I. Technical Data

Reductions						
1st speed	2nd speed	3rd speed	4th speed	5th speed	rev. speed	speedometer
6,34	3,60	2,14	1,41	1,0	5,82	2,25

Installation: flanged to engine

Operation: optionally 2nd to 5th speed synchromesh, 1st and reverse gear with claw shift
or 1st to 5th speed synchromesh, reverse speed with claw shift

Actuation: by central floor shift or rotary selector shaft

Pto: the transmission can be optionally provided with the ZF pto N 243/4
Direction of rotation of output end = opposite to input
Output speed = 0.92 × engine speed
Actuation manually or pneumatically

Weight (without pto): approx. 99 lbs.

Oil capacity: approx. 1.8 lits. (slightly more for pto version)

Oil type: mild EP gear oil types of viscosity class SAE 80 (refer to Maintenance, page 5)

Oil changes: 1st change after 1,500 miles or 60 hours of operation
2nd change after 6,000 miles
3rd and subsequent changes, every 36,000 miles

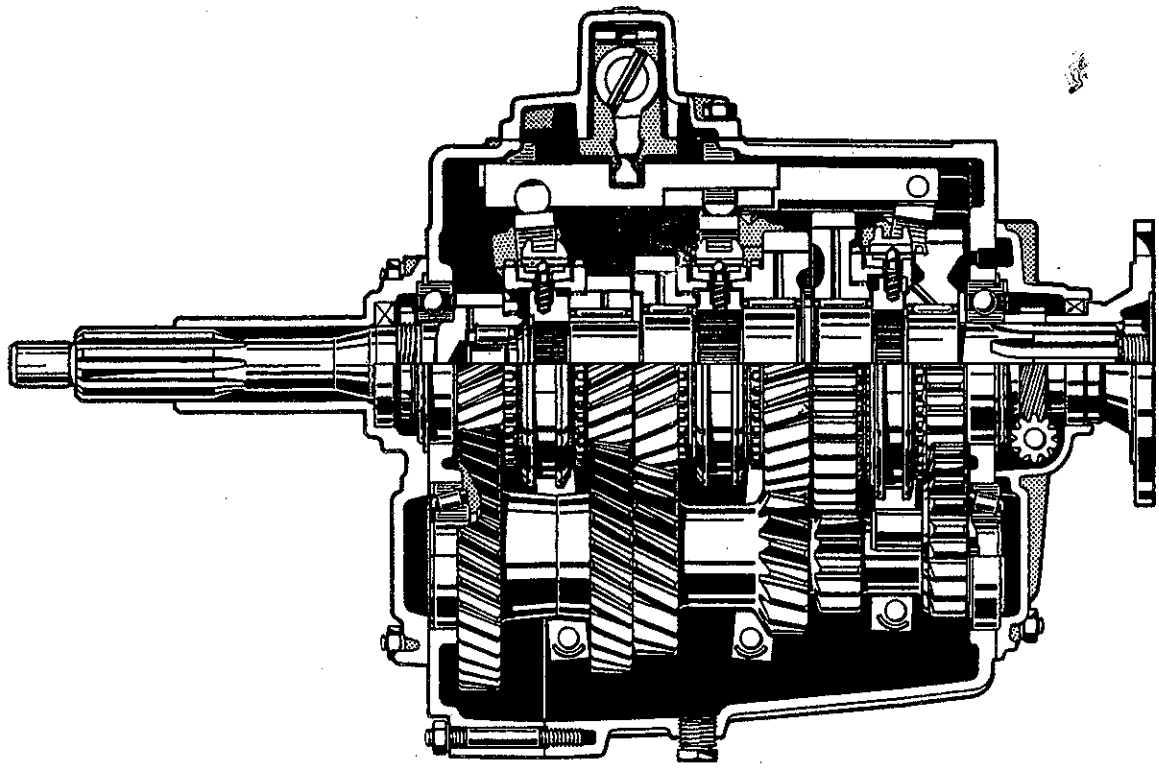
II. Description

Design and Operation

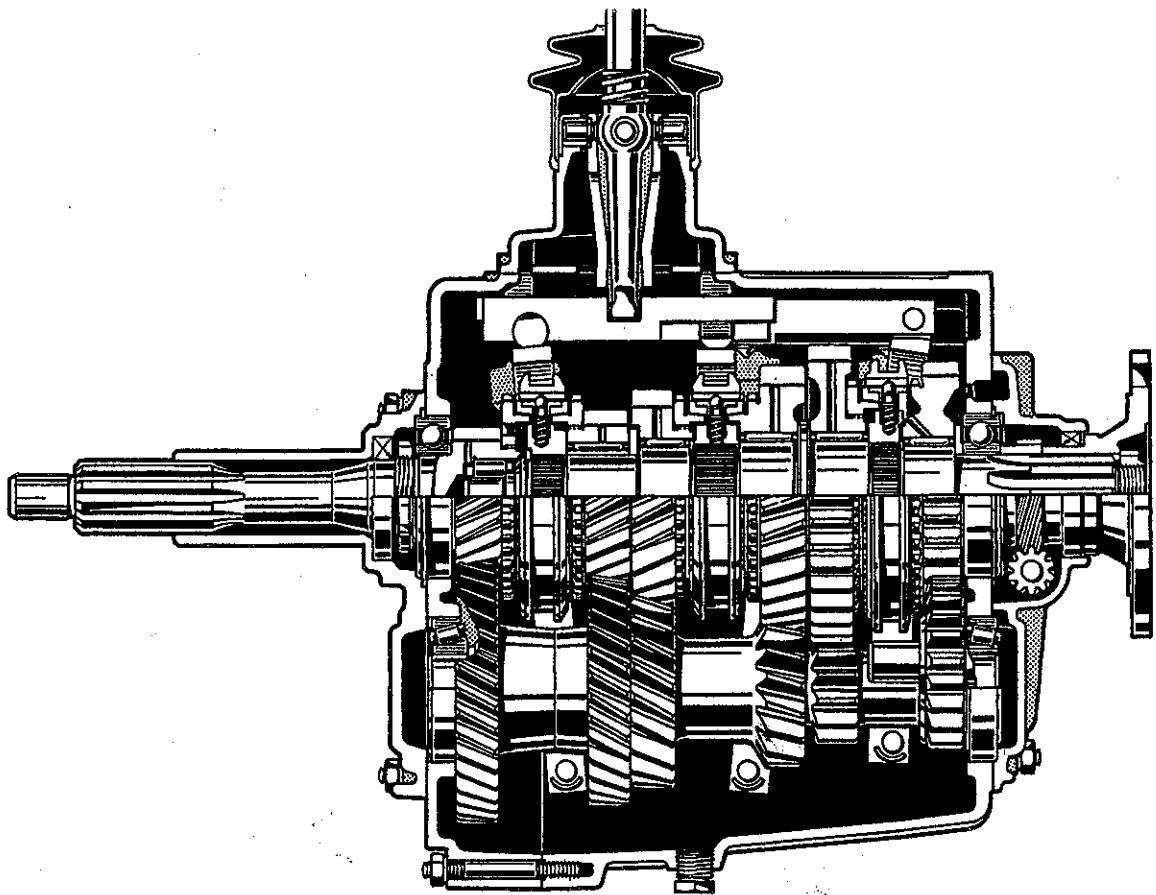
The ZF Synchroma five-speed transmission S 5-24/3 is installed in passenger cars and light commercial vehicles. All forward speeds are fully synchronized. The transmission is flanged directly to the engine and is actuated by means of a set back or a central floor shift or by a rotary selector shaft, depending on type of vehicle. The design of the transmission and the use of shift control rods for transmitting the shifting forces guarantee easy and accurate shifting of the transmission in all situations.

The transmission is a countershaft (layshaft) type. The mating gears of all the speeds are constantly in mesh, the wheels on the countershaft are permanently attached to shaft, while the counterwheels are freely rotating on needle bearings of main shaft. During the shifting operation, the speeds of the members to be coupled are synchronized by ZF-B-synchronizers. The idler gear of the pertinent speed is coupled to the main shaft by means of the toothed shifting sleeve of the synchromesh assembly and the power flow is guided via the pertinent gears to the output end. At direct speed (ratio 1.0) the countershaft is not included in the power flow, that is, the input shaft and the main shaft are coupled directly to each other. The direction of the output speed of the claw-shift reverse gear is changed by a built-in intermediate gear (so-called reverse gear).

The shifting sleeves are operated by shift forks, which are actuated by shift rods. The shift forks are guided on bearing pins and are held in the engaged position or in the idling position by spring detents. A built-in shift lock guarantees that only one speed can be engaged at a time.



with rotary selector shaft



with central floor shift

Pto

The transmission version for light commercial vehicles can be optionally provided with the ZF pto N 243/4. Seen in driving direction, the pto is attached to the righthand end of the transmission and is driven by the countershaft of the transmission via an intermediate gear. It is engaged and disengaged by a sliding gear. The direction of rotation of the pto output is opposite to the direction of rotation of the engine. Actuation is manually by means of an additional hand lever, or pneumatically by means of a single-acting compressed-air cylinder, which is charged with compressed air for engagement and bled for disengagement; a built-in compression spring serves to disengage pto.

The pto N 243/4 is preferably suited for operating tipper pumps. Output speed is 0.92 × engine speed.

Description of ZF-B-Synchronizer Assembly

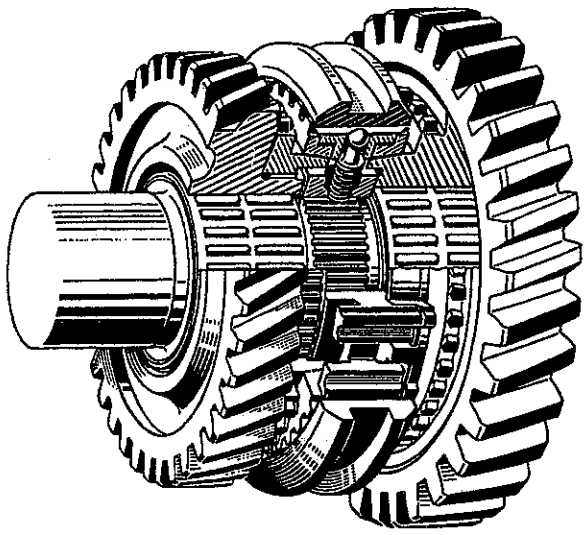


Fig. 1

Design

The following components are assembled between the gear wheels of 1st and reverse speed, of 2nd and 3rd speed, as well as 4th and 5th speed:

1. The synchronizer (A).
   Axially and radially immovable in relation to main shaft (B) on which it is located.

2. Compression springs (C) and ball pin (K).
   Both members are installed in synchronizer.

3. Thrust piece (D),
   with ball pin (K) guided in its bore.

4. Blocking rings (synchronizer rings) (F),
   which are placed loosely between gear wheel (G) and synchronizer.

These components permit establishing uniform angular speeds between the gear wheel to be coupled and the shaft, before the sliding sleeve (H) and its internal teeth enter the clutch teeth of the (pertinent) gear wheel.

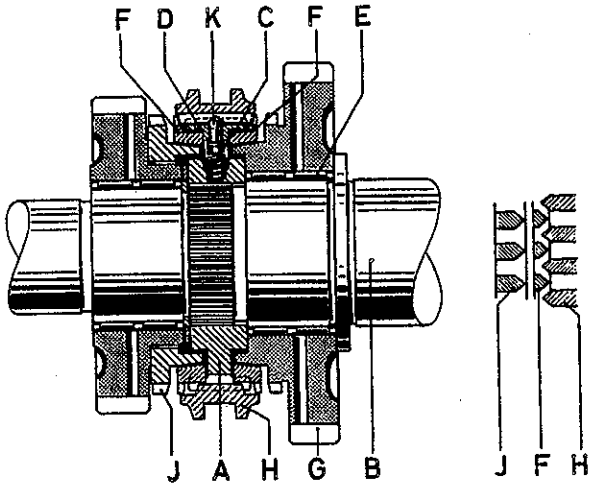


Fig. 2

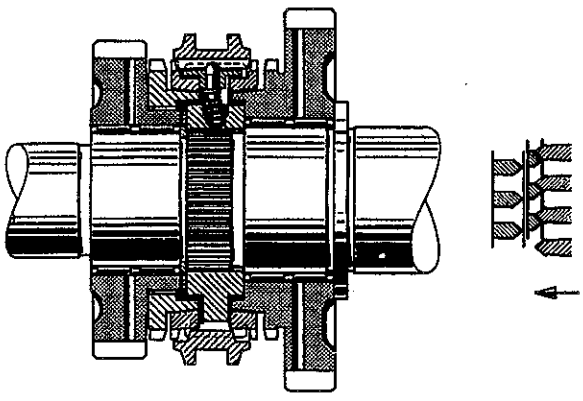


Fig. 3

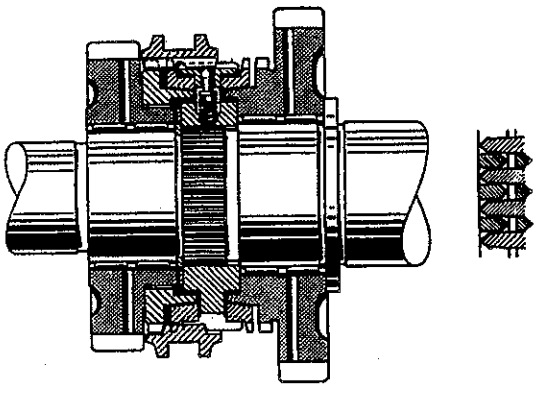


Fig. 4

Operation of Synchronizer Assembly

1. Idling (Fig. 1 and 2).
   Sliding sleeve (H) is in center position; it is held in this position by a shift fork which is located by a detent bolt. Gear wheels (G) are rotating freely on main shaft.

2. Shifting operation (Fig. 3 and 4).
   The shifting sleeve (H) is axially pushed forward in one direction (in the example shown to the left). The sliding sleeve will take the ball pins (K) and thrust pieces (D) along, since the ball pins are pushed by the preloaded synchronizer springs (C) and their upper ends into the V-shaped annular groove of the sliding sleeve. Thrust pieces (D) are in connection with the lefthand and right-hand blocking ring (synchronizer ring) (F). When the sliding sleeve is moving to the left, the lefthand blocking ring is also moved to the left by the thrust pieces. After approx. 0.5 mm the blocking ring and its conical surface are abutting against the surface of clutch body (J), which is also of conical design. This will rotate the blocking ring by approx. 2 mm in relation to the sliding sleeve and the synchronizer (A) until the blocking ring and its lugs are resting in the slots of the synchronizer. The position of the blocking ring in relation to the sliding sleeve is therefore such that the teeth on the OD of the ring are offset in relation to the tooth gaps of the sliding sleeve (Fig. 3). When the sleeve is moving on, its teeth will rest against those of the blocking ring and submit an axial force against the ring. The flat abutting angle on the sliding surface of the clutch body (J) and the blocking ring will establish forces in radial direction which are stronger than the forces transmitted to the sliding sleeve in axial direction. This will reduce the difference in speed between the gear wheel to be coupled and the main shaft (as well as the sliding sleeve). Only when the two speeds are synchronized, the blocking ring and the gear wheel are turned back slightly (approx. 1 to 2 mm) until the teeth of the sliding sleeve are in line with the tooth gaps of the blocking ring. At this moment the resistance will be overcome which has prevented any additional movements of the the sliding sleeve during the shifting operation and the sleeve is now pushed into the coupling teeth of the pertinent gear wheel (Fig. 4). This is the end of the shifting cycle.

A) Synchronizer

B) Main shaft

C) Synchronizing springs

D) Thrust piece

E) Needle bearing

F) Blocking ring
(synchronizing ring)

G) Gear wheel

H) Sliding sleeve

J) Clutch body

K) Ball pin

III. Handling

Economic driving of a vehicle requires the engine to run constantly at its most favorable speed range. On most engines, this speed range is restricted, but a five-speed transmission permits easy adaptation of the engine to the changing driving conditions.

Since the forward speeds of type S 5-24/3 are fully synchronized, speeds can be shifted fast, reliably and noiselessly without shifting in sequence (double clutching) when shifting up and without revving up when shifting down. 1st speed may be an exception, since it is optionally provided with a claw shift.

Due to the design of the ZF-B-synchromesh assembly, gears can be shifted only when full synchronization is attained. But it is important to keep pushing the shift lever during the shifting until the pertinent speed is engaged.

To protect synchonizer components in the transmission, in the main clutch and the engine, shifting down should be effected only, when the driving speed corresponds to the max. speed of the next-lower gear speed.

The reverse gear may be engaged only with the vehicle stopped, since otherwise the shifting claws may be damaged.

The clutch pedal should always be depressed both when shifting forward speeds and reverse. **Perfect condition of the main clutch contributes considerably to the prevention of shifting trouble.**
The clutch should engage and disengage completely. The specified pedal lash should therefore be checked regularly.

The pto (actuated manually or pneumatically) can be operated with the vehicle stopped or driven, but the pto may be engaged on principle only when the vehicle is stopped, that is, disengage main clutch and wait for approx. 6 seconds (until countershaft stops). Also throw out main clutch when disengaging pto.

IV. Maintenance and Lubrication

Oil Grade

Add oil prior to operating transmission. Use mild EP gear oil types of viscosity class SAE 80 only.

Mild gear oil types are EP oil grades which will cause no corrosion on steel and non-ferrous metal parts and no embrittlement of gaskets and seals in the presence of condensate water. They should always meet our „Lube Oil Requirements for ZF- Transmissions No. 13-118".

Consequently, EP gear oil grades SAE 80 acc. to Spec. MIL-L-2105 (A) must be used for synchronized and nonsynchronized transmissions. When in doubt, ask oil company or ask one of our service departments for the „ZF List of Lubricants for ZF Synchronized Transmissions".

Oil Supply and Filling Up

The oil for the wheels and bearings of transmissions is supplied by splash lubrication. For a full charge, oil is added at the oil filler neck, which serves simultaneously for measuring overflow, until oil is flowing over. Seen in driving direction, the oil filler neck is at hte left of the transmission. The required oil quantity is approx. 2.4 lits.

Slightly more oil is required for the version with pto. Here too, the oil is filled in up to overflow.

Oil Level Inspection

The oil level in the transmission should be checked regularly. The level should never be more than 10 mm below rim of overflow hole, since too low an oil level will be a particular risk when driving on mountain roads. Too much oil is also detrimental and excessive splashing will lead to overheating of transmission.

The oil level should be checked only with the vehicle in horizontal position and should not be checked immediately after driving the vehicle, but some time later when the oil has become quiet and somewhat colled down to prevent any faulty measurements due the expansion of the warm oil.

Add oil up to overflow if checkup shows that the oil level is too low.

Oil-Change Periods

For new or repaired

a) for passenger car
1st change after 5

b) for trucks and veh
1st change after 5,

ıch 100,000 km

ıax., yet at least once a year

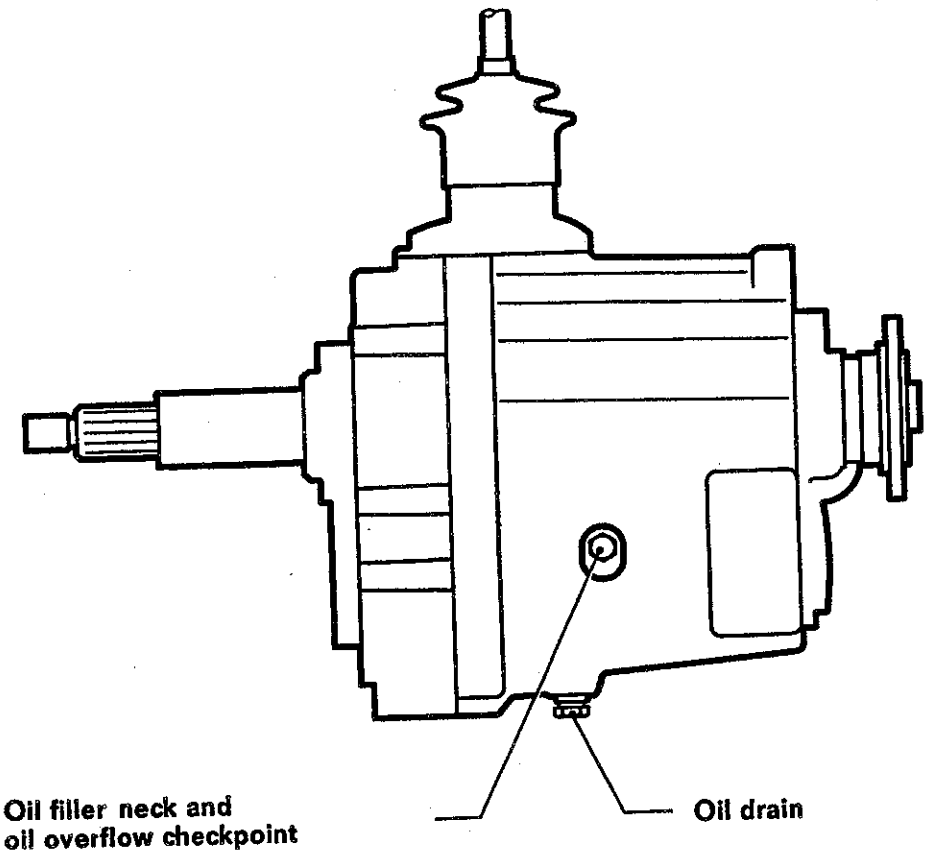
c) for vehicles with s
oil change prior to putting vehicle into service and again after taking it out of service at the end of a season.

Refer to Technical Data on page 2

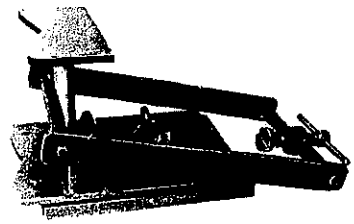
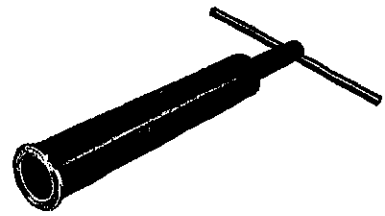
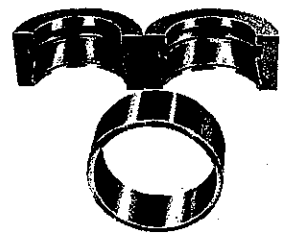
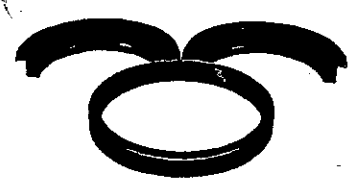
Draining the Oil

Prior to draining the used oil, the vehicle must be operated for a short period so that any condensate water can be absorbed by the oil. The oil is drained at operating temperature.

The oil drain plug is at the bottom of the transmission. Prior to screwing drain plug back, clean magnet from adhering abrasives.



V. Tools

		Tool No.
Tool .1. Assembly stand		1249 898 651
Tool .2. Socket wrench for loosening and tightening slot nut (435) on main shaft		1211 898 151
Tool .3. Puller for reverse bolt (502)		1211 898 206
Tool .4. Universal puller		1248 898 201
Tool .5. Insert for pulling tapered ball bearings (204 and 430) on input shaft and main shaft		1249 898 201
Tool .6. Socket wrench for loosening and tightening slot nut (201) on input shaft		1249 898 151
Tool .7. Insert for pulling roller bearings (302) on countershaft		1248 898 209
Tool .8. Device for pulling 3rd and 4th gear wheel from main shaft		1249 898 202

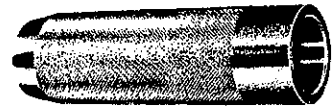
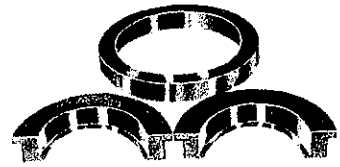
SPECIAL TOOLS

TOOLS FOR GEARBOX TYPE Z.F. S 5-24/3

Page/ Tool n°	Z.F. Reference	Names	R.V.I. Reference	Repere D.P.R. R.V.I.	Fig. n°	Comments
8.1	1249 898 651	Stand, replaced by assembly : — support — frame	1076 0001	50 00 261 076 50 00 260 001	3	
8.2	1211 898 151	Pin-wrench	5004	50 00 265 004	2	see text H.5, page 21
8.3	1211 898 206	Extractor, replaced by assembly : — extractor — connection	6043 2038	50 00 266 043 50 00 262 038	6	used with 2038
8.4	1248 898 201	Extractor	0010	50 00 260 010	5 - 9 and 14	see text, page 20
8.5	1249 808 201	Shells and rings	2041	50 00 262 041	5 and 9	used with 0010 Extract rear bearing the tachometric screw
8.6	1249 898 151	Pin-wrench	9185	50 00 269 185	8	
8.8		Shells and rings	9188	50 00 269 188	15	used with press or extractor n° 0005

TOOLS FOR GEARBOX TYPE Z.F. S 5-24/3

Page/ Tool n°	Z.F. Reference	Names	R.V.I. Reference	Repere D.P.R. R.V.I.	Fig. n°	Comments
9.9	1249 898 051	Bush, replaced by tube of Ø 42,2 x Ø 47,5 length 150 mm	—	—	30 and 35	see text H.1 and H.2, page 20
9.10	1249 898 004	Bush, replaced by tube of Ø 52,6 x Ø 60 length 160 mm	—	—	—	see text B.12, page 16
9.11	1249 898 301	Adjustment plate	9189	50 00 269 189	44	
9.12	1249 898 203	Shells and rings	9190	50 00 269 190	—	used with a press

		Tool No.
Tool .9. Bushing for pressing inner races of tapered ball bearing (430) and inner race (411) on main shaft		1249 898 051
Tool .10. Bushing for installing synchronizing assembly (407 and 416)		1249 898 004
Tool .11. Plate for adjusting tapered roller bearing (301) on countershaft		1249 898 301
Tool .12. Device for pulling tapered ball bearing inner race from input shaft		1249 898 203
Tool .13. Mandrel for installing ball bearing (3) into housing of external drive		1249 898 053

VI. Disassembly of Transmission

Note: Numerals in brackets, for example (626), refer to part numbers in exploded view at end of instructions.

A) Disassembly of Transmission

1. Clamp transmission to assembly stand .1.

2. Remove gear shift.

2.1 **Floor Shift**

Remove bellows. Loosen cap and holding ring. Pull shift lever completely out of shift head (626) (Fig. 1). Loosen nuts (102) and remove shift head. Remove washer (617).

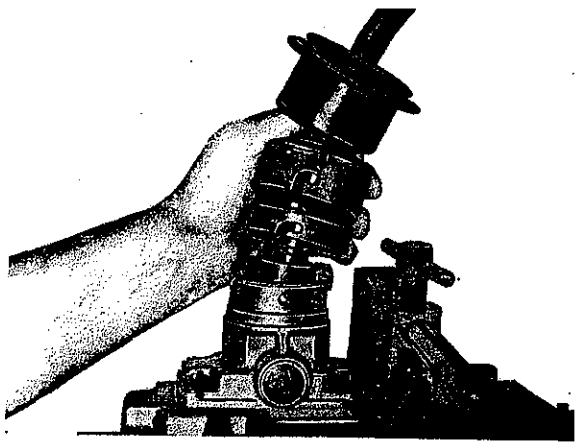


Fig. 1

2.2 **Rotary Selector Shaft**

Loosen nuts (102) and lift off shift housing (621). Push out plug (618). Knock set pins (619 and 620) out of shaft (631) and shift finger (623). Remove cover (609). Remove snap rings (610 and 611). Pull gear shifting shaft out of housing.

3. Loosen nuts (10). Unflange external drive.

4. Remove tachometer cover.

4.1 Engage two speeds. Loosen slot nut (434) with slot nut wrench .2. (Fig. 2) and pull drive flange from shaft.

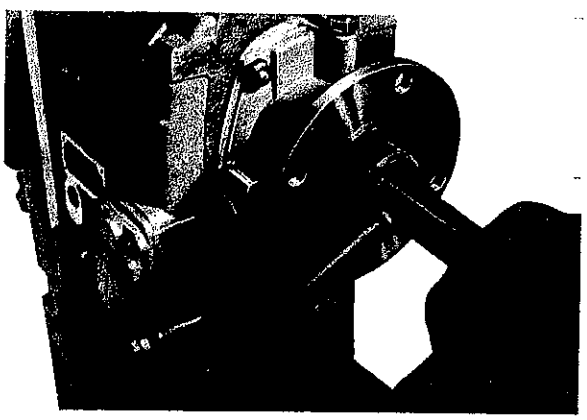


Fig. 2

4.2 Unscrew nuts (102) (Fig. 3) and screw (507). Remove tachometer cover. Push shaft sealing ring (804) out of cover.

4.3 Remove tachometer worm (432). Remove circlip (431) from groove of ball bearing (Fig. 4). Pull off ball bearing (430) with special tools .4. and .5. (Fig. 5).

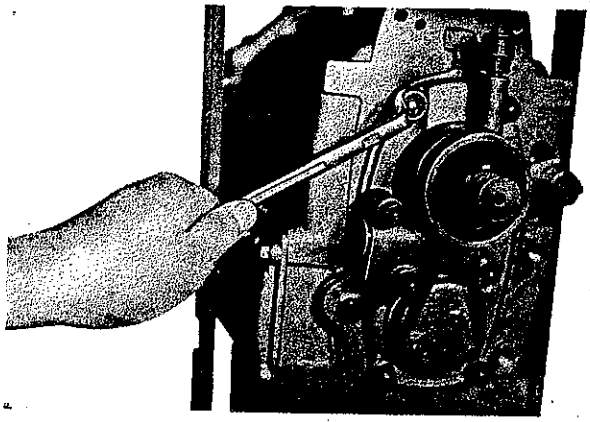


Fig. 3

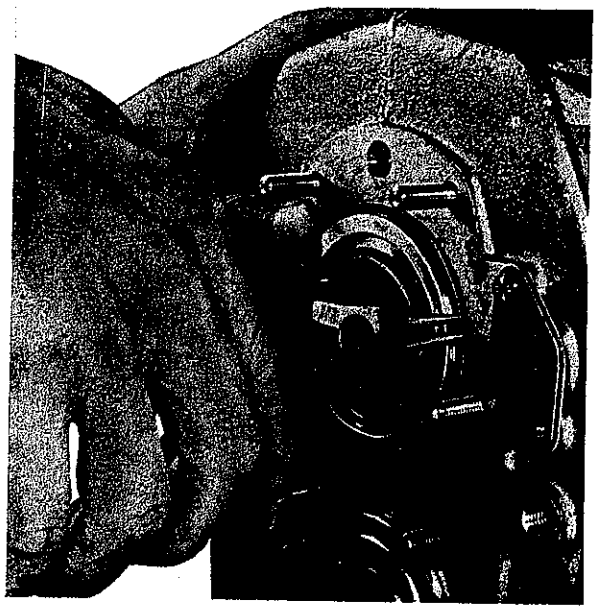


Fig. 4

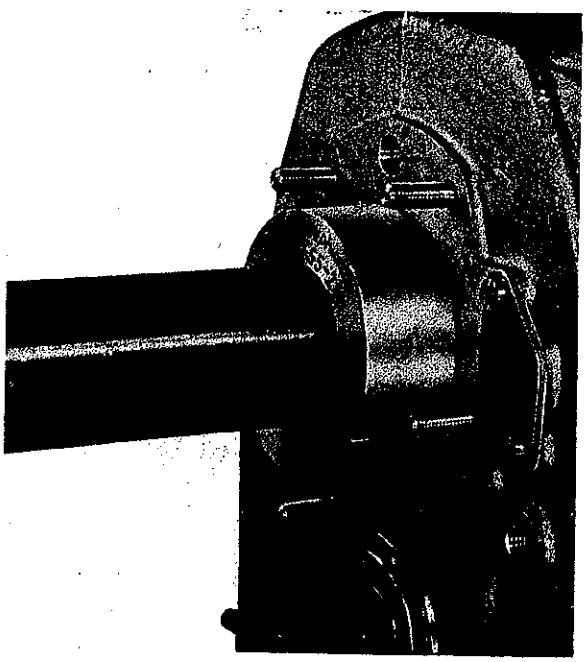


Fig. 5

5. Remove reverse gear assembly.

5.1 Loosen nuts (102) on cover (127) and then remove cover. Pull out reversing shaft (502) with puller .3. (Fig. 6).

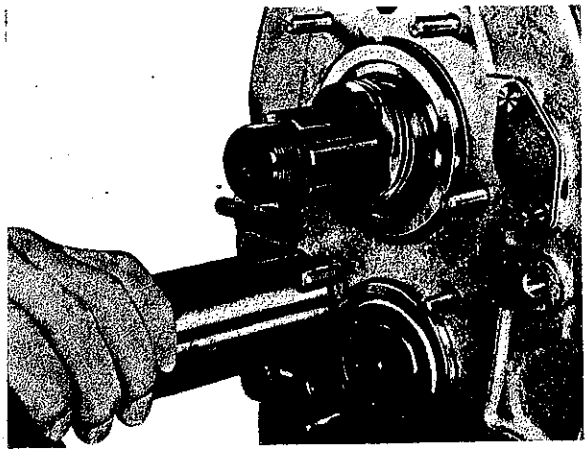


Fig. 6

5.2 Remove reversing gear (505) with the two thrust washers (501 and 504) and needle cage (503) from housing.

6. Remove throwout bearing flange.

6.1 Unscrew nuts (102) and remove throwout bearing flange (201) (Fig. 7). Push shaft sealing ring (203) out of flange.

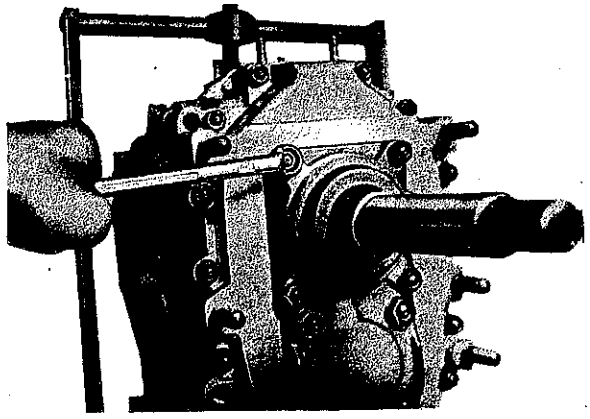


Fig. 7

6.2 Loosen slot nut (204) on input shaft with slot nut wrench .6. (Fig. 8). Caution, lefthand threads!

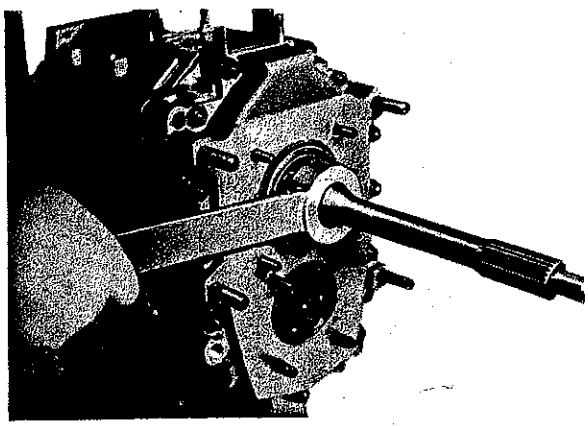


Fig. 8

6.3 Snap circlip (206) out of ball bearing groove and pull out tapered ball bearing (207) with puller .4. and .5. (Fig. 9).

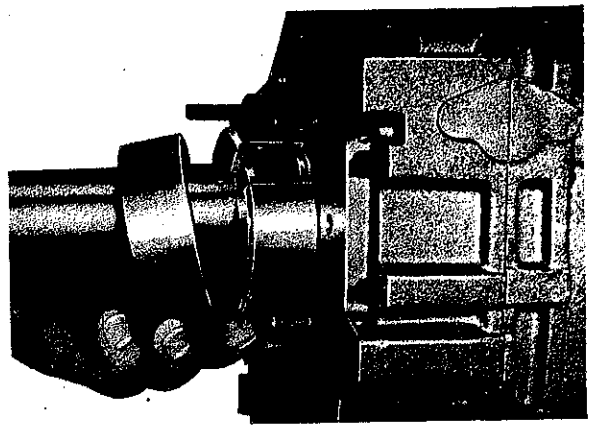


Fig. 9

7. Remove housing front end.

7.1 Knock-out two set pins (116) (Fig 10).

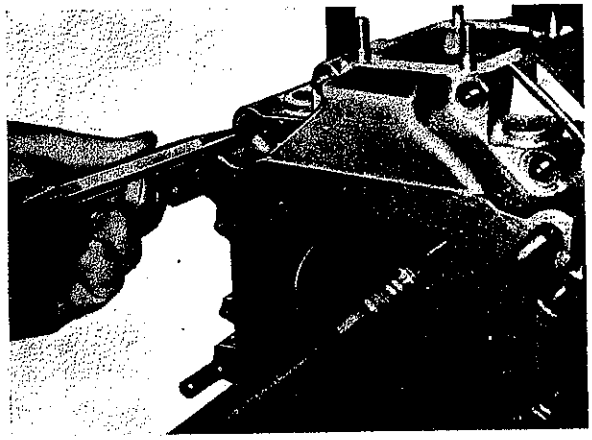


Fig. 10

7.2 Loosen nuts (102) on housing front end (101) and lift off housing front end (Fig. 11).

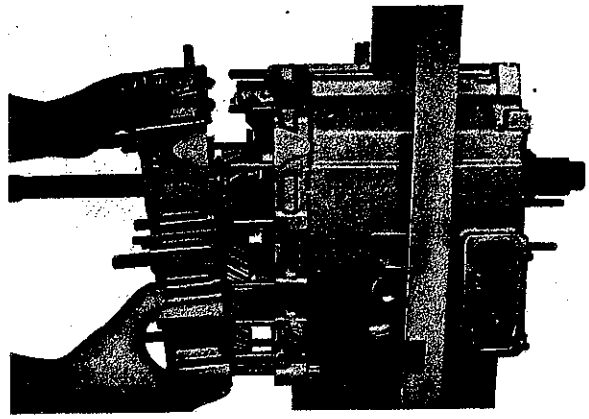


Fig. 11

8. Remove inner shift components.

8.1 Unscrew hex. screws (633) (Fig. 12) and pull joint pin (605 and 615) out of housing. It will be of advantage to tilt transmission with assembly stand .1: so that the input shaft pointing upwards and the shift forks are slightly guided to prevent canting.

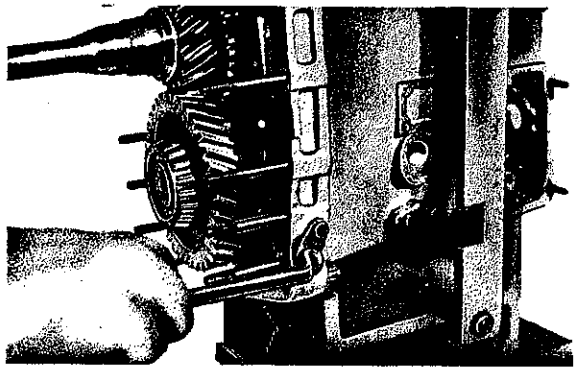


Fig. 12

8.2 Remove shift rods (601 and 602) from shift forks (604, 606 and 607). Remove shift rods.

9. Pull transmission shafts with shift forks completely out of housing (Fig. 13). For this purpose, swing transmission back into horizontal position.
Remove drive shaft (208), cam cage (401) and blocking ring (402) from main shaft.

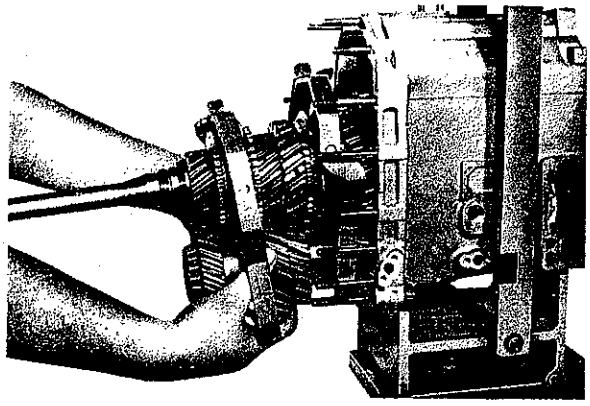


Fig. 13

B) Disassembly of Countershaft

Pull-off roller bearing (302) with tools .4. and .7. (Fig. 14). Remove retaining ring (303). The constant gear wheel (304) and the 5th speed gear wheel (305) can be forced from countershaft only by means of a 20-ton press; wheels are shrunk-fit.

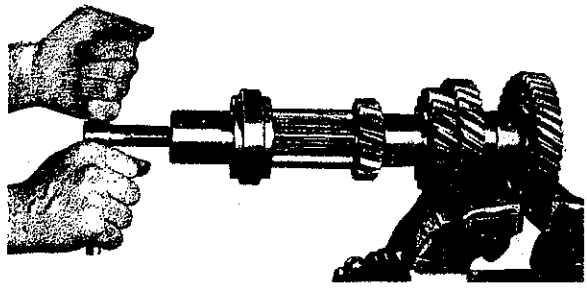


Fig. 14

C) Disassembly of Main Shaft

1. Clamp main shaft between soft jaws into vise (output end down). Remove circlip (403). Pull sliding sleeve (408) from synchronizer (407). Make sure that none of the three compression springs (406), the ball pin (405) and thrust pieces (404) are lost.

2. Position puller .8. against 3rd gear wheel (413) (Fig. 15). Now, a conventional puller can be used to pull off the 3rd, 4th or 5th gear wheel, as well as the synchronizer. Remove needle cage (414).

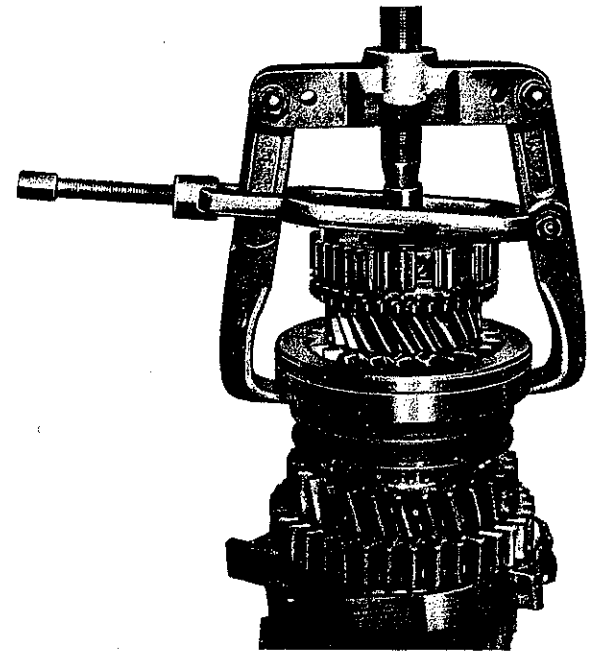


Fig. 15

3. Remove circlip (415) (Fig. 16). Pull sliding sleeve (408) from synchronizer assembly (416). Watch out for compression springs (406), ball pins (405) and thrust pieces (404). Unclamp main shaft, turn by 180° and clamp at cylindrical splining.

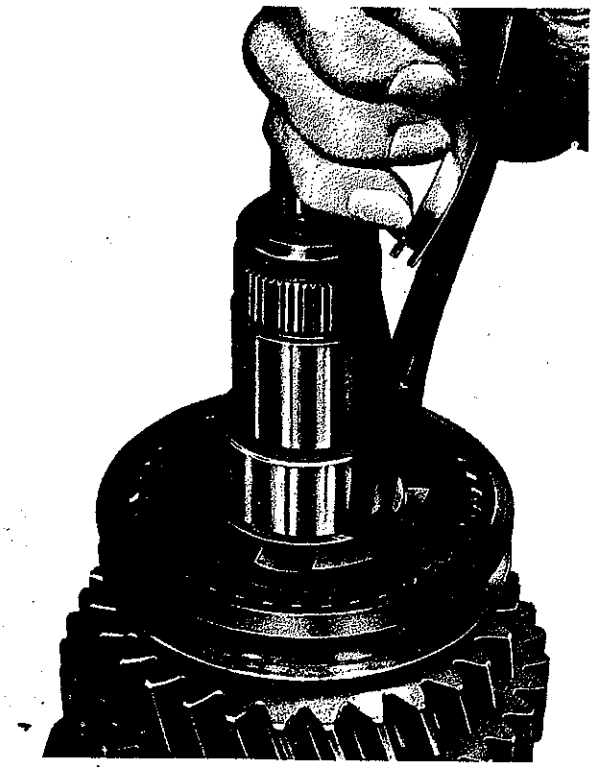


Fig. 16

4. Remove gear wheel reverse speed (428) with a 2-arm puller (Fig. 17). Remove needle cage (414). Pull-off slinding sleeve (427). Remove compression springs (406), ball pins (423) and thrust pieces (422) from synchronizer assembly (424).

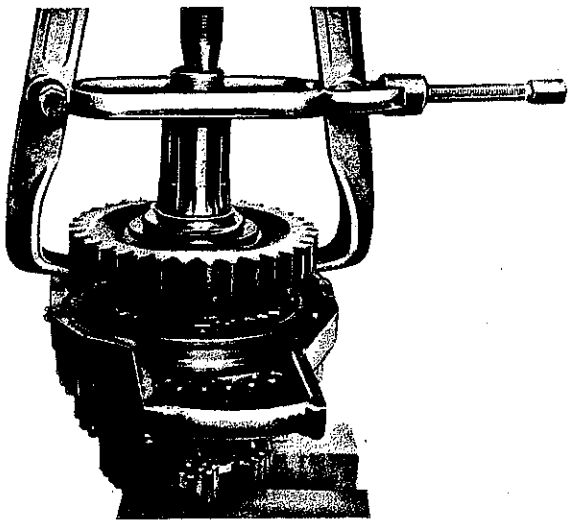


Fig. 17

5. Remove circlip (415) (Fig. 18). Remove 1st gear wheel (420) with synchronizer (424) under a press. Remove needle cage (418). Turn main shaft by 180° and remove second gear wheel (417) with synchronizer (416) on press.

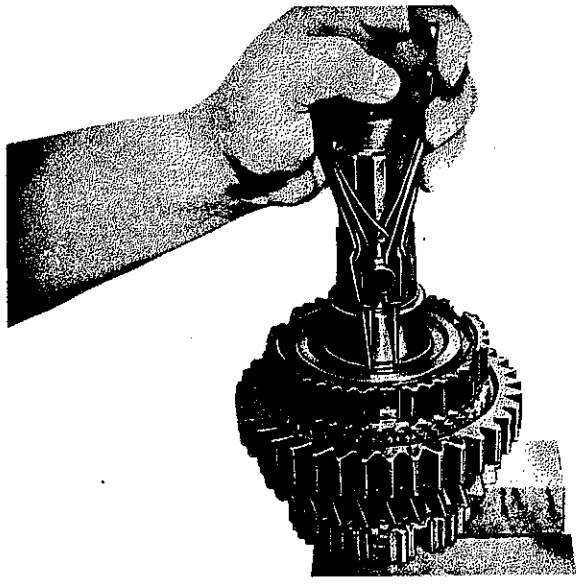


Fig. 18

Remove all seals and gaskets, as well as shaft sealing rings (203, 804, 628, 629, 630), seals and O-rings from housing halves, tachometer cover, guide flange and shift housing (621).

D) Disassembly of External Drive

1. Remove output flange.
   Clamp external drive with double gear between soft jaws into a vise and engage slide gear (4). Unscrew hex. screw (31) (Fig. 19) and pull output flange (27) from shaft. Push washer (29) out of output flange.

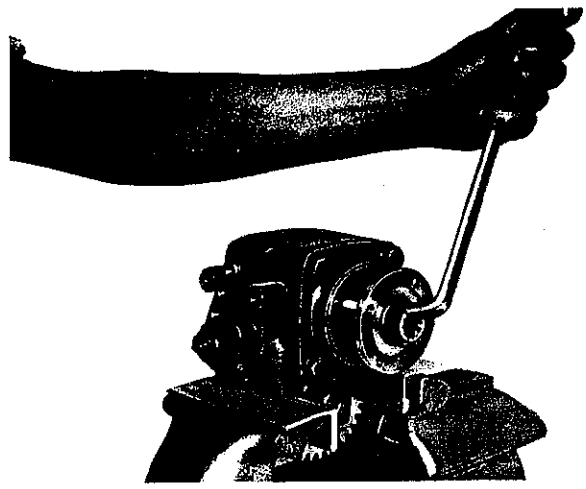


Fig. 19

2. Remove double gear.
   Press-out bolt (37) in direction of transmission output end (push against closed end of bolt) and remove double gear (35) with roller bearing (34) and washer (36) (Fig. 20).

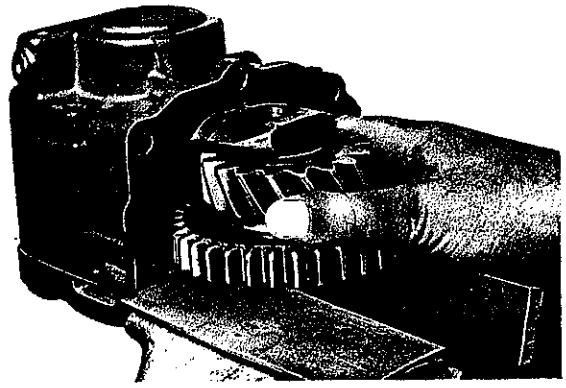


Fig. 20

3. Remove output shaft.

3.1 Unscrew hex. screws (33) on cover (25).

3.2 Knock output shaft into housing with a soft hammer (plastics or lead) until closing cover (1) can be removed. Also remove cover (25); remove ball bearing (22) and shaft sealing ring (26).

3.3 Knock output shaft back until ball bearing (3) comes out of bearing seat. Remove circlip (2). Push slide gear (4) out of ball bearing and then pull output shaft out of housing (Fig. 21).

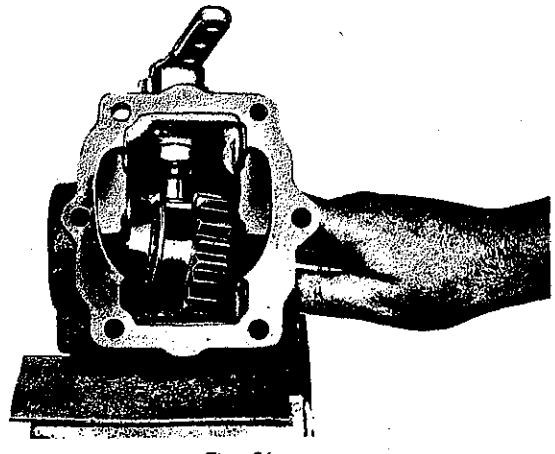


Fig. 21

3.4 Press slide gear and ball bearing from output shaft. Watch out for the two balls (5) and compression spring (6).

4. Remove shift lever.

Mark position of shift lever. Loosen hex. nut (10) and remove shift lever (16). Pull inner shift lever (20) from bore. Push out shaft sealing ring (18). Unsnap circlip (19) for removing slide piece (21).

VII. Checking of Individual Components

1. Check blocking rings (synchronizing rings) (402 and 421) for wear. It will be of advantage to replace blocking rings always against new ones when repairing transmission.
2. Check short teeth of synchronizer for wear and damage.
3. Check all slide pieces for wear.
4. Check shift forks for damage and wear.
5. The running surfaces of the needle bearings on main shaft (419), on reversing shaft (502) and in bores of gear wheels, as the needles themselves, should show no signs of wear or dents.
6. Check teeth of all gear wheels for wear and dents.
7. Check output flange (433) and input shaft for score marks caused by shaft sealing rings.
8. Check drive pins and guide grooves on shift rails (601 and 602) for wear.
9. Wheels of countershaft are shrunk-fit. They can be removed only on a 20-ton press. For shrinking, heat gear wheels to 150 to 180° C and then slide on countershaft. Be sure to maintain the above temperature, since excesses beyond 180° C may cause structural changes, which in turn might impair hardness. At temperatures below 150° C, the expansion of the wheel is too low and gear wheel might seize when pressed on shaft (also refer to „Preassembly of Countershaft").

VIII. Assembly of Transmission

Prior to assembling the transmission, all components must be cleaned well. The sealing surfaces of the housing front and rear end should always be smoothed down to remove remaining varnish and pertinent damage. Prior to reassembly, each part must be checked for wear or other faults and lubricated well. Gaskets, shaft sealing rings, O-rings and lock washers should always be replaced by new ones.

Make particularly sure that no chips or other foreign particles remain in housing. For inserting shafts and bolts, always use a soft hammer (plastics, lead etc.). Never hit hardened transmission membres with a steel hammer. When installing studs, make sure that they are inserted into tapped-through holes together with housing cement (for good sealing).

The assembly of the individual shafts and of the entire transmission proceeds vice versa to disassembly. When assembling wheels, levers and the like with hubs on one side, correct positioning during assembly is important.

A) Preassembly of Housing Components

Screw studs (106, 107, 108, 117, 118, 119, 129, 133, 134, 135 and 138) into tapped holes of housing components.

Note:
New studs for through-holes are installed coated with sealing compound. Attach guide pieces (620 or 626) or (621 or 625) to housing rear end (120) or housing front end (101) (Fig. 22).

Screw-on nuts (102) with spring washers (103) (underneath), tightening torque 2.0 to 2.5 kpm.
Then lock nut with 3 punch marks.

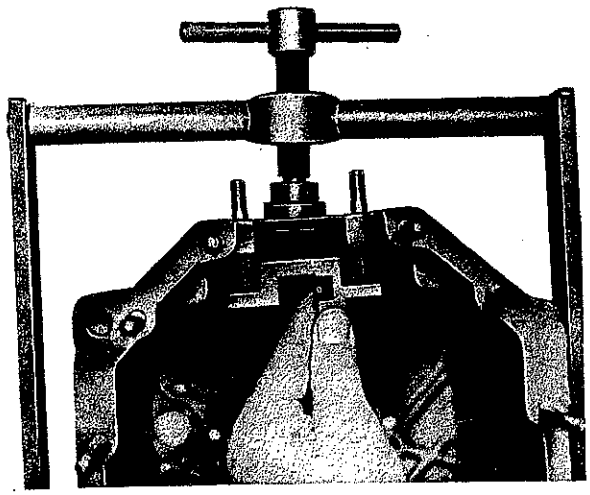


Fig. 22

For transmission with central floor shift:

Attach splashboards (619) together with guide piece (620) to housing rear end seen in driving direction to the right (Fig. 23) or with guide piece (621) to front end seen in driving direction to the left. Then provisionally attach the three shift forks (604, 606 and 608) with joint pins (605 and 602) in housing. Place shift rods (601 and 602) into guide piece (620) and attach to shift forks. Slide-on housing front end. Measure distance between rails and splashboards. Distance should be uniformly 0.4 mm on both sides, corrections are made by loosening fastening nuts (102) and by shifting board. Remove shift rods and shift forks again.

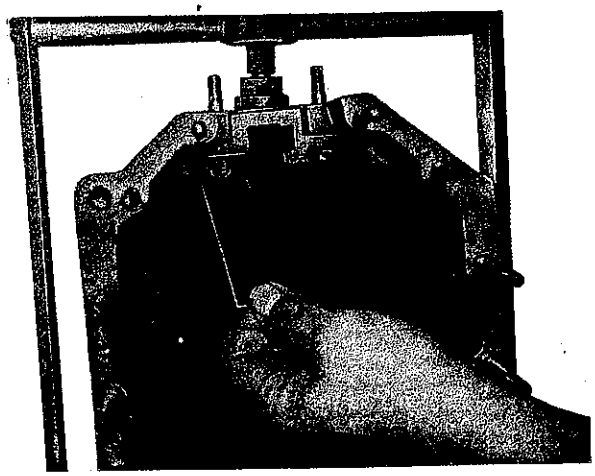


Fig. 23

B) Preassembly of Main Shaft

1. Clamp main shaft (419) between soft jaws into vise (output end on top).
2. Slide needle cage (418) and 1st gear wheel (420) onto shaft with splining on top (Fig. 24). Position locking ring (421).

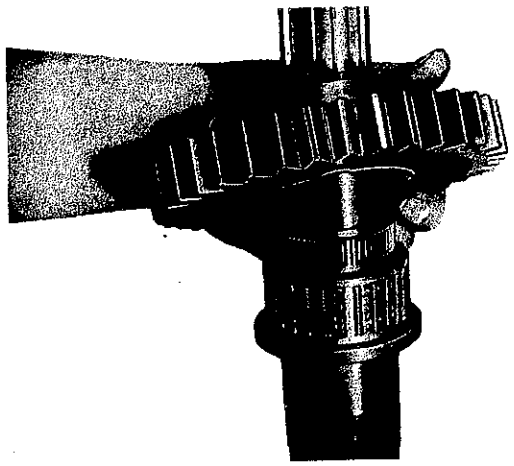


Fig. 24

3. Insert circlip (426) into groove of synchronizer 1st - reverse gear (424) and turn in such a manner that the notched pin (425) can be pushed into hole provided.
4. Heat synchronizer (424) to approx. 80° C and push on splining of shaft as shown in Fig. 25. The recess for the circlip (426) should point upwards.

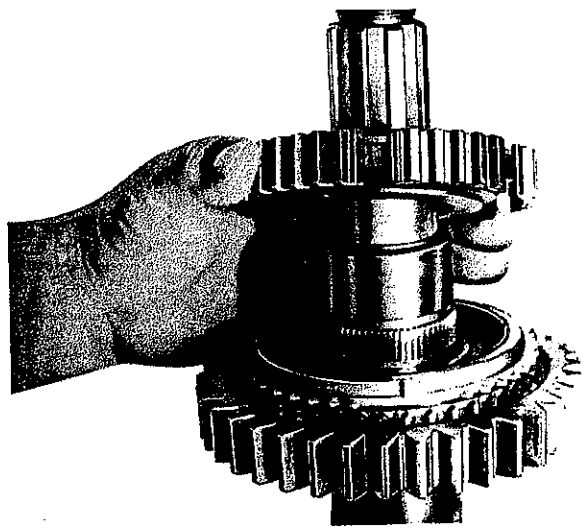


Fig. 25

5. Insert circlip (415) into radial groove of main shaft. Circlip should fit tightly in groove. For this reason, the ring is available in two different sizes 2.4 and 2.5 mm thick.

6. Glue one compression spring (406), one ball pin (423) and one thrust piece (422) together with grease (ball pin seated in thrust piece as shown in Fig. 26).

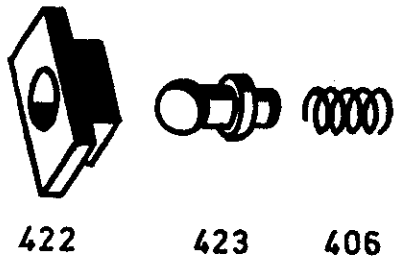


Fig. 26

7. Place glued parts with compression springs first into bores of synchronizer (Fig. 27) and attach with grease.

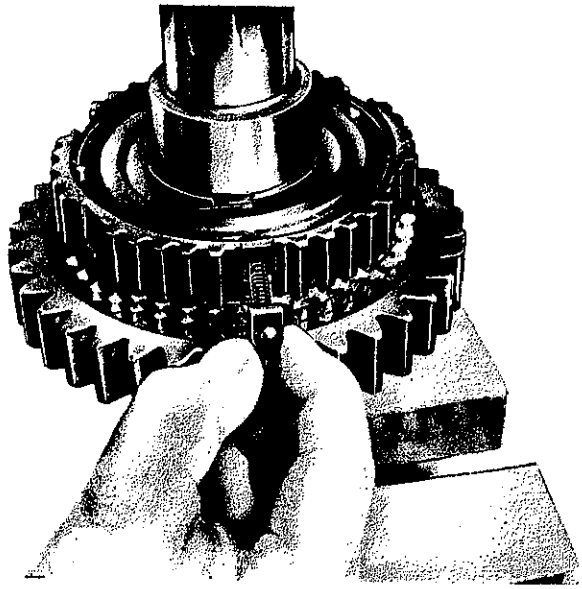


Fig. 27

8. Place two slide pieces (607) into shift fork (608). Place sliding sleeve (427) into shift fork. Narrow, smooth end of sleeve should be at elevations for slide piece bores (refer to Fig. 28).

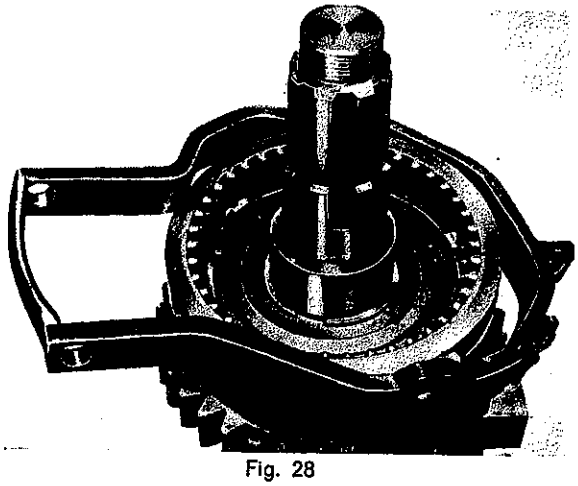


Fig. 28

Place sliding sleeve (427) on synchronizer. Make sure that the ball pins enter into the teeth cut out lowest (Fig. 28). Smooth side of sleeves pointing upwards.

9. Attach needle cage (414) and gear wheel reverse speed (428) with clutch teeth facing downwards (Fig. 29).

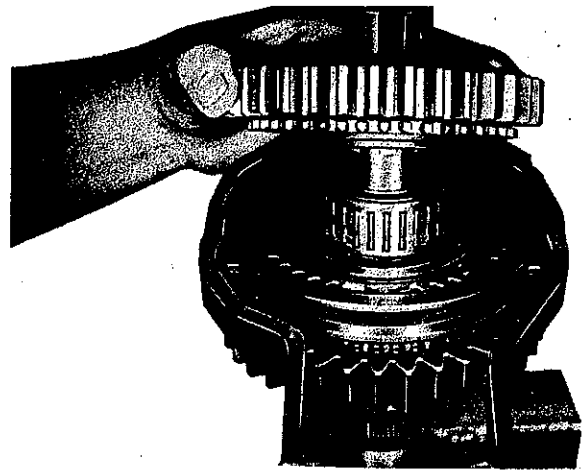


Fig. 29

10. Place thrust washer (429) with collar on top on spur gear. Press one inner race of tapered ball bearing (430) with bushing .9. up to stop on washer (Fig. 30). Running surface of balls up. Clamp main shaft turned by 180°.

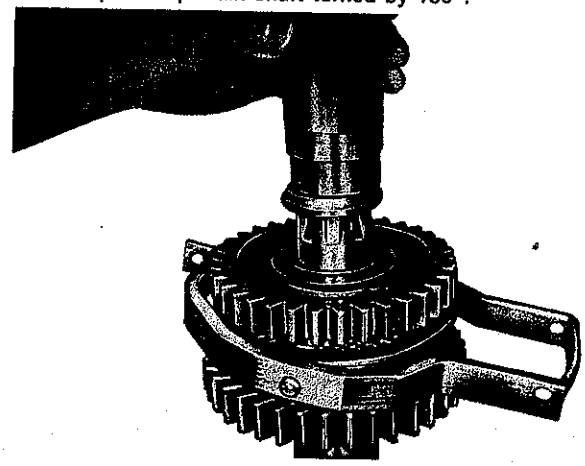


Fig. 30

11. Slide needle cage (418) and second gear wheel (417) with clutch teeth up onto main shaft (Fig. 31).

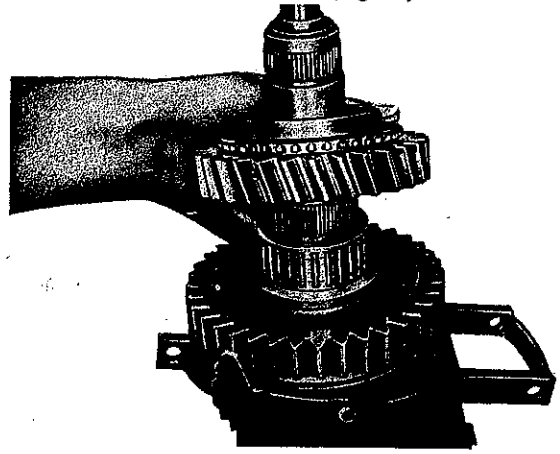


Fig. 31

12. Place blocking ring (402) on cone of second gear wheel (teeth down). Heat synchronizer (416) to approx. 80° C and press-on with installation bushing .10. Insert circlip (415). Circlip (415) should be seated tightly in groove. Available ring thickness: 2.4 and 2.5 mm.

13. Glue one compression spring (406), one ball pin (405) and one thrust piece (404) each with grease into bores of synchronizer (Fig. 32).

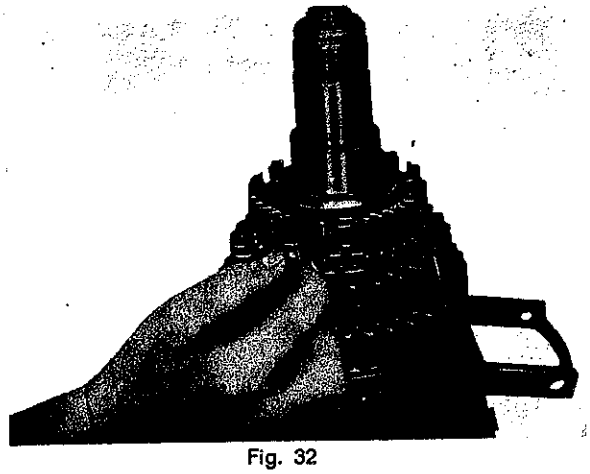


Fig. 32

14. Position sliding sleeve (408) on sychronizer (416) (Fig. 33). Ball pins should be able to engage with the three teeth cutout lowest.

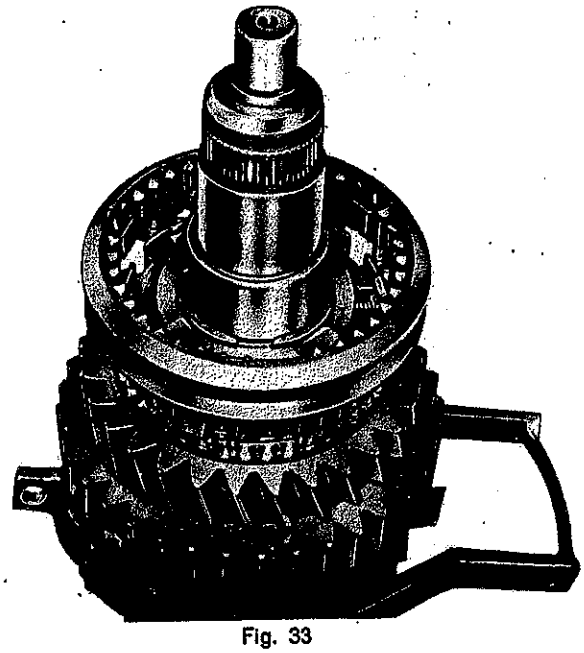


Fig. 33

15. Position second blocking ring (402) with teeth up. Slide needle cage (414) and third gear wheel (413) over main shaft (Fig. 34).

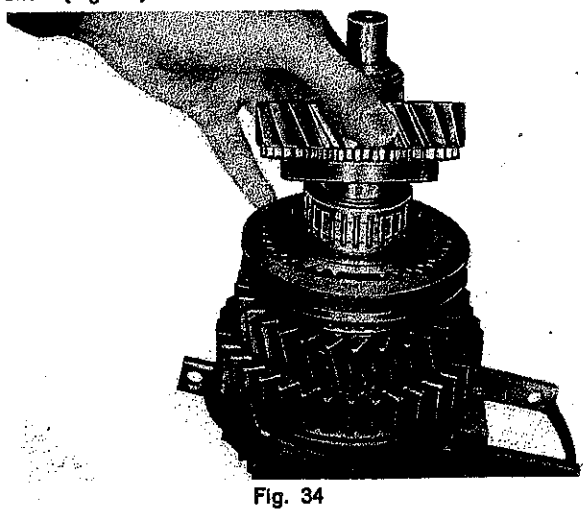


Fig. 34

16. Place thrust washer (412) on 3rd gear wheel. Place inner race (411) with installation bushing .9. up to stop against thrust washer (Fig. 35).

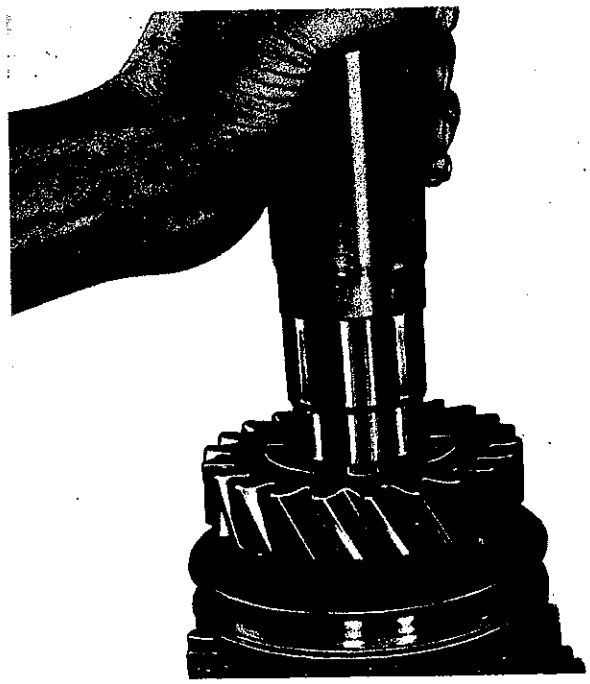


Fig. 35

17. Slide needle cage (410) and 4th gear wheel (409) with clutch teeth up onto main shaft (Fig. 36).

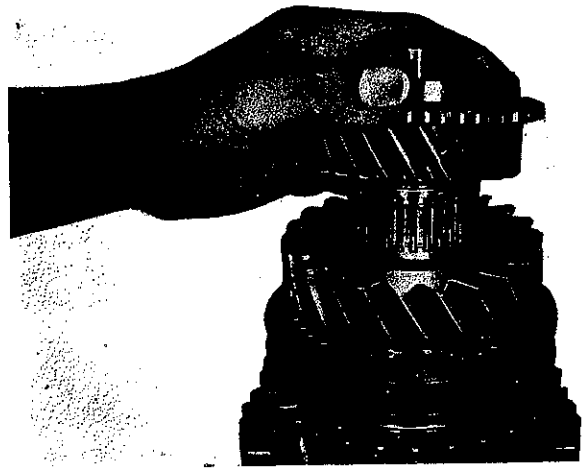


Fig. 36

18. Heat synchronizer 4th and 5th gear (407) to approx. 80° C and push onto splining with longer end of hub first (Fig. 37). Use special tool .9. for this purpose, too. Insert one circlip (403) to fit tightly in radial groove. Rings are available 2.3, 2.4 and 2.5 mm thick.

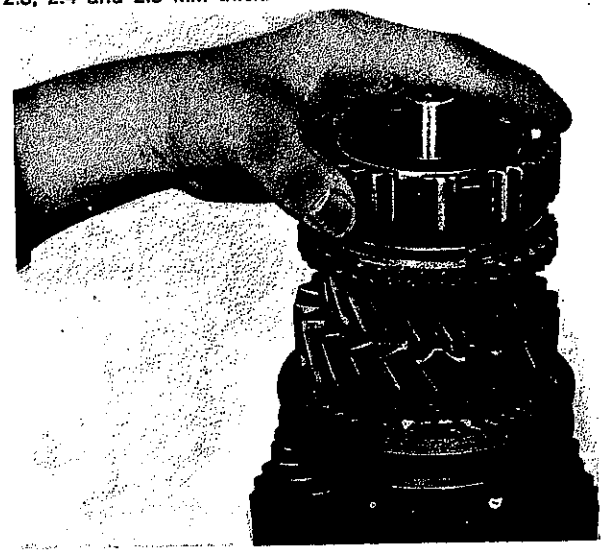


Fig. 37

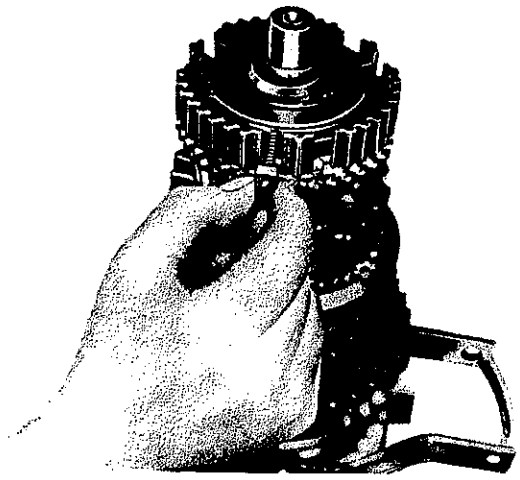


Fig. 38

19. Mount synchronizing member (Fig. 38) and sliding sleeve (Fig. 39) as described under paragraph 13 and 14.

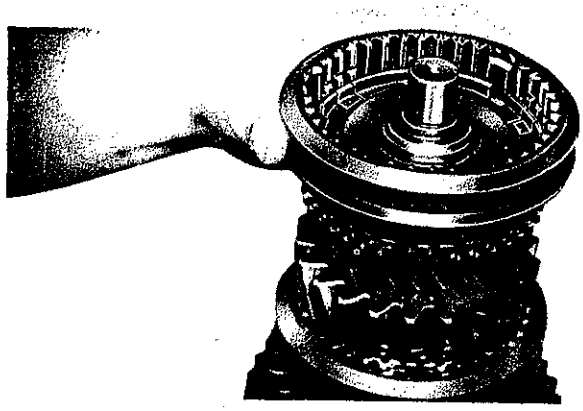


Fig. 39

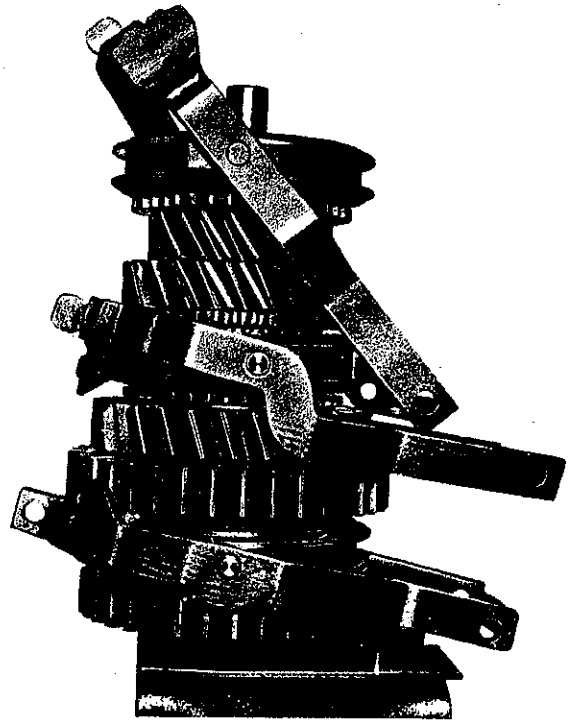


Fig. 40

20. Glue slide pieces (603) with grease into bores of shift forks (604 and 606). Place shift forks into pertinent sliding sleeves (Fig. 40). Seen in driving direction, the welded-on detent washers should be at the right and the offset fork in the center.

C) Preassembly of Countershaft

Make bores of gear wheels and fitted seats on countershaft free of oil, grease and dust. Heat 4th gear wheel (305) and constant wheel (304) to 150 to 180° C and push individually against stop on countershaft. Note that the 4th gear wheel is pressed on with the ring gear first and the constant wheel with the hub first. Place locking ring (303) into radial groove. Ring should be free of play and is therefore available 2.3, 2.4 and 2.5 mm thick.

Press-on both inner races of tapered roller bearings (302) up to stop. The larger diameters are each at gear wheels.

D) Adjustment of Countershaft

1. Insert outer races of roller bearings (302) with larger ID's first into bores of housing front end and housing rear end.

Place countershaft into housing rear end (Fig. 41). Mount housing front end and attach with at least 8 nuts to rear end. Mount tachometer cover and also attach. Knock countershaft as well as bearing outer races with a plastic hammer in the direction of the tachometer cover.

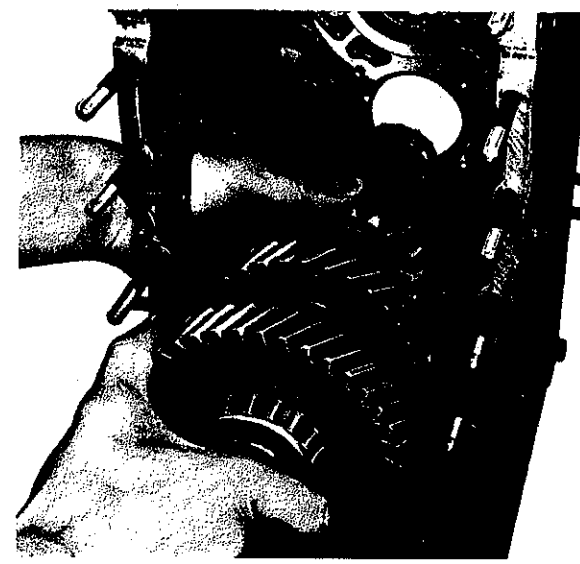


Fig. 41

2. Apply depth gauge to measure gap between bearing outer race and face end of housing (Fig. 42).

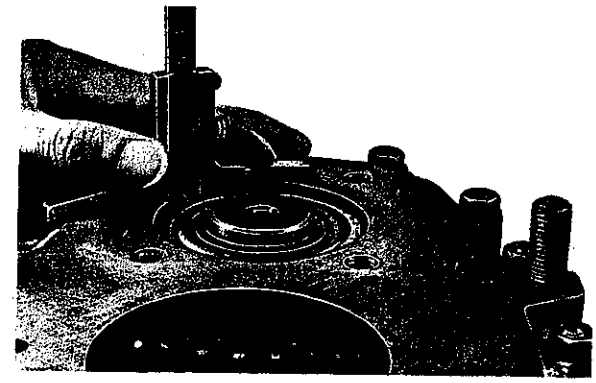


Fig. 42

3. Place one compensating washer (301) 0 to 0.05 mm thicker than the measured dimension on outer race of front bearing (Fig. 43).

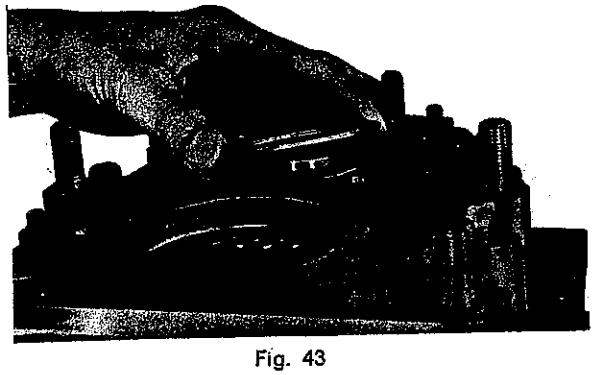


Fig. 43

4. Screw-on adjusting plate .11. (Fig. 44). Check bearing of countershaft. Countershaft should rotate free of play but without binding. A slight resistance when turning shaft should be felt. Compensating washers 2.0, 2.05, 2.1, 2.15, 2.2, 2.25, 2.3, 2.35, 2.4, 2.45, 2.5, 2.55, 2.6, 2.65, 2.7, 2.75, 2.8 and 2.9 mm thick are available

   Disassemble housing components again and remove adjusting plate .11.

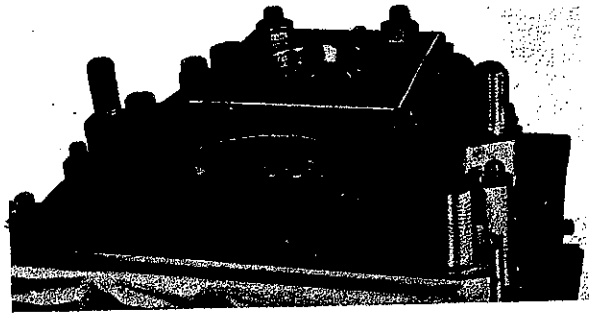


Fig. 44

E) Installation of Gear Shafts

1. Insert countershaft through center (606) and rear (608) shift fork. Introduce main shaft and countershaft together into housing rear end (Fig. 45).

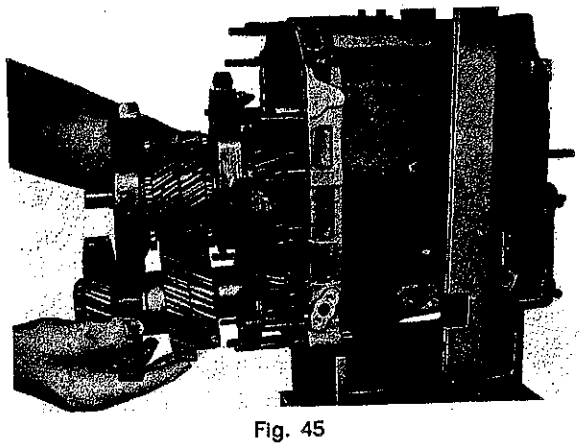


Fig. 45

2. Place blocking ring (402) and cam cage (401) on journal of main shaft. Slide input shaft (208) over cam cage (Fig. 46).

3. Attach shift rod 1st - reverse gear (602) with bolt into bore of shift fork (608) first. Then rod 2nd - 3rd gear (601) and finally shift rod 4th - 5th gear (601), refer to Fig. 47.

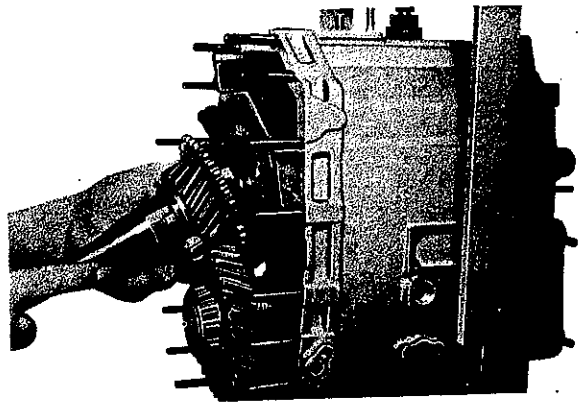


Fig. 46

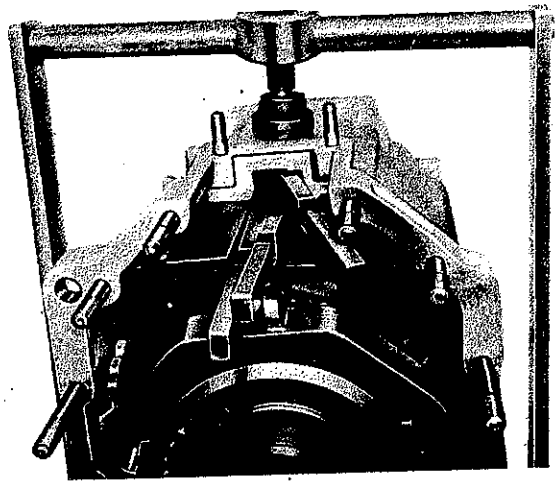


Fig. 47

4. Slide joint pins (605 and 615 or 624) through bores of housing and shift forks. It will be of advantage to lift forks with a screw driver for better alignment of bores (Fig. 48). Place seals (625 or 634) underneath the two joint pins (605). Screw-in hex. screws (623 or 633) with spring washers (622 or 632) underneath and tighten.

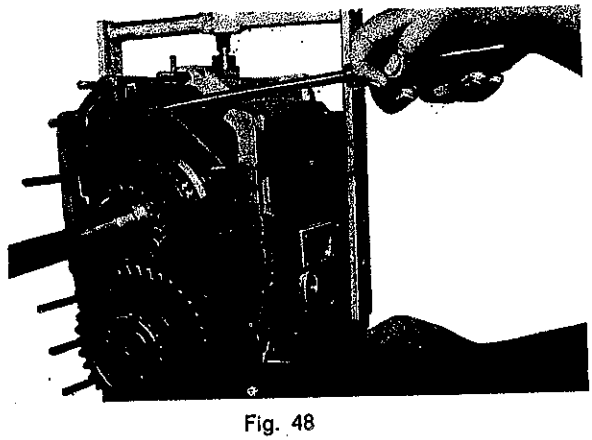


Fig. 48

5. Coat flat surface of housing rear and front end with sealing compound.

6. Mount housing front end (101), while sliding shift rods into guide pieces (620 or 626 and 621 or 625). The two splashboards (619) enter notches on housing components. Screws nuts (102) with spring washers (103) underneath on studs and tighten slightly. Force-in cylindrical pins (116). Tighten nuts (102) to 2.0 — 2.5 kpm.

F) Continued Assembly of Transmission

Insert circlip (206 and 431) into grooves of tapered ball bearings (207 and 430). Push both tapered ball bearings into housing bores. Slide inner race of ball bearing, lock washer (205) and slot nut (204) on input shaft (Fig. 49). Screw slotted nut on threads (lefthand threads) and tighten with tool .6. (tightening torque 18 to 22 kpm), while engaging two speeds. Bend one tab of lock washer into matching groove of slot nut.

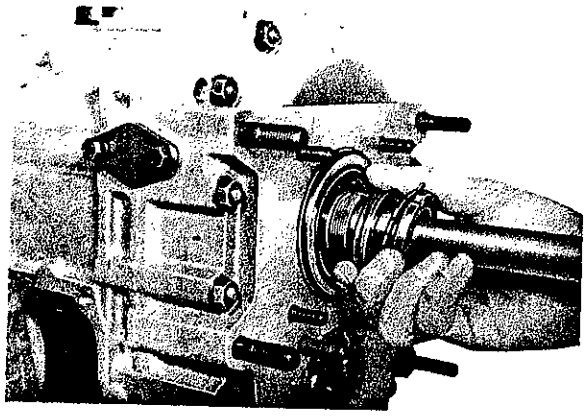


Fig. 49

G) Installation of Reversing Gear

1. Slide needle cage (503) into bore of reversing gear (505). Glue thrust washer (501) with grease to end with projecting hub. Attach washer (504) to other end (bent tabs are outside). Insert reversing gear into housing with projecting hub facing input end (Fig. 50).

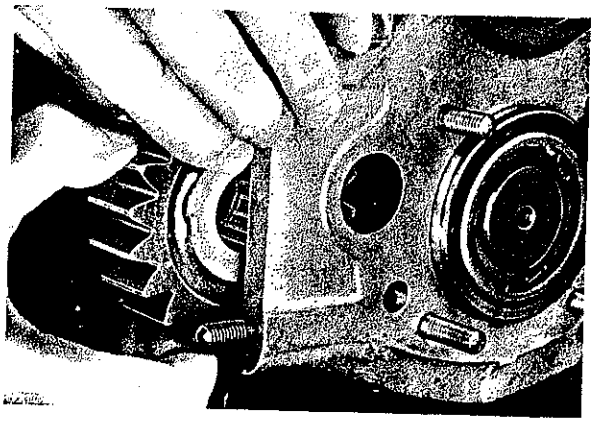


Fig. 50

2. Put finger through housing bore and move reversing gear with thrust washers into position matching bore. Insert reversing shaft (502) in such a manner that the threaded bore faces the bearing of the countershaft and is in alignment with bore in tachomenter cover (rotary lock) (refer to Fig. 51), while provisionally mounting cover. Mount gasket (126) and cover (127) (Fig. 50), place spring washers (103) and nuts (102) on studs and tighten to 2.0 — 2.5 kpm.

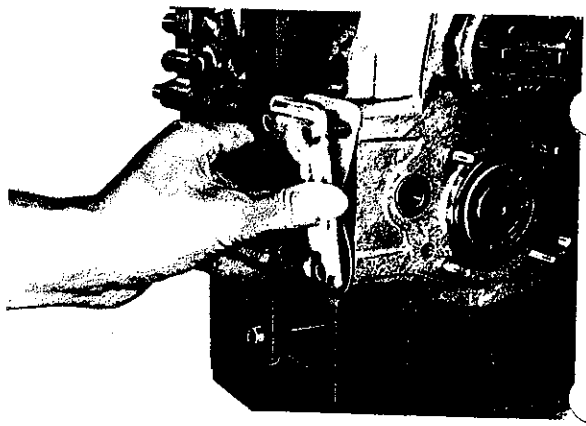


Fig. 51

H) Mounting of Tachometer Cover

1. Press ball bearing inner race with installation bushing .9. on main shaft.
2. Attach tachometer worm as shown in Fig. 52 and press also with bushing .9. up to stop on inner race.

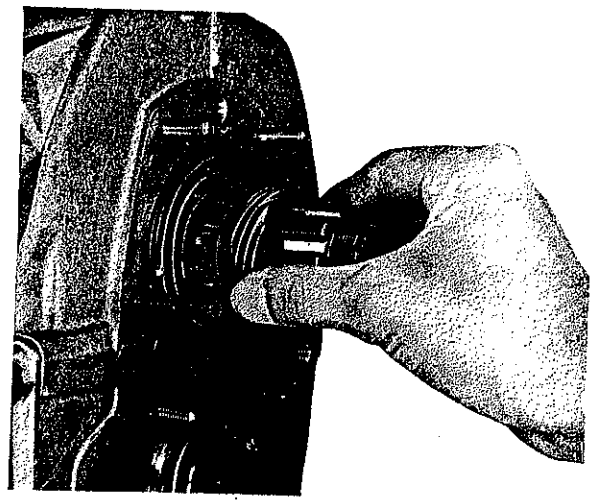


Fig. 52

3. Apply depth gauge to measure distance from bearing end to housing sealing surface (Fig. 53).

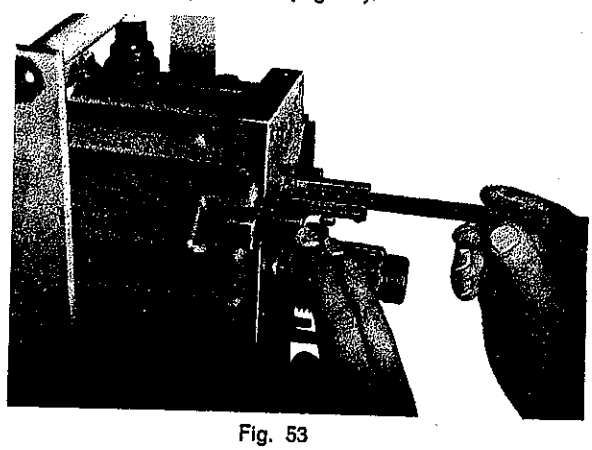


Fig. 53

4. Determine distance from sealing surface of tachometer cover (802) up to smaller (lower) recess (Fig. 54). The difference of the two dimensions less 0 to 0.1 mm end play (while trying for dimension 0.0) provides the thickness of the compensating washers (801) to be placed into recess of tachometer cover. Compensating washers are available 0.4, 0.5, 0.6, 0.7 and 0.8 mm thick. Force shaft sealing ring (804) with sealing lip inwards into tachometer cover.

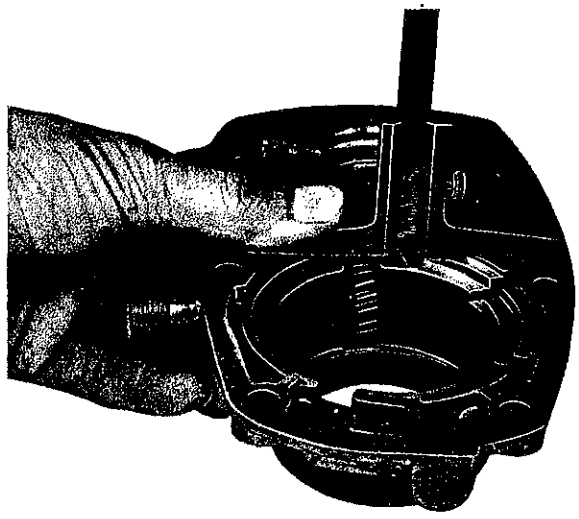


Fig. 54

Insert washers (801). Coat sealing surface of tachometer cover with sealing compound and place on housing (Fig. 55).

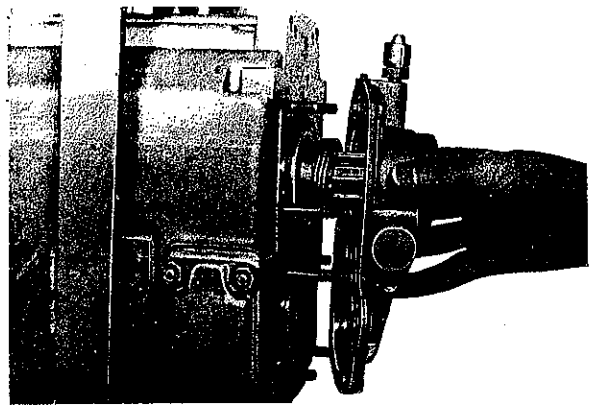


Fig. 55

Mount spring washers (103) and nuts (102) and tighten to 2.0 to 2.5 kpm. Turn screw (507) with spring washer (506) underneath into threads of reversing shaft (502). Slide sealing ring (811) up to stop on tachometer shaft (809).

5. Slide output flange (433) on main shaft. Screw-on slot nut (434) and tighten with slot nut wrench .2. (tightening torque 18-22 kpm). Knock collar of nut with punch into groove of output shaft.

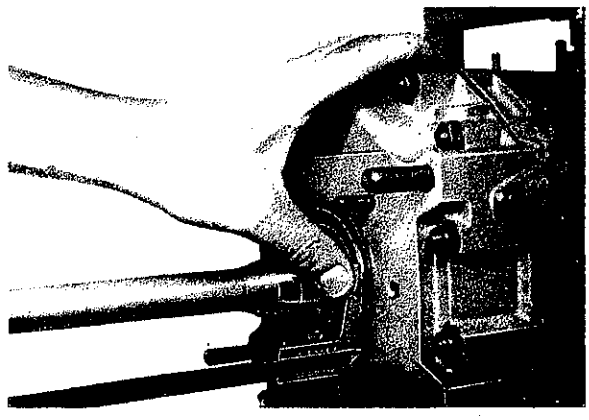


Fig. 56

I) Mounting of Guide Flange

1. Push shaft sealing ring (203) with sealing lip toward inside of housing into guide flange (201).
2. Apply depth gauge to measure distance from upper edge of ball bearing outer race (207) to housing sealing surface (Fig. 56).
3. Determine depth of pertinent recess in guide flange (Fig. 57).

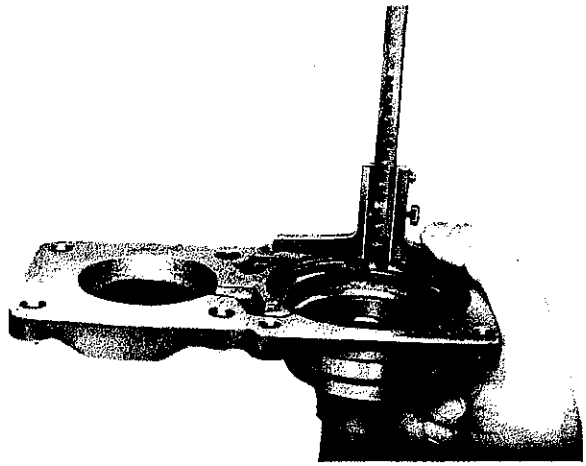


Fig. 57

4. The difference of the two dimensions less 0 to 0.1 mm for end play (trying for dimension 0.0) provides the thickness of the fitted washers (202) to be placed into recess of guide flange. Fitted washers are available 0.6, 0.7 and 0.8 mm thick.
5. Glue fitted washer with grease into recess. Coat sealing surface of guide flange with sealing compound. Slide guide flange over input shaft and abut against housing. Srew nuts (102) with spring washers (103) on studs and tighten to 2 to 2.5 kpm.

K) Mounting of Gear Shift

1. **Floor Shift**

Place gasket (618) and washer (617) on housing. Place shift head (616) on gasket (Fig. 58). Screw hex. nuts (102) with spring washers (103) underneath on studs and tighten to 2 to 2.5 kpm.

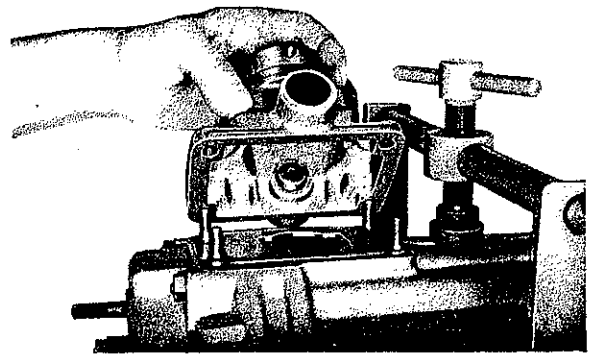


Fig. 58

2. **Rotary Selector Shaft**

Press one bearing bushing (627) from inside into long arm of shift housing and force-in shaft sealing ring (628) from outside with sealing lip outwards up against stop. Press-in second bearing bushing (627) 4-5 mm deeper than stop collar for larger shaft sealing ring (629).

Insert shaft sealing ring (629) with sealing lip inwards and wiper (630) with sealing lip outwards (Fig. 59). Fill cavities between bearing bushing (627) and the two shaft sealing rings (628 and 629) with hot bearing grease. Introduce gear shifting shaft (631) while sliding-on locking clamp (622) and shift finger (623). Force set pins (620 and 619) into bores of finger and shaft.

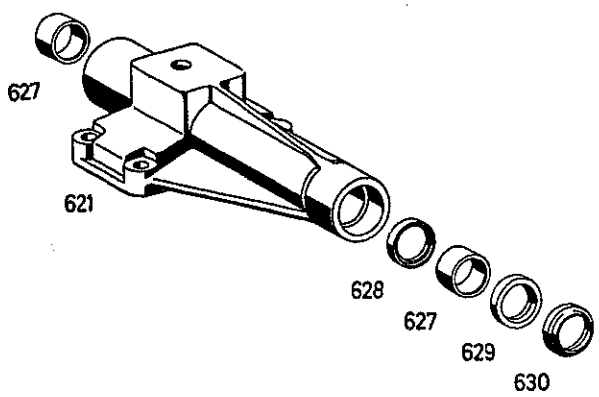


Fig. 59

Slide stop washer (613), as well as spacer bushing (616), compression spring (635) and washer (617) over thinner stem of gear shifting shaft. Then insert circlip (611). Place larger compression spring (614) over washer (617). Position stop washer (612) and place circlip (610) into radial groove of housing. Coat closing cover (609) on outer dia. with sealing compound and then push into bore. Place gasket (624) on housing, mount shift housing and attach with nuts (102) and spring washers (103) underneath. Tightening torque of nuts 2.0 to 2.5 kpm.

L) Assembly of External Drive

1. Install shift lever.
Press shaft sealing ring (18) with sealing lip inwards in housing bore for shift lever. Clamp external drive housing into vise. Protect sealing surface by means of aluminium jaws against damage. Slide slide piece (21) into bore of inner shift lever (20) and locate with circlip (19). Introduce inner shift lever into housing. Slide outer shift lever (16) into mark positioned on splining of inner lever and clamp with hex. screw (17), lock washer (15) and nut (10). Secure nut by bending lock washer. Insert bolt (39) into housing bore.

2. Install output shaft.

2.1 Slide compression spring (6) with one ball (5) each on end into cross bore of output shaft. Glue balls down with grease. Mount slide gear (4) on shaft as shown in Fig. 60. Note that the shift groove is at seat of small ball bearing (3) and that the portions of the inner splining cut down lowest are above balls (5).

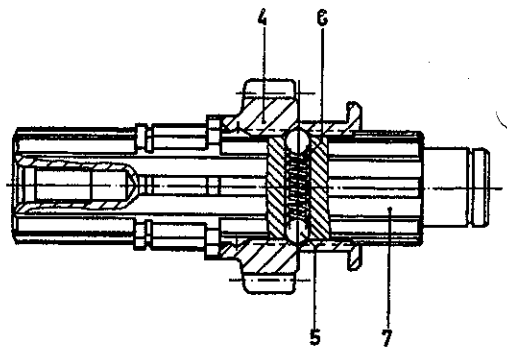


Fig. 60

2.2 Press ball bearing (3) on output shaft and then insert circlip (2). Insert pre-assembled output shaft into housing (Fig. 61).

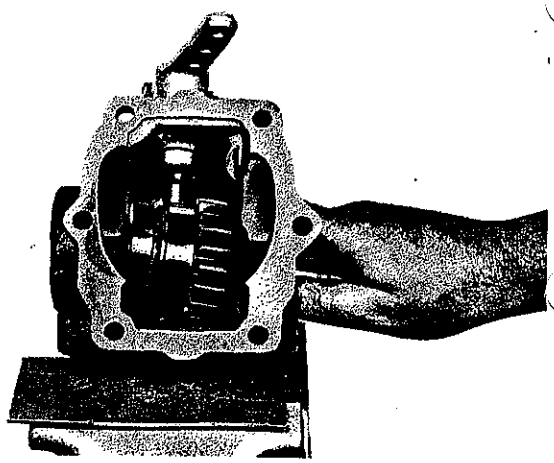


Fig. 61

2.3 Apply depth gauge to measure from sealing surface of cover (25) on housing to stop flange of ball bearing (22) (Fig. 62).

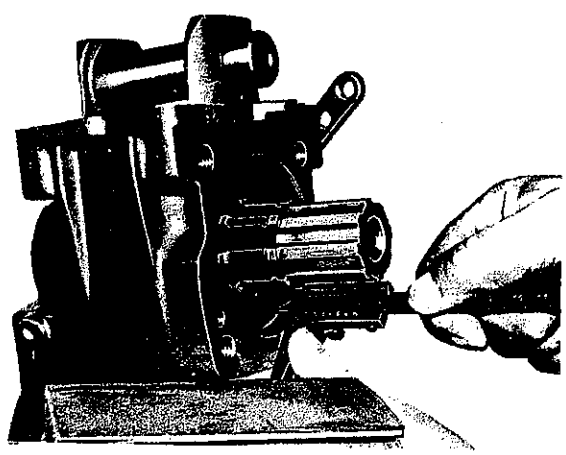


Fig. 62

2.4 Press ball bearing (22) up to stop into cover (25). Place gasket (24) on cover and determine projection of ball bearing outer race with depth gauge (Fig. 63).

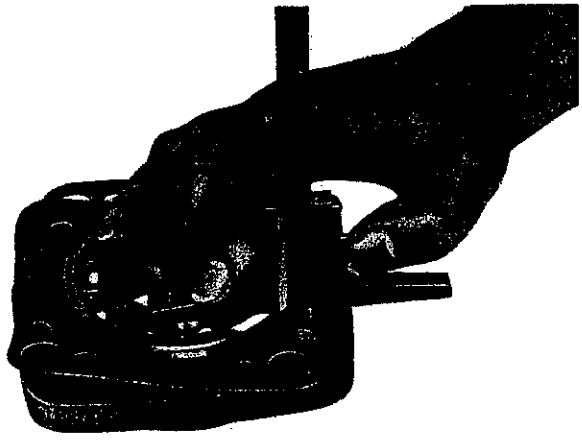


Fig. 63

2.5 The difference between the distances measured under 2.3 and 2.4 provides the thickness of the spacing washer (23) to be inserted. Washers are available 1.7, 1.8 and 1.9 mm thick. The deviation of the washer thickness from the computed dimension may result in max. 0.1 mm play.

2.6 Place selected spacing washer (23) into housing bore. Place bolt (39) with collar outwards into housing (Fig. 64). Push shaft sealing ring (26) into cover with sealing lip facing toward inside of housing. Mount gasket (24) and attach cover (25) with hex. screws (33) and spring washers (32) underneath. Make sure that the oil bores of the housing and the cover are in alignment. The tightening torque of the hex. screws (33) is 7.0 kpm.

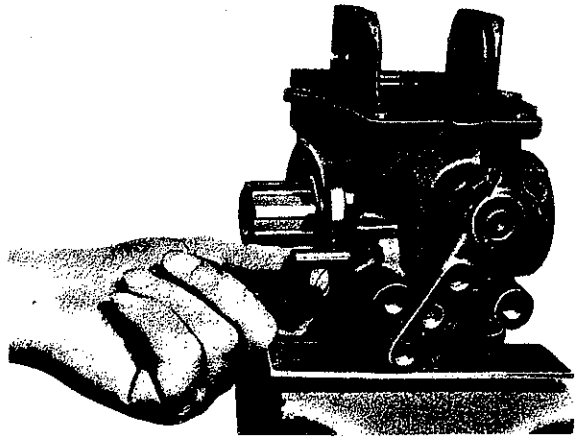


Fig. 64

2.7 Use tool .13. to knock ball bearing (3) and output shaft against stop of shaft flange on ball bearing (22). Coat closing cover (1) on OD with sealing compound and then push into bore.

3. Install double gear.

Insert tapered roller bearing (34) into doulbe gear (35). Push double gear with fitting washer (36) into housing (Fig. 65). Select washer (36) in such a manner that the double gear fits free of play but does not bind. Washers are available 2.1, 2.3, 2.5 and 2.7 mm thick. Press-in bolt (37) with bore toward output flange.

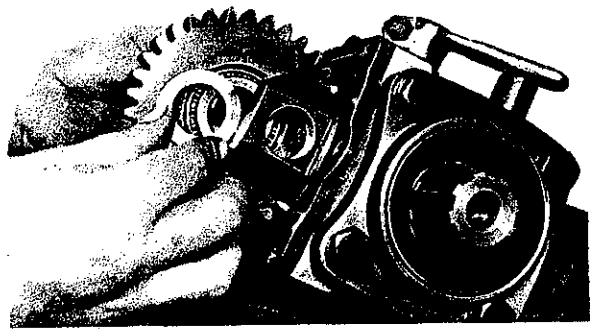


Fig. 65

4. Slide output flange (27) on shaft. Push washer (29) with O-ring (28) inserted into bore. Screw-in hex. screw (31) with spring washer (30) underneath and tighten.

M) Flanging of External Drive to Transmission Housing

1. Slide gasket (38) over studs (12, 13 and 14) on housing rear end. Introduce external drive into housing, screw-on nuts (10) with spring washers (11) underneath and tighten to 2.0 — 2.5 kpm.

N) Test Shift Transmission and external Drive

After installing transmission into vehicle, fill-in gear oil SAE 80 according to Spec. MIL-L 2105 A (refer to section „Maintenance").

IX. Ordering Spare Parts

Orders for spare parts should always be made through your **RENAULT DODGE DEALER**

X. Key to Illustrations

Group Transmission Housing

101 Housing front end
102 Hex. nut
103 Spring washer
104 Hex. nut
105 Spring washer
106 Stud
107 Stud
108 Stud
109 Hex. screw
110 Cover
111 Gasket
112 Hex. screw
113 Spring washer
114 Cover
115 Gasket
116 Cylindrical pin
117 Stud
118 Stud
119 Stud
120 Housing rear end
121 Closing plug
124 Closing plug
125 Type rating plate
126 Gasket
127 Cover
128 Stud
129 Stud
130 Washer
131 Compression spring
132 Detent pin
133 Stud
134 Stud
135 Stud
137 Washer
138 Stud

Group Input Shaft

201 Throwout bearing flange
202 Fitted washer
203 Shaft sealing ring
204 Slot nut
205 Lock washer
206 Circlip
207 Ball bearing
208 Input shaft

Group Countershaft

301 Compensating washer
302 Roller bearing
303 Locking ring
305 Bevel gear 4th speed
304 Bevel gear constant
306 Countershaft

Group Main Shaft

401 Cam cage
402 Blocking ring (synchronizing ring)
403 Circlip
404 Thrust piece
405 Ball pin
406 Compression spring
407 Synchronizer 4th + 5th speed
408 Sliding sleeve 2nd — 5th speed
409 Bevel gear 4th speed
410 Needle cage
411 Inner race
412 Thrust washer
413 Bevel gear 3rd speed
414 Needle cage
415 Circlip
416 Synchronizer 2nd + 3rd speed
417 Bevel gear 2nd speed
418 Needle cage
419 Main shaft
420 Spur gear 1st speed
421 Blocking ring (sychronizing ring)
422 Thrust piece 1st speed
423 Ball pin
424 Synchronizer 1st + reverse speed
425 Notched pin
426 Circlip
427 Sliding sleeve 1st + reverse speed
428 Spur gear reverse speed
429 Thrust washer
430 Ball bearing
431 Circlip
432 Tachometer worm
433 Output flange
434 Slot nut

Group Reversing Assembly

501 Thrust washer
502 Reversing shaft
503 Roller cage
504 Thrust washer
505 Reversing gear
506 Spring washer
507 Hex. screw

Group Gear Shift (Rotary Selector Shaft)

601 Shift rod 2nd — 5th speed
602 Shift rod 1st + reverse speed
603 Slide piece
604 Shift fork 4th + 5th speed
605 Joint pin
606 Shift fork 2nd + 3rd speed
607 Shift fork 1st + reverse speed

608 Slide piece
609 Closing cover
610 Circlip
611 Circlip
612 Stop washer
613 Stop washer
614 Compression spring
615 Joint pin
616 Spacer bushing
617 Washer
618 Plug
619 Hollow set pin
620 Hollow set pin
621 Shift housing
622 Locking clamp
623 Shift finger
624 Gasket
625 Guide piece
626 Guide piece
627 Bearing bushing
628 Shaft sealing ring
629 Shaft sealing ring
630 Wiper
631 Gear shifting shaft
632 Spring washer
633 Hex. screw
634 Gasket
635 Compression spring

Group Gear Shift (Floor Shift)

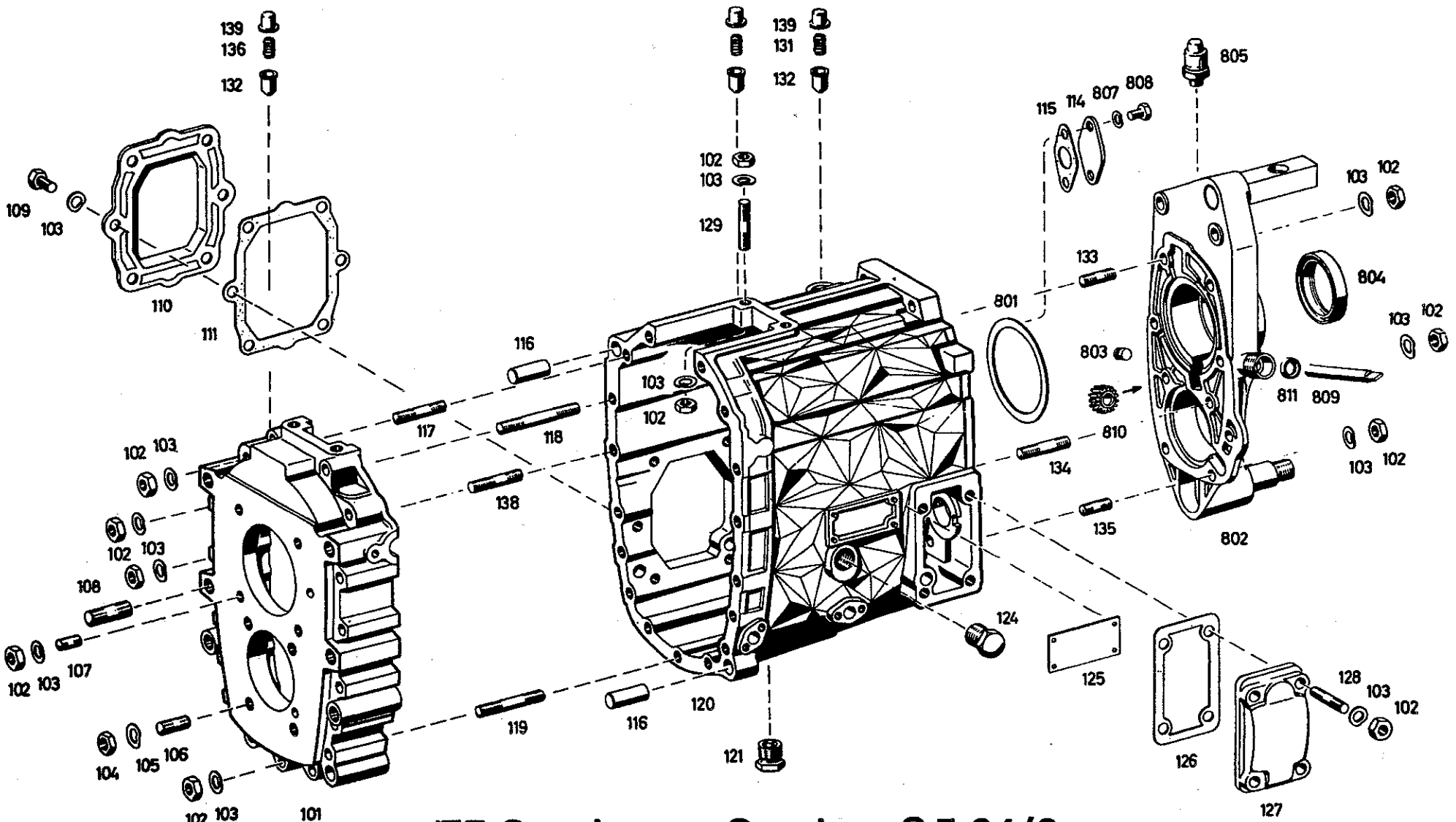
601 Shift rod 2nd — 5th speed
602 Shift rod 1st — reverse speed
603 Slide piece
604 Shift fork 4th + 5th speed
605 Joint pin
606 Shift fork 2nd + 3rd speed
607 Slide piece
608 Shift fork 1st + reverse speed
609 Washer
610 Compression spring
611 Compression spring
612 Stop bushing
615 Holding pin
616 Shift head
617 Stop plate
618 Gasket
619 Splash board
620 Guide piece complete
621 Guide piece complete
622 Spring washer
623 Hex. screw
624 Joint pin 1st + reverse speed
625 Gasket

Group Tachometer Drive

801 Washer
802 Tachometer cover
803 Closing plug
804 Shaft sealing ring
805 Breather
806 Switch
807 Spring washer
808 Hex. screw
809 Tachometer shaft
810 Tachometer pinion
811 Shaft sealing ring

Pto

1 Closing cover
2 Locking ring
3 Ball bearing
4 Slide gear
5 Ball
6 Compression spring
7 Output shaft
8 Closing cover
9 Housing
10 Hex. nut
11 Spring washer
12 Stud
13 Stud
14 Stud
15 Lock washer
16 Shift lever
17 Hex. screw
18 Shaft sealing ring
19 Circlip
20 Shift lever
21 Slide piece
22 Ball bearing
23 Compensating washer
24 Gasket
25 Cover
26 Shaft sealing ring
27 Output flange
28 O-ring
29 Washer
30 Spring washer
31 Hex. screw
32 Circlip
33 Hex. screw
34 Inner race
35 Double gear
36 Washer
37 Pin

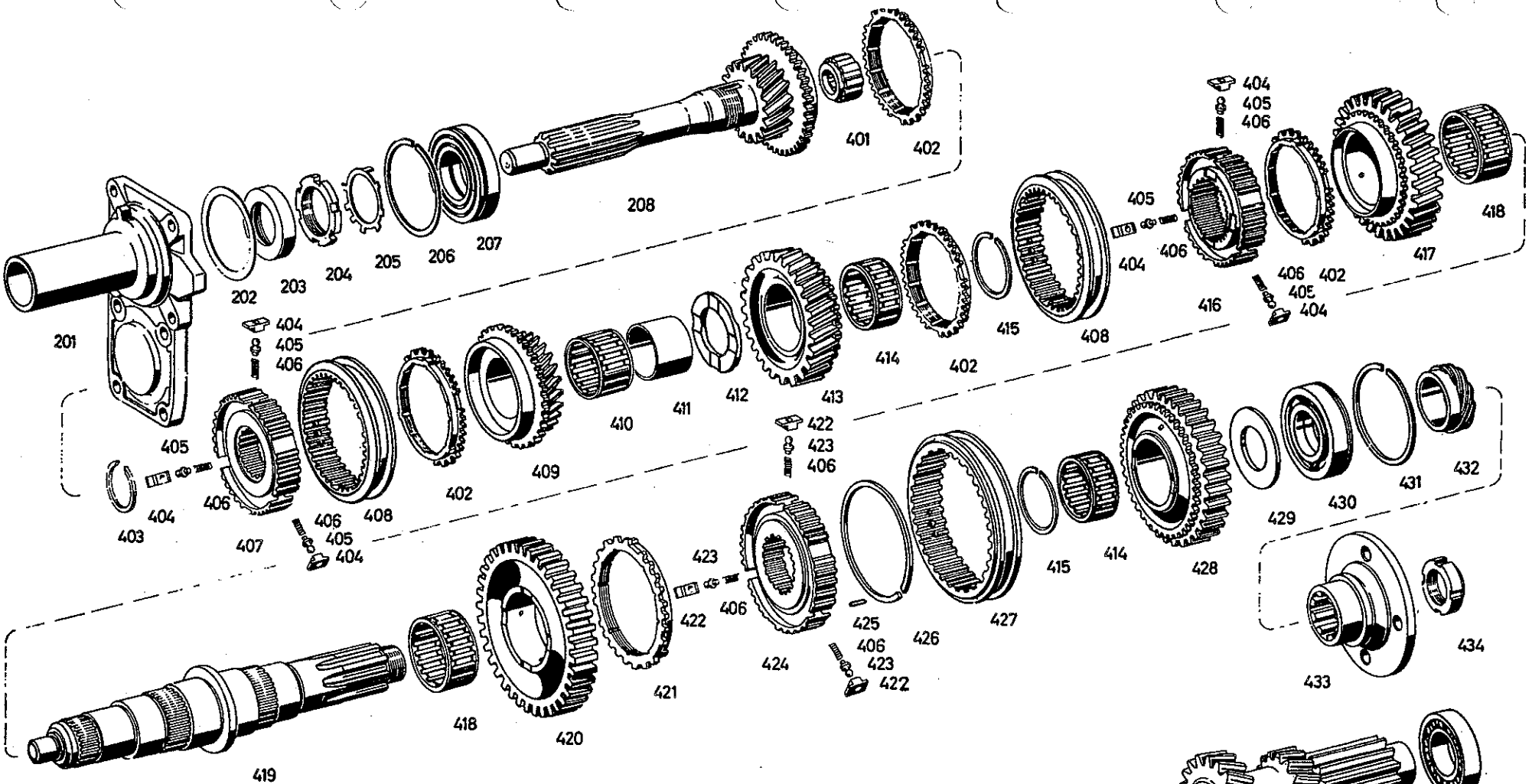


ZF-Synchroma-Gearbox S 5-24/3

Gear housing

Tachometer drive

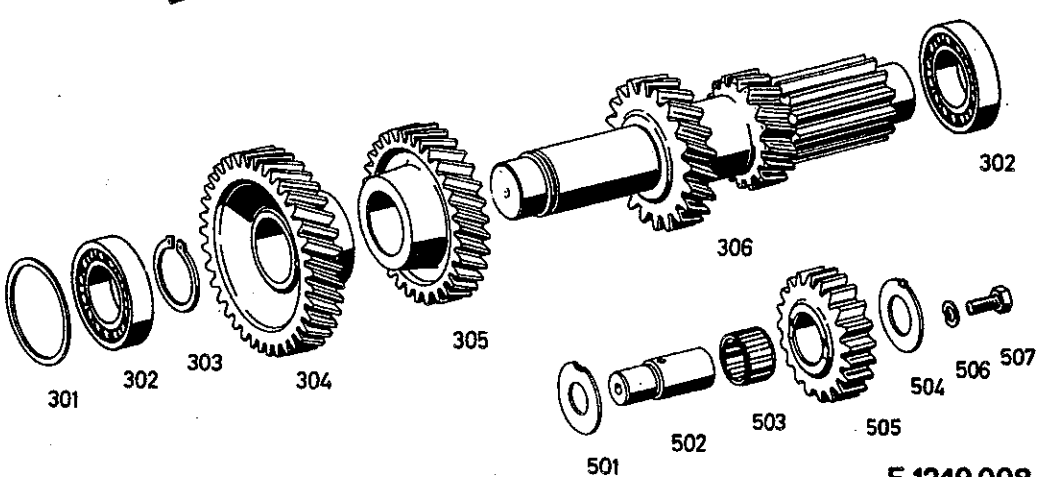
E 1249.009



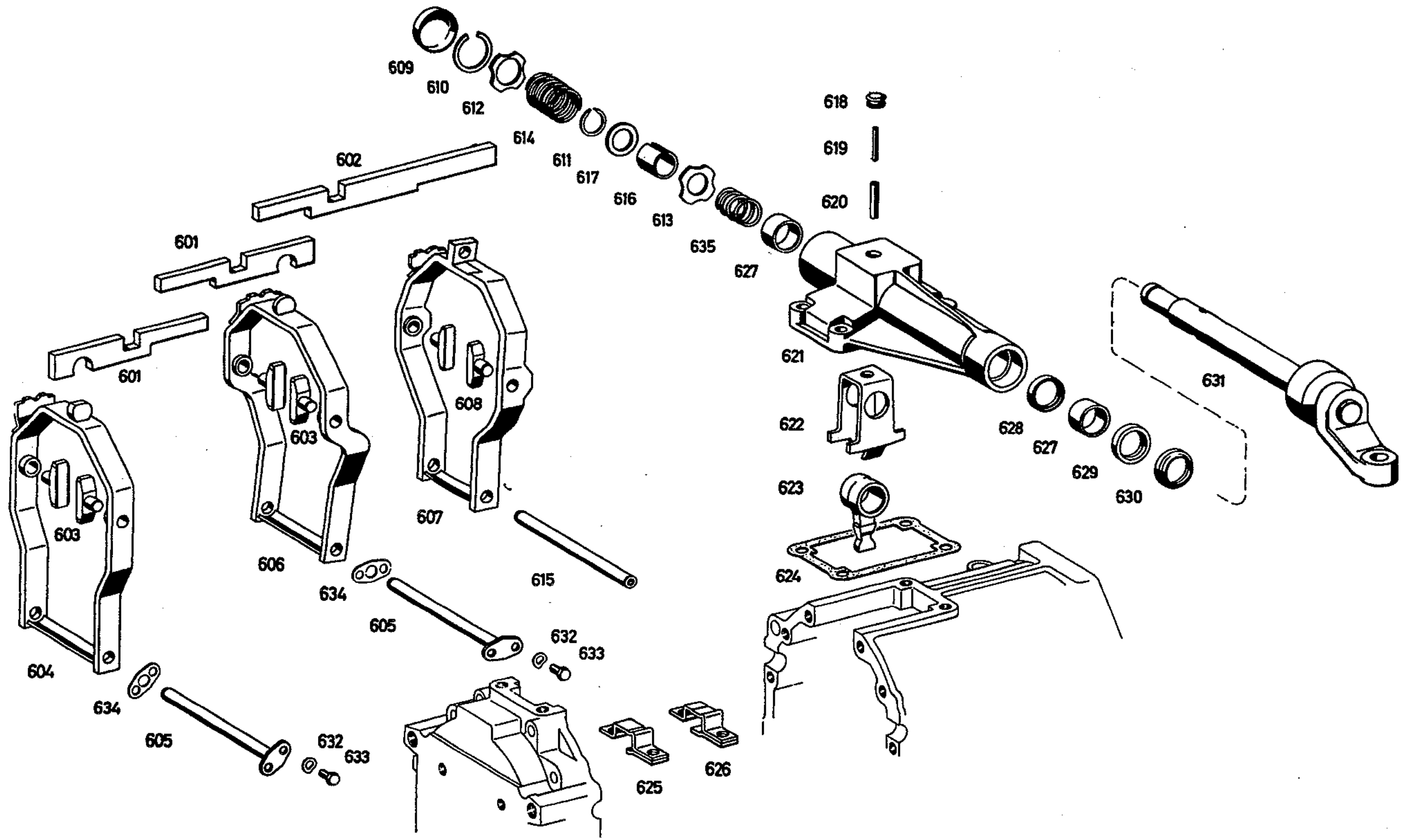
ZF-Synchroma-Gearbox S 5-24/3

Input Shaft — **Main Shaft**

Countershaft — **Reversing Assembly**



E 1249.008

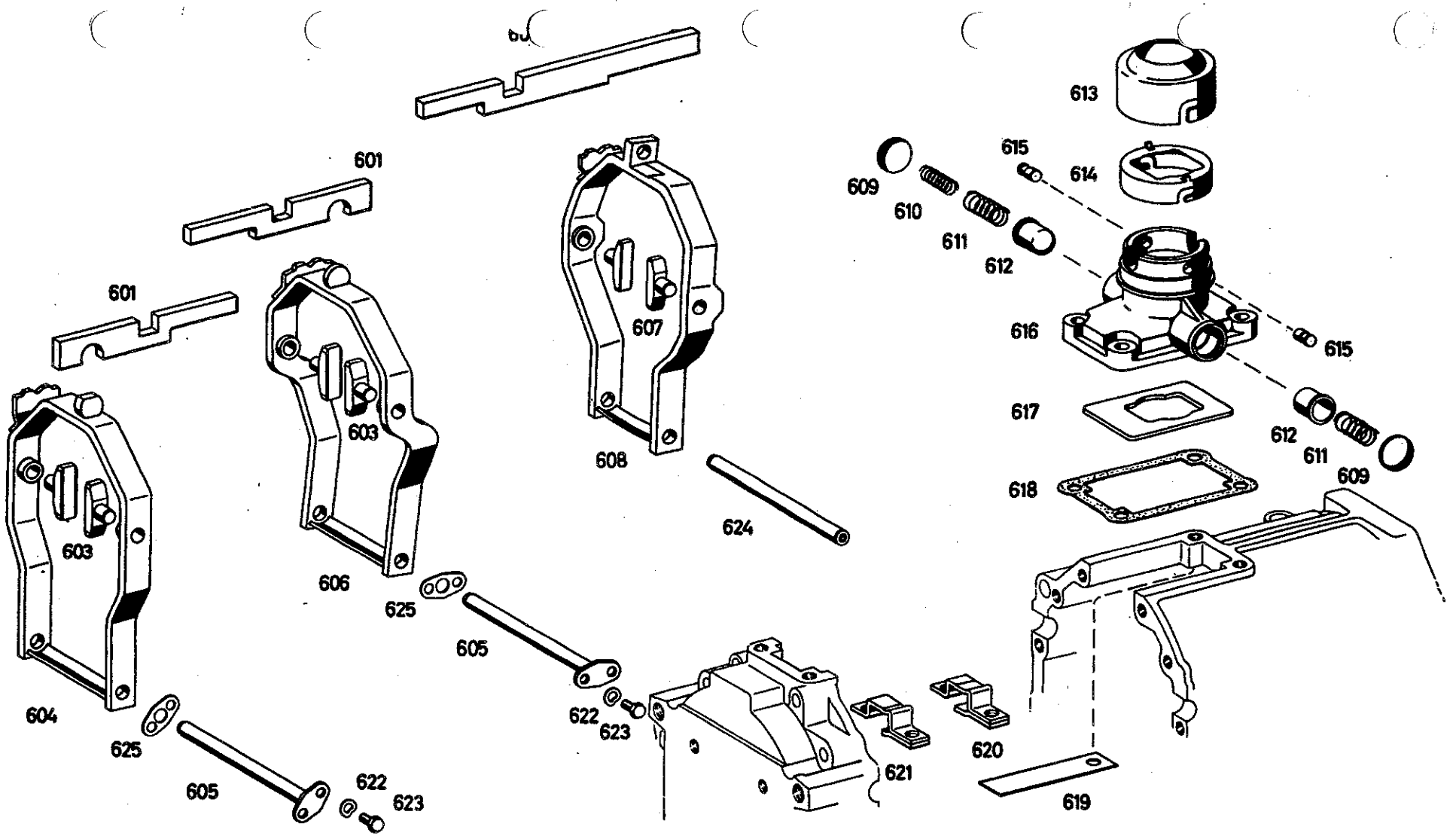


ZF-Synchroma-Gearbox S 5-24/3

Gear Shift

(Ro y Selector aft)

E1 9.010

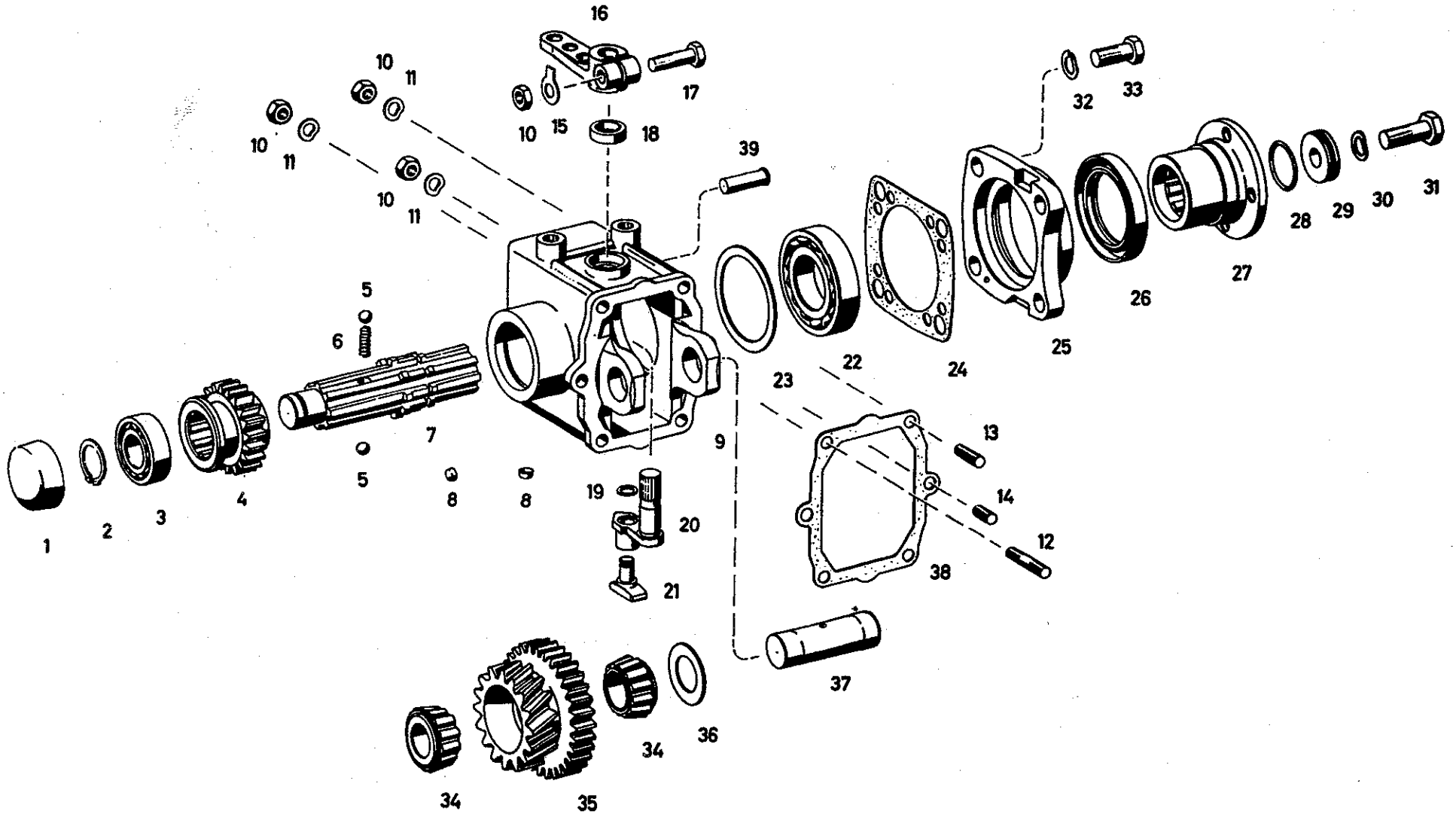


ZF-Synchroma-Gearbox S 5-24/3

Gear Shift

(Floor Shift)

E 1249.014



Power take off N 243/4

for ZF-Synchroma-Gearbox S 5-24/3