

6 S 380 O.D. Transmission

	Page
GENERAL	85
GEAR SELECTION AND ENGAGEMENT	86
SPECIFICATIONS AND DATA	88
TIGHTENING TORQUES	90
TOOLS	91
OVERHAULING THE TRANSMISSION	99
☐ Gear control box	99
☐ Disassembly	99
☐ Assembly	99
☐ Check levers mounting	100
☐ Disassembling the transmission	101
☐ Disassembling the rear cover bearings	104
☐ Disassembling the transmission bearings	105
☐ Disassembling the main shaft	105
☐ Disassembling the drive input shaft	107
☐ Disassembling the transmission shaft	107
CHECKS	111
☐ Transmission	111
☐ Hubs - sliding sleeves - forks	111
☐ Bearings	111
☐ Shafts - gears	111
☐ Synchronizing devices	111
☐ Mounting the transmission shaft	113
☐ Mounting the main shaft	114
☐ Rods - forks - selector - driver	117
☐ Disassembly - assembly	117
☐ Mounting the transmission	117
☐ Adjusting the transmission shaft bearing end float	117

GENERAL

The 6 S 380 O.D. transmission is mechanical with synchronized engagement of forward gears.

It is composed of a light alloy box (which also serves as a clutch cover), a rear cover (where the speed engagement controls and gearing are housed) and a control box.

There is an opening on the side of the transmission to apply a power take-off.

Drive transmission is accomplished by a set of helical-toothed constant mesh gears, for both forward and reverse gears.

The splined or machined gears are on four shafts: input, main, transmission and reverse gear.

The input and main shafts are supported, in the transmission, by watertight, non-adjustable ball bearings.

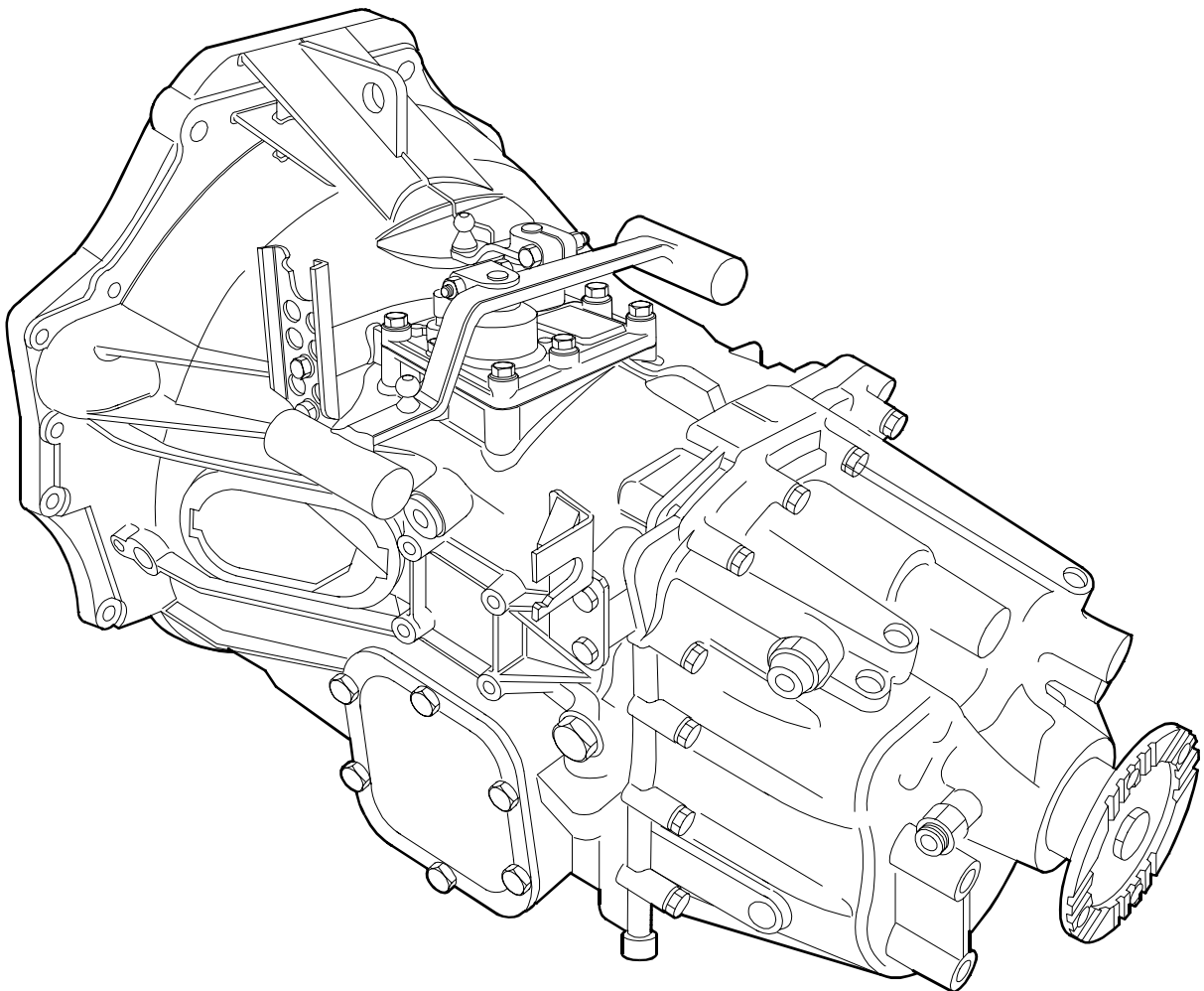
The transmission shaft is supported, in the transmission, by roller bearings that can be adjusted axially by means of ring shims.

6th, 5th, 4th, 3rd and reverse gears (new version transmissions) are synchronised by means of single taper free synchroniser rings; double taper wheels are used for 1st and 2nd gear.

Control inside the transmission is accomplished with five rods: a main rod to select and engage gears; four rods equipped with forks for engaging gears.

The outer engagement lever is provided with two counterpoised weights. They dampen the control (Bowden) wire engagement thrust and consequently attenuate noise.

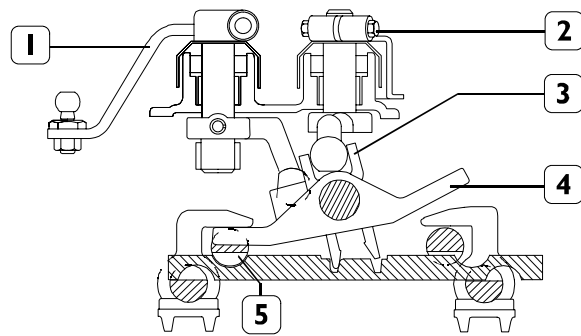
Figure 1



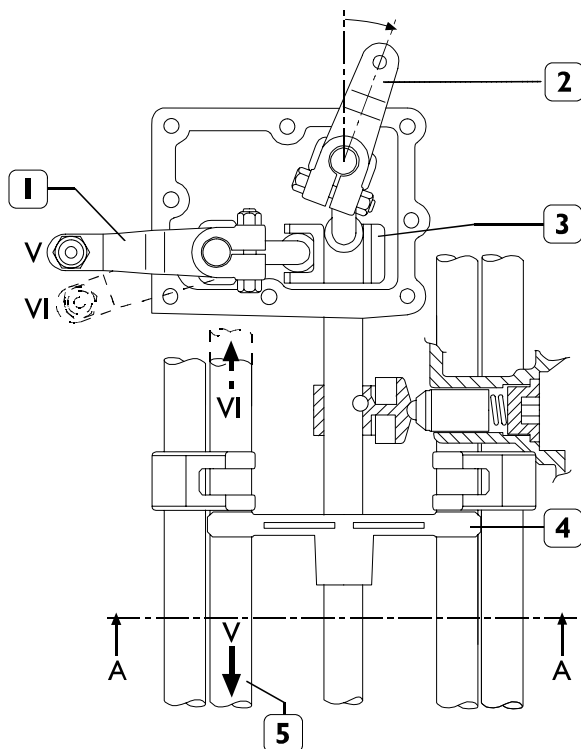
85939

5th/6th gear selection and engagement arrangement

Figure 4



SECTION A-A



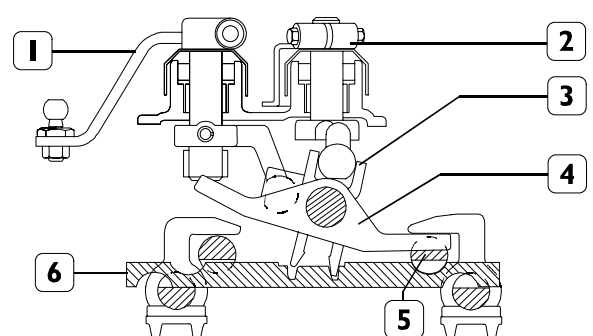
84149

This arrangement is obtained by moving the selector lever (2) clockwise. In this way, the selector (4) is inserted in the 5th/6th gear engagement rod (5).

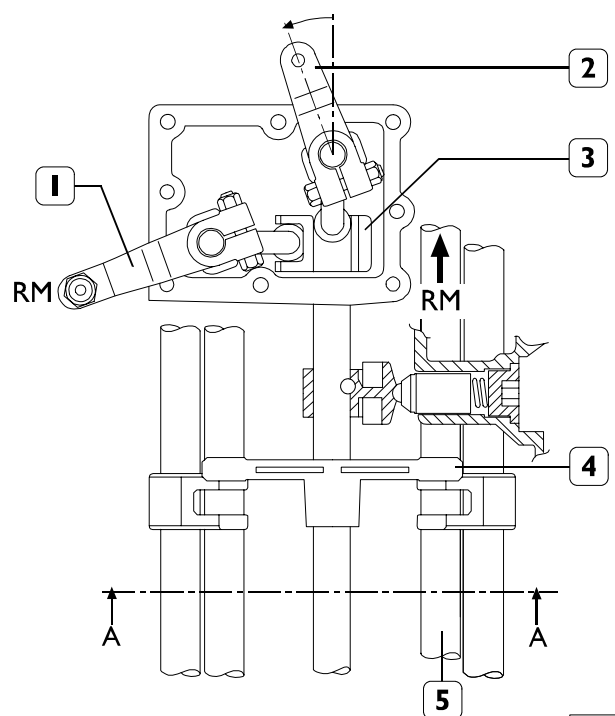
By moving the lever (1), the slider (3) will axially move the 5th/6th gear engagement rod.

Reverse gear selection and engagement arrangement

Figure 5



SECTION A-A



84150

This arrangement is obtained by moving the selector lever (2) anticlockwise. In this way, the selector (4) is inserted in the reverse gear engagement rod (5).

By moving the lever (1), the slider (3) will axially move the reverse gear engagement rod (5).

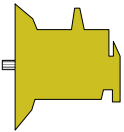
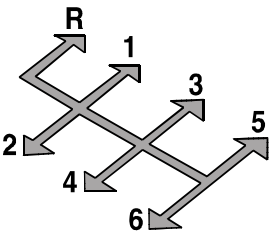
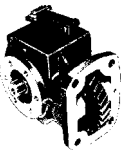
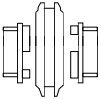
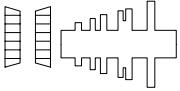
Safety device

The transmission is equipped with a device which prevents the simultaneous engagement of two gears.

It consists of a suitably shaped rod (6) fitted transversally in the transmission box.

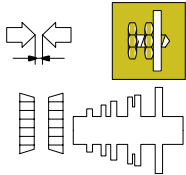
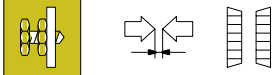
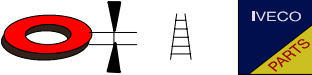
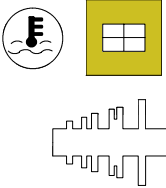
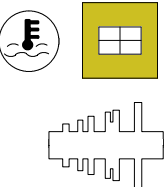
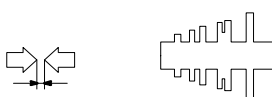
The slider (3), moves the rod (6) under the action of the lever (2). This keeps the selected gear engagement rod free and prevents movement of the other gears by engaging their respective grooves.

SPECIFICATIONS AND DATA

	TRANSMISSION	6 S 380 O.D.
	Type	Mechanical
	Input torque	320 Nm
	Weight	63 kg
	Speeds	6 forward speeds 1 reverse speed
	Speed control	Mechanical
	Power take-off	Optional
	Speed engagement: Forward speeds ☐ 5 th /6 th - 3 rd /4 th ☐ 1 st /2 nd Reverse speed Speed retention mechanism	Single-cone synchronizer Dual-cone synchronizer clip-on, in new version transmission with single taper synchroniser ring Sliding sleeves retained by pawls and springs
	Gears	Helical-toothed constant mesh gears
	Gear ratio First Second Third Fourth Fifth Sixth Reverse	5.375 3.154 2.041 1.365 1 0.791 4.838
	Shaft bearings: Main shaft Transmission shaft	watertight ball bearing tapered roller

O.D.. = Over Drive

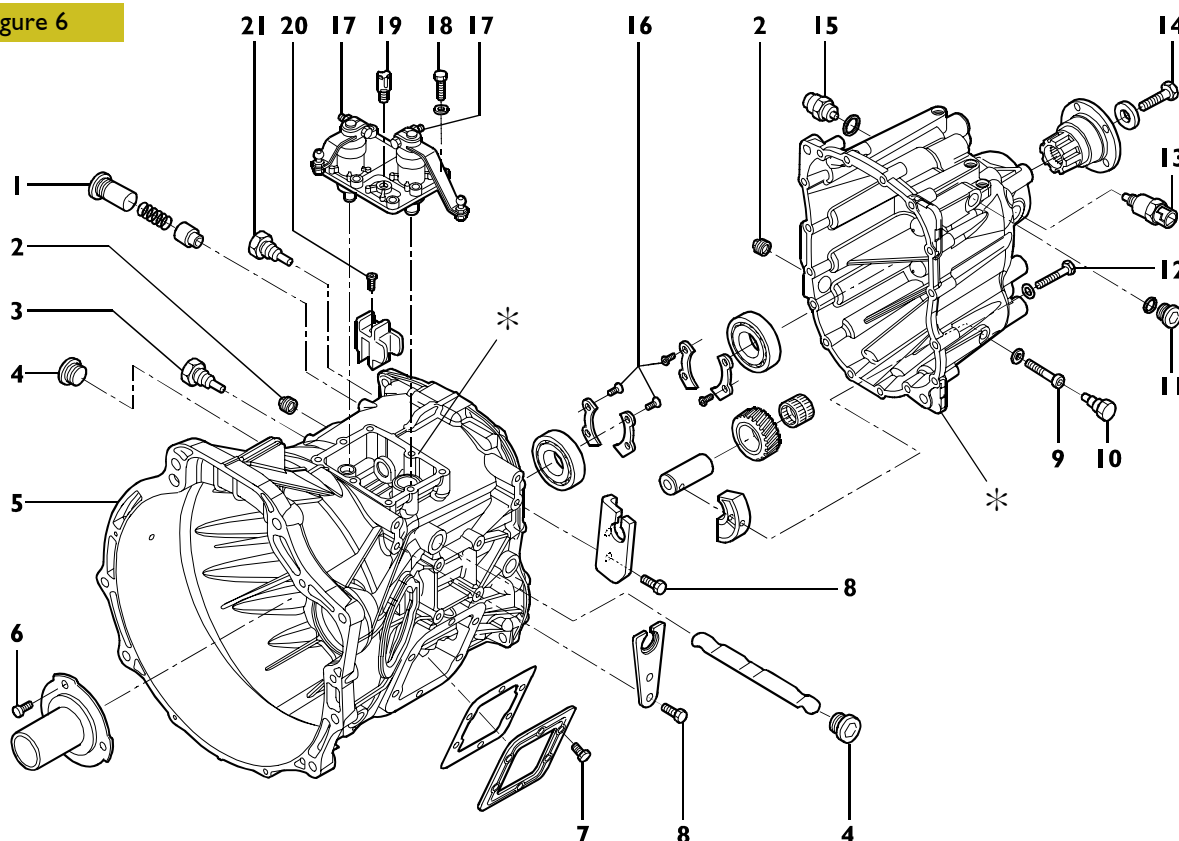
SPECIFICATIONS AND DATA

	Transmission shaft bearing end play	$0 \div -0.05 \text{ mm}$
	Transmission shaft bearing end play adjustment	by shims
	Shim thickness for transmission shaft bearing end play adjustment	-
	Main shaft Temperature for fitting: ☐ hubs for sliding sleeves ☐ 1 st -R gear bushes and gear ☐ front bearing*	$80^{\circ} \div 110^{\circ}\text{C}$ $110^{\circ} \div 150^{\circ}\text{C}$ $90^{\circ} \div 110^{\circ}\text{C}$
	Transmission shaft Temperature for fitting: ☐ bearings ☐ 5 th -4 th gears	80°C (max 120°C) $170^{\circ} \div 160^{\circ}\text{C}$
	Gear end float: 1 st - 3 rd - 4 th - R - 5 th gear 2 nd gear	$0.15 \div 0.40 \text{ mm}$ $0.25 \div 0.5 \text{ mm}$
	5 th - 4 th gear sliding sleeve hub retaining ring end float	$0 \div 0.15 \text{ mm}$
	5 th - 4 th gear sliding sleeve hub retaining ring thickness	-
	Retaining ring end float: ☐ transmission shaft front bearing ☐ main shaft roller bearing	$0 \div 0.1 \text{ mm}$ $0 \div 0.1 \text{ mm}$
	Transmission shaft rear bearing retaining ring thickness	-
	Sealant	LOCTITE 510 LOCTITE 242 LOCTITE 5206
	Type of oil: Quantity	TUTELA TRUCK GEARLITE 2.2 litres

* = Do not use hot air equipment to heat bearing.

TIGHTENING TORQUES

Figure 6



52506

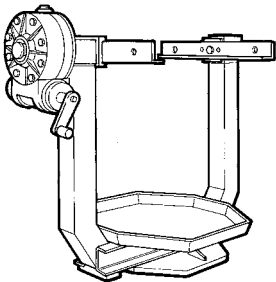
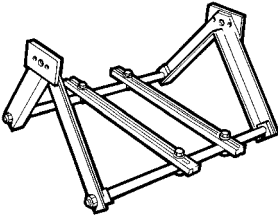
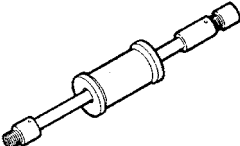
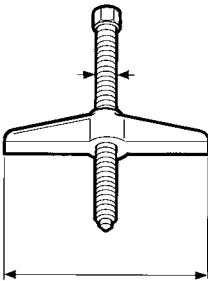
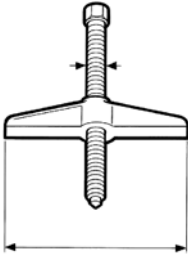
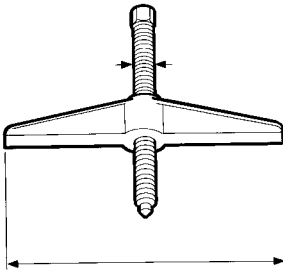
	DESCRIPTION	TORQUE	
		Nm	kgm
1	Plug retaining spring and reverse gear hardening push rod	32 ±10%	3.2 ±10%
2	M22x1.5 plug	50	5
3●	3rd and 4th gear fork articulation pins	45●	4.5
4	Plugs for rod preventing gear engagement	32	3.2
5	Clutch housing, screw to fasten clutch housing to crankcase	80	8
6	Constant mesh shaft cover fastening screw	23 ±15%	2.3 ±15%
7■	Screw securing p.t.o. side cover	46 ±15%	4.6 ±15%
8	Screw securing control cable mounting	23 ±15%	2.3 ±15%
9	Screw securing reverse gear shaft	23 ±15%	2.3 ±15%
11	Side plug on rear cover	35	3.5
12*	Screw securing rear cover	23 ±15%	2.3 ±15%
13	Speedometer transmitter fixing	50	5
14	Screw locking sleeve for transmission coupling on main shaft	235	23.5
15	Fixing switches and reversing lights	40	4
16●	Screw securing ball bearing retaining ring	9.5 ±15%	0.9 ±15%
17	Nut for screw securing lever to control rod	34 ±15%	3.4 ±15%
18	Screw securing gear control mounting	23 ±15%	2.3 ±15%
19	Oil vapour breather	10 ±15%	1 ±15%
20●	Screw securing driver to main rod	9.5●	0.9
21●	5th and 6th gear fork articulation pins	45	4.5

* Spread LOCTITE 5206 sealant on the contact surfaces

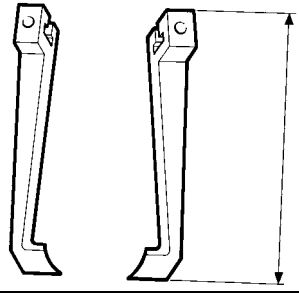
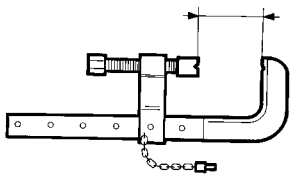
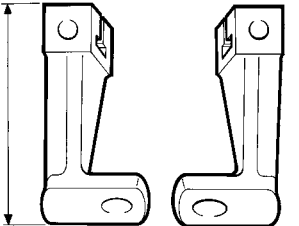
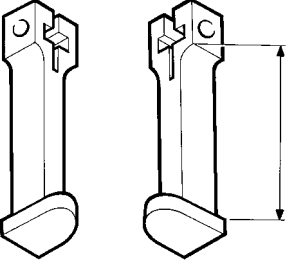
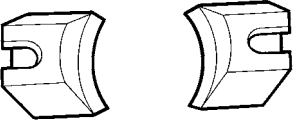
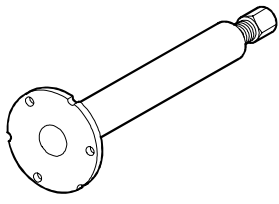
● Spread LOCTITE 242 on the thread

■ Spread LOCTITE 510 on the thread

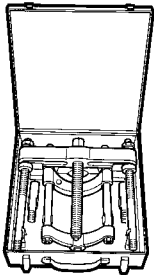
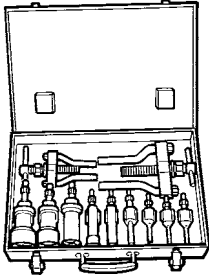
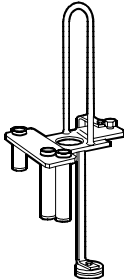
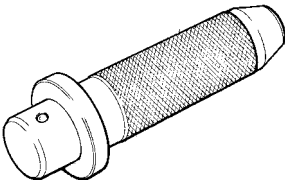
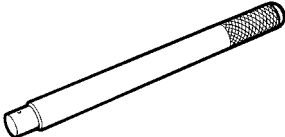
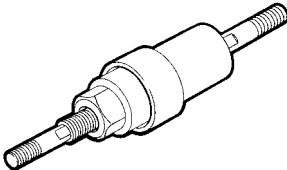
TOOLS

TOOL NO.	DESCRIPTION	
99322205		Assemblies overhaul revolving stand
99322225		Unit support (to use with stand 99322205)
99340205		Percussion extractor
99341002		Single-acting scaffold
99341003		Single-acting bridge
99341004		Pair of brackets

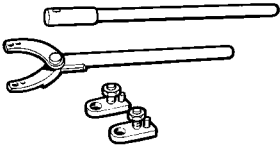
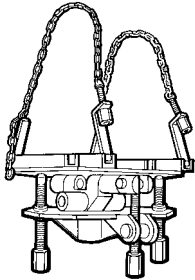
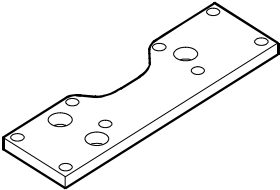
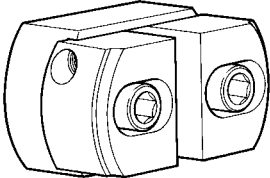
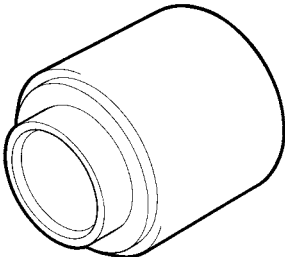
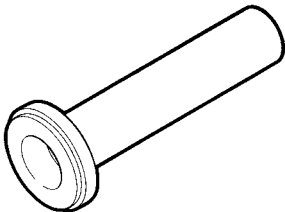
TOOLS

TOOL NO.	DESCRIPTION	
99341012		Pair of brackets
99341015		Constrictor
99341017		Pair of brackets with hole
99341019		Pair of tie rods with grips
99341025		Grips
99345003		Extractor for gearbox front half-casing

TOOLS

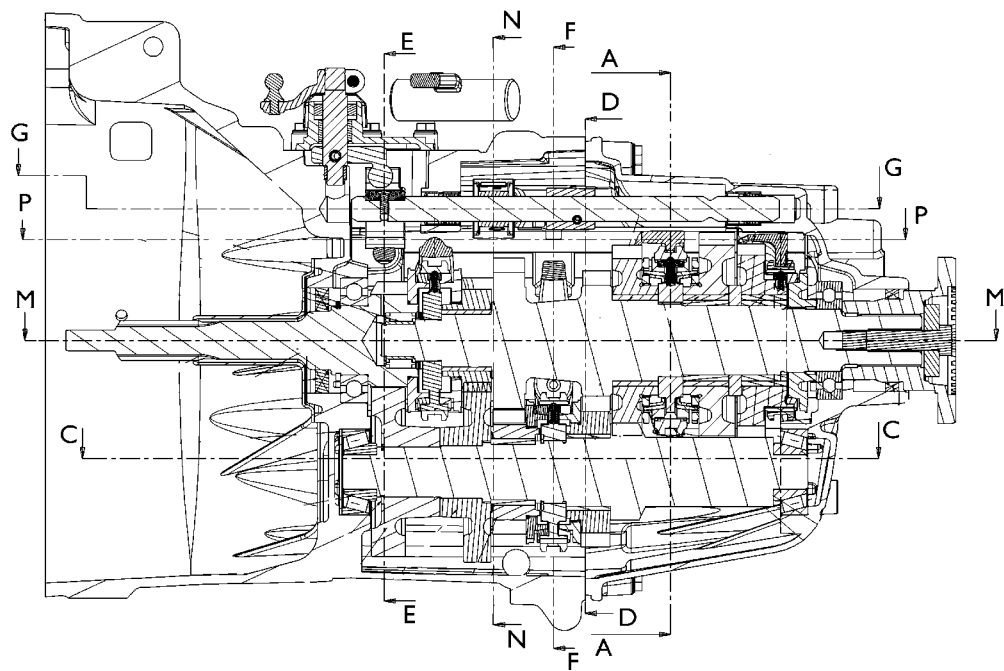
TOOL NO.	DESCRIPTION	
99348001		Extractor with locking device
99348004		Universal male extractor from 5 to 70 mm
99360522		Tool to extract and insert main shaft, transmission shaft and rod - fork assembly
99370006		Handle for interchangeable drivers
99370007		Handle for interchangeable drivers
99370234		Tool for fitting rear bearing and sleeve on main shaft

TOOLS

TOOL NO.	DESCRIPTION
99370317	 Reaction lever with extension for holding flange
99370629	 Transmission support during removal from and refitting to vehicle
99371057	 Bracket for supporting gearbox during overhaul (use with 99322205-99322225)
99374091	 Punch for fitting bearing external races (dia. 55 ÷ 69 mm use with 99370007)
99374452	 Keying device to fit gasket on transmission rear cover (use with 99370006)
99374453	 Keying device to fit gasket on transmission

LONGITUDINAL SECTION

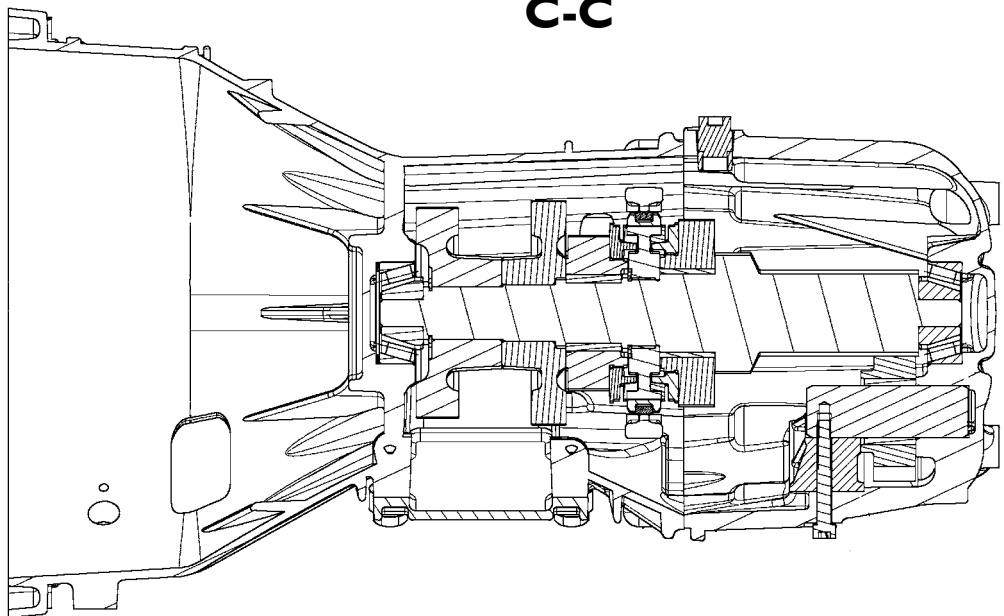
Figure 7



87899

Figure 8

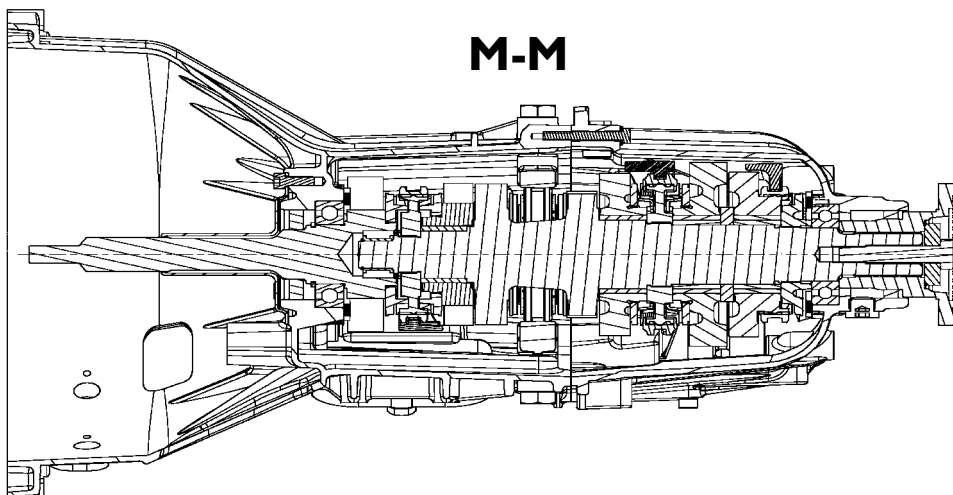
C-C



87881

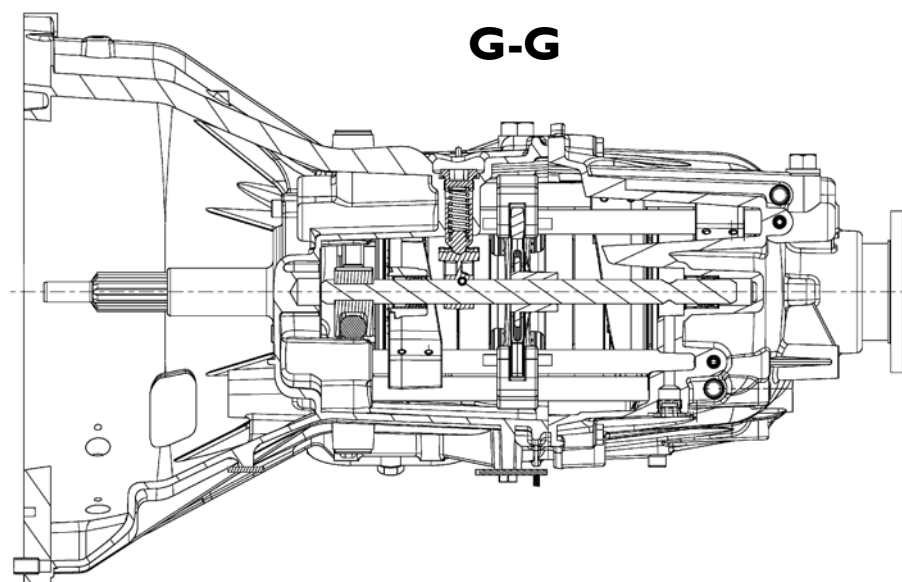
LONGITUDINAL SECTION

Figure 9



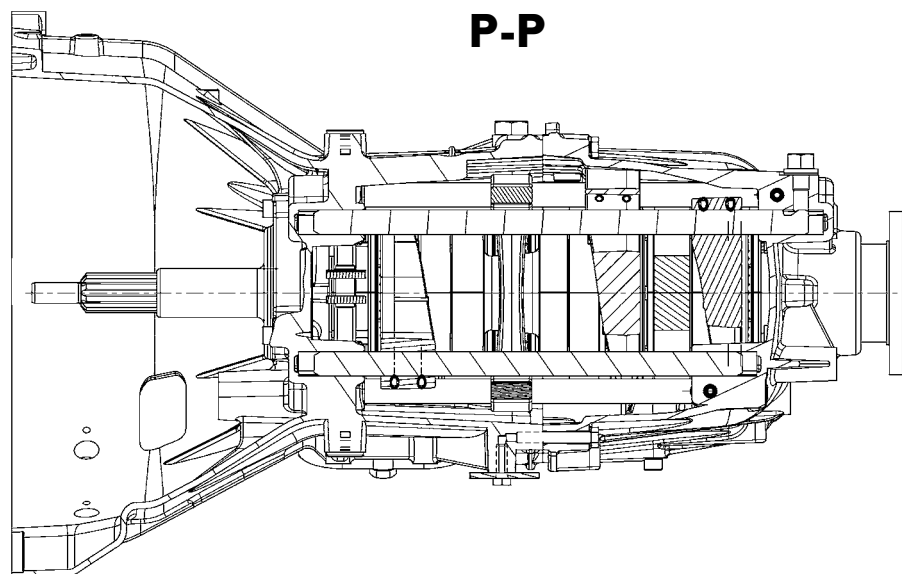
87900

Figure 10



87901

Figure 11



87902

TRANSMISSION TRANSVERSAL CROSS-SECTIONS

Figure 12

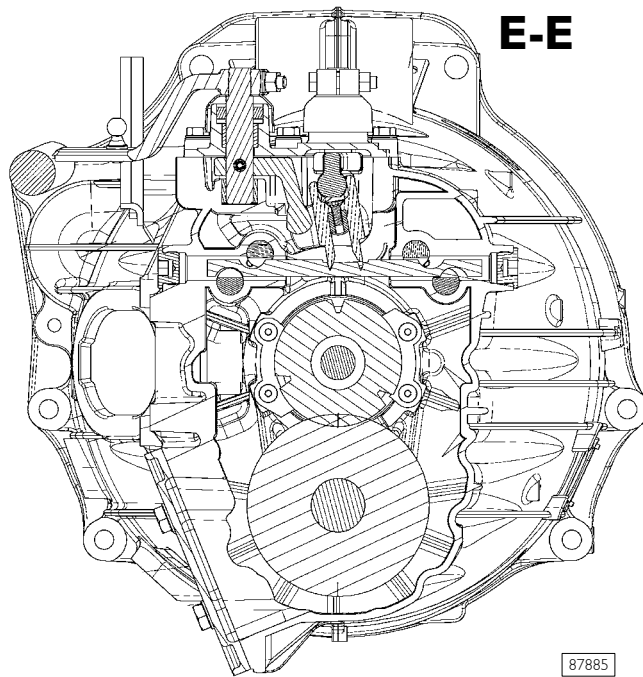


Figure 14

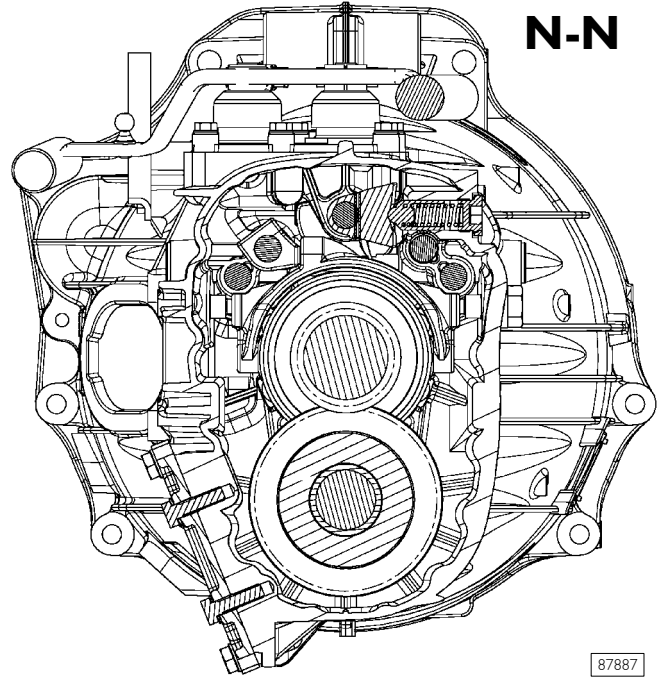


Figure 13

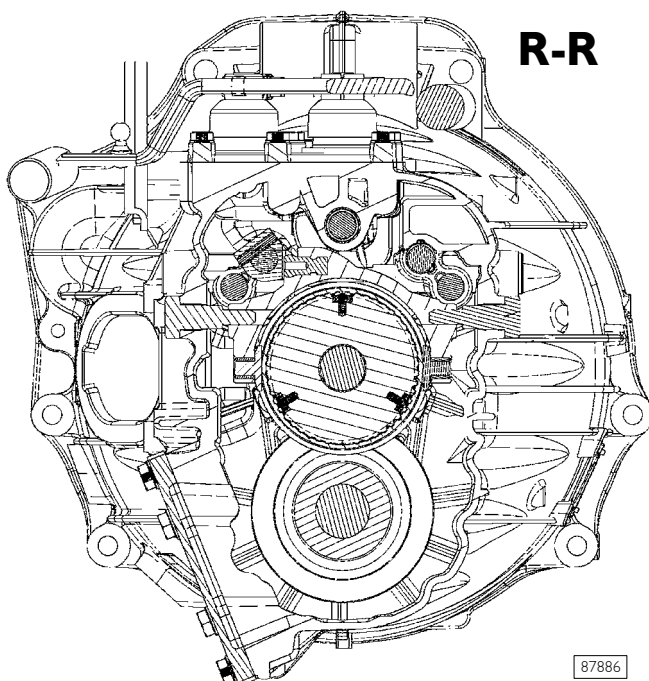
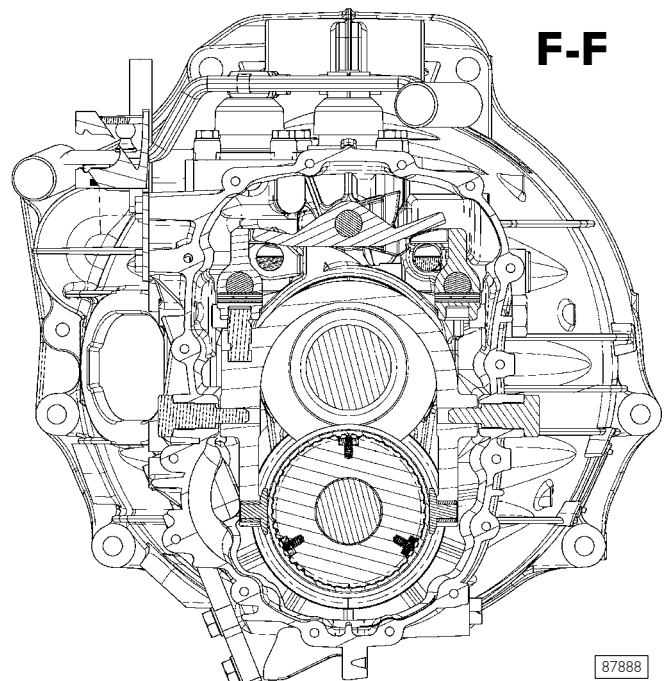
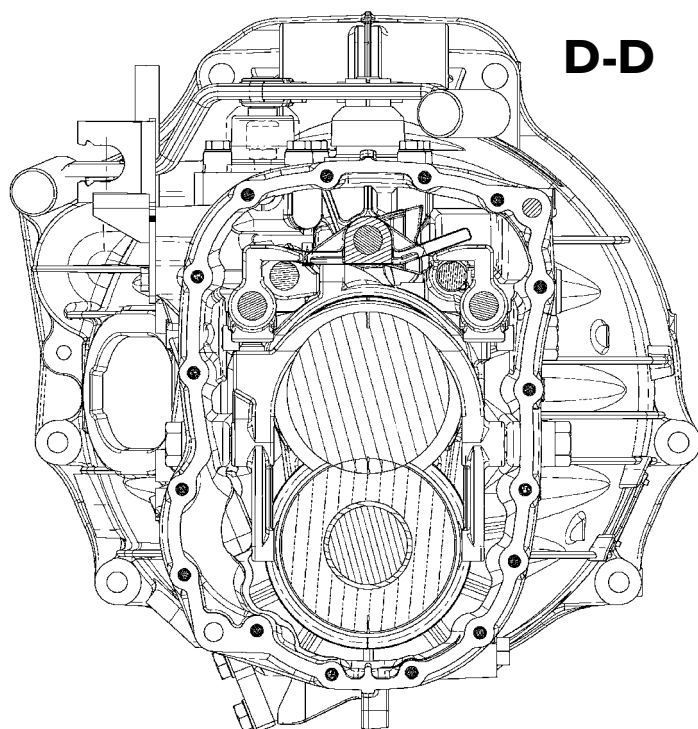


Figure 15



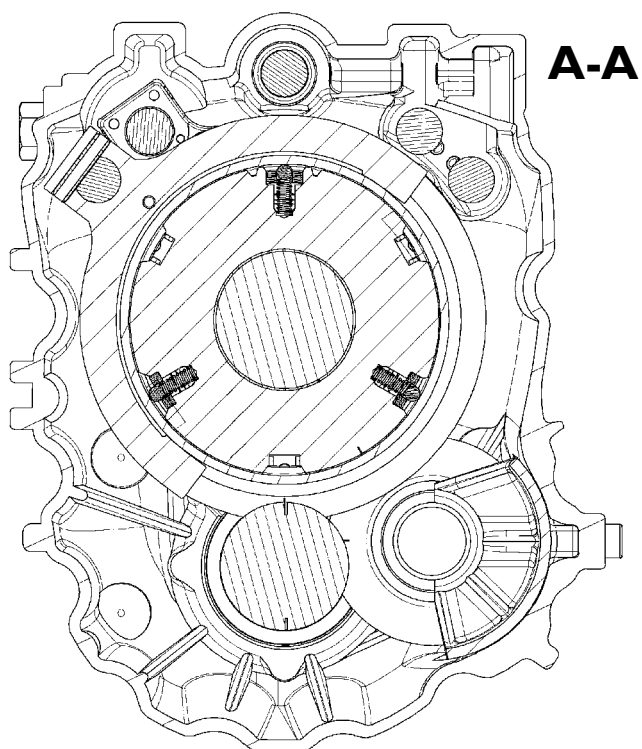
TRANSMISSION TRANSVERSAL CROSS-SECTIONS

Figure 16



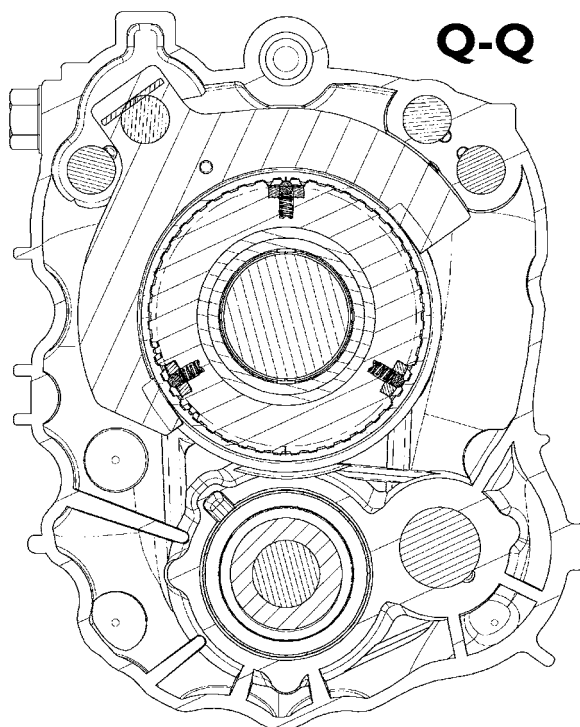
87889

Figure 17



87890

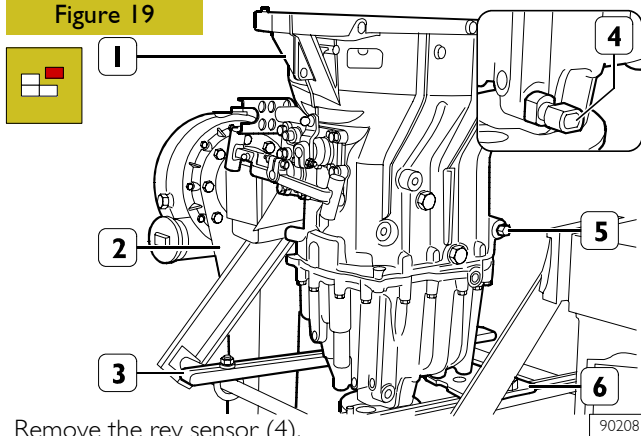
Figure 18



87891

530210 OVERHAULING THE TRANSMISSION

Figure 19



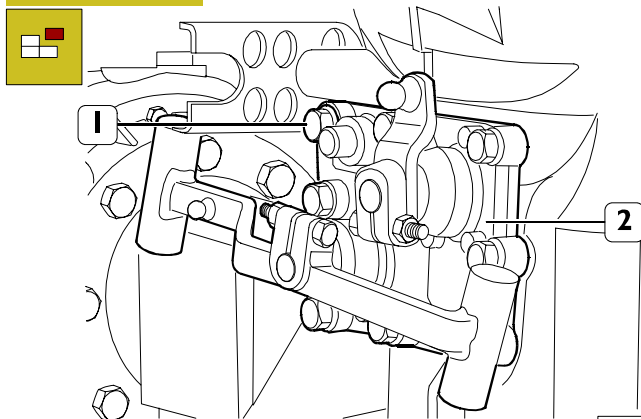
Remove the rev sensor (4).
Fit the gearbox (1) with the bracket 99371057 (5) and secure this to the brackets 99322225 (3) on the rotary stand 99322205 (2).
Remove the plug (4) and drain off the lubricating oil.



The used oil must be disposed of according to the law in force.

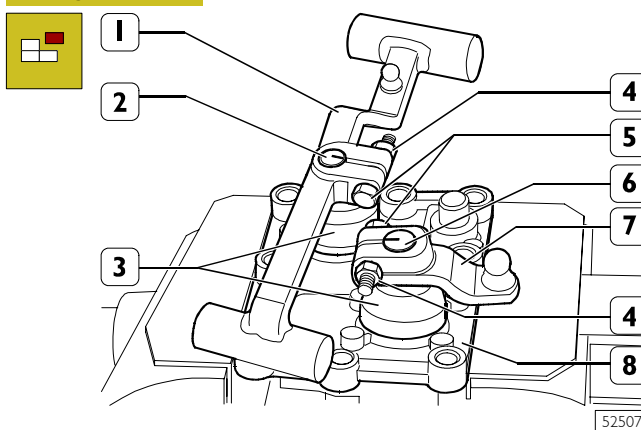
530220 Gear control box Disassembly

Figure 20



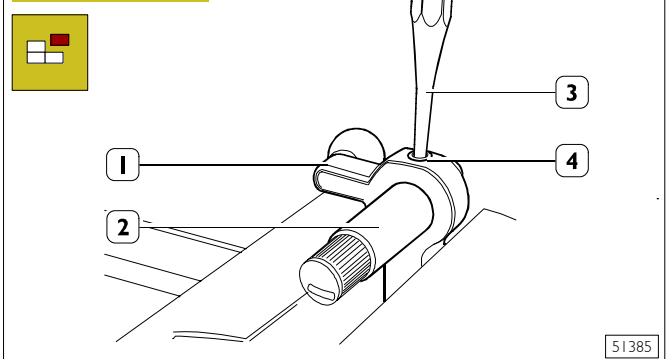
Shift to neutral.
Take out the fixing screws (1) and remove the gear control box (2).

Figure 21



Mark the assembly position of the levers (1 and 7) on their respective shafts (2 and 6). Loosen the nuts (4) for the retaining screws (5).
Extract the levers (1 and 7) from the shafts (2 and 6) and extract these from the box (8). Take off the caps (4).

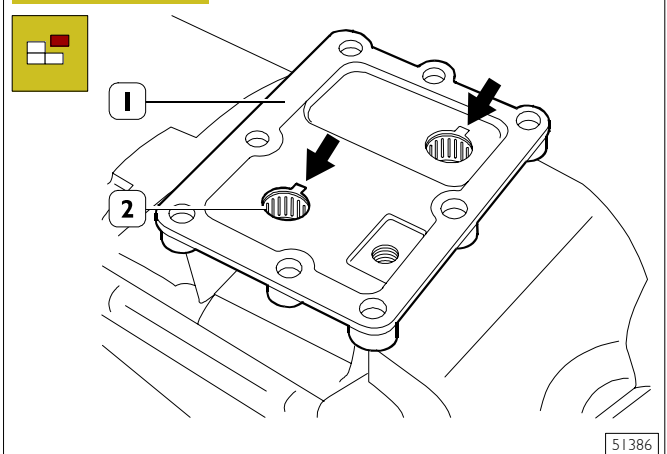
Figure 22



With a punch (3), remove the spring pin (4) and extract the shaft (2) from the internal lever (1).
Repeat these steps for the other shaft.

NOTE The coupling lever is bound to the stem by two snap pins.

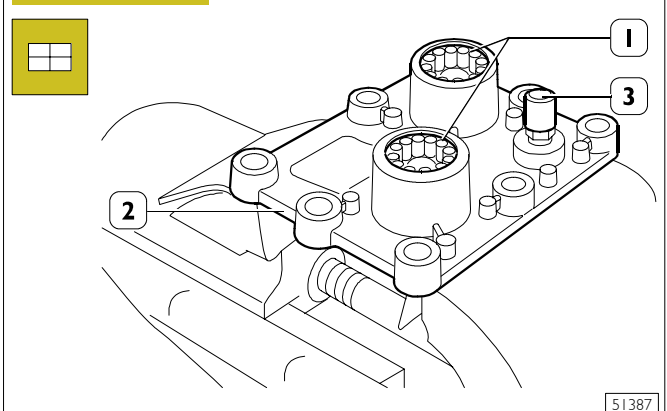
Figure 23



Use a punch on the point shown by the arrow and eject the O-rings and roller bushes (2) from the box (1).

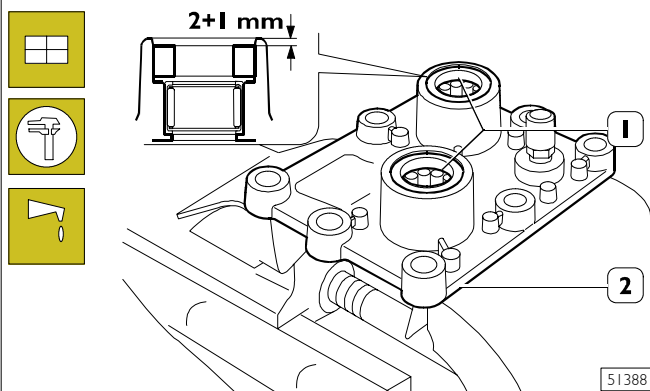
Assembly

Figure 24



Thoroughly clean the oil vapour vent (3).
With a suitable punch, mount the roller bearings (1) in the box (2).

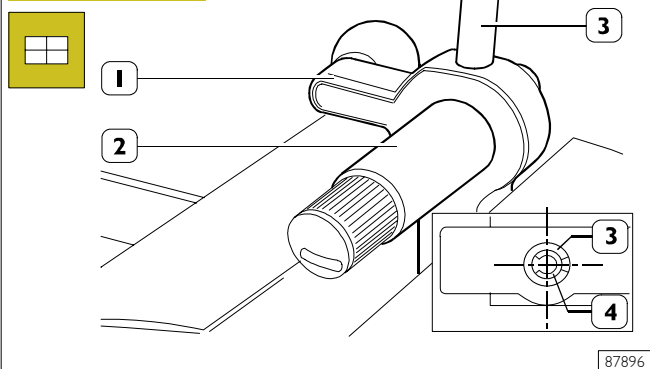
Figure 25



Using a suitable punch, mount the O-rings (1) in the box (2), positioning them at the height shown.

Pack the gap between the O-ring and roller bearing with grease.

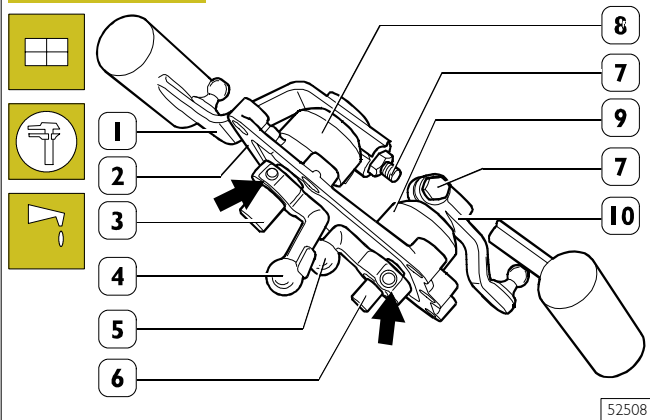
Figure 26



Mount the selection and engagement levers (1) on their respective shafts (2) and fasten them with the spring pins (3).

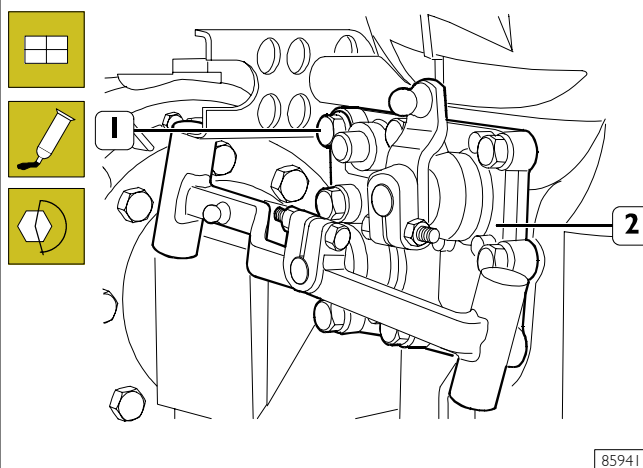
NOTE The spring pin (3) must be positioned with the cut horizontal. Fit spring peg (4), with cutting edge positioned at 180° from spring peg (3) cutting edge, in spring peg (3) engagement lever.

Figure 27



Lubricate the roller bearings (1, Figure 25) with TUTELA MR3 grease and mount the shafts (3 and 6) complete with the internal levers (4 and 5) in the box (2). Mount the caps (8 and 9) and levers (1 and 10) on the shafts (3 and 6) in the position marked during disassembly without tightening the nuts for the fixing screw (7).

Figure 28



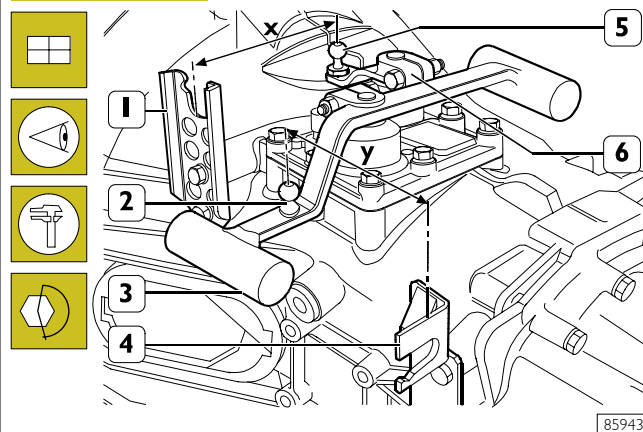
Thoroughly clean the mating surfaces of the gear control box (2) and apply LOCTITE 5706 sealant on them.

Fit the box (2) on the transmission, taking care that the levers and shafts are positioned correctly in their respective seats.

Tighten the screws (1) to the required torque.

Check levers mounting

Figure 29



Check the assembly of the selection (6) and engagement (3) levers.

The selection (6) and engagement (3) levers must be mounted on their respective shafts so that:

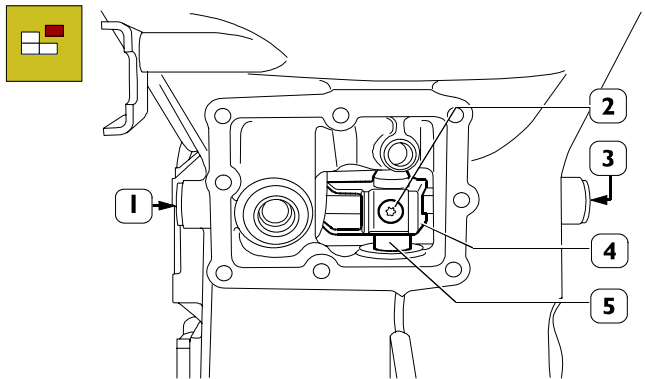
- ☐ between the c/c distance of the pin (5) of the selection lever (6) and the outside of the bracket (1) there is a distance **X** of 134 mm;
- ☐ between the c/c distance of the pin (2) of the engagement lever (3) and the outside of the bracket (4) there is a distance **Y** of 135 mm.

If a different value is measured, orientate the lever concerned on the respective shaft appropriately.

Then tighten the nuts for the screws to the required tightening torque.

Disassembling the transmission

Figure 30



51924

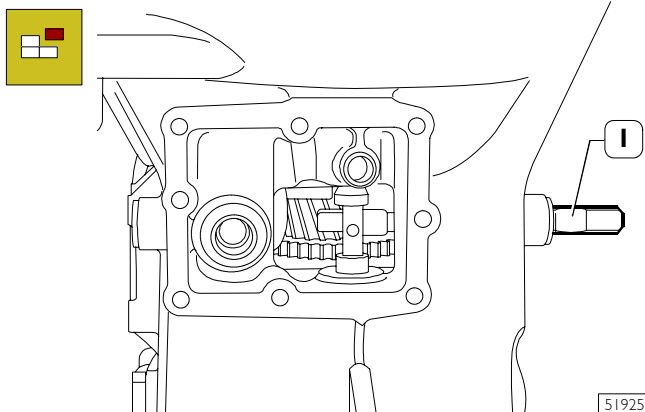
Shift to neutral.

Dismantle the gear control box as described under the relevant heading.

Remove the two side plugs (1 - 3). Remove the screw (2) and take off the rod (5) dragging device (4).

NOTE The screw threading (2) is treated with LOCTITE 242.

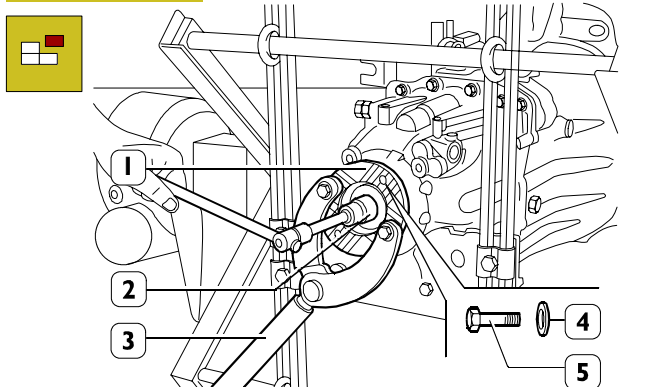
Figure 31



51925

Mark the assembly position of the rod (1) preventing engagement of more than one gear at the same time and remove it from the transmission.

Figure 32

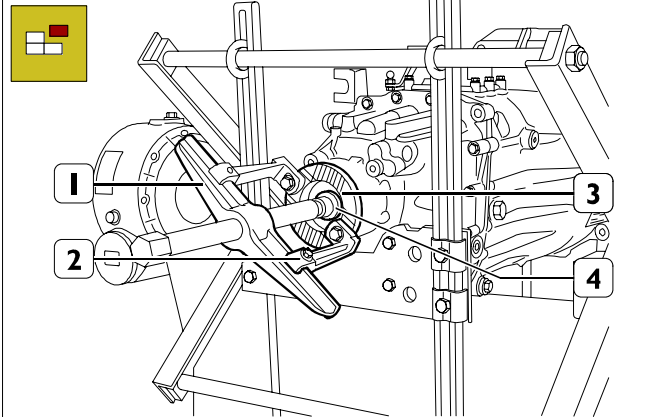


51926

Block rotation of the sleeve (1) by applying the lever 99370317 (3). With the bushing (2) remove the screw (5) with the washer beneath (4).

Take out the lever 99370317 (3).

Figure 33

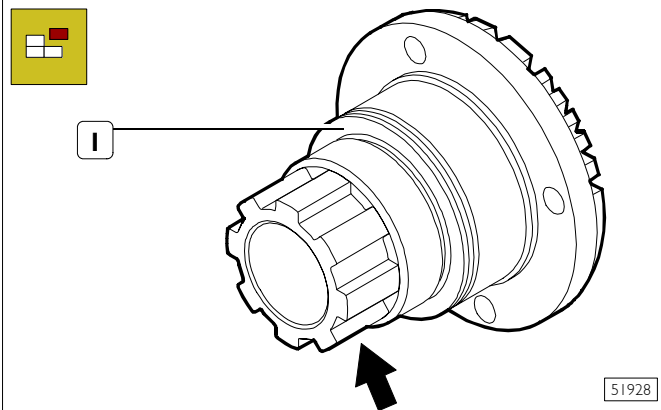


90250

Extract the sleeve (3) from the main shaft.

NOTE If difficult, remove the sleeve (3) with extractor made up of link 99341003 (1) and grips 99341017 (2) and block (4).

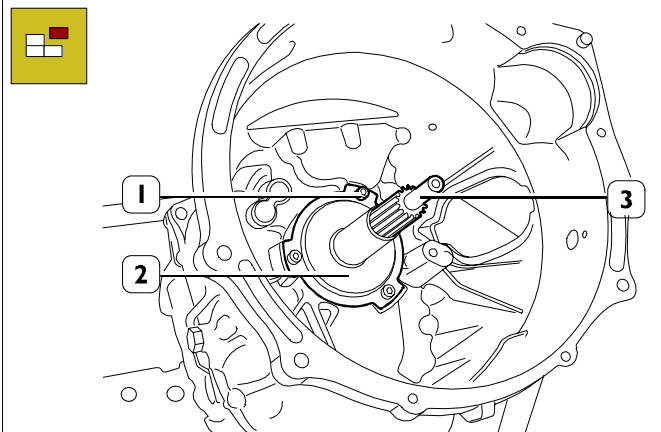
Figure 34



51928

NOTE When putting away the sleeve (1) take care not to damage the phonic wheel (→) obtained by machining.

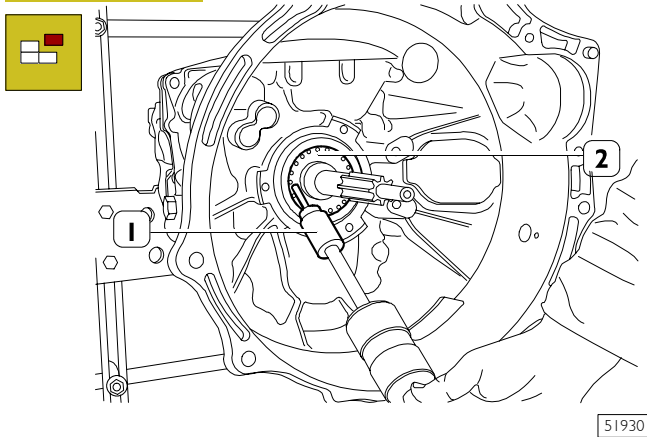
Figure 35



51829

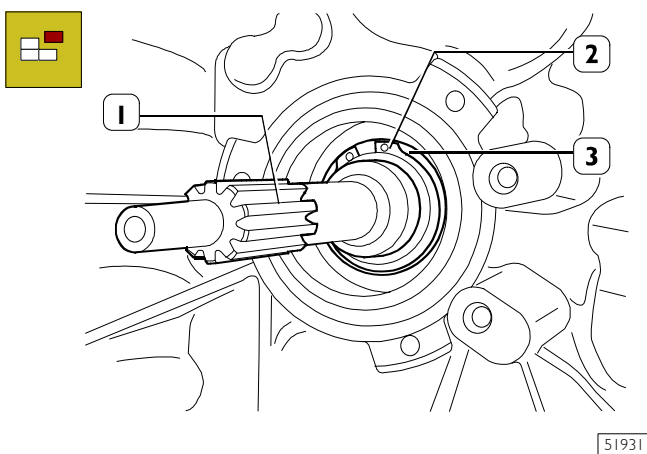
Remove the screws (1) and take off the cover (2) protecting the input shaft (3).

Figure 36



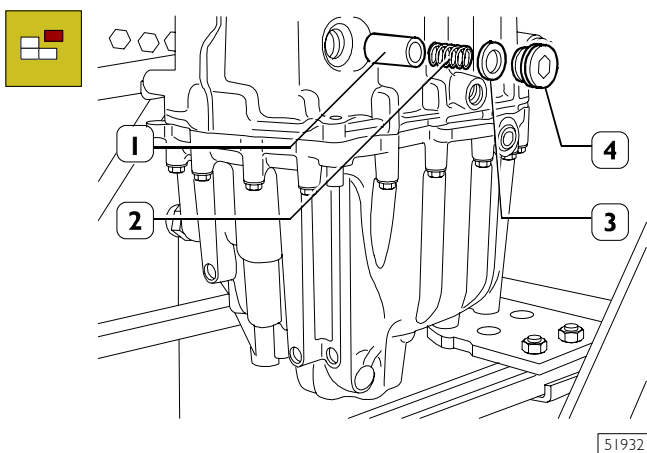
Perforate the o-ring (2) with a suitable hook and ram extractor 99340205 (1) and remove the o-ring from the transmission box.

Figure 37



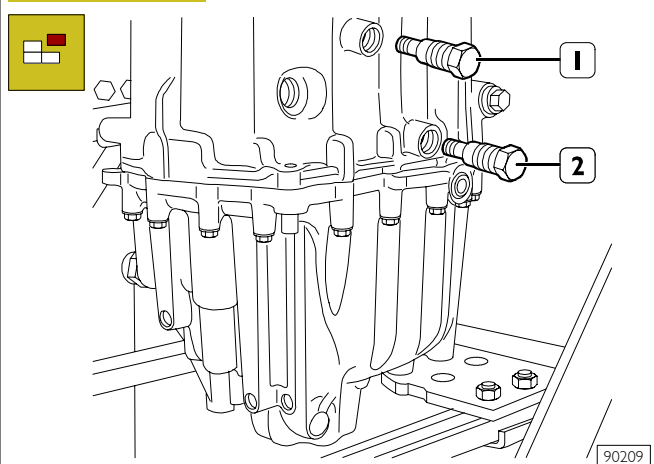
Remove the circlip (2) retaining the front bearing (3) from the input shaft (1).

Figure 38



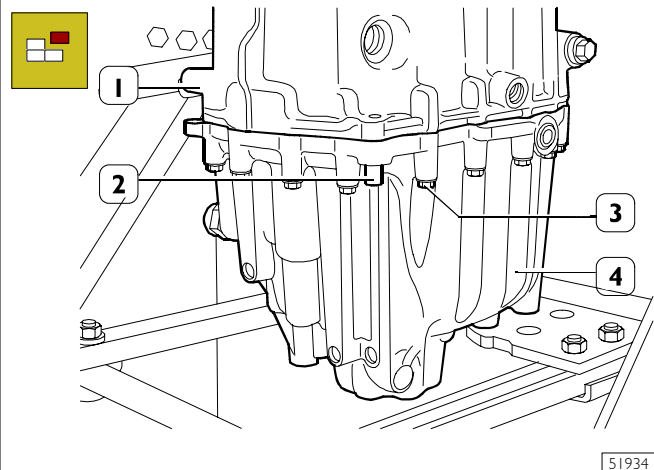
Take out the plug (4) with the washer (3), and extract the spring (2) and the push rod (1).

Figure 39



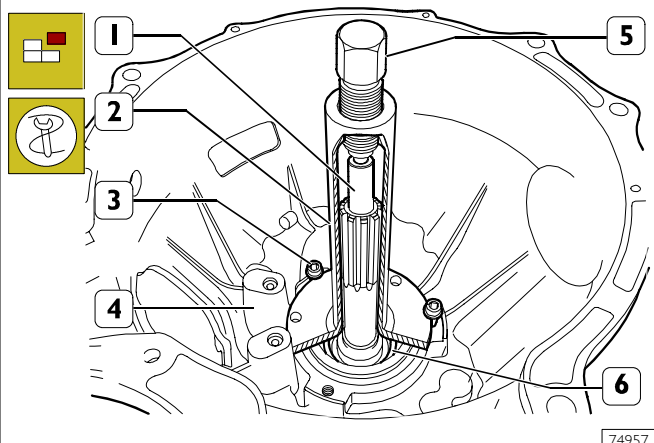
Remove the two fork knuckle pins (1) which control the 3rd – 4th speed and the two fork knuckle pins (2) which control the 5th – 6th speed.

Figure 40



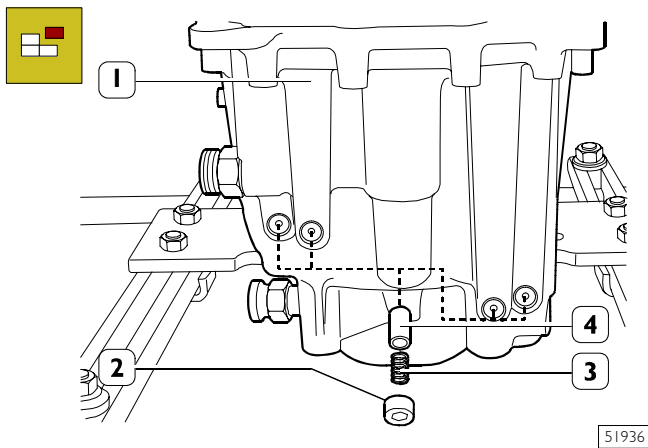
Push the two locating pins (2) downwards until taking them out of the rear cover (4). Remove the screws (3) securing the rear cover (4) to the transmission (1).

Figure 41



Fit the drive input shaft (1) with tool 99345003 (2) and secure this onto the gearbox (4), with the screws (3); screw down the screw (5) of tool (2) to extract the gearbox from the bearing (6).

Figure 42

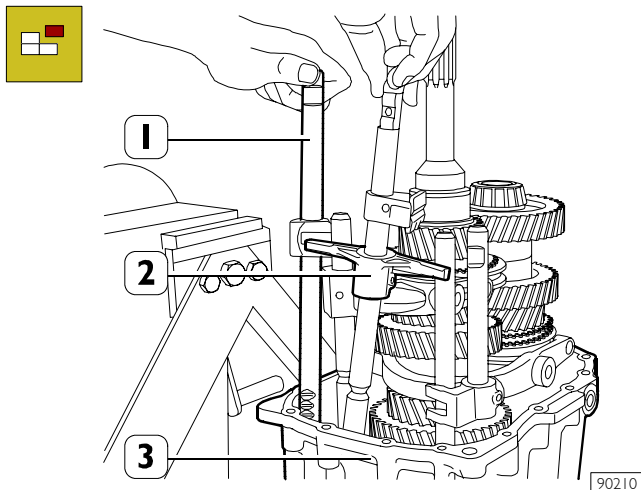


51936

Drill the cups (2), screw a special screw into them.

Using the screw, extract the cups (2) from the rear cover (1). Remove the springs (3) and pawls (4).

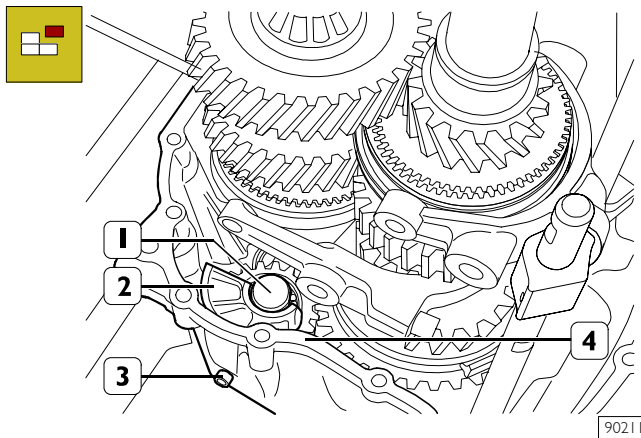
Figure 43



90210

Remove the rod (1) controlling the 3rd/4th gear and the main rod (2) from the rear cover (3).

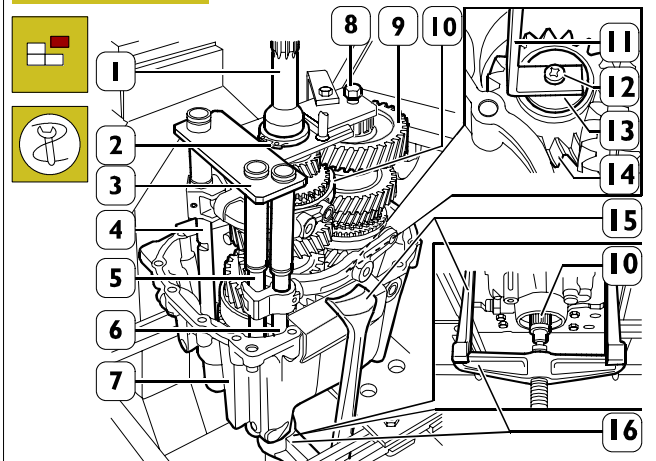
Figure 44



90211

Take out the screw (3) and remove the reverse gear shaft (1) with the mounting (2) from the rear cover (4).

Figure 45



90212

Mount the tool 99360522 (3) onto the rods (4, 5 and 6), on the input shaft (1) and on the transmission shaft (9).

Secure the tool 99360522 (3) on the input shaft (1) with the retaining ring (2) and with the screw (8) to the transmission shaft (9).

Insert the part (13) of the bracket (11) into the reverse gear (14) and tighten the screw (12).

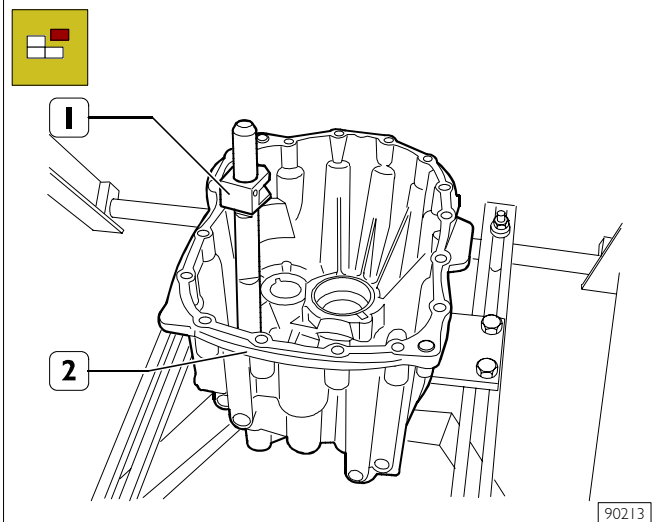
Hook the tool 99360522 (3) onto the lift.

Apply the extractor composed of the bridge 99341004 (16) and ties 99341012 (15) onto the rear cover (7).

NOTE In order not to damage the rear cover (7), place special protections between it and the ties (15).

Using the extractor screw and the lift on the main shaft (10), remove the main shaft (10) from the rear ball bearing and extract the shaft-rod assembly from the rear cover (7).

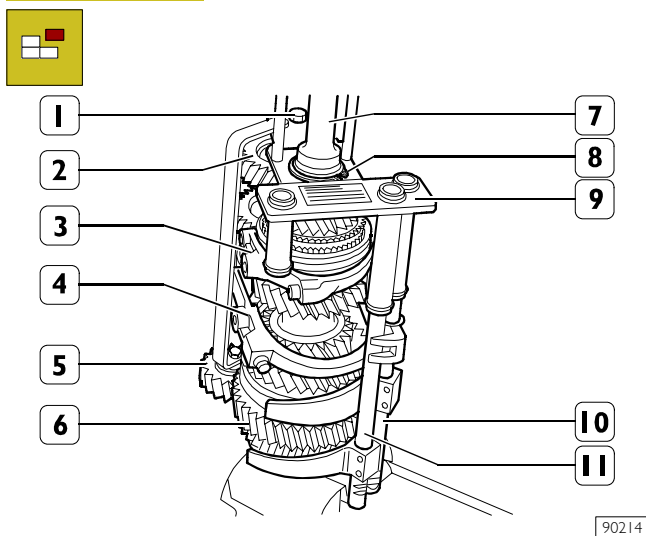
Figure 46



90213

Remove the rod (1) from the rear cover (2).

Figure 47



Clamp the primary shaft (6) in a vice.
Remove the rods (10 and 11) with the relevant forks. Remove the forks (3 and 4) and the small blocks.

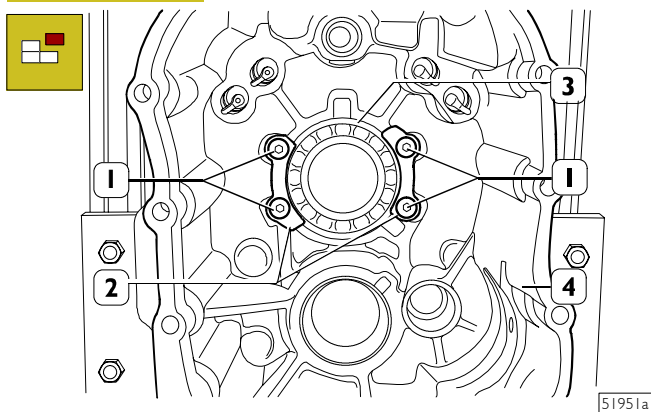


Support the secondary shaft (2), slacken the screw (1) and remove the secondary shaft (2).

Remove the RM gear (4).
Remove the snap ring (8) and the tool 9936522 (9).
Remove the input shaft (7).

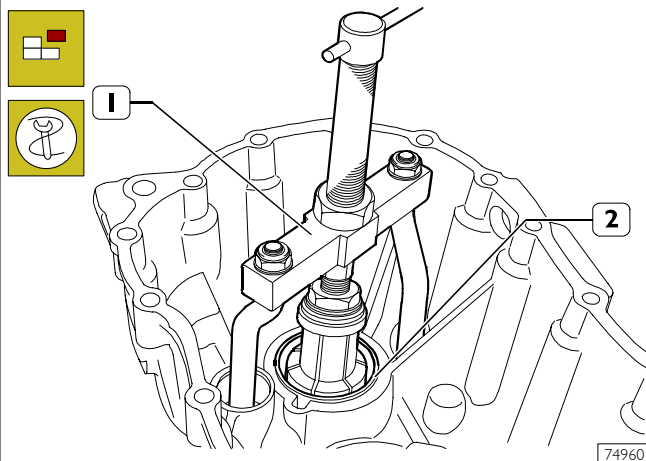
Disassembling the rear cover bearings

Figure 48



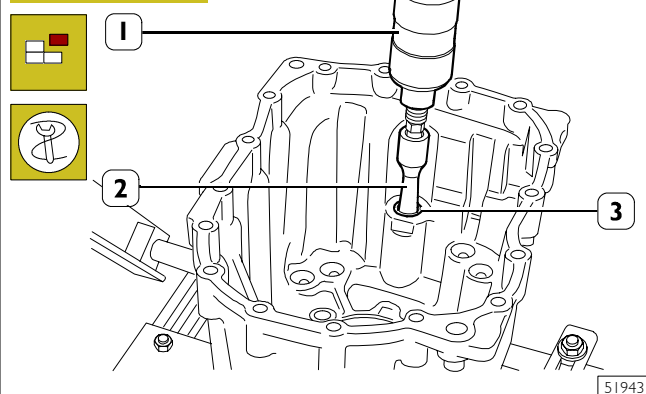
Remove the screws (1) securing the plates (2).
Take out the plates (2).
Turn over the rear cover (4) and remove the bearing (3).

Figure 49



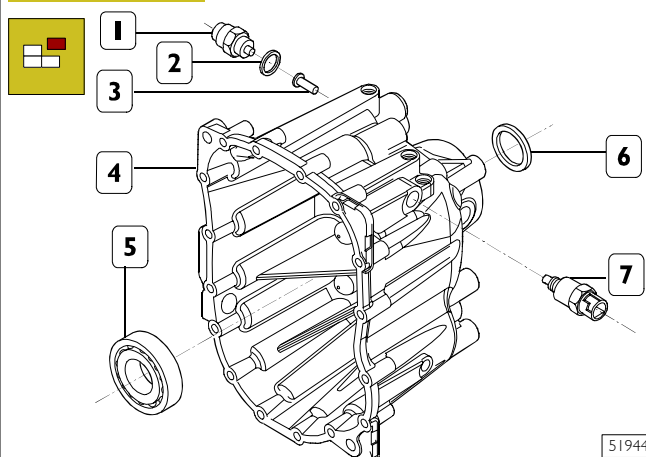
Using universal extractor 99348004 (1), remove the outer ring (2) of the transmission shaft bearing.

Figure 50



Using the percussion extractor 99340205 (1) and part 99348004 (2), extract the bushing with the ball bearings (3).

Figure 51



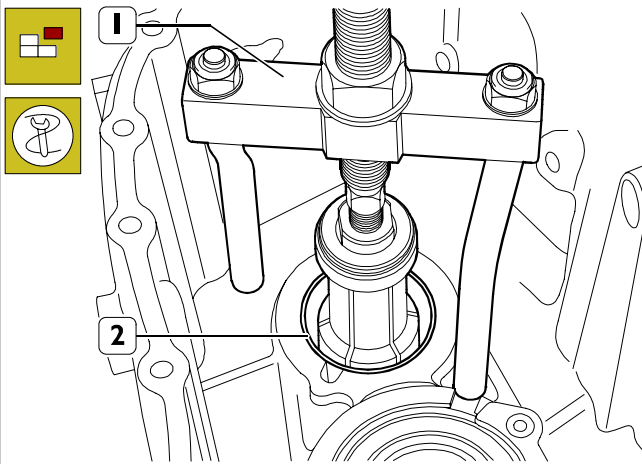
Turn over the rear cover (4).

Take out the O-ring (6).

Using a suitable punch, remove the ball bearing (5). Remove the tachograph sensor (7) and the reversing light switch (1) with the washer (2) and extract the push rod (3).

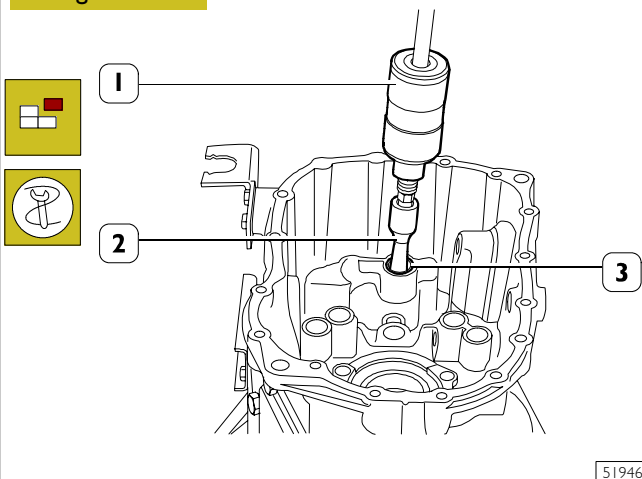
Disassembling the transmission bearings

Figure 52



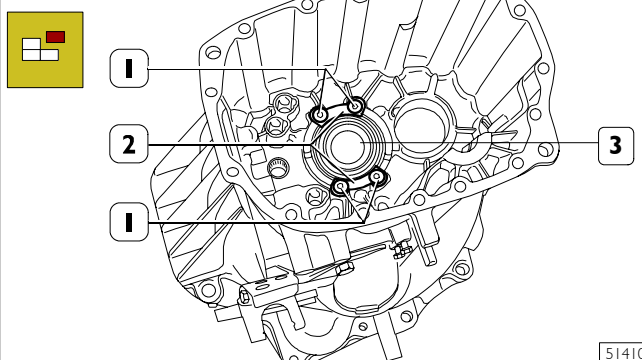
Using universal extractor 99348004 (1), remove the outer ring (2) of the transmission shaft bearing.

Figure 53



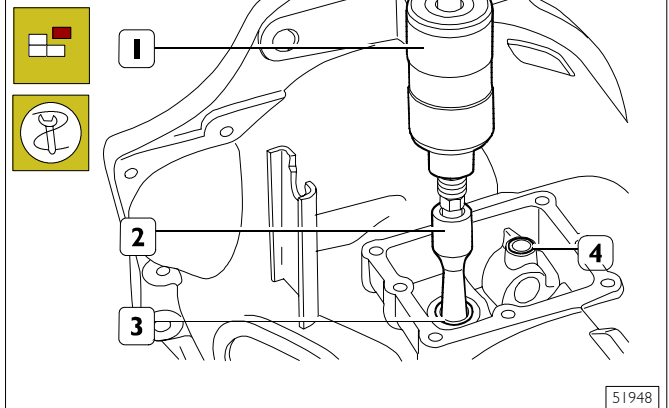
Using the percussion extractor 99340205 (1) and part 99348004 (2), extract the bushing with the ball bearings (3).

Figure 54



Remove the screws (1) securing the plates (2). Take out the plates (2). Turn over the transmission. Using a suitable punch, remove the ball bearing (3).

Figure 55

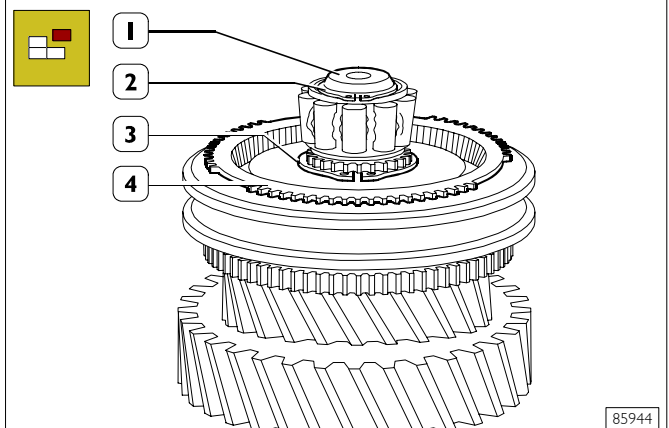


Using the percussion extractor 99340205 (1) and part 99348004 (2), extract the roller bearing (4-3).

Disassembling the main shaft

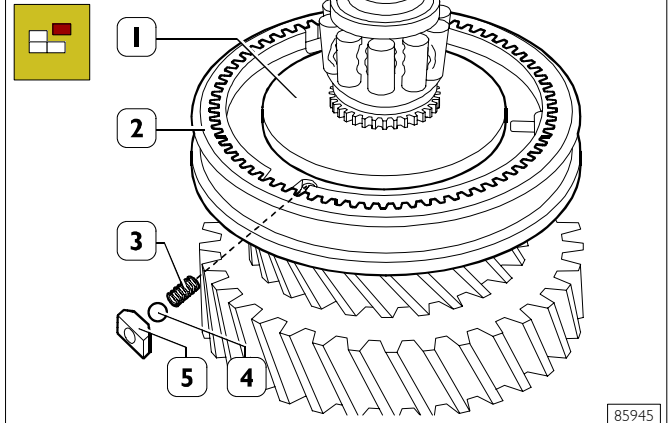
NOTE Mark the assembly position of each synchronizing device on the respective gear.

Figure 56



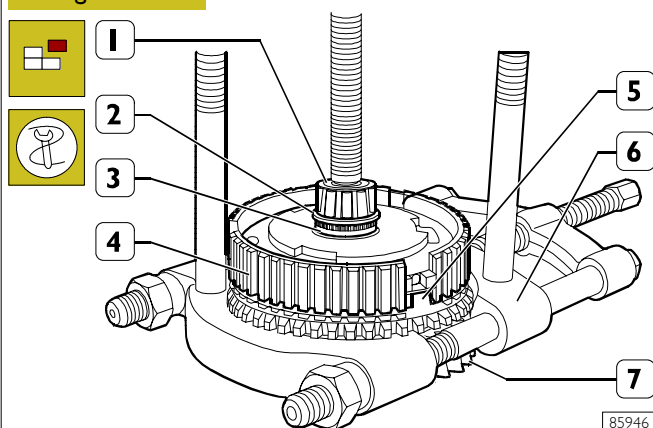
Tighten the primary shaft (1) in a vice. Remove the synchroniser ring (4) and the circlip (2). Remove the circlip (3) from its housing.

Figure 57



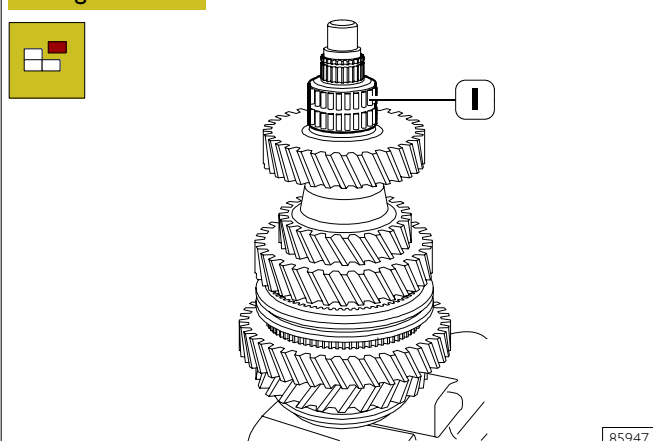
Remove the sliding sleeve (2) for engaging 5th - 6th gear from the hub (1) and, taking care as the plugs (5) come out with the balls (4) and springs (3), recover them.

Figure 58



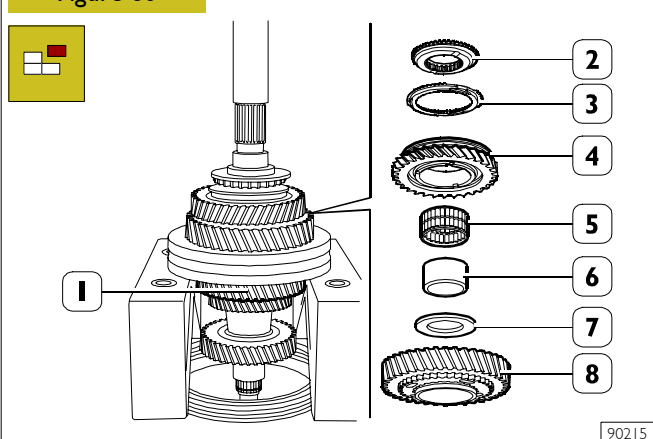
Use extractor 99348001 (6) as shown in the figure to extract the primary shaft (1), the 5th gear (7), the synchroniser ring (5), the hub (4), the circlip (3) and the roller bearing (2).

Figure 59



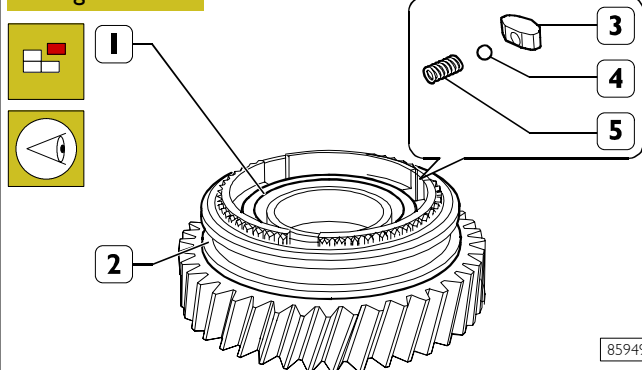
Remove the roller half cages (1).

Figure 60



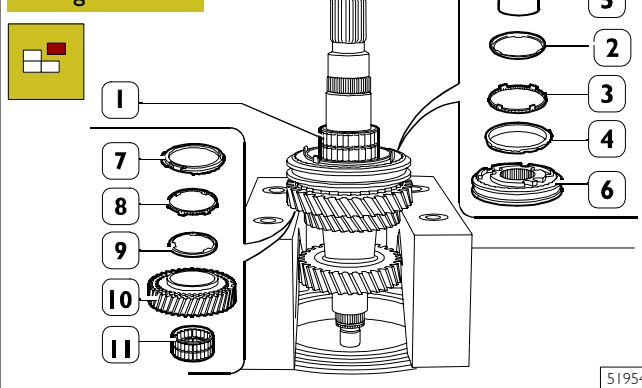
Use the hydraulic vice to remove from the primary shaft (1): the 1st speed gear (8), the spacer (7), the bush (6), the roller cage (5), the R.M. gear (4) together with the coupling elements, the synchronising ring (3) and the serrated ring (2).

Figure 61



Remove the reverse gear engagement sliding sleeve (2) from the reverse gear (1). Retrieve hub (1) and pads (3) with respective balls (4) and springs (5).

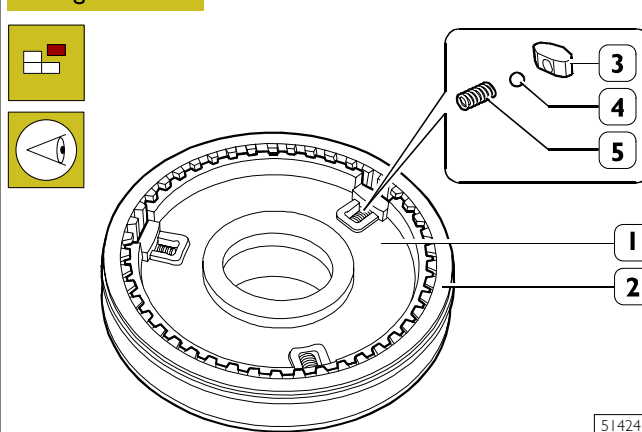
Figure 62



Take out the synchronizer ring (4), middle ring (3), ring (2) and roller bearing (1).

Using a hydraulic press, remove the 2nd gear (10), ring (9), middle ring (8), synchronizer ring (7), synchronizer assembly (6) and the bushing (5). Take out the roller bearing (11).

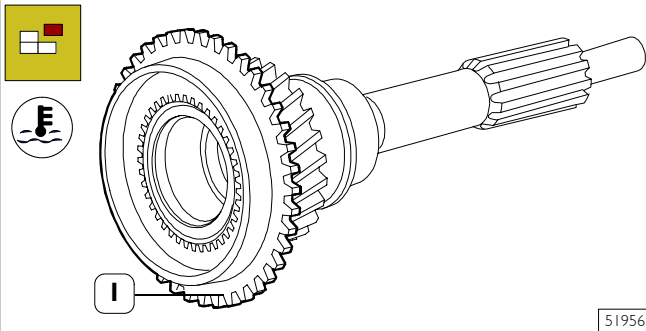
Figure 63



Remove the sliding sleeve (2) for engaging 1st-2nd gear from the hub (1) and, taking care as the plugs (3) come out with their relative balls (4) and springs (5), recover them.

Disassembling the drive input shaft

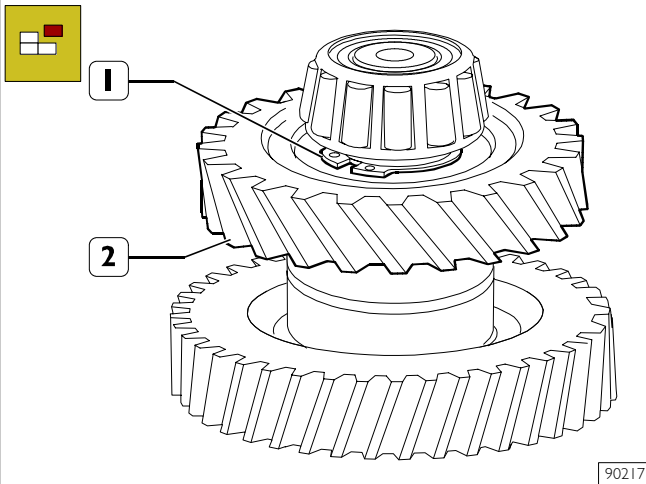
Figure 64



To replace the cog-wheel (1), use the same general tools for disassembly as for assembly, heat it to a temperature of 80°C.

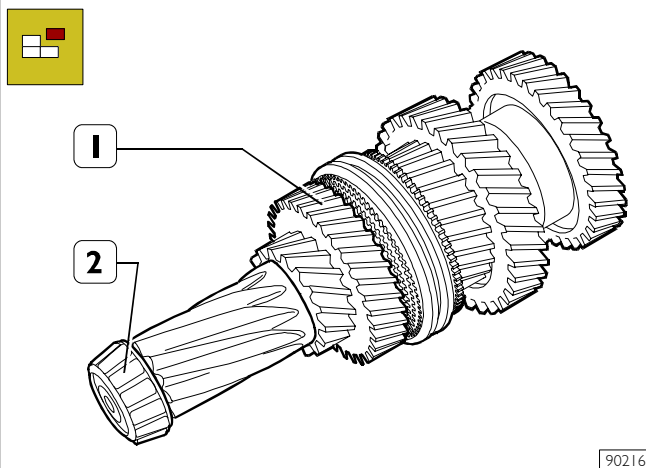
Disassembling the transmission shaft

Figure 65



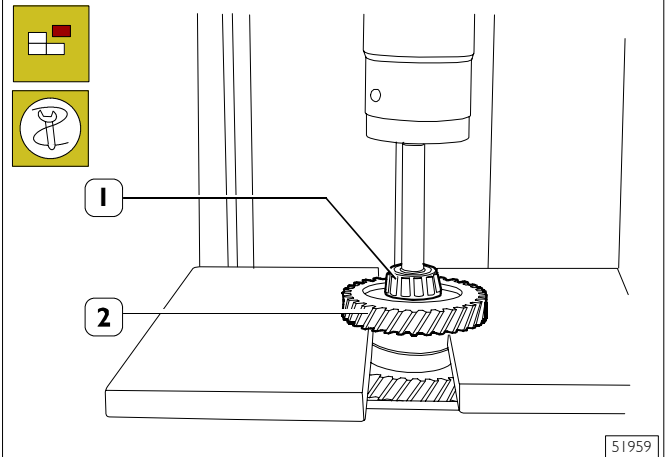
Take out the retaining ring (1) holding the 5th gear (2).

Figure 66



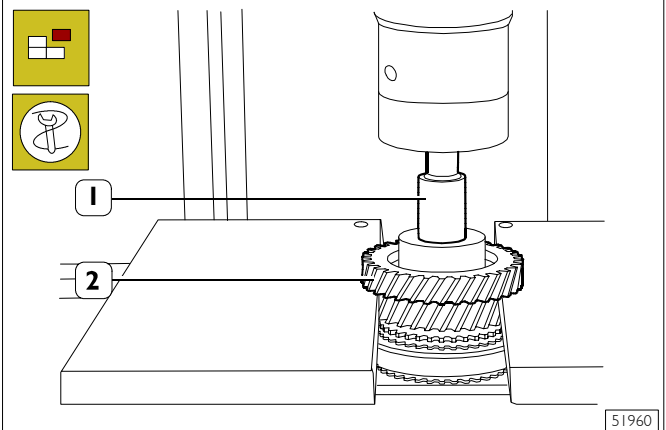
Using general tools, extract the internal ring (2) of the rear tapered roller bearing from the transmission shaft (1).

Figure 67



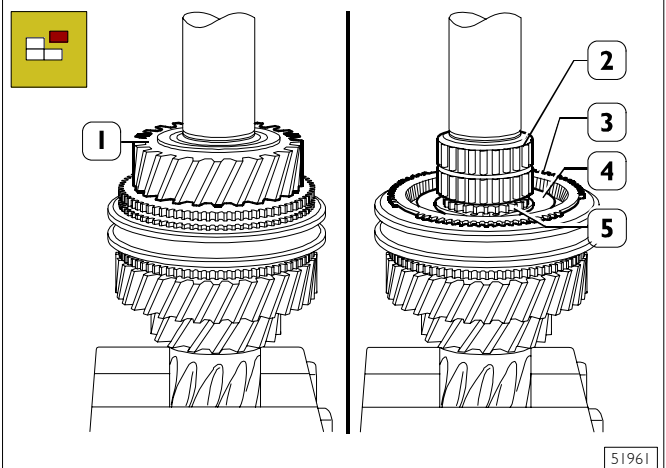
Using a hydraulic press, extract the 6th gear (2) and the internal ring (1) of the tapered roller bearing from the transmission shaft.

Figure 68



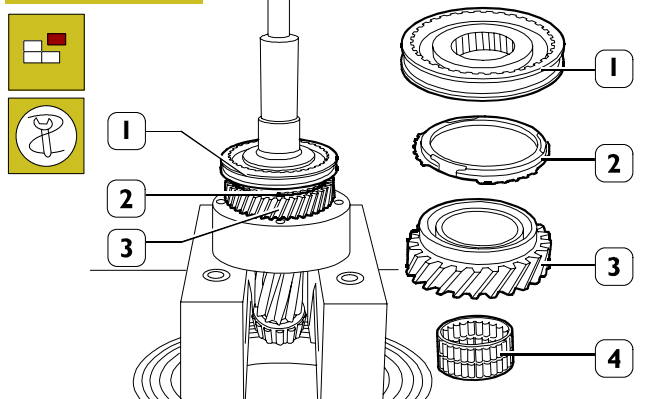
Using a hydraulic press, remove the 5th gear (2) from the transmission shaft (1).

Figure 69



Remove the 3rd gear (1) and the roller bearing (2). Remove the synchronizer ring (3). Remove the retaining ring (5) securing the hub (4).

Figure 70

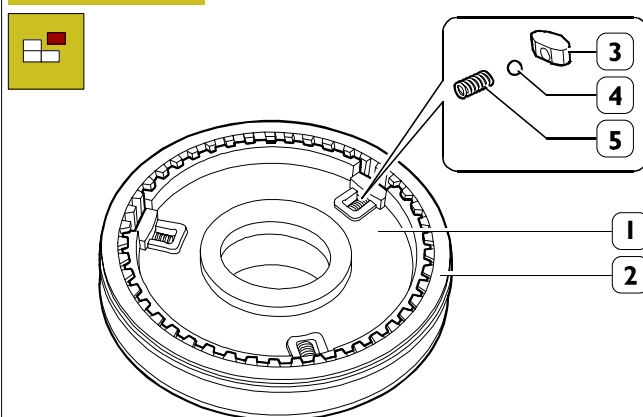


51962

Using a hydraulic press, remove the 4th gear (3), the synchronizer ring (2) and the synchronizer assembly (1).

Remove the half roller bearings (4).

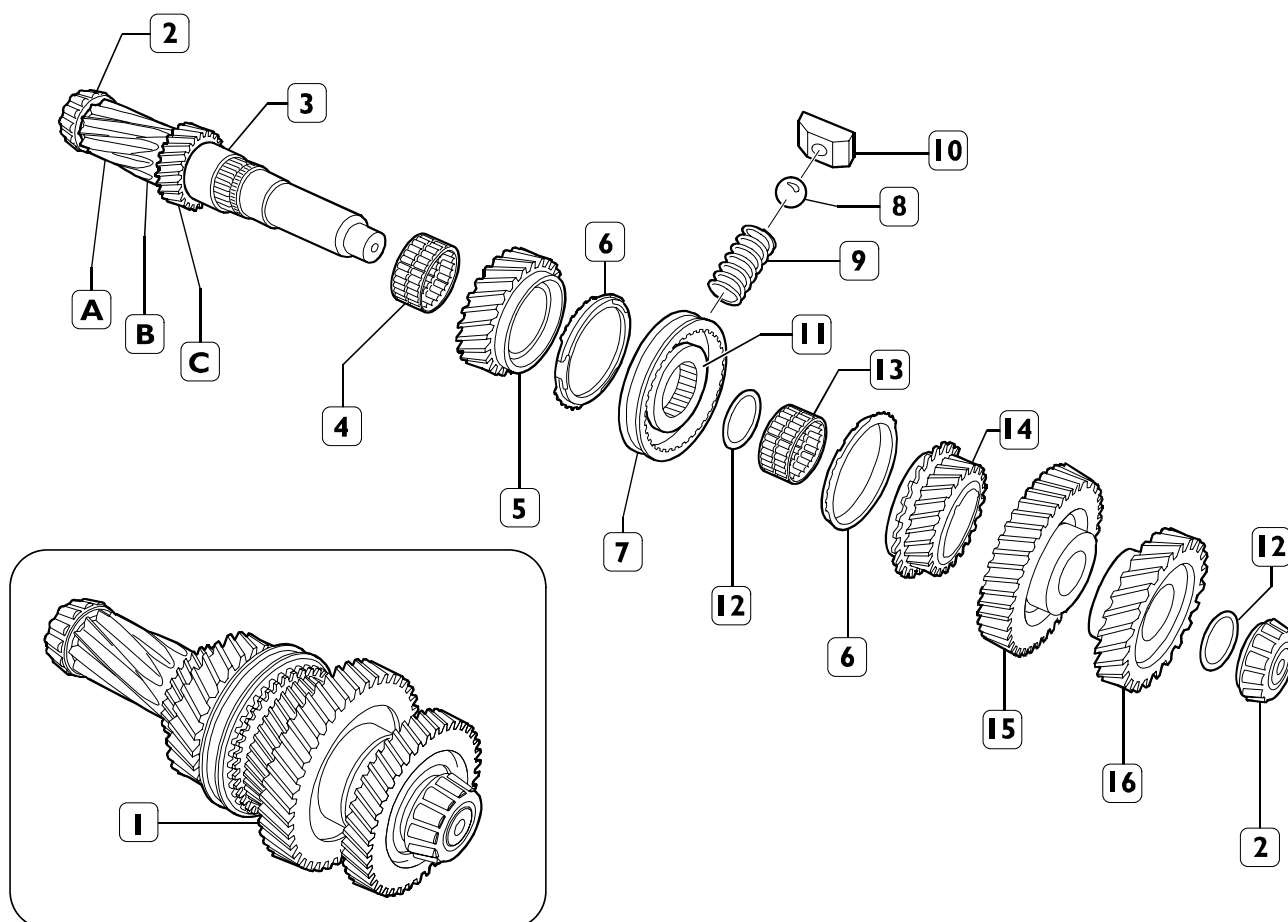
Figure 71



51424

Remove the sleeve (2) for engaging the 3rd-4th gear from the hub (1) and, taking care over the plugs (3) coming out with their relative balls (4) and springs (5), recover them.

Figure 72

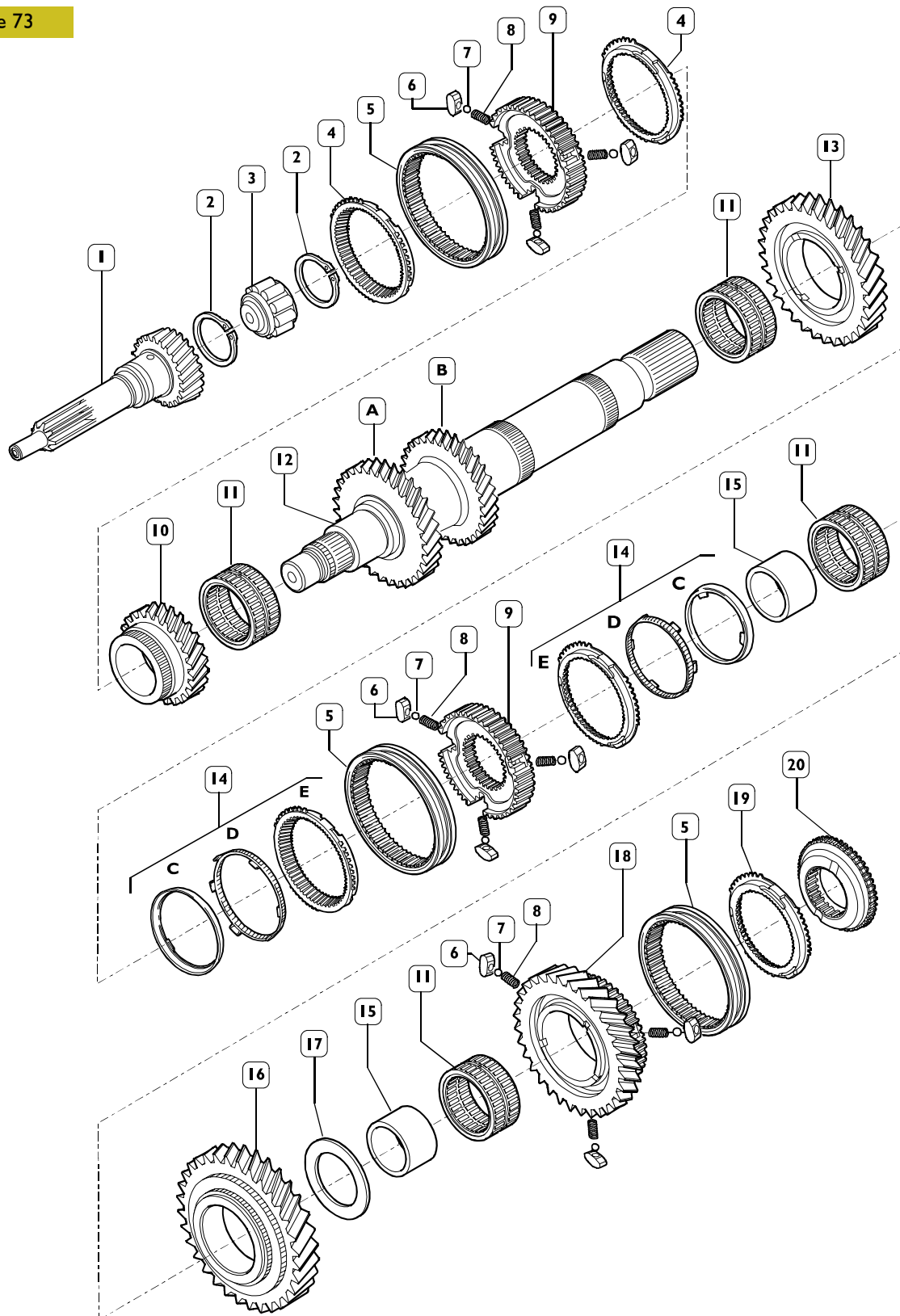


90218

TRANSMISSION SHAFT ASSEMBLY DRAWING

1. Transmission shaft assembly - 2. Tapered roller bearing - 3. Transmission shaft with reverse gear toothing (A), 1st gear (B), 2nd gear (C) - 4. Tapered bearing - 5. 4th gear - 6. Synchronizer ring - 7. Sliding sleeve - 8. Ball - 9. Spring - 10. Plug - 11. Hub - 12. Retaining ring - 13. Half roller bearings - 14. 3rd gear - 15. 6th gear - 16. 5th gear.

Figure 73

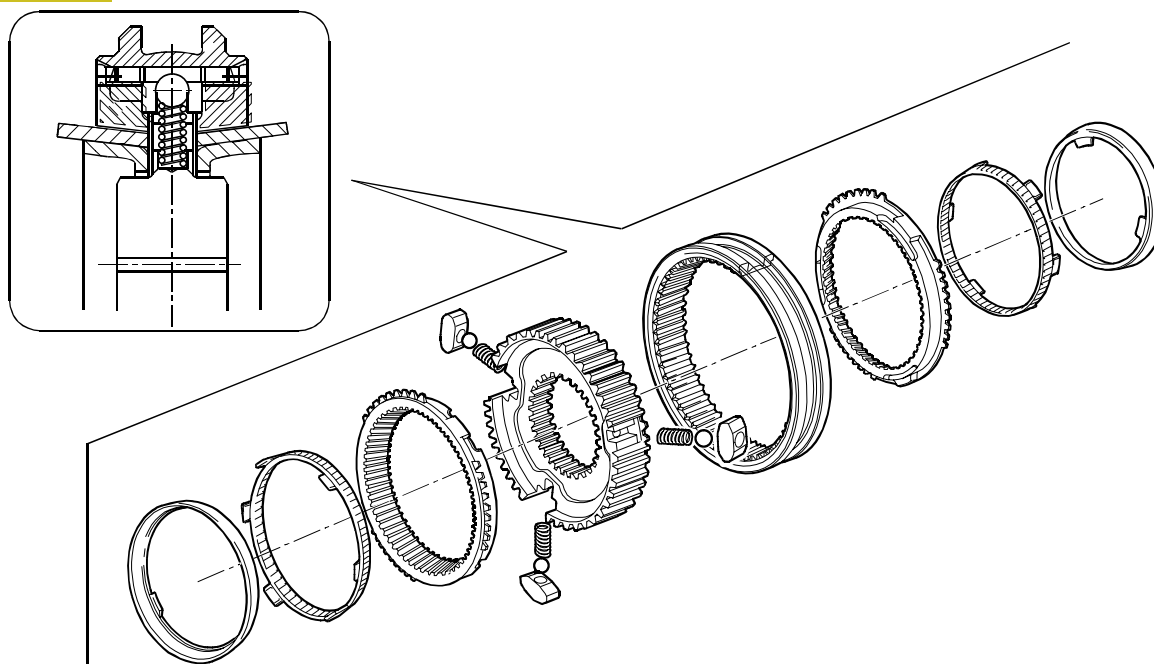


90219

PRIMARY SHAFT AND INPUT SHAFT ASSEMBLY

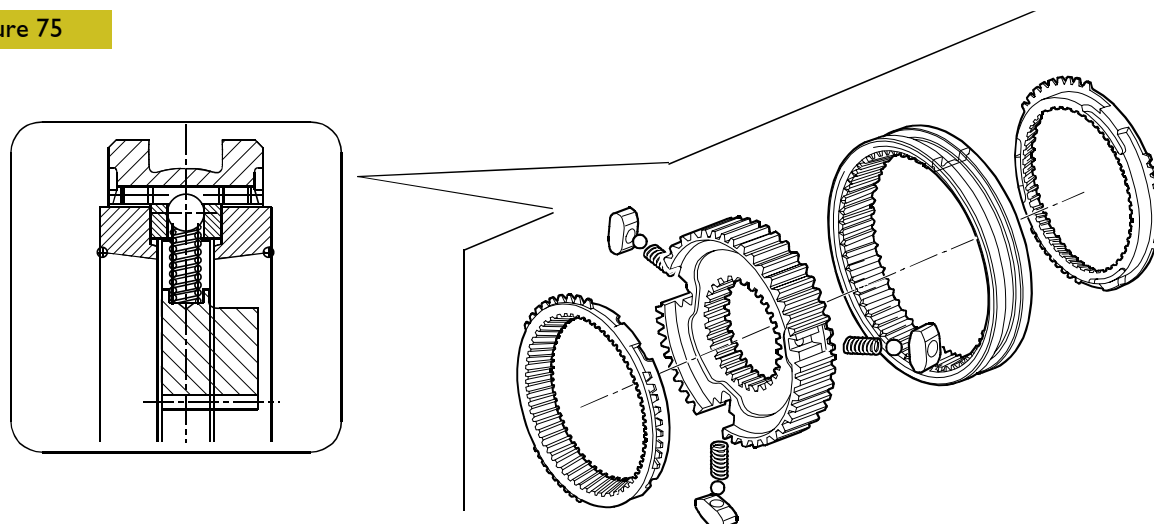
- I. Input shaft with 5th speed gear. - 2. Retaining ring - 3. Roller bearing - 4. Single cone synchronizer ring - 5. Sliding sleeve - 6. Plug - 7. Ball - 8. Spring - 9. Hub - 10. 6th gear - 11. Main shaft with 3rd gear tooting (A), 4th gear tooting (B) - 12. Roller bearing - 13. 2nd gear - 14. Dual cone synchronizer - internal ring C, middle ring D, synchronizer ring E - 15. Bushing - 16. 1st gear - 17. Spacer ring - 18. Reverse gear - 19. Synchroniser ring - 20. Gear.

Figure 74



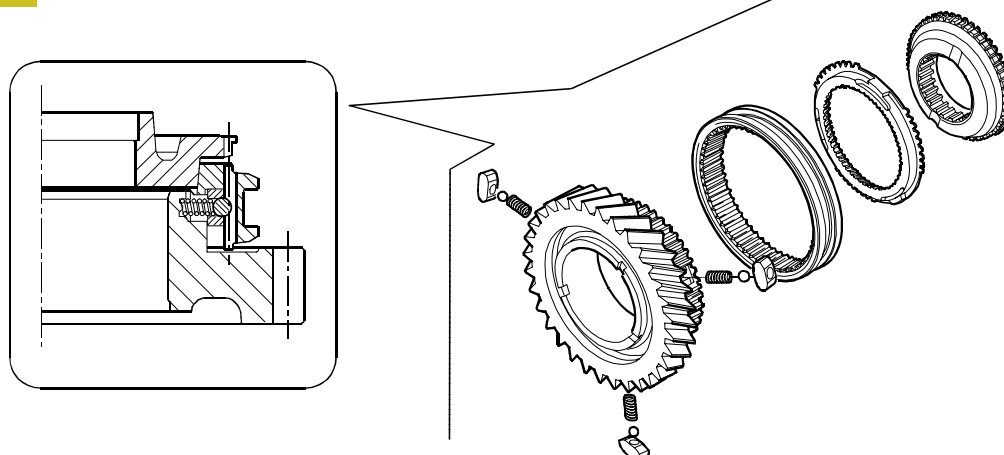
1ST-2ND GEAR DUAL CONE SYNCHRONIZER ASSEMBLY

Figure 75



3RD - 4TH - 5TH - 6TH GEAR SINGLE CONE SYNCHRONIZER ASSEMBLY

Figure 76



SINGLE CONE SYNCHRONIZER ASSEMBLY REVERSE GEAR

CHECKS

Transmission

The transmission and relative covers must show no sign of cracking.

The mating surfaces of the covers and transmission must not be damaged or deformed. Remove any remains of sealant from them.

The seats of the bearings, reverse gear shaft and gear control rods must be neither damaged nor too worn.

Hubs - sliding sleeves - forks

The grooves on the hubs and relative sliding sleeves must not be damaged. The sliding sleeve must run freely on the hub. The plugs and balls for positioning the sliding sleeve must be neither damaged nor worn. The toothing of the sliding sleeves must not be damaged. The forks must be sound with an end float, in the radial groove of the sleeve, no greater than 1 mm.

Bearings

The roller bearings must be in perfect condition with no signs of wear or overheating. They must only be removed if they are to be replaced.

Shafts - gears

The seats on the shafts, for bearings, must be neither damaged nor worn. The toothing of the gears must be neither damaged nor worn.

Synchronizing devices

Check the wear on the synchronizer rings, proceeding as follows:

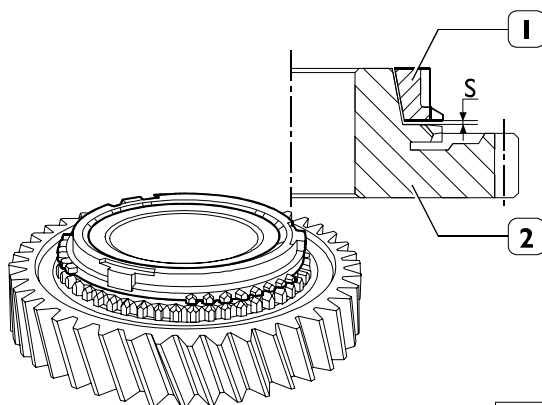


After this check, the synchronizer rings must be marked on their respective gears to avoid swapping their positions over when assembling.

- ☐ See that the friction surface is not undulated.

BK-type single cone synchronizers for 3rd/4th/5th/6th gears

Figure 77



52510

Arrange the synchroniser ring (1) on the respective gear or reverse taper ring (2).

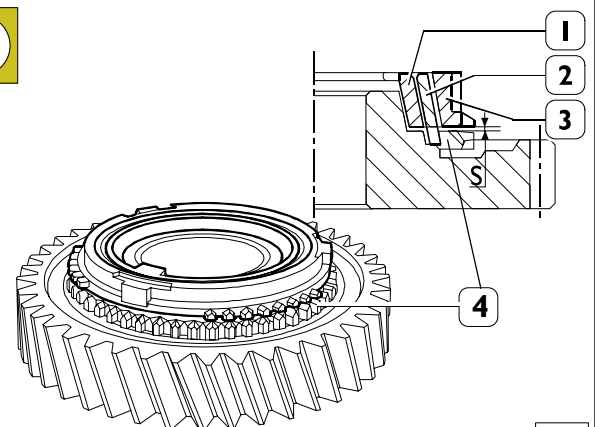
With a feeler gauge, check the distance **S** on two diametrically opposite points.

If the measured value **S** is less than 0.8 mm, replace the synchronizer ring.

Turn the synchronizer ring (1) so as to ensure correct coupling on the cog-wheel.

D-type dual cone synchronizers for 1st/2nd gears

Figure 78



52511

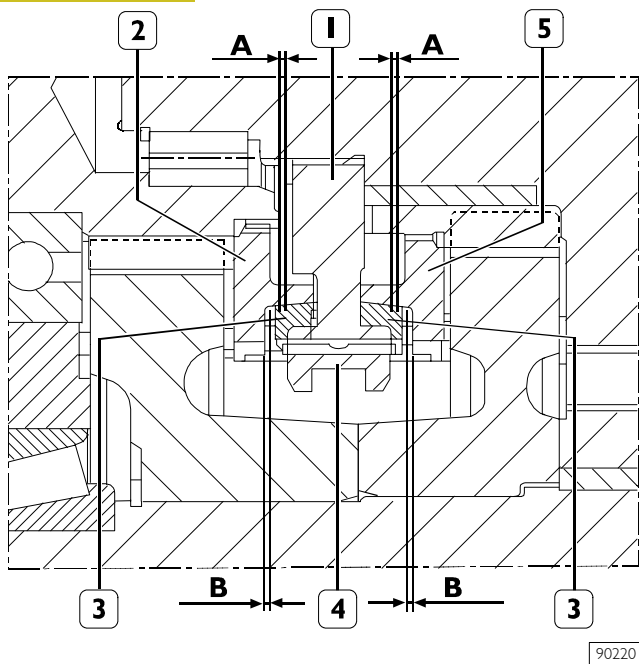
Position the internal ring (3), middle ring (2) and the synchronizer ring (1) on the tapered cog-wheel (4) of the gear.

Turn the synchronizer ring (1) so as to ensure correct coupling between the parts.

Applying a uniform force of 50 N on the synchronizer ring (1), measure the distance **S** on two diametrically opposite points with a feeler gauge.

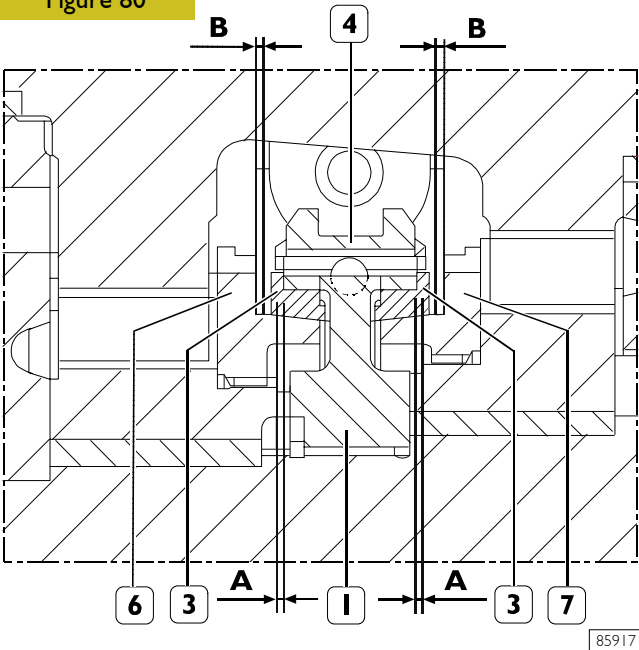
If the average measured value **S** is less than 1.5 mm, replace all the rings.

Figure 79

5TH - 6TH GEAR SYNCHRONISERS

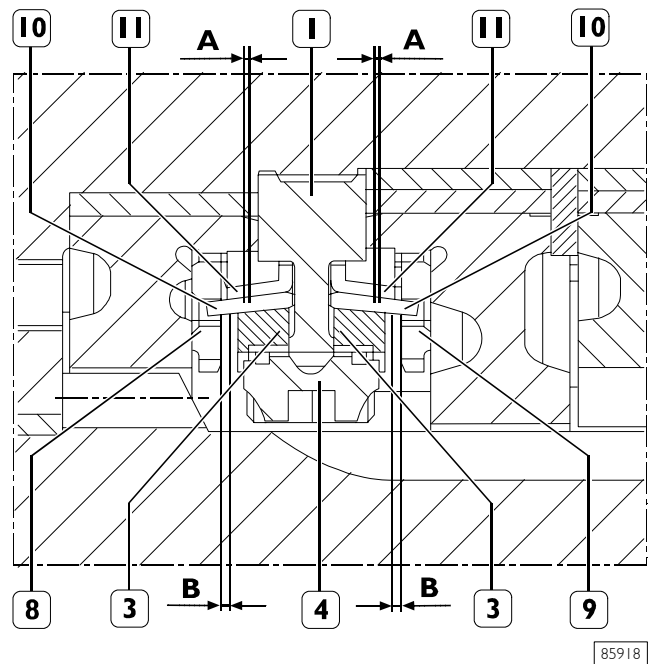
- A. synchronization reserve 6th-5th gear: $1 \pm 1,4$ mm
 B. 5th-6th release clearance: $0,3 \pm 0,7$ mm

Figure 80

3TH/4TH GEAR SYNCHRONISERS

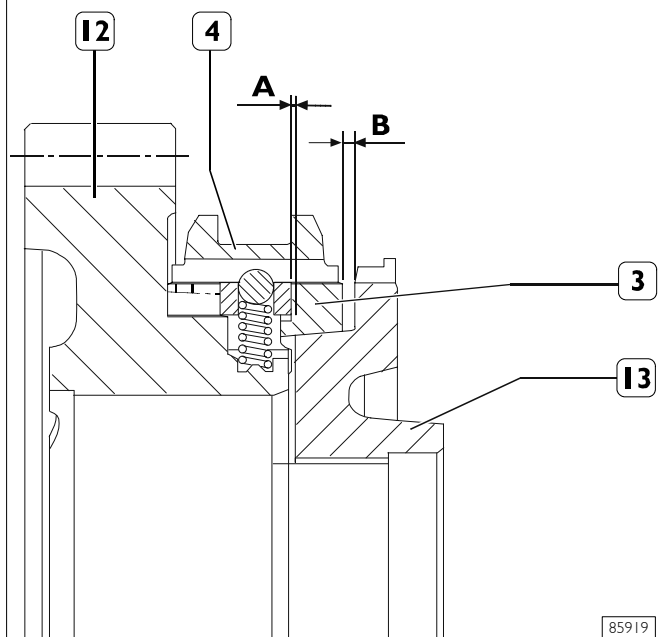
- A. synchronization reserve 1st-2nd gear: $1 \pm 1,4$ mm
 B. 1st-2nd release clearance: $0,3 \pm 0,7$ mm

Figure 81

2ND-1ST GEAR SYNCHRONISERS

- A. synchronization reserve 2nd-1st gear: $1,6 \pm 2,0$ mm
 B. 1st-2nd release clearance: $0,9 \pm 1,5$ mm

Figure 82



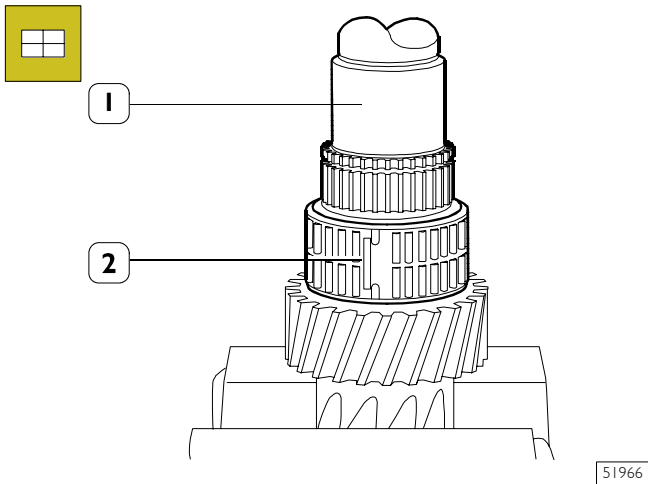
REVERSE GEAR SYNCHRONISER

- A. Synchronization reserve: $0,9 \pm 1,4$ mm
 B. release clearance: $0,35 \pm 0,85$ mm

1. Hub - 2. 5th gear - 3. Synchronizer ring - 4. Sliding sleeve - 5. 6th gear cog-wheel - 6. 3rd gear cog-wheel -
 7. 4th gear cog-wheel - 8. 2nd gear cog-wheel - 9. 1st gear cog-wheel - 10. Middle ring - 11. Ring - 12. Reverse gear -
 13. Reverse gear ring

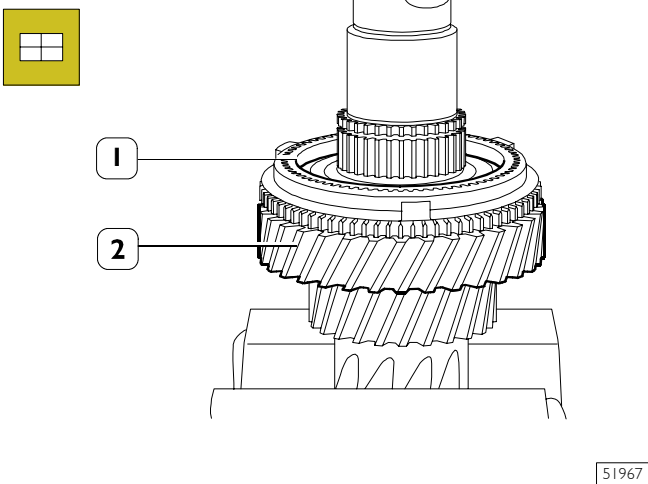
Mounting the transmission shaft

Figure 83



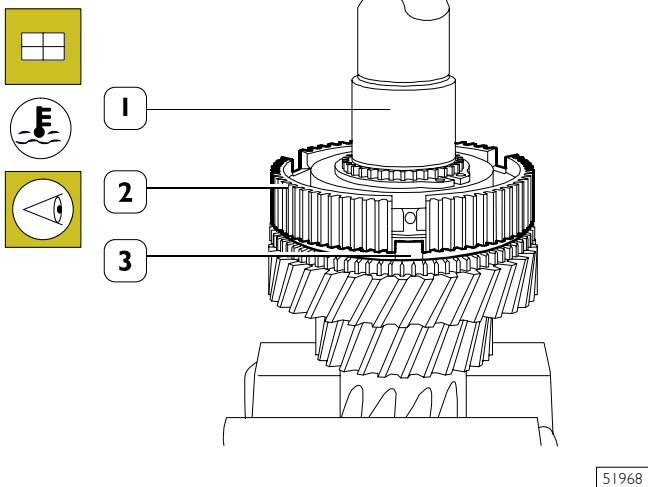
Clamp the transmission shaft (1) in a vice and position the half roller bearings (2) on it.

Figure 84



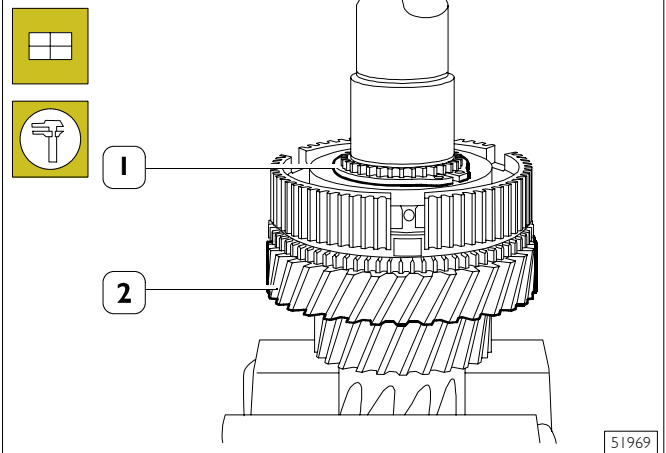
Mount the 4th gear (2) and position the synchronizer ring (1) on this.

Figure 85



Heat the hub (2) to a temperature of $110^{\circ} \pm 150^{\circ}\text{C}$ and mount it on the transmission shaft (1), taking care that the protrusions (3) of the synchronizer ring are positioned correctly in their seats in the hub (2).

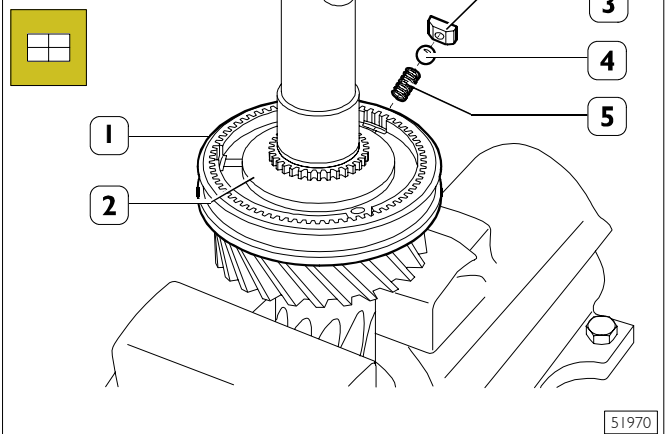
Figure 86



Mount the retaining ring (1) whose thickness produces null end float in its seat.

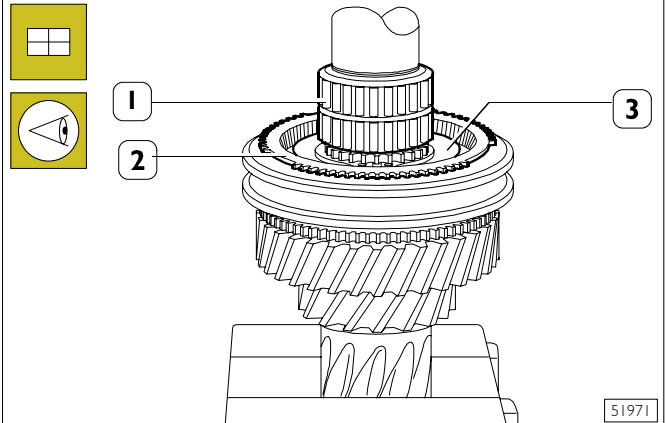
Check the end float of the 4th gear (2). It should be $0.15 \div 0.40$ mm.

Figure 87



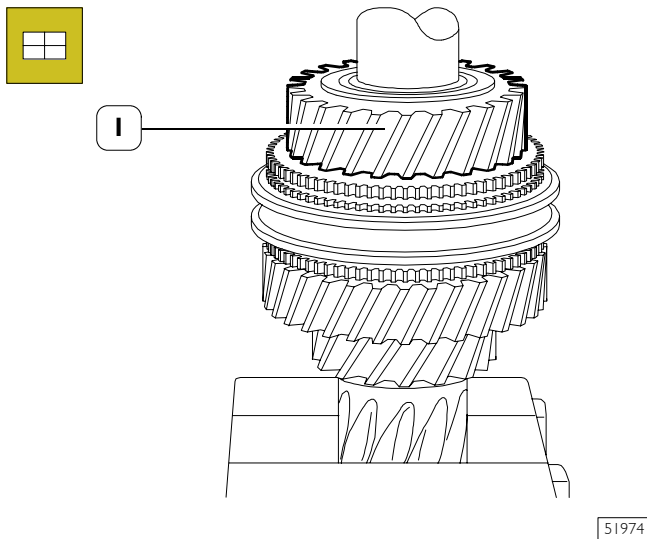
Mount the sliding sleeve (1) on the hub (2). Put the springs (5), plugs (3) and balls (4) into the seats in the hub (2), settling them under the sliding sleeve (1).

Figure 88



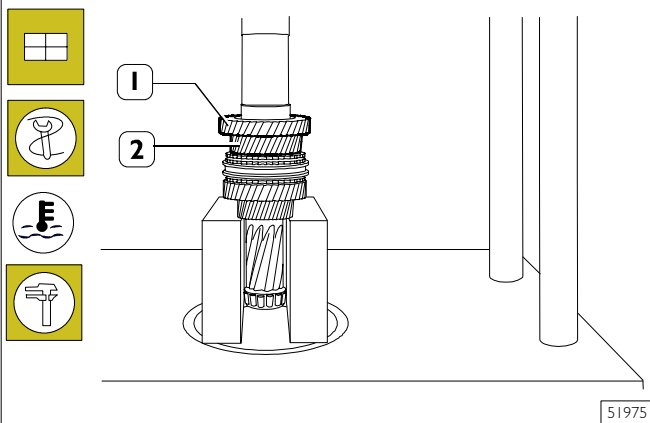
Position the synchronizer ring (2) on the hub (3) so that its protrusions enter the seats in the hub (3). Mount the roller bearing (1).

Figure 89



Mount the 3rd gear (1).

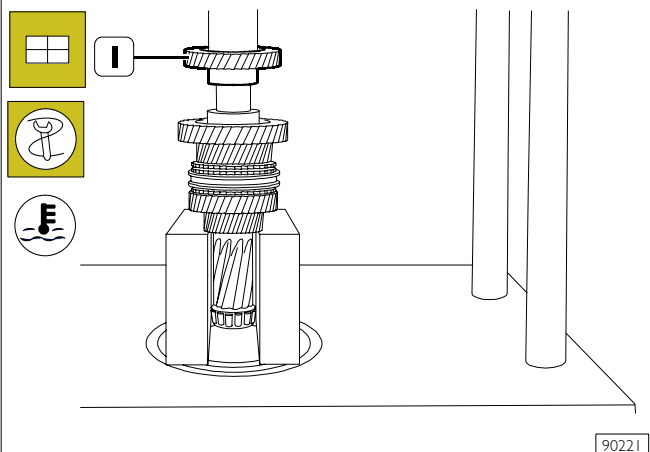
Figure 90



With a hydraulic press, mount the 6th gear (I) pre-heated to approx. 170°C.

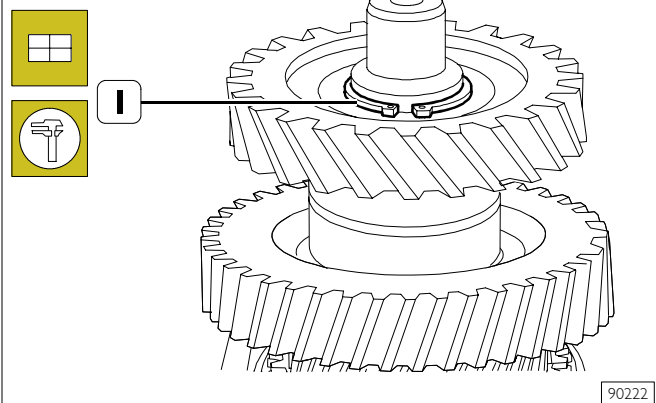
Check the end float of the 3rd gear (2). It should be $0.15 \div 0.40$ mm.

Figure 91



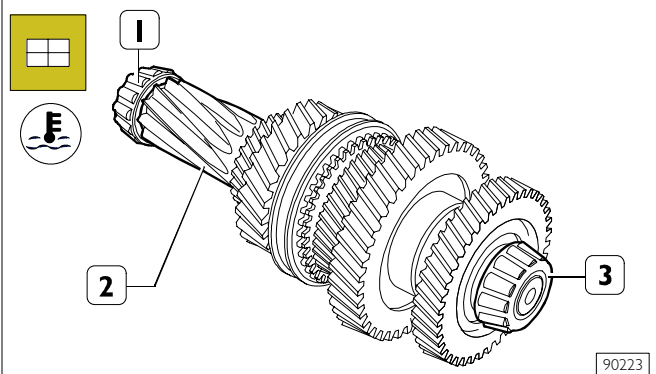
With a hydraulic press, mount the 5th gear (I) pre-heated to approx. 170°C.

Figure 92



Mount the retaining ring (1) whose thickness produces null end float in its seat.

Figure 93

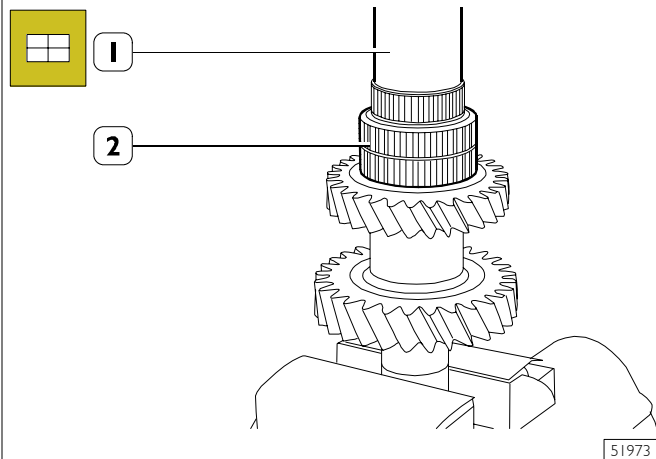


Heat the internal rings (1-3) of the tapered roller bearings to a temperature of approx. 80°C and, with a suitable punch (1), mount them on the transmission shaft (2).

Mounting the main shaft

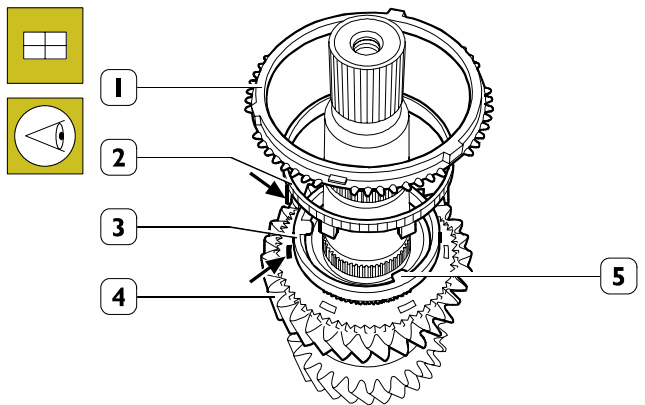
NOTE Mount the synchronizer rings on their respective gears according to the marks made during disassembly or when checking in the case of replacement.

Figure 94



Tighten the main shaft (1) and position the roller bearing (2) on it.

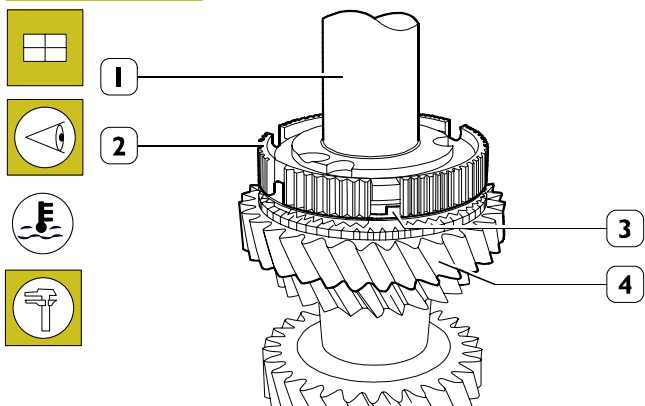
Figure 95



51980

Mount the 2nd gear (4) and position the ring (3), middle ring (2) and synchronizer ring (1) on it, taking care that the tongues (→) of the middle ring (2) enter the slots (→) in the gear (4).

Figure 96

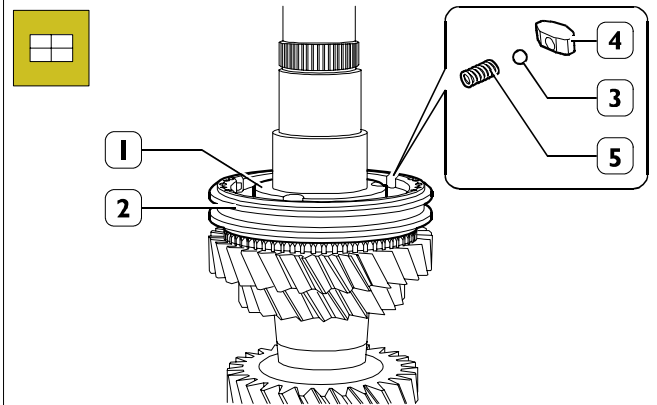


51981

Heat the hub (2) to a temperature of $80^{\circ} \pm 110^{\circ}\text{C}$ and mount it on the main shaft (1), taking care that the projections (3) of the synchronizer ring and the tongues (→) of the ring (3, Figure 95) are positioned correctly in the seats in the hub (2).

Check the end float of the gear (4). It should be $0.25 \div 0.5 \text{ mm}$.

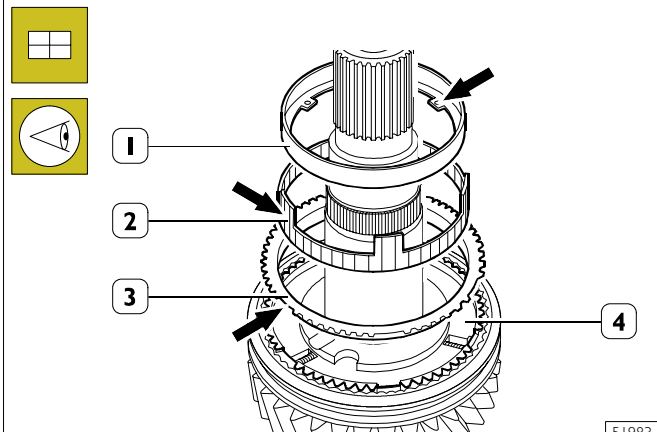
Figure 97



51982

Mount the sliding sleeve (2) on the hub (1). Put the springs (5), plugs (4) and balls (3) into the seats in the hub (1), settling them under the sliding sleeve (2).

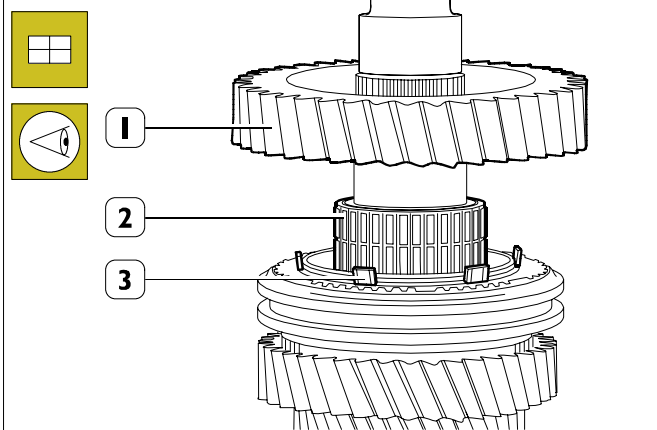
Figure 98



51983

Position the synchronizer ring (3), middle ring (2) and ring (1) on the hub (4), taking care that the tongues (→) of the ring (1) and the projections (→) of the ring (3) enter the seats in the hub (4).

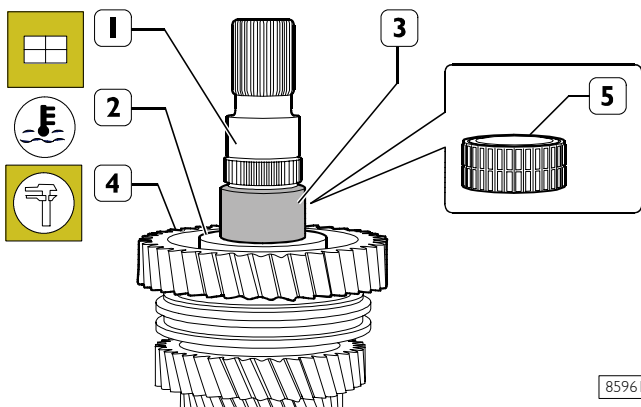
Figure 99



51984

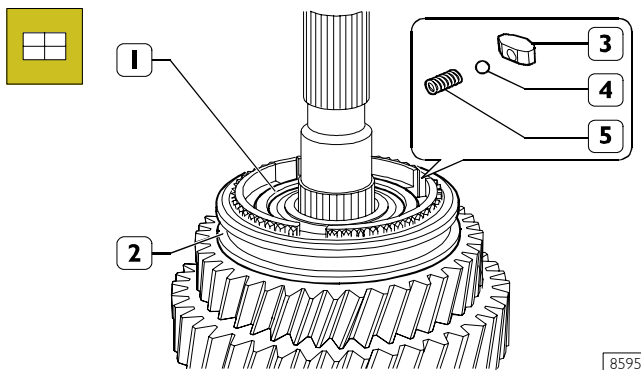
Position the roller bearing (2). Mount the 1st gear (1) taking care that the tongues (3) of the middle ring enter the slots in the gear (1).

Figure 100



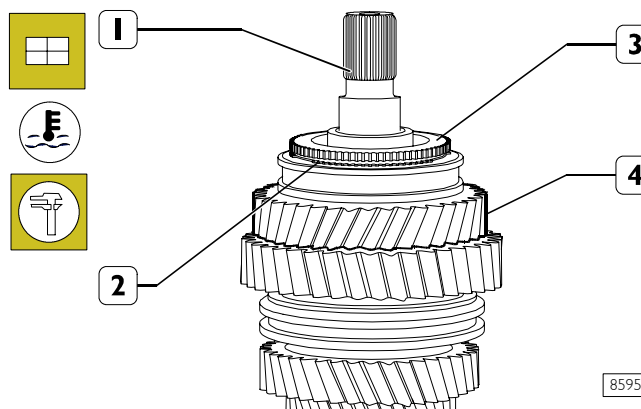
Heat the spacer ring (2) to a temperature of approx. $80^{\circ} \pm 110^{\circ}\text{C}$ and mount it on the main shaft (1). Check the end float of the gear (4); this should be $0.15 \pm 0.3 \text{ mm}$. Heat the bushing (3) to a temperature of approx. $80^{\circ} \pm 110^{\circ}\text{C}$ and mount it on the main shaft (1). Mount the roller bearing (5).

Figure 101



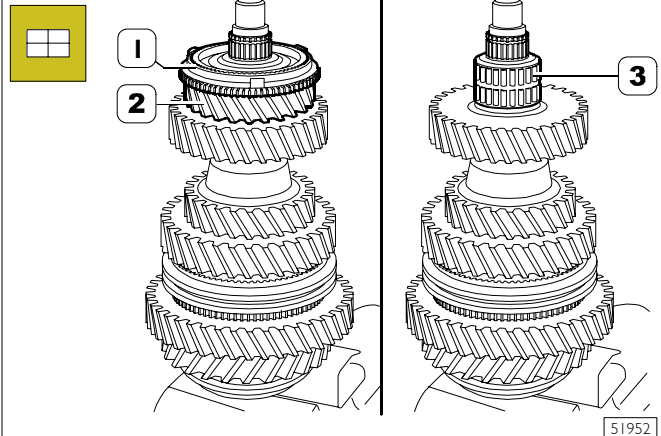
Fit reverse gear (1). Fit sliding sleeve (2) on reverse gear hub (1). Insert the springs (5), the pads (3) and the balls (4) in the hub seats (1) and arrange them with respect to the sliding sleeve (2).

Figure 102



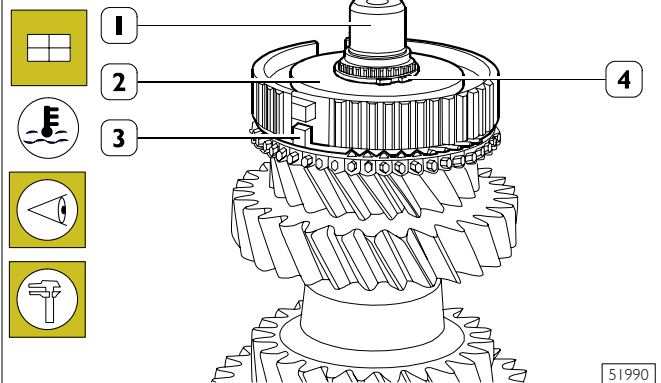
Fit the synchroniser ring (2). Heat the gear ring (3) to $110^{\circ} \pm 150^{\circ}$ and fit on primary shaft (1). Check reverse gear play (4) which must be $0.15 \pm 0.4 \text{ mm}$.

Figure 103



Turn the main shaft over and position the half roller bearings (3) on it. Mount the 6th gear (2) and position the synchronizer ring (1) on it.

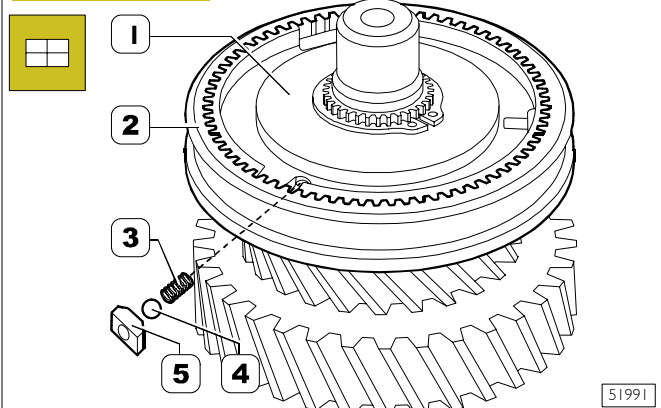
Figure 104



Heat the hub (2) to a temperature of approx. $80^{\circ} \pm 110^{\circ}\text{C}$ and mount it on the main shaft (1) taking care that the projections (3) of the synchronizer ring are positioned in the seats in the hub (2).

Mount the retaining ring (4) whose thickness produces null end float in its seat.

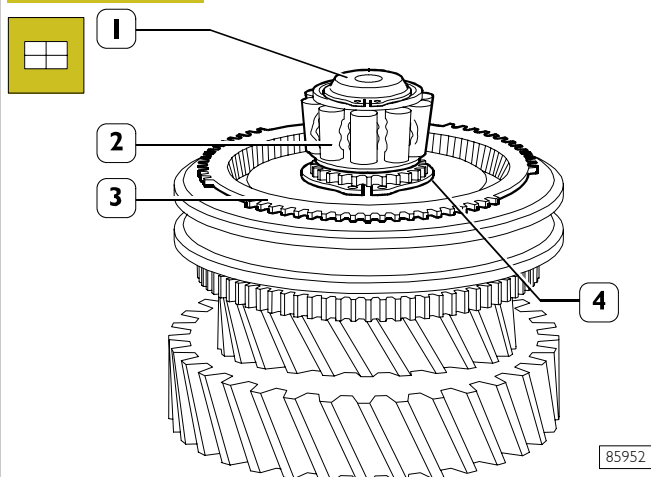
Figure 105



Mount the sliding sleeve (2).

Put the springs (3), plugs (5) and balls (4) into the seats in the hub (1) and position them under the sliding sleeve (2).

Figure 106

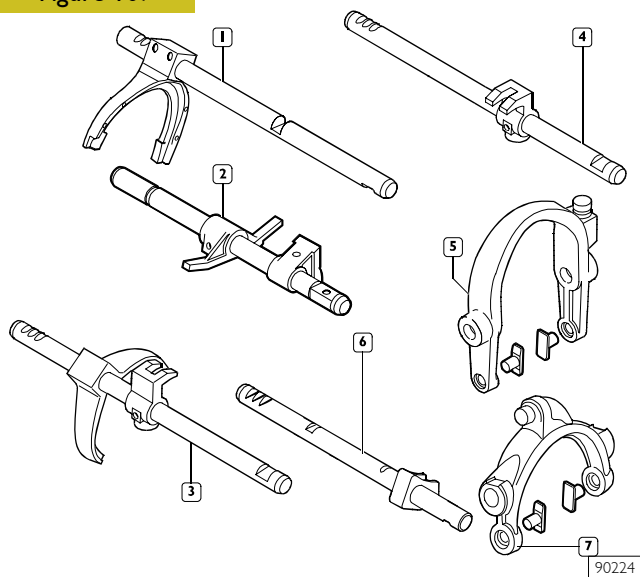


Heat the bearing (2) to $80 \pm 10^\circ\text{C}$ and fit on primary shaft (1). Fit the circlip (4) and synchroniser ring (3).

Rods - forks - selector - driver

Disassembly - assembly

Figure 107



1. Rod with reverse gear engagement fork - 2. Main rod - 3. Rod with 1st-2nd gear engagement fork - 4. Fork control rod (5) - 5. 3rd-4th gear engagement fork - 6. Fork control rod (7) - 7. 5th-6th gear engagement fork

Check the state of the plugs (2) of the 3rd-4th-5th-6th gear engagement fork and replace them if they are worn.

To replace the forks of the selector and driver from their respective control rods it is sufficient to remove the retaining spring pins with a suitable punch.

For assembly, carry out these steps in reverse order, replacing the spring pins.

NOTE Spring pegs must be positioned with the cutting edge placed level.

Mounting the transmission

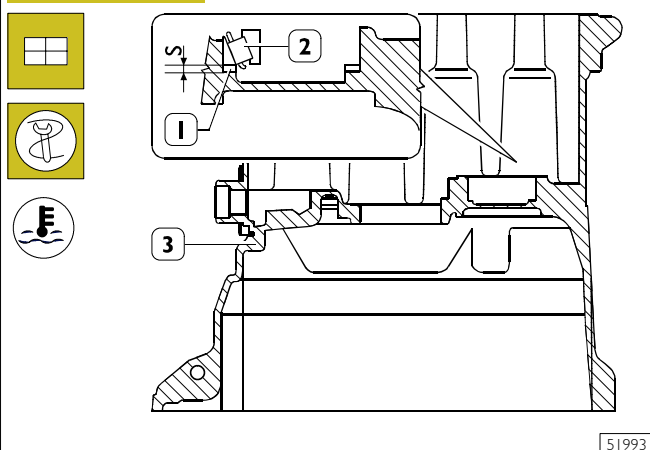
NOTE During assembly, the gaskets, retaining rings, O-rings, spring pins, safety plates and springs must always be replaced with new parts.

The nuts and screws must be tightened to the required torque unless specified otherwise, with the thread dry and degreased.

Adjusting the transmission shaft bearing end float

NOTE The transmission shaft bearing end float is only adjusted if the bearings, transmission shaft gears, transmission shaft, transmission or rear cover have been replaced or if too much clearance has been found.

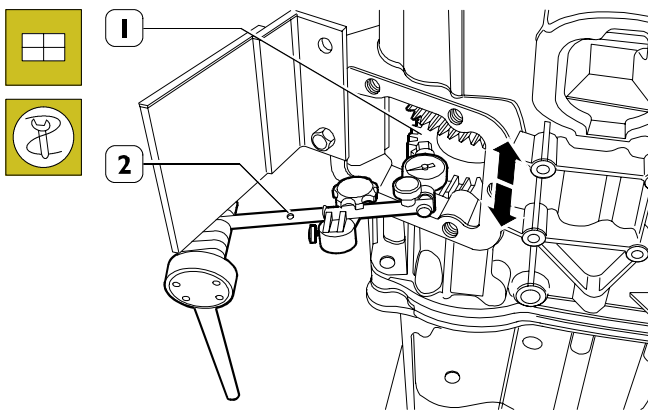
Figure 108



Determine the thickness **S** of the ring (1) for adjusting the transmission shaft bearing end float, proceeding as follows:

- ☐ position the thinner adjustment ring (1) 1.65 mm thick in the seat in the transmission (3);
- ☐ heat the seat of the bearing (2) to approx. 60°C . Mount the external ring of the bearing (2) with the punch 99374091 and grip 99370007, see Figure 110;
- ☐ mount the transmission shaft complete with the internal rings of the tapered roller bearings;
- ☐ mount the external ring of the rear bearing in the rear cover in a similar manner to the front one (see Figure 110);
- ☐ mount the rear cover on the transmission;
- ☐ screw on the 8 fixing screws so that between one screw and another there is a hole for a free screw and tighten them to the required torque;
- ☐ turn the transmission shaft to settle the bearings;

Figure 109



52512

- using a comparator (2) zeroed on the 5th gear toothing of the transmission shaft (1) measure its end float **A** through the opening for the power take-off connection and note it down.

The thickness **S** is given by:

$$S = A + B + C$$

Where:

A = measured end float, e.g. 0.18 mm;

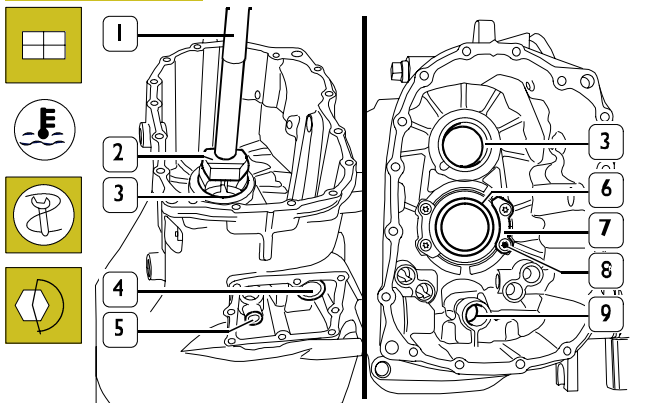
B = average bearing pre-load, e.g. 0.02 mm;

C = adjustment value used for the measurement 1.65 mm;

$$S = 0,18 + 0,02 + 1,65 = 1,85$$

Then mount the rear cover, transmission shaft and external ring of the front bearing.

Figure 110



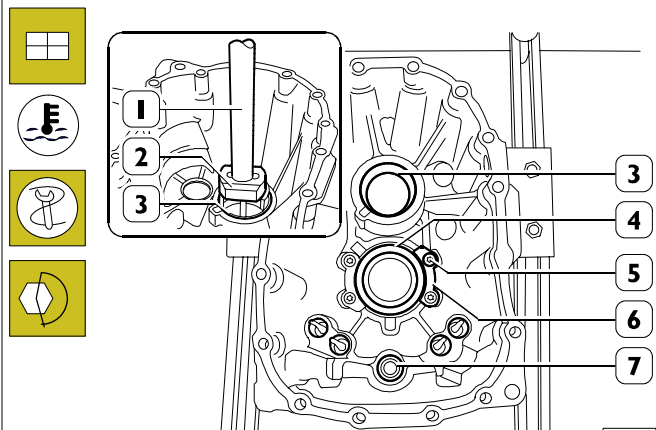
51996

Position the adjustment ring (1, Figure 108) of the thickness determined with the above measurement. Heat the bearing seats of the box to a temperature of approx. 80°C and mount:

- the external ring (3) of the front tapered roller bearing with punch 99374091 (2) and grip 99370007 (1);
- the ball bearing (6) with a general punch;
- the bushing with ball bearing (9) and the roller bearings (4-5) with a general punch.

Position the retaining plates (7) and secure them to the box, tightening the screws (8) to the required torque.

Figure 111



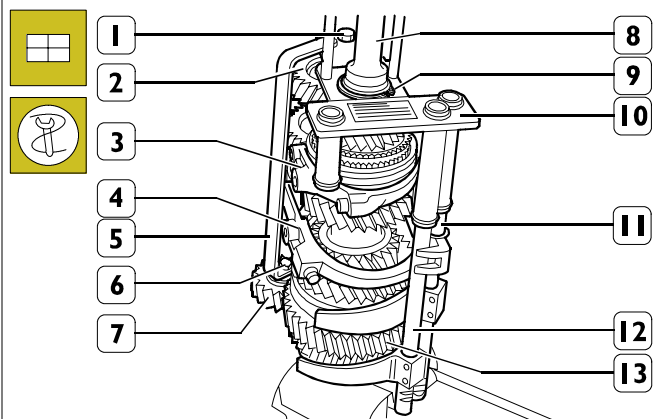
51997

Heat the bearing seats of the rear cover (1) to a temperature of approx. 80°C and mount:

- the external ring (3) of the tapered roller bearing with punch 99374091 (2) and grip 99370007 (1);
- the ball bearing (4) and the bushing with ball bearings (7) with a general punch.

Position the retaining plates (6). Secure these to the rear cover, tightening the screws (5) to the required torque.

Figure 112



90225

Clamp the primary shaft (13) in a vice, fit on it the synchronising ring and the input shaft (8).

Fit tool 99360522 (10) on the input transmission shaft (8) and fasten with the circlip (9).

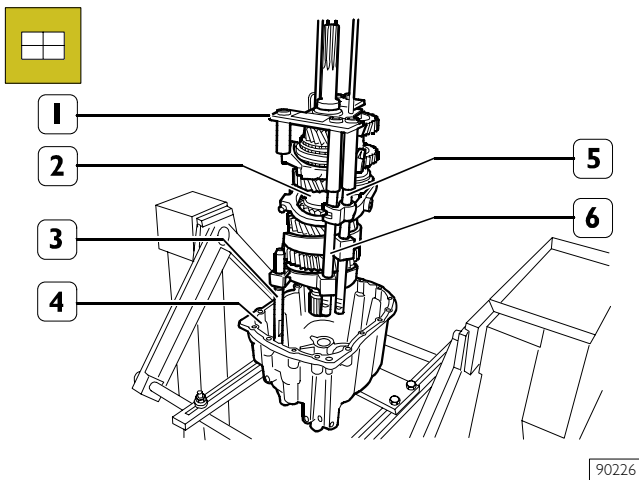
Couple the secondary shaft (2) to the primary shaft (13) and fasten by tightening the screw (1) on the tool (10).

Fit the clutch forks: 3rd - 4th speed (4) and 5th - 6th speed (3) on the relevant sliding sleeves.

Couple the rods (11 and 13), fit the relevant forks on the sliding sleeves and clamp the rods with the sleeves of tool 99360522 (10).

Couple the reverse gear (7) with the shafts (2 and 13) and fasten it to them with the part of the bracket (5) tighten the screw (6).

Figure 113

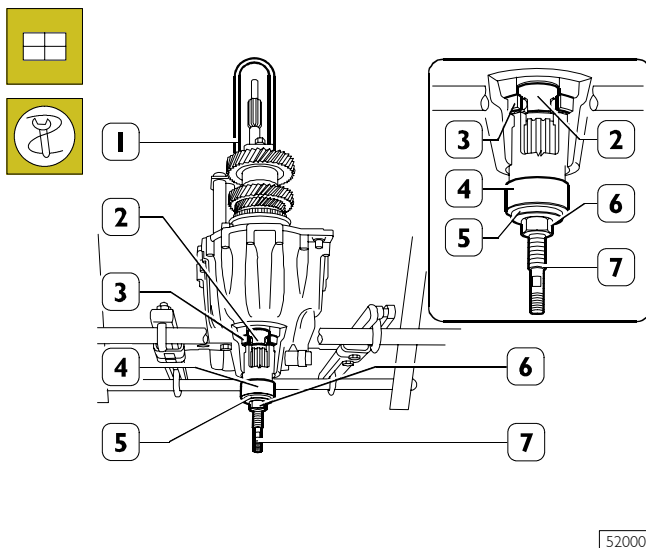


Fit the rod (3) in the rear cover (4).

Hook hoist to tool 99360522 (1), lift the unit (2) as previously mounted, and partially insert it into the rear cover (4).

During this operation, check that the output shaft goes into the supporting ball bearing and the control rods (5 -6) go into their respective seats.

Figure 114

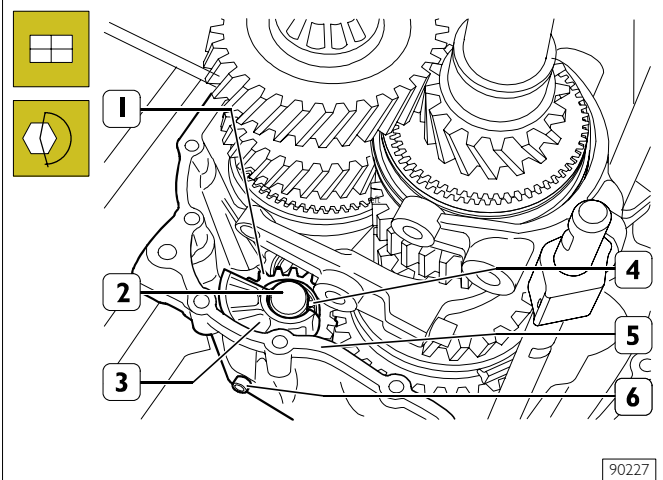


Screw tool 99370234 pin (7) into output shaft hole (2) and fit bushing (4) and spacer (5) on tool.

Screw on the nut (6) and at the same time lower the hoist so the output shaft (2) is positioned on the rear ball bearing (3).

Remove tools 99360522 (1) and 99370234 (4-5-6-7).

Figure 115

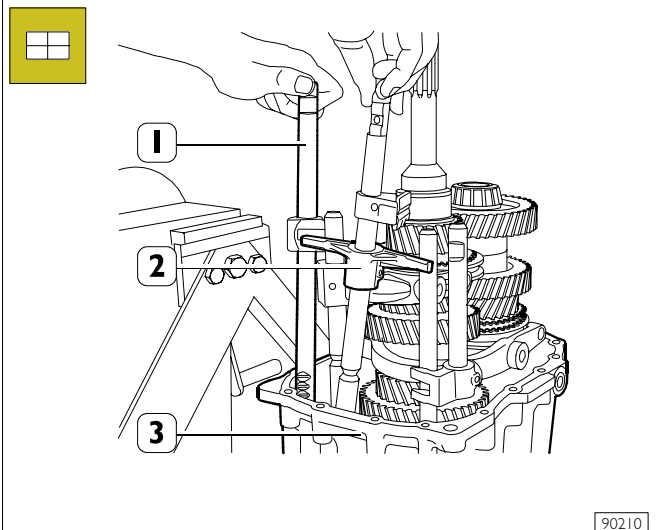


Place the roller bearings (2) in the reverse gear (1).

Fit the stem (2) and the support (3) so that the respective holes for the fastening screw are aligned with the relevant hole on the rear cover (5).

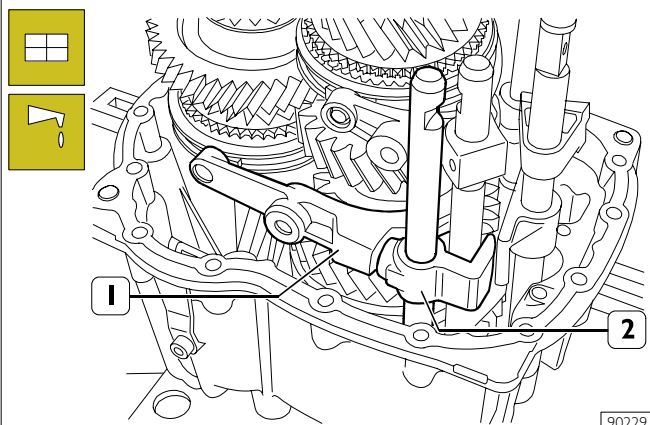
Drive in the fastening screw (6) of the stem (3) and the support (4) on the rear cover (5) and tighten it to the prescribed torque.

Figure 116



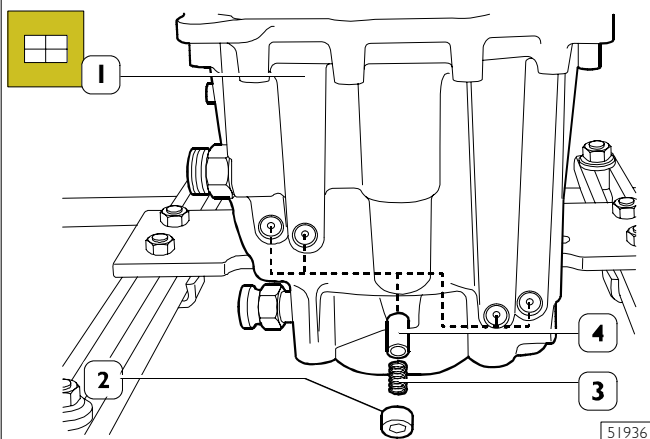
Fit the control rod (1) of the 3rd - 4th speed and the main rod (2) in the rear cover (3).

Figure 117



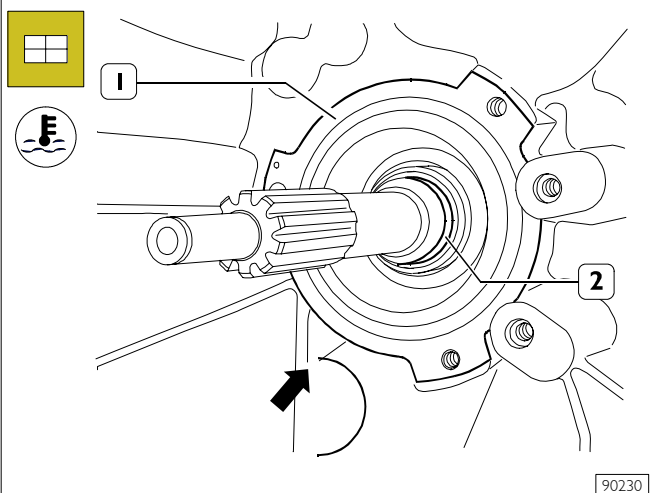
Apply some grease on the pin of the dragging device (2) and fit the clutch fork (1) for the 3rd – 4th speed on this device.

Figure 118



Put the pawls (4) and springs (3) in the rear cover (1) and drive in the retaining cups (2) with a suitable punch. Apply LOCTITE 5206 on gearbox attachment.

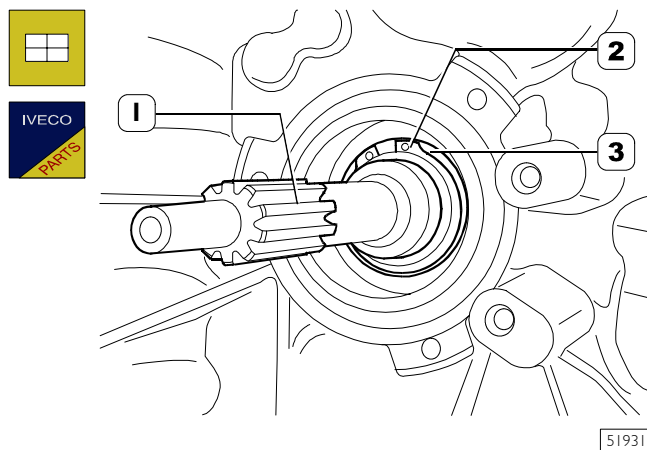
Figure 119



Warm up the front bearing inner ring (2) at 90+/-10°C and fit the gearbox (1) on the rear cover.

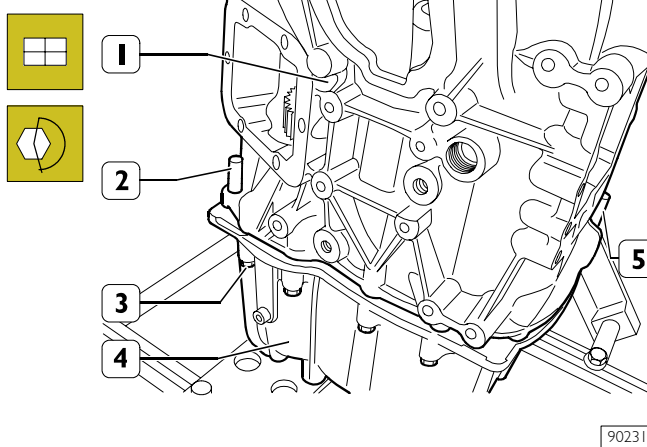
NOTE When fitting the gearbox, check that the shafts and the control rods fit correctly in the respective seat and that the fork (1, Figure 117) does not disconnect from the clutch rod (2, Figure 117) for the 3rd – 4th speed.

Figure 120



Fit a new retaining ring (2) securing the front bearing (3) onto the input shaft (1).

Figure 121

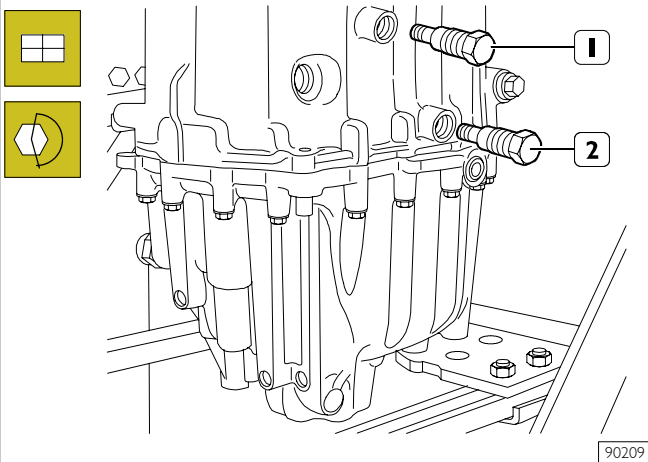


Screw on the screws (2) securing the rear cover (3) to the transmission (1) without fully tightening them.

Mount the centring pins (4) in the rear cover (3) and in the transmission (1).

Tighten the screws (2) to the required torque.

Figure 122



NOTE Make sure that the clutch control rods are all in neutral position.

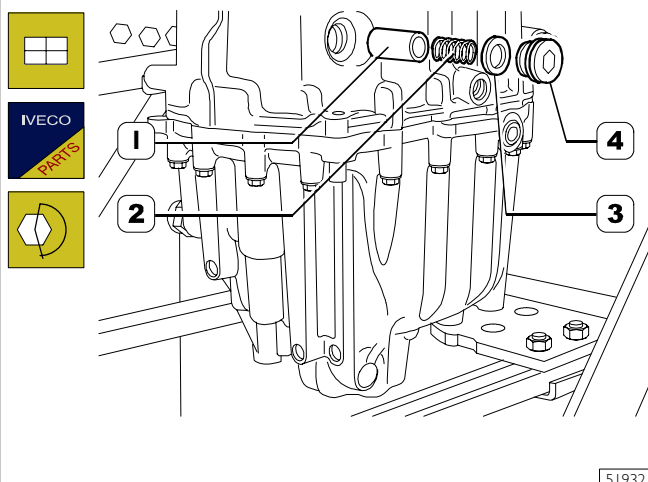
Apply LOCTITE 242 to the thread of the pins (1).

Screw the pins (1) into the box, checking that their ends go into the hole of the 3rd/4th gear engagement fork link (1, Figure 117) and then tighten them to the required torque.

Drive in the pins (2) and check that their ends fit in the knuckle hole of the clutch fork for the 5th – 6th speed and tighten it to the prescribed torque.

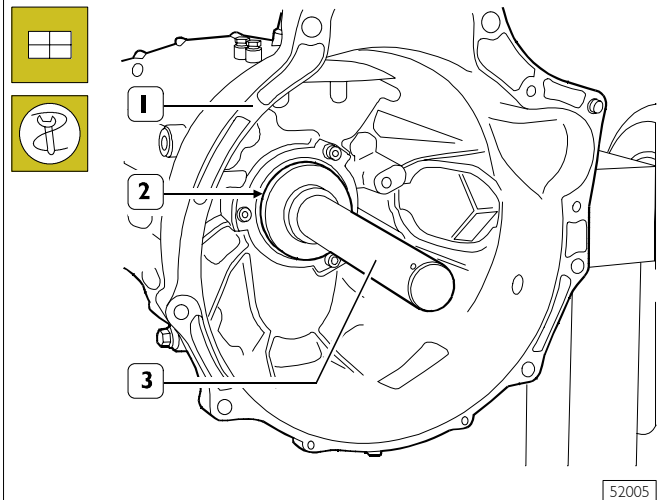
NOTE If during these assembly operations the fork (1, Figure 117.) comes free of the control rod, it will not be possible to mount the pins (1) until they have been reconnected.

Figure 123



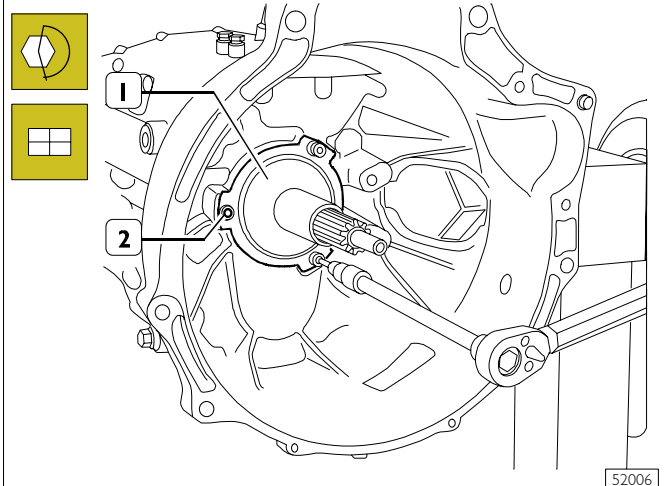
Mount the push rod (1) and the spring (2). Screw on the plug (4) with a new washer (3), tightening it to the required torque.

Figure 124



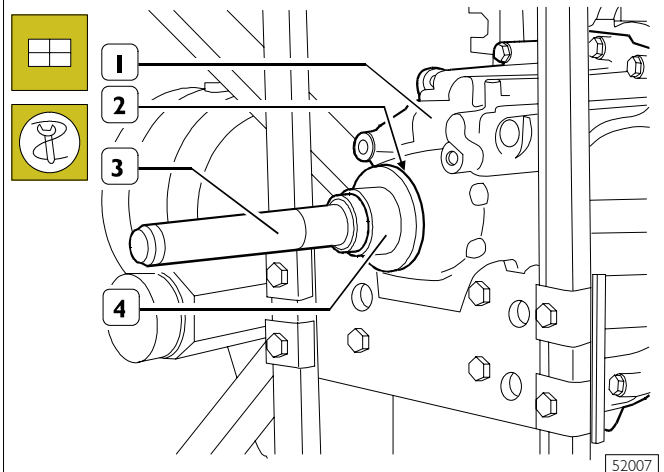
Using the key 9937455 (3), mount the O-ring (2) in the transmission (1).

Figure 125



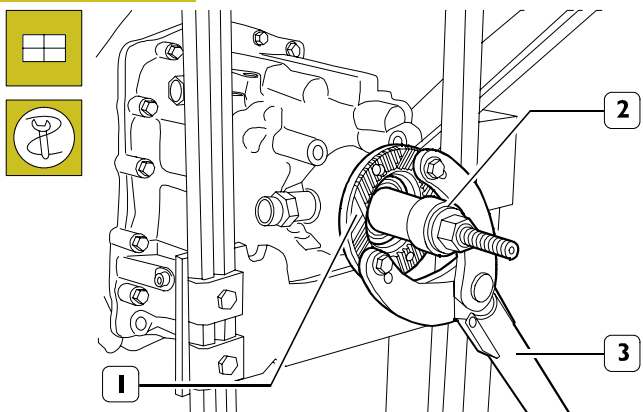
Mount the cover (1) protecting the input shaft and tighten the screws (2) to the required torque.

Figure 126



Mount the O-ring (2) in the rear cover (1) with the key 99374454 (4) and the grip 9937006 (3).

Figure 127

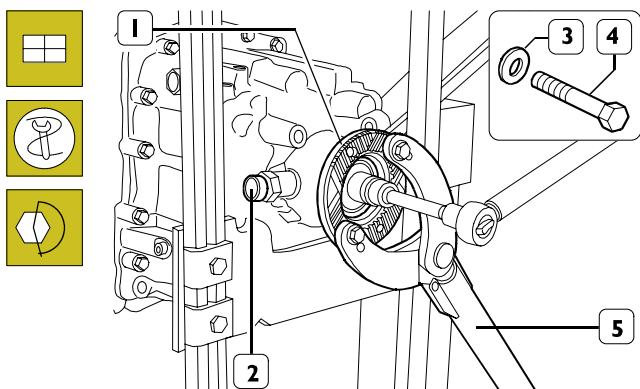


52008

Fit the transmission shaft coupling (1) onto the output shaft.

If there is any interference, use the tool 99370234 (2) for assembly with the lever 99370317 (3) to lock the coupling.

Figure 128



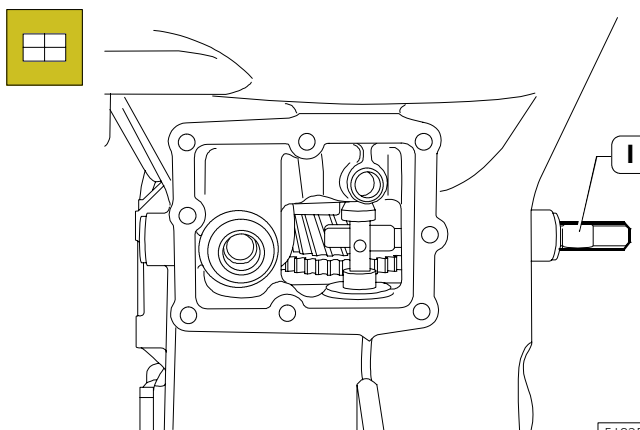
52009

Mount the washer (3) and screw on the screw (4).

Lock the rotation of the flange (1) with the lever 99370317 (5) and tighten the screw (4) to the required torque.

Mount the tachograph sensor (2) and the reversing light switch.

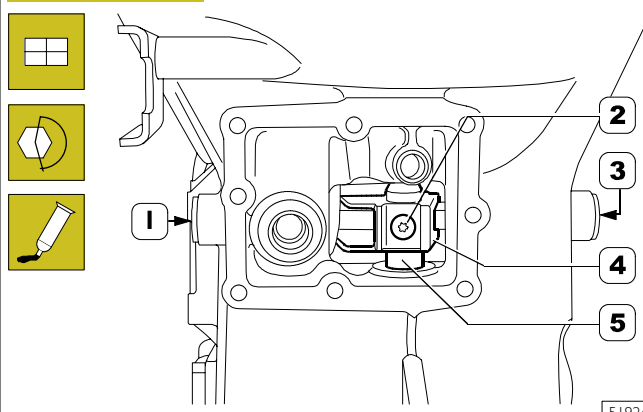
Figure 129



51925

Mount the rod (1) preventing engagement of more than one gear at the same time, in the position marked during disassembly.

Figure 130



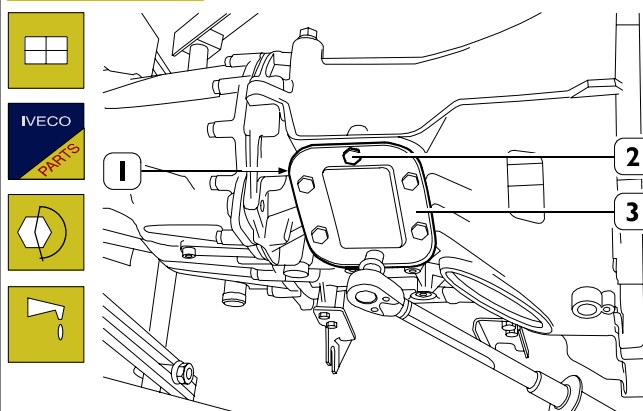
51924

Apply sealant to the thread of the plugs (1 - 3), screw them into the box, tightening them to the required torque.

Position the driver (4) on the rod (5).

Secure it with the screw (2) after applying LOCTITE 242 onto its thread.

Figure 131



52118

Fit a new gasket (1) onto the transmission.

Apply LOCTITE 510 on the screw threading (2).

Mount the side cover (3) and tighten the fixing screws (2) to the required torque.

Mount the control box as described under the relevant heading.

Mount the oil drainage plug, tightening it to the required torque.

Fill the transmission with lubricating oil in the required quantity and grade.

Mount the oil filler and level indicator cap, tightening it to the required torque.