

BEML - TATRA 815

26RR36 22 255 6x6.1R/50T, 51T

Workshop manual

Part 3 – GEARBOX

Publication numer: 03-0254-ENG/00





3 GEARBOX

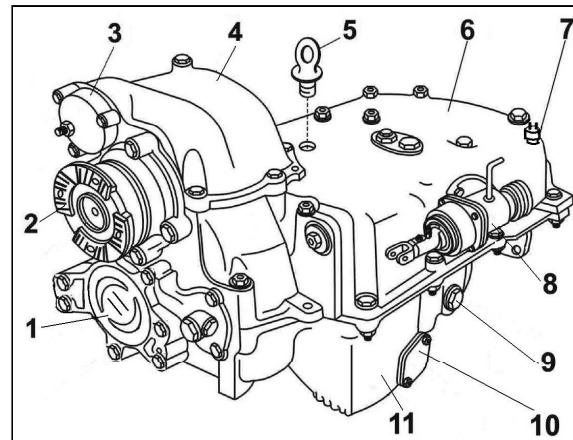
3.1 Description and Main Technical Specifications

The vehicles BEML - TATRA T 815 - 26RR36 22 255 6x6.1R/50T and BEML - TATRA T 815 - 26RR36 22 255 6x6.1R/51T je use the mechanical three-shaft gearbox with gears in constant mesh and fitted with a pre-selection gear shifting (H/N and L/R gears). Except for the 1st gear and the reverse gear all other gears are synchronized. The type designation of the installed gearbox is **TATRA 10 TS 140**.

The gearbox is mechanically actuated and fitted with a pneumatic booster. The pre-selected H/N and L/R gears are shifted electro-pneumatically indirectly using the pre-selector on the gearshift lever.

An **overall arrangement of the gearbox** is illustrated in following figure.

The gearbox housing consists of the pre-selection gear shifting casing cover 4, the gearbox housing upper part 6 and the lower part 11. These parts are screwed together. The torque from the engine clutch is transferred from the (articulated) propeller shaft to the flange (carrier) 2, which is attached to the gearbox input shaft. The oil pump 1, which is situated on the layshaft, provides the gearbox pressure lubrication. The inspection and filler hole is closed with a plug 9. Under the cap 10 there is an oil filter screen. To make the gear shifting easier, the pneumatic booster 8 is used. The shifting of two constant mesh gears (H and L) of the pre-selection gear control is actuated indirectly electro-pneumatically using the piston in the gearshift cylinder (under the cover 3). In the rear part of the gearbox the push-button switch 7 of the back-up light is situated. To handle the gearbox housing, use the lifting eye 5 (a part of the vehicle equipment).



Legend: 1 - oil pump for the gearbox pressure lubrication, 2 - torque inlet from clutch-shaft carrier, 3 - cover, 4 - upper cover, 5 - lifting eye, 6 - gearbox housing upper part, 7 - push-button switch, 8 - gear shifting pneumatic booster, 9 - inspection and filler hole plug, 10 - oil filter, 11 - gearbox housing lower part

Fig. 3.1 Design of the gearbox exterior

A **gearbox design** is clear from the internal design arrangement of the gearbox (See Fig. 3.2). The torque comes to the gearbox flange 4 of the input shaft 5. The constant mesh synchromesh sleeve 13 is slided onto the connecting gearing of the constant mesh H (N) 12 or L (R) drive gear 16 after the respective H (N) or the L(R) gear is pre-selected on the pre-selector, which is situated on the gearshift lever, and after the clutch is disengaged. Hereby the contact is switched on, the electric circuit of the indirect pneumatic control is closed and the gear is shifted by the air pressure acting on the piston 9, which is attached using a nut on the shifter rod 10, whose position is arrested using the ball 14 through the spring being pressed by the closing screw (spring pretension). On the rod there is a shifter fork with guide blocks engaged in the constant mesh synchromesh sleeve. Since gears 12 and 1 or 16 and 18 are in the constant mesh, the torque is transmitted from the countershaft 24 to gears (individual gear speeds) situated on the outlet shaft 31: R – reverse gear 33, 1 – first gear 36, 2 – second gear 40, 3 – third gear 38, 4 – fourth gear 41 and 5 – fifth gear 44.

In combination of the five basic gear speeds with two gears of pre-selection gear control H (N) and L(R), the gearbox proper has 10 gear speeds altogether. Gears H (N) 11 and L (R) 16 on the input shaft and 5th speed 44 and 4th speed 41 gears on the outlet shaft 31 are carried on needle bearings. Gears of 3rd speed



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38, 2nd speed 40, 1st speed 36, R reverse 33 and R idler gear 26 are supported by rollers 7 x 14 27 and 34. Gears of 3rd speed 22, 4th speed 19, L (R) gear (plus 5th speed) 18 and H (N) gear 1 are pressed on the involute splining on the countershaft 24. The gearing of 2nd speed 20, 1st speed and the reverse (R) speed are made on the countershaft 24. During the gearshifting of individual gears the torque is transmitted from gears through the synchronizer of 2nd and 3rd gear speeds 39, 4th and 5th gear speeds 42, and the coupling sleeve 1st speed and reverse 35, and hereby onto the input shaft 5 and onto the outlet shaft 31 by means of connecting gearing, which fits movably on the gears involute splining, except for the 1st gear. The input shaft 5 seats in the upper part and on the cover of the gearbox housing in two tapered roller bearings 7 and 17. The countershaft 24 and the outlet shaft 31 fits on antifriction bearings in the upper part and the lower part of the gearbox housing. The inner bearing orifices are situated in the gearbox on webs, which reduce the shafts deflection (bearings are located between 1st and 3rd gears on the input shaft and between gearing of 1st and 3rd gear speeds on the countershaft).

The countershaft support: tapered roller bearings 2, 23 and roller bearing 30.

The outlet shaft support: tapered roller bearings 32, 37 and roller bearing 45.

In the upper part of the gearbox (from the side of the auxiliary gearbox), the reverse gear pin 25 fits movably in two holes and the reverse gear 26 is supported on two rows of rollers on it. The rollers are axially locked with shims from the side of gear faces. The pin is locked with a lock pin 28.

The torque from the gearbox is transmitted to the auxiliary gearbox through the involute splining on the outlet of the gearbox outlet shaft 31.

The **pressure lubrication of the gearbox** includes two systems:

The oil splash system – the oil is drawn from the pump into the complete line 21, in which the oil splashes the gearing mesh of 5th, 4th, 3rd and 2nd gears. Into the mesh of the H (N) and L(R) gears the oil is drawn through the oil splash pipe.

The lubrication ports – the oil is drawn from a hole in the pump 3 through the pipe into a hole in the outlet shaft 31, in which the oil passes through lubrication holes into roller bearings of 5th, 4th, 3rd, 2nd, 1st speed and R (reverse) gears.

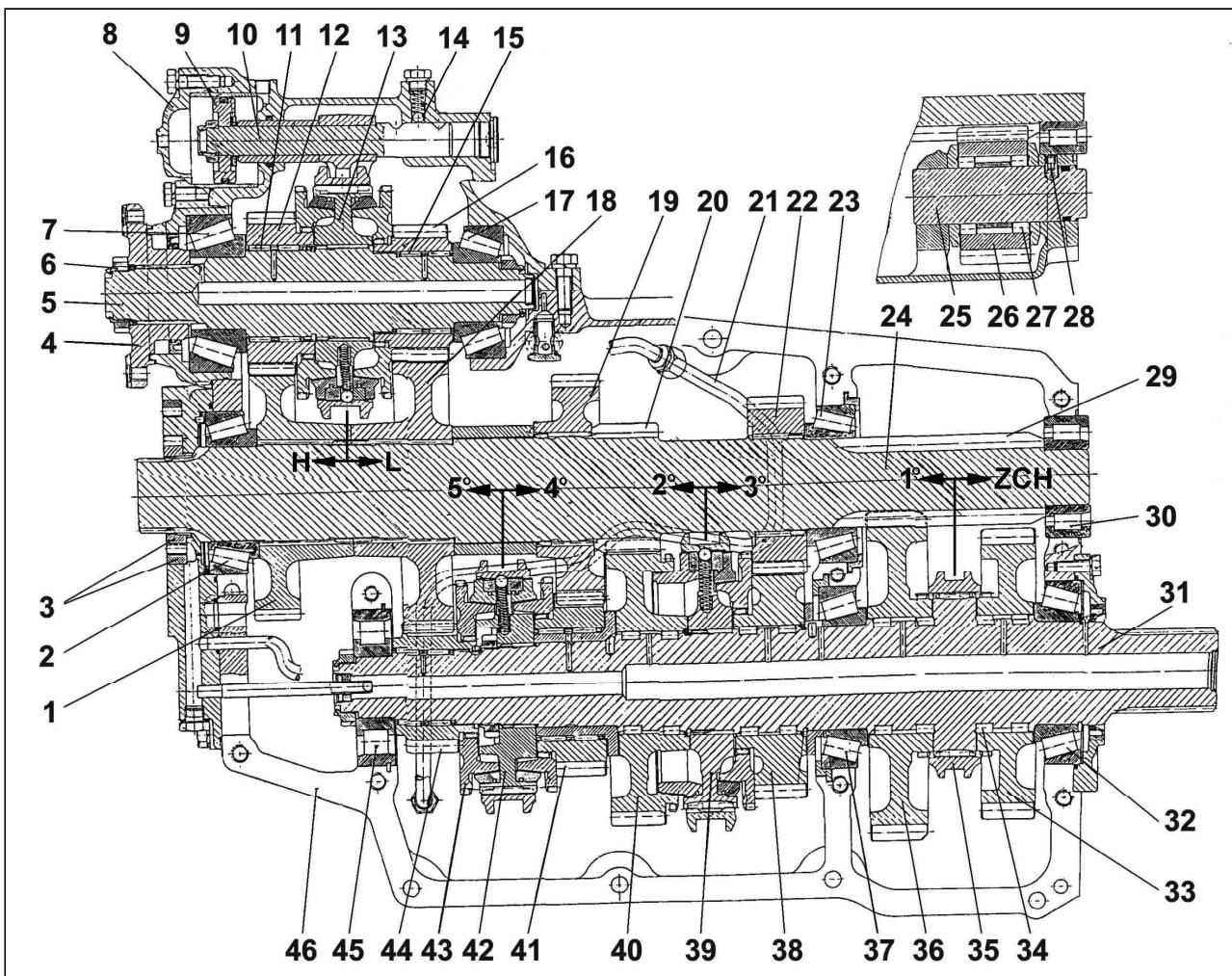
Into the input shaft the oil is drawn through the complete line 21 via the hollow screw into a port in the upper part of the gearbox housing and then into a hole into the input shaft and through lubrication holes the oil gets to the roller bearing of H (N) and L(R) gears.

The oil is sucked by the gear pump 3 through the suction pipe, which is slided through a hole in the lug of the lowermost part of the gearbox bottom, in which the complete oil filter with the oil cooler are attached.

The shifting of constant mesh H (N) and L(R) gears are controlled electro-pneumatically using the pre-selector on the gearshift lever. After depressing the clutch pedal the electro-pneumatic shift valve of the pre-selected gear will be actuated and the pressure air will be conveyed to the respective side of the gearshift mechanism piston. The piston motion is transferred to the shifter rod c/w fork and to the sleeve of the constant mesh synchromesh, and hereby the preselected gear is shifted. After releasing the clutch pedal the electro-pneumatic valve will be switched off and the pressure air escapes from the working cylinder through the valve into the open air.

Mechanism of the gearbox shifting

Shifting of individual gears: 1st and R (reverse) gears are controlled by the fork, which is screwed to the shifter rod being carried movably in guide holes in the upper half of the gearbox. In the shifter rod there is a slot for the booster shifter finger.



Legend: 1, 18, 19, 22 - gears on countershaft; 2 - countershaft bearing; 3 - oil pump housing; 4 - input shaft carrier; 5 - input shaft; 6 - lock nut; 7, 17 - input shaft bearings; 8 - gearshift cylinder; 9 - pneumatic gearshift cylinder piston; 10 - shifter rod c/w fork; 11, 15 - input shaft needle bearings of pre-selected gears; 12, 16 - input shaft gears; 13 - synchromesh clutch of pre-selected gears (H, L); 14 - gear arrestment (H/L); 20, 29 - countershaft gearing; 21 - pressure oil distribution manifold, 23, 30 - countershaft bearings; 24 - countershaft; 25 - reverse gear pin; 26 - reverse idler gear; 27 - rollers of the reverse idler gear bearing; 28 - lock pin; 31 - outlet shaft; 32, 37, 45 - outlet shaft bearings; 33, 36, 38, 40, 41, 44 - outlet shaft gears; 34 - rollers of gears bearings on the outlet shaft; 35 - sliding sleeve (1st gear, reverse); 39 - synchromesh clutch (2nd and 3rd gears); 42 - synchromesh clutch (4th and 5th gears); 43 - connecting gearing; 46 - gearbox housing

Fig. 3.2 Design of the gearbox interior

The 2nd and 3rd gears are controlled by the double-arm fork, which is situated on two bolts in the upper and in the lower part of the gearbox housing. In the fork the two ball-surface pins are pressed. Two guide blocks are slided on them. A slot for the booster-shifter finger is milled into the fork lug.

The 4th and 5th gears are controlled by the double-arm fork, which is bolted to the shifter rod. This is carried movably in guide holes in the upper half of the gearbox. On the shifter rod there is a sliding sleeve, which is secured with a lock screw. In the fork the two ball-surface pins are pressed, on which two guide blocks are slided.



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The **synchromesh mechanism** serves to shift the H (N) and L(R) gears, 4th and 5th gears and 2nd and 3rd gears continuously. During the gearshifting the shifter fork acts on the coupling sleeve 1, which develops the sliding force on the block 2 through the ball 3, and hereby it slides the synchromesh cone 6 on the external cone of the connecting gearing of the respective gear. Hereby the synchromesh element comes into a friction contact with the gear. The opposite synchromesh cone is slid out from the cone of the connecting gearing of the gear being in mesh (counter-gear). At this moment the connecting gearing of the coupling sleeve will mesh out of the connecting gearing of the gear being in mesh and will engage into a connecting gearing of gears being brought into mesh. Arrestment slots for the ball in the sleeve secure the coupling sleeve against self-sliding. The ball c/w spring 4, which fit in a hole of the carrier 5, will secure the locking.

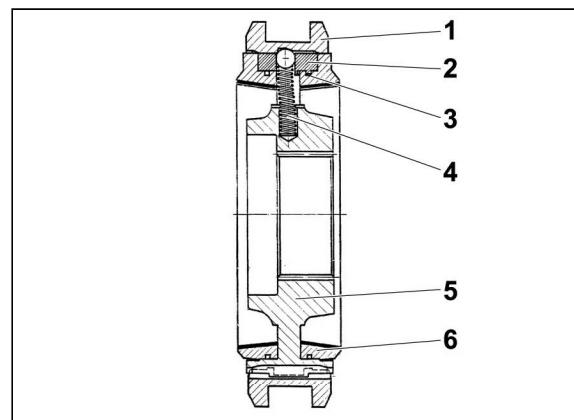


Fig. 3.3 Synchronizer

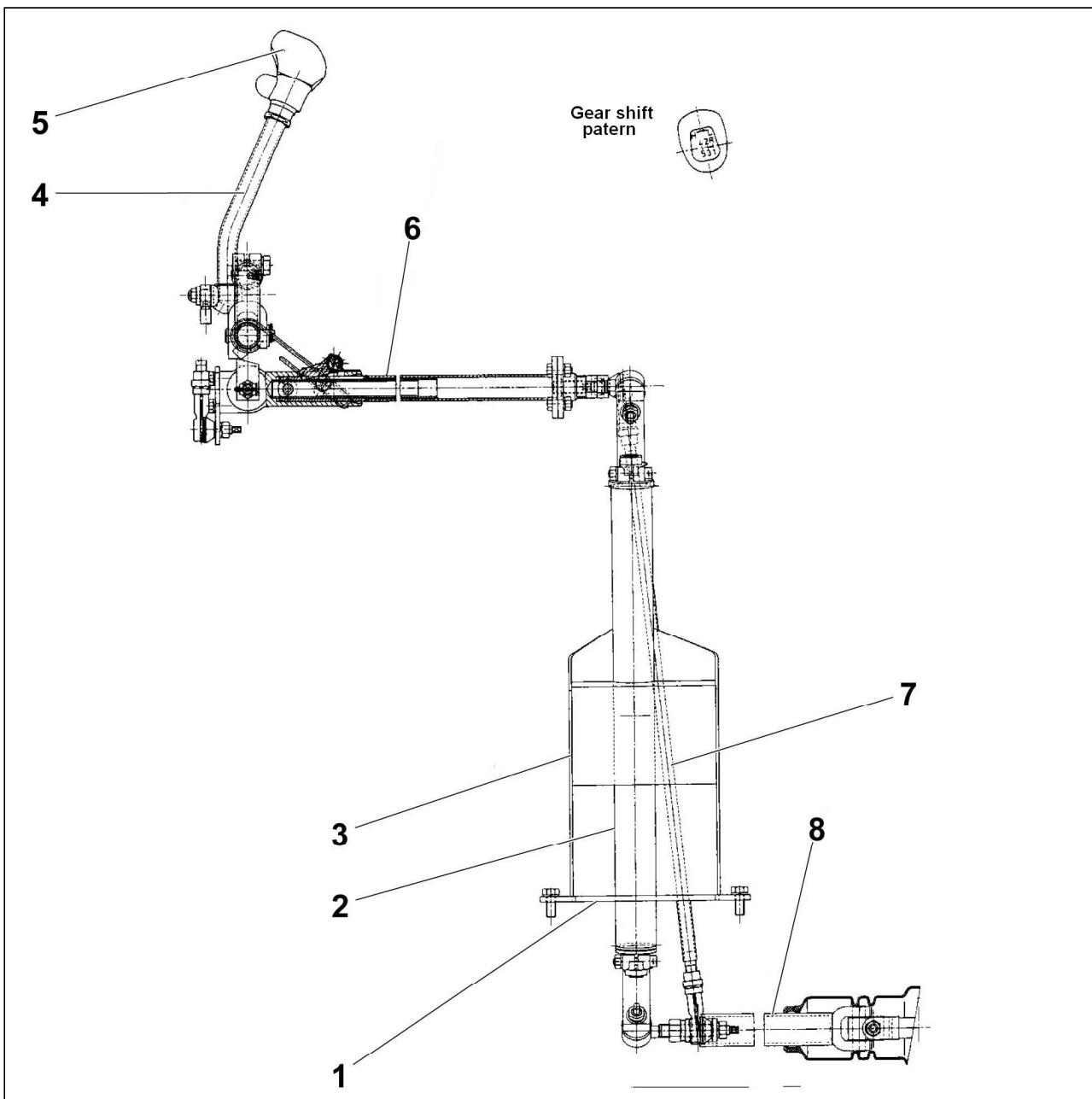
The **gearbox** is mechanically actuated and fitted with the shift booster (See Fig. 3.4).

The mechanical part of the control is attached to the longitudinal beam 1 of the auxiliary ladder-type frame using the screw connection by means of the shift bracket 3. The main parts of the mechanical control include the gearshift lever 4 and handle 5 c/w pre-selector lever (H-L), shifter rod 6, which is attached to the gearshift lever bracket and is screwed to the engine bonnet. They are interconnected by ball pins c/w selector shift tie-rod 7, which is connected to the speed-down shifter rod 2 and complete shifter rod 8. The shifter rod 8 links to the shift booster. The articulated joints of individual parts enable to transfer the motion from the gearshift lever to the fork of the gearshift pneumatic booster. The gearshift diagram is illustrated in the figure.

H – High range – normal constant gear

L – Low range – reduced gear

R – Reverse gear



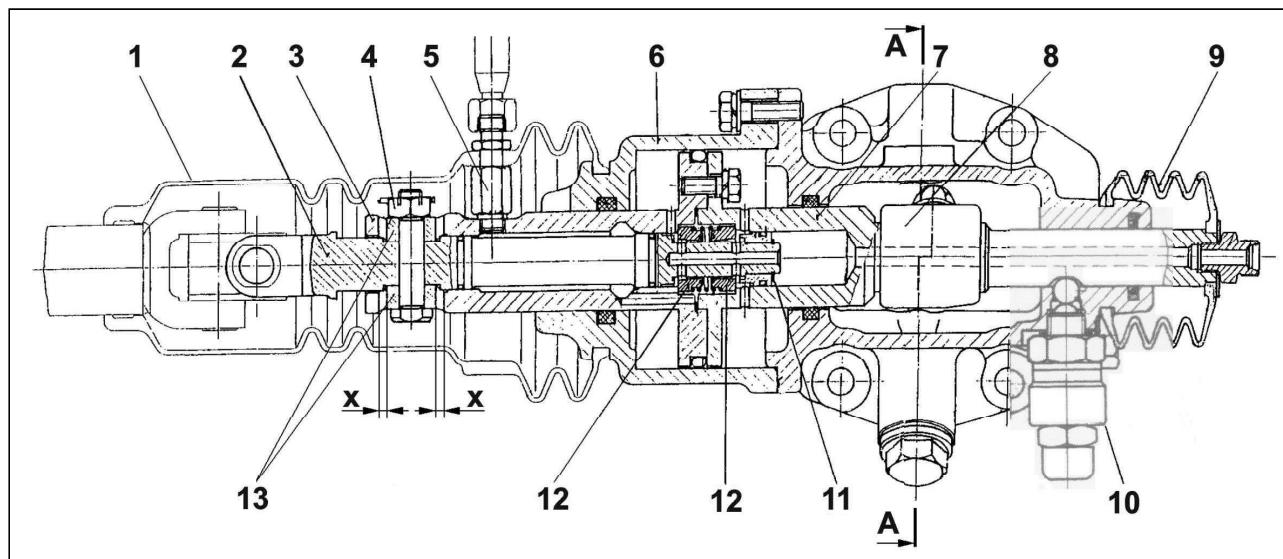


Fig. 3.5 Pneumatic shift booster

On termination of the driver's effort on the gearshift lever and after the gear speed is shifted, the piston and the hollow piston rod will stop, the respective valve and hereby also the pressure air supply will close and the unnecessary pressure air will blow off out the shift booster cylinder into the open air.

Main Technical Specifications

Tab. 3.1 Gearbox technical specifications

Data	Unit	Value
Number of gears		10 forward and 2 reverse
Input shaft maximum speed	(rpm)	2,000 + 10%
Maximum transferred torque	(Nm)	1 400
Pressure air required for the shift booster and H + L gear shifting	(kPa) (kg/sq.cm)	520 - 800 5.2 - 8.0
Axial clearance of tapered roller bearings – input shaft	mm	0,0 - 0,1
Axial clearance of tapered roller bearings - countershaft	mm	0,06 - 0,16
Axial clearance of tapered roller bearings – outlet shaft	mm	0,1 - 0,2
Gearbox weight (w/o oil filling)	(kg)	334



3.2 Faults Causes and Troubleshooting

Fault	Cause	Remedy	Mentioned in:
The shift booster is not functioning, is difficult to shift, permanent air leakage	Shaped rings do not seal	Removal and repair of the shift booster	(See Subchapter 3.5.5), (See Subchapter 3.5.9)
Gears cannot be shifted, the shift booster is not working – the shifter rod is not moving, the pneumatic control is OK	Seized gearshift rod	Repair and/or replacement of damaged parts	(See Subchapter 3.5.5), (See Subchapter 3.5.9)
The gear-shifting cannot be accomplished	The gearshift lever impacts into a cutout in the engine cover	Repair the gearshift control mechanism	(See Subchapter 3.5.4)
The position of the shifter finger to shift in R and 1st gear speed cannot be obtained	The arrestment pin out of function – it cannot be pressed	Repair and/or replacement of damaged parts	(See Subchapter 3.5.5), (See Subchapter 3.5.9)
The shift booster does not finish the gear-shifting	Slackened/damaged shifter finger	Tightening and/or replacement of the shifter finger	(See Subchapter 3.5.5), (See Subchapter 3.5.9)
The shift booster has been damaged mechanically	Mechanical damage	Replacement of the shift booster	(See Subchapter 3.5.5)
The oil leaks round the flange	The shaft seal is leaky	Replacement of the shaft seal	(See Subchapter 3.5.9)
Increased axial clearance of tapered roller bearings	Seating, wear of bearings	Clearance adjustment, replacement	(See Subchapter 3.5.3)
Air leakage from the gearshift cylinder	Faulty shaped rings	Replacement of shaped rings	(See Subchapter 3.5.9)
Some of speed-reducing gears cannot be shifted	Piston seized in the liner	Replacement of both piston and liner	(See Subchapter 3.5.2)



Fault	Cause	Remedy	Mentioned in:
The gearbox overheats excessively	The lubrication pump is not functioning	Replacement of faulty oil pump components	(See Subchapter 3.5.6)
The oil leaks from the pump housing	Slackened threaded connections, faulty shaped rings	Tightening of screw connections, replacement of shaped rings	(See Subchapter 3.5.6)
The gearbox upper cover is leaky	Loosened screw connections, the seal foil has been impaired	Tighten the screw connections, replace the seal	(See Subchapter 3.5.7)
The H/L gear shift mechanism cannot be adjusted	The constant mesh synchromesh is not functioning	Replacement of the synchromesh	(See Subchapter 3.5.7)
The input shaft tapered roller bearings are too noisy	Wear of bearings	Replacement of bearings	(See Subchapter 3.5.7)
Some of gear speeds cannot be shifted	Loosened shifter forks, excessive wear of guide segments	Tightening and/or replacement of worn parts	(See Subchapter 3.5.7)
Gear speeds are slipping out	Wear of connecting gearing cones and/or synchromesh cones	Replacement of connecting gearing and/or synchromesh components	(See Subchapter 3.5.10)
During the gear changing between individual gears, the gears are shifted "across teeth"	Wear of connecting gearing synchromesh cones and splining on the sleeve and connecting gearing	Replacement of faulty components	(See Subchapter 3.5.8), (See Subchapter 3.5.10)
Increased noise in the gear train	Wear of the gearing teeth, wear of anti-friction gear bearings	Replacement of gears and worn parts	(See Subchapter 3.5.8), (See Subchapter 3.5.10)
The gearbox overheats excessively – the oil pump is OK	Fault in the lubrication pipes distribution and in the oil splash mechanism	Replacement of the oil distribution, cleaning of lubrication ports	(See Subchapter 3.5.8), (See Subchapter 3.5.10)



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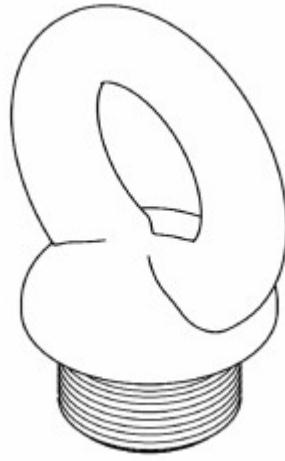
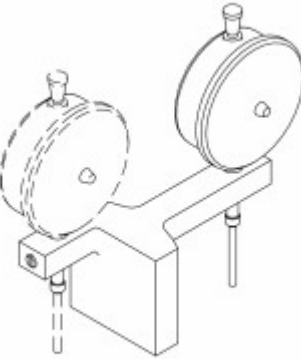
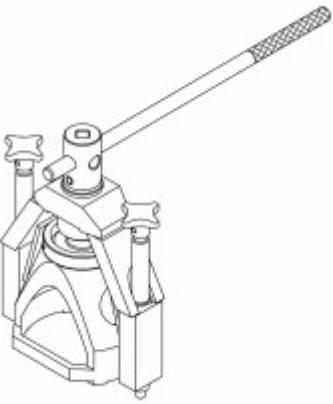


Fault	Cause	Remedy	Mentioned in:
The gearbox partition plane is leaky	Loosened screw connections, impaired seal foil	Replacement of the seal, tightening of connections	(See Subchapter 3.5.8), (See Subchapter 3.5.10)
The oil is pumped over from gearbox to the auxiliary gearbox	Shaft seals leakage	Replacement of shaft seals and worn parts	(See Subchapter 3.5.8), (See Subchapter 3.5.10)
Cracked/damaged gearbox housing	Mechanical damage	Replacement of gearbox housing	(See Subchapter 3.5.8), (See Subchapter 3.5.10)



3.3 List of Special Tools

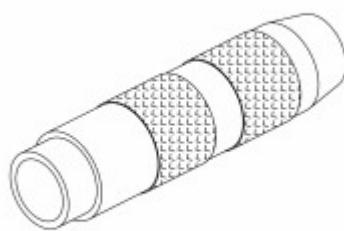
Tab. 3.2 *Special tools for the gearbox removal and installation*

<p>Name: Suspension eye for pulling of gearbox</p> <p>Tool number: 2010420154</p>	
<p>Name: Set up gauge (together with dial gauge)</p> <p>Tool number: MMU 1740.1</p>	
<p>Name: Tool to set up clearance of driven shaft bearings</p> <p>Tool number: MRP 0811</p>	



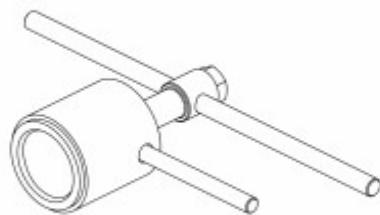
Name: Driver of L-H and S-Q gear-shift bar distance tube

Tool number: PRL 0501



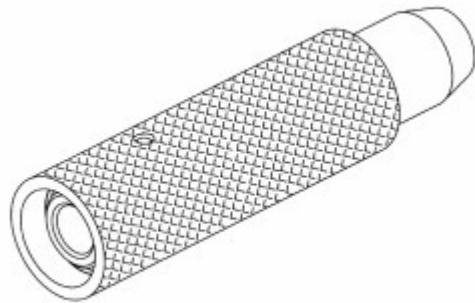
Name: Puller of NJ 2309 bearing

Tool number: PRL 0578



Name: Driver to press of insert into the drive shaft

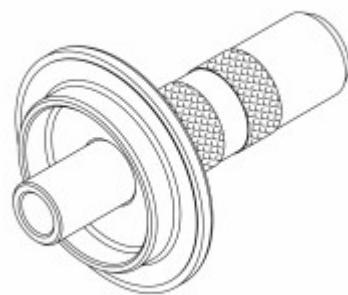
Tool number: PRL 0641





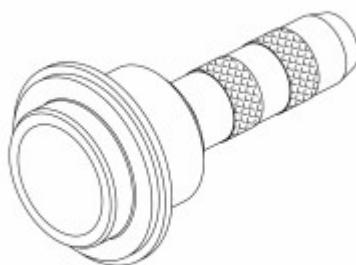
Name: Driver of shaft seals 85x110x12, 85x100x7

Tool number: PRL 0700.1



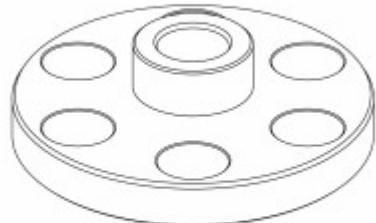
Name: Driver of shaft seal 75x100x10

Tool number: PRL 0740



Name: Stand for driver PRL-0700.1

Tool number: PRL 0920



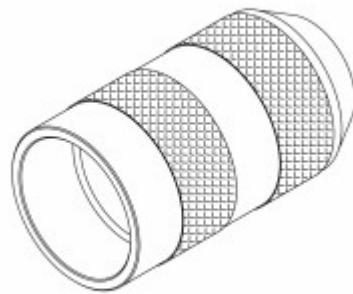


03 Gearbox



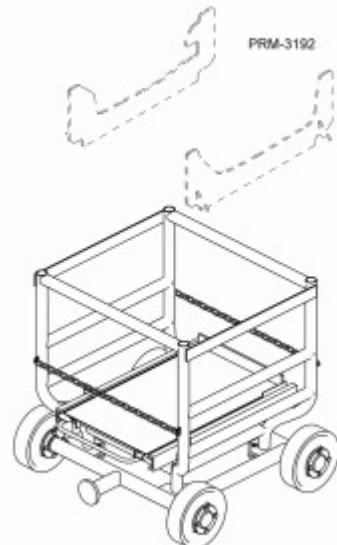
Name: Driver of inner race of bearing 32312

Tool number: PRL 0921



Name: Assembly trolley of gearbox

Tool number: PRM 0245



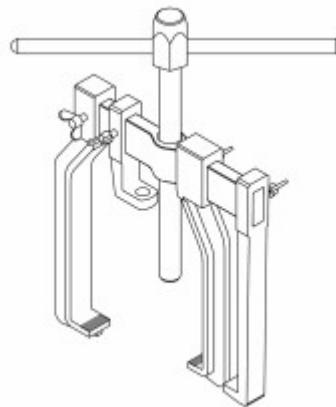


03 Gearbox



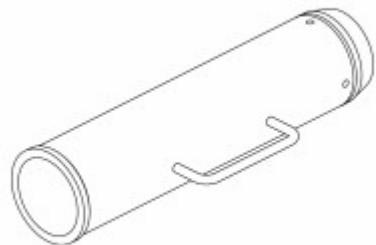
Name: Universal puller

Tool number: PRM 0777



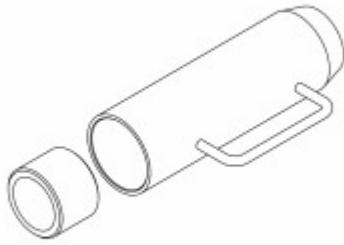
Name: Driver of gearbox bearings and gears

Tool number: PRM 2211



Name: Driver of gearbox bearings and gears

Tool number: PRM 2212.1



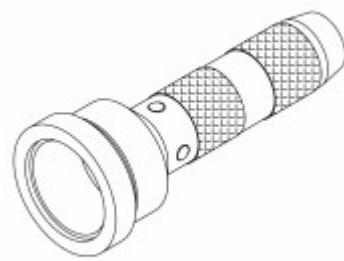


03 Gearbox



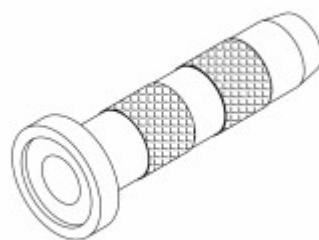
Name: Driver of bearings N 410, 32310

Tool number: PRM 2218



Name: Driver of bearing NJ 2309

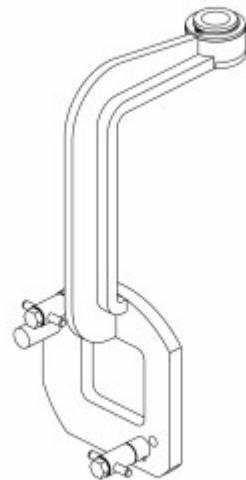
Tool number: PRM 2219





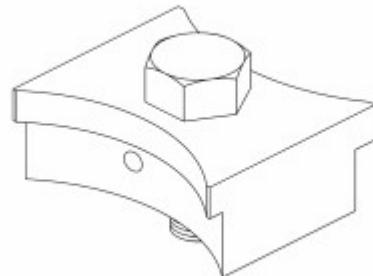
Name: Tool to position gear shift rods and selector forks

Tool number: PRM 2434



Name: Fixing tool of gear shifting cylinder liner

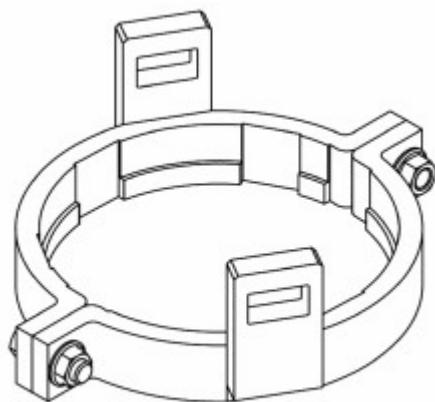
Tool number: PRM 2439.1





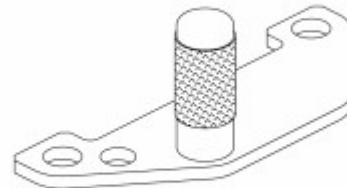
Name: Puller of synchronizer carrier

Tool number: PRM 2756



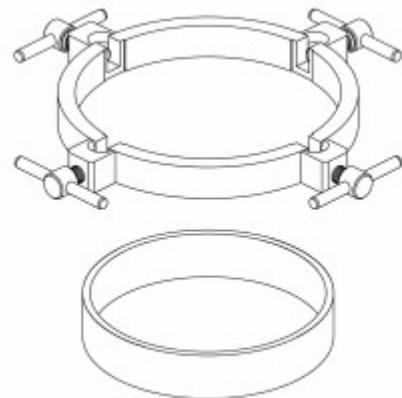
Name: Positioning tool to arrest gear shifting rods

Tool number: PRM 2862



Name: Tool to fit of synchronizer

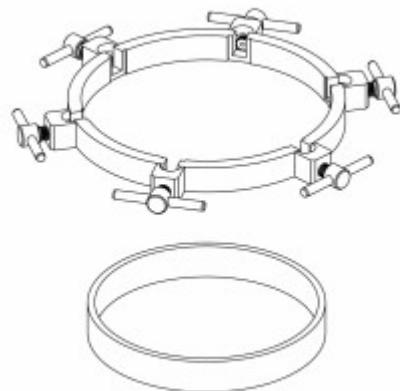
Tool number: PRM 2894





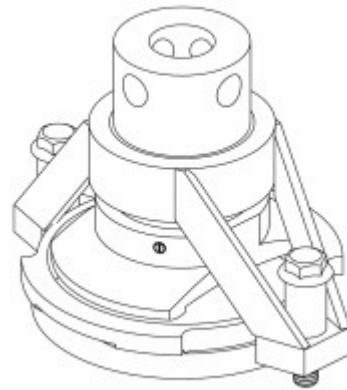
Name: Tool to fit of synchronizer

Tool number: PRM 2895



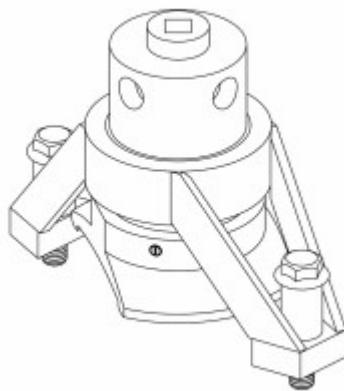
Name: Tool to set up clearance of drive shaft bearings

Tool number: PRM 2898.1



Name: Tool to set up clearance of layshaft bearings

Tool number: PRM 2899



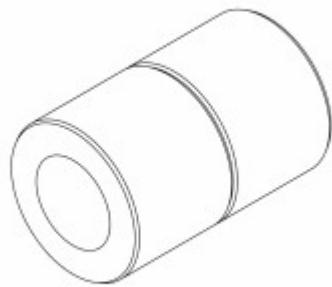


03 Gearbox



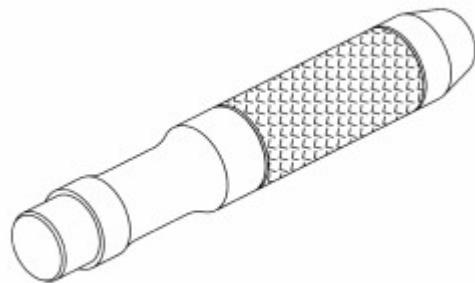
Name: Tool to fit reverse gear wheel pin

Tool number: PRM 3169



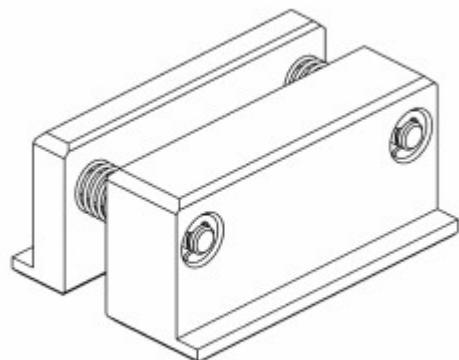
Name: Driver to press bushings into the selector fork

Tool number: PRM 3170



Name: Tool to press pins into the selector fork

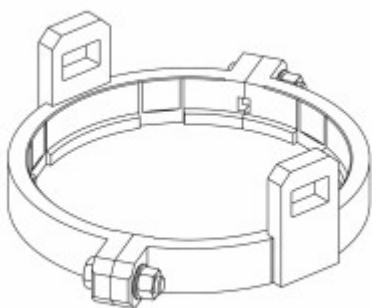
Tool number: PRM 3172





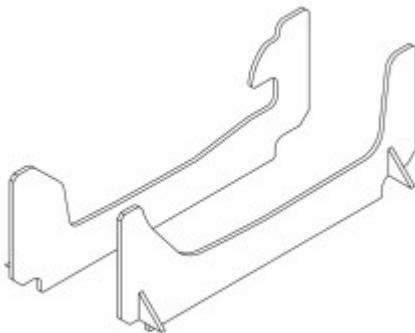
Name: Puller of 2-3 gear synchronizer carrier

Tool number: PRM 3176



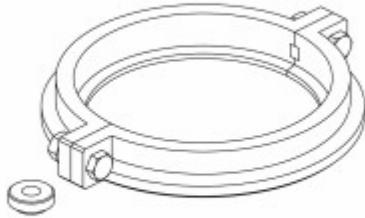
Name: Superstructure for gearbox assembly trolley
PRM-0245

Tool number: PRM 3192



Name: Puller of gear synchronizer carrier

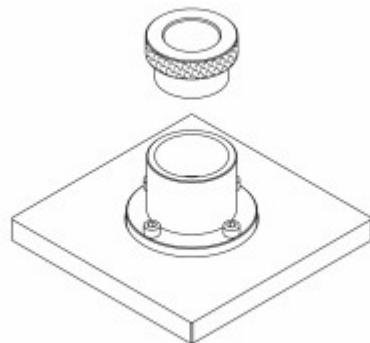
Tool number: PRM 3259





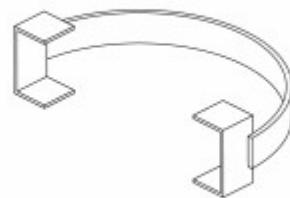
Name: Assembly stand of driven shaft

Tool number: PRM 3276



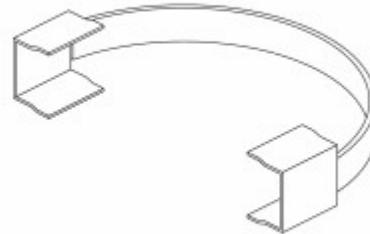
Name: Tool to arrest connecting sleeve of synchronizer

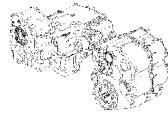
Tool number: PRM 3277



Name: Tool to arrest connecting sleeve of synchronizer

Tool number: PRM 3278





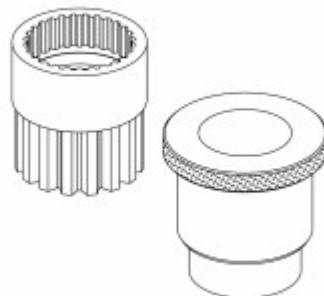
Name: Support for disassembly of gearbox drive and driven shafts

Tool number: PRM 3425



Name: Reduction part for stand PRM-3276

Tool number: PRM 3351



Name: Taper tube to be slide when assembly driven shaft cover

Tool number: PRM 3761





Name: Wrench for nut 442 0 5257 132 4

Tool number: URN 0203



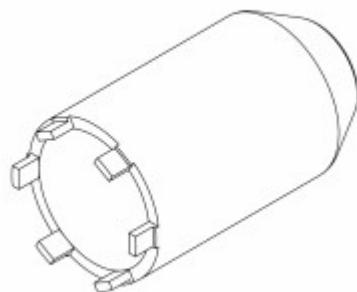
Name: Wrench for nut 442 0 5257 075 4

Tool number: URN 0356



Name: Wrench for nut 442 0 5286 032 4

Tool number: URN 1277





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Name: Wrench for nut 442 0 5257 144 4

Tool number: URN 1296

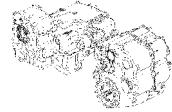




3.4 Survey of Torque Specifications

Tab. 3.3 Survey of torque specifications for screw connections

Data	Unit	Value
Plug – oil filler hole	(Nm)	200 ± 20
M8 – gearbox oil filter		16 - 23
Rear cover screws		56 - 80
M10 – gearshift cylinder cover		32 - 46
M10 – shift booster		32 - 46
M12 – upper and lower part of the gearbox housing		80 ± 10
M14 – upper and lower part of the gearbox housing		120 ± 10
M14 – upper cover		100 ± 10
Gearshift lever pin connection		85 ± 5
Gearshift lever screwed connection		78 ± 8
Shift selector screwed connection		23 ± 3
Shifting finger locking screw		110 - 11
Booster cylinder screws		16 - 23
Oil pump cover nuts		56 - 80
Flange nuts		400 ± 40
R - N gears shifter rod nuts		160 ± 16
Shifter fork C and Z and 6/4 and 5/3		110 ± 10
Shift locking sleeve 6/4 and 5/3		110 ± 10
1 st - 2 nd gear speed gearshift fork		300 ± 30
Drive shaft locking nut		400 ± 40
Driven shaft locking nut		400 ± 40
M12 – pump housing and gearbox housing		56 - 80



3.5 Working Procedures

3.5.1 Oil Change in Gearbox

a) Reason for the Oil Change

1. Regular oil changes in accordance with the TDS (TATRA Drain Specification) after every three years of operation at the latest.

b) Technical Conditions

1. Clean the oil filter screen during the oil change.
2. Replace shaped sealing rings and lock washers during installation of the oil filter.
3. The oil filter screen must not be damaged.
4. Apply the sealant to the bearing surface of the filter cap and the housing.
5. The cap must fit with its recess into a slot in the metal sheet cover.
6. Use the oil according the manufacturer's specification.
7. No oil is allowed to leak from below the filter cap and through the inspection hole plug after the oil change.

c) Oil Change Procedure

1. Place a suitable pan under the gearbox to catch the oil, which spills out.
2. Dismount two fastening bolts **1** on the filter cover **2** at the gearbox-housing bottom on the left-hand side.

CAUTION:

Do not confuse the gearshift fork pin **3, which is situated at the gearbox-housing bottom, to be the drain plug.**

3. Remove the oil filter **1** and allow the oil to spill out into a pan prepared.

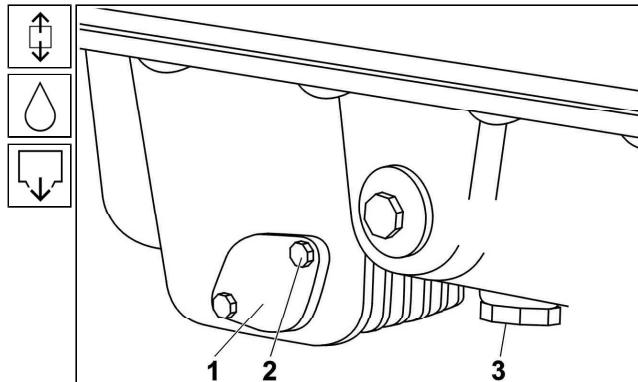


Fig. 3.6 Gearbox drain hole



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4. Use the kerosene to rinse out the filter **3** and clean the magnet from dirt.
5. Carefully clean the bearing surfaces of the gearbox housing and the filter cap from residues of the sealant.
6. Apply the sealant to bearing surfaces and fit the shaped sealing ring **1** on the filter body **3**.
7. Slide the filter **3** into a hole in the gearbox housing so that the cap fits in the inner metal sheet cover **1** and use two screws c/w spring washers to attach the filter **3**.

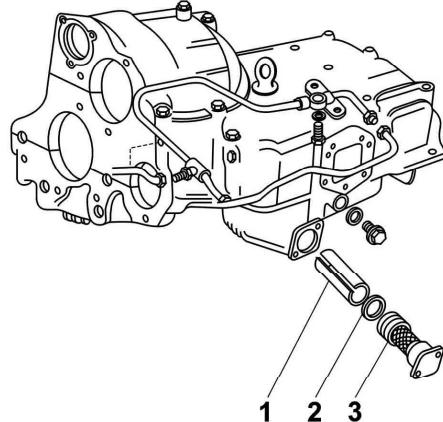
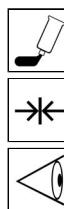


Fig. 3.7 Oil filter

8. Dismount the oil filler and inspection plug (see arrow) and top up the oil into gearbox up to the lower edge of the filler and inspection hole, mount a new sealing ring onto the plug and reinstall it..
9. Carry out a test run with the vehicle and check the plug and the oil filter cap for leaks.

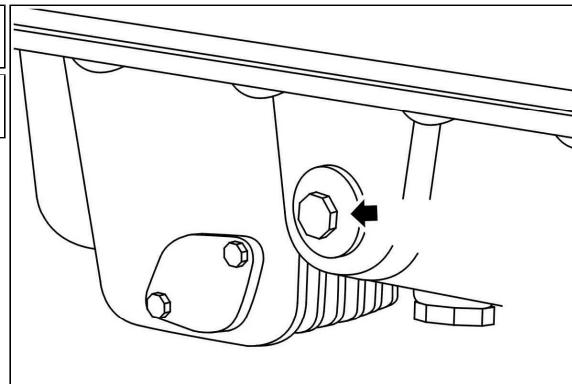


Fig. 3.8 Filler and inspection hole



3.5.2 Adjustment of the H (N) / L (R) Gearshift Mechanism

a) Reasons for the Adjustment

1. The air leaks from the gearshift cylinder.
2. The piston seizure in the gearshift cylinder.
3. Some of pre-selected gears cannot be shifted.

b) Technical Conditions

1. Replace all seals and washers.
2. Adjustment of piston stops to **0.2 to 0.5 mm** before stops of the synchromesh sleeve on the coupling gearing.
3. No air is allowed to leak from the gearshift cylinder.
4. Use the tool **PRM 2439.1** for adjustment.
5. Drain the air from the pneumatic system.

c) Adjustment Procedure

1. Stand the vehicle on a level ground and secure it against motion. Remove the removable cover above gearbox on the cargo truck platform .
2. Disconnect the propeller shaft at the gearbox flange(See Part 2) and push it aside so that it would not obstruct.
3. Disconnect the pressure air inlet manifold from the shift cylinder cover **2**.
4. Dismount screws **1** from the cylinder cover and remove the cover **2** and the shaped sealing ring **3** .
5. Use the tool **PRM 2439.1** to lock the cylinder liner **4** in position and apply the transmission oil to the cylinder liner interior and convey the compressed air to push the piston **6** towards the liner outer edge **4**.
6. Should the piston **6** not move, dismount the plug **7** from the other side and tap the piston **6** via the gearshift rod **8** to slacken it, while swiveling the input shaft so that the synchromesh sleeve slides on.
7. Unlock and unscrew the nut **5** and use the compressed air to move the piston **6** out of the cylinder. Replace the faulty components with new ones.

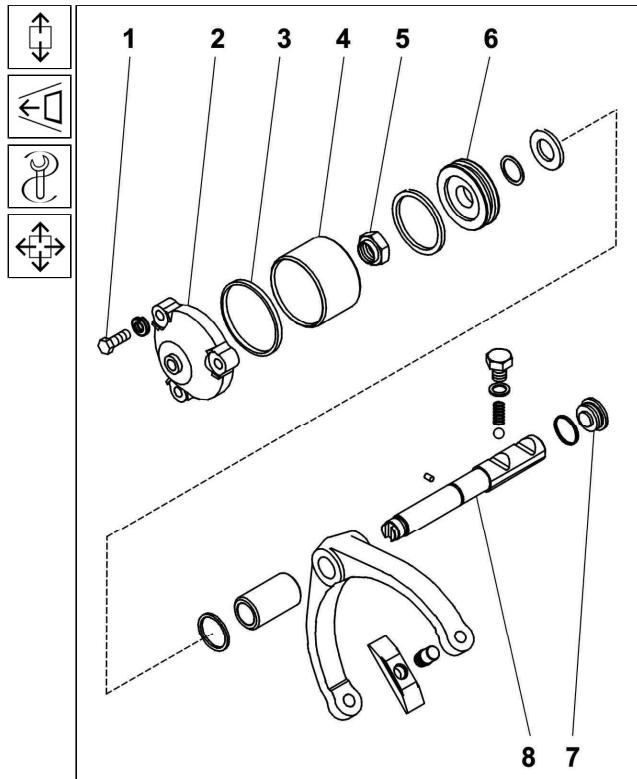


Fig. 3.9 H/L gearshift cylinder



8. Press the gearshift rod **3** including bushing **1** and H (N) /L(R) gearshift sleeve **2** towards the L(R) drive gear as far as it goes.
9. Measure the depth of the recess 'X'.

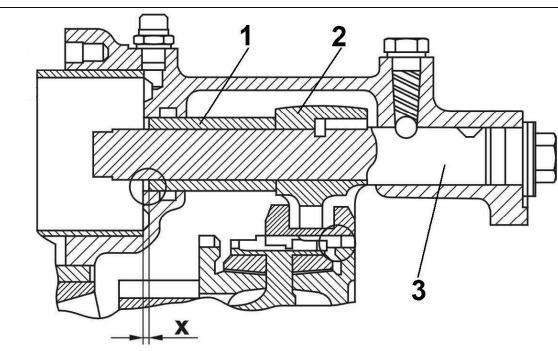


Fig. 3.10 H/L speeds gear-shifting

10. Use spacer washers **2** to adjust the stop **1** on the H/L gearshift housing so that the clearance of **Y = 0.2 to 0.5 mm** is obtained on the synchromesh sleeve. Calculate the thickness of spacer washers needed to be placed between the spacer tube and the stop **1** out of the formula **Z = X - Y**
Where:
'Z' - thickness of spacer washers,
'X' - bushing recess depth,
'Y' - clearance between the synchromesh sleeve and the L(R) drive gear.

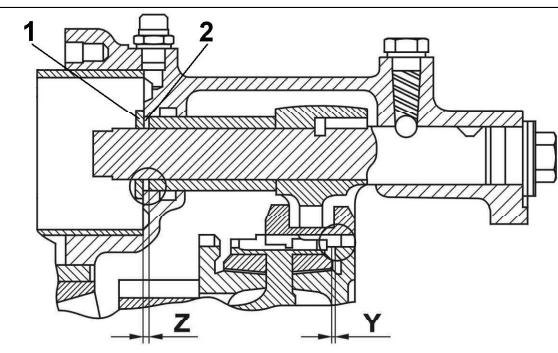


Fig. 3.11 H/L gears adjustment (1)

11. After this stop is set, fit the piston on the shifter rod and tighten the nut **1**. Mount the cover and gearshift cylinder, and using the compressed air, dislodge the piston to the second marginal position until the synchromesh sleeve fits on the H drive gear. Remove the cylinder cover.
12. Measure the distance of '**X₁**' between the housing wall and the piston face.

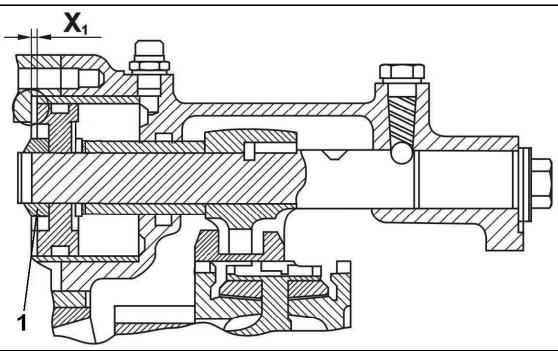


Fig. 3.12 H/L gears adjustment (2)



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13. Use spacer washers to adjust the piston stop so that the clearance of $Y_1 = 0.2 \text{ to } 0.5 \text{ mm}$ is on the synchromesh sleeve .



14. Calculate the thickness ' Z_1 ' of spacer washers to be put between the washer and the piston out of the formula:

$$Z_1 = X_1 + Y_1$$

where:

' Z_1 ' - thickness of spacer washers,
' X_1 ' - distance from the housing wall to piston,

' Y_1 ' - clearance between the synchromesh sleeve and the "H" speed drive gear.

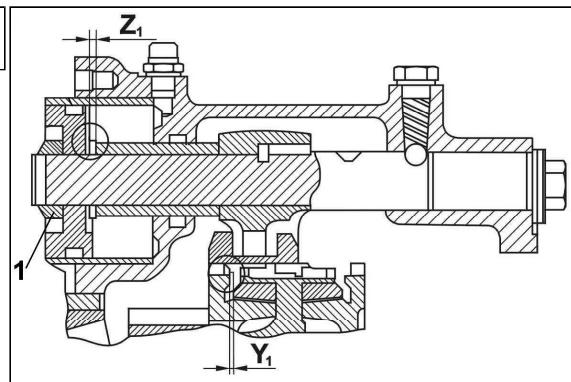


Fig. 3.13 H/L gears adjustment (3)

15. Tighten the nut 1 to the torque of **$160 \pm 16 \text{ Nm}$** and lock it with a punch in the groove using a suitable tool with the minimum radius of 2.5 mm.
16. Fit the shaped "O" ring 3 on the gearshift cylinder liner 4 (See Fig. 3.9), install the gearshift cylinder cover 2 and tighten to the torque of **$32 - 46 \text{ Nm}$** .
17. Attach the air manifold to the cylinder cover 2.
18. Attach the propeller shaft to the gearbox flange in accordance with a procedure mentioned in the section (See Part 2).
19. Start the engine and make sure that H/L gears can be shifted properly.
20. Use the soap water to check the air manifold connections for leaks.
21. Install the removable cover above gearbox on the cargo truck platform.



3.5.3 Removal and Installation of the Shaft Sealing of the Gearbox Input Shaft Carrier

a) Reasons for Removal

1. The oil leaks round the carrier.
2. The increased axial clearance of the input shaft.

b) Technical Conditions

1. The axial clearance of the input shaft is **0.00 to 0.1 mm**.
2. Replace all shaped sealing rings, shaft seals and washers with new ones.
3. Apply the sealant to bearing surfaces of the cover, gearbox housing and screw threads.
4. No oil is allowed to leak round the carrier or from the cover.
5. Use the specified tools for removal and installation; use the dial indicator on the magnetic stand for adjustment of the axial clearance.

c) Removal Procedure

1. Stand the vehicle on a level ground and secure it against motion. Remove the removable cover above gearbox on the cargo truck platform .
2. Disconnect the sliding flange of the propeller shaft from the input shaft carrier according to procedure (See Part 2) and move the propeller shaft aside so that it would not obstruct.
3. Use the dial indicator **1** c/w magnetic stand **2** and assembling lever **3** (pry it against the flange **4**) to check the axial clearance of the flange **4**, which should range between **0.00 to 0.1 mm**.

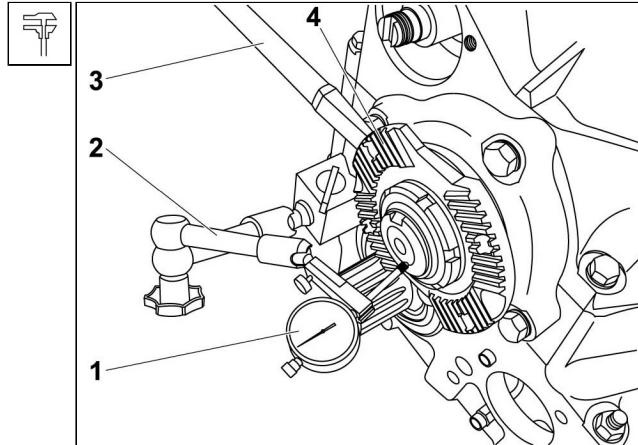


Fig. 3.14 Inspection of the input shaft axial clearance



4. Shift in the 1st or 2nd gear speed, unlock and use the tool **URN 1296** to dismount the flange nut **2** and remove the shaped ring **1**.
5. Use the tool **PRM 0777** to withdraw the carrier **5**. Should the measured clearance be within the tolerance (**0.00 - 0.1 mm**), use the prybar to pry the shaft seal **3** out (it is not necessary to dismount the cover **4** of the drive shaft).
6. Should the measured clearance exceed the specified range, dismount the fastening bolts **7** and remove the input shaft cover **4** together with outer ring of the tapered roller bearing **6**.
7. Pry the shaft seal **3** and the tapered roller bearing outer ring **6** out of the input shaft cover and remove the shaped sealing ring **8**.

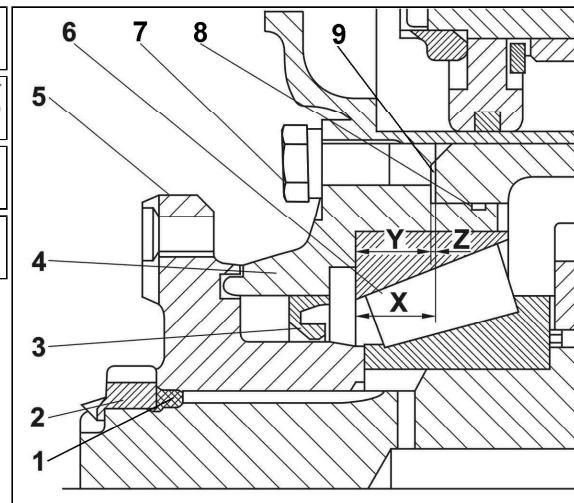


Fig. 3.15 Replacement of the gearbox input shaft carrier seal

d) Installation Procedure

Note:

Before installation of the carrier on the input shaft, it is necessary to adjust the drive shaft axial clearance to the value of **0.00 - 0.1 mm**. During adjustment of the axial clearance, proceed as follows:

1. Use the tool **PRM 2898.1** to pull the outer ring of the tapered roller bearing **6** towards the housing so that the bearing **6** has the zero clearance. After this position is set, swivel the shaft several times (shift the gear out) so that the tapered rollers fit in raceways correctly. Use the depth gauge **MMU 1740.1** to measure the distance of **X** from the gearbox face to the face of the outer ring. Carry out the measurement in three different points at least. Put down the measured values. While measuring the input shaft cover continuously, find out the distance between the bearing surface of the cover and the bearing surface of the bearing outer ring **Y**. Place a necessary number of spacer washers under the flange of the input shaft cover (of the **Z** dimension) to obtain the axial clearance of **A = (0.00 to 0.1 mm)** as follows:
$$Z = X - (Y + A)$$
2. Dismount the tool. Use the tool **PRL 0740** to press the shaft seal **3** into the input shaft cover **4** (fill the space between the edge and dust cup with grease) and install the tapered roller outer ring **6**. In addition, install spacer washers **9** and shaped ring **8**. Apply a layer of the sealant to the bearing surface of the gearbox housing cover **4**. Use bolts **7** to attach the cover **4** to the gearbox housing.

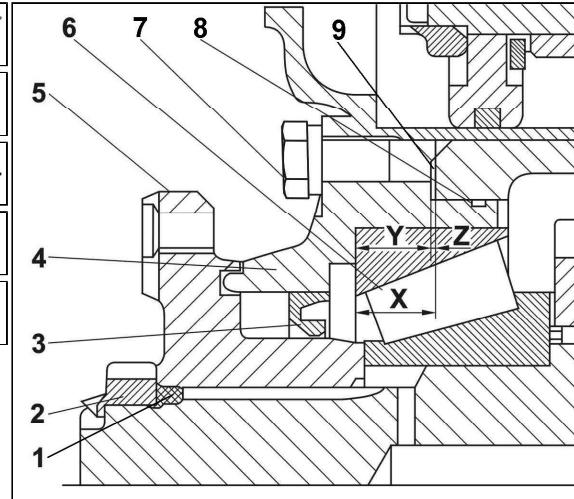
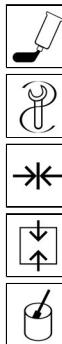
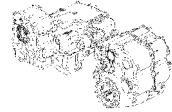


Fig. 3.16 Replacement of the gearbox input shaft carrier seal



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Remember to apply the sealant to the thread of the lower bolt, which is mounted into a through hole, and tighten the bolts to the torque of **56 - 80 Nm**.

3. Apply the grease to the input shaft splining, fit carrier **5** and shaped ring **1**, mount nut **2**, shift in the 1st or 2nd gear speed and use the wrench **URN 1296** to tighten the nut to **400 ± 40 Nm**. Use the dial indicator c/w magnetic stand **1** (See Fig. 3.14) to check the axial clearance. Lock the nut with a punch in the grooves – the min. radius of the tool is **2.5 mm**.
4. Shift the gear out and attach the propeller shaft to the input shaft carrier in accordance with a procedure mentioned in (See Part 2).
5. Install the removable cover above gearbox on the cargo truck platform.
6. Start the engine and make a test run with the vehicle.



3.5.4 Removal and Installation of the Gearshift Control Mechanism Subassemblies

a) Reasons for Removal

1. Defective ELGES bearings of the shifter rod.
2. The gearshift lever impacts into a cutout in the engine cover (the gear-shifting cannot be accomplished).
3. The complete shifter rod, complete shift selector tie-rod and shifter rod have been damaged.
4. Worn (loose) complete ball pins.

b) Technical Conditions

1. Smear the friction areas with the plastic lubricant.
2. Fit washers to recesses of ELGES bearings of the shifter rod to the dimension of **1,6 - 1.8 mm** before installation of bearings.
3. Use nuts to set the ball pin of the selector tie-rod towards the speed-down shifter rod axis to the dimension of **49 mm**.
4. The clamping splined connections of shift levers and speed-down shifter rod **must not be greased**.
5. Position the shifter levers on both ends in the same direction.
6. The spring, which unlocks the telescopic cylinder, must be free movable towards the pawl pin within the whole range of gear-shifting (when shifting all gear speeds).
7. The shift gate must be movable within the whole shift range after installation.
8. Check the telescopic cylinder pawl during the cab tilting for function.
9. Replace battered bushes, ball pins, pierced bags, and defective ELGES bearings of the damaged part of the shift control mechanism and lock rings with new ones.

c) Removal Procedure of Individual Subassemblies

1. Stand the vehicle on level ground and secure it against motion.
2. Secure a place enough in front of the vehicle to tilt the cabin.
3. Remove all loose objects from inside the cabin.
4. Set the gearshift lever into neutral.
5. Remove the removable cover above gearbox on the cargo truck platform.



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6. Unplug cable of the H/L meshes pre-selector 1.
7. Unscrew the screw 6 and dismount the complete handle 7.
8. Remove the ball 4, spring 5 and selector lever 3 from the gearshift lever.
9. Unscrew 2 pcs of screws 2 from the complete gearshift lever 8 and move the H/L meshes selector 1 out.
10. Loosen the cable clip 9 from the gearshift lever 8 and withdraw the gearshift bag 10.
11. Unlock and tilt the cabin into the front position.

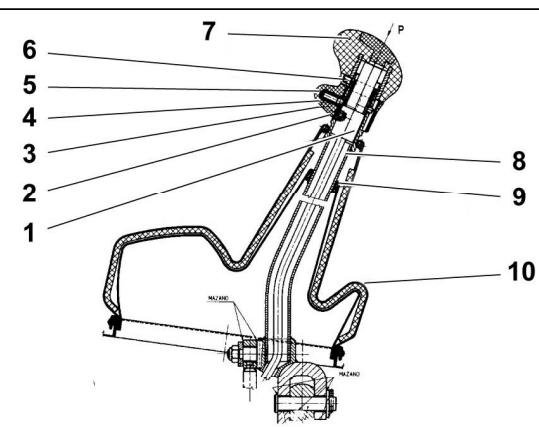


Fig. 3.17 Removal of the gearshift lever c/w shifter rod bracket

12. Unscrew nuts 4 and remove washers 3.
13. Remove screws 2 from the flange connection of shift bar 1 and complete selector tie-rod 5.

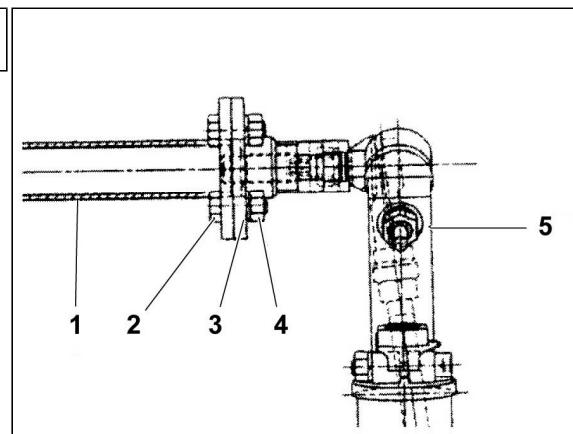


Fig. 3.18 Removal of the shift bar and selector tie-rod



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14. Dismount the nut and press out the pin **6** of the shifter fork fixing the shifter rod **7** to the shift booster **5**.
15. Dismount screws **1** fixing the shift bracket **2** to the longitudinal beam and remove them together with shifter rod **3** and selector tie-rod **4**.

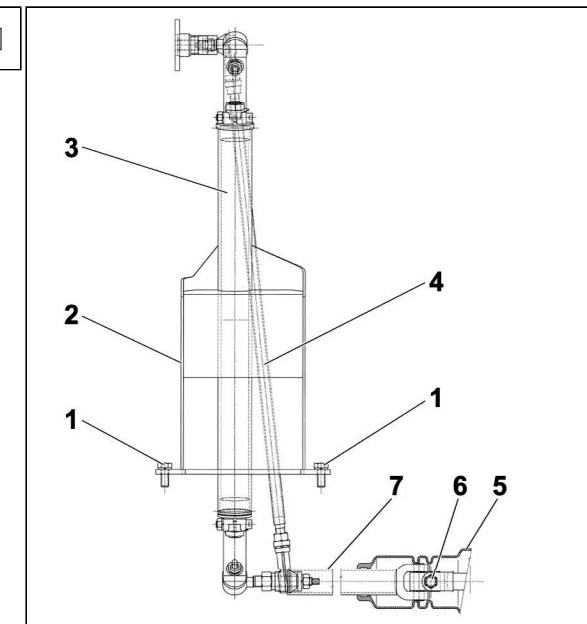


Fig. 3.19 Removal of the shift bracket

16. Dismount nuts from screws **1** and remove screws from holes of shift levers **2**.
17. Unlock the lock washer and unscrew the nut **8**.
18. Withdraw levers **2** from location of the speed-down shifter rod **4**.
19. Remove lower (upper) shims **9**, bushes **7**, bearings **6**, and washers **5**.
20. Remove the shifter rod **4**. Place the shift bracket **3** apart.

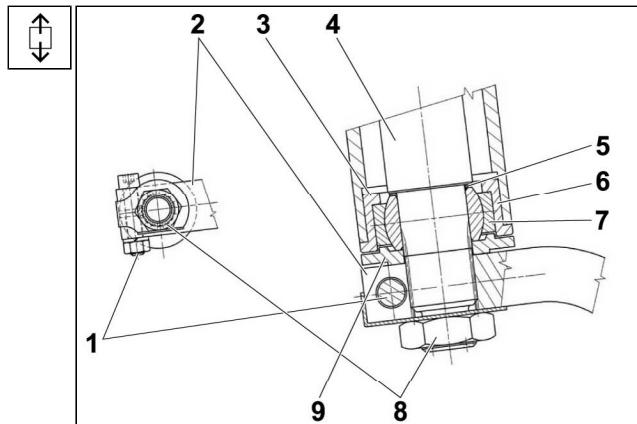


Fig. 3.20 Removal of shift levers



03 Gearbox



21. Dismount nuts **1** and **3** fixing ball pins **2** and **4** and withdraw spring washers c/w selector tie-rod **5**.
22. Unscrew ball pins **2** and **4** from the selector tie-rod **5**.

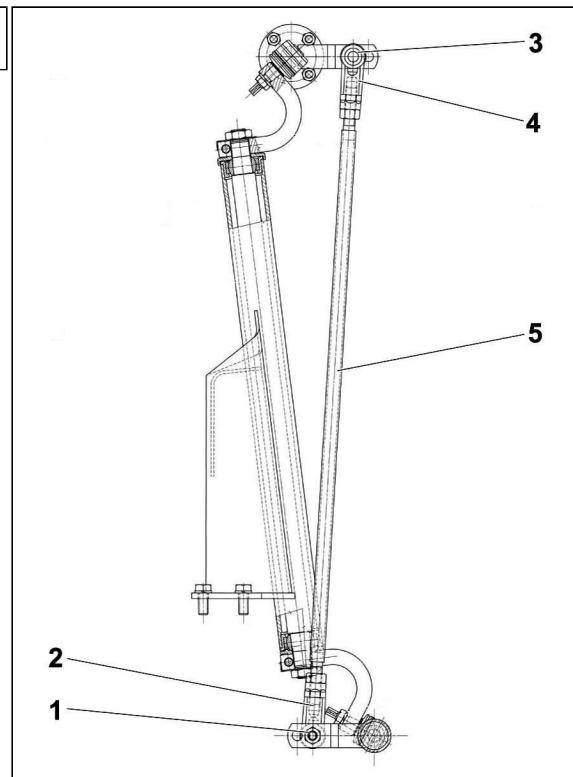


Fig. 3.21 Removal of ball pins

23. Unscrew nut **2** and remove washer **3**.
24. Withdraw the locking spring of telescopic cylinder **1** from the shift tube.

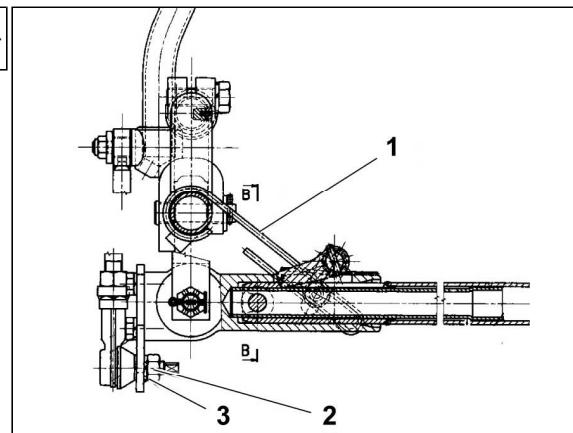
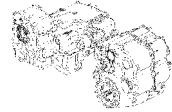


Fig. 3.22 Shift tube - disassembly



03 Gearbox



25. Remove split pin **2**, unscrew crown nut **3** and move screw **4** out.
26. Slide the head of gearshift lever **1** out of holders on the shift tube **5**.

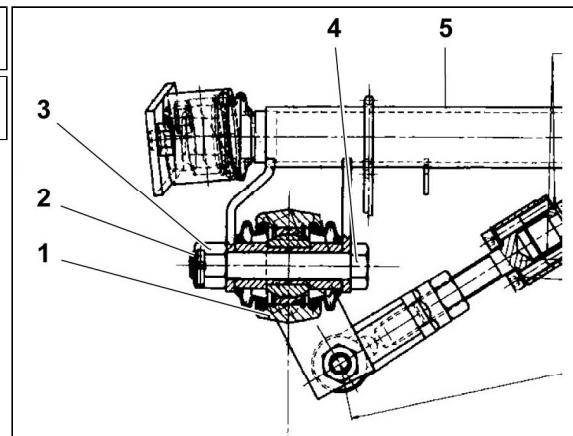
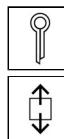


Fig. 3.23 Gearshift lever head - removal

27. Unscrew the self-locking nut **4** and remove the shim **3**.
28. Withdraw the complete selector tie-rod **2** from pin on the gearshift lever **5**.
29. Remove split pin **7** and take out washer **6**.
30. Slide the pin **8** out and remove the gearshift lever from the shift tube.
31. Press 2 pcs of bushes **1** out of the gearshift lever **5**.

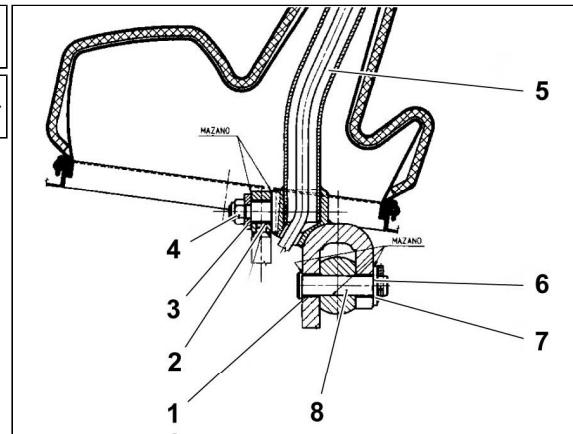
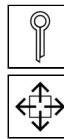


Fig. 3.24 Gearshift lever - disassembly

32. Mount complete ball pin **1** on the pin **6** and secure with nut **2**.
33. Loosen the nut **2** and unscrew the complete ball pin **1** from pin **6**.
34. Unscrew 4 pcs of screws **3** c/w washers **7**, remove the pin **6** and yoke **5** on the opposite end of the selector tie-rod **4**.
35. Press the bush **8** out of eye in the selector tie-rod **4**.

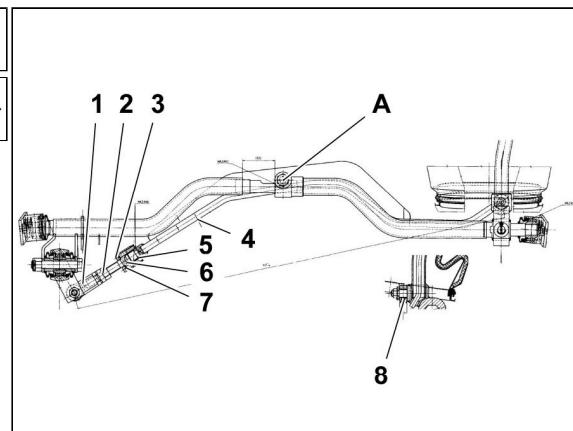
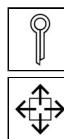


Fig. 3.25 Complete selector tie-rod - disassembly



03 Gearbox



36. Remove the split pin 3 , washer 2 and pin 1 from the carrier head.
37. Withdraw the carrier head from the shift bar 4.

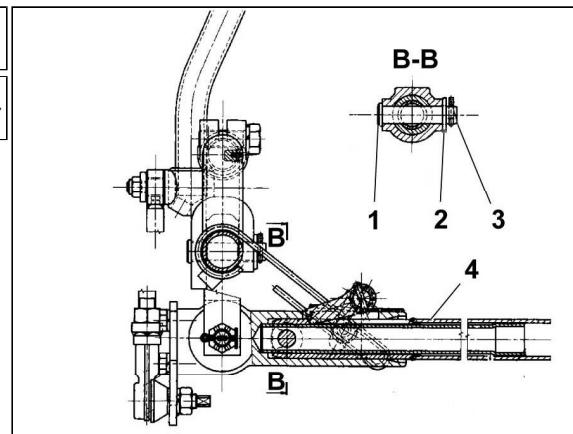
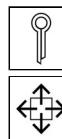


Fig. 3.26 Carrier head - disassembly 1

38. Unscrew 2 pcs of screws 5 c/w washers 4.
39. Withdraw the selector bracket 1 from the carrier head 2.
40. Remove 2 pcs of dust seals 3 from the carrier head 2.
41. Slide 2 pcs of gearshift lever pins 6 out of the bearing ELGES in the carrier head 2.

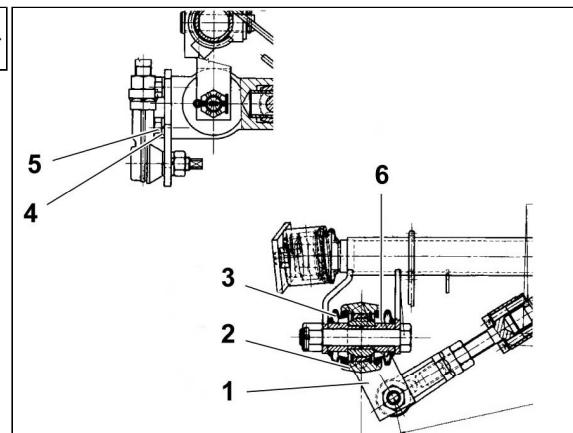


Fig. 3.27 Carrier head - disassembly 2

42. Move the inner tube 4 out of the shift bar 5.
43. Remove the auxiliary screw nail 2 , complete pawl pin 6 , pawl spring 3 and pawl 1 from the carrier head.

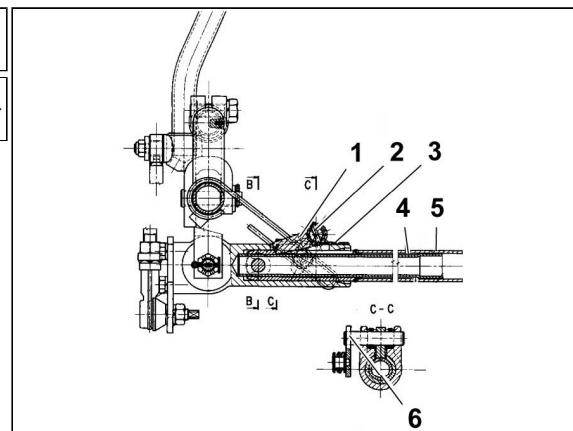
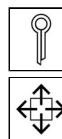


Fig. 3.28 Carrier head - disassembly 3



03 Gearbox



44. Remove the inner retaining ring 4.
45. Press the spherical baring ELGES 3 out.
46. Remove the inner retaining ring 2 from the carrier head 1.

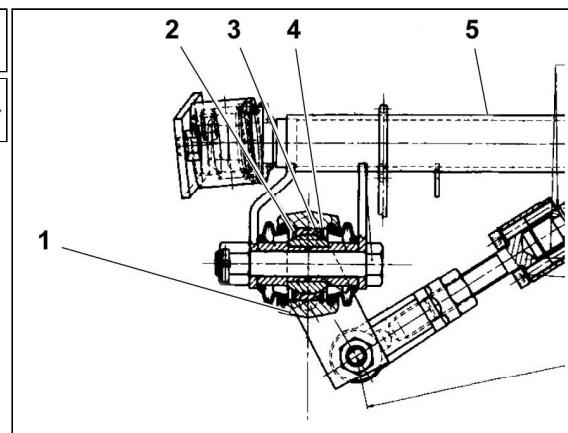
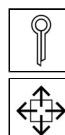


Fig. 3.29 Carrier head - disassembly 4

47. Withdraw the gearshift lever bag 2 from border of the gearshift lever hole on the engine cover.
48. Unscrew 4 pcs of nuts 4 and withdraw washers 3.
49. Move the gearshift lever 1 out of the hole in the engine cover.

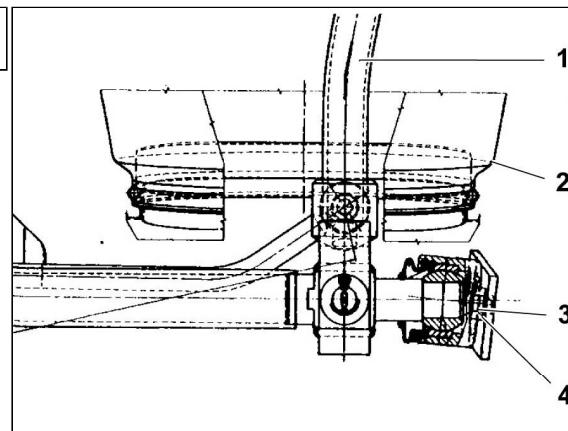


Fig. 3.30 Gearshift lever - removal

50. Withdraw the assembled shift bearings 5 from ends of shift tubes 1 and 5 (See Fig. 3.29).
51. Move the dust seal 2 and inner retaining ring 3 from the shift bearing 5.
52. Press the spherical bearing ELGES GE 17 FW 4 out the shift bearing 5.

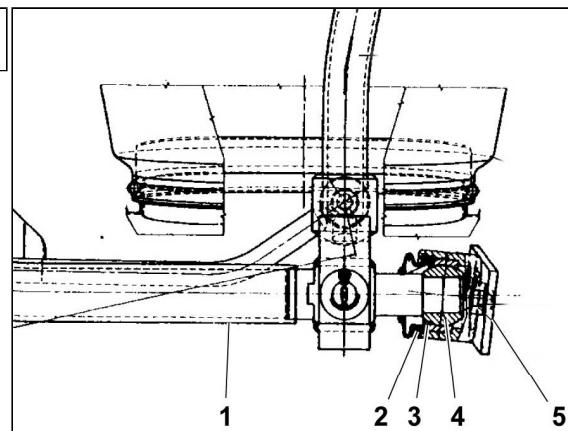


Fig. 3.31 Disassembly of the gearshift lever



03 Gearbox



53. Dismount screw **4** c/w washer **3** and remove wedge **2**.



54. Move the shift tube **1** out of the shift tube **5**.

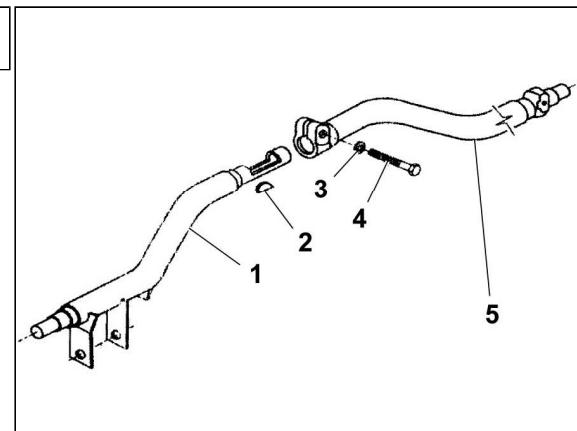
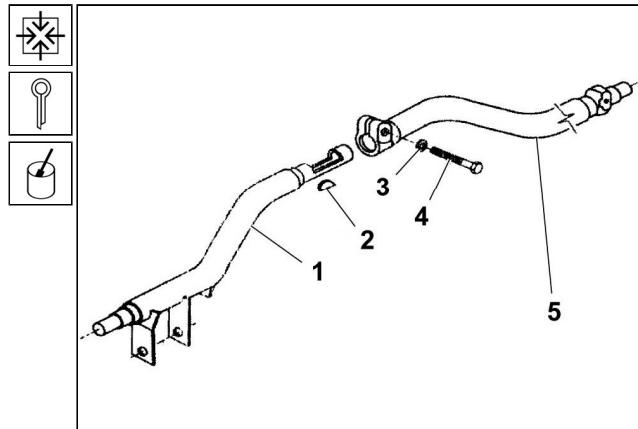


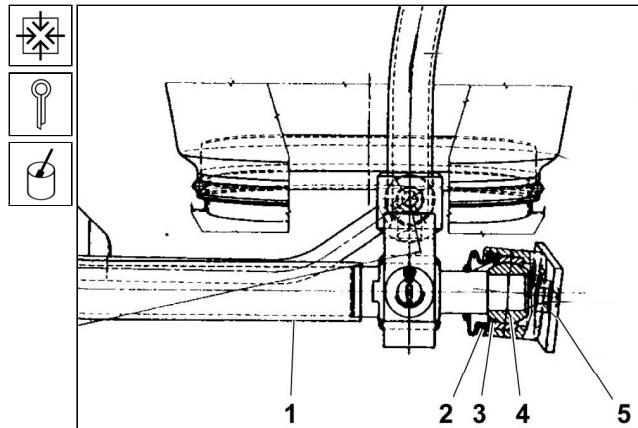
Fig. 3.32 Removal of the pawl c/w spring

**d) Installation procedure of individual sub-assemblies**

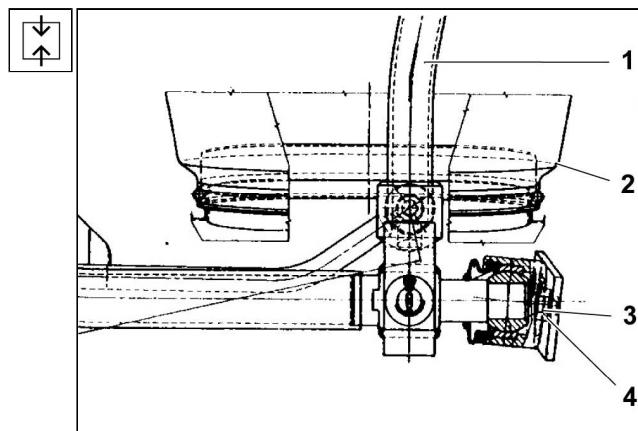
1. Install the shift tube **1** into the shift tube **5** and apply the plastic grease **AK2**.
2. Use the wedge **2** to secure the shift tubes **5** and **1** in position and use screw **4** and washer **3** to attach them.

*Fig. 3.33 Shift tube - assembly*

3. Press the spherical bearing ELGES GE 17 FW **4** into the shift bearing **5**.
4. Secure it with inner retaining ring **3**.
5. Fit the dust seal **2** into the shift bearing **5**.
6. Fill the bearing and space in the dust seal with the plastic grease **AK2**. Assemble 2 pcs of shift bearings in that manner.
7. Install the assembled shift bearings **5** on ends of shift tubes **1** and **5** (See Fig. 3.36).

*Fig. 3.34 Shift bearing - assembly*

8. Slide the gearshift lever **1** into a hole in the engine cover and use 4 pcs of washers **3** and 4 pcs of nuts **4** to attach it.
9. Pull the gearshift lever bag **2** over the border of the hole for the gearshift lever on the engine cover.

*Fig. 3.35 Gearshift lever - installation*



03 Gearbox



10. Fit the inner retaining ring **2** into the carrier head **1**.
11. Press the spherical bearing ELGES **3**.
12. Secure it with the inner retaining ring **4**.

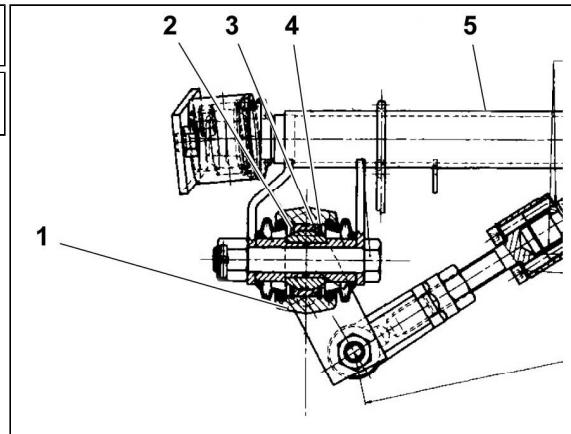


Fig. 3.36 Carrier head - assembly 1

13. Install pawl **1**, pawl spring **3**, complete pawl pin **6** into the carrier head and secure it with the screw nail **2**.
14. Slide the inner tube **4** into the shift bar **5**.
15. Smear it with plastic grease **AK2**.

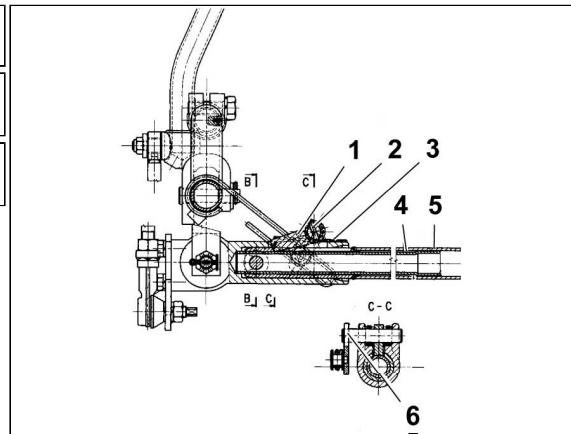


Fig. 3.37 Carrier head - assembly 2

16. Slide 2 pcs of gearshift lever pins **6** into bearing ELGES in the carrier head **2**.
17. Fit 2 pcs of dust seals **3** into the carrier head **2**.
18. Fill the bearing and space of dust seals with the plastic grease **AK2**.
19. Use 2 pcs of screws **5** and 2 pcs of washers **4** to fix the selector bracket **1** to the carrier head **2**.

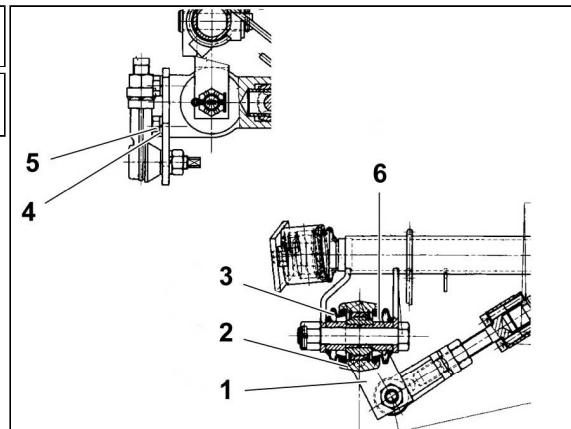


Fig. 3.38 Carrier head - assembly 3



03 Gearbox



20. Fit the carrier head on the shift bar **4** and use pin **1**, washer **2** and split pin to secure it in position.

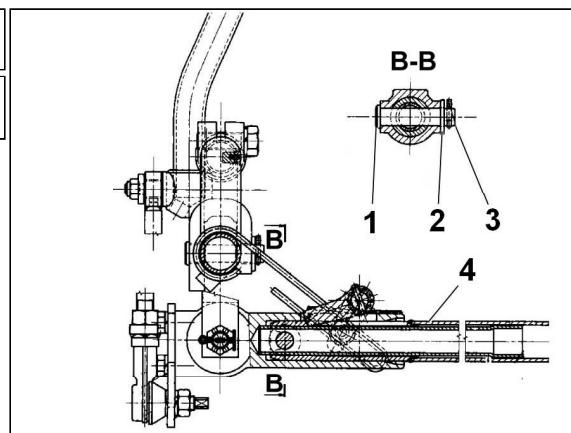


Fig. 3.39 Carrier head - assembly 4

21. Press the bush **8** into eye of the selector tie-rod **4**.
22. Install yoke **5** and pin **6** on the opposite end of the selector tie-rod **4** and use 4 pcs of screws **3** and washers **7** to attach it.
23. Mount the complete ball pin **1** on the pin **6** and secure it with nut **2**.
24. Loosen the nut **2** and use the ball pin **1** and pin **6** in order to adjust the selector tie-rod length to 699 - 709.

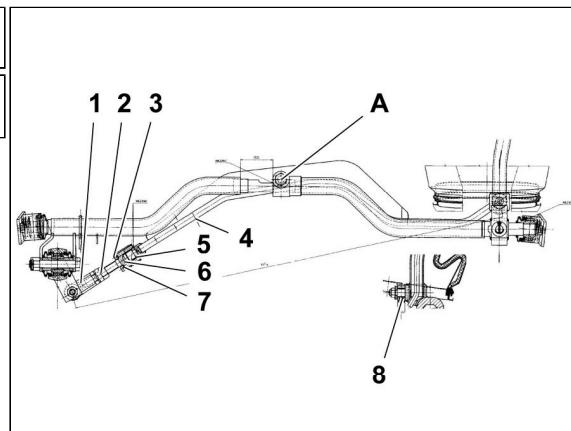


Fig. 3.40 Complete selector tie-rod - assembly

25. Press 2 pcs of bushes **1** into the gearshift lever **5**.
26. Fit the gearshift lever on the shift tube and slide the pin **8** on. Apply the plastic grease **A K2**.
27. Fit washer **6** and secure with split pin **7**.
28. Install the complete selector tie-rod **2** onto pin on the gearshift lever **5**, apply the plastic grease **A K2** and use shim **3** and self-locking nut **4** to secure it.

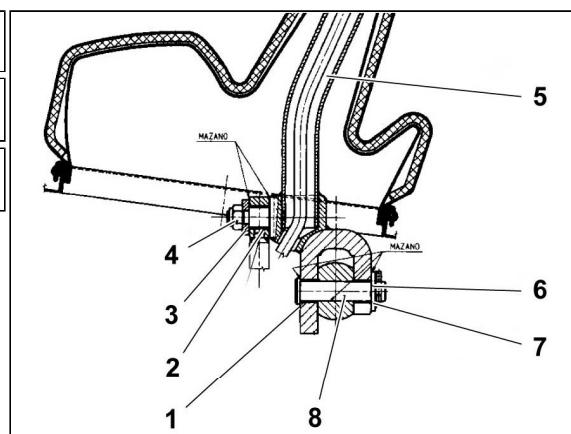


Fig. 3.41 Gearshift lever - assembly



03 Gearbox



29. Install the gearshift lever head 1 between holders on the shift tube 5.
30. Mount screw 4 and smear it with plastic grease AK2.
31. Mount the crown nut 3, tighten it to the nearest slot and secure with split pin 2.

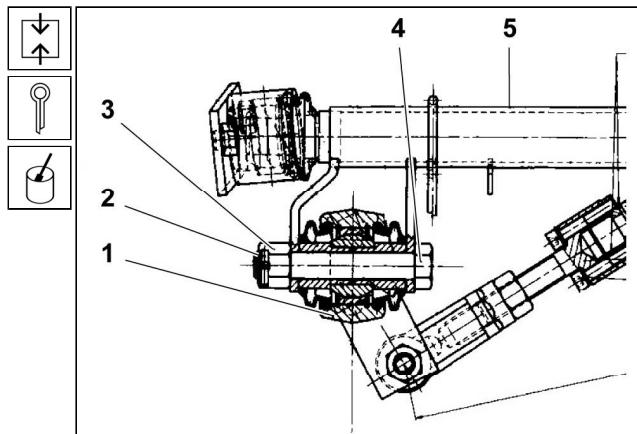


Fig. 3.42 Gearshift lever head - installation

32. Install the telescopic cylinder locking spring 1 on the shift tube and secure it with washer 3 and nut 2.

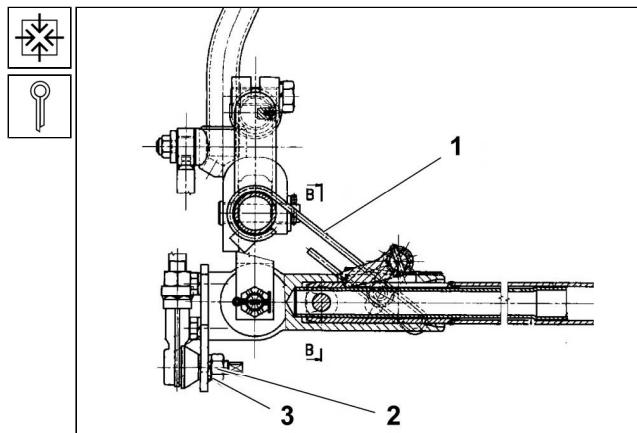


Fig. 3.43 Shift tube - assembly

33. Install the shifter rod 4 into the shift bracket 3.
34. Measure up washers 5 to the dimension of 1.8 ± 0.2 mm and slide these on a recess in the shifter rod 4.
35. Press bearings 6 on the shifter rod 4, mount bushes 7 and fit upper (lower) shims 9.
36. Install levers 2 on clamping connections of the shifter rod 4. Position the shift levers 2 on both ends in the same direction. The clamping splined connections of shift levers 2 and speed-down rod 4 must not be greased.
37. Mount the nut 8 and tighten the screw connection of the gearshift lever pin to 78 ± 8 Nm. Lock it with a lock washer.
38. Insert screws 1 and mount nuts into holes of shift levers. Tighten the screw connection of the shift lever to 23 ± 3 Nm.

Note:

Smear the friction bearing with the plastic lubricant during installation.

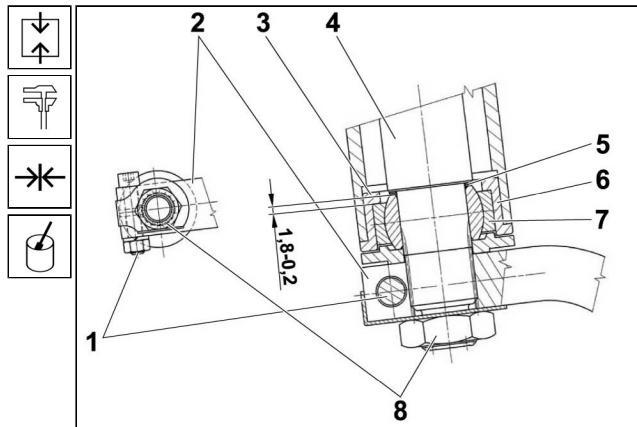


Fig. 3.44 Installation of shift levers



39. Mount ball pins **2** on the selector tie-rod **7** and lock them with nuts in position.
40. Slide ball pins **2** so that their holes face the holes in ball pins **5** and **8** (marginal holes must stay free).
41. Fit spring washers on ball pins **2**, mount nuts **1** and tighten.
42. Slide levers **6** on locations of ball joints **5** and **8** and mount nuts **4**.
43. Use nuts to attach the ball pin **2** and ball pin **5** (fixing ball pins to the flange of selector tie-rod and shifter rod).

Note:

Smear the friction bearing with the plastic lubricant during installation.

The rod must be easy to rotate after the tightening-up to specified torques.

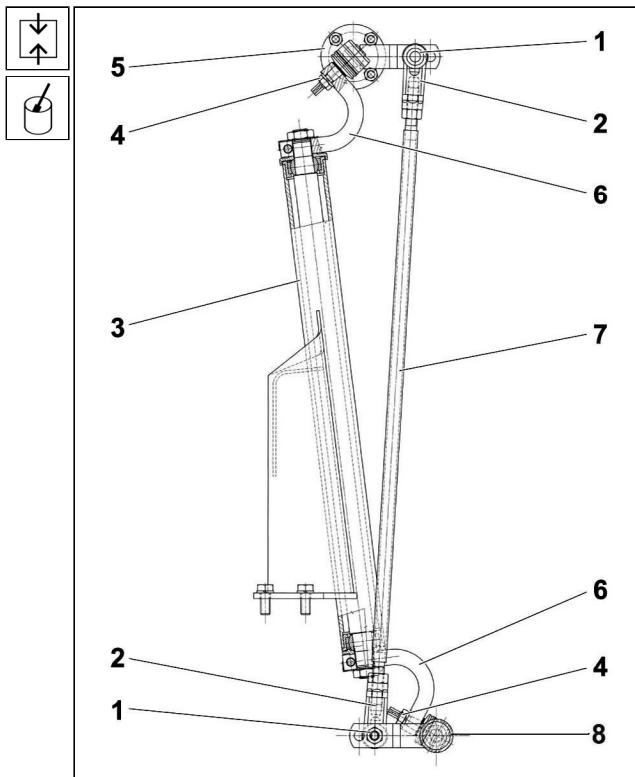


Fig. 3.45 Installation of ball pins

44. Fit the shift bracket **2** on the longitudinal beam and use screws **1** to attach it together with the shifter rod **3** and selector tie-rod **4**.
45. Assembly the selector tie-rod **4** (2 pcs nuts and 2 pcs pins). The distance between the joints seating fases set up to **605 mm** (keep the screwed joints symmetry).
46. Use nuts **8** to adjust the ball pin of the selector tie-rod **4** towards the axis of the speed-down rod **3** to the dimension of **49 mm**.
47. Position the shifter rod **3** c/w selector tie-rod **4** and slide the shifter rod **7** c/w fork facing the shift booster **5** so that their holes are concentric.
48. Press the shifter fork pin **6**. Mount the nut and secure it with a suitable tool. Slide the protective bag on the connection.

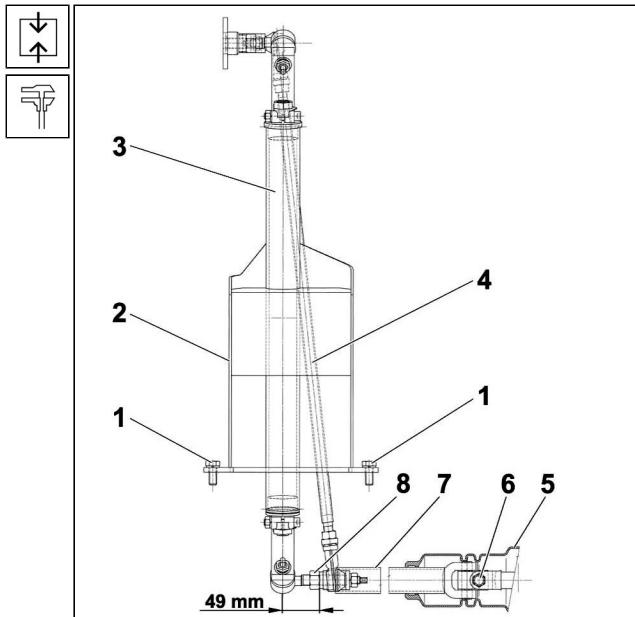


Fig. 3.46 Installation of the shift bracket



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49. Fit bolts **2** and use washers **3** and nuts **4** to mount the flange connections of shifter rod **1** and complete selector tie-rod **5**.

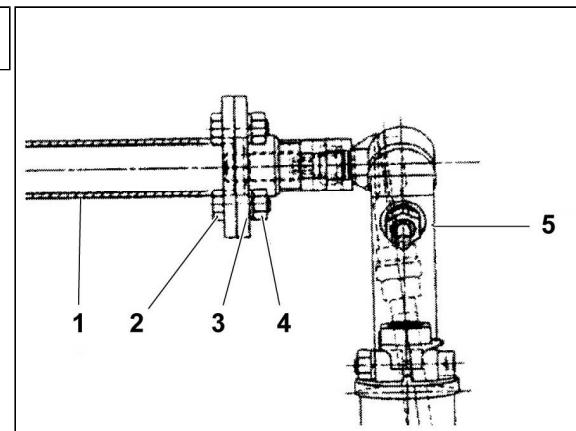


Fig. 3.47 Installation of the gearshift lever c/w shifter rod bracket

50. Slide the protective bag **10** on the gearshift lever **8** and use the cable clip **9** to attach it.
51. Slide the L/H gear preselector **1** into complete gearshift lever **8** and use two screws **2** to fix it.
52. Fit the preselector lever **3** on the gearshift lever, insert spring **5** and ball **4**.
53. Mount the complete handle **7** and secure it with a screw **6**.
54. Connect the L/H gear preselector cable **1**.
55. Tilt the vehicle cab into the operating position and secure it.
56. Install the removable cover above gearbox on the cargo truck platform.
57. Check the gear shifting for function, the shift gate must be movable within the whole shift range after installation.

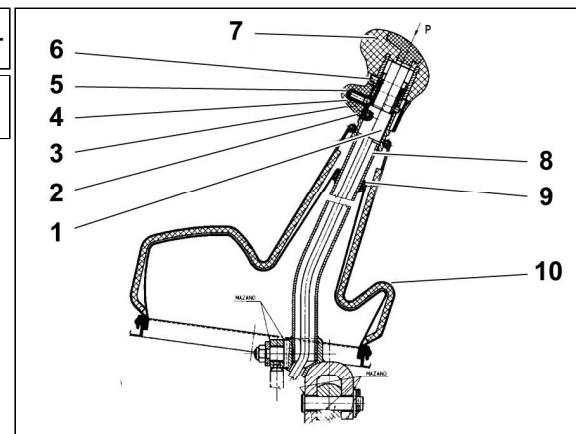


Fig. 3.48 Gearshift lever - assembly



3.5.5 Removal and Installation of the Shift Booster

a) Reasons for Removal

1. The shift booster is not functioning while the pneumatic control is OK.
2. The shift booster has been damaged mechanically.
3. The shifter finger or the gearshift rod has suffered damage.
4. Rubber sealing rings are leaky.
5. Replacement of the gearbox.

b) Technical Conditions

1. Replace all sealing rings, shaped rings and collars with new ones.
2. Tighten the lock screw of the shifter finger properly.
3. The bearing surfaces of the gearbox and shift booster must be cleaned from residues of the sealant and must be fully clean.
4. No air may leak from the shift booster at the nominal air pressure.

c) Removal Procedure

1. Stand the vehicle on a level ground and secure it against motion. Remove the removable cover above gearbox on the cargo truck platform .
2. Move the gearshift lever in neutral.
3. Detach air manifolds **1**, **2** and **5** from the shift booster **3**. Unscrew the screwed connection of the intake manifold **5** from the front part of the shift bar. Withdraw the protective bag **4** from the shift booster **3** and move it on the shift tube **6**.
4. Unplug electric cable of the neutral switch from the shift booster **3**.
5. Unscrew the pin nut **3**, remove (knock off) the pin **3** from the control shift bar **2** and shift tube **4**.
6. Dismount screws **1** fixing the shift booster housing to the gearbox.

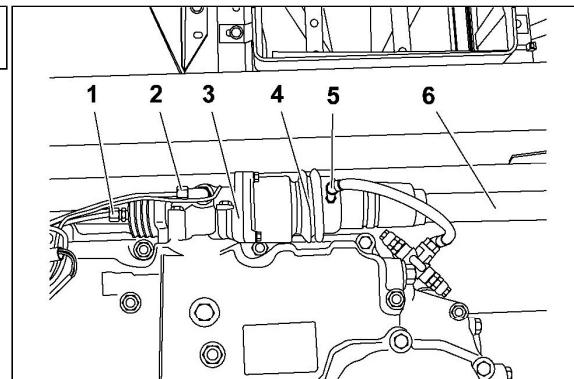


Fig. 3.49 Disconnection of the air manifold

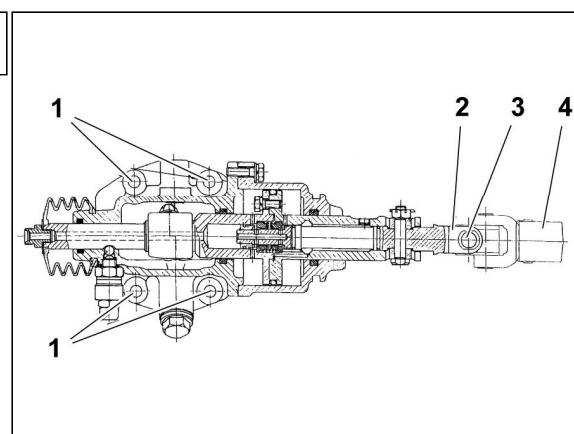


Fig. 3.50 Gearbox shift booster – removal



7. Remove screws **6** c/w spring washers **7**. Withdraw the shift booster **5**. Remove the blocking element **1** c/w springs **3** and **4**, arresting balls **2** and center pins **8**.

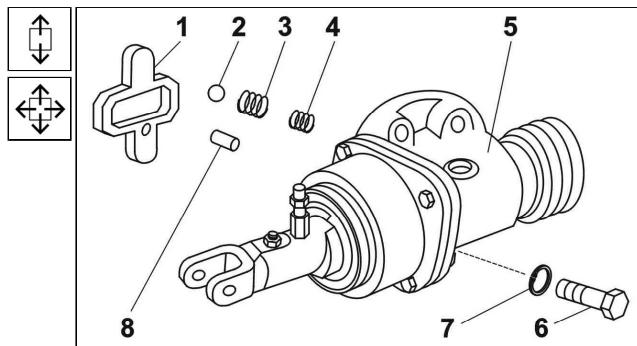


Fig. 3.51 Attachment of the shift booster - removal

d) Installation procedure

1. Install the blocking element **1** c/w springs **3** and **4**, ball **2** and center pins **8** into the shift booster housing.
2. Apply a layer of sealant to the contact surface of the shift booster housing **5**. Fit the shift booster **5** on the gearbox contact surface and hammer it on. Smear the threads of screws **6** with sealant. Use screws **6** c/w spring washers **7** to attach the shift booster **5** to the gearbox. Tighten the screws **6** to the torque of **32** to **46 Nm**.

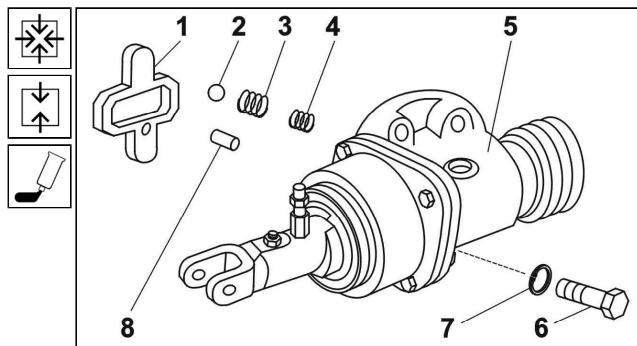


Fig. 3.52 Attachment of the shift booster - installation

3. Attach the shift tube **4** with pin **3** to the control rod **2** of the shift booster. Mount the nut on the pin **3**, tighten and secure.
4. Attach the shift booster to the gearbox with screws **1**.

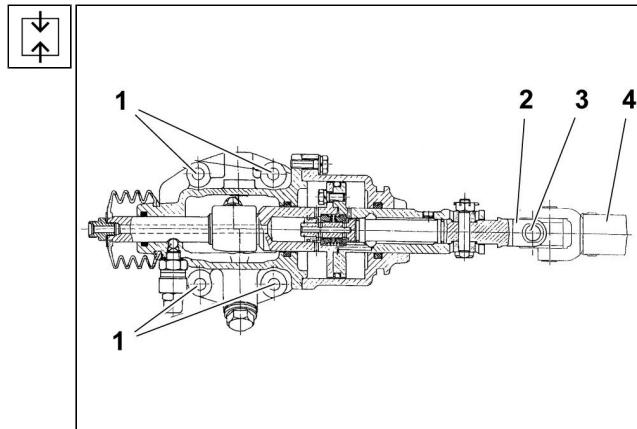


Fig. 3.53 Gearbox shift booster - installation



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5. Pull the protective collar **4** over the joint and slide inside the screwed joint c/w sealing ring of the intake manifold **5**.
6. Screw the screwed connection into the front part of the shift bar and mount the union nut of the air intake hose **5** into the shift booster **3**. Attach the air manifolds **1**, **2** to the shift booster **3**.
7. Plug electric cable of the neutral switch to the shift booster **3**.
8. Install the removable cover above the gearbox on the cargo truck platform.
9. Start the engine, check the gear-shifting for function and road test the vehicle.

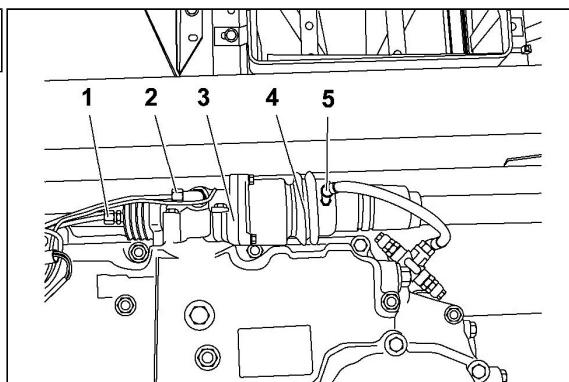


Fig. 3.54 Connection of the air manifold



3.5.6 Removal and Installation of the Gearbox Oil Pump

a) Reasons for Removal

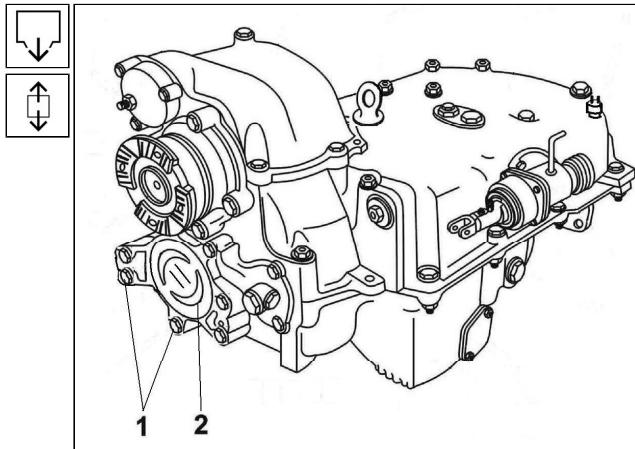
1. The gearbox overheats excessively.
2. The oil leaks from the pump housing.
3. The working surfaces of the oil pump have been worn.
4. The oil pump gear teeth have been worn or damaged.

b) Technical Conditions

1. Replace all shaped rings and seals with new ones.
2. Remove residues of the old seal from bearing surfaces.
3. Check the plugs on the oil pump housing for condition.
4. Adjust the axial clearance of the countershaft during replacement of the oil pump housing.

c) Removal Procedure

1. Stand the vehicle on level ground and secure it against motion. Remove the removable cover above gearbox on the cargo truck platform .
2. Drain the oil from gearbox according to a procedure (See Subchapter 3.5.1).
3. Disconnect the propeller shaft from gearbox (See Part 2), push the carrier towards the clutch and move the shaft aside so that it would not obstruct.
4. Unscrew six nuts **1** and remove the pump cover **2** together with sealing ring and spring washers.

**Note:**

Degrease the pump cover in benzine.

Fig. 3.55 Oil pump cover - removal



5. Remove the inner gear **3** and the outer gear **2** from the pump housing **4**.
6. Dismount two fastening bolts **10** c/w washers **9**, hammer the oil pump housing **4** to slacken it and remove the pump housing **4**.
7. Remove shaped rings **1**, **6**, **7**, **8** and **11** and shim **5** and place them separately.

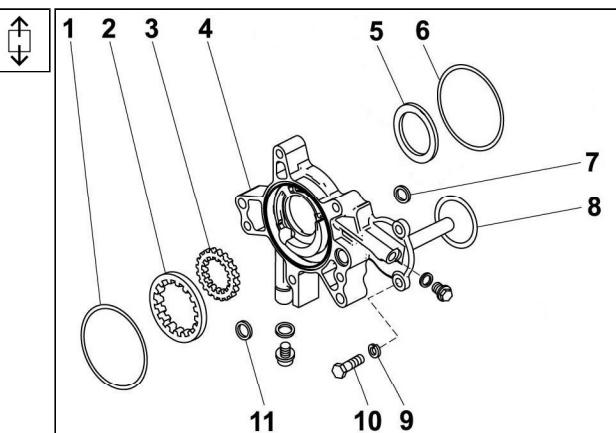


Fig. 3.56 Gearbox oil pump - removal

d) Installation Procedure

1. Adjust the axial clearance of tapered roller bearings of the countershaft as follows:
 - fit the tool **2 PRM 2899** on the countershaft, and mount bolts **1** and **3**,
 - Adjust the zero clearance while swiveling the flange **5** using the bar **4** continuously,

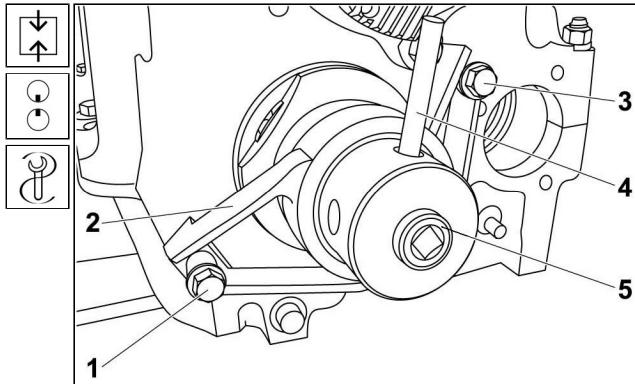


Fig. 3.57 Tightening-up of the tapered roller bearing

- Use the depth gauge **MMU 1740.1** c/w dial indicator **2** to measure up the distance of 'y' from the face of the housing **1** to the front surface of the outer bearing ring **3**
- carry out the measurement in three different points at least and put down the measured values

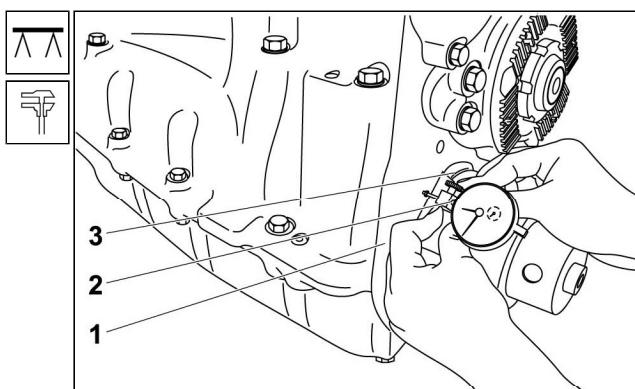


Fig. 3.58 Adjustment of the countershaft bearings axial clearance - 1



- fit the shim 1 into the pump housing
- Use the depth gauge **MMU 1740.1** c/w dial indicator 2 to measure up the distance of 'x' from the face of the housing to the shim 1
- the difference of measured values " $x - y$ " must be within a range of **+ 0.06 to + 0.16 mm** (axial clearance)
- if differences " $x_{\max} - y_{\min}$ " or " $x_{\min} - y_{\max}$ " are not within the specified allowable axial clearance, it is necessary to remove the shim 1 and insert the shim of the required dimension into the housing.

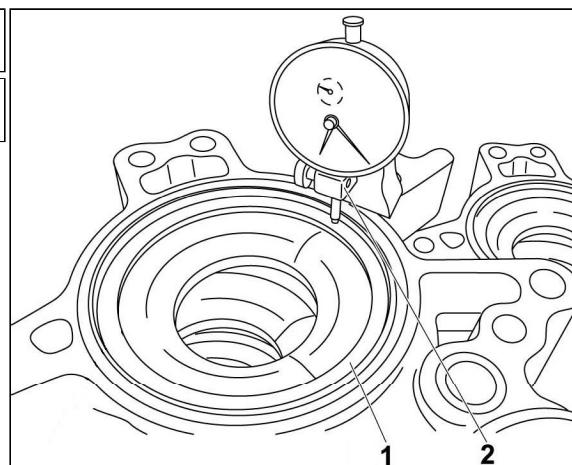
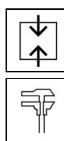


Fig. 3.59 Adjustment of the countershaft bearings axial clearance - 2

2. Install shaped rings 1, 5, 6 and 7 into a slots on the bearing surface of the pump. Install the ring 14 on the oil tube protruding from the gearbox.
3. Apply the sealant to the pump housing bearing surface 4, fit the housing on the gearbox and use two bolts 11 c/w washers 10 to attach it. Tighten the bolts 11 to the torque of **56 to 80 Nm**.
4. Install the outer gear 2 and the inner gear 3 into the oil pump housing 4 and smear both gears with oil.
5. Check whether plugs 8 and 12 c/w sealing rings 9 and 13 on the oil pump housing 4 are tightened properly.
6. Apply the sealant to bearing surfaces of the oil pump cover.
7. Install the oil pump cover 2 c/w sealing ring and spring washers and tighten six nuts 1.
8. Tighten the nuts 1 to the torque of **56 - 80 Nm**.
9. Clean and install the oil filter in accordance with a procedure mentioned in the section (See Subchapter 3.5.1), top up the oil into gearbox.
10. Install the propeller shaft in accordance with a procedure mentioned in the section (See Part 2).
11. Shift in neutral in gearbox, start the engine and increase the engine speed to 800, 1000, 1400 and 1800 rpm.
12. Loosen the plug 12 (See Fig. 3.60) in the lubricating port in the pump housing 4.

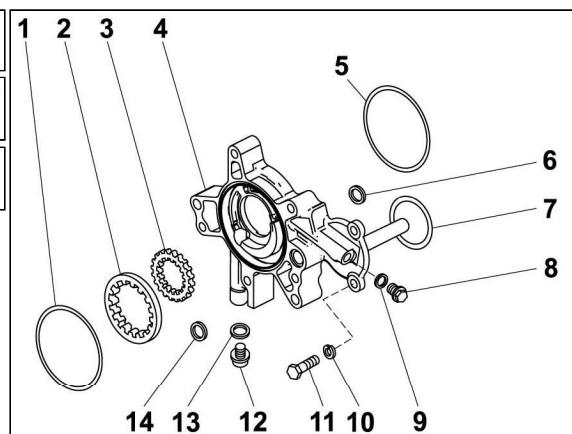


Fig. 3.60 Gearbox oil pump - installation

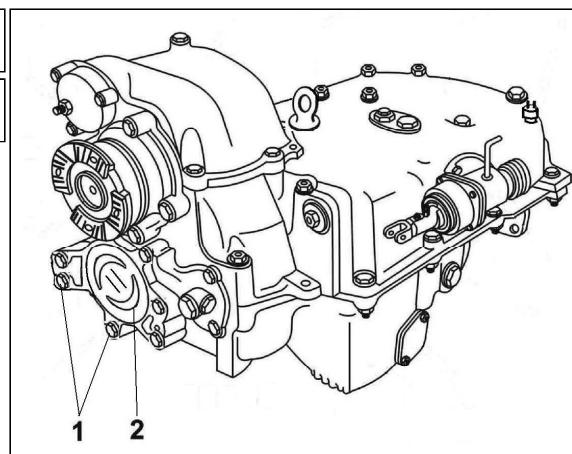
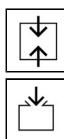
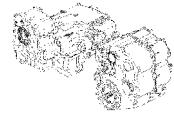


Fig. 3.61 Oil pump cover - installation

**03 Gearbox**

-
13. While checking the oil leakage under the plug, check whether the pump delivers the oil.
 14. Tighten the plug.
 15. Install the removable cover above gearbox on the cargo truck platform.



3.5.7 Removal and Installation of the Gearbox Upper Cover c/w Input Shaft

a) Reasons for Removal

1. The gearbox upper cover is leaky.
2. The H (N) / L(R) gearshifting cannot be adjusted.
3. A repair of the complete input shaft.
4. The constant mesh gears cannot be shifted.

b) Technical Condition

1. The speed-reducing gearbox cover (not a single spare part) has been machined together with the gearbox housing, and for that reason, it must not be confused.
2. The bearing surfaces of the cover and the gearbox housing must be clean and degreased thoroughly.
3. The input shaft axial clearance must be within the range of **0.0 - 0.1 mm**.
4. The shaft seal and the shaped sealing ring must be replaced with new ones.

c) Removal Procedure

1. Stand the vehicle on a level ground and secure it against motion. Remove the removable cover above gearbox on the cargo truck platform.
2. Shift in the H (N) constant mesh gear.
3. Dismount the flange connection from the propeller shaft c/w input shaft and move it out of mesh together with the input shaft flange towards the engine clutch (See Part 2).
4. Dismount union nuts from the air inlet manifold for the pneumatic gearshift cylinder of H (N) / L(R) constant mesh gearshifting.
5. Unlock and unscrew the nut **2** from the gearbox input shaft flange and remove the flange from the involute splining of the input shaft.
6. Dismount bolts **1** and **4** from the input shaft cover **3**, use the screwdriver the pry out the cover from the gearbox-bearing surface and remove the cover from its location.
7. Dismount bolts **6** fixing the upper cover **5** to the upper half of the gearbox housing **7**.
8. Pry out the upper cover **5** (slacken it from centering pins away from the upper half of the gearbox housing **7**) and remove the cover from the sliding sleeve of the constant mesh synchromesh.
9. Remove the complete input shaft from its mounting in the upper half of the gearbox housing.

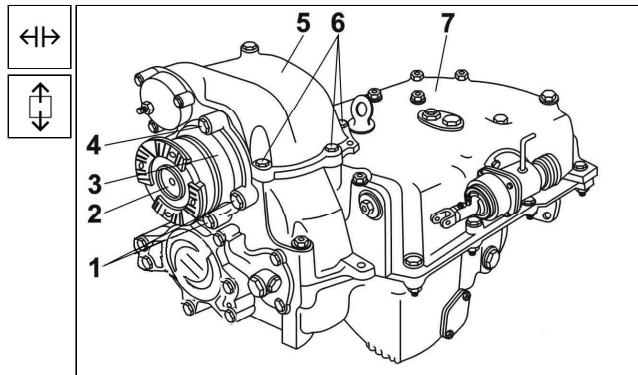


Fig. 3.62 Speed-reducing gearshift casing - removal


d) Installation Procedure

1. Clean the bearing surfaces from dirt and degrease them.
2. Install the complete input shaft with the sleeve engaged on the L(R) gear connecting gearing into its mounting position in the upper half of the gearbox housing **6**.
3. Apply a 3 mm thick layer of the sealant for the cover bearing surface of the gearbox housing upper half **6** (do not smear it close to the lubricating port).
4. After the bearing surface is prepared in such a manner, fit the upper cover **4** with guide blocks into a slot of the synchromesh sleeve and on centering pins with the upper half of the gearbox housing.
5. Use bolts **7** to attach the upper cover **4** and tighten to **100 ± 10 Nm**.
6. Adjust the axial clearance of drive shaft bearings, use screws **3** and **8** to attach the cover **5** and install the flange **2** on the drive shaft **1** in accordance with a procedure mentioned in (See Subchapter **3.5.3**).
7. Adjust the H (N) / L(R) gear-shifting in accordance with a procedure mentioned in the section (See Subchapter **3.5.2**).
8. Attach the propeller shaft with a procedure mentioned in the section (See Part **2**).
9. Install the removable cover above gearbox on the cargo truck platform.
10. Make a test run with the vehicle.

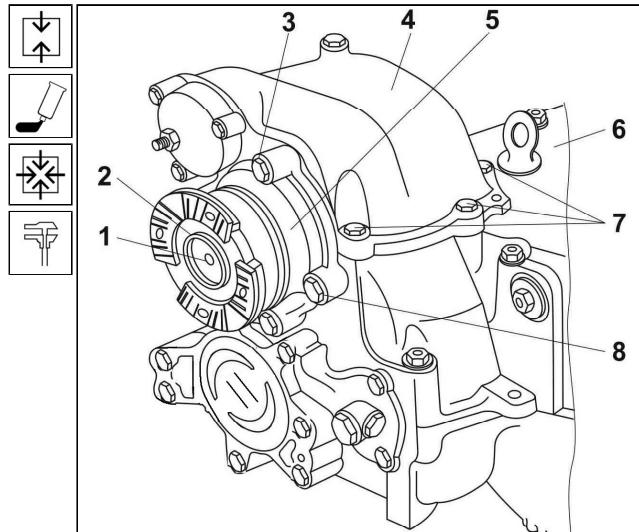


Fig. 3.63 Speed-reducing gearshift casing - installation



3.5.8 Removal and Installation of the Gearbox

a) Reasons for Removal

1. Some of the gearbox components have been cracked.
2. Some of gear speeds cannot be shifted.
3. Gears are slipping out spontaneously.
4. A big clearance resulting from the excessive wear of gear teeth.
5. Damage to the gear teeth.
6. An excessive gearbox noise.
7. Replacement of the auxiliary gearbox.
8. Replacement of the front backbone tube.

b) Technical Conditions

1. Use wheel chocks to secure the vehicle against motion during repair.
2. Replace all shaped sealing rings, shaft seals and washers with new ones.
3. Use the specified special tools for the gearbox removal and installation.

c) Removal Procedure

1. Stand the vehicle on a level ground and secure it against motion. Remove the removable cover above gearbox on the cargo truck platform.
2. Drain the oil from the gearbox in accordance with a procedure mentioned in the section (See Subchapter 3.5.1).
3. Dismount bolts from the propeller shaft carrier flange at the gearbox and move the propeller shaft universal joint out of mesh together with the input shaft carrier (See Part 2).
4. Loosen all clamps of air manifolds and electric cables.
5. Dismount the shift booster 6 in accordance with a procedure mentioned in the section (See Subchapter 3.5.5).
6. Disconnect the air inlet manifold 1 from the pneumatic gearshift cylinder 2 of the H (N) / L (R) constant mesh preselection shifting.
7. Disconnect electric cables of the reverse gear push-button switch 5 and unscrew the button switch 5.
8. Unscrew the plug including sealing ring from the gearbox housing 4 and install the lifting eye 3 (20 1042 015 4).
9. Hang the gearbox 4 on the lifting device.
10. Dismount nuts from stud bolts and remove bolts connecting the gearbox 4 to the auxiliary gearbox.
11. Move the gearbox 4 being hanged on the lifting device forwards so that the gearbox

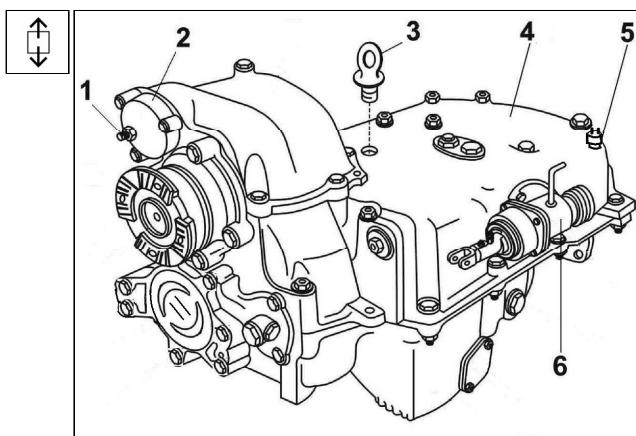


Fig. 3.64 Gearbox - removal



outlet shaft would move out of the auxiliary gearbox input shaft splining.

12. Remove the gearbox **4** from the vehicle and place it on the handling truck **PRM 0245** c/w superstructure **PRM 3192**.

d) Installation Procedure

1. Use the lifting device c/w tool to dislodge the gearbox **4** above a hole in the frame and lower it down towards the auxiliary gearbox. Install the shaped rings into slots on the face of the gearbox housing and use the RHODORSEAL sealant to stick the shaped rings to protect them against falling-out. Apply the plastic lubricant to the inner involute splining of the auxiliary gearbox input shaft splining.
2. Shift in the gear in the gearbox, move the gearbox towards the auxiliary gearbox and while swiveling the input shaft flange (swivel the outlet shaft), slide the involute splining into the internal gearing of the auxiliary gearbox input shaft. After the gearbox is slided to the auxiliary gearbox face, use nuts c/w spring washers and bolts to attach the connection and tighten the bolts.
3. Install the shift booster **6** c/w gearshift tube (See Subchapter **3.5.5**).
4. Mount the propeller shaft to the input shaft flange using four bolts and tighten to the torque of **65 - 85 Nm** (See Part **2**).
5. Mount union nuts of the air intake manifold **1** for the shift pneumatic cylinder **2** of shifting H (N) / L(R) constant meshes.
6. Dismount the lifting eye **3** (20 1042 015 4) from the gearbox housing **4** and reinstall the plug c/w sealing ring.
7. Install the push-button switch of the reverse gear **5** and plug the cable.
8. Attach all clamps fixing the air manifolds and electric cables.

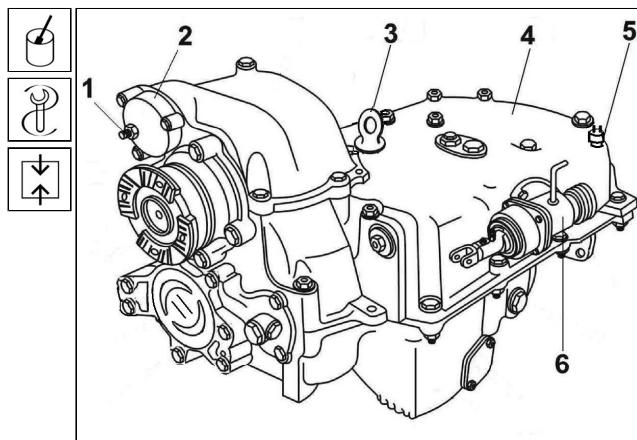


Fig. 3.65 Gearbox - installation

9. Check whether the cover **1** c/w oil filter is tightened properly and fill the gearbox through the inspection and filler hole **2** with the specified amount of the transmission oil and tighten the oil filler plug **2** (See Subchapter **3.5.1**).
10. Install the removable cover above gearbox on the cargo truck platform.
11. Start the engine and check the gearshifting of all gear speeds for function.
12. Make a test run with the vehicle.
13. Check the oil level on termination of the test run.

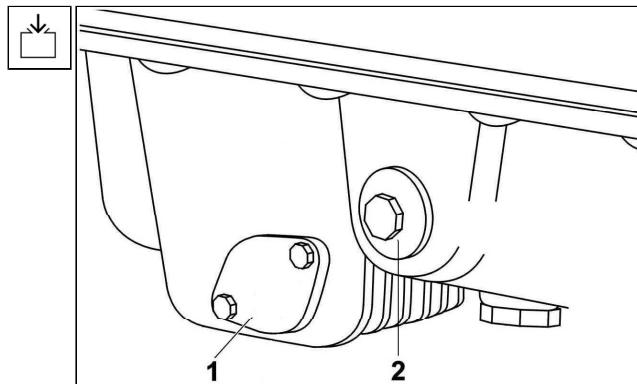


Fig. 3.66 Gearbox inspection and filler holes



3.5.9 Disassembly and Assembly of the Shift Booster

a) Reasons for Disassembly

1. The shift booster is not functioning while the pneumatic control is OK.
2. The shift booster has been damaged mechanically.
3. The shifter finger or the gearshift rod has been damaged.
4. Rubber sealing rings are leaky.

b) Technical Conditions

1. Replace the protective collar and all sealing rings with new ones.
2. Replace rubber parts, springs, and balls, arrestment pin and guide blocks with new ones.
3. Thoroughly tighten the locking screw of the shifter finger.
4. Apply the grease **MOBIL-GREASE MP** to all movable parts including all "O" rings.

c) Disassembly Procedure

1. Dismount the shift booster from the gearbox (See Subchapter 3.5.5).
2. Unscrew the water-proof button 17; remove steel balls 16 and sealing ring 18.
3. Dismount the locking screw of the shifter finger 12 and bolts 8 fixing the shift booster cylinder 7 to the gearshift housing 13. Dismount the tube neck 15, remove the protective dust cup 14 and move the shift booster cylinder 7 c/w shifter rod 2 (front part) out of the gearshift housing 13 .
4. Mark the mutual position of the control rod 1 and shifter rod 11 (rear part), unscrew screws 9 fixing both parts and disconnect the shifter rod.
5. Remove the outer lock ring 19, guide 10, valve 20, spring 21 and the other valve body 20 from the control rod 1 on the side of the shifter finger.
6. Remove the split pin 4 from the pin nut 5 . Unscrew the nut 5 , remove the fork pin 6 and guide blocks 3.
7. Withdraw the shift booster cylinder 7 from the front part of the gearshift rod 3.

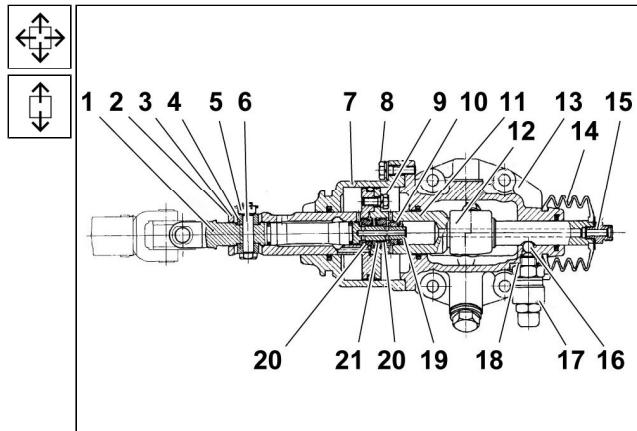


Fig. 3.67 Shift booster - disassembly



8. Dismount the plug **1** c/w sealing ring **2** from the gearshift housing and remove spring **3**, dismount the screw **8** c/w sealing ring **7**, take out springs **6**, balls **5** and arrestment pin **4**.

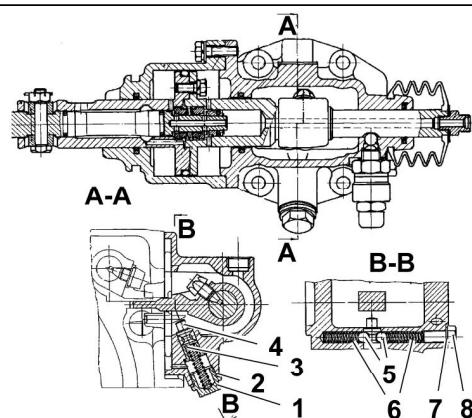
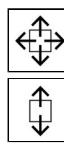


Fig. 3.68 Arrestment pin - removal

d) Assembly Procedure

Note:

Visually check the working surfaces of individual components whether they are clean and machined properly. Apply the grease to all movable parts including shaped rings during assembly of the shift booster.

1. Slide two inner seals **7** on the control rod **1**.
2. Install the outer seal **8** into the shift booster cylinder **9**, and fit the shift cylinder on the gearshift rod - front part **2**.
3. Slide the control rod **1** into the front part of the gearshift rod **2** and clamp the control rod forked piece into a vice. (Do not damage the inner seal during the sliding-in of the control rod **1**).
4. Adjust the control rod **1** and the gearshift rod **2**, install guide blocks **3** and the fork pin **5** and apply the grease to guide blocks sliding surfaces.
5. Gently tighten the nut **6**, loosen it round the angle of 90° and lock the nuts with a split pin **4**.
6. Slide the inner seal **7** on the guide **16**.
7. Install valve **28**, spring **29**, and guide **16** on the end of the control rod **1** and secure it with a circlip **27**.
8. Install the shaped ring **10** on the gearshift rod – front part **2** and insert the shaped ring **30** into a recess.
9. Fit the gearshift rod – rear part **17** on the gearshift rod – front part **2** and use bolts **15** c/w washers to connect both parts together. Tighten the screws to the torque of **16 - 23 Nm**.
10. Install outer seals **9** and **8** into the gearshift housing **20**.
11. Slide the gearshift housing **20** c/w shifter finger **18** on the gearshift rod – rear part **17**.

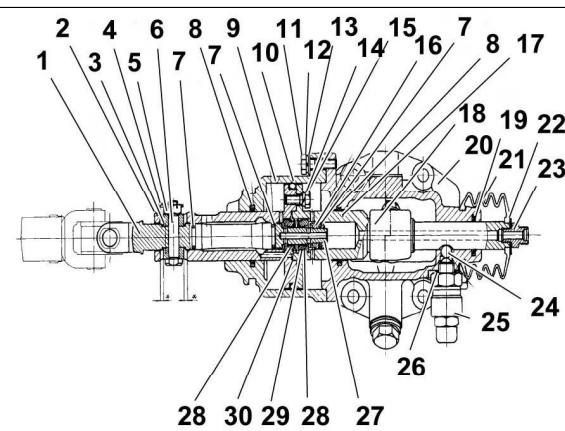


Fig. 3.69 Shift booster - assembly



03 Gearbox



12. Use the locking screw to lock the shifter finger 18 in position and tighten to **110 - 11 Nm**.
13. Adjust the mutual position of the gearshift housing 20 and shift booster cylinder 9 and use bolts 11 c/w washers 12 and 13 to mount them together. Tighten the screws to the torque of **16 - 23 Nm**.
14. Install the protective dust cup 21 on the gearshift rod – rear part 17 and mount the neck 23 c/w lock washer 22.
15. Install the sealing ring 26 on the water proof button 25, insert the steel balls 24 and screw button 25 into the gearshift housing 20.
16. Install the spring 6 c/w ball 5 and arrestment pin 4, insert the other ball 5 and spring 6 . Mount screw 8 c/w sealing ring 7 and tighten the screw.
17. Slide the spring 3 into the arrestment pin.
18. Tighten closing plugs 1 c/w washer 2 to compress the spring 3.
19. Apply the sealant to the bearing (sealing) surfaces of the shift booster housing and cylinder.

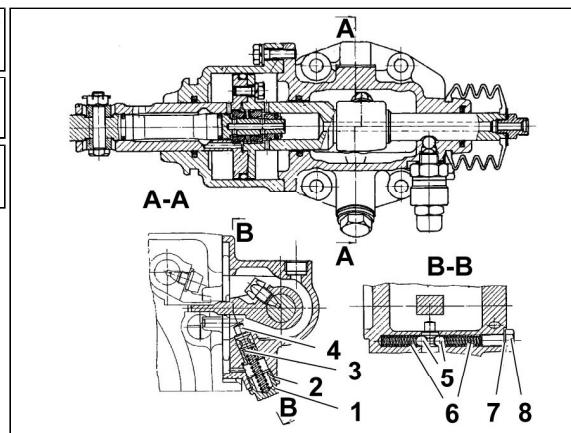
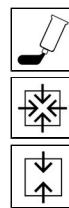


Fig. 3.70 Arrestment pin - installation

20. After assembly, check the booster for function as follows:
 - mount the air intake neck 2
 - check the tightness at standstill by the pressure of **0.6 MPa (6.0 kg/sq.cm)**- inlet to neck 2
 - travel of the control rod 1 - distance 'x' in both directions at the pressure of **0,6 MPa (6.0 kg/sq.cm)**
 - when reinstalled, an audible blow-off from the bleeder hole 'C' must be heard
21. Install the shift booster on the gearbox (See Subchapter 3.5.5).

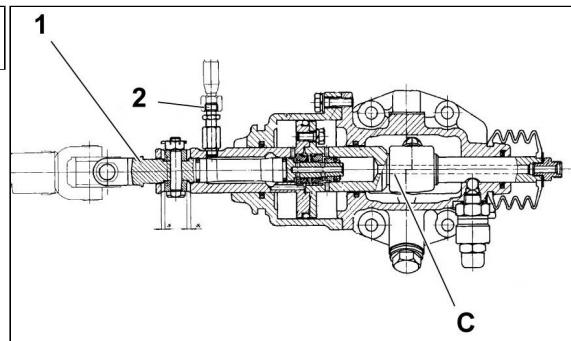


Fig. 3.71 Checking the booster for function



3.5.10 Disassembly and Assembly of the Gearbox

a) Reasons for Disassembly

1. The partition plane is leaky.
2. Cracked/damaged housing.
3. Some gear cannot be shifted. Causes of a wrong function have been ascertained.
4. The slipping-out of gears.
5. The synchromesh is not working during the gear changing – it shifts across the teeth.
6. Increased noise of the gearbox gearing train.
7. The gearbox overheats excessively, while the oil pump is functional.
8. The general overhaul of the gearbox.

b) Technical Conditions

1. When a general overhaul needs to be carried out, replace all antifriction bearings with new ones. Otherwise, it is enough to replace them only when the ball races or rolling elements have been worn too much. All rolling elements must roll on ball races uniformly without jerking. The contact zone must be situated in two thirds of the ball race width (it must not come to the center). No pitting or a sunken race is allowed to occur on rolling elements and in the contact zone on ball races or on the outer ring.
2. Teeth faces must not show any wear in the contact zone, i.e. sunken place towards the non-functional surface of teeth, pitting (crumbled pieces of material) in the contact zone, mainly at foot of the teeth.
3. The raceways in gear holes and on both the input and the output shafts must not show sunken places on raceways (increased radial clearance – noise), pitting (crumbled pieces of material) for rollers.
4. Replace all shaped rings, shaft seals, lock rings and washers with new ones.
5. Dip the shaft seals for 30 minutes in the specified transmission oil, fill one third of the circumference round the edge with the specified plastic lubricant and press under a uniform pressure.
6. Clean and degrease the bearing surfaces of cover, gearbox housing and screw threads and apply the 3-mm thick layer of the sealant to them. The layer is to be applied to one bearing surface, round holes the sealant should be applied in the space between the hole and the housing cavity and allow the sealant to dry out for 5 minutes at least before the sealing surfaces are connected.
7. Install rollers of one classification group during replacement of rollers on ball races. Use the plastic lubricant for the installation. Use needle bearings of one classification group for one bearing. Apply the specified oil to the location of the shaft before installation.
8. Discard faulty or excessively worn parts.
9. Clean (wash) the parts before installation. Check the functional surfaces (damage, completeness of the machining); if possible, use the suitable tool to correct the damage.
10. When more gearboxes are repaired at the same time, do not confuse individual parts of the gearbox, in which the bearing orifices are machined in a screwed condition. The part numbering is given on the gearbox housing face.
11. Keep the mounting dimensions of the 2nd through 5th gear and the H (N) / L(R) constant mesh gears synchromesh.
12. Press the specified inner rings of bearings, synchromesh and gears in a preheated condition (100 °C).
13. Keep the minimum specified axial clearance of **0.25 mm** of pivoted gears.



14. Check the teeth clearance of individual sets of gearings (the permissible clearance is within a range of **0.15 - 0.4 mm**).
15. Keep the tightening sequence and specified tightening torques for screw connections according to a survey of torque specifications.
16. Keep the specified axial clearances for bearings of the input and output shafts and countershaft.
17. Use the specified tools for removal and installation.

c) Disassembly Procedure

1. Lift the gearbox using a lifting device and support it on an assembly truck **PRM 0245** .
2. Convey the air through the screwed connection on the upper gearbox cover to shift in the H (N) constant mesh gear.
3. Dismount the booster (See Subchapter **3.5.5**) in case that it was not already dismounted.
4. Dismount two fastening screws **4** of the oil filter **5** , drain the residues of oil into a prepared vessel and remove the oil filter **5** from the gearbox housing **3**.
5. Unscrew six nuts **1** and withdraw the pump cover **2** c/w sealing ring and spring washers.

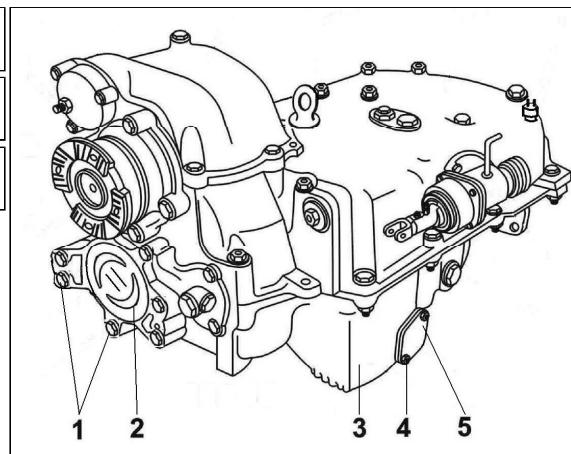
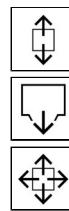


Fig. 3.72 Oil drain from the gearbox

6. Use the wrench **URN 1296** to unlock and dismount the nut **2** from the input shaft carrier **1**.
7. Use the puller **PRM 0777** to withdraw the input shaft flange from the involute splining of the input shaft **1**.
8. Dismount bolts **7** connecting the upper cover of the speed-reducing gearshift casing **4** to the gearbox housing **6** and dismount bolts **8** and **3** from the input shaft cover **5**.
9. Pry out the input shaft cover **5** and withdraw it from its seating in the housing.
10. Pry out the upper cover **4** (slacken it from centering pins) from the upper half of the gearbox housing **6** and move the cover out of the constant mesh synchromesh sliding sleeve.

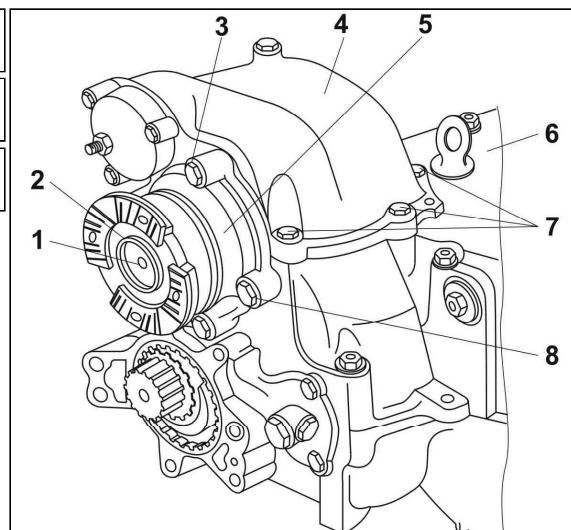
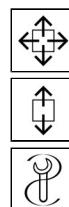


Fig. 3.73 Speed-reducing gearshift casing



03 Gearbox



11. Use the textile belts to remove the complete input shaft from its location in the upper half of the gearbox housing.

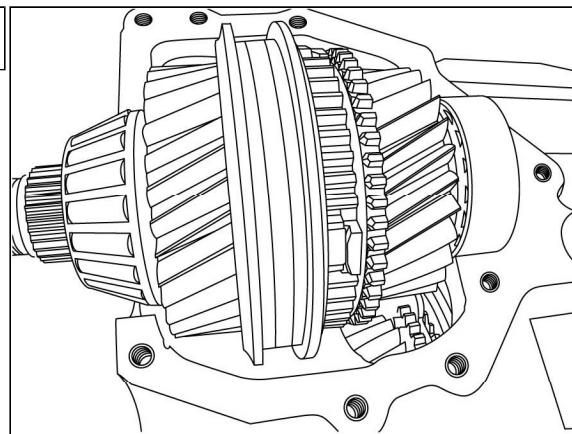


Fig. 3.74 Removal of the input shaft

12. Remove the inner gear **2** and the outer gear **1** from the pump housing **3**.
13. Dismount two screws **9** c/w washers **8**.
14. Knock off the pump housing **3** to release it and dismount it.
15. Remove shaped rings **5**, **6**, **7** and **10**, take out shim **4** and place it separately.

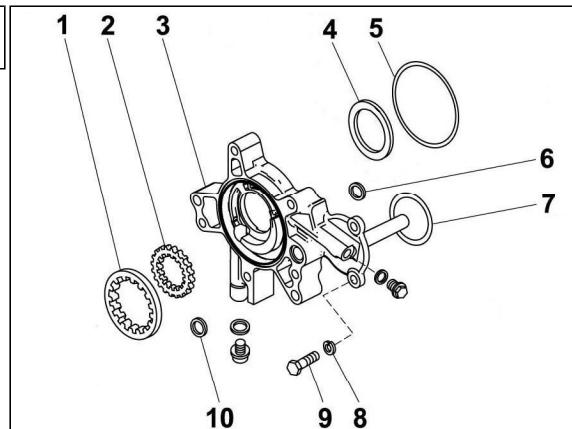


Fig. 3.75 Pump housing

16. Unscrew all bolts (marked with arrows) connecting both parts of the gearbox housing.
17. Dismount the arresting screw **2** and the fastening screw of the gearshift fork **3**.
18. Dismount the reverse gear light switch **1**.

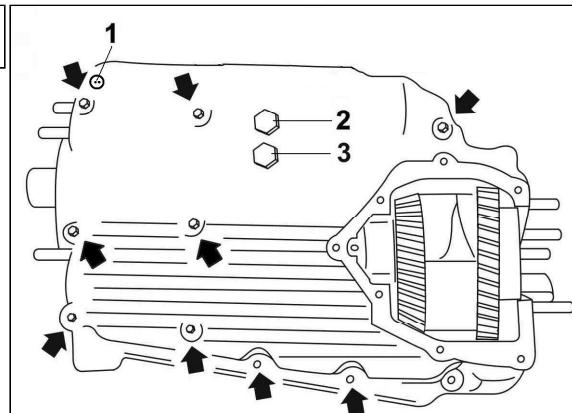


Fig. 3.76 Removal of the housing cover



03 Gearbox



19. Turn the gearbox on the assembly truck by 180° round its longitudinal axis (with the lower part up) and unscrew the resting screws.
20. Dismount bolts from the input shaft flange and use the force-off screws to pull the flange from its location in the gearbox housing.
21. Use the suitable tool to loosen both parts of the gearbox housing in the place of centering pins and withdraw the lower part from the upper part.
22. Use the screw M6 to remove the lock pin **1** of the idler gear **2** from the lower part of the gearbox housing **4**.
23. Press out the idler gear pin **3** in the arrow direction and move the idler gear **2** c/w shims, rollers and spacers out of its position.

CAUTION:

Place the bearing rollers separately from other ones !

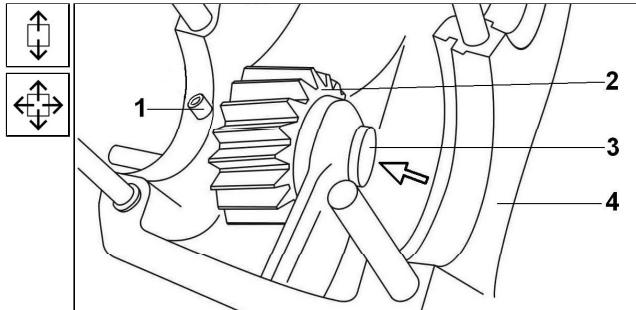


Fig. 3.77 Removal of the idler gear

24. Disconnect the union nuts of the oil manifold and dismount the splash section only (the upper part). If the lower part is damaged, dismount the manifold of the whole oil manifold.

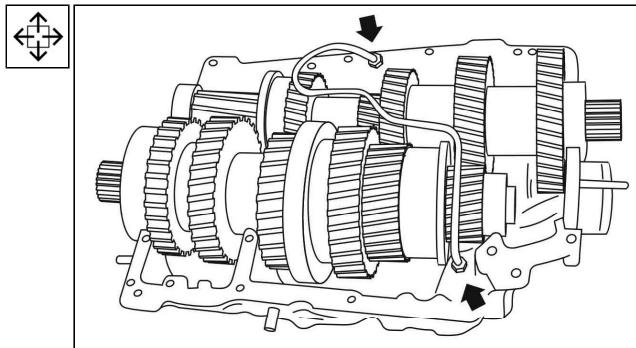


Fig. 3.78 Removal of the oil manifold

25. Remove both shafts from the upper part of the gearbox one after another – first the countershaft followed by the output shaft c/w 2nd - 3rd speed gearshift fork.
26. Unscrew the closing screw **1** from the housing face (to pull out the 4th - 5th gear shifter rod).

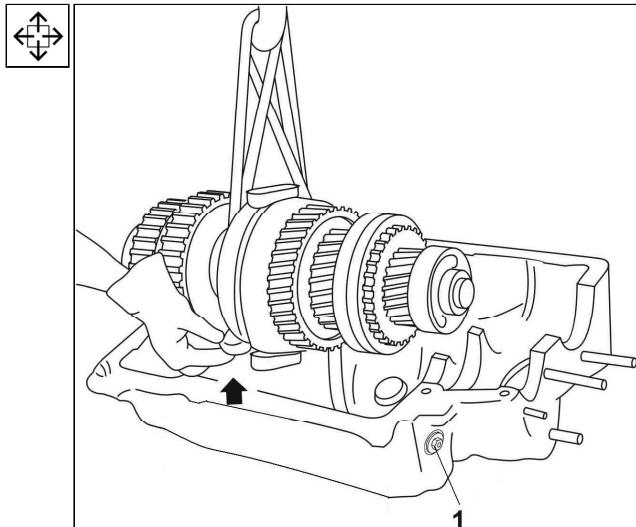


Fig. 3.79 Removal of shafts



03 Gearbox



27. Dismount the screw 2 from the sliding sleeve 1.

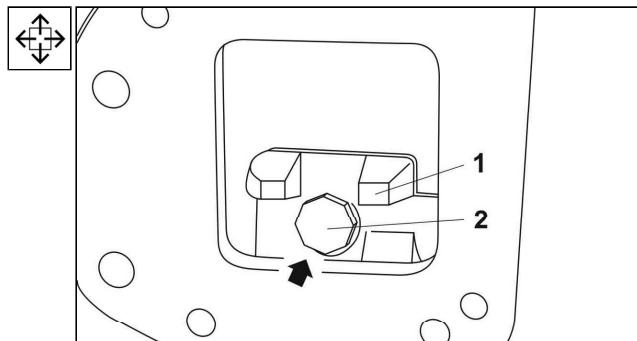


Fig. 3.80 Loosening of the sliding sleeve

28. Dismount screws 3, remove the fork 4 and 1st gear - reverse shifter rod.
29. Dismount screws 1, remove the fork 2, shifter rod and 4th - 5th gear shifter sleeve.

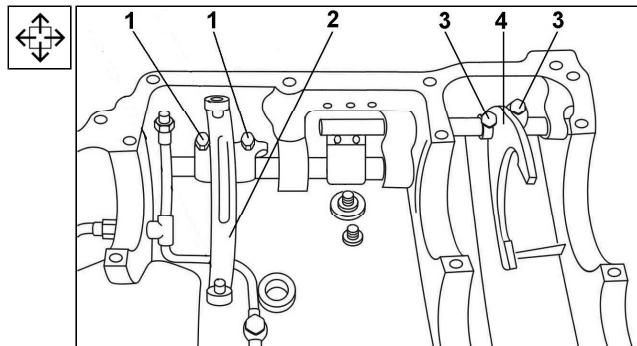


Fig. 3.81 Removal of gearshift rods and forks

Disassembly of the complete output shaft:**CAUTION:**

In case that you intend to reinstall the rollers 7x14 of 1st, 2nd, 3rd and the reverse gears of the roller mounting, it is necessary to place them in a safe place separately! Mark the boxes with rollers not to confuse them.

30. Fit the output shaft with its involute splining into the tool **PRM 3276**.
31. Dismount the outer ring of the roller bearing, unlock the slotted nut and use the wrench **URN 0356 1** to dismount the slotted nut.

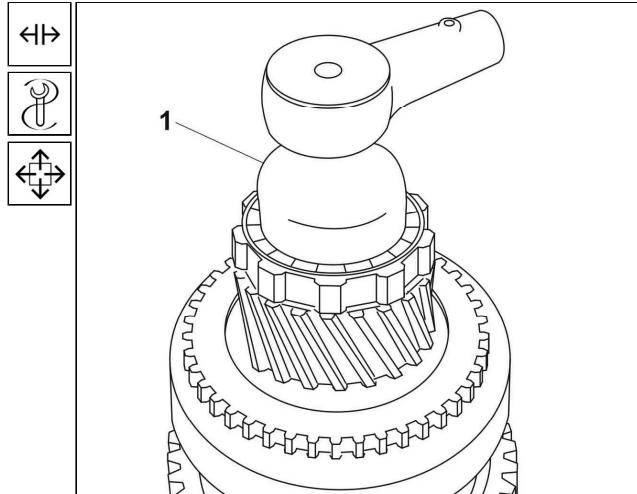
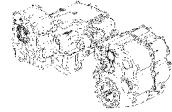


Fig. 3.82 Output shaft nut loosening



03 Gearbox



32. Use pullers **PRM 0777**, **PRM 3259** c/w support **PRM 3425** to withdraw the connecting gearing **2** c/w 5th speed gear **3** and the inner ring of the roller bearing **5**. Remove two needle bearings **4** from the shaft roller mounting.

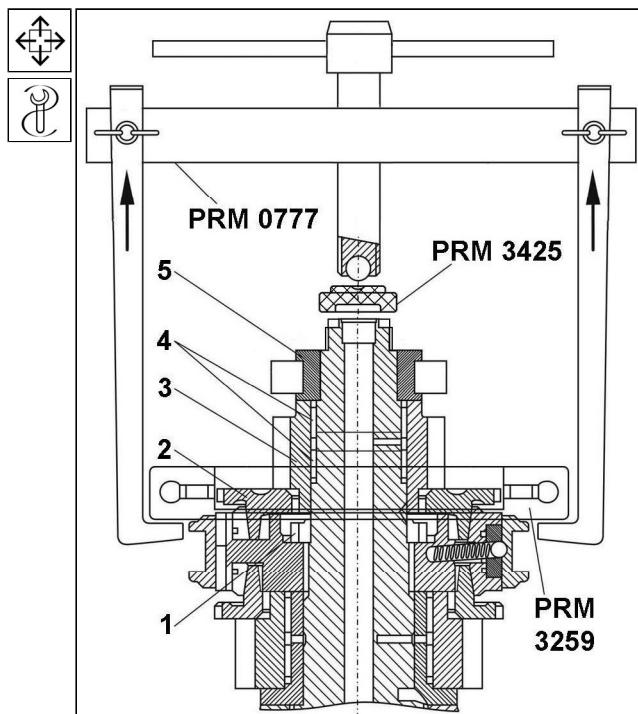


Fig. 3.83 Withdrawal of the connecting gearing and gear

33. Use the wrench **URN 1277** to dismount the slotted nut **1** and use the puller **PRM 0777** c/w support **PRM 3425** to remove the 4th – 5th gear synchromesh **2** from the shaft.

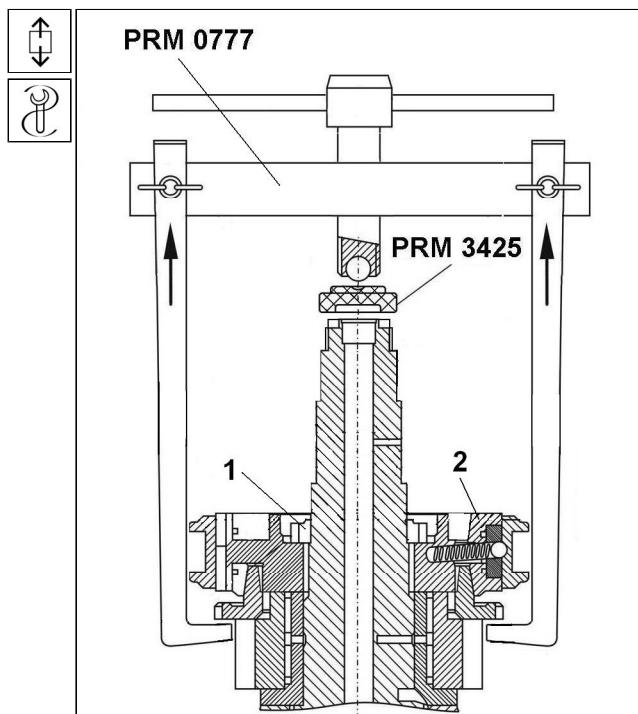


Fig. 3.84 Removal of the 4th-5th gear synchromesh



03 Gearbox



34. Remove the 4th gear driven gear **1** c/w 4th gear speed connecting gearing. Remove the needle bearings **2**.

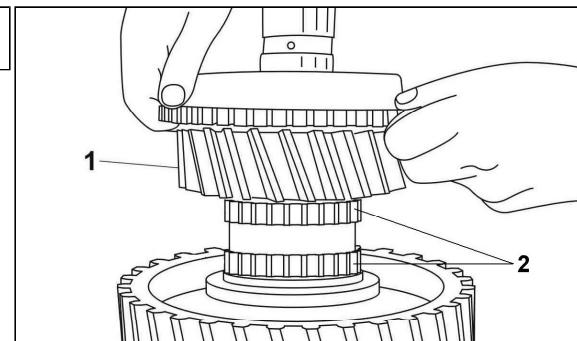


Fig. 3.85 Removal of the driven gear

35. Use the puller **PRM 0777** c/w support **PRM 3425** to withdraw the 2nd gear speed driven gear **1** c/w 4th gear speed bushing **3**. Take out and place separately the rollers **2** of the shaft roller mounting. Move the lock pin **4** out of the shaft orifice.

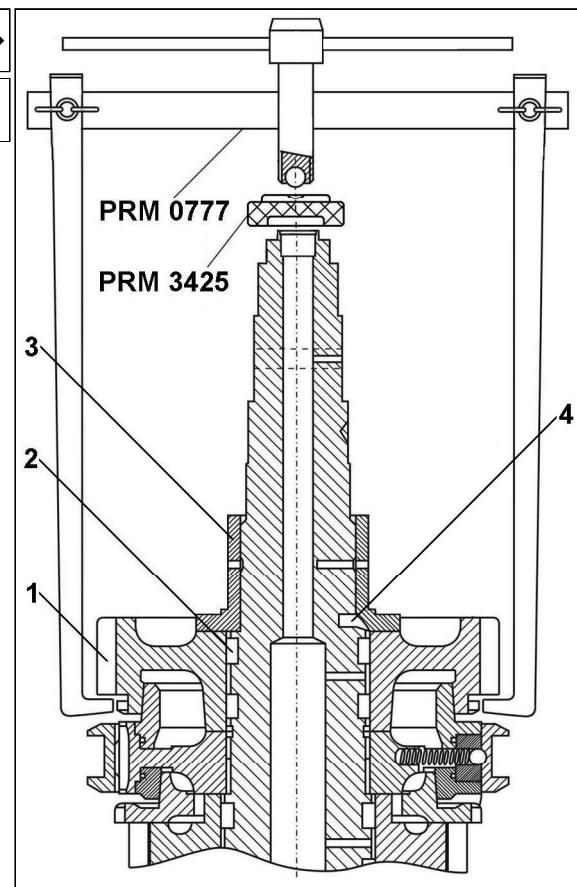


Fig. 3.86 Withdrawal of the gear



03 Gearbox



36. Remove the lock ring **1** from the 2nd – 3rd gear synchromesh carrier.

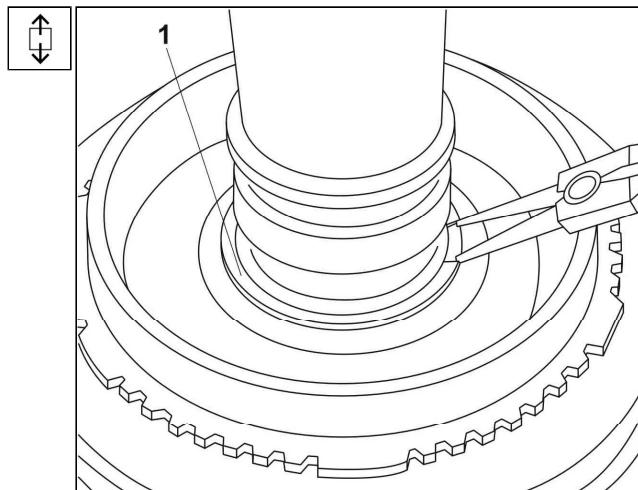


Fig. 3.87 Removal of the lock ring

37. Use tools **PRM 0777**, **PRM 3176** and **PRM 3425** to withdraw the 3rd gear speed driven gear **1** c/w connecting gearing **2** and synchromesh **3**. Take out and place separately the rollers from the shaft roller mounting.

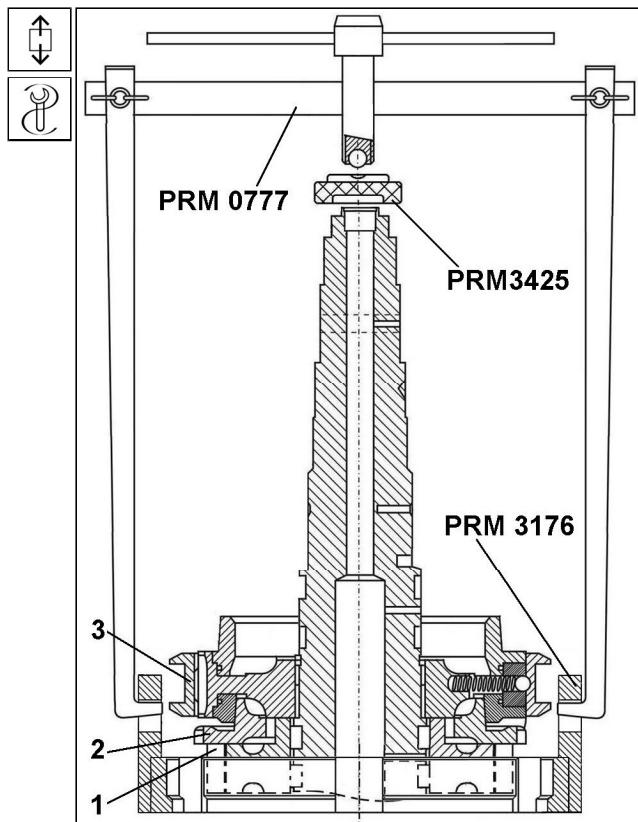


Fig. 3.88 Withdrawal of the gear c/w synchromesh



38. Remove the lock ring **3**, move out the axial shim **2**, pull out the roller **6 x 12** and remove the tapered roller bearing outer ring **1**.

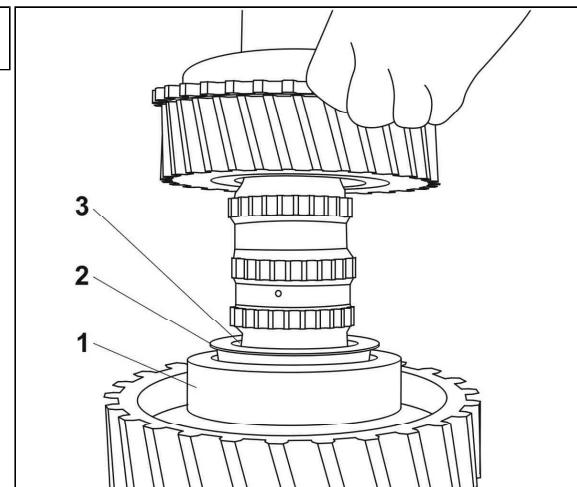


Fig. 3.89 Removal of the bearing inner ring

39. Fit the input shaft facing the driven gear rim **4** into a suitable tool **6** (common support plate). Press the 1st gear driven gear **4** c/w inner ring of tapered roller bearing **2** out of the shaft **1** in the arrow direction under a press. Remove and place rollers **3** of the shaft rolling mounting in a safe place.
40. Remove the reverse gear coupling sleeve **5**. Remove the output shaft **1** from the tool.

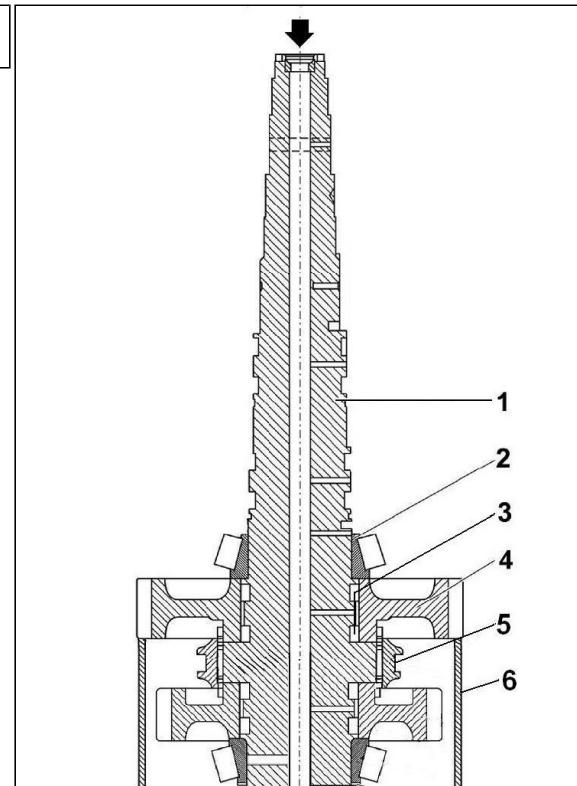


Fig. 3.90 Removal of the driven gear



41. Turn the output shaft 1. Remove the lock ring 5 from the splined side of the output shaft and use the tool **PRM 0777** c/w support stand **PRM 3425** to withdraw the reverse driven gear 2 c/w inner ring 4 of the tapered roller bearing. Remove and place rollers 3 of the shaft rolling mounting in a safe place.

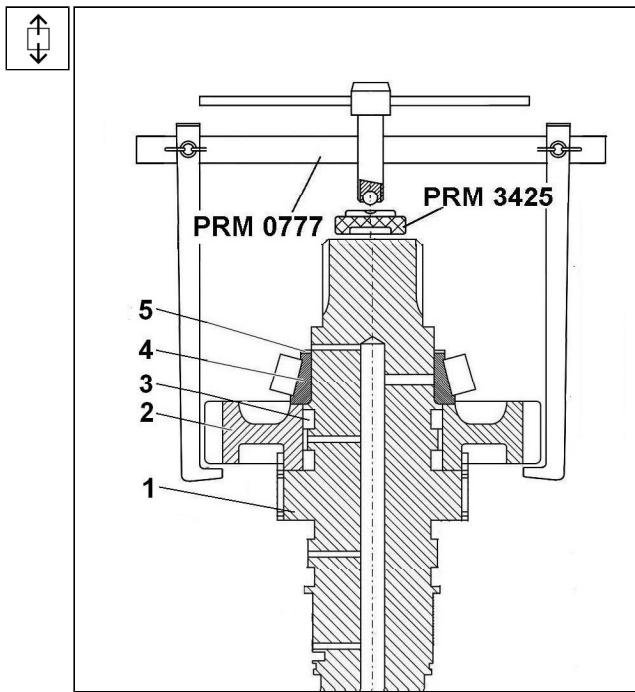


Fig. 3.91 Removal of the driven reverse gear

Disassembly of the complete countershaft:

42. Withdraw the thrust ring 3 c/w outer ring of tapered roller mounting 2. Withdraw the outer ring of the roller bearing 5 and inner ring of the bearing 5 c/w countershaft gear 1 and inner ring of the bearing 2 using the tool **PRL 0578** from the side of 1st gear teeth of the countershaft 4.

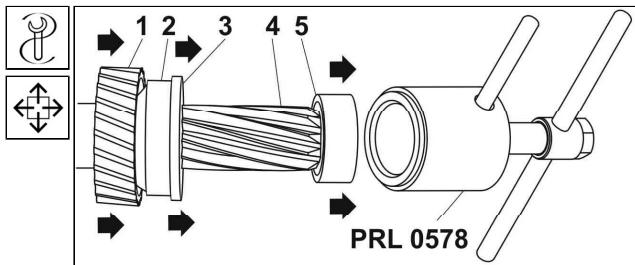


Fig. 3.92 Use of the tool PRL 0578

03 Gearbox



43. Remove the outer ring of the tapered roller bearing **2**.
44. Install the shaft facing the constant mesh L (R) driven gear rim **4** into a suitable tool **5** (common support plate) and press the inner ring of the bearing **2**, constant mesh gear H (N) **3** and constant mesh L (R) driven gear **4** out of the shaft **1** in the arrow direction. Remove the shaft from the tool.

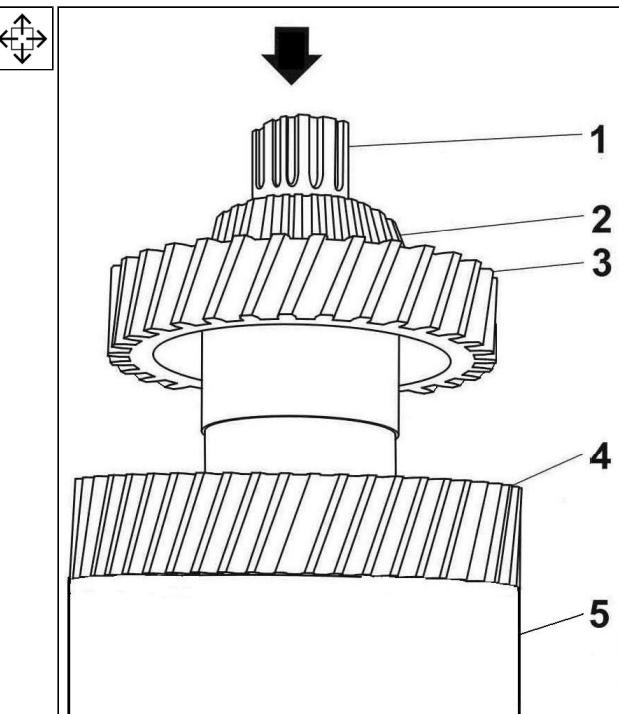


Fig. 3.93 Countershaft

45. Withdraw the spacer **3** and fit the shaft **4** facing the 4th speed countershaft gear rim **2** into a suitable tool **1** (common support plate) and press out the gear under a press.

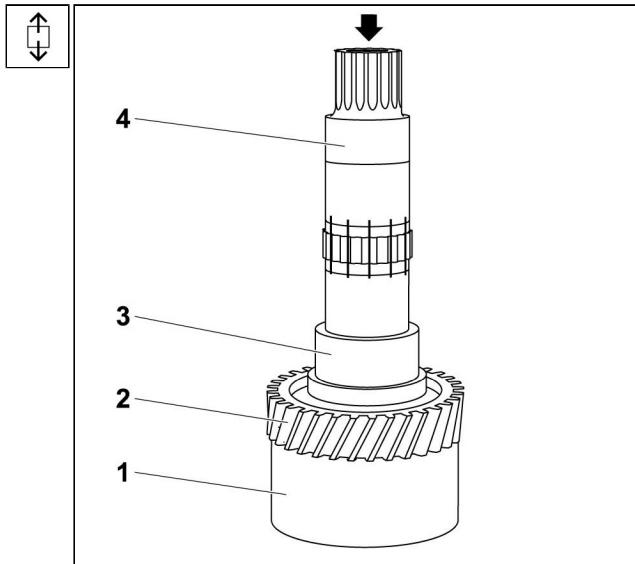


Fig. 3.94 Removal of the 4th speed gear

**Disassembly of the input shaft upper cover:**

46. Dismount three bolts **1** from the gearshift cylinder cover **2** and withdraw the cover **2**.

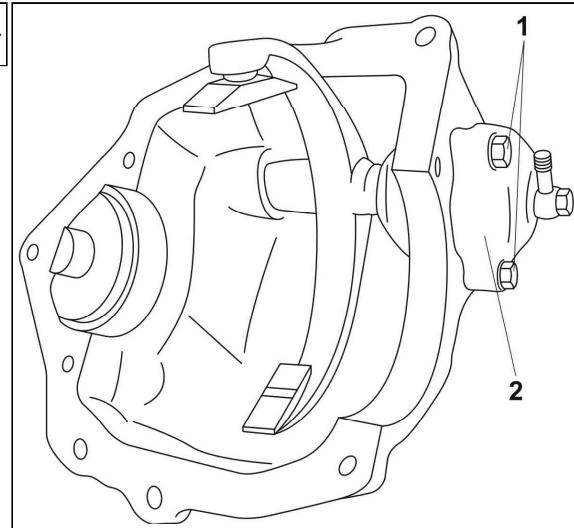


Fig. 3.95 Gearshift cylinder cover

47. Unlock and dismount the nut **1** from the gearshift rod **4**.
48. Remove the piston **2** c/w washer **6** and spacer washers - bind them together separately.
49. Remove the gearshift cylinder liner **3**.
50. Unscrew the plug **7** from the orifice for location of the gearshift rod **4** in the upper cover.
51. Dismount the closing screw from the upper cover and remove the spring c/w arresting ball **5** from the gearshift rod **4**.

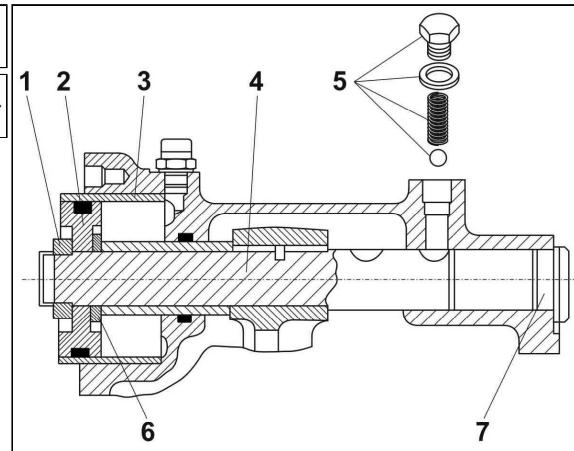
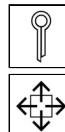


Fig. 3.96 Gearshift cylinder



03 Gearbox



52. Move the shifter rod **2** in the arrow direction so that the pin **3** locking the position of the gearshift fork **4** would move away from the fork.
53. Remove the locking dowel **3** and move the gearshift rod **2** out of its location in the cover **1** completely.
54. Remove the gearshift fork **4** c/w spacer tube from the cover **1**.

Note:

Check the bush of shifter fork **4** for condition. If the bush was damaged, press it out. Check the pin of shifter fork **4** for condition. If the pin was damaged, press it out.

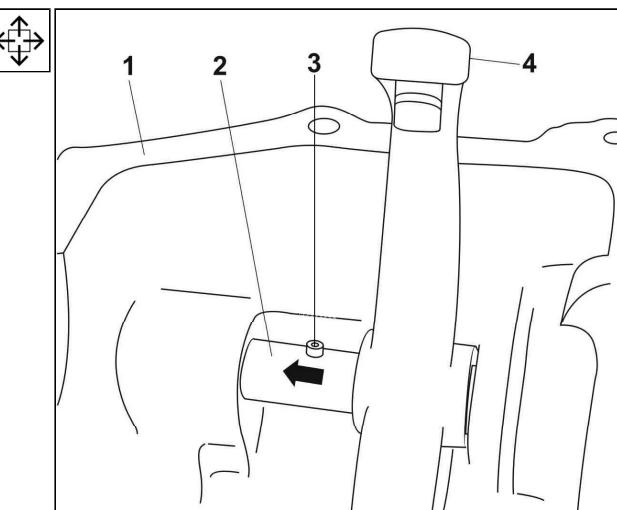


Fig. 3.97 Gearshift rod c/w fork

Disassembly of the complete input shaft:

55. Withdraw the H (N) constant mesh drive gear **3** c/w connecting gearing **4** and the inner ring of the tapered roller bearing **2** from the side of the input shaft splining **1**. Use pullers **PRM 0777** and **PRM 3259** to remove the bearings.

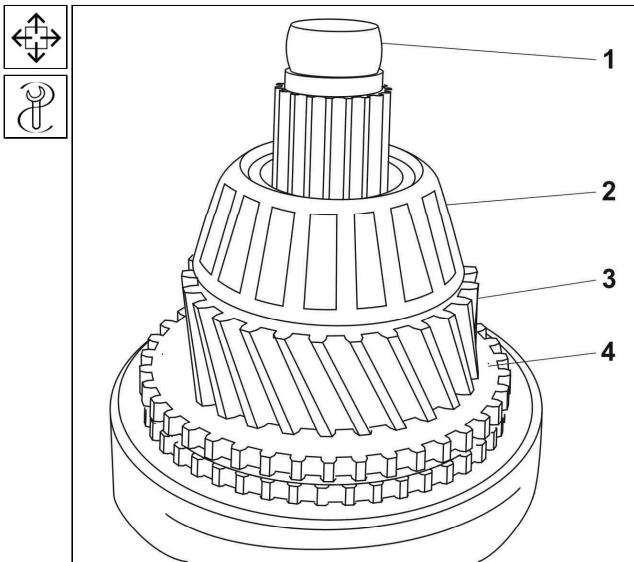


Fig. 3.98 Input shaft



03 Gearbox



56. Use the wrench **URN 0203** to unlock and to dismount the slotted nut from the input shaft.

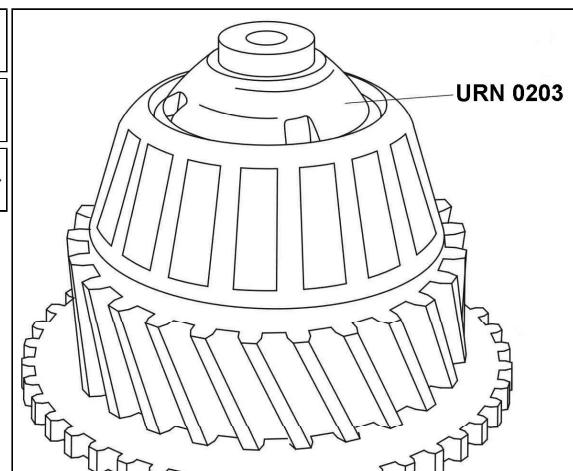


Fig. 3.99 Removal of the input shaft nut

57. Use pullers **PRM 3259**, **3425** and **PRM 0777** to remove the L(R) constant mesh drive gear **2** c/w connecting gearing **1** and the inner ring of the tapered roller bearing **3**. Remove the needle bearings.

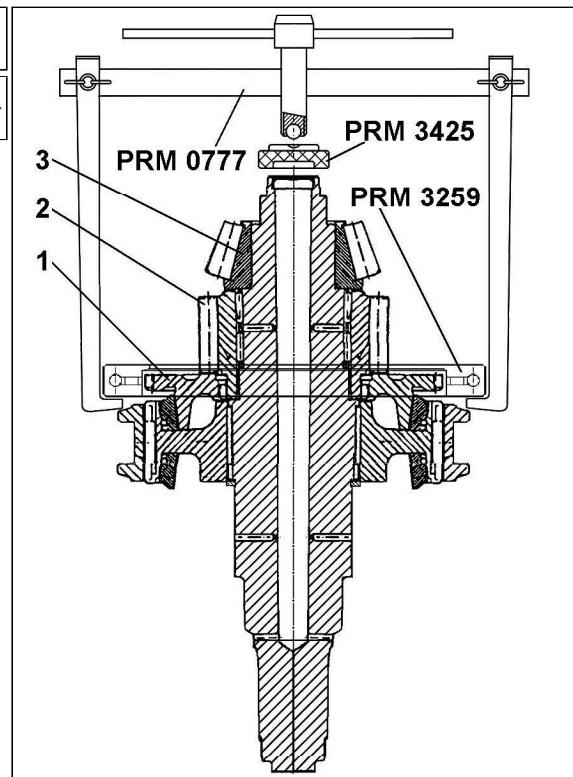
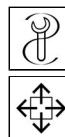
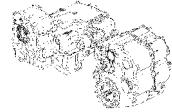


Fig. 3.100 Withdrawal of the L (R) gear constant mesh drive gear c/w bearing and connecting gearing



58. Remove the lock ring **2** and use pullers **PRM 0777**, **PRM 3259** and **PRM 3425** to withdraw the constant mesh synchromesh **3** from the shaft **1**.

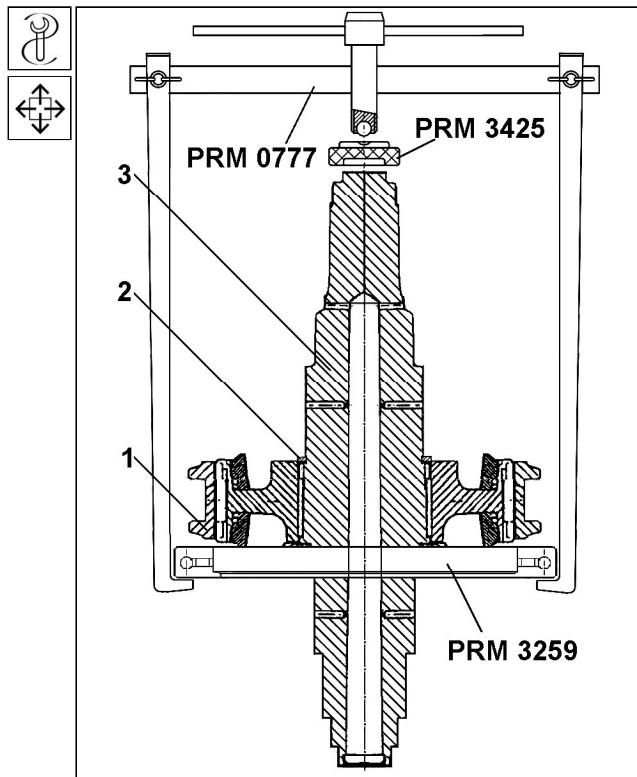


Fig. 3.101 Withdrawal of constant mesh synchromesh

Disassembly of the synchromesh:

59. With respect to a possibility of the “shooting-out” of balls when dismantling the coupling sleeve, lay down the complete synchromesh on the support plate and/or cover it with a piece of cloth and apply the force to the coupling sleeve **1** in the arrow direction to loosen the balls **3** c/w springs **2** from the position.

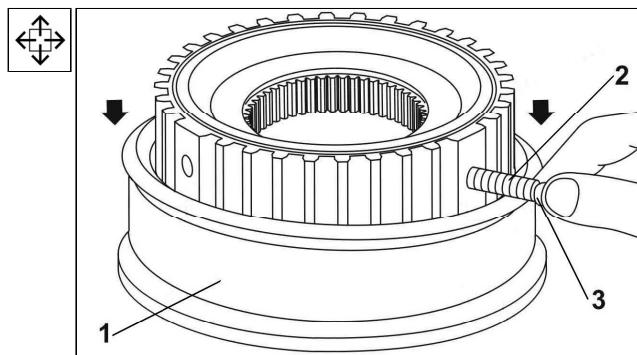


Fig. 3.102 Disassembly of the synchromesh



60. After the complete removal of the coupling sleeve **6**, remove four blocks **5** c/w springs **3** and balls **4** and move both synchromesh cones **1** and **7** out of the carrier **2**.

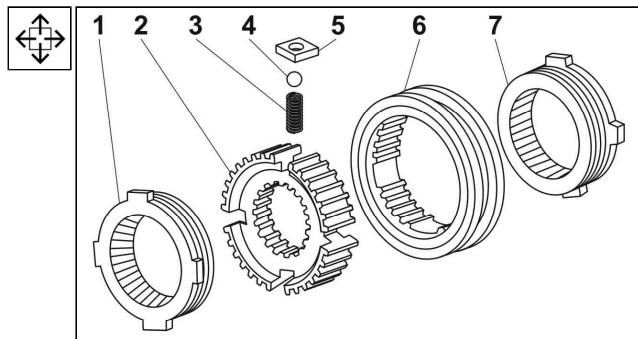


Fig. 3.103 Removal of the synchromesh

d) Assembly Procedure

Assembly of the Synchromesh:

Note:

This procedure is valid for the 2nd - 3rd, 4th - 5th gear speeds and constant mesh synchronizers.

1. Fit two blocks **2** (place them at 4th – 5th gear speeds opposite each other and at 2nd – 3rd gear speeds alternately) to the synchromesh cone **3** so that the block lugs fit into the circumferential groove of the synchromesh cone **3** and place them into the synchromesh carrier **1** together with the synchromesh cone.

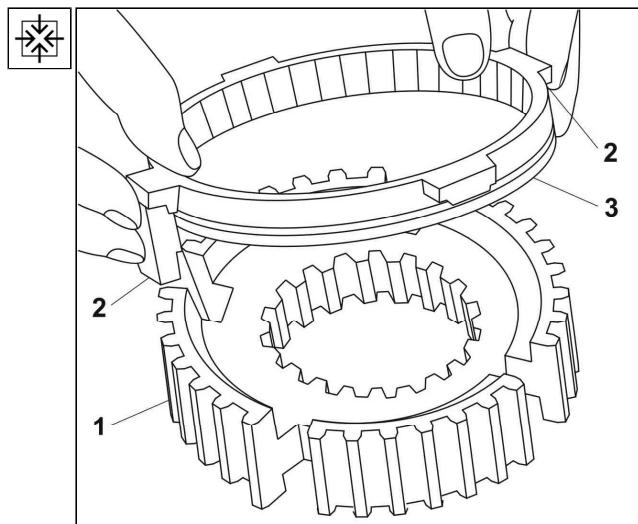


Fig. 3.104 Assembly of the synchromesh - 1

03 Gearbox



2. Swivel the synchromesh carrier **1** c/w synchromesh cone **5** and two (three) blocks **4** and mount the other synchromesh cone **3** c/w blocks **2** in the same way.

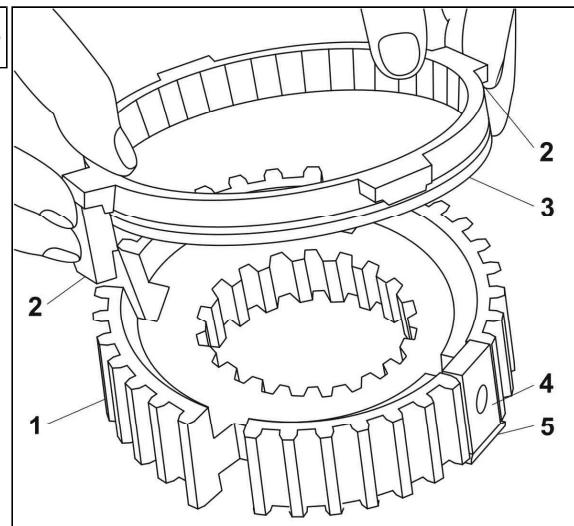


Fig. 3.105 Assembly of the synchromesh - 2

3. Install the support plate **6** (a part of the tool **PRM 2894** and **PRM 2895**) into the coupling sleeve **5**.
4. Install the assembled synchromesh carrier **1** c/w guide blocks **2** into the inner splining of the coupling sleeve **5**.
5. Install springs **3** into orifices of blocks **2** and carrier **1**.

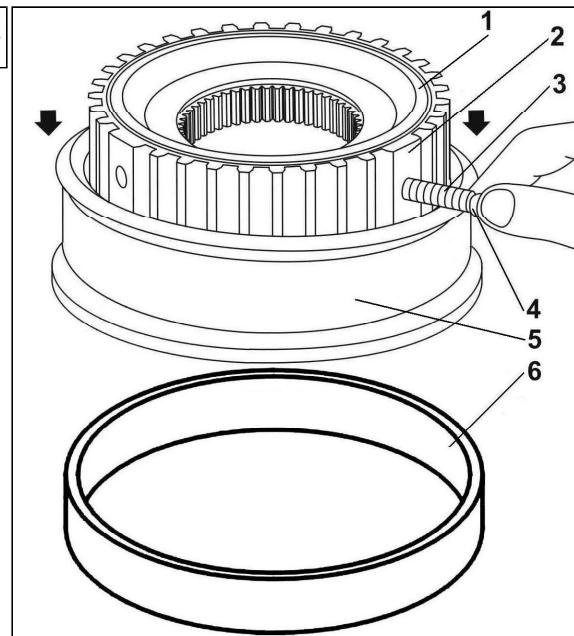
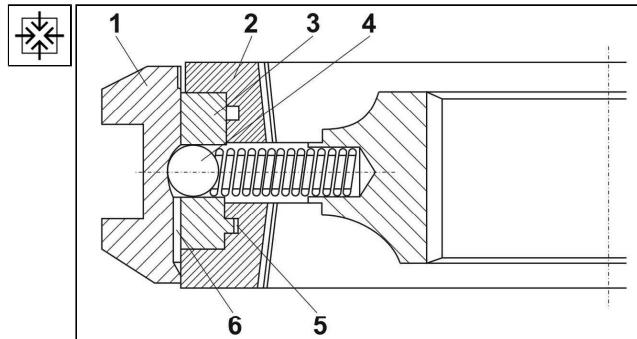


Fig. 3.106 Assembly of the synchromesh - 3

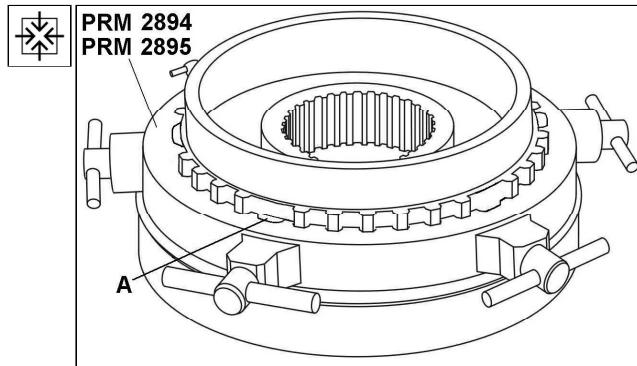
03 Gearbox


Note:

The carrier **2** must be directed towards the coupling sleeve so that the elongated recess **6** for the ball **4** in the coupling sleeve **1** is situated always on the side, onto which the block **3** with its lug **5** engages into the circumferential groove of the synchromesh cone.

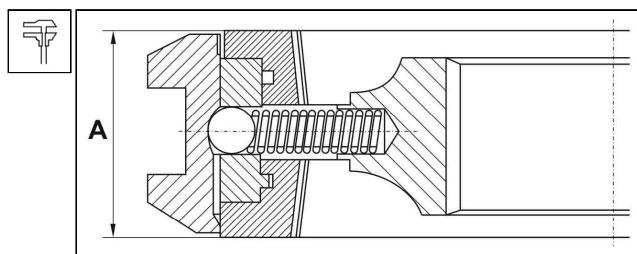

Fig. 3.107 Assembly of the synchromesh - 4

6. Install the tool **PRM 2894** (for 4th - 5th gear speeds and constant meshes) or **PRM 2895** (for 2nd and 3rd gear speeds) through the installed springs on the carrier.
7. Install balls **4** (See Fig. 3.107) through grooves **A** in the tool.
8. Press balls **4** in the tool into guide blocks **3** and applying the even pressure, slide the coupling sleeve **1** onto connecting gearing of the carrier **2**.


Fig. 3.108 Installation of synchromesh balls
Note:

To prevent the balls from the shooting-out, it is necessary to ensure that the pressure acts on the sleeve in the axis and in the place to be compressed very quickly. If the assembly is not successful, make sure again whether block locks are situated on the side, to which the elongated recesses for balls are directed.

9. Inspect a correct assembly – an easy rotation of synchromesh cones having a clearance between stops in the carrier.
10. Keep the distance of “ **A** ”, which may be:
 - **42 mm as a maximum** at 2nd - 3rd gear synchromesh;
 - **49 mm as a maximum** at 4th - 5th gear synchromesh and constant meshes.


Fig. 3.109 Condition for a correct assembly of the synchromesh

**Assembly of the complete countershaft:**

11. Use the puller **PRM 2212.1** to press the 3rd gear heated to about **100° C** from the side of the 1st speed gearing (in the figure this operation is marked with arrows I.) on the shaft and press the inner ring of the tapered roller bearing heated to **100° C** to it as far it goes (in the figure this operation is marked with arrows II.).

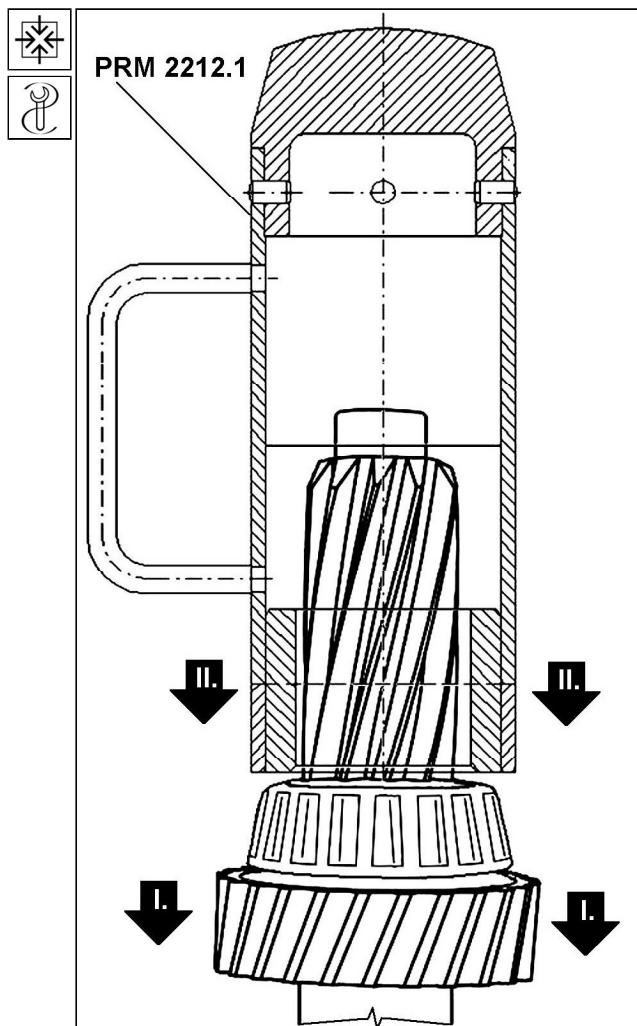


Fig. 3.110 Pressing-in of the gear and bearing



03 Gearbox



12. Use the tool **PRM 2219** to press the inner ring of the roller bearing **2** heated to about **100° C** on the end of the shaft **1**.

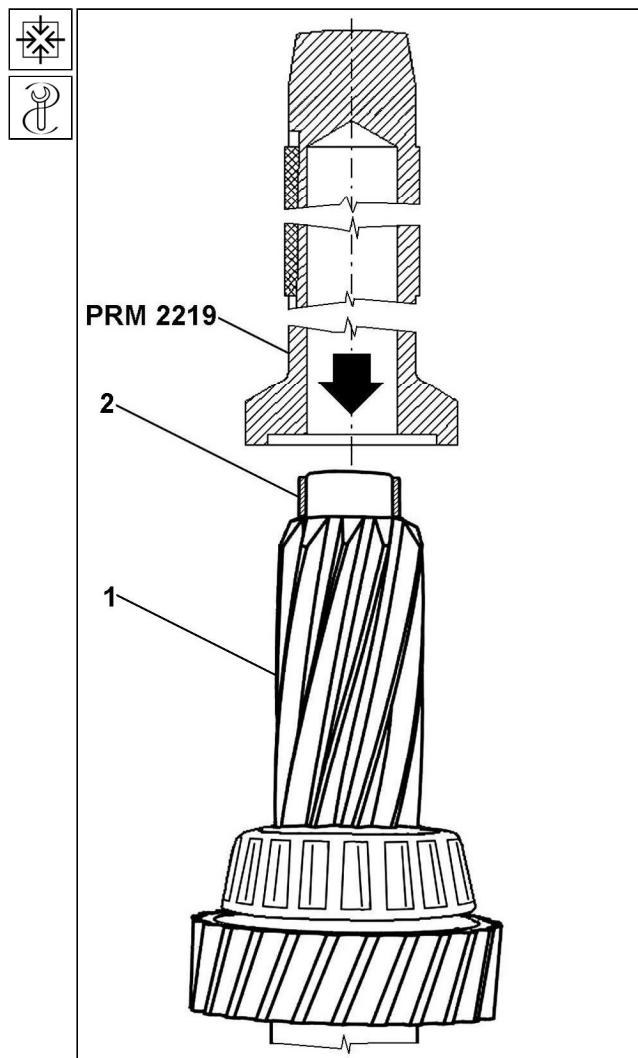


Fig. 3.111 Pressing-in of the roller bearing inner ring

13. Heat the 4th speed countershaft gear **2** to about **100°C** and using the tool **PRM 2211**, press it as far as it goes from the splined end of the shaft.

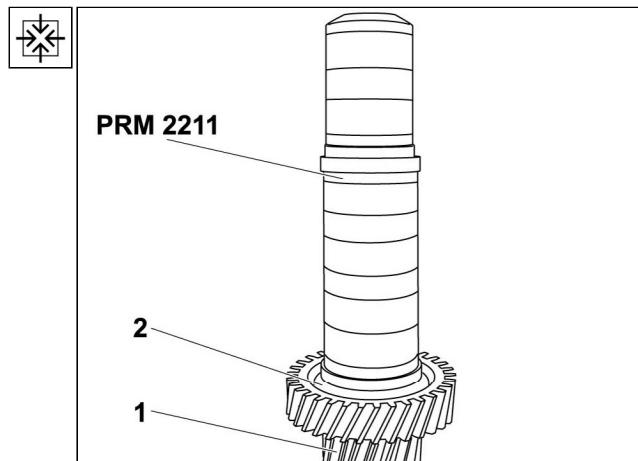


Fig. 3.112 Installation of the 4th speed gear



03 Gearbox



14. Fit the distance ring **1**. Use the tool **PRM 2212.1** to press the 5th speed constant mesh driven gear **3** heated to about **100°C** on the shaft **2**.

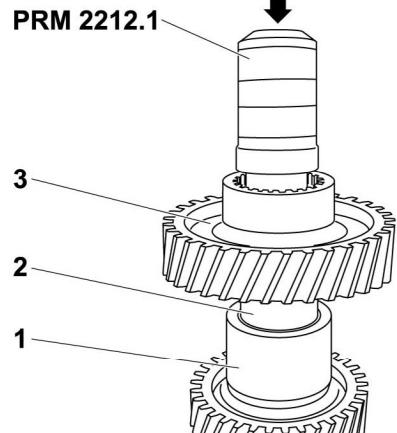


Fig. 3.113 Installation of the 5th speed gear

15. Use the tool **PRM 2212.1** to press the constant mesh H(N) driven gear **2** heated to about **100°C** on the shaft **1**.

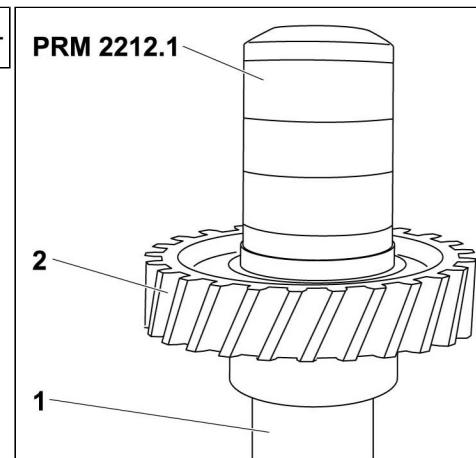


Fig. 3.114 Installation of the constant mesh driven gear



03 Gearbox



16. Slide the inner ring of tapered roller bearing 2 heated to about **100°C** on location of the shaft 1 and use the tool **PRM 2212.1** to press it to the gear face.

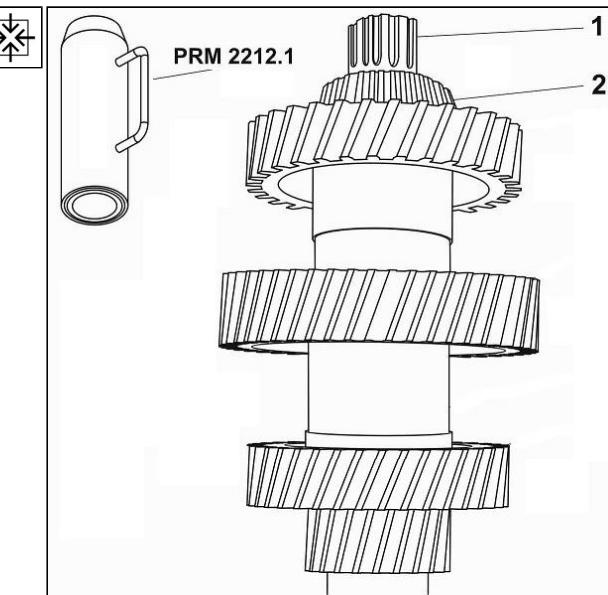


Fig. 3.115 Use of tools PRM 2211 and PRM 2212.1

17. Fit the thrust ring 4 on the outer ring of the tapered roller bearing 3 on the 3rd speed gear 2. Mount the respective outer rings of the countershaft on inner rings of bearings 1, 3 and 5.

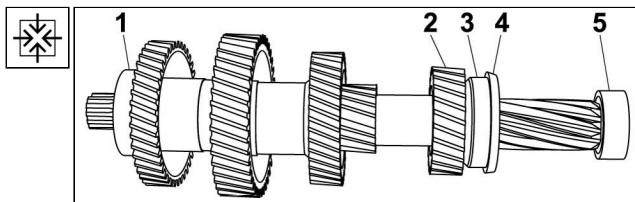


Fig. 3.116 Countershaft

Assembly of the complete output shaft:**Note:**

Check gears for the axial clearance during assembly; this must be **0.25 mm** at least. Apply the oil to needle bearings and smear the rollers with grease.

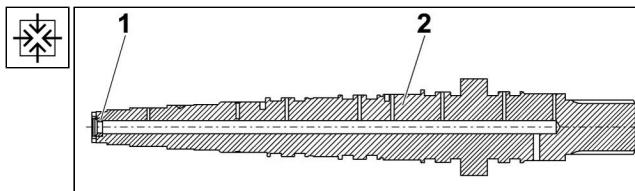


Fig. 3.117 Output shaft

18. Thoroughly clean (in petrol) the shaft 2, especially the lubricating ports and races for location of rollers and bearings before assembly. Make sure whether the roller raceways are not deformed and/or check the roller for a free motion along its whole circumference. In addition, check whether the liner 1 is locked properly in the front part of the output shaft.



03 Gearbox



19. Install the shaft **1** into the tool **PRM 3276**.
20. Install rollers **3** of one classification group into raceways for the reverse gear rollers **2**. Fit the reverse gear.
21. Make sure that the reverse gear **2** is free to rotate and use the feeler gauge to check the minimum axial clearance of **0.25 mm** using the suitable shim (or the angle bar) between the gear hub face and the hub face for the bearing location.

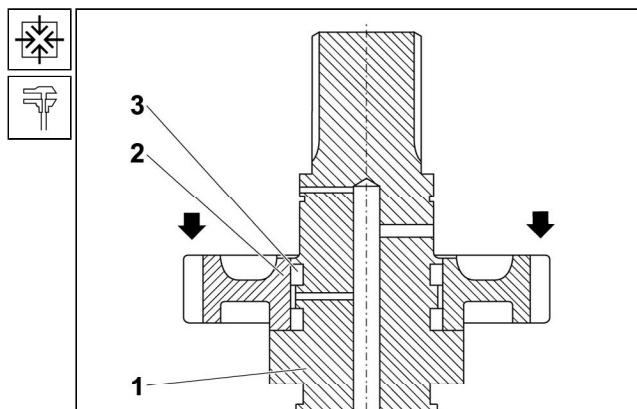


Fig. 3.118 Installation of the reverse gear

22. Use the tool **PRM 2211** to slide the inner ring of the tapered roller bearing **3**, heated to about **100° C**, on the shaft **1** as far it goes, secure it with a lock ring **4**, which sets the axial clearance to a minimum, between the lock ring **4** and the inner ring of the tapered roller bearing **3**. Rings **4** are delivered in eight different thickness values.

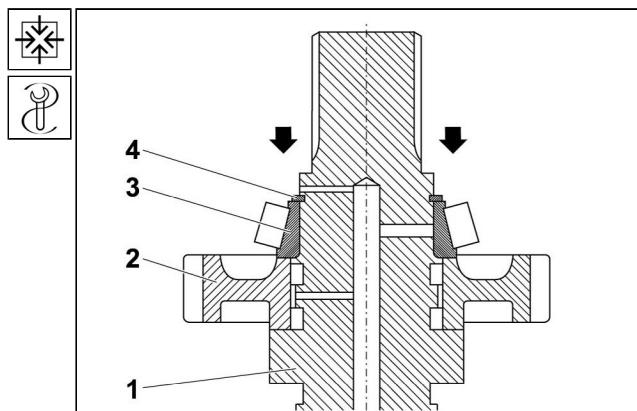


Fig. 3.119 Installation of the tapered roller bearing

23. Swivel the output shaft **1** and locate it with its splining into the tool **PRM 3276**. Slide the coupling sleeve **2** on the shaft and check the shifting on the involute splining of the reverse gear.
24. Apply the grease to raceways of rollers **3** for location of the 1st gear driven gear **4** and fit rollers of one classification group in position.
25. Slide on the 1st speed gear **4**. Check whether the 1st speed gear **4** is free to rotate and use a feeler gauge, suitable shim or an angle bar to check the minimum axial clearance of **0.25 mm** between the gear hub face and the hub face for location of the bearing.
26. Check the shift-changing of the coupling sleeve **2** on the involute splining of the 1st speed driven gear **4**.

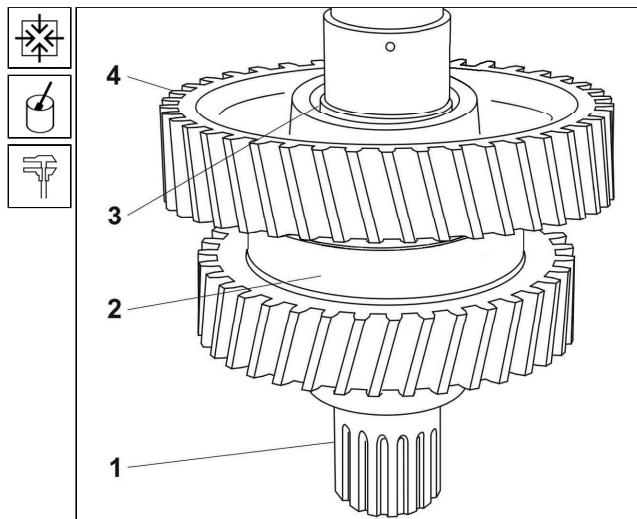


Fig. 3.120 Reverse gear and 1st gear coupling sleeve



27. Use the tool **PRM 2211** to slide the inner ring of the tapered roller bearing **2** (heated to about **100° C**) onto the shaft **1** towards the gear **3** as far it goes.

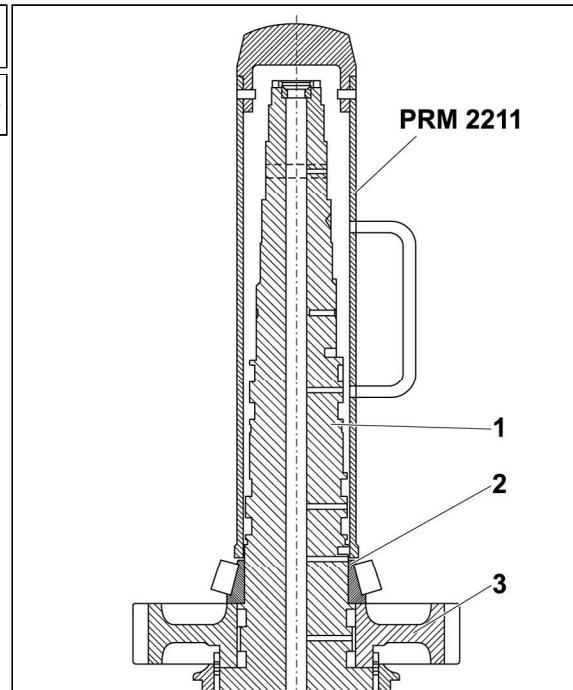
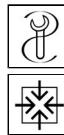


Fig. 3.121 Installation of the tapered roller bearing on the gear side

28. Fit the thrust ring **2** on the outer ring of the tapered roller bearing **1** and place the bearing outer ring on the bearing inner ring.
 29. Tap the lock pin into a shaft orifice, slide on the shim **3** and secure it using the selected lock ring **4**, which sets the axial clearance between the lock ring **4** and the shim **3** to a minimum. Rings **4** are delivered in 8 different thickness values.
 30. Apply the grease into roller raceways for location of the 3rd speed driven gear and fit rollers **5** 7x14 of one classification group into them. Install the coupling gearing **7** on the involute splining of the driven gear **6** and slide this gear train onto rollers. Check whether the 3rd speed gear **6** is free to rotate and check the minimum clearance of **0.25 mm** between the gear hub face and the hub face with the involute splining for location of the 2nd – 3rd gear synchromesh carrier using a suitable shim and/or angle bar.

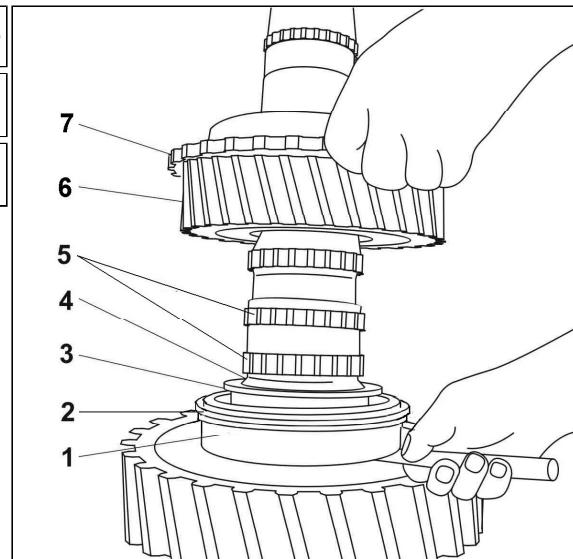


Fig. 3.122 Assembly of the 3rd speed driven gear and bearing

31. Prior to start the assembly of the complete synchromesh on the output shaft, it is necessary to lock the synchromesh-coupling sleeve against motion. Use the fixation tools **PRM 3277** and **PRM 3278**, which should be fitted so that the fixation clamps are situated in points of synchromesh cone locks. The tool **PRM 3277** for the 4th - 5th gear synchromesh serves for the synchromesh of contant meshes too.



32. Use the tool **PRM 2211** to slide the heated (to about 100° C) 2nd – 3rd gear synchromesh **2** (with a bigger hub diameter facing the 3rd speed gear **3**) into splining of the shaft **1**.

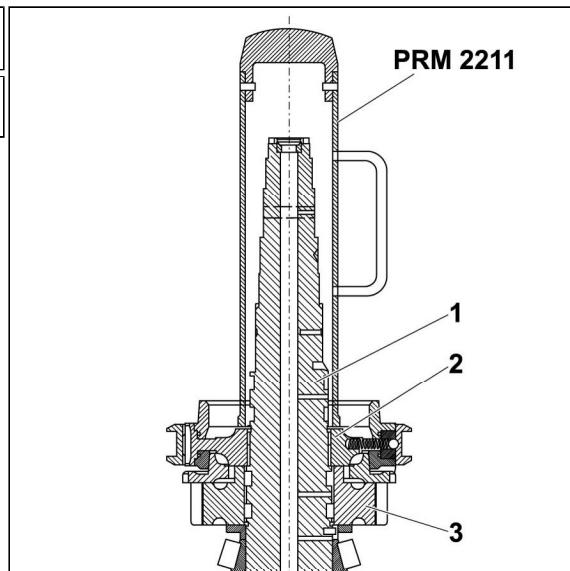


Fig. 3.123 Installation of the synchromesh

CAUTION:

During heating the synchromesh must be supported in the place of the carrier hub so that the synchromesh cone does not come into contact with the warming plate of the heater resulting in the undesirable heating of the synchromesh cone.

33. Use the lock ring **1** to lock the synchromesh **7** on the shaft **3** in position.
34. Apply the grease to raceways of roller rings **2** for location of the 2nd speed driven gear **6** and place the rollers 7x14 of one classification group into them. Slide the driven gear **6** on rollers **2** and check it for a free rotation. Use the feeler gauge, suitable shim and/or the angle bar to check the minimum axial clearance of **0.25 mm**.
35. Tap the lock pin **5** into an orifice in the shaft **3** (with beveling facing up) and use the tool **PRM 2212.1** to slide the 4th gear bushing **4** heated to the temperature of about 100° C as far it goes.

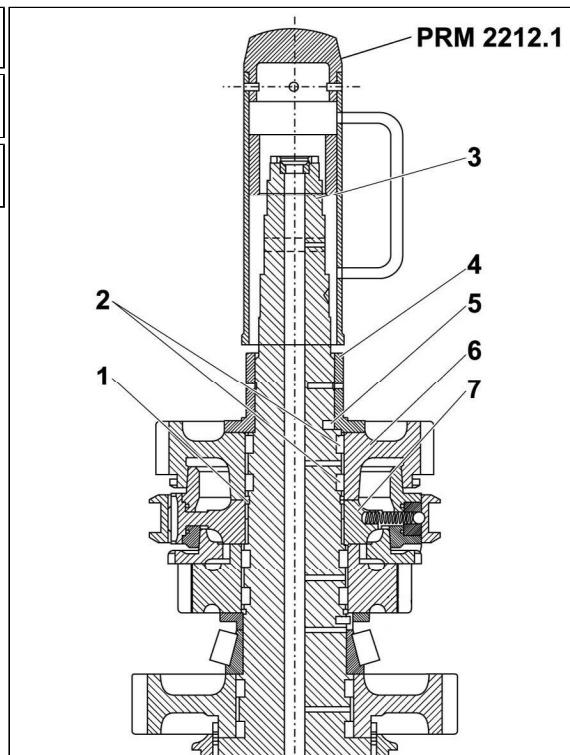
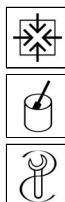


Fig. 3.124 Installation of the gear bushing



03 Gearbox



36. Slide the gear bush 1 of the needle bearing 3 on the shaft 6 and smear it with oil. Fit the connecting gearing 4 on the involute splining of 4th speed driven gear and slide this assembly onto the needle bearing 3.
37. Check the driven gear 2 whether it is easy to rotate. Use the suitable shim or angular iron and feeler gauge to measure up the minimum axial clearance of **0.25 mm** between the gear hub face and the hub face with involute splining for location of the 4th – 5th gear synchromesh carrier.
38. Use the tool **PRM 2212.1** to slide the heated (to about **100°C**) 4th - 5th gear synchromesh 5 (with a recess in the carrier hub facing up) on the shaft splining. Proceed according to instructions mentioned in the point 32 and in the following caution during heating and installation of the synchromesh.

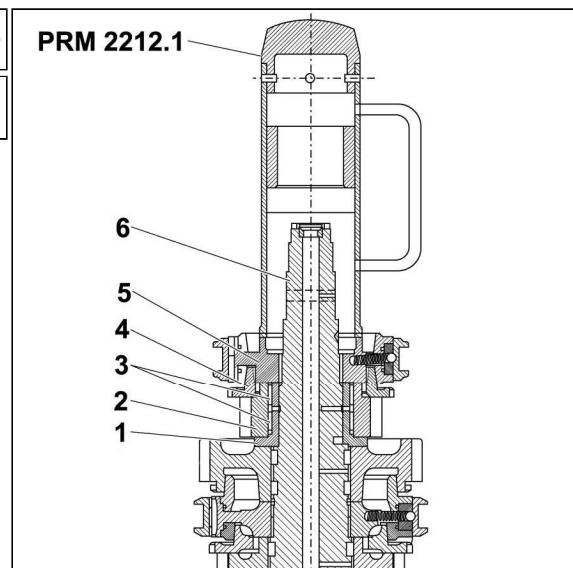
**PRM 2212.1**

Fig. 3.125 Installation of the synchromesh I

39. Use the wrench **URN 1277** to mount the slotted nut 2 on the shaft 1 and tighten to the torque of **400 ± 40 Nm**. Lock the nut 2 with a punch into the slot with the minimum tool radius of **2.5 mm**.

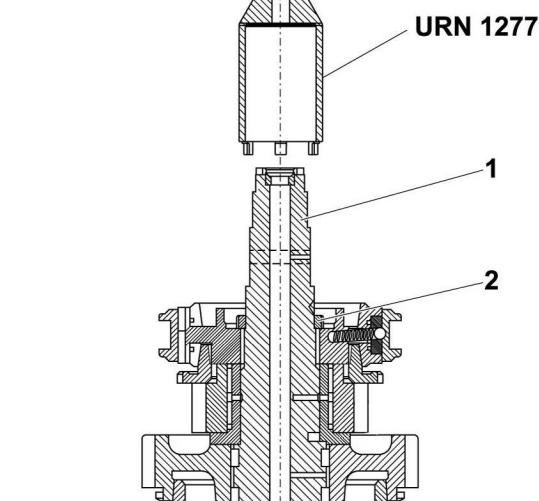


Fig. 3.126 Tightening-up of the nut at the synchromesh

03 Gearbox



40. Slide the needle bearing **2** on the output shaft **1**. Mount the coupling gearing **4** on the involute splining of the 5th speed driven gear **3** and slide this gear train on the needle bearing **2**.

41. Check the driven gear **3** whether it is easy to rotate. Use the suitable shim or angle iron and the feeler gauge to measure up the minimum axial clearance of **0.25 mm** between the gear hub face and the hub face for location of the inner bearing ring.

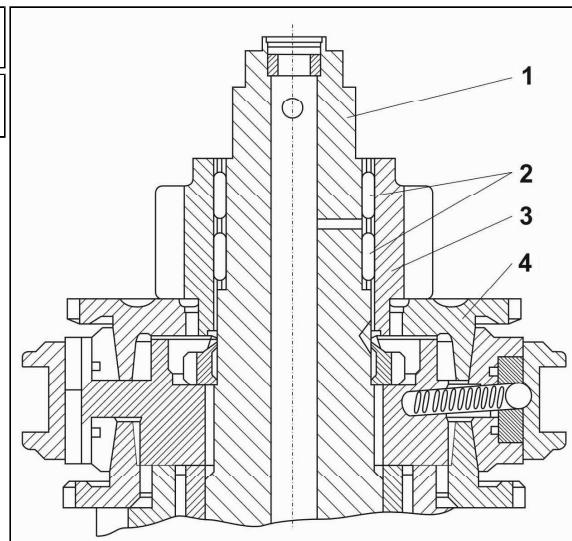


Fig. 3.127 Installation of 5th speed driven gear

42. Heat the inner ring of the roller bearing **2** to about **100° C** and use the tool **PRM 2218** to press it on the shaft **1**.

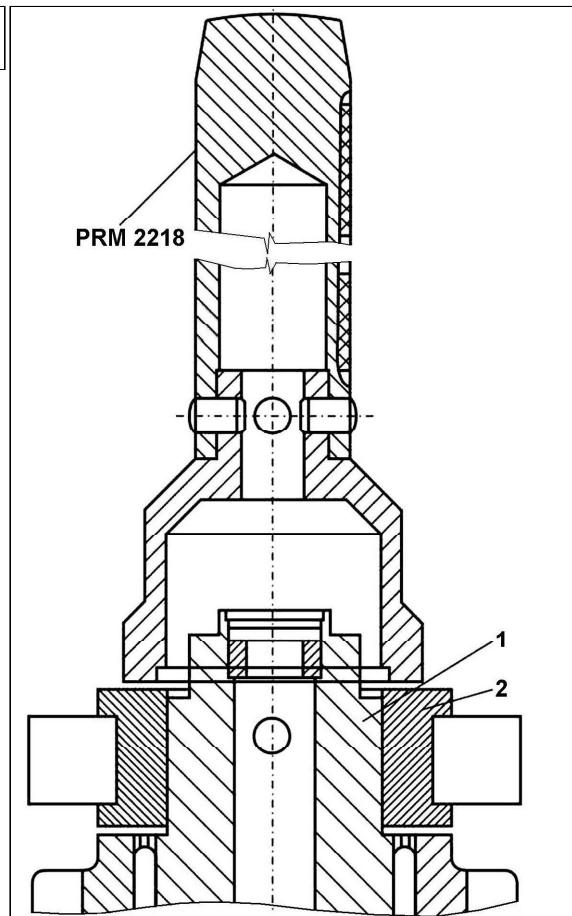


Fig. 3.128 Use of the tool PRM 2218



43. Use the wrench **URN 0356** to mount the slotted nut **2** and tighten it to **400 ± 40 Nm**. Lock the nut with a punch in the grooves with the minimum tool radius of **2.5 mm**.
44. Slide the outer ring of the roller bearing c/w lock ring on the bearing inner ring **1**.

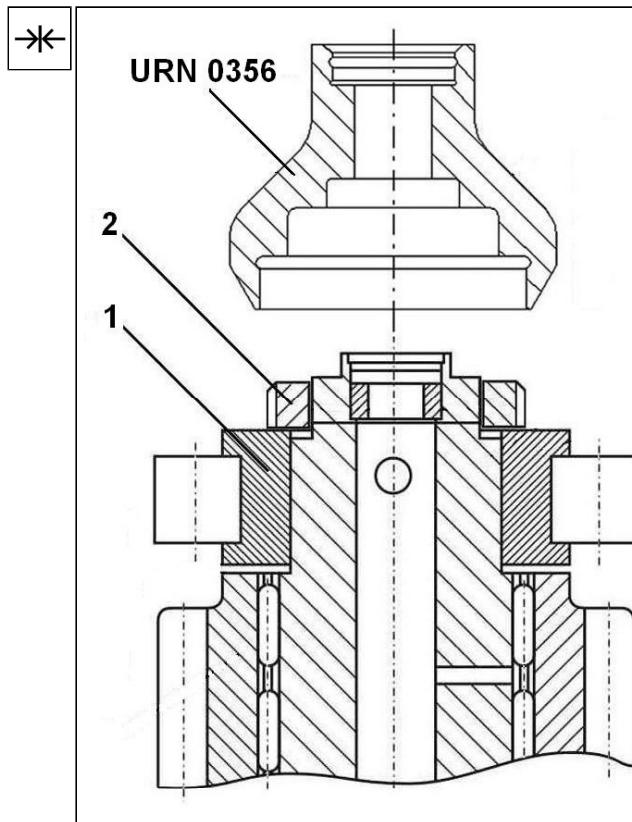


Fig. 3.129 5th speed gear locking

Assembly of the complete input shaft:

45. Thoroughly clean (in petrol) the whole input shaft **1**, especially the lubricating ports. Check whether the liner **2** is pressed properly in the input shaft cavity.
46. Fit the shaft into tools **PRM 3276** and **PRM 3351**.

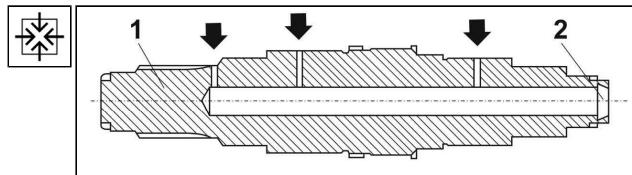
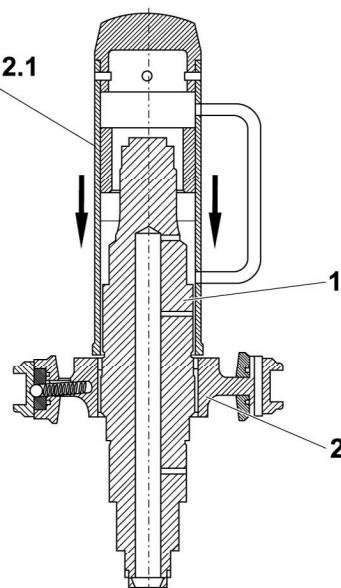


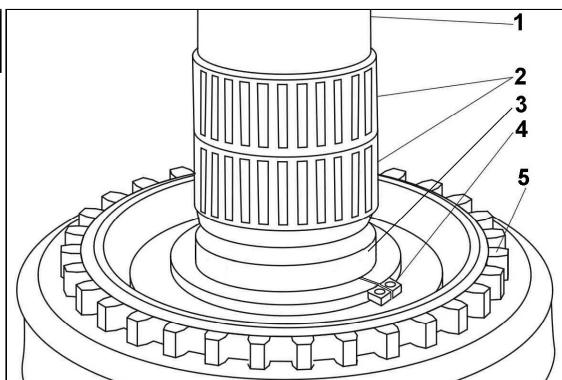
Fig. 3.130 Input shaft



47. Use the tool **PRM 2212.1** to fit the complete synchromesh **2** heated to about **100°C** – with a smaller diameter of the carrier hub facing the involute splining for the flange on the shaft from the side of the input shaft splining **1**. To heat and to press the synchronizer, proceed in a similar manner as mentioned at the output shaft.


PRM 2212.1

Fig. 3.131 Installation of the preselection gear control

48. Lock the complete synchromesh **5** on the input shaft **1** with a lock ring **4**. To heat and press in the synchromesh, proceed in the similar manner as on the output shaft. Use the tool **PRL 0641** to force on spacer **3** on the input shaft **1**, slide on the needle bearing **2** and apply oil to.


Fig. 3.132 Synchromesh locking



49. Fit the coupling gearing **4** on the H (N) constant mesh drive gear splining **3** and slide this gear train on the needle bearing. Check the gear **3** whether it is easy to rotate. Use the suitable shim or angler iron and the feeler gauge to measure up the minimum axial clearance of **0.25 mm** between the gear hub face and the hub face for location of the inner bearing ring.
50. Heat the inner ring of the tapered roller bearing **2** to **100° C** and use the tool **PRL 0921** to press it on the input shaft **1**.
51. Check the constant mesh synchromesh sleeve for the gear shifting.
52. Swivel the shaft and place it into the tool again.

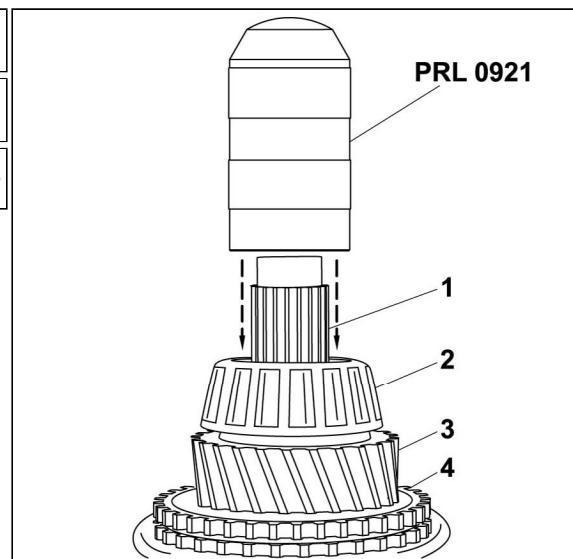


Fig. 3.133 Use of the tool PRL 0921

53. Fit the input shaft **1** on the needle bearing **2** and oil it.

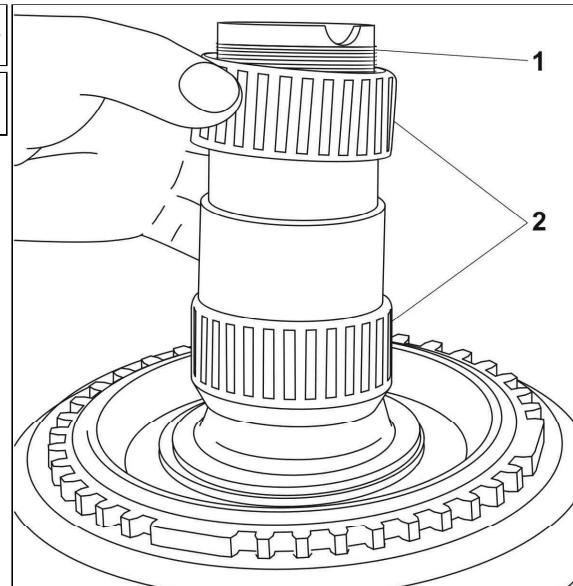
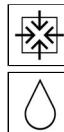


Fig. 3.134 Installation of the needle bearing



54. Fit the coupling gearing **3** on the L(R) constant mesh drive gear involute splining **2** and slide this gear train on the needle bearing.
55. Make sure whether the gear **2** is free to rotate. Use the suitable shim or angular iron and feeler gauge to measure up the minimum axial clearance of **0.25 mm** between the gear hub face and the hub face for location of the inner bearing ring.
56. Heat the tapered roller bearing inner ring **1** to **100° C** and use the tool **PRM 2218** to slide it on the shaft.
57. Mount the nut and use the wrench **URN 0203** to tighten it to the torque of **400 ± 40 Nm**. Lock the nut with a punch in the grooves using the tool with the minimum radius of **2.5 mm**.
58. Slide the bearing outer ring on tapered roller bearing **1**.

Assembly of the complete input shaft upper cover:

59. Press a new gearshift cylinder liner **2** into the gearbox upper cover **1** and use the tool **PRM 2439.1** to lock it.
60. Insert the shaped ring **3** into an orifice for location of the bushing and use the tool **PRL 0501** to press the bushing **4**.
61. Slide the shifter rod **5** into an orifice of the upper cover (from the opposite side of the gearshift cylinder), tap the roller **6x6 7** into a hole in the rod in position and slide the complete constant mesh fork **6** onto it. Fit the fork **6** onto the shifter rod shoulder as far as it goes.
62. Set the slot in the shifter rod **5** into the central position facing the arresting hole in the housing cover.
63. Install the arrestment **8** – in the following sequence: ball, spring, washer and mount the closing screw into a hole in the upper cover **1** and shift the shifter rod **5** into the position of the engaged H (N) gear.

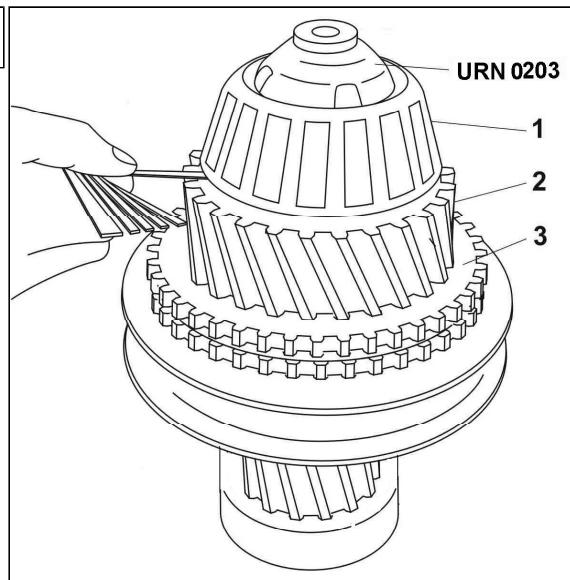


Fig. 3.135 Installation of the L(R) gear

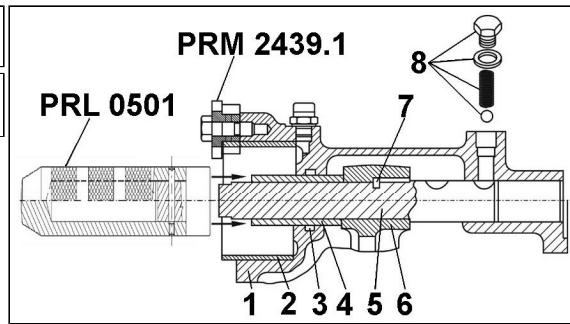
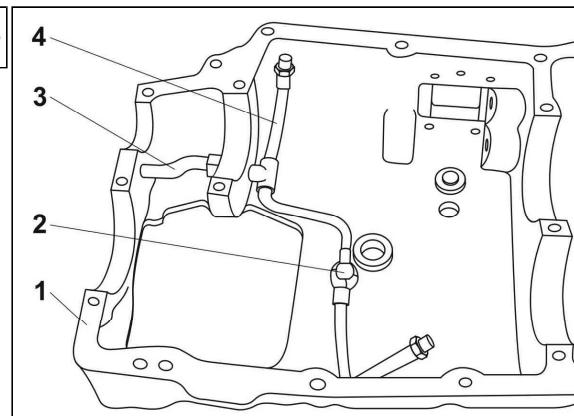


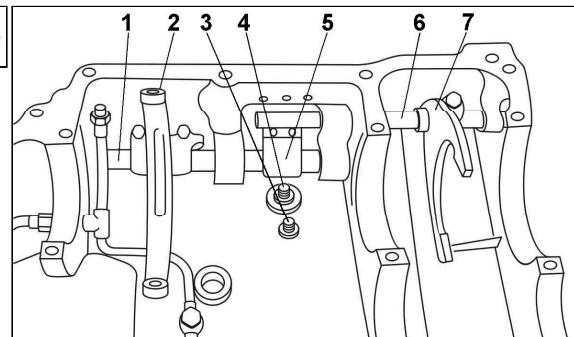
Fig. 3.136 Use of tools PRL 0501 and PRM 2439.1

**Overall assembly of the gearbox:**

64. Install the oil pipelines **3** and **4** into the upper part **1** of the gearbox housing (placed in the handling truck **PRM 0245**); first clean this upper part thoroughly. Remember to install two new sealing rings at the screw **2**.

*Fig. 3.137 Installation of the oil pipelines*

65. Install the screw of the shifter fork **4** ($2^{\text{nd}} - 3^{\text{rd}}$ speed) and arresting screw **3** c/w nut (the screw consists of the arresting pin and spring) into the upper part of the housing. Smear the screw thread fixing the gearshift fork **4** with the sealant.

*Fig. 3.138 Installation of the 4th-5th gearshift rod*

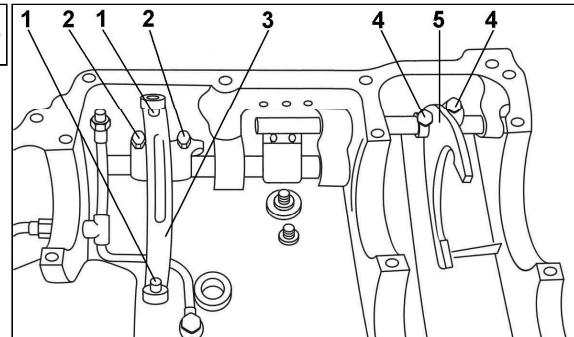
66. Install the shifter rod **1**, $4^{\text{th}} - 5^{\text{th}}$ gear fork **2** and the sliding sleeve **5**. Mount the locking screw into the sliding sleeve **5**. Tighten the screw to the torque of $110 \pm 10 \text{ Nm}$.

67. Mount the shifter rod **6** and the 1^{st} speed and the reverse speed shifter fork **7**.

68. Mount screws **2** and **4** into threaded holes of forks hubs **3** and **5** with screw threads smeared with the adhesive **LOCTITE 270** and gently tighten the screws.

69. Apply the grease to pins **1** of the fork **3** and stick guide blocks onto pins.

70. Adjust both forks **3** and **5** into the neutral position approximately.

*Fig. 3.139 Installation of gearshift forks*



03 Gearbox



71. Use the grease to stick guide blocks to 2nd – 3rd gear shift fork 3 pins .
72. Fit the fork 3 (marked with the arrow) into a slot of the 2nd – 3rd gear synchromesh sleeve.
73. Use the cloth band to place the output shaft 5 c/w 2nd – 3rd gear shift fork 3 into the housing 1.

Note:

While positioning the shaft into the housing, take care that 2nd-3rd speed shifter fork fits on the shifter and arresting pin and guide blocks of 4th-5th speed and 1st speed-reverse fork fit in grooves of sliding sleeves.

Simultaneously check whether the retaining ring of the roller bearing and the thrust ring of the central tapered roller bearing fit in the housing grooves properly. After the shaft is fitted in position, inspect whether the retaining ring and the thrust ring seat in the housing free.

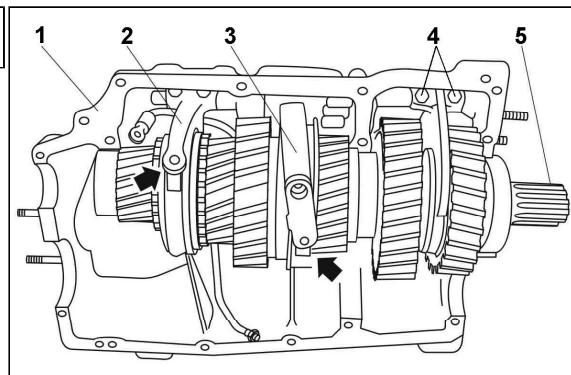


Fig. 3.140 Installation of the output shaft

74. Insert one ball and two springs (inner and outer) into holes 5. Insert the ball into a hole 4 and insert the spring into a hole 1 of the tool **PRM 2434**. Use bolts to attach the setting tool **PRM 2434** to the contact surface of the gearbox housing. Hereby the position of both shifter rods is arrested. Use the screw 2 to connect the tool **PRM 2434** to the 2nd – 3rd speed fork 3 . Position the shifter rods so that the arresting balls would fit into middle cutouts in the gearshift rods (neutral position).

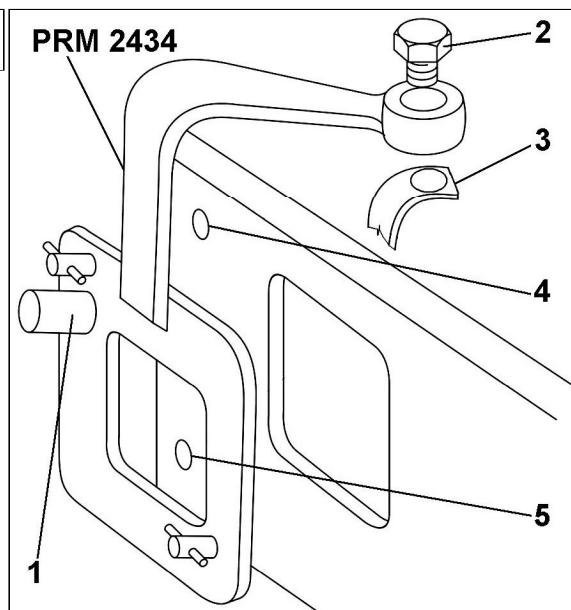


Fig. 3.141 Use of the tool PRM 2434

03 Gearbox



75. Lock the output shaft **2** with blocks **1** to protect it against the axial motion while setting the axial clearance of both marginal bearings (zero clearance).

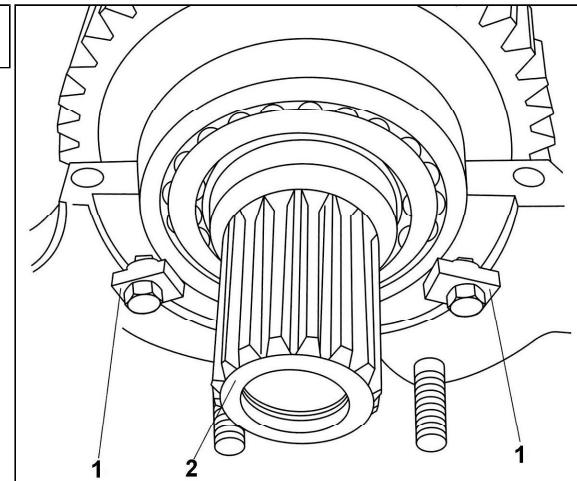


Fig. 3.142 Arrestment of the output shaft

76. In this position of the output shaft, adjust the position of the gearshift fork c/w rods as follows:

Slide the 1st speed - reverse speed shifter rod **6** (See Fig. 3.138) alternately into the arresting position of the engaged reverse speed + 1st speed and the neutral gear position. Hereby the shifter rod is set by means of the arresting ball into a position, in which the recess plane for the blocking element on the shifter rod is parallel to the clamping plane of the shift booster and the bearing surface for the shifter finger forms an angle of 8° with the lower plane of the 2nd - 3rd gear shifter fork. Position the gearshift fork so that the faces of the coupling sleeve are in the same distance from the involute splining on the 1st speed gear and on the reverse speed gear (the sleeve must not rub against the splining, fork segments in the engaged condition must have a clearance in the sleeve groove and segments must not rub against the groove bottom). Tighten screws **4** (See Fig. 3.140) in the fork to the torque of **110 ± 10 Nm**.

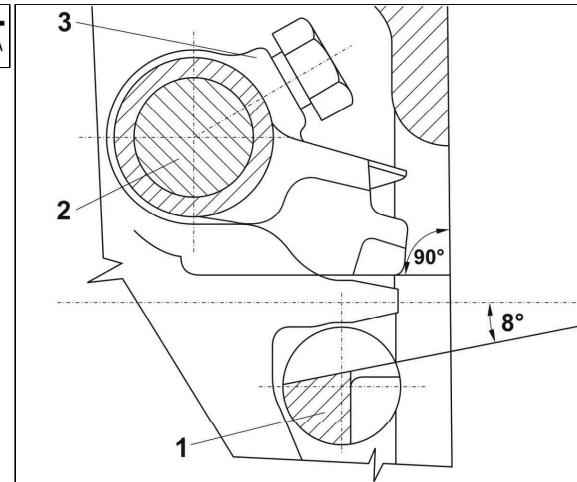


Fig. 3.143 Adjustment of the gearshift fork and rods



03 Gearbox



77. Using the fixing screw of the gearshift fork, adjust the cutout on the 2nd - 3rd shifter fork and cutouts on the 1st speed and the reverse speed gearshift rod and on the 4th - 5th speed sliding sleeve into one level. Use the feeler gauge, which is a part of the tool **PRM 2434**, for the adjustment.

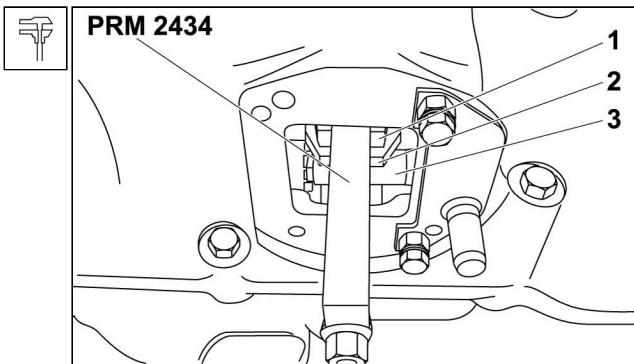


Fig. 3.144 Setting slots of shifter forks and shifter rod

78. Swivel the 4th - 5th speed shifter rod 1 (See Fig. 3.138) so that a gap between the 4th - 5th speed sliding sleeve and the 2nd - 3rd speed gearshift fork lug is $2 \pm 1 \text{ mm}$. The bottom plane of the sliding sleeve 5 is perpendicular to the clamping plane of the shift booster on the gearbox housing in this position.

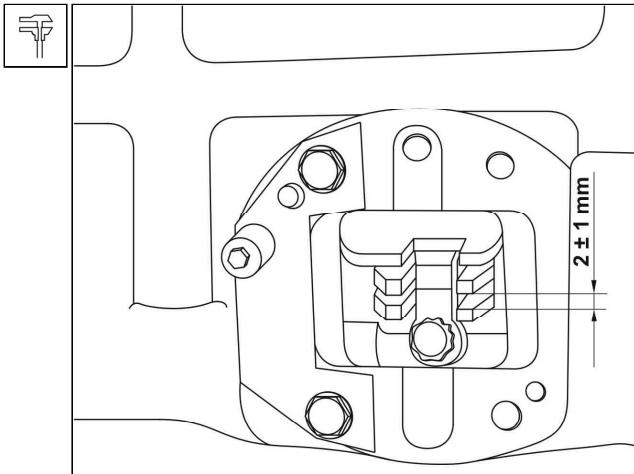


Fig. 3.145 Adjustment of the gearshift mechanism clearance

79. Adjust the 4th - 5th gear synchromesh-coupling sleeve precisely to the middle (neutral) position. Swivel the shaft to make sure whether some of synchromesh cones are not carried along. Adjust the gearshift fork in the circumferential groove so that the clearance between blocks and the sleeve would be the same on both sides. Tighten the screws 2 (See Fig. 3.139) in the fork to the torque of $110 \pm 10 \text{ Nm}$.
80. After setting of forks and sleeves neutral positions (See Fig. 3.140) it is necessary to check whether the blocks have the same clearance in sleeves on both sides also with gear speeds engaged.
81. Fit the countershaft into the gearbox housing. Make sure that the shaft is free to rotate and check teeth clearances at all gearings of both shafts.



03 Gearbox



82. Dismount the setting tool **PRM 2434** and mount the tool **PRM 2862** for the arrestment of gearshift rods instead.

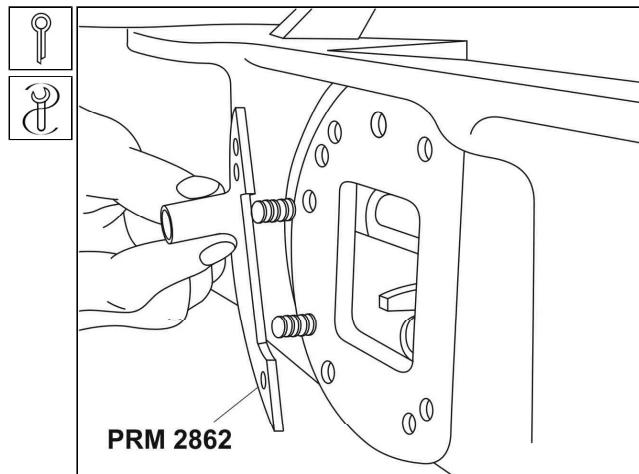


Fig. 3.146 Arrestment of gearshift rods

83. Install the other part of the oil pipes distribution, properly tighten the oil line screw connections and check whether holes in the distribution are pointed to the center of individual gearings.

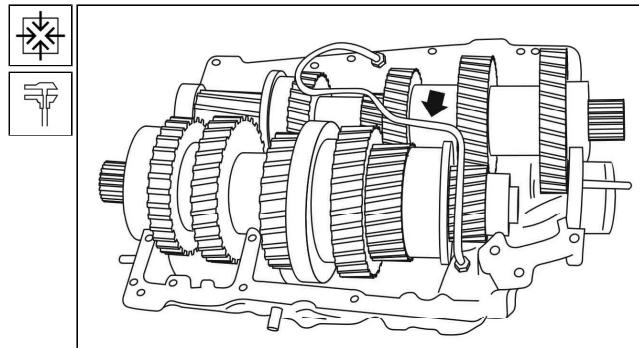


Fig. 3.147 Installation of the oil manifold



84. Remove the output shaft axial motion lock.
85. Apply the grease to traces of rollers of the reverse speed intermediate gear **2** in the lower part of the gearbox.
86. Install one row of rollers 7x14 **3** of one classification group, insert the spacer **4** and install the other row of rollers 7x14 **5** of one classification group.
87. Slide one part of the tool **PRM 3169**, place the shim **1**, the other part of the tool **PRM 3169** and shim **6**.

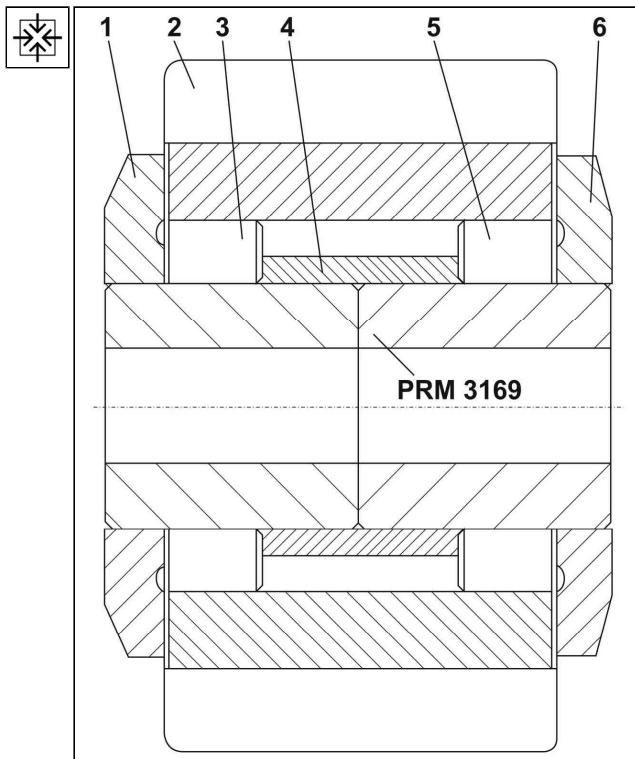


Fig. 3.148 Use of the tool PRM 3169

88. Install the suction tube into the bottom part of the gearbox housing. Tap the tube from the filter side to lock it (with $R = 2.5$ mm).
89. Install the assembled intermediate gear **2** into the lower part of the gearbox housing **4**. Fit the shaped ring into a slot in the pin **3** and smear the pin **3** with oil. Slide the pin **3** into a hole for location in the housing **4** and rolling mounting in the reverse speed intermediate gear **2** in the arrow direction so that the hole for the lock dowel **1** faces the hole in the housing **4**. Remove the tool **PRM 3169** during installation of the pin **3**. Lock the pin **3** with a dowel **1** in position and check the axial clearance of the intermediate gear, which should be **0.25 mm** at least.
90. Thoroughly clean and degrease the bearing surfaces of the upper and the lower halves of the gearbox housing. Apply the sealant to the bearing surface of the upper half of the gearbox housing – a method of application and the drying-out time are stipulated by the sealant manufacturer. Fit the lower half of the gearbox housing on the bearing surface prepared in such a manner. Tighten the bolts to connect both parts of the gearbox housing together.
91. Mount the other fastening bolt of the 2nd -3rd speed gearshift fork into the lower part of the gearbox housing so that the pin fits into the fork bushing. Apply the sealant to the bolt thread and tighten to **300 ± 30 Nm**. Turn the gearbox upside down and mount other bolts.

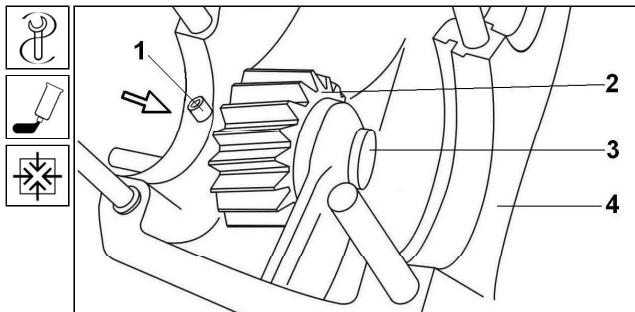


Fig. 3.149 Installation of the idler gear



03 Gearbox



92. Shift the shifter sleeve to the connecting gearing of the L(R) gear. Use textile belts to install the input shaft into location in the housing.
93. Apply the sealant to the surface of the gearbox upper part.

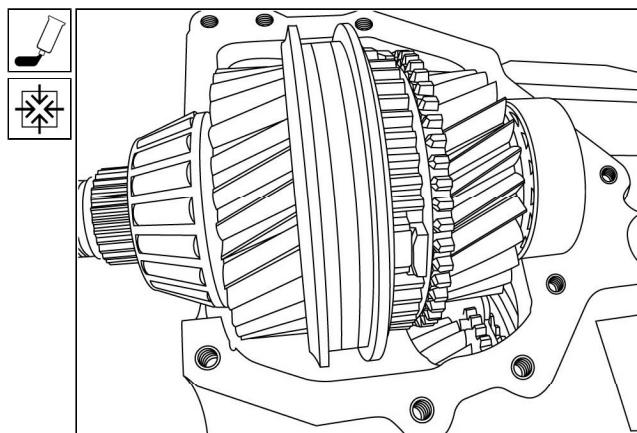


Fig. 3.150 Installation of the input shaft

94. Insert the guide blocks 3 of the shifter fork 2, which are situated in the upper cover 1, into a groove in the constant mesh synchromesh sliding sleeve, fit the cover 1 onto centering pins and tap it using a mallet.

Note:

Use the tool **PRM 3170** to press the bush of shifter fork 2 (if it was pressed out).
Use the tool **PRM 3172** to press the pin of shifter fork 2 (if it was pressed out).

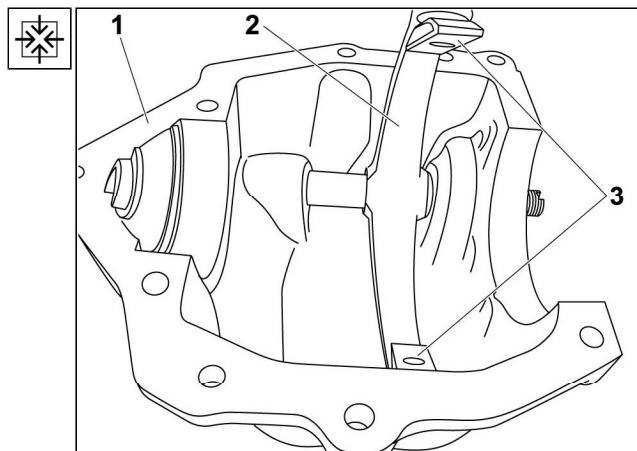


Fig. 3.151 Upper cover

95. Tighten the screw connections in three steps (until the resistance increases, to the half of the tightening torque, to the nominal tightening torque) in the mentioned sequence and lock. Tighten the screw connections to attach the upper cover (marked with the sequence of 19 - 25) to **100 ± 10 Nm**. Tighten the screw connections M 12 of the upper half and the lower half of the gearbox housing to **80 ± 10 Nm** and nuts M 14 to **120 ± 10 Nm**. Install the reverse speed switch (see the arrow).

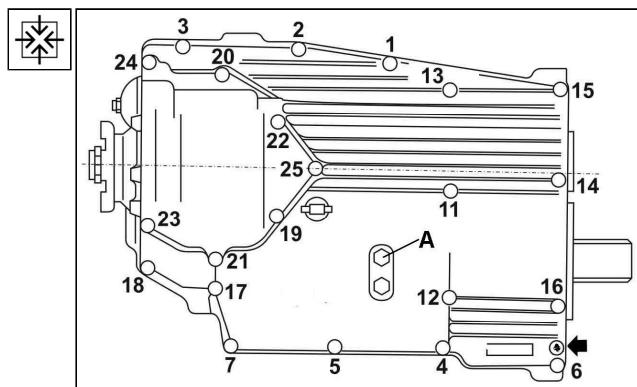


Fig. 3.152 Installation of the gearbox housing



96. Use the feeler gauge to check and/or use the arresting screw **1** to adjust the cut-out of the 2nd – 3rd gear speed shifter fork to one plane with cut-outs of the 1st gear + reverse gearshift rod and 4th - 5th gear speed sliding sleeve.
97. Tighten the lock nut to lock the arresting screw **1**. Use the gauge to check the dimension of the gap between the shifter sleeve **2** (4th-5th speed) and nose of the coupling sleeve (2nd- 3rd speed) and shifter rod **3** (1st speed and reverse speed) and nose of the coupling sleeve (2nd- 3rd speed). The gap should make 2 ± 1 mm.
98. Adjust the input shaft axial clearance (See Subchapter 3.5.3).
99. Set the tool **PRM 2899** on the countershaft. Mount screws **1** and **2**. Set the zero clearance using the rod **3** while moving round the countershaft continuously via the input shaft flange.

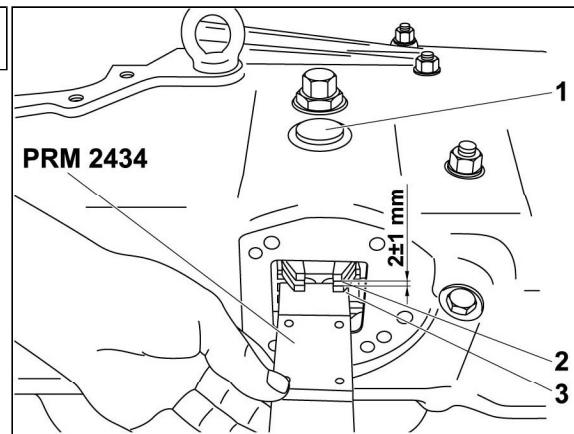


Fig. 3.153 Inspection of the gearshift mechanism clearance adjustment

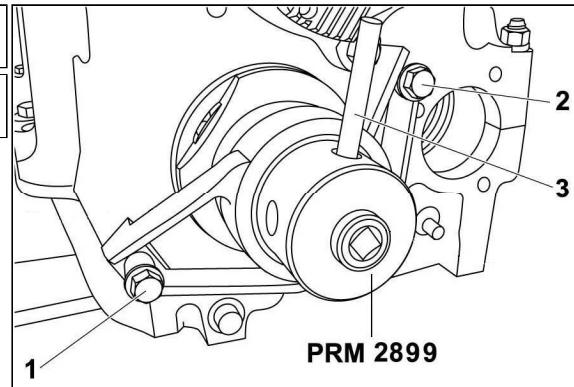


Fig. 3.154 Tightening-up of the tapered roller bearing

100. Use the tool **MMU 1740.1** c/w dial gauge **2** to measure up the distance of "Y" from the housing face to the outer ring face. Carry out the measurement in three different places at least. Note down the measured value.

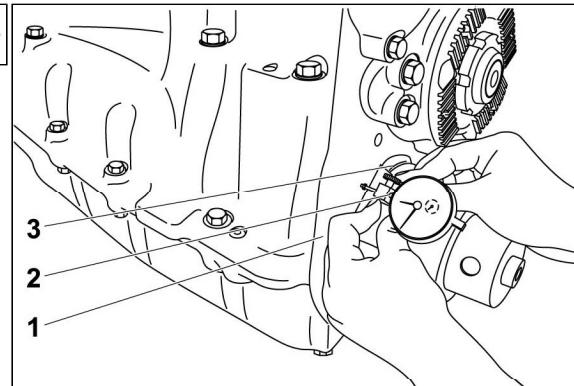


Fig. 3.155 Clearance in the pump mounting - 1



03 Gearbox



101. Insert the shim **1** into the pump housing.
102. Use the tool **MMU1740.1** c/w dial indicator to measure up the depth of "X" from the face of the pump housing to the shim **1**.
103. The difference of measured values " $x - y$ " must be within $+ 0.06$ to $+ 0.16$ mm (axial clearance). If the differences " $x_{\max} - y_{\min}$ " or " $x_{\min} - y_{\max}$ " are not within the specified axial clearance, it is necessary to remove the shim **1** and fit a shim of the required dimension into the housing.

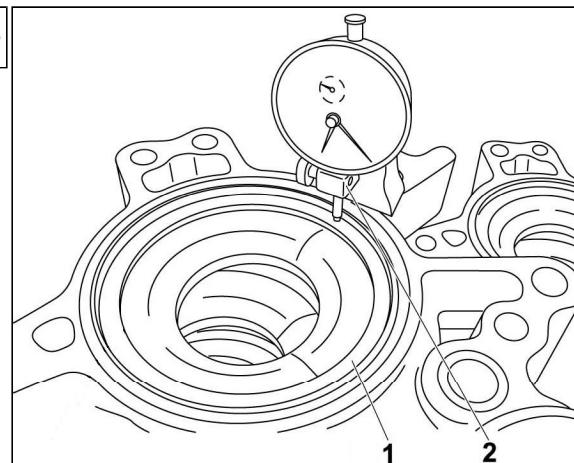


Fig. 3.156 Clearance in the pump mounting - 2

104. Insert three shaped rings **2** through **4** into front recesses on the bearing surface of the pump. Fit the fifth ring 11.3 x 2.4 onto the oil pipe tube, which is pressed into the pump housing.

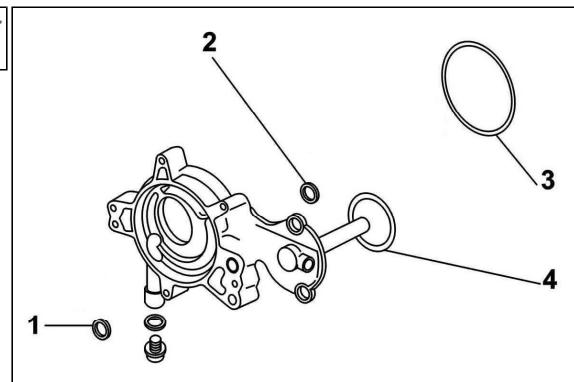


Fig. 3.157 Pump seals

105. Apply the sealant to the bearing surface of the pump housing, fit the housing on gearbox and attach it using two screws. Tighten the screws to **56 - 80 Nm**.

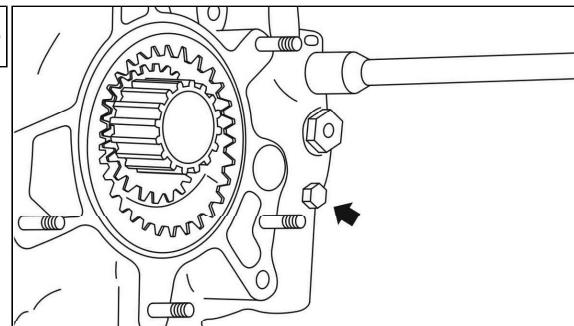


Fig. 3.158 Installation of the pump housing



03 Gearbox



106. Insert the inner gear **1** and the outer gear **2** into the oil pump housing and smear both gears with oil.

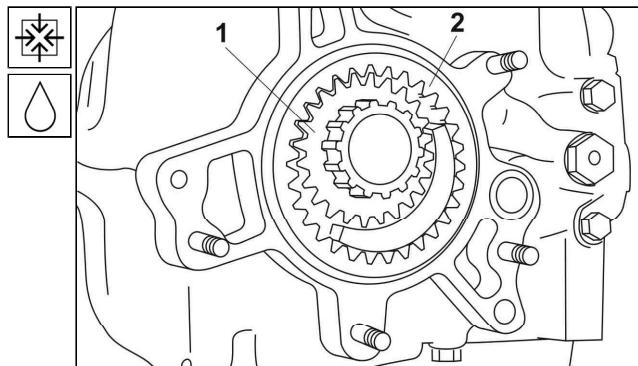
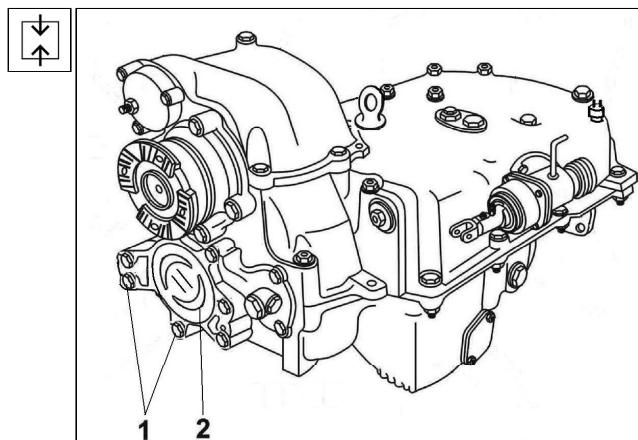


Fig. 3.159 Installation of the pump gears

107. Smear the bearing surfaces of the pump cover with sealant.
108. Install the pump cover **2** c/w sealing ring and spring washers, and mount six nuts **1** and tighten.
109. Tighten the nuts **1** to **56 - 80 Nm**.
110. Clean and install the oil filter according to the procedure (See Subchapter **Oil Change in Gearbox**), and add oil into gearbox.



111. Press the shifter rod **3** c/w spacer tube **1** and constant mesh fork **2** to the H (N) and L(R) constant mesh drive gear as far it goes. Measure the depth of 'X' of the countersinking.
112. Use spacer washers to adjust the gear-shift mechanism of preselection gear control (See Subchapter **3.5.2**).
113. Dismount the tool **PRM 2862** for arrestment of the gearshift rods and degrease the bearing surface, apply the sealant to it, mount the shift booster.

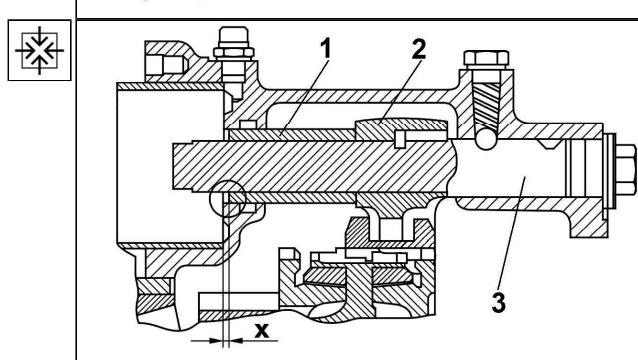
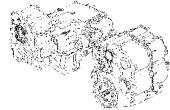


Fig. 3.161 Countersinking depth of the spacer tube



114. Attach the pressure air hose to the shift booster. Swivel and move the piston rod to make sure that individual gear speeds can be shifted properly. Shift into the neutral after the inspection.

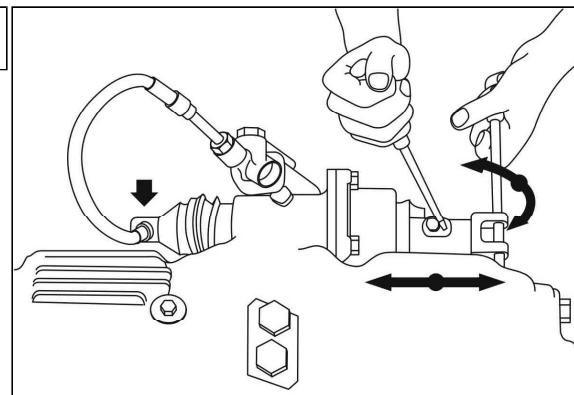


Fig. 3.162 Inspection of the gear shifting

115. Use the tool **MRP 0811** to press the outer ring of tapered roller bearing **2** of the output shaft **1** towards the housing to obtain the zero clearance. While doing so, swivel the shaft **1** several times so that the tapered rolls are fitted on raceways in position.

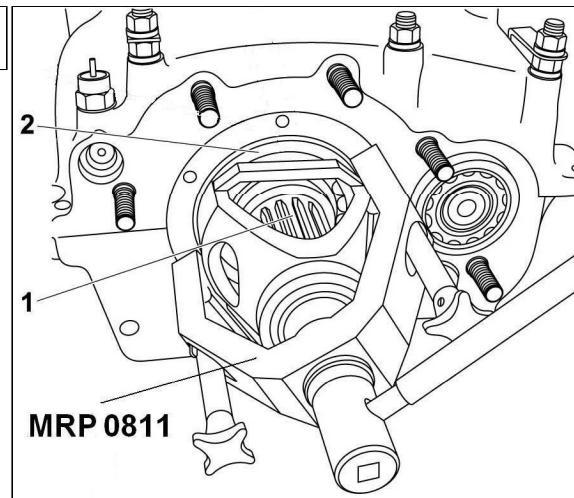


Fig. 3.163 Use of the tool PRM 0811

116. Use the tool number **MMU 1740.1** c/w dial indicator **3** to measure up the distance of '**X**' between the front surface of the gearbox housing **1** and the front surface of the bearing outer ring **2**; carry out the measurement in two different places at least and put down the measured.

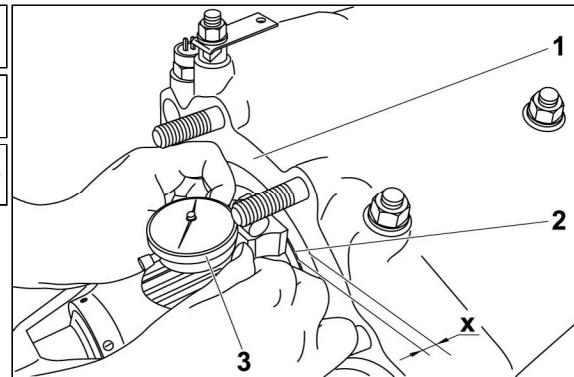


Fig. 3.164 Measurement of the output shaft tapered roller bearings clearance – 1



03 Gearbox



117. Use the tool **MMU 1740.1** c/w dial indicator to measure the recess depth of "Y" in the rear cover for the outer ring of the tapered roller bearing in three points at least and note down the measured.
118. If the difference of **X - Y** is not within a range of the specified axial clearance, i.e. **0.1 to 0.2 mm**, it is necessary to place the spacer washers of the "S" thickness into the cover. The thickness of washers "S" is calculated according to a formula: $S = X - Y - (0.1 - 0.2)$.

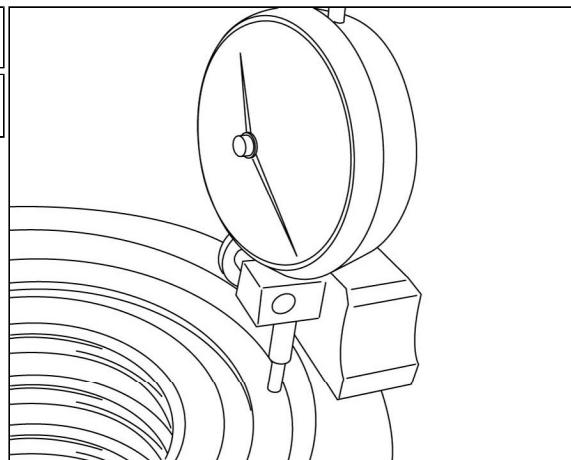


Fig. 3.165 Clearance of the output shaft tapered roller bearings - 2

119. Use the tool **PRL 0700.1** c/w support **PRL 0920** to press the shaft seal **1** and smear it with the grease from the inner edge side to one third of the.

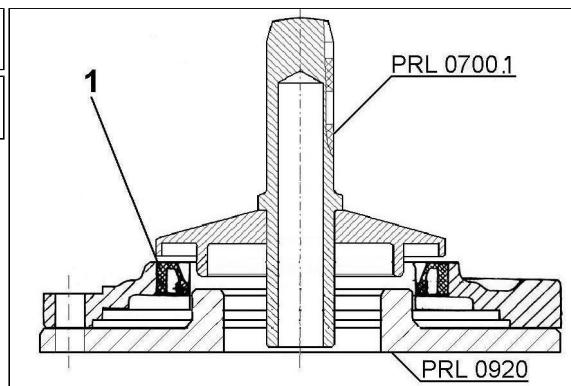


Fig. 3.166 Pressing-in of the output shaft seal

120. Fit the shaped "O" ring **4** on the outer ring of the tapered roller bearing.
121. Install spacer washers **3** into the rear cover **2** – thicker ones facing the bearing.
122. Use bolts **1** to attach the rear cover **2** to the gearbox housing and tighten to the torque of **56 - 80 Nm**. Use the taper tube **PRM 3761** to slide the cover on.

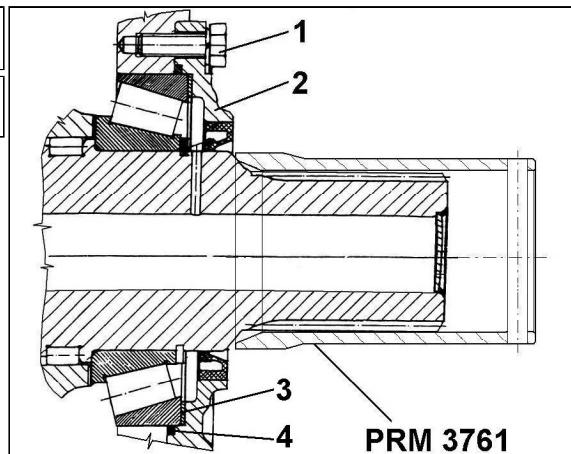


Fig. 3.167 Attachment of the rear cover

121. Fill the gearbox housing with the oil to the specified level (See Subchapter 3.5.1).