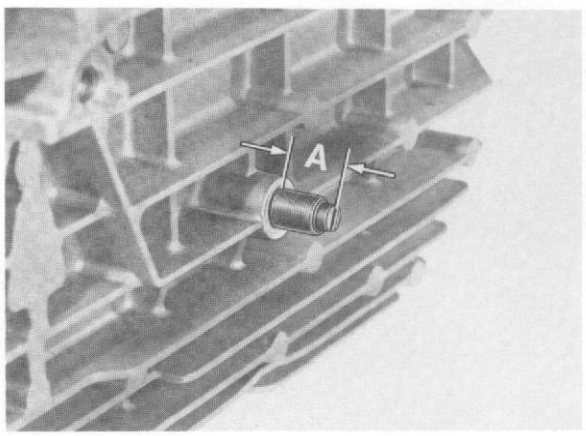
7 - Selector rod, 2nd and 3rd gear



'87 models onward

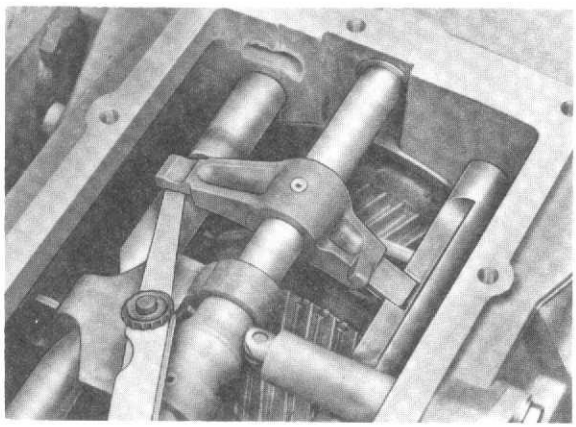
1.Select neutral.

2.Carry out rough adjustment of preselect spring (2). To do so, screw adjustor pin (1) into case until approx. 20 mm project.

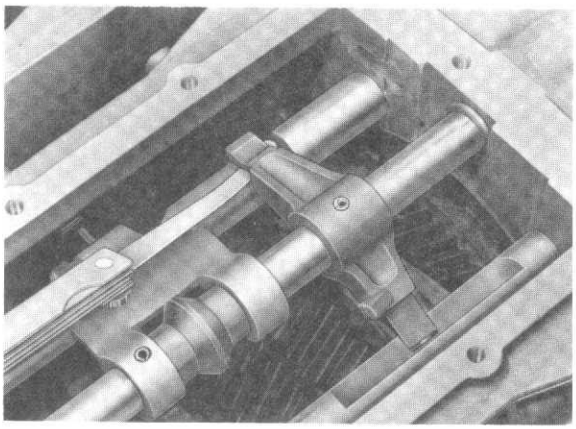


A = approx. 20 mm

3. Select 3rd gear and with a feeler gage, adjust play s = 0.2 + 0.1 mm between selector finger and 4/5 selector rod. Adjustment is by means of adjuster pin (1).

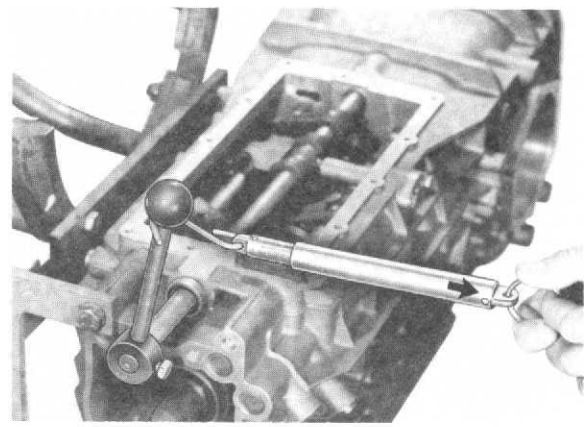


'86 models

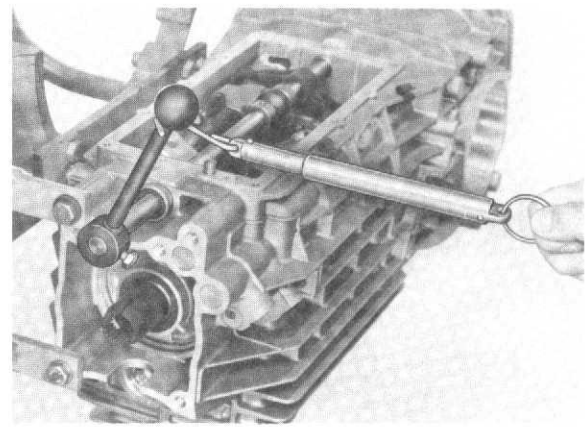


'87 models

4. Measure spring force of preselect spring. Specified force 60...80N. To measure, attach Special Tool 9155 to internal selector arm, attach commercially available spring balance (0...100N) beneath ball, pull internal selector arm with selector finger to 1/R shift level and read spring force from spring balance.



'86 models



'87 models onward

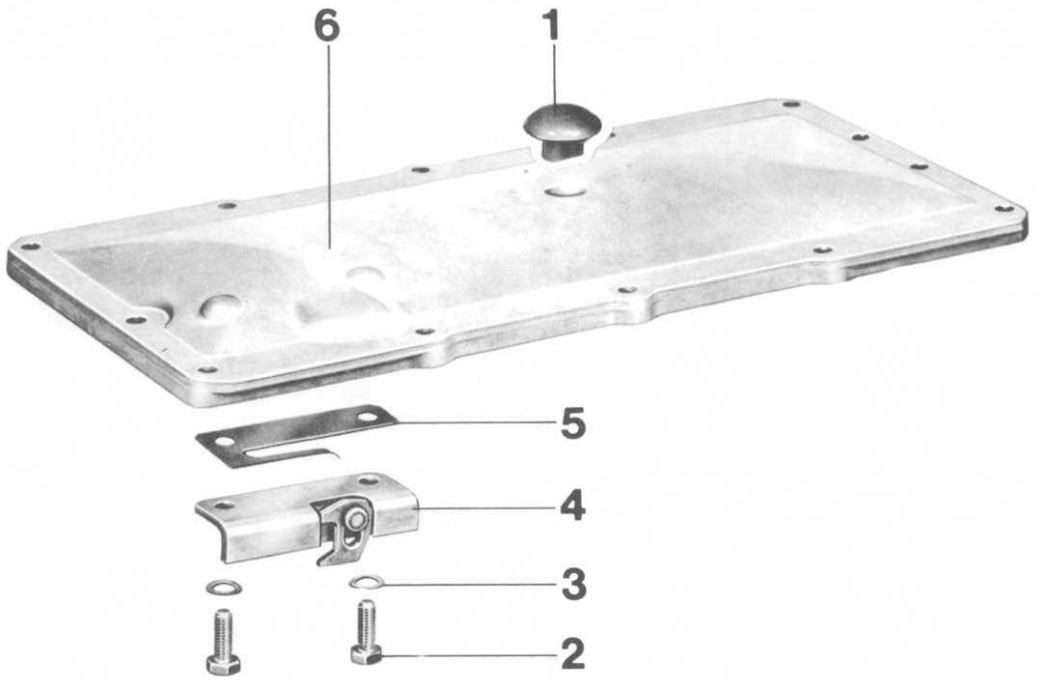
5. If necessary, turn adjusting pin to set force of preselect spring to specified value.

Note:

If the spring force is changed, recheck the clearance s = 0.2 + 0.1 mm between selector finger and selector rod and readjust if necessary (see Step 3).

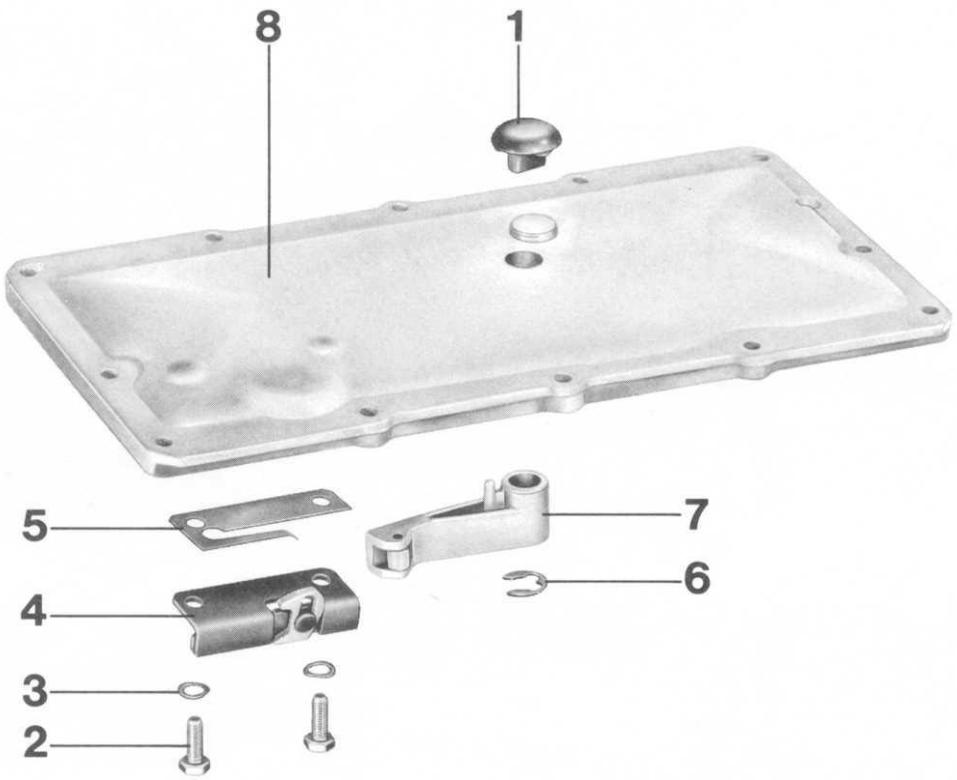
6. As a check, select each gear in turn with Special Tool 9155 (turn drive pinion during this procedure) and ensure that all the gears can be selected in the correct manner.

DISASSEMBLING AND ASSEMBLING UPPER TRANSMISSION COVER



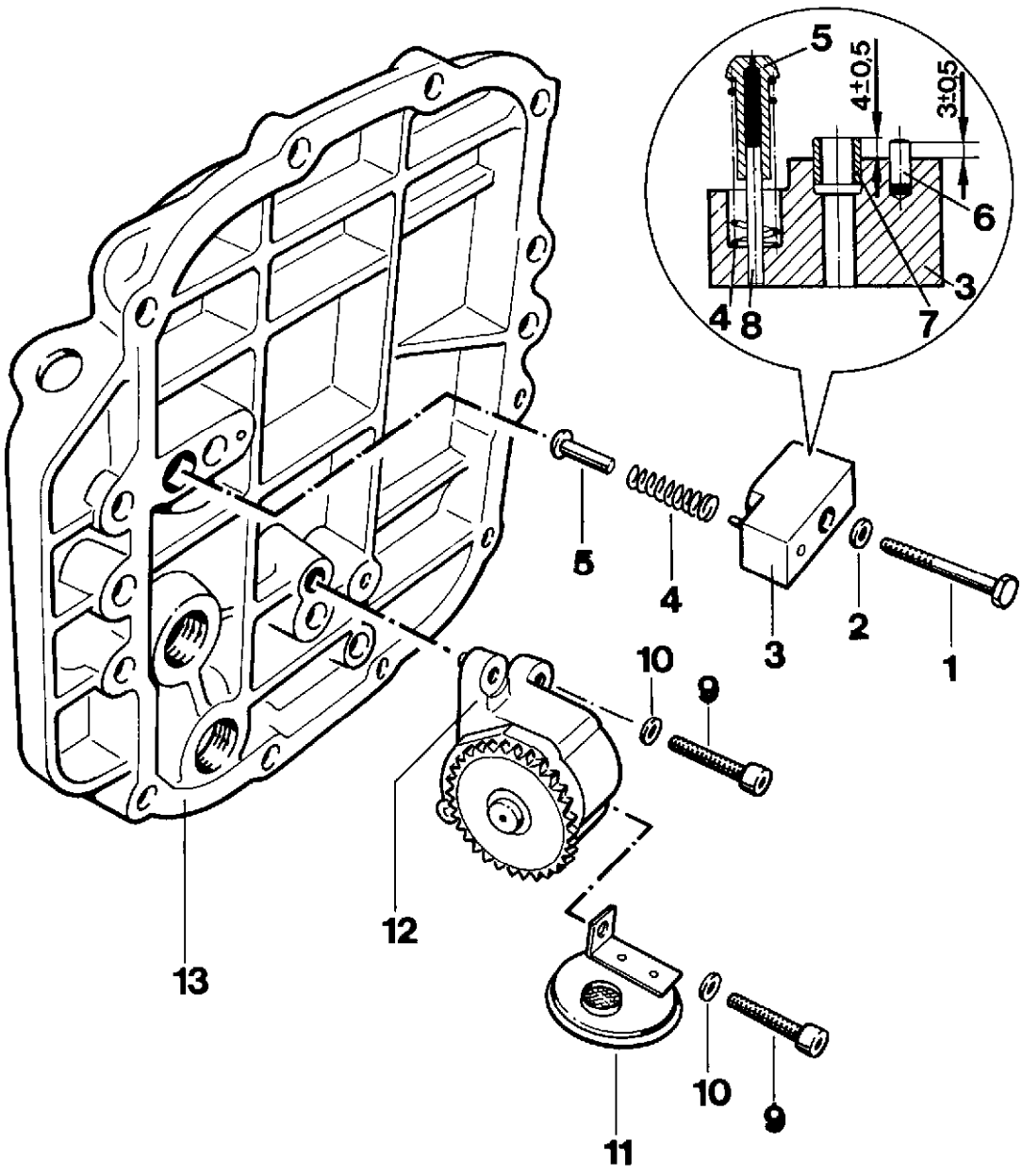
No.	Description	Qty.	Note When: Removing	Note When: Installing	Special Instructions
1	Vent	1			
2	Bolt	2		Torque: 9Nm (7 ftlb)	
3	Washer	2			
4	Gear arrest	1		Check that locking pawl moves easily	
5	Leaf spring	1		Install in correct position	
6	Case cover	1			

DISASSEMBLING AND ASSEMBLING UPPER TRANSMISSION COVER ('87 MODELS ONWARD)



No.	Description	Qty.	Note When: Removing	Installing
1	Air bleed	1		
2	Hex bolt	2		Tightening torque 9 Nm (6.6 ftlb)
3	Spring washer	2		
4	Gear lock	1		Check that locking cam moves freely
5	Leaf spring	1		Install right way round
6	Circlip	1		
7	Roller lever	1		
8	Case cover	1		

Dismantling and assembling housing cover with oil pump



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No.	Designation	Qty.	Note: Removal	Note: Installation
1	Hexagon head bolt	1		Tighten to 10 Nm (7 ftlb.)
2	Washer	1		
3	Bracket	1		
4	Thrust spring	1		
5	Valve	1		
6	Roll pin	1		Fitting depth 3 ± 0.5 mm
7	Adapter sleeve	1		Fitting depth 4 ± 0.5 mm
8	Roll pin	1		Press in flush
9	Pan-head screw	3		Tighten to 10 Nm (7 ftlb.)
10	Washer	3		
11	Suction cone with strainer	1		
12	Oil pump	1		
13	Housing cover	1		

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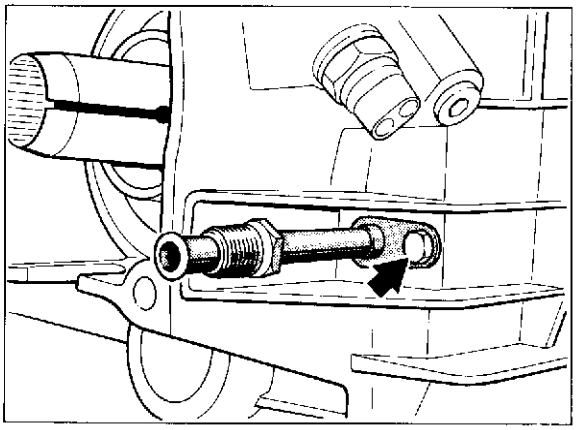
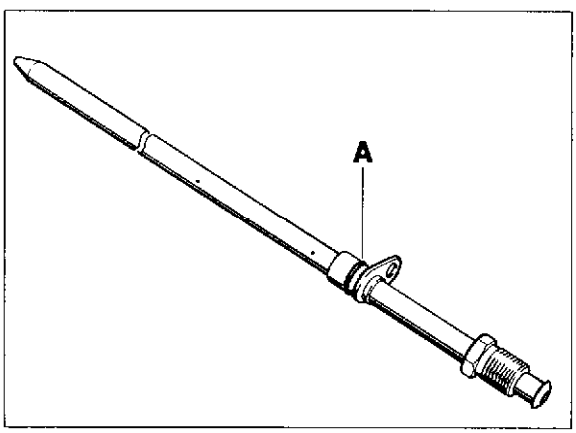
Replacing O-ring for spray tube (type G28/57)

1. Remove spray tube, undoing hexagon head bolt and pulling out tube.



1332-34

2. Coat new O-ring with transmission oil and push tube carefully into the housing.
   Tighten hexagon head bolt to 10 Nm (7 ftlb.).



1333-34

A = O-ring

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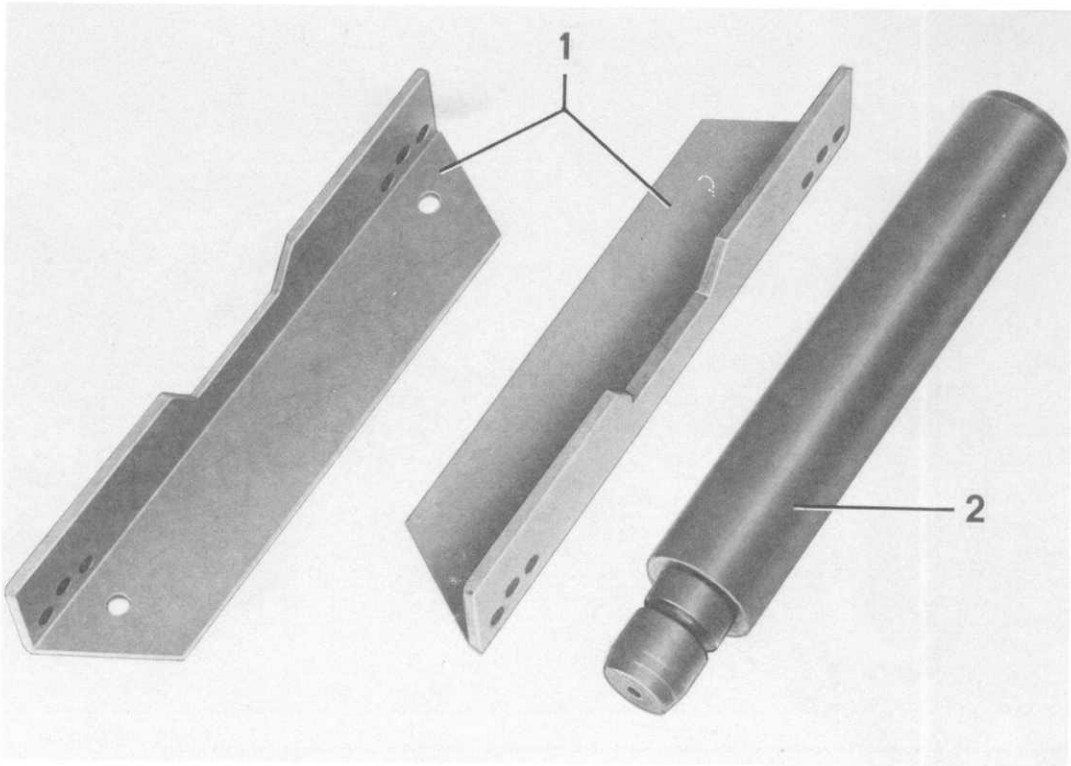
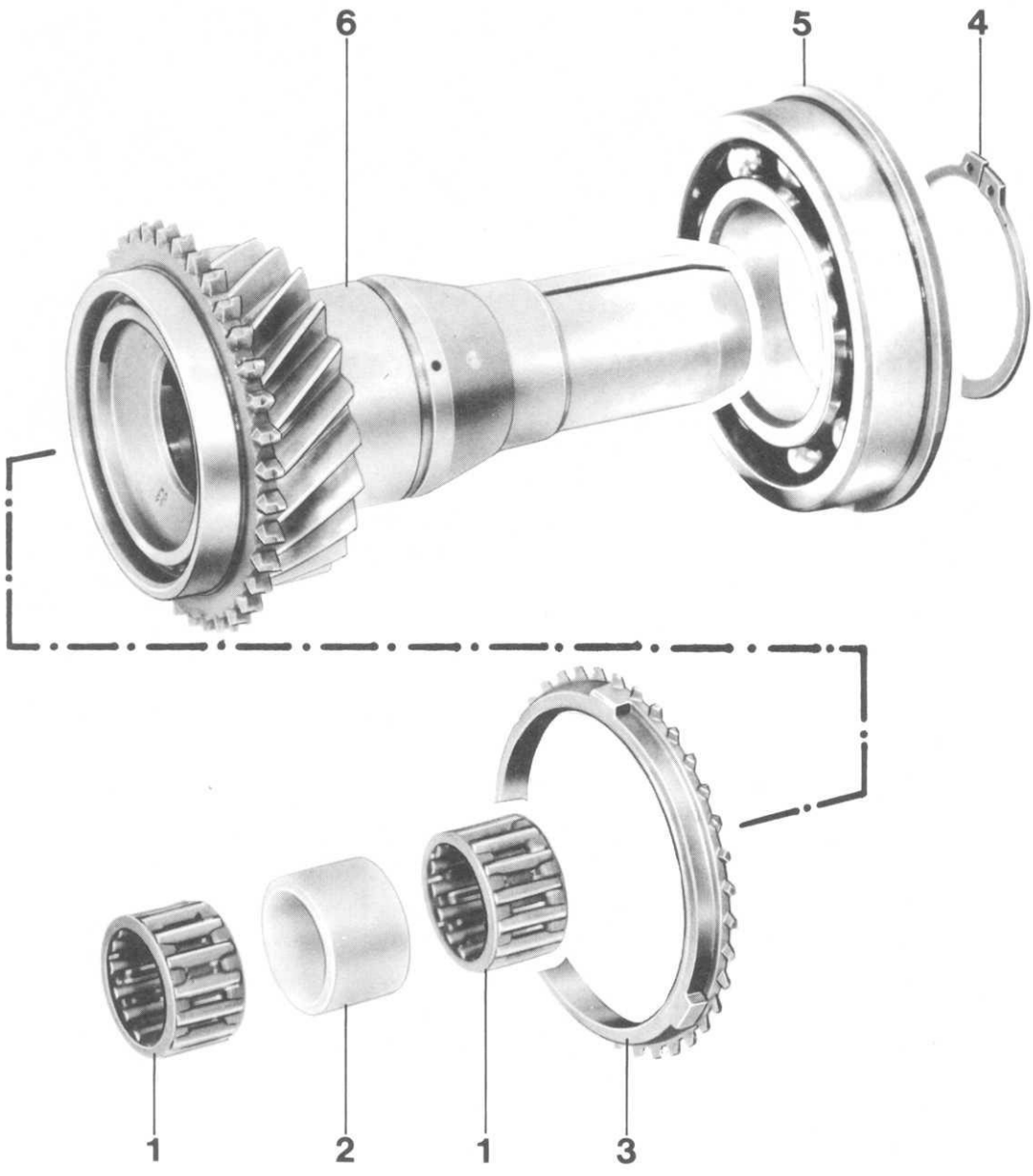
TOOLS



No.	Description	Special Tool	Remarks
1	Take-up rail	VW 457	
2	Pressure pad	VW 407	

DISASSEMBLING AND ASSEMBLING DRIVE SHAFT



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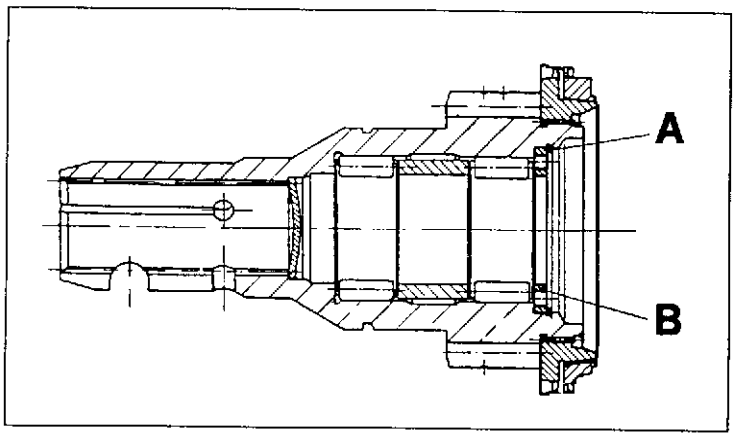
No.	Description	Qty.	Note when: Removing	Installing
1	Needle	2		Install with bearing grease
2	Thrust ring	1		
3	Synchronizing ring	1	Mark for reassembly	Mount with same gear. Check for wear
4	Circlip	1		
5	Grooved ball bearing	1	Press off with VW 457 and VW 407	Heat to approx. 100° C/212° F and drive on
6	Drive shaft	1		

Note

As of MY '92, a modified drive shaft with new needle cages and axial retainer is used.



A = Snap Ring
B = Thrust washer

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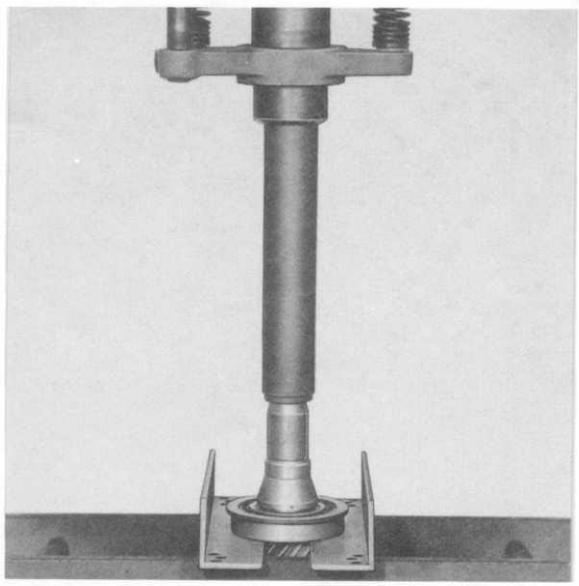
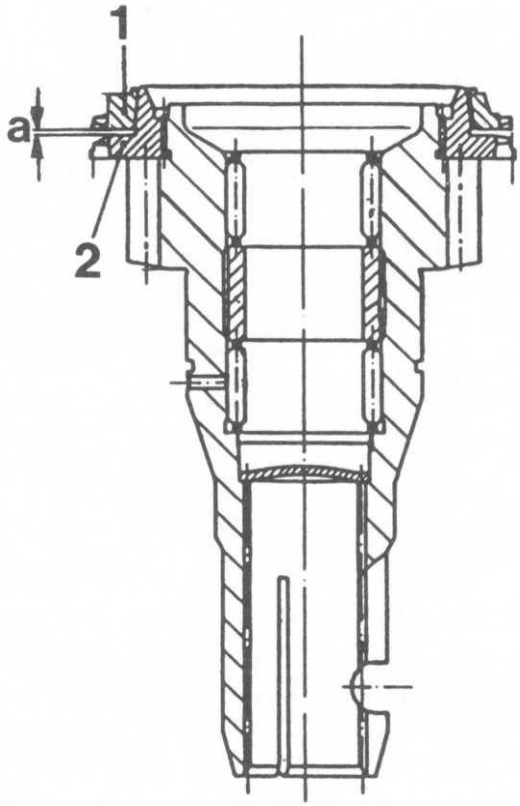
DISASSEMBLING AND ASSEMBLING DRIVE SHAFT

Disassembling

1. Remove circlip.

2. Press off grooved ball bearing with a pertinent pressure pad and Special VW 457.





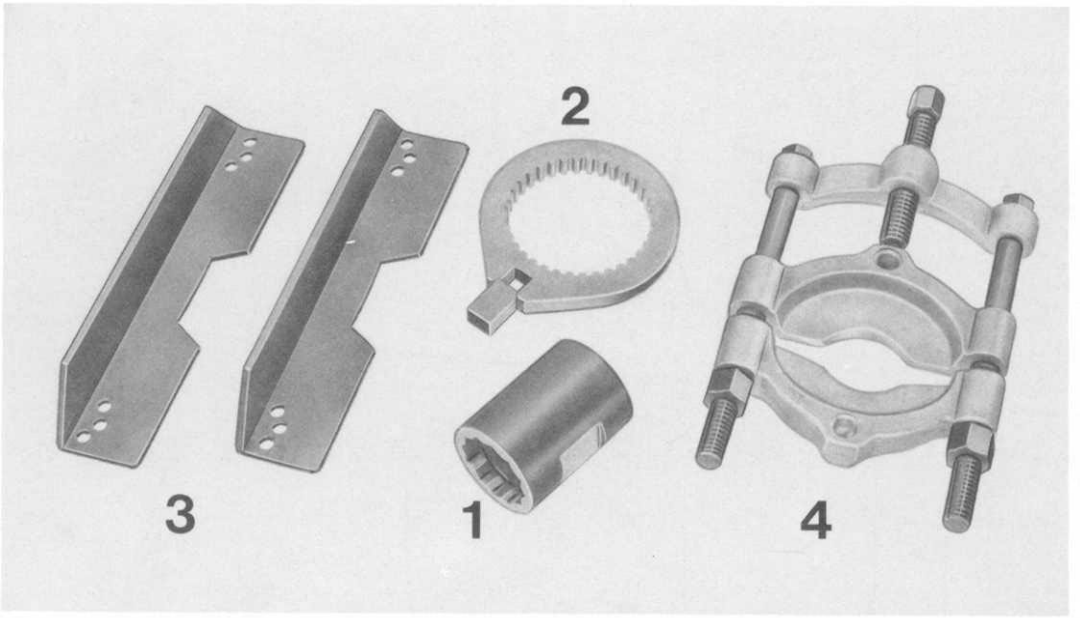
Assembling

1. Heat grooved ball bearing to approx. 100° C / 212° F and drive on.

2. Check synchronizing ring by pressing ring against taper of gear wheel and measure gap "a" with a feeler gage blade.

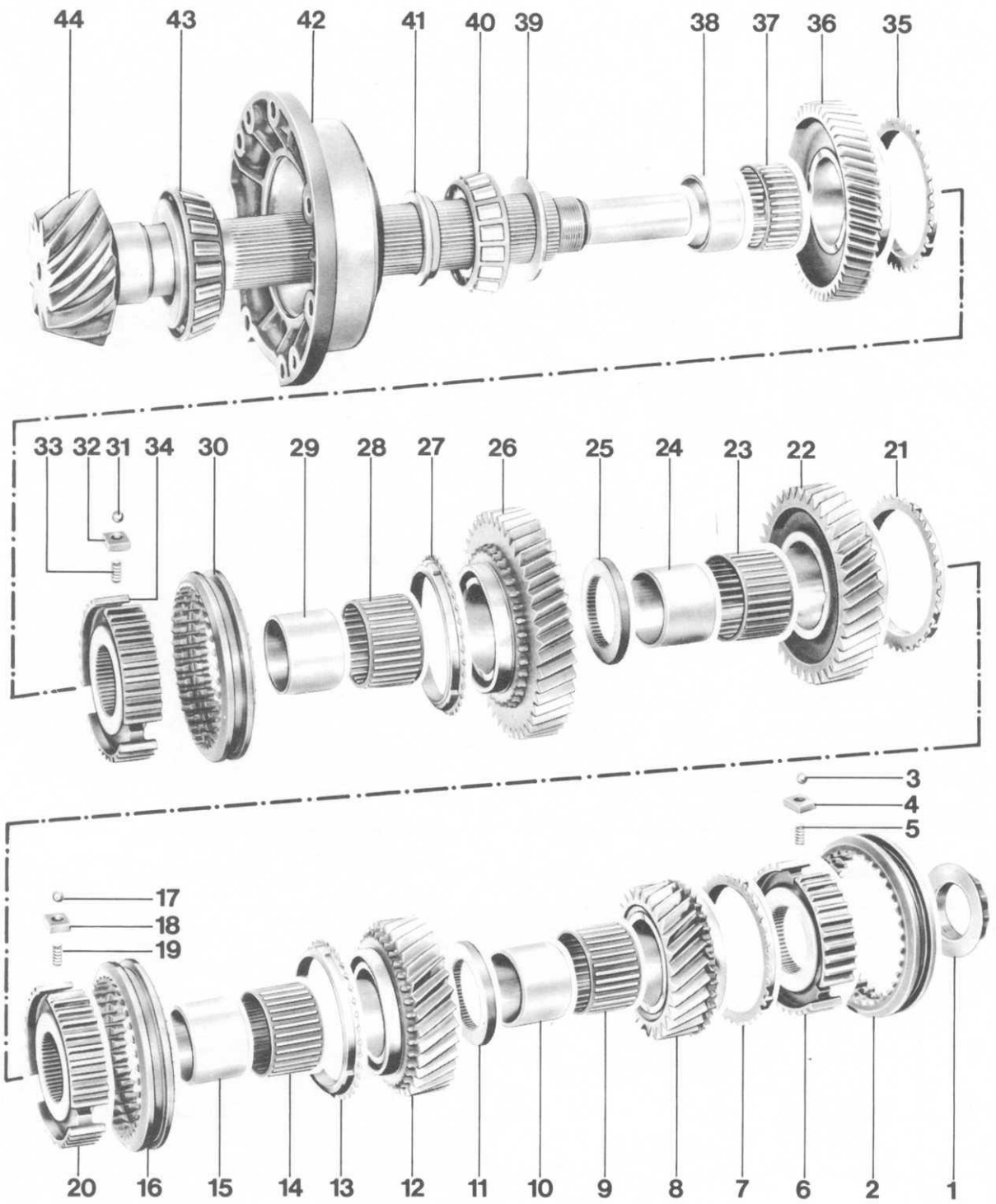
Installed distance (new) = 0.9 to 1.5 mm
Wear limit = 0.6 to 0.7 mm

TOOLS



No.	Description	Special Tool	Remarks
1	Holder	9219	
2	Wrench socket	9218	
3	Holding rail	VW 457	
4	Separator	-	Standard

DISASSEMBLING AND ASSEMBLING DRIVE PINION



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No.	Description	Qty.	Note When: Removing	Installing
1	Locknut	1	Remove with Special Tool 9218 and 9219	Tightening torque 300 Nm (221 ftlb) and lock by punching collar
2	Actuating sleeve	1	Remove together with guide sleeve and synchromesh parts	
3	Ball	3		
4	Intercept stop	3		Insert right way round
5	Compression spring	3		
6	Guide sleeve	1		
7	Synchromesh ring	1	Mark for reinstallation	Check for wear, reinstall with original gear
8	Free gear, 4th gear	1		
9	Needle cage	1	Mark for reinstallation	Reinstall with original gear
10	Inner race	1	Mark for reinstallation	Heat to approx. 100°C, install with original gear
11	Thrust washer ('85/'86 models = 6.0 mm) ('87 models = 10.5 mm)	1		
12	Free gear, 3rd gear	1		
13	Synchromesh ring	1	Mark for reinstallation	Check for wear, install with original gear
14	Needle bearing	1	Mark for reinstallation	Install with original gear

No.	Description	Qty.	Note When: Removing	Installing
15	Inner race	1	Mark for reinstallation	Heat to approx. 100°C, install with original gear
16	Operating sleeve	1	Remove together with guide sleeve and synchromesh parts	
17	Ball	3		
18	Intercept stop	3		Insert right way round
19	Compression spring	3		
20	Guide sleeve	1		
21	Synchromesh ring	1	Mark for reinstallation	Check for wear, install with original gear
22	Free gear, 2nd gear	1		
23	Needle cage	1	Mark for reinstallation	Install with original gear
24	Inner race	1	Mark for reinstallation	Heat to approx. 100°C, install with original gear
25	Thrust washer ('85/'86 models = 6 mm) ('87 models = 2.5 mm)	1		
26	Free gear, 1st gear	1		
27	Synchromesh ring	1	Mark for reinstallation	Check for wear, install with original gear

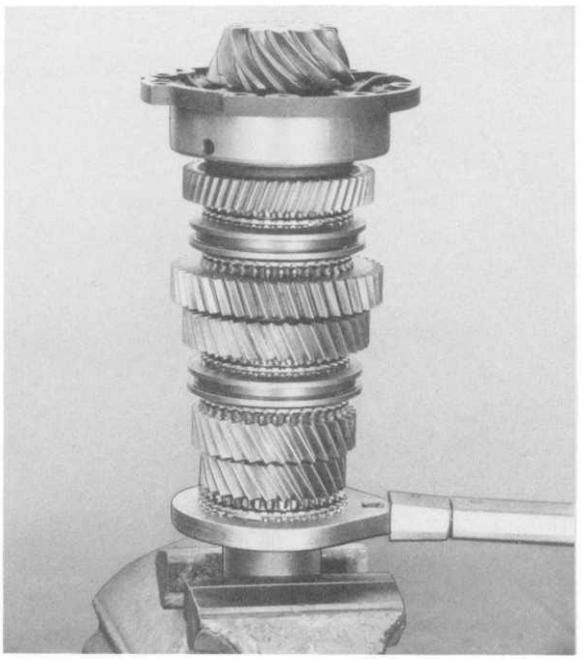
No.	Description	Qty.	Note When: Removing	Installing
28	Needle cage	1	Mark for reinstallation	Install with original gear
29	Inner race	1	Mark for reinstallation	Heat to approx. 100°C, install with original gear
30	Operating sleeve	1	Remove together with guide sleeve and synchromesh parts	'87 models onward, with recess (see page 35 - 213 for installation position)
31	Ball	3		
32	Intercept stop	3		Insert right way round
33	Compression spring	3		
34	Guide sleeve	1		
35	Synchromesh ring	1	Mark for reinstallation	Check for wear, install with original gear ('87 models onward, with modification to tips of teeth, brown for identification).
36	Free gear III, reverse gear	1		
37	Needle bearing	1	Mark for reinstallation	Install with original gear
38	Inner race	1	Mark for reinstallation	Re-measure if necessary, heat to approx. 100°C (see page 39 - 216)
39	Shim	1	Mark for reinstallation	Calculate thickness if necessary
40	Taper roller bearing inner race	1	Press off together with bearing cover	Heat to approx. 100°C
41	Spacer	1		

No.	Description	Qty.	Note When: Removing	Installing
42	Bearing cover	1	Press off	
43	Taper roller bearing inner race	1	Press off with suitable press-off tool	Heat to approx. 100°C
44	Drive pinion	1		Adjust if necessary, note pairing code

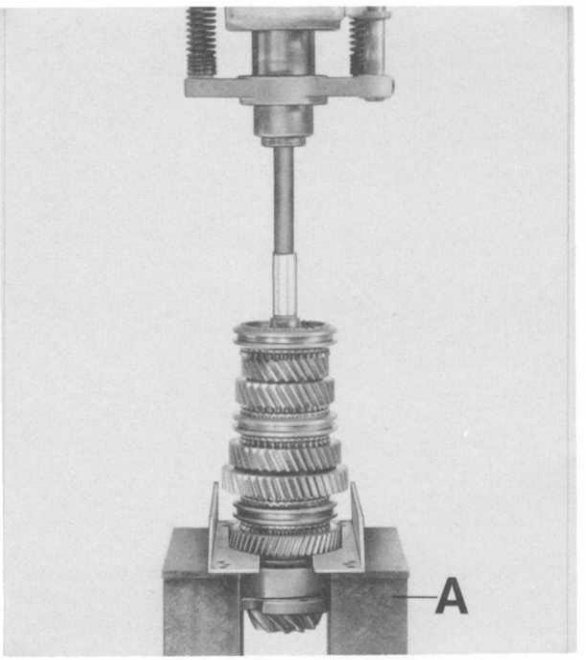
DIASSEMBLING AND ASSEMBLING DRIVE PINION

Disassembling

1. Remove lock nut for drive pinion with Special Tools 9219 and 9218.

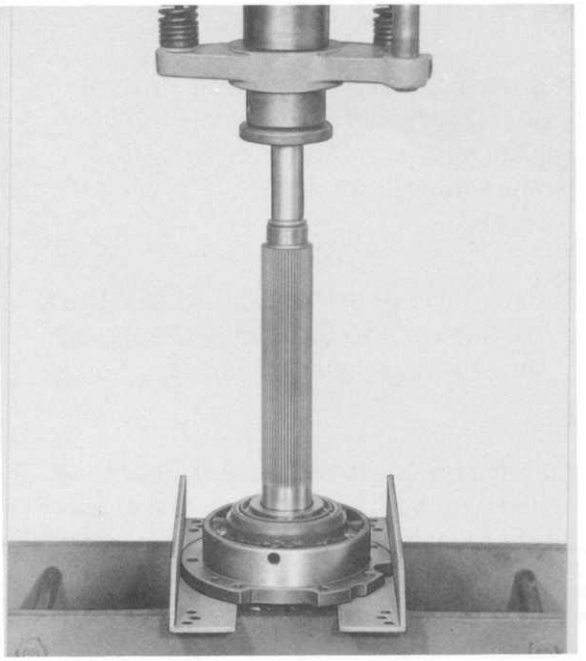


2. Press off gear wheels with Special Tool VW 457 and a pertinent support.

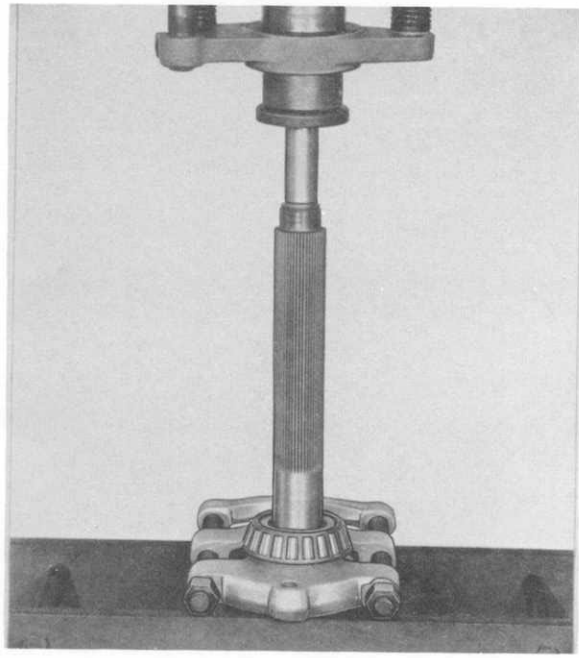


A = Standard U-iron (U 200) approx. 260 mm long.

3. Press off bearing cap with a pertinent pressure pad.



4. Press off large taper roller bearing inner race with a pertinent separator.



Assembling

Note

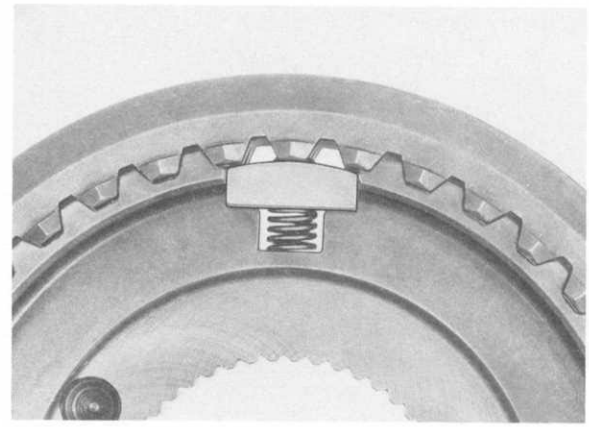
If drive pinion has to be adjusted, it must only be assembled after completion of adjustments (see "Adjusting Drive Pinion" on page 39 - 215).

1. Inner races of needle bearings as well as bearing surfaces on guiding sleeves and thrust washers must be cleaned of oil.

Lubricate needle cages, bores and bearing surfaces on both sides of gear wheels with oil thoroughly.

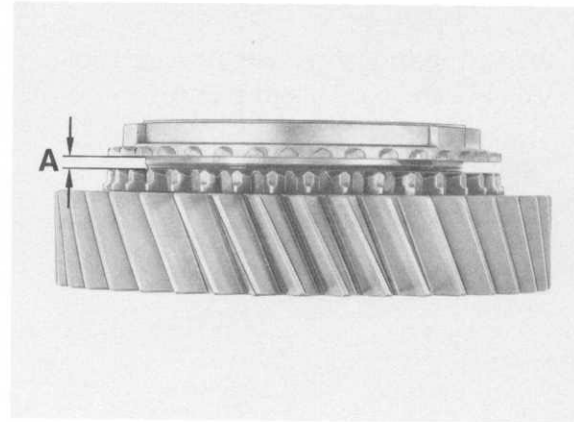
2. Mount bearing assembly on drive pinion and apply initial pressure of 20 kN (2 tons).

3. Mount drives for synchronization in correct position (domed side facing sliding sleeve).



4. Check synchronizing rings by pressing rings against tapers of gear wheels and measuring gaps "A" with a feeler gage blade.

Installed distance (new) = 0.9 to 1.5 mm
Wear limit = 0.6 to 0.7 mm



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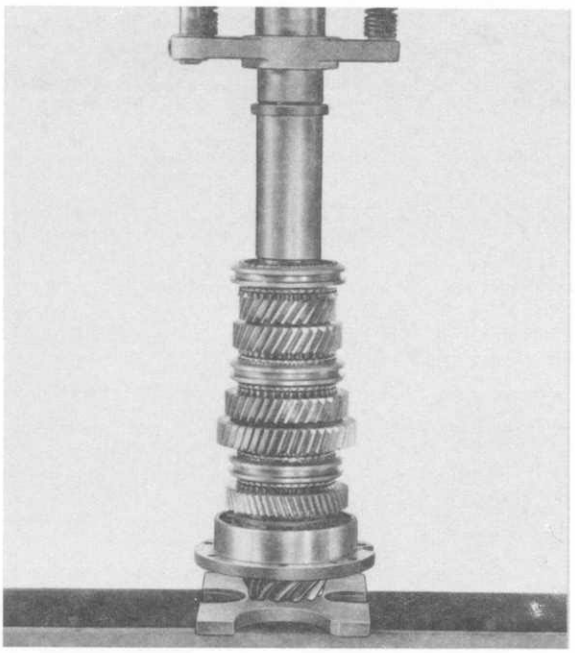
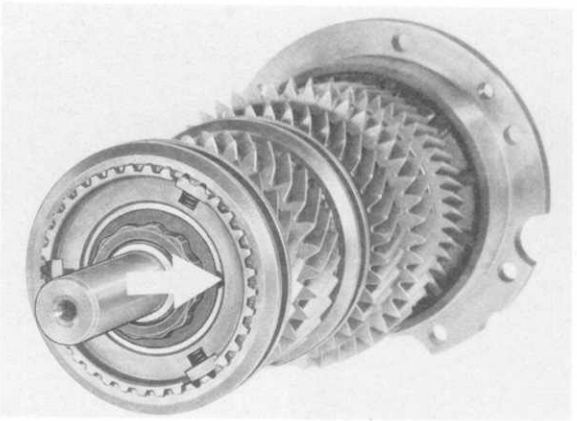
5.Apply approx. 60 kN (6t) to press assembled drive pinion into position over hub of guide sleeve.

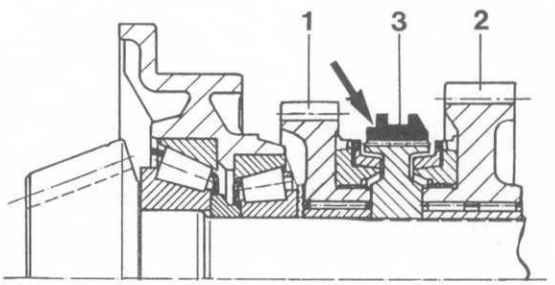


6.Tighten locknut to 300 Nm (221 ftlb) and lock by punching collar.



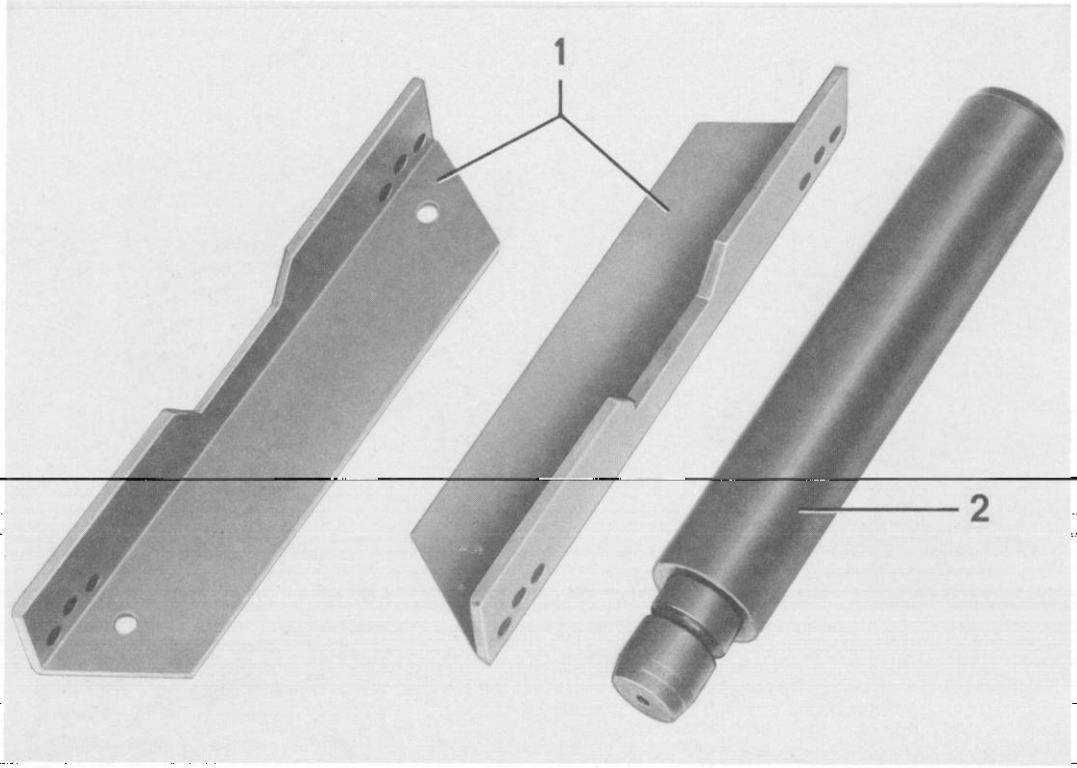
Modification, '87 models onward

The tips of the teeth of the 1st and reverse-gear operating sleeve have been modified. Note installation position, the recess (arrowed) must face the reverse free gear.



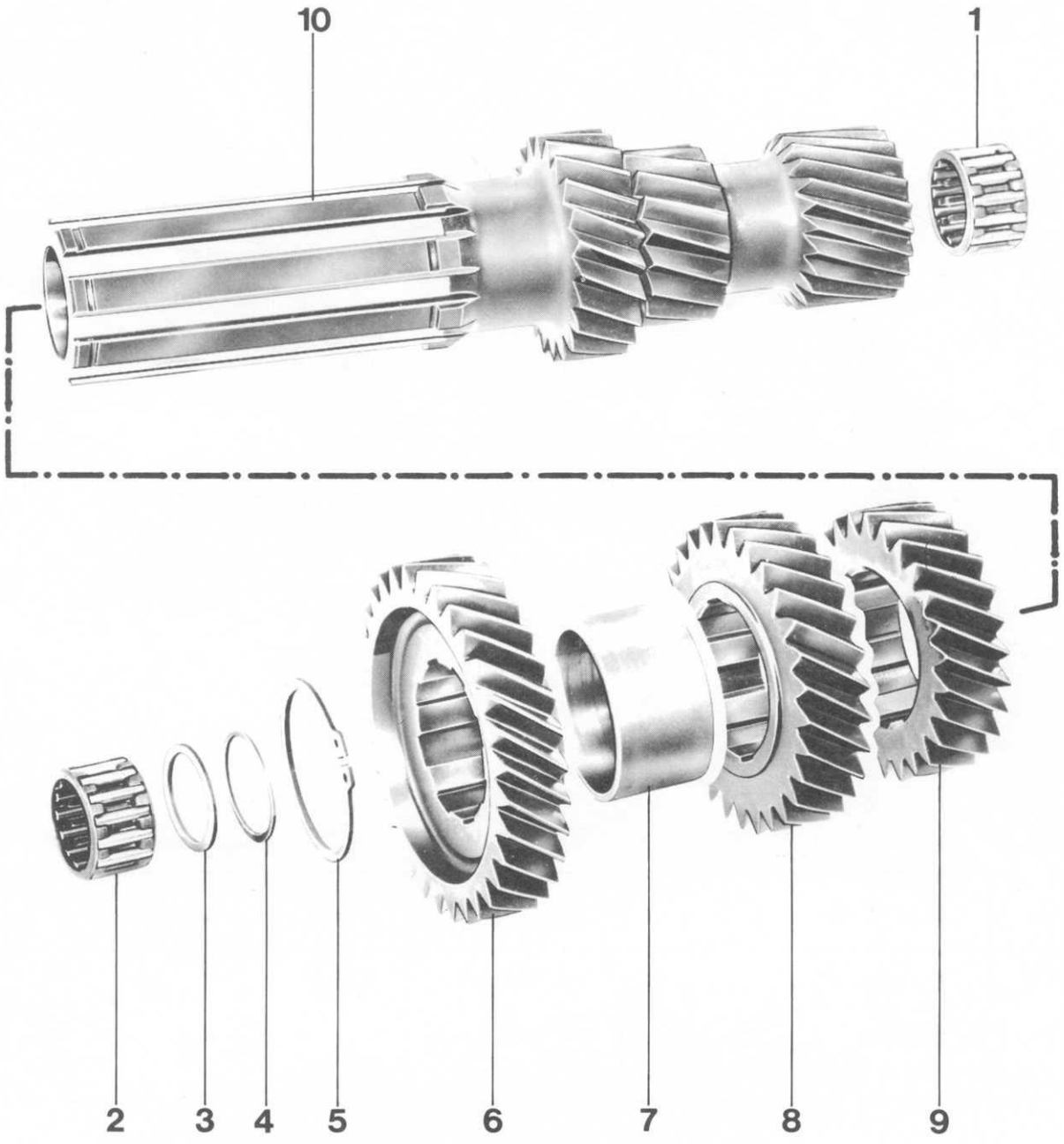
1 = Free gear, reverse gear
2 = Free gear, 1st gear
3 = Operating sleeve 1st/reverse gear

TOOLS

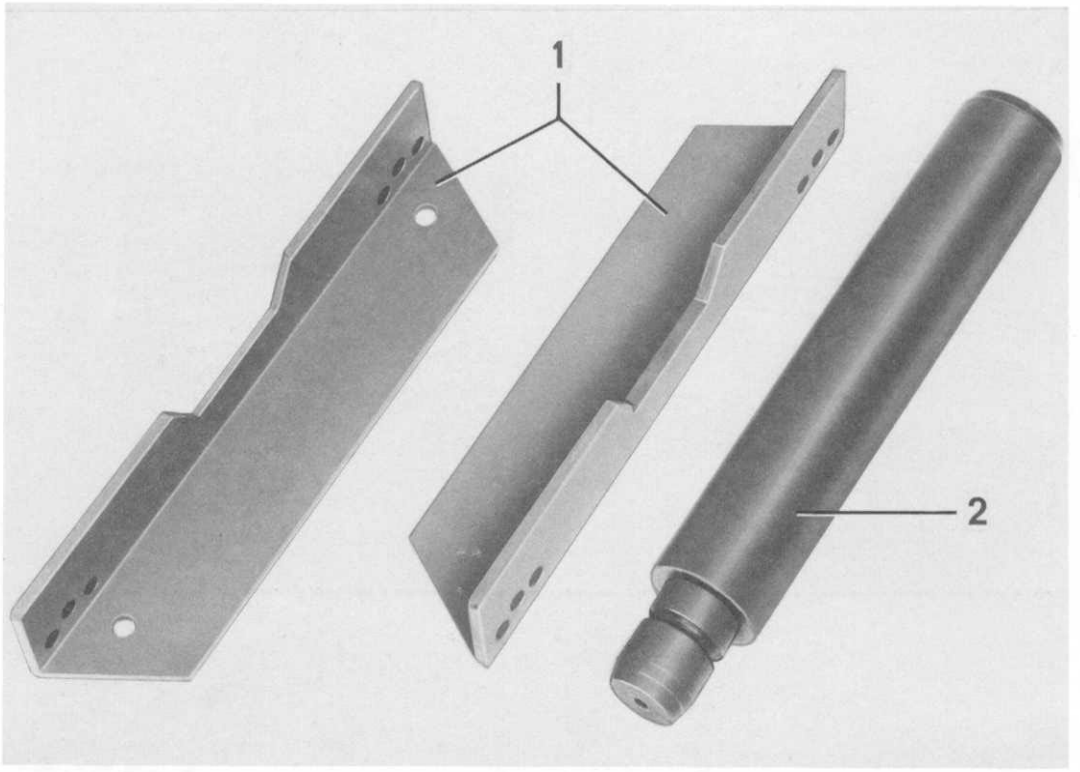


No.	Description	Special Tool	Remarks
1	Take-up rail	VW 457	
2	Mandrel	VW-407	

DISASSEMBLING AND ASSEMBLING COUNTERSHAFT

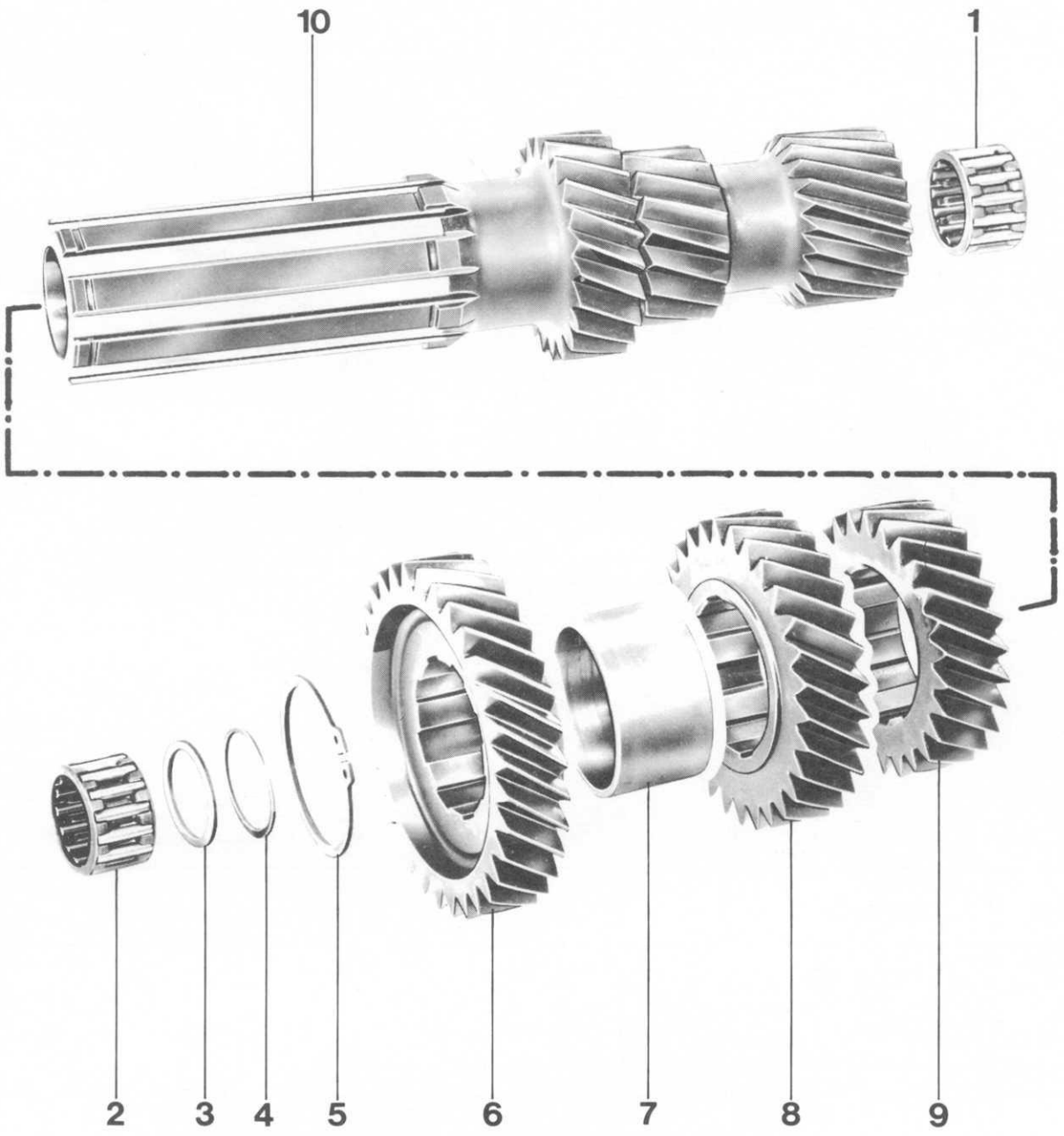


TOOLS



No.	Description	Special Tool	Remarks
1	Take-up rail	VW 457	
2	Mandrel	VW 407	

DISASSEMBLING AND ASSEMBLING COUNTERSHAFT



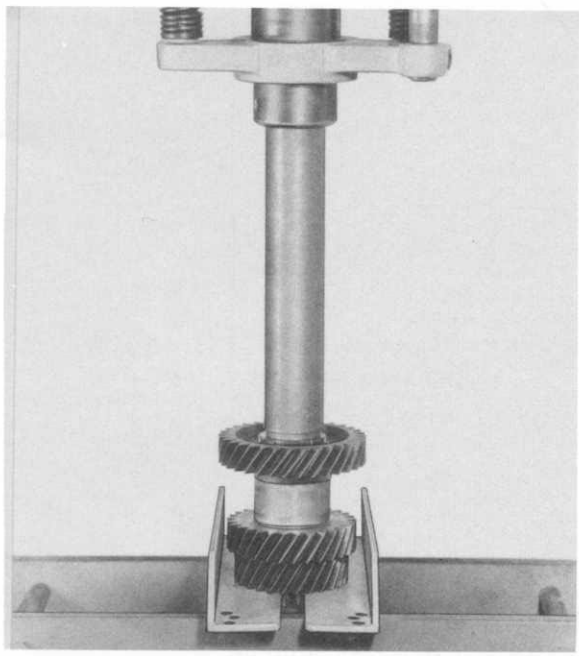
No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
1	Needle cage	1			
2	Needle cage	1			
3	Washer	1			
4	Circlip	1			
5	Circlip	1			
6	Gear	1	Press off with VW 407 and VW 457	Replace only in pairs; collar faces spacer	
7	Spacer	1			
8	4th gear	1	Press off with VW 407 and VW 457	Replace only in pairs; pair number and manufacturing date face 3rd gear	
9	3rd gear	1	Press off with VW 407 and VW 457	Replace only in pairs; collar faces stop	
10	Countershaft	1			

DISASSEMBLING AND ASSEMBLING COUNTERSHAFT

Disassembling

1. Remove circlip.

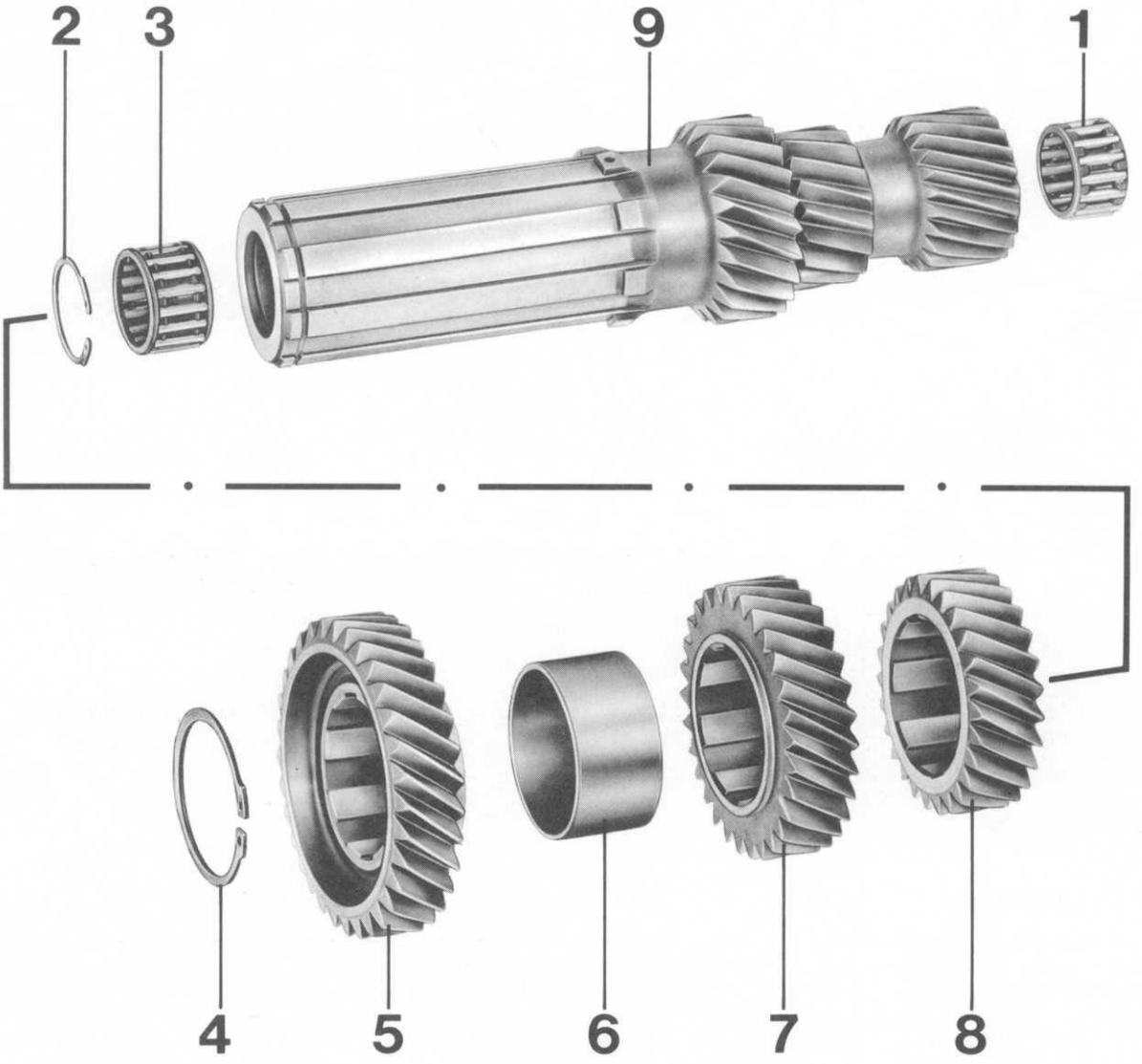
2. Press off gear wheels with a suitable mandrel and Special Tool VW 457.



Assembling

Heat gear wheels to approx. 100° C / 212° F and install to correct position

DISASSEMBLING AND ASSEMBLING LAYSHAFT (87 MODELS ONWARD)



No.	Description	Qty.	Note When: Removing	Installing
1	Needle cage	1		
2	Circlip	1		
3	Needle bearing	1		
4	Circlip	1		
5	Fixed gear	1	Press off with VW 407 and VW 457	Always replace as a pair, collar toward spacer
6	Spacer	1		
7	Fixed gear, 4th gear	1	Press of with VW 407 and VW 457	Always replace as a pair, collar toward spacer
8	Fixed gear, 3rd gear	1	Press of VW 407 and VW 457	Always replace as a pair, collar toward stop
9	Layshaft	1		

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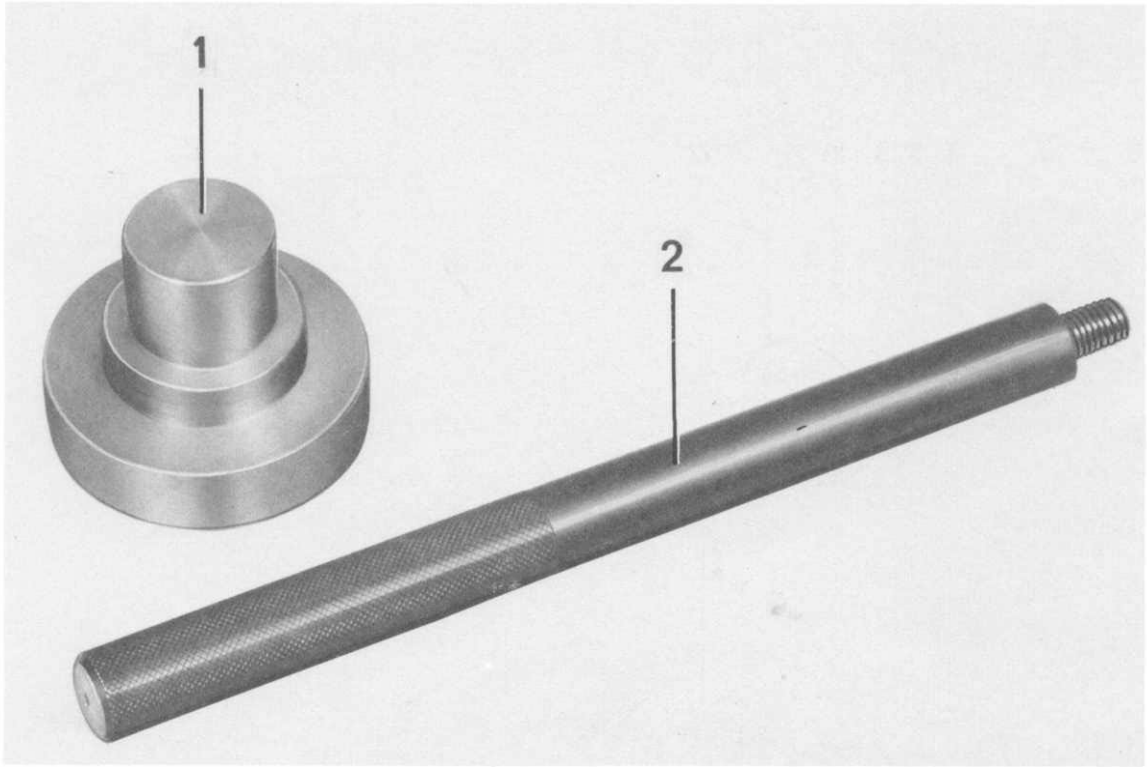
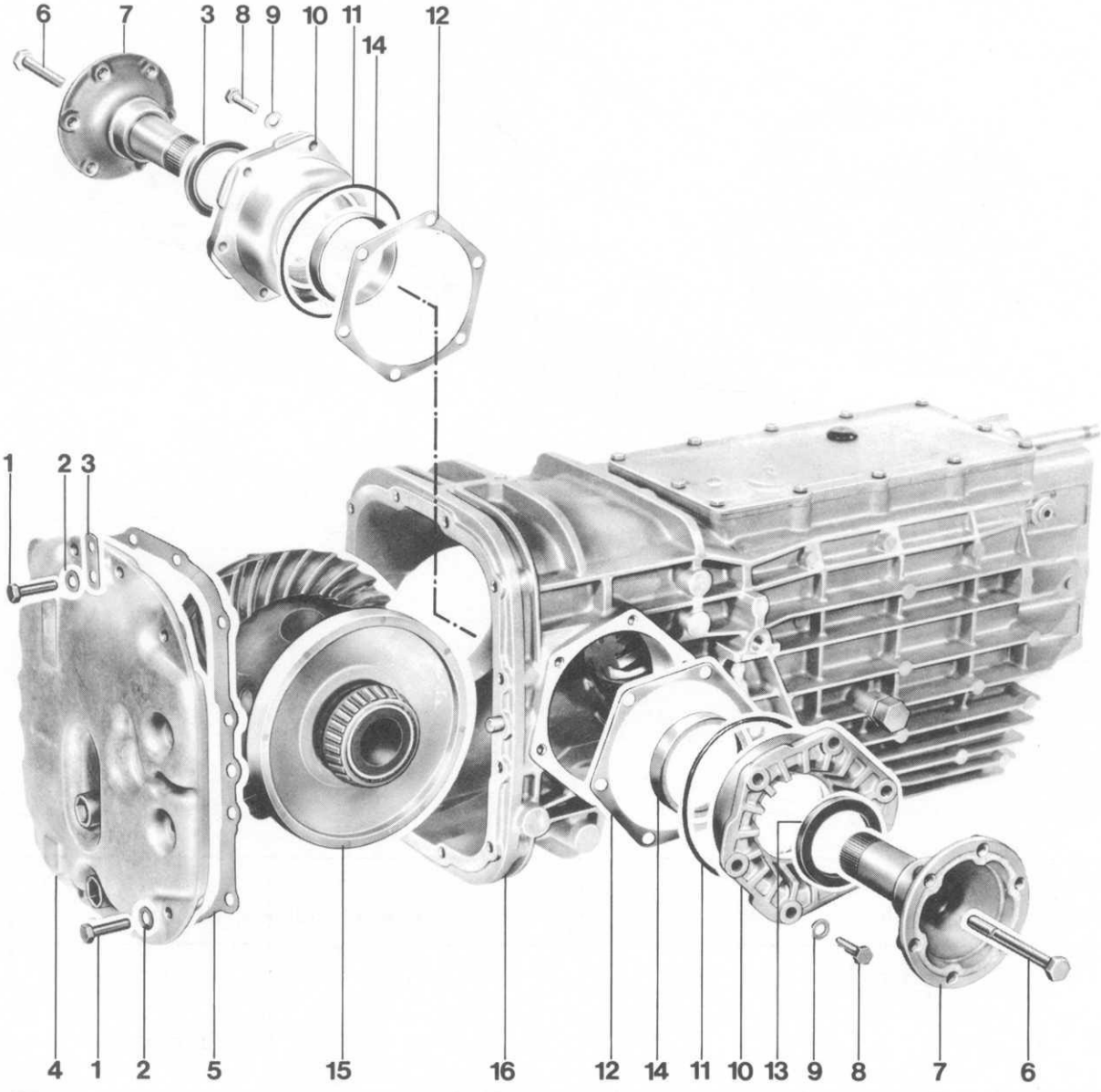
TOOLS



No.	Description	Special Tool	Remarks
1	Pressure pad	9147	
2	Rod		From P 254

REMOVING AND INSTALLING DIFFERENTIAL



No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
1	Bolt	12		Torque: 22 Nm (16 ftlb)	
2	Washer	12			
3	Holder	1			
4	Case cover	1			
5	Gasket	1		Replace	
6	Bolt	2		Torque: 43 Nm (31 ftlb)	
7	Joint flange	2			
8	Bolt	12		Torque: 22 Nm (16 ftlb)	
9	Washer	12			
10	Bearing cap	2	Mark for reassembly	Must be installed on same side	
11	O-ring	2		Replace, coat with transmission oil	
12	Shim	X	Note number and thickness on each side for reassembly	Determine again, if necessary	

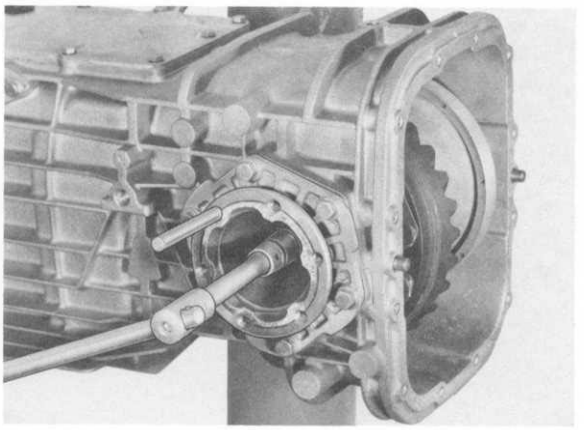
No.	Description	Qty.	Note When: Removing	Installing	Special Instructions
13	Seal	2	Drive out with suitable screw-driver	Drive in with Special Tool 9147	
14	Taper roller bearing outer race	2	Mark for reassembly	Install in same bearing cap, heat bearing cap to approx. 100° C/ 212° F and press in with a pertinent pressure pad	
15	Differential	1		Adjust, if necessary	
16	Case	1			

REMOVING AND INSTALLING DIFFERENTIAL

Removing

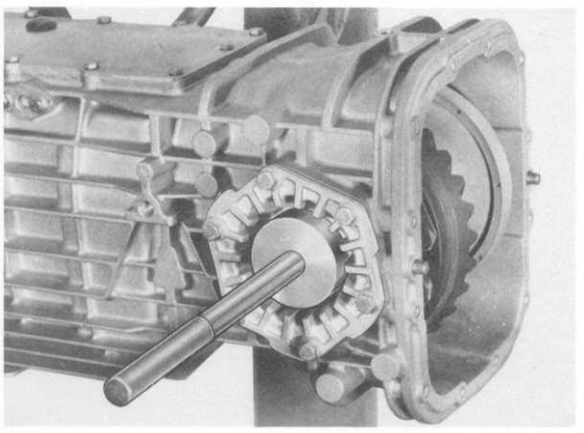
1. Drain transmission oil.

2. Unscrew joint flange bolt and remove joint flange.



Installing

Drive in joint flange seal with Special Tool 9147.



Note

Preload of the taper roller bearings could cause tension on the case when tightening bolts for the side case covers, which later could impair installation of the rear case cover. Consequently the rear case cover should be installed before tightening the bolts.

Measuring the plate wear on the proportional-slip differential

Note

The wear dimension can be determined only by means of the measuring cylinder - special tool 9514.

1. Remove output cylinder.

Note

In order to avoid venting of the differential system, the pressure line at the output cylinder must not be disconnected when the gearbox is installed. In this case, unflange the output cylinder with pressure line from the housing.

2. Back off the adjusting screw of the measuring cylinder as far as possible (facilitates assembly of the cylinder).

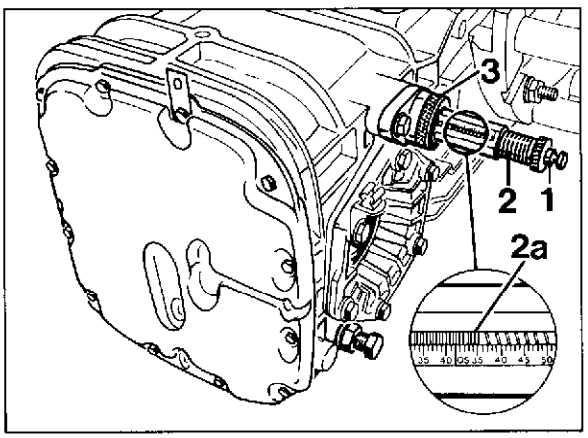
3. Mount the measuring cylinder on the gearbox and tighten the knurled nut.

Note

If the gearbox is installed, it is recommended to use two studs M 8 x 45 with continuous thread to secure the measuring cylinder.

4. Screw in the adjusting screw at the measuring cylinder until there is no longer any axial play at the spacer tappet. Read off the wear dimension in this position.

   New dimension = 34.5 mm
   Wear dimension = 45.0 mm



357-39

LS = Measuring range for longitudinal lock 911 Carrera 4

QS = Measuring range for transverse lock 928 S 4, 928 GT and 911 Carrera 4

1 - Spacer tappet
2 - Adjusting screw
2a - Measuring groove on adjusting screw
3 - Knurled nut

Note

When the wear dimension has been reached, the plates of the lock must be replaced. Do not correct the wear dimension at the thrust bearing under any circumstances.

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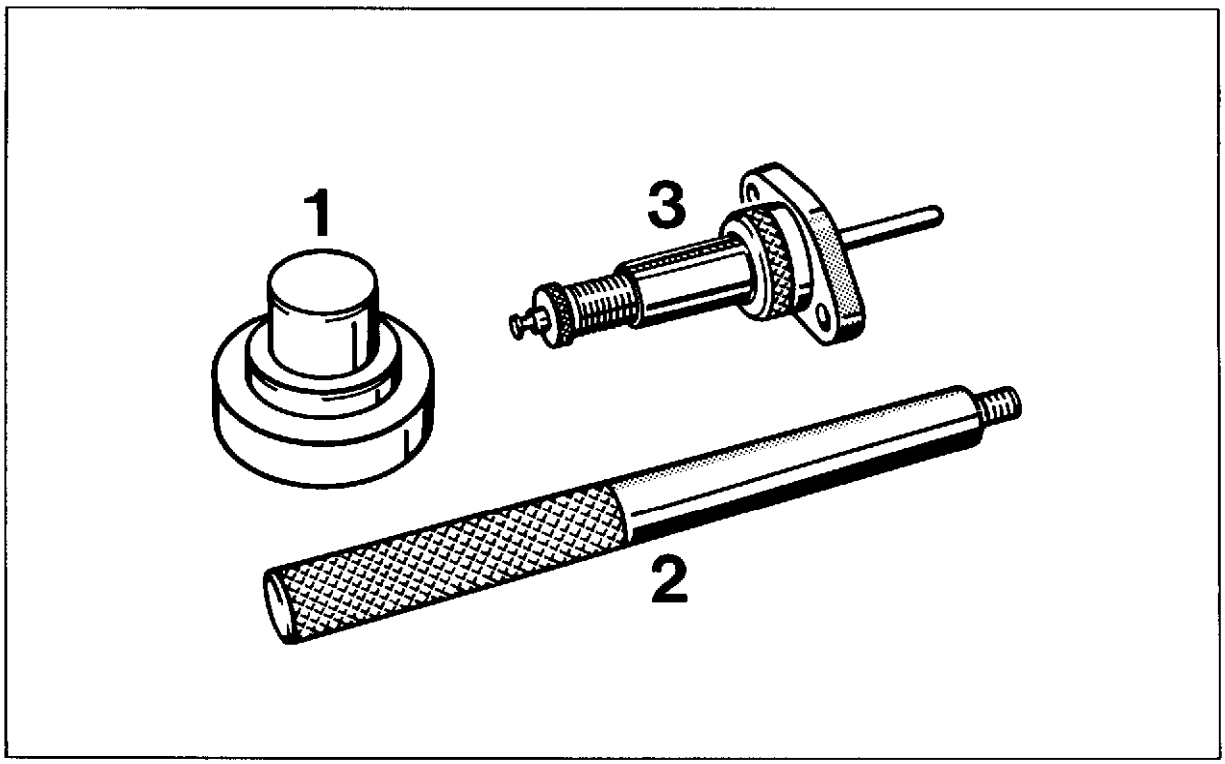
Removing and installing the proportional-slip differential

Tool



354-39

Nr.	Bezeichnung	Sonderwerkzeug	Bestellnummer	Erläuterung
1	Thrust piece	9147	000.721.914.70	
2	Pin	-	-	from P254
3	Measuring cylinder	9514	000.721.951.40	-

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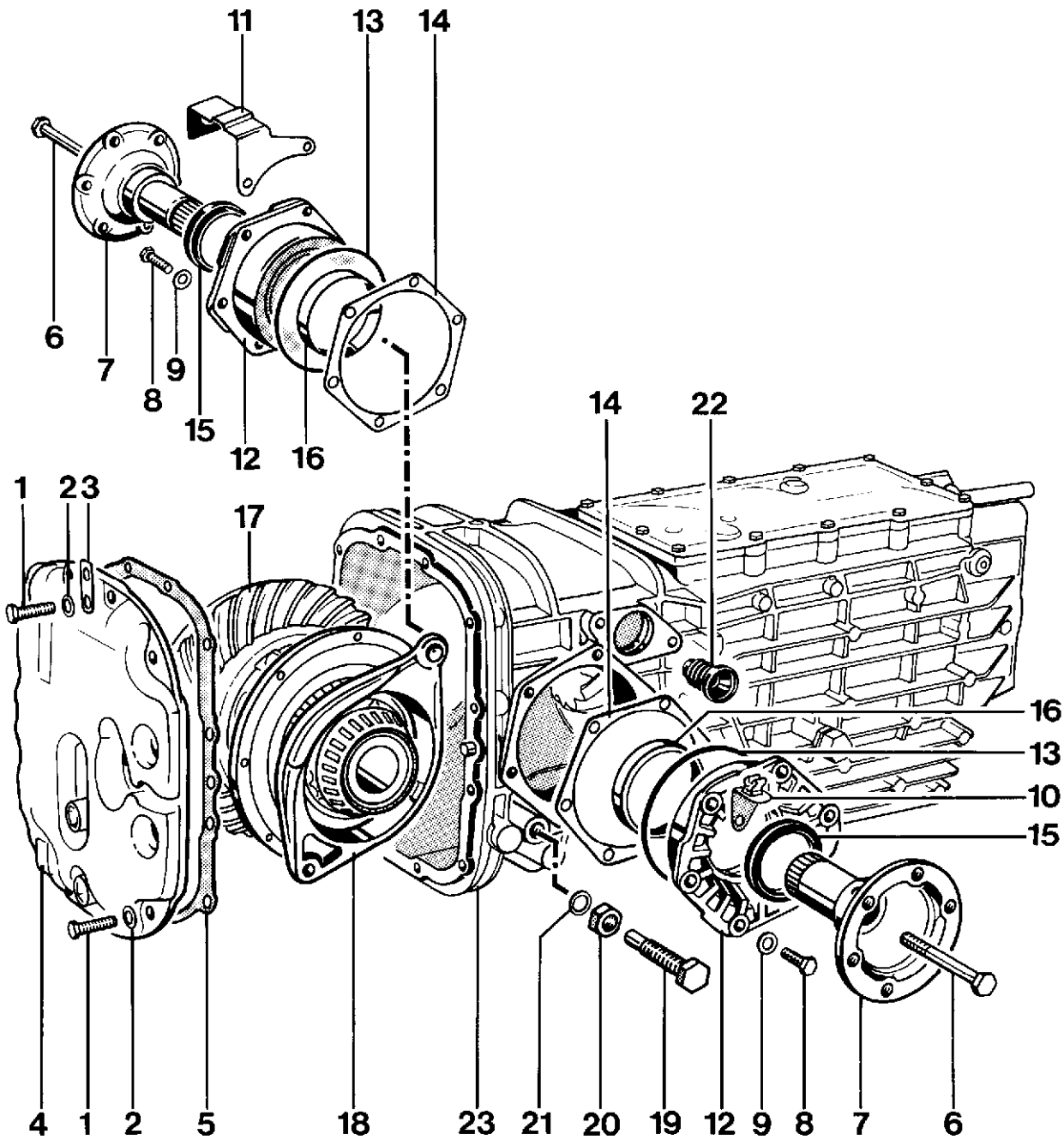
Removing and installing the proportional-slip differential



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No.	Description	Qty.	Note when Removing	Note when Installing
1	Hexagon screw	12		Tighten with 22 Nm
2	Washer	12		
3	Retaining plate	1		
4	Housing cover	1		
5	Seal	1		Renew
6	Hexagon screw	2	Block flexible flange with suitable mandrel	Tighten with 43 Nm
7	Flexible flange	2		
8	Hexagon screw	12		Tighten with 22 Nm
9	Washer	12		
10	Retaining plate	1		
11	Retaining plate	1		
12	Bearing cap	2	Identify for red-installation	Must be fitted on the same side
13	O-ring	2		Renew, coat with gear oil
14	Shim	X	Note number and thickness for re-installation per side	Determine anew if necessary
15	Sealing ring	2	Drive out with a suitable screwdriver	Drive in with special tool 9147
16	Taper roller bearing outer raceway	2	Mark for re-installation	Install in the same bearing cap, heat bearing cap up to approx. 100 °C and press in with suitable thrust piece.
17	Porsche limited-slip differential	1		Readjust if necessary
18	Engaging lever	1		Fit in the correct position

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No.	Description	Qty.	Note when: Removing	Installing
19	Thrust bearing	1	Only adjust or remove if the plates of the lock are removed or determine installation position for re-installation	Readjust if necessary. Screw in with Loctite 222 and lock with hexagon nut
20	Hexagon nut	1		Tighten with 85 Nm
21	Sealing ring*	1		Renew
22	Bellows	1		Oil slightly and press in home with a suitable pipe piece (e.g VW 418a)
23	Gearbox	1		

* Deleted as of MY '92. Sealing is done with Loctite 222.

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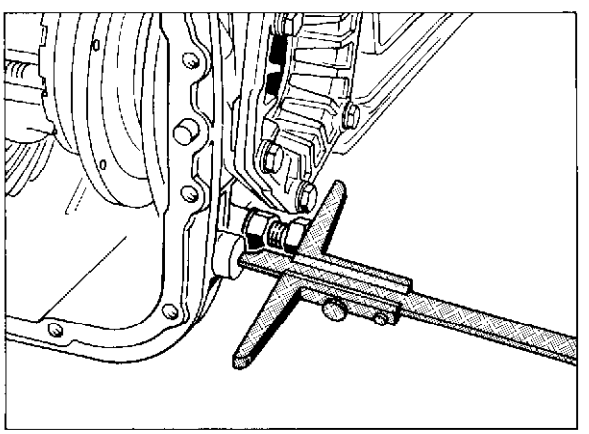
Assembly instructions for removal and installation

Removal

Note

Before the limited-slip differential is removed, determine the wear condition of the plates under all circumstances (refer to Page 39-206a).
If the worn plates are reused, the thrust bearing (No. 19) must not be adjusted. If adjustment or removal of the thrust bearing should be necesssary (e.g. in the event of leaks), measure the installation position of the thrust bearing for re-installation under all circumstances.



355-39

Installation

Note

Always renew the output cylinder as well if the bellows (No. 22) leaks.

1. Adjusting the thrust bearing: (required only if the plates were renewed)

- The locking torque and drive set must be adjusted.

- The bellows (No. 22) must be installed. Screw in the thrust bearing by only a few turns.
  Pay attention to the installation position of the engaging fork.

- Back off the adjusting screw of the measuring cylinder as far as possible (facilitates assembly of the cylinder).

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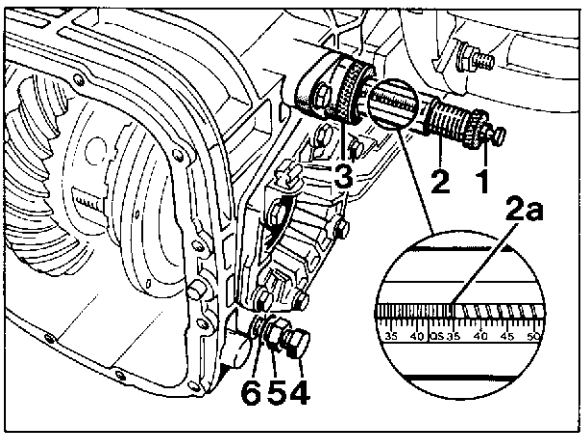
- Fit the measuring cylinder - special tool 9514 - on the gear and tighten the knurled nut.

- Set a setting dimension of 34.5 mm (in the transverse lock measuring range) with the adjusting screw on the measuring cylinder.

LS = Measuring range for longitudinal lock 911 Carrera 4

QS = Measuring range for tranverse lock 928 S 4, 928 GT and 911 Carrera 4



356-38

1 - Spacer tappet
2 - Adjusting screw
2a - Measuring groove on adjusting screw
3 - Knurled nut
4 - Thurst bearing
5 - Hexagon nut
6 - Sealing ring

- Screw in the thrust bearing until there is no longer any axial play at the spacer tappet of the measuring cylinder. Lock the thrust bearing with the hexagon nut in this position (tightening torque 85 Nm)

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Bleeding hydraulics of Porsche controlled slip differential (PSD)

Preparatory work:

- Remove rear left inner fender
- Connect bleeding device to PSD hydraulic reservoir
- Disconnect vent line
- Build up bleed pressure (approx. 1.5 - 2.0 bar)

1. Bleeding the pressure reservoir

To charge the pressure reservoir, the **ignition must be switched on.**
When the pressure reservoir has been charged, the pump cuts out; reservoir pressure is then approx. 180 bar.

- Connecting the bleed cylinder.
- Switch off the ignition.
- Carefully open the bleed connection and allow the pressure level to drop gradually.
  While this is being done, the **ignition must remain switched off**, to ensure that pressure is completely reduced and air expelled from the reservoir.
- Repeat this procedure several times, making sure that the **ignition is switched on or off at the appropriate stages in the procedure.**

2. Bleeding the valve block and the locking line to the lock slave cylinder

- Connect the 9288 system tester
- Switch the ignition "ON"
- Connect the bleed cylinder to the bleed screw on the slave cylinder
- Open the bleed screw on the slave cylinder
- Select "Start PSD Bleeding" and actuate repeatedly until no further air emerges
- The bleeding device must remain switched on, because the reservoir volume is used up rapidly.
- After this, close the bleed screw on the slave cylinder
- Select "Stop Bleeding" and "Start Pressure Reduction" at the system tester
- Switch off the bleeding device and disconnect it
- Screw on the reservoir cover
- Open the vent line at the reservoir again
- Check level in reservoir. The liquid must be approx. 1 cm above the step in the reservoir body (with the pressure reservoir charged)

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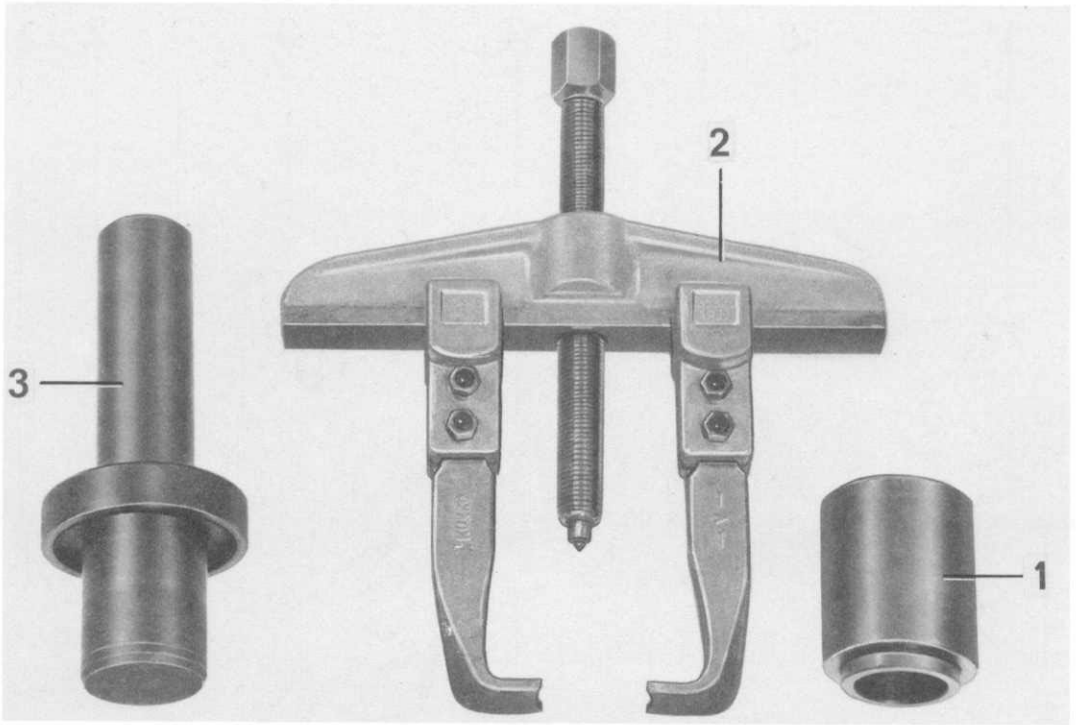
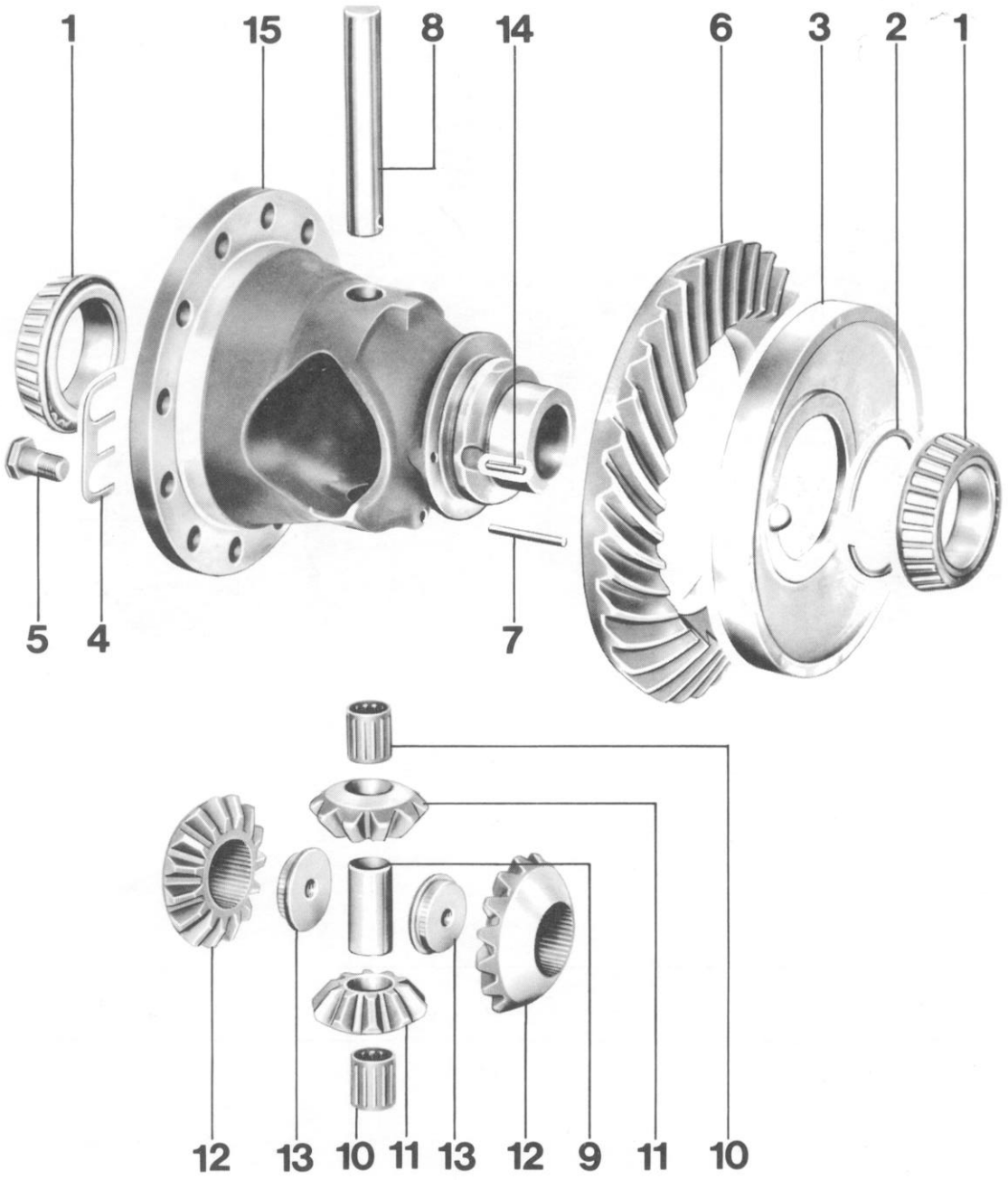
TOOLS



No.	Description	Special Tool	Remarks
1	Pressure pad	P 263	
2	Extractor	-	Standard
3	Pressure pad	P 264 b	

DISASSEMBLING AND ASSEMBLING DIFFERENTIAL



No.	Designation	Qty.	Note When: Removing	Installing
1	Tapered roller bearing - inner race	2	use suitable extractor and P 261 to remove	drive on with P 264 b
2	Retaining ring	1		
3	Rotor	1		
4	Locking plate	6		fit replacement
5	Hex bolt	12		threads must be dry and free of grease. Torque setting 165 Nm (120.4 ftlb)
6	Ring gear	1		Threaded holes for ring gear bolts must be dry and free of grease. Check alignment and adjust if necessary
7	Lock dowel	1		
8	Differential pin	1		
9	Spacer *	1		
10	Needle roller *	2		
11	Small bevel gear	2		Apply MoS_2 paste to convex surface. Always replace as a pair.

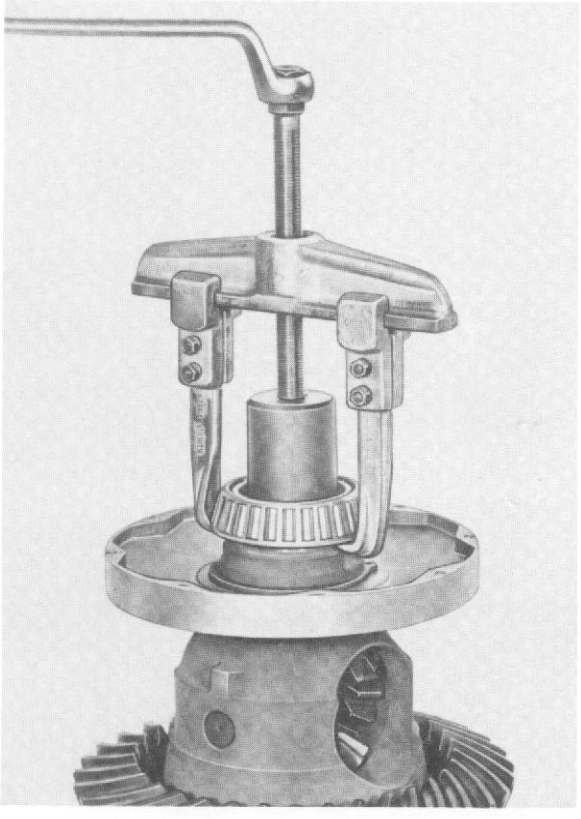
No.	Designation	Qty.	Note when: Removing	Installing
12	Large bevel gear	2		Apply MoS_2 to convex surface. Only replace as a pair.
13	Threaded rod	2		
14	Dowel pin	1		
15	Differential housing	1		

*Needle bearing changed from 86 models onward. The new needle bearings mean that the spacer need no longer be fitted.
The new needle bearings are not interchangeable with the earlier version.

DIASSEMBLING AND ASSEMBLING DIFFERENTIAL

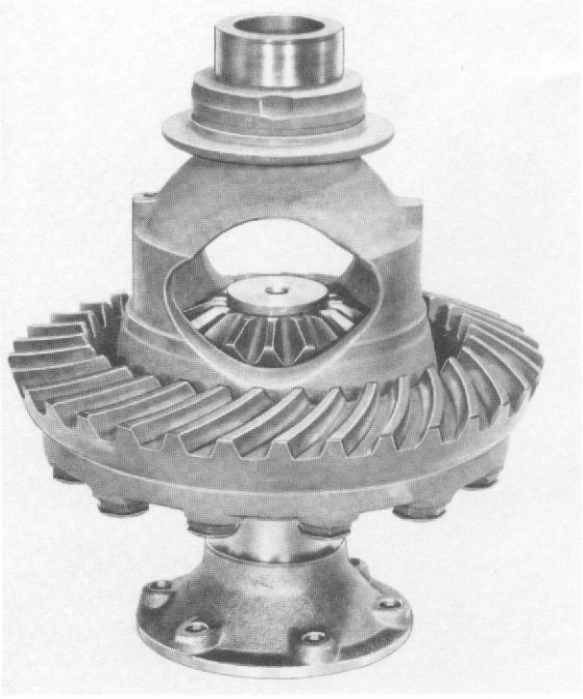
Diassembling

1. Pull off taper roller bearing inner race with a suitable extractor and Special Tool P 263.



2. Coat oval surface of differential gears with MoS_2 paste.

3. Install large differential gears with press-fit threaded plates through large opening in differential case and hold with joint flanges.



Assembling

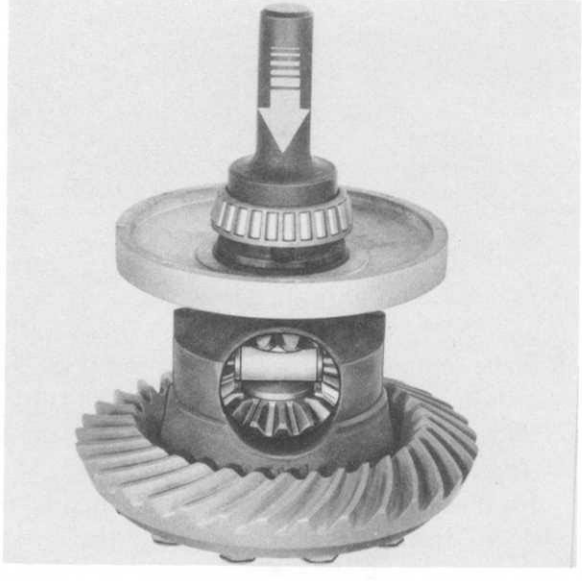
1. Place ring gear on case and tighten ring gear bolts to torque of 165 Nm (119 ftlb). Slide lockplate into groove of bolts, squeeze together at front with a pliers (to unite lockplate with bolt) and bend down over a hexagon surface to lock.

4. Install small differential gears between large differential gears and turn, until bores of gears are aligned with bores in case.

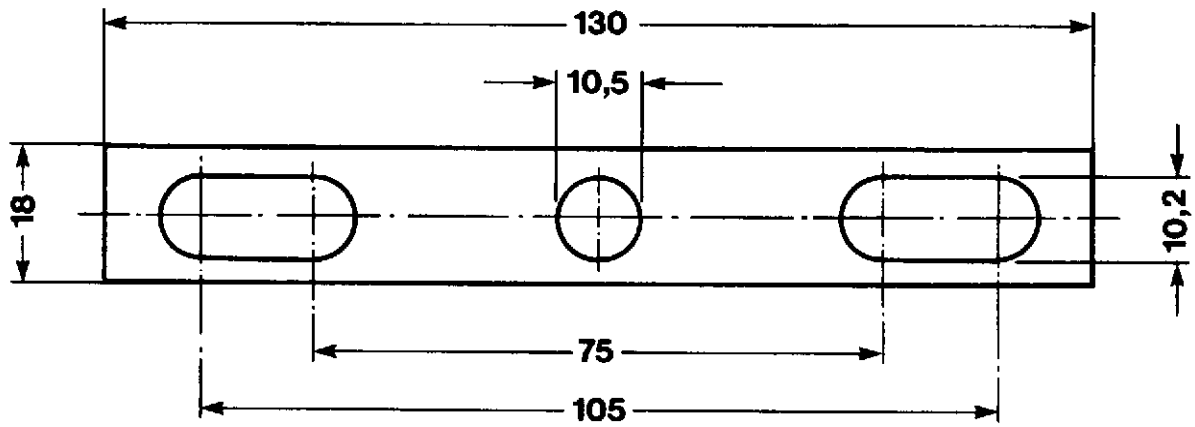
5. Install needle cages and spacer.

6. Drive in differential shaft in correct position and lock with pin.

7. Drive on taper roller bearing inner race with P 254 b.

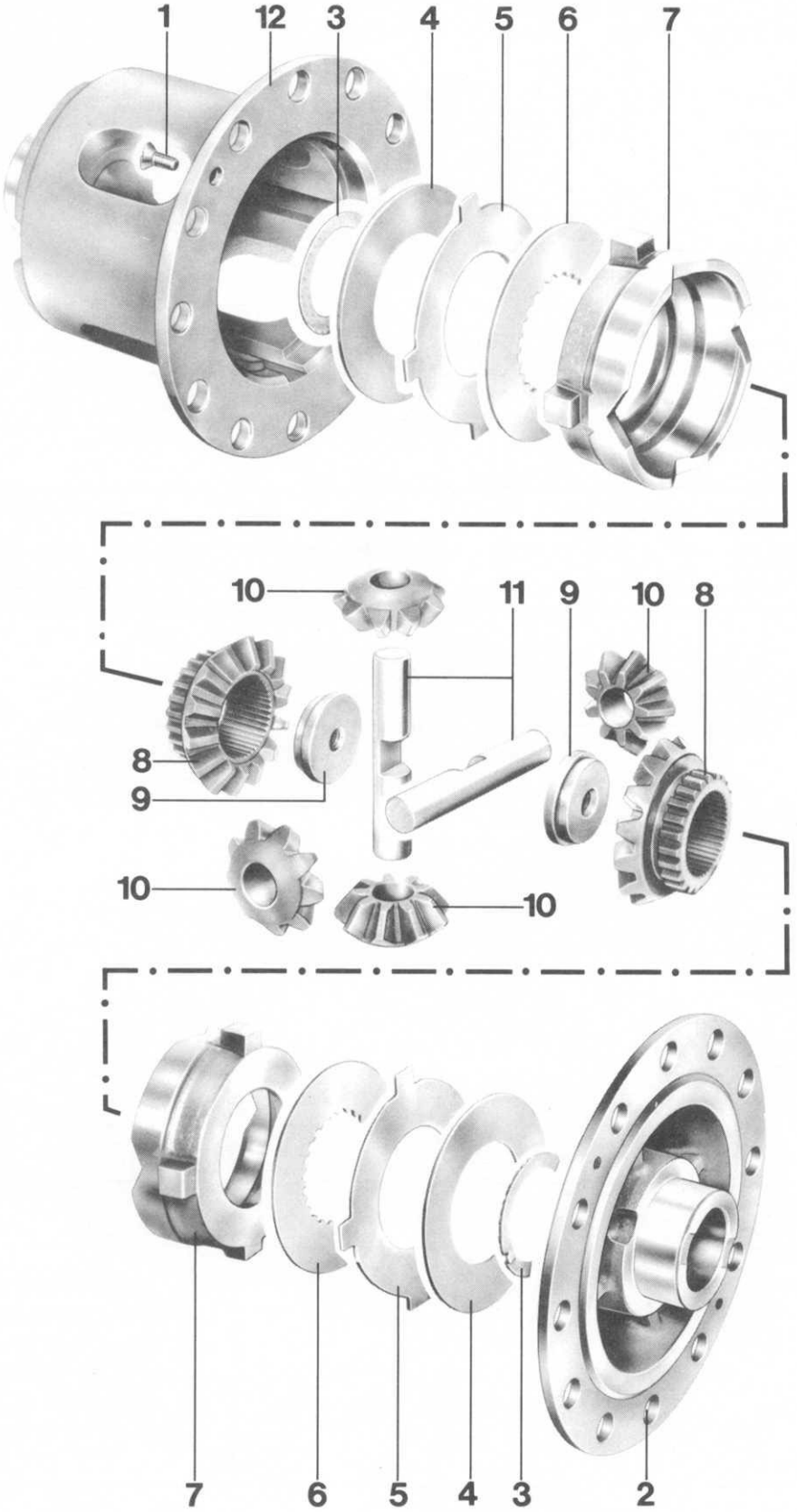


TOOL



No.	Designation	Special tool	Remarks
1	Connector	---	Improvised tool The connector for the flexible flange may be fabricated from a 6 x 18 piece of flat steel.

DISASSEMBLING AND REASSEMBLING LIMITED-SLIP DIFFERENTIAL

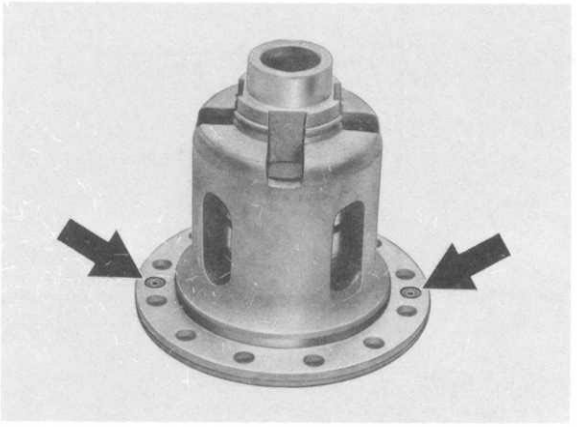


No.	Designation	Qty.	Note when: Removing	Installing
1	Flat-head screw	2		torque down to 10 Nm (7.3 ftlb)
2	Housing cover	1		
3	Take-up disk	2		install in correct position
4	Disk spring	2		install right way round
5	Outer plate	2		
6	Inner plate (molybedenum coating)	2		
7	Pressure ring	2		
8	Axial bevel gear	2		
9	Screw disk	2	push out of axial bevel gear	install in cor-corect position
10	Bevel pinion	4		
11	Differential axle	2		
12	Differential housing	1		

DISASSEMBLING AND REASSEMBLING LIMITED-SLIP DIFFERENTIAL (40% LOCK-UP)

D i s a s s e m b l i n g

1. Unscrew flat-head screw from housing cover and remove cover.



2. Remove all internals.

R e a s s e m b l y

1. Check all parts for wear or damage and replace as necessary.

a) Differential housing:
Check guide grooves for outer plates and pressure rings for wear.

b) Pressure rings:
Check for signs of heavy wear or ridging on the guide dogs and contact surfaces. The rings must move easily in the differential housing.

c) Axle bevel gears:
The contact surfaces for the take-up plates should not be worn and the inner plates must move easily on the splines.

d) Plates:
Check inner and outer plates for wear. There should be no signs of excessive wear on the guide dogs of the outer plates or the teeth of the inner plates.

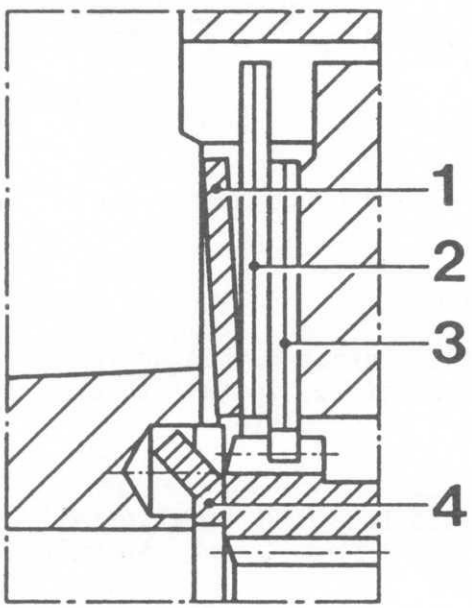
2. Apply transmission oil to all slide faces of plates, pressure rings and differential axles prior to reassembly.

3. Insert take-up disks so that the dog engages the hole in the housing or cover. As an aid to assembly, apply enough grease to the disks to hold them in place.

4.Install remaining components as shown in the exploded drawing.

N o t e

The disk springs must be installed with the convex side pointing in toward the plate package.



1 - Disk spring

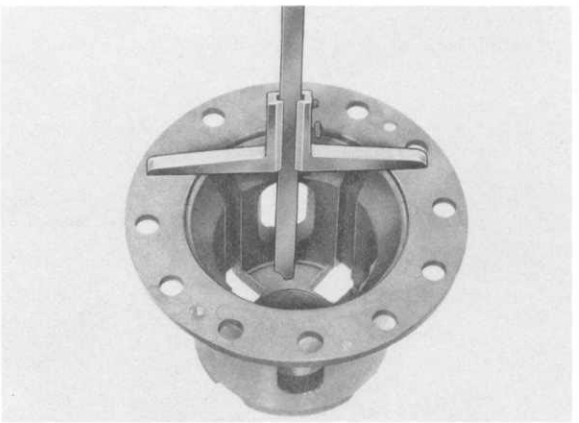
2 - Outer plate

3 - Inner plate

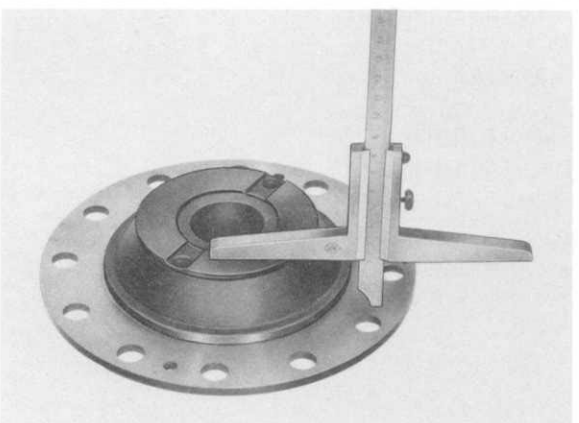
4 - Take-up disk

Reestablishing the thickness of the plate package; if new parts have been installed, the thickness of the plate package must be reestablished.

1.Use a depth gage to measure depth of housing "a".
Example: a = 110.80 mm



2.Measure the cover at "b".
Example: b = 29.20 mm



3.Calculate clearance "c" inside housing. c = a - b

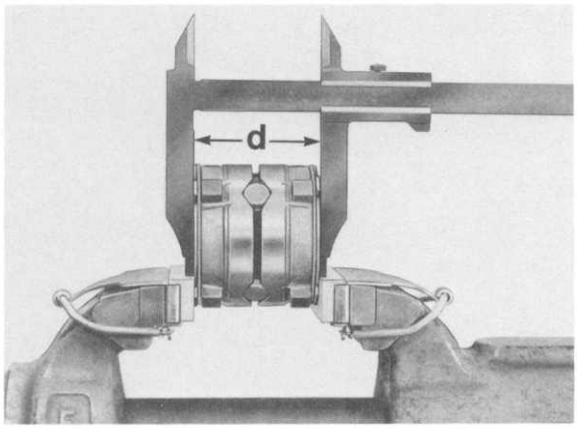
Example:

a = 110.80 mm
b = 29.20 mm

c = 81.60 mm

4.To measure the thickness "d" of the plate package (with 2.0 mm thick outer plates, but without disk springs), hold the plate package lightly in a vise and measure "d" with a micrometer.

Example: d = 76.40 mm.

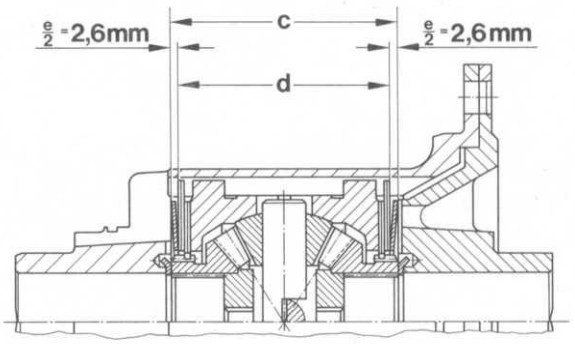


5.To determine "e" (must be equal to 5.20 mm) e = c - d

Example:

c = 81.60 mm
d = 76.40 mm

e = 5.20 mm
========



$e_2 + e_2 = e = 5.2$ mm

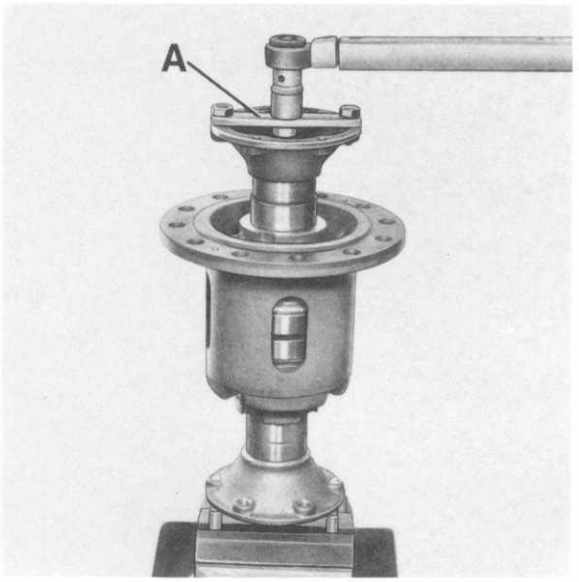
N o t e

If "e" is greater than or less than specified, install thicker or thinner outer plates.

"e" less than 5.20 mm - install thinner plates
"e" greater than 5.20 mm - install thicker plates

Outer plates of thicknesses 1.9 mm, 2.0 mm and 2.1 mm are available.

6.After assembly, measure the slip torque with drive applied to one axial bevel gear and the other fixed. Clamp a flange with two screws in the vise and place differential in position. Locate second flange with improvised connector and turn differential with a torque wrench. A torque of 10...35 Nm (7.3...25 ftlb) must be attained.



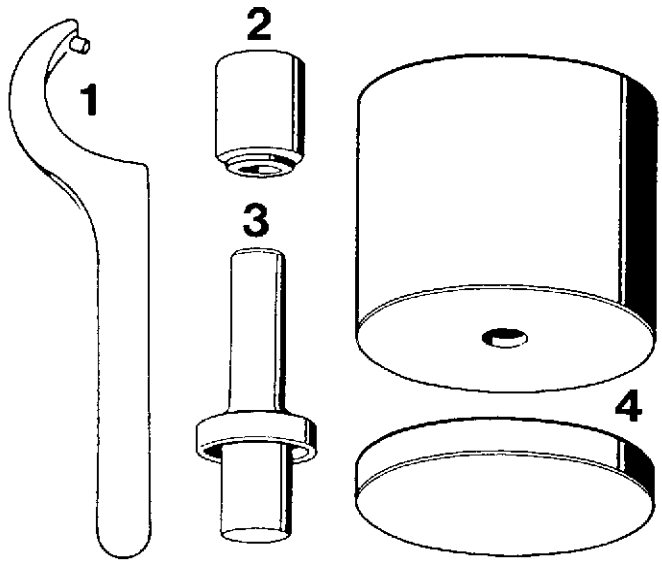
A = Connector (improvised)

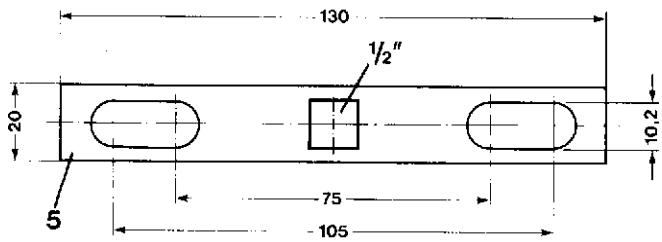
N o t e

If the specified torque is not attained with the thickest outer plates, all the plates are worn and require replacement.

Dismantling and assembling the proportional-slip differential

Tool





No.	Description	Special Tools	Order Number	Remarks
1	Sickle spanner	–	–	commercially available
2	Thrust piece	P 263	000.721.263.00	
3	Thrust piece	P 264 b	000.721.264.20	
4	Measuring fixture	9508/1	000.721.950.81	2 parts
5	Connection piece	–	–	Self-manufacture (flat steel 10 x 20)

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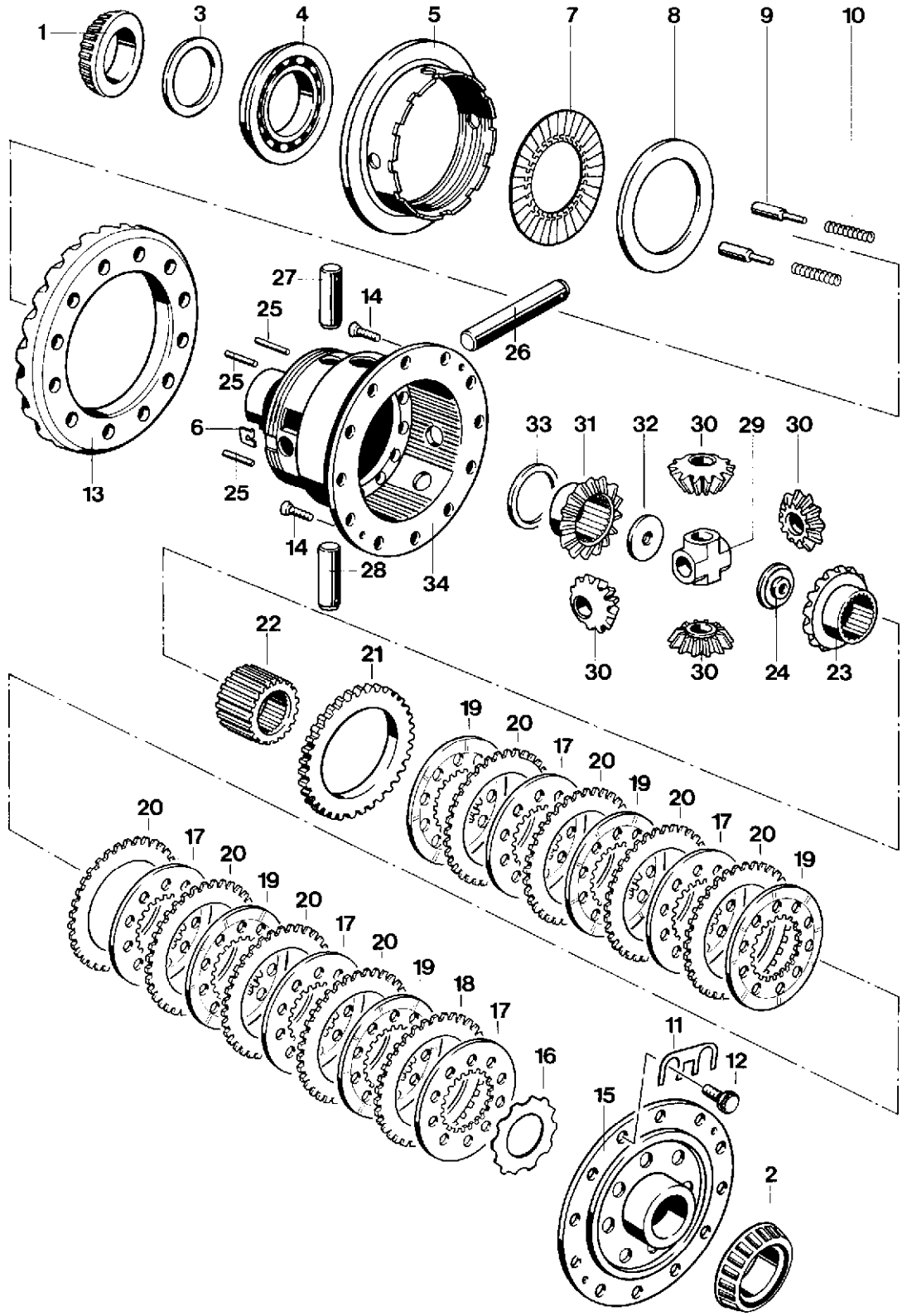
Dismantling and assembling the proportional-slip differential



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No.	Designation	Qty.	Note when: Removing	Installing
1	Taper roller bearing - Outer raceway	1	Pull off with suitable puller	Press on home with special tool P 264 b
2	Taper roller bearing - Outer raceway	1	Pull off with suitable puller	Press on home with suitable pipe piece
3	Stop disk	1		
4	Engaging bearing	1		
5	Adjusting nut	1	Bend up tab washer, back off nut by several turns and attach adhesive tape to lever disk	Set basic locking torque and secure with tab washer
6	Tab washer	1		Renew
7	Lever disk	1	Degrease surface and fix position of the lever segments with adhesive tape	Install in correct position, Pull off fixing tape
8	Thrust ring	1		Flat side to the thrust pins
9	Thrust pin	4		Replace in sets only
10	Pressure spring	4		
11	Tab washer	6		Replace. Push into the groove of the hexagon screws, pull together at the front with plyers (so that the tab washer is firmly attached to the hexagon screw) and secure downwards over a hexagon face.
12	Hexagon screw	12		The thread must be dry and free of grease. Tighten with 165 Nm

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No.	Designation	Qty.	Note when: Removing	Installing
13	Ring gear	1		Heat up to approx. 120 °C, threads for ring gear screws must be dry and free of grease. Pay attention to pair number. Readjust if necessary.
14	Countersunk screw	2		Tighten with 10 Nm
15	Cover	1		
16	Friction washer	X	Note thickness for re-installation	Redetermine thickness if necessary
17	Inner plate (sintered coating)	5		Oil with gear oil. The oil bores in the support plate must be positioned exactly flush over each other
18	Outer adjusting plate	X	Note thickness for re-installation	Redetermine thickness if necessary
19	Inner plate (Gylon)	5		Pay attention to installation position. The color point must be visible during assembly. Oil with gear oil
20	Outer plate (1.5 mm thick)	8		
21	Thrust ring	1		Large, flat side faces the plate assembly
22	Plate support	1		
23	Axle bevel gear	1		Replace only in sets with taper pinion
24	Threaded piece	1		
25	Clamping pin	3		Drive in so that position is correct
26	Pin	1		
27	Pin	1		

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No.	Designation	Qty.	Note when: Removing	Installing
28	Pin	1		
29	Cross-piece	1		
30	Taper pinion	4		Replace only in sets with axle bevel gears
31	Axle bevel gear	1		Replace only in sets with taper pinion
32	Threaded piece	1		
33	Friction washer	X	Note thickness for re-installation	Redetermine thickness if necessary
34	Housing	1		

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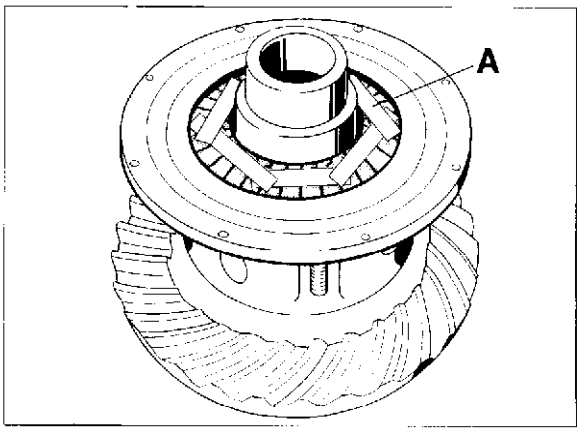
Assembly and dismantling instructions

Dismantling

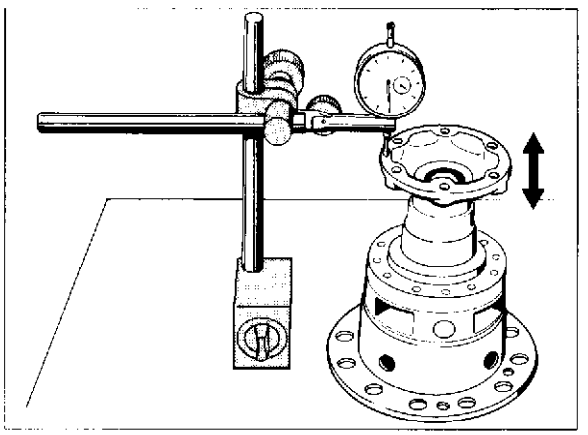
Relieve the lever disk (No. 7) by undoing the adjusting nut (No. 5). Degrease the lever disk and fix the segments for re-installation with adhesive tape.



A = Adhesive tape 296-39

Assembly

1. Determine the axial play of the axle bevel gears and adjust to 0.05...0.15 mm by inserting the corresponding friction washers (No. 16/33).

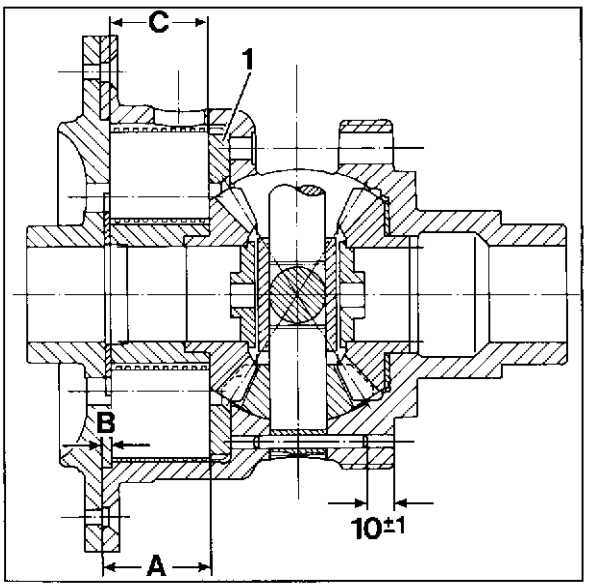


197-39

Note

If parts (e.g. differential housing or bevel gears) are replaced, the finished friction washers must be installed for measurement.

2. Drive in the clamping pins for the taper pinion shafts in the correct position.



297 - 39

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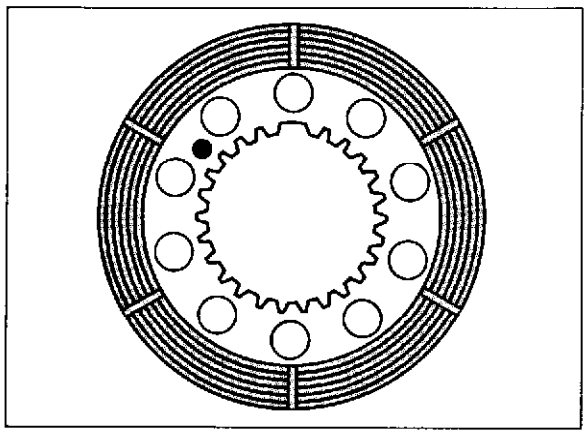
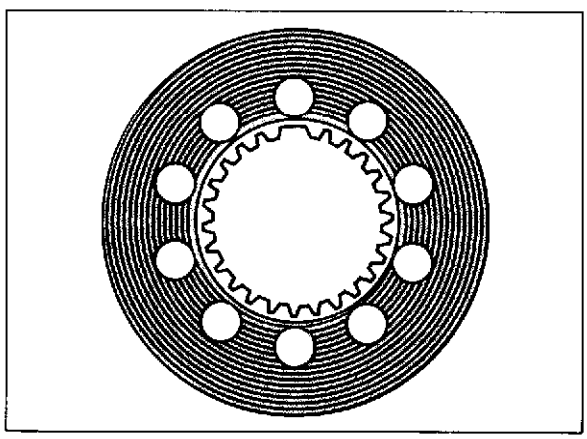
3. Distinguishing features of the inner plates:

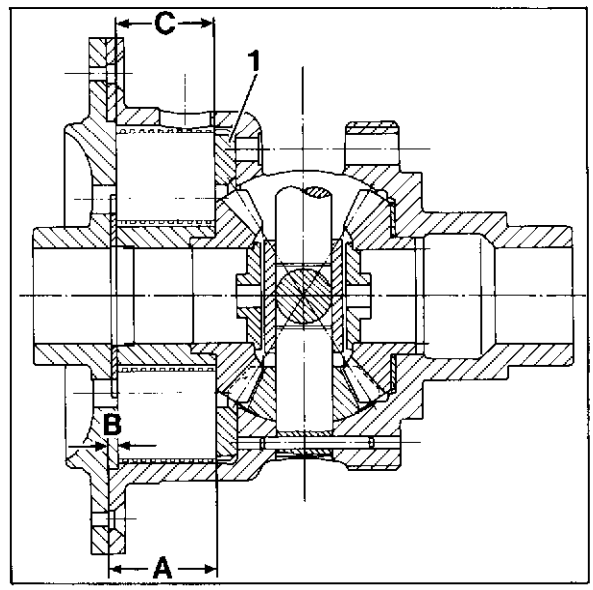


Inner plate (Gylon) 288-39



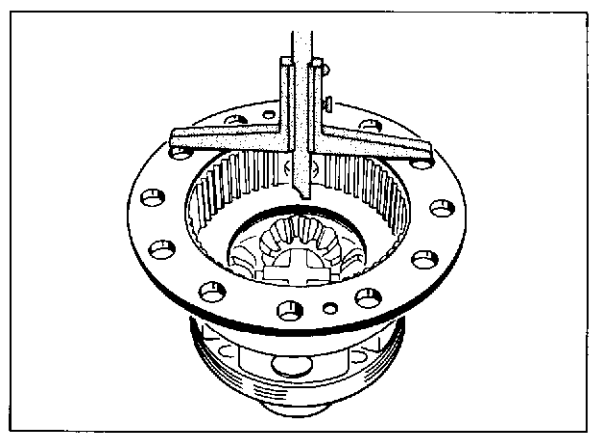
Inner plate (Sintered coating) 289-39

4. Determine the thickness of plate assembly "C":



1 = Thrust ring
C = Assembly thickness 297-39

- Fit the thrust ring and determine the dimension "A":



299-39

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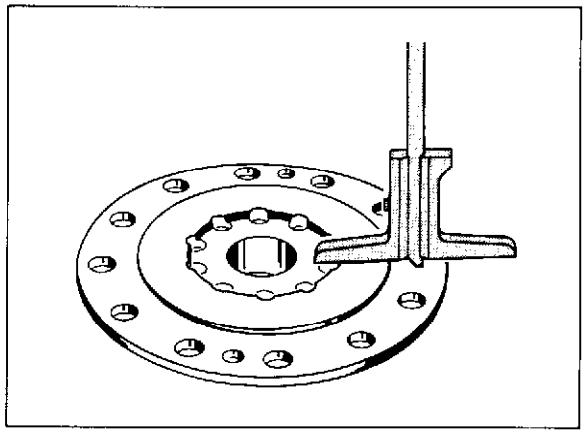
- Determine the dimension "B"



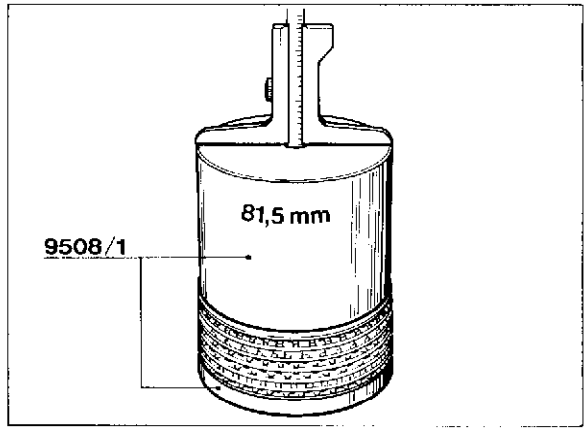
300-39

- Determine the clear distance "C" (assembly thickness) in the housing.
  "C" = "A" - "B"

Example:

A =		38.90 mm
B =	–	3.60 mm
C =		35.30 mm

Assemble the complete plate assembly in accordance with the exploded drawing and measure with special tool 9508/1.



184-39

Example

Measurement result:		115.30 mm
Height of the special tool*	–	81.50 mm
Package thickness		33.80 mm

* marked on tool

- Adjust the thickness of the plate assembly to the calculated value "C" ± 0.1 mm by means of the outer adjusting plate (No. 18).

5. Installation position of Gylon inner plates:
   Fit Gylon inner plates so that the color point is visible during assembly and so that the spiral groove for the oil supply runs from inside to outside in clockwise direction when looking at the plate assembly (assembly direction) (refer to simplified diagram).

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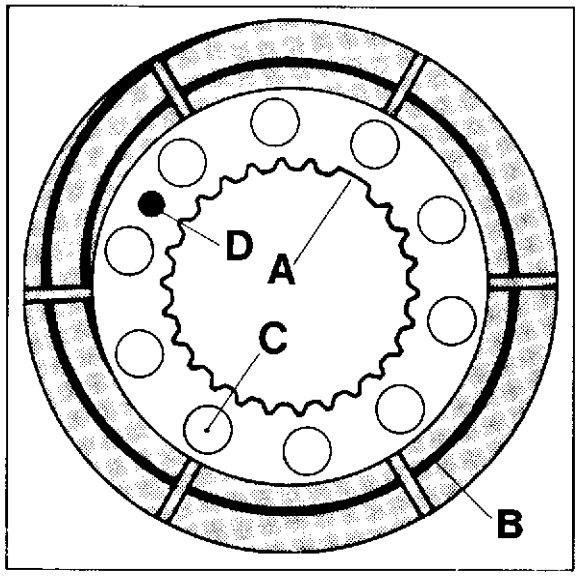
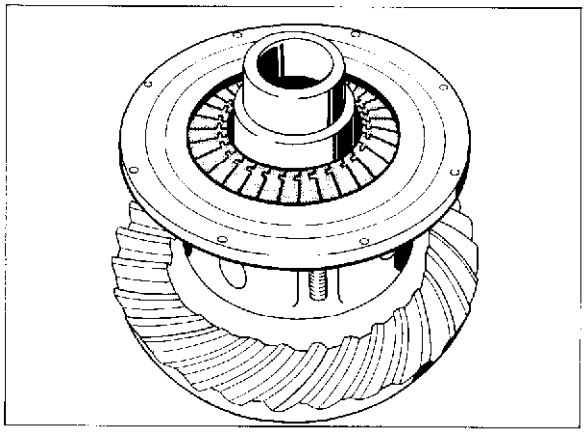
In addition, the oil bores in the supply plate of the inner plates must lie exactly flush over each other. A missing tooth on the support plate facilitates assembly.



207-39

A = Missing tooth
B = Spiral groove
C = Oil bore
D = Color point

6. Installation position of the lever disk.

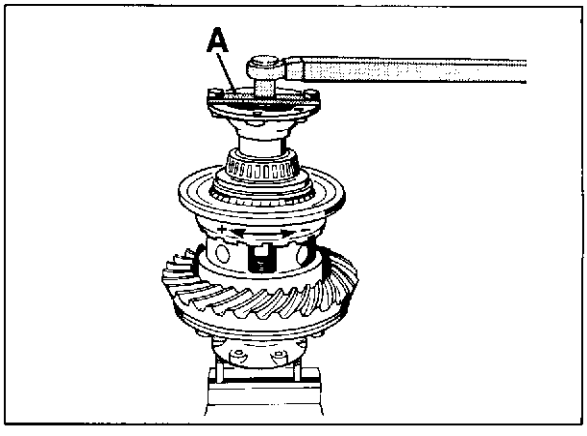


295-39

7. Setting the basic locking torque

- Limited-slip differential completely assembled (with engaging bearing and taper roller bearing inner raceways)

- Measure the cranking torque with one fixed and one driven axle bevel gear. For this purpose, clamp one flange in the vice with two screws and measure the torque at the other flange.



A = Connection piece

301-39

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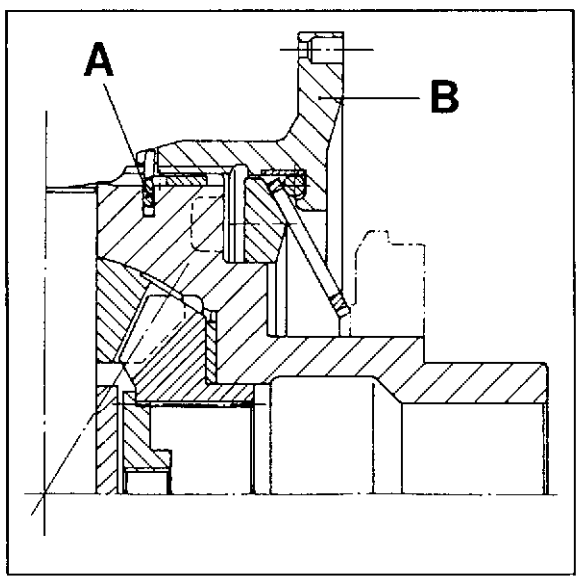
- Adjust the cranking torque to 100 Nm by turning the adjusting nut with the sickle spanner. Then back off the adjusting nut to the locking groove at which the torque is just below the cranking torque of 20 Nm.

- Secure the adjusting nut with a tab washer.



287-39

A = Tab washer
B = Adjusting nut

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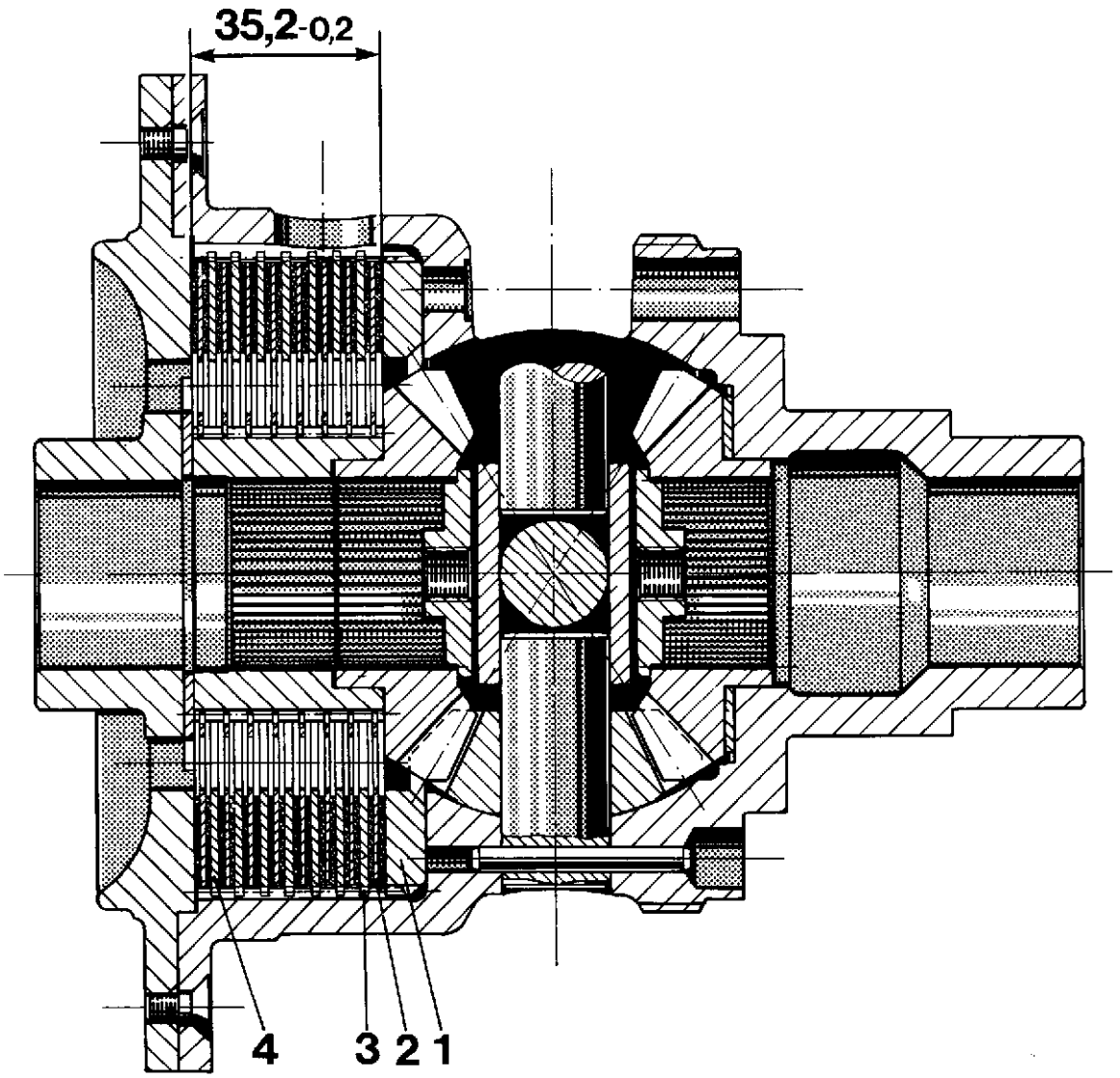
Dismantling and ass. controlled lim. slip differential with Valeo friction discs



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No.	Designation	Qty.	Note: Removal	Note: Installation
1	Thrust ring	1		Large, flat side faces disc pack
2	Inner disc (Valeo)	8		
3	Outer disc (1.5 mm)	6		
4	Outer disc (Adjusting disc)	1		

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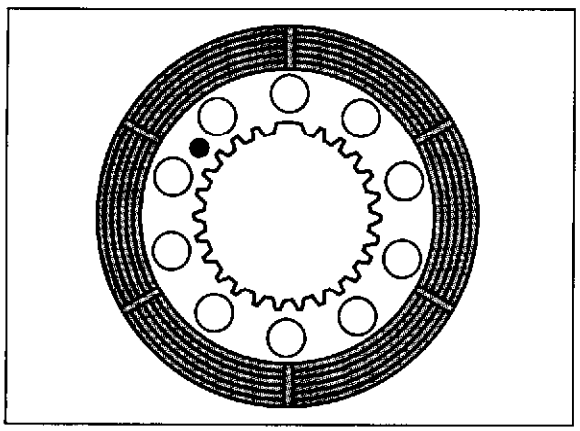
Dismantling and assembly notes

Note

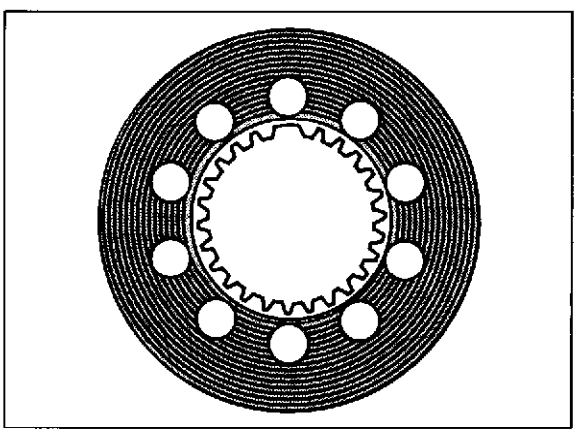
Following fitting of the Valeo friction discs, stacking and adjustment of the disc pack have been modified.

1. Differences between the types of inner discs used:



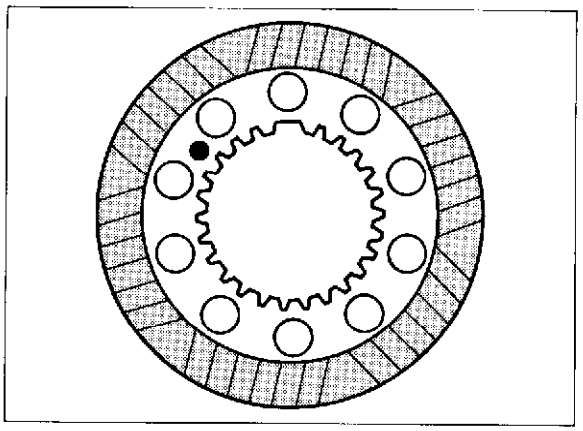
288-39

Inner disc (Gylon)



289-39

Inner disc (sintered bellows)



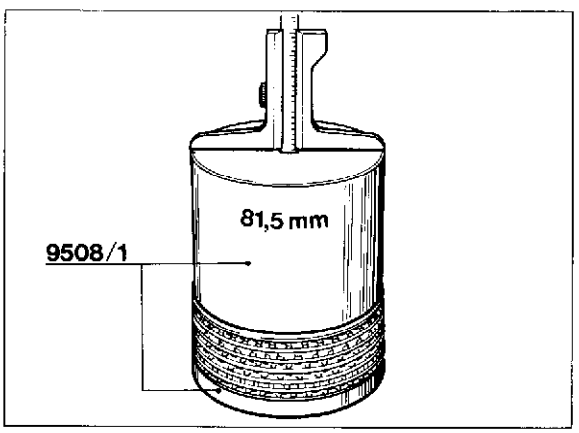
1311-39

New Valeo inner disc

2. Determine thickness of disc pack

Pack thickness (new) = 35.2 – 0.2 mm
Wear limit = 33.8 mm

Measure complete disc pack without thrust ring using Special Tool 9508/1.



184-39

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Example

Measurement result	115.20 mm
Special tool height*	– 81.50 mm
Pack thickness	33.70 mm

* Engraved on Special Tool

Note

If the wear dimension has been reached, all inner discs must be replaced. To adjust the discs to the specified pack thickness, use the outer adjusting disc (No. 4).

3. Oil discs with transmission oil before fitting.

4. The oil bores in the carrier plate of the inner disc must line up exactly.

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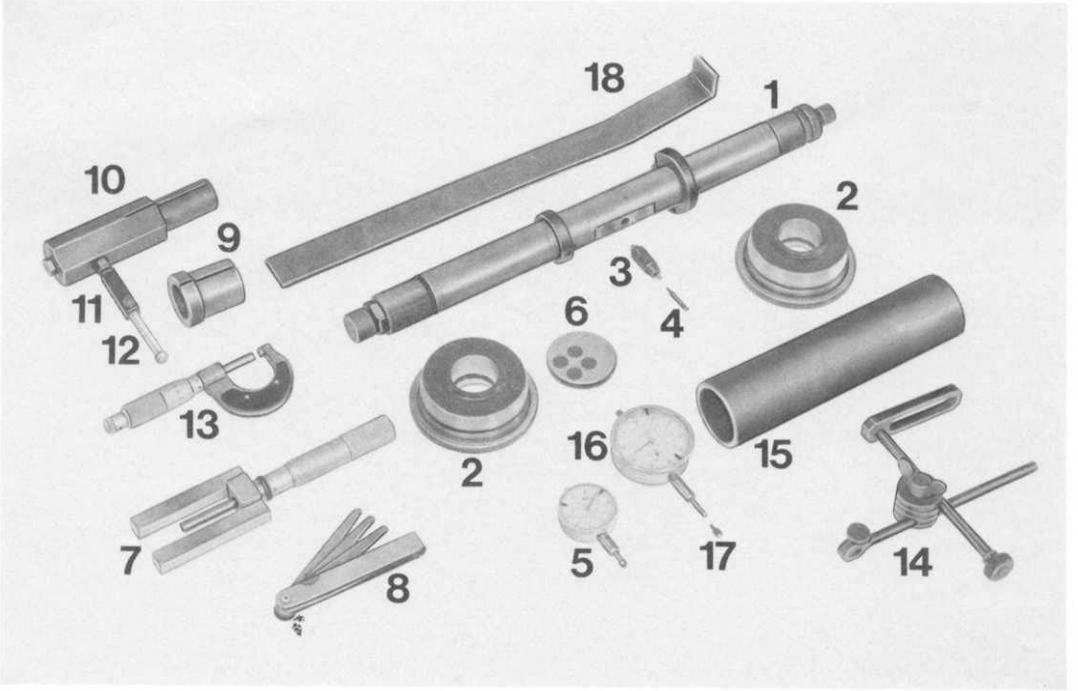
TOOLS

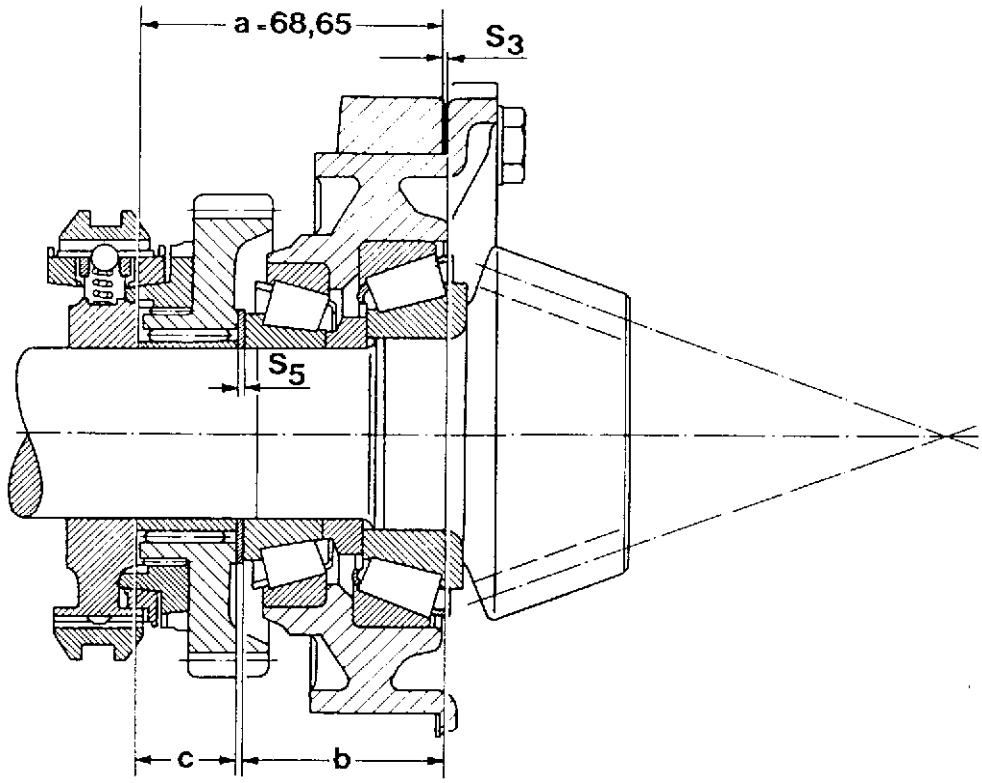


No.	Description	Special Tool	Remarks
1	Universal gage	VW 385/1	
2	Centering discs	VW 385/4	
3	Gage plunger	VW 385/14	
4	Dial gage extension	9150	
5	Dial gage	-	Standard, 3 mm range
6	Gage plate	VW 385/17	
7	Master gage	VW 385/30	
8	Feeler gage	-	Standard, 0.05 to 1 mm
9	Bushing	9145	
10	Locking sleeve	VW 521/4	
11	Adjustable lever	VW 388	
12	Gage plunger	9196	
13	Gage bolt	-	Standard
14	Dial gage holder	VW 387	
15	Pipe	9238	
16	Dial gage	-	Standard
17	Dial gage extension	VW 382/10	
18	Lever	-	Local manufacture

DETERMINING THICKNESS OF SHIM S_5 ON DRIVE SHAFT

N o t e

The thickness of the shim determines the position of the idlers and reverse gear relevant to the housing and to the selector rods/selector forks.



Size "a" = Specified size determined by design factors (68.65 mm)
Size "b" = Flange area bearing cover to end of drive-fit tapered roller bearing
Size "c" = Length of needle bearing - inner race
S_3 = Shim S_3

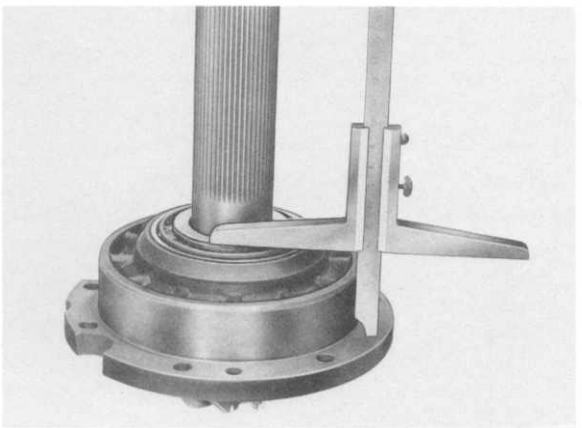
To calculate the thickness of the shim

$$S_5 = 68.65 - b - c + S_3$$

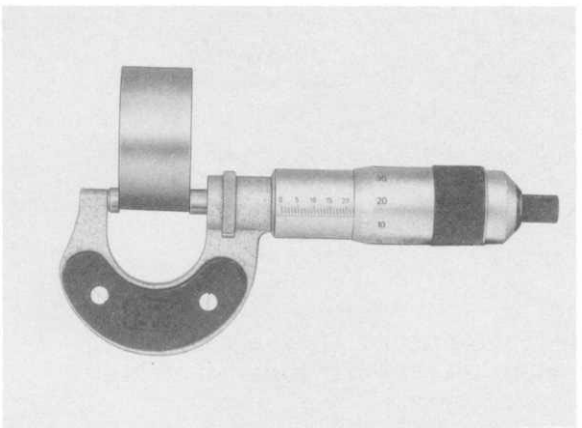
b, c and S_3 are measured values

Measuring Procedure:

1. Determine thickness of shim S3 (see page 39 - 221).
2. Apply 20 kN (2t) to the bearing assembly, pressing it on to drive shaft.
3. Measure "b" (e.g. 44.20 mm).



4. Measure "c" (e.g. 22.18 mm).



5. Calculate S_5

$S_5 = 68.65 - b - c + S_3$

$S_5 = 68.65 - 44.20 - 22.18 + 0.45$

$S_5 = 2.72$

Note

Shims from 2.20 mm to 3.30 mm are available in 0.1 mm graduations.

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Note

For manufacturing reasons at the beginning of standard production transmissions of

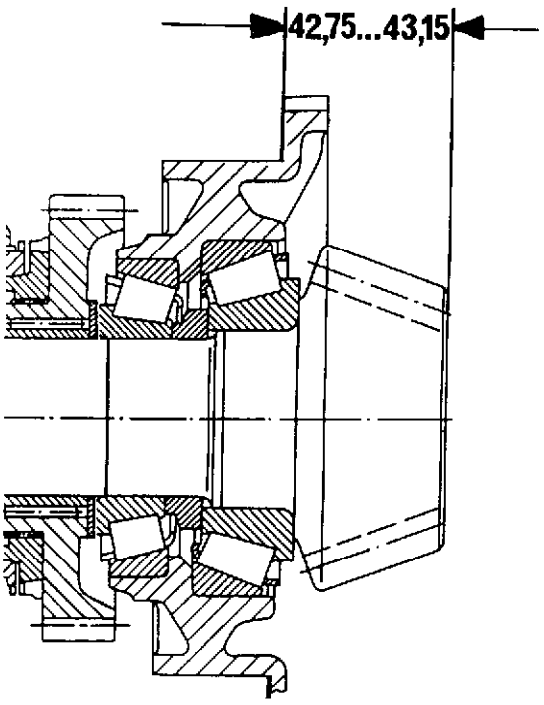
Type G 28.10 from Transm. No. 11 F 00070 to 11 F 00451
and
Type G 28.11 from Transm. No. 11 F 05069 to 11 F 05322

had been assembled with bearing assemblies, for which the following adjustment has to be made to determine the thickness of shim S_5.

$$S_5 = 112.00 - b - c + S_3 - 0.5$$

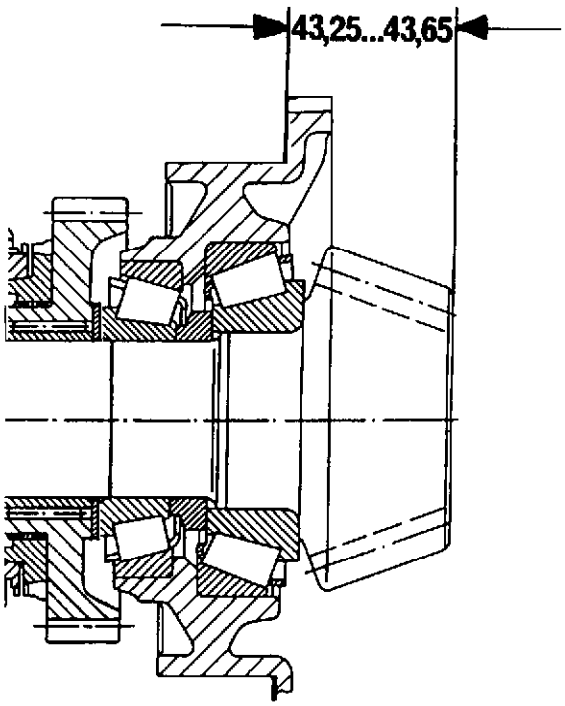
Old and new bearing assemblies differ as shown below.

Old Version



$S_5 = 112.00 - b - c + S_3 - 0.5$

New Version



$S_5 = 112.00 - b - c + S_3$

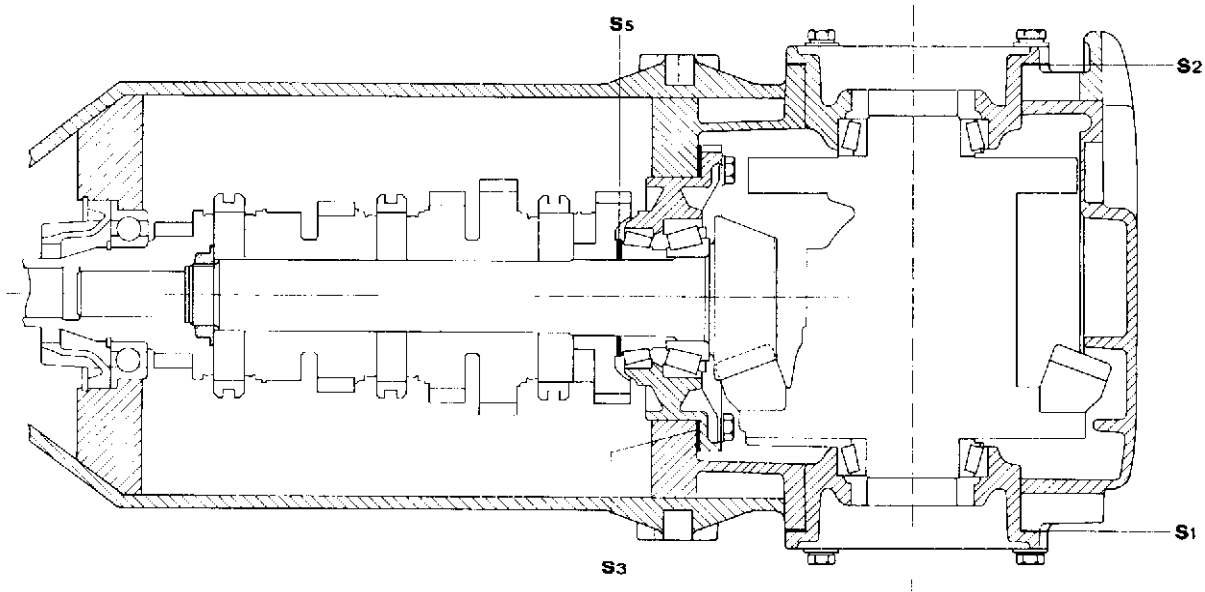
Recommended Sequence of Adjusting Drive Pinion and Ring Gear

When it becomes necessary to adjust the drive pinion and ring gear, it would be in the interest of economical procedures to keep to the following sequence.

1. Determine the total shim thickness "Stot" (S_1 plus S_2) for the specified pre-load of the taper roller bearing/differential.
2. Determine shim thickness "S_3".
3. Determine shim thickness "S_5".
4. Divide total shim thickness "Stot" in S_1 and S_2 so that there is the specified amount of backlash between the ring gear and drive pinion.

The goal of adjustments is to relocate the point of optimal quiet running as was determined in the special testing machine during production.

Perfect results require absolute care and cleanliness during all assembly measuring operations.



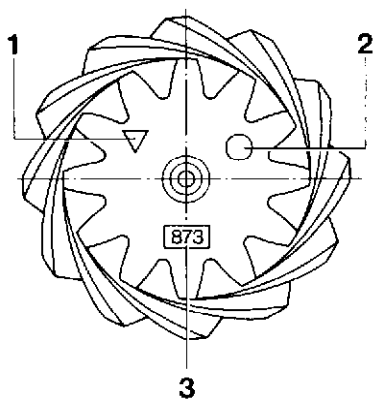
Location of Shims

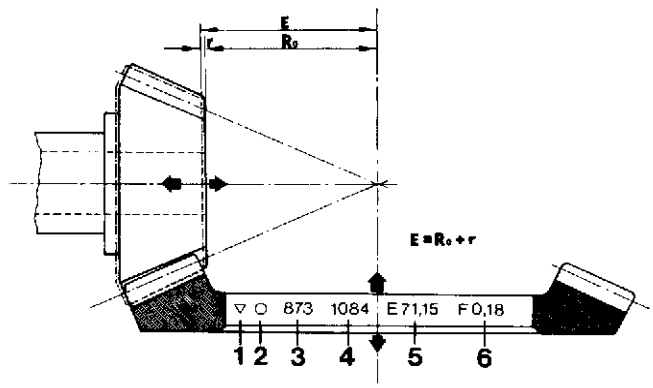
S_1 = Shim for ring gear
S_2 = Shim for ring gear
S_3 = Shim for ring gear
S_5 = Shim for pinion/ring gear

ADJUSTING DRIVE PINION AND RING GEAR

General

Careful adjustment of the pinion and ring gear is important to guarantee a long service life and quiet running for the final drive. This is why pinions and ring gears are matched during production and checked on special testing machines for the most favorable surface appearance and low noise levels in both directions of rotation. The position of quietest running is determined by moving the pinion in an axial direction, keeping the ring gear within specified backlash tolerances. The devitation "r" from the design distance "R_o" is measured, added to design distance "R_o" and inscribed on the ring gear as adjusting distance "E".





1 = Porsche trademark
2 = Manufacturing code
3 = Serial pair number from 001 to 999
4 = Manufacturing month and year, four digits (e.g. 1084)
5 = Adjusting distance E (e.g. E 71.15)
6 = Backlash F (e.g. F 0.18)
R_o = Design distance 70.70 mm
E = Adjusting distance (R_o + r)
r = Devitation from R_o

The drive pinion and ring gear only have to be adjusted when jobs on the final drive require the replacement of parts having direct influence on the adjustment. Refer to the following table to avoid unnecessary adjustments!

Adjust / Replaced Part	Ring Gear ($S_1 + S_2$)	Drive Pinion with Adjusting Distance "E" (S_3)
Transmission case	X	X
Side transmission cover	X	X
Bearing bracket with taper roller bearing for drive pinion	X	X
Drive pinion/ring gear	X	X
Differential case	X	
Taper roller bearing for differential	X	

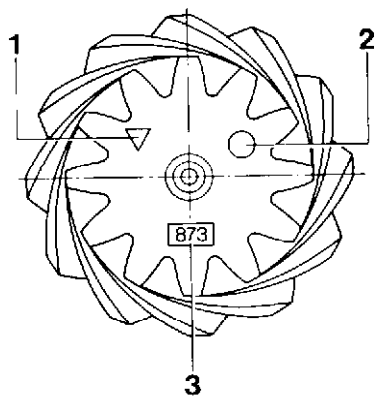
Note

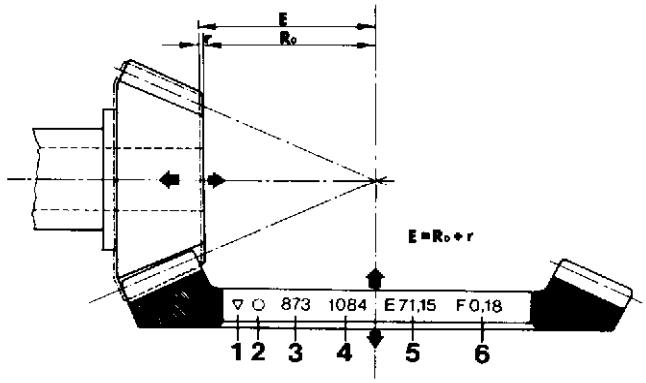
When changing shim thickness S_3 it will always be necessary to redetermine the thickness of shim S_5.

Adjusting Pinion

Note

There are different marks and codes for adjustment of the drive pinion/ring gear from 1985 models on.





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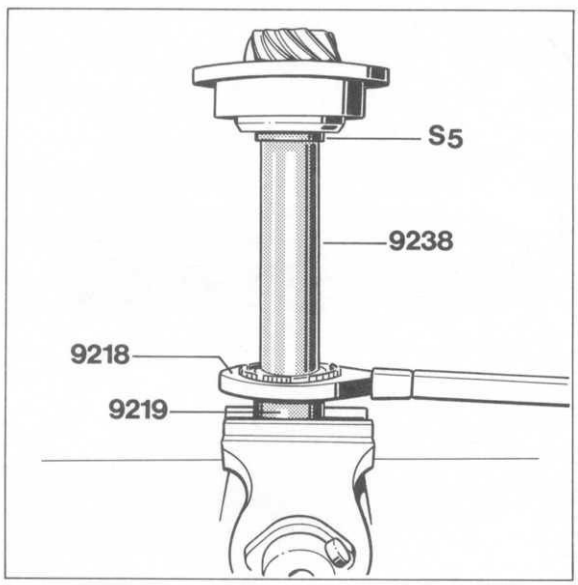
r = Deviation from R_o

With the new system (e.g. E 71.15) it is no longer necessary to look for the corresponding design distance R. E, the adjusting distance, can be applied direct on the master gage without calculations.

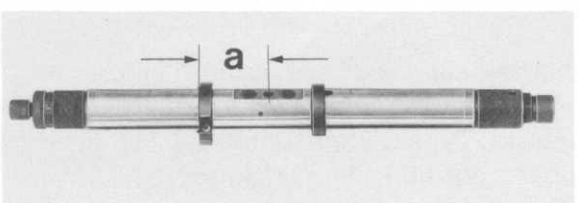
Note

In older model manual transmissions the complete drive pinion had been installed before adjusting the pinion in the case.
This is no longer possible from 1985 models on (Transm. Type G 28/10 and G 28/11), since shim thickness S_5 can only after determining the pinion position (shim thickness S_3).

1. Mount bearing assembly on drive pinion and preload with 20 kN (2 tons).
2. Slide Special Tool 9238 with shim "S_5" on drive pinion in place of gear set, install 4th and 5th gear guiding sleeve and tighten collar nut to torque of 300 Nm (217 ftb). Use Special Tools 9218 and 9219 for this operation.

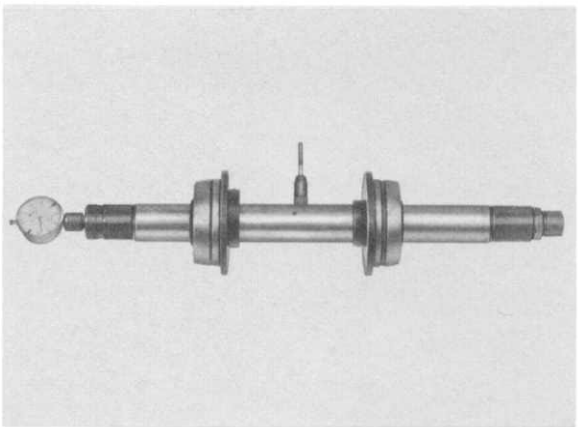


3. Install drive shaft.
4. Install drive pinion without shim S3 and tighten all bearing cap bolts to torque of 30 Nm (22 ftlb).
5. Install one side bearing cap without an O-Ring and bolt down with two hexagon head bolts.
6. Set adjusting ring of universal gage VW 385/1 to distance "a".

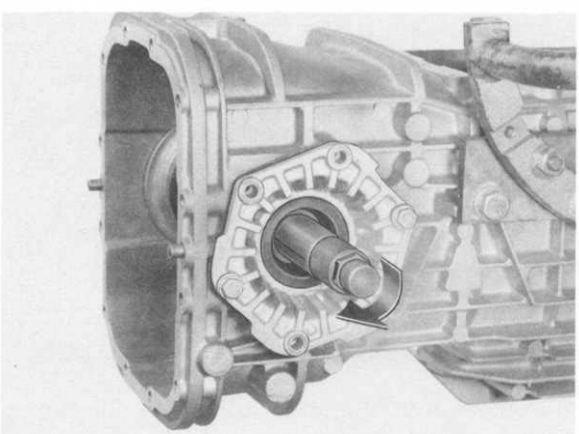


a = approx. 80 mm

7. Slide centering discs VW 385/4 on to universal gage and screw in gage plunger VW 385/14 with a 20 mm dial gage extension 9150.



8. Insert universal gage in case.
9. Install second side bearing cap without an O-ring and bolt down with two hexagon head bolts.
10. Pull out centering discs of universal gage with the spindle far enough, that the univer sal page can still be just turned by hand.



11. Set master gage VW 385/30 to adjusting distance E (e.g. 71.15 mm).

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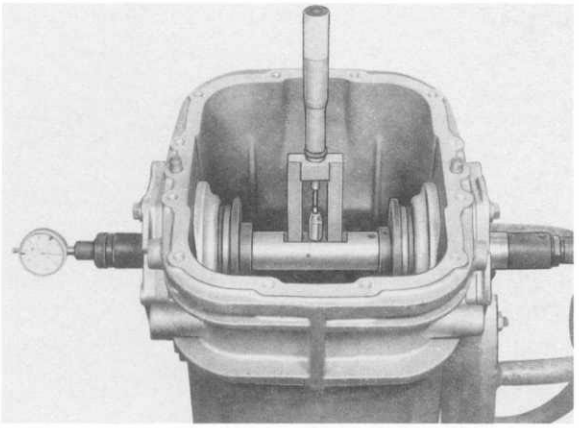
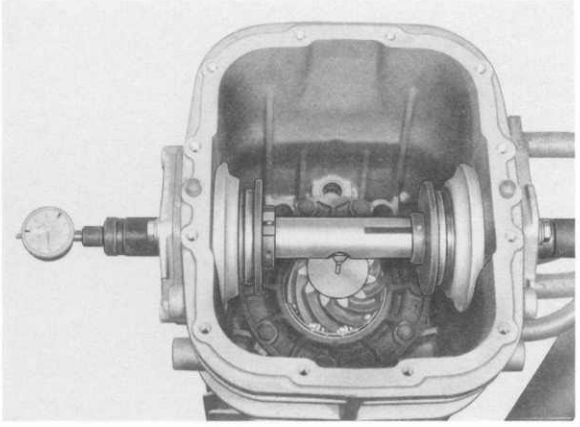
12. Apply master gage and set dial gage (3 mm range) to zero with 1 mm preload.



13. Place gage plate VW 385/17 on pinion head.

14. Turn universal gage carefully unitl dial gage extension is perpendicular to face of pinion head. At this moment the dial gage needle reaches its reversing motion point, at which the dial gage must be read.



Note

The measured value will always deviate from the set distance "E" in antilockwise direction (small needle of dial gage will be between 0 and 1), i.e. if the dial gage has a preload of 1 mm the value deviating from 1 must be added to shim thickness S3.

15. The determined amount of deviation is shim thickness S3 and this shim is installed between the bearing cap and transmission case. Round of this value to the nearest 0.05 mm (e.g. 0.22 mm rounded off to 0.25 mm).

16. Determine shim thickness S5 (see page 39 - 215).

17. Recheck adjusting distance "E" after installing the shims of determined thickness. A deviation of ± 0.03 mm is acceptable.

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ADJUSTING RING GEAR (Stotal)

Note

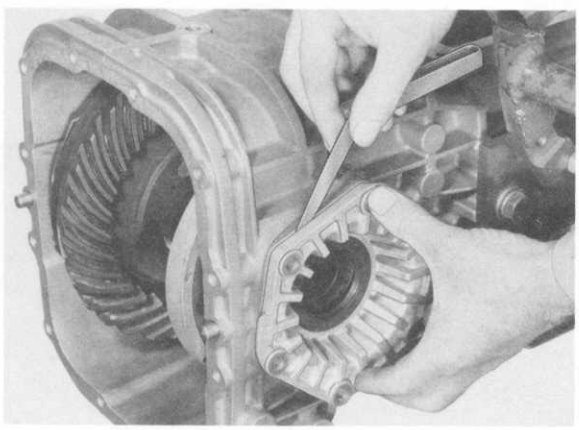
The drive pinion must not be installed for this adjustment.

1. Install differential with ring gear in case.

2. Install side transmission cover (ring gear end) without shims and tighten all bolts to torque of 22 Nm (16 ftlb).

3. Guide in second side transmission cover without shims carefully.

4. Check gap between transmission case and side transmission cover with a feeler gage.



5. Calculate total shim thickness "Stot".

Stot = Gap - 0.03 mm (bearing preload)

Example:

Gap		1.25 mm
Bearing preload	-	0.30 mm
Stot		0.95 mm

ADJUSTING BACKLASH

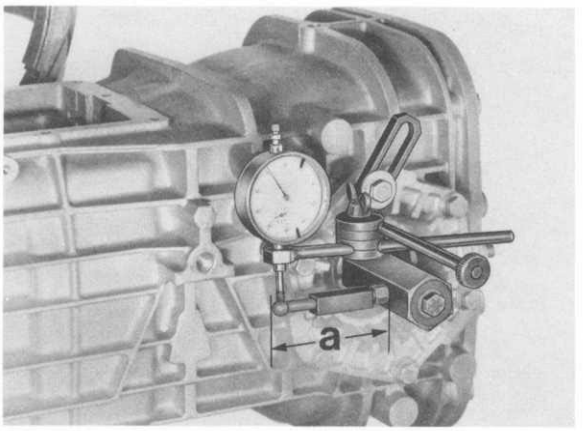
1. Install drive pinion with shims S_3 determined for drive pinion adjustment and tighten all bearing cap bolts to torque of 30 Nm (22 ftlb).

2. Place differential in case.

3. Install side transmission covers, placing determined shim "Stot" on ring gear end and tightening all bolts to torque of 22 Nm (16 ftlb).

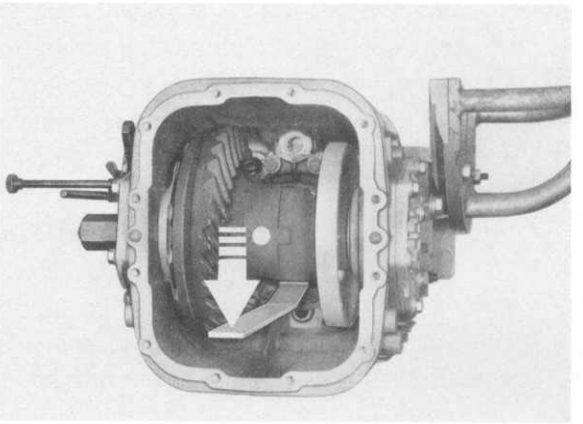
4. Turn differential in both directions several times to settle taper roller bearings.

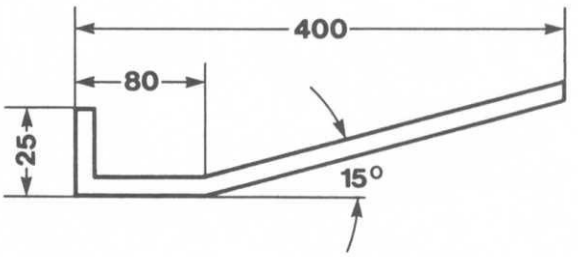
5. Install gages, setting gage plunger VW 388 to distance "a" = 80 mm.



6. Turn ring gear carefully to stop by hand and set dial gage to zero.

7. Hold drive pinion with locally manufactured hooks and turn back rings gear carefully. Read and note amount of backlash.





Hooks manufactured locally of 30 x 5 mm flat steel.

DETERMINING THICKNESS OF SHIMS S_1 AND S_2

The measured backlash must be brought to the value specified by the drive pinion/ring gear manufacturer by way of dividing "Stot".

The specified backlash is inscribed on the ring gear. Deviations of up to - 0.05 mm are acceptable. The specified backlash must never be exceeded.

Determining Shim Thickness S_1 (Ring Gear End)

S_1 = Stot (total shim thickness)
- measured backlash
+ specified backlash (inscribed on ring gear)

Example:

Stot	0.95 mm
- measured backlash	0.88 mm
	0.07 mm
+ specified backlash (e.g. 0.20 mm)	0.20 mm
S_1	0.27 mm

Determining Shim Thickness S_2 (Opposite Ring Gear)

S_2 = Stot - S_1

Example:

Stot	0.95 mm
S_1	- 0.27 mm
S_2	0.68 mm

Note

Experience with these drive pinions/ring gears has shown that shims S_2 (opposite ring gear) can be selected approx. 10 to 15 % thinner in favour of shims S_1 (ring gear end).

1. Remove side transmission covers and divide shims "Stot" to give the shim thickness determined for S_1 and S_2.

Note

Make sure of a certain amount of backlash when tightening nuts for the side transmission covers. The drive pinion and and ring gear must never be brought to seize.

2. Check backlash and, if necessary, change shims S_1 and S_2 again until specified backlash is reached.

3. Check backlash on periphery four times by turning ring gear 90^{o} each time. The four measurements must not deviate from each other by more than 0.05 mm.