



ZF-Synchroma-Gearbox S 5-18/3

**Assembly, Maintenance
and Operating Instructions**

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ZF-SYNCHROMA-GEARBOX S 5-18/3

Assembly, Maintenance and Operating Instructions

Input Shaft	Gear	Ratios						Output Shaft	Gear
		1st	2nd	3rd	4th	5th	6th		
1st	1st	3.81	2.57	1.70	1.30	1.10	0.85	1st	1st
2nd	2nd	3.81	2.57	1.70	1.30	1.10	0.85	2nd	2nd
3rd	3rd	3.81	2.57	1.70	1.30	1.10	0.85	3rd	3rd
4th	4th	3.81	2.57	1.70	1.30	1.10	0.85	4th	4th
5th	5th	3.81	2.57	1.70	1.30	1.10	0.85	5th	5th
6th	6th	3.81	2.57	1.70	1.30	1.10	0.85	6th	6th

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2. Synchro Springs (C)

A synchro spring is attached to each side of the synchrobody. They press the pressure plates tightly on the sliding sleeve (D).

3. Pressure Plates (D)

They are axially displaced on selection of the sliding sleeve and thus press the synchro rings onto the cone of the clutch body (E).

4. Synchro Rings (F)

These are placed laterally between gear wheel (G) and synchrobody (A). There is no synchro ring on the reverse gear wheel, as this is not synchronized.

These components permit establishing of 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 (permanent) gear wheel.

I. Technical Data

Type	Input Torque max. kpm	Ratios							PTO	
		1. Gear	2. Gear	3. Gear	4. Gear	5. Gear	R. Gear	Speedo	Md Ab permissable kpm*	Output Speed
for CAR	25	3,85	2,4	1,76	1,26	1,0	3,67	2,5		
	25	3,85	2,08	1,39	1,0	0,87	3,67	to		
	30	2,99	1,76	1,3	1,0	0,87	3,67	3,4		
for light commercial vehicles	16	6,0	3,24	2,04	1,3	1,0	5,47	2,17	12	1,02 × n Engine
	16	6,0	3,03	1,81	1,3	1,0	5,47	to		
	18	5,33	3,24	2,04	1,3	1,0	5,47	4,0		

* For correct value, refer to ZFF technical department.

Weight: ca. 33 kg

Oil capacity: ca. 1,6 liter

II. Description

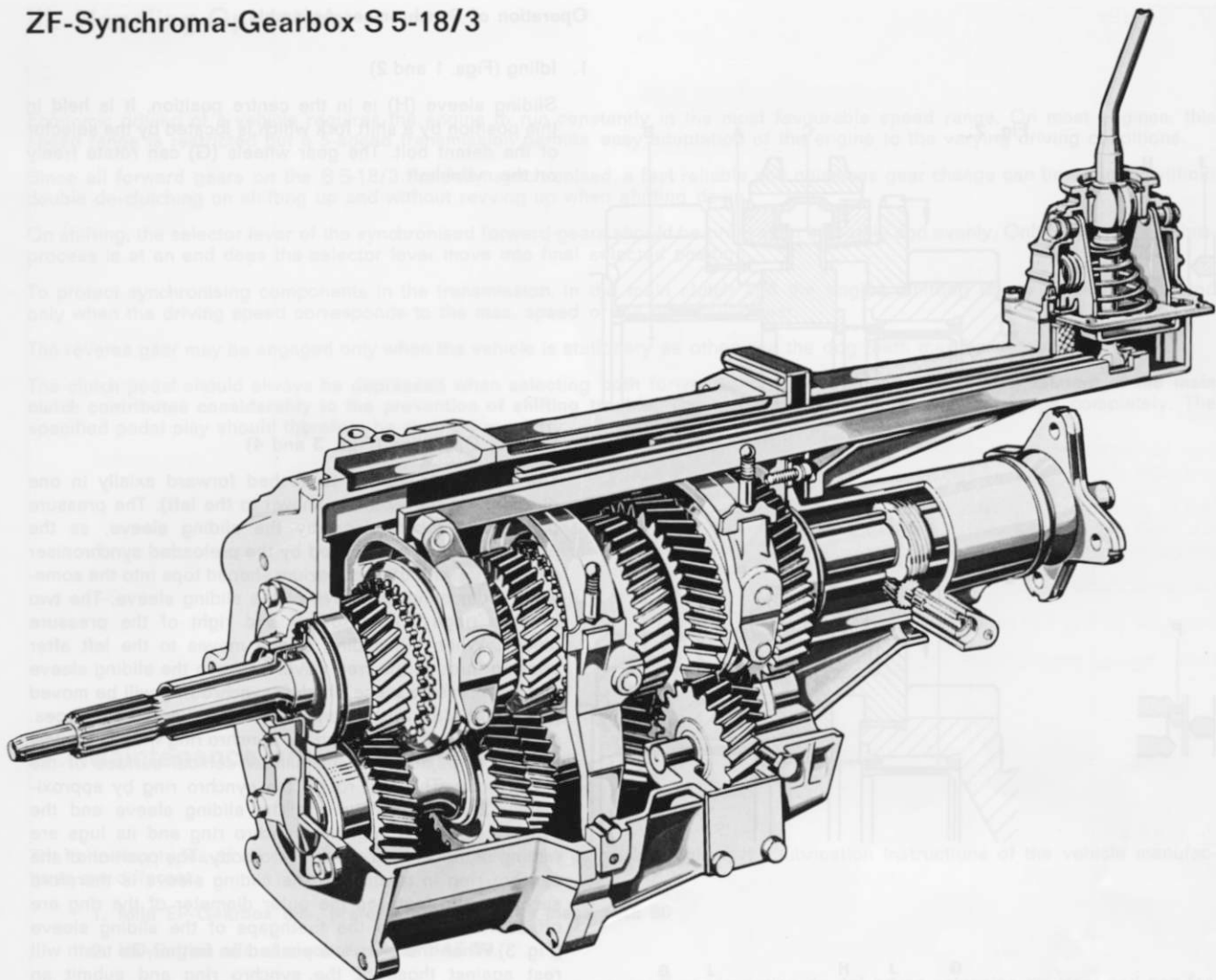
The ZF Synchroma 5 speed gearbox S 5-18/3 is an up to date gearbox synchronised in all forward gears. The reverse gear has a claw clutch. The transmission is flanged directly to the engine and is actuated by means of a set back or a central floor shift or by a steering column depending on the type of vehicle. The design of the transmission and the use of push 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 speeds remain constantly in mesh. Whilst the wheels on the countershaft are permanently attached to the shaft, the needle bearing counter wheels can rotate freely on the main shaft. During the shifting operation, the speeds of the members to be coupled are synchronised by ZF-B synchronisers. The idler gear of the pertinent speed is coupled to the mainshaft by means of a clawed sleeve and the power flow is guided by the pertinent gears to the output end.

At direct speed (that can be 4th or 5th gear according to gearbox type) the countershaft is not included in the power flow i. e. the input shaft and the main shaft are coupled directly to each other and consequently the engine revolution and the torque change to 1:1. In reverse gear the direction of the output speed is changed by a built-in intermediate gear (so-called reverse gear).

The shifting sleeves supply shift forks which are guided by bearing spigots entering the gearbox housing and which are actuated by the push rods. The shift forks are held in the engaged position by spring detents. A built-in shift lock guarantees that only one speed can be engaged at a time.

ZF-Synchroma-Gearbox S 5-18/3



Description of ZF-B-Synchroniser Assembly

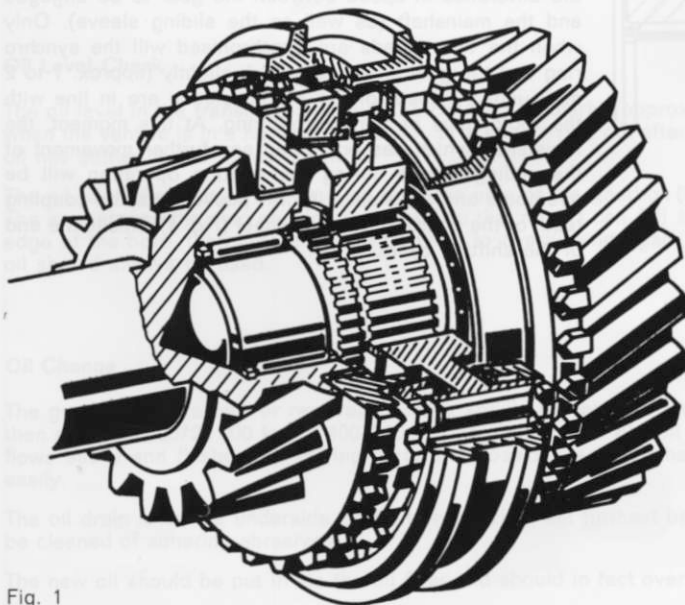


Fig. 1

Description

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

1. The Synchrobody (A)
Axially and radially immovable in relation to main-shaft (B), on which it is located.
2. Synchro Springs (C)
A synchro spring is attached to each side of the synchrobody. They press the pressure pieces lightly on the sliding sleeve (H).
3. Pressure Pieces (D)
They are axially displaced on selection of the sliding sleeve and thus press the synchro rings onto the cone of the clutch body (J).
4. Synchro Rings (F)
These are placed loosely between gear wheel (G) and synchrobody (A). There is no synchro ring on the reverse gear wheel, as this is not synchronised.

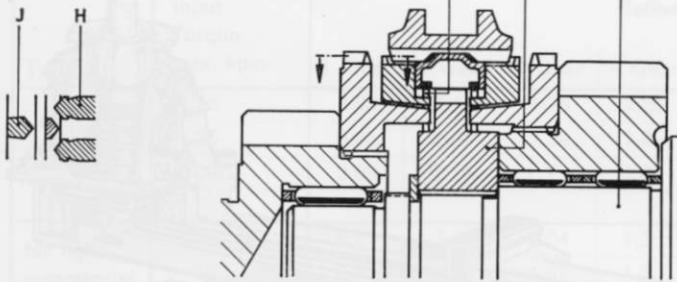
These components permit establishing of uniform angular speeds between the gear wheel to be coupled and the shaft before the sliding sleeve (H) and its internal teeth enter the clutch teeth of the (pertinent) gear wheel.

Operation of Synchroniser Assembly

1. Idling (Figs. 1 and 2)

Sliding sleeve (H) is in the centre position. It is held in this position by a shift fork which is located by the selector of the detent bolt. The gear wheels (G) can rotate freely on the mainshaft.

Fig. 2



2. Shifting Operation (Figs. 3 and 4)

The sliding sleeve (H) is pushed forward axially in one direction (in the example shown to the left). The pressure pieces are taken along by the sliding sleeve, as the pressure pieces are pushed by the preloaded synchroniser springs (C) with their trapezium shaped tops into the somewhat wider annular groove of the sliding sleeve. The two synchro rings (F) lie to left and right of the pressure pieces. When the sliding sleeve moves to the left after passing through the free travel between the sliding sleeve and the pressure piece, the left synchro ring will be moved to the left side in the same way by the pressure pieces. After approximately 0.5 mm the synchro ring with its conical surface is adjacent to the similar conical surface of the clutch body. This will rotate the synchro ring by approximately 2 mm in relation to the sliding sleeve and the synchro body (A) until the synchro ring and its lugs are resting in the slots of the synchro body. The position of the synchro ring in relation to the sliding sleeve is therefore such that the teeth on the outer diameter of the ring are offset in relation to the toothgaps of the sliding sleeve (Fig. 3). When the sleeve is pushed on further, its teeth will rest against those of the synchro ring and submit an axial force against the ring. The flat adjoining 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 which are transmitted to the sliding sleeve in axial direction. This will continually reduce the difference in speed between the gear to be engaged and the mainshaft (as well as the sliding sleeve). Only when the two speeds are synchronised will the synchro ring and the gear wheel turn back slightly (approx. 1 to 2 mm) until the teeth of the sliding sleeve are in line with the tooth gaps of the synchro ring. At this moment, the resistance which has prevented any further movement of the sliding sleeve during the shifting operation will be overcome and the sleeve is now pushed into the coupling teeth of the appropriate gear wheel (Fig. 4). This is the end of the shifting cycle.

Fig. 3

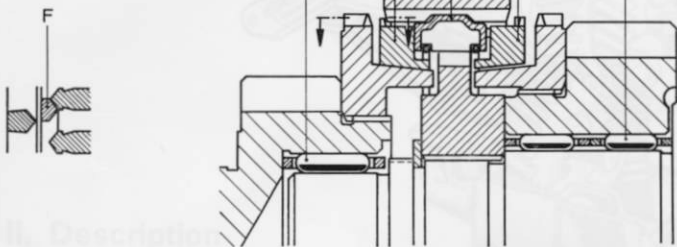
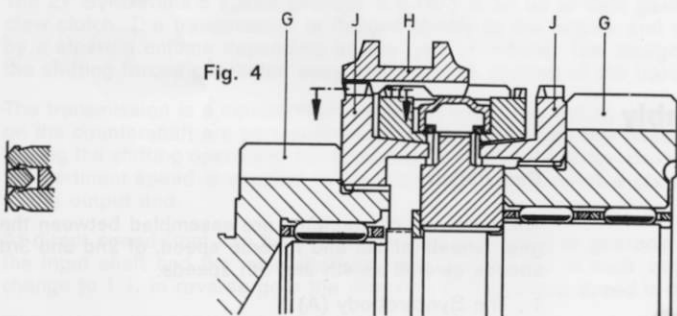


Fig. 4



- A) Synchro Body
- B) Mainshaft
- C) Synchro Springs
- D) Pressure Piece
- E) Needle Bearing
- F) Synchro Ring
- G) Gear Wheel
- H) Sliding Sleeve
- J) Clutch Body

III. Handling Operation

Economic driving of a vehicle requires the engine to run constantly in the most favourable speed range. On most engines, this speed range is restricted but a 5-speed transmission permits easy adaptation of the engine to the varying driving conditions.

Since all forward gears on the S 5-18/3 are fully synchronised, a fast reliable and noiseless gear change can be effected without double de-clutching on shifting up and without revving up when shifting down.

On shifting, the selector lever of the synchronised forward gears should be pressed in smoothly and evenly. Only when the synchro-process is at an end does the selector lever move into final selected position.

To protect synchronising 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.

The reverse gear may be engaged only when the vehicle is stationary as otherwise the dog teeth may be damaged.

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

IV. Maintenance and Lubrication

The following types of oil can be used for lubrication of the gearbox unless the lubrication instructions of the vehicle manufacturer are different.

1. Mild EP-Gearbox oils, preferably of viscosity class SAE 80
2. HD-Engine oils of viscosity class SAE 30

Mild gear oil types are those EP oil grades which in the presence of condensation do not cause corrosion on steel and non-ferrous metal parts and hardening of gaskets and seals. So-called multi-purpose or universal oils can be used if they meet our „Lubrication Oil Requirements for ZF Transmission Nr. 13-118“. In case of doubt, please ask an oil supplier.

To facilitate the choice of oil for vehicles used abroad, it should be mentioned that multi-purpose oil SAE 80, with mild EP-Additives, as per specification MIL-L- 2105 (A), can meet these requirements.

Oil Level Check

The oil level in the transmission should be checked regularly (approx. every 10.000 km). The check should be undertaken only when the vehicle is in a horizontal position. If this is carried out after driving, then some time should be allowed to elapse until the oil has settled in the transmission.

The oil filler plug should be removed from the side of the gearbox (to the right as seen on the output flange) to check the oil level. The area around the plug should be cleaned so that no dirt can fall into the transmission. If the oil level has dropped below the edge of the bore, then the oil should be filled to overflowing again. Then close the oil filler plug. If possible, the same type of oil should always be used.

Oil Change

The gearbox oil in a new or repaired gearbox should be changed first after 4000 to 5000 km or after 100/125 working hours, and then every 16 000/20 000 km or 400/500 working hours. The old oil should always be drained after driving as it is then warm, flows easily and flushes the driving parts and possibly removes the water condensation which has formed from the gearbox more easily.

The oil drain is on the underside of the transmission, set furthest back. Prior to screwing the drain plug back, the magnet should be cleaned of adhering abrasives.

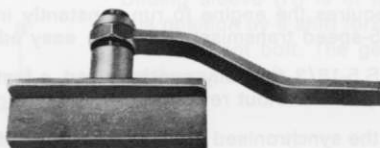
The new oil should be put in via the oil filler and should in fact overflow at the end of the bore (required oil capacity approx. 1,6 l).

Often, lubricants and additives are offered in addition to the oil. The oils meeting our instructions already have their additives which the transmission needs. Anything further is not necessary, and could even cause damage.

V. Tools

Tool .1.

Device for fastening transmission into vice



Tool Nr.

1253 898 653

Tool .2.

Tool for pulling out ball bearing of the mainshaft and input shaft.

In a larger number of these gearboxes, the ballbearings are fitted with divided inner ring. The following tools are necessary for the assembly of this bearing.

Universal Puller

Insert for pulling ball bearings (212 and 423)

Puller for ball bearing inner ring



1253 898 205

1248 898 201

1253 898 203

1255 898 202

Tool .3.

Puller for reverse bolt (only for heavy vehicle versions)



1211 898 206

Tool .4.

Basic Tool



1253 898 204

Tool .5.

Gripping piece for pulling roller bearings (303 and 309) off the counter shaft.



1253 898 202

Tool .6.

Bushes for pressing synchroniser onto mainshaft

for 1.—R. gear

2.—3. Gear

4.—5. Gear



1255 898 052

1255 898 053

1255 898 054

Tool .7.

Pressure piece for knocking spring rings onto synchroniser

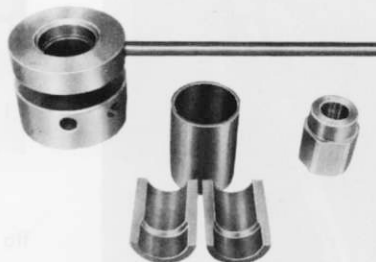


Tool Nr.

1253 898 054

Tool .8.

Tool for pressing ball bearing (212 and 423) on the main- and input shafts



1253 898 652

Tool .9.

Pressing mandril for the shaft seal (207) in the withdrawal bearing carrier (206)



1255 898 051

Tool .10.

Tool for pressing shaft seal into the speedo bush



1253 898 654

Tool .11.

Mandril for pressing the tapered roll bearing inner ring onto the counter shaft



1211 898 051

VI. Stripping of Transmission

Note: The numerals in brackets e. g. (611) refer to part numbers in exploded view at end of instructions.

Screw tool .1. into the thread of the oil drain plug (to fasten transmission more securely, the full thread in the housing should be used) and secure gearbox with the tool in the vice. Pull the lock nut of the tool .1. lightly.



Fig. 1



Fig. 2

A) Removal of Gear Shift

1. Remote floor shift (Car)

- 1.1 Remove boot (643). Remove circlips (642) from the groove of the gear lever turret (Fig. 1). Pull the gearchange control lever (640) with the bushes (641) from the gear change turret (Fig. 2).

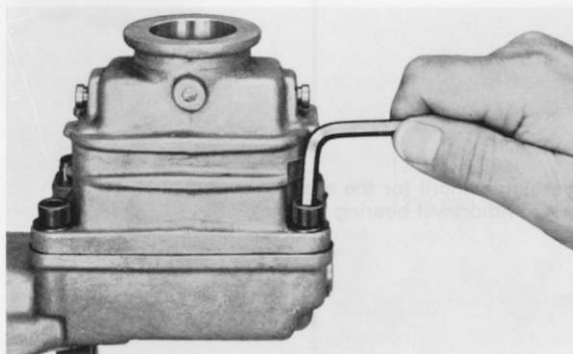


Fig. 3

- 1.2 Loosen the 4 screws (637) (Fig. 3) and lift off the gear change turret from the selector arm (Fig. 4). Take off guide plate.



Fig. 4

- 1.3 Pull pivot pins (630) from the gear change turret. Take out interlock swing (625) with torsion springs (633 and 633.1).

- 1.4 Screw off the 4 nuts (648) on the selector arm (619) (Fig. 5) and pull selector arm over the selection rods. Take pivot piece (624) out of selector arm.

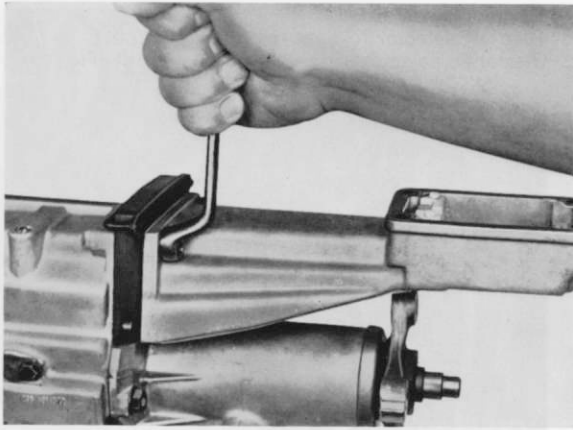


Fig. 5

1.5 Take out cylindrical screws (645) (Fig. 6) and take off vibration damper (644).

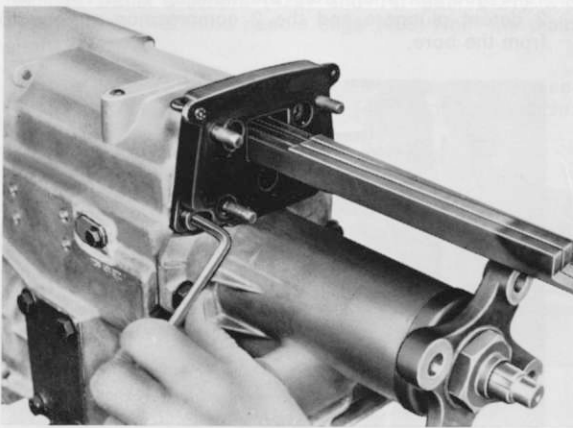


Fig. 6

2. Centrally located direct gear change (commercial vehicle)

- 2.1 Slip off the gaiter (643). Unhook cap (655) from the pivot pins (652) and pull selection lever completely out of the gearchange turret.
- 2.2 Loosen the 4 nuts (648) and lift up gearchange turret from housing (629). Remove selector gate (653).
- 2.3 Pull pivot pins (630) from the gearchange turret. Take out interlock swing (625) with torsion spring (633 and 633.1).

B) Dismantling of Speedo Cover

1. Push back the safety tab on the nut (430) and loosen nut (Fig. 7). For this, 2 gears must be engaged. Pull the output flange (429) from the mainshaft.

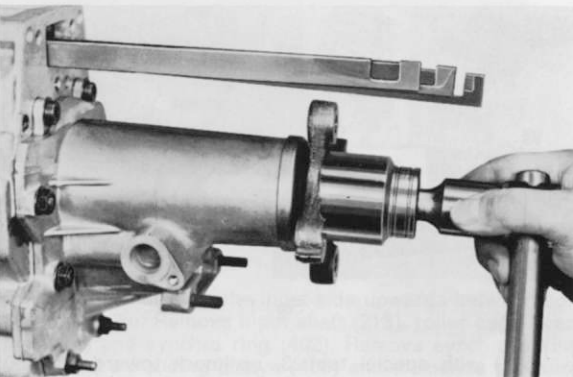


Fig. 7

2. Loosen nuts (808) and screws (803). Take off speedo cover (801). Slip off short distance bushes (428), speedo worm (427) and long spacing bushes (426).

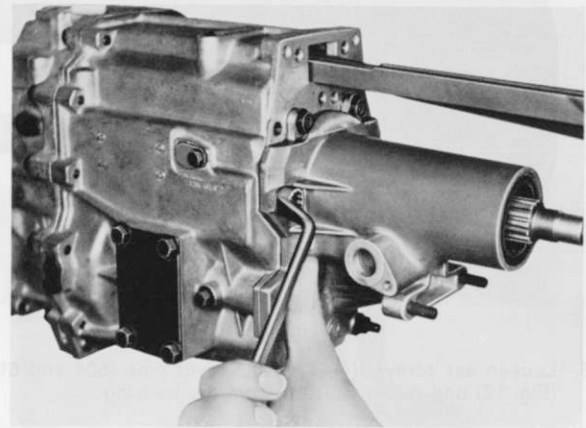


Fig. 8

3. Snap spring ring (425) out of ball bearing groove (423) and slide off the spacer (424). Pull the ball bearing from the mainshaft with tool .2. Attach the spacer (424) to the ball bearing.

C) Dismantling of Front Part of Housing

1. Loosen nuts (201) (Fig. 9) and front cover (203).

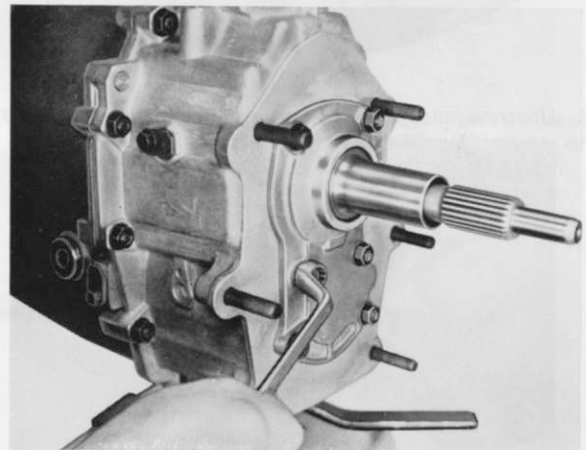


Fig. 9

2. Remove circlip (208) (Fig. 10) and take off spacer (209).
3. Dismantle spring ring. Pull off ball bearing (212) with tool .2.

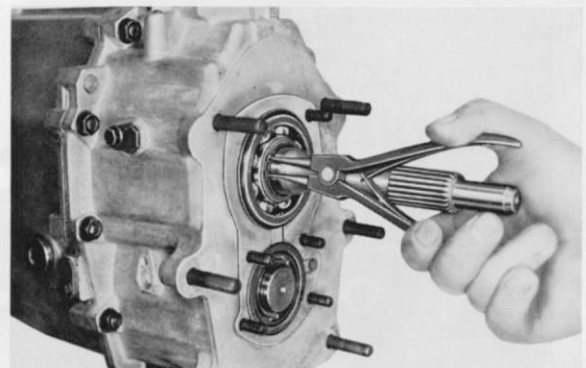


Fig. 10

4. Push back the 2 dowels (106) (Fig. 11).

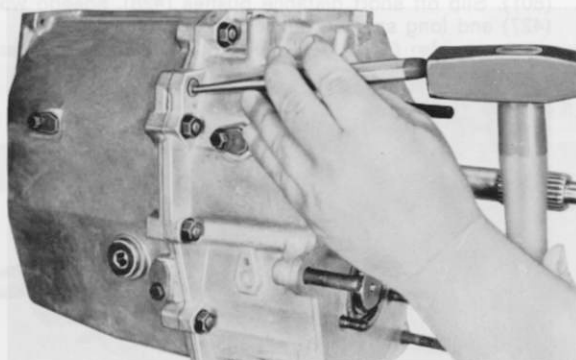


Fig. 11

5. Loosen set screws (602) on the pivot pins (604 and 610) (Fig. 12) and pull pivot pins from the housing.

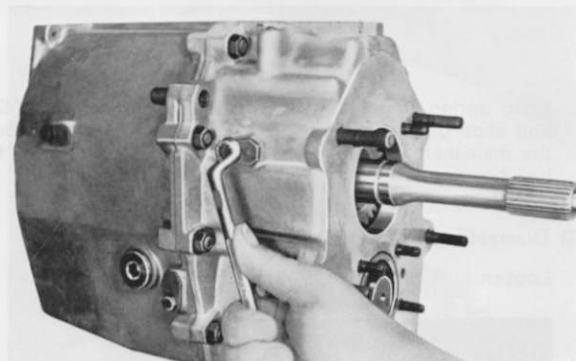


Fig. 12

6. Unscrew nuts (102) and turn cylindrical screws (Fig. 13).

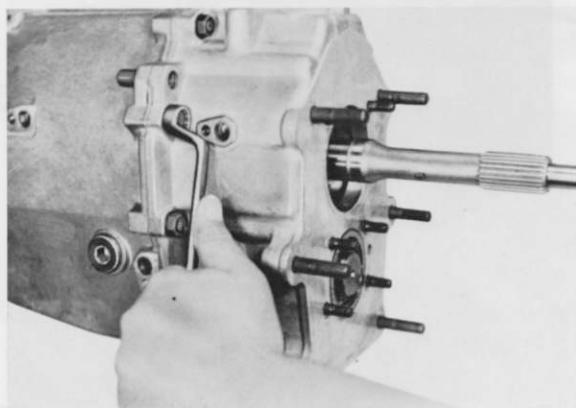


Fig. 13

7. Take off front part of housing (101) (Fig. 14). Pull detent plunger (617) and compression spring (616) from the bore.

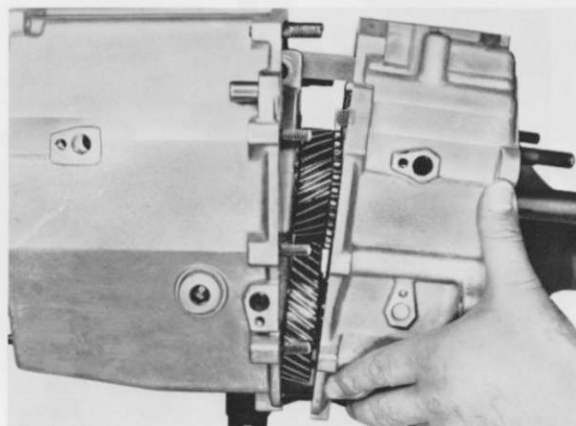


Fig. 14

D) Dismantling of Gearbox Shafts

1. Take off selector fork 4th and 5th gear (601).
2. Dismantle selector rods (608, 612 and 614) (Fig. 15).

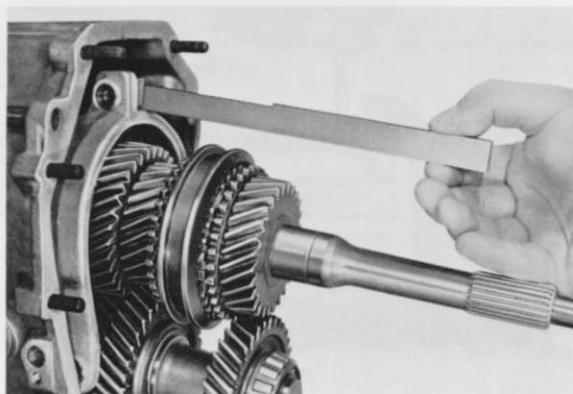


Fig. 15

3. Take gearbox shaft from the housing (Fig. 16). Pull the 2 detent plungers and the 2 compression springs (616) from the bore.

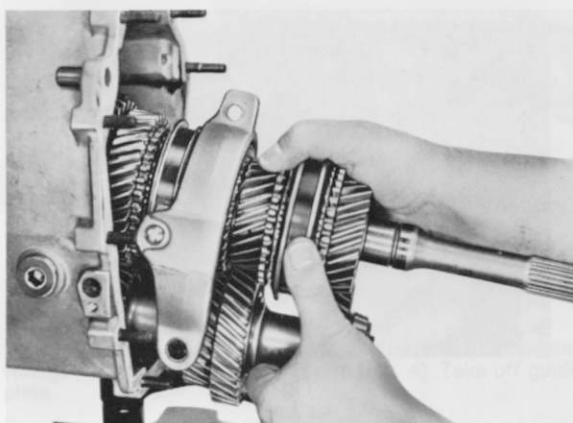


Fig. 16

E) Dismantling of Reverse Gear

1. Undo the screws (118) and take off the cover plate (117).
2. Remove the set screws (507) from the housing (Fig. 17) or pull out the dowel (511). Pull out the reverse idler shaft

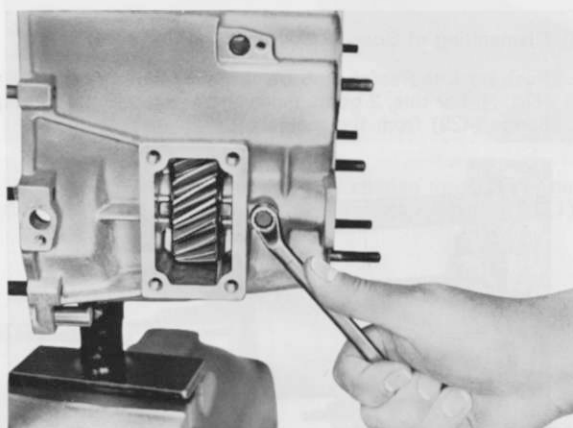


Fig. 17

(505) with special tool .3. or knock towards the output side with a fitted mandril (Fig. 18). Take out the reverse gear (502) with the 2 thrust washers (501). Pull the 2 needle cages (503) from the bore of the gear.

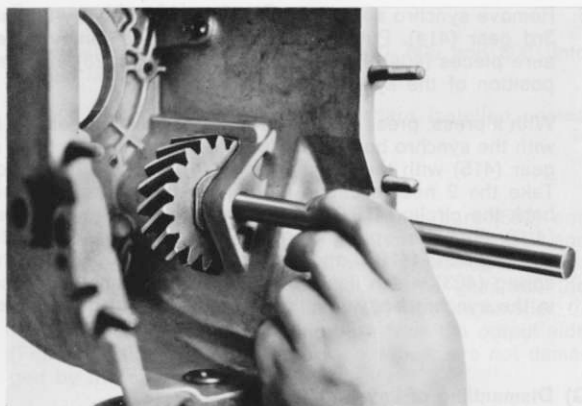


Fig. 18

F) Dismantling of Mainshaft

1. Remove thrust washers (422) and 1st gear (421) with synchro ring (402) and needle cage (408) from the mainshaft.
2. Remove synchro spring (403) from the pressure piece (404) (Fig. 19). Pull sliding sleeve (420) from the synchro

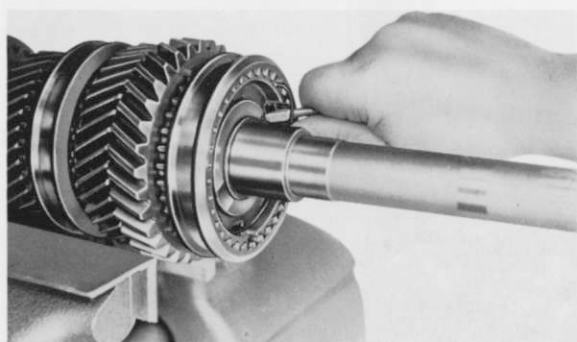


Fig. 19

body (419) and take off pressure piece (404). Remove circlip (409) from groove (Fig. 20) and mark position of the synchro body on the mainshaft.

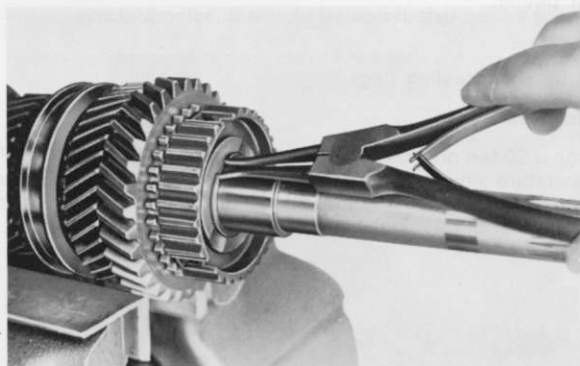


Fig. 20

3. Clamp mainshaft with the input side upwards between soft jaws of a vice. Remove input shaft (213), roller cage bearing (214) and synchro ring (402). Remove synchro spring (403). Pull off sliding sleeve (406) and dismantle pressure piece (404). Remove circlip (401) and mark position of the synchrobody on the shaft (Fig. 21).

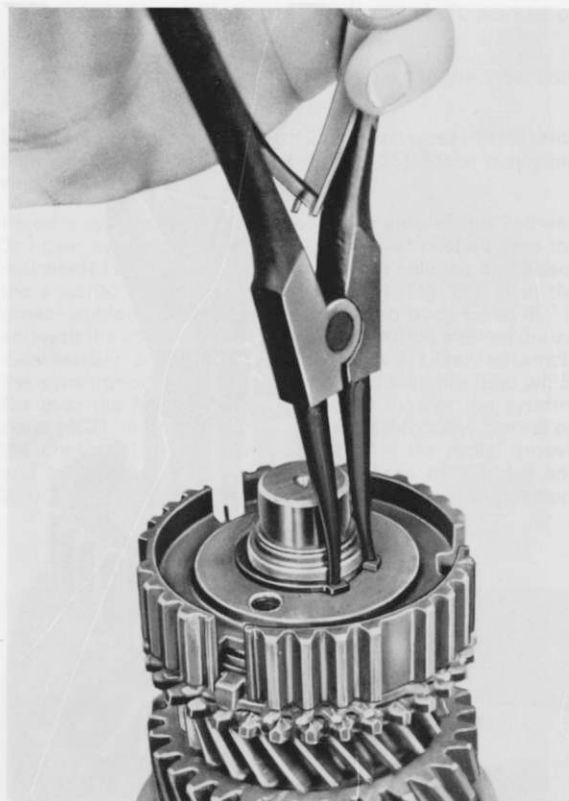


Fig. 21

4. Pull off synchro body 4th and 5th gear (405) with 2 screws M 8 and conventional pulling bridge (Fig. 22). Take off synchro ring (402), 5th gear (407) and needle cage (408).

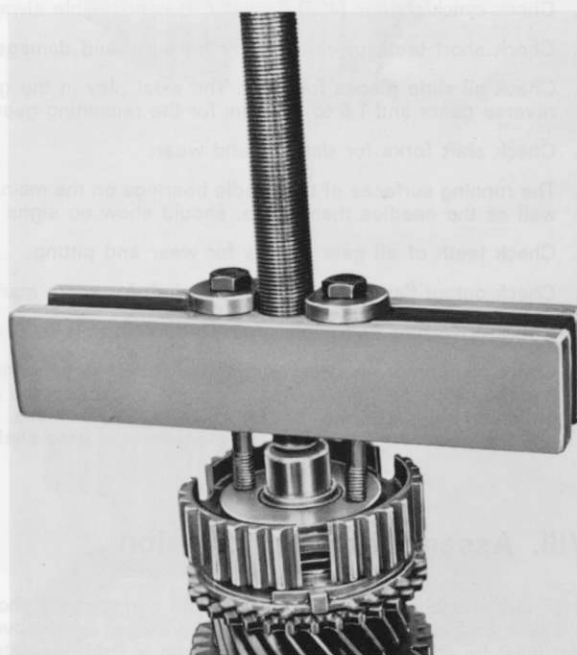


Fig. 22

5. Remove circlip (409). Push the thrust washer (410) with the 3rd gear (411) from the cylindrical splining of the shaft. Take off synchro ring (402) and needle cage (412).



Fig. 23

6. Remove synchro spring (403) on the synchro body 2nd and 3rd gear (414). Pull off sliding sleeve and remove pressure pieces (404). Remove circlip (413) (Fig. 23) and mark position of the synchro body on the shaft.
7. With a press, press down first of all the reverse gear (418), with the synchro body to the output side, and then the 2nd gear (415) with the synchro body (414) to the input side. Take the 2 needle cages (416) from the mainshaft. Bend back the circlip (419.2) on the synchro body reverse gear (419). Remove spring ring (419.1) and take off circlip, spacing plate (419.3) and synchro spring (403). The synchro spring (403) which lies **behind the welded angular pieces** in the synchro body reverse gear should not be removed.

G) Dismantling of Layshaft

Remove circlip (301) and pull off roller bearings (303 and 309) with tools .4. and .5. The constant gear wheel (304), the 5th speed gear wheel (306) and the 3rd speed gear wheel (307) can be pressed from the counter shaft individually with the help of a 20 ton press, as these gears are shrunkfit. It should be noted that the circlip (305) should be removed before the pressing of the 5th speed gear wheel. Remove all gasket parts such as shaft seals, (207, 811, 812) gaskets and O-Rings from the housing halves, the speedo cover, the withdrawal bearing flange and the pivot pins.

VII. Checking of Individual Components

1. Check synchro rings (402) for wear. It is advisable always to replace synchro rings with new ones when repairing transmissions.
2. Check short teeth of clutch body for wear and damage.
3. Check all slide pieces for wear. The axial play in the groove of the sliding sleeve must be 0,2 mm to 0,45 mm for 1st and reverse gears and 1,6 to 1,85 mm for the remaining gears.
4. Check shift forks for damage and wear.
5. The running surfaces of the needle bearings on the mainshaft (417), on reverse shaft (505) and in the bores of gear wheels, as well as the needles themselves, should show no signs of wear or pitting.
6. Check teeth of all gear wheels for wear and pitting.
7. Check output flange (429) and input shaft for score marks caused by shaft sealing rings.
8. Check drive pins and guide grooves on shift rails (608, 612, 614) for wear.
9. Gears of counter shaft are shrunk-fit. They can be removed only on a 20 ton press. For shrinking, heat gears to 150 to 180° C and then slide on counter shaft. Be sure to maintain the above temperature since a temperature in excess of 180° C may cause structural changes which in turn might impair hardness. At temperatures below 150° C, the expansion of the gear is too low and the gear wheel might seize when pressed onto shaft (also refer to „Preassembly of Countershaft“).

VIII. Assembly of Transmission

Prior to assembly of the transmission, all components should be carefully cleand. The sealing surfaces of the housing front end 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 sure in particular that no chips or other foreign particles remain in the housing. For inserting shafts and bolts, always use a soft hammer (plastic, lead etc.). Never hit hardened transmission parts with a steel hammer. When installing studs, make sure that they are inserted into tapped-through holes together with sealing compound (for good sealing).

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

A) Preassembly of Housing Components

Screw studs (104, 105, 108, 109, 110, 805 and 806) into tapped holes of housing.

Note: New studs for through holes are installed coated with sealing compound.

B) Assembly of Reverse Gear Wheel

1. Put needle cages (503) into reverse gear bore (502) and stick needles with grease. Stick a thrust washer (501 and 510) on each side of the wheel with grease (the turned down flaps lie outwards). Put the reverse gear into the housing. Push the reverse idler shaft with the smaller ϕ first into position in the housing bore from the output side (Fig. 24). Take care that the thrust washers are not damaged by the shaft.
2. Insert screws (507) with spring washer (506) (underneath) and tighten to 2,0 to 2,5 kpm (see Fig. 17). The securing bolt must come to lie behind the shaft (not in the groove). On various gearbox types a dowel (511) must be put through the housing into the shaft bore.
3. Fasten gasket (116) and cover (117) onto the housing with set screws (118) and spring washers (103) (underneath). Tighten torque of the screws to 2 to 2,5 kpm.

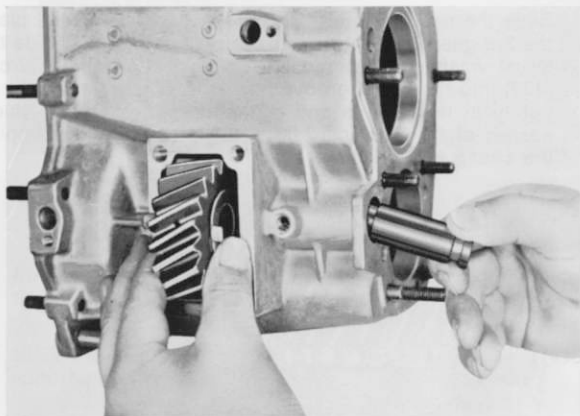


Fig. 24

C) Preassembly of Mainshaft

Note: New synchrombodies (405, 414 and 419) have no cylindrical splining in their hub. This is pressed onto the hardened mainshaft. Therefore, when using old synchrombodies, it should be noted, that before pres-

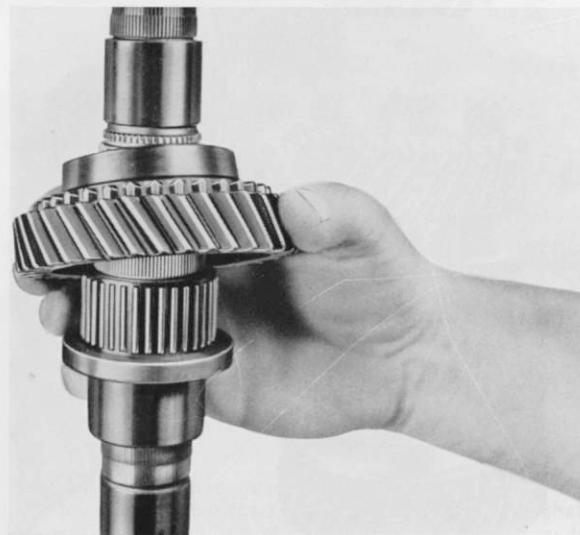


Fig. 25

sing, the positions of the hub and shaft, marked on disassembly, should be in line.

1. Clamp mainshaft (417) between soft jaws in the vice. Output end on top.
2. Slide needle cage (416) and 2nd gear wheel (415) onto mainshaft with dog teeth on top (Fig. 25). Place a synchro ring (402) on the cone of the gear.
3. Place a synchro spring (403) onto the side of the 2nd and 3rd gear synchro body (414) which is first pushed onto the mainshaft i.e. on the side which has the splining and attach the squared off end into the cross slot (Fig. 26). Heat the preassembled 2nd and 3rd gear synchro body up to 80° C and with the splines lined up into the position marked during disassembly, press onto mainshaft (Fig. 27). Only assemble the synchrobody with tool .6. or with a suitable tube which fits over the hub. Make sure that the lugs of the synchro rings (402) lie in the recess of the synchrobody. Spring on the circlip (413); this must sit tightly in the radial groove and is therefore available in thicknesses of 1,8; 1,9 and 2,00 mm. Use tool .7. for tapping the circlip into position.

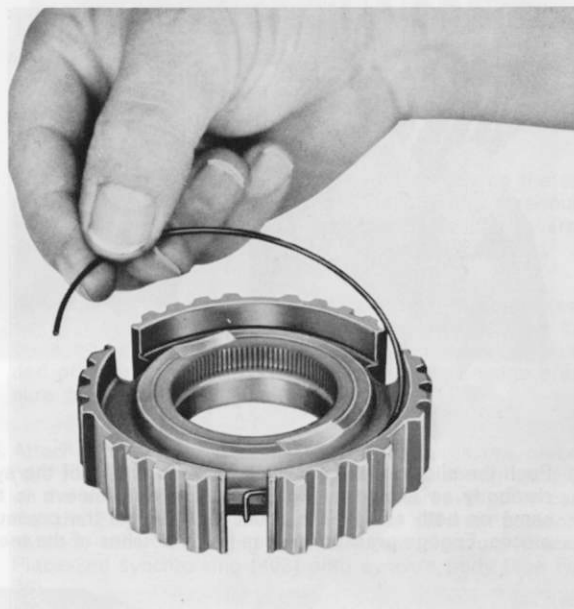


Fig. 26

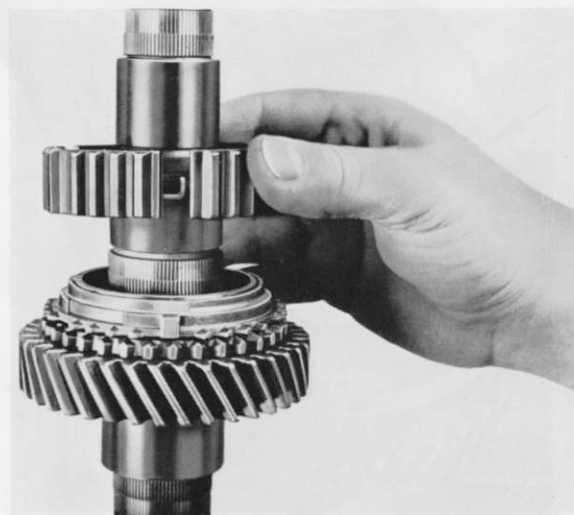


Fig. 27

4. Attach the 3 pressure pieces (404) with grease to the assembled synchro spring such that the wire is fixed in the recesses of the pressure pieces. The squared off end of the synchro spring must come to lie on the inside of a pressure piece (Fig. 28) so that the spring cannot distort.

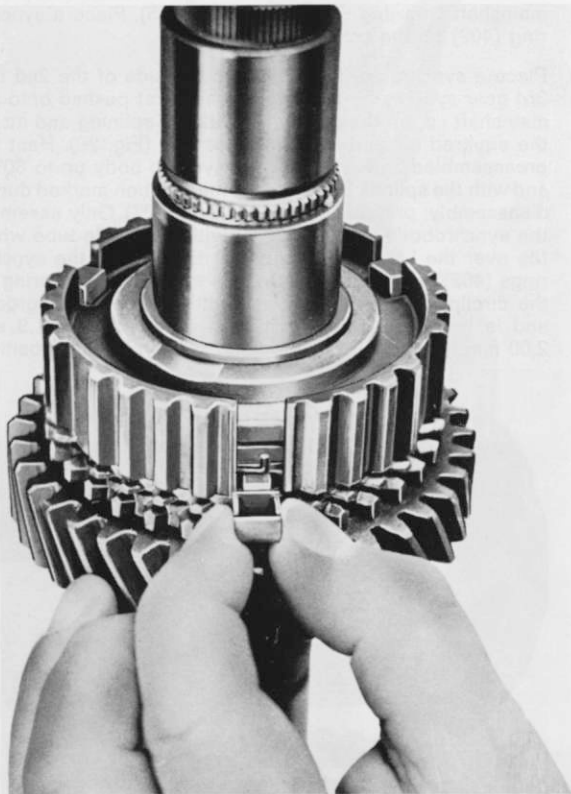


Fig. 28

5. Push the sliding sleeve (406) onto the splining of the synchrobody as shown in Fig. 29 (This sliding sleeve is the same on both sides). The 3 flat teeth lie on the pressure pieces. Engage pressure pieces in the notches of the teeth.

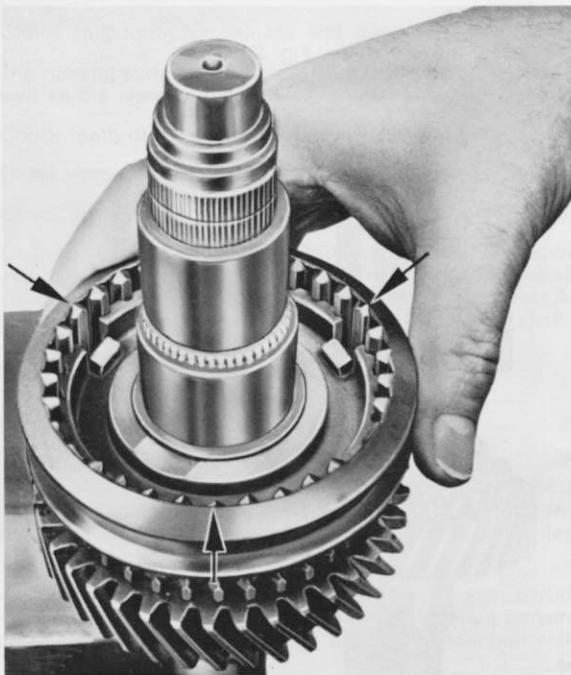


Fig. 29

6. Attach second synchro spring (403) in the pressure pieces (Fig. 30). The squared off end of the spring must lie on the inner side of a pressure piece. Moreover, take care that the 2 spring ends are assembled in different positions to each other i. e. lie in 2 different pressure pieces. Lay the second synchro ring (402) on the synchro body (see Fig. 31).



Fig. 30

7. Slide the needle cage (412) onto the mainshaft and place the 3rd gear (411) into the synchro ring (Fig. 31). Slide the thrust washer (410) onto the splining and snap a circlip (409) into the radial groove of the shaft. The ring must sit tightly in the groove and is therefore available in thicknesses of 1,8; 1,9 and 2,00 mm. Use tool .7. for tapping the circlip into position.



Fig. 31

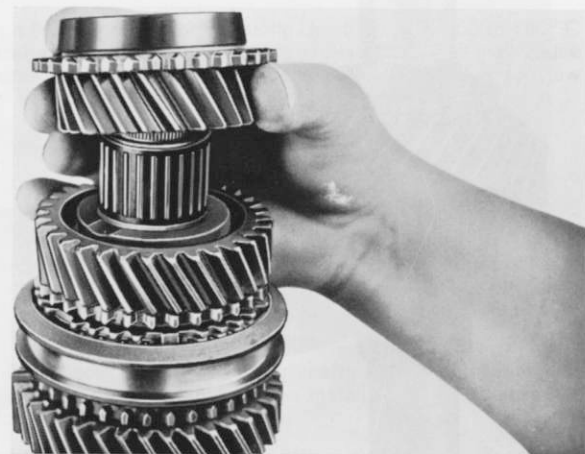


Fig. 32

8. Slide the needle cage (408) and 5th gear wheel (407) with the dog teeth upwards onto the bearing seat of the shaft (Fig. 32). Place a synchro ring (402) on the cone of the gear.
9. Place a synchro spring (403) onto the side of the synchrobody (405) with the longer hub and attach squared off end to the cross slot (see Fig. 26). Heat 4th and 5th gear synchrobody to 80°C and press it with the longer hub first onto mainshaft (Fig. 33). Use tool .6. and note the marked position when pressing on and insert the lugs of the synchro rings into the notches of the synchrobody. Select a circlip (401) thick enough to sit tightly in the radial groove. The ring is available in thicknesses of 1,8; 1,9 and 2,0. Attach circlip and with tool .7. push into groove.



Fig. 33

10. Release mainshaft and with output side upwards fasten firmly again in the vice.
11. Slide the needle cage (416) and reverse gear wheel (418) with the dog teeth upwards onto the shaft (Fig. 34).

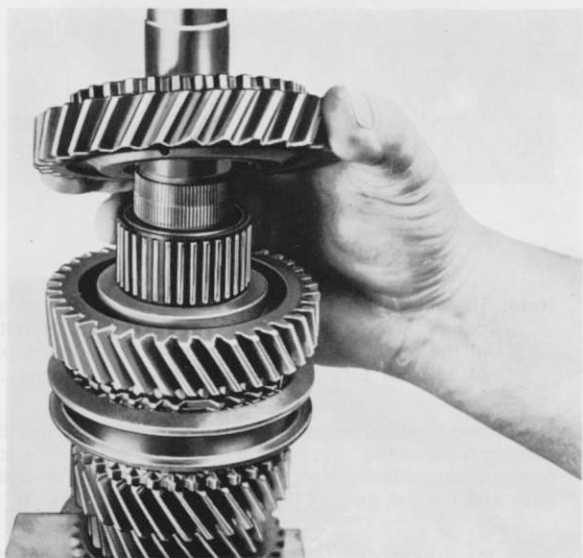


Fig. 34

12. Heat 1st and reverse gear synchrobody (419) 80°C and with the longer hub placed first in the position on the shaft splining, marked during stripping, (Fig. 35), press up to stop with tool .6. Insert circlip (409) in the radial groove

of the mainshaft. The circlip must sit tightly in the groove. Available ring thicknesses 1,8; 1,9 and 2,00 mm. Push circlip up to stop in the groove with tool .7.

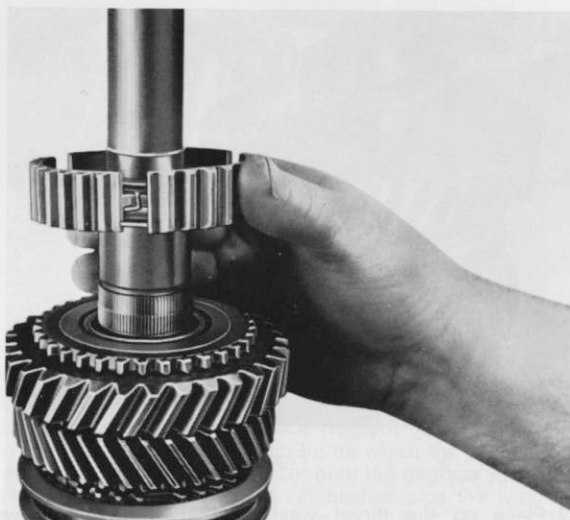


Fig. 35

13. Stick the 3 pressure pieces (404) with grease on the assembled synchro spring (403) (see Fig. 28). The wire must stick in the grooves of the pressure pieces and the squared off ends lie on the inner side of the pressure piece.
14. Slide the sliding sleeve (420) onto the synchrobody (see Fig. 29) such that the 3 flat teeth come to rest on the pressure pieces. The narrower collar and the small rounded off teeth must lie against reverse gear. Engage pressure pieces in the notches of the teeth.
15. Attach 2nd synchro spring (403) in the pressure pieces (see Fig. 30). The squared off ends of the spring must lie on the inner side of a pressure piece. Moreover, take care that the 2 spring ends are assembled in different positions to each other i.e. lying in 2 different pressure pieces. Place 2nd synchro ring (402) onto synchro body (see Fig. 36).
16. Slide needle cage (408) and 1st gear (421) with clutch teeth downwards (Fig. 36).

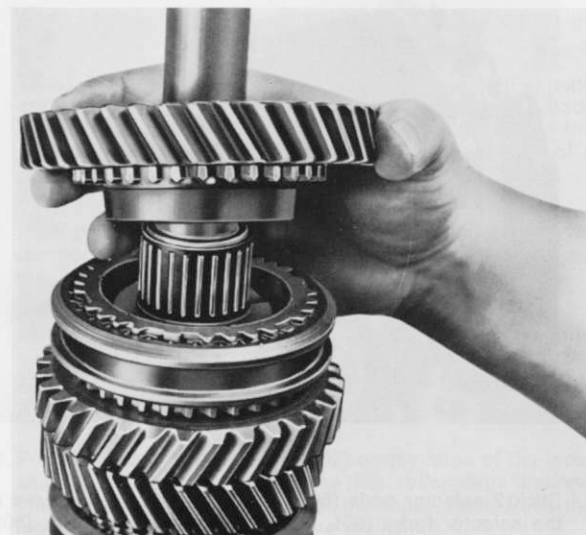


Fig. 36



Fig. 37

17. Place on the thrust washer (422) with step upwards (Fig. 37).

D) Preassembly of Layshaft

Make bores of helical gear and fitted seats on the layshaft free of oil, grease and dust. Heat 3rd gear (307) and 5th gear (306) to 150° - 180° C and push individually against stop on layshaft. Note that the 3rd gear is put on the shaft with the side having the locating hole and the somewhat wider collar first. Insert circlip (305). Warm constant gear (304) likewise to 150° - 180° C and press on with the longer hub first. Press on both inner races of the taper roller bearing (303 and 309) up to the stop. The larger diameters are each towards the gear wheels. Place circlip (301) in radial groove. On gearboxes with manufacturer's number under 1152, ball bearings are used to some extent. In such a case the rear bearing (309) should not yet be pressed on (only after the installation of gearbox shaft into the housing).

E) Installation of Gear Shafts

1. Stick pressure spring (616) and detent plunger (617) into the 3 retaining bores of the gearbox front and rear with grease (Fig. 38).

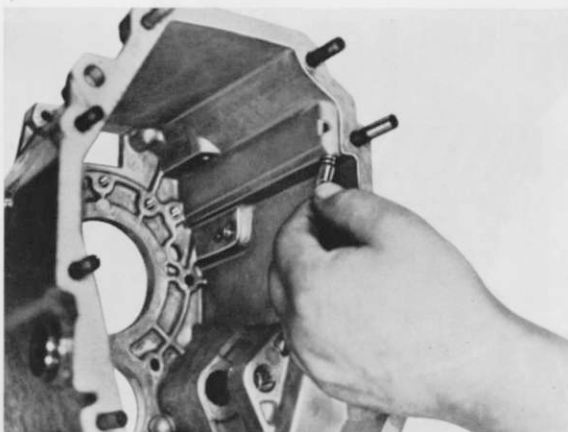


Fig. 38

2. Stick 2 selector pads (607) with grease into the bores of the selector forks (601, 609, 613), for selector fork (609) in the middle holes and for forks (601 and 613) in the lower holes (Fig. 39).

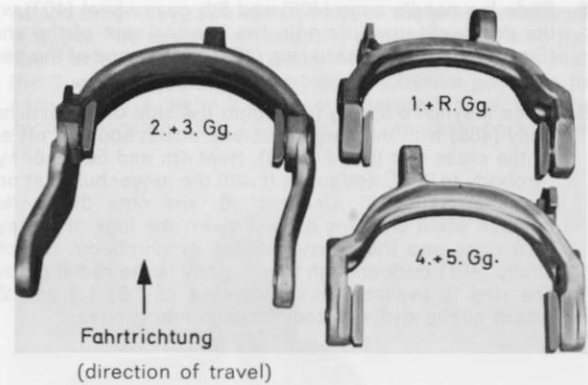


Fig. 39

3. Insert layshaft with the small teeth first into the housing (Fig. 40).
4. Place selector fork 1st and reverse gear (613) in the groove of the 1st and reverse sliding sleeve (420) and 2nd and 3rd selector fork (609) in the 2nd and 3rd sliding sleeve (406). The detent pad must lie on the side of the installed reverse gearwheel (502).

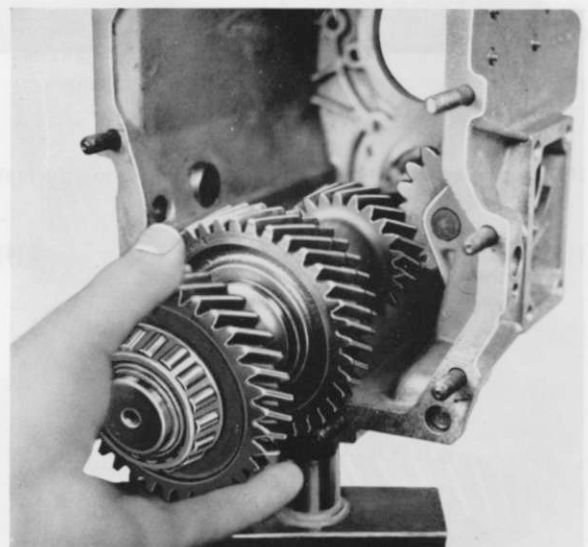


Fig. 40

Note: The selector fork 1st and reverse gear has a detent pad with open detents, therefore with only 1 notch in the middle as shown in Fig. 41. The detent pad of selector fork 4th and 5th gear has 3 notches.

5. Push preassembled mainshaft with output side first into the bearing base of the housing (Fig. 42). Pay attention to correct position of forks (detent plunger (617) over the detent pad) and the 1st gear (421).
6. Snap the spring ring (425) into the radial groove of the ball bearing (423). Push ball bearing with the spacer (424) dismantled during disassembly onto the mainshaft (Fig. 45). Bind layshaft to the mainshaft with tape (see Fig. 45).
7. With pressing tool .8., the threaded pieces belonging to it and the 2 distance bushes (426 and 428), press the ball bearing to the stop on the thrust washer (422). Then tap the ball in the housing bore. Leave tool .8. tight.

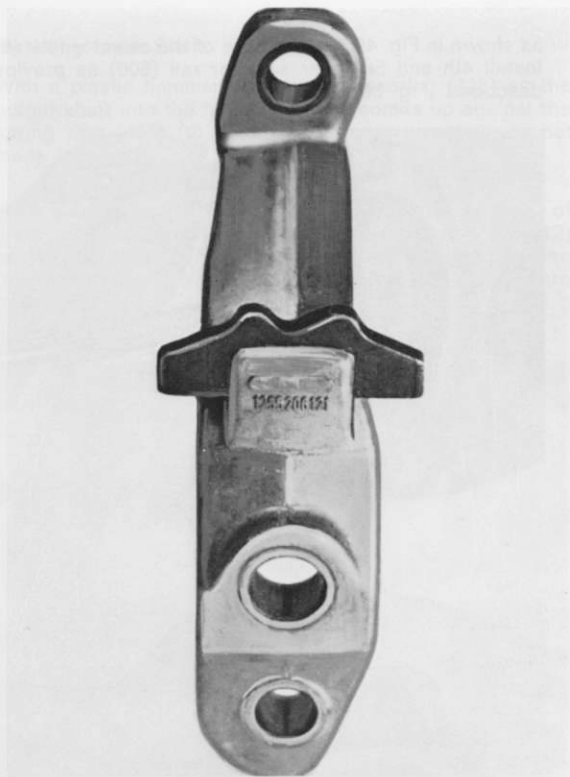


Fig. 41

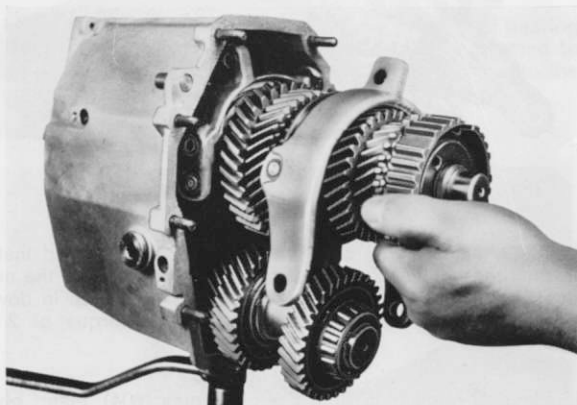


Fig. 42

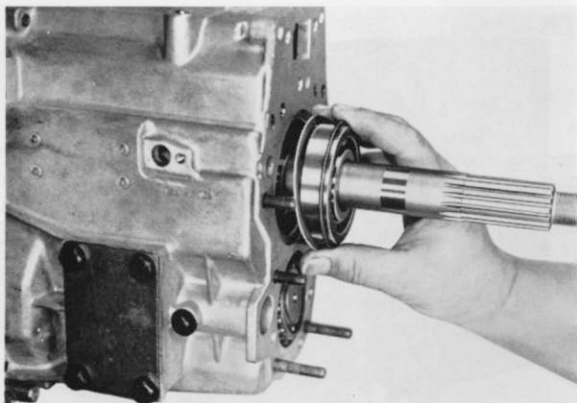


Fig. 43

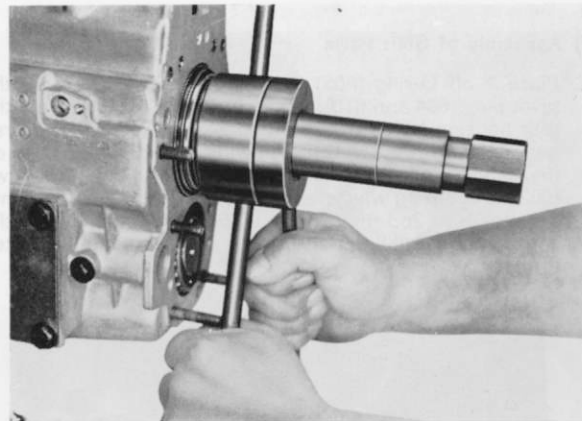


Fig. 44

8. Turn the housing such that the open side points upwards. With a depth gauge measure from the face of the synchro-body to the gearbox joint face (without gasket) (Fig. 45). A straight edge with the high lip on which the slide of the depth gauge is set must be put onto the gearbox joint face (Fig. 45). The measurement established plus the width of the straight edge should amount to $53,5 \pm 0,1$ mm. The difference between the measured size and the theoretical size shows the thickness of the spacer (424), which lies between the recess of the housing and the spring ring (425). The shim (424) which is available in thicknesses of 0,6; 0,8; 1,0; 1,2 and 1,4 mm must, if necessary, be exchanged. Stand gearbox in horizontal position again and take of pressing tool .8.

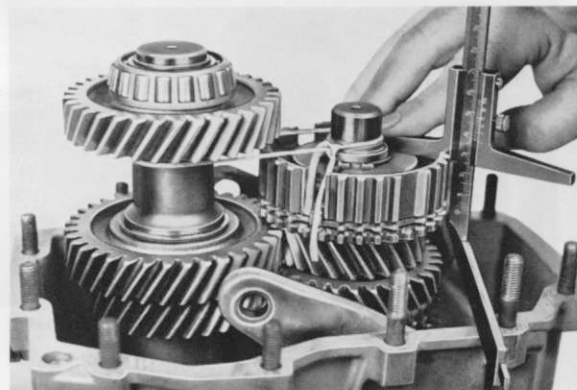


Fig. 45

9. Take off tape. Stick the 3 pressure pieces (404) with grease onto the installed synchro spring on synchro body 4th and 5th gear (405) such that the wire is fixed in the recesses and the squared off end on the inner side of a pressure piece (see Fig. 28).
10. Push the sliding sleeve (426) onto the splining of the synchrobody (see Fig. 29). The 3 flat teeth come to rest on the pressure pieces. Engage pressure pieces in notches.
11. Attach the second synchro spring (403) to the pressure pieces (see Fig. 30). Attach the squared off end of the spring again as described for synchrobody 2nd and 3rd gear.
12. Put the second synchro ring (402) on the cone of the input shaft (213) (see Fig. 33). Place the roller cage bearing into the spigot bearing bore of the input shaft. Push the input shaft on the spigot of the mainshaft.

F) Assembly of Shift Parts

1. Place 1 off O-ring (605) into the grooves of each of the pivot pins (604 and 610). Put 2 pivot pins (604) through the rear housing bores into the bores of the 1st and reverse gear selector fork (613) (begin with pivot pin which lies on the detent pad side as shown in Fig. 46). Tighten screws (602) with spring washers (603). Push pivot pins (610) into selector fork 2nd and 3rd gear (609) and fasten with the screws (602) and spring washers (underneath). Tighten torque screws (602) to 0,8 to 1,2 kpm.

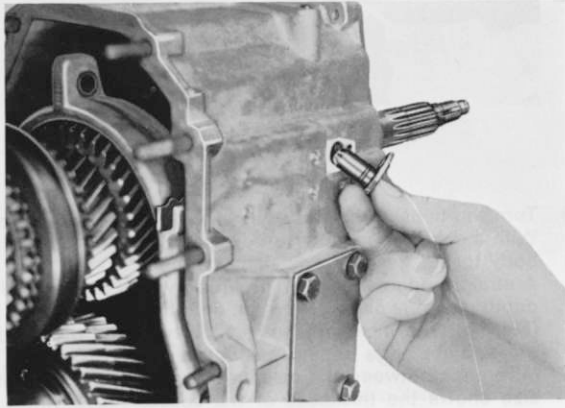


Fig. 46

2. Place the 4th and 5th gear selector fork onto the sliding sleeve as shown in Fig. 47.

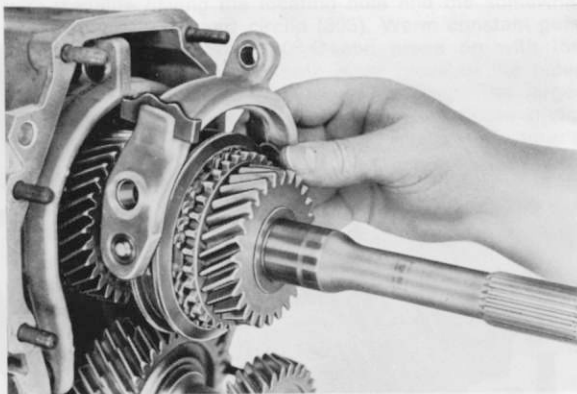


Fig. 47

3. Assemble shift rails. First the shortest, reverse gear shift rail (Fig. 48). Note that the notch at the end of the rail lies near the shift lever (640) and should point upwards. This applies also for the 2 other shift rails. Insert welded pivots 2nd and 3rd gear shift rails (612) with the 2 plastic bolts (611).

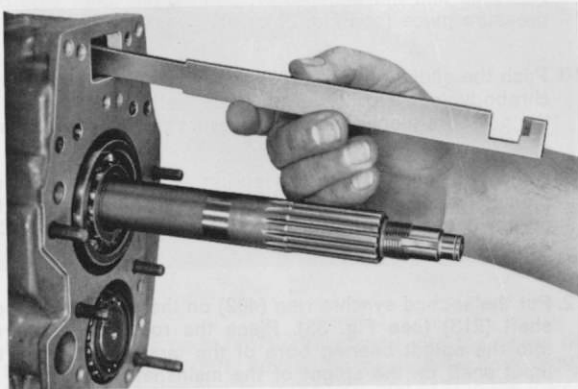


Fig. 48

as shown in Fig. 49 into the bore of the selector fork (609). Install 4th and 5th gear selector rail (608) as previously described (Fig. 50).

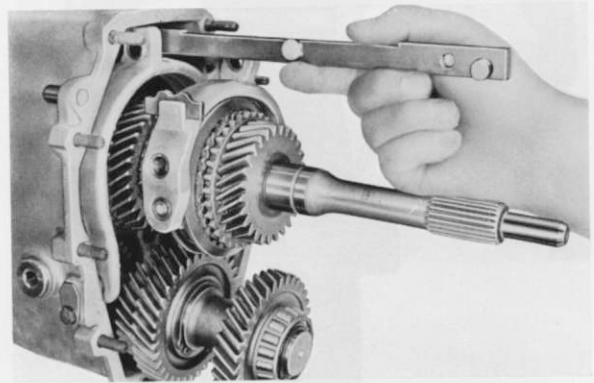


Fig. 49

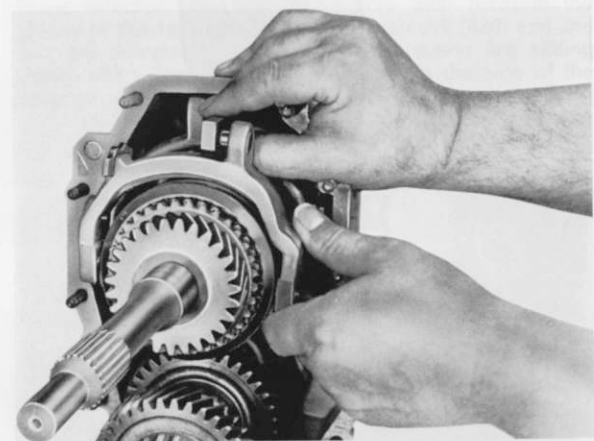


Fig. 50

4. Slide gasket (107) over the protruding studs and install gearbox housing front part (101) (Fig. 51). Screw the nuts (102) with spring washer (103) on the stud. Tap in dowel (106) and then tighten nuts (102) to a torque of 2 to 2,5 kpm.
5. Place O-rings (605) into the pivot pins (604). Insert pivot pins through the housing into the bore of the 4th and 5th gear selector fork. Screw in bolts (602) with spring washer (603) and tighten to 0,8 to 1,2 kpm.

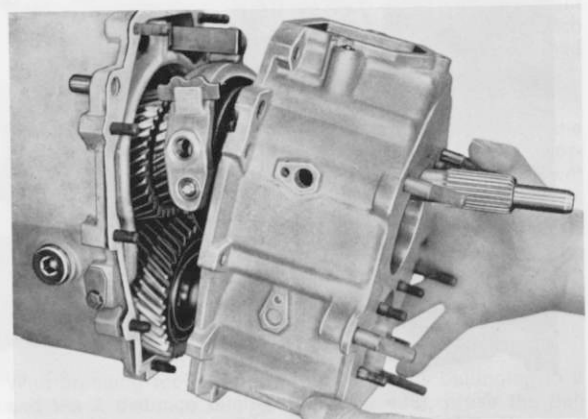


Fig. 51

G) Installing Input Shaft

1. With a plastic hammer, tap the ball bearing (423) on the output shaft into the housing until it comes up against the spring ring (425) (to ensure that measurements are not made in error).
2. With a depth gauge, measure the space from the front of the housing to the setting surface of the ball bearing (212) on the input shaft (Fig. 52). Press input shaft with hand firmly and evenly to make it lie in the bore of the synchro ring.

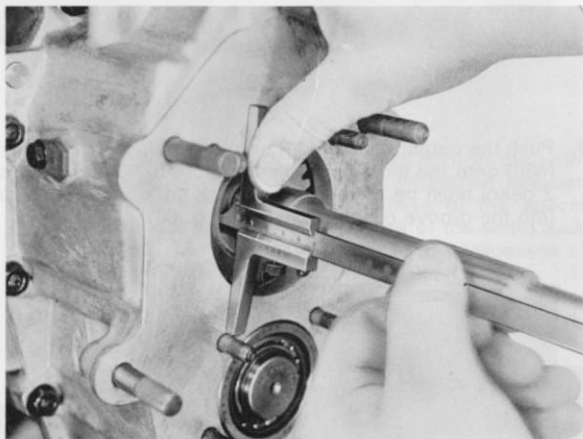


Fig. 52

3. Insert spring ring (211) into the groove of the ball bearing (212). Measure from the upper surface of the bearing to the spring ring. The spring ring must be pressed onto the outer edge of the bearing groove (Fig. 53).

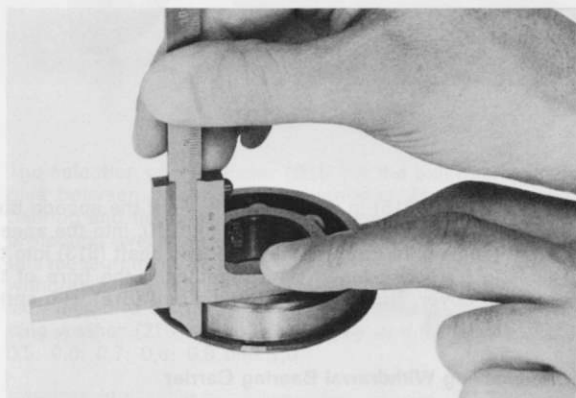


Fig. 53

4. The difference between the 2 measurements less 0,5 mm to 0,8 mm for the axial play of the 4th gear synchro ring (402) gives the thickness of the spacer (209), which must be placed under the ball bearing (212). The shims are available in thicknesses of 0,5; 0,6; 0,7; 0,8; 0,9; 1,0; 1,1; 1,2; 1,3; 1,4 and 1,5 mm.
5. Push the spacing washer over the input shaft. Press the ball bearing (212) with pressing tool .8. up to the stop on the input shaft and into the housing (Fig. 54).

Note: When pressing in the ball bearing, the ball bearing must be driven into the housing bore with a plastic hammer after approximately 2 turns of the tool.

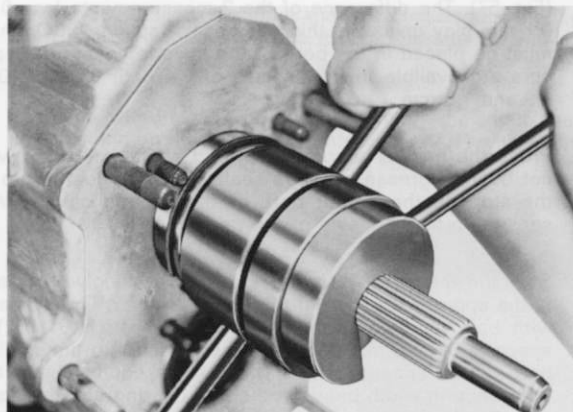


Fig. 54

6. Select a spacer (209) such that the circlip (208) sits tightly in the radial groove of the input shaft. Assemble the spacer and circlip (Fig. 55).

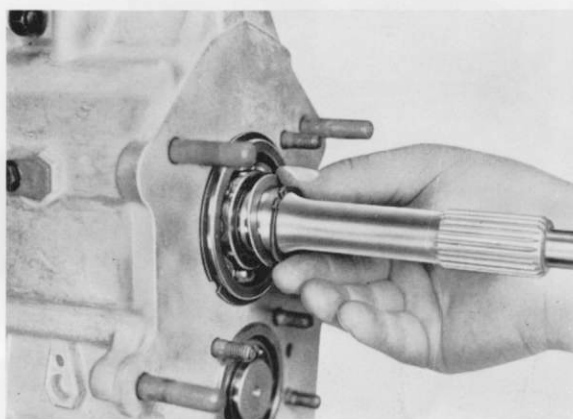


Fig. 55

H) Assembling Speed Cover

1. Firstly, tap the outer ring of the roller bearing (303) on the largest diameter into the housing bore. For this, use a plastic or lead hammer.
2. Place gasket (802) on the gearbox rear housing.
3. Gently, with a plastic or lead hammer, tap the outer ring of the ball bearing (423) into the housing up to the stop. With a depth gauge measure the distance from the upper surface of the outer bearing ring to the gearbox joint face with gasket in place (Fig. 56).

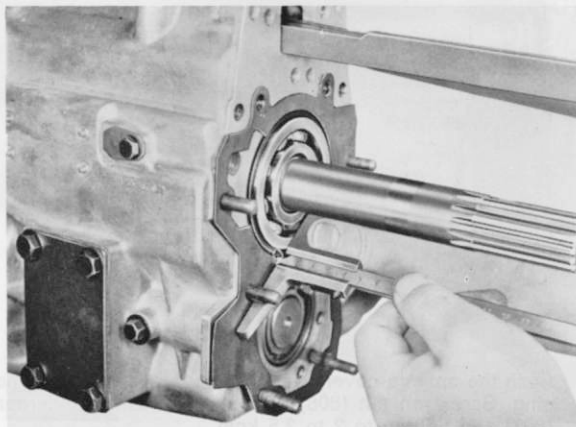


Fig. 56

4. Determine the depth of the mating bore in the speedo cover (Fig. 57). The difference of the 2 measurements less 0 to 0,1 mm play gives the thickness of the spacer (804) which must be placed in the bore of the speedo cover. The spacers are available in thicknesses of 0,4; 0,5; 0,6; 0,7; 0,8; 0,9 and 1,0 mm.
5. Press the needle bearing (810) and shaft seal (811) with hot bearing grease between sealing lip and dust lip up to the stop on the output bore of the speedo cover. With sealing lip to the inside of the gearbox.
6. Stick the spacer (804) for the mainshaft bearing with grease in the appropriate bore of the speedo cover. On layshafts with ball bearings (installed up to gearbox No. 1152) a spacer (302) 1,5 mm thick must be placed into the smaller bore of the speedo cover. The shim is equivalent to the difference in width between the ball bearing and the equivalent roller bearing. The installation of both bearing versions is carried out on the input side.

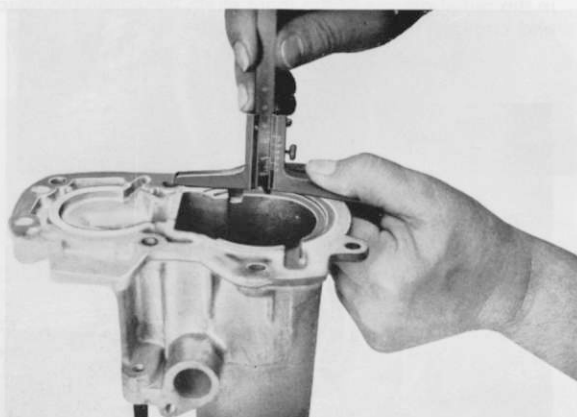


Fig. 57

7. Place long distance bush (426), speedo worm (427) and short distance bush (428) on the mainshaft (Fig. 58). Set split ring into the groove of the mainshaft and push cir-clip over. With a depth gauge measure the space between the split ring and the shorter bush (428). The space must be 0,17 to 0,22 mm. It can be corrected by fitting varying sized distance bushes 33,35; 33,4; 33,45; 33,5; 33,55; 33,6; 33,65 or 33,7 mm. long.

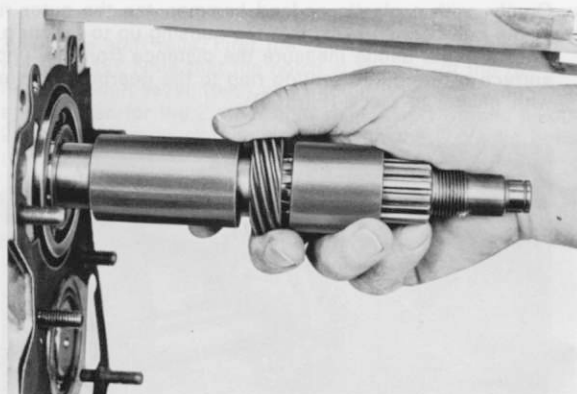


Fig. 58

8. Push the speedo cover over the studs and up to the housing. Screw on nut (808) with spring washer underneath (807) and tighten to 2 to 2,5 kpm.

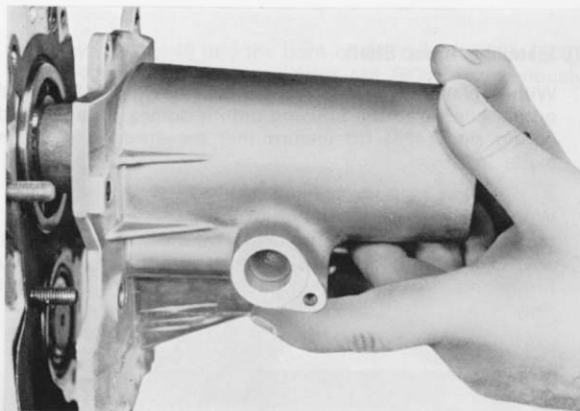


Fig. 59

9. Push the output flange (429) onto the mainshaft. Screw nut (430) onto the thread and tighten to 14 to 16 kpm (for this, 2 gears must be engaged). Tap lock tab of nut with a drift into the groove of the mainshaft (Fig. 60).

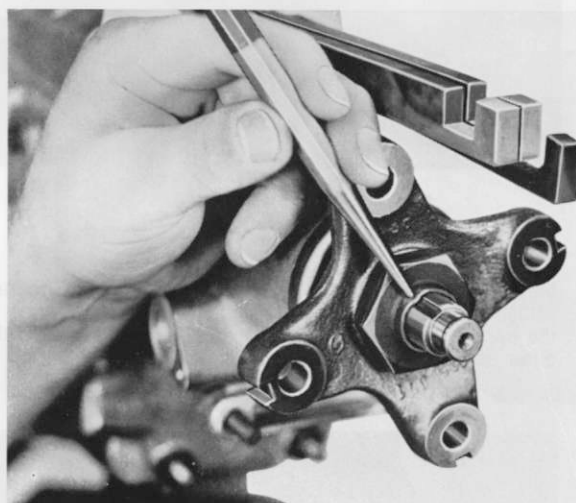


Fig. 60

10. Place O-ring (815) in the radial groove of the speedo bush (814). Press shaft seal (812) with tool .10. into the speedo bush (sealing lip upwards). Put speedo shaft (813) into the speedo bush and insert both together in the bore of the speedo cover. Screw in self locking bolt (816) with spring washer (807).

I) Assembling Withdrawal Bearing Carrier

1. With the larger internal dia facing the inside of the gearbox, place the outer ring of bearing (303) into the bore for the layshaft bearing of the front cover (101).
2. Push gasket (204) over the threaded studs.
3. Press shaft seal (207) into the bore of the withdrawal bearing carrier (206) with tool No. .9. Sealing lip must point to inside of the housing.
4. Gently tap layshaft with a plastic or lead hammer towards rear (output side) until the bearing outer ring lies on the speedo cover. Press down the front bearing outer ring and with a depth gauge, measure the distance from the upper edge of the bearing outer ring to the gearbox joint face with the gasket in place (Fig. 61).

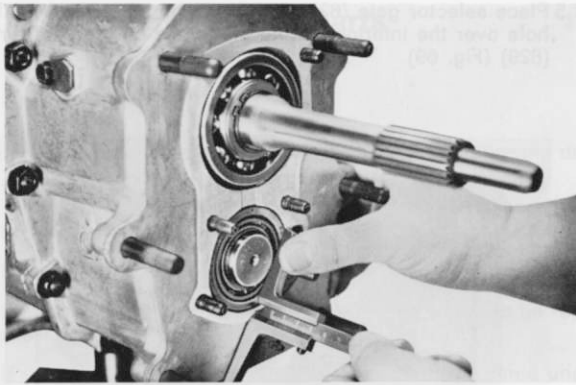


Fig. 61

5. Determine the depth of the appropriate bore in the withdrawal bearing carrier (Fig. 62). The difference between the 2 measurements gives the thickness of the spacer (302), which must be placed in the bore of the withdrawal bearing carrier. The shims are available in thicknesses of 0,4; 0,5; 0,6; 0,7; 0,75; 0,8; 0,85; 0,9; 0,95; 1,0; 1,05; 1,1; 1,15; 1,2; 1,25; 1,3; 1,4 and 1,5. The installed taper roller bearing must have between 0 and 0,05 mm pre-load.

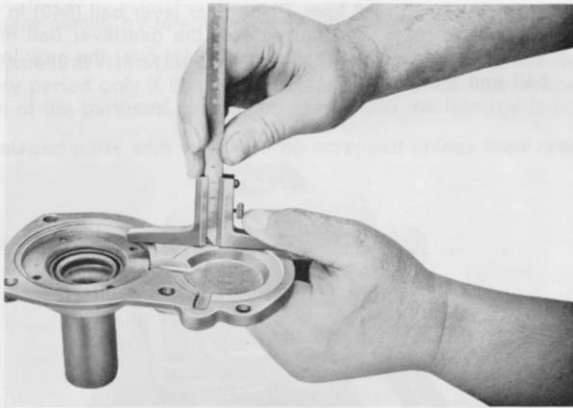


Fig. 62

6. The selection of the spacer (804) for the ball bearing must give between 0 and 0,05 mm pre-load. Hold the layshaft bearing and firstly measure the amount of the ball bearing projecting over the sealing surface (Fig. 63) and then take this measurement from the depth of the smaller bore in the withdrawal bearing carrier (Fig. 64). The resultant dimension less 0 to 0,1 mm play gives the thickness of the spacing washer (210) which is available in thicknesses of 0,4; 0,5; 0,6; 0,7; 0,8; 0,9 and 1,0.

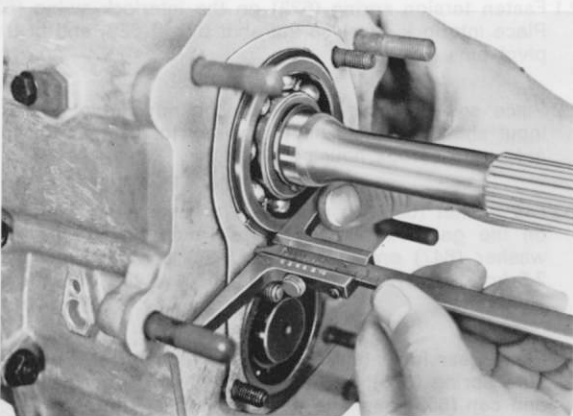


Fig. 63

7. Stick the spacer for the input shaft bearing and for the layshaft bearing with grease into the appropriate bore of the withdrawal bearing barrier.
8. Push the withdrawal bearing carrier over the input shaft and position on the housing. Tighten nuts (201) with spring washer (202) underneath to 2 to 2,5 kpm.

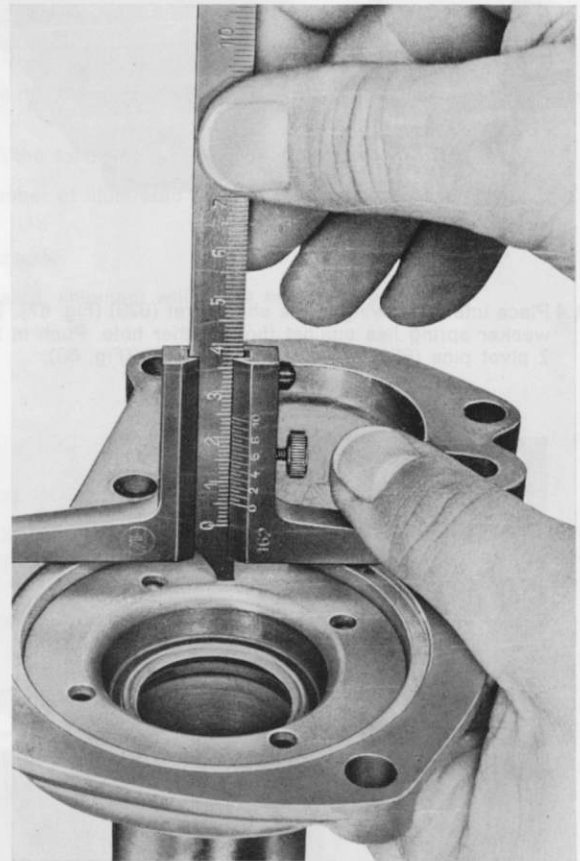


Fig. 64

K) Assembling Selector Knob

1. Remote gear levers (Cars)

- 1.1 Push vibration damper (644) over the shift rods and fasten with the set screws (645) and spring washers (646).
- 1.2 Place the pivot piece (624) on the 2 locating bolts in the gear change extension (619). Push shift arm over the shift rods (Fig. 65). Tighten nuts (648) with thrust washer (647).

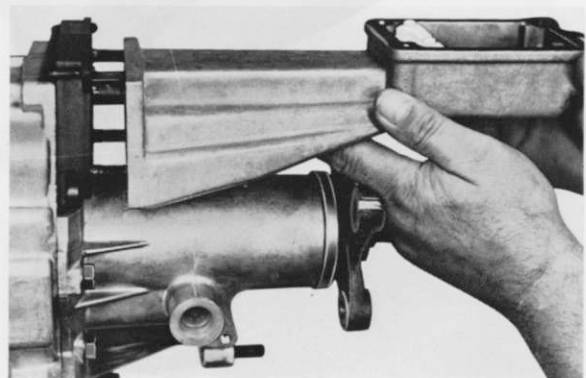


Fig. 65

- 1.3 Place ring (659) with the bore to the taper compression spring (628) in the shift turret (629). Place taper compression spring on the ring. Fasten **torsion springs** (633 and 633.1) to interlock swing as shown in Fig. 66. The stronger spring lies against the shorter tang.

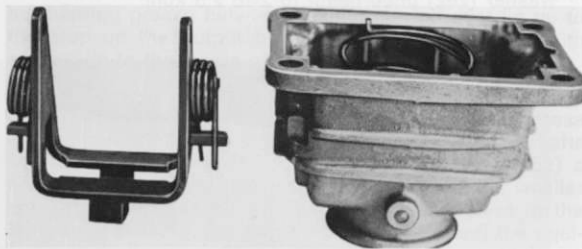


Fig. 66

- 1.4 Place interlock swing in the shift turret (629) (Fig. 67). The weaker spring lies against the breather hole. Push in the 2 pivot pins (630) and press in the bore (Fig. 68).

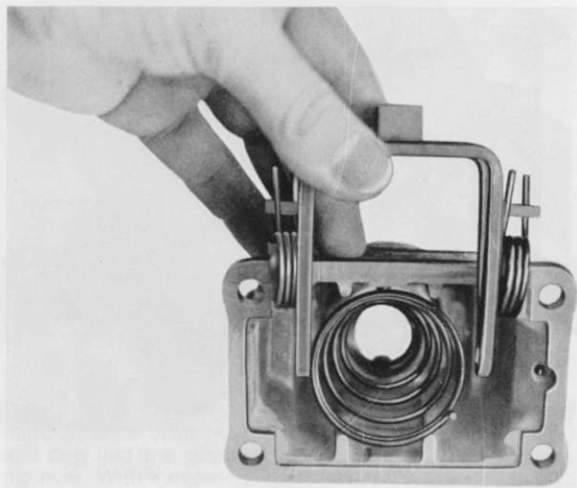


Fig. 67



Fig. 68

- 1.5 Place selector gate (627) with the 2 bores to the breather hole over the interlock swing and place on the shift turret (629) (Fig. 69).

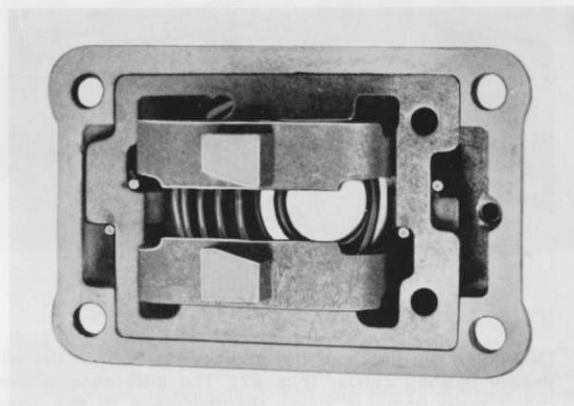


Fig. 69

- 1.6 Fit gasket (626). Place preselected shift turret on top (Fig. 70). Screw and tighten set screws (637) with spring washer (636) to 2 to 2,5 kpm. Place gear lever ball (640) in the shift turret (629). The flat side of the gear lever ball must point rearwards. Push ball socket (641) over the gear lever ball and insert circlip (642).



Fig. 70

2. Centrally mounted direct gearchange (heavy vehicles)

- 2.1 Fasten torsion spring (633) on the interlock swing (625). Place interlock swing in the shift turret (629) and fit the 2 pivot pins (630).
- 2.2 Place selector gate (653) with the nose pointing to the input shaft and the selector guides to the gearbox inner onto the gearbox housing.
- 2.3 Lay gasket (626) on and place preassembled shift turret on the gearbox housing. Screw nuts (648) with spring washer (647) onto the studs (650) and tighten to 2 to 2,5 kpm. Screw breather valve (635) in the thread of the shift turret.
- 2.4 Place gear lever ball (640) in the shift turret. Push pressure spring (628), socket (645) with cylindrical side first, and cap (655) over the gear lever ball. Attach cap to the pivot bolts (652). Put boot (643) over cap. Test transmission.

IX. Ordering of Spare Parts

Orders for spare parts should always provide the following data to guarantee fast and correct delivery.

1. Type identification (on type rating plate)
2. Production number of transmission (on type rating plate)
3. Designation of desired spare parts. Always use name as shown in Spare Parts List and Assembly Instructions.
4. State ten-digit number punched-in or cast on part to be replaced. This number is indispensable, if the type number of the transmission cannot be given.
5. If you cannot supply any or several of the data listed under 1. to 4. the following instructions are important.
 - a) Number of illustrated table supplied with Spare Parts List or number of illustrated table in the pertinent Assembly Instructions.
 - b) Make and type designation of vehicle, name of chassis manufacturer.
6. Method of despatch such as Post, Freight, Express etc. Unless indicated, shipment will be as selected by us.

A perfectly clear order should be as follows:

I am ordering herewith one mainshaft 1255 304 073 for transmission:

S 5-18/3, production number 6043, by express mail.

Immediate delivery required.

Orders placed by telephone or cable should be acknowledged in writing.

Shipment at risk of buyer, even when spare parts are not charged for. Spare parts are exchanged free of charge during the warranty period only if damaged parts are sent to us free of cost and without previous changes made thereon, and when an inspection of the pertinent component shows that the damage is the result of a production or material fault.

Damaged parts sent to us will be scrapped unless their return is expressly requested when shipped.

Payment: All spare parts are deliver c.o.d.

X. Key to Illustrations

Housing Group

101	Front Housing
102	Nut
103	Spring Washer
104	Stud
105	Stud
106	Dowel
107	Gasket
108	Stud
109	Stud
110	Stud
111	Sealing Washer
112	Magnetic Drain Plug
113	Drain Plug
114	Rear Housing
115	Type Plate
116	Gasket
117	Cover
118	Bolt
119	Cover
120	Stop Plate
121	Stud
122	Spring Washer
123	Nut
124	Set Screw
125	Spring Ring
126	Operating Shaft (Rev. Light)

Input Shaft Group

201	Nut
202	Spring Washer
203	Centralising Flange
204	Gasket
205	Stud
206	Clutch Withdrawal Bearing
	Carrier
207	Oil Seal
208	Circlip
209	Shim
210	Shim
211	Spring Ring
212	Ball Bearing
213	Input Shaft
214	Roller Cage Bearing

Layshaft Group

301	Circlip
302	Shim
303	Ball/Roller Bearing
304	Constant Gear
305	Circlip
306	5th gear/4th Gear
307	3rd Gear
308	Layshaft
309	Ball Bearing

Mainshaft Group

401	Circlip
402	Synchro Ring
403	Synchro Ring

404	Pressure Piece
405	4th & 5th gear synchro body
406	Sliding sleeve
407	Complete 5th gear/cpl. 4th g.
408	Needle Bearing
409	Circlip
410	Thrust Washer
411	Complete 3rd Gear
412	Needle Bearing
413	Circlip
414	2nd & 3rd gear synchro body
415	Complete 2nd gear
416	Needle Bearing
417	Mainshaft
418	Reverse Gear
419.1	Spring Ring
419.2	Circlip
419.3	Cover Plate
420	Sliding sleeve for 1st & Rev.
421	Complete 1st gear
422	Thrust Washer
423	Ball bearing
424	Shim
425	Spring Ring
426	Distance Bush
427	Speedo Worm
428	Distance Bush
429	Output flange
430	Nut
431	Washer

Reverse Gear Group

501	Thrust Washer
502	Reverse Idler
503	Needle Bearing
504	Distance Ring
505	Reverse Idler Shaft
506	Spring Washer
507	Bolt
508	Roller Bearing
509	Washer
510	Thrust Washer
511	Dowel

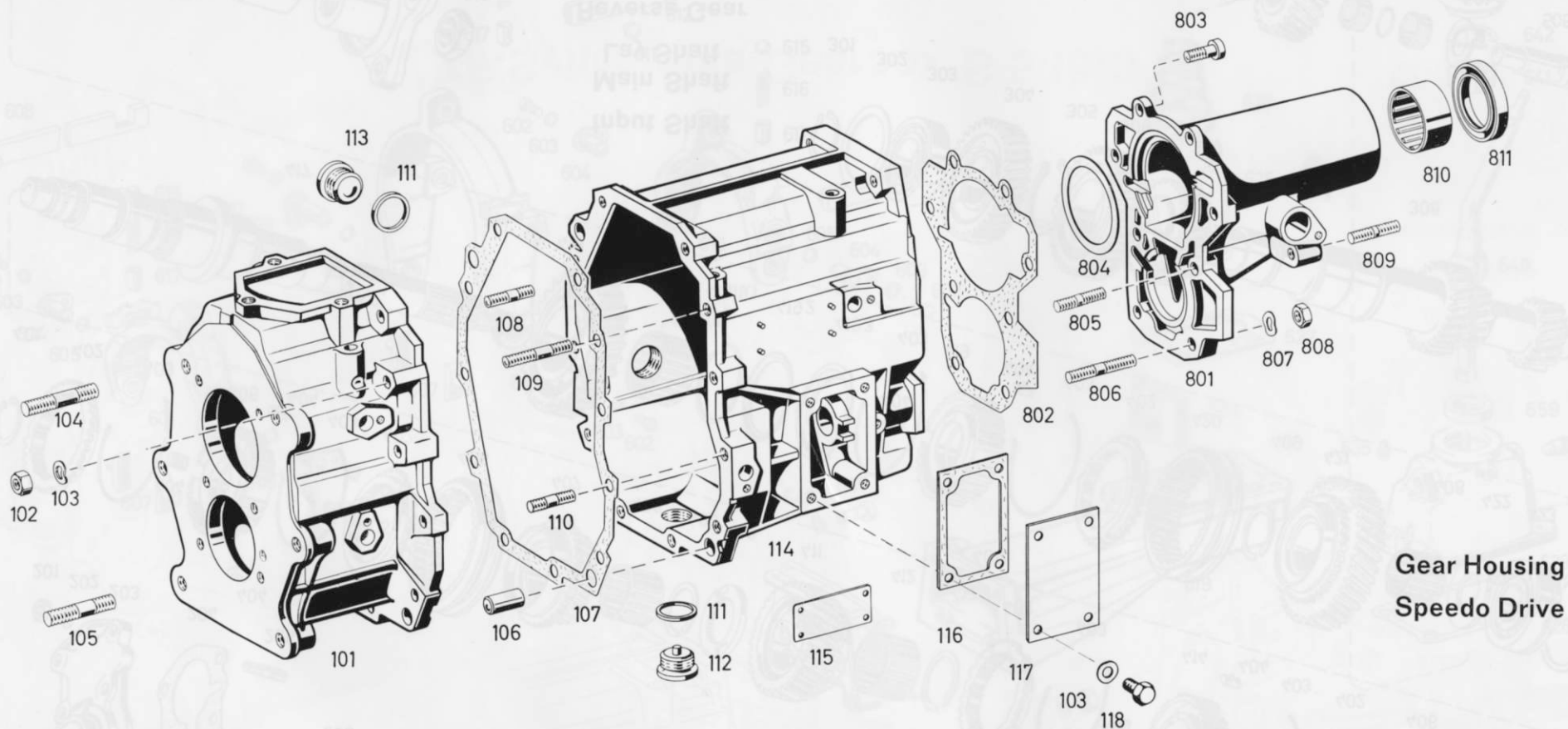
Gear Change Group

601	4th & 5th gear selector fork
602	Bolt
603	Spring Washer
604	Pivot Pin
605	O Ring
607	Selector Pad
608	4th & 5th gear selector Rod
609	2nd & 3rd gear selector fork
610	Pivot Pin
611	Pivot Bolt
612	2nd & 3rd gear selector Rod
613	1st & Rev. Gear Selector Fork
614	1st & Rev. Gear Selector Rod
615	Ball
616	Pressure Spring
617	Detent Plunger
618	Gasket
619	Gear change extension

620	Washer
621	Pressure Spring
622	Pressure Spring
623	Guide Body
624	Guide Piece
625	Interlock Swing
626	Gasket
627	Selector Gate
628	Conical coil spring
629	Gear lever turret
630	Pivot Pin
631	Spring Washer
632	Bolt
633	Gear lever bias spring
633.1	Gear lever bias spring
634	Pivot pin
635	Breather
636	Spring Ring
637	Short Set Screw
638	Long Set Screw
639	Selector Pad
640	Shift lever ball
641	Shift lever socket
642	V Ring
643	Rubber Gaiter
644	Vibration Damper
645	Set Screw
646	Spring Ring
647	Spring Washer
648	Nut
650	Stud
651	Bayonet Cap
652	Guide Pin
653	Interlock Plate
654	Dust Cap
655	Cap
656	Locating Block
657	Gear Knob
658	Nut
659	Locking Ring
660	Intermediate Plate
661	Gasket

Speedo Drive Group

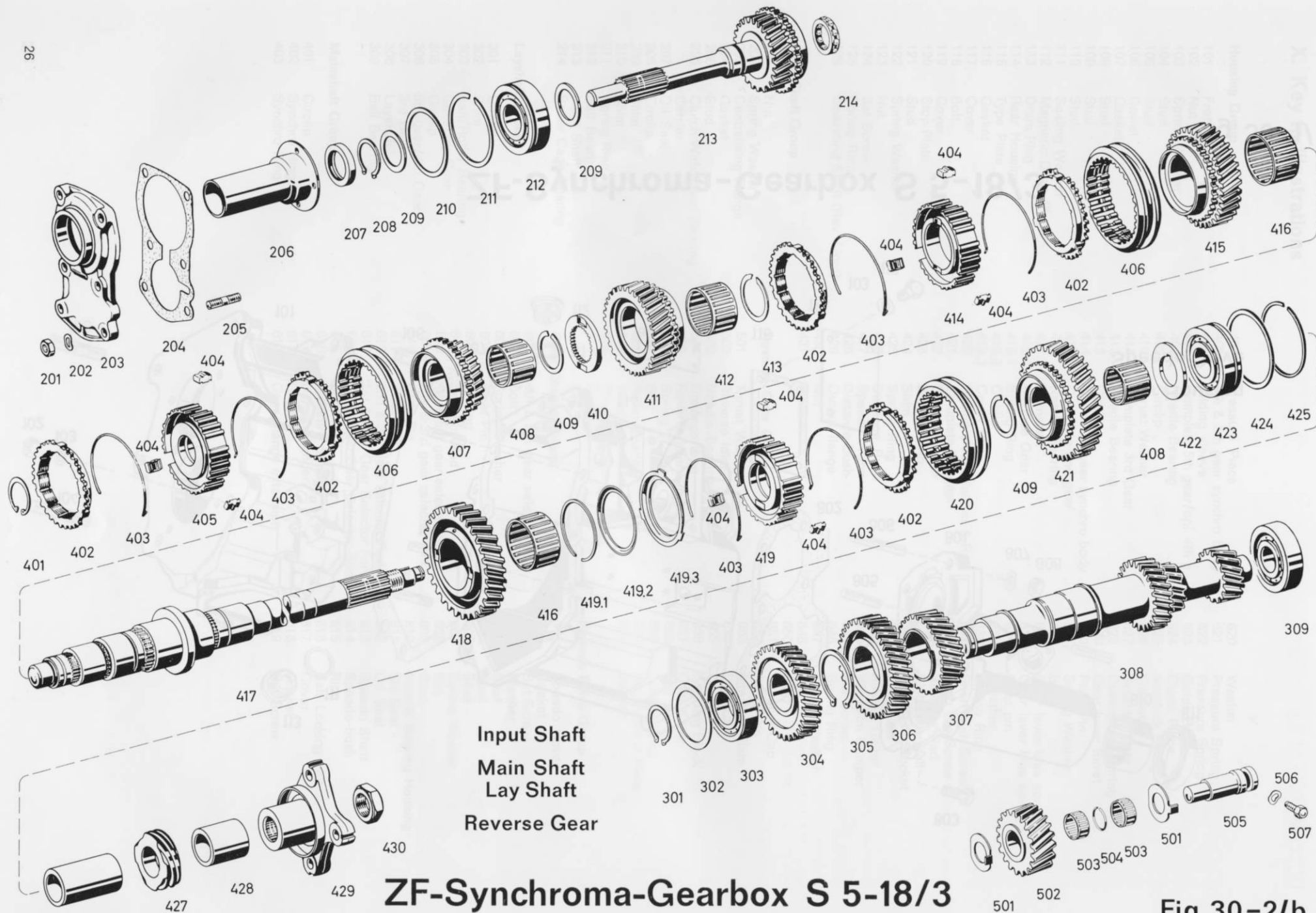
801	Speedo Cover
802	Gasket
803	Set Screw
804	Washer
805	Stud
806	Stud
806.1	Stud
807	Spring Washer
808	Nut
809	Stud
810	Needle Bearing Housing
811	Oil Seal
812	Oil Seal
813	Speedo Shaft
814	Speedo bush
815	Ring
816	Self Locking Nut
817	Cover
818	Gasket
819	Set Screw

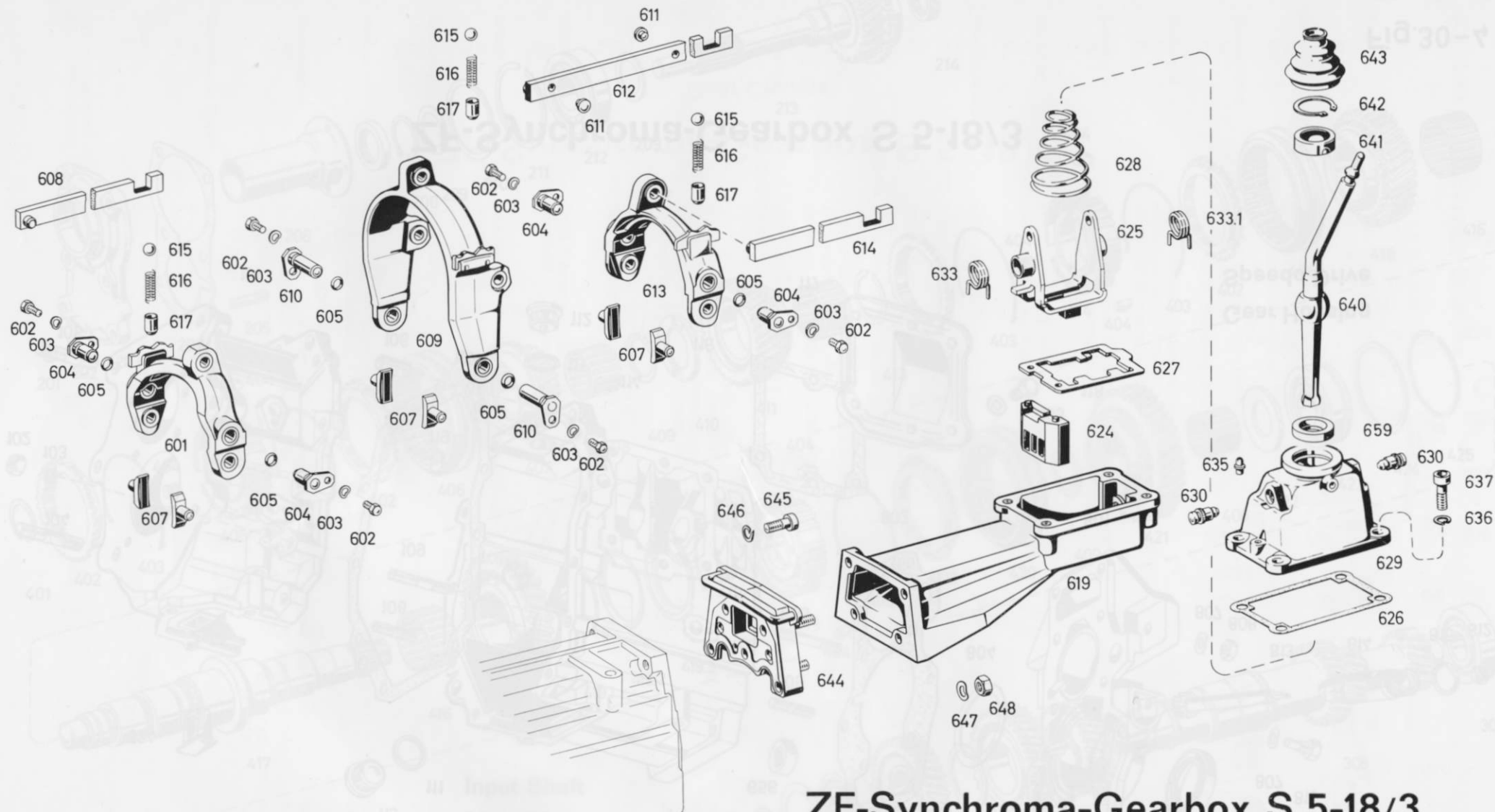


**Gear Housing
Speedo Drive**

ZF-Synchroma-Gearbox S 5-18/3

Fig. 30 -1/b

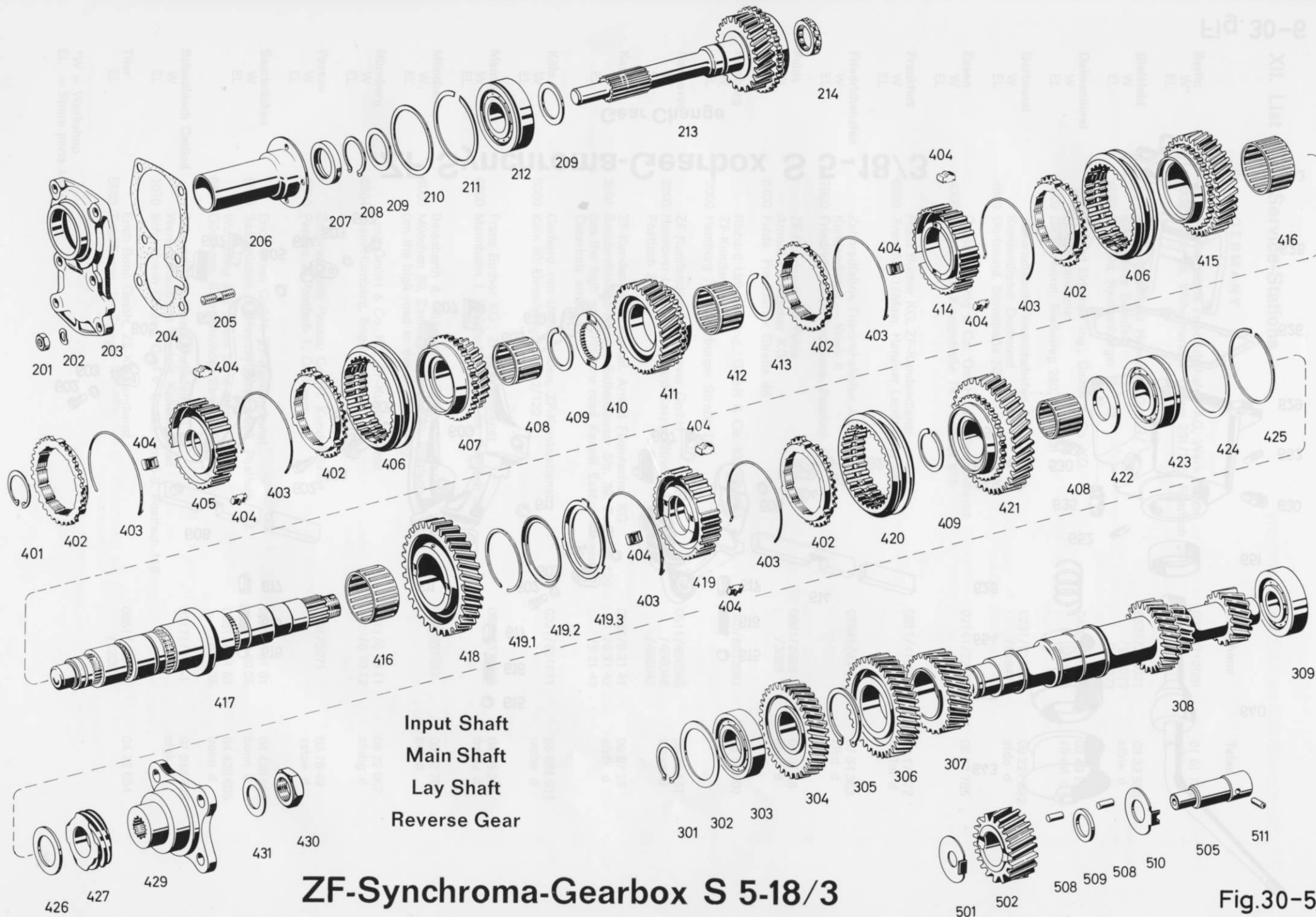




ZF-Synchroma-Gearbox S 5-18/3

Gear Change

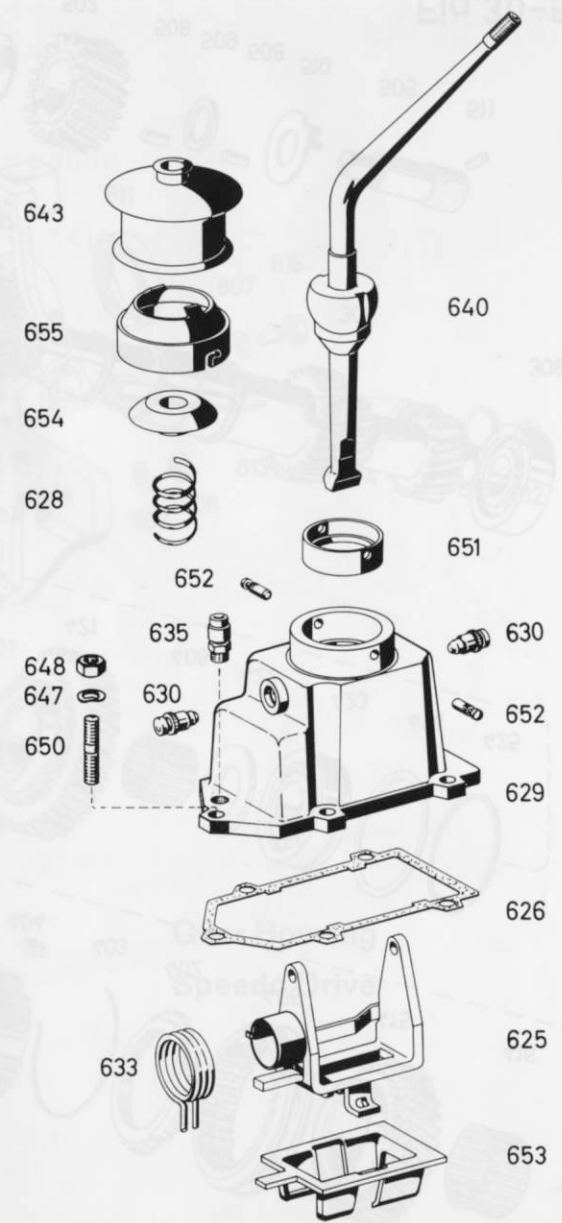
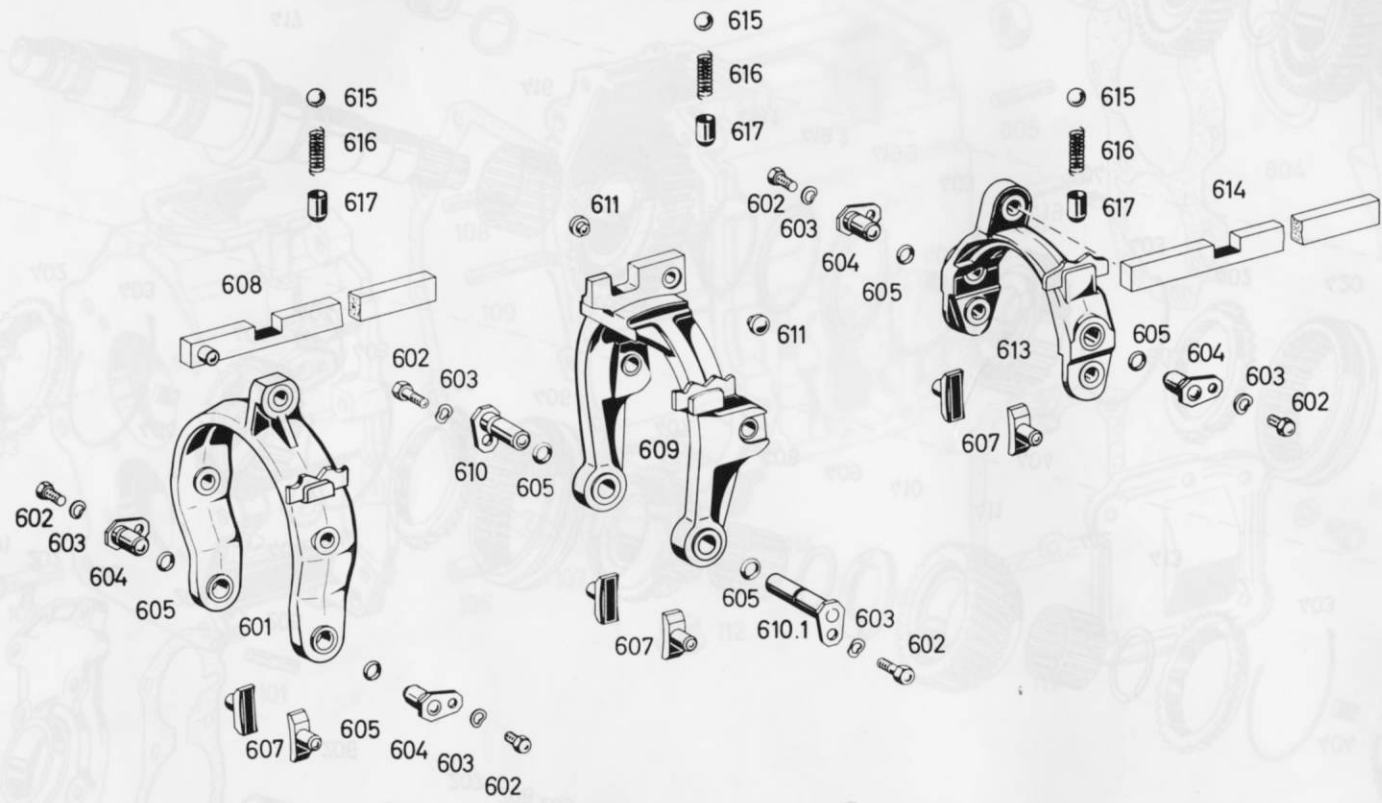
Fig.30-3/a



ZF-Synchroma-Gearbox S 5-18/3

Fig.30-5

30



ZF-Synchroma-Gearbox S 5-18/3

Gear Change

Fig.30-4

Fig.30-6

XII. List of ZF-Service-Stations

GERMANY		Telephone	Telex
Berlin W* EL	Zahnradfabrik Friedrichshafen AG, Werk Berlin 1000 Berlin 26, Wilhelmsruher Damm 231/245, Postfach 24	030/4112091	01 81 789 zfbn d
Bielefeld W EL	ZF-Kundendienst Hannover GmbH Zweigstelle Bielefeld 4800 Bielefeld, Reichenberger Str. 42	0521/200071 /200072 /200073	09 32 596 zfbie d
Delmenhorst W EL	Richard Urbanek Ing., GmbH & Co. KG ZF-Kundendienst 2870 Delmenhorst, Riedeweg 280, Postfach 74	04221/60025 /60026	02 49 285 zfkdd d
Dortmund W EL	Zahnradfabrik Friedrichshafen AG, Kundendienst Dortmund 4600 Dortmund, Bornstraße 207	0231/812891 /818441	08 227 892 zfd d
Essen W EL	Gustav Hennig & Co. GmbH., ZF-Kundendienst 4300 Essen-Ruhr, Kruppstraße 74, Postfach 673	02141/221951	08 57 785
Frankfurt W EL	Franz Bucher KG, ZF-Kundendienst 6000 Frankfurt 1/Main, Hanauer Landstraße 336	0611/415021	04 17 272 buffm d
Friedrichshafen W EL	Zahnradfabrik Friedrichshafen AG, Kundendienst — Werk II 7990 Friedrichshafen/Bodensee, Postfach 307	07541/84-1	07 34 363 zfk d
Fulda W EL	ZF-Kundendienst Fulda Arnold Fikentscher KG, 6400 Fulda, Frankfurter Straße 45	0661/3028 /3029	04 97 56 afzff d
Hamburg W EL	Richard Urbanek Ing., GmbH & Co. KG ZF-Kundendienst 2000 Hamburg 70, Angerburger Straße 18	040/6932041	02 14 907
Hannover W EL	ZF-Kundendienst Hannover GmbH 3000 Hannover-Linden, Bernhard-Caspar-Straße 7, Postfach 21265	0511/456045 /456046 /456047	09 22 151 zfhan d
Kassel W EL	ZF-Kundendienst Kassel, Arnold Fikentscher KG 3501 Sandershausen-Kassel, Bettenhäuser Str. 39, Postfach 120 (on the high way tributary road Kassel East, entrance Osterholz street.)	0561/5 21 41 /5 21 42 /5 21 43	09 97 25 afzfk d
Köln W EL	Gerhard von Umscheiden, ZF-Kundendienst 5000 Köln 30, Ehrenfeldgürtel 112/122	0221/551011	08 881 011 ums d
Mannheim W EL	Franz Bucher KG, ZF-Kundendienst 6800 Mannheim 1, Waldhofstraße 82-84, Postfach 369	0621/372066	04 63 236 frabu d
München W EL	Beissbarth & Müller oHG, ZF-Kundendienst 8000 München 80, Zamdorfer Straße 90, Postfach 80 02 60 (on the high road to the airport Riem)	089/931051	05 22 793 bei d
Nürnberg W EL	Lang GmbH & Co. KG, ZF-Kundendienst 8504 Stein-Nürnberg, Bogenstraße 3	0911/6 70 11 /6 70 12	06 22 867 zfnbg d
Passau W EL	Zahnradfabrik Passau GmbH, Kundendienst 8390 Passau 2, Postfach 1, Grubweg	0851/2071	05 78 49 zetpe d
Saarbrücken W EL	Erich Bonn GmbH, ZF-Kundendienst 6600 Saarbrücken 3, Mainzer Straße 269, Postfach 733	0681/6 61 61 /6 80 35	04 428 959 bonn d
	Workshop and Spare parts store: 6604 Güdingen, Saargemünder Straße 48	0681/6 61 61 /6 80 35	04 428 605 bonn d
Schwäbisch Gmünd W EL	Zahnradfabrik Friedrichshafen AG, Werk Schwäbisch Gmünd, Kundendienst 7070 Schwäbisch Gmünd, Graf v. Soden Str. 5-9, Postfach 119	07171/601-1	07 248 825 zfgk d
Trier EL	Erich Bonn GmbH, ZF-Kundendienst 5500 Trier-Euren, Im Speyer 4	0651/42815 /72092	04 72 634

*W = Workshop
EL = Spare parts store

ZF-Service-Stations outside Germany

EUROPE		Telephone	Telex
Austria W EL	Zahnradfabrik Friedrichshafen Ges. m. b. H. Wien ZF-Kundendienst für Österreich Triester Strasse 134 — 136, 1232 Wien-Inzersdorf Cables: ZF-Getriebe Wien	0222/67 15 48	011 291 zfwien a
Belgium W EL	Agence ZF-Service S.P.R.L. 1440, Chaussée de Wavre, 1160 Bruxelles-Auderghem Cables: Zetefservis Bruxelles	02/72 40 64 /72 70 32	22 451 zetefservis bru
Denmark W EL	Skandia-Motorimport, Sjaelland A/S Hesselager 21, 2600 Glostrup/København Cables: Skandiamotor	01/45 15 99	27 444 skaglo dk
	Branch: Skandia-Motorimport, Fr. Jensen A/S Egholmsgade 7, 9000 Aalborg , P.O.Box 117	08/13 22 44	69 771 skamo dk
Finland W EL	Atoy OY, Industry department Lauttasaarentie 54, P.O.Box 10137, 00200 Helsinki 20 Cables: Atoy Helsinki	67 33 71	12 555 atoy sf
France W EL	ZF-France S.a.r.L. Rue de Villeneuve 3/11, 94533 Rungis Silic	6 86 68 40	26 954 zf fra
W EL	O. M. A. - ZF Zone Industrielle 28, 4ème Avenue, 13700 Vitrolles	89 02 39	43 463 fra
W EL	Etablissement Cauchois 150, Rue des Marquillies, 59013 Lille Cedex	53 93 21	
W EL	Strasbourg Garlouis, S.A. 1-3, Rue des Pompiers, 67300 Schiltigheim Post adresse: B.P. 27, 67042 Strasbourg Cedex	33 38 38	87 083
Greece W EL	U. J. Phostiropoulos & Cia. E. E. Leoforos Athinon 26, Athen 209 , P.O.Box 1122 Cables: Inghosti Athen	52 04 23 52 05 42 53 39 10	216 360 fost gr
EL	Branch: U. J. Phostiropoulos & Cia. E. E. Monastiriou Str. 61, Thessaloniki	51 33 13 51 64 06	
Great Britain W EL	ZF Gears (Great Britain) Ltd. Lilac Grove, Beeston, Nottingham NG 91 QX Cables: Transgear Nottm.	0602/25 35 50 /22 18 65 /22 18 66	377 062 transgear nottm
Italy W EL	S.A.I.M. S.p.A. Sviluppo Applicazioni Industriali Meccaniche Via Leon Battista Alberti 10, 20149 Milano Cables: Sviluppasaim Milano	02/38 15 70 /38 44 81	33 393 saimspa
W EL	Spare parts store: Servicio Assistenza e Ricambi	31 51 93 34 47 43	
W EL	Workshop: Officina di Assistenza 20090 Limite/Milano , Nuova Strada Rivoltana	9 04 60 15	
W EL	Branch: S.A.I.M. S.p.A. Sviluppo Applicazioni Industriali Meccaniche Viale Aventino 32/a, 00153 Roma	578 440	
W EL	CETRULLO VITTORIO Viale Pindaro, 45—65, 65100 Pescara	60 335	
W EL	SCARPAZZA BALDO Zona Industriale 9° strada, 18, 35100 Padova	66 11 76	
W EL	Autoriparazioni BOMBARA Strada del Barocchio, 39, 10136 Torino	32 17 18	
W EL	IGNAZIO ZAPPA S.r.l. Circonvallazione Nomentana, 474, 00162 Roma	42 33 81 42 53 59	
W EL	ROSSI ROMANO Viale Trento, 204, 36100 Vicenza	2 65 47	
W EL	AVLES-SELVA Via E. Mattei, 50, Strada per Ravenna, 40134 Bologna	53 00 15	
W EL	FADES Largo S. Maria del Pianto, 40/41, 80144 Napoli	33 00 42 51 57 61	

		Telephone	Telex
W	RICCI FRANCO	9 11 35	
EL	Via Ruscelli, 50, 47026 S. Piero in Bagno (Forli)		
W	AUTOCAR	4 32 50	
EL	Via Aurelia Ovest, 81/a, 54100 Massa	4 39 49	
W	SAPIENZA LUCIANO	21 28 46	
EL	Via Gelso Bianco, 28, 95121 Catania		
W	LONGO ROCCO	24 66 34	
EL	Via S. Caterina, 2 (Rione S. Giorgio), 70124 Bari		
W	MONACHESI & MOZZONI	28 44	
EL	Via Terria, 4, 62100 Macerata		
W	VALLEBONA S.p.A.	2 38 64	
EL	C.P. 201 (anche per GM), 09100 Cagliari		
Jugoslavia	Autocommerce		
W	Zastopniško Podjetje	061/32 30 46	31 189
EL	Trdinova Ulica 4, 61000 Ljubljana , P.O.Box 422		31 299
	Cables: Autocommerce Ljubljana		acljb yu
	Workshop:		
	Gral-Avtoobnova	061/34 20 10	31 427
	Titova Ulica 136, 61000 Ljubljana , P.O.Box 280		
	Cables: Gral Ljubljana		
	Branch:		
W	Autocommerce	01 14 02	11 328
EL	Zastopniško Podjetje	01 14 21	acbgd yu
	Kataniceva 18, Beograd	01 14 36	
Netherlands	Technisch Bureau Media B.V.	070/98 25 20	31 087
W	Treubstraat 31, 2100 Rijswijk (Z-H) , Postbus 2		media nl
EL			
Norway	A/S Auto Supply Co.	02/13 24 50	11 629
W	Ringeriksvn, 243, Oslo 1 , 1314 Skui		asao n
EL	Cables: Autosupply		
Portugal	SIPAVEL, Sociedade de Isolamentos para Veiculos, Lda.	53 79 53	12 25
EL	Rua Ramalho Ortigão, 3-r/ch	53 85 05	fmtl p
	Lisboa 1	56 28 40	
	Cables: SIPAVEL LISBOA	56 37 59	
Sweden	K.G. Knutsson Aktiebolag	08/25 26 60	15 04
W	Ulvsvandavägen 146, 16111 Bromma 11/Stockholm , P.O.Box 11069		kgk s
EL	Cables: Knuting Stockholm		
	Branches:		
W	Ruskvadersgatan 10, 40077 Göteborg 48 , P.O.Box 48019	031/53 04 60	20 955
EL			kgk s
W	Koepmangatan 29, 85231 Sundsvall	060/12 19 45	
EL			
W	Murmansgatan 112, 21225 Malmö	040/93 23 45	
EL			
Switzerland	SKAG — Steuerungen und Kupplungen AG	01/50 11 50	
W	Andreasstraße 17, 8050 Zürich , P.O.Box 636		
EL	Cables: SKAG Zürich		
Spain	for gear boxes, gear drives, axles, gears, locking differentials and pumps:		
W	I.S.A. Industrias Aviación de Subsidiarias, S.A.	35 28 00	72 113
EL	Apartado 250, Carretera de Carmona, Sevilla	35 29 00	isa e
	Polígono Industrial de Calonge		
	Cables: ISA Sevilla		
	for steering gears with pumps and exhaust brakes:		
W	IMENASA	25 11 00	36 718
EL	Industrias Metálicas de Navarra, S.A.		ain e
	Apartado Correos 140, Carretera de Barañain 17, Pamplona		
	Cables: IMENASA		
Turkey	Arsimidis Muessesesi-Otomobil, Malzemesi Ticareti T.A.S.	44 74 60	22 585
W	Rue Okcu Musa Caddesi 39/51, P.O.Box 832, Istanbul-Karaköy		arch tr
EL	Cables: Archimidis Istanbul		

AFRICA		Telephone	Telex
Ivory Coast W EL	Société d'Importation de Pièces Automobiles S.A.R.L. (S.I.P.A.) B.P. 2171, 34, Autoroute de l'Aéroport Abidjan/Côte d'Ivoire	32 30 18 35 57 50	698
Gabon Camerun Congo Republic Tchad Central African Republic	African and Eastern Trading Company (Hamburg) G.m.b.H. Kippingstr. 6, 2000 Hamburg 13 Post adresse: Hamburg 1, P.O.Box 644 Cables: Ethiopie Hamburg	0411/3 49 01	212 523 aetco d
Gabon W EL	Company in charge of service: Hatton & Cookson Matforce, B. P. No. 75 Libreville, (Republic of Gabon)		
Camerun W EL	Ciacam Matforce, B. P. No. 4025 Douala, (Federal Republic of Camerun)		
Congo W EL	S. C. K. N. Congo Matforce, B. P. No. 652 Pointe Noire, (Republic of Congo)		
Republic Tchad W EL	G. B. Ollivant (Congo) Ltd., P. B 712 Avenue du Général de Gaulle, Fort Lamy, (Republic of Tchad)		
Central African Republic W EL	S. C. K. N. CA B. P. No. 799 et 809 Bangui, (Central African Republic)		
Republic of South Africa Rhodesia W EL	TRADE RELATIONS INTERNATIONAL (Pty.) Ltd. P.O.Box 2259, Johannesburg (Republic of South Africa) Office and Workshop: P.O.Box 4007, Bosworth Street, Alrode/Alberton, Transvaal, (Republic of South Africa) Cables: ZAFBURG	834 - 45 59 869 - 82 16	 43 - 09 27
South-West-Africa W EL	O & O Electric and Engineering (PTY) Ltd P.O.Box 5056, Krupp Str. 33, Windhoek/S.W.A.	2-66 50	56 465 wk
AMERICA			
Argentina W EL	Rehm S. C. P. A. Avenida Maipú 3146/50, Casilla de Correo No. 9 Olivos (Prov. Buenos Aires) Cables: ZETAEFE-SERVICE Olivos	791-40 88 797-53 94	
Brazil W EL	ZF-DO BRASIL, S. A. Caixa Postal 1626, São Paulo , Works and Administration: Rua Senador Vergueiro, 428, 09500 São Caetano do Sul Cables: Ultramarin-São-Paulo	42-21 22	023 865 zf sco
Chile W EL	Robert Bosch de Chile, Equipos y Maquinarias, S. A. Av. San Eugenio 68, Santiago de Chile , Casilla 832 Cables: CHILEBOSCH	25 96 48 25 96 91 25 97 93	03 53 emasa sgo
Colombia EL	Automotora LEMKO, Ltda. Apartado Aéreo 4989 Carrera 30/15-16, Bogotá D. E. Cables: LEMKO Branch: Carrera 5/24-10, Cali	37 27 16 37 46 83 77 15 63	
EL Salvador Guatemala Honduras Nicaragua Costa Rica	Servicio Centroamericano ZF, S.A. Boulevard Venezuela No. 1153 San Salvador / El Salvador, C.A. Cables: ZETAFEZA	21 32 17	
Peru EL	Tecnica Import, S. A. Lima , Palca 201 — Casilla 171 Cables: TECNICAIMPORT	32 30 88	
Venezuela W EL	SERVEPESA, Servicios de Vehículos Pesados, S.A. Avenida República Dominicana Boleita Norte, Caracas 107 Cables: Servepesa	34 23 55 34 24 55	21 136 zico servepesa

	ASIA	Telephone	Telex
Iran W EL	G. Reza Sanaty, Ave. Saadi, Passage Saadi No. 11, Teheran Cables: Sanasadi Tehran Workshop: Ave. Ghazvin Estegahe Soleymaniyeh No. 1425—1431, Teheran	39 38 39 95 53 91	
Jordan W EL	Adeeb M. Sabbagh Bros. Co., Motor Engineers & Agents P.O.Box 868, Amman Cables: AMS-Amman	2 21 95 Office 2 30 69 Workshop	
Kuwait W EL	GLOBE, Commercial Establishment P.O.Box 4580, Kuwait/Arabia Cables: Globecom	42 88 29 43 10 73	
Lebanon EL	Adeeb M. Sabbagh, Motor Engineers & Agents, P.O.Box 3694, Beyrouth Cables: AMS-Beyrouth	4 12 75	
Saudi Arabia W EL	Diesel-Electric Company P.O.Box 1049, Jeddah/Saudi Arabia Cables: Delcent Jeddah Branches:	22 222	
W EL	P.O.Box 297, Jeddah/Saudi Arabia Cables: Diesectric Jeddah	22 122 22 123	
W EL	P.O.Box 86, Riyadh/Saudi Arabia Cables: Diesectric Riyadh	22 222 22 522	
W EL	P.O.Box 24, Dammam/Saudi Arabia Cables: Diesectric Dammam	22 444	
Syria EL	Adeeb M. Sabbagh, Motor Engineers & Agents B.O.Box 743, Damascus Cables: AMS-Damascus	1 84 05	

AUSTRALIA

Victoria W EL	Transpec Limited 570, Geelong Road, Brooklyn/Melbourne, Vic 3025 P.O.Box 223, Footscray/Vic. 3011 Cables: Transmotor Melbourne Branches:	3 14 09 22	30 225 transpec aa
Western-Australia EL W	144, Welshpool Road Welshpool/Perth, W. A. 6106 Cables: Transmotor Perth	68 32 36	93 009
South-Australia W EL	539, Grand Junction Road Wingfield/Adelaide, S. A. 5013 Cables: Transmotor Adelaide	62 61 15	82 891
New South Wales W EL	180, Silverwater Road Auburn/Sydney, N. S. W. 2144 Cables: Transmotor Sydney	6 48 28 92	21 443 transpec
Queensland W EL	1832, Ipswich Road Rocklea/Brisbane, Qld. 4106 Cables: Transmotor Brisbane	47 43 33	41 296
Tasmania W EL	Tasmania Transpec Limited G. P. O. Box 90 Launceston 7250	31 20 18	

Telephone	Address	Telephone	Address
Ivory Coast W EL	Automatons de Pièces Automobiles S.A. (S.P.A.) Ave. 8888/8889, 2nd No. 11, Téhéran Cables: Samsad Tehran 1022 20	Iran W EL	G. Rostami Ave. 8888/8889, 2nd No. 11, Téhéran Cables: Samsad Tehran 809
Gabon Cameroon Congo Republic of the Congo Central African Republic	Office Workshop Ave. 8888/8889, 2nd No. 11, Téhéran 1022 20	Jordan W EL	Abd M. Sabagh Bros. Co., Motor Engineering P.O. Box 888, Amman Cables: AMS-Amman 825 112
Gabon W EL	Services to agents in various P.O. Box 4580, Kuwait/Via Cables: Dipscom 1022 20	Kuwait W EL	GLOBE Commercial Establishment P.O. Box 4580, Kuwait/Via Cables: Dipscom 1022 20
Cameroon W EL	Abd M. Sabagh, Motor Engineers & Agents P.O. Box 384, Beyrouth Cables: AMS-Beyrouth 1022 20	Lebanon W EL	Abd M. Sabagh, Motor Engineers & Agents P.O. Box 384, Beyrouth Cables: AMS-Beyrouth 1022 20
Congo W EL	Diasec Electric Company P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20	Saudi Arabia W EL	Diasec Electric Company P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20
Republic of the Congo W EL	Diasec Electric Company P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20	W EL	Diasec Electric Company P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20
Central African Republic W EL	Diasec Electric Company P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20	W EL	Diasec Electric Company P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20
Republic of South Africa W EL	TRADE RELATIONS INTERNATIONAL (Pty) Ltd P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20	W EL	TRADE RELATIONS INTERNATIONAL (Pty) Ltd P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20
South-West Africa W EL	G.O. Electric and Engineering (Pty) Ltd P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20	W EL	G.O. Electric and Engineering (Pty) Ltd P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20
AUSTRALIA			
Argentina W EL	Transgas Limited P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20	Victoria W EL	Transgas Limited P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20
Brazil W EL	Transgas Limited P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20	Western Australia W EL	Transgas Limited P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20
Chile W EL	Transgas Limited P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20	South Australia W EL	Transgas Limited P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20
Colombia W EL	Transgas Limited P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20	New South Wales W EL	Transgas Limited P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20
EL Salvador Guatemala Honduras Nicaragua Costa Rica	Transgas Limited P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20	Queensland W EL	Transgas Limited P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20
Paraguay W EL	Transgas Limited P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20	Tasmania W EL	Transgas Limited P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20
Venezuela W EL	Transgas Limited P.O. Box 108, Jeddah/Via Cables: Diasec Jeddah 1022 20		