23 Manual Gearbox

Specifications

Gearbox

Model		1502	1602	1802	2002	2002 TI	2002 tii
Type		Standard gearbox 232/6 [1] Manual four-speed gearbox with Porsche baulk-ring synchromesh; 1 reverse speed				Standard gearbox 242/6 [2] Manual four-speed gearbox with Borg Warner baulk-ring synchromesh; 1 reverse speed	
1st gear	Ratio	3.834				3.764	
	Number of teeth	30/34 19/14				31/34 20/14	
2nd gear	Ratio	2.052				2.021	
	Number of teeth	30/26 19/20				31/30 20/23	
3rd gear	Ratio	1.345				1.320	
	Number of teeth	30/23 19/27				31/23 20/27	
4th gear	Ratio	1.0				1.0	
Reverse gear	Ratio	4.172				4.096	
	Number of teeth	30/17/37 19/14/17				31/17/37 20/14/17	
Speedometer drive	Ratio	2.5				2.5	
	Number of teeth	10 4				10 4	
Synchromesh ring outer diameter (off-load)	mm (in)	$76.7^{+0.2}_{-0.1}$ ($3.02^{+0.0078}_{-0.0039}$)					
End gap	mm (in)	15.5 + 1 (0.61 + 0.039)					
Molybdenum coating	mm (in)	0.3 ± 0.05 (0.0118 ± 0.0019)					
Max. permissible wear of synchromesh ring	mm (in)					If gap between synchromesh ring and clutch is less than 0.8mm (0.0315 in), replace synchromesh ring. The gap between the new sychromesh ring and the clutch must be 1.0mm (0.0394 in).	

[1]) Previous version with Porsche baulk-ring synchromesh (not on BMW 1502)
[2]) Gearbox for BMW 2002 tii and touring 2002 tii (with Borg Warner baulk-ring synchromesh): standard gearbox 242/4; for BMW 1502; standard gearbox 242/14

Specifications

Gearbox

Model		1502	1602	1802	2002		2002 TI	2002 tii
Width of selector fork guide web 1st-4th gear	mm (in)	$5^{-0.030}_{-0.078}$ ($0.1969^{-0.0012}_{-0.0031}$)						
Reverse	mm (in)	$6^{-0.07}_{-0.145}$ ($0.2362^{-0.0028}_{-0.0057}$)						
Output shaft (A)	mm (in)	138 ± 0.1 (5.433 ± 0.0039)						
Output shaft/drive shaft axial play	mm (in)	0.5 ... 1.0 (0.0197 ... 0.039)						
Output shaft bearing		6306 C 3					6306 C 3 FAG or SKF	
Drive shaft bearing		6206 C 3					either FAG 6206 C 3/ E. TNH. C 3 or SKF 6206 C 3/3 61 781	
Layshaft end float	mm (in)	0 ... 0.1 (0 ... 0.0039)					0.1 ... 0.2 (0.0039 ... 0.0079)	
Layshaft bearing		6304-C3, ball dia. 10 mm (0.39 in)			front: either FAG 6304 C 3/ 700 730 or SKF 6304 C 3/ 361 153 A		rear: roller bearing NJ 304 DIN 5412	
Press fit overlap of gears on layshaft — 3rd gear wheel	mm (in)	0.074 ... 0.106 (0.0029 ... 0.0043)						
Press fit overlap of gears on layshaft — constant value	mm (in)	0.086 ... 0.118 (0.0034 ... 0.0046)						
Press-on force	kp (lb)	approx. 4000 (8820)						
Press-off force	kp (lb)	approx. 10000 (22000)						
Temperature to which gear wheels are heated		120° ... 150°C (248 ... 302°F)						
Oil grade		Branded SAE 80 or SAE 90 gearbox oil or branded HD oil for four-stroke engines according to engine oil specifications; not hypoid oil						
Capacity	litres (US qts/ Imp. pints)	1.0 (1.1/1.8)						
1st oil change at	km (miles)	1000 (600)						
2nd oil change at	km (miles)	30000 (20000)						
Oil change every	km (miles)	30000 (20000)						

Tightening torques in Nm (mkp) (lb.ft)

Gearbox to engine M 8 bolts	25 ... 27 (2.5 ... 2.7) (18.1 ... 19.5)	Housing cover	25 (2.5) (18.1)
M 10 bolts	47 ... 51 (4.7 ... 5.1) (34 ... 37)	Rubber mount/cross member	25 (2.5) (18.1)
Output flange	100[1)] (10.0) (72.3)	Bracket	25 (2.5) (18.1)
Sealing flange	10 (1.0) (7.2)	Oil drain plug	60 (6.0) (43)
Cap bearing on crossmember (rubber bushing) —M8	22 ... 24 (2.2 ... 2.4) (16 ... 17.4)		
M10	43 ... 48 (4.3 ... 4.8) (31 ... 34.7)		
Crossmember at body	22 ... 24 (2.2 ... 2.4) (16 ... 17.4)		
Strut mounting at gearbox	22 ... 24 (2.2 ... 2.4) (16 ... 17.4)		
Mounting on gearbox	20 ... 25 (2.0 ... 2.5) (14.5 ... 18.1)		
Strut at selector arm	22 ... 24 (2.2 ... 2.4) (16 ... 17.4)		

Specifications

Gearbox

Models			1502	1602	1802	2002		2002 TI	2002 tii
Getrag gearbox 235/5			Manual five-speed gearbox with Porsch Baulk-ring synchromesh; 1 reverse speed						
1st gear		Ratio	3.368						
	Number of teeth		30/32 19/15						
2nd gear		Ratio	2.16						
	Number of teeth		30/26 19/19						
3rd gear		Ratio	1.579						
	Number of teeth		30/25 19/25						
4th gear		Ratio	30/22						
	Number of teeth		19/28						
5th gear		Ratio	1.0						
Reverse gear		Ratio	4.0						
	Number of teeth		30/16/38 19/15/16						
Speedometer drive		Ratio	2.5						
	Number of teeth		10 4						
Synchromesh ring extl. dia. off-load	1st gear	mm (in)	82.0 ± 0.15 (3.228 ± 0.0059)						
	2nd/3rd gear	mm (in)	82.4 ± 0.15 (3.244 ± 0.0059)						
	End gap	mm (in)	15.5 ± 0.5 (0.61 ± 0.0197)						
	4th/5th gear	mm (in)	77 ± 0.15 (3.03 ± 0.0059)						
	End gap	mm (in)	15.0 + 1.0 (0.59 + 0.0394)						

Specifications

Gearbox

Model		1502	1602	1802	2002		2002 TI	2002 tii
Molybdemum coating	mm (in)	0.3 ± 0.05 (0.0118 ± 0.00197)						
Width of selector fork guide web, 1st/2nd/3rd and reverse gear	mm (in)	$6^{-0.15}$ ($0.236^{-0.0059}$)						
4th/5th gear	mm (in)	$5^{-0.15}$ ($0.197^{-0.0059}$)						
Output shaft axial play at section X	mm (in)	0 ... 0.09 (0 ... 0.0035)						
Drive shaft bearing	front	NZ306E roller bearing						
	rear	6306 C 3 DIN 625						
Distance cover sealing surface/speedometer drive pinion	mm (in)	22 ± 0.1 (0.866 ± 0.0039)						
Double gear end float	mm (in)	0.1 ... 0.2 (0.0039 ... 0.0078)						
Layshaft end float	mm (in)	0.1 ... 0.2 (0.0039 ... 0.0078)						
Layshaft bearing	front	either FAG 6304 C 3/700 730 or SKF 6304 C 3/361 153 A						
	rear	NJ205E -DIN 5412 roller bearing						
Press fit overlap 5th gear wheel	mm (in)	0.087 ... 0.128 (0.0034 ... 0.00504)						
4th gear wheel	mm (in)	0.084 ... 0.116 (0.0034 ... 0.00456)						
Press-on force	kp (lb)	approx. 4000 (8820)						
Press-off force	kp (lb)	approx. 10000 (22000)						
Temperature to which gear wheels are heated	^{o}C (^{o}F)	120 ... 150 (248 ... 302)						
Oil grade		Branded SAE 80 or SAE 90 gearbox oil or branded HD single or multigrade oil for four-stroke engines as shown in engine oil specifications; not hypoid oil						
Oil capacity litres (US qts/Imp. pints)		1.4 (1.5/2.52)						
1st oil change at	km (miles)	1000 (600)						
2nd oil change at	km (miles)	30000 (20000)						
Oil change every	km (miles)	30000 (20000)						

Specifications

Model	1502	1602	1802	2002		2002 TI	2002 tii

Tightening torques in Nm (mkp) (lb.ft)

Gearbox to engine M8 bolts	25 ... 27 (2.5 ... 2.7) (18.1 ... 19.5)	Crossmember to body	20 ... 23.5 (2.0 ... 2.35) (14.4 ... 17)
M10 bolts	47 ... 51 (4.7 ... 5.1) (34.0 ... 37)	1st gear wheel to layshaft	60 (6.0) (43.4)
Bearing block to gearbox	20 ... 25 (2 ... 2.5) (14.5 ... 18.1)	Housing cover	25 (2.5) (18.1)
Strut to selector arm	22 ... 24 (2.2 ... 2.4) (16 ... 17.4)	Rubber mounting cross member	25 (2.5) (18.1)
Strut to bearing block	22 ... 24 (2.2 ... 2.4) (16 ... 17.4)	Bracket/body	25 (2.5) (18.1)
Cap bearing (rubber bushing) at crossmember M8	22 ... 24 (2.2 ... 2.4) (16 ... 17.4)		
M10	43 ... 48 (4.3 ... 4.8) (31 ... 34.7)		

23 00 005 Subsequent installation of five-speed gearbox

Remove gearbox 23 00 020.

Change over release lever with release collar.

Fill gearbox with oil.

In order to prevent the bracket from knocking against the gearbox tunnel the tunnel should be refinished on the right, looking in direction of travel, in the area (A).

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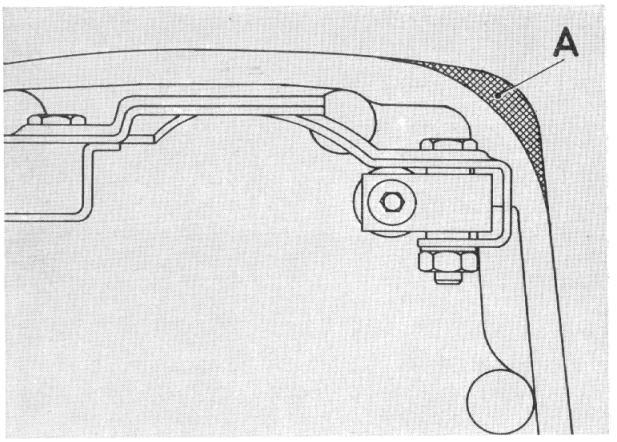

Remove the two existing support blocks (1 and 2).

Fix five-speed gearbox to engine.

Fit rubber mounts and cross member.

Bolt support blocks to cross member temporarily.

Raise five-speed gearbox.

Align support blocks in relation to gearbox tunnel and mark position.

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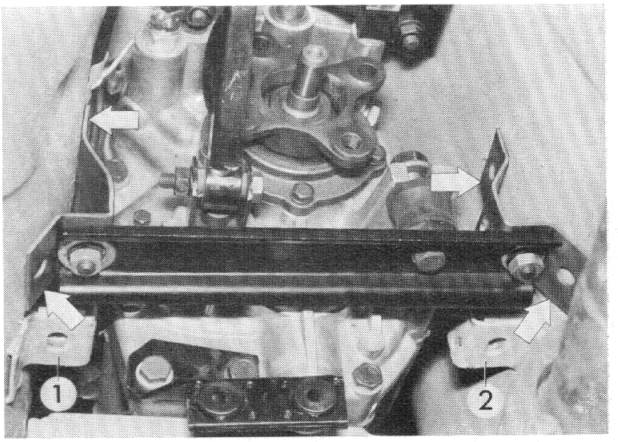

It is essential that the distance B (3.149"/80 mm) be maintained between engine mounting and support blocks.

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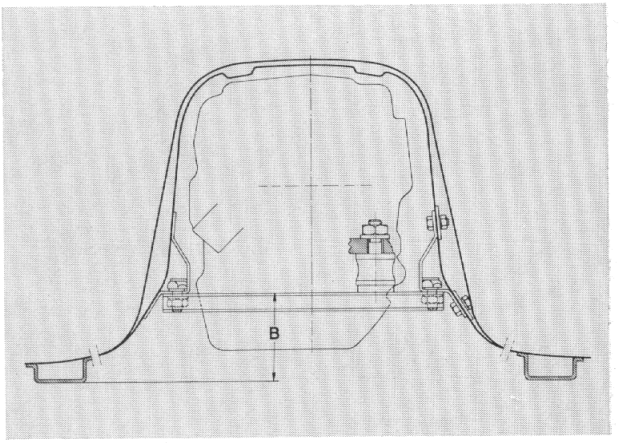

Mark support blocks on gearbox tunnel and drill fixing holes.

Bolt support blocks firmly to gearbox tunnel.

Exchange complete propeller shaft.

Renew speedometer shaft.

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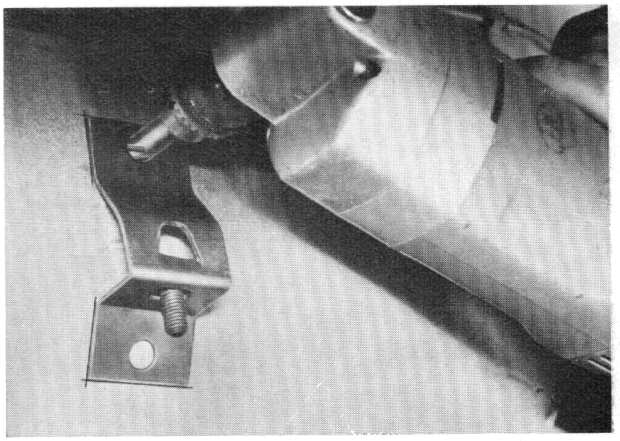
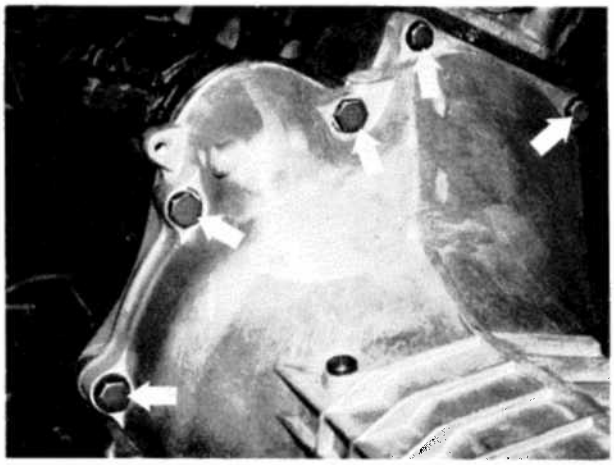


23 00 020 Removing and fitting gearbox



Unscrew all gearbox fixing bolts which are accessible from above.

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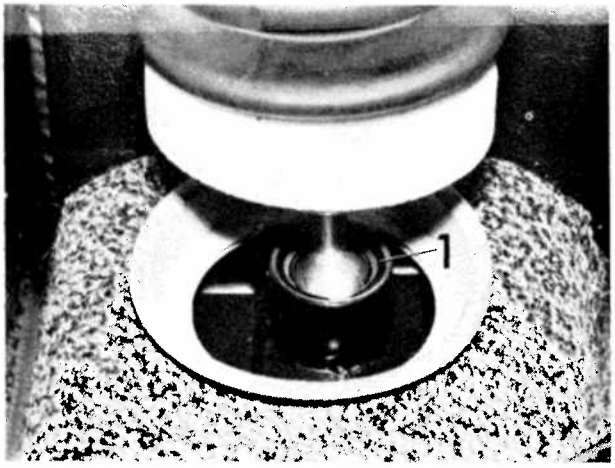

Push up gaiter and foam rubber ring.

Lift out circlip (1).

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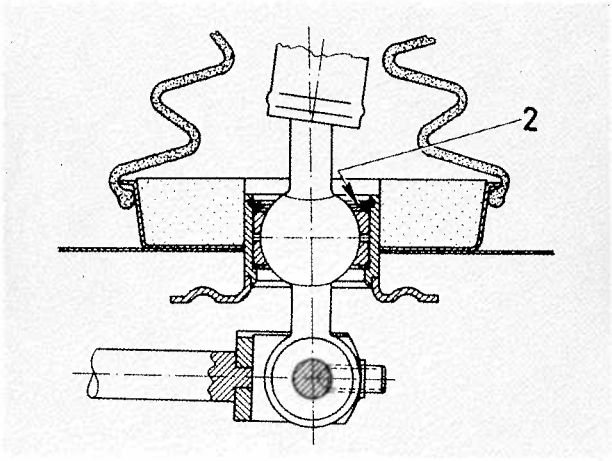

Fitting instruction: Insert ball cups with Longterm 2.

Refit gear lever with shims (2) to obtain tight fit.

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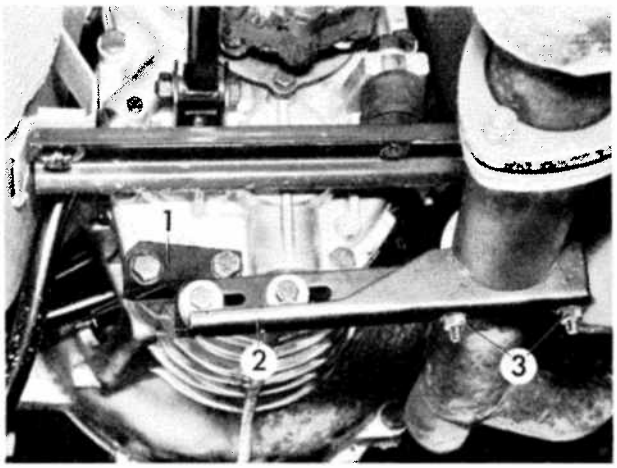

Remove exhaust bracket.

Fitting instruction: Secure exhaust pipe on exhaust manifold.

Slacken retaining plate (1).

Push bracket (2) tension-free against the exhaust pipe.

Secure retaining plate (1) on gearbox and bracket.

Then tighten clamp (3).

If any other fitting sequence is used severe booming noises can result.

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Remove exhaust pipe (3) from exhaust manifold.

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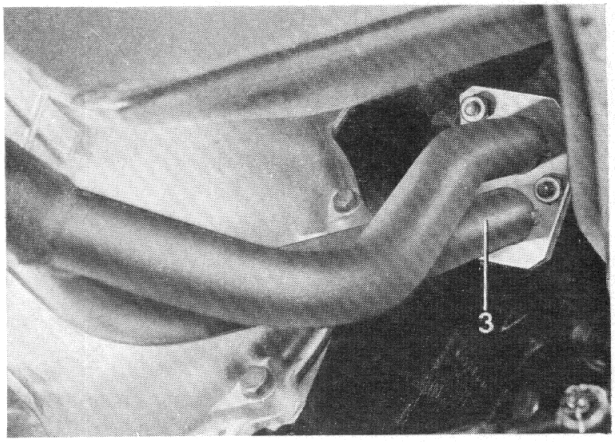

Remove propeller shaft from gearbox. The 'Guibo' coupling or flexible disc remains on the propeller shaft.

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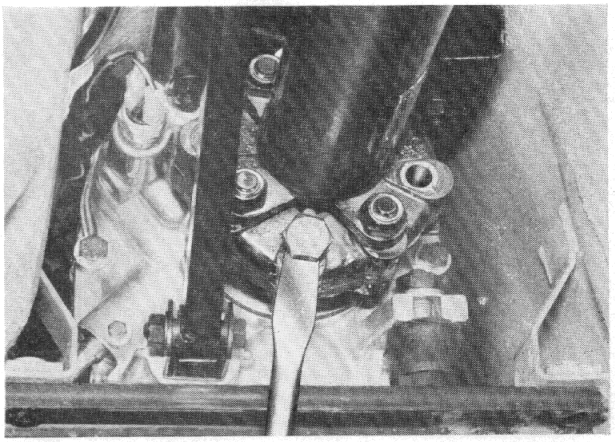

Fitting instruction: Do not damage screw thread.
Push 'Guibo' coupling upwards as necessary.
Only use lock nuts once.

Warning: To prevent stress in the 'Guibo' coupling, tighten the nuts, never the bolts.

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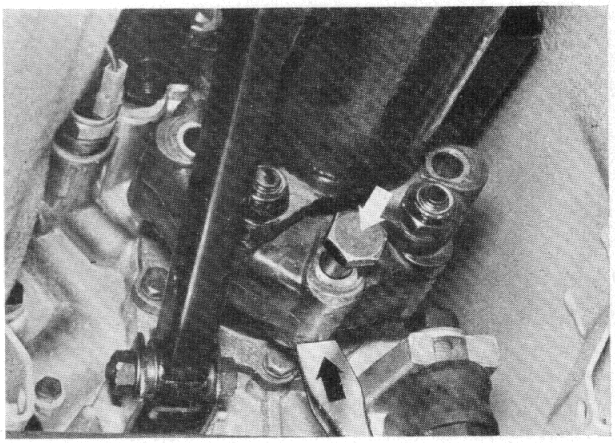

Remove centre bearing block.
Fold the propeller shaft downwards and pull away from centering pin.

Fitting instruction: Preload the centre bearing by 0.08 in (2 mm) (A) in direction of travel.

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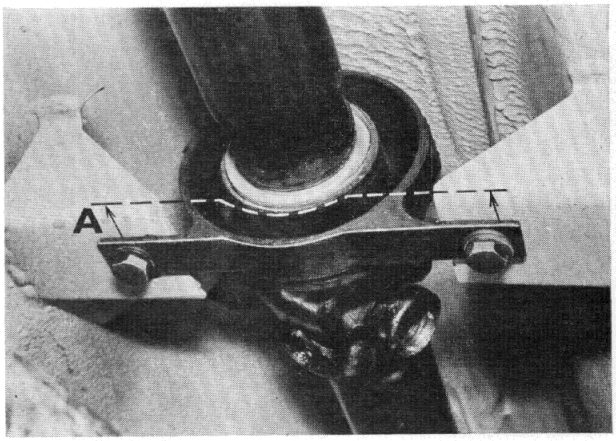

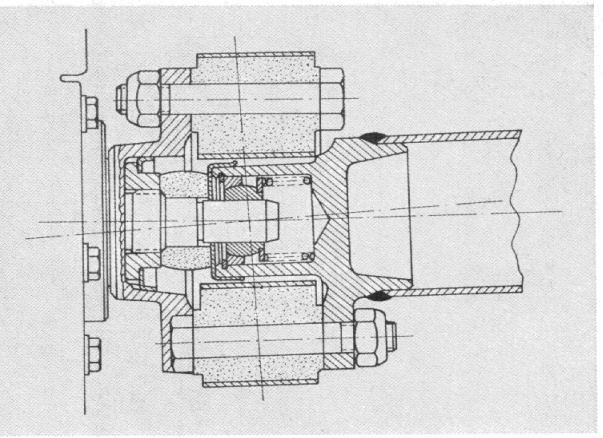

Fitting instruction: Do not damage the screw cap. Check free movement of centering bearing and pack with Long-term 2 if necessary.

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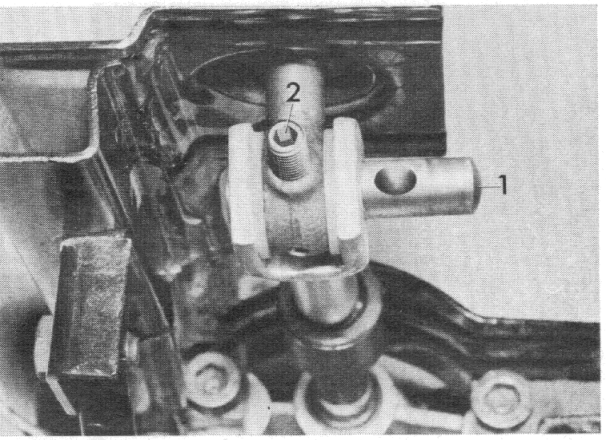

Older version:
Unscrew bolt (2) and remove bearing pin (1).
Push gear lever upwards.

Fitting instruction: Secure bearing pin (1) in the centering bore with the bolt (2).

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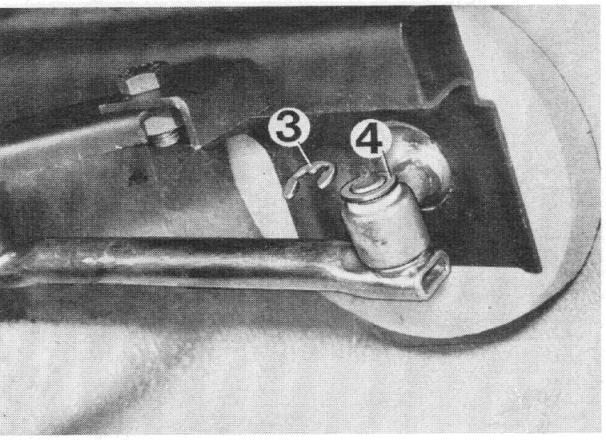

New version:
Remove circlip (3) and take off washer (4).
Pull out selector rod.

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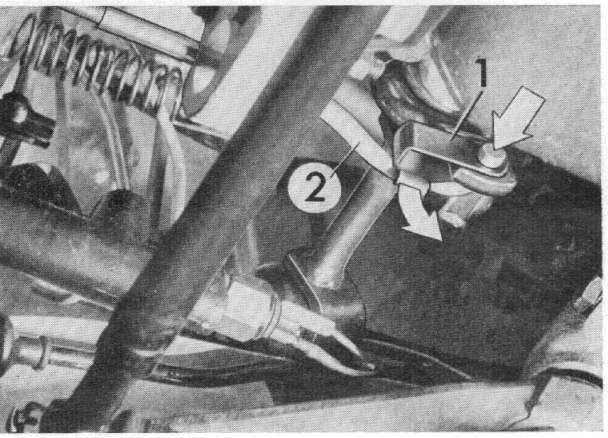

Mechanical clutch operation
Disconnect spring. Press keeper (1) down.
Remove thrust rod (2) forwards.

When installing: Adjust clutch operating clearance – 21 00 004.

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Hydraulic clutch operation:
Disconnect spring (1), remove circlip (2) and pull slave cylinder out forwards.

When installing: Adjust clutch operating clearance – 21 00 004.

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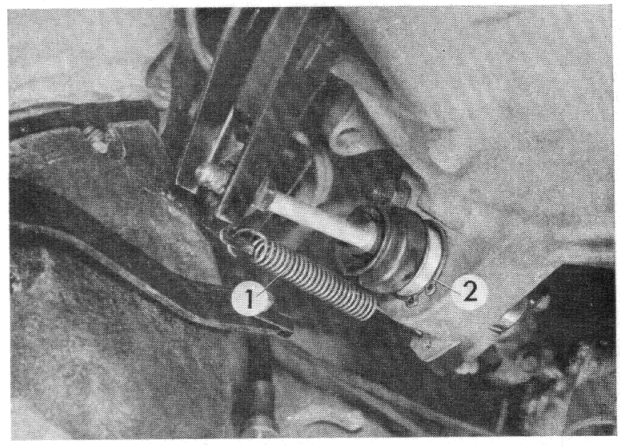

On version with automatic wear compensation, extract snap ring (1), push back sleeve (2), remove circlip (3) and pull out the slave cylinder.

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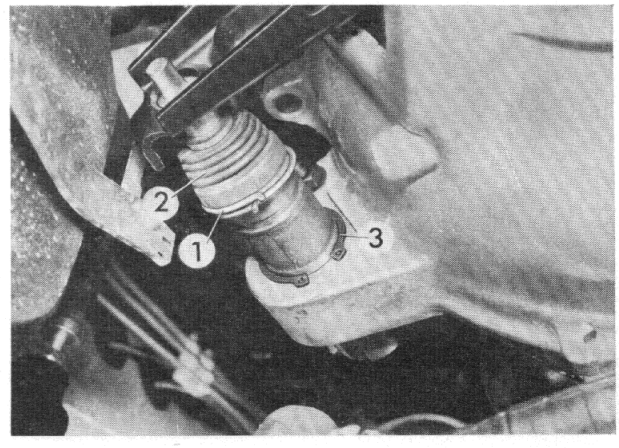

Fitting instruction: Note fitted position of torsional retainer.

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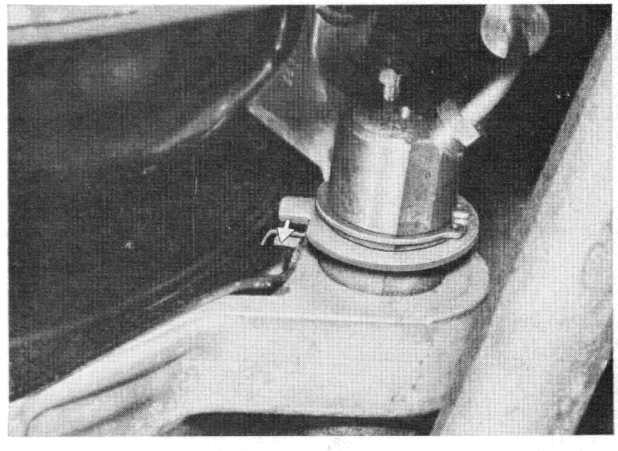

If a support bracket is installed, loosen the bracket and detach the cover plate.
Support engine with suitable block between sump and front axle sub-frame.

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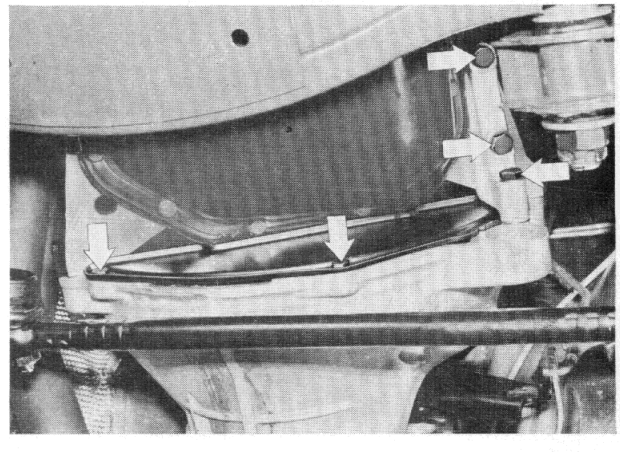

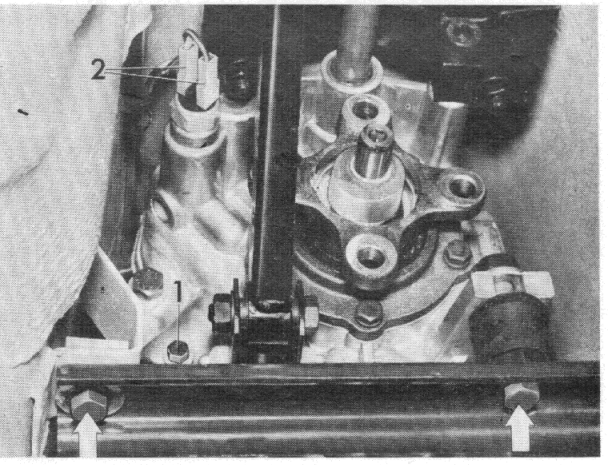

Slacken bolt (1) and pull out speedometer shaft.
Pull off cables (2) for reversing light switch.
Slacken crossmember.
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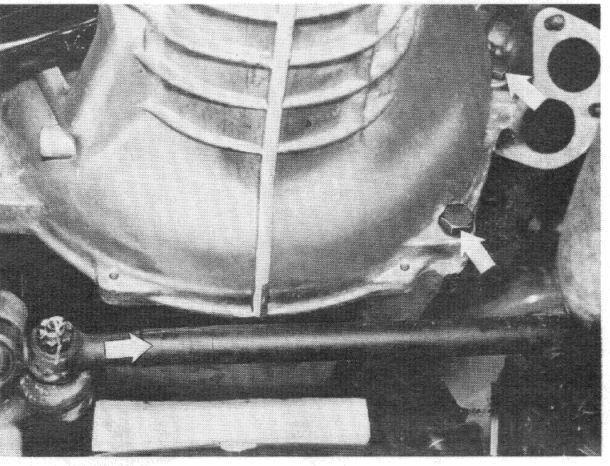

Turn steering to full right-hand lock and unscrew the remaining gearbox attachment bolts.
Pull gearbox out to the rear.
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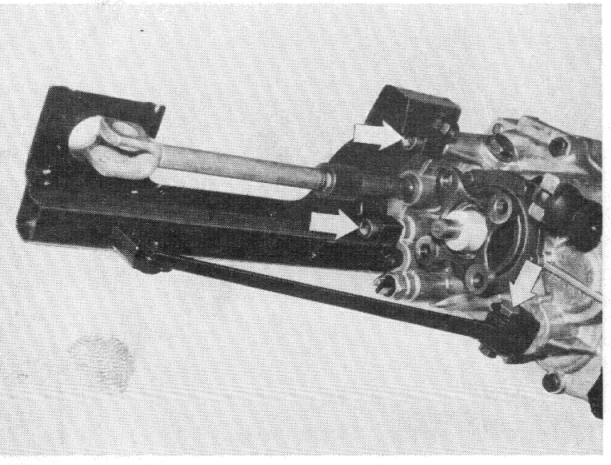
23 00 552 Stripping and assembling gearbox
A) Four-speed gearbox 232



Remove bracket and stay.
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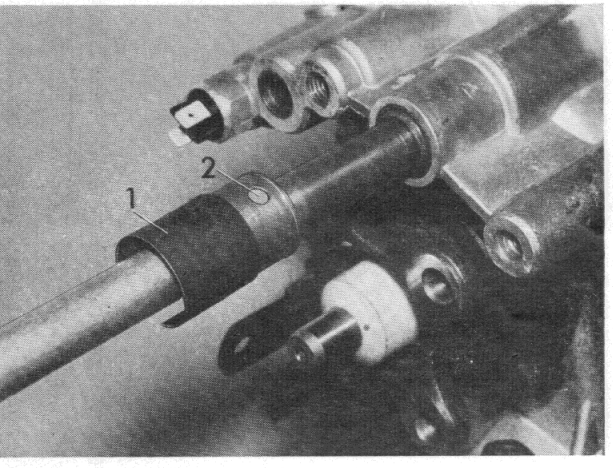

Push back spring sleeve (1) and drive out cylindrical pin (2).
Pull off selector shaft and joint.
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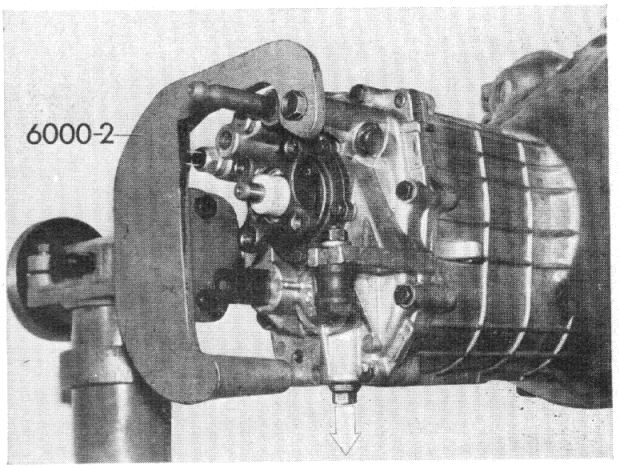
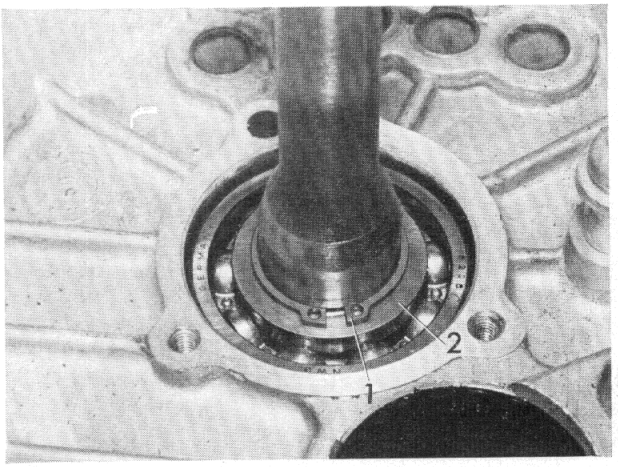
Remove bracket for exhaust support.
Secure gearbox on 6000-2 mounting plate.
Drain the oil.

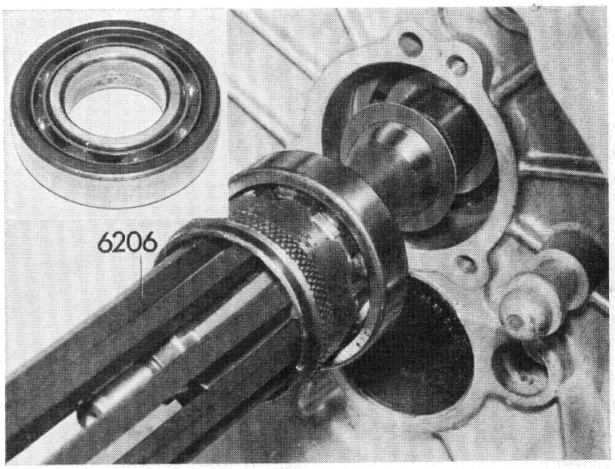


Remove guide sleeve 23 11 590.
Lift out circlip (1).
Remove shims (2).



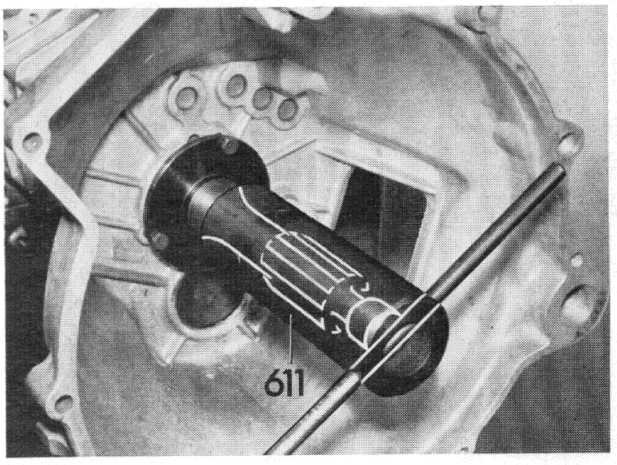
Pull out ball bearing with Rillex 6206.

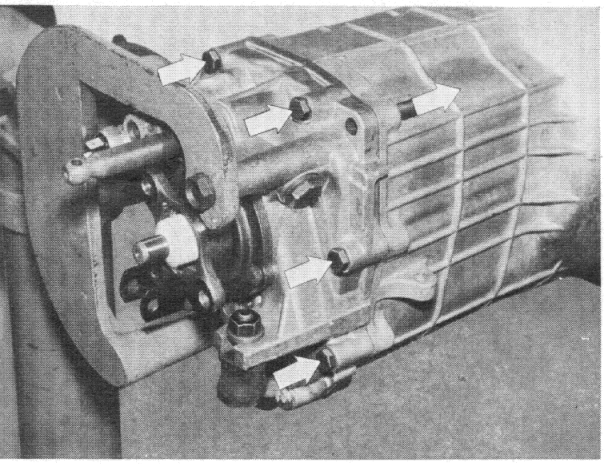
Warning: Shims
If a ball bearing with plastic cage is installed in such a way as to prevent use of the Rillex 6206 puller, the gearbox cover must be loosened and the gearbox housing forced off with special tool 611 (Fig. 4).



Make up a brass or steel pressure pad 28 mm (1.1 in) in diameter and 25 mm (1 in) long.
Place the pad on the input shaft.
Attach the 611 press-on tool to the gearbox housing.
Do not use the two pressure pins on the tool.
Force off the gearbox housing.

Warning: There are shims on the input shaft and layshaft.





Unscrew fixing bolts on gearbox housing cover. Drive cylindrical pins out of gearbox housing.
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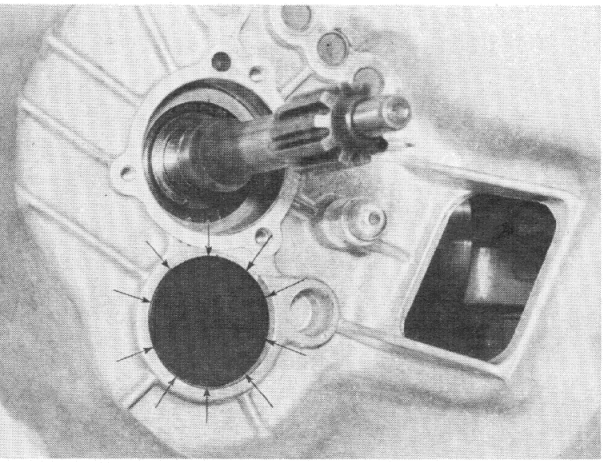

Heat gearbox housing around sealing cover so that the ball bearing on the layshaft slides out easily.
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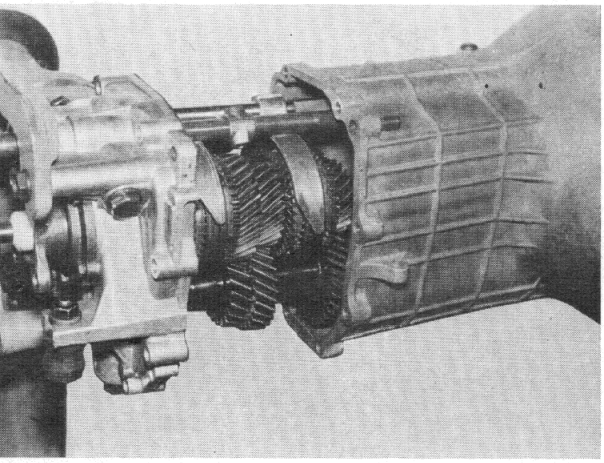
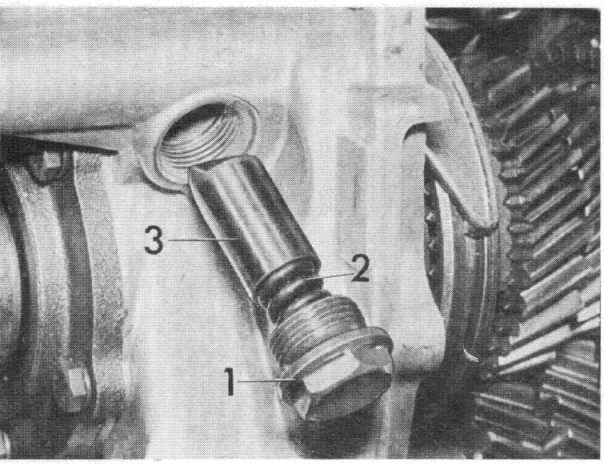


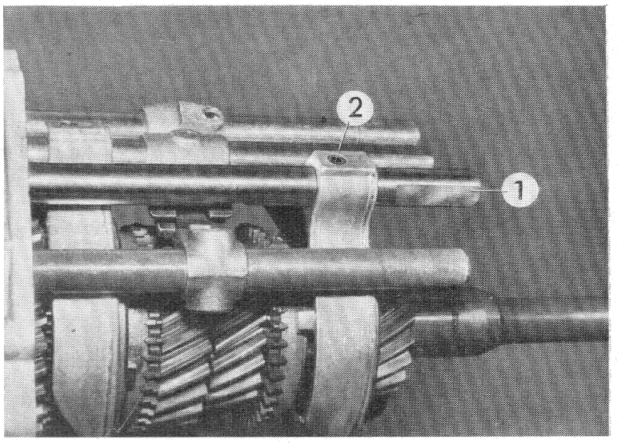
Pull off gearbox housing.

When installing: Use a new gasket.
■

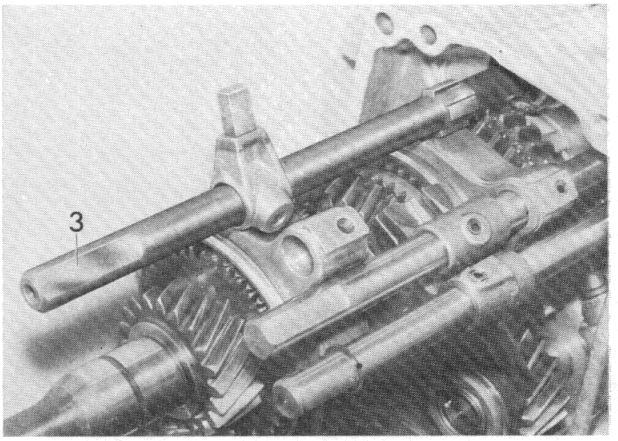


Remove screw plug (1).
Take out spring (2) and locking pin (3).
■

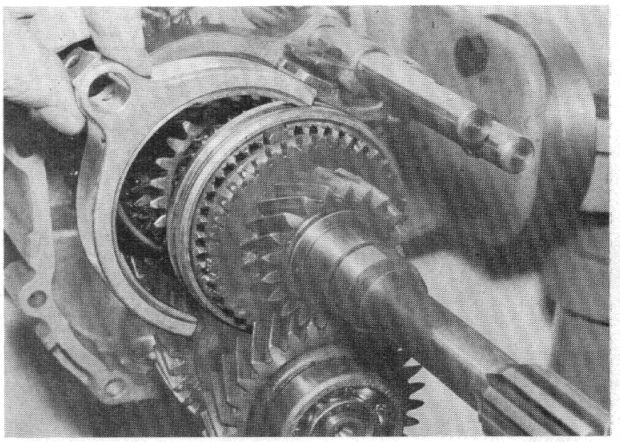
Set selector rod (1) to 4th gear position.
Turn guide sleeve until the locating pin (2) can be driven out properly.
Pull out selector rod (1) forwards.
Note: Loose ball bearings.



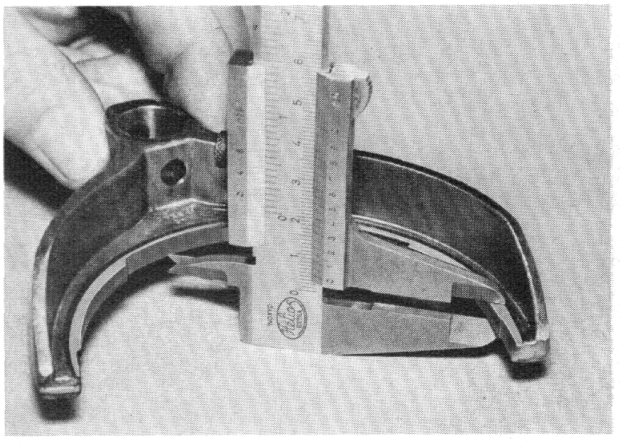
Withdraw selector shaft (3) forwards;
for this purpose swing selector bar upwards.



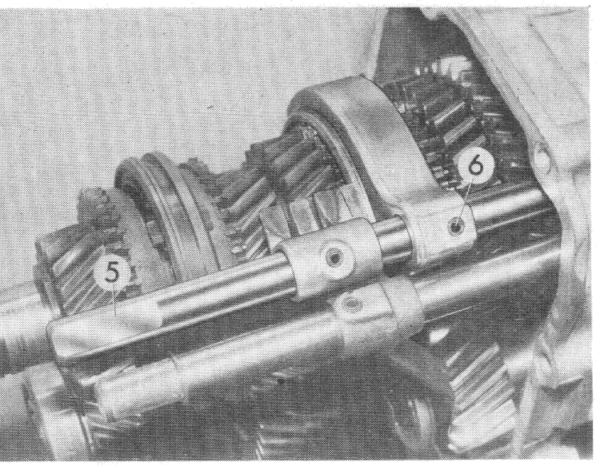
Set selector sleeve to neutral position.
Remove selector fork.



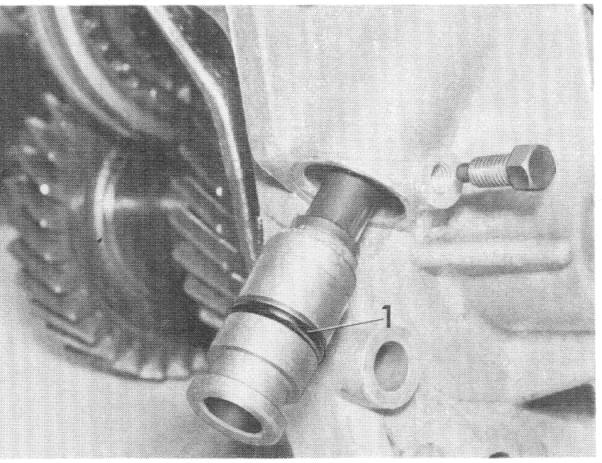
Check selector fork for wear[1]), replace if necessary.



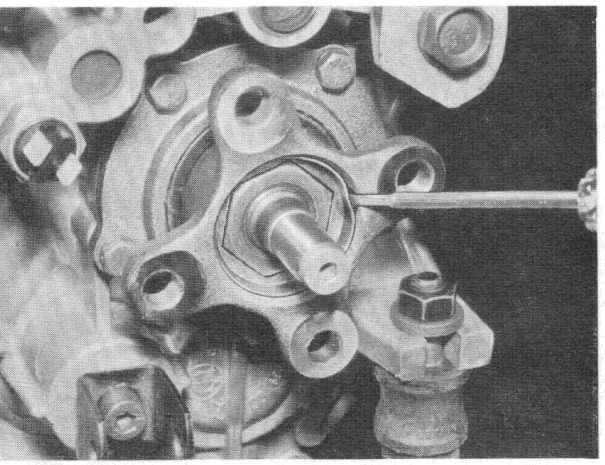
[1]) See Technical data.



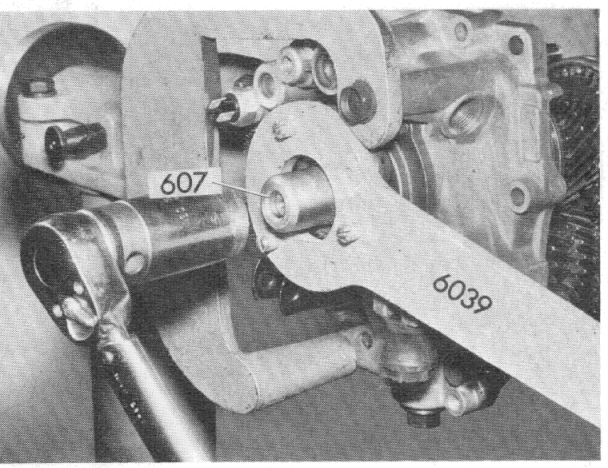
Push selector rod (5) into 2nd gear position.
Turn guide sleeve until the locating pin (6) can be driven out properly.
Pull out selector rod forwards.



Remove selector fork.
Push 2nd gear wheel into neutral position.
Check selector fork for wear[1]).
Remove plug-in bush and speedometer pinion.
Fitting instruction: Check 'O' ring[1]) and renew if necessary.
Renew complete plug-in bush in the case of a defective sealing ring.



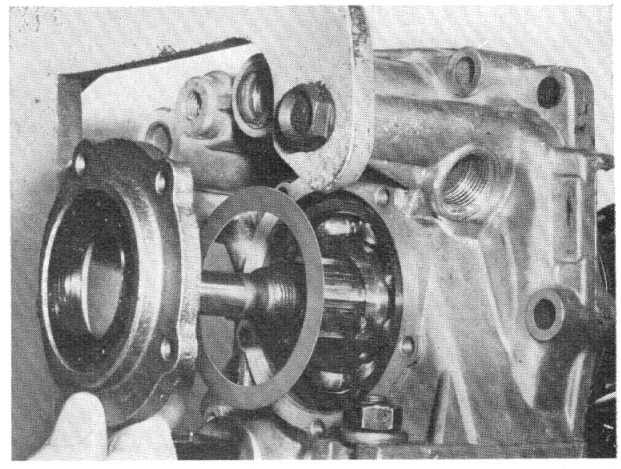
Pull off bumper.
Lift out locking plate.
Fitting instruction: Prize locking plate into groove.



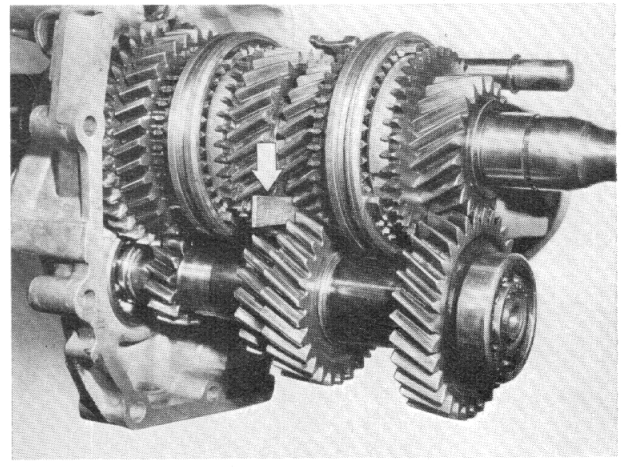
Push guide sleeve 607 onto centering pin.
Hold flange with 6039, unscrew flange nut and pull off flange.

[1]) See Technical data.

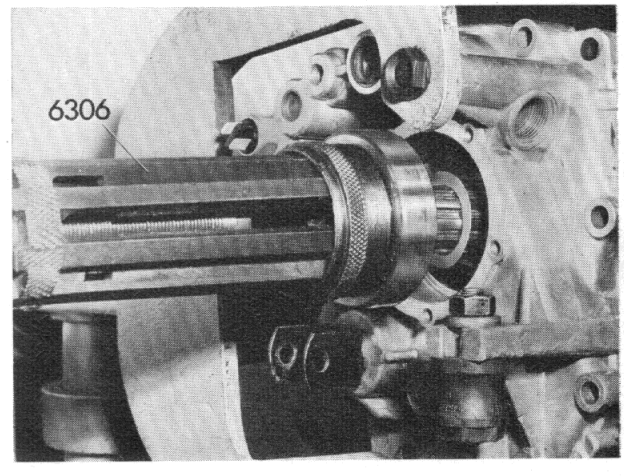
Remove support ring.
Warning: Shims.



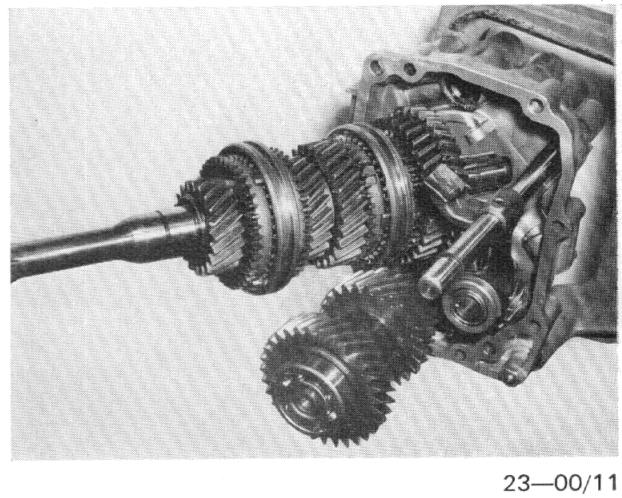
In order to prevent the synchromesh unit of the 3rd gear wheel from being pushed off when the grooved bearing on the output shaft is removed, a 2 mm (0.079 in.) metal strip must be placed between the 2nd and 3rd gearwheels.

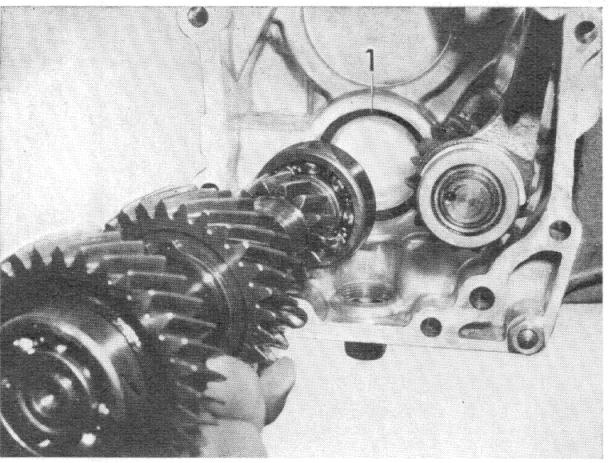


Extract grooved ball bearing from output shaft with Rillex 6306 and pull out of gearbox housing cover.
Warning: Shim must not be lost.



Swing drive and output shafts out to the right.

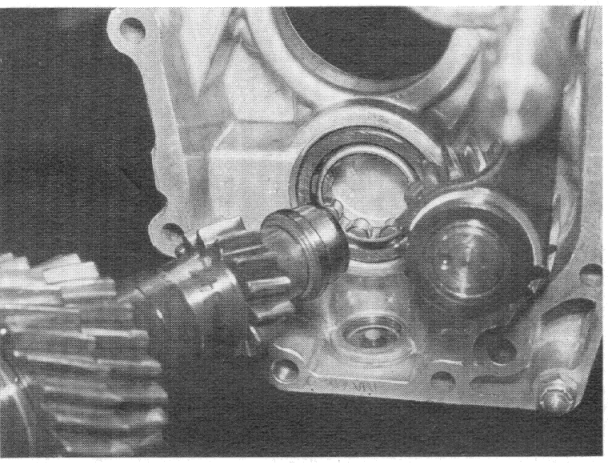




Drive layshaft out forwards with plastic hammer.

Warning: Shims (1).

■

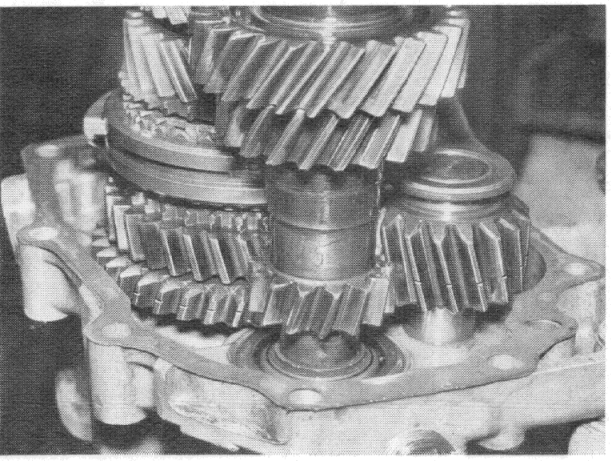


Version with roller bearing:

When repairing, replace the ball bearing by roller bearing NJ 304 DIN 5412 C 3.

Warning: The larger diameter roller cage faces the housing cover.

■

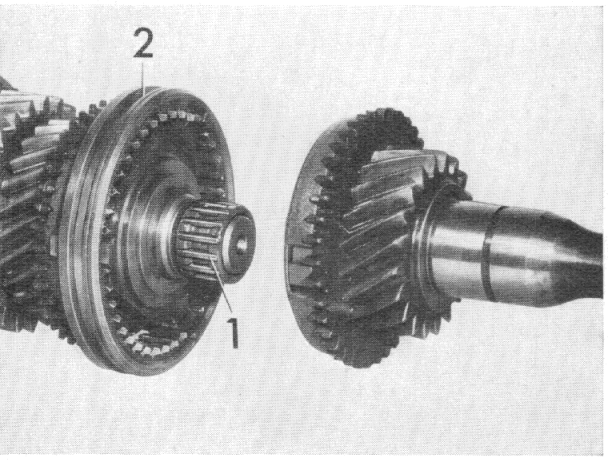


Pull the shift rod with lever and the reverse gear pinion out of the gearbox cover. Note that balls may escape.

Warning: When the Borg-Warner synchromesh was introduced, the meshing angle of the reverse pinion and its associated gearwheels was changed from 20° to 15°.

15° mesh angle pinions and gearwheels are identified by a groove round the outer face.

■

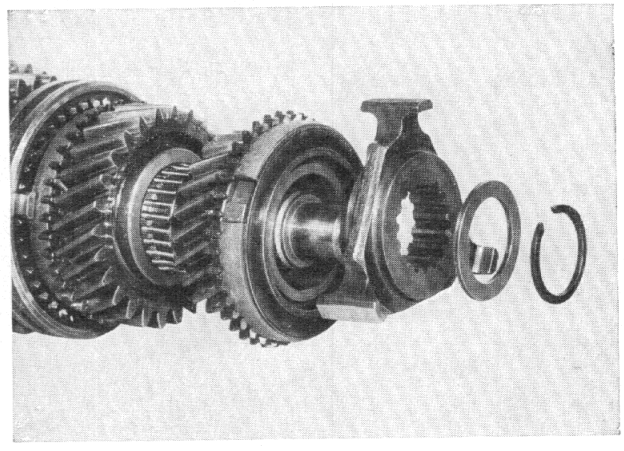


Pull the input shaft with needle roller cage (1) and selector fleeve (2) away from the output shaft.

■

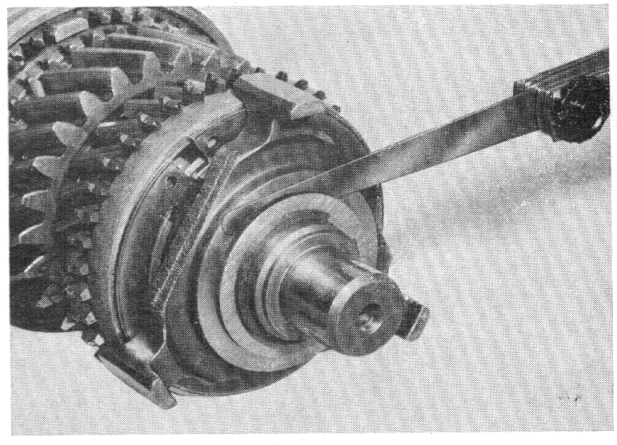
Lift out circlip.
Remove thrust washer, shim, sliding sleeve and 3rd gearwheel with needle cage.

■



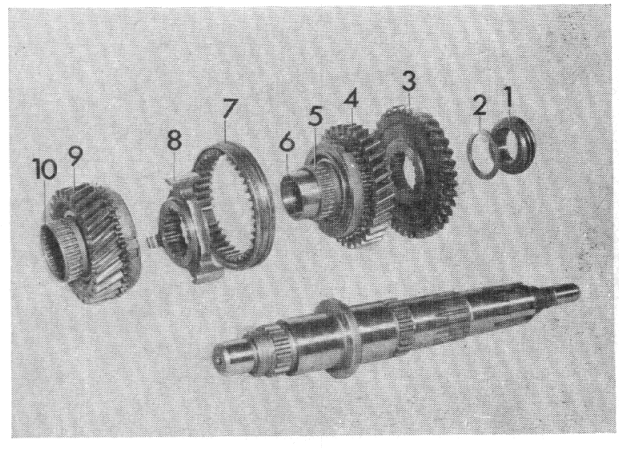
Fitting instruction: Place 3rd gear pinion, guide sleeve and thrust washer on to the output shaft.
Allow the circlip to spring into position.
Determine the gap between the thrust washer and the guide sleeve with a feeler gauge, and shim to zero play.

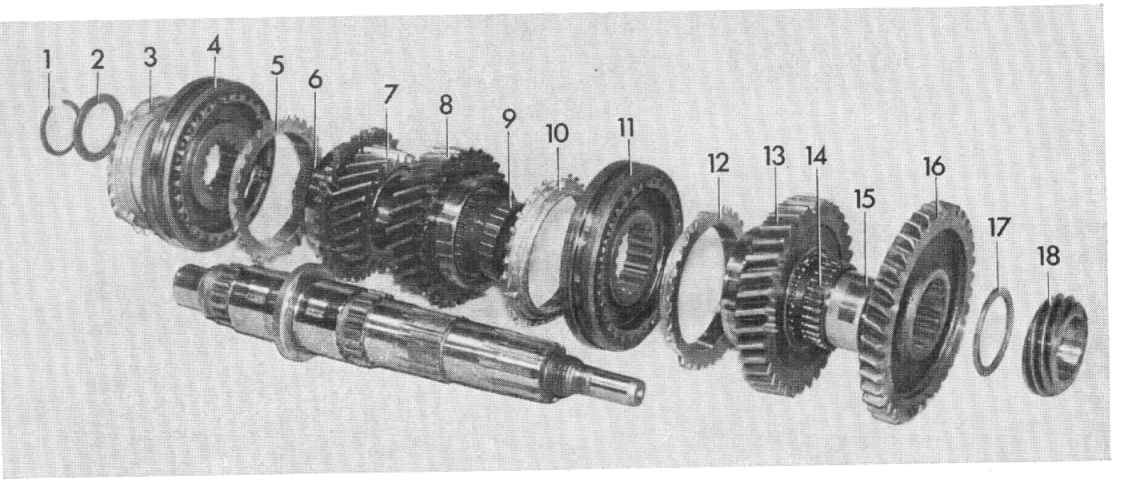
■

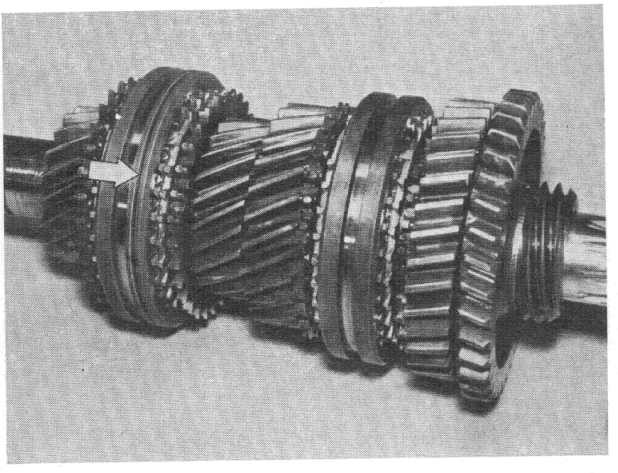


Press out the output shaft.
Installed positions (Porsche synchromesh):
Speedometer pinion (1), thrust washer (2), reverse gear pinion (3), 1st gear pinion (4), needle cage (5), distance bushing (6), selector sleeve (7), guide sleeve (8), 2nd gear pinion (9) and needle cage (10).
Fitting instructions: The ground side of the reverse gear pinion (3) must face the 1st gear pinion.

■

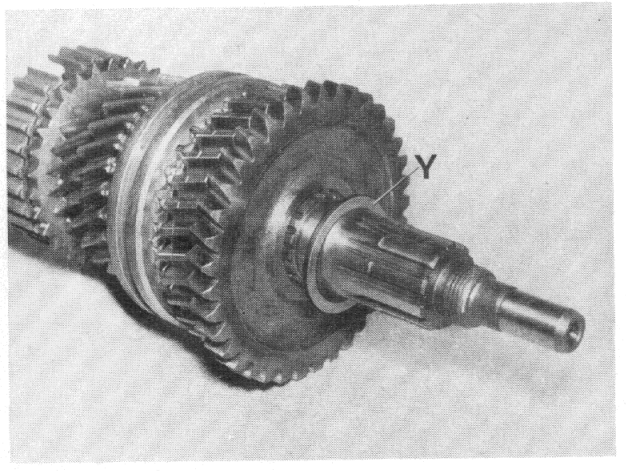






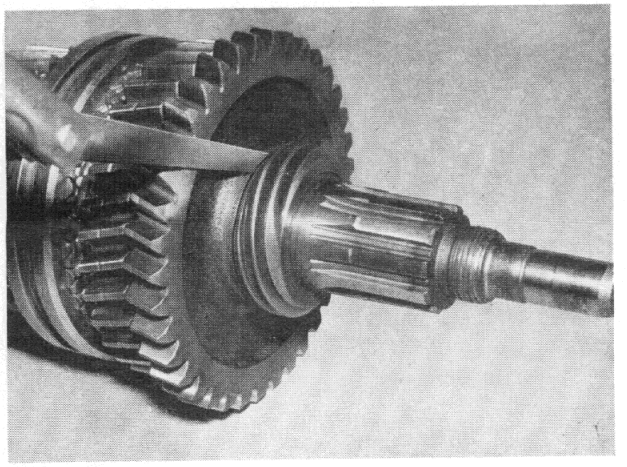
Installed positions (Borg-Warner synchromesh):
Circlip (1), thrust washer (2), synchromesh ring (3), synchromesh housing with sliding sleeve (4), synchromesh ring (5), needle roller cage (6), 3rd gear pinion (7), 2nd gear pinion (8), needle roller cage (9), synchromesh ring (10), synchromesh housing with sliding sleeve (11), synchromesh ring (12), 1st gear pinion (13), needle roller cage (14), reverse gear pinion (16), washer (17), speedometer drive worm (18).

Warning: Mark corresponding synchromesh rings and gear pinions.
■



When installing: Install the 3rd/4th gear sliding sleeve with the groove in the sleeve facing the 3rd gear pinion.
■

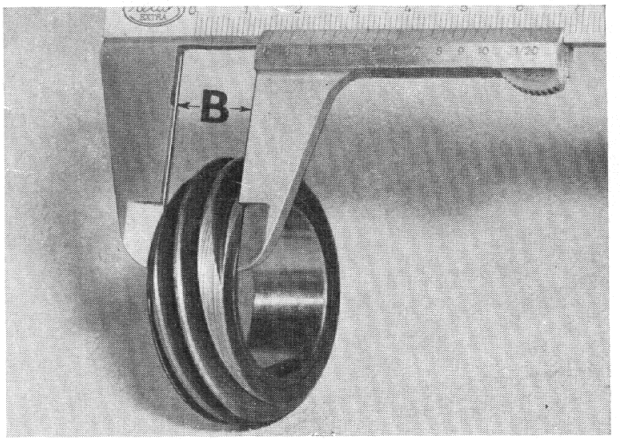
Assemble and check dimensions of output shaft.
Note: Use shim Y to adjust endplay to 0 . . . 0.09 mm (0.0035 in).
■



Insert shim Y in front of reverse gear pinion.
Press speedometer worm wheel up to shoulder on output shaft.
Determine endplay.
■

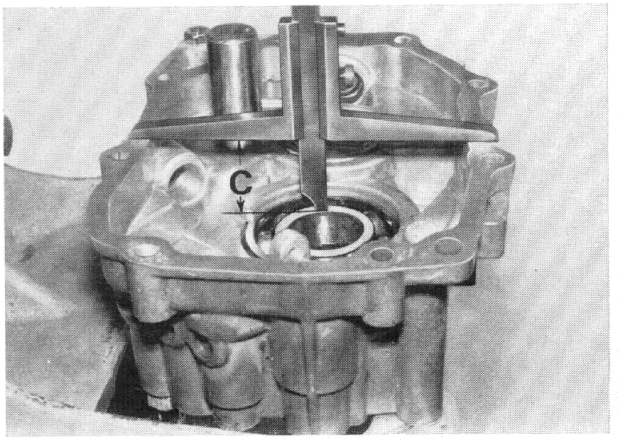
Measure thickness of speedometer drive wheel (B).
Press speedometer drive wheel on to the output drive shaft.

■



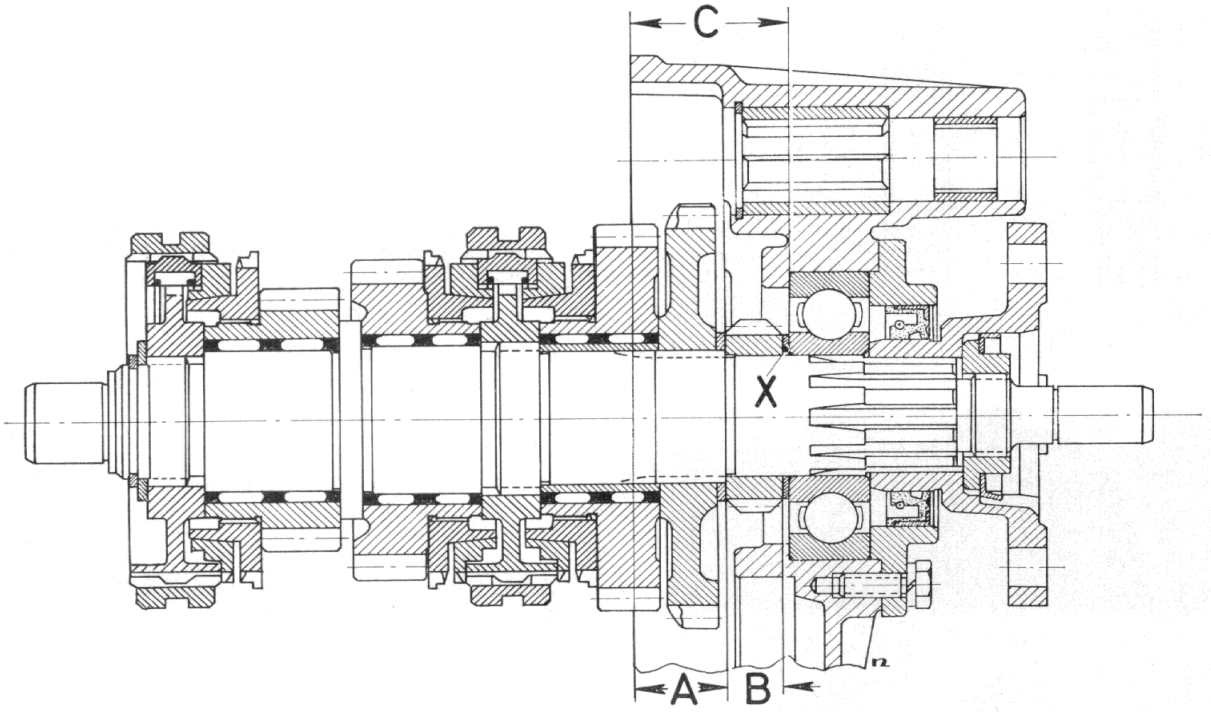
Press ball bearing into the gearbox cover until it is a tight fit.
Measure distance (C), without gasket.

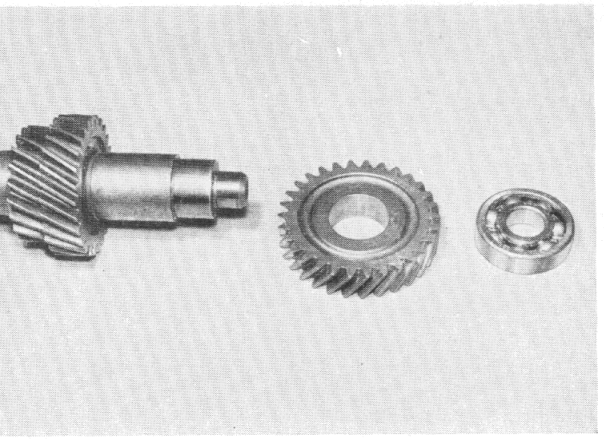
■



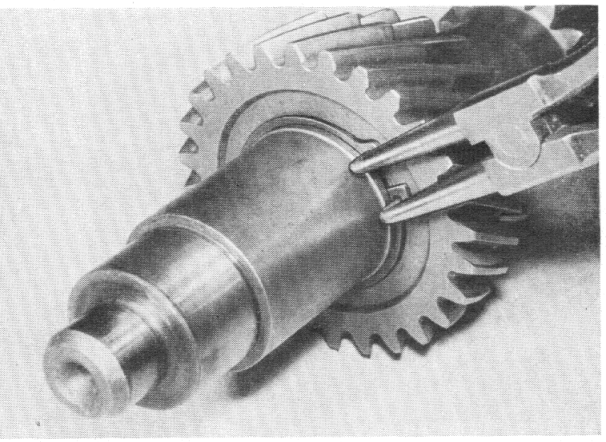
Determine thickness of shim X.

Example:		
	A desired thickness	22.0 mm (0.8661 in)
	B	14.8 mm (0.5827 in)
		36.8 mm (1.4488 in)
	C	37.0 mm (1.4567 in)
	X	0.2 mm (0.0079 in)

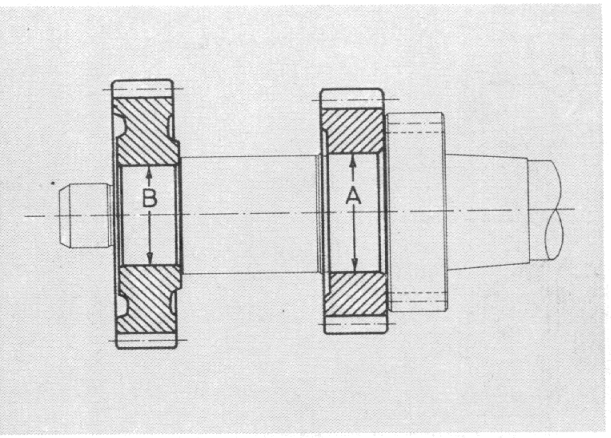




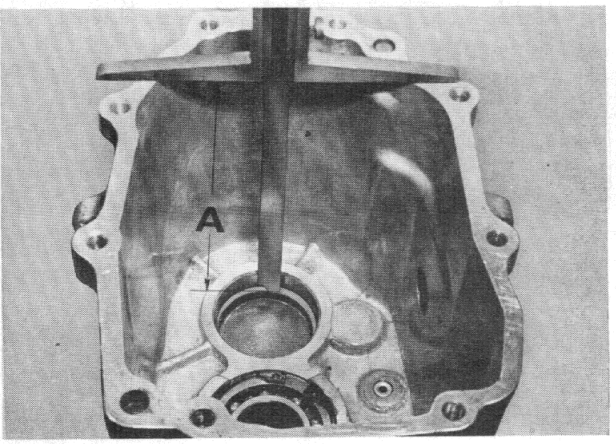
Before continuing with assembly, check layshaft, install and fit.
Note that gears must always be replaced in pairs.
Pull off ball bearing.
Force off fourth gear (cold).
■



Remove circlip.
Force off third gear (cold).
If there are any score marks on the surface, polish with fine cloth.
■



Important: Before pressing on gears, check press-fit overlap while cold (approx. 20° C/68° F).
Third gear A = 0.084 ... 0.116 mm (0.00331 ... 0.00457 in)
Fourth gear B = 0.087 ... 0.129 mm (0.00343 ... 0.00509 in)
Oil the layshaft slightly.
Heat gears to 120 ... 150° C (248 ... 284°F).
Pressure required for forcing gears into position: approx. 4000 kg (8800 lb).
■

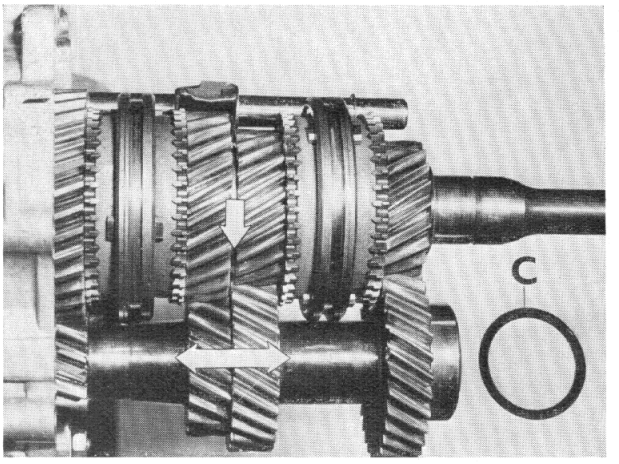


Measure gap A from housing sealing surface to circlip.
■

Check tooth engagement.

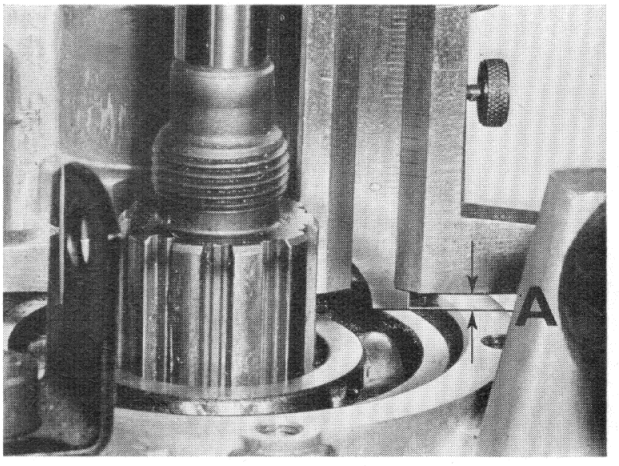
Tooth engagement can be altered with the shims C in front of the grooved bearings of the layshaft.

■



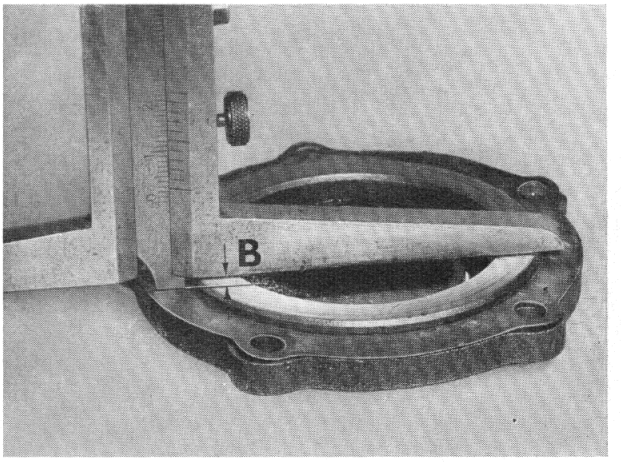
Check distance A from housing cover to grooved ball bearing.

■



Measure flange height B of sealing cover with seal in position.

■



Note: There should be no play between grooved bearing outer race and sealing cover.

Any play should be reduced to zero with shims (1).

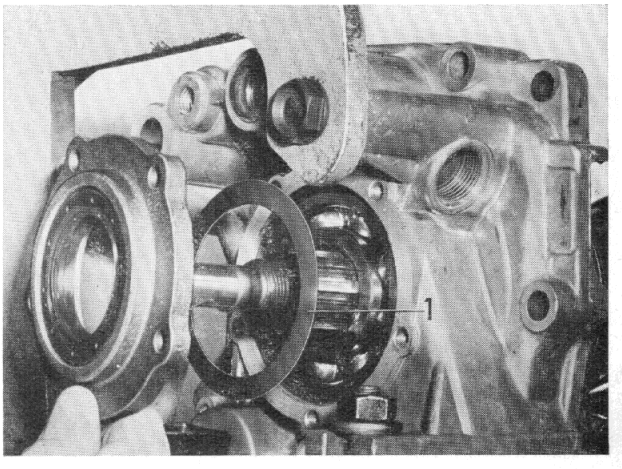
Example:

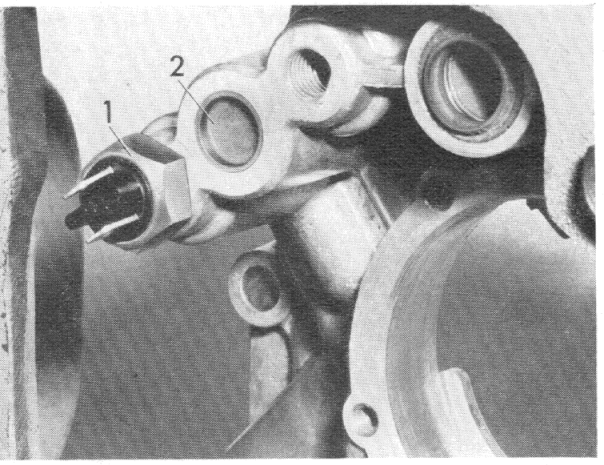
A	= 3.0 mm (0.118 in.)
-B	= 2.8 mm (0.110 in.)
	0.2 mm (0.008 in.) shim thickness.

Secure sealing cover.

Secure and lock output flange.

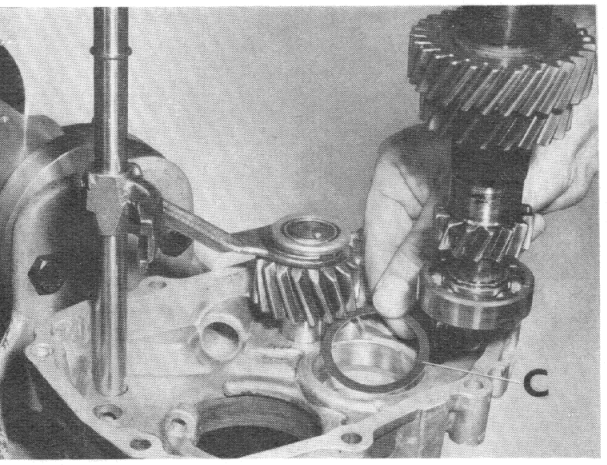
■





Remove reversing light switch (1) and sealing cap (2). The arrestor balls should be pushed down with a screwdriver through the exposed bores.

■

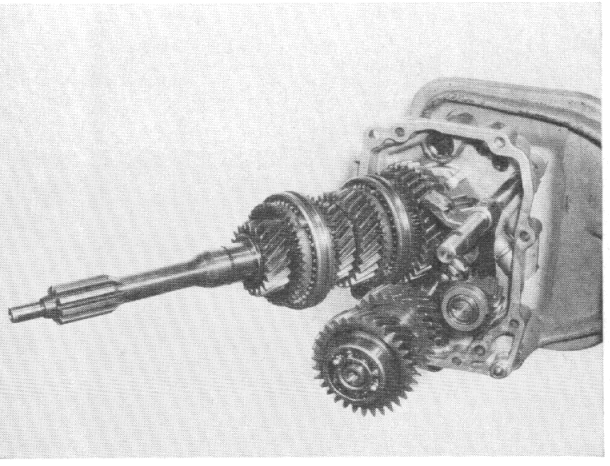


Insert arrestor ball, press downwards and push reverse gear selector rod with reverse idler pinion into housing cover until 1st arrestor locates.

Place the previously determined shim C in housing cover.

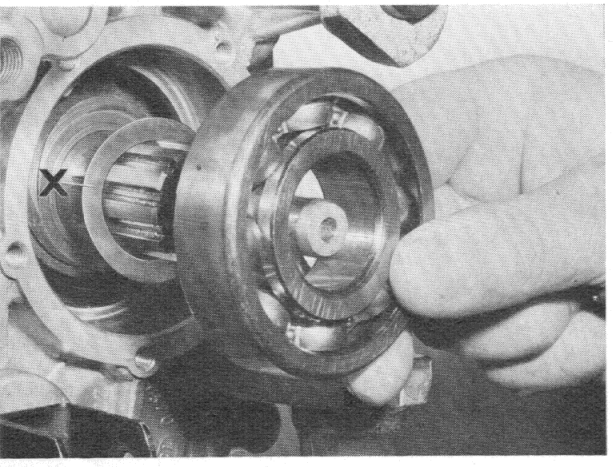
Press in layshaft.

■



Push drive and output shafts into housing cover.

■



Place the previously determined shim X in front of the speedometer pinion.

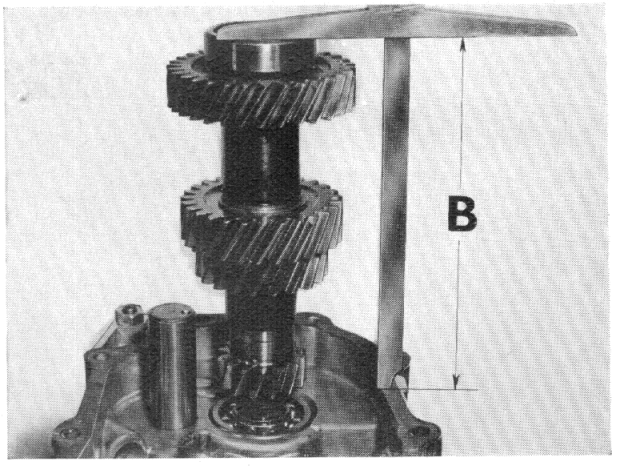
Drive grooved bearing into housing cover.

■

Fit layshaft into gearbox housing cover.

Measure B - height of layshaft with sealing ring in position.

Remove layshaft.



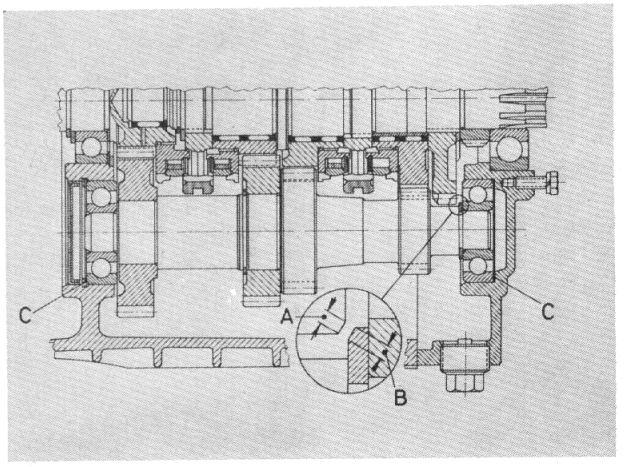
Determine thickness of shim C.

Example: A = 165.3 mm (6.508 in.)
B = 165.0 mm (6.496 in.)
C = 0.3 mm (0.012 in.)

Tooth engagement can be altered with the shim C.

In the case of gearbox noises check the reverse gear pinion toothing at the output end and support disc on the layshaft for signs of abrasion, if necessary grind down both parts in the areas A and B.

A 1.4 ± 0.3 mm (0.055 ± 0.012"),
B 1.3 ± 0.3 mm (0.051 ± 0.012").

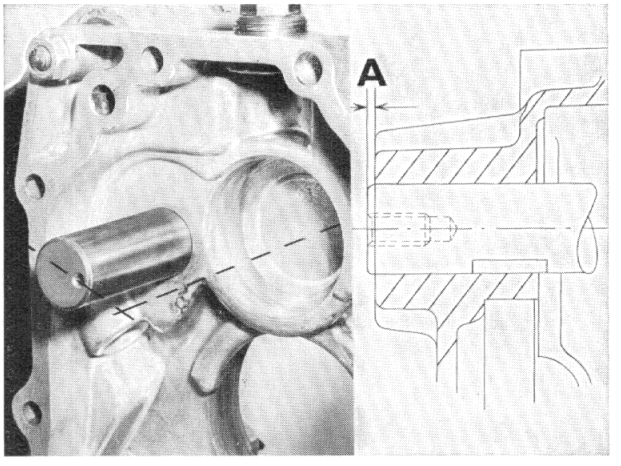


Renew badly worn pin for reverse idler gear.

Fitting instruction: Heat gearbox cover to approx. 120° C (248° F)

Note: Pin is oval. Hole in pin must face layshaft.

Note fitted length of pin (A 2 mm / 0.079").

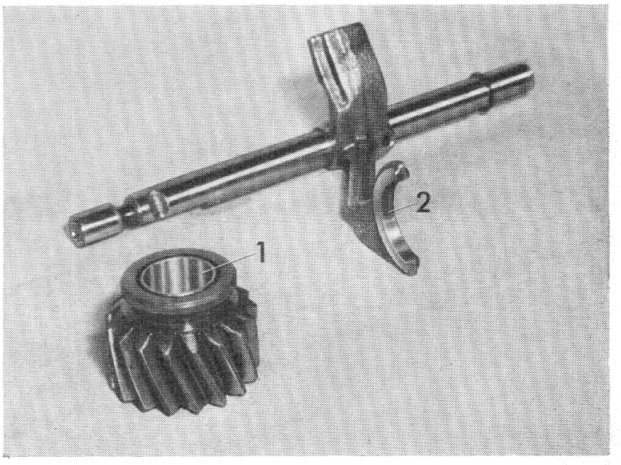


Renew bush for reverse idler pinion.

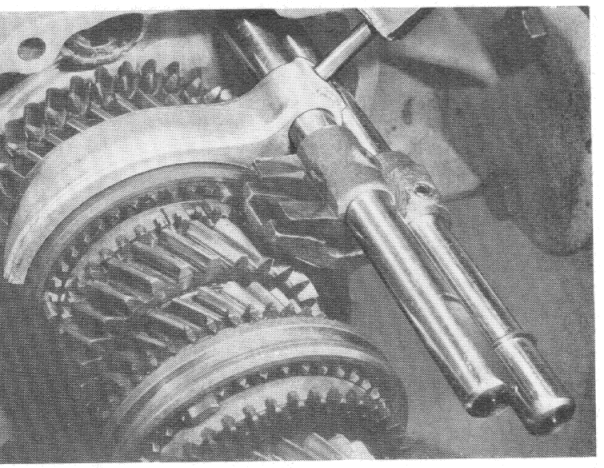
Ream out new bush (1) to

$$21.3\ ^{+0.073}_{+0.040}\ \text{mm dia. (0.838}\ ^{+0.0028}_{+0.0016}\ \text{in. dia.).}$$

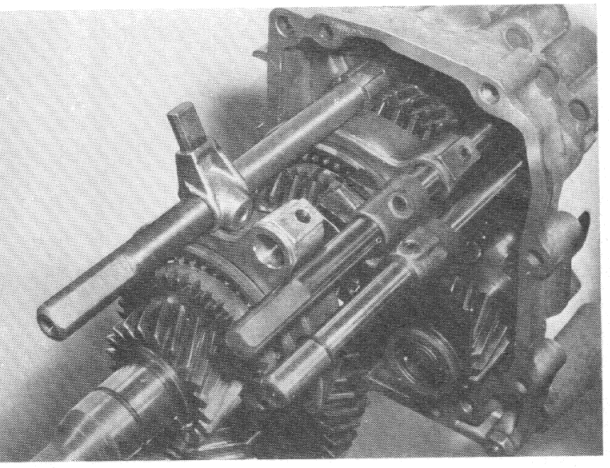
Check wear[1]) on the selector fork (2), renew selector fork if necessary.



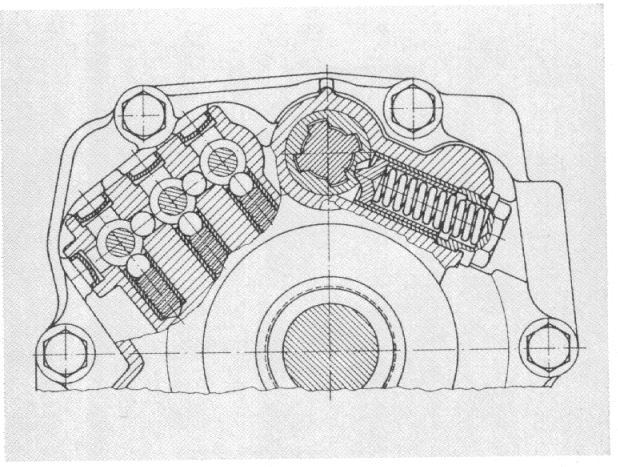
[1]) See Technical data.



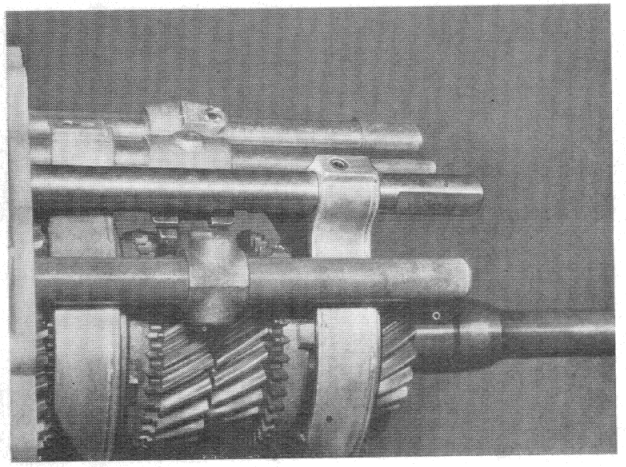
Push selector fork of 1st/2nd gear into selector sleeve.
Insert locking and arrestor ball.
Fit selector rod.
Secure selector fork with locating pin.
■



Push selector fork of 3rd/4th gear into selector sleeve.
Fit selector shaft.
Care: Note position of taper bush.
■

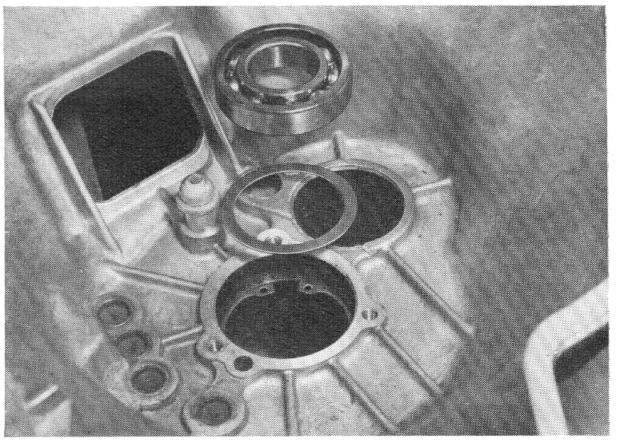


Fit locking pin.
Fitted position of locking pin in taper bush.
Insert locking and arrestor balls.
Arrangement of arrestor and locking balls.
■

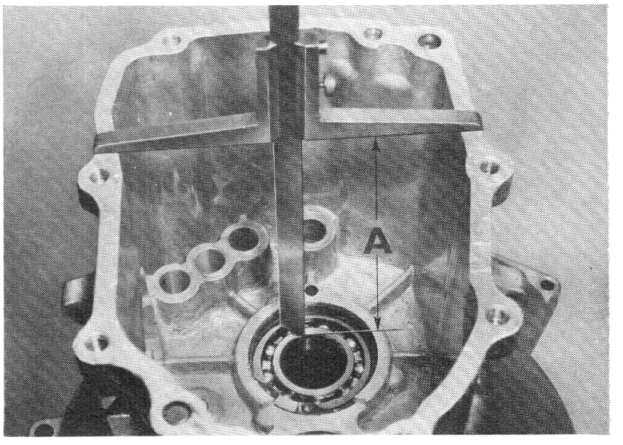


Fit selector rod of 3rd/4th gear.
Secure selector fork with locating pin.
Fit sealing cap, reversing light switch and speedometer pinion.
■

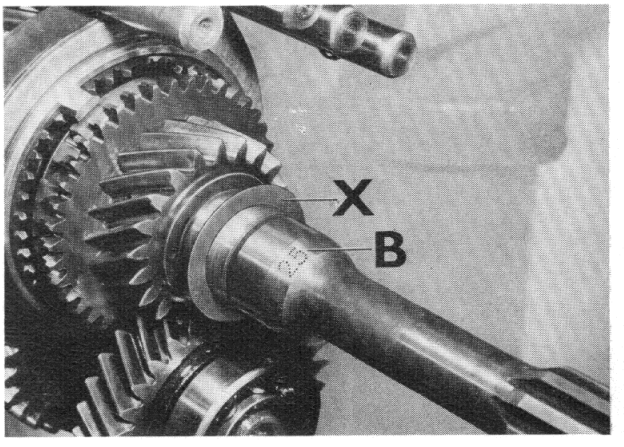
Fit 1 mm (0.039") shim and grooved bearing into housing.



Check distance A from housing sealing surface to grooved bearing.

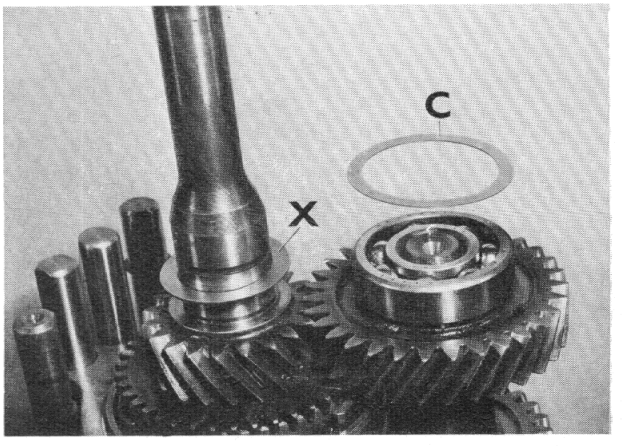


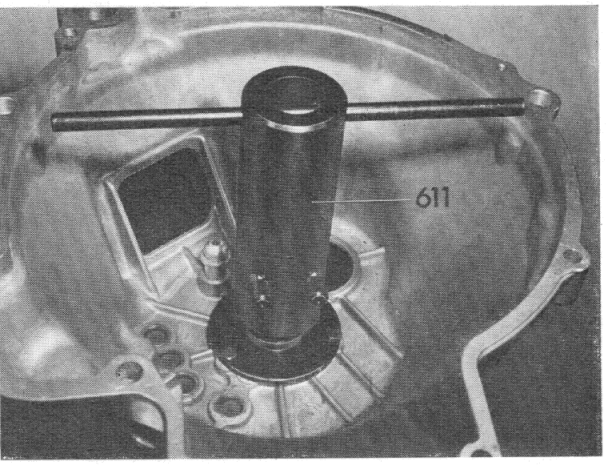
B is electrically engraved on the input shaft.
Having determined the actual sizes A and B, column X will give the required thickness of the shim X.



A	B	ins	X mm
153.9	45-50	(0.0196)	0.5
(6.059)	35-40	(0.0236)	0.6
	25-30	(0.0276)	0.7
153.8	45-50	(0.0157)	0.4
(6.055)	35-40	(0.0196)	0.5
	25-30	(0.0236)	0.6
153.7	45-50	(0.0118)	0.3
(6.051)	35-40	(0.0157)	0.4
	25-30	(0.0196)	0.5
153.6	45-50	(0.0078)	0.2
(6.047)	35-40	(0.0118)	0.3
	25-30	(0.0157)	0.4

Place shim X on the input shaft.
Stick shim C, which was determined for tooth engagement, on grooved bearing with grease.
Lay gasket on the housing cover.



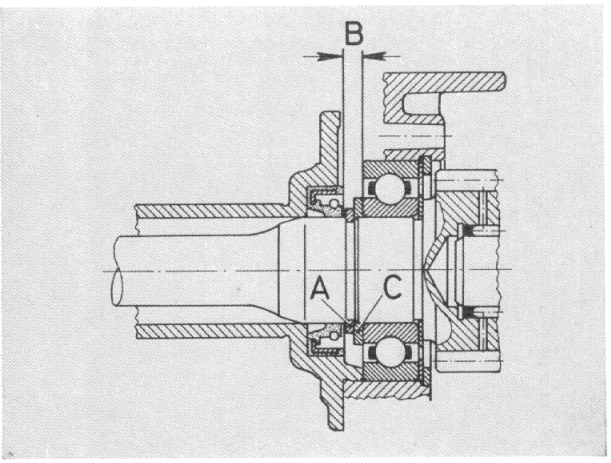


Slip the gearbox housing over the gear assembly.

Using the pressure device 611 press the input shaft into the grooved ball bearing / the housing onto the housing cover.

Secure housing cover.

■



Measure thickness A of circlip.

Insert circlip in the input shaft groove.

Determine distance B from circlip to grooved ball bearing. Check shim thickness C.

Example: B = 4.0 mm (0.157")
- A = 2.0 mm (0.078")
C = 2.0 mm (0.079") shim

Fit shim C.

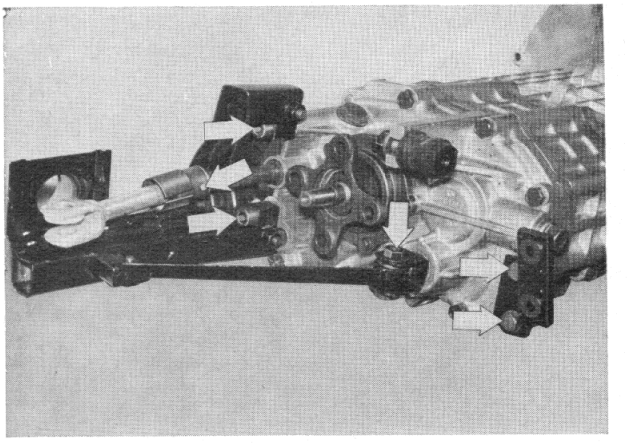
Fit guide sleeve for clutch release collar 23 11 590.

■

B) Stripping and reassembling of five-speed gearbox

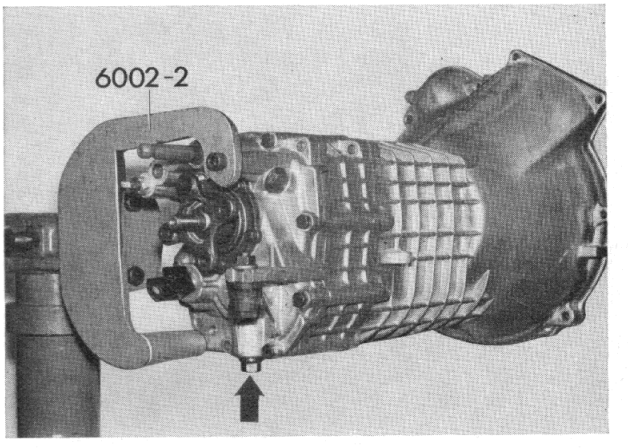
Remove console, strut, gearshift rod and exhaust support.

■



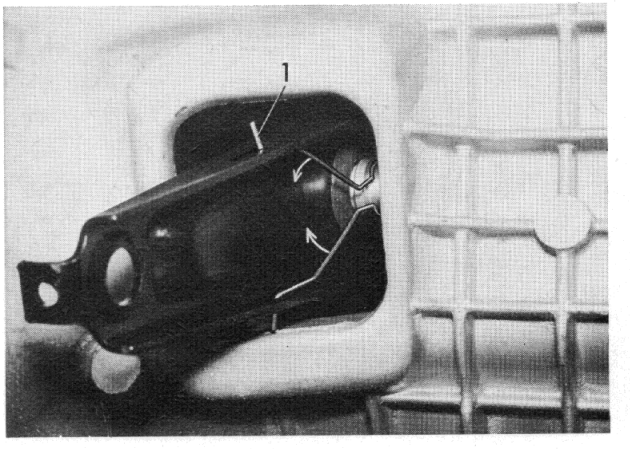
Fasten gearbox to holder plate 6002-2.
Drain oil.

■



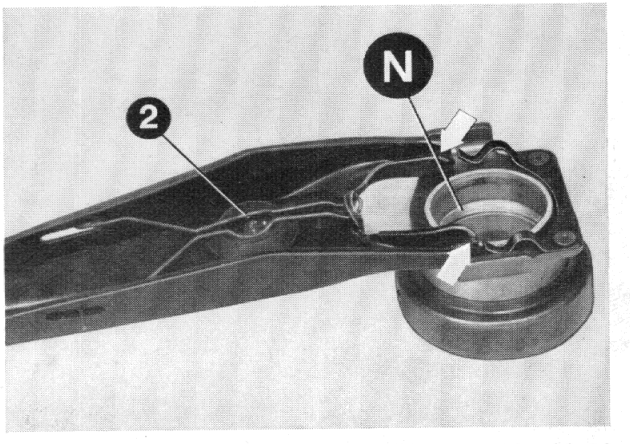
Press spring (1) together and lift out over collar.
Take release lever out to the front.

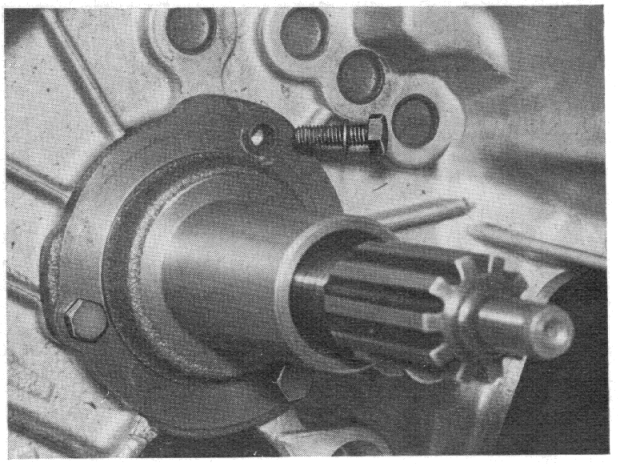
■



Note when fitting: Check angular seal (2). Coat bearing surfaces with Molykote Longterm 2.
Fill lubrication groove (N) in the inner drillway of the release bearing with Molykote Longterm 2.
If this is not done, the release bearing may seize on the guide sleeve.
Replace lubricating felt pad in the knuckle bolt if it has become loose or dry.

■





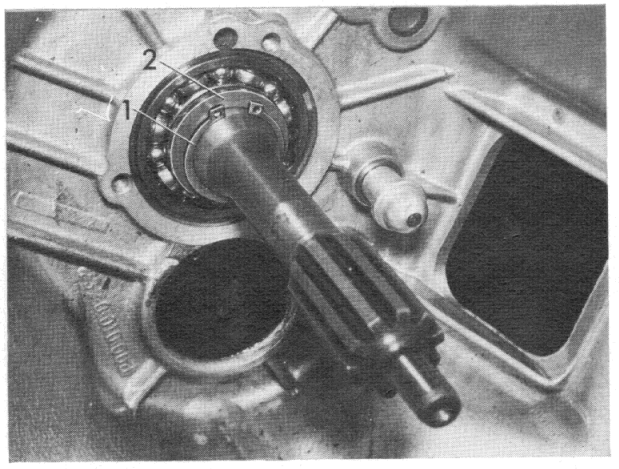
Remove guide sleeve.

Note shims.

Note when fitting: Check copper sealing rings and replace if necessary.

Apply a thin coat of Molykote Longterm 2 on the guide sleeve and the release lever bearing surface.

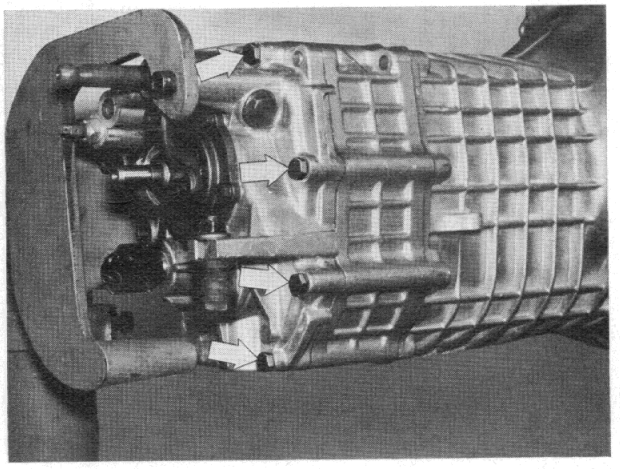
■



Take out circlip (1).

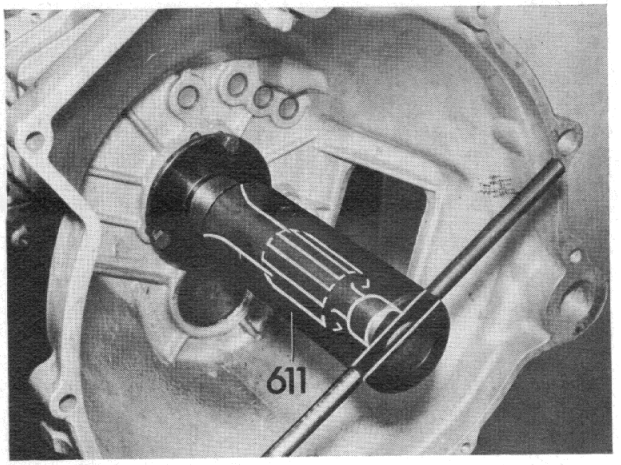
Remove shims (2).

■



Unscrew fastening bolts for gearbox cover.

■



Make thrust unit of brass or steel.

Outer dia. 28 mm (1.1024"), length 25 mm (0.9843")

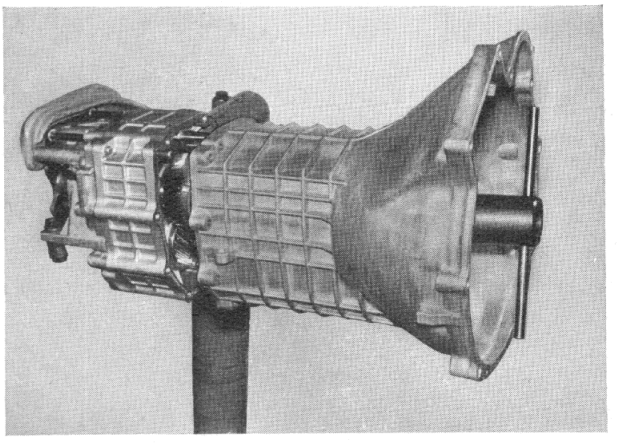
Fit thrust unit on to drive shaft.

Attach pressing tool 611 to tousing.

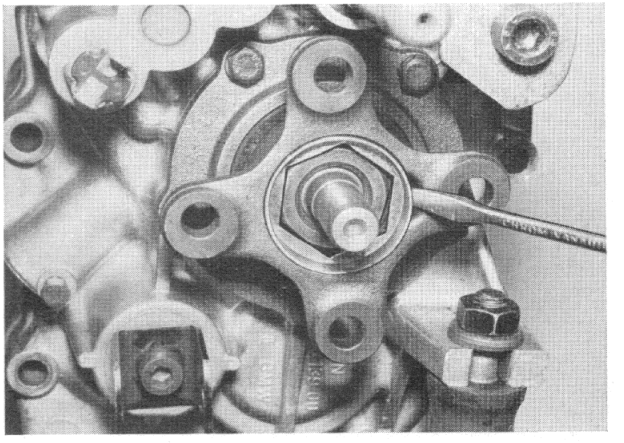
Do not install the two thrust bolts.

■

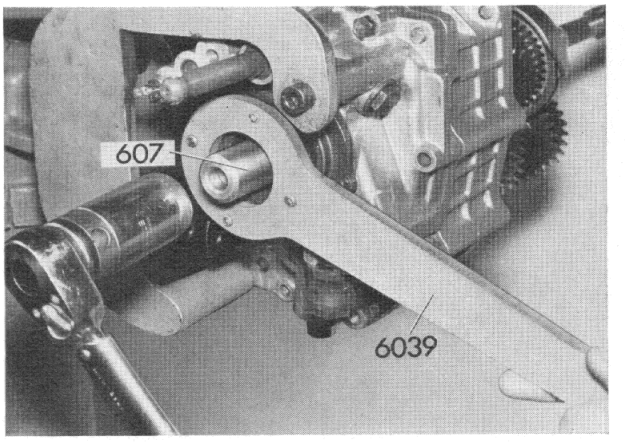
Press housing away from intermediate housing.
Care: Shims on the input and lay shafts.
Fitting instruction: Renew gasket.



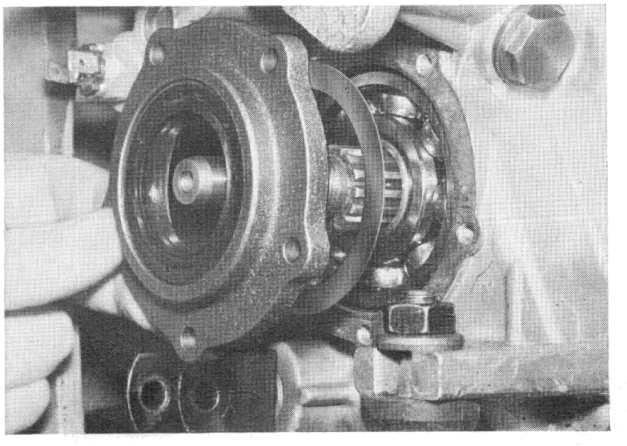
Lift out locking plate.
Fitting instruction: Prize locking plate into groove.

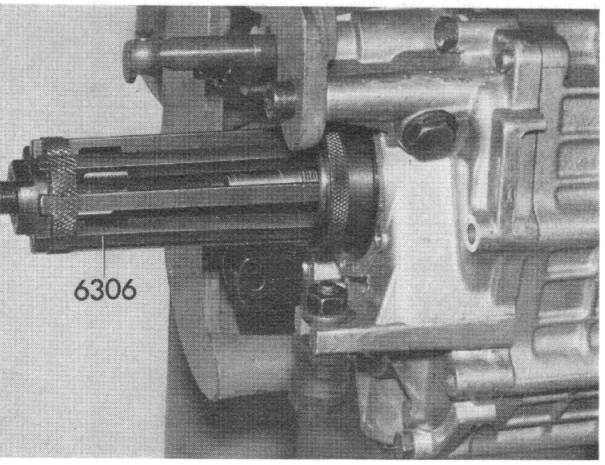


Push guide sleeve 607 onto centering pin.
Hold flange with retaining spanner 6039, unscrew flange nut and pull off flange.



Remove support ring.
Care: Shims.



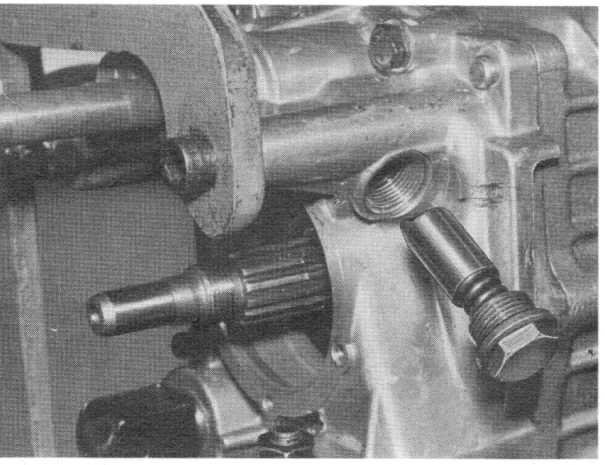


Hold gearbox cover and intermediate housing together with two bolts.

Pull out grooved ball bearing with bush — Rillex 6306.

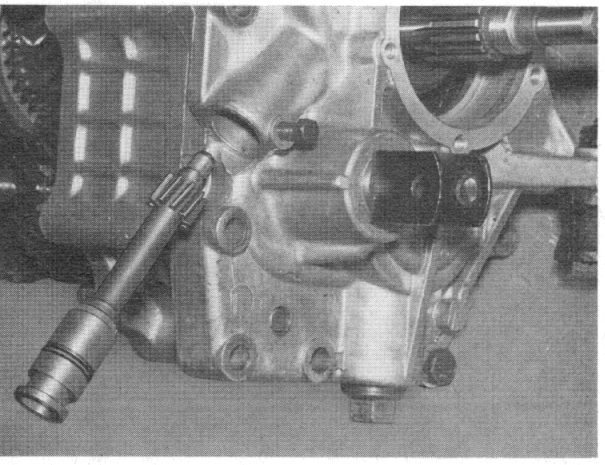
Fitting instruction: Only use C3 bearing.

■



Remove locking pin in neutral position.

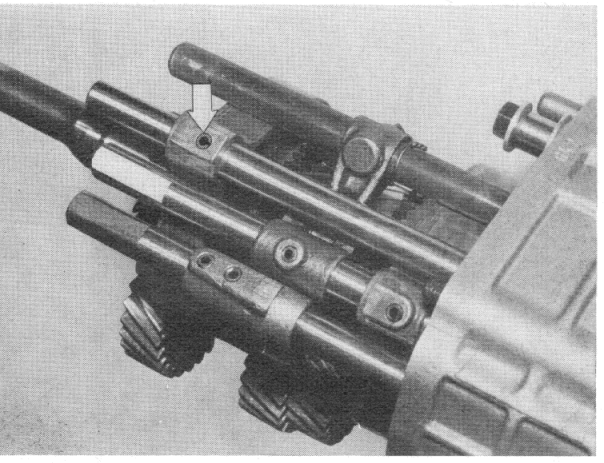
■



Remove speedometer pinion.

Fitting instruction: Check 'O' ring and renew if necessary.

■

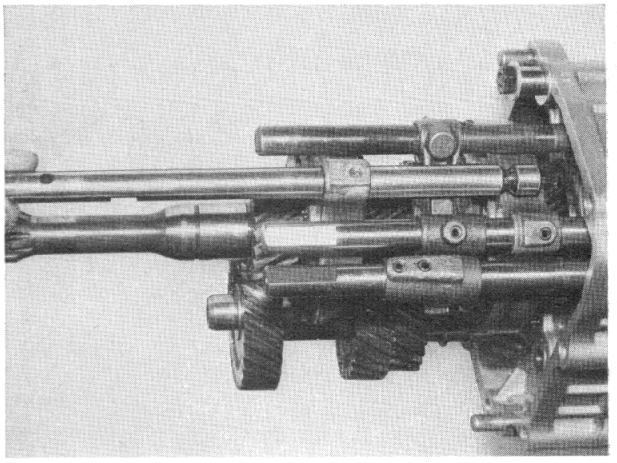


Engage 5th gear.

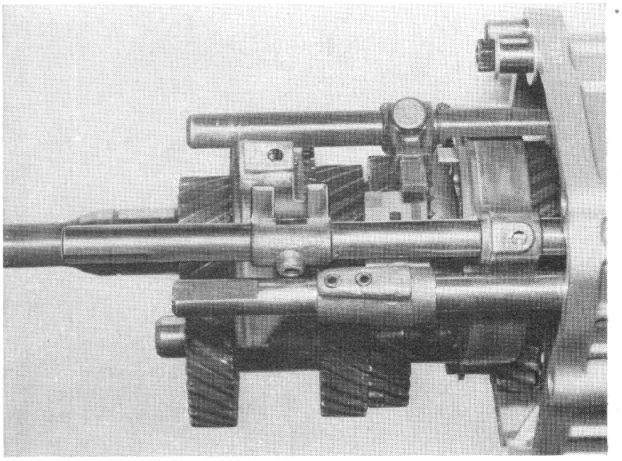
Turn guide sleeve until the locating pin can be driven out.

■

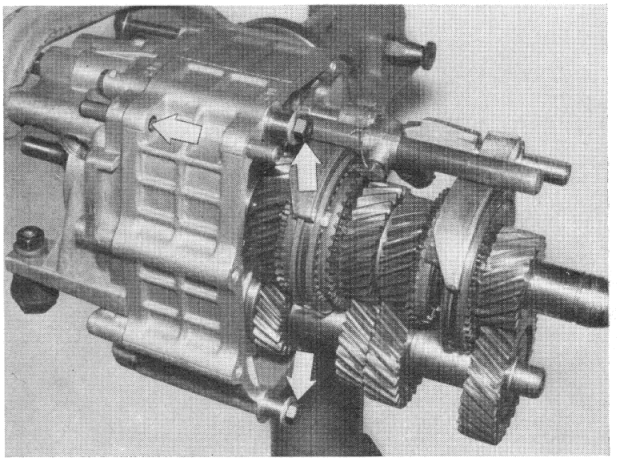
Drive selector rod of 4th/5th gear out forwards.
Care: Loose ball bearings.



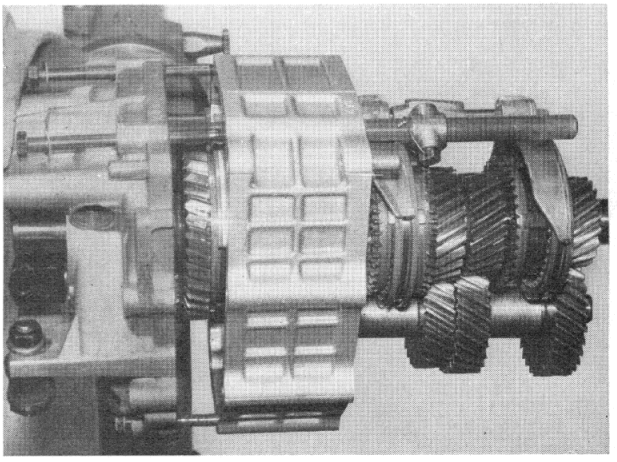
Engage 3rd gear.
Turn guide sleeve until the locating pin can be driven.
Drive out selector rod of 2nd/3rd gear with driver.
Care: Loose ball bearings.

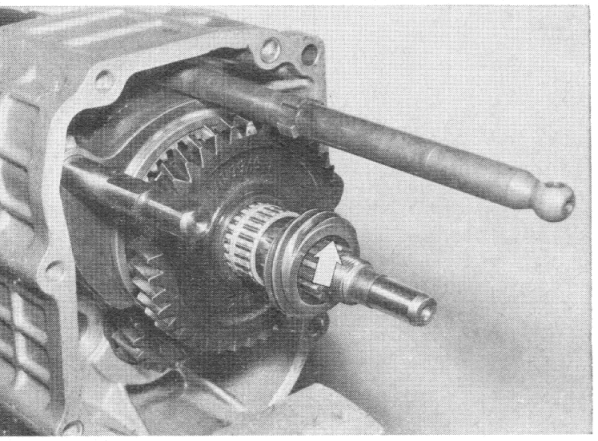


Set selector sleeve to neutral position.
Drive cylindrical pins out of intermediate housing.
Remove the two fixing bolts.



Pull gear assembly with intermediate housing, selector shaft and selector rod of 1st/reverse gear from gearbox cover.
Fitting instruction: Renew gasket.
Care: Loose ball bearings.



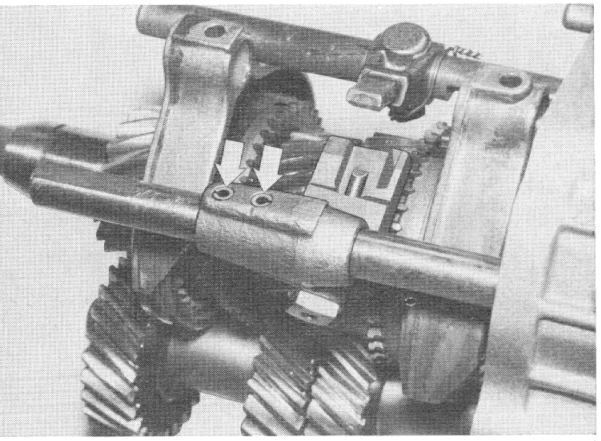


Clamp intermediate housing in vice.

Pull off speedometer pinion and reverse gear pinion with needle cage.

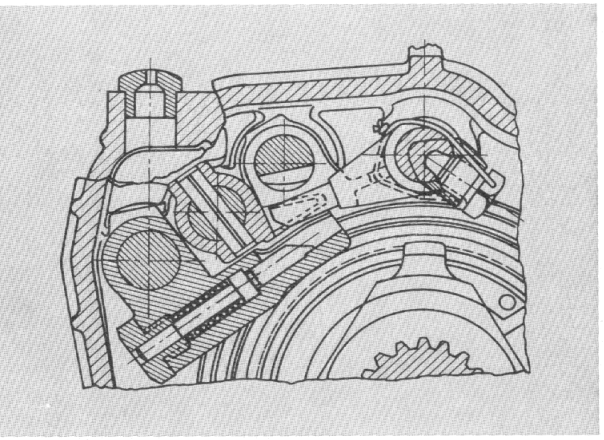
Fitting instruction: The backed off side of the speedometer pinion faces the output.

■



Drive locating pins out of driver of 1st and reverse gear.

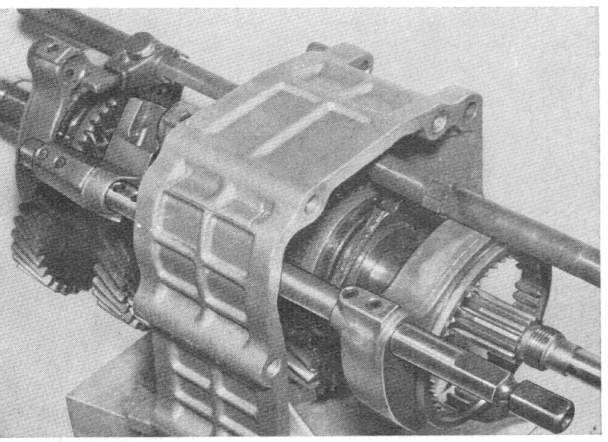
■



Fitting instruction: Check locking pin and selector bar and renew if necessary.

Note fitted position of locking pin.

■



Pull selector rod with selector fork out to the rear.

Remove selector forks of 2nd/3rd and 4th/5th gears.

Fitting instruction: Check selector forks[1]) and selector sleeves for wear and renew if necessary.

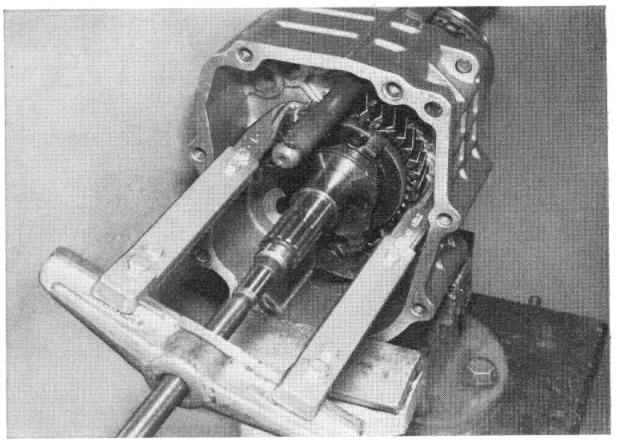
■

[1]) See Technical data.

Knock output shaft in direction of output flange up to stop in the intermediate housing.

Pull off selector pinion of 1st gear with guide sleeve and spacer bush (two-armed extractor with extra long guides).

■



Fitting instruction: Checks synchromesh unit.

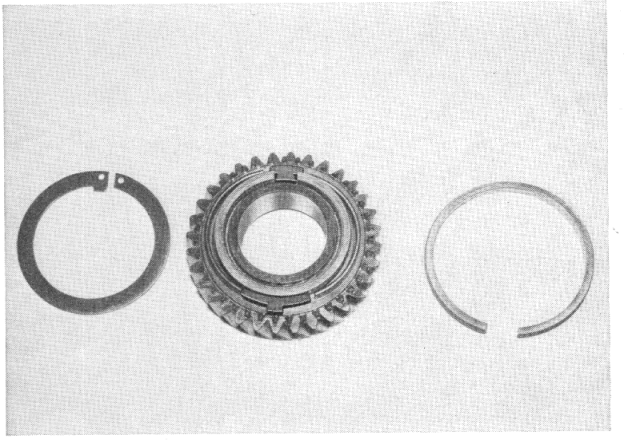
Lift out circlip, remove synchromesh ring, check individual parts.

Note: Synchromesh ring of 1st gear is oval.

Identification of synchromesh rings by paint spots:

1st gear - green
2nd/3rd gear - yellow
4th/5th gear - white

■

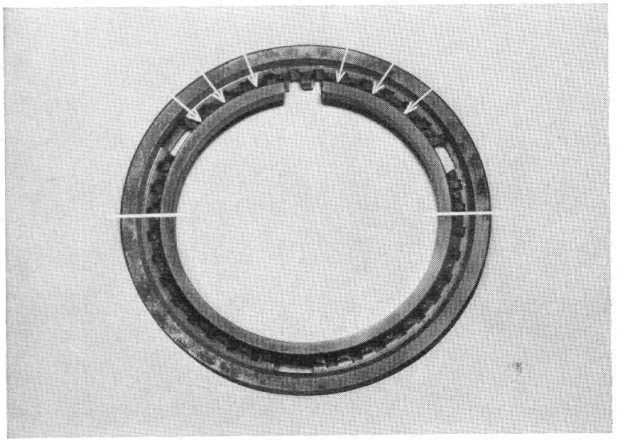


Push synchromesh ring into selector sleeve.

Front edge of selector sleeve and synchromesh ring must be in the same plane.

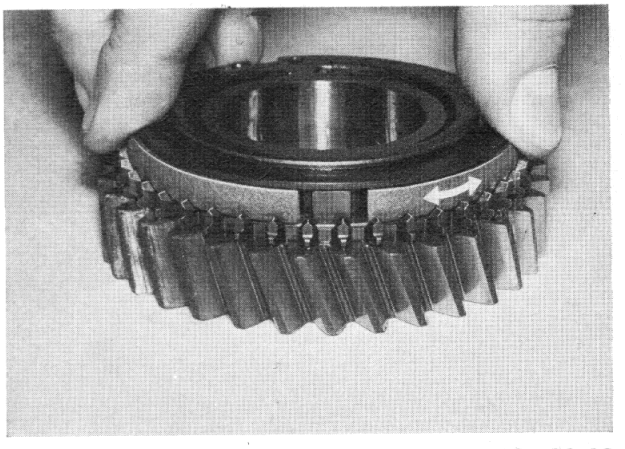
If the pattern of wear of the synchromesh ring is predominantly at the two abutting ends, the synchromesh ring must be renewed.

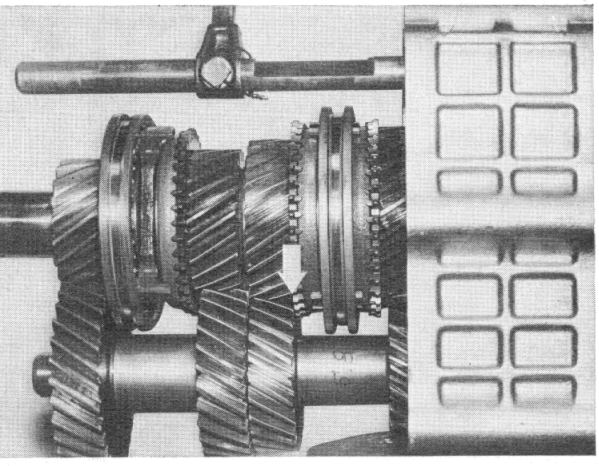
■



After assembly it should be possible to turn the synchromesh ring easily by hand.

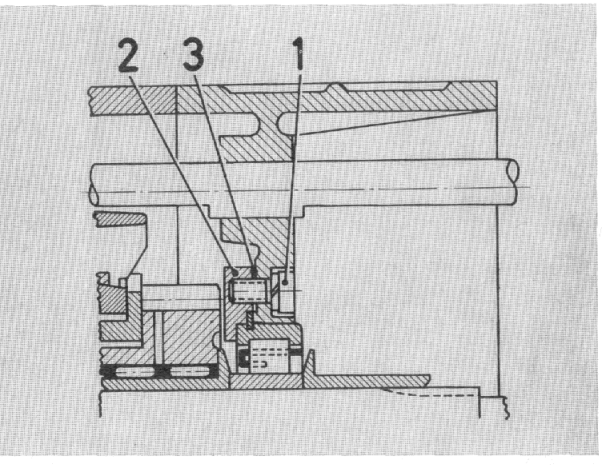
■





Knock output shaft carefully forward until the synchromesh unit of 3rd gear locates on the 3rd gear pinion of the layshaft.

■

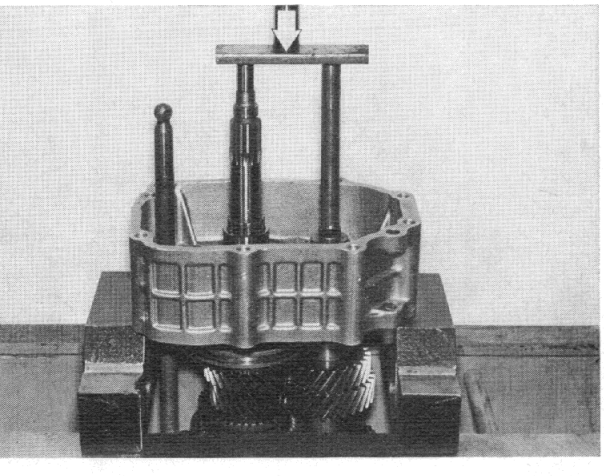


Unscrew socket head screws (1) and remove retaining keys (2).

Care: Shim.

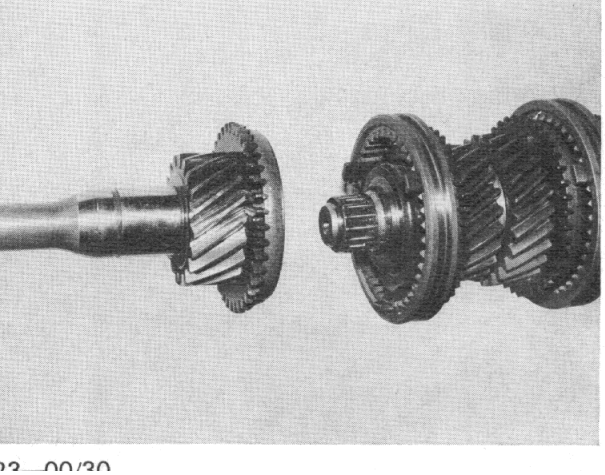
Fitting instruction: Do not tilt retaining keys, use shims (3) to obtain good fit.

■



Position an approx. 135 mm (5.25") long tube on the hex. head bolt of the layshaft. Lay a flat bar on the output shaft and tube. Press out gear assembly.

■



Remove drive shaft, selector sleeve and needle cage.

Fitting instruction: Check synchromesh unit;

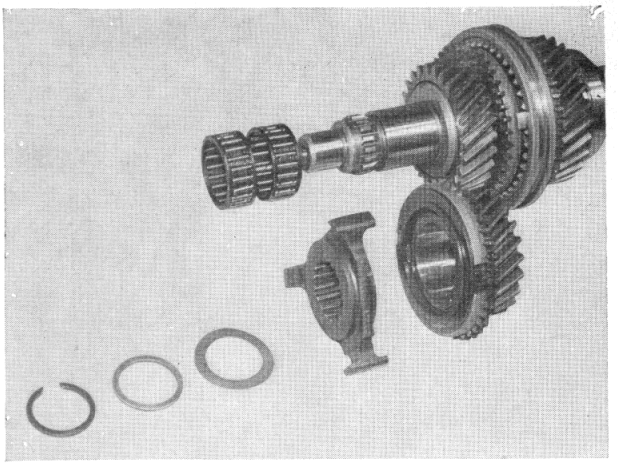
see page 23-00/29.

■

Lift out circlip.

Remove support disc, shim, sliding sleeve and 4th gear pinion with needle cage.

■

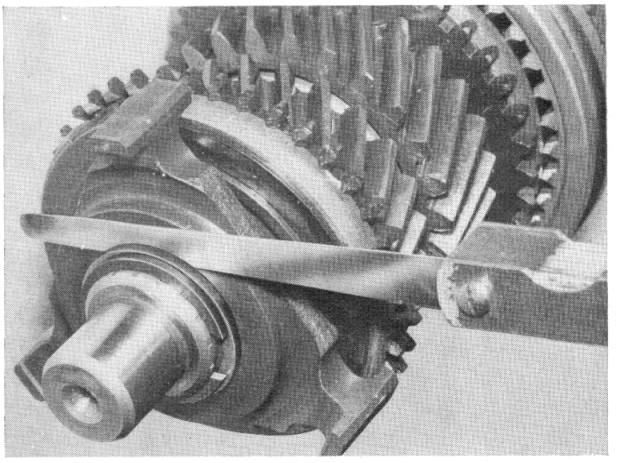


Fitting instruction: Push 4th gear pinion, guide sleeve and support disc onto output shaft.

Fit circlip.

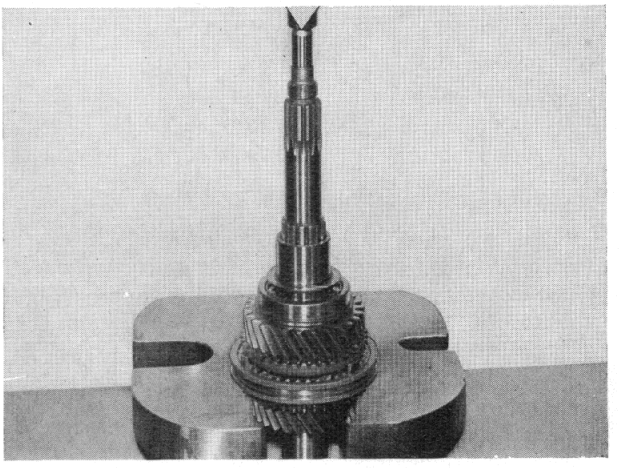
Ascertain clearance between support disc and guide sleeve - feeler gauge - and shim up so that there is no play.

■



Press out output shaft.

■

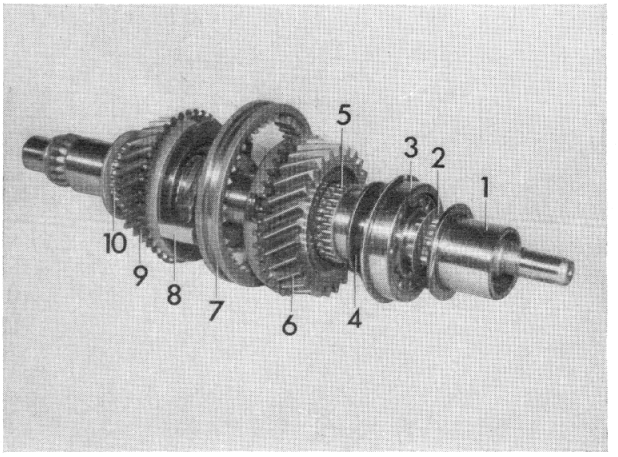


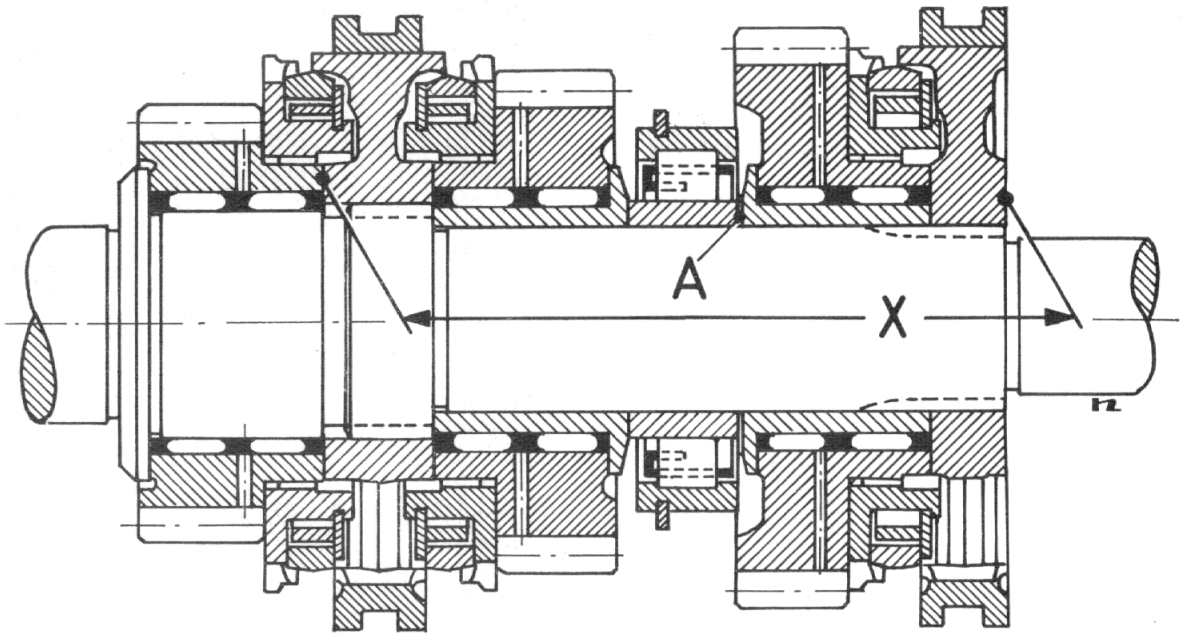
Fitted position of individual parts:

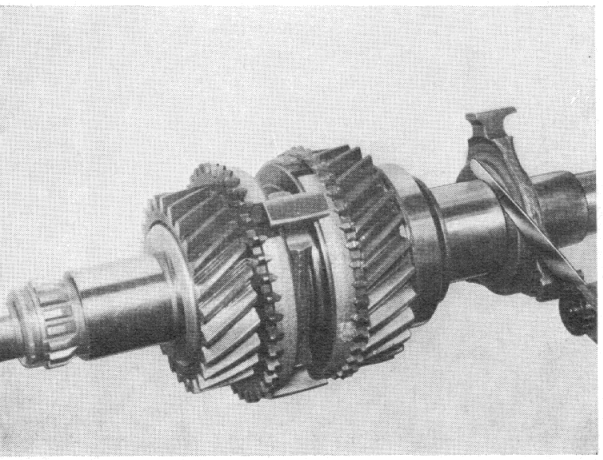
Spacer bush (1), shim (2), roller bearing (3), spacer bush (4), needle bearing (5), 2nd gear pinion (6), selector sleeve (8), 3rd gear pinion (9) and needle bearing (10).

Fitting instruction: Check synchromesh units; see page 23—00/29.

■







Fitting instruction: Shim up individual parts at shaft section X with shim (A) to 0-0.09 mm (0.0.0035").

■

In order to determine shim (A) press 3rd gear pinion with needle bearing, guide sleeve, 2nd gear pinion with needle bearing, spacer bush, roller bearing, spacer bush of 1st gear without gear pinion and guide sleeve onto the output shaft so that there is no play.

Determine play between spacer bush of 1st gear and guide sleeve and adjust with shim (A).

Note: See above for fitted position of shim (A).

■

Before continuing assembly check layshaft.

Gear pinions must only be renewed in pairs.

Press off 5th and 4th gear pinions in cold condition. Pressure required, approx. 12 t (26.460 lb.).

Fitting instruction: In the cold condition (approx. 20° C / 68° F) there must be a press fit overlap of A 0.087 ÷ 0.128 mm (0.0034 ÷ 0.00508") on the 5th gear pinion and B 0.084 ÷ 0.116 mm (0.0033 ÷ 0.00456") on the 4th gear pinion.

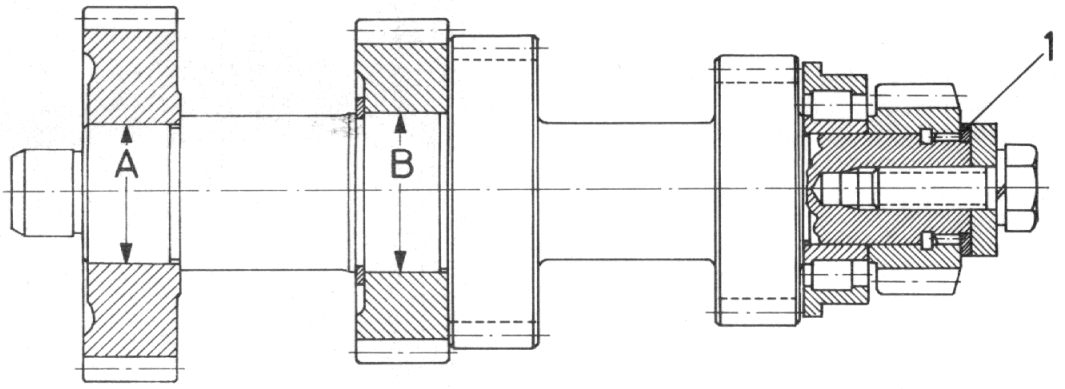
Lightly oil layshaft. Heat gear pinion to 120 ÷ 150° C (248 ÷ 302° F). Pressure required, approx. 4 t (8820 lb.).

When renewing the 1st gear pinion unscrew screw and pull off gear pinion with support disc and shim. Push output and layshaft into roller bearing in intermediate housing.

Fitting instruction:

Adjust the clearance between gear pinion and support disc to zero with shim (1). Clean screw thread, coat with blue Loctite and tighten screw with a torque of 6.0 mkp (43.38 ft/lb).

■

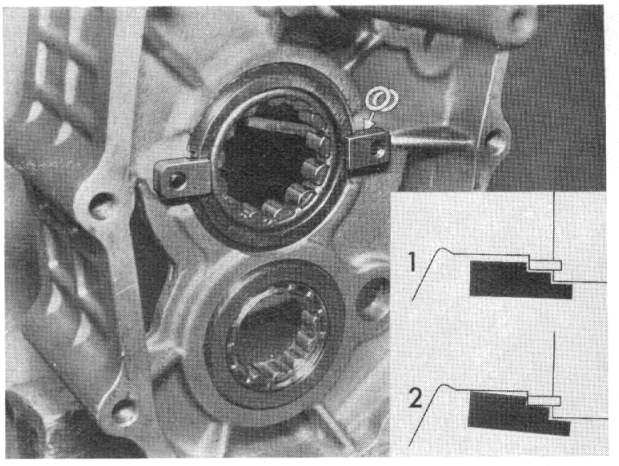


Press roller bearing of output and layshaft into intermediate housing.

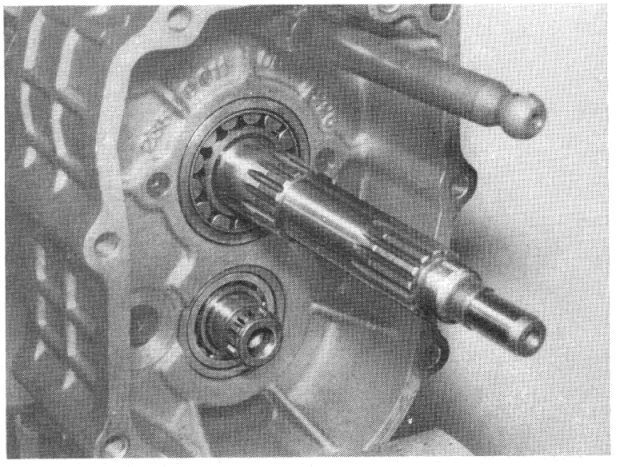
Do not tilt retaining keys, use shims to obtain good fit.

1 correct fitted position of retaining keys.

2 incorrect fitted position of retaining keys.



Push output and layshaft without 1st gear pinion into the roller bearing.

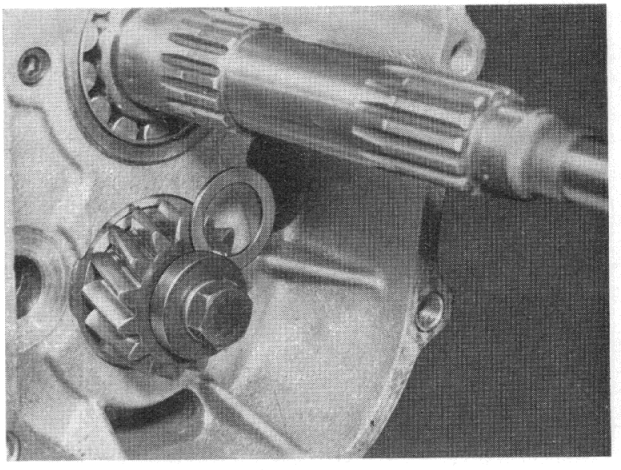


Push 1st gear pinion onto layshaft.

Secure support disc.

Adjust clearance between gear pinion and distance washer with a shim of appropriate thickness.

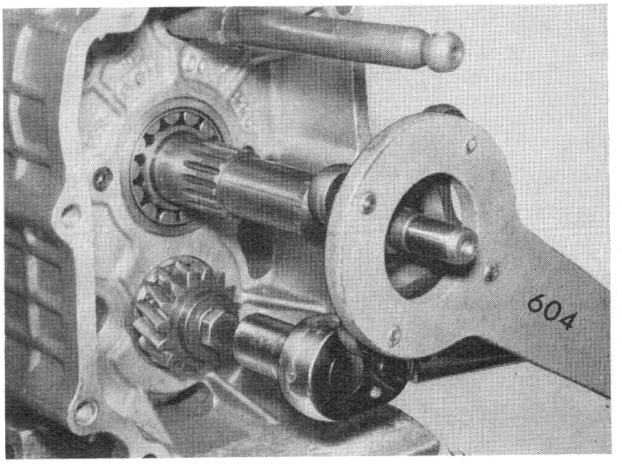
Secure screw with blue Loctite.

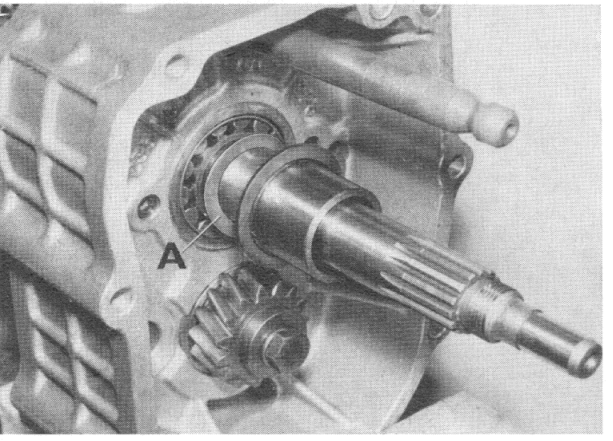


Engage 2nd gear.

In order to secure screw push output flange onto output shaft and hold with retaining spanner 604.

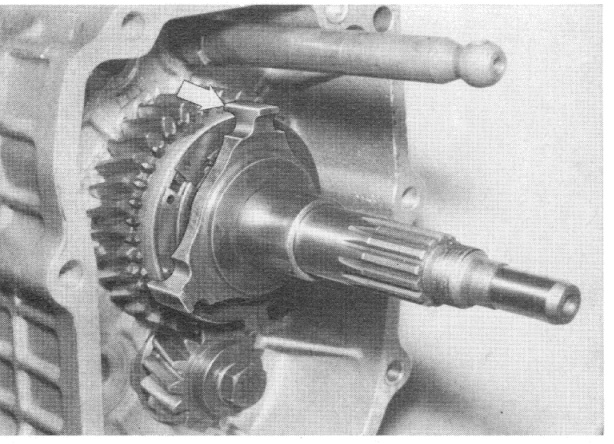
Return 2nd gear to neutral position.





Press the previously determined shim (A) — see page 23—00/32 — and spacer bush onto output shaft.

■

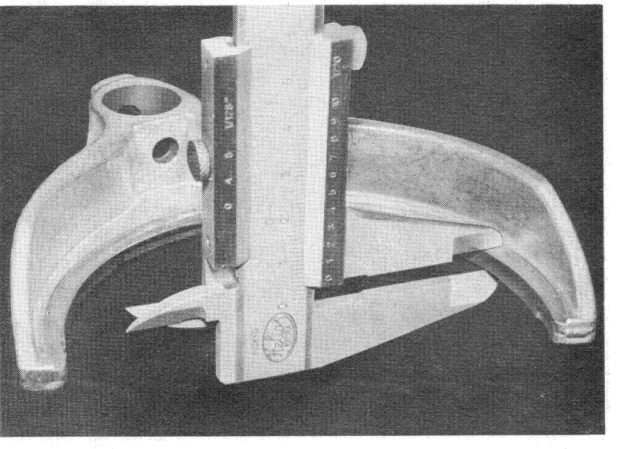


Push 1st gear pinion and guide sleeve onto output shaft.

Press on spacer bush.

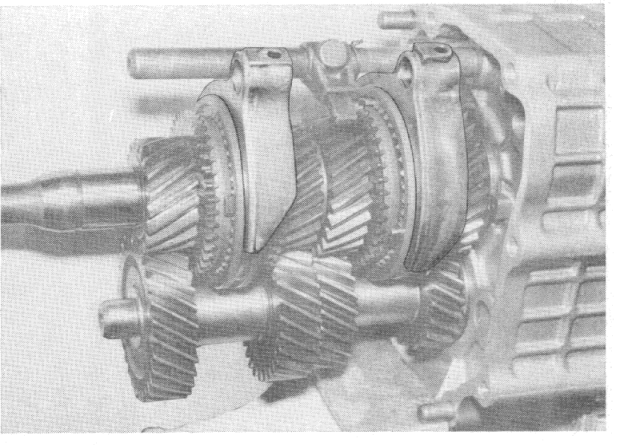
Note: The long guide bars on the guide sleeve face the 1st gear pinion.

■



Check selector forks for wear[1]) and renew if necessary.

■



Place selector forks of 2nd/3rd and 4th/5th gear in the selector sleeves.

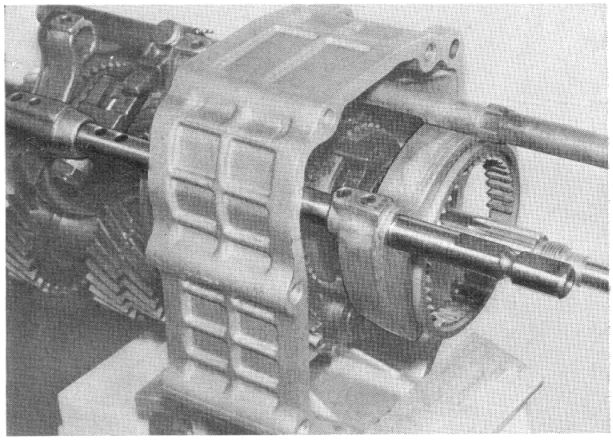
■

[1]) See Technical data.

Fit shift rod into intermediate housing together with the shifting fork for the first gear and the reserve gear. Push cam follower onto the shift rod. Press shift sleeve into shifting fork and onto guide sleeve.

Secure cam follower by means of clamping pins. Make sure that the open ends of the clamping pins face either in the direction of thrust or in the direction of tension.

■

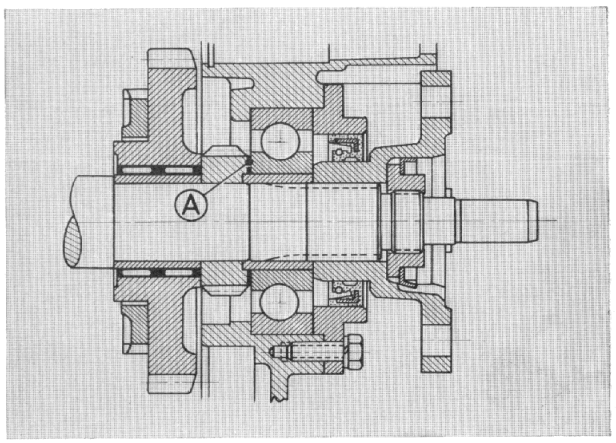


Fit reserve gear onto output drive shaft.

Adjust mesh position of output drive shaft and countershaft by fitting in shims (A) between the speedometer drive wheel and the grooved ball bearing.

For this purpose, fit grooved ball bearing into gearbox cover.

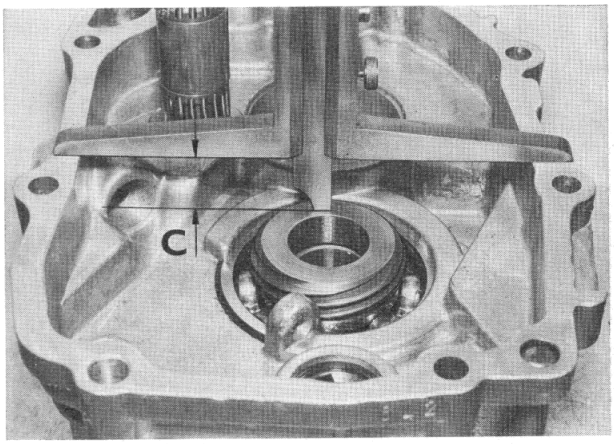
■



To make sure that gear mesh is correct, measure distance (C) from the cover sealing surface to the speedometer drive wheel. This shoul be 22 ± 0.1 mm (0.8661 ± 0.00394").

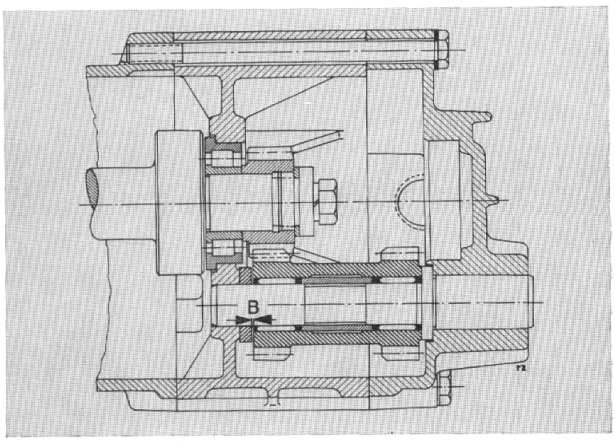
Press grooved ball bearing out of cover.

■

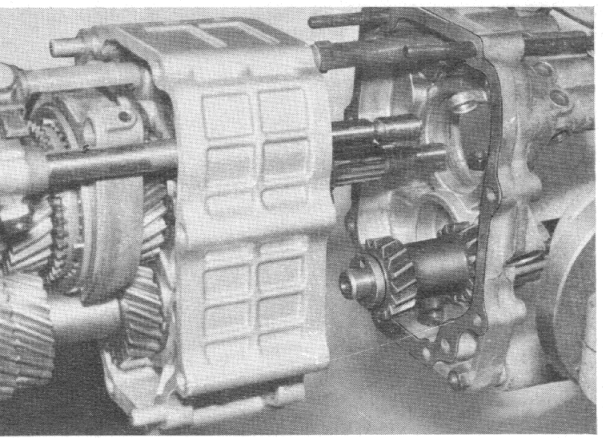


Before fitting gearbox cover, check axial play[1]) (B) of the double gear.

■



[1]) see Specifications

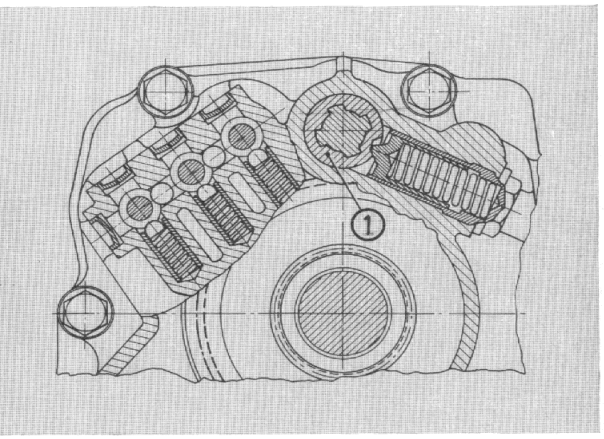


Remove reversing light switch and take off cover.

Fit double gear and contact disc onto shaft.

Attach sealing to gearbox cover by applying grease.

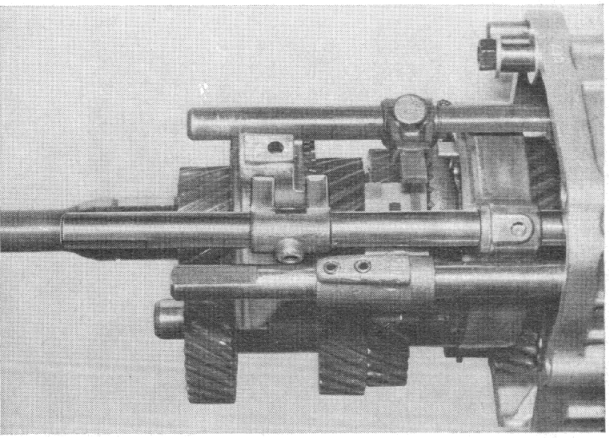
■



Fit wedged bush (1) in correct position. Insert clamping and locking balls through the open drillways. Using a screwdriver, push clamping balls down. Then fit shifting rods in position.

Note correct position of clamping and locking balls.

■



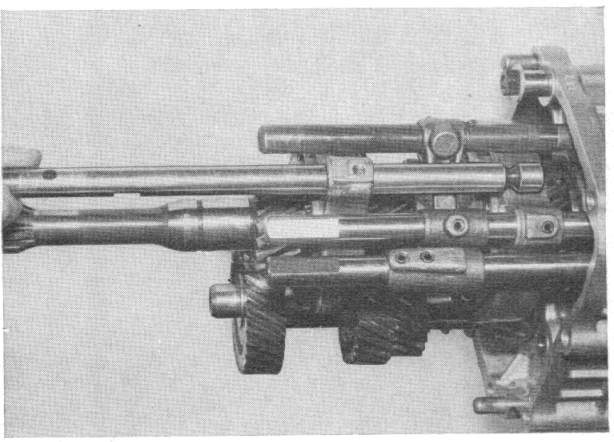
Screw gearbox cover intermediate housing with the help of two bolts. Press the shift rod for the first gear and the reverse gear into idling position.

Insert clamping and locking balls for fifth gear.

Fit shift rod for second gear and third gear and secure shifting fork with the help of clamping pin.

Make sure that the open end of the clamping pin faces in the direction of thrust or tension.

■



Move shifting sleeve for fourth gear and fifth gear into idling position.

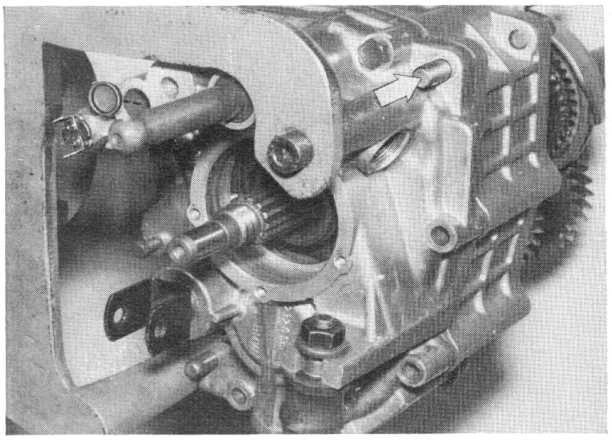
Insert clamping and locking balls.

Fit in shift rod for fourth gear and fifth gear and secure shifting fork with the help of a clamping pin. Make sure that the open end of the clamping pin faces in the direction of thrust or tension.

■

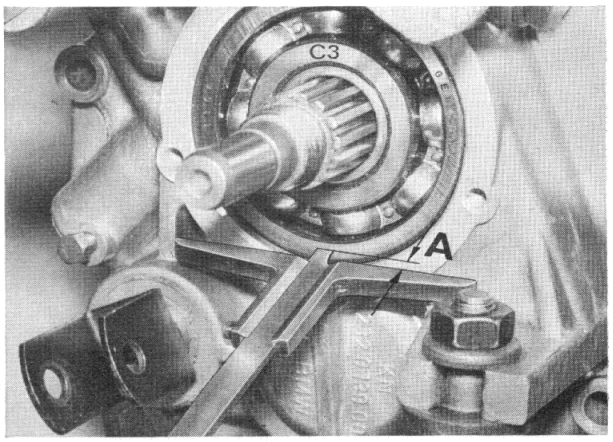
Secure reversing light switch.
Fit sealing cap with sealing compound.
Drive cylindrical pins into the intermediate housing.
Fit locking pin and speedometer pinion.

■



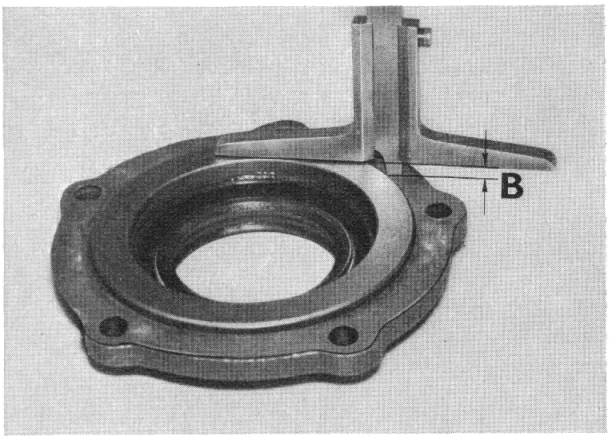
Push bush onto output shaft.
Drive grooved ball bearing fully home.
Only use C3 bearing.
Determine distance A, e.g. 3.2 mm (0.126").

■



Determine distance B with seal in position, e.g. 2.8 mm (0.11").

■



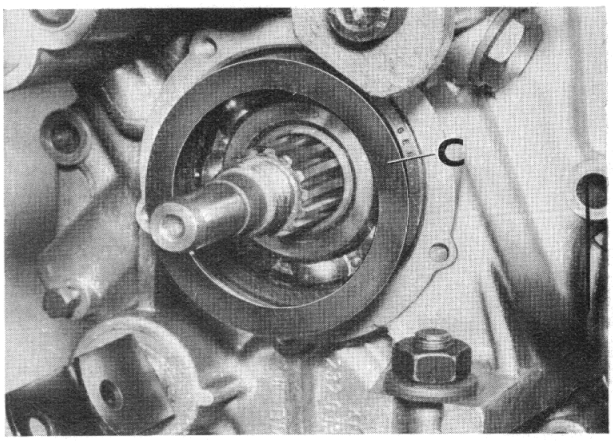
Determine thickness of shim C.
There must be no play between grooved ball bearing and sealing cover.

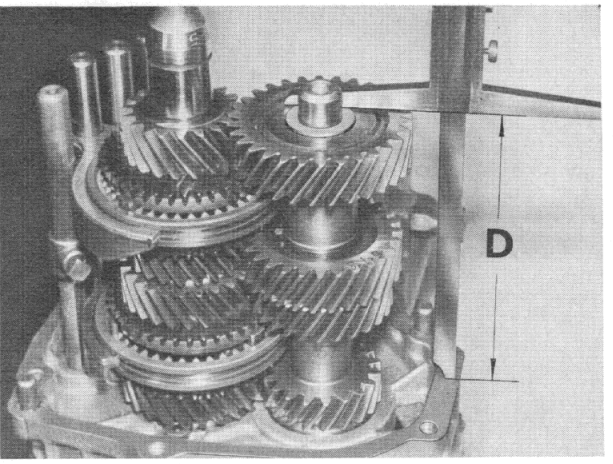
Example:

A	=	3.2 mm (0.126")
B	=	2.8 mm (0.110")
C	=	0.4 mm (0.016")

Fit shim C and sealing cover.
Secure output flange.

■

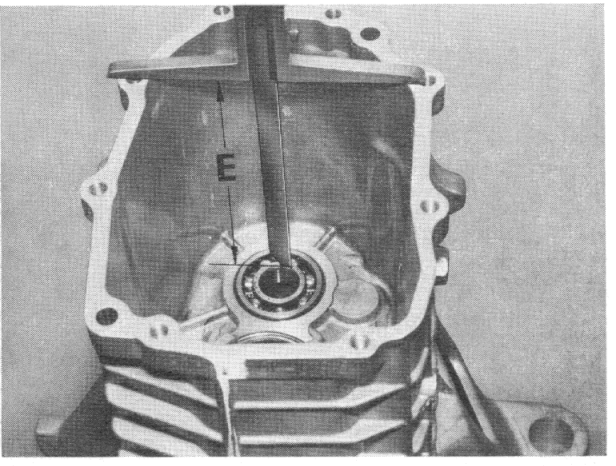




Remove bolts on gearbox cover/interm intermediate housing.

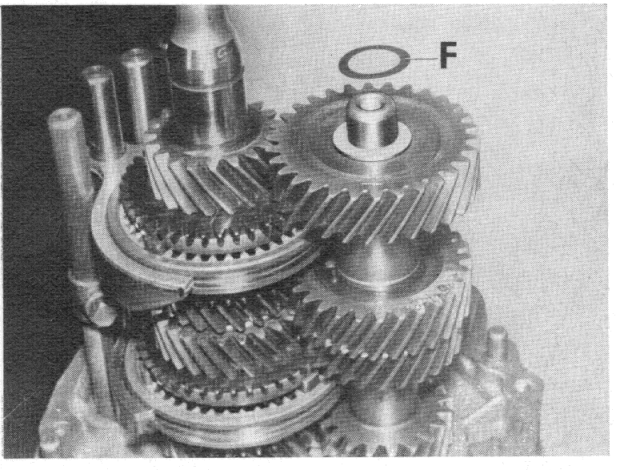
Measure distance D with gasket in position, e.g. 149.5 mm (5.886")

■



Determine distance E from housing sealing surface to grooved ball bearing, e.g. 150 mm (5.905").

■

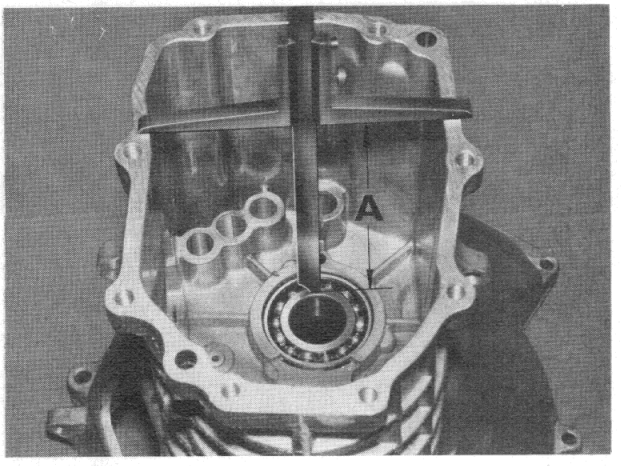


Determine thickness of shim F and place on layshaft.

Example:

E	=	150.0 mm (5.905")
D	=	149.5 mm (5.886")
		0.5 mm (0.0197")
		-0.2 mm (0.0079")
		permissible play
F	=	0.3 mm (0.0118")

■



Determine distance A from housing sealing surface to grooved ball bearing, e.g. 150.9 mm (5.941").

■

B is electrically engraved on the output shaft, and can be read off at that point, e.g. 42.

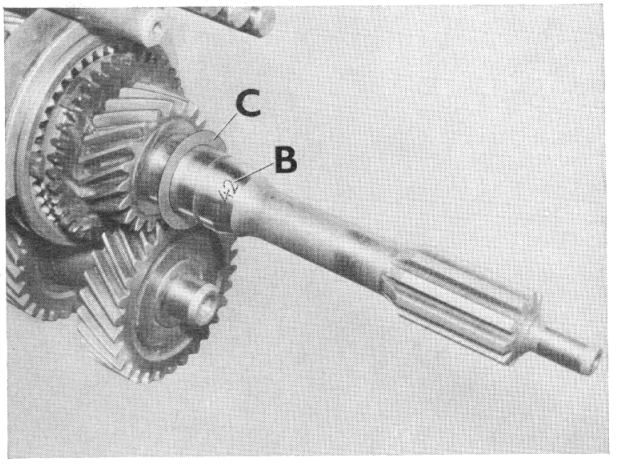
The engraved numbers always denote the digit after 23.

Take thickness of shim C from table in column C.

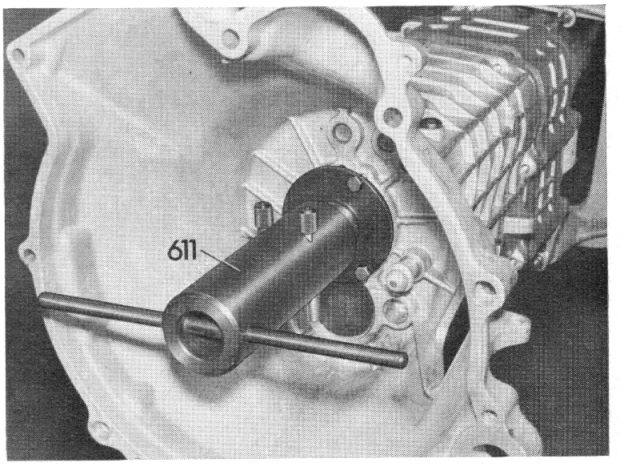
Example:

A	=	150.90 mm (5.941 in.)
B	=	0.42 mm (0.017 in.)
C	=	0.50 mm (0.020 in.)

Place shim C on the output shaft.



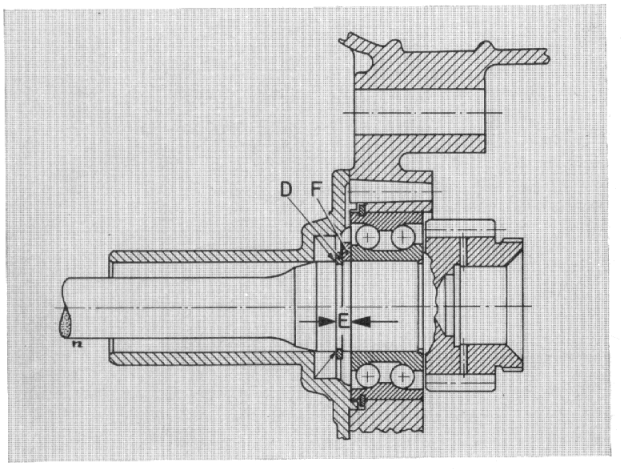
A	B	C
150.6 (5.929)	23.6 (0.9291)	0. (0)
	23.5 (0.9252)	0.1 (0.0039)
	23.4 (0.9212)	0.2 (0.0078)
150.7 (5.933)	23.6 (0.9291)	0.1 (0.0039)
	23.5 (0.9252)	0.2 (0.0078)
	23.4 (0.9212)	0.3 (0.0118)
150.8 (5.937)	23.6 (0.9291)	0.2 (0.0078)
	23.5 (0.9252)	0.3 (0.0118)
	23.4 (0.9212)	0.4 (0.0157)
150.9 (5.941)	23.6 (0.9291)	0.3 (0.0118)
	23.5 (0.9252)	0.4 (0.0157)
	23.4 (0.9212)	0.5 (0.0196)
151.0 (5.945)	23.6 (0.9291)	0.4 (0.0157)
	23.5 (0.9252)	0.5 (0.0196)
	23.4 (0.9212)	0.6 (0.0236)
151.1 (5.949)	23.6 (0.9291)	0.5 (0.0196)
	23.5 (0.9252)	0.6 (0.0236)
	23.4 (0.9212)	0.7 (0.0275)
151.2 (5.953)	23.6 (0.9291)	0.6 (0.0236)
	23.5 (0.9252)	0.7 (0.0275)
	23.4 (0.9212)	0.8 (0.0315)
151.3 (5.957)	23.6 (0.9291)	0.7 (0.0275)
	23.5 (0.9252)	0.8 (0.0315)
	23.4 (0.9212)	0.8 (0.0315)



Push gearbox housing over the gear assembly.

Using the pressure device 611 press the input shaft into the ball bearing and/or the gearbox housing onto the intermediate housing.

Secure gearbox cover.



Measure thickness of circlip D.

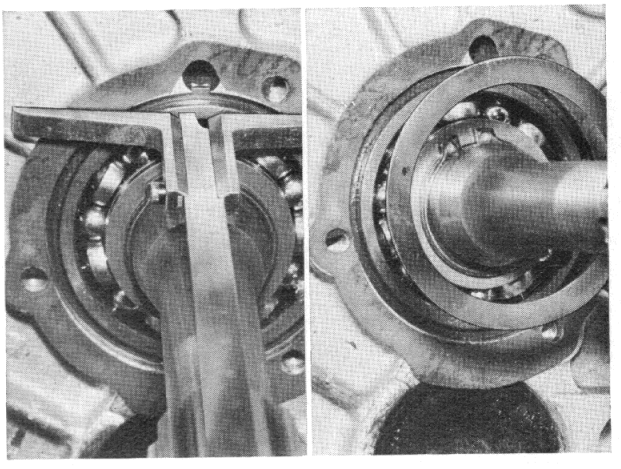
Determine distance E from circlip to ball bearing.

Check thickness of support disc and shim F.

Example:

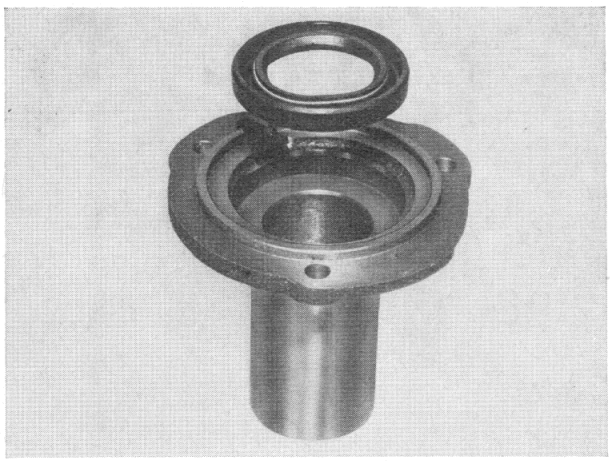
E	=	4.8 mm (0.189")
- D	=	2.0 mm (0.078")
F	=	2.8 mm (0.111")

There must be no play between ball bearing and circlip.



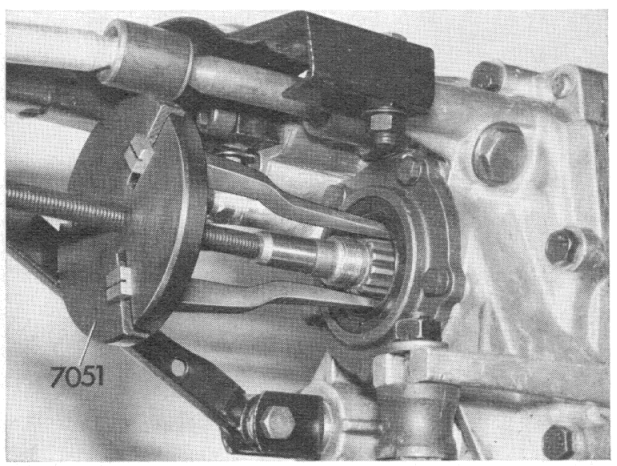
Attach guide sleeve gasket to housing with adhesive.

Determine distance from ball bearing and shim to zero.



Renew radial seal in the guide sleeve — open side faces gearbox housing.

■



Renew radial sealing ring on output flange.

Remove radial sealing ring with extractor 7051.

Fitting instruction: Drive in radial sealing ring flush.

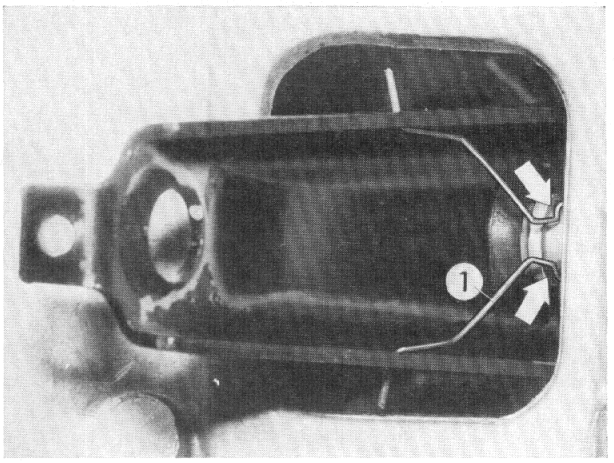
■

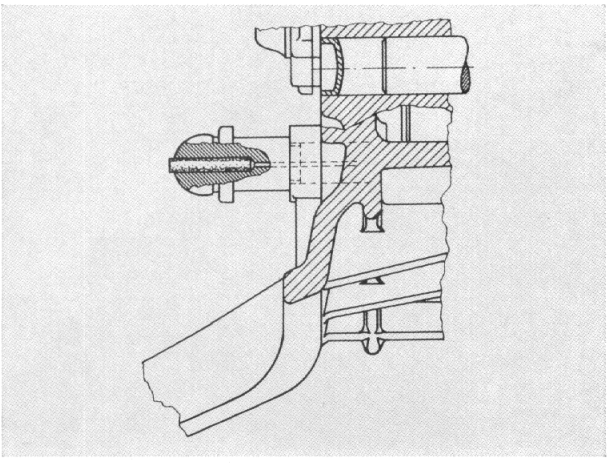
23 11 590 Removal and fitting of guide sleeve for clutch release lever

— with gearbox removed —

Remove spring (1) and take out release lever.
Note when fitting: Spring (1) must be located behind the collar.

■





Replace lubricating felt pad in the knuckle bolt if it has become loose or dry.

■

Check angular seal (2).

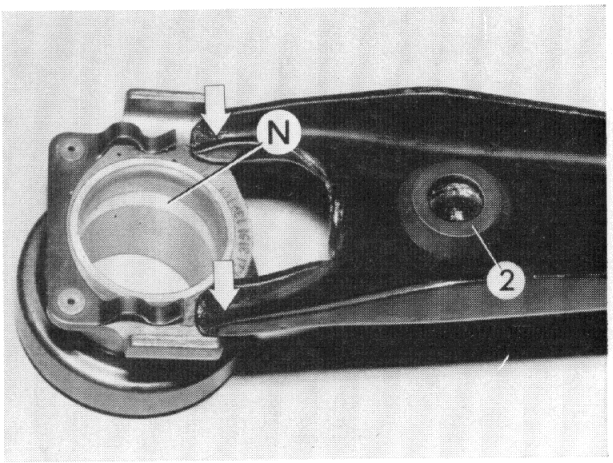
Note when fitting:

Coat bearing surfaces with Molykote Longterm 2.

Fill lubricating groove (N) in the inner drillway of the release lever bearing with Molykote Longterm 2.

If this is not done, the release lever bearing may seize on the guide sleeve.

■

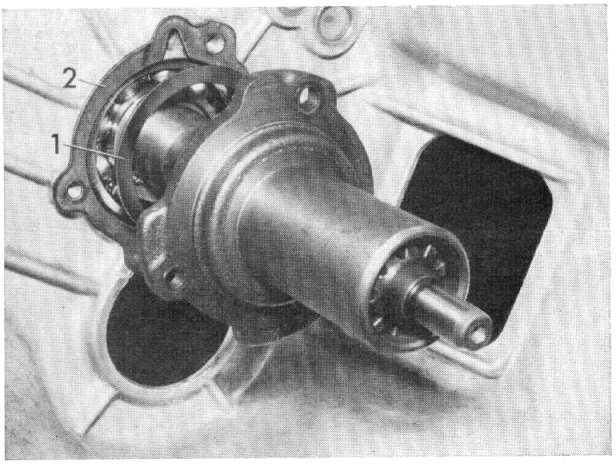


Remove guide sleeve.

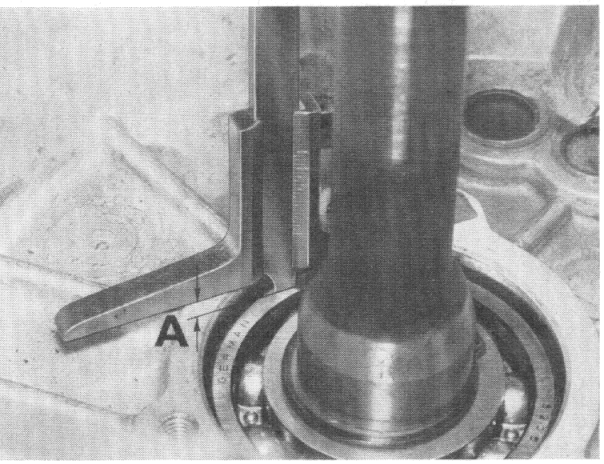
Note: Shims (1).

Note when fitting: Replace sealing (2). Coat guide sleeve and release lever bearing surface with Molykote Longterm 2.

■



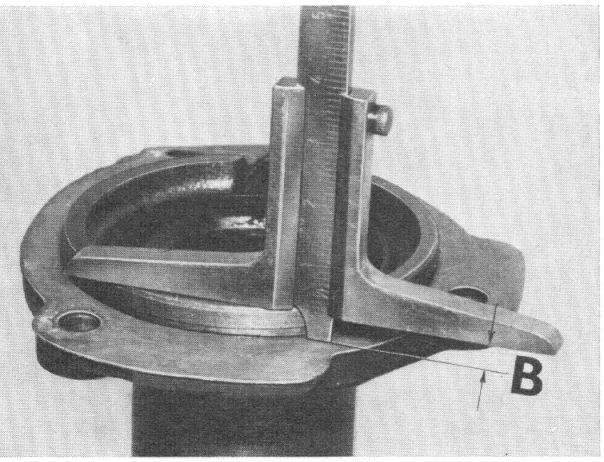
23 11 591 Replacement of guide sleeve for clutch release lever



Remove guide sleeve cf. 23 11 590.

Note when fitting: Measure distance A from housing to grooved bearing.

■



Measure (B) = collar height of guide sleeve with seal.
If there is any play, reduce to zero by means of shims.

Example:

A	5.0 mm	(0.1968")
- B	4.7 mm	(0.1850")
	0.3 mm	(0.0118") thickness of shim

■

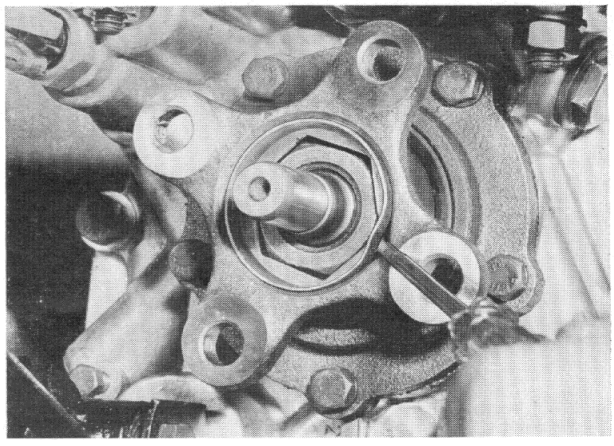
23 12 051 Renewing radial seal on output flange

Dismantle propeller shaft at front and centre bearing 26 11 000.

Pull off bumper.

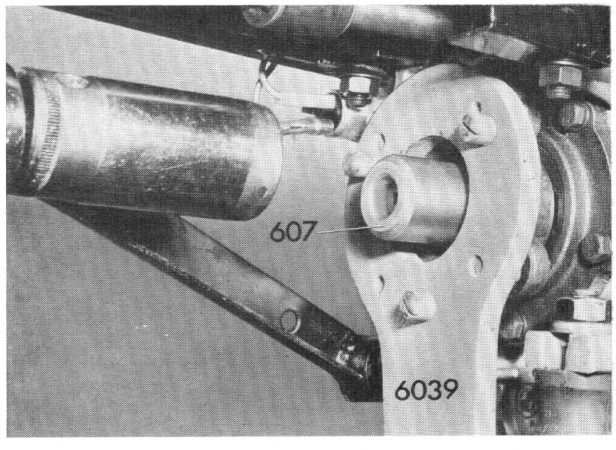
Lift out locking plate.

Fitting instruction: Prize locking plate into groove.

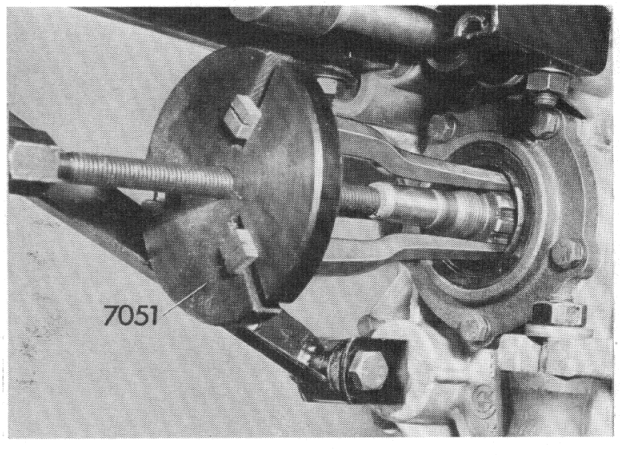


Push guide bush 607 on centering pin.

Hold flange with retaining spanner 6039, unscrew flange nut and pull off flange.

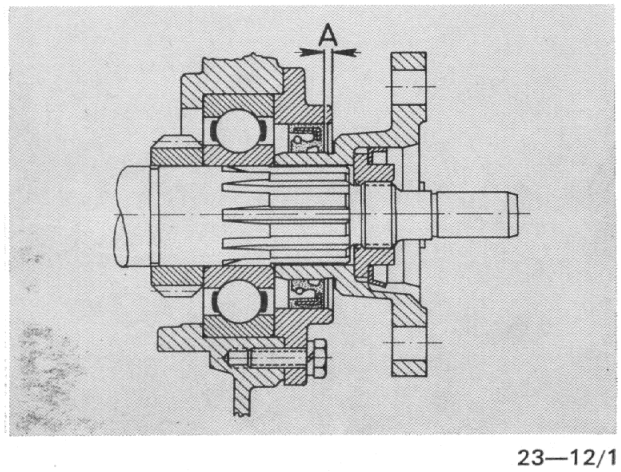


Remove radial seal with extractor 7051.

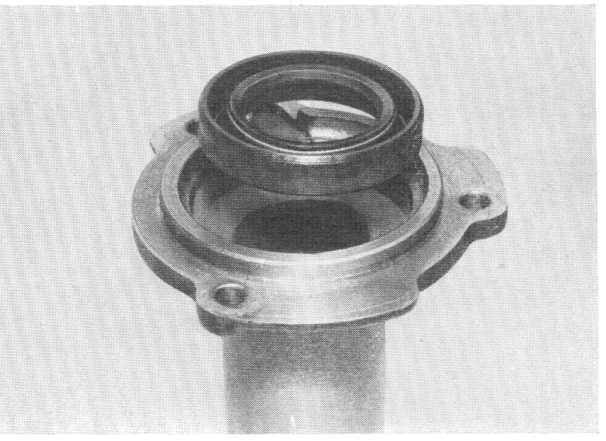


Fitting instruction: Note fitted depth A 2 mm (0.079").

Pack grease into groove between the two sealing lips.



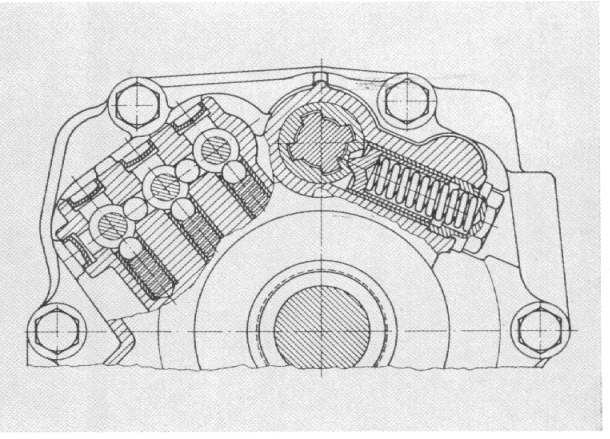
23 12 501 Renewing radial seal on drive shaft



Remove guide sleeve 23 11 590.
Lift out radial seal.
Fitting instruction: Press radial seal fully home.
Open side faces gearbox housing.
Renew gasket.

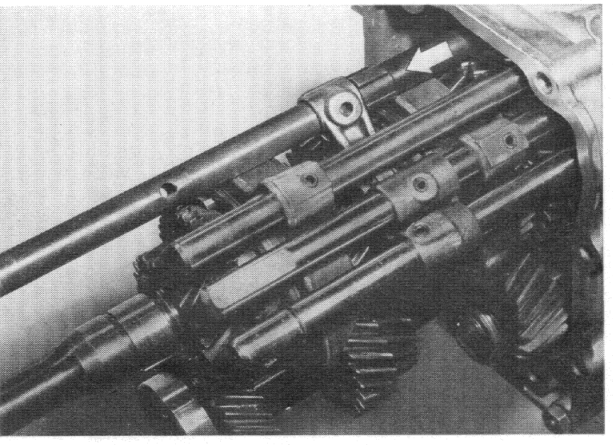
■

23 12 571 Renewing radial seal on selector shaft
— gearbox housing dismantled —



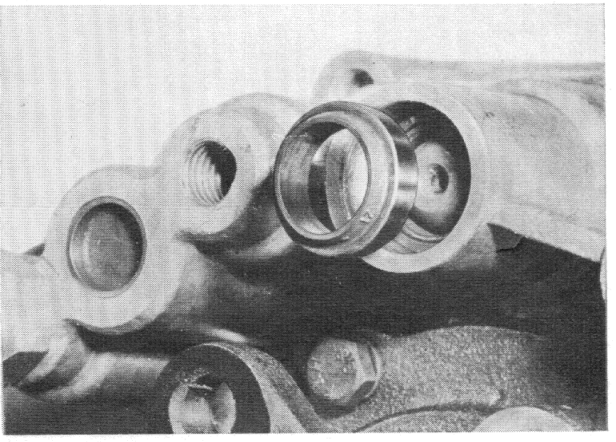
Remove locking pin.
Fitting instruction: Note fitted position of locking pin in the taper bush.

■



Drive adapter sleeve out selector bar.
Pull selector shaft as far as possible out of gearbox cover.

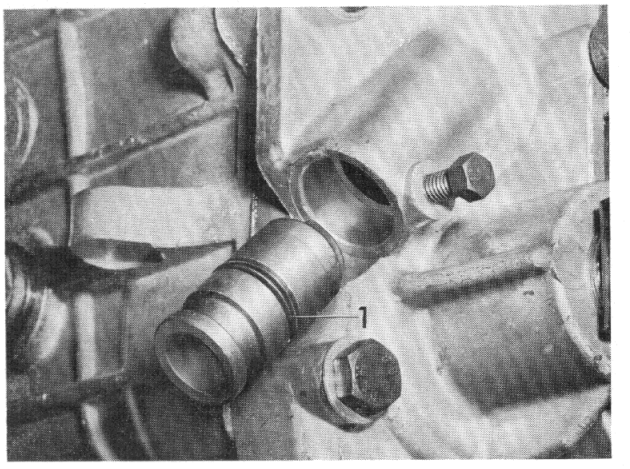
■



Lift out radial seal.
Fitting instruction: Insert radial seal flush.
Pack sealing lips with grease.

■

23 22 100 Removing and fitting speedometer pinion



Remove speedometer shaft.

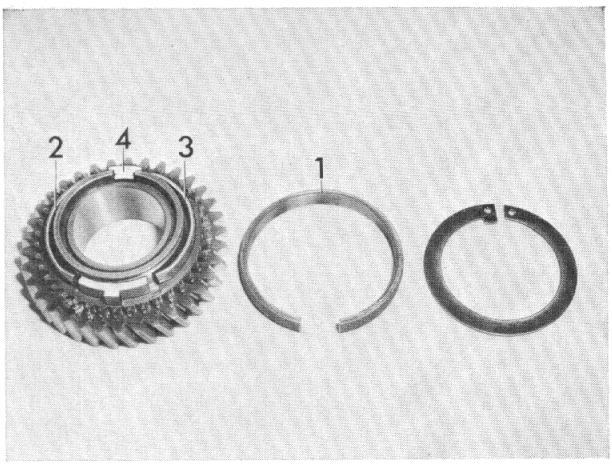
Pull out plug-in bush and speedometer pinion.

Fitting instruction: Check 'O' ring (1) and renew if necessary.

In the case of oil loss through the sealing ring (1) the plug-in bush must be renewed.

23 23 503 Synchromesh — dismantling and reassembly

— Drive shaft dismantled —

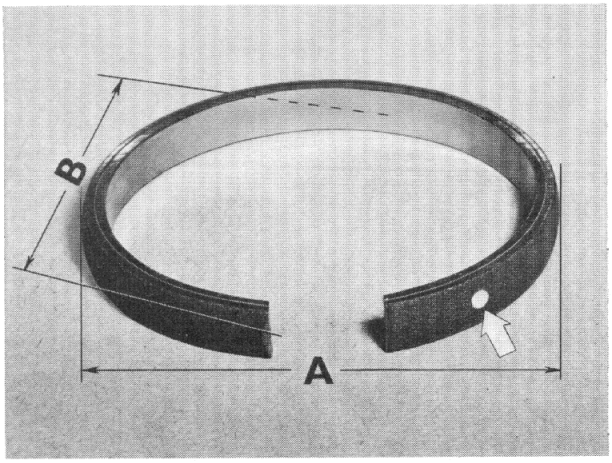


A) Porsche baulk ring synchromesh

Lift out the lock washer.

Remove synchromesh ring (1), baulk strap (2 & 3), block (4) and stop (5).

Inspect individual parts[1]), and renew if necessary. ■



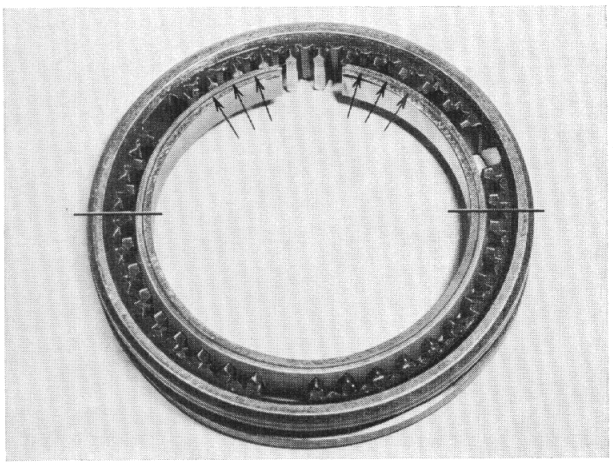
Note: The synchromesh ring for first gear is more oval in shape than the rings for second, third and fourth gears.

B must be 0.8 + 0.25 mm (0.032 + 0.010 in.) smaller than A.

Synchromesh rims identification marks:

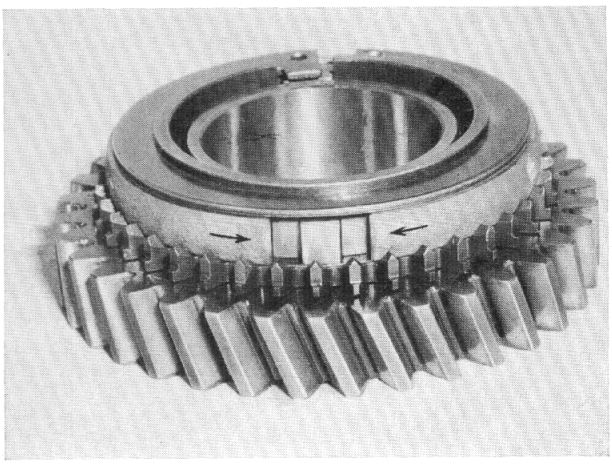
1st gear: white spot

2nd, 3rd & 4th gears: blue spot. ■



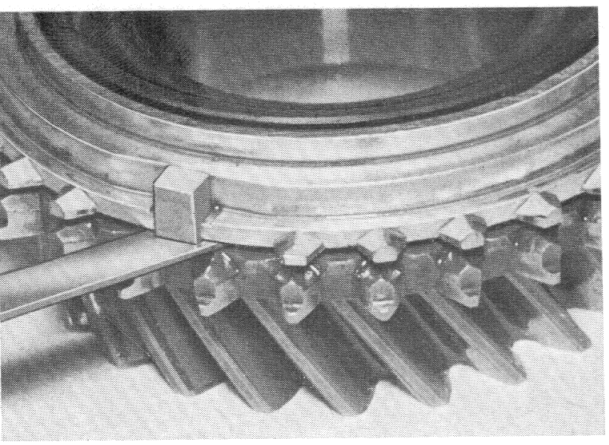
Press the synchromesh ring into the selector sleeve.

The front faces of the selector sleeve/synchromesh ring must be level. The synchromesh ring must be renewed if both ends have spread excessively. ■



After reassembly, the synchromesh ring must be able to turn easily. ■

[1]) See technical data



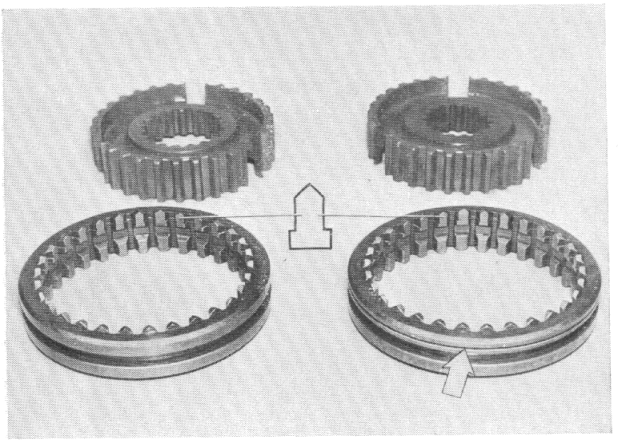
B) Borg-Warner Synchromesh

The synchromesh rings must be renewed when clearance between the synchronising drum and clutch is less than 0.8 mm (0.032 in.).

Note: the measurement should be taken close to the stops.

With new synchromesh rings the clearance must be 1.0 mm (0.039 in.).

■

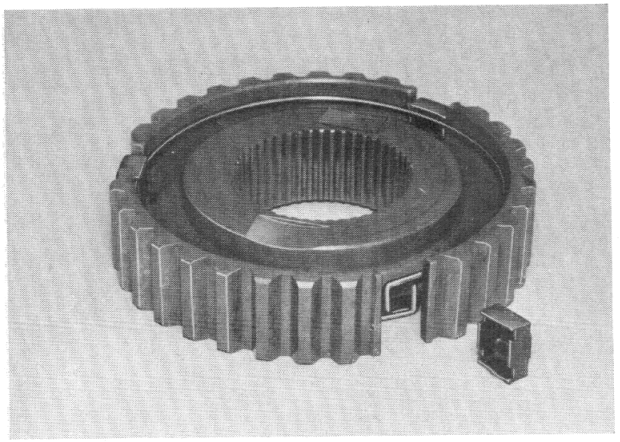


Press the selector sleeve out of the synchromesh housing, examine all parts and renew if necessary.

When installing: The teeth in the selector sleeve are recessed for 1st, 2nd and 3rd gears.

When reassembling, the groove in the selector sleeve for 3rd gear must be visible.

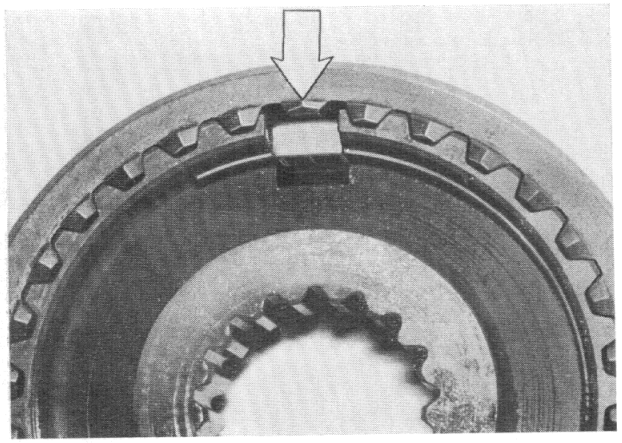
■



Stagger the hooks on the synchromesh springs in a longitudinal groove.

Attach the pressure plates to the synchromesh springs.

■



Press the selector sleeve with the flat teeth over the pressure plates.

■