ZF-Synchroma 5 DS-25 Gearbox Manual

The following is a copy of the manual for the ZF-Synchroma 5 DS-25 gearbox. It has five forward speeds and one reverse. The main gearbox and the axle drive with differential are accommodated in one housing. The front part of the gearbox is constructed as a bell housing and accommodates the release mechanism with the external control lever. The gearbox is mounted directly to the engine and therefore can be used for front or rear engine drive.

There are several versions of these gearboxes and they were used in several performance and racing cars, including the Ford GT40, the de Tomaso Pantera and Mongusta, the Maserati Bora, and the BMW M1.

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5/17/2003

I. Technical Data

Input torque mkg (ft. lbs.)	Ratios: Change speed gear (optional) 1st speed	2nd	3rd	4th	5th	Reverse	Bevel wheel drive (optional)	Speedometer
on request	2,42	1,61 1,47 1,40	1,23 1,13 1,09 1,04	1,0 0,958	0,917 0,846	3,75	4,5 4,22 4,0 3,77 3,56 3,4 3,22	2,4

Weight: approx. 53,5 kg (118 lbs)

Oil capacity: approx. 2,01 (3,5 pints)

II. Description

The ZF-Synchroma gearbox 5 DS-25 has 5 forward speeds and one reverse. The main gearbox and the axle drive with the differential are accommodated in one housing. The front part of the gearbox is constructed as bell housing and accommodates the release mechanism with the external control lever. The gearbox is mounted direct to the engine and therefore can be used for front or rear engine drive.

The gearbox type 5 DS-25 is equipped with a remote control connection, which can be largely adapted to the installation conditions of the gearbox in the vehicle. The input shaft runs from the engine coupling below the axle drive to the speed change gear. The output shaft, which lies above the input shaft, transmits the torque through the bevel gear drive to the differential. From the two output flanges the power is transmitted directly to the driving gears by means of cardan shafts.

The gearbox is equipped either with the ZF cam type self locking differential or the ZF multiple disc self locking differential. The characteristics of the ZF self locking differentials are as follows: perfect compensation of the differing wheel speeds on curves; starting of the vehicle even with bad road conditions on one side; no wheel spin, hence reduction of tyre wear and smooth , safe control of the vehicle. Skidding in a curve is practically impossible due to the high internal resistance of the differentials. The mating gears of the forward speeds are in constant mesh. One gear wheel of each speed is firmly fixed to the shaft whilst the mating gear is carried in roller bearings and can rotate freely.

During gear change this gear is coupled with the shaft through a displacement of the toothed sliding sleeve and the power flow is transmitted through the respective gear train. The toothed sliding sleeves are secured against jumping out of gear. The built-in synchronizer ensures that the parts to be coupled have obtained equal rotational speed. For reversing operations the sense of rotation of the output shaft is altered by the engagement of the so-called reversing gear.

III. Maintenance

Since all 5 forward speeds of the gearbox type 5 DS-25 are locksynchronized even the most inexperienced driver will be able to obtain quick, safe and silent gear changes without the necessity of double-de-clutching.

Due to the construction of the synchronizer the respective gears can only be engaged after the parts to be coupled have obtained equal rotational speed. It is, of course, important to maintain the pressure on the gear lever until the gear is fully engaged.

against premature wear, the changedown should only be carried out when the engine speed necessitates the engagement of the next lower gear. The reverse gear should only be engaged with the vehicle at rest, otherwise the gears will be damaged.

For all upward or downward changes and for the engagement of reverse the clutch pedal must be fully depressed.

The satisfactory condition of the main clutch contributes considerably towards avoiding gear change troubles. It must always completely engage and completely disengage the gears. Routine checks should be carried out to ensure that the specified pedal clearance is maintained.

IV. Lubrication

Oils, which cause corrosion (formation of rust) on steel or bronze components, are not suitable for lubricating the gearbox.

1. If the gearbox is intended for sports cars or other road vehicles, a mild, branded transmission oil of the viscosity group SAE 90 (or SAE 80) should be used.

   The first oil change should be carried out after 5 000 km (3 000 miles) and all subsequent changes after every 20 000 km (12 000 miles). The oil should be drained off immediately after a journey when the oil is still warm, flows easily and thus helps to remove any particles of wear from the gearbox.

2. If the gearbox is intended for racing cars or sports cars, Hypoid transmission oils should be used. In this case special steps must be taken to inspect the gearboxes after each race. Since Hypoid transmission oils tend to form residues it will be necessary to fill the gearbox with fresh oil before every race.

V. Maintenance

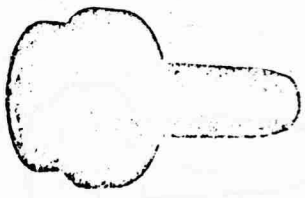
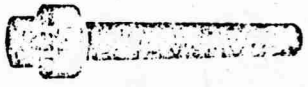
The oil filler is situated on the right side of the gearbox and is closed by a screw plug. Care should be taken that the filler hole and its immediate surroundings are perfectly clean before the filler plug is unscrewed. The gearbox is filled with oil up to the top mark on the dipstick. The dipstick is situated on the upper side of the gearbox and serves at the same time as a breather for the gearbox. In order to guarantee a satisfactory venting of the gearbox this also should be kept in a clean condition.

The oil drain plug is situated on the underside of the gearbox, i. e., at the lowest position directly beneath the gearshift operating shaft. The magnet on the oil drain plug which collects metal particles of wear, must be thoroughly cleaned every time the oil is changed.

Under normal conditions the oil level should be checked after every 5 000 km (3000 miles) but at the slightest suspicion of any leakage in the gearbox the oil level must be checked immediately.

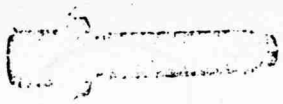
Branded oils already have all additives necessary for the gearbox. Special additives are not recommended.

VI. Tools

		Tool No.
Tool . 1 . Replacer for pressing the needle bearing outer ring (403) into the housing		1031 898 054
Tool . 2 . Replacer for pressing the needle bearing (231) into the housing		1031 898 051

Tool No.

Tool . 3 .
Replacer for pressing the needle bushing (232) into the housing



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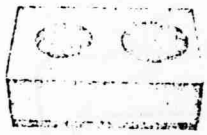
Tool . 4 .
Mounting plate for mounting the input and output shaft



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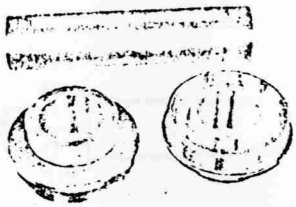
Tool . 5 .
Setting device for output shaft pinion

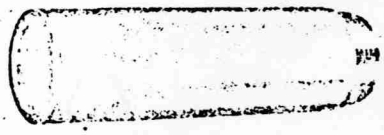


1016 898 702

Tool . 6 .
Measuring ring for output shaft ball bearing (ball bearing 1016 304 018)

1016 898 351

Tool . 7 .
Replacer for inner ring of ball bearing (420) on output shaft



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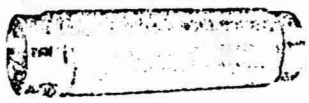
Tool . 8 .
Replacer for bearing inner rings (237) on input shaft



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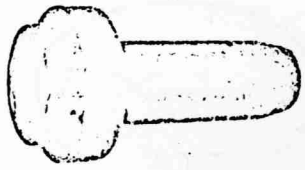
Tool . 9 .
Replacer for pressing the bearing inner rings (910) into the housing



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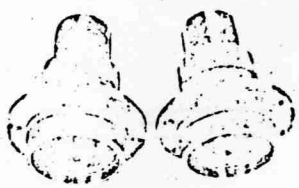
Tool . 10 .
Setting device for taper roller bearing on differential

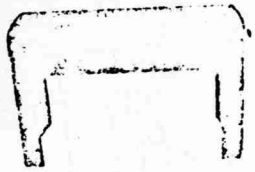


1031 898 701

Tool . 11 .
Measuring ring for adjusting the taper roller bearing (910) on differential (for setting device 1031 898 701)

1031 898 351

Tool . 12 .
Bridge for setting device 1031 898 701



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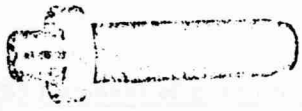
1016 989 101

Tool . 13 .
Replacer for pressing the shaft seals (921) into the differential flange



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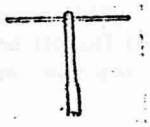
Tool . 14 .
Remover for bush (804) on speedometer drive



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Tool . 15 .
Adaptor for removing the taper roller bearing (910)

1031 989 202

Tool . 16 .
Pressure plate for removing the taper roller bearing

1016 898 552

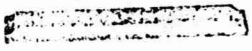
Tool . 17 .
Universal remover

1211 898 207

Tool . 18 .
Plate for removing the synchronizer bodies of 2 nd/3 rd gear and 4 th/5 th gear

1031 898 203

Tool . 19 .
Yoke for withdrawing the outer bearing ring (911) from the differential flange



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A) Removal of differential

1. After unscrewing the fixing bolts (106) remove the top cover (103) from the main housing.

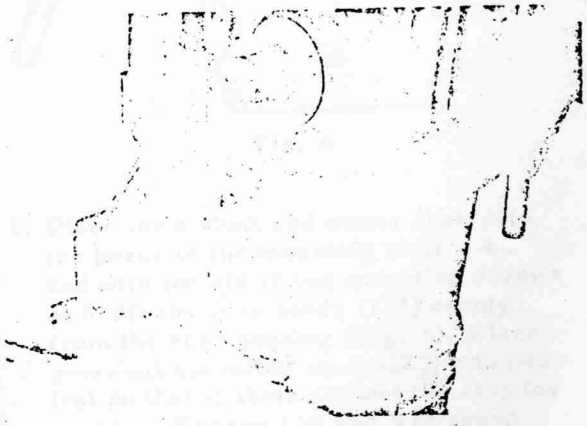


Fig. 1

2. Remove locating screw (801) for the bush (804) of the speedometer and withdraw the speedometer drive from the main housing, using tool . 14 . (Fig. 1).

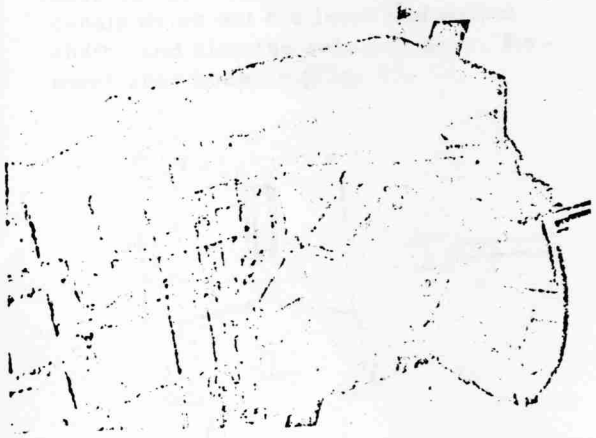


Fig. 2

3. Unscrew nuts (920) on left and right flange (918 and 908). With the aid of two mounting bars press both flanges evenly out of the housing bore (Fig. 2). Withdraw one taper roller bearing (910) from the housing, using tool set . 15. , . 16 . and . 17 . (Fig. 3). Remove differential together with the crown wheel from the main housing.

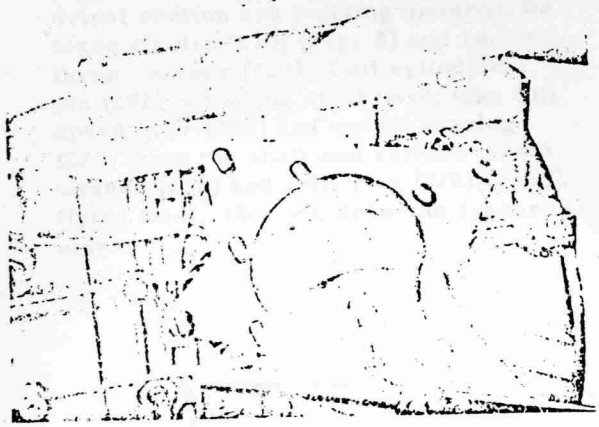


Fig. 3

B) Removal of gear shafts out of the housing

Remove all nuts (139) and hexagon socket screws (129, 130 and 131) from the rear cover (138). Knock out locating pins (116) and lift off the complete rear housing with the rear cover (123)(Fig. 4).

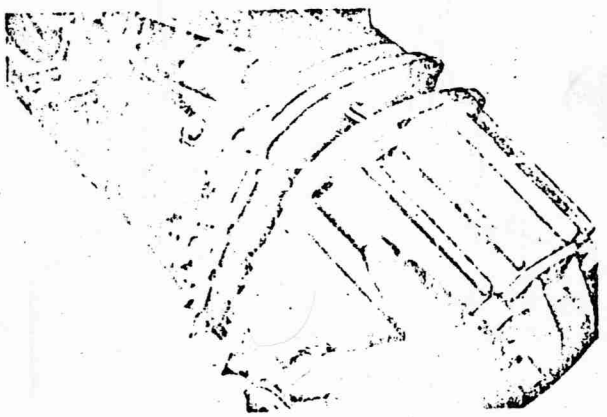


Fig. 4

C) Dismounting the gear shafts

Fig. 5

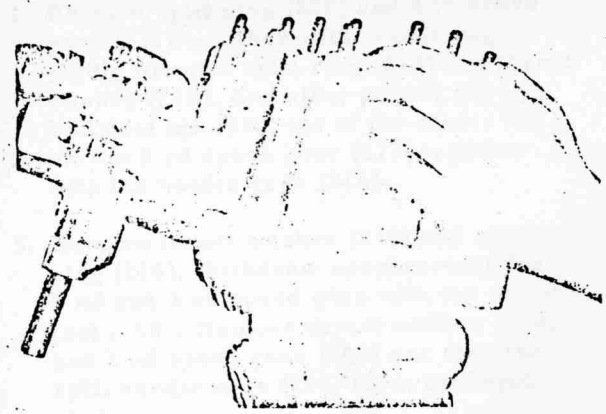


Fig. 6

1. Place input shaft and output shaft into the bores of the mounting plate . 4 . and with the aid of two mounting screws M 8 lift the rear cover (138) evenly from the rear housing (Fig. 5). Place gearshift operating shaft (625) into neutral so that it abuts against the stop for reverse. Engage 1 st and 5 th speed gear by pushing the two outer selector bars downwards and engage the 2 nd speed gear by raising the centre selector bar (636). The position of the operating shaft and the engagement of the 1st, 5 th and 2 nd speed gears is most important, otherwise it will not be possible to remove the rear housing. Unscrew nuts (240 and 422) on the input and output shafts. (Nut on output shaft has left-hand thread). Slightly lift the complete rear housing and with the aid of a soft hammer evenly drive out the input and output shafts and also the selector bars. Remove rear housing (Fig. 6).

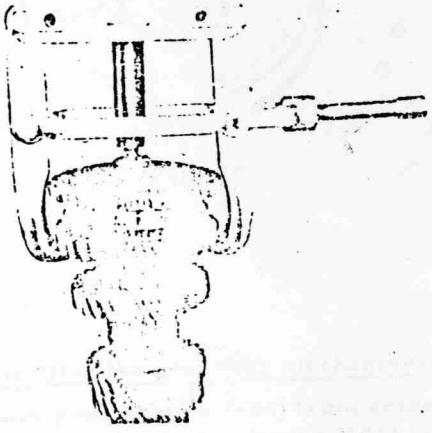


Fig. 7

2. Remove selector forks from gear shafts. Pull the 1 st speed gear (412) together with the synchronizer from the output shaft, using a two-legged withdrawing tool (Fig. 7). Any further dismantling of the output shaft can only be carried out with a hydraulic press.

3. Place output shaft in the mounting plate . 4 . , so that the splines on the cylindrical section are pointing upwards. Release circlip (230) (Fig. 8) and remove thrust washer (229). Pull cylindrical pin (202) out of the shaft bore; take 5th speed gear (228) and needle bearing (227) from the shaft and remove thrust washer (226) and split ring (222)(Fig. 9). Using tool . 18 . withdraw the synchronizer.

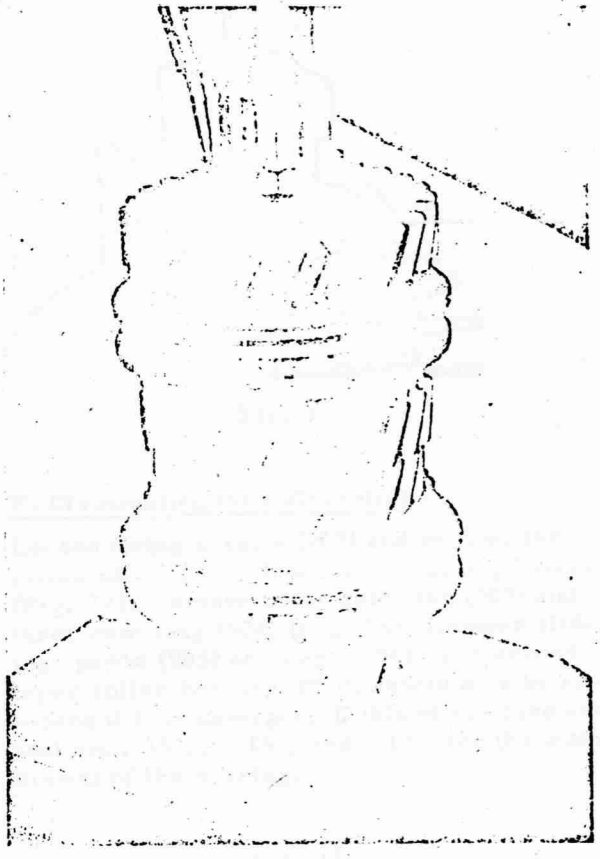


Fig. 8

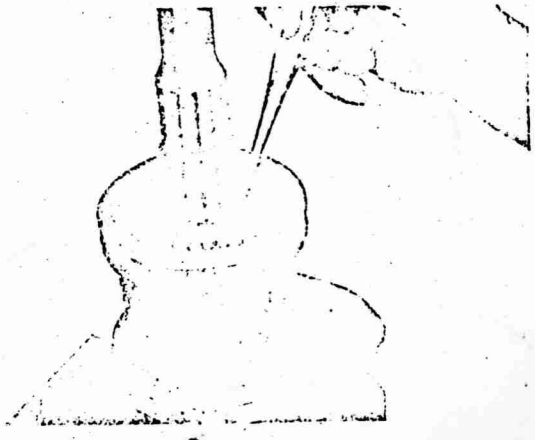


Fig. 9

4. Remove split ring (222) and 4 th speed gear (221) together with needle cage (220). Remove split ring (219) and thrust washer (218), and after pulling the cylindrical pin (203) out of the shaft, lift off the 3 rd speed gear (217) together with the needle cage (216).

5. Remove thrust washer (215) and split ring (214). Withdraw synchronizer for 2 nd and 3 rd speed gear with the aid of tool . 18 . Remove thrust washer (207) and 2 nd speed gear (206) and take the split needle cage (205) from the input shaft.

D) Dismantling the synchronizer

Press the sliding sleeve for the reverse gear (418) or the sliding sleeves (213 and 225) out of the respective synchronizers (Fig. 10). In order to prevent the 3 balls (210, 414) and the 3 springs (211,415)from falling out, it would be advisable to cover the synchronizers with a piece of cloth before removing the sliding sleeves.

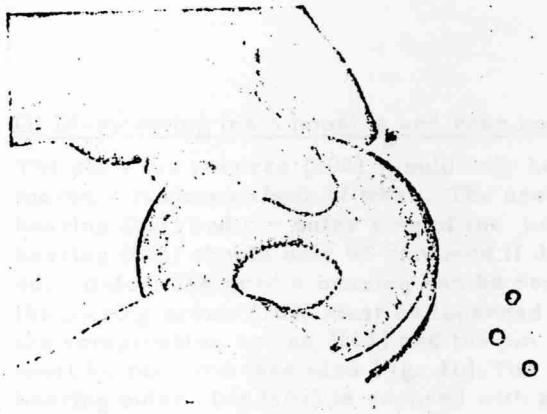


Fig. 10

E) Dismantling the gearshift mechanism

1. Remove grub screws (604) from selector arm (611) and selector finger (601). Pull external operating shaft (610) out of the selector arm and remove the selector finger. After loosening the hexagon screws (605,606 and 608) on the selector bracket (609) remove the bracket. Unscrew the 4 plugs (637) on the rear housing. Take the 3 pins (634) and the 3 springs (633) out of the bores and also remove the 2 pins (635 and 640), the sliding piece (623) and the spring (624) of the reverse stop.

2. Unscrew nuts (628) on centering piece (627) and remove centering piece. With the aid of an Allen key, which is inserted through the bore for the plug (Fig. 11), unscrew the grub screw (613) only just far enough that the finger (614) can be pulled from the internal operating shaft. Now pull the operating shaft out of the rear housing at the side of the centering piece. Loosen screw (615) and take the inner gate (617) and the outer gate (618) as well as the pin (619) and the springs (620) out of the rear housing.

Withdraw the reverse gear (501).

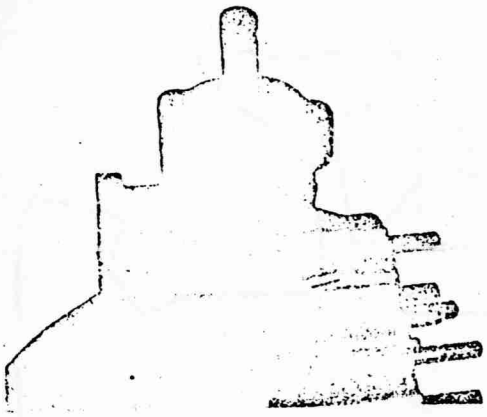
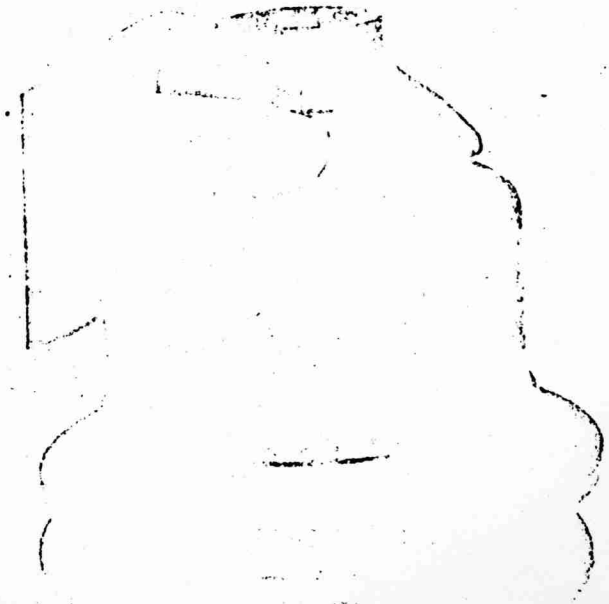


Fig. 11

F) Dismounting the differential

Loosen fixing screws (907) and remove the crown wheel (901). Separate the casing halves (Fig. 12). Remove outer cam ring (903) and inner cam ring (904) (Fig. 13). Remove sliding pawls (905) and cage (906). The second taper roller bearing (910) should only be removed if it is damaged. If this is the case use tool set . 15 . , . 16 . and . 17 . for the withdrawal of the bearing.

Fig. 12



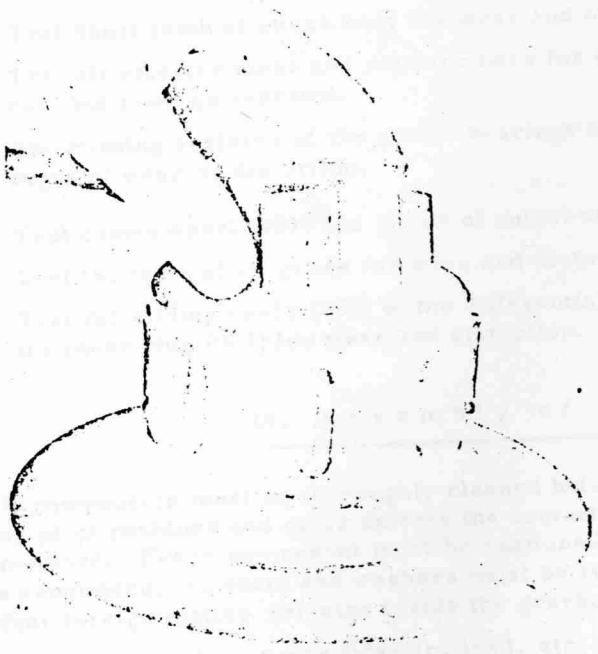


Fig. 13

G) Dismounting main housing and rear housing

The shaft for reverse (502) should only be removed if it shows signs of wear. The needle bearing (231) and the outer ring of the needle bearing (403) should only be removed if damaged. Before the needle bearing can be removed, the locking screw (109) must be loosened and the compression spring (111) and the pin (112) must be removed (see also Fig. 16). The needle bearing outer ring (403) is secured with a locating screw (108).

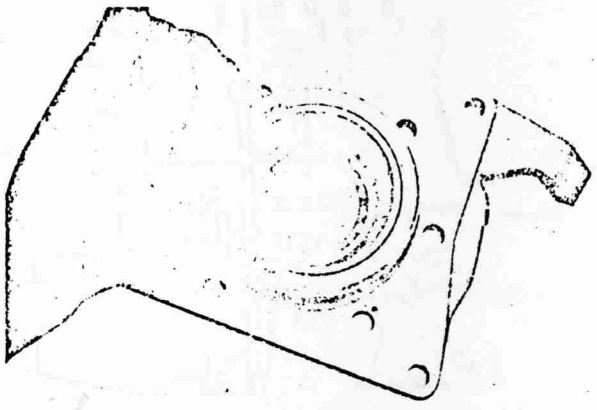


Fig. 14

H) Dismounting the differential flange

Release circlips (915) on output drive axles (922) (Fig. 14) and press out the axles. Force out the bearing outer rings (911) with tool .19. Release circlips (913) (Fig. 15) and press the ball bearings out of the flanges. Remove seal rings (921).

Remove all gaskets from main housing, rear housing, cover plates and flanges.

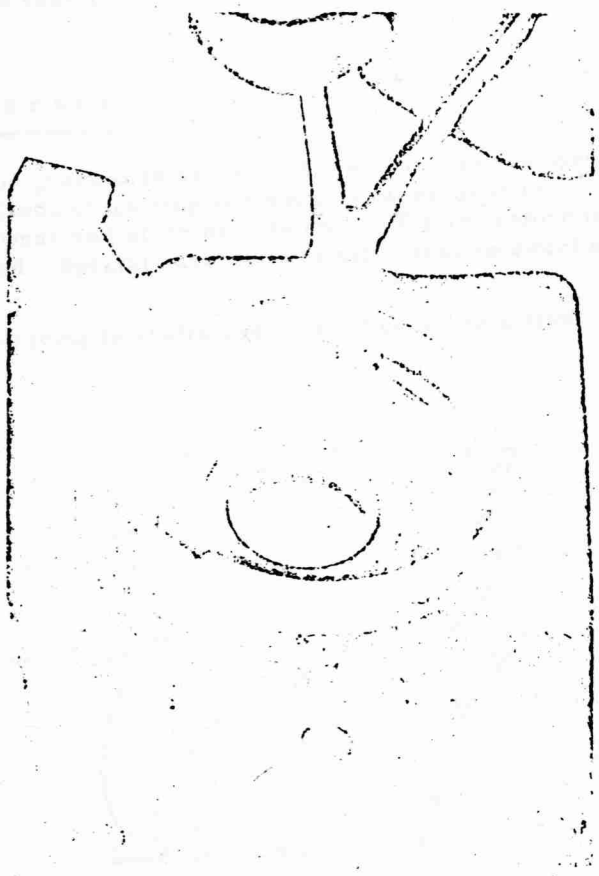


Fig. 15

VIII. Checking of individual components

1. Test the synchronizer rings (208, 223, 413) for wear. It would be advisable to renew the synchronizer rings.
2. Test short teeth of clutch body for wear and other defects.
3. Test all selector forks and selector bars for wear. Bent selector forks should not be straightened out, but must be renewed.
4. The running surfaces of the needle bearings and the needles themselves should have no visible signs of wear or distortion.
5. Test crown wheel (901) and pinion of output shaft (401) for wear.
6. Test the teeth of all gears for wear and distortion.
7. Test the sliding pawls (905) of the differential, the cage (906) as well as the outer ring (903) and the inner ring (904) for wear and distortion.

IX. Assembly of Gearbox

All components must be thoroughly cleaned before the gearbox is assembled. In order to remove any paint residues and other defects the contact surfaces of housing and housing cover must be smoothed. Every component must be examined for wear and other defects and well oiled before it is assembled. Gaskets and washers must be renewed. Special care must be taken that no swarf or other foreign matter remains inside the gearbox.

Always use a soft hammer (plastic, lead, etc.) for driving in shafts and pins. Never use a steel hammer on any hardened gearbox components!

A) Pre-assembly of main housing and rear housing

1. Using tool . 1 . for needle bearing outer ring (405) and tool . 2 . for the needle bearing (231), press both into the main housing so that the close fitting bolt (108) with the spring washer (107) can be screwed into the bore of the needle bearing outer ring and the pin (112) can be placed into the bore of the needle bearing. In order to make quite sure that the pin is correctly positioned, it would be advisable to measure the bore with a depth gauge.

   Place compression spring (111) on the pin (Fig. 16) and screw the locking screw (109) with washer (110) into the thread of the main housing.

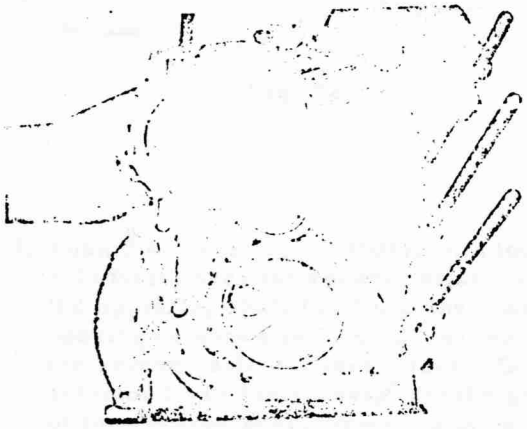


Fig. 17

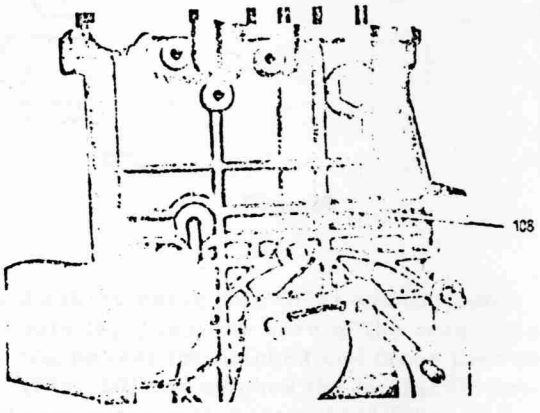


Fig. 16

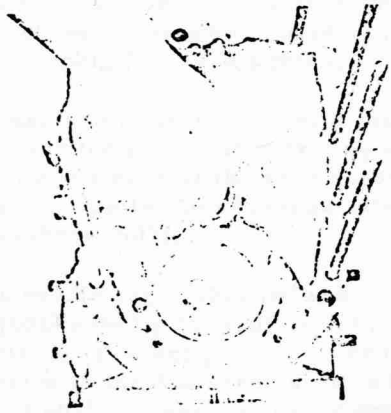


Fig. 18

2. With the aid of tool . 3 . press the needle cage (232) into the bore on the clutch side of the main housing (Fig. 17) and secure it with the two cylindrical pins (117)(Fig. 18). Put the oil collector pan (119) with the pipe through the bore of the housing (Fig. 17)and secure it with two screws (117) (Fig. 18).

3. Press the reverse shaft (502) from the outside into the rear housing until the locating pin (503) abuts. With the rear cover (138) in position, the locating pin (503) of the reverse shaft must fit into the recess in the rear cover.

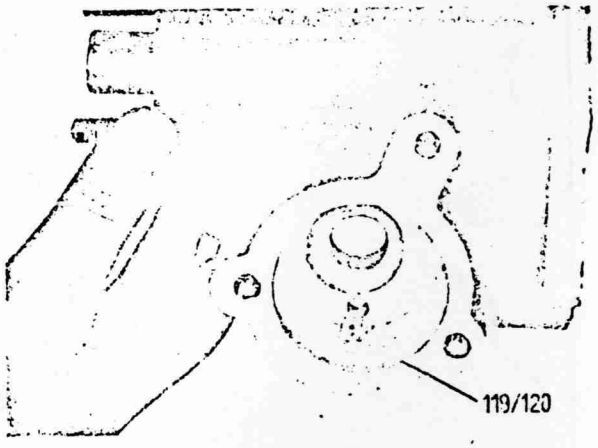


Fig. 19

B) Installation of gearshift mechanism

1. Insert spring (620) and pin (619) into the cross bore of the rear housing (Fig. 19).

Fig. 20

2. Push the outer gate (618) and the inner gate (617) into the bore of the rear housing so that the notched end faces inwards (Fig. 20) and catches the pin (619). Secure gates with screw (615) (Fig. 21).

Fig. 21

Fig. 22

3. Push the reverse gear (501), with toothed side first, over the reverse shaft. Guide the operating shaft (625) into the rear housing as shown in Fig. 22 and mount the reverse selector lever (622). Guide selector lever for reverse into the groove of the reverse gear. Now push the operating shaft into the rear housing until the pin in the shaft fits into the slot of the reverse selector lever. Keep the shaft in this position and slide the finger (614) over. Secure finger by tightening the grub screw (613). For this purpose an Allen key must be inserted through the bores of the housing and the two gates. Screw in plug (637) and tighten.

4. Push centering piece (627) with gasket (626) over the gearshift operating shaft until it rests against the rear housing and secure it with the two hexagon nuts (628) and washers (607).

5. Press needle cage (603) and shaft sealing ring (602) with lip towards inside, into the selector bracket (609). Secure the bracket with the 3 hexagon screws (605, 606 and 608) and washers to the rear housing.

6. Place one spring (633) and one pin (634) into each of the 3 adjacent cross bores, which cut the bearing bores for the selector shafts. Place one interlocking piece into the bore between the selector shafts. The longer interlocking piece (635) is inserted first. Close all 4 bores with screw plugs (637).

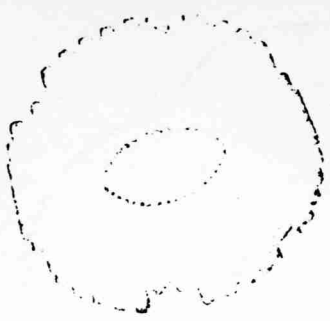


Fig. 25

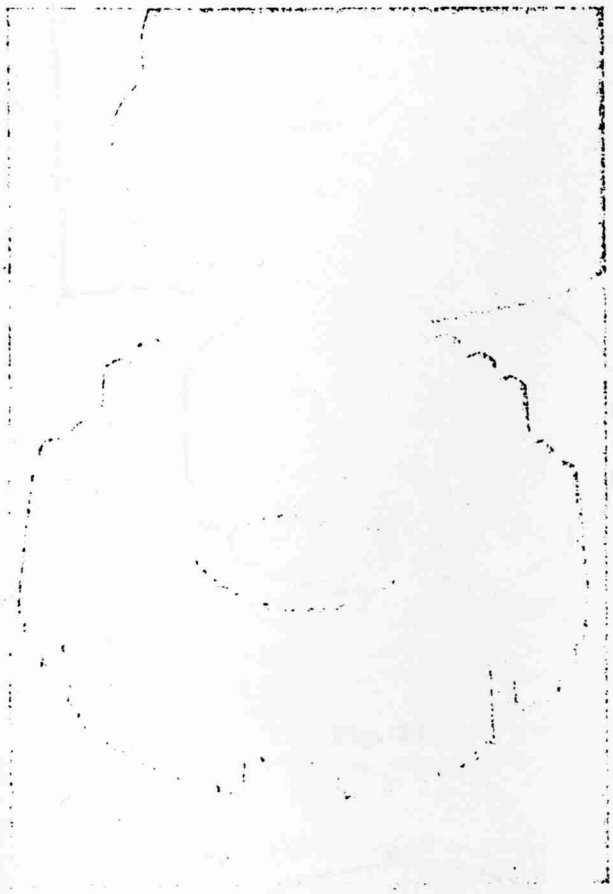


Fig. 23

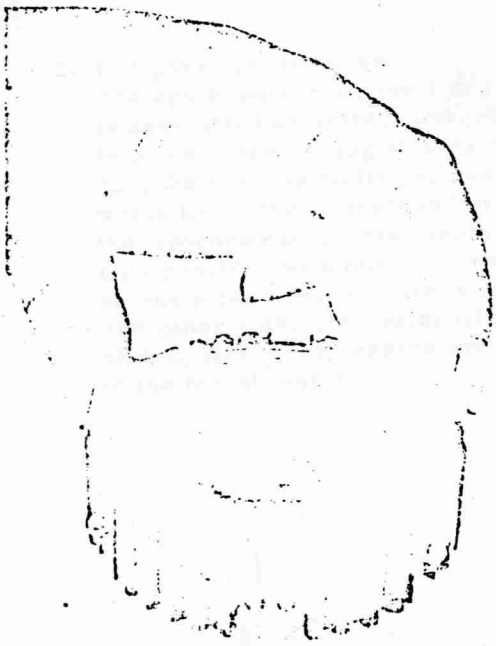


Fig. 26

Fig. 24

C) Pre-assemble the synchronizer

1. Synchronizer for 2 nd/3 rd gear and 4 th/5 th gear
   a) Place one compression spring (211) with some grease into each of the bores of the synchronizer (209,224)(Fig. 23).
   b) Place pawls (212) over the springs (Fig. 24).
   c) Place one ball (210) with some grease on the springs (211) in the bore of each pawl (Fig. 25).

d) Place synchronizer rings (208,223)into the synchronizer so that the 3 drivers of the rings are on the outside and the pawls protrude over the outer diameter of the synchronizer rings (Fig. 26).

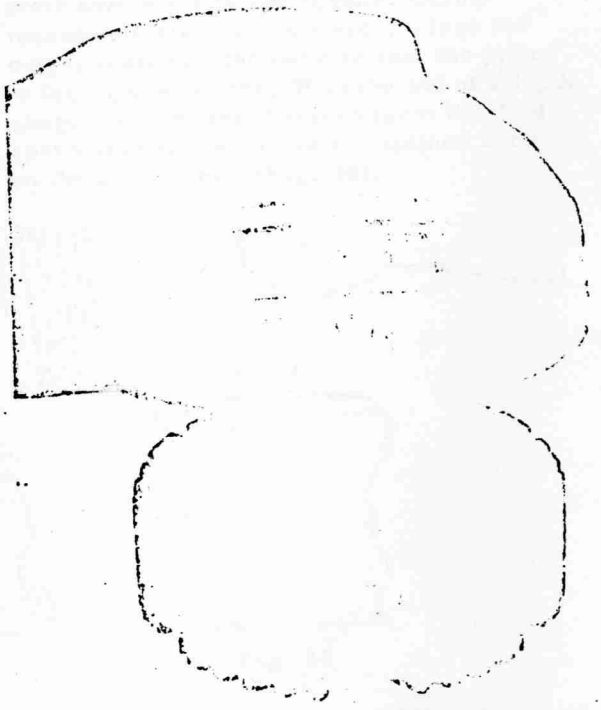


Fig. 27

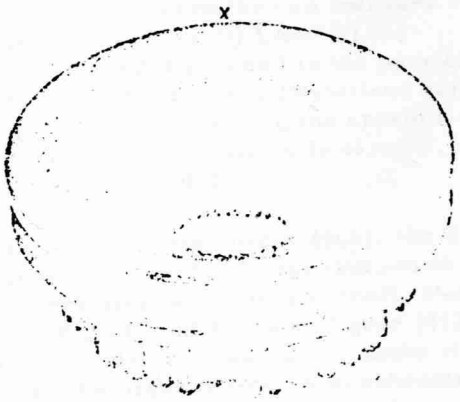


Fig. 28

e) Push the sliding sleeve (213,225) over the pre-assembled synchronizer so that the balls (210) engage with the teeth , which in Fig. 27 are marked with a cross (slightly cut back)and the drivers of the synchronizer rings fit into the tooth gaps of the sliding sleeve (Fig.28).

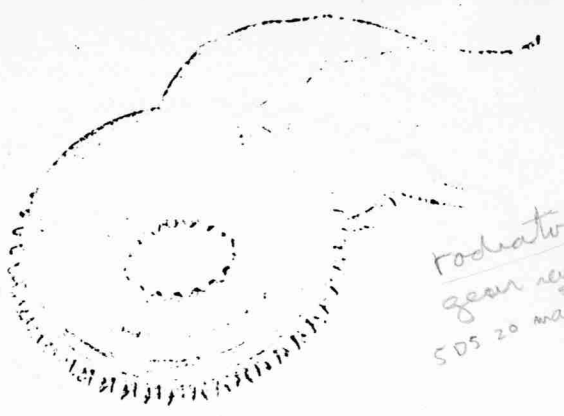


Fig. 29

2. 1 st gear synchronizer
The synchronizer for the 1 st speed gear is assembled as already described, but in place of the sliding sleeves (213 and 225) the reverse sliding sleeve, (418) which has external teeth is pushed over the synchronizer. This synchronizer is only provided with one synchronizer ring on one side; a thrust plate is welded to the other side. (The external teeth of the sliding sleeve for reverse are on the side of the thrust plate).

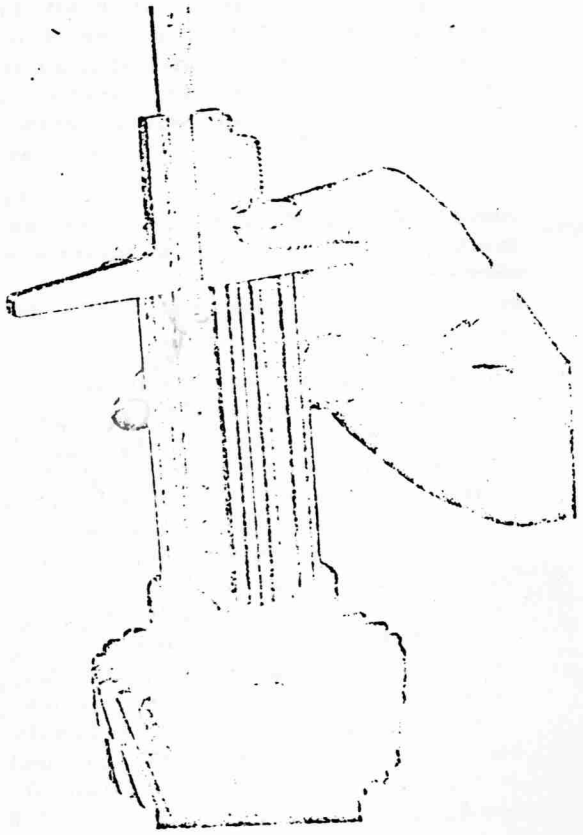


Fig. 30

D) Pre-assembly of output shaft

1. Press the inner ring with the assembled rollers (402) on the output shaft until it rests against the pinion. Mount 5 th speed gear (404) with teeth towards bevel pinion, speedometer worm (405), 4 th speed gear (406), with collar towards speedometer pinion and the 3 rd speed gear (407) with teeth towards 4 th speed gear. Clamp mounting plate . 4 . in a vice. Place the output shaft into the bore so that the pinion is facing downwards. With the aid of a depth gauge measure the distance from the 3 rd speed gear to the end of the splined section on the output shaft (Fig. 30).

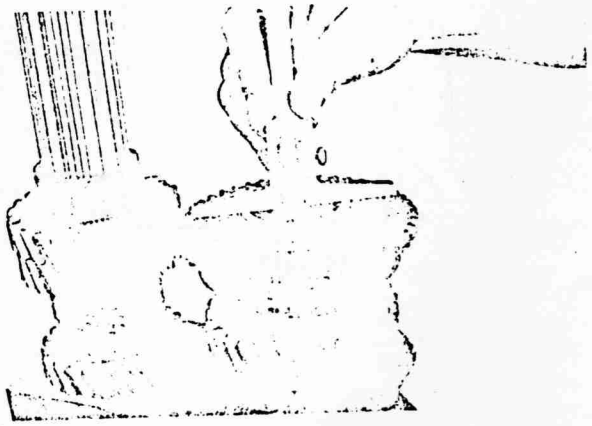


Fig. 31

2. Place the 2 nd speed gear (409) on a ground steel plate. Place inner ring (410), 1 st gear synchronizer (417) and spacer (408) on the 2 nd speed gear.
Place a depth gauge on the spacer and measure the height from steel plate to spacer.

3. The difference between the two measurements (obtained under D) 1. and D) 2.) should be 0 to+0,1 mm and is the permissible standout of the shaft. Deviations can be compensated by selecting the appropriate spacers, which are available in sizes 2,0 to 2,8 mm in steps of 0,1 mm.

4. Press the appropriate spacer (408), the 2 nd speed gear (409) (collar facing downward) and the inner ring on the output shaft. Push needle cage (411) and 1 st speed gear (412) (with clutch body upwards) on the inner ring. Now press the pre-assembled synchronizer on the shaft so that the thrust plate faces upwards (Fig. 32).

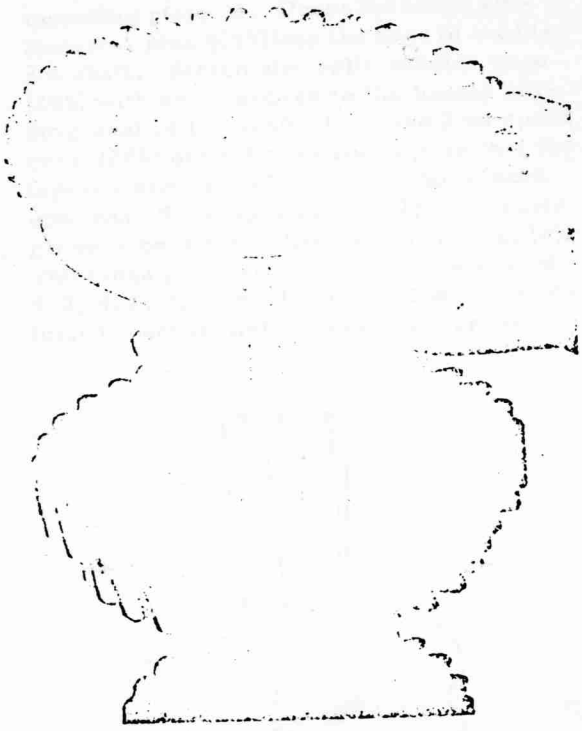


Fig. 32

E) Setting the output shaft

Place pre-assembled output shaft into the main housing. Fit rear housing to main housing and secure with two nuts diagonally opposed. Support main housing on bell housing so that the output shaft is in vertical position. Place the two rings of tool . 5. into the bores for the differential bearing and insert plug gauge. The measurement marked on the outer diameter of the crown wheel represents the distance from face of output shaft to the axis of the differential bearings. The radius of the plug gauge (27,5 mm) must be deducted from this valve. The difference is the height, which must be determined with distance gauges.

Example:

Measurement to output shaft	75,25 mm
Minus radius of plug gauge	27,50 mm
Height of distance gauges =	47,75 mm

Place the appropriate distance gauges between plug gauge and face of output shaft (Fig. 33). Push measuring ring . 6. over the rear housing end of the output shaft until it rests against the shaft collar. Determine distance between measuring ring and contact face of rear housing with a depth gauge (Fig. 34). Deduct measurement from housing contact face to seating surface of the bearing in the rear housing. The difference between these two measurements corresponds to the thickness of the shims, which must be placed between the collar of the ball bearing (420) and the rear housing. The shims (419) are available in the following sizes: 0,1 ; 0,15 ; 0,3 ; 0,5; 0,6; 0,7 ; 0,8 ; 0,9 ; 1,0 ;1,1 ; 1,2 ; 1,3 and 1,4 mm.

Remove rear housing again and fit the ball bearing with the shim underneath (Fig. 35).

Press one inner ring of ball bearing (420) on the output shaft, using tool .7. Also press ball bearing (237) of the input shaft into the rear housing.

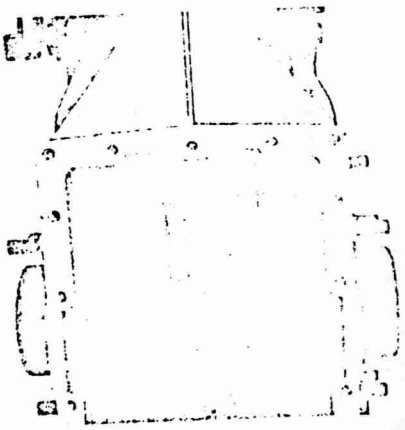


Fig. 33

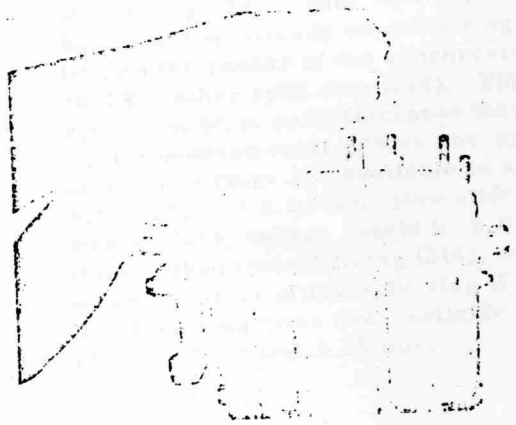


Fig. 34

Fig. 35

F) Pre-assembling the input shaft

1. Place input shaft (201) with the threaded end to the bottom, into the small bore of mounting plate .4. Press the lower cylindrical pins (203) into the bore of the input shaft. Attach the split needle cage (205) with some grease to the lowest bearing seat of the shaft. Push the 2 nd speed gear (206) over the needle cage so that the tapered shoulder of the clutch body faces upwards. Slide split ring (207) with inner grooves over the cylindrical pin (Fig. 36). The rings (207) are available in sizes of 4.0, 4.1, 4.2 and 4.3 mm. The rings selected must fit tightly into shaft groove.

Fig. 36

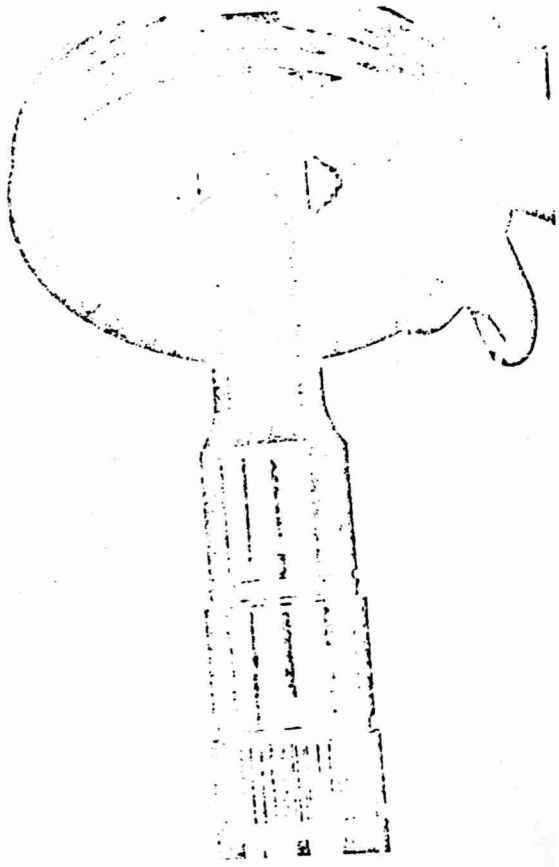
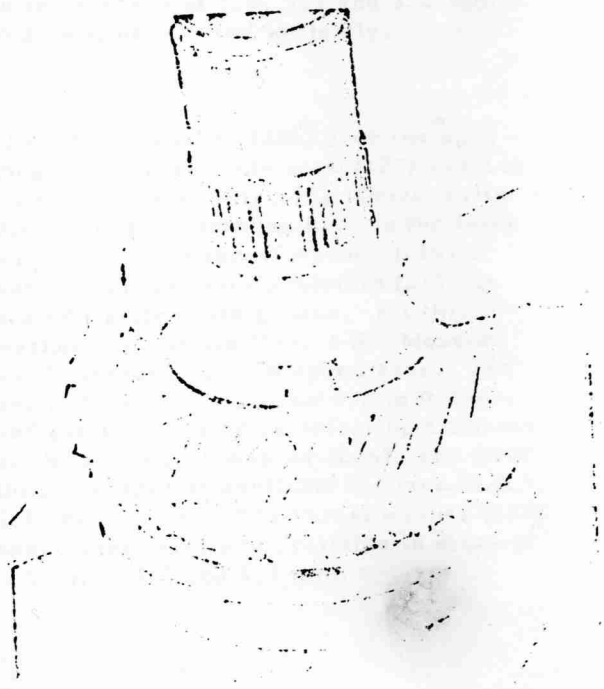


Fig. 37

Fig. 38

2. Press the pre-assembled synchronizer for 2nd/3rd speed gear on the shaft so that the recess on the inner diameter faces downwards (Fig. 37). Make sure that the two halves of the already mounted ring (207) fit into the recess of the synchronizer. Insert the other split ring (214). This ring also must be of such thickness that it sits tightly between shaft groove and synchronizer. The rings are available in sizes of 3.0, 3.1, and 3.2 mm. Now slide a thrust washer (215), which should be 0.05 mm thicker than the split ring (214), over the outer diameter of the split ring (Fig. 38). The thrust washers are available in sizes of 3.05, 3.15 and 3.25 mm.

Fig. 39



3. Mount needle cage (216) and 3 rd speed gear (217) with clutch body facing downwards. Drive the two cylindrical pins (203) into the bore of the shaft. Place split ring (218) with grooves over the cylindrical pins (Fig. 39). The split ring must sit tightly in the groove. The rings are available in the following thicknesses: 3.9, 4.0 and 4.1 mm. Measure axial clearance of 3 rd speed gear. For this purpose it is advisable to use a dial gauge and a dial gauge holder, which according to the design is placed either on the mounting plate or secured to the unmachined surface of the input shaft (Fig. 40). The axial clearance should be 0.3 to 0.4 mm; it can be adjusted by selecting the appropriate thrust washer (215) underneath the 3 rd speed gear. Press thrust washer (219) over the split ring.

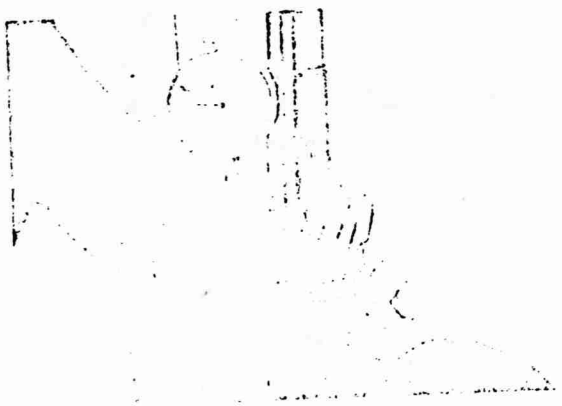
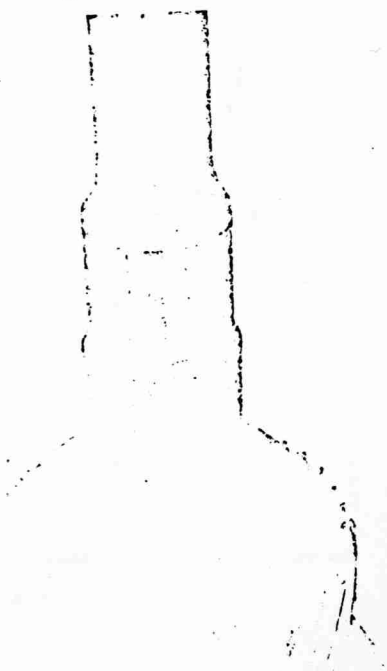


Fig. 40

Fig. 41



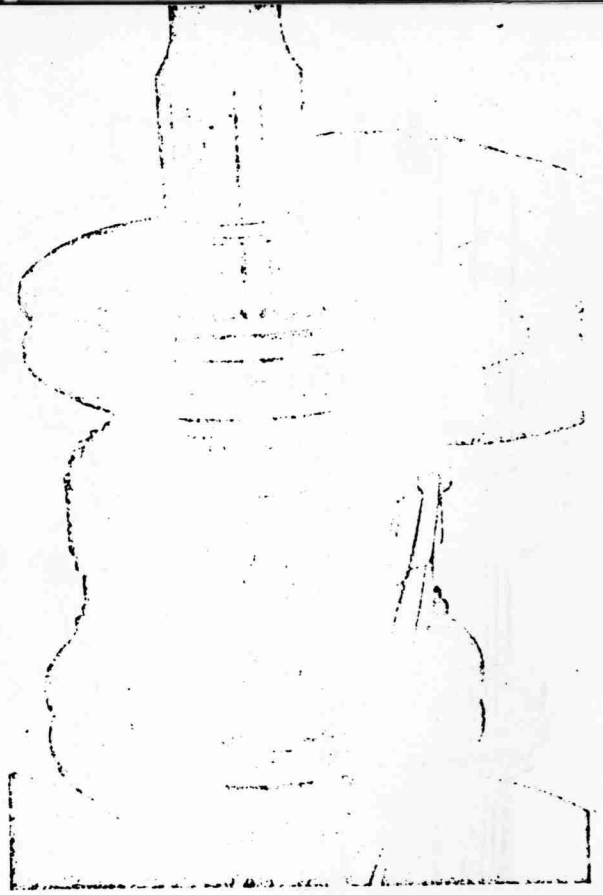


Fig. 42

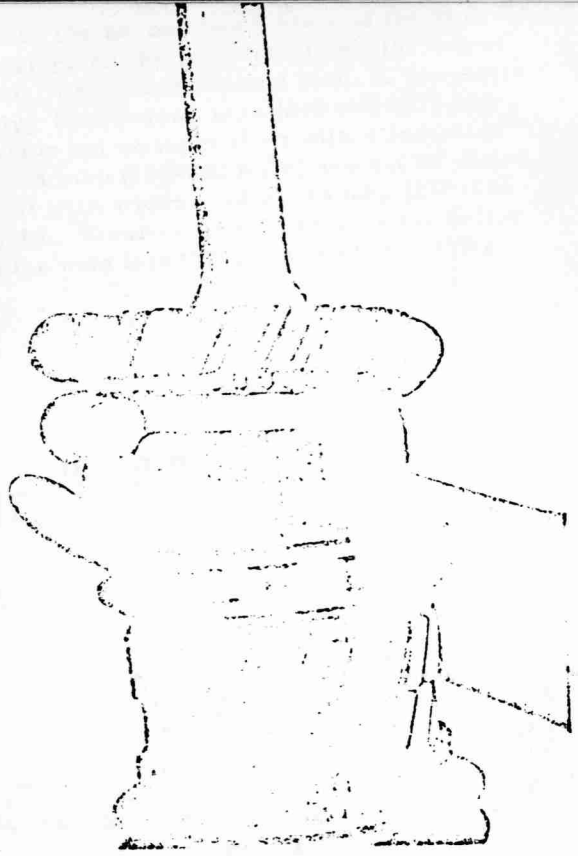


Fig. 43

4. Place needle cage (220) and 4 th speed gear (221), with clutch body facing upwards, on the thrust washer. Insert split ring (222) (Fig. 41), which must sit tightly in the groove. The rings are available in thicknesses of 3.0, 3.1 and 3.2 mm. Mount preassembled synchronizer for 4th/5th speed gear so that the recess on the inner diameter faces downwards (Fig. 42). The previously inserted ring (222) must be seated in the recess. Secure synchronizer by inserting the split ring (222). The split rings are available in thicknesses of 3.0, 3.1 and 3.2 mm and must be pressed in tightly.

5. Slide thrust washer (226) over the split - ring and mount needle cage (227) and 5 th speed gear (228) (Fig. 43). Drive cylindrical pin (202) into the bore in the input shaft. Select a thrust washer (229) of such thickness that the circlip (230) is seated tightly in its groove. Fit thrust washer and circlip (Fig. 44). Measure axial clearance of 5 th speed gear. The axial clearance should be 0.2 to 0.3 mm, and can be adjusted by selecting a thinner or thicker thrust washer (226). The first thrust washer is available in sizes of 2.5, 2.6 and 2.7 mm. The thrust washer (229) next to the circlip is available in sizes of 4.0, 4.1, 4.2 and 4.3 mm.

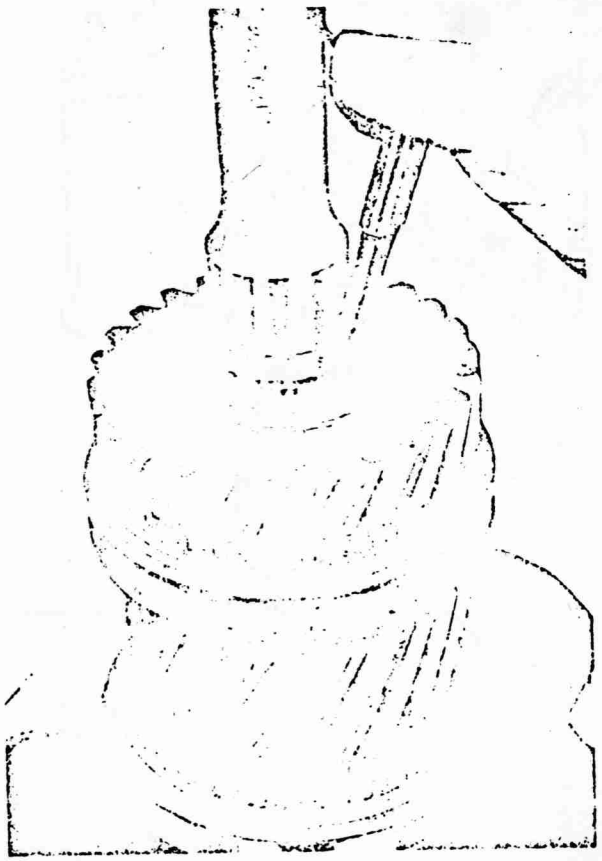


Fig. 44

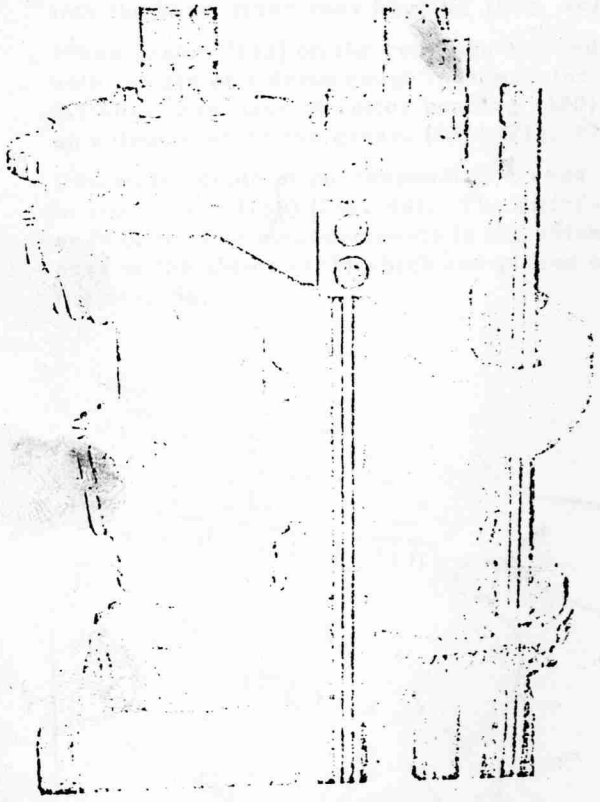


Fig. 45

5. Press the second inner rings of the ball bearings on the input shaft and the output shaft, using tool .7. and tool .8. respectively. Screw down nuts (240 and 422) and tighten nut on input shaft with a torque of 25-28 mkp (180-202 ft/lb) and nut on output shaft with a torque of 32-35 mkp (230-252 ft/lb). Secure nuts by preening the collar of the nuts into the grooves of the shafts.

Fig. 46

G) Assembly of gearbox

1. Place the pre-assembled input shaft and the pre-assembled output shaft into mounting plate .4., so that the threaded ends of the shaft face upwards. Press one inner ring of ball bearing (237) on the input shaft, using tool .8.
2. Guide 1 st speed selector bar (631) into the 1 st speed selector fork (632) (see Fig. 45 and exploded view 21-1), and tighten the two grub screws (604) evenly. Push 4 th/5 th speed selector fork (638) on the 4 th/5 th speed selector bar (639). Secure with grub screw (604). Push 2 nd/3 rd speed selctor bar (636) through the bore of the 4 th/5 th speed selctor fork and the 4 th/5 th speed selector bar through the bore of the 2 nd/3 rd speed selector fork. Now guide all 3 selector bars into the sliding sleeves.
3. Engage 1 st and 5 th gear by pushing the two outer selector bars downward and engage the 2 nd gear by pushing the centre selector fork upwards (Fig. 45). Put gearshift operating shaft (625) into neutral between 1 st speed and reverse by pulling it outwards.
4. Place the rear housing on the shafts and in the first instance push the centre selector bar through the bore and put it into neutral. Subsequently push the other two selector shafts through the appropriate bores. Take care that none of the pins (634) or interlocks (635 and 640) drop out.

Fig. 47

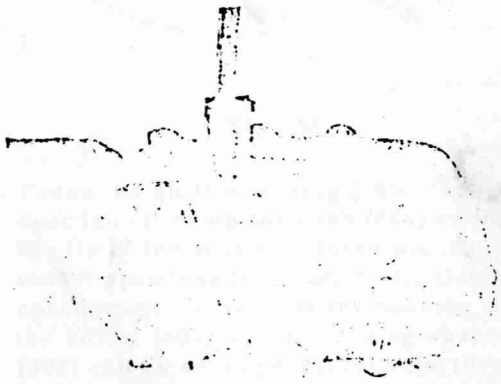


Fig. 48

II) Mounting the rear cover

1. Place sliding piece (623) and spring (624) into the bore in the rear housing (Fig. 46).

   Place gasket (132) on the rear housing and with the aid of a depth gauge measure the distance from face of roller bearing (420) on output shaft to the gasket (132) (Fig. 47).

   Determine depth of corresponding recess in rear cover (138) (Fig. 48). The difference of the two measurements is the thickness of the shims (421) which are placed on the bearing.

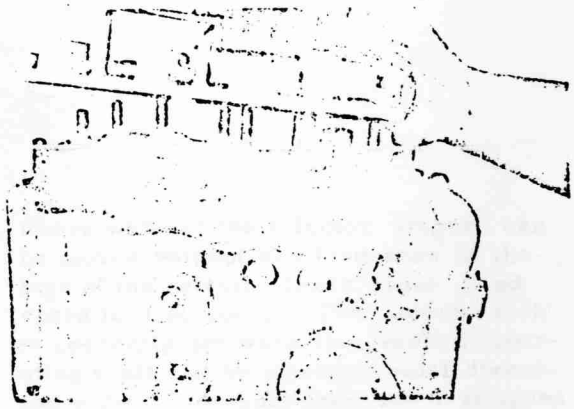


Fig. 49

2. The thickness of the shims (239), which are placed on the ball bearing (237) of the input shaft, must be determined in the same manner as described under H)1. Place the shims selected on the bearings.

3. Place rear cover (138) in position (Fig. 49) and secure it with nuts (139) and spring washers (107). Tighten nuts with a torque of 1.5 - 2 mkp (11 - 14 ft/lb).

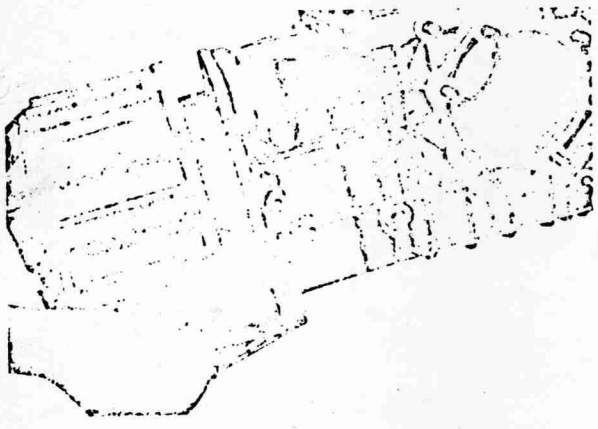


Fig. 50

Fig. 51

I) Joining the pre-assembled rear housing to the main housing

1. Put all sliding sleeves into neutral. Take the complete rear housing out of the mounting plate .4. and push the shafts and gears into the pre-assembled main housing (Fig. 50). It would be advisable to coat the rollers of the inner ring (402) on the output shaft with some grease, to make it easier for the rollers to be guided into the outer ring (403). Make sure that the selector rods are in the bores. Secure rear housing to main housing with studs (129, 130, 131) and spring washers (128) and nuts (139) and spring washers (107). Drive in locating pins (116) Fig. 51) and tighten studs and nuts with a torque of 1.5 - 2mkp (11 - 14 ft/lb).

2. Engage all gears several times and make sure that the stops are not jamming. During a change to a higher or lower gear it should be impossible to engage two gears at the

Fig. 52

3. Press the shaft seal ring (805) for the speedometer into the bush (804) so that the lip of the seal ring faces inwards and insert speedometer shaft (803). Guide the speedometer drive into the housing so that the screw (801) with the spring washer (802) can be screwed through the thread in the housing and into the bore of the bush (Fig. 52).

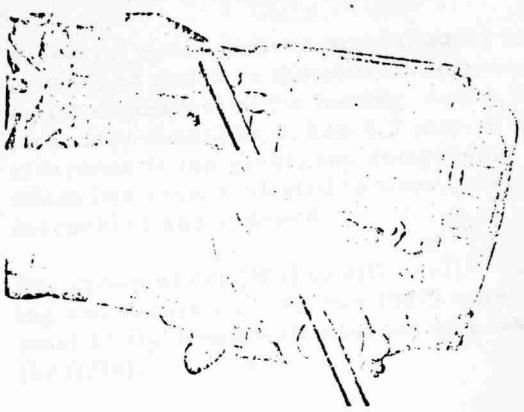


Fig. 53

4. Check whether the selector finger can be moved without any hindrance in the lugs of the selector forks from 2 nd speed to 1 st speed. The selector fork is correctly set when the gearshift operating shaft can be moved in axial direction without hindrance from the 1 st speed position to 2 nd speed position with the gears in neutral. If this is not the case, one of the two grub screws (604) must be loosened with the aid of a key which is inserted through the elongated hole in the rear housing, and the other grub screw must be tightened (Fig. 53) until the gearshift operating shaft can be moved to and fro in axial direction. Subsequently the previously loosened grub screw must be tightened again. Place cover plate (126) with gasket (125) on the elongated hole and secure it with nuts (127.1) and spring washers (127).

Fig. 54

Fig. 55

Fig. 56

K) Assembly of differential

1. Lubricate all running surfaces of the inner ring (904) the outer ring (903), the cage (906) and also the pawls (905) with Molycote paste G.

2. Place cage on work bench. Push inner ring (904), with lip first, into the cage and place the pawls into the elongated holes (Fig. 54).

3. Push outer ring over the cage and the pawls (Fig. 55) and push the casing (902) over the differential (Fig. 56).

4. Screw the casing halves provisionally together and measure the overall clearance (axial clearance) of the butting faces. This clearance should be 0.3 to 0.7 mm. If the clearance is too great, the component, which has been subjected to wear must be discovered and renewed.

5. Fix crown wheel (901) to differential casing and secure with screws (907) which must be tightened with a torque of 8 mkp (67 ft/lb).

Fig. 57

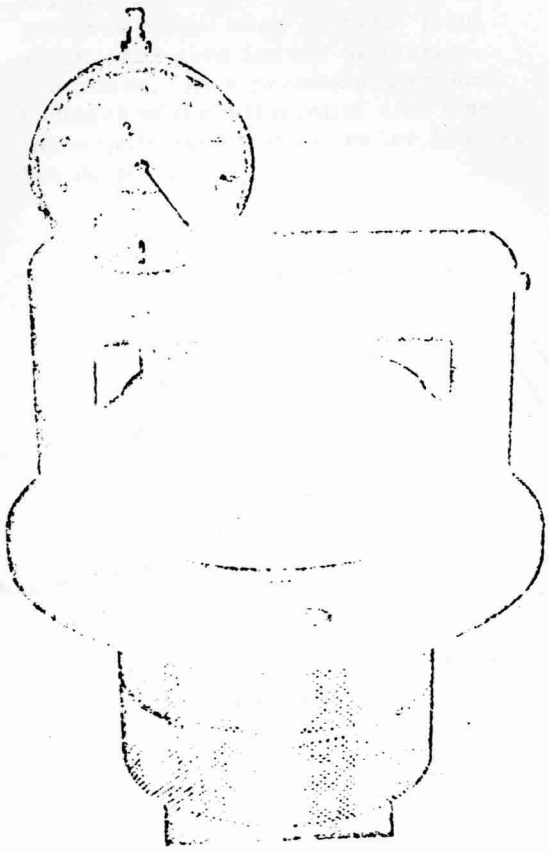


Fig. 58

L) Setting the differential

1. Place differential into the main housing (crown wheel to the left, seen in the direction of travel, i.e. on the opposite side to the bore for the speedometer drive). Press bearing inner rings(910) on the differential casing, using tod. 9. Press outer rings of the roller bearing (911) into the setting device .10. Mount setting device on both sides to the housing (with gasket in position and tighten all 6 studs with a torque of 4.2 mkp (30 ft/lb).

2. Screw in the sleeve of the setting device on both sides until

   a) the bearing of the differential is free from play and a slight resistance can be felt,

   b) the backlash between crown wheel and output shaft is 0.15 to 0.18 mm, measured on outside diameter of crown wheel (Fig. 57). Localize setting sleeves.

3. Now remove the two setting devices from the housing and take out the bearing outer rings. Place measuring ring .11. in place of the outer rings into the setting device and with the aid of gauge yoke .12., measure the distance from face of measuring ring to seating face of mounting flange (Fig. 58).

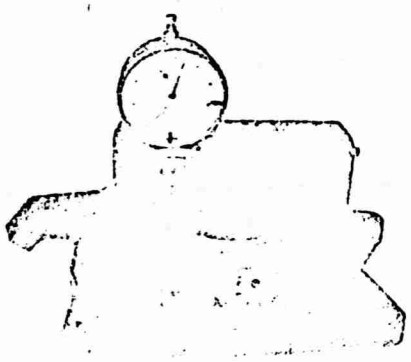


Fig. 59

4. Place measuring ring .11. into the flange, which will be mounted to the side on which the setting device was previously attached, and repeat the measuring procedure (Fig. 59).

The difference between the two measurements is the thickness of the shims (912), which must be placed into the flange behind the bearing outer rings.

s. Measure the second side in the same manner. Take care that the shims (912) for this flange are not placed into the other flange. The shims are available in sizes of 0.1, 0.2, 0.3, 0.4, 0.5 and 1.0 mm.

Fig. 60

Fig. 61

M) Pre-assembly and mounting of flange to housing

1. Press ball bearing (917) into the right flange (908) and place the appropriate number of shims (914) in the bearing, so that the circlip (913) fits tightly (without play) into the groove. Insert the shims (912), which were previously measured for the right flange (Fig. 60) and press in the bearing outer ring (Fig. 911). Fit shaft seal ring (921) with lip towards inside using tool .12. Press output drive axle (922) into the ball bearing (917). Place shims (916) on the inner ring of the ball bearing and secure with circlip (Fig. 61). The circlip must sit tightly without play in the groove. Both circlips (914 and 916) are available in sizes of 1.0, 1.1, 1.2, 1.3 and 1.4 mm.

the same manner.

3. Mount both flanges to the housing together with the same gaskets (909) which were used for the measuring procedure. As a precaution, recheck backlash of the differential and also make quite sure that the roller bearing has no play.

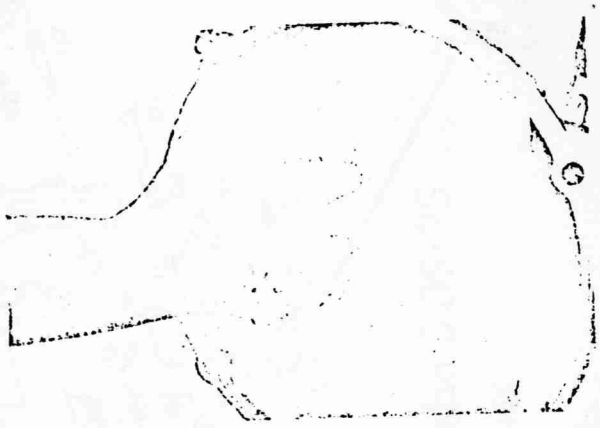


Fig. 62

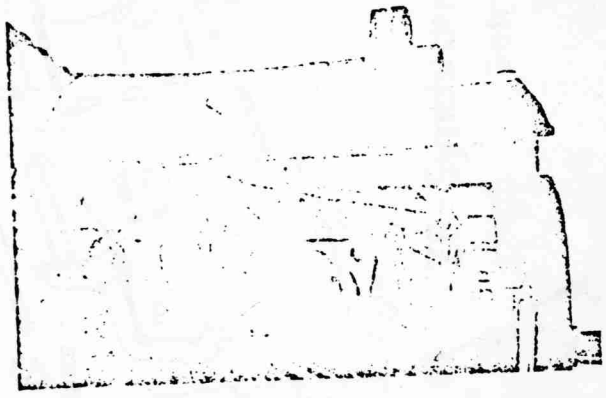


Fig. 63

4. Press shaft seal ring (233), with lip facing inside, into the guide flange. Fit guide flange (234) to housing and secure it with the 3 screws (236) and spring washers (235) (Fig. 62). Guide clutch release shaft (1006) into the bore, slide clutch release spring (1005), clutch release fork (1004) and second clutch release spring (1001) on the shaft. Drive in tension pin (one large and one small).

Mount top cover (103) with gasket (102) and secure the cover to the main housing with screws (106) and spring washers (107) (Fig. 63). Fit magnetic screw plugs (122) and oil dipstick (105).

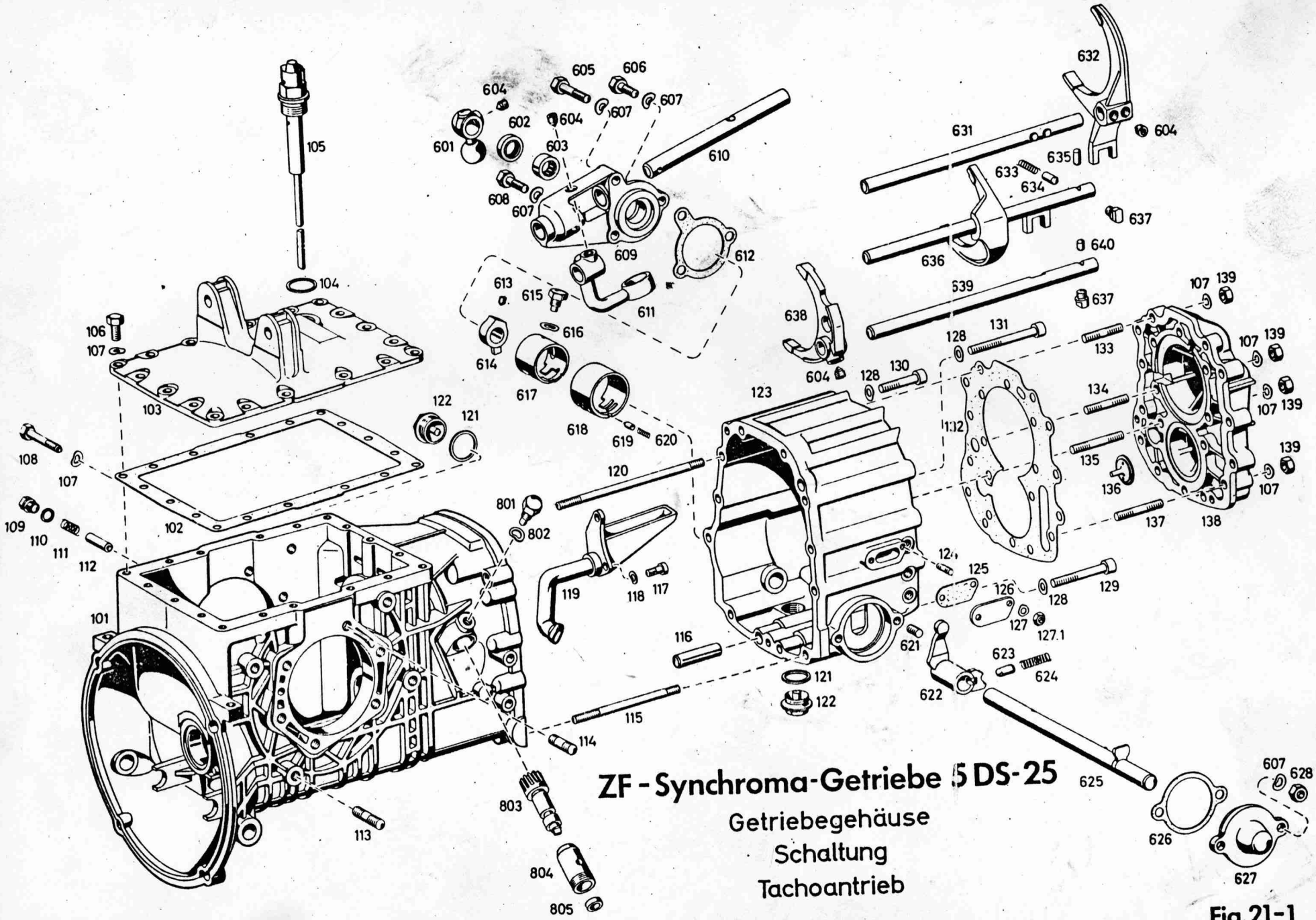
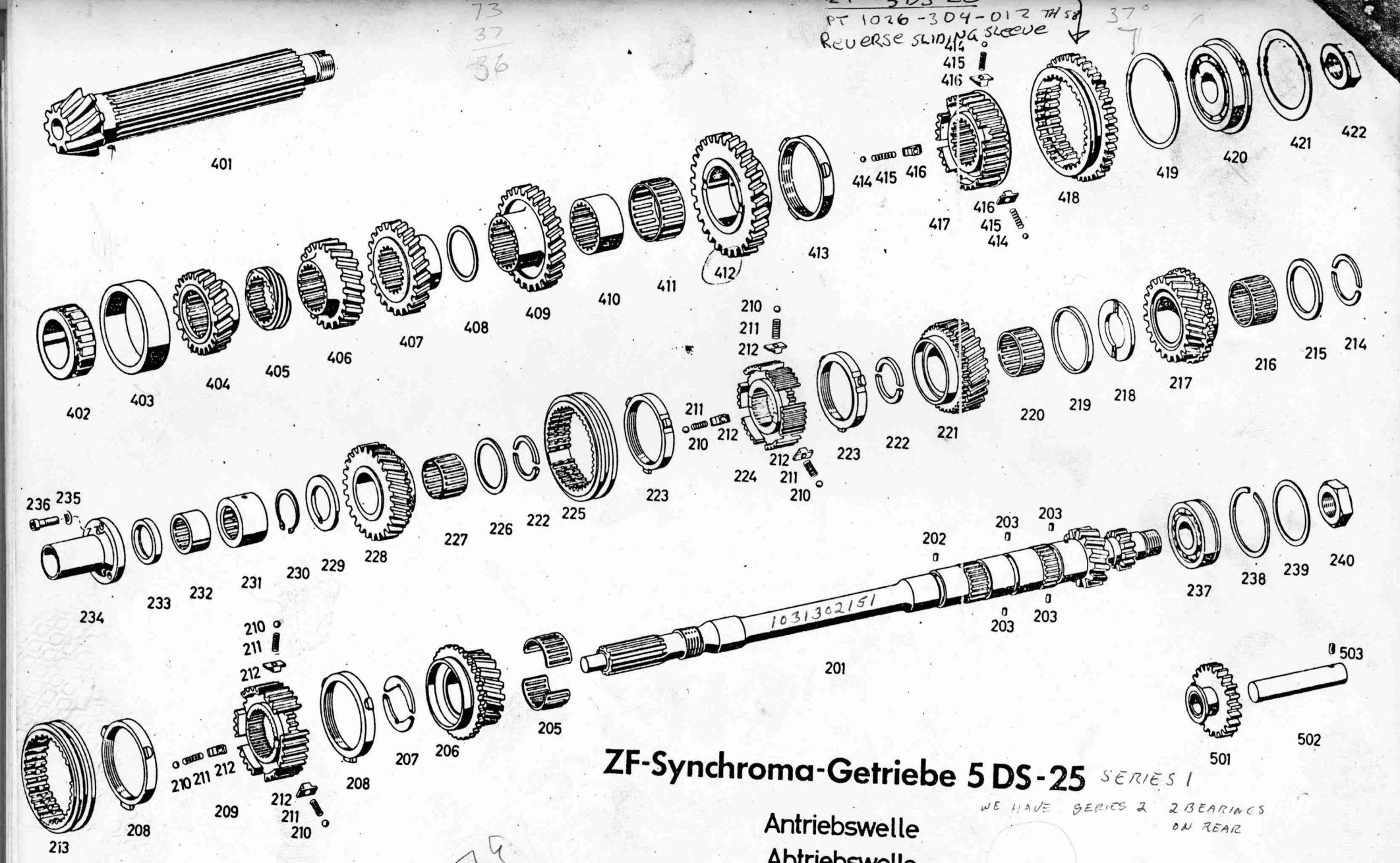

ZF - Synchroma-Getriebe 5 DS-25
Getriebegehäuse
Schaltung
Tachoantrieb

Fig. 21-1



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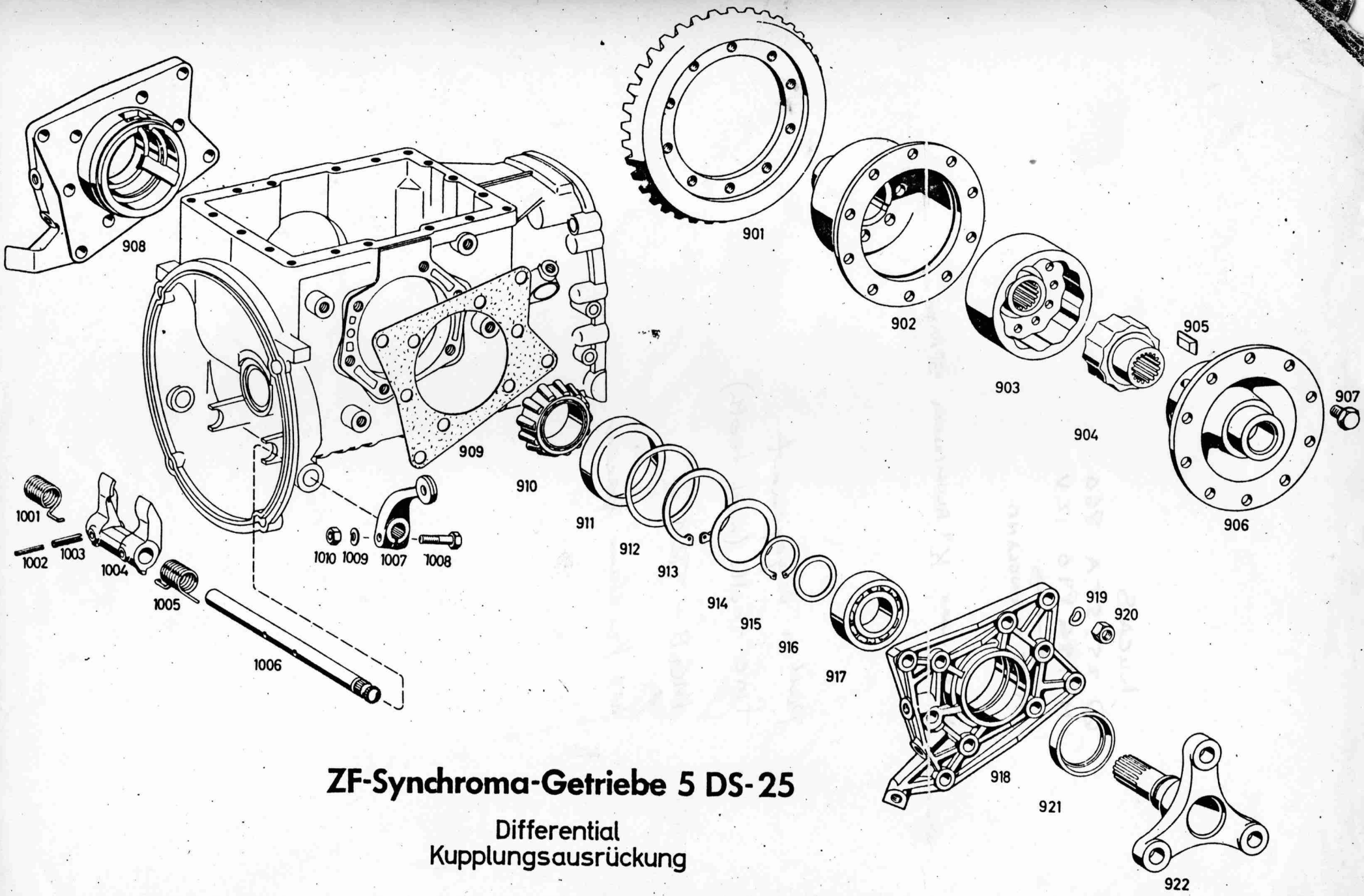
Antriebswelle
Abtriebswelle
Rücklauf

Fig.21-2



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Differential
Kupplungsausrückung

Fig.21-3