Transmission and Differential

Main Group T

Transmission

Four Speed Synchromesh Transmission

Three Speed Transmission

Three-Speed Gearbox

General

The gearbox and differential are united in one casing. The entire power unit, i. e. engine and gearbox, is mounted in three rubber elements on the front-axle carrier.

Gearbox Casing

The gearbox casing is a light-alloy casting divided in the plane of the shaft centres. Fitted to the casing top is the cover with the shift rods. This design affords appreciable advantages for repair work. The casing top and bottom are machined as one unit and must, therefore, be exchanged together. The three casing parts are assembled with a liquid sealing compound (Wevolic).

Gearbox

The gearbox has four forward speeds and one reverse gear. All four forward speeds are synchronized and, for greater ease of shifting and reducing gear wear, provided with a locking device. The forward-speed gearsets are in constant mesh and have helical-cut teeth in the second, third and fourth-speed gears.

The gears of the first (and reverse) and second speed on the **drive shaft** are machined from the solid with the shaft. The third and fourth-speed gears are made separately and fitted to the drive shaft by means of a common key.

On the **gear-shifting shaft** only the gear for the reverse is firmly fitted to the shaft whereas the shift gears of the four forward speeds run each by itself in needle-roller bearings.

Thus, one gear of each of the forward-speed gearsets is firmly attached to the drive shaft whereas the counter gear can turn freely on the gear-shifting shaft.

The double idler gear (reverse shift gear) is mounted on a plain bearing on a shaft in the casing top and turns only when the reverse has been shifted in.

The gear ratios are as follows:

First speed	1 : 4.58
Second speed	1 : 2.39
Third speed	1 : 1.54
Fourth speed	1 : 1.03
Reverse	1 : 4.58

The gearboxes of the Models LP/LS 600 and LT 600 are distinguished only by the different gear ratio between the small helical-cut gear of the gear-shifting shaft and the large helical-cut gear driving the axles.

LP/LS 600

Ratio	4.87
Number of teeth	15/73

LT 600

Ratio	5.29
Number of teeth	14/74

Shifting Operation and Synchronization

The reverse is put in operation by meshing the double idler gear with the pinion on the drive shaft on the one hand and with the corresponding gear on the gear-shifting shaft.

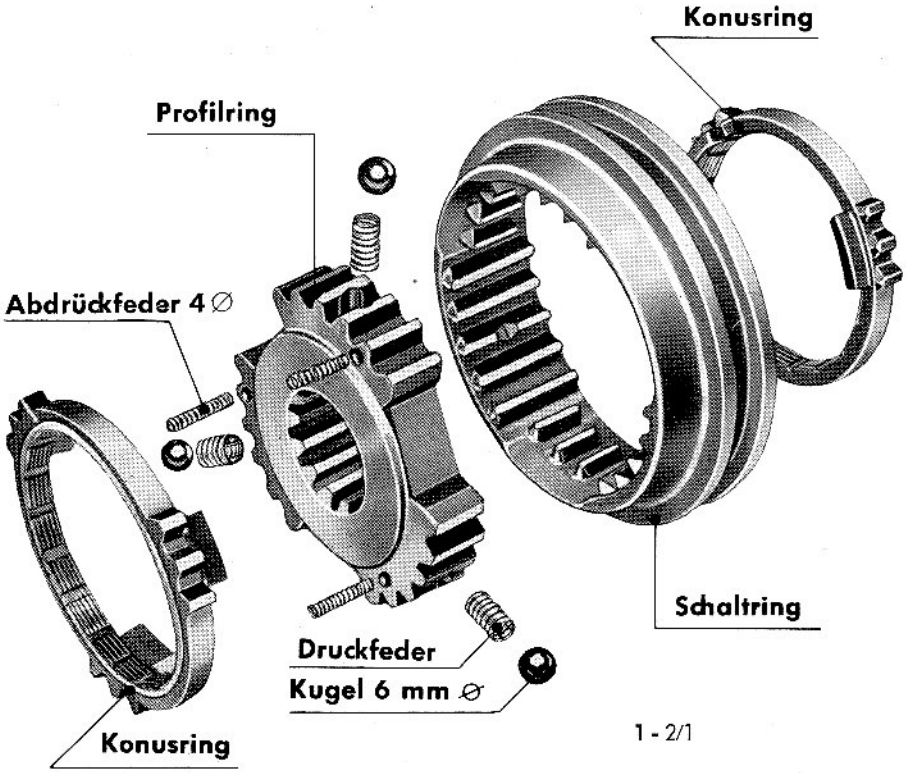
The forward-speed gears are engaged by the axial movement of shift rings after the synchronizer unit involed has been put into action, which brings the speeds of the gears and shift rings to synchronization so that the dogs of the shift rings mesh with the dogs of the corresponding shift gear silently without clashing.

Between the gear-shifting shaft gears of the first and second as well as the third and fourth speeds synchronizer units are arranged which in changing gears go into action either to one or the other side. Each synchronizer unit consists, as shown in Fig. 1 – 2/1, of the shift ring, the profile ring, the three compression springs and the three 6-mm diameter balls (arresting the shift ring in neutral position), the three release springs of 4 mm diameter and the two cone rings.

The external cone located at each forward-speed shift gear and the dog ring are, by their function, also considered parts of the synchronizer unit.

The profile ring has a splined bore and is firmly attached to the gear-shifting shaft through the latter's splines. The shift ring and cone rings are connected, through gear teeth, with the profile ring and are, furthermore, axially movable to the dog ring and external cone of the shift gear. The cone rings have internal cones which match the external cones of the respective shift gears. The three release springs located in drillings of the profile ring provide for the centring of the two cone rings forming parts of each synchronizer unit.

In neutral position the shift ring is kept in its position relative to the cone rings or the corresponding cone in either of the respective shift gears by the spring-loaded balls located in the drillings of the profile ring.



1 - 2/1

Konusring	=	Cone ring
Profilring	=	Profile ring
Schaltring	=	Shift ring
Abdrückfeder	=	Release spring, 4 mm diam.
Druckfeder	=	Compression spring
Kugel	=	Ball, 6 mm diam.

The synchronization functions as follows:

The cone ring is equipped, on its inside, with stops by means of which it is constantly entrained by the profile ring rotating with the gear-shifting shaft. The bevels of the cone ring teeth and those of the shift ring are, thus, always staggered to such an extent that when the shift ring is shifted the bevels opposing each other cannot slide past each other without contemporaneously performing relative motions. The teeth are, hence, not arranged to meet "on gaps" but in "locked position".

When by actuating the shift fork the shift ring is moved axially, the cone ring is pushed over the bevels so far towards the external cone of the shift gear until the two faces touch, creating a friction drive. Synchronization is thus initiated.

By the difference in the speeds of the shift ring and cone ring on the one hand and the shift gear external cone on the other the cone ring is now held in locked position. The shifting effort constantly acting upon the cone ring through the shift fork and shift ring tends to turn the cone ring so far back that the bevels can slide past each other. However, at the same time, the shifting effort also increases the pressure holding the two cone faces together and thus also the locking pressure created by the difference in the speeds of the cone ring and shift gear external cone. Only when synchronization has been achieved, the locking pressure disappears. Now the shifting effort is able to turn the cone ring out of its locked position so that the teeth can pass each other, the shift ring is moved on sidewise and the dogs of the shift ring and the shift gear can engage.

For the proper functioning of the gearshift and the locking synchronization it is of essential importance that

1. the shift fingers have the prescribed position relative to the shift dogs,
2. the shift forks have been carefully adjusted so that in the neutral position of the shift ring they are accurately centred in the shift ring groove and, hence, do not exert any one-sided pressure on the synchronizer unit,
3. the prescribed clutch pedal play has been provided so that during gear shifts the clutch can always be disengaged completely.

It results that, on the one hand, the clutch pedal play must always be watched closely and, on the other hand, the clutch pedal must always be depressed all the way down to the stop with every gear shift. Faulty clutch pedal play, negligence in disengaging the clutch, sticking clutch disc (e. g. rust on the splined shaft or the hub), sticking friction rings (e. g. clutch disc fouled by oil), damaged clutch facing, warped clutch disc (e. g. as a result of faulty flanging of the engine and the gearbox), warped clutch pressure plate (e. g. by irregular, uneven bolting or unbolting of the clutch) may result in an overly great locking effort having to be applied when shifting gears, causing premature wear of the cone rings.

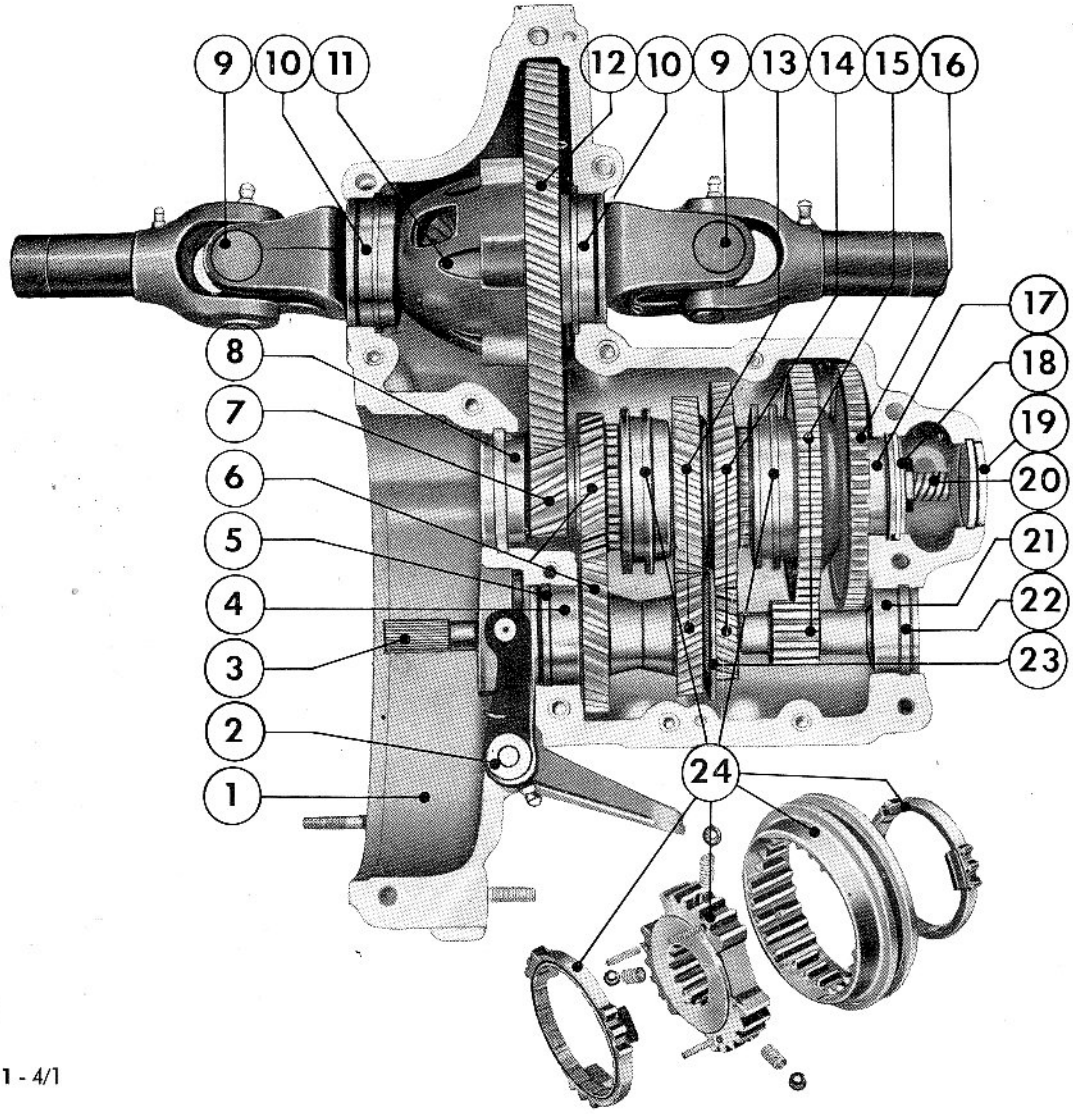
In maintenance and repair work it is, hence, always necessary after mounting the engine to check by shifting into reverse whether the clutch disengages properly.

Lubrication

Lubricant:	Gearbox Summer Oil SAE 90 Gearbox Winter Oil SAE 80 (below 0° C)
Oil Quantity:	1 litre
Oil Changes:	After 500 km, 3000 km, 12000 km, thereafter every 12000 km

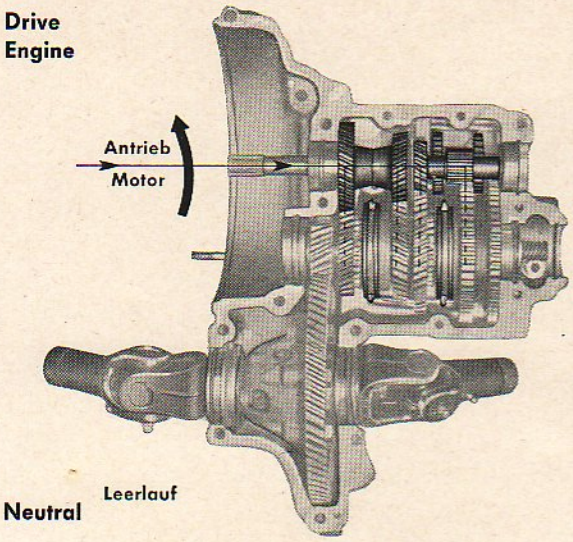
LLOYD 4-Speed All-Synchromesh Gearbox

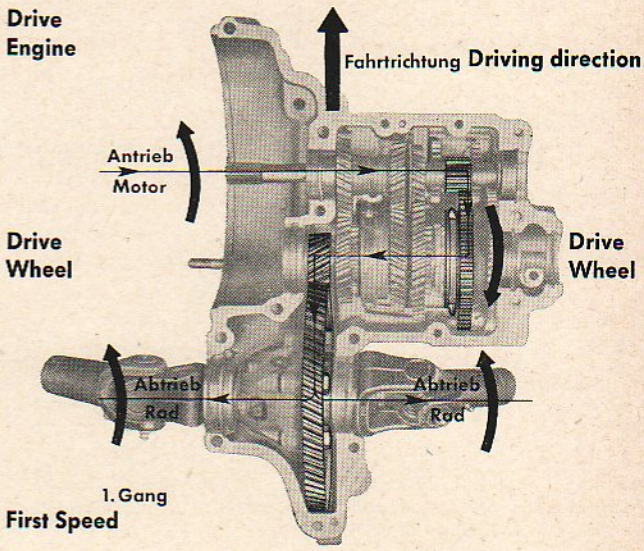
(Gearbox casing top removed)

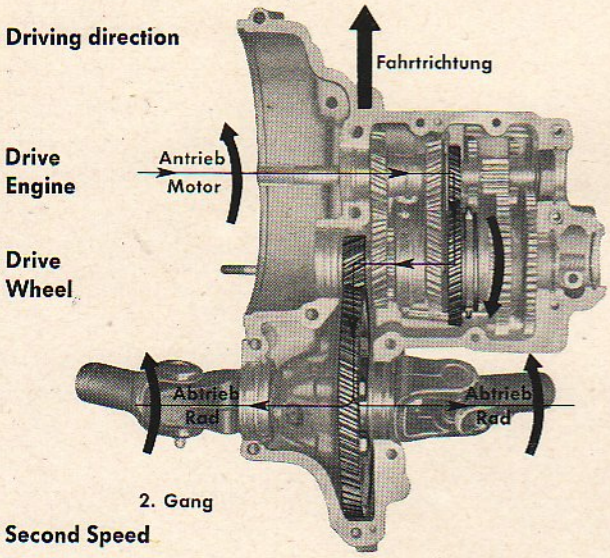


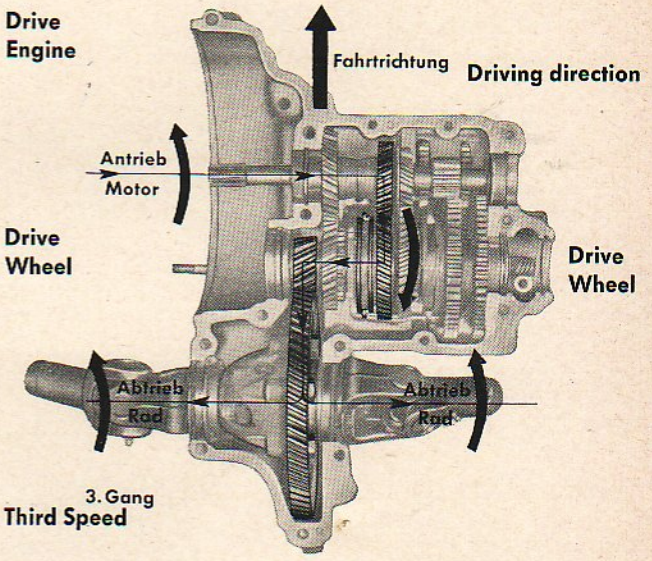
1 - 4/1

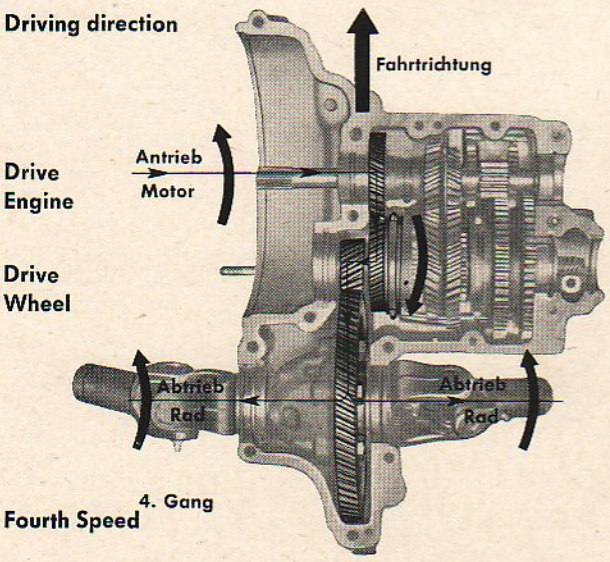
1 – Gearbox casing, bottom part
2 – Clutch lever
3 – Drive shaft
4 – Bearing
5 – Sealing ring retainer
6 – Gearset, fourth speed
7 – Gear-shifting shaft
8 – Roller bearing bush
9 – Universal joint
10 – Bearing ring
11 – Differential housing
12 – Large helical-cut gear
13 – Gearset, third speed
14 – Gearset, second speed
15 – Gearset, first speed
16 – Reverse gear
17 – Bearing
18 – Locking ring
19 – Cover with round-cord ring
20 – Speedometer wormgear
21 – Bearing
22 – Cover with round-cord ring
23 – Oil-throw disc
24 – Synchronizer units

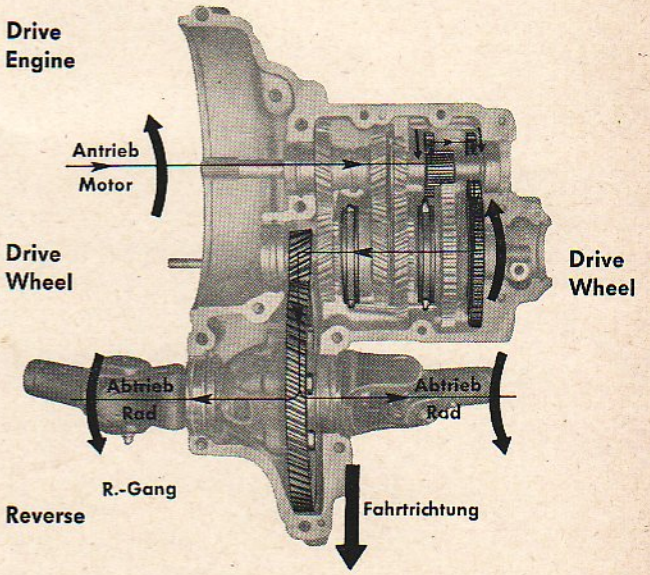












The arrangement of the shafts and differential and the flow of power are shown as if, with the casing bottom part removed, one looks into the open gearbox from below.

Dismantling and Re-installing the Gearbox

Same sequence of operations as "Dismantling and Re-installing the Engine". See Main Group E – Engine.

Disassembling and Assembling the Gearbox Casing

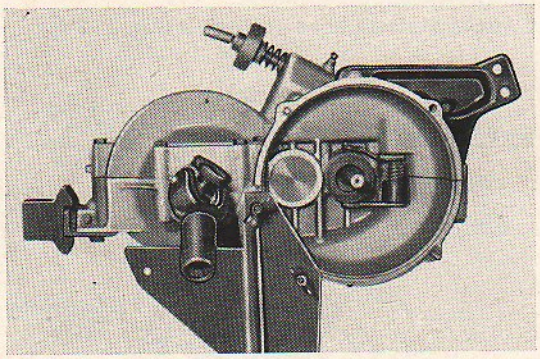
(Gearbox has been dismantled)

The following special tool is required:

WO 42 – Extractor for rocker pin and idler gear (4-speed gearbox).

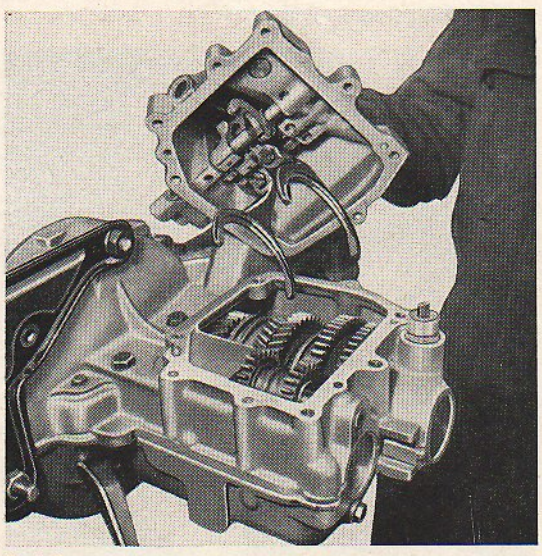
Dismantling

1. Drain off gearbox oil (collar screw SW 20 with gasket).
2. Fasten gearbox on gearbox stand (Fig. 2 - 1/1).



2 - 1/1

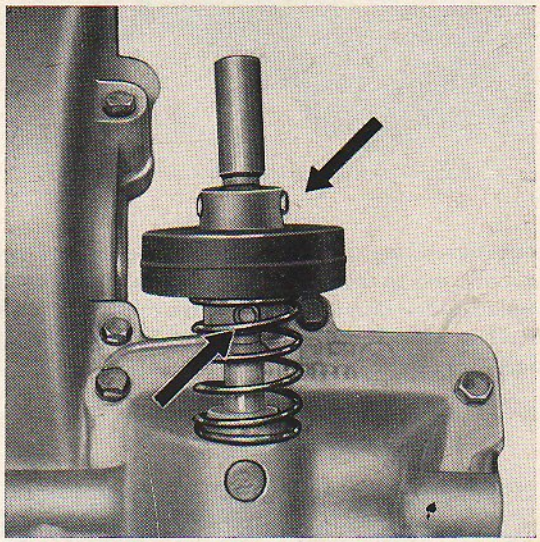
3. Unscrew gearbox cover (eight hexagon screws SW 10 secured by spring washers) (Fig. 2 - 1/2).



2 - 1/2

Attention: Remove gearbox cover only when shift forks are in neutral, i. e.

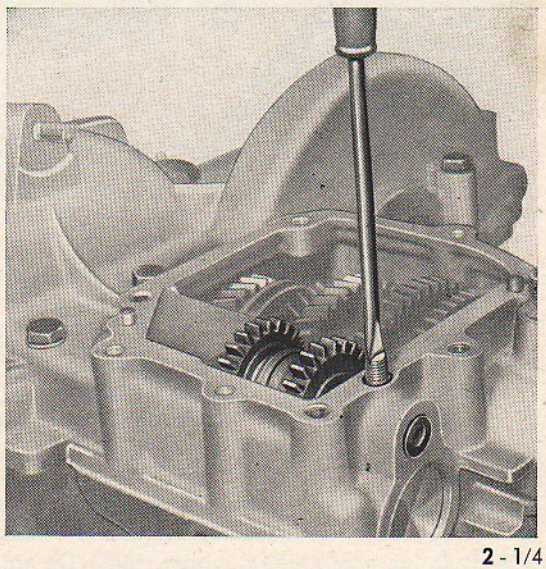
- the shift dog shaft can be moved axially,
- the upper pin of the gearshift rubber coupling is in a horizontal, the lower pin in a vertical position. (Fig. 2 - 1/3).



2 - 1/3

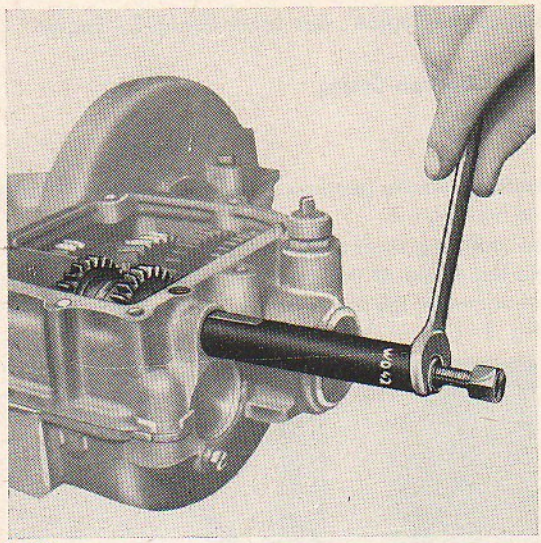
The gearbox cover has been cemented on. So no gasket will be found. When removing the cover, tap it gently with a rubber mallet, do not pry it off by pushing any edged tool into the joint.

4. Unscrew heater bracket (Part No. 1 319 401 - 2) and rubber mounting block.
5. Dismantle reverse idler gear.
   a) Unscrew grub screw (Fig. 2 - 1/4).



2 - 1/4

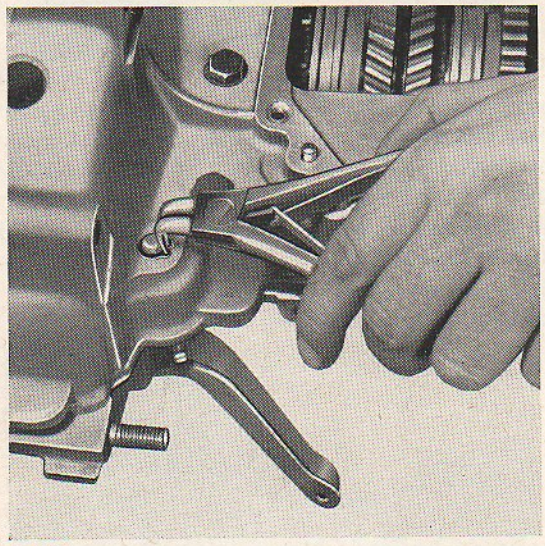
b) Pull out idler gear pin with special tool WO 42, take out idler gear (Fig. 2 - 2/1).



2 - 2/1

Attention: Carry out the work described under 5 only if a repair job so requires or the gearbox casing must be replaced. For dismantling the drive shaft, gear-shifting shaft or differential assembly the reverse idler gear need not be removed.

6. Remove the snap ring on the clutch lever pin by means of snap ring pliers (Fig. 2 - 2/2).

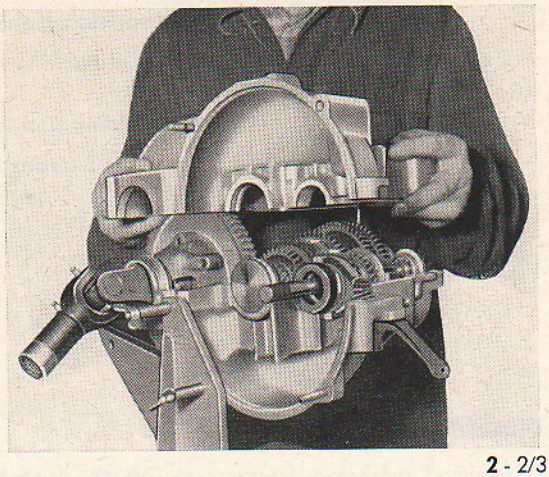


2 - 2/2

With a light-alloy mandrel drive out the pin, in downward direction, from the drilling in the casing top.

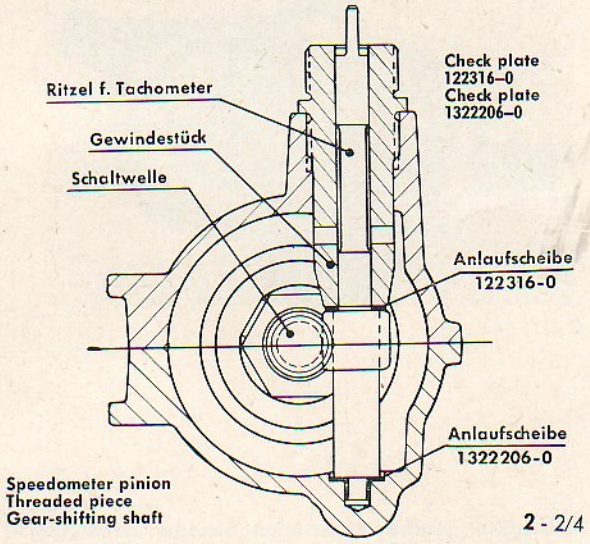
7. Dismantle gearbox casing top, unscrewing eight hexagon screws SW 14 above and four hexagon screws SW 14 below (secured by spring washers).

Attention: The casing top and bottom parts have been assembled with a liquid sealing compound. If removal is difficult, tap gently with a rubber mallet. Do not use any edged tool to pry the joint open (Fig. 2 - 2/3).



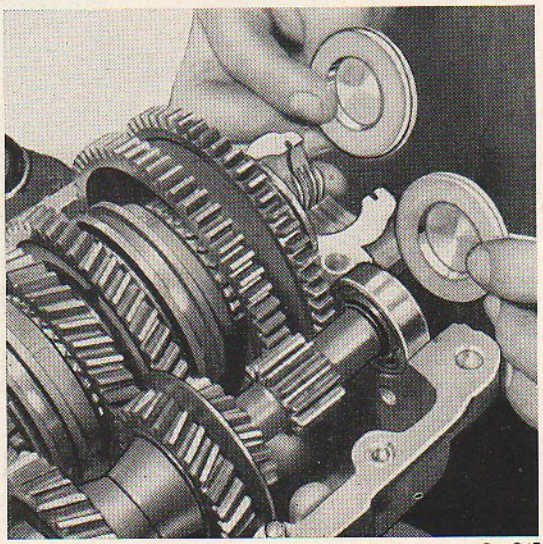
2 - 2/3

8. Drive out clutch lever pin all the way, remove clutch lever and return spring.
9. Remove speedometer pinion.
One check plate above and below (Fig. 2 - 2/4).



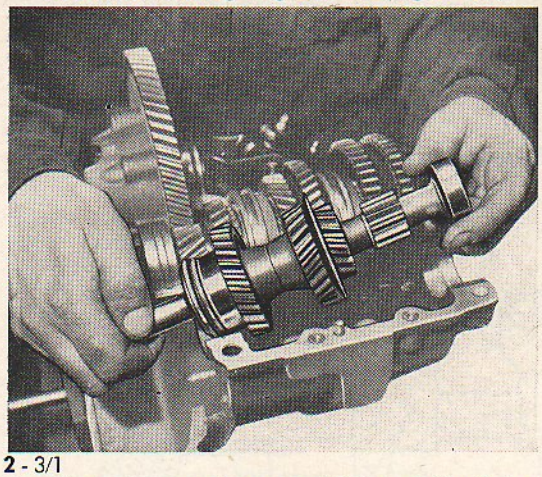
2 - 2/4

10. Remove both sealing covers (with rubber cord rings) – one for the drive shaft and one for the shifting shaft boring (Fig. 2 - 2/5).



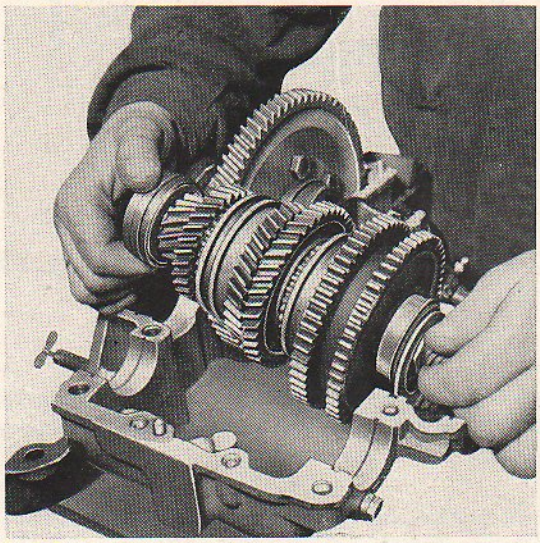
2 - 2/5

11. Lift out the complete drive shaft with ball bearings and radial sealing ring retainer (Fig. 2 - 3/1).



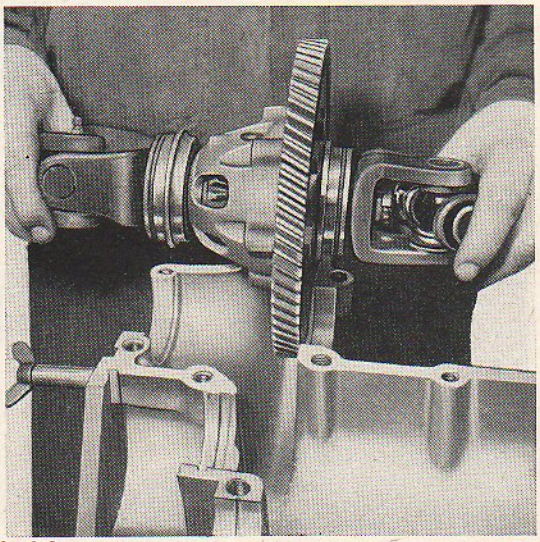
2 - 3/1

12. Lift out the complete gear-shifting shaft with locking washer, ball bearing and roller bearing (with bush) (Fig. 2 - 3/2).



2 - 3/2

13. Lift out differential assembly (with inner universal joints) (Fig. 2 - 3/3).



2 - 3/3

Put away the disassembled parts carefully and protect them from dirt and accidental damage.

Assembling

Assembling is done in the reverse order with the following points requiring special attention:

1. Clean the casing and all parts.

2. Remove remains of the sealing compound carefully with solvent. Before screwing the casing parts together again apply a thin coat of "Wevolic" to the joint surfaces.

3. Check the casing parts for any external damage and possible cracks. If necessary replace both casing top and bottom parts together.

4. Make sure that no bush projects from the joint surface. Oil leak!

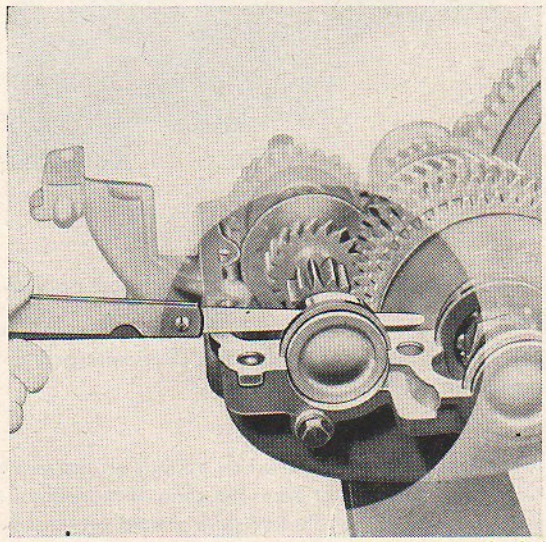
5. Check the seatings of the ball and roller bearings in the casing for the proper fit of the outer races.

6. Check the drive shaft, gear-shifting shaft, differential assembly and gaskets. Replace worn or damaged parts.
   For dismantling and re-assembling see the respective instructions.

7. Do not forget to re-install any shims. The drive shaft, gear-shifting shaft and differential assembly must not have any play in their bearings. After exchanging the casing or disassembling the gearsets check them for freedom from play and eliminate any existing play by placing the required shims as follows:

Drive shaft

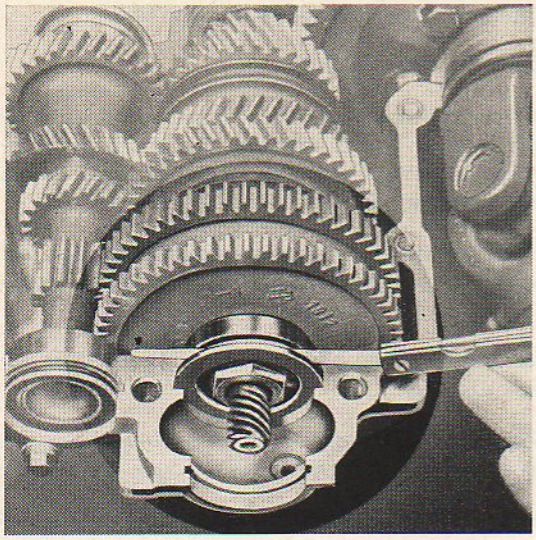
Shims 39.7 mm diam., 0.2 and 0.3 mm thick (Spare Part No. 122 023/24-0). Install between outer race of bearing 6203 and sealing cover (Fig. 2 - 3/4).



2 - 3/4

Gear-shifting shaft

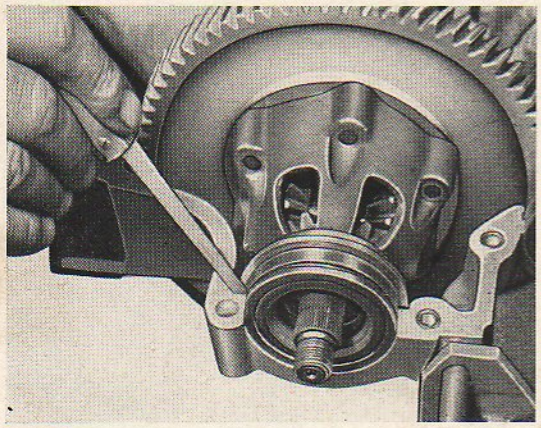
Shims 53 mm diam., 0.1, 0.2 and 0.3 mm thick (Spare Parts No. 13 22 016/17/18-0). Install between locking ring 53 mm diam. and outer race of bearing 6303. (Fig. 2-4/1).



2 - 4/1

Differential assembly

Shims 72 mm diam., 0.1, 0.2 and 0.3 mm thick (Spare Part No. 13 22 019/20/21-0). Install on clutch side between collar of bearing race (for bearing 6006 and radial sealing ring) and gearbox casing (Fig. 2 - 4/2).



2 - 4/2

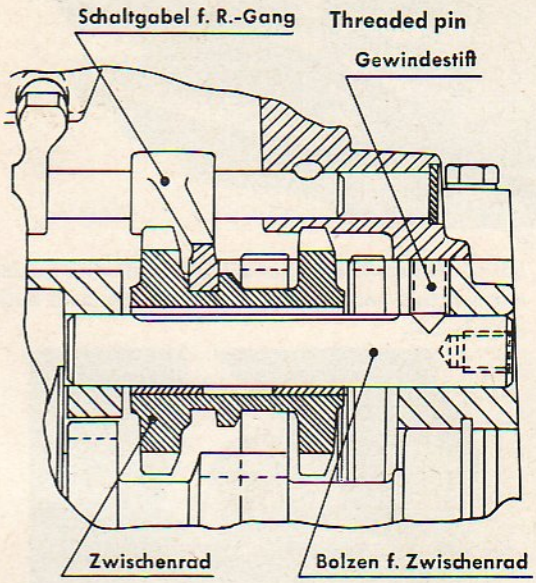
Install differential assembly so that it bears against the gearbox.

For further instruction refer to "Dismantling and Reassembling Differential Assembly".

Attention: Take care that when putting on the gearbox casing top you do not bend the shim. If more than one shim is required, the thicker shim should preferably be installed on the outer side.

8. Install the reverse idler gear so that the beveled sides on the tooth flanks face outward (Fig. 2 - 4/3).

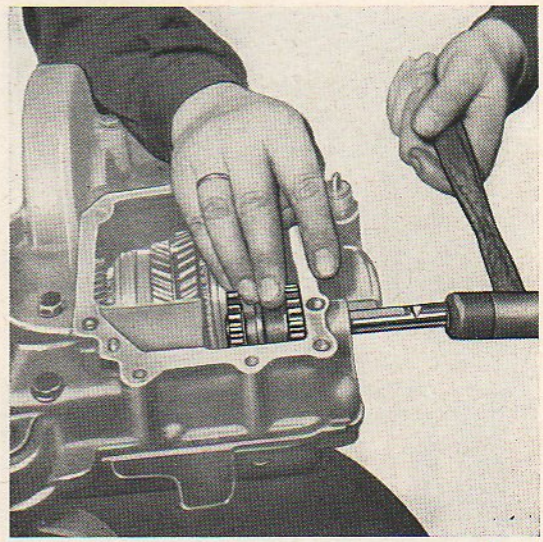
Shift fork, reverse gear



Idler gear pin **Idler gear** 2 - 4/3

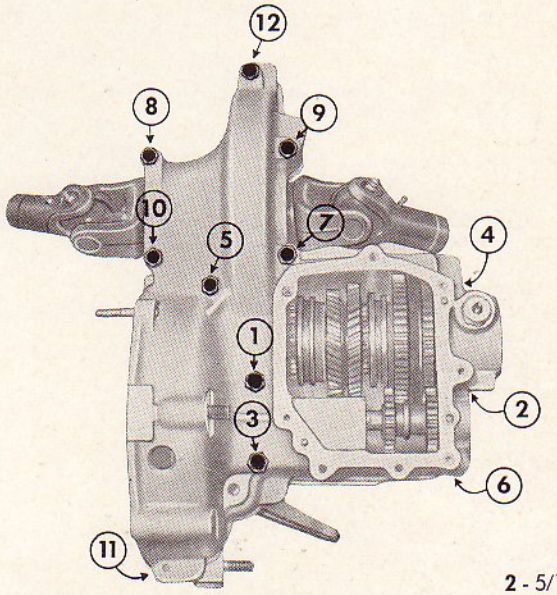
When driving in the oiled idler pin, hold the idler gear against the outer casing wall so as to avoid damaging the bronze bush in the idler gear.

The oil groove and notch of the bolt must be on the upside (Fig. 2 - 4/4).



2 - 4/4

9. Screw together the gearbox casing top and bottom parts and tighten the screws at a torque of 2.5 mkg in the order shown in Fig. 2 - 5/1.



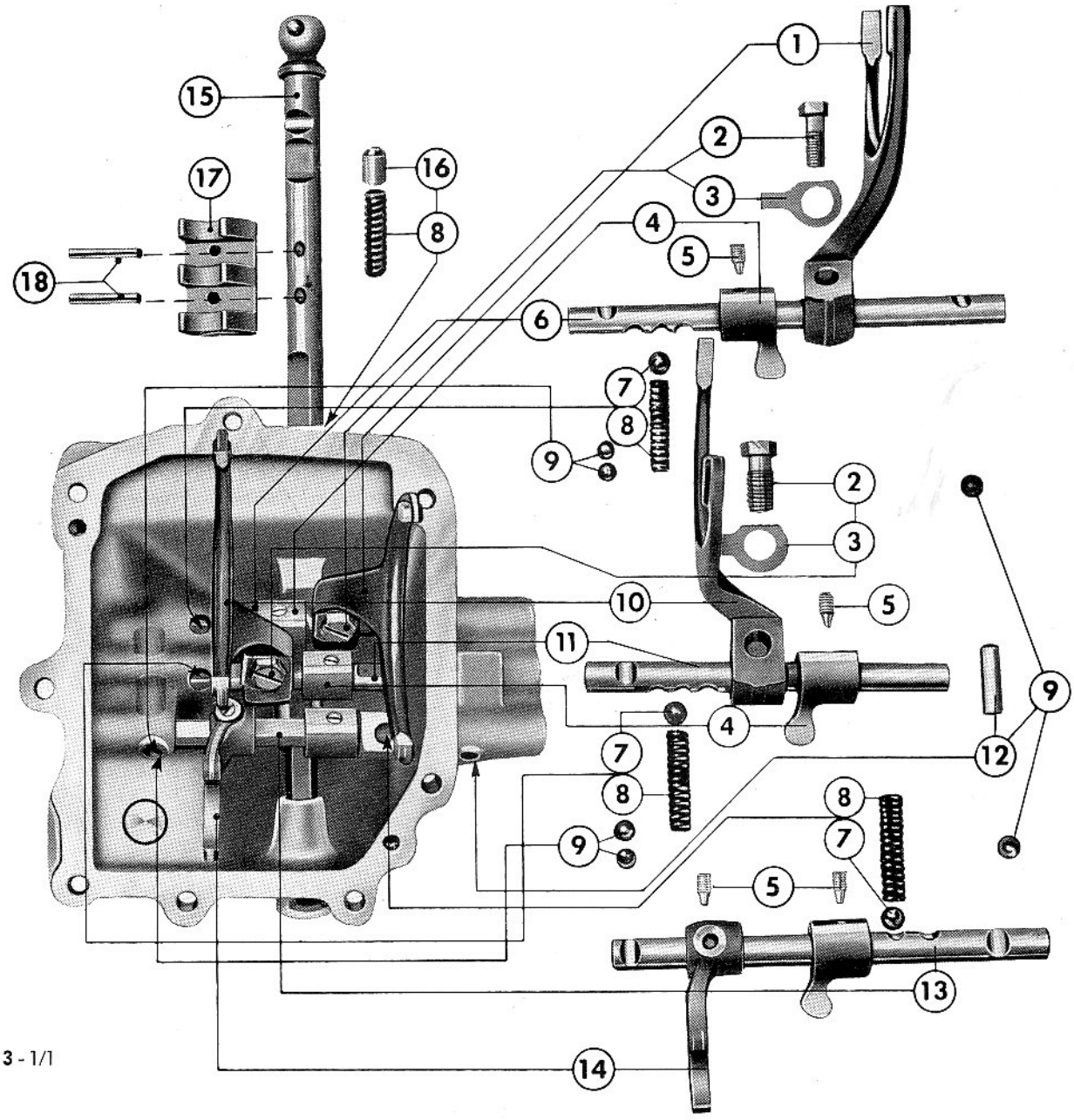
2 - 5/1

Construction

In the gearbox cover three shift forks are fitted each to one shift rod. The shift forks are actuated by their respective dogs through shift fingers.

The shift rods are held in their positions relative to the gearbox cover by a spring - and - ball arresting device **(speed arrester).** Between the three shift rods locking devices are provided **(internal and external shifting locks)** which when one shift rod is actuated prevent the others from moving.

The reverse gear is secured by a spring lock from being engaged inadvertently.



3 - 1/1

1. Shift fork, 3rd and 4th speed
2. Hexagon-head screw, slotted (2 each)
3. Lock washer
4. Shift finger (3 each)
5. Threaded pin (4 each)
6. Shift rod, 3rd and 4th speed
7. Ball, 8 mm diam. (3 each)
8. Arresting spring (4 each)
9. Ball, 7 mm diam. (6 each)
10. Shift fork, 1st and 2nd speed
11. Shift rod, 1st and 2nd speed
12. Pressure pin
13. Shift rod, reverse gear
14. Shift fork, reverse gear
15. Shift-dog shaft
16. Arresting pin
17. Shift dog
18. Fastening pin (2 each)

Removing and Refitting the Gearbox Cover in the Car

The gearbox cover may be removed and refitted in the car. Unbolting and pulling forward the power and drive assembly, as was necessary with the three-speed gearbox, is no longer required.

Removing the gearbox cover can only serve the purpose of checking the gears, shift forks, etc. A removal or exchange of the gearbox cover parts cannot be effected without dismantling the gearbox because the shift forks must then be re-aligned. This latter operation, however, can only be performed with the gearbox removed from the car and partly disassembled.

General Remarks on Aligning the Shift Fingers and Forks

Readjustment of one or both forward-speed shift forks is necessary if

- the complete gear-shifting shaft is replaced,
- parts of the gear-shifting shaft are replaced, or
- the gearbox casing is replaced.

As mentioned before, the proper functioning of the gear-shift and the locking synchronization depends on

1. the shift fingers having the correct position relative to the shift dogs,

2. the shift forks being in the dead centre of the shift rings both in neutral or with one of the gears engaged.

Readjustment of the forward-speed shift forks may become necessary because as a result of possible structural deviations in the gearbox casing and admissible production tolerances in the gear-shifting shaft and its parts the postion of the shift rings relative to the shift forks may be affected. The friction-less movement of the shift rings in the shift forks and the proper function of the gear-shift and the locking synchronization depends, hence, to a high degree on the forward-speed shift forks being properly and individually aligned with their respective synchronizer units.

The shift-finger collars are fastened to the shift forks by threaded pins. Hence, no misalignment can occur in their transverse position relative to the shift dogs. Since the speed arrester allows a rotary motion of the shift rod, however, the shift-finger collar can swing back and forth in the same sense and so take up various positions within the shift dog (i. e. in its longitudinal direction).

With the shift-finger collars properly positioned one of them – depending on the position of the shift dog in one of the speed-gear planes – is exactly flush with the respective shift dog whereas one of the other two is located between two dogs and the third is outside the dog. Since the shift-finger collar and the shift fork are firmly fastened to each other, the position of the shift-finger collar relative to the shift dog can only be readjusted by turning the shift rod in the clamp fastening of the shift fork.

The reverse-gear shift fork is fastened, in like manner as the shift-finger collars, to its shift rod by means of a threaded pin and does not require any adjustments.

The two forward-speed shift forks, however, are held to their respective shift rods by means of clamping screws. They are, hence, not firmly fastened in their position relative to the respective shift rings (on the gear-shifting shaft) and their respective shift-finger collars, but may be moved sidewise, if necessary.

When the gearbox cover is reassembled, the shift-finger collar should always be brought in its correct position first and the shift fork aligned with the gear-shifting shaft afterwards. In doing so, care should be taken that the shift rod does not turn in the shift fork during this operation or else the position, determined before, of the shift-finger collar in the shift dog will be altered.

Since with the gearbox cover completely assembled it will be difficult to determine the position of the shift-finger collars relative to the shift dogs and make any necessary adjustments and, furthermore, a readjustment of the shift forks also requires a check of the shift-finger collars, such adjustments must be made while the unit is assembled.

Therefore, after fitting the 3rd and 4th-speed shift rod the 1st and 2nd-speed rod should not be fitted unless the 3rd and 4th-speed shift fork has been aligned. Likewise, we recommend that after fitting the 1st and 2nd-speed shift rod the alignment of the respective shift fork operating these two speeds is performed and only after this operation has been completed the reverse gear shift rod should be mounted.

Readjusting the shift forks when making repairs

If the gearbox cover as fitted by the manufacturer has not been disassembled, but an exchange of the gearbox casing or the complete gear - shifting shaft has been made or parts of the gear - shifting shaft have been replaced, readjustment of one or both shift-forks for the forward speeds may become necessary. In that event, first check, by turning the gear-shifting shaft, whether the shift forks are running smoothly in the shift rings both in neutral and with any gear engaged. If a shift fork jams laterally in any gear-shift position, it must be readjusted. To this end, the gearbox cover need not be disassembled if you proceed as follows:

The slotted screw in the respective shift fork is freed from its lock washer and loosened by means of a socket wrench just enough to allow the shift fork to be moved slightly on the gear-shifting shaft by means of a strong screwdriver. It is important that the clamping effect of the screw is not undone, but only lessened or else, as mentioned above, a sidewise movement of the shift fork might also cause the shift rod to turn and, as a result, the shift-finger collar might be moved out of its proper position in the shift dog. Readjustment of the shift-finger collar, however, will require the partial disassembly of the gearbox cover.

If in readjusting the 3rd and 4th-speed shift fork the shift rod has been turned out of its proper position so that as a result of the wrong position of the shift-finger collar in the shift dog proper gear-shifting is no longer possible, the reverse-gear and 1st and 2nd-speed shift rods must be dismantled. After readjusting the shift-finger collar and the 3rd and 4th-speed shift fork and refitting the 1st and 2nd-speed shift rod the shift-finger collar and shift fork for the 1st and 2nd speeds must be realigned. The reverse-gear shift rod is then refitted without any realignment being required in its case.

If in readjusting the 1st and 2nd-speed shift fork the respective shift rod is turned out of its proper position, realignment of the shift-finger collar will only require the dismantling of the reverse-gear shift rod.

Disassembling and reassembling the dismantled gearbox cover

Disassembling

Before you start disassembling the gearbox cover, make sure that all shift forks are in neutral.

1. Unscrew breather (hinge-cap oiler) SW 10 and screw plug SW 19.

2. Drive out pin in rubber coupling for the gear-shift and shift-dog shaft (using a 3 mm drift) and remove coupling.

3. Remove gaskets.
   Make holes in the gaskets and pull them out sidewise, using a wire hook.
   Do not break them out so as to avoid damaging the drillings.

Shift rod drillings	6 gaskets, 12 mm diam.
Shifting plane arrester drilling	1 gasket, 12 mm diam.
Shifting lock (ext.) drilling	1 gasket, 8 mm diam.
Shift-dog shaft drilling	1 gasket, 14 mm diam.

4. Dismantle the reverse-gear shift rod.

   a) Drill off the punched ends of the threaded pins in the shift fork and shift-finger collar and unscrew the pins.

   b) Drive out the shift rod from the oil-filler side, using a light-alloy drift. As soon as the shift rod opens the shifting lock (int.) drilling, swing around the gearbox cover and let the first pair of 7 mm diam. balls drop out.

   c) Keep on driving out the shift rod and remove the reverse-gear shift fork and shift-finger collar.

   d) Continue driving out the shift rod, covering up (e.g. by means of a screwdriver) the speed arrester drilling to prevent the ball from flying out.
   As soon as the shift rod opens this drilling, swing around the gearbox cover and let the 8 mm diam. ball and arresting spring drop out.

   e) Pull out the shift rod all the way and take out the first 7 mm diam. ball, the pressure pin and the second 7 mm diam. ball from thes hifting lock drilling (ext.).

5. Dismantle the 1st and 2nd-speed shift rod.

   a) Drill off the punched end of the threaded pin in the shift-finger collar.

   b) Free the clamping screw of the shift fork from its lock washer and unscrew the threaded pin and clamping screw SW 11.

   c) Drive out the shift rod to the oil-filler side.
   First remove the shift-finger collar and the shift fork from the shaft. Pull out the shift rod all the way, again covering up the speed arrester drilling, and remove the 8 mm diam. ball, the speed arrester drilling, and remove the 8 mm diam. ball, the speed arrester pin and the second pair of 7 mm diam. balls of the shifting lock (int.) from the drillings. Turn the cover around accordingly.

6. Dismantle the 3rd and 4th-speed shift rod.

   a) Drill off the punched end of the threaded pin in the shift-finger collar.

   b) Free the clamping screw of the shift fork from its lock washer and unscrew the threaded pin and clamping screw.

   c) Drive out the shift rod towards the oil-filler side.

   First remove the shift fork and the shift-finger collar from the shaft. Pull out the shift rod all the way, again covering up the speed arrester drilling. Turn around the cover and let the 8 mm diam. ball and the speed arrester pin drop out.

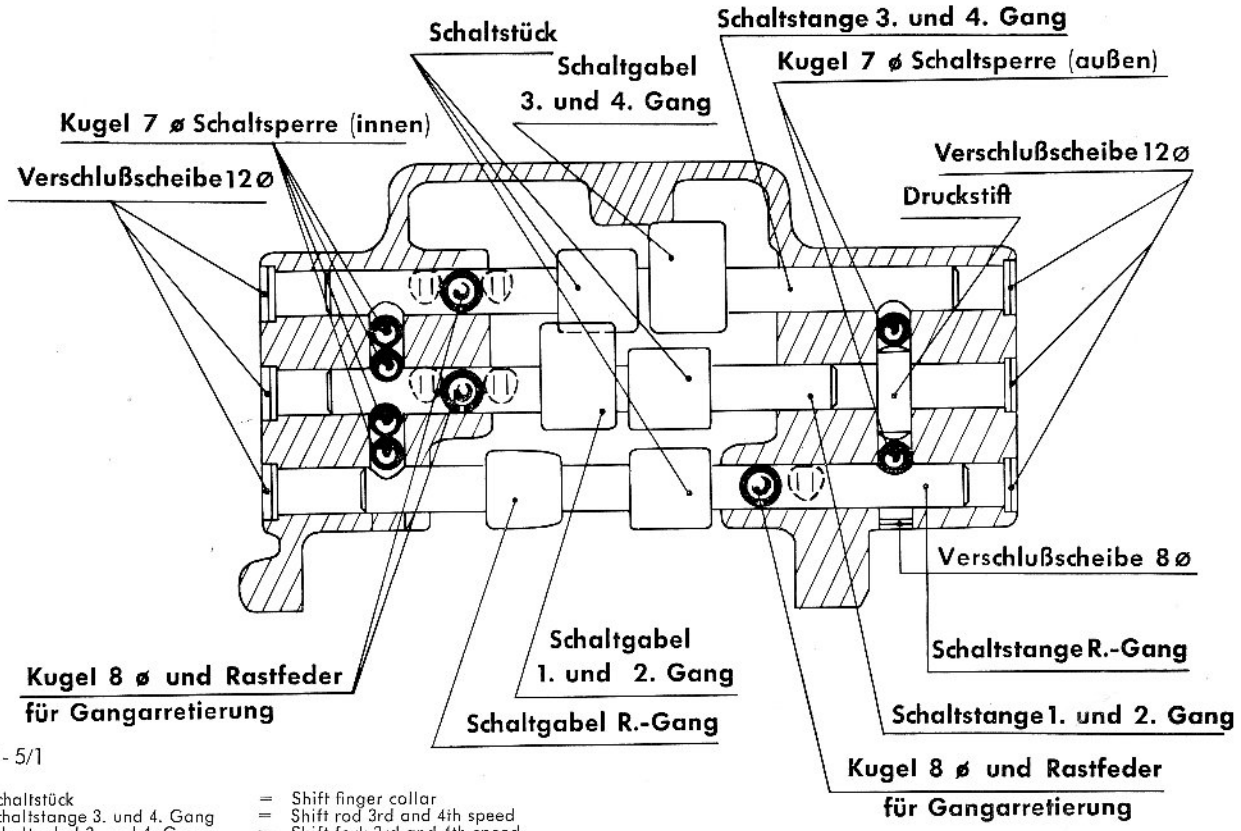
7. Dismantle the shift dog and the shift-dog shaft.

   a) Pull out the shift-dog shaft until it hints the stop (i.e. the 3rd and 4th-speed shifting plane). Drive out the lower fastening pin through the tapped breather hole by means of a 4 mm drift. Take care not to damage the thread.

   b) Push in the shift-dog shaft over the reverse-gear lock until it hits the stop (i.e. the reverse-gear shifting plane). Drive out the upper fastening pin as under 7a) above.

   c) Pull out the shift-dog shaft. Remove the shift dog.
   Attention: The arresting pin and spring of the shifting plane arrester become free and fall out.
   To avoid interchanging the balls when assembling the unit, store them by sizes and make sure that
   six (6) 7 mm diam. and
   three (3) 8 mm diam. balls
   are on hand.

Arrangement of parts for speed arresting and shifting locks in the gearbox cover



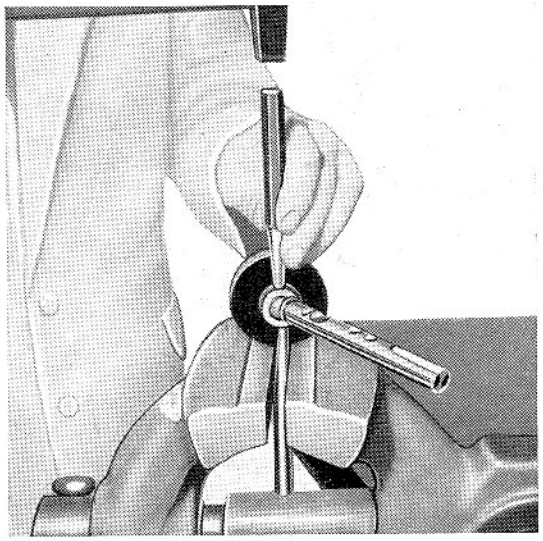
3 - 5/1

Schaltstück	=	Shift finger collar
Schaltstange 3. und 4. Gang	=	Shift rod 3rd and 4th speed
Schaltgabel 3. und 4. Gang	=	Shift fork 3rd and 4th speed
Kugel 7 ⌀ Schaltsperre (außen)	=	Ball 7 diam. shifting lock (outside)
Kugel 7 ⌀ Schaltsperre (innen)	=	Ball 7 diam. shifting lock (inside)
Verschlußscheibe 12 ⌀	=	Seal disc 12 diam.
Druckstift	=	Pressure pin
Kugel 8 ⌀ und Rastfeder für Gangarretierung	=	Ball 8 diam. and arresting spring for speed arrester
Schaltgabel 1. und 2. Gang	=	Shift fork 1st and 2nd speed
Schaltgabel R.-Gang	=	Shift fork reverse speed
Verschlußscheibe 8 ⌀	=	Seal disc 8 diam.
Schaltstange R.-Gang	=	Shift rod reverse speed
Schaltstange 1. und 2. Gang	=	Shift rod 1st and 2nd speed
Kugel 8 ⌀ und Rastfeder für Gangarretierung	=	Ball 8 diam. and arresting spring for speed arrester

Reassembling – Adjusting Shift Forks

Check gearbox cover and removed parts. Replace worn or damaged parts. Do not straighten bent shift forks, but replace.

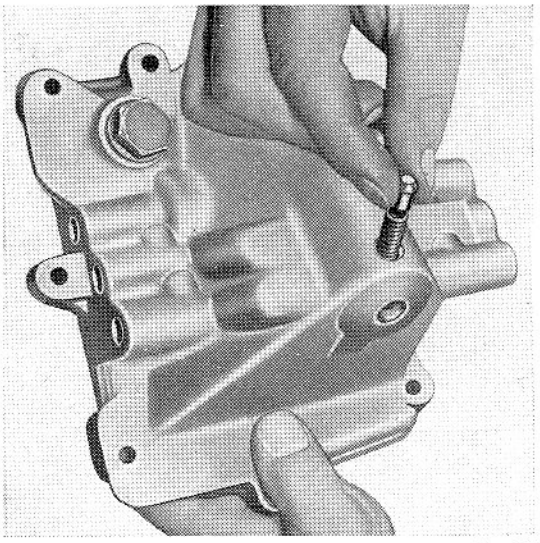
1. Fasten rubber coupling for gear shifting with new rivet pin to shift dog shaft. Expand rivet pin in true mid position with a punch (Fig. 3 - 5/2).



3 - 5/2

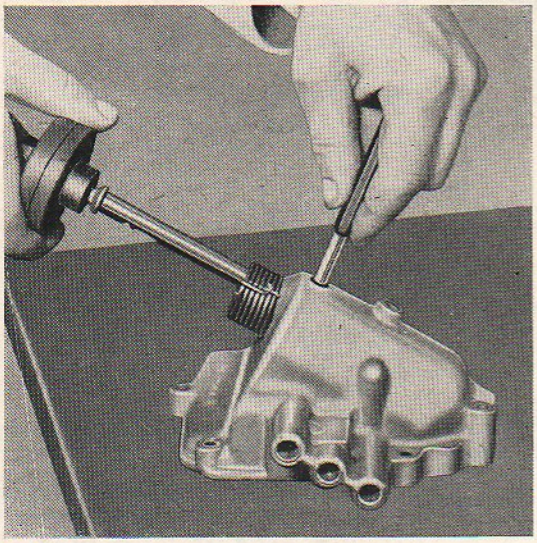
2. Install shift dog shaft.

   a) Compress compression spring for shifting with binding wire (when adjusting afterwards shift forks it is practicable to have the shift dog shaft relieved from spring pressure).



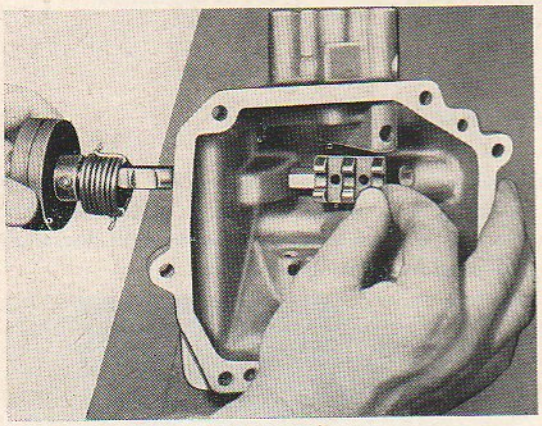
3 - 5/3

c) Press down arresting pin with a drift. Insert shift-dog shaft with slipped-over compression spring up to the middle of shaft. Give care to the position of shift dog shaft; be sure that undercuts in the shaft for the arresting device show downwards! (Fig. 3 - 6/1).



3 - 6/1

d) Push shift dog onto the shaft (introduction from either side possible as shift dogs are symmetrical). (Fig. 3 - 6/2).



3 - 6/2

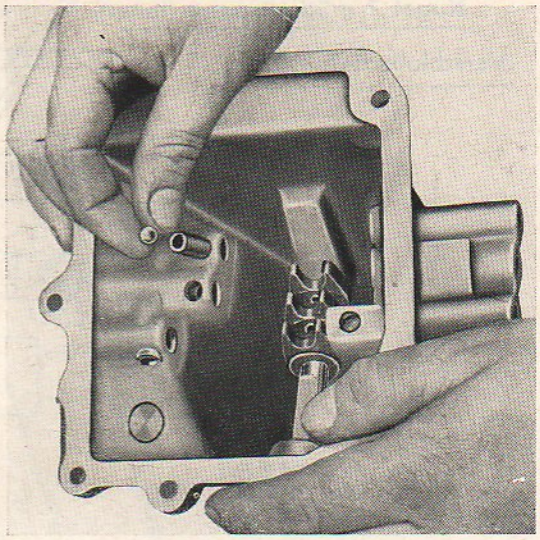
e) Press inside shift dog shaft until it catches the 1st arresting undercut (1st, 2nd, 3rd, 4th gear).

f) Secure shift dog with new tension pins to the shaft.

g) Check functioning of shifting plane arresting by repeatedly moving dog shaft.

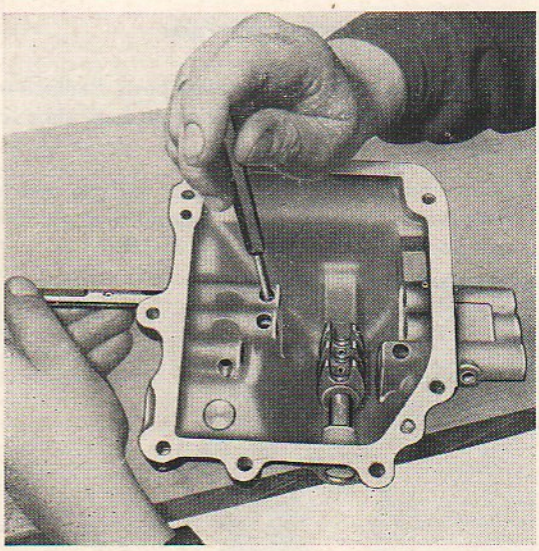
3. Install shift rod 3rd and 4th speed.

a) Insert arresting spring and 8 mm diam. ball for speed arrester (Fig. 3 - 6/6).



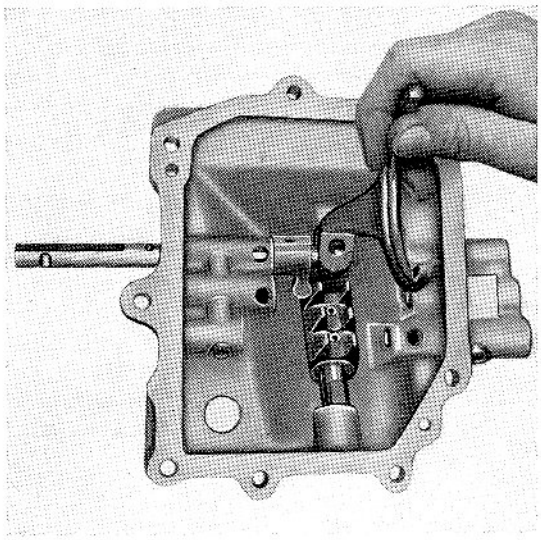
3 - 6/3

b) Insert shift rod (longest of 3 shift rods, 140 mm long) unto the middle of rod. Press down ball with drift. Give care to the position of shift rod. The 3 undercuts in the rod must show downwards that means they should face the ball for speed arrester! (Fig. 3 - 6/4).



3 - 6/4

c) Shift finger collar – finger to shift fork – (all 3 shift finger collars are alike) and put shift fork 3rd and 4th speed (cut in Part-No. 13 22 411 – 0) onto the shift rod (Fig. 3 - 7/1).



3 - 7/1

d) Push shift rod through up to neutral undercut of the speed arresting device (2nd or central undercut).

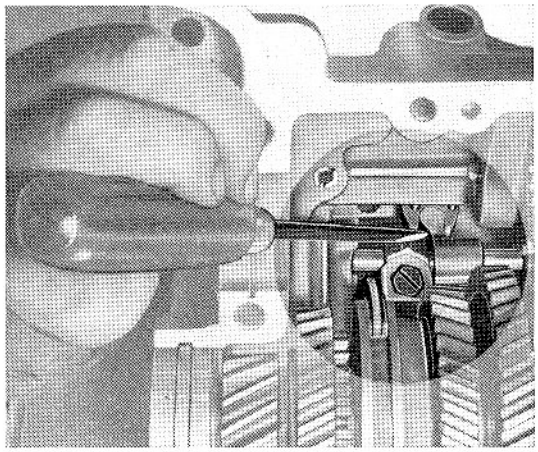
e) Fasten shift finger collar with threaded pin. Tighten well threaded pin with a convenient screw driver and thereafter secure by punch marks on both sides of screw slot.

f) **Moderately** clamp shift fork with slotted hex head bolt SW 11 – Do not forget installing lock plate. Not yet bend over lock plate.
The position of the shift fork on the shift rod is governed by the flattened surface for the introduction of the clamping screw.

4. Adjust shift fork 3rd and 4th speed in relation to shifter shaft.
For this purpose tilt over gearbox top part at the gearbox carrier (see "Shop Tools for Workshop"), install the complete shifter shaft – shift rings in neutral – and secure the gearbox cover from below with two screws. (See also Fig. 3 - 10/4). Now the shift fork must be in the groove of the 3rd and 4th speed shift ring.

a) Place shift dog in the plane of the 3rd/4th speed, that means: pull out shift dog shaft until it bears against its stop.

b) Align shift dog so that finger is flush with the respective shift dog (Fig. 3 - 7/2).



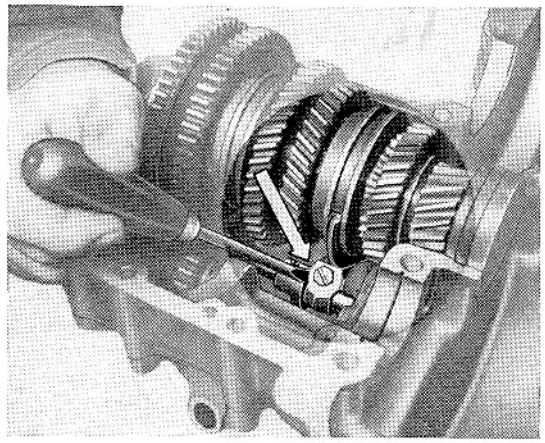
3 - 7/2

As shift finger collar and shift rod are rigidly connected to each other, this adjustment may be done only if shift rod is rotatable in the clamp connection of the shift fork, that is, when the fork has been clamped in position only moderately.

c) Turn oil-coated shifter shaft – drop also some oil into the groove of shift ring. Check whether shift ring runs in the shift fork free from friction.

If the shift fork is not in true centre position, but exerts an unilateral pressure while turning the shaft, it is necessary to have the position of the shift fork corrected by displacing it in axial direction. In doing so, proceed with delicacy, since as experience shows only very small corrections are necessary. Press shift fork and do not strike it!

A strong screw driver which – depending on the correction required – should be applied between shift fork and shift finger collar or between shift fork and cover wall, has proved best for this job. (Fig. 3 - 7/3).



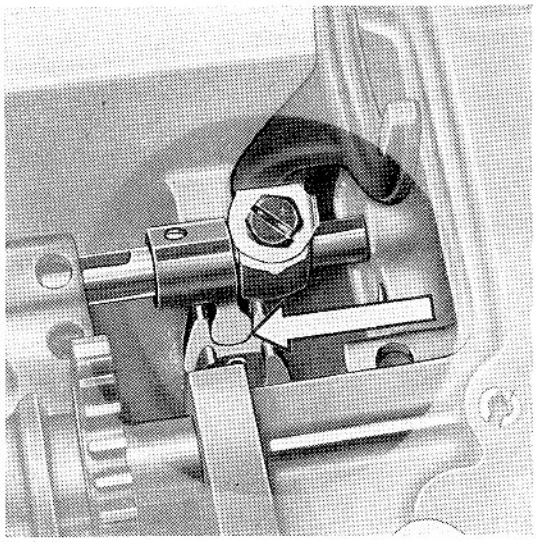
3 - 7/3

While one hand uses the screw driver as a lever, the other should turn the shifter shaft. After correction is finished, the clamping screw on the shift fork is to be firmly tightened with the screw driver. Make sure shift-finger collar is not displaced in the shift dog owing to the correctioning and tightening of the shifter fork.

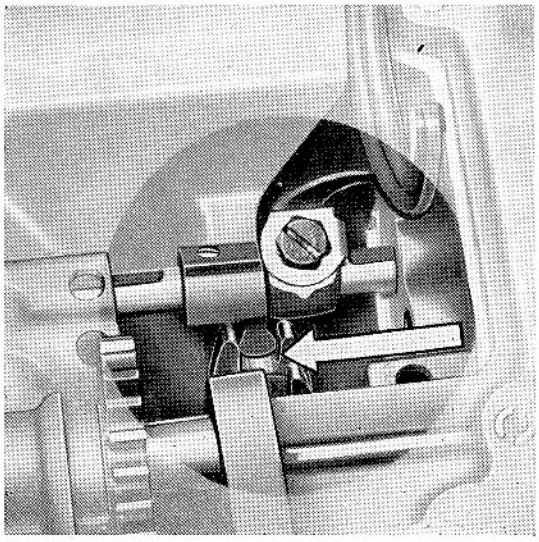
Attention! If the shift-finger collar is not flush with the respective shift dog, this may result, after moving the shift dog into the two other shifting planes or when shifting these gears, in an impediment which makes gear shifting eventually impossible.

In Fig. 3 - 8/1 is shown the correct position of the shift-finger collar.

Fig. 3 - 8/2 shows – in a widely exaggerated representation – the incorrect position.



3 - 8/1



3 - 8/2

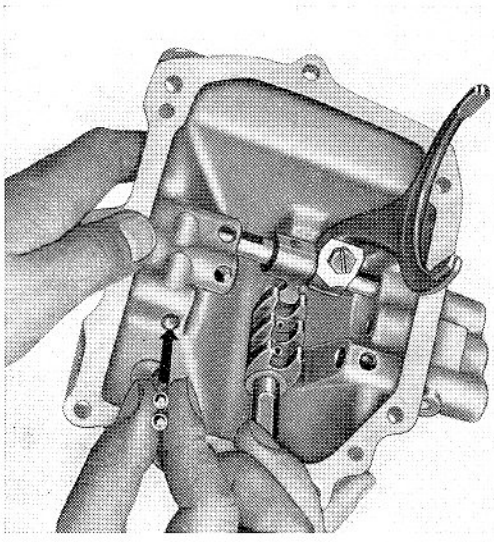
d) Shift 3rd and 4th speed into gear and check in these shift positions for free motion of the shift fork in the groove on the shaft ring by turning each time the shifter shaft.

If, with a speed shifted into gear, the shift fork exerts a pressure on one side in the shift ring, the clamping screw needs be loosened somewhat again and the position of shift fork to be corrected correspondingly.

Naturally, it is of importance in this case that, while correcting, the position of the shift-finger collar in the shift dog will not be subjected to any change!

e) If there are no troubles, neither in neutral nor in the endwise positions (speeds shifted into gear), the clamping screw should now be tightened down with a box spanner SW 11 and, after shifting all gears for a second time (by turning the shifter shaft), locked by bending over the lock plate after removal of the gearbox cover.

5. Install shift rod 1st and 2nd speed.
   a) Insert the 1st pair of balls 7 mm diam. for shifting lock (inside) (Fig. 3 - 8/3).



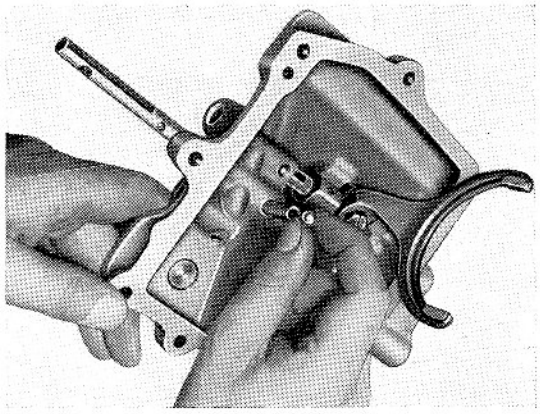
3 - 8/3

Attention! Inclination of the gearbox cover at a corresponding angle prevents.

- balls from falling down
  in the bore for speed arrester 1st / 2nd speed,
- one or both balls from rolling out
  of the still open bore for the shift rod.

b) Insert shift rod (shortest of 3 shift rods, 113 mm long) and push it over shifting lock (inside). Insert arresting spring and ball 8 mm diam. for speed arrester.

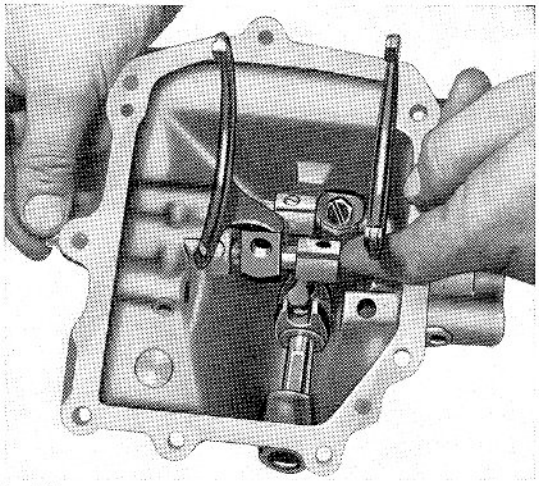
Give care to the position of shift rod. The 3 undercuts lying side by side must point downwards, that is, to the ball for speed arrester (Fig. 3 - 9/1).



3 - 9/1

c) Depress ball with a drift. Push shift rod over arresting bore.

d) Install shift fork 1st and 2nd speeds (stamped with Part-No. 13 22 402 – 0) and shift finger collar – finger pointing to shift fork – onto shift rod (Fig. 3 - 9/2).



3 - 9/2

e) Push shift rod through to neutral undercut on the speed arresting device (2nd or central notch).

f) Fasten shift finger collar with threaded pin. Tighten well and secure by punch marks!

g) **Moderately** clamp shift fork with slotted hex head screw SW 11 – do not forget lock plate. Not yet bend over lock plate.

The position of shift fork on the shift rod is governed by the flattened surface for the introduction of the clamping screw.

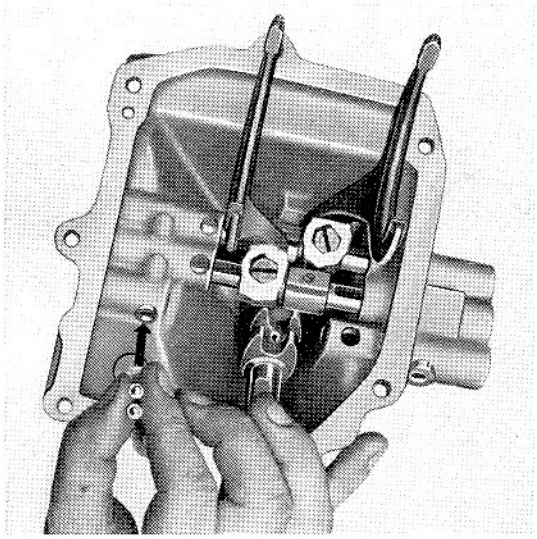
6. Adjust shift fork 3rd and 4th speed in relation to shifter shaft.

The same sequence of operations as specified under Item 4!

7. Install shift rod for reverse speed.

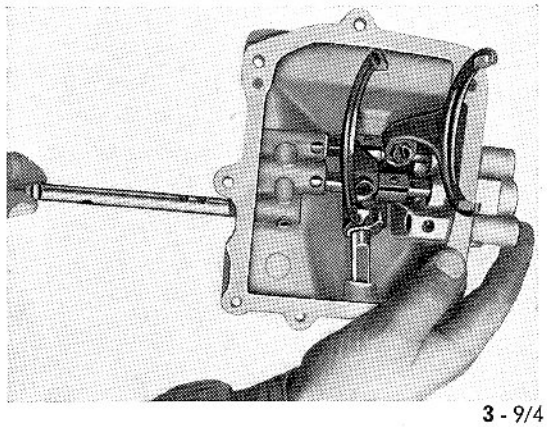
a) Insert the 2nd pair of balls 7 mm diam. for shifting lock (inside).

For this purpose tilt over gearbox cover in order to prevent one or both balls from rolling out of the not yet closed bore for shift rod! (Fig. 3 - 9/3).



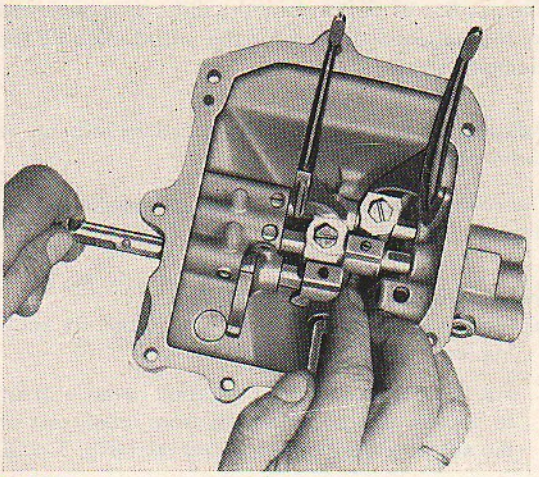
3 - 9/3

b) Push in shift rod for reverse speed half way. Give care to the position of shift rod: both undercuts lying side by side must point downwards, that is, to the speed arrester ball (Fig. 3 - 9/4).



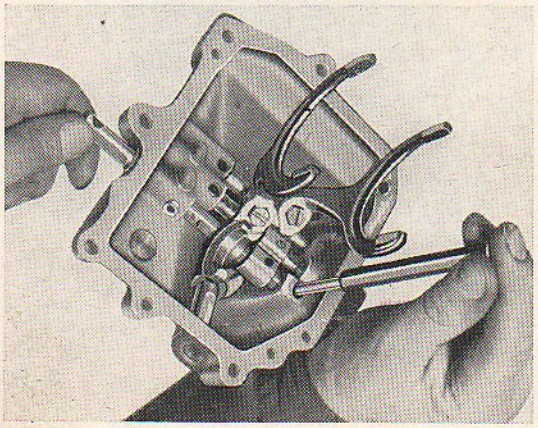
3 - 9/4

c) Put shift fork for reverse speed and shift finger collar – finger must point to the shift fork – onto the shifter shaft (Fig. 3 - 10/1).



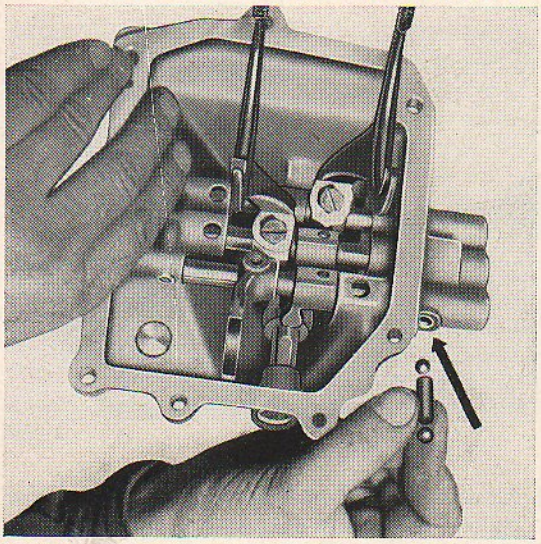
3 - 10/1

d) Insert arresting spring and speed arrester ball, 8 mm diam. Depress balls with a drift and push shift rod through to the bore for shifting lock (outside) (Fig. 3 - 10/2).



3 - 10/2

e) Insert 1st ball 7 mm diam., pressure pin, 2nd ball 7 mm diam. for shifting lock (outside) (Fig. 3-10/3).

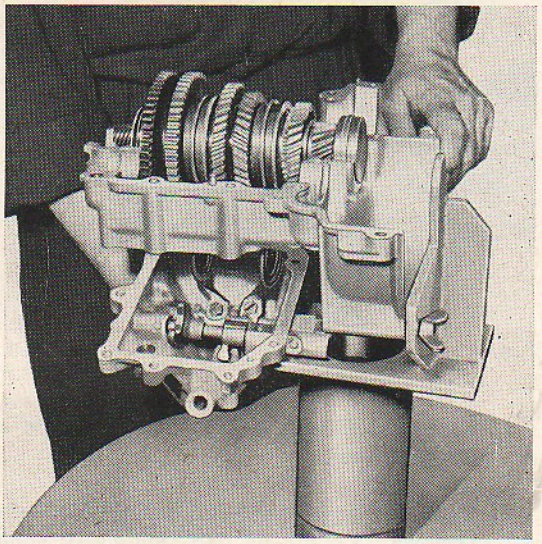


3 - 10/3

f) Push shift rod through to 2nd undercut (neutral position).

g) Secure shift fork and shift finger collar with threaded pins. Well tighten and secure with punch marks!

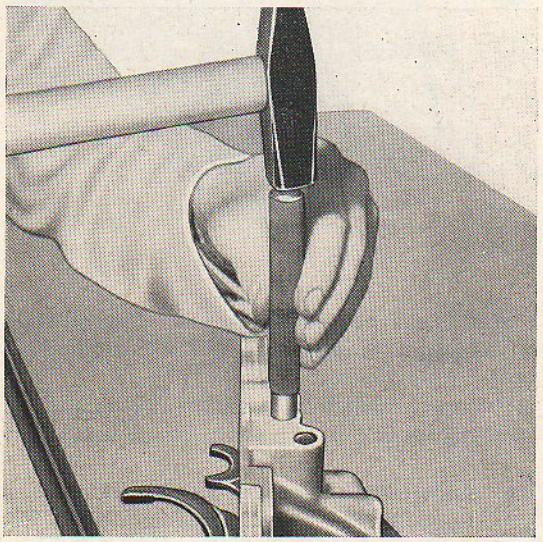
8. Reinstall and bolt together reassembled gearbox cover to the gearbox top part from below. Check gear shifting and arrangement of shift fork. (Fig. 3 - 10/4).



3 - 10/4

9. Separate with a pair of nippers wire clip of compression spring for gear shifting. Remove wire and put spring in proper functional position. Thereafter, check once again gear shifting and position of shift fork.

10. Remove gearbox cover from top part of gearbox and close bores for shift rods, shift dog shaft, shift plane arresting and shifting lock (outside) with new sealing plates (Fig. 3 - 10/5).



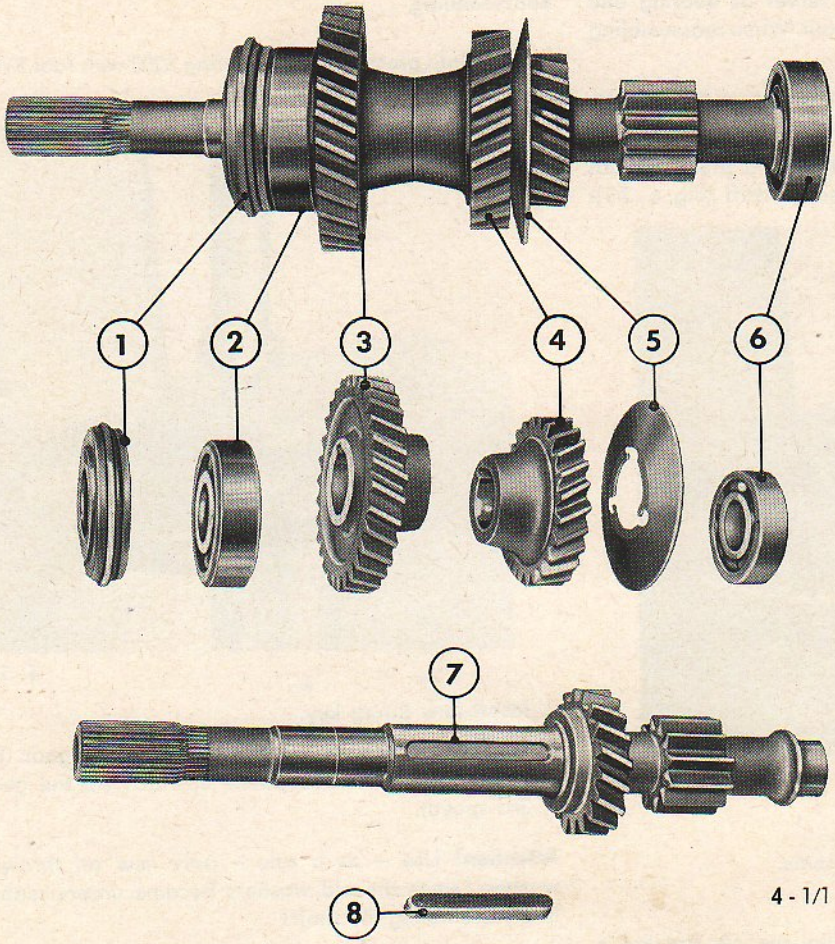
3 - 10/5

a) Undercuts in gearbox cover should be given a coat of liquid sealing compound "Wevolic".

b) Insert sealing plates (with convex-shaped side outwards) and flatten out convex shape with the help of a flat-pointed drift by striking with a hand hammer. Thus, plate becomes straightened so that sealing of the bore is achieved. Do not hammer sealing plate completely plane, otherwise the undercuts in the gear cover will suffer damage!

Attention! In order to obtain an unobjectionable tight fit, it is essential that an exactly matching drift will be used. Therefore, drifts of 8, 12 and 14 mm diam. should be available!

11. Screw in screw plug and breather. Do not forget fitting sealing rings!



1 – Ring retainer for sealing ring (with sealing ring 17 x 35 x 8 and cord ring 17 x 35 x 8 and cord ring 38 diam. x 3).

2 – Grooved bearing 6303.

3 – Gear 4th speed.

4 – Gear 3rd speed.

5 – Oil thrower washer.

6 – Grooved bearing 6203.

7 – Drive shaft.

8 – Fitting key A 6 x 6 x 45.

4 - 1/1

Disassembling and Reassembling Drive Shaft removed from Car

The following special tools and shop tools will be required:

WO 22 – Clutch assembly drift.

WO 57 – Assembly tool for radial seal on gear drive shaft (3rd and 4th speed gearbox).

SW 2 – Shop tool for self-manufacturing.

SW 3 – Shop tool for self-manufacturing.

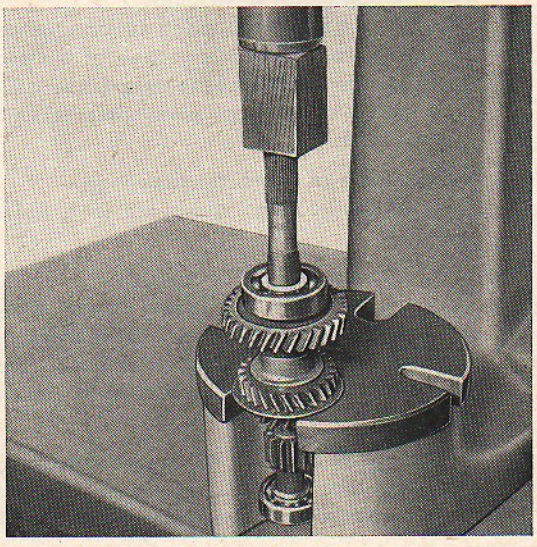
Disassembling

1. Pull off ring retainer for radial seal from shaft.

2. Remove radial seal from ring retainer. Do not damage seat in ring retainer!
   As in reassembling a new seal shall be generally used, the old ring may get ruined during dismantling.

3. Take rubber cord ring off from ring retainer.

4. Pull off gear 3rd speed including gear 4th speed and grooved bearing 6303 with a press (Fig. 4 - 1/2).

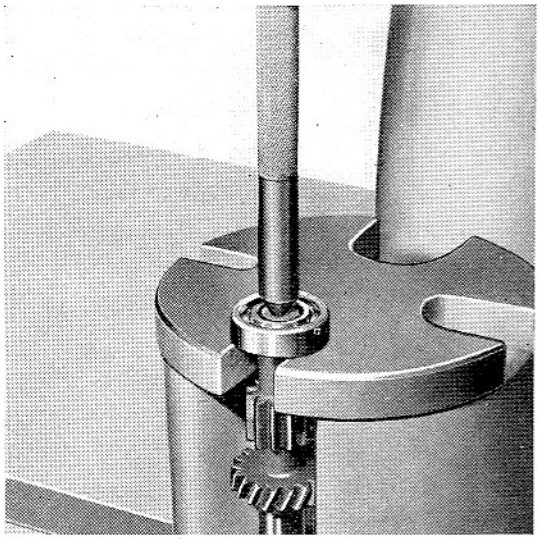


4 - 1/2

Attention! Oil thrower washer serves as bearing and will be damaged while pressing out. When reassembling change washer!

A hard wood block prevents splines from being damaged!

5. Pull off grooved bearing 6203 with a press. Special tool WO 22 is suited for use as drift (Fig. 4 - 2/1).



4 - 2/1

6. Remove fitting key.
7. Clean drive shaft and components.

   Before reassembling check

   a) the working surface of radial seal for running-in marks,

   b) the splines for wear (put on clutch disk and check radial clearance),

   c) the bearing surfaces for gears whether the necessary driving fit is still existing,

   d) the condition of the keyway for fitting key,

   e) the true running of drive shaft.
   Place shaft with both bearing surfaces on prisms and measure excentricity in way of the seat of gear 3rd speed. Permissible excentricity 0.03 mm max. In the case of not permissible excentricity replace shaft.

   f) the condition of antifriction bearings.
   Replace all bearings which are in a defective state.

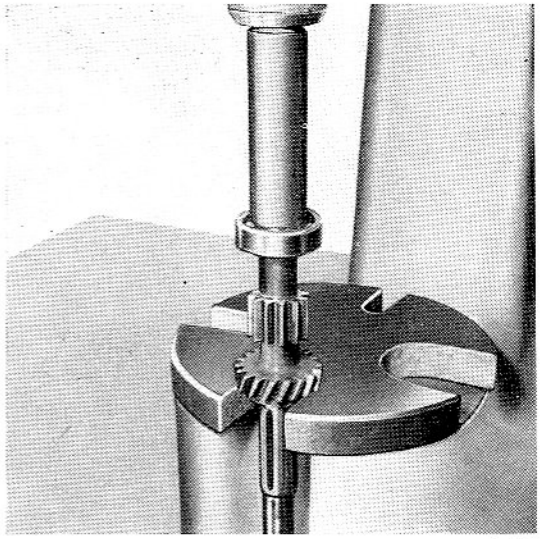
   g) gears for wear or for damage.
   If gears 1st and 2nd speed reveal signs of damage or heavy wear, a new drive shaft should be fitted. If necessary, change under all circumstances counter gears of shifter shaft simultaneously.

   In case gears 3rd and 4th speeds require to be replaced, change under all circumstances also the corresponding counter gears of the shift shaft.

   h) Give shaft and components a coat of oil.

Reassembling

1. Press into place grooved bearing 6203 with tool SW 3 (Fig. 4 - 2/2).



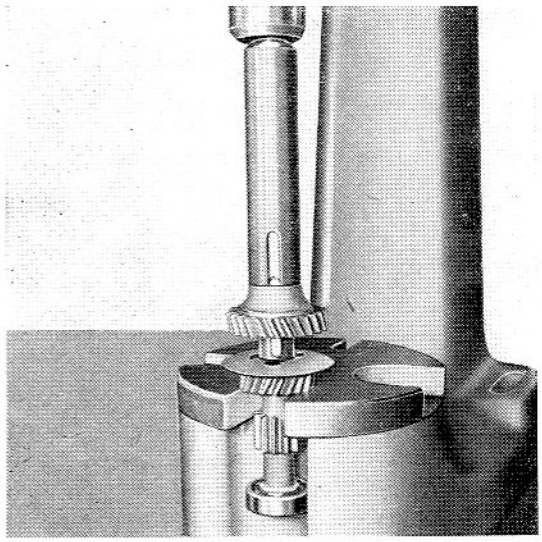
4 - 2/2

2. Insert new fitting key.
3. Fit new oil thrower washer to 2nd speed gear. Be sure that convex side points upwards (to the gear 3rd speed).

Attention! Use – as a rule – only new oil thrower washers, since the old washers become unserviceable in disassembling the shaft!

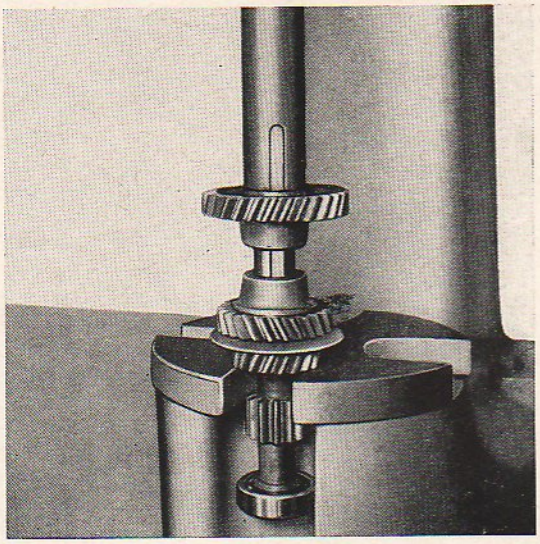
Note. Till December 1957 oil thrower washers were built in without spring noses.
If repair is required, install only washers with spring noses! See Fig. 4 - 1/1 (5).

4. Press onto the shaft gear 3rd speed with shop tool SW 2.
   Previously line up keyway in the gear and slot in the driver tube with the fitting key! (Fig. 4 - 2/3).



4 - 2/3

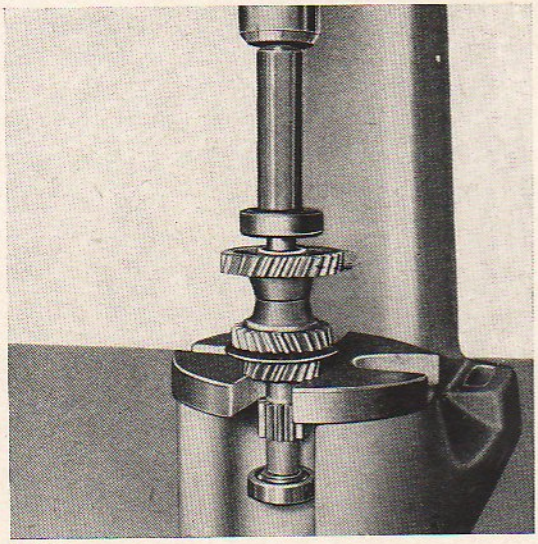
5. Press 4th speed gear onto the shaft with shop tool SW 2.
   Previously line up keyway in the gear with fitting key! (Fig. 4 - 3/1).



4 - 3/1

Attention! Be sure gears have driving fit. Prior to pressing onto the shaft heat gears to about 80° C in an oil bath.

6. Press groove bearing 6306 onto the shaft with shop tool SW 3 (Fig. 4 - 3/2).

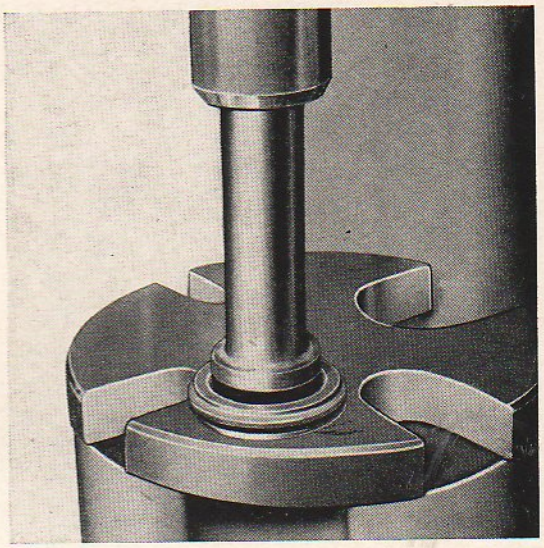


4 - 3/2

After pressing gears and grooved bearing onto the shaft make sure that all parts are tightly fitted together and the oil thrower washer is under pressing pressure.

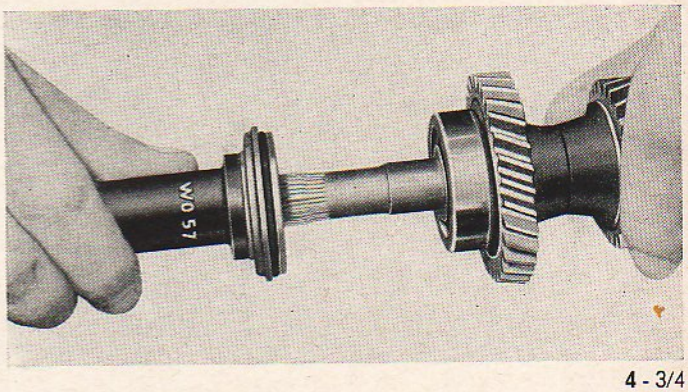
7. Put new rubber cord ring on ring retainer.

8. Press new radial seal 17 x 35 x 8 into holder ring with the help of special tool WO 57 until it bears against holder ring. Previously coat well both parts with oil (Fig. 4 - 3/3).



4 - 3/3

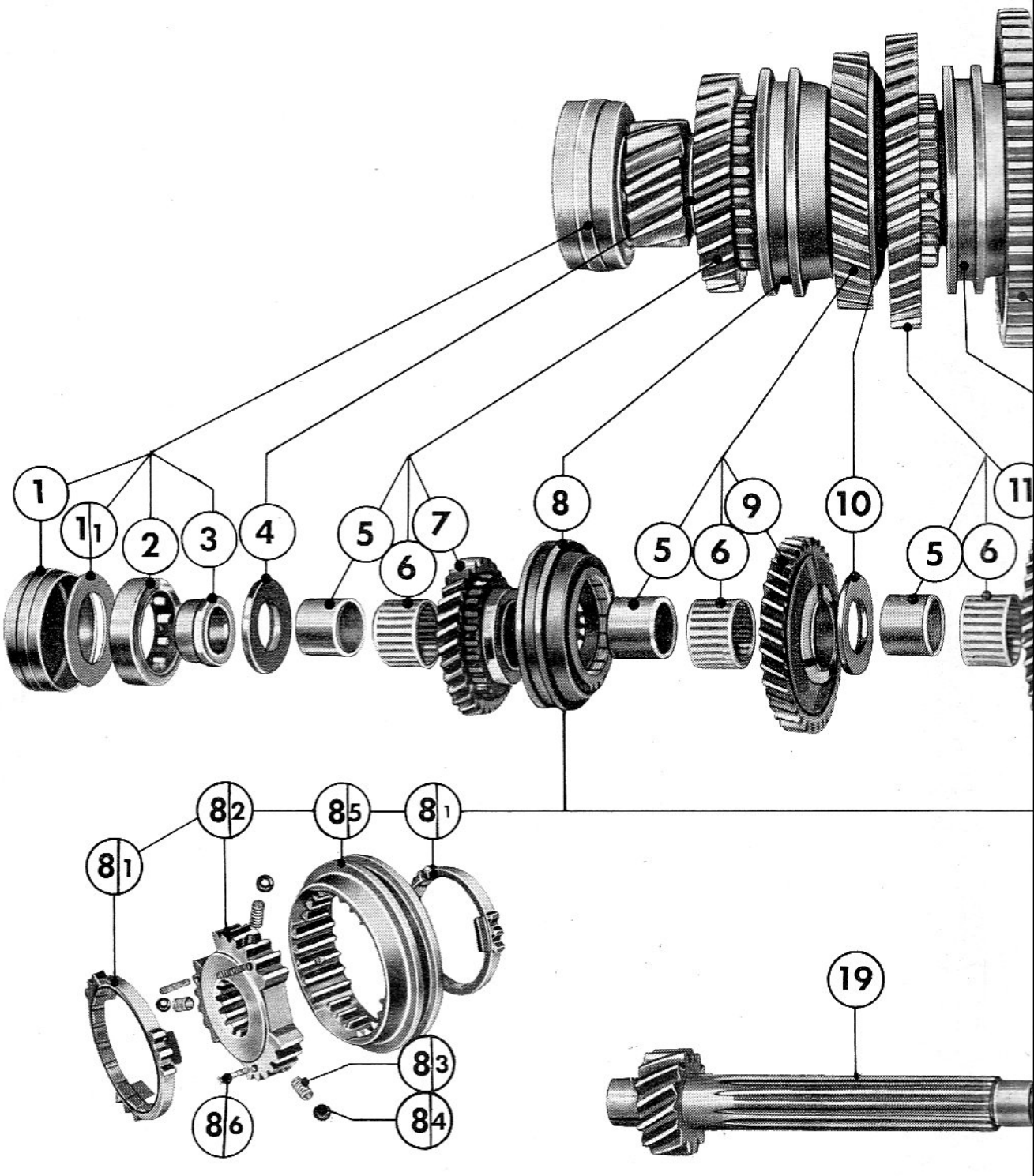
9. Push ring retainer over splines until it bears against the grooved bearing, only by using fitting tool WO 57. Lip of the ring seal should point to the grooved bearing (Fig. 4 - 3/4).



4 - 3/4

Check axial clearance of the drive shaft in the gearbox. If necessary, install shims between grooved bearing 6203 and sealing cover. For more details see section – Disassembling and Reassembling Gearbox.

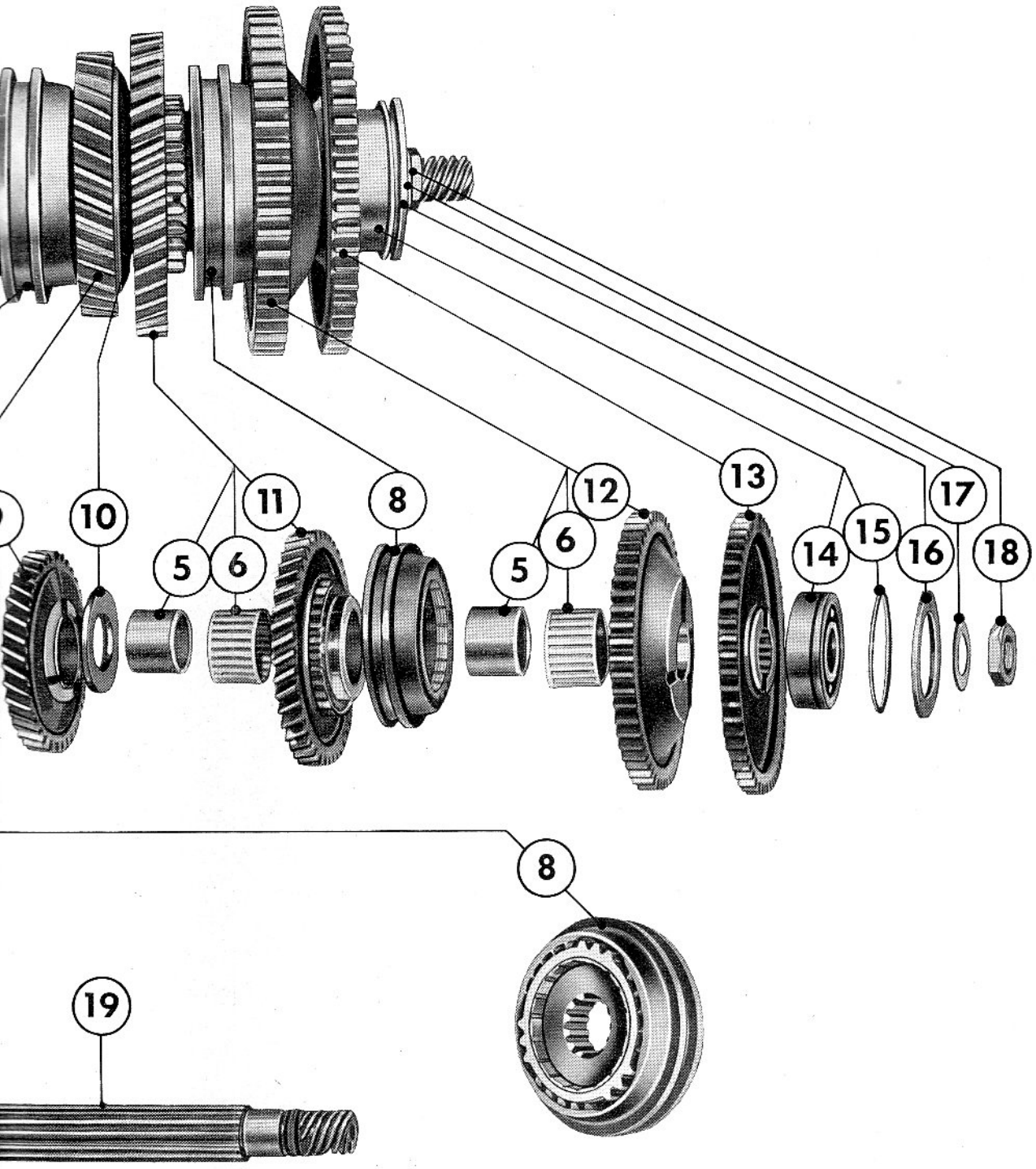
Shifter Shaft



1 – Bush for roller bearing
1/1 – Spacer
2 – Parallel-roller bearing NJM 20 DIN 5412
3 – Inner bearing ring
4 – Thrust washer
5 – Racer for needle bearing
6 – Needle bearing

7 – Shift gear 4th speed
8 – Synchronizing unit comprising
8/1 – Cone ring (2 pces.)
8/2 – Profile ring
8/3 – Compression spring (3 pces.)
8/4 – Ball 6 mm diam. (3 pces.)
8/5 – Shift ring

8/6 – Fo
9 – Sh
10 – In
11 – Sh
12 – Sh
13 – Re
14 – G



peed
nit comprising
es.)

ring (3 pces.)
(3 pces.)

8/6 – Forcing-off spring (3 pces.)
9 – Shift gear 3rd speed
10 – Intermediate washer
11 – Shift gear 2nd speed
12 – Shift gear 1st speed
13 – Reverse gear
14 – Grooved bearing 6303 DIN 625

15 – Snap ring SP 47 A DIN 5417
16 – Lock ring, 53 diam.
17 – Lock plate
18 – Hex nut M 17 x 1
19 – Shifter shaft

Disassembling and Reassembling Shifter Shaft removed from Car

(from Gearbox No. 9548)

Up to gearbox No. 9547 (included) no repair to parts or no exchange of components is permitted on shifter shaft. If the shifter shaft or parts of it is worn or damaged or if troubles in gear shifting occur, which are due to failure of the synchronization device, a new complete shifter shaft has to be installed!

The following shop tools are required:

SW 1 – Driver tube for needle bearing – Inner rings of shifter shaft.

SW 3 – Driver tube for grooved bearing on drive and shifter shafts.

SW 6 – Hole plate for shifter shaft.

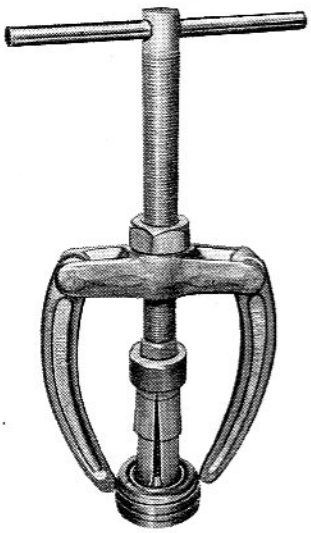
SW 7 – Slotted plate for shifter shaft.

SW 8 – Chuck for shifter shaft.

Disassembling

1. Remove lock ring 53 mm diam.
2. Remove bearing bush with roller bearing.
3. Take outer bearing ring (with cage) out of bearing bush.

   Generally, the bearing bush can be readily separated from the bearing by striking several times against the inner bushing bottom (for example, with a hammer handle). Extract roller bearing with universal internal pulling device if bearing should have a fast seat (Fig. 5 - 2/1).



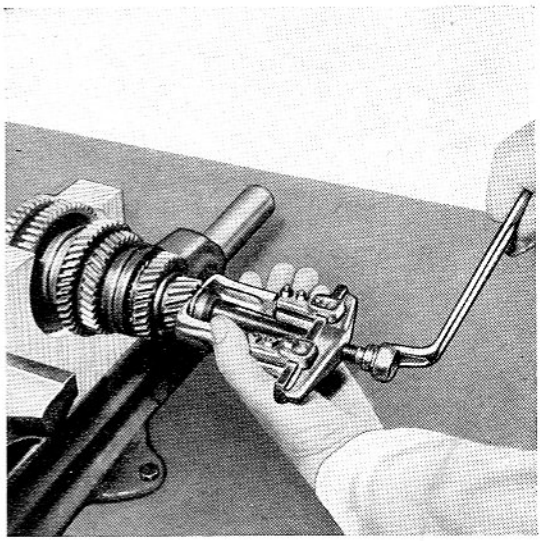
5 - 2/1

4. Take spacer out of bearing bush.
5. Pull inner roller bearing ring off with universal puller (Fig. 5 - 2/2).

   Attention! As from December 1957 there are no spacers fitted in the bearing bush.

   Old type: Measure of depth 15 + 0.2 mm.
   Spacer must be installed!

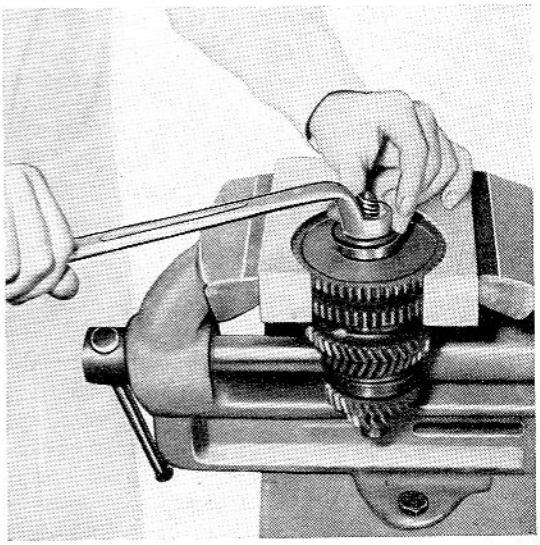
   New type: Measure of depth 13.6 + 0.1 mm.
   No spacer should be installed!



5 - 2/2

Items 3–5 are only required if roller bearing NJM 20 has to be replaced because of wear or damage.

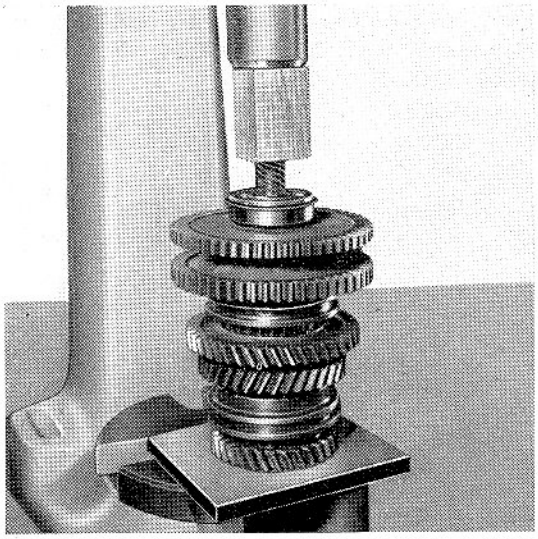
6. Clamp shifter shaft in way of reverse gear in the parallel vice by using a hard wood piece SW 8.
7. Unlock hex nut for shifter shaft SW 24 and unscrew (Fig. 5 - 2/3).



5 - 2/3

Shifter shaft

8. Press out grooved bearing 6303 (with snap ring) with a press. To do this, use hole plate SW 6 (serving as support for shift gear 4th speed). First pressing-out operation (Fig. 5 - 3/1).



5 - 3/1

Hard wood piece prevents speedometer worm from being damaged!

Remove snap ring from grooved bearing only if bearing requires to be replaced.

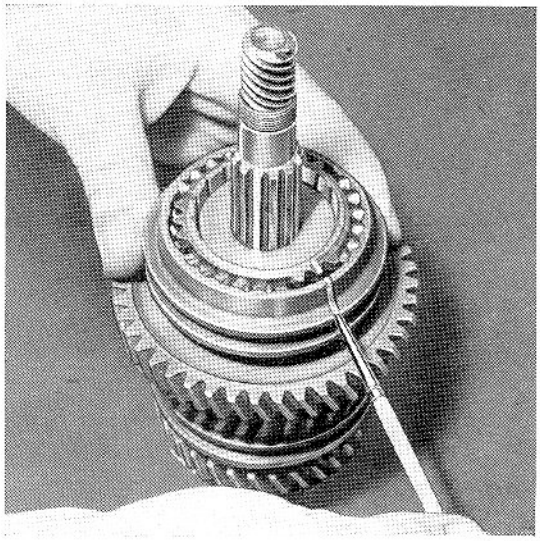
9. Take off reverse gear, 1st speed shift gear, and the necessary needle bearing cage.

10. Take 1st speed cone ring out of profile ring.

11. Pull released compression springs out of their holes in the profile ring.

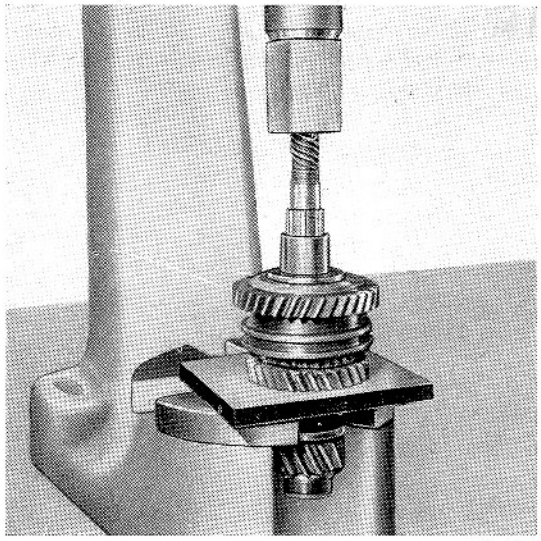
Attention! The 1st speed cone ring differs from 2nd, 3rd and 4th speed cone ring only by a minor deviation in the angle of taper of the inner cone. (Difference not visible with naked eye). This ring therefore fits only the 1st speed shift gear and is marked by a yellow spot. As it is possible that this identifying mark may disappear during service, the ring must, if necessary, identified so that no confusion may take place when reassembling.

Note. As cone and shift rings are being run in during service, it is advisable to identify these parts while removing so that parts can be reinstalled in the same order – even in respect of the direction of rotation. In reassembling each synchronization unit, the cone ring should be installed not only in its original position in relation to the pertaining shift ring, but also the same position of both parts should be realized also in respect of the direction of rotation so that the same tooth sectors will come into mesh again (Fig. 5 - 3/2).



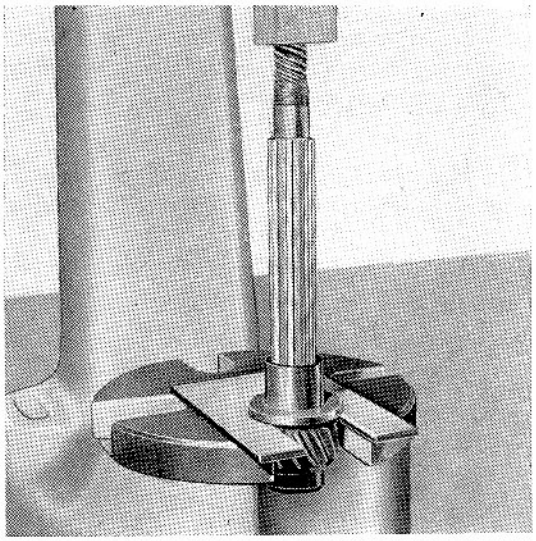
5 - 3/2

12. Remove inner needle bearing ring on shift gear 1st speed by means of a press. – 2nd pressing-out operation –.
13. Remove shift ring including profile ring, cone ring 2nd speed, shift gear 2nd speed and pertaining needle bearing cage.
14. Press off from shaft inner needle bearing ring for 2nd speed shift gear including intermediate washer with the aid of a press – 3rd pressing-out operation (Fig. 5 - 3/3).



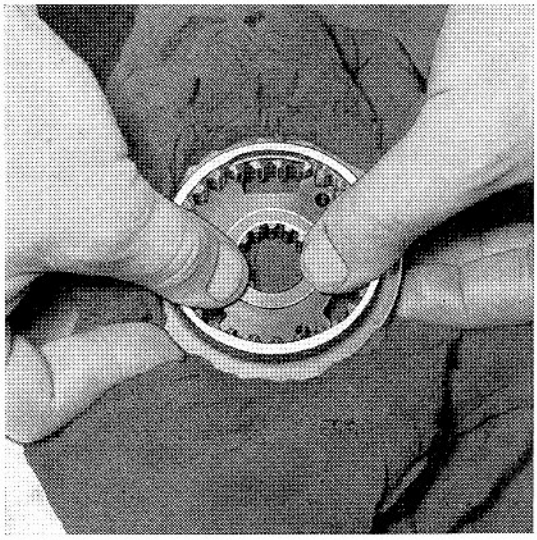
5 - 3/3

15. Remove shift gear 3rd speed and pertaining needle bearing cage.
16. Take cone ring 3rd speed out of profile ring.
17. Take released compression springs out of their bores in the profile ring.
18. Press out inner needle bearing ring for shift gear 3rd speed with the aid of a press. – 4th pressing-out operation –.
19. Remove shift ring including profile ring, cone ring 4th speed, shift gear 4th speed with pertaining needle bearing cage.
20. Press off inner needle bearing ring for shift gear 4th speed including thrust washer with the aid of a press. To do this, use slotted plate SW 7 (Fig. 5-4/1) – 5th pressing-out operation –.



5 - 4/1

21. Separate shift and profile rings. To prevent balls, 6 mm dia. which are under spring pressure, from jumping away, cover both parts with cleaning rags when pressing out the profile ring (Fig. 5 - 4/2).



5 - 4/2

22. Take compression springs from the holes in the profile ring.

23. Clean shifter shaft and components. Brush out inner cone of cone rings. (To do this, use a spark plug brush).

24. Prior to reassembly examine
    a) the helical gear for wear or damage. If necessary, change shifter shaft concurrently with large helical gear (differential),
    b) worm for speedometer drive. If necessary, change also shifter shaft and speedometer pinion,
    c) concentricity of shifter shaft. Place shaft with both bearing surfaces on prisms and measure excentricity in way of the middle of shaft. Permissible excentricity:
    max. 0.05 mm.

    Change shaft in the case of oversize excentricity,

    d) condition of antifriction bearing. If necessary, renew bearing – roller or needle bearing with inner ring,

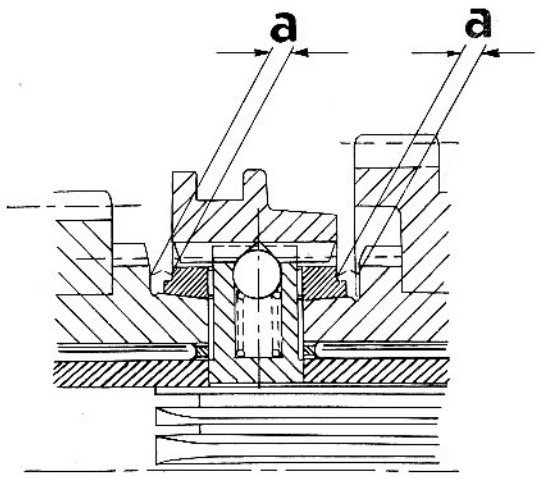
    e) shift gears for wear or damage. If damage or heavy wear have taken place change shift gears and counter gears (eventually drive shaft).
    The 3rd and 4th speed gears should be changed only by pairs,

    f) all components of synchronizing assembly particularly cone rings, for

- wear to inner cone.

  Measure distance between straight faces of toothing on shifter gear and cone ring.
  If the wear limit (measure "a") is attained, change cone ring (Fig. 5 - 4/3).

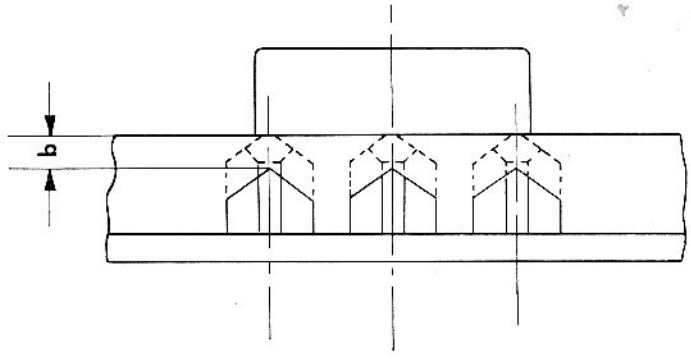
  1st speed . . . . . min. 2.6 mm
  2nd, 3rd and 4th speeds . . . . . min. 2.8 mm



5 - 4/3

- wear of tooth sectors.

  Measure tooth wear with a depth gauge. If the wear limit (measure "b" max. 0.6 mm) is attained, change cone ring (Fig. 5 - 4/4).



5 - 4/4

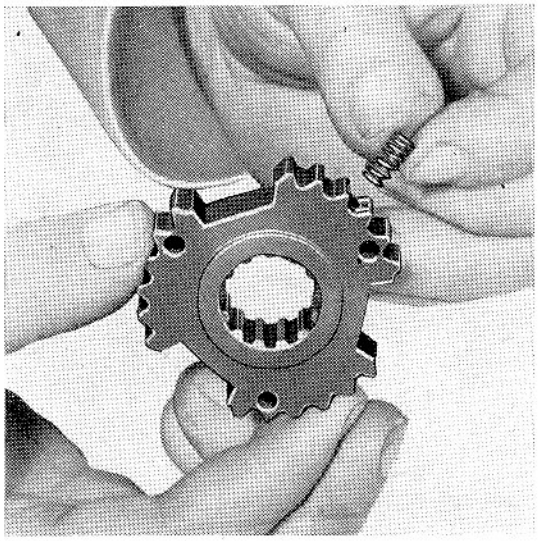
Reassembling

For reassembling proceed in the reverse order, taking care of the following points:

1. Coat with oil all parts before reinstallation.

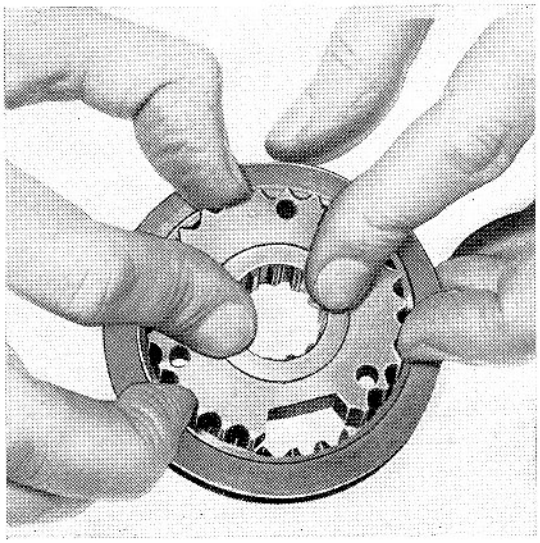
2. Heat inner needle bearing rings, spacer and thrust washer before installation in an oil bath to about 90°. Push rings and washers at one stroke quickly onto the shaft until they bear against their seatings. Work into place prematurely shrunk parts with the aid of a press. To do this, use driver tube SW 1.

3. Prior to installation of the synchronizing units, reassemble profile ring and shift ring in each case.
   a) Put compression springs 6 mm dia. into the blind holes in the profile ring (Fig. 5 - 5/1).



5 - 5/1

   b) Put balls 6 mm dia. on the compression springs. Depress balls with finger-tip and push profile ring into place without tilting until it engages within the shifter ring. (Fig. 5 - 5/2).



5 - 5/2

Apply profile ring so that tooth spaces on the profile ring, at the bottom of which are located spring and ball, are facing those shift ring dogs which in their middle carry the notch for the balls!

   c) After reassembling check by pressing the profile ring on both sides whether the balls properly engage in the notch of the shift ring.

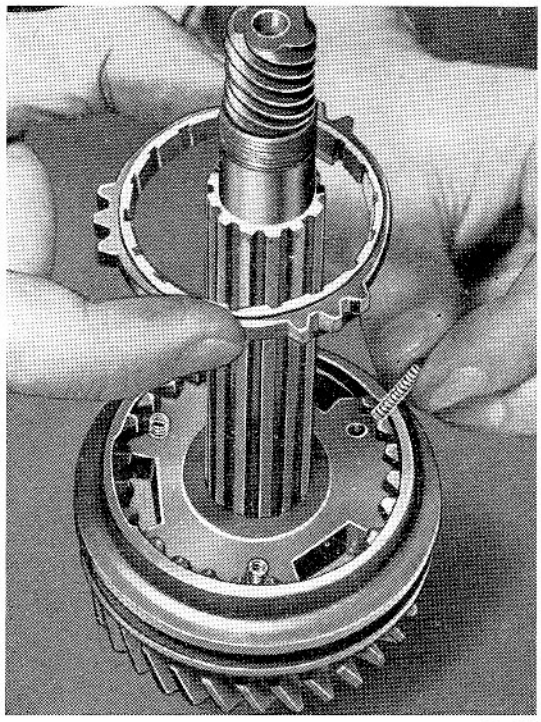
4. For the installation of both synchronization units proceed in the following order:

   a) Place 1st cone ring onto the outer cone of the already built-in shift gear. Be sure cams lie upwards, i.e.: towards profile ring

   b) Place profile ring (preassembled with shift ring) so that cams of the first cone ring come to lie in the corresponding undercuts in the profile ring.

   c) Insert forcing-off springs.

   d) Place 2nd cone ring so that its cams are facing those of the 1st cone ring (Fig. 5 - 5/3).



5 - 5/3

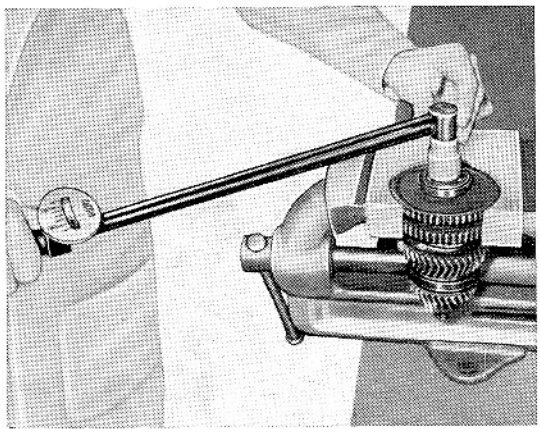
Do not confuse cone ring 1st speed with other rings.

5. Press with a press grooved bearing 6303 into place by using driver tube SW 3.
   Do not forget snap ring when installing a new grooved bearing!

6. Set new lock plate with nose in the undercut of shaft. Tighten hex nut M 17 x 1 (SW 24) with a torque of
   6 m/kg
   and lock it. (Fig. 5 - 6/1).

7. When replacing roller bearing NJM 20, do not forget spacer in the bushing! This refers only to bushings having a depth of 15 + 0.2 mm!

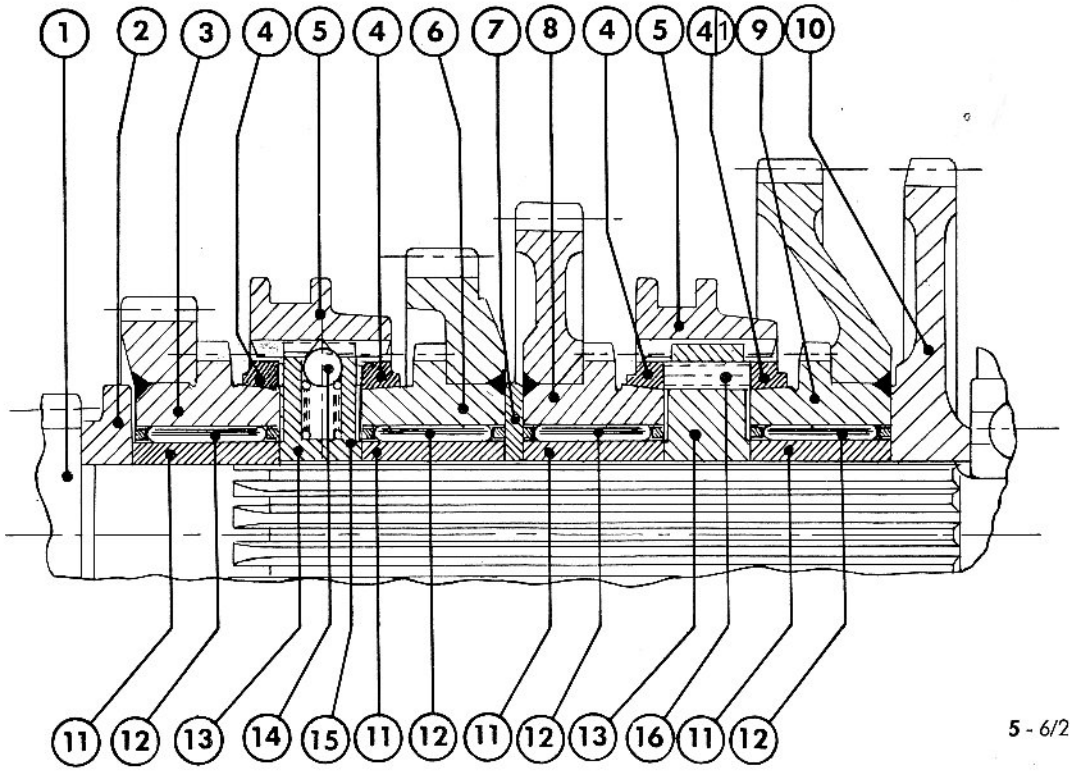
8. Check axial clearance of shifter shaft in the case. If necessary, insert shims between lock ring 53 mm dia. and outer ring of grooved bearing 6303.
   See also section "Disassembling and Reassembling Gearbox".



5 - 6/1

Sectional View of Shifter Shaft

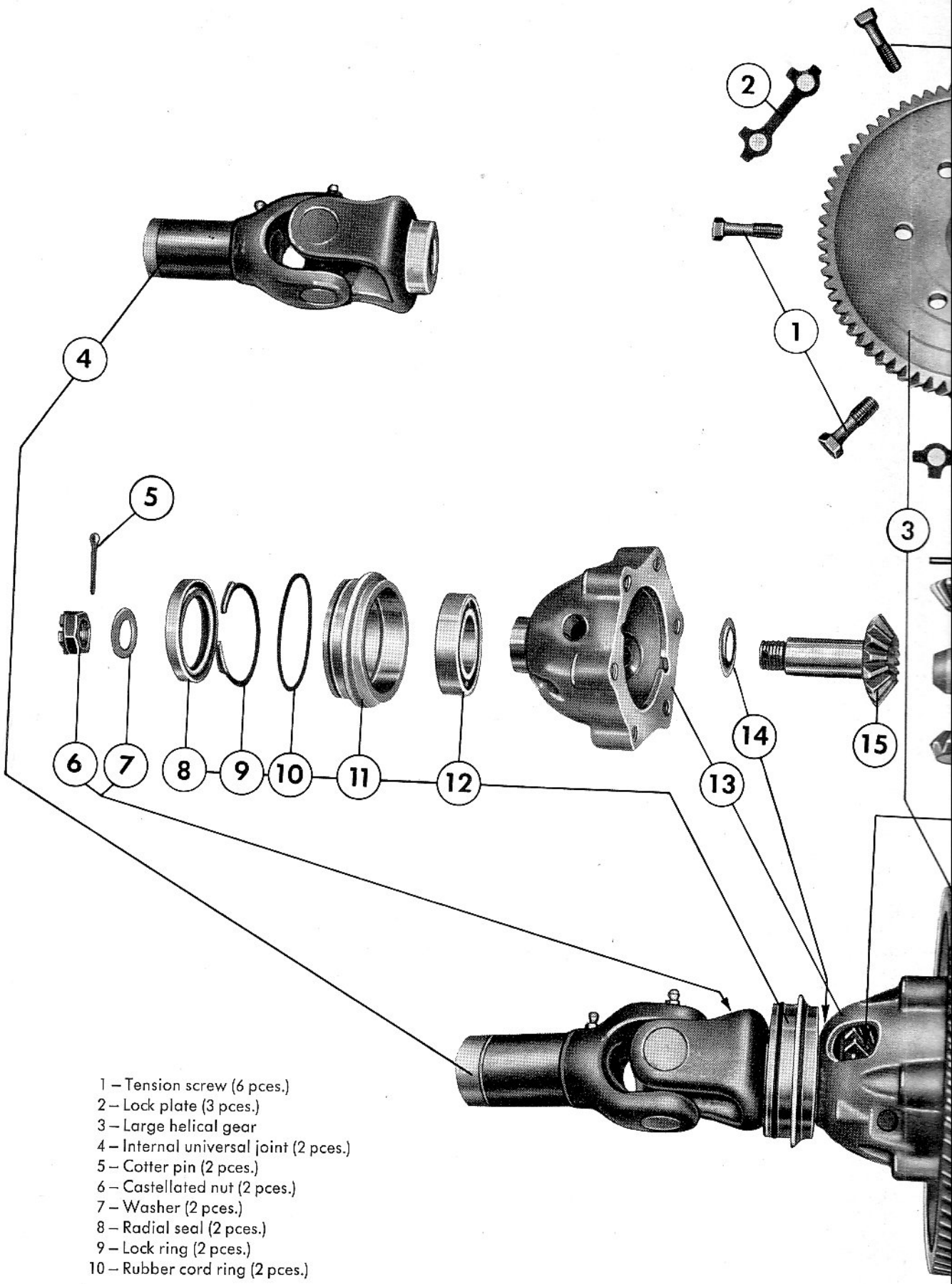
Arrangement of parts on the splined portion of shaft



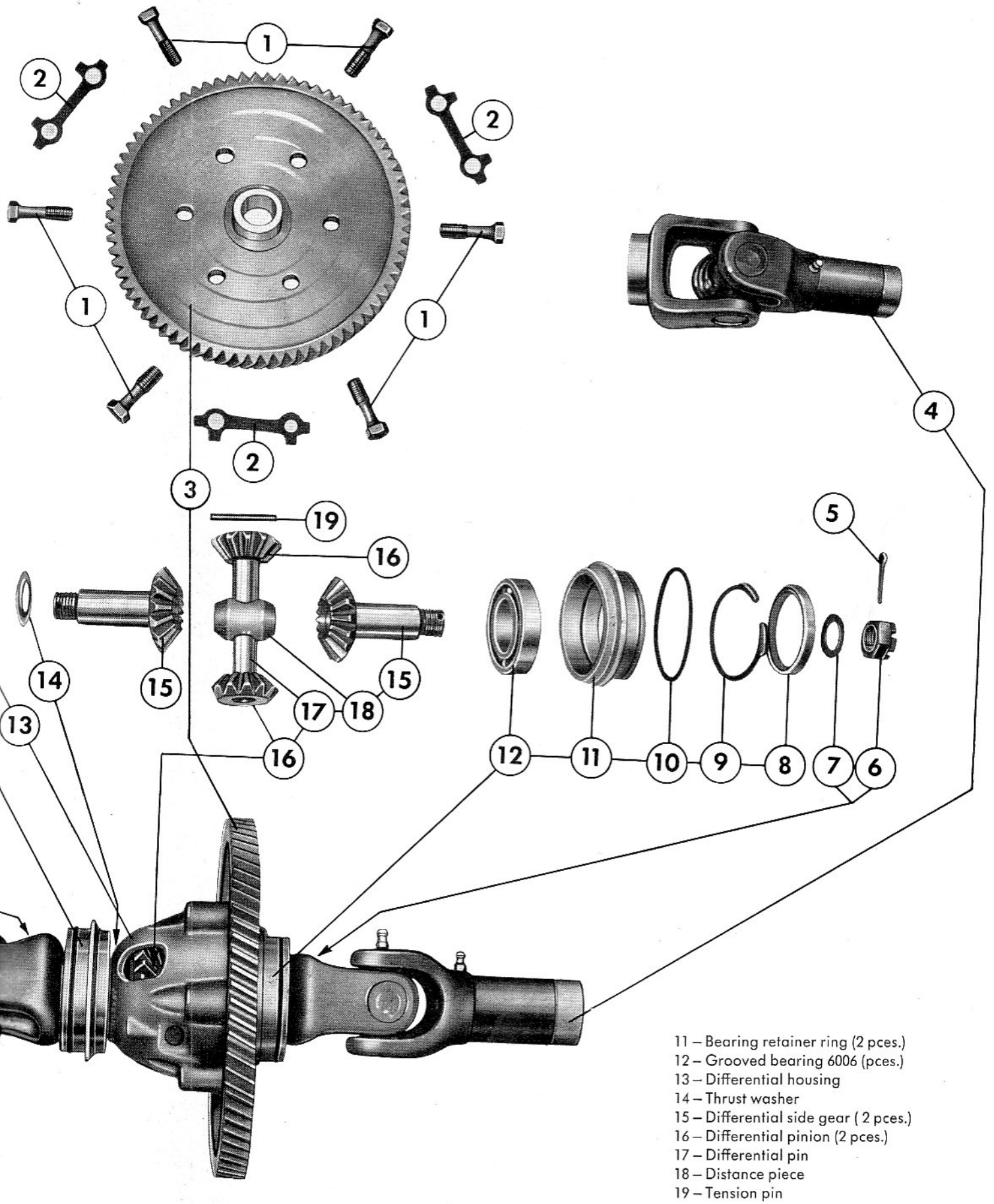
5 - 6/2

1 – Shifter shaft
2 – Thrust washer
3 – Shift gear 4th speed
4 – Cone ring (2nd, 3rd and 4th speed)
4/1 – Cone ring (1st speed)
5 – Shift ring
6 – Shift gear, 3rd speed
7 – Intermediate washer
8 – Shift gear 2nd speed
9 – Shift gear 1st speed
10 – Shift gear reverse speed
11 – Bushing for needle bearing
12 – Needle bearing
13 – Profile ring
14 – Ball 6 mm dia.
15 – Compression spring
16 – Forcing-off spring

Differential assembly



1 – Tension screw (6 pces.)
2 – Lock plate (3 pces.)
3 – Large helical gear
4 – Internal universal joint (2 pces.)
5 – Cotter pin (2 pces.)
6 – Castellated nut (2 pces.)
7 – Washer (2 pces.)
8 – Radial seal (2 pces.)
9 – Lock ring (2 pces.)
10 – Rubber cord ring (2 pces.)



11 – Bearing retainer ring (2 pces.)
12 – Grooved bearing 6006 (pces.)
13 – Differential housing
14 – Thrust washer
15 – Differential side gear (2 pces.)
16 – Differential pinion (2 pces.)
17 – Differential pin
18 – Distance piece
19 – Tension pin

Disassembling and Reassembling Differential Assembly removed from Car

The following special and shop tools are used:

WO 23 – Inner special joint remover.

WO 39 – Assembly tool for radial seal (flywheel side).

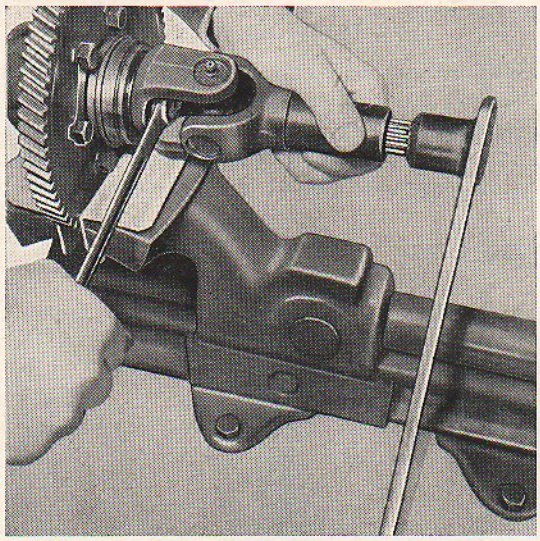
SW 4 – Shop tool for self-manufacturing.

SW 5 – Shop tool for self-manufacturing.

SW 9 – Shop tool for self-manufacturing.
(For shop tools see Sheet G 8 - 1).

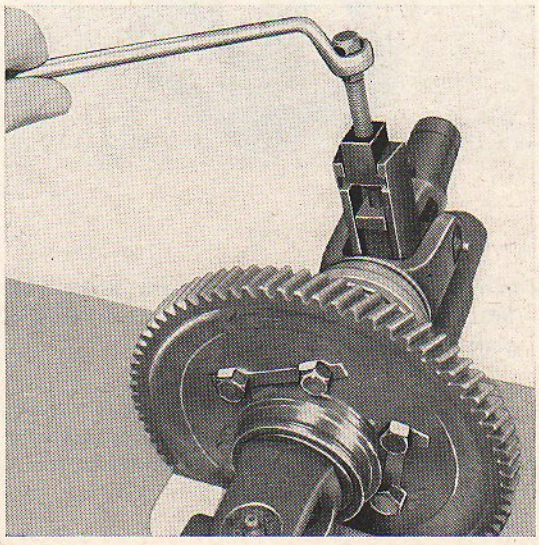
Disassembling

1. Dismount internal universal joints.
   a) Remove cotter pins from castellated nuts and lossen nuts. Hold up with tool SW 9 (Fig. 6 - 2/1).



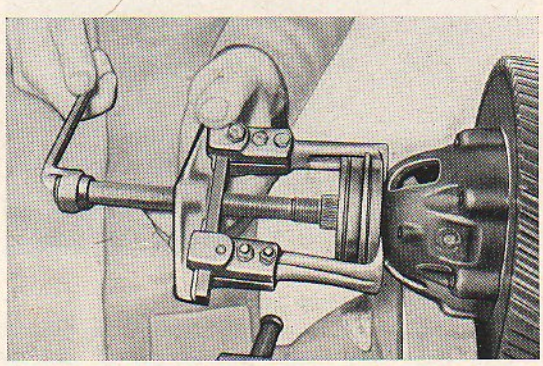
6 - 2/1

   b) Take off universal joints with the aid of special tool WO 23 (Fig. 6 - 2/2).



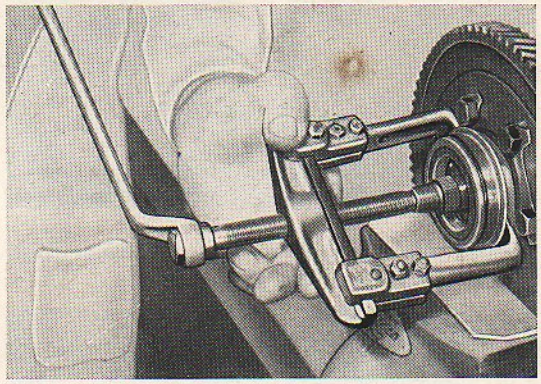
6 - 2/2

2. Remove bearing retainer rings (with grooved bearing and radial seal).
   To do this, use a suitable universal pulling device which should be applied behind the outer ring of the grooved bearing on the differential housing side (Fig. 6 - 2/3).



6 - 2/3

On the large helical gear side the hooks of the pulling device can be applied only behind the bearing retainer ring collar because of limited space (Fig. 6 - 2/4).



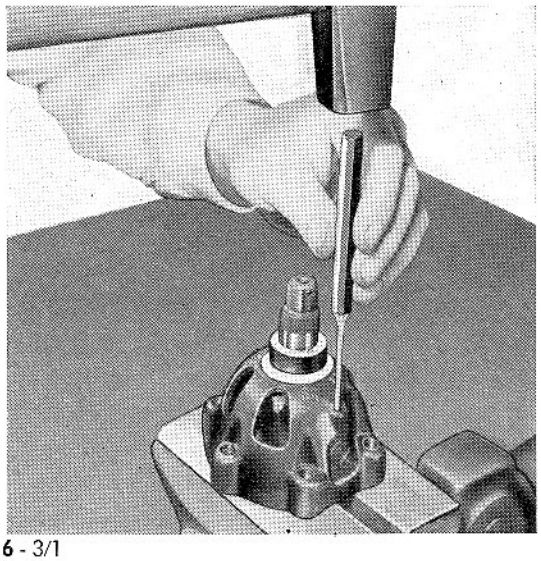
6 - 2/4

Note: Depending on the type of the available pulling device it may become eventually necessary previously to remove several tension screws in the large helical gear.

3. Unlock hex head screws (tension screws) SW 14 in the large helical gear and loosen. Remove differential housing from helical gear and pull differential side gear out of helical gear.

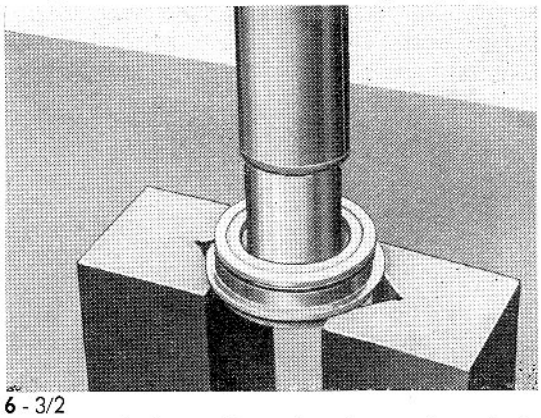
Differential assembly

4. Drive out tension pin for differential pin with a drift (Fig. 6 - 3/1).



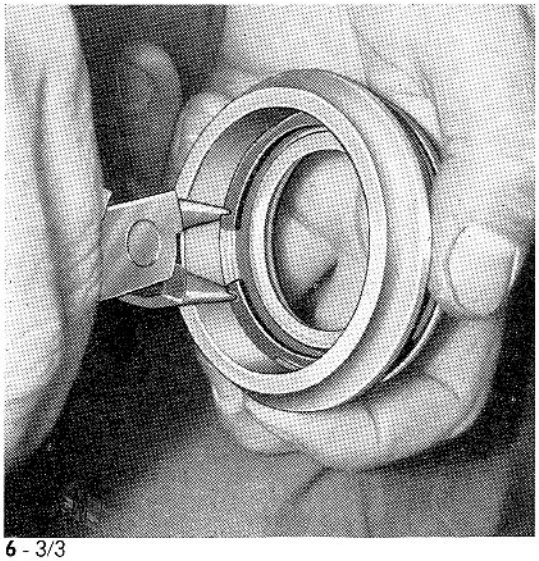
6 - 3/1

5. Drive out differential pin.
6. Take differential pinions, distance pieces, differential side gear and thrust washer out of differential housing.
7. Press grooved bearing 6006 out of bearing retainer ring with the aid of shop tool SW 4. Pressure is applied with drift on inner bearing ring! (Fig. 6 - 3/2).



6 - 3/2

8. Remove lock ring (inner bearing retainer ring) with a pair of Seeger pliers (Fig. 6 - 3/3).



6 - 3/3

9. Remove radial seal (inside bearing retainer ring). Do not damage seat in the bearing retainer ring! As in reassembling new seals shall be principally used, the old seal may be permitted to get ruined while removing.

10. Remove rubber cord ring (on bearing retainer ring).

Reassembling

1. Check cleaned parts. Replace damaged or worn parts.

   Coat all components with oil before installation.

   In examining the differential housing, pay attention to the following points:

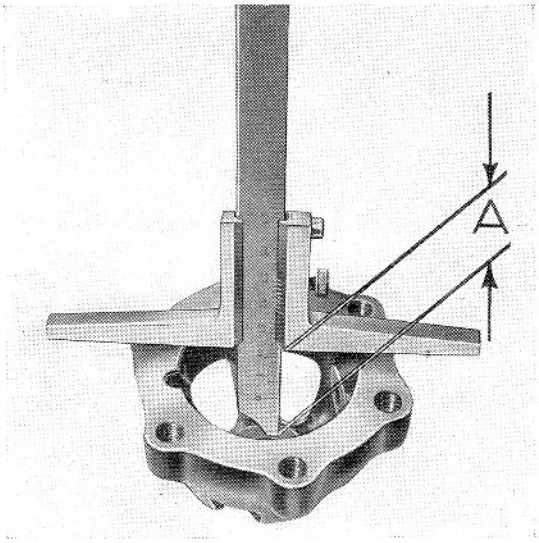
   a) the depth measure "A" in a new housing will be:

   50.45 + 0.1 mm.

   This measure may increase up to 52 mm owing to wear, but any difference should be compensated by steel washers. The distance between bearing surface in differential housing and differential side gear shall not be inferior or superior to

   0.1 – 0.3 mm

   (Fig. 6 - 3/4).



6 - 3/4

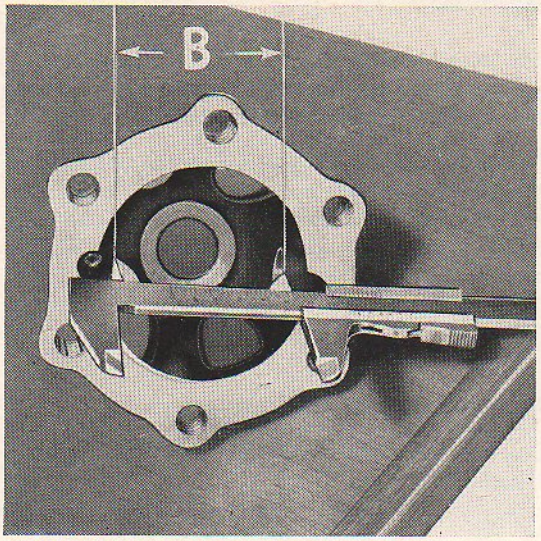
   b) In new condition the inside measure "B" between the bearing surfaces of the two differential pinion will be:

   54 + 0.1 mm

   This measure may increase up to 56 mm owing to wear, but the difference should also be compensated in this case by steel washers so that a clearance of

   0.1 – 0.2 mm

   for the differential pinions is maintained (Fig. 6 - 4/1).



6 - 4/1

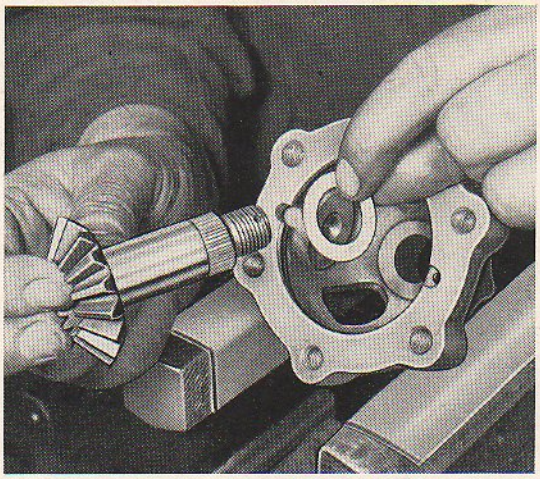
c) Be sure that the differential pin should not be damaged or out of round.

d) Diam. of pin (new) . . . . 13.983 – 13.994 mm
Bore in different.
Pinion . . . . . 14.000 – 14.018 mm
If clearance between bolt and differential pinion exeeds
0.15 mm
pinion and bolt should be replaced.

2. Reassemble differential housing.

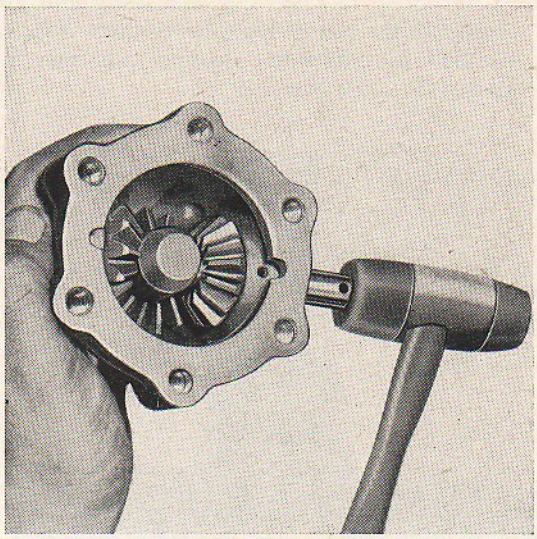
a) Insert large differential gear with interposed thrust washer (Fig. 6 - 4/2).

b) Insert differential pin.



6 - 4/2

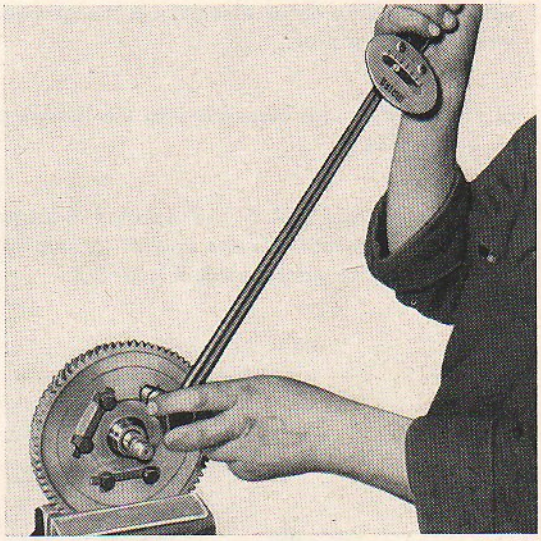
Put into position 1st differential pinion, distance piece and 2nd differential pinion on the differential pin. Drive differential pin entirely home and lock with new tension pin (Fig. 6 - 4/3).



6 - 4/3

3. Insert 2nd differential side gear in the hub of the large helical gear. Bolt together large helical gear and differential housing.
Tighten up tension pins crosswise with a torque of
4.7 m/kg
and lock them.

Use new lock plates! (Fig. 6 - 4/4).



6 - 4/4

4. Preassemble bearing rings.

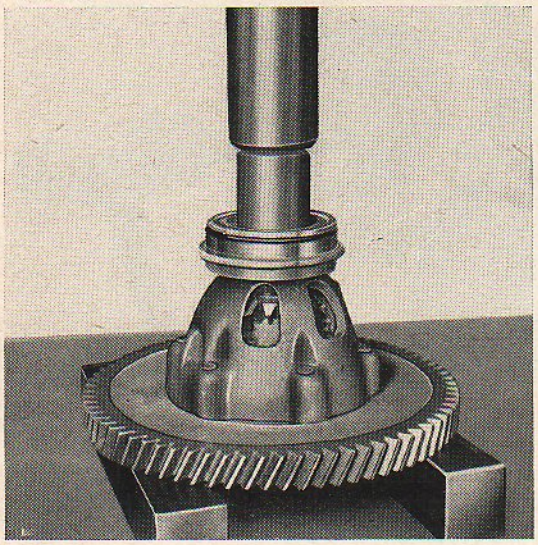
a) Insert locking ring with a pair of Seeger pliers.

b) Drive in grooved bearing 6006 until it seats against locking ring.
Special tool WO 39 is suited as driving drift.

c) Drive in new radial seal – after coating with oil, sealing lip towards inside – until it bears against locking ring.

Use special tool WO 39 as driving drift.

5. Press bearing retainer rings with shop tool SW 4 rings onto the hub of large helical gear resp. onto the hub of differential housing until they bear against the collar (Fig. 6 - 5/1).

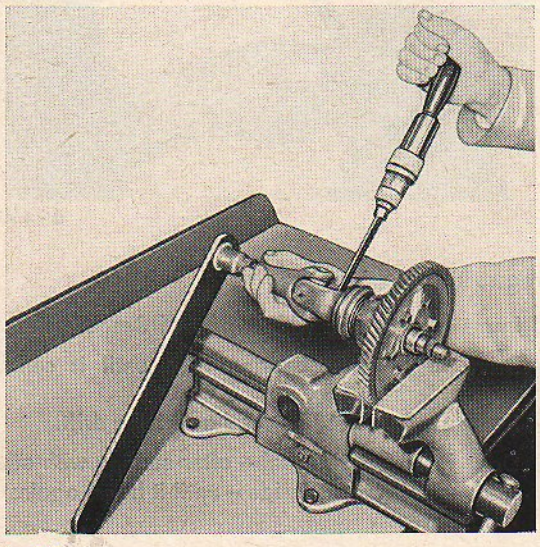


6 - 5/1

6. Before mounting the internal universal joints, check whether the differential assembly in the gearbox is mounted free of play.

   a) Place differential assembly into the bottom part of gearbox.

   b) Use shop tool SW 5 and position differential assembly so that it bears against its seating on the change speed gear side (Fig. 6 - 5/2).



6 - 5/2

This effects that:

- any eventually still existing minor clearance between grooved bearing and locking washer (on both bearing retainer rings) will be eliminated,
- the axial clearance of the differential assembly in the gearbox between housing and collar of bearing retainer ring on the engine side, which might eventually occur due to the summation of permissible design tolerances, becomes noticeable.

7. Measure clearance with feeler gauge.

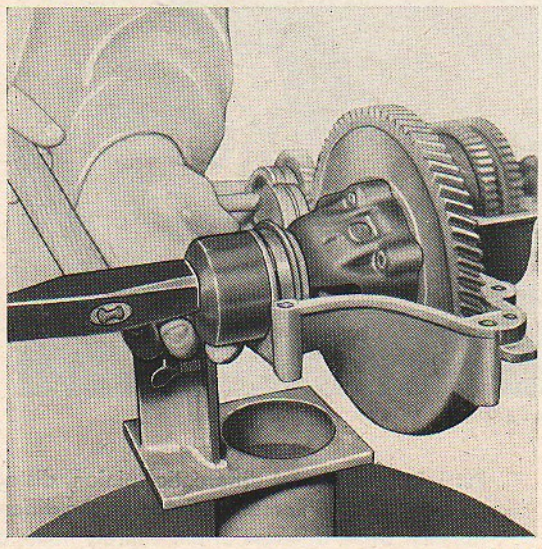
   See Section "Disassembling and Reassembling Gearbox".

8. Remove differential housing from gearbox and put into position spacers of corresponding thickness on the bearing retainer ring on the differential housing side. See Section "Disassembling and Reassembling Gearbox".

9. Put in position new rubber cord ring.

10. Install internal universal joints and secure them with new cotter pins. Hold up with shop tool SW 9!

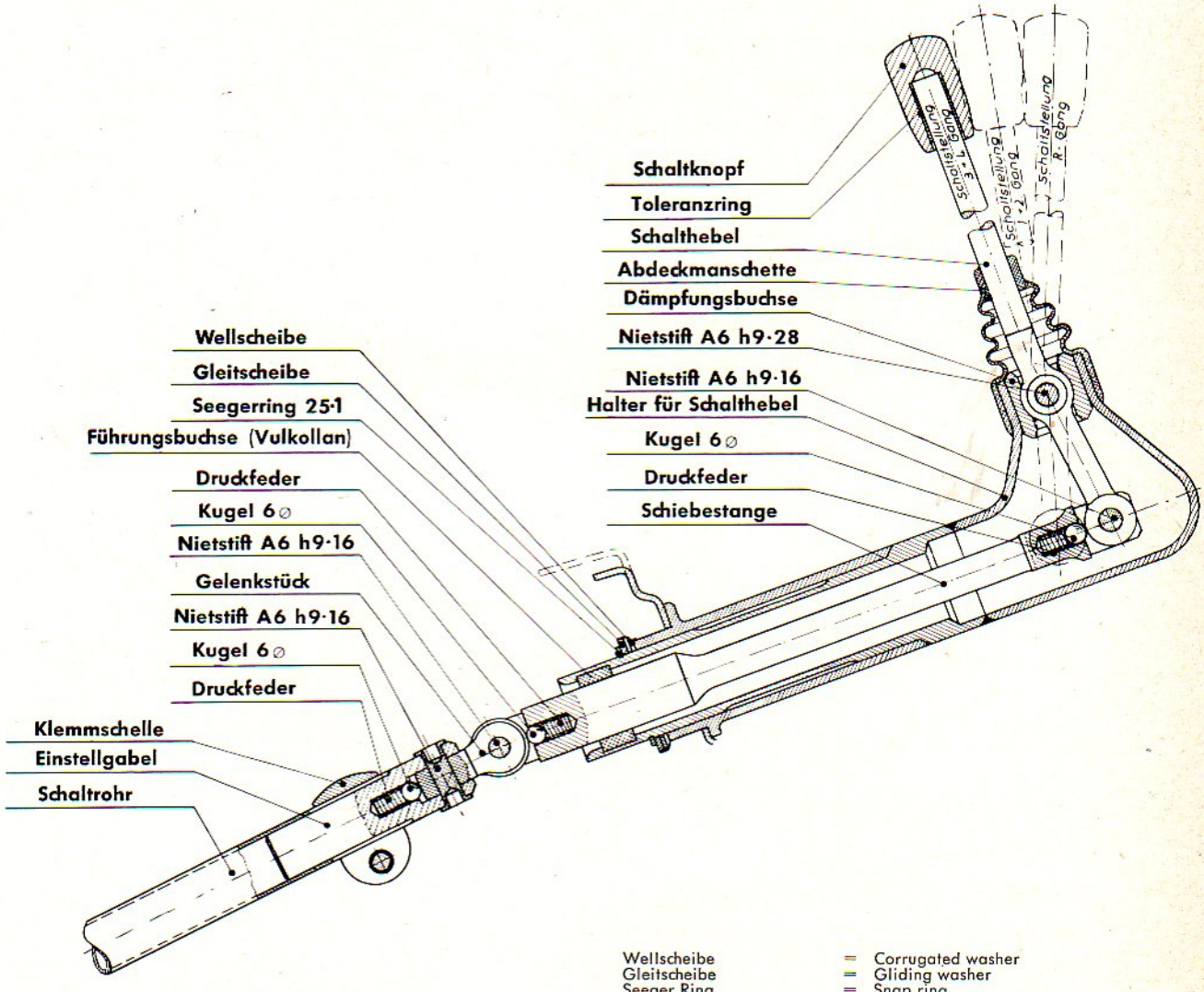
    In tightening bolts apply a torque of 10 – 12 kg (Fig. 6 - 5/3).



6 - 5/3

General

Shifting of gears is accomplished by means of the pivotable shifting gear lever located in the gear shift lever holder and the shift fitted with a universal joint for kinematic reasons. The shift rods are connected to the shift dog shaft (in the gearbox cover) through a flexible rubber coupling. The gearshift lever is mounted in a rubber bushing (damping bush); the gearshift lever is guided in a fibre bush (Vukollan). Spring-loaded balls provide for constant absence of play in the shift rods. The gearshift assembly needs neither be lubricated nor readjusted.



7 - 1/1

Wellscheibe	=	Corrugated washer
Gleitscheibe	=	Gliding washer
Seeger Ring	=	Snap ring
Führungsbuchse (Vulkollan)	=	Guide bush (Vulkollan)
Druckfeder	=	Compression spring
Kugel 6 ⌀	=	Ball, 6 diam.
Nietstift A 6 h 9.16	=	Rivet pin A 6 h 9.16
Gelenkstück	=	Universal joint
Nietstift A 6 h 9.16	=	Rivet pin A 6 h 9.16
Kugel 6 ⌀	=	Ball, 6 diam.
Druckfeder	=	Compression spring
Klemmschelle	=	Clamp
Einstellgabel	=	Adjusting fork
Schaltrohr	=	Shift tube
Schaltknopf	=	Knob on gearshift lever
Toleranzring	=	Tolerance ring
Schalthebel	=	Gearshift lever
Abdeckmanschette	=	Cuff
Dämpfungsbuchse	=	Damping bush
Nietstift A 6 h 9.28	=	Rivet pin A 6 h 9.28
Nietstift A 6 h 9.16	=	Rivet pin A 6 h 9.16
Halter für Schalthebel	=	Gearshift lever holder
Kugel 6 ⌀	=	Ball, 6 diam.
Druckfeder	=	Compression spring
Schiebestange	=	Gearshift control rod

Gearshift Principle

As shown in Fig. 7 - 2/1 the gearshift lever movements for shifting into 3rd and 4th, 1st and 2nd and into reverse speeds are accomplished in three superposed "shift planes". In centre position between the different speeds the gearshift lever is in "neutral", in this position a spring automatically pressing the shift lever into the lowermost shift plane (3rd and 4th speed). (Rest position).

If the gearshift lever is being drawn against spring pressure towards the steering wheel into the shift plane in the middle (1st and 2nd speed), the reverse gear spring lock (resistance due to the arresting devices on the shift dog shaft in the gearbox cover) comes into action. Only after overcoming the resistance due to the spring lock, the gearshift lever is free to be pulled further towards the steering wheel into the upper shift plane.

For shifting gears, the following movements are to be made on the gearshift lever.

1st and 2nd speed

Pull gearshift lever from neutral position towards steering wheel until resistance is felt due to the arresting device and turn it sidewards either downwards (1st speed) or upwards (2nd speed).

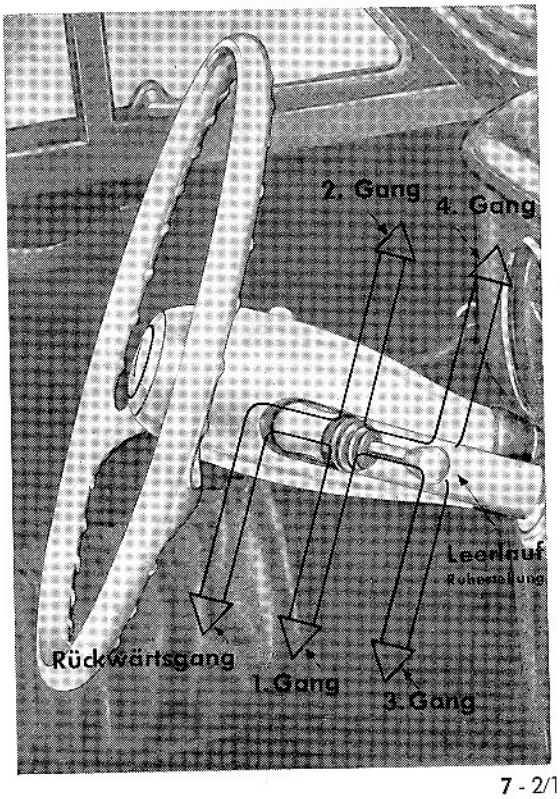
In changing gears from 1st to 2nd speed move gearshift lever exactly along its seating against arresting device. In doing so, be sure to see that the gearshift lever is maintained in the same (middle) shift plane, therefore in centre position, and in this position it does not give way to the spring pressure in downward direction (away from steering wheel) – otherwise you would eventually shift gears into the 4th speed – or that in centre position the gearshift lever will not be excessively pulled towards the steering wheel, otherwise the reverse gear spring lock gets eventually overshifted.

3rd and 4th speed

After pulling gearshift lever back from 2nd speed, let gearshift lever come under the influence of the spring action which pulls it automatically into the lower shift plane. Swivel gearshift lever – without pulling – sidewards either in downward direction (3rd speed) or in upward direction (4th speed).

Reverse speed

Shifting into reverse must be done only with stationary car! Pull gearshift lever in centre position (neutral) towards the steering wheel beyond the arresting device, the resistance of which can be clearly felt, into its extreme position and swivel it in a sideward movement downwards.



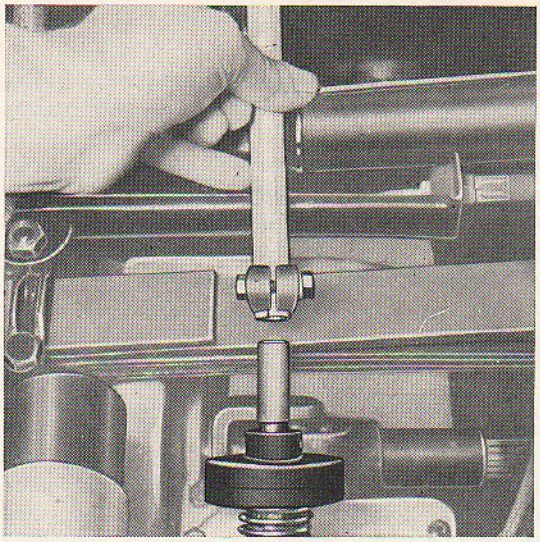
7 - 2/1

Dismantling and Reinstalling Gearshift Assembly

Dismantling

1. Push shift dog shaft in the gearbox cover by actuating the gearshift lever (pull gearshift lever until it engages) into the reverse speed shift plane.

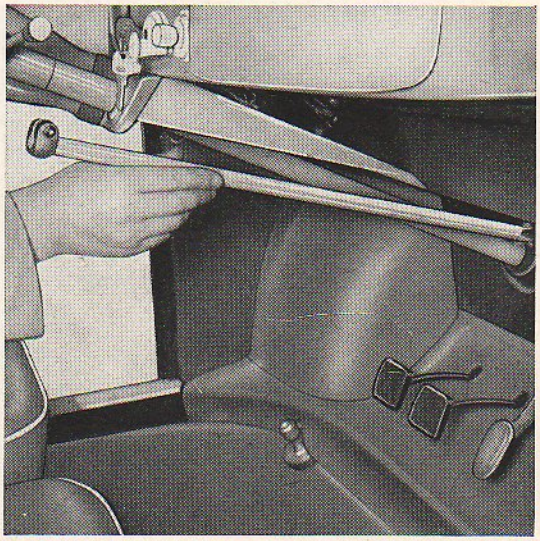
2. Loosen lower shift tube clamp (at universal joint head piece of rubber coupling) (hex nut SW 10). Push shift tube upwards so that universal joint head piece is free (Fig. 7 - 3/1).



7 - 3/1

3. Remove clamp from shift tube.

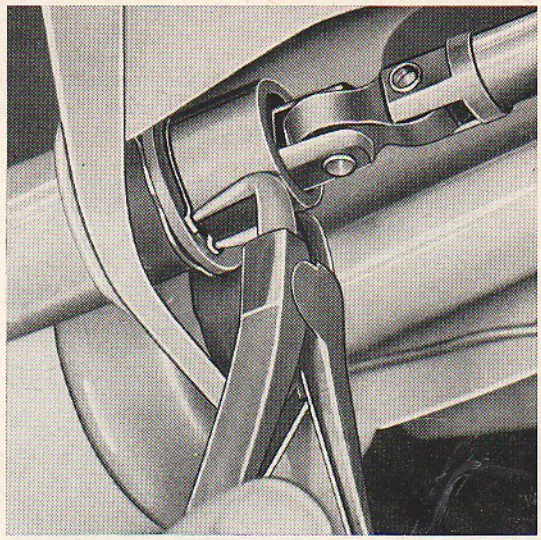
4. Loosen upper shift tube clamp (at the adjusting fork of shift rods below instrument panel) (hex nut SW 10); clear shift tube of adjusting fork and pull out shift tube (Fig. 7 - 3/2).



7 - 3/2

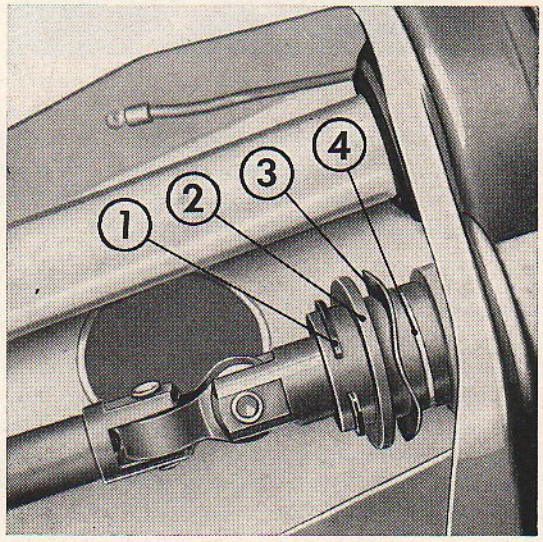
5. Remove holder of gearshift lever from end plate.

   a) Lift snap ring with a pair of Seeger pliers out of groove (Fig. 7 - 3/3).



7 - 3/3

   b) Remove snap ring (1), gliding washer (2) and corrugated washer (3) (Fig. 7 - 3/4).



7 - 3/4

6. Dismount steering wheel.

   a) Lift out horn knob.

   b) Disconnect horn cable from terminal.

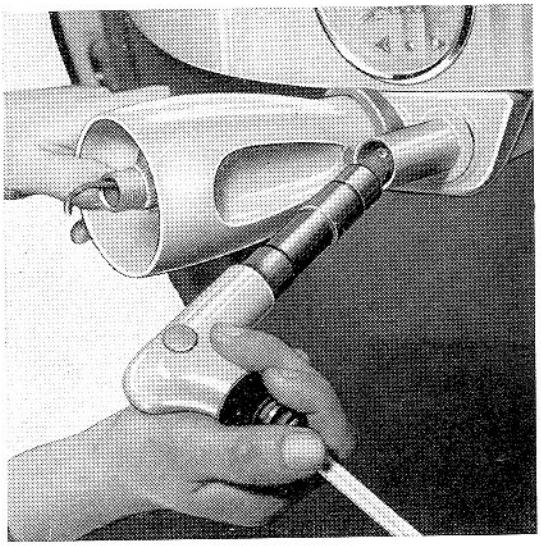
   c) Unscrew hex nut SW 30.

   d) Remove corrugated washer.

   e) Lift steering wheel off splined end of steering column.

7. Dismount supporting ring for steering columnjacket.
   a) Remove safety ring (steering wheel support) with a pair of Seeger pliers.
   b) Lift out ring retainer after loosening the two half-round head screws.
   c) Remove felt ring.
   d) Lift out supporting ring.

8. Push aside steering column jacket. Pull gearshift lever holder (with gearshift lever and shift rods) out of guide tube of the end plate (Fig. 7 - 4/1).



7 - 4/1

Move steering column jacket only in horizontal direction! By moving forth and back the jacket in vertical direction, there is danger of the contact spring of the horn being bent upwards.

Attention! In order to be able to lift the gearshift lever holder when disconnected at the end plate out of the guide tube, it is absolutely necessary to carry out the jobs as indicated under items 6 and 7. Pushing the gearshift lever holder with violent force along the steering column jacket results in a deformation of the fastenings and involves the risk of damage to the varnishing of both parts.

Reinstalling

The installation of the gearshift assembly is made in the reverse order. In doing so, attention is to be given to the following points:

1. Prior to fitting the gearshift lever holder check:
   a) whether the shift rods are free from play. If any play can be felt, the shift rods should be disassembled and damaged or worn parts be replaced,
   b) the cuff, damping bush (pull off cuff!) and Vulkollan guide bush for their serviceability. Worn parts should be renewed,
   c) the condition of the groove in the gearshift lever holder, destined to take the snap ring Fig. 7 - 3/4, (4). Remachine worn-out groove, if necessary, and in reassembling use a correspondingly broader gliding washer.

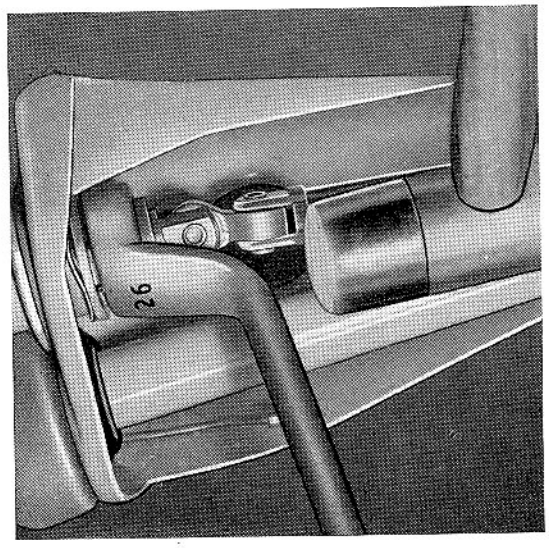
   Gliding washers (Part-No. 13 34 414 – 0 are available in the following sizes:
   2.2 / 2.4 / 2.6 / 3 mm.

2. Clean gearshift lever holder from old grease. Before reinstalling coat bearing surfaces well with grease.

3. Insert gearshift lever holder until it bears against its seat. Put on a new corrugated washer. Install gliding washer. Be sure that the gliding washer just covers the groove serving to house the snap ring! Eventually select a thicker or thinner washer.

Note: In order to avoid rattling noises while driving owing to the gearshift lever holder being lifted off or falling down to the guide tube on the bearing plate give care to a proper initial tension of the corrugated washer. The gearshift lever holder should fit the guide tube with an initial tension of about 50 kg. This value is available when the corrugated washer in assembled condition has an initial tension of from 1.0 to 1.2 mm. As the groove serving to take the snap ring has a width of 1.1 mm, the a/m initial tension is attainable by inserting the snap ring – provided dimensioning of the gliding washer is effected according to item 3.

4. Put in place snap ring. Use box wrench SW 26 and let ring engage by getting a blow with a hammer against socket wrench (Fig. 7 - 4/2).



7 - 4/2

5. Push shift tube from inside car through sealing cuff at the dashboard. Put in position lower clamp. Put universal joint head (bottom) and adjusting fork (top) into the shift tube.

6. Tighten lower clamp.

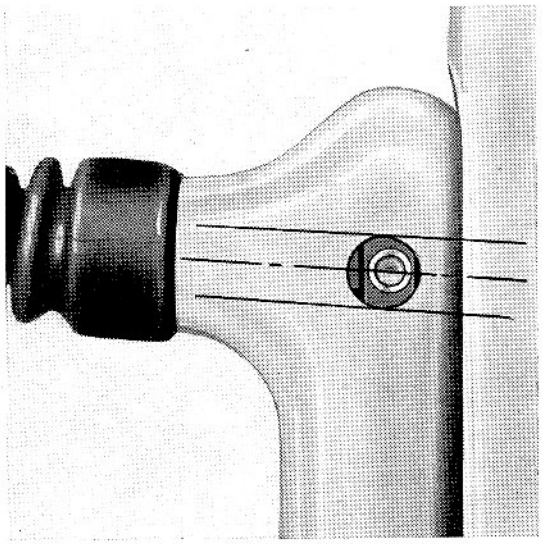
7. Adjust gearshift assembly. For this job an assistant will be needed!

   a) Remove ruber plugs in the gearshift lever holder.

   b) Move shift dog shaft into the shift plane: first and second speeds.

      Only with the help of an assistant!

   c) Adjust shift rods by moving gearshift lever in such a manner that the rivet pin serving to connect gearshift lever and gearshift control rod is precisely fitted in the centre of bore in the gearshift lever holder (Fig. 7 - 5/1).



7 - 5/1

   d) With the shift rods in this position, tighten upper clamp at the shift tube. In order to get sufficient space for the legs, gearshift lever shall stand in horizontal position with the 1st and 3rd speeds shifted into gear!

Attention! The correct adjustment of the gearshift assembly according to item 7 is of some importance, because the gearshift lever or the gearshift control rod – especially in the two end positions: 3rd/4th speed – reverse speed – may follow the movements of the power unit, when the car is running, without any clash inside the gearshift holder.

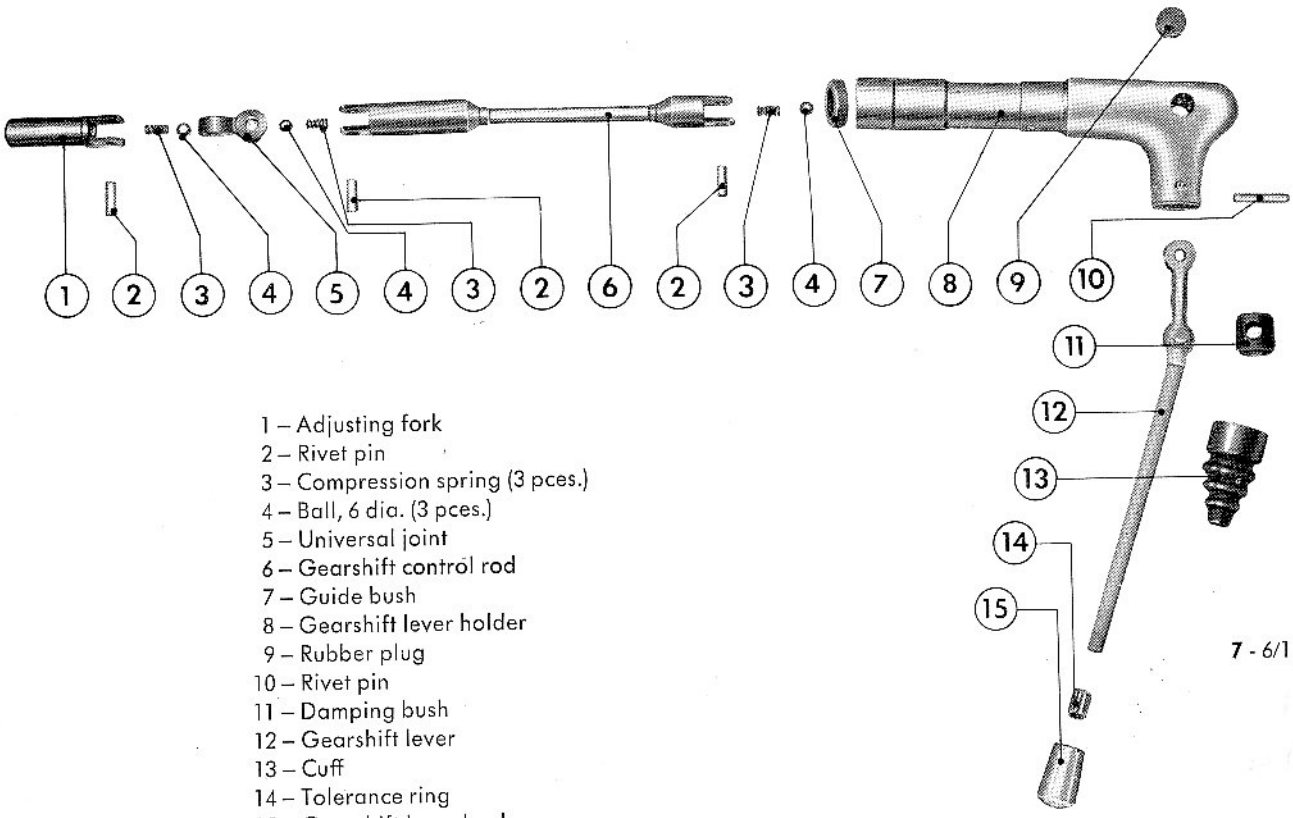
8. Fasten steering wheel jacket.

9. Mount steering wheel and horn knob. Do not forget snap ring and corrugated washer!
   Tighten fastening nut for steering wheel with a torque of 4 m/kg.

10. Check function of gearshifting in a trial run.

Disassembling and Reassembling Gearshift Assembly

(Gearshift Assembly removed from Car)



7 - 6/1

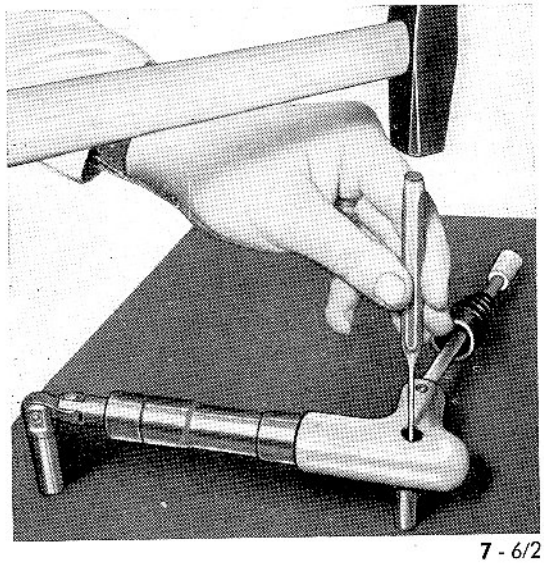
1 – Adjusting fork
2 – Rivet pin
3 – Compression spring (3 pces.)
4 – Ball, 6 dia. (3 pces.)
5 – Universal joint
6 – Gearshift control rod
7 – Guide bush
8 – Gearshift lever holder
9 – Rubber plug
10 – Rivet pin
11 – Damping bush
12 – Gearshift lever
13 – Cuff
14 – Tolerance ring
15 – Gearshift lever knob

Disassembling

The following shop tools are required:
SW 10 – Fitting tube for shift rods.

1. Pull cuff off gearshift lever holder. Remove rubber plug.

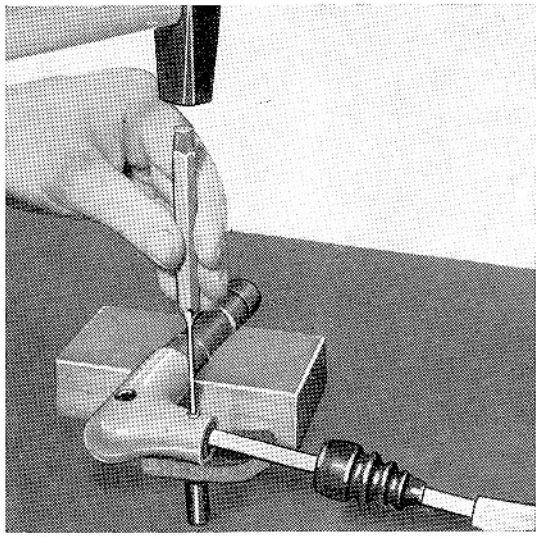
2. Drive out rivet pin serving to connect gearshift lever to gearshift control rod with a 3 mm drift.
   Push fitting tube SW 10 into the bore of gearshift lever holder for supporting shift rods. (Fig. 7 - 6/2).



7 - 6/2

3. Take shift tube with universal joint and adjusting fork out of holder. Remove free and compression spring.

4. Drive out with a drift rivet pin serving to connect gearshift lever to gearshift lever holder.
Fitting tube SW 10 serves as a support. Felt interposed between holder and tube prevents damage to varnishing (Fig. 7 - 7/1).



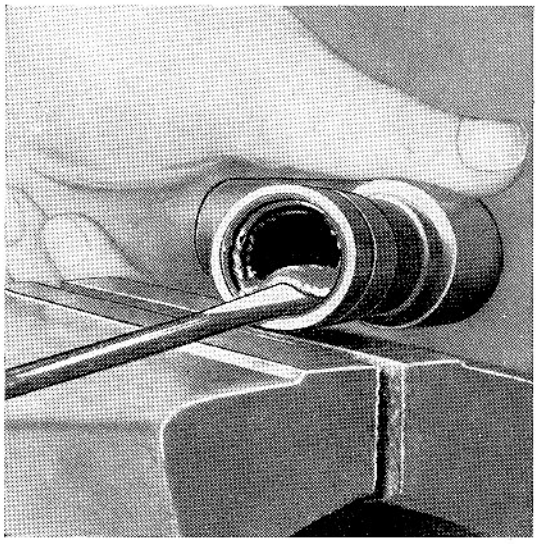
7 - 7/1

5. Pull gearshift lever out of holder.

6. Press gearshift lever knob carefully off gearshift lever. Remove tolerance ring from gearshift lever knob. Withdraw cuff.

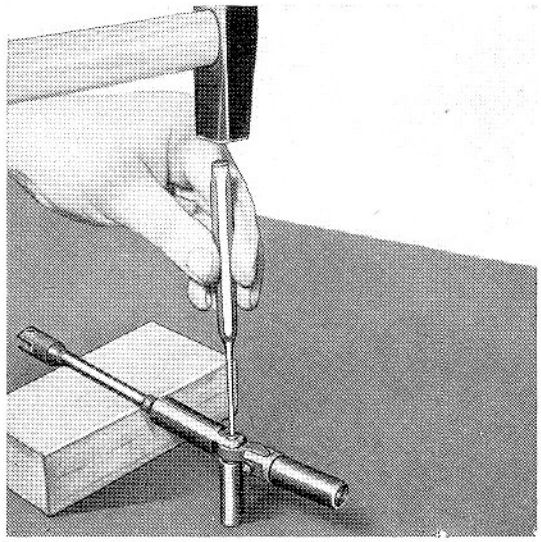
7. Remove rubber damping bush.

8. Remove Vulkollan guide bush (Fig. 7 - 7/2).



7 - 7/2

9. Drive out rivet pin which connects gearshift control rod with universal joint with the aid of a drift. In doing this, use fitting tube SW 10 as a support. (Fig. 7 - 7/3).



7 - 7/3

10. Take out free ball and compression spring.

11. Separate universal joint and adjusting fork by driving out rivet pin. Use again fitting tube SW 10 as a support!

12. Take out ball and compression spring.

Reassembling

Reassembling is to be made in the reverse order, attention having to be paid to the following points:

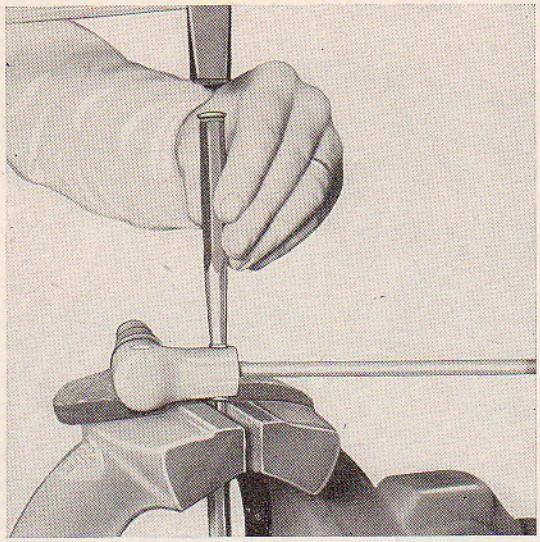
1. Clean and check parts.
Parts the bore of which for the rivets are worn, should be replaced. Slackened compression springs should be replaced. As a rulle use only new rivet pins in reassembling. Replace all worn fibre bushings or damaged cuffs. Check gearshift lever knob for fast seat. If necessary, renew tolerance ring.

2. In reassembling adjusting fork universal joint and gearshift control rod give care that the flattened side of the universal joint comes to lie towards adjusting fork.

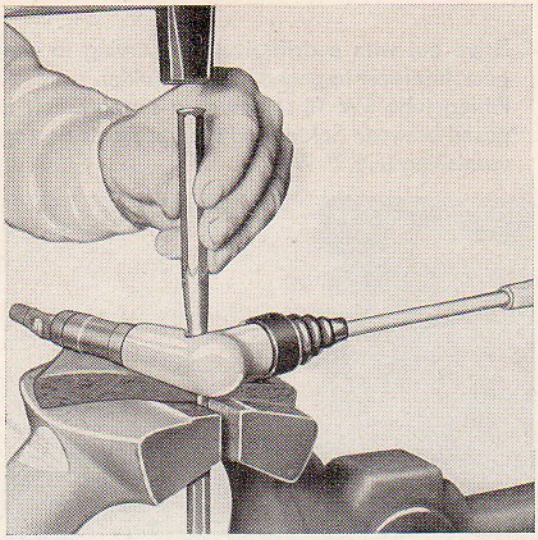
3. Be sure that rivet pins are truly centered after insertion. In any case support with a sharp-pointed drift and widen with a flattened drift both ends of rivet pins (Fig. 7 - 8/1 and 2).

4. Give compression spring and balls a coat of viscous grease to facilitate mounting.

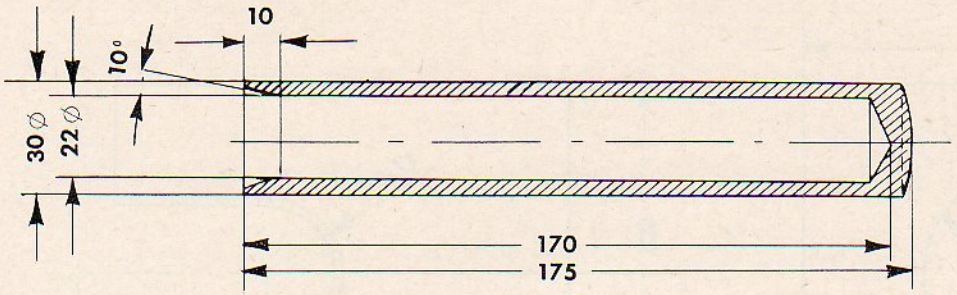
5. In riveting gearshift lever holder avoid damage to varnishing by placing felt underneath (Fig. 7 - 8/1 and 2).



7 - 8/1

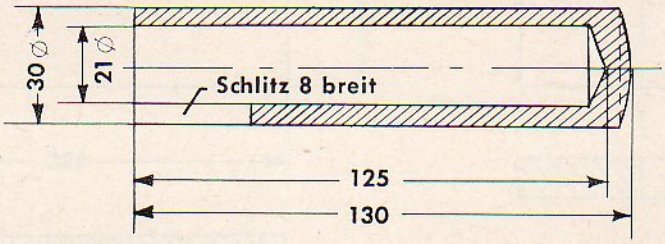


7 - 8/2



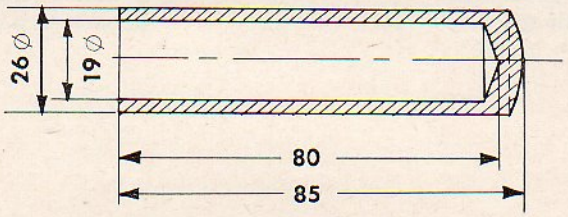
SW – 1

Driving tube
for inner needle bearing
rings on shifter shaft



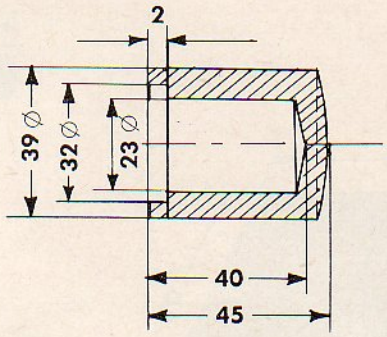
SW – 2

Driving tube
for gears 3rd and 4th speed
on drive shaft



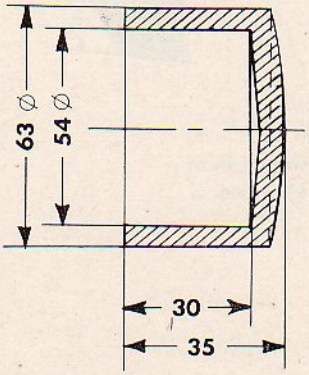
SW – 3

Driving tube
for grooved bearing on
drive and shifter shafts



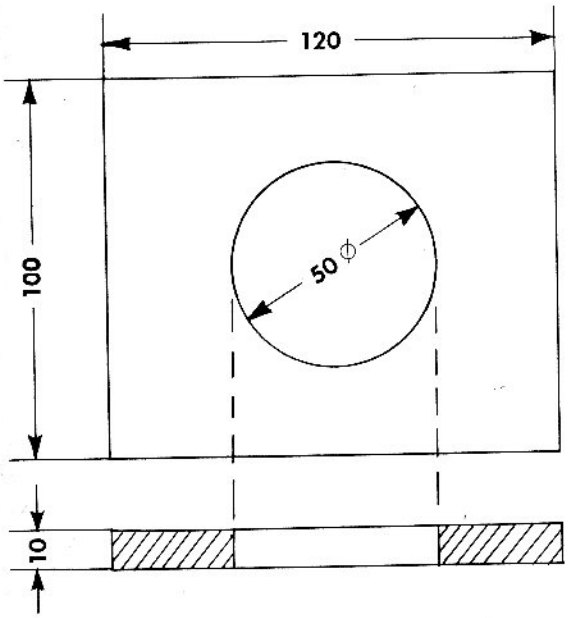
SW – 4

Tube for pressing grooved
bearing out of bearing
retainer ring and for
pressing in position bearing
retainer rings on the hubs
(differential)

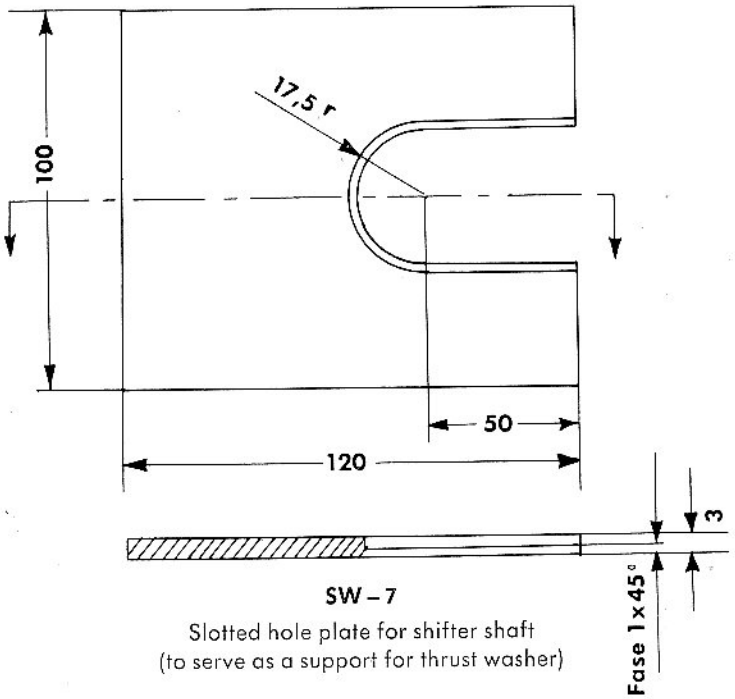


SW – 5

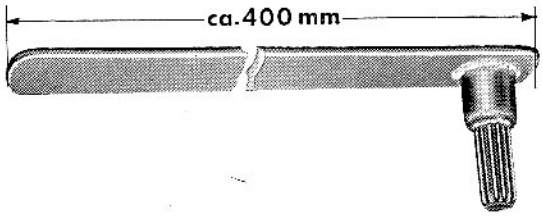
Tube for final positioning
of bearing retainer rings
(differential)



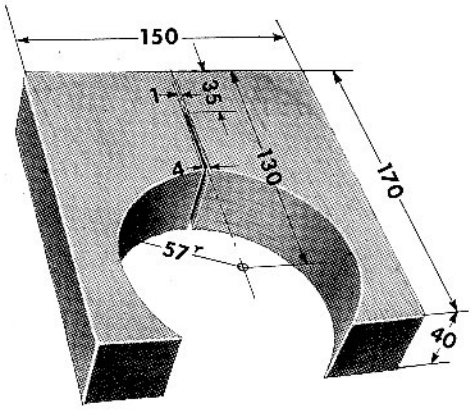
SW – 6
Hole plate for shifter shaft (to serve as a support for shift gear 4th speed)



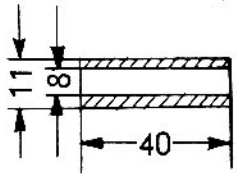
SW – 7
Slotted hole plate for shifter shaft (to serve as a support for thrust washer)



SW – 9
Holding key for internal universal joint. Splined piece may be taken from an old inner universal joint shaft.



SW – 8
Chuck for shifter shaft
Material: Hard wood



SW – 10
Fitting tube for shift rods

General

Change-speed and differential gears are housed in a single case. The entire power plant assembly – engine/ transmission – is supported on 3 rubber pads at the front axle bearer.

Transmission Case

The transmission cover with gearshift rods is placed on the one-piece transmission case. Opposite the clutch case is mounted the speedometer housing with speedometer drive pinion. The differential assembly is held in position by two bearing covers which can be removed from the transmission case. The said case parts are light alloy castings and bolted together by interposing paper gaskets.

Transmission

The transmission is of the sliding selective gear type, giving three forward speeds and one reverse speed.

The 1st, 2nd and reverse speed gears have straight flanked toothing. The 3rd speed double gear has helical toothing and is in constant mesh.

The 1st and reverse speed gears on the **driving shaft** are cut with the shaft from the solid. The gears of the 2nd and 3rd speed are made as double gear in one piece and coupled to the drive shaft by means of a key (fitting key).

The gears of the 1st (respt. reverse) speed and 2nd speed on **the sliding gear shaft** have keywayed bores and are connected to the latter over the keyways on the sliding gear shaft in a non positive manner, whereas the helical tooth gear of the 3rd speed may rotate freely on a bronze bushing. This gear is limited in axial direction by the helical tooth pinion on the sliding gear shaft, on the one hand, and by a Seeger retaining ring mounted in a annular groove in the shaft (with thrust washer), on the other hand. The intermediate gear for the reverse speed is slidably supported in the lower part of the case on a shaft (bolt) and is in constant mesh with the drive shaft.

Gear Shifting

To obtain the 1st or reverse speed as well as the 2nd speed, the straight flanked sliding gears are shifted in axial direction (on the sliding gear shaft). Shifting of the 3rd speed into gear is effected by moving the 3rd speed free running helical tooth gear into mesh with the 2nd speed sliding gear by shifting a collar of dogs provided on the lastmentioned gear into mesh with the corresponding recesses on the helical tooth gear.

The gear ratios are the following:

		Number of teeth
1st speed	4.58 to 1	12/55
2nd speed	2.19 to 1	21/46
3rd speed	1.31 to 1	26/34
Reverse speed	4.58 to 1	12/55

The transmission for model LP/LS 600 and LT/LTK 600 differ only by the gear ratios of the small helical tooth gear on the slide gear shaft and that of the large helical tooth gear for axle drive. For the total gear reduction and speedometer drive, the constructional alterations carried out in the course of later developments must be taken into consideration in accordance with the specification given in the list overleaf.

Type	Chassis-No.	Gear Ratio i =	Large Helical Tooth Gear for Axle Drive and Differential Case	Sliding Gear Shaft	Speedometer Pinion	Remarks
LT/LTK 600	from 6 / 109 907 to 6 / 112 660	4.87	125 101 – 0 73 teeth diff. case 125 102 – 1	122 200 – 0 15 teeth Worm 3 threads	122 314 – 0 8 teeth	
LT/LTK 600	from 6 / 112 661 to 6 / 113 452	4.87	125 101 – 1 73 teeth diff. case 125 102 – 2	122 200 – 0 15 teeth Worm 3 threads	122 314 – 0 8 teeth	Helical Tooth Gear: Bore of 8 mm enlarged to 10 mm (125 101 – 1) Bolts M 10
LT/LTK 600	from 6 / 113 453	4.87	125 101 – 1 73 teeth diff. case 125 102 – 2	1 722 200 – 1 15 teeth Worm 4 threads	1 722 202 – 0 10 teeth	
LP/LS 600	from 6 / 204 181 to 6 / 241 350	4.5	1 325 101 – 0 72 teeth diff. case 125 102 – 1	1 322 200 – 0 16 teeth Worm 4 threads	1 322 301 – 0 10 teeth	
LP/LS 600	from 6 / 241 351 to 6 / 252 260	4.5	1 325 101 – 1 72 teeth diff. case 125 102 – 2	1 322 200 – 0 16 teeth Worm 4 threads	1 322 301 – 0 10 teeth	Helical Tooth Gear: Bore of 8 mm enlarged to 10 mm 13 25 101 – 1)
LP/LS 600	from 6 / 252 261 to 6 / 255 052	4.5	1 325 101 – 1 72 teeth diff. case 125 102 – 2	1 322 200 – 2 16 teeth Worm 5 threads	1 322 301 – 1 12 teeth	
LP/LS 600	from 6 / 255 053	4.18	1 325 101 – 2 71 teeth diff. case 125 102 – 2	1 322 200 – 4 17 teeth Worm 4 threads	1 322 301 – 2 9 teeth	

Lubrication:

Lubricant: Transmission oil SAE 90 (summer and winter)

Amount of oil: 0.9 l.

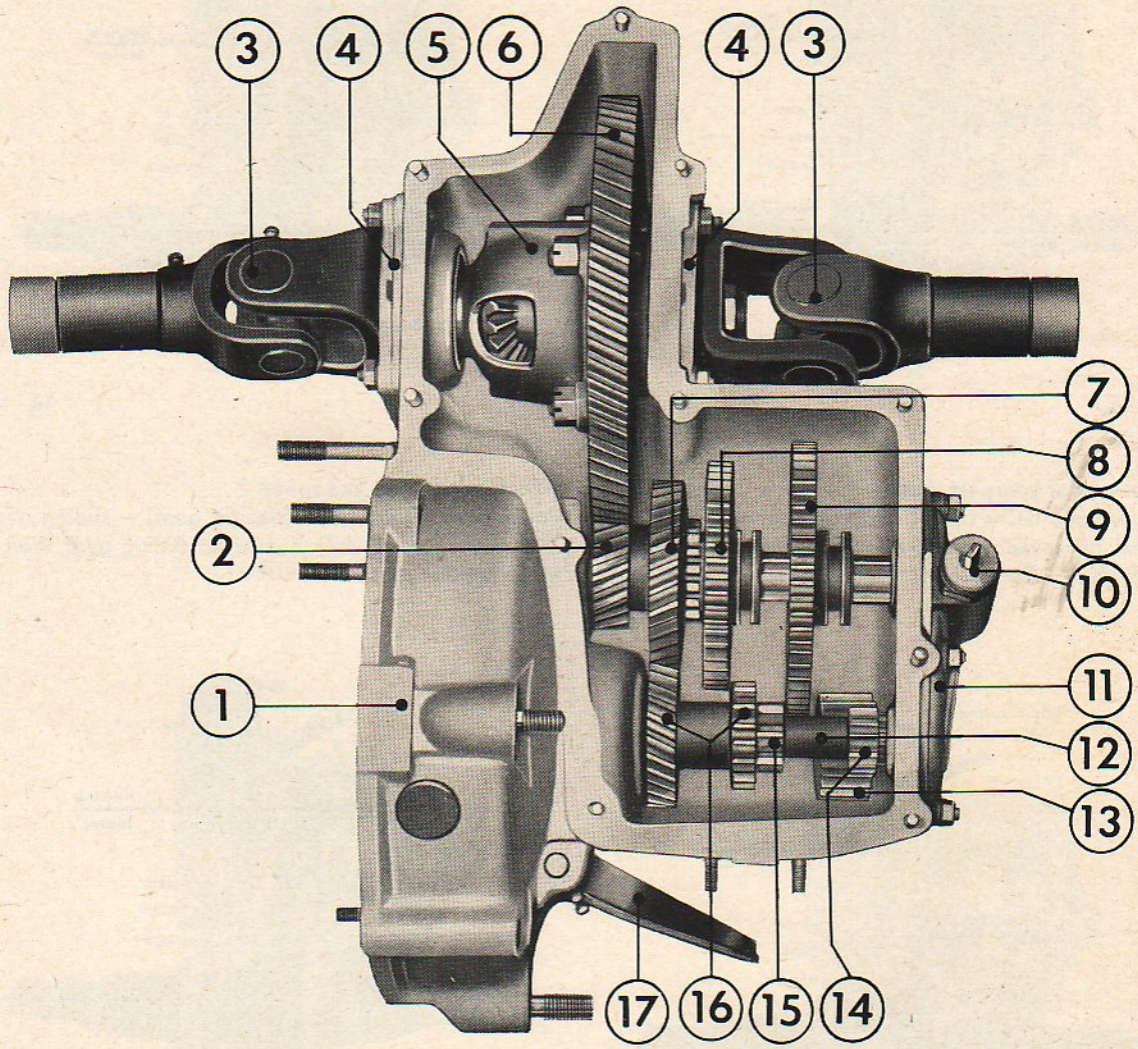
Oil change: at km 500 – 3 000 – 12 000. Thereafter every 12 000 kilometers.

Transmission – Removing and Reinstalling

to be effected in the sequence of operation as "Engine Removing and Reinstalling" see Main Group M – Engine.

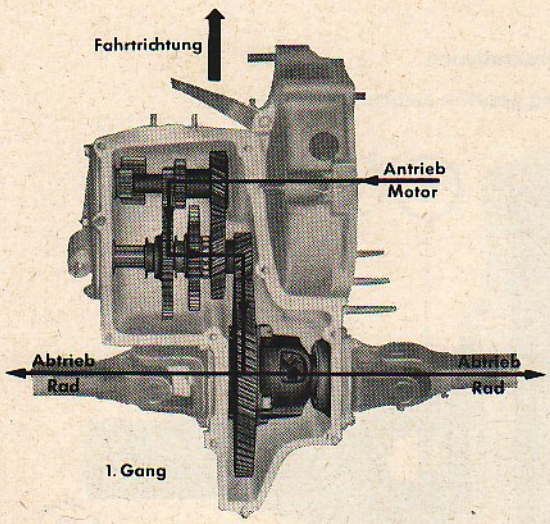
Lloyd Three-speed transmission

– Transmission cover removed, sliding gears in neutral position –



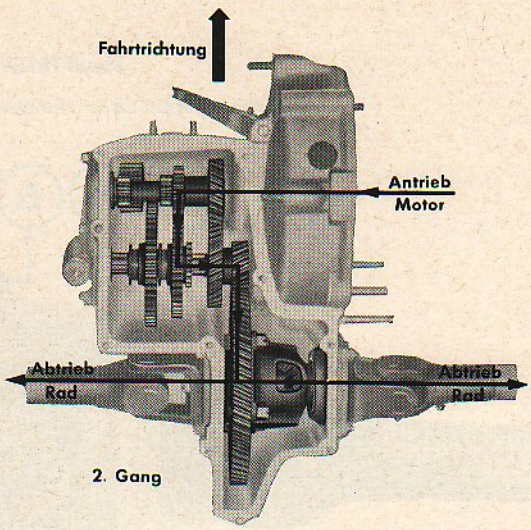
1 – Transmission case
2 – Sliding gear shaft
3 – Inner universal joint
4 – Bearing cover
5 – Differential case
6 – Large helical tooth gear for axle drive
7 – 3rd speed helical tooth sliding gear
8 – 2nd speed sliding gear
9 – Sliding gear 1st and reverse speed
10 – Speedometer pinion
11 – Speedometer housing
12 – Drive shaft
13 – Reverse speed intermediate gear
14 – Reverse speed gear
15 – 1st speed gear
16 – 2nd and 3rd speed double gear
17 – Clutch lever

Power Flow



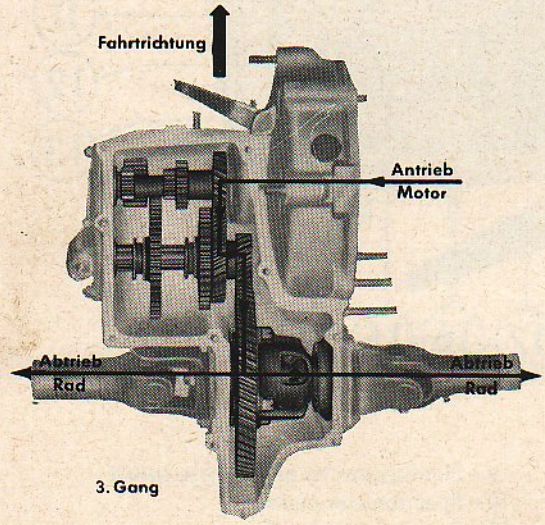
10 - 4/1

– Position of gears 1st speed –
Power flow: Drive shaft (1st speed gear) – sliding gear wheel 1st speed – small helical tooth gear on sliding gear shaft – large helical tooth gear for axle drive.



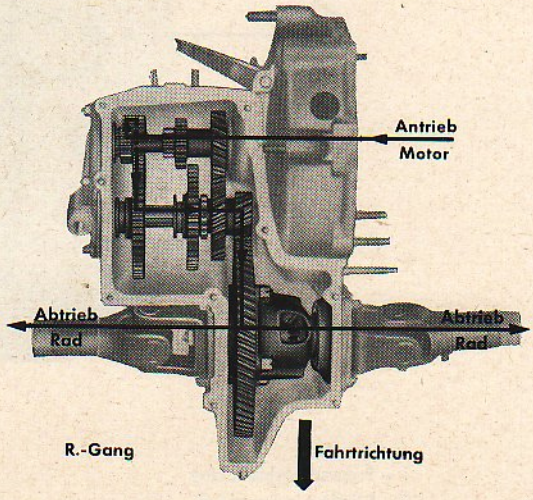
10 - 4/2

– Position of gears 2nd speed –
Power flow: Drive shaft (double gear) – sliding gear 2nd speed – small helical gear on sliding gear shaft – large helical gear for axle drive.



10 - 4/3

– Position of gears 3rd speed –
Power flow: Drive shaft (double gear) – 3rd speed helical sliding gear – small helical gear on sliding gear shaft – large helical gear for axle drive.



10 - 4/4

– Position of reverse speed gears –
Power flow: Drive shaft (reverse speed gear) – reverse speed intermediate gear – reverse speed sliding gear – small helical gear on sliding gear shaft – large helical gear for axle drive.

The following special and shop tools will be required:

WO 22 – Clutch assembly drift.

WO 23 – Inner coupling joint remover.

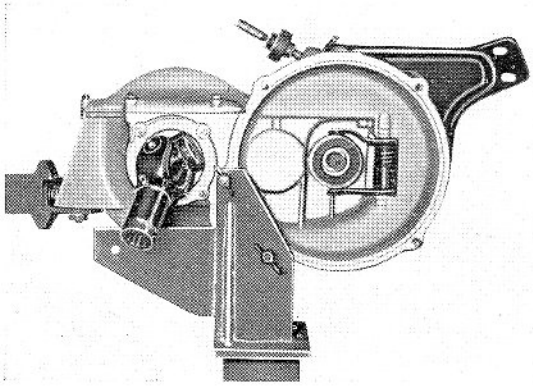
WO 57 – Assembly tool for radial seal on transmission drive shaft.

SW 3, 9, 11-17 Shop tools for self-manufacturing

Disassembly

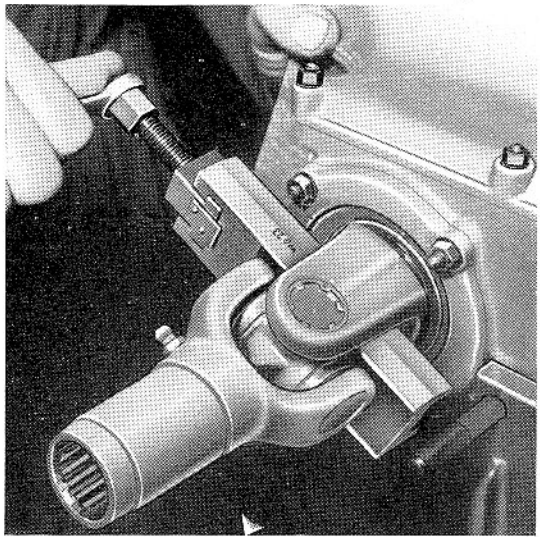
– Transmission removed

1. Drain transmission oil (shoulder bolt SW 20 with gasket).
2. Bolt transmission to transmission carrier (Fig. 11-1/1).



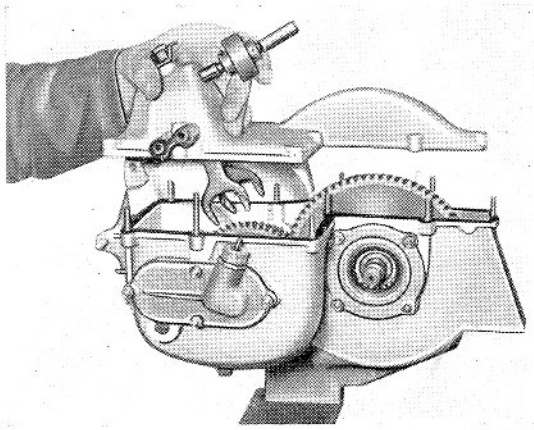
11 - 1/1

3. Unscrew bracket for heating (Item-No. 13 19 401 – 1) and rubber pads.
4. Remove inner universal joint.
   a) Remove cotter pin from flat castellated nut SW 22 and unscrew. Use tool SW 9 for holding up. Remove sealing washers 1 x 28 diam. (See also four-speed transmission, section "Disassembling and reassembling differential assembly").
   b) Pull off inner universal joint with special tool WO 23 (Fig. 11 - 1/2).



11 - 1/2

5. Remove clutch lever:
   a) Remove upper Seeger retaining ring on bolt for clutch lever with the aid of Seeger pliers.
   b) Drive out bolt to the bottom.
   c) Retract clutch lever with return spring through case slot into the clutch casing and remove.
6. Unscrew transmission cover:
   a) Put shifter forks to neutral position.
   b) Unscrew 10 hex nuts SW 10 (with interposed spring washers) take off transmission cover (Fig. 11 - 1/3).

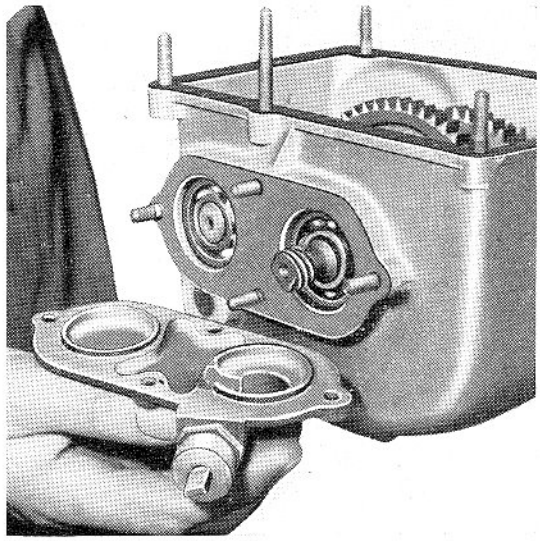


11 - 1/3

If cover can be moved only heavily, use rubber hammer. Never drive sharp tools in between cover and case!

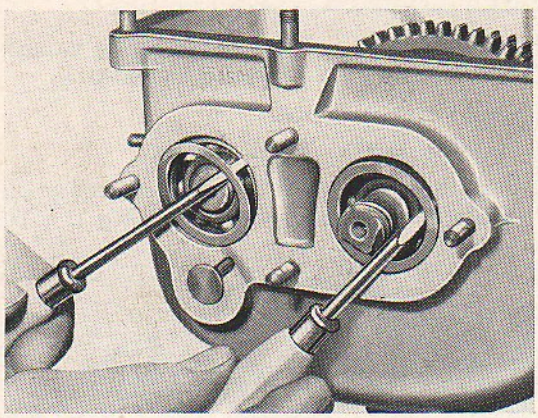
Attention! Up to chassis-No. 6/257 801 or 6/113 922 only 8 bolts for bolting together transmission cover – transmission case. From chassis-No. 6/257 802 or 6/113 923 forward there are mounted two additional studs on the transmission case.
Disassemble and reassemble transmission cover – See Sub-Group 13.

7. Unscrew speedometer housing (4 hex head bolts SW 10 with interposed spring washers) (Fig. 11 - 1/4).



11 - 1/4

8. Remove eventually existing spacers (between speedometer housing shoulder and grooved bearing 6203) (Fig. 11-2/1). For more details see under Reassembly!



11 - 2/1

9. Remove packings for speedometer housing and transmission cover.

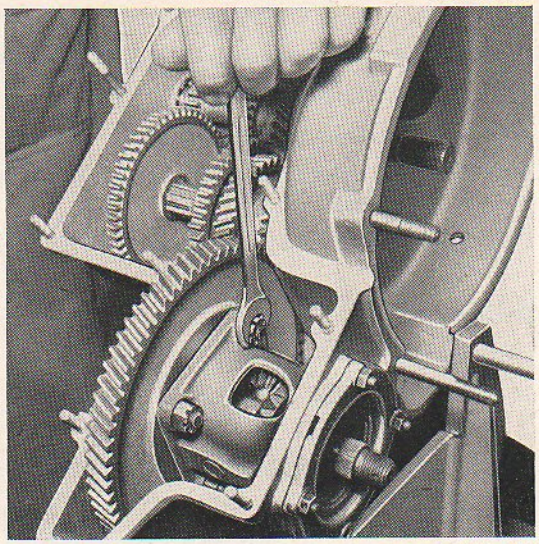
10. Disassemble speedometer housing:

    a) Unscrew threaded plug with box socket SW 22.

    b) Take out pinion with thrust washer (Fig. 11 - 2/2).

11 - 2/2

11. Remove cotter pins from 4 special castellated nuts SW 14 on differential case and loosen. First block up transmission gears by shifting gears into 3rd and reverse speed (Fig. 11 - 2/3).

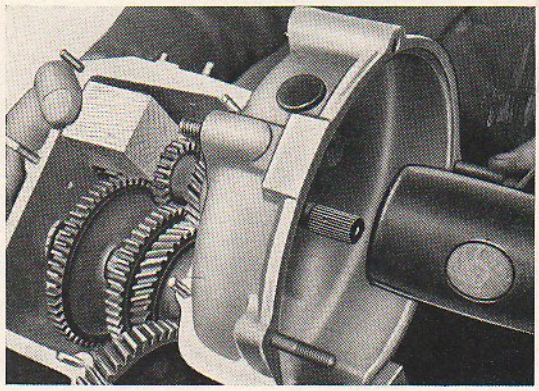


11 - 2/3

12. Dismantle drive shaft. At the same time pull off helical tooth double gear of 2nd and 3rd speed from drive shaft.

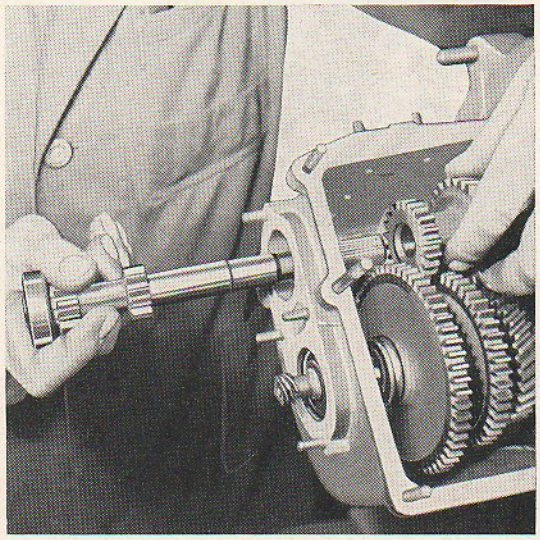
    a) Place lock block SW 15 between double gear and case.

    b) Drive out driving shaft from clutch casing with rubber hammer (Fig. 11 - 2/4).



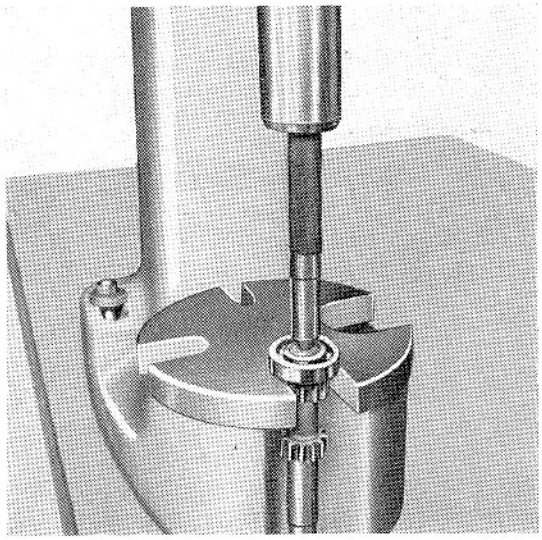
11 - 2/4

    c) Take drive shaft (with grooved bearing 6203) on the speedometer side and double gear out of transmission case (Fig. 11 - 2/5).



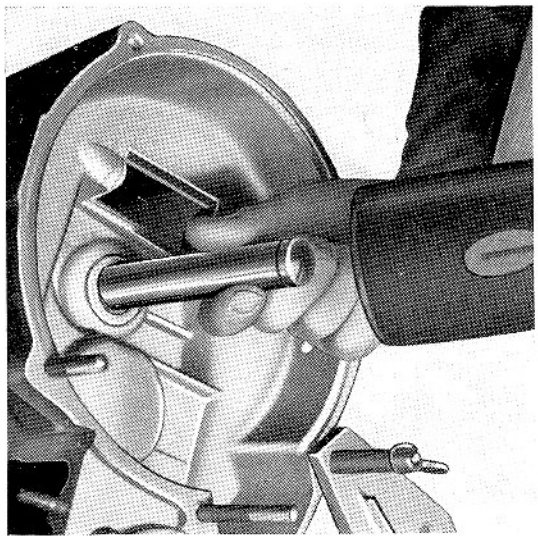
11 - 2/5

13. Pull off grooved bearing 6203 with a press. Special tool WO 22 should be used as driver (Fig. 11 - 3/1).



11 - 3/1

14. Drive out radial joint ring A 17 x 28 x 7 DIN 6503 and grooved bearing 6203 (clutch side) with shop tool SW 3 from clutch case (Fig. 11 - 3/2).



11 - 3/2

As a rule a new joint ring should be used in reassembling the transmission so that in dismantling this ring may be allowed to suffer damage. However, greatest care should be given to ensure that in dismantling the old joint ring the case bore will not be damaged.

Attention:
Up to chassis-No. 6/230 777 or 6/111 967, 3rd speed gear of the double gear and 3rd speed sliding gear have straight flanked toothing. From chassis-No. 6/230 778 or 6/111 968 forward, these gears are of the helical tooth type.

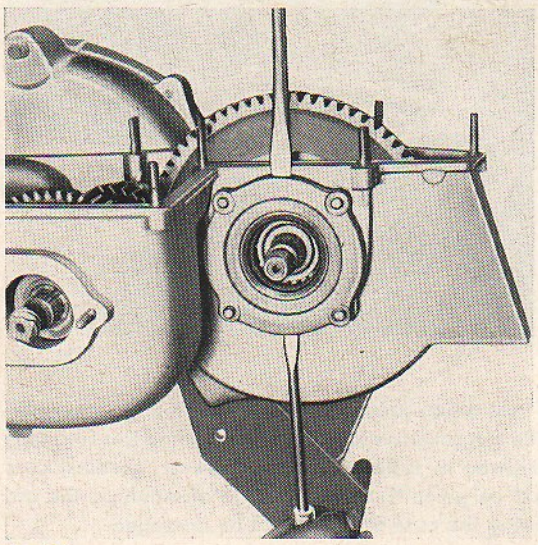
From chassis-No. 6/237 131 or 6/112 375 forward, the diameter of the drive shaft has been increased from 17 to 18 mm in way of the double gear, the bore of the double gear having been increased correspondingly. The pertaining fitting key has been extended by 12 mm.

In case of repairs refer to the following indications to ensure that the same aforementioned parts will be installed again.

Chassis-No.	Drive-Shaft Parts-No.	Double Gear Parts-No.	Fitting Key Parts-No.	Sliding Gear 3rd Speed Parts-No.
to 6/230 777 or 6/111 967	122 004–0	122 005–0	A 5 x 5 x 28 DIN 6885	522 008–0
to 6/230 778 or 6/111 968	122 004–0	422 010–0	A 5 x 5 x 28 DIN 6885	422 011–0
to 6/237 131 or 6/112 375	122 004–1	422 010–1	A 5 x 5 x 40 DIN 6885	422 011–0

15. Removal of differential.

a) Remove both bearing covers. Unscrew 4 hex nuts SW 10 (with interposed spring washers) on each bearing cover. Loosen bearing cover from the flanges by a short tap on the threaded end of the opposite differential side gear with a rubber hammer and force cover out uniformly with two large screw drivers. For this purpose insert screw drivers in the recesses provided in the bearing cover (Fig. 11 - 4/1).

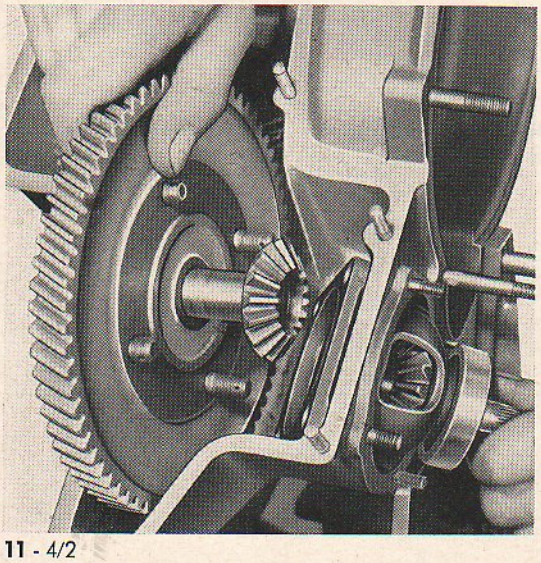


11 - 4/1

b) Remove joints.

c) Unscrew the four loosened castellated nuts on differential case. Separate differential cage from large helical tooth gear and turn it so that differential bolt lies horizontally. Conduct differential case through case opening for bearing cover and tilt it downwards.

d) Remove large helical gear for axle drive (with grooved bearing 6006 and differential side wheel) (Fig. 11 - 4/2).

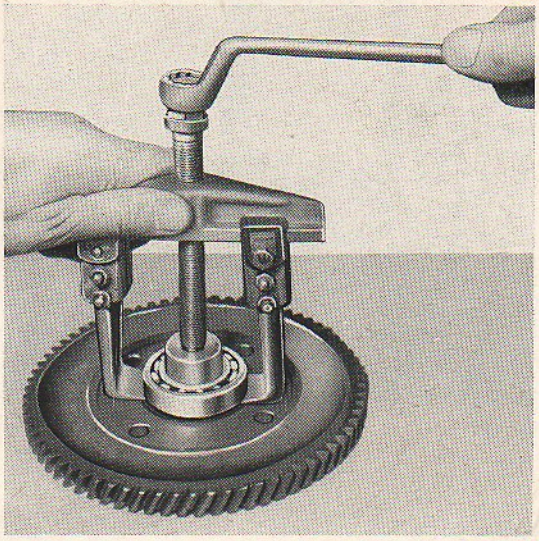


11 - 4/2

e) Take out differential side gear from large helical tooth gear.

f) Remove differential case (with grooved bearing 6006) out of transmission case.

16. Pull off grooved bearing 6006 from large helical tooth gear with conventional type puller, using for this job thrust piece SW 14 (Fig. 11 - 4/3).



11 - 4/3

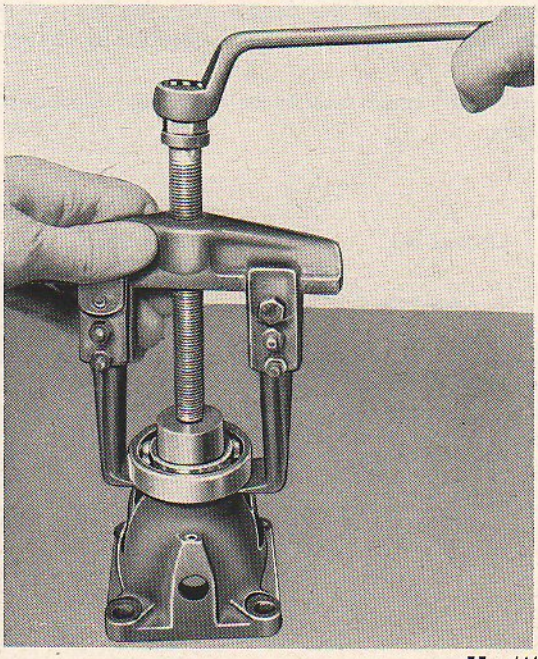
17. Disassemble differential case.

a) Drive out tension pin for differential bolt with driver.

b) Push out differential bolt.

c) Take spacer, differential pinion gears, differential side gear and thrust washer out of case.

d) Pull grooved bearing 6006 out of differential case with conventional type puller using for this job thrust piece SW 14 (Fig. 11 - 4/4).



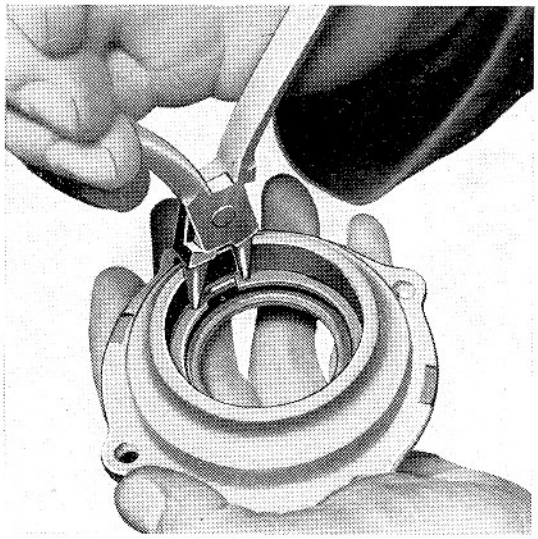
11 - 4/4

The "Kukko" puller as shown in Figs. 11-4/3 and 11-4/4 (Makers Kleinbongartz & Kaiser, Remscheid-Hasten) can also be supplied by the Matra-Werke, Frankfurt.

18. Disassemble bearing cover.

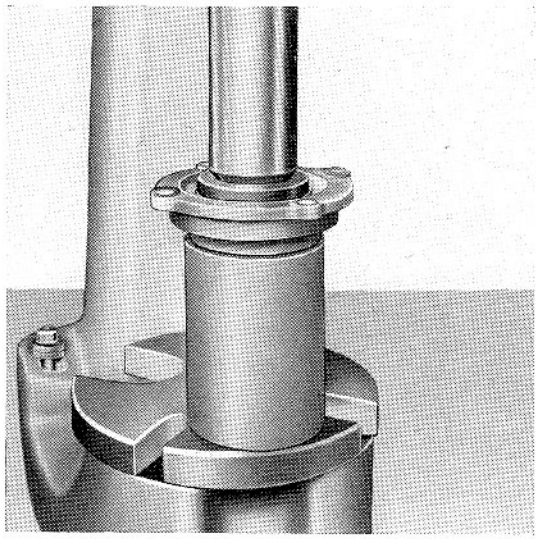
a) Remove eventually existing spacers – to eliminate any possible exial clearance of the differential in the transmission case between grooved bearing 6006 and split locking ring (Seeger ring). For more details see under "Reassembly".

b) Remove Seeger-ring with Seeger pliers. (Fig. 11 - 5/1).



11 - 5/1

c) Press radial joint ring A 40 x 55 x 8 DIN 6503 out of bearing cover with tool SW 13. As support use fitting tube SW 12 (Fig. 11 - 5/2).



11 - 5/2

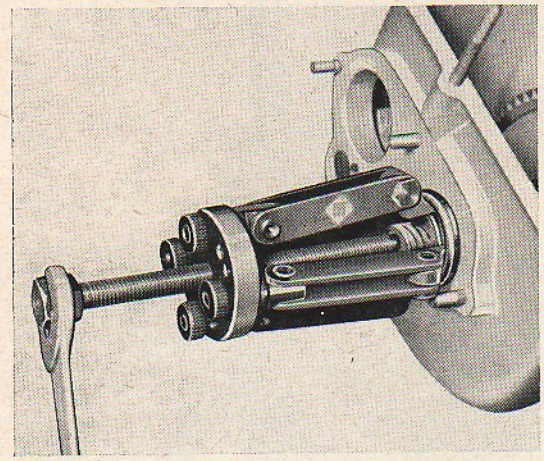
Attention!

1. Up to chassis-No. 6/237 376 or 6/112 254 no spacer is contained in the differential. In case of repairs to the transmission in the a/m vehicles it is recommendable to install spacer (Parts-No. 125 106 – 0) subsequently.
2. From chassis-No. 6/241 351 or 6/112 661 forward 4 hex head bolts are used for the connection of the large helical tooth gear for axle drive to the differential case. (Previously M 8). Bores in the gear and case have been enlarged correspondingly to 10 mm dia. See also chart, page 10 - 2. When reassembling give care to see that different torques must be applied to tighten bolts M 8 and M 10.
3. From chassis-No. 6/255 053 (LP/LS 600) forward, the total gear reduction has been reduced to protect the engine. From a/m chassis-No. forward the small helical tooth gear on the sliding gear shaft has 17 teeth, the large helical tooth gear for axle drive 71 teeth (i = 4.18). Previously, 16/72 teeth (i = 4.5). The total gear reduction has not been altered in the models LT/LTK 600.
   In case of repairs, when in doubt about the correct assembly of the component parts, please refer to the chart on page 10 - 2!
4. From chassis-No. 6/263 022 or 6/114 297 forward differential gears of greater thickness are installed. Alteration of module from 2.5 to 2.9! **There are no differential gears Module 2.5 available any more.** In the case of wear or damage to one of the differential gears of minor thickness all 4 differential gears should then be replaced by such ones of the thicker type.

	Module 2.5 up to chassis-No. 6/263 021 or 6/114 296		**Module 2.9**	
	Parts-No.	Number of Teeth	Parts-No.	Number of Teeth
Differential side gear	525 115 – 1	19	13 25 110 – 0	16
Differential pinion gear	125 104 – 1	15	13 25 111 – 0	13

19. Dismantling sliding gear shaft.

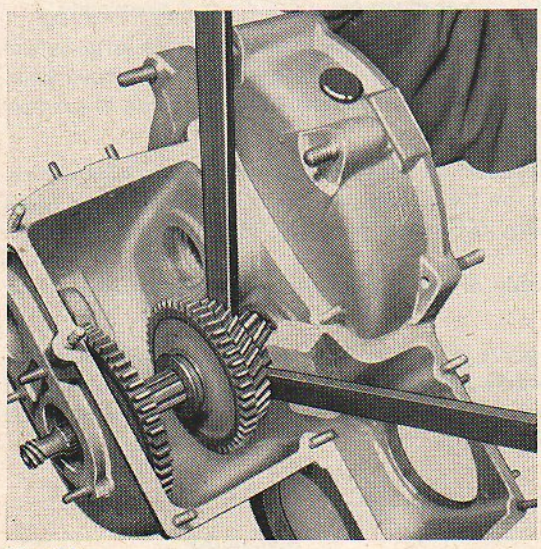
a) Pull out grooved bearing 6203 (Speedometer drive side) (Fig. 11 - 6/1).



11 - 6/1

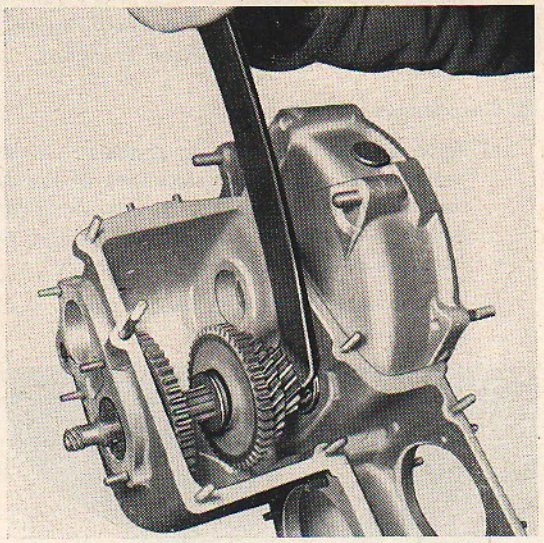
The puller type "Bärenklaue" as shown above (Makers: Messrs. Albert Schrem, Giengen a. d. Brenz) can also be supplied as commercial type tool by the Matrawerke Frankfurt a/M.

b) Apply two fitting tools as lever behind 3rd speed helical tooth sliding gear and press out sliding gear shaft until hook SW 17 can be applied behind the small helical tooth gear on the sliding gear shaft (Fig. 11 - 6/2).



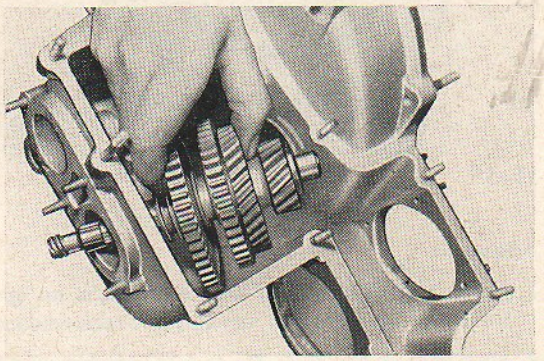
11 - 6/2

c) Push sliding gear shaft with tool SW 17 entirely out of the clutch sided grooved bearing 6203 (Fig. 11 - 6/3).



11 - 6/3

d) Take out sliding gear shaft (Fig. 11 - 6/4).



11 - 6/4

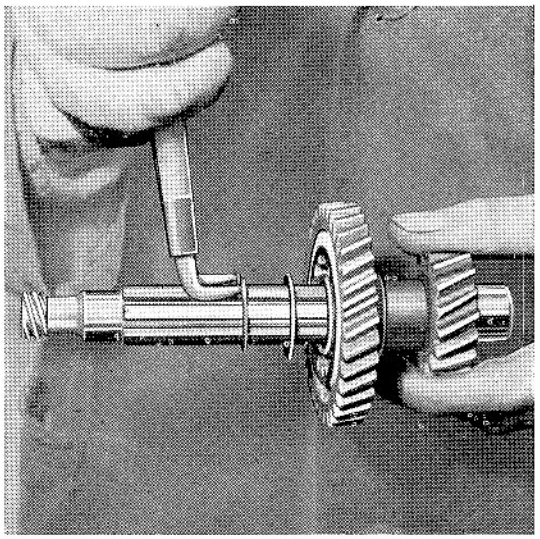
Attention! Apply fitting tool close to the hub of the sliding gear. Before commencing pushing, be sure that levers fit well so as to avoid damaging gears and transmission. If, when forcing out sliding gear shaft (with the aid of the two fitting tools), the grooved bearing should likewise become forced out of the case, the sliding gear shaft has to be built out completely. In this case it should be proceeded with special care in order to ensure that the a/m levers will not slip off.

In this special case no pulling out of the grooved bearing according to the instructions given under (21) will be required.

20. Disassembly sliding gear shaft.

    a) Pull off sliding gears 1st/reverse speed and 2nd speed from the shaft.

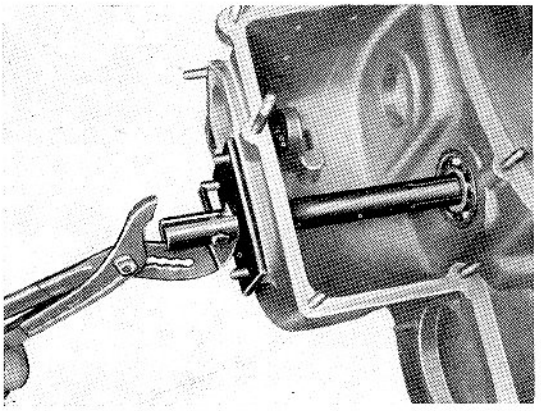
    b) Pull helical sliding gear 3rd speed from bronze bushing after removal of Seeger ring and thrust washer (Fig. 11 - 7/1).



11 - 7/1

21. Pull grooved bearing 6203 (clutch side) with tool SW 16 out of transmission case.

The dished end of the 6-fold slotted tube is to be put through the inner race of the bearing and the cylindrical bolt has to be pushed through entirely. This causes the tube to expand behind the bearing so that the bearing may now be pulled out, after the thrust plate being placed on the studs, by means of lever action (Fig. 11 - 7/2).



11 - 7/2

If the grooved bearing is destroyed so that it cannot be removed with the a/m tool, the transmission case may be slightly warmed up from the clutch side.

Attention!

1. Up to chassis-No. 6/230 777 or 6/111 967 the 3rd speed sliding gear and the corresponding counter gear on the drive shaft have straight flanked toothing (see also under "Attention" page 11 - 3).

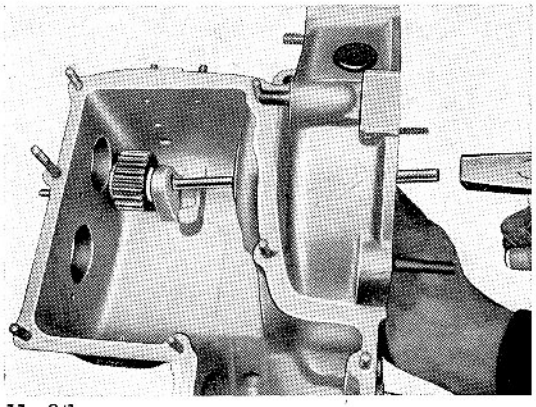
2. From chassis-No. 6/239 730 or 6/112 511 forward the annular groove to take the locking ring is cut deeper by 0.5 mm. Should with some cars (up to chassis-No. 6/239 729 or 6/112 510) it be the case that the locking ring is being lifted out of the groove (gears do not stay in mesh in the 3rd speed) due to the side pressure exerted by the sliding gear, the sliding gear shaft is to be exchanged by such one with a deeper groove. In doing this remove old locking ring (**22** x 1.2 DIN 471) and install new locking ring (**21** x 1.2 DIN 471).

Diameter of sliding gear shaft measured from the bottom of groove	old type	21 mm dia.
	new type	20 mm dia.

3. For changes in the total gear reduction (different number of teeth of the small helical tooth gear on the sliding gear shaft) and in the speedometer reduction (different number of teeth of the speedometer worm) or for the correct assembly of the sliding gear shaft, large helical tooth gear for axle drive and pinion for speedometer drive, please refer to Chart on page 10 - 2.

22. Dismantle reverse speed intermediate gear.

a) Drive out intermediate gear bolt from the clutch side by means of a long driver (Fig. 11 - 8/1).

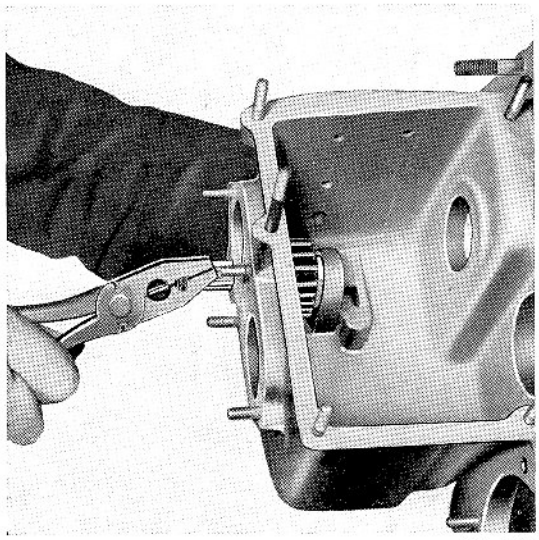


11 - 8/1

b) Pull out bolt entirely. Apply pliers to the tension pin (Fig. 11 - 8/2).

c) Take out intermediate gear (one thrust washer, 2 mm thick, for each intermediate gear – parts No. 122 012 – 0 on both sides of intermediate gear).

Attention! Carry out operations specified under item 22 only if there is a special case of repair concerned or if the transmission case needs be replaced!



11 - 8/2

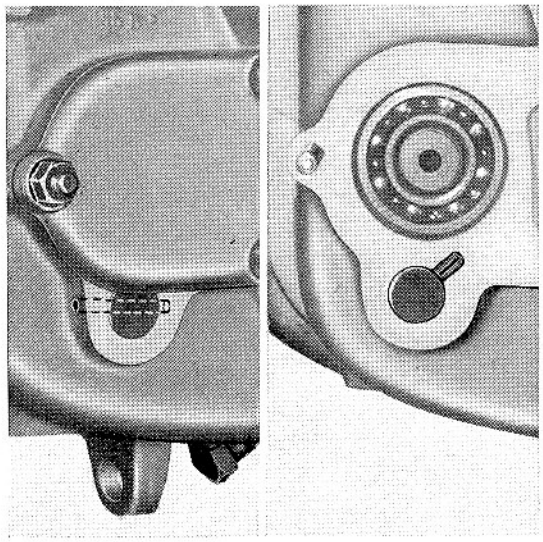
23. Clean transmission case and components. Remove residual jointing material with a dissolver (when leaving the factory, transmission cover gasket has been sticked on the case wiht liquid luting agent "Wevolic").

Attention!

1. Up to chassis-No. 6/222 086 or 6/111 120 the intermediate gear bolt is provided with a 4 mm wide oil groove.
2. From chassis-No. 6/222 087 or 6/111 121 forward, instead of the oil groove, the bolt shows a well visible flattened section which should point upwards when fitted.
3. From chassis-No. 6/238 117 or 6/112 440 forward the bolt is fitted with oil bores. When fitting this hollow bolt see that the flat section points downward.
   The 3 different bolts are exchangeable. In the case of transmissions which are provided with intermediate gear bolt without oil bores, only a hollow bolt shaft be fitted in the case of a repair. To this end, refer to the information under item (5).

4. From chassis-No. 6/251 875 or 6/113 421 forward, the intermediate gear is equipped with a bronze bush to improve the running characteristic. This intermediate gear may be in each case installed later, but it shall be paired only with a bolt fitted with an oil bore. Therefore, up to chassis-No. 6/238 116 or 6/112 439 replace intermediate gear bolt simultaneously.

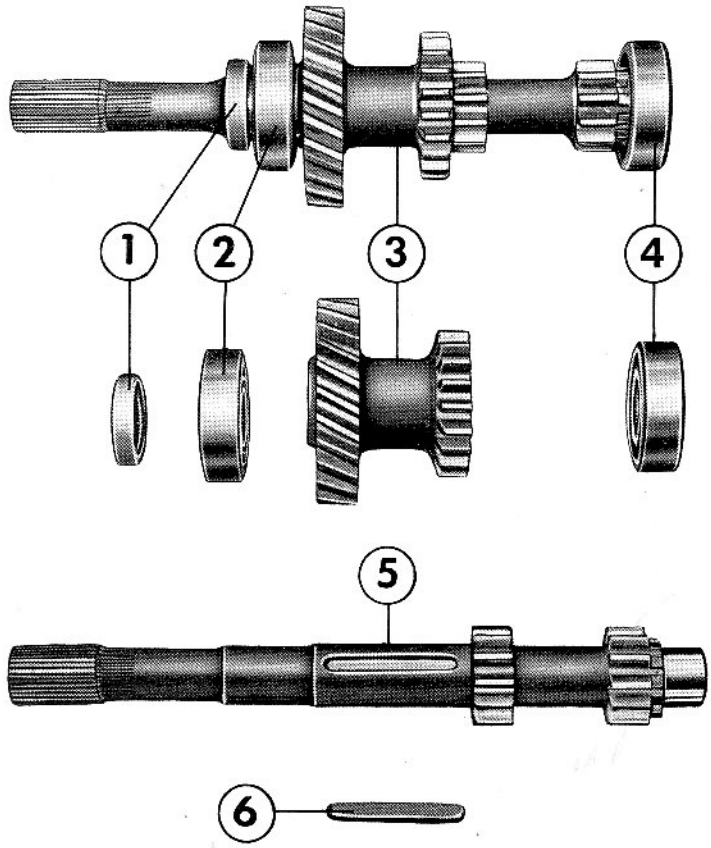
5. Up to chassis-No. 6/267 126 or 6/114 634 all a/m types of bolts are drilled to take the tension pin. The tension pin locking device is fitted externally at the case. All three types of bolts have the same Parts-No. 122 010 – 0!



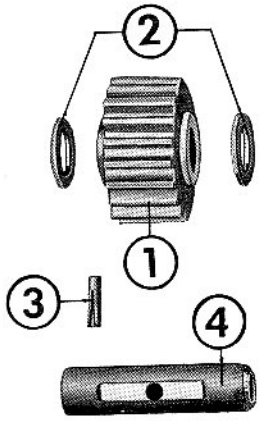
11 - 8/3

From chassis-No. 6/267 127 or 6/114 635 forward,the tension pin locking device for the bolt has been altered. The bolt is not drilled throughout the entire length, but the tension pin inserted in a blind hole, lying in a recess cut in the case wall, which is covered outside by the speedometer housing. Parts-No. of this intermediate gear bolt is 122–010 – 1! Fig. 11 - 8/3 shows on the left the old and on the right the new bolt locking device.

Drive Shaft Assembly



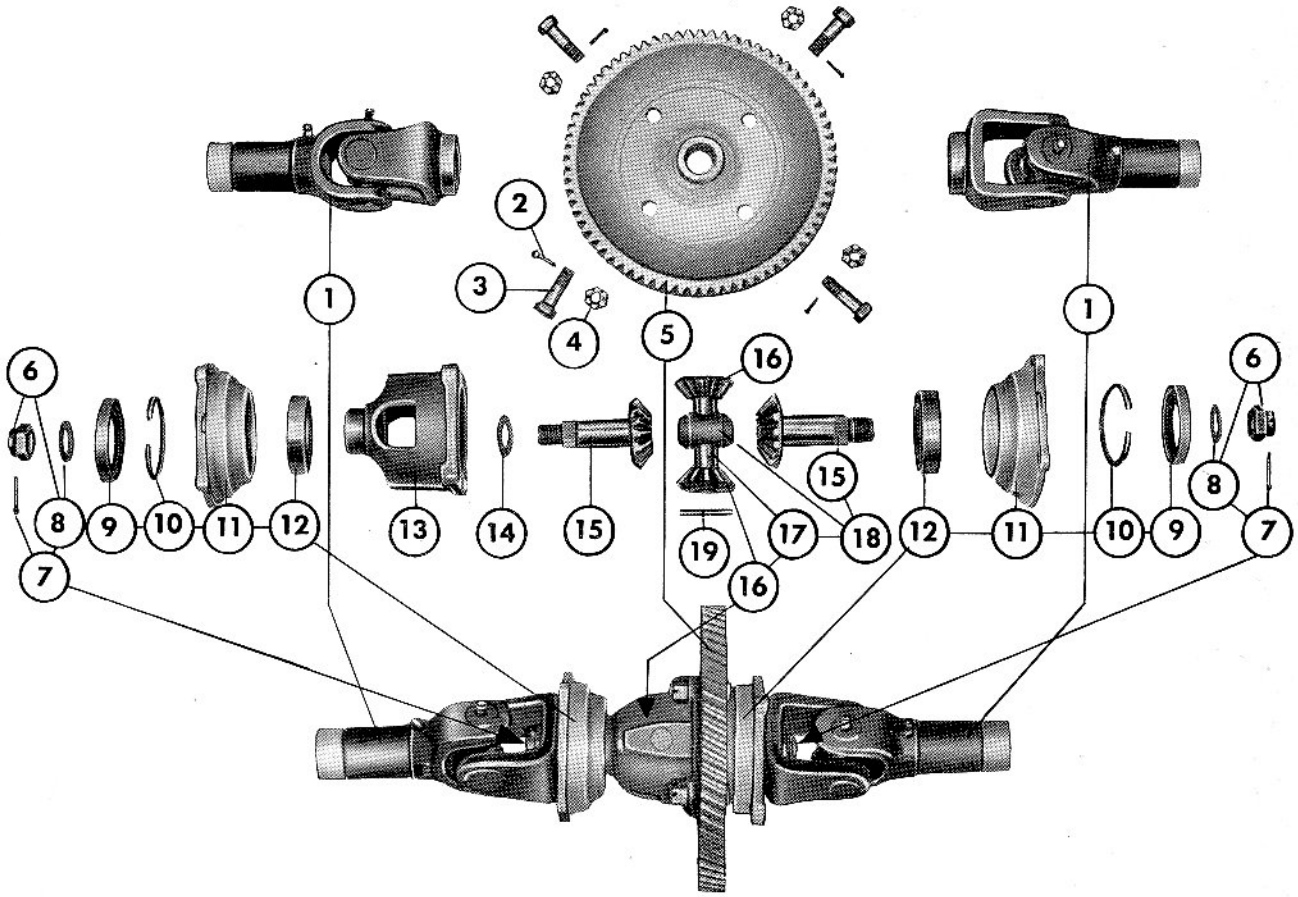
1 – Radial joint ring A 17 x 28 x 7 DIN 6503
2 – Grooved bearing 6203 DIN 625
3 – Helical tooth double gear 2nd and 3rd speed
4 – Grooved bearing 6203 DIN 625
5 – Drive shaft
6 – Fitting key A 5 x 5 x 40 DIN 6885



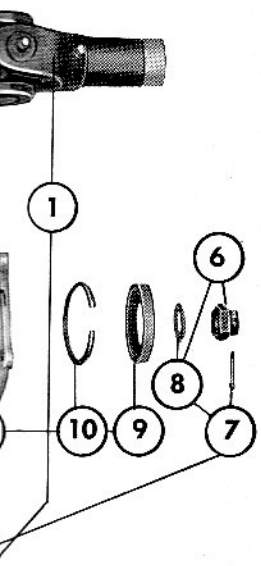
Reverse Speed Intermediate Gear

1 – Intermediate gear with bushing
2 – Thrust washer (2 pces.)
3 – Tension pin 4 x 16 DIN 1481
4 – Intermediate gear bolt

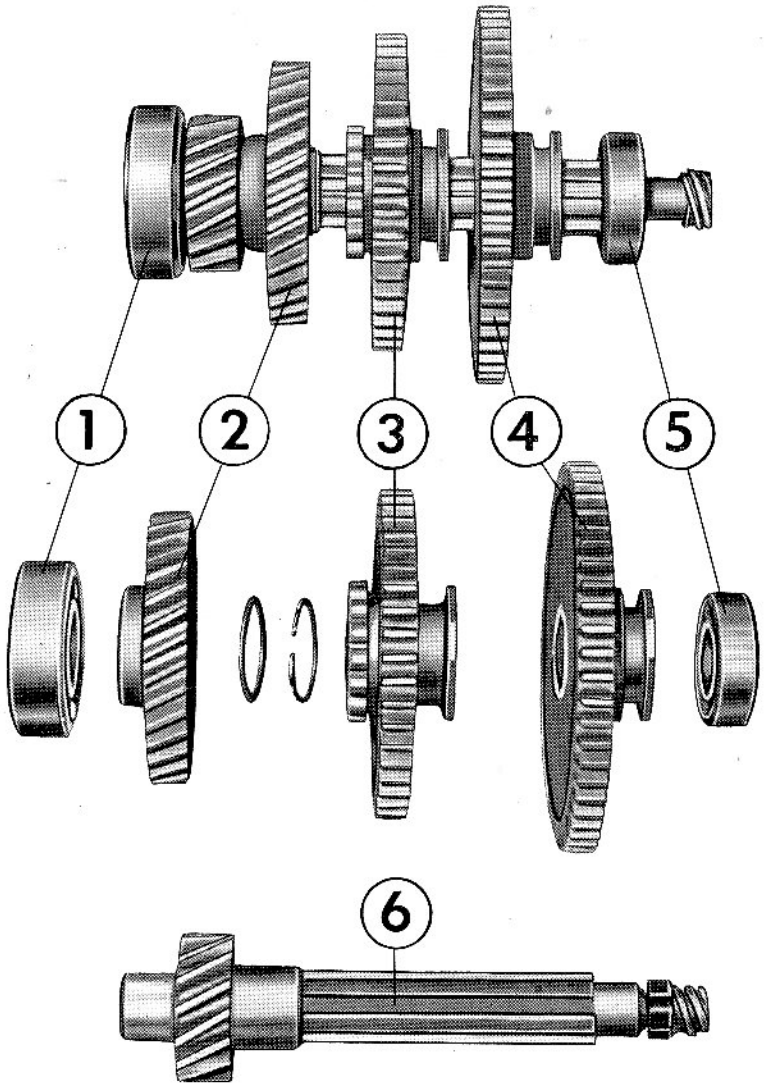
Differential Assembly



1	Inner universal joint	2 pces.
2	Cotter pin 2 x 18 DIN 94	4 pces.
3	Hex head bolt M 10 (M 8)	4 pces.
4	Castellated nut M 10 (M 8)	4 pces.
5	Large helical gear for axle drive	
6	Flat castellated nut M 16 x 1.5	2 pces.
7	Cotter pin 3 x 28 DIN 94	2 pces.
8	Washer	2 pces.
9	Radial joint ring A 40 x 55 x 8	2 pces.
10	Seeger ring	2 pces.
11	Bearing cover	2 pces.
12	Grooved bearing 6006	2 pces.
13	Differential case	
14	Thrust washer	
15	Differential side gear	2 pces.
16	Differential pinion gear	2 pces.
17	Differential bolt	
18	Distance piece	
19	Tension pin 4 x 40 DIN 1481	



Sliding Gear Shaft Assembly



1 – Grooved bearing 6304 DIN 625
2 – Helical tooth sliding gear 3rd speed
3 – Sliding gear 2nd speed
4 – Sliding gear 1st and reverse speed
5 – Grooved bearing 6203 DIN 625
6 – Gear change shaft with bushing

Inspection

1. **Transmission Case**

Inspect

a) transmission case for external damage and eventual cracks; if necessary install a new case,

b) seats of grooved bearings in the case and in the bearing covers whether the outer race of the bearing fits well.

2. **Drive Shaft**

Inspect

a) splines for wear (put clutch plate on the shaft and check for radial clearance).

b) contact area of radial joint ring for worn-out surfaces.

c) bearing surface of the double gear for proper tunking/driving fit.

d) proper condition of the keyway.

e) the drive shaft for out-of-round condition. Place shaft with both bearing surfaces on prismatic pieces and measure excentricity by height at seat of the double gear. (Place feeler pin of dial gauge in the mid of seat, i. e., on the non-supporting part of the seat).

Tolerable out-of-true condition: max. 0.01 mm. If this value is exceeded, a new shaft must be fitted. (In way of the splines for the clutch plate the excentricity must not exceed 0.1 mm. When fitted in place, a minimum value of 0.15 mm is permissible at this spot).

f) condition of antifriction bearings. Remove not absolutely irreprochable bearings!

g) gears for damage o wear. If 1st or reverse speed gears are damaged or heavily worn down, a new drive shaft must be fitted. If necessary, counter gears on the sliding gear shaft should likewise be renewed. If the 2nd and 3rd speed double gear requires to be replaced, all corresponding counter-gears on the sliding gear shaft must be replaced in any case.

3. **Sliding gear shaft**

Inspect

a) small helical tooth gear for wear or damage. If necessary, renew sliding gear shaft jointly with the large helical gear for axle drive.

b) worm for speedometer drive for wear or damage. If necessary, remove sliding gear shaft and speedometer pinion.

c) condition of all anti-friction bearings. Remove all bearings, which are in a not absolutely irreprochable condition.

d) sliding gears for wear or damage. In case of damage or heavy wear, install new sliding gears and counter gears (if necessary), double gear or drive shaft). The 3rd speed sliding gear shall always be renewed jointly with the double gear on the drive shaft.

e) bushing of 3rd speed sliding gear and thrust washer for wear.

Radial clearance between bushing and sliding gear; maximum 0.08 mm. If the clearance is nearing in the limit value of wear or if a loose fit of the bushing is stated (bushing turns on the sliding gear shaft) either a new sliding gear shaft – if necessary a new sliding gear, too – must be installed or a new bushing should be shrunk on to the shaft. (Slide gear shafts are supplied **only** completely with shrunk-on finished bushing!)

Attention! The last-mentioned case of repair comes only in question if there is a possibility of reconditioning the new shrunk-on bushing by grinding or precision turning so that a radial clearance between bushing and sliding gear from 0.04 to maximum 0.06 mm will be ensured.

The old bushing is to be replaced by opening with a chisel (in doing so the shaft is to be supported in an unobjectionable manner on a suitable wooden base). Heat the new bushing, before placing on the shaft, to about 300° C (until annealing color appears), if necessary with a torch, and, finally, finish it as directed in the foregoing.

4. **Reverse Speed Intermediate Gear**

Inspect bolt (running surface of intermediate gear) and intermediate gear for wear. If necessary, install new parts of latest construction. See under "Attention" in page 11 - 8.

The intermediate gear is deliverable only as assembly (including bushing) but the bushing can be supplied separately. In both cases the bushing will be delivered in a finished condition so that, after inserting a new bushing, no refinishing of the bore will be necessary.

5. **Differential**

a) Check differential case for wear on the contact faces of differential bevel gears.

The heigh measure "A" will be in new condition:

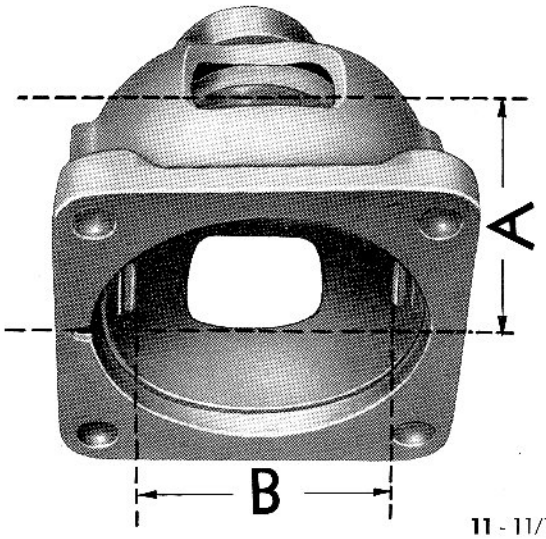
50.45 + 0.1 mm

This measure is allowed to be increased to 52 mm owing to wear, but the difference must be compensated by steel washers. The measure for the distance between contact faces in the case and differential side gear shall not be under or above 0.1 – 0.3 mm (Fig.).

The inner side measure "B" shall be in new condition:

54 + 0.1 mm

This measure is allowed tobe increased to 56 mm owing to wear, but in this case any difference should be compensated by steel washers so that the differential pinion gears will have a clearance from 0.1 to 0.2 mm (Fig. 11 - 11/1).



11 - 11/1

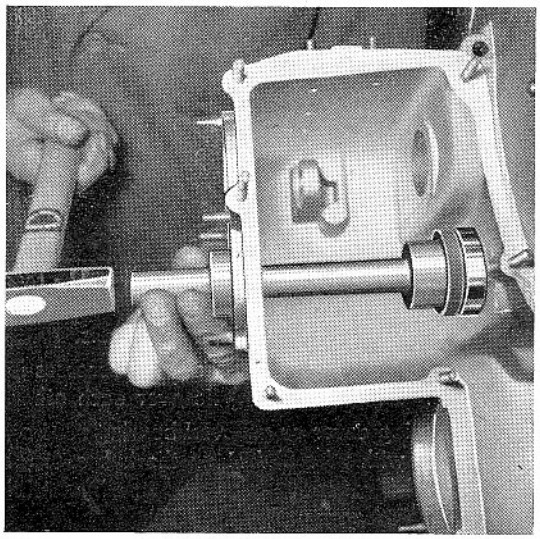
b) The differential bolt should not be damaged or out of true.
Bolt, new . . . . . 13.983 – 13.994 mm
Bore in differential
pinion gear, new . . . . . 14.000 – 14.018 mm
If the clearance between bolt and differential pinion gear will be greater than 0.15 mm, a new pinion gear and bolt must be installed. Inspect differential bevel gears for visible wear and damage. If required, renew bevel gears. In doing this, refer to the hints given in page 11 - 5.

d) Check large helical tooth gear for axle drive for wear and damage.
If necessary, replace jointly with the slide gear shaft.
Refer to the alterations specified under the note "Attention".

Reassembly

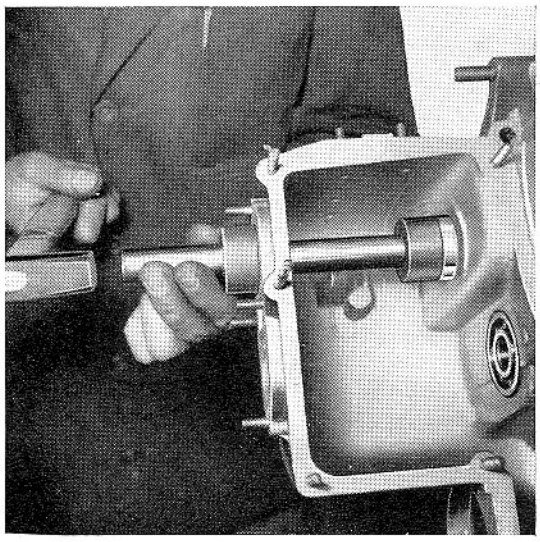
Before installing, oil all components!

1. Insert grooved bearing 6304 on sliding gear shaft into transmission case by using tool SW 13 – to be placed on drift SW 11 – do not tilt bearing while positioning on the gear change shaft (Fig. 11 - 12/1).



11 - 12/1

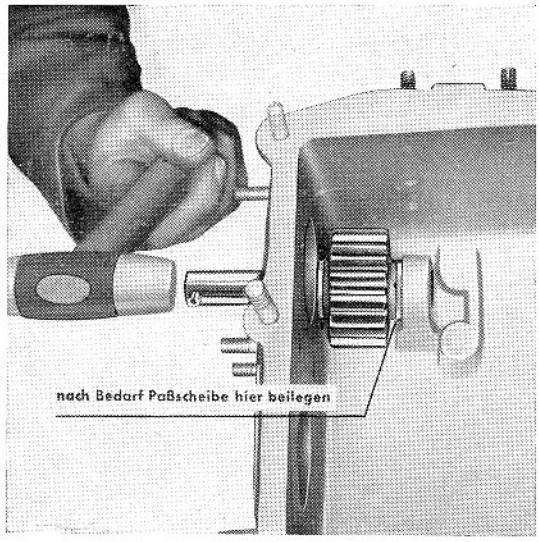
2. Insert grooved bearing 6203 for drive shaft into the transmission case with drift SW 11. Do not tilt bearring while positioning on the shaft (Fig. 11 - 12/2).



11 - 12/2

3. Install reverse speed intermediate gear so that the bevelled side of tooth flanks comes to lie on the inner side. Place in position the two pertaining thrust washers (2 mm thick) on both sides of gear.

To ensure oil tightness it is recommendable to give the intermediate gear bolt of older design (passage for tension pin entirely drilled through; locking outside on case) at the outer end a coat of liquid luting agent "Wevolic" in a width of abt. 5 mm (Fig. 11 - 12/3).



11 - 12/3

The intermediate gear shall have an axial play from 0.1 to 0.2 mm. If the axial play is more than 0.3 mm, use a spacer of corresponding thickness:
The following spacers are available:

Parts-No. 13 14 231 – 0	0.3 mm
Parts-No. 1 22 013 – 0	0.5 mm

Install spacer washer between gear and inner thrust washer! In Fig. 11 - 12/3 marked by arrow.

4. Reassemble differential case:

   a) Install differential side gear with interposed thrust washer.

   b) Insert differential bolt. First differential pinion gear, distance piece and second differential pinion gear are to be put on the bolt; thereafter drive bolt in entirely, locking it with a new tension pin.
   (See also four-speed transmission "Differential Group", Reassembly).

5. Insert preassembled differential case from inside through the bearing cover opening. Turn differential case until differential bolt lies in a horizontal plane.

6. Place large helical tooth gear – with hub shoulder outwards – into the case and push second differential side gear through the hub of the large helical tooth gear (in doing so, lift a little differential case). Bolt together differential case and large helical tooth gear.

   Use only original hex head bolts – M 8 or M 10 – (See alterations under "Attention").

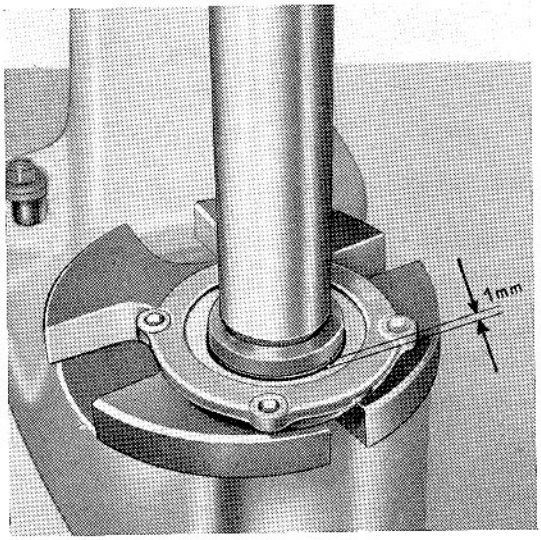
   Tighten up castellated nuts with the specified torque only after installation of the sliding gear and drive shaft. For this purpose it is necessary to lock the transmission in position by simultaneously shifting into gear two speeds.

7. Preassemble both bearing covers.

   a) Insert locking ring with Seeger pliers.

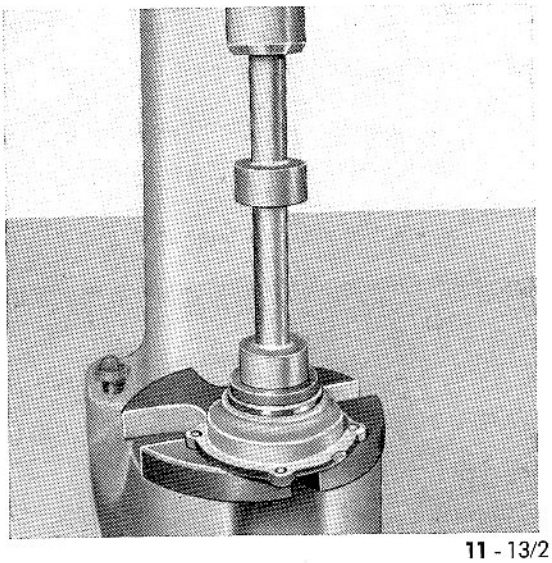
   b) Press in new radial joint ring A 40 x 55 x 8 DIN 6503 into the bearing cover with tool SW 13. Be sure not to tilt joint in applying it to the bearing cover!

      Attention! Be sure that sheet metal cage of the joint ring protrudes 1 mm from the race. Therefore, do not press in joint ring entirely against locking ring! (Fig. 11 - 13/1).



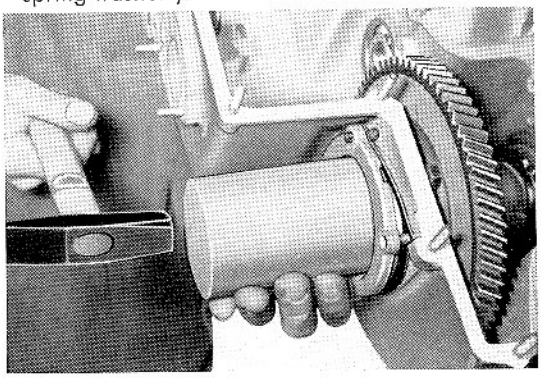
11 - 13/1

   c) Push in grooved bearing 6006, using tool SW 13 – to be placed on drift SW 11 – until it strikes against locking ring (Fig. 11 - 13/2).



11 - 13/2

8. Provide both bearing covers with new gaskets.
   a) Place cover on the studs so that both recesses in the cover (for dismounting) lie over each other.
   b) Drive bearing cover or grooved bearing 6006 on both sides with tube SW 11 on the hub seat (at the large helical tooth gear and at differential case) until its bearing (Fig. 11 - 13/3).
   c) Tighten up crosswise hex nuts (interposed with spring washers).



11 - 13/3

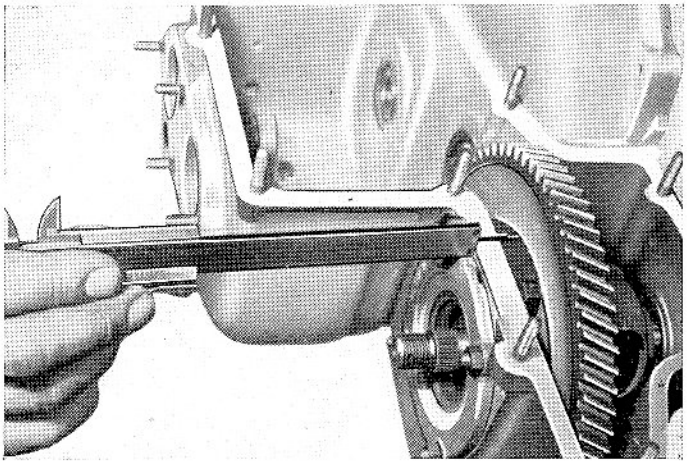
9. Check to see whether the differential in the transmission case is positioned free from any axial play. Should unfavorable conditions prevail owing to the collision of deviating tolerance, it is possible that the inner races of grooved bearing, after installation of the bearing cover, do not fit tightly against the shoulder of the large helical gear or differential case as required. As the grooved bearing owing to its tunking fit is incapable of taking up any lateral forces while running, travelling of the differential in axial direction might occur in such a case. Practically, this may be felt by jerks when starting the car or by a loud noise of the gears in mesh – different in the case of pull and thrust – in a very annoyant and disadvantageous manner.
   For examination put into place the differential by giving the threaded piece of the differential side gear some sharp blows with a rubber hammer until it bears against both sides.

In doing so, check for eventual axial play of the differential by measuring the respective clearance: large helical gear – outer edge transmission case and, if required, compensate by placing on both sides spacer rings of corresponding thickness between locking ring and grooved bearing (after removal of bearing cover)

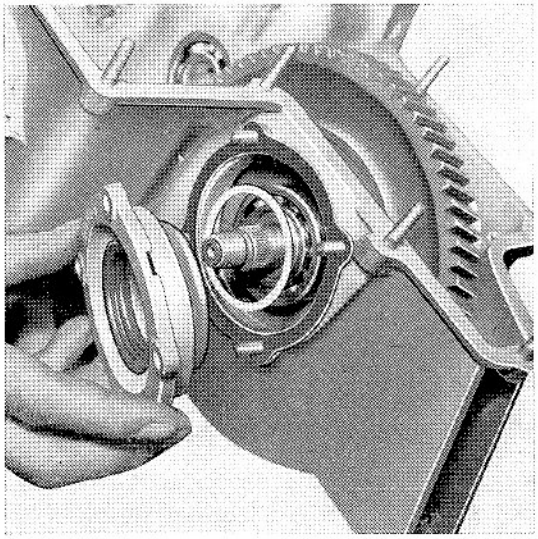
(Fig. 11 - 14/1 and 2).

Spacer rings are available in the following sizes:

Parts-No. 125 109 – 0	0.1 mm
Parts-No. 125 110 – 0	0.2 mm
Parts-No. 125 111 – 0	0.3 mm



11 - 14/1



11 - 14/2

10. Check differential for easy running.

11. Assembling of the gear change shaft.

a) Push 3rd speed helical tooth sliding gear on to the bushing of gear shaft (hub into direction of small helical gear on gear change shaft); put in place thrust washer and insert locking ring with Seeger pliers into the groove on sliding gear shaft. Care is to be given that the locking ring is correctly seated under tension on the whole circumference.

b) Verify whether sliding gear, as prescribed, runs without axial play. Should such a play be found, change thrust washer by a corresponding thicker one.

Thrust washers
are available in the following sizes:

Part-No. 122 007 – 0	1.3 mm
Part-No. 122 040 – 0	1.5 mm
Part-No. 122 041 – 0	1.7 mm

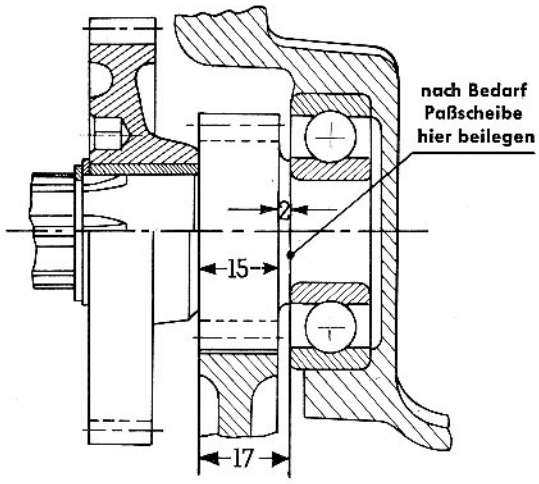
c) Place 2nd speed sliding gear (ring of dogs must show to helical tooth sliding gear 3rd speed) and 1st/reverse speed sliding gear (groove for shifter fork must lie outside) on the shaft.

12. Installing gear change shaft.

Attention! Give care that the small helical gear on gear change shaft and the large helical gear for axle drive are in alignment.

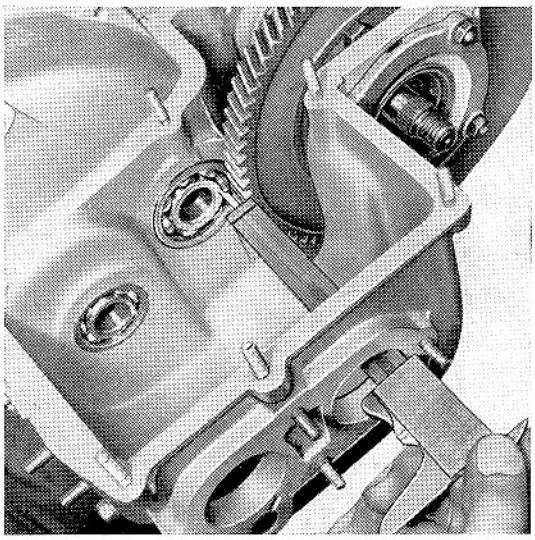
As both gears – measured across teeth – have the same width (15 mm), and the width of the small helical gear on gear change shaft including collar is 15 + 2 = 17 mm, the distance: Outer edge large helical gear – inner race – grooved bearing 6304 must likewise be 17 mm is gears are well aligned.

If there should be unfavorable conditions owing to deviating tolerances prevail, it is possible that the a/m measure will be exceeded in service. In such a case it is necessary to compensate any difference by inserting spacers of corresponding thickness between small helical gear on the gear change shaft and inner race of grooved bearing, a play of 0.2 mm being considered as negligible (Fig. 11 - 15/1).



11 - 15/1

a) Measure distance between outer edge large helical gear – inner race of grooved bearing 6304. (Fig. 11 - 15/2).



11 - 15/2

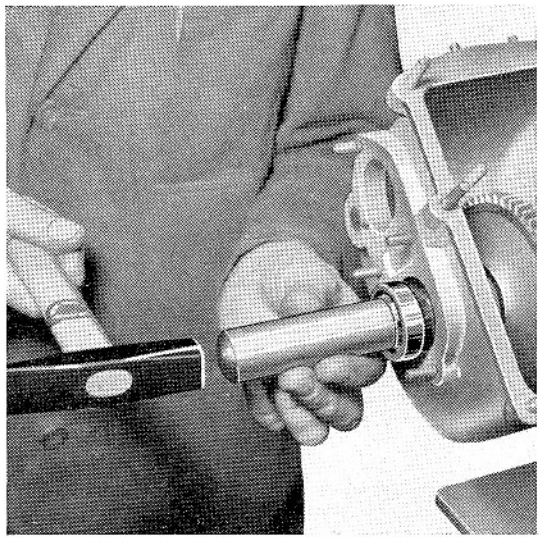
If it is found that the measure 17 + 0.2 mm is exceeded, spacer washer of corresponding thickness is to be placed, before installation of the gear change shaft, on the supporting bolt of the gear change shaft (for grooved bearing 6304).

The following spacers are available:

Parts-No. 522 004	0.3 mm
Parts-No. 522 005	0.5 mm

b) Move gear change shaft with sliding gears until it bears against grooved bearing on the clutch side.

Put the outer grooved bearing on the shaft journal. Drive in or over gear change shaft and bearing jointly with drift tube SW 3. Apply light blows until they bear on both sides (Fig. 11 - 15/3).



11 - 15/3

Attention! In drifting in the shaft, care is to be used to ensure that the teeth of both helical gears are in mesh with each other and do not clash together in order to avoid teeth being damaged.

Never strike the worm for speedometer drive with a hammer, even not with a rubber hammer. Already slightest damage to the worm results in noisy gear operation and eventually in grippage of the speedometer drive.

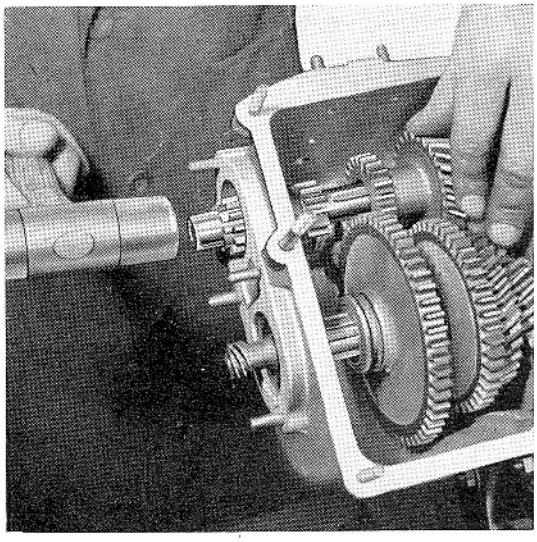
c) Check for alignment of both helical tooth gears.

12. Install drive shaft.

a) Insert fitting key.

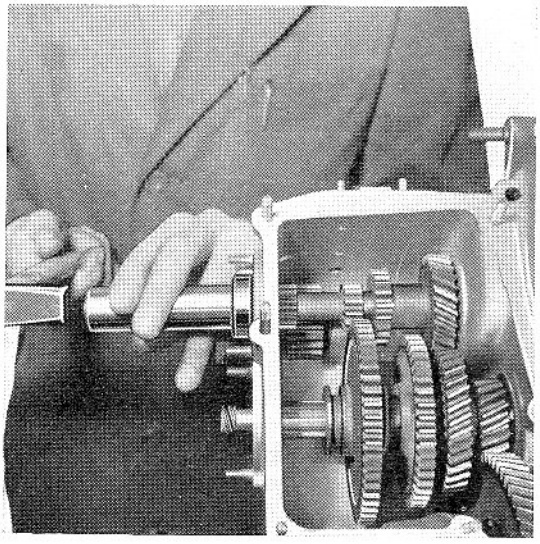
b) Hold double gear in front of grooved bearing on the clutch side. Conduct drive shaft through bearing hole on the speedometer drive side and place it against the double gear with fitting key in correct position to the keyway (in the double gear).

c) Drive in drive shaft through the double gear into grooved bearing on the clutch side until reverse speed gear commences to mesh with intermediate gear. Be sure that there is no gear clash. (Fig. 11 - 16/1).



11 - 16/1

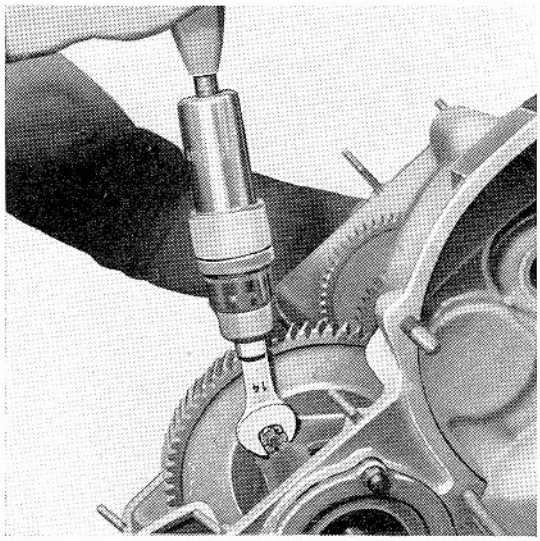
d) Put outer grooved bearing on shaft journal and drive in or over bearing and shaft jointly with drift tube SW 3 until its bearing (Fig. 11 - 16/2).



11 - 16/2

13. Lock in position change gear by simultaneously shifting into gear 3rd and reverse speed. Tighten up fastening nuts on the large helical tooth gear for axle drive with the specified torque. Thereafter, secure with cotter pin. (Fig. 11 - 16/3).

M 8 = ...	3.3 mkg
M 10 = ...	5.0 – 5.5 mkg



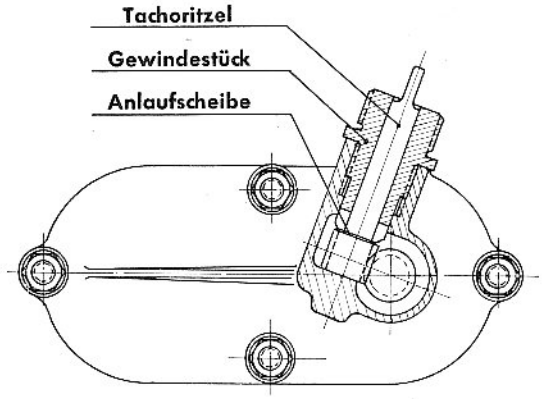
11 - 16/3

14. Reassemble speedometer housing. Do not forget to place in thrust washer (Part-No. 122 316–0, 0.5 mm)

First, oil screw plug. Then screw into place, otherwise there might be danger gripping.

When renewing speedometer pinion, give care to correct number of teeth.

Axial play of speedometer pinion shall not exceed 0.3 mm, otherwise a second thrust washer has to be installed. Protruding speedometer pinion, if any, may be compensated by shortening screw plug (Fig. 11 - 16/4).



11 - 16/4

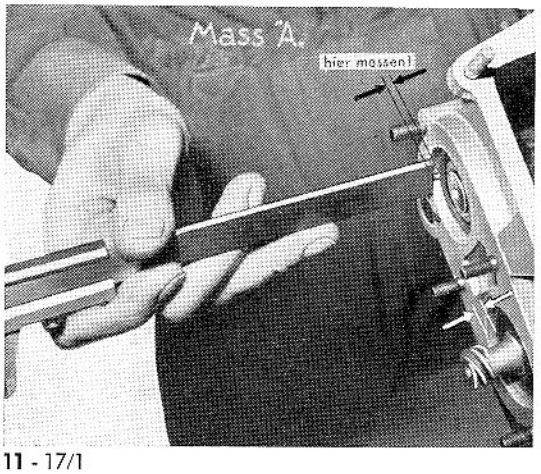
15. Attach preassembled speedometer housing.

Attention! Drive and gear change shafts should run without axial play! In order to avoid wandering of these shafts or of the grooved bearings, the shoulders at the speedometer housing must bear against both outer races of bearing. If unfavourable conditions should prevail owing to the presence of different tolerances, it is possible that after screwing-on speedometer cover there is no bearing whatever on these points. In any case, before fitting the cover, it must be stated by measuring whether spacer washers must be installed for compensation.

a) Install new paper gasket.

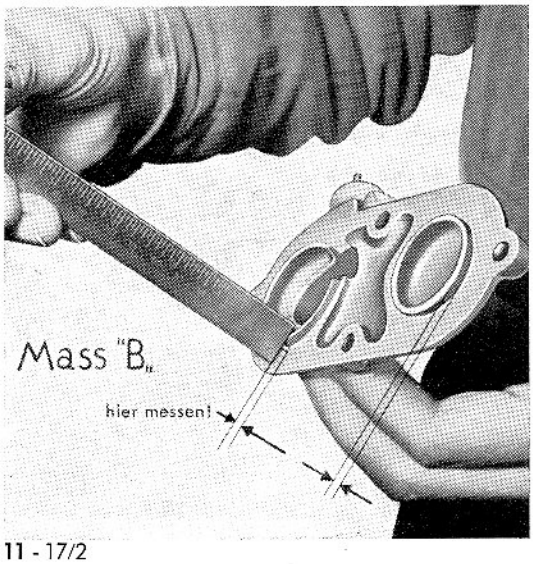
b) Check whether it is necessary to interpose spacer washers between cover collar and grooved bearing 6203.

Measure distance of both grooved bearings from outer edge transmission case (including gasket) (Fig. 11 - 17/1).



11 - 17/1

Measure height of both ring collars on speedometer housing (Fig. 11 - 17/2).



11 - 17/2

The difference between A – B means the thickness of the spacer washer to be inserted.

The following spacers are available:

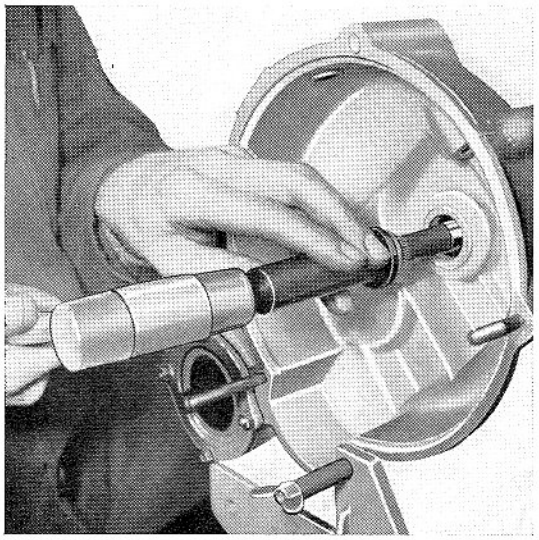
Parts-No. 122 022	0.1 mm
Parts-No. 122 023	0.2 mm
Parts-No. 122 024	0.3 mm

c) Bolt-on speedometer housing.

16. Mount new radial seal ring for drive shaft.

a) Oil bearing surface of seal ring for drive shaft and seal ring.

b) Drive seal ring in until tool collar bears against transmission case, using tool WO 57 (sealing lip for grooved bearing) (Fig. 11 - 17/3).



11 - 17/3

17. Check change gear and differential for easy run.

18. Paste new transmission cover gasket on the transmission case with liquid luting agent "Wevolic".

19. Put sliding gears and shifter forks in neutral position. Place in position transmission cover and secure it provisionally with four nuts only.

20. Verify shifting and running of all gears.
If there are any irregularities as regards the position of the sliding gears to their counter gears on the drive shaft, straighten shifter forks correspondingly. In doing so proceed as follows:

First check adjustment of shifter fork of 2nd/3rd speed.

It is of great importance that the dogs on the 2nd speed sliding gear will bear over the whole width when 3rd speed is shifted into gear. In order to ensure in this case that the gear shift position is fully engaged, on the one hand, and the shifting fork is not under tension, on the other hand, the 2nd speed sliding gear (with 3rd speed shifted into gear) shall be allowed to be moved up to 0.3 mm towards the 3rd speeds helical tooth gear still beyond the pressure point of the locking device.

If the sliding gear or the shifter fork – with gearshift position lock engaged – can be moved more than indicated to the 3rd speed helical tooth gear, the dog coupling between both gears does not completely function.

If with 3rd speed into mesh, no motion to 3rd speed helical tooth gear is possible, there is danger that the gearshift position lock has failed to become entirely engaged, the shifter fork be put under tension and the shifter fork dogs bear only on one side in guide of the sliding gear.

This results in rapid wear of the shifter fork.

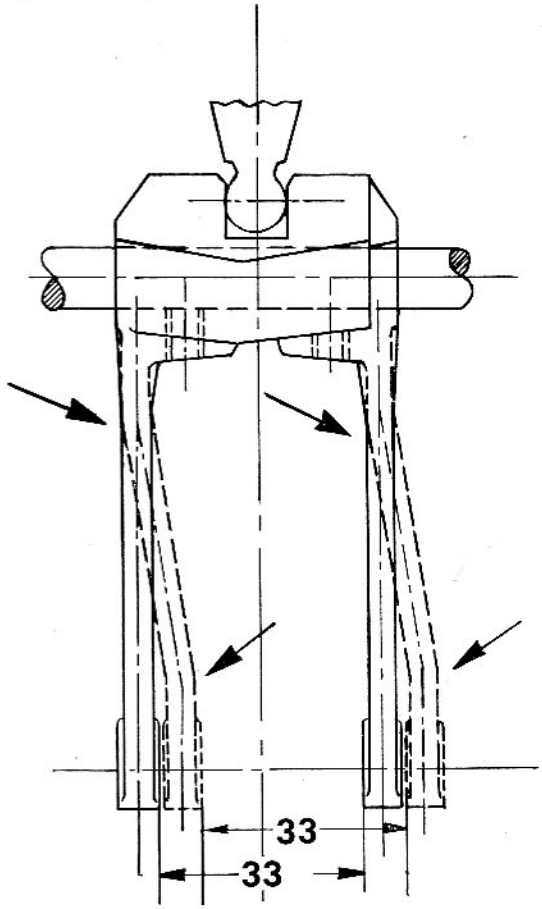
In both cases adjust shifter fork correspondingly.

In adjusting the shifter fork, give care to see that the shifting dogs are always at a right angle to the gear change shaft! Therefore, it is necessary to have the shifter fork bent twice.

In Fig. 11 - 18/1 the bends are marked by arrows.

When the 3rd speed gears are in mesh as prescribed or if the shifter fork has been bent correspondingly, check in neutral position the distance between both shifter forks in way of the dogs.

If examination reveals that this measure is greater or smaller than 33 mm, the shifter fork for 1st and reverse speeds must be adjusted correspondingly. (Fig. 11 - 18/1).



11 - 18/1

The gear cover mut be easily movable up and down in all gear positions, i. e., the shifter fork dogs must engage in the sliding gear guide without any constraint.

Studs, which do not stand exactly vertically in the transmission case, have to be straightened before installing the cover.

21. Screw down transmission cover crosswise, commencing from the centre, and tighten up nuts uniformly.

22. Install clutch lever.

23. Screw on bracket for heating and rubber pads.

24. Fill in transmission oil, conforming to manufacturer's instruction.

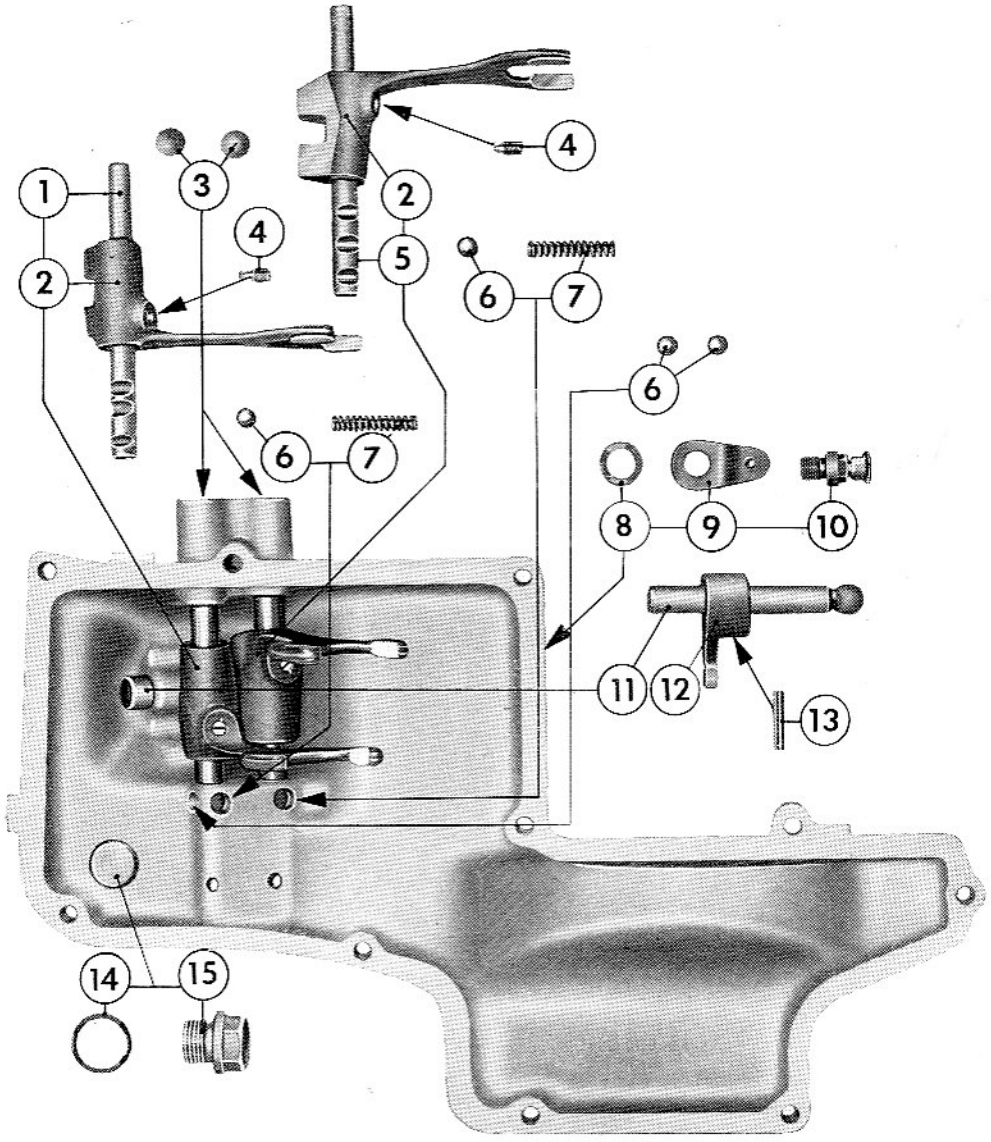
Construction

In the transmission cover there are fastened by means of threaded pins two shifter forks each on a gear shift rod which is slidable in the cover.

The shifter forks with the gear shift rods are moved by the gear shift finger which is fastened to the gear shift finger shaft by means of a tension pin.

Gear shifting operation

In neutral position the recesses in the shifter forks lie side by side. In shifting a speed into gear, the gear shift finger moves through the thus formed road at right angle to the shaft, selects the corresponding shifter fork and moves it in the direction of shaft.

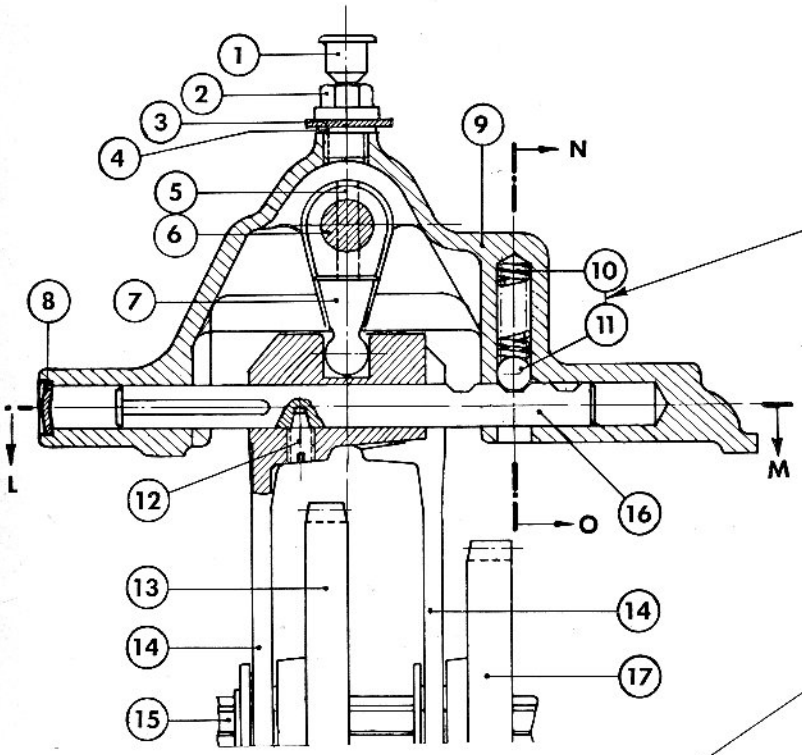


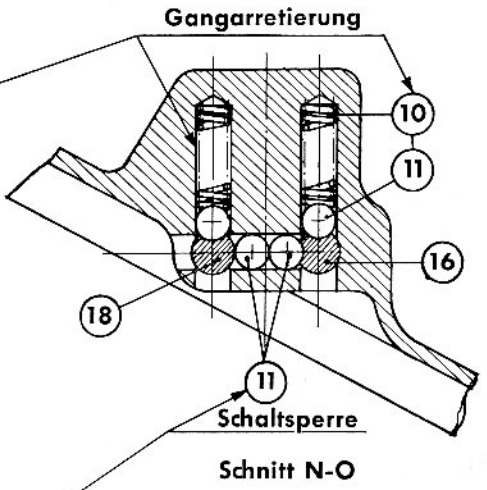
1 – Gear shift rod, 2nd and 3rd speed
2 – Shifter forks (2 pces.)
3 – Seal, 12 dia. (2 pces.)
4 – Threaded pin (2 pces.)
5 – Gear shift rod 1st and reverse speed
6 – Lock ball, 8 dia. (4 pces.)
7 – Spring (2 pces.)
8 – Joint ring
9 – Eyeplate
10 – Vent
11 – Gear shift finger shaft
12 – Gear shift finger
13 – Tension pin
14 – Joint ring
15 – Screw plug with collar

Gear Shift Position Lock and Gear Shift Rod Interlock

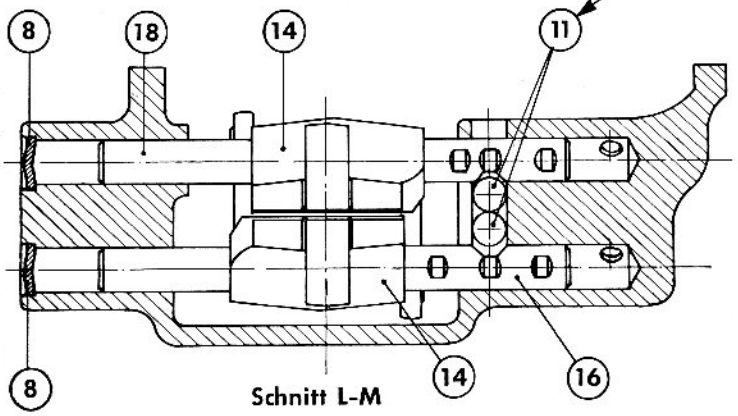
The gear shift rods (with shifter forks) are kept in neutral position and in the two gear positions in relation to the transmission cover by spring-loaded balls (gearshift position lock).

Between the gear shift rod there is provided a ball interlock. Thus, in actuating one of the shifting rods the other is prevented from moving (gearshift rod interlock).





Schnitt N-O



Schnitt L-M

1 – Lubricator
2 – Screw plug with hole
3 – Eyeplate
4 – Joint ring
5 – Tension pin
6 – Gear shift finger shaft
7 – Gear shift finger
8 – Closing plate, 12 dia. (2 pces.)
9 – Transmission cover
10 – Spring (2 pces.)
11 – Ball, 8 dia.
12 – Threaded pin
13 – Sliding gear 1st reverse speed
14 – Shifter forks
15 – Gear change shaft
16 – Gear shift rod 1st reverse speed
17 – Sliding gear 2nd/3rd speed
18 – Gear shift rod 2nd/3rd speed

Removing and reinstalling transmission cover (in the car)

The transmission cover can be removed and reinstalled in the car. For this operation the transmission need not be removed from the car.

Engine and transmission are to be separated from the front axle carrier and pulled forward until the unscrewed transmission cover can be taken out from below under the upper front spring. In doing this, the assembly is supported on the front axle-longitudinal carrier and lower front spring. The rear engine rubber pad is being supported against the L. H. shock absorber arm, thus preventing the power plant to slide back.

It is recommended to proceed in the following sequence:

Removal

Attention! In order to secure that while taking out the transmission cover no dirt may fall down into the open transmission, clean thoroughly transmission and crankcase before starting repair work and blow off with compressed air!

1. Close fuel cock.
2. Loosen both battery cable from battery terminal.
3. Loosen connecting hose between air intake and heater. Take off air intake after loosening three hex nuts from decoration mould.
4. Dismantle front decoration mould. With the LT/LTK 600 types dismantle front hood panel and bumper.
5. Loosen heating hose on heater. Bend away heating hose.
6. Loosen Bowden wire for heating fastened on the holder of the heater. Unlock wire at heating flap lever.
7. Take cables running to the dynamo out of the terminal on the right wheel case.
8. Pull off fuel hose from pipe connection to fuel pump.
9. Disengage gas- and starter-wire on the carburetor. Loosen and take out wires on air filter tube respectively fan casing.
10. Unscrew Bowden wire for defroster fastened on the holder of the engine hood. Unhook wire on flap lever.
11. Remove defroster hose from the nozzle on engine hood and bend it to the side.

    Attention! Avoid bending of heating and defroster hose, so that they will suffer no permanent deformation. Furthermore this may result in an unfavorable reduction of the heating and defrosting effect due to the diminution of the sectional area of the hose.

12. Disengage tension spring for gearshift tube at transmission cover.
13. Loosen clamping screw on gearshift tube and push gearshift tube upward.
14. Unscrew speedometer spiral from case.
15. Loosen clutch cable and pull it out of clutch lever and thrust bearing.
16. Remove hose for preheating on air filter tube; unscrew intake hood on exhaust manifold.
17. Unscrew heater from heater holder.
18. Unscrew brass nuts for fastening exhaust manifold to the cylinder heads.
19. Take out heater with exhaust manifold (as a unit) from below to the right, thereby pulling exhaust manifold – sliding tube out of spherical flange connection of the exhaust tube.
20. Unscrew lateral engine suspension (underneath dynamo bracket) from bracket arm of front axle carrier.
21. Unscrew rear engine suspension from front axle carrier.
22. Unscrew engine suspension clamp, rear (top) and front (bottom) from front axle carrier.
23. Pull out forward the whole assembly.
24. Unscrew and lift off transmission cover.
25. Protect open transmission against dirt by covering.

Installation

The installation has to be made in the reverse order.

Disassembly

Make sure that both shifter forks are in neutral position.

1. Screw out oil filler cap SW 19.

2. Unscrew lubricator SW 10 (with eyeplate and seal).

3. Separate coupling (for gear shift) from gearshift finger shaft by driving out the lower tension pin.

4. Remove sealing plates:
   Drill plates and pull them out in axial direction with a wire hook. Do not break out plates to avoid damage to bore in transmission cover!

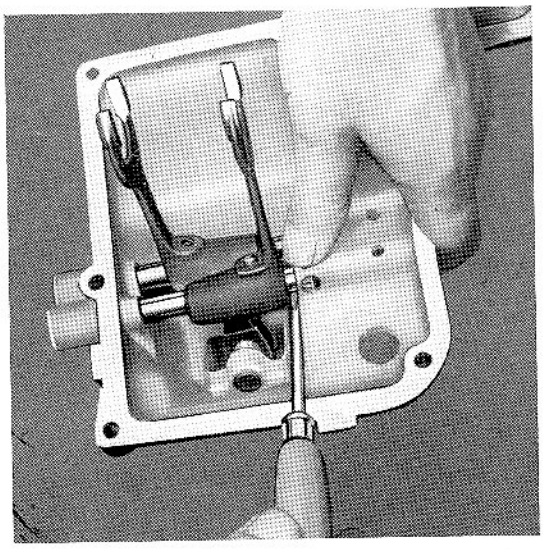
5. Remove punch marks on the threaded pins of shifter forks with a 3 mm dia. drill. Do not yet screw out threaded pins.

6. Dismantle 2nd/3rd speed gear shift rod.

   a) Shift fork (with gear shift rod) into gear position "2nd speed" i. e. push fork towards outer edge of cover.

   b) Slacken threaded pin. Push back shifter fork, without moving gear shift rod, entirely back in the direction of the gearshift position; lock and clamp well again with threaded pin.

   c) Push gear shift rod out of 2nd speed notch. Put screw driver between shifter fork and transmission cover, using it as a lever (Fig. 14 - 1/1).



14 - 1/1

   d) Take out gear shift rod. In doing this, cover bore for gearshift position lock to prevent spring-loaded ball from jumping out.
   Remove shifter fork.

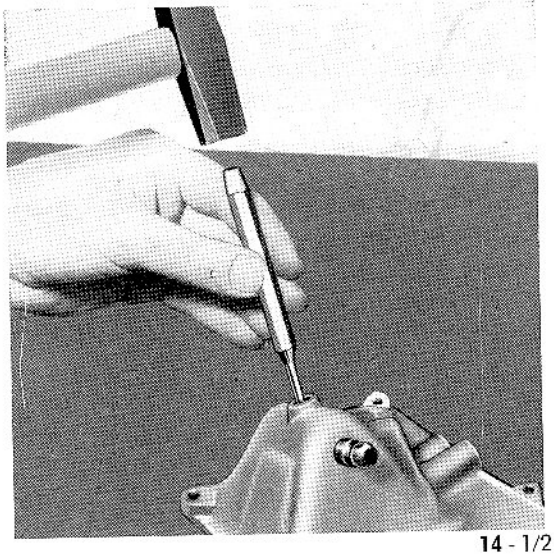
7. Tilt transmission cover.
   Let fall out ball and locking spring.

8. Take out released (2 pces.) balls of gearshift rod interlock out of horizontal opening. Swing correspondingly cover.

9. Dismantle gear shift rod 1st/reverse speed.
   The same sequence of operations as under items 6 and 7.

10. Dismantle gear shift finger shaft.

    a) Drive tension pin out of gear shift finger and shaft. For this operation use a 4 mm dia. drift through the tapped hole for vent (Fig. 14 - 1/2).



14 - 1/2

    b) Take out shaft; remove gear shift finger.

Be sure that four 8 mm dia. balls are existing!

Clean parts. Blow out bores in the transmission cover and vent by means of compressed air.

Disassembling and reassembling transmission cover (taken out)

Check

1. Transmission cover for damage to flange areas or for warping. If there are oil leakages inspect cover for porous points; if necessary renew.

2. Be sure that gearshift rods can be easily moved in the transmission cover. If required, ream out bores with a 10 mm dia. reamer.

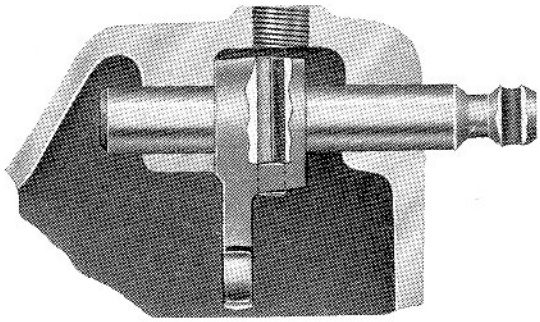
3. Check notches on the gearshift rods for wear. If necessary, install new rods.

4. Check shifter fork for wear and eventual cracks. If required, install a new one.
   The shifter forks must neither be bent nor twisted. The dogs must be at right angle to the gearshift rod and be in strict alignment with each other. If necessary, straighten out shifter fork.
   (For more details see under "Transmission Disassembly and Reassembly").

5. If gear shift troubles occur, for example, gears fail to stay in mesh, check springs for proper tension. The length of decompressed springs shall be 33 ± 1 mm.

Reassembly

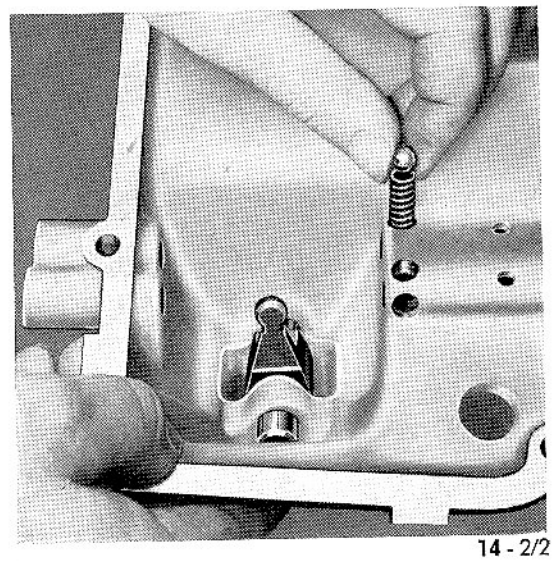
1. Insert gear shift finger shaft and gear shift finger and connect with new tension pin. Give care to proper relationship of the gear shift finger (Fig. 14-2/1).



14 - 2/1

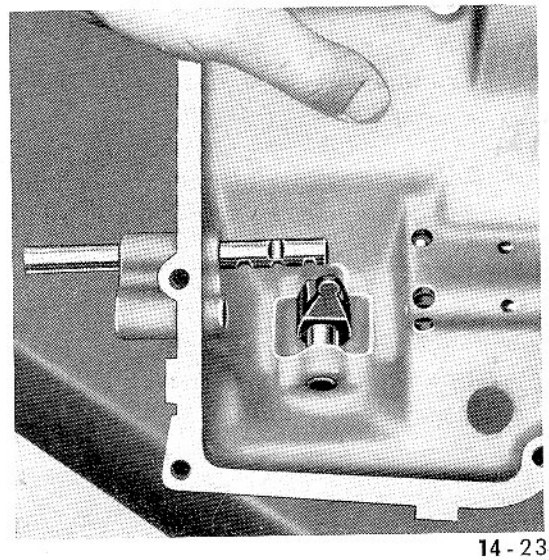
2. Install shifter fork 1st/reverse speed.

   a) Spring and ball for gear shift position lock (Fig. 14 - 2/2).



14 - 2/2

b) Insert gear shift rod 1st/reverse speed (Fig. 14-2/3).



14 - 23

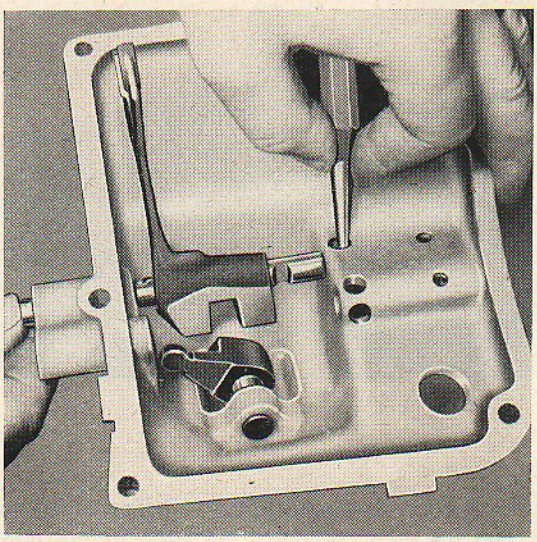
The both gear shift rods differ in the distances between the notches in the rods for gear shift position lock (Fig. 14 - 2/4).

Schaltstange für 2. und 3. Gang

Schaltstange für 1. und Rückwärts-Gang

14 - 2/4

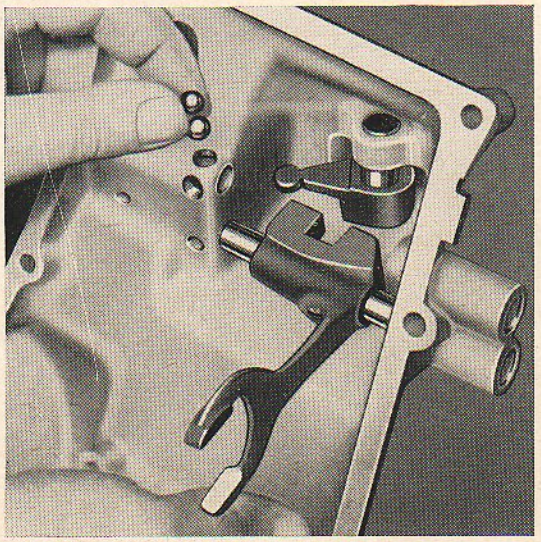
c) Put shifter fork onto gear shift rod. Move gear shift rod to idle speed notch (centre notch). In doing this, press down spring and ball with a pin. Give care to the proper position of the shifter fork after installation! (Fig. 14 - 3/1).



14 - 3/1

d) Fix shifter fork with new threaded pin. Well tighten with a suitable screw driver and secure by punching. Check whether the threaded pin is seated centrically in the bore hole of the gear-shift rod, otherwise the pin would slacken while running, thus causing gearshift trouble.

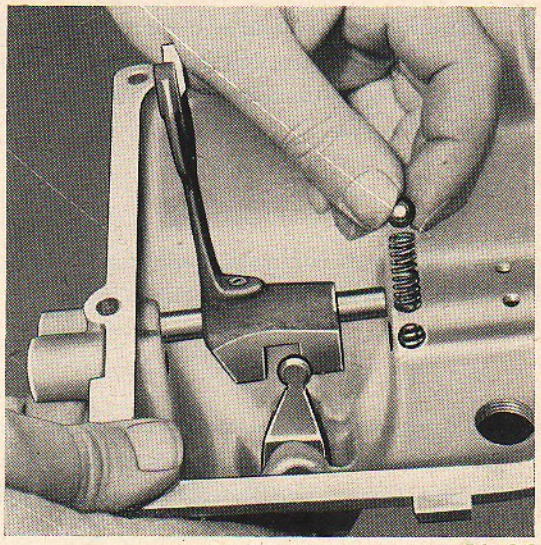
3. Insert both balls for gearshift rod interlock. Tilt transmission cover correspondingly. Thereafter, when installing the gearshift rod 2nd/3rd speed, give care that these balls do not fall down or escape in the still uncovered bores (Fig. 14 - 3/2).



14 - 3/2

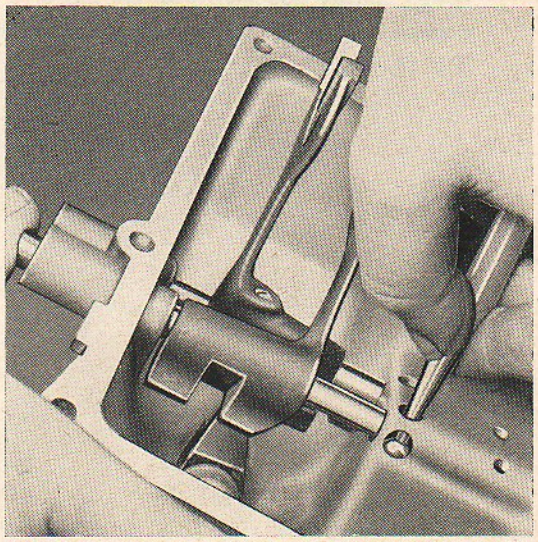
4. Install 2nd/3rd speed shifter fork.

a) Insert spring and ball for gear shift position lock (Fig. 14 - 3/3).



14 - 3/3

b) Install gear shift rod 2nd/3rd speed. Put shifter fork on the rail and shift gear shift rod to the idling speed notch (centre notch). In doing so, press down spring and ball with a mandril. After installation give care to the proper position of the shifter fork (Fig. 14 - 3/4).



14 - 3/4

c) Lock shifter fork with new threaded pin. Tighten well with suitable screw driver and secure by punching.

Check whether the threaded pin is seated centrically in the bore of the gearshift rod, otherwise slackening of the pin while running would result, thus causing gearshift trouble.

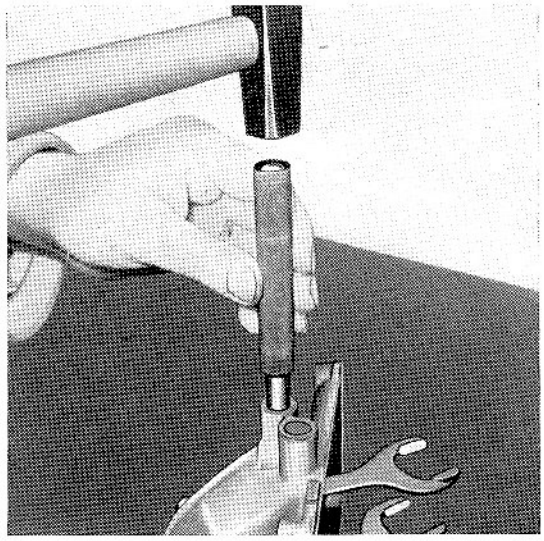
5. Shift all speeds into mesh. Verify function of gearshift interlock and gearshift position lock.

6. Check adjustment of shifter forks by putting transmission cover on the associated transmission.
See also „Transmission Disassembly and Reassembly".

7. Seal gear shift rod bores with new sealing plates.

a) Give counterbores in the transmission cover a coat with liquid "Wevolic".

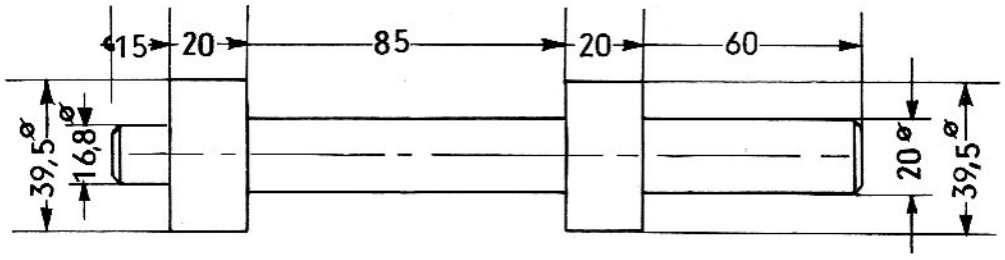
b) Install sealing plates (convex side outwards) and flatten convex side then with the aid of a flat-pointed mandril by a blow with a hand hammer (Fig. 14 - 4/1).



14 - 4/1

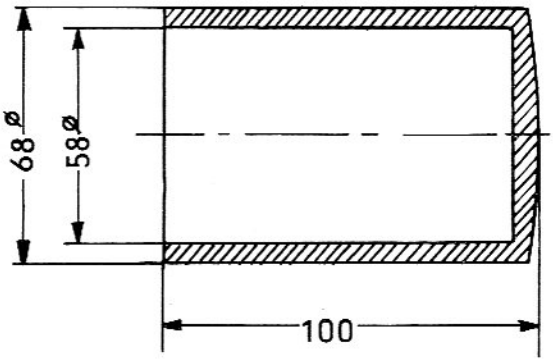
Now, the sealing plate becomes flattened, causing thus the plate to tighten the bore. Do not fully straighten sealing plate, otherwise there is risk of damaging counterbore in transmission cover! In order to secure a correct tight fit, it is of great importance to use an exactly fitting drift of 12 mm dia.

8. Screw in screw plug and vent (with eyeplate). Do not forget sealing plates!



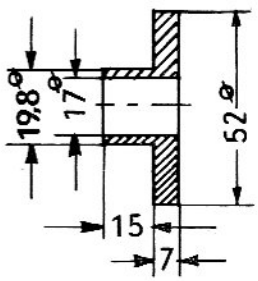
SW – 11

Fitting drift for grooved bearing Tool steel, harden.



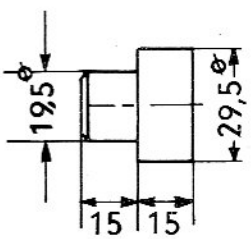
SW – 12

Tube for drifting into place bearing covers (differential)
Steel tube, harden.



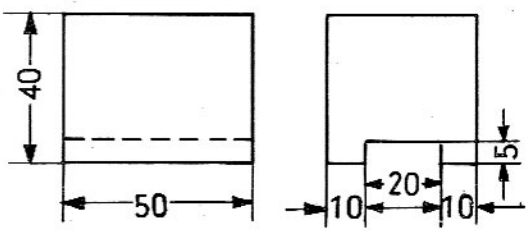
SW – 13

Drifting-in bush for grooved bearing 6304 (in connection with SW-11)
Tool steel, harden.



SW – 14

Pressure piece for pulling-off grooved bearing 6006 (differential) (in connection with commercial type puller)
Tool steel, harden.

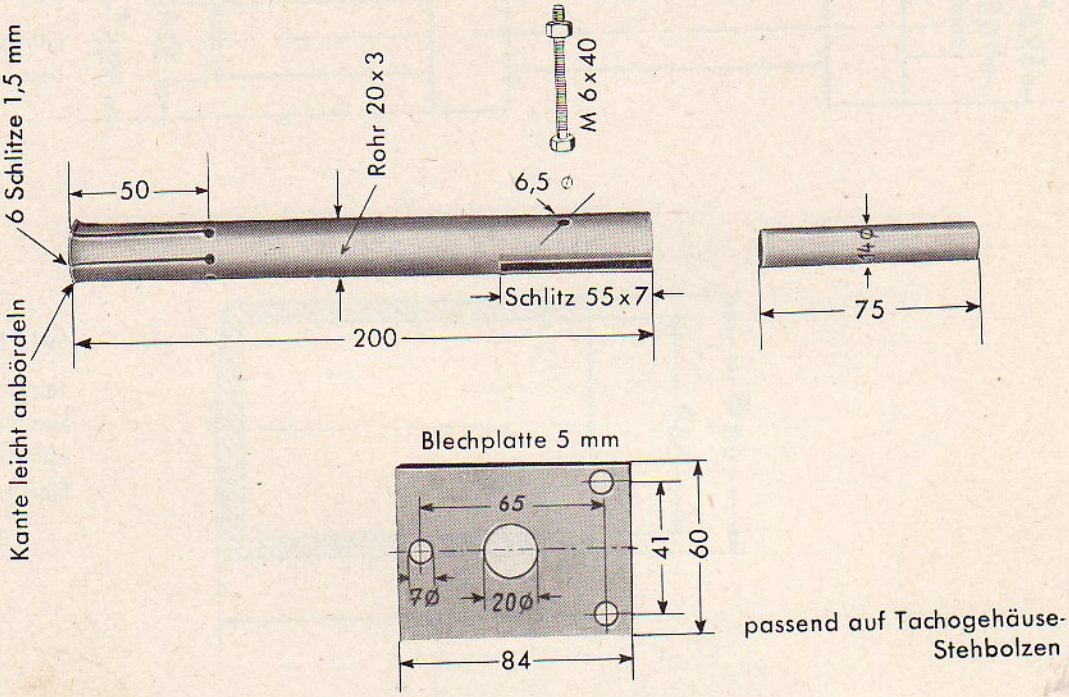


SW – 15

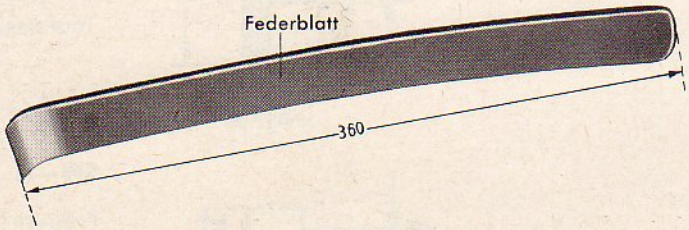
Locking block for double gear,
Hard wood.

SW – 16

Fixture for pulling-out grooved bearing 6304



passend auf Tachogehäuse-Stehbolzen



SW – 17

Fitting hook for forcing out sliding gear shaft.