

NSU PRINZ

Owners
Workshop
Manual

NSU Prinz
1, 2, 3, 4
4L, Super L
Sport Prinz
1957-72

CHAPTER 6

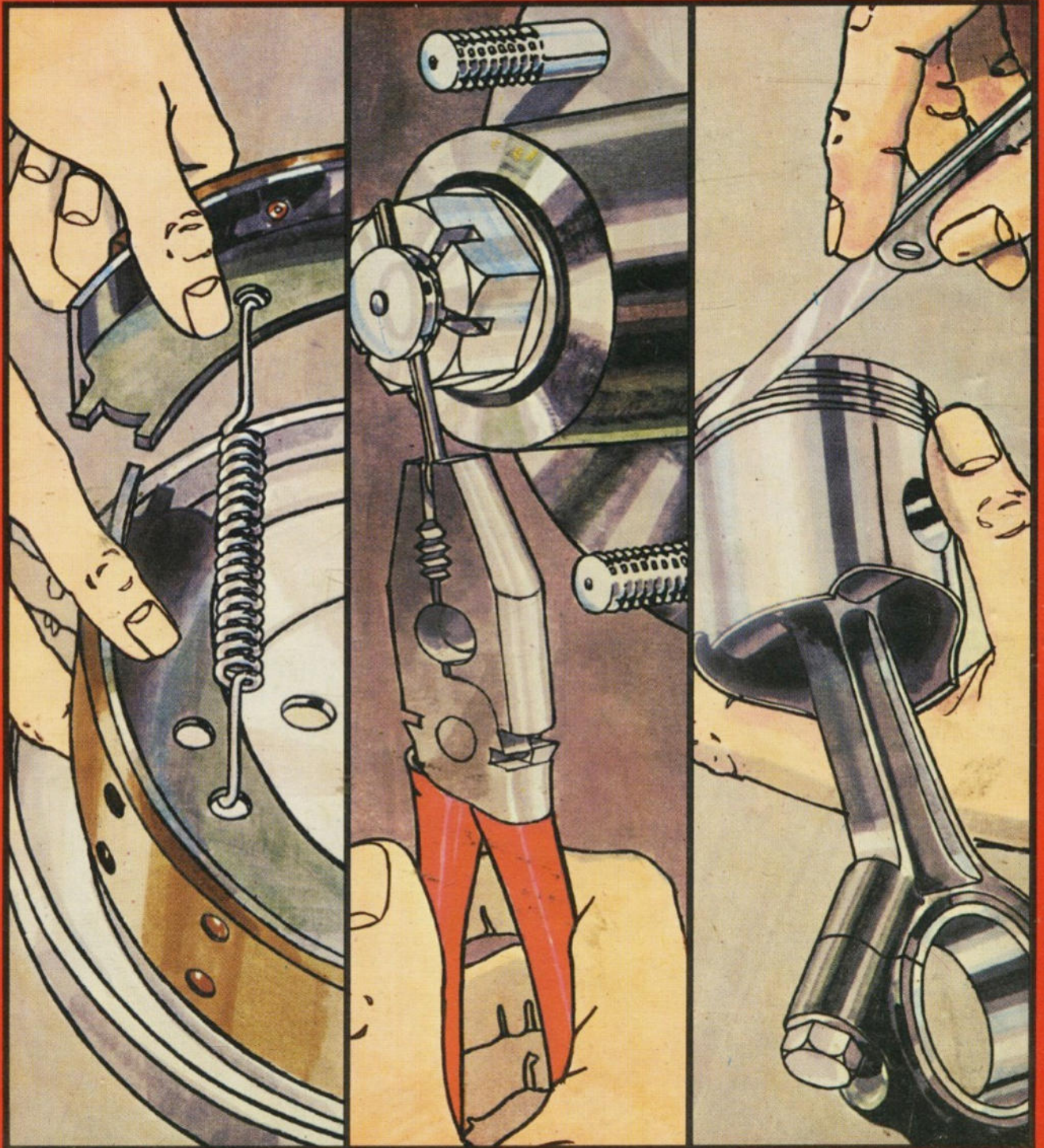
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THE GEARBOX

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Autobooks



CHAPTER 6

THE GEARBOX

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6:1 Description

The gearbox and differential are in unit with the engine and situated in the lower half casing. Synchromesh assistance is now fitted as standard to all models covered by the manual but the original models had a straight gear-change.

As similar to the engine, due to the compact design of the complete power unit, it is considered advisable to completely remove the power unit before attempting any rectification work. It is a simple operation to remove the power unit full details of which are given in **Chapter 1**. The gearbox is very reliable and there should be no for-see reason why it should be dismantled except at high mileage when major overhaul is necessary.

All models are fitted with four forward gears and reverse and these are shown in exploded view form in **FIG 6:1**. Throughout this chapter there are copious illustrations to assist in dismantling and reassembling the various components.

6:2 Synchromesh transmission (dismantling and overhaul), Prinz 1, 2 and 3

Dismantling:

This may only be dismantled with the engine away from the car and stripped as far as removing the differential unit. Then proceed as follows:

- 1 Using a rubber faced hammer, lightly tap the underside of the differential unit as shown in **FIG 1:46** and lift away from the transmission casing.
- 2 Remove the three snap rings on the selector fork shaft. Undo the three bolts and spring washers holding the retainer plate to the casing and lift away the retainer plate.
- 3 Using a suitable size parallel pin punch drive out the selector shafts from below and lift away the selector shafts together with their forks still attached. At the same time also lift away the mainshaft and its shims as one complete assembly as shown in **FIG 6:2**.

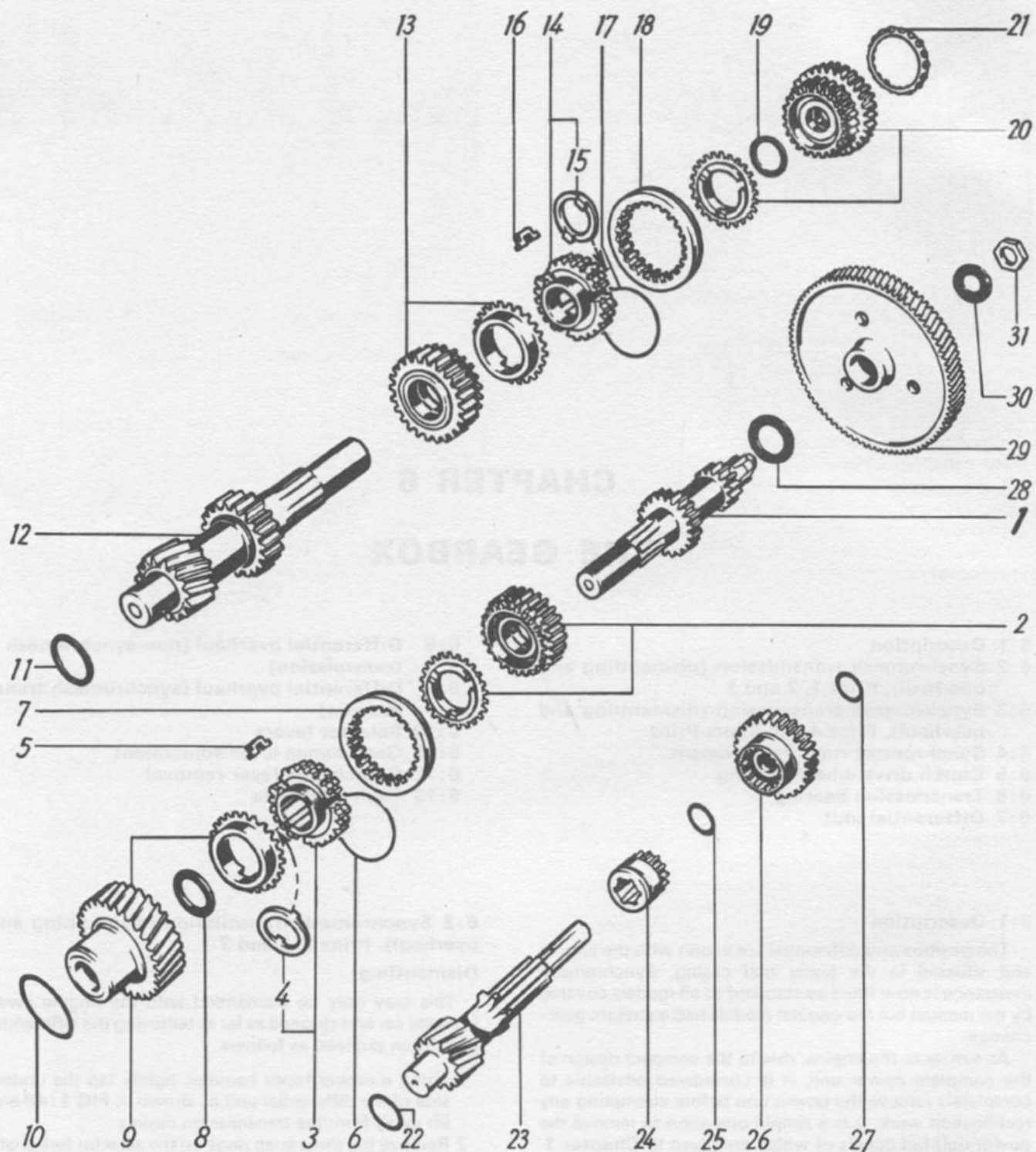


FIG 6:1 Gearbox internal components

Key to Fig 6:1	1 Mainshaft	2 Pinion and synchronizer ring	3 Hub assembly	4 Engagement plate	5 Distance piece
6 Spring ring	7 Sliding sleeve	8 Washer	9 Pinion and synchronizer ring	10 Ring	11 Ring
12 Layshaft	13 Pinion and synchronizer ring	14 Hub assembly	15 Engagement plate	16 Distance piece	17 Spring ring
18 Sliding sleeve	19 Washer	20 Double pinion	21 'Star' ball retainer	22 Thrust washer	23 Reverse shaft
24 Reverse selecting gear	25 Thrust washer	26 Pinion for reverse shaft	27 Thrust washer	28 Washer	29 Pinion
30 Locking plate	31 Nut				

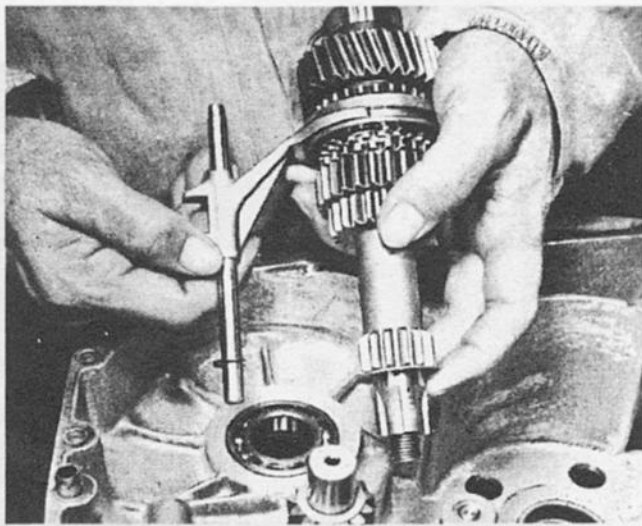


FIG 6:2 Mainshaft removal

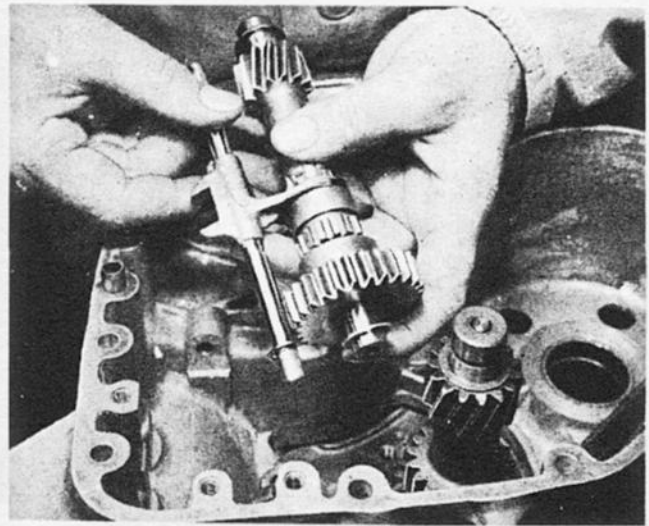


FIG 6:3 Reverse shaft removal

- 4 Remove the reverse shaft in the same manner as the mainshaft (see FIG 6:3).
- 5 Lift away the complete layshaft assembly which will include selector shafts, fork, shims and ballrace bearing as shown in FIG 6:4.

Reassembly:

- 1 It is first necessary to measure the axial play for which the thrust washers must be fitted between the gears and shafts. Refit the layshaft with the ballrace bearing at the twin gearwheel. The mainshaft and reverse shaft should be refitted with only one thrust washer to each.
- 2 Using a vernier depth gauge measure the depth of the righthand crankcase housing to the gears as shown in FIG 6:5 left. This is dimension A. Next measure the lefthand crankcase housing surface to gearshaft bushing seat as shown in FIG 6:5 right. This is dimension B.
- 3 Repeat the same above procedure for all three shaft bushings. Once all dimensions have been determined, subtract dimension B from dimension A, giving a new figure C. From this deduct the thickness of the gasket D, this being .2mm. The result will be the thickness of shims required to correctly position the gears and shafts.

Example.

Dimension A = 10.0 mm
Dimension B = 5.0 mm

$C = A - B = 5.0 \text{ mm}$
D = .2 mm
Shim thickness = 4.8 mm

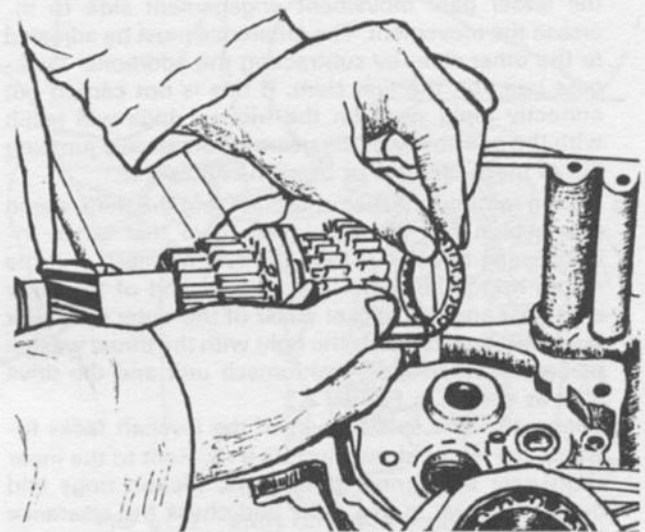


FIG 6:4 Layshaft removal

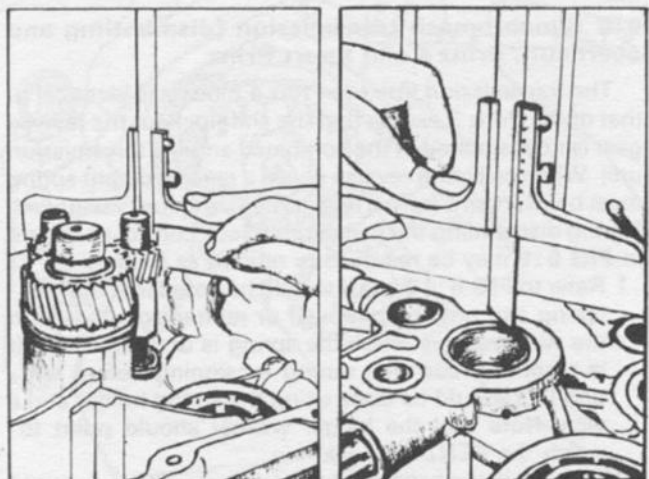


FIG 6:5 Righthand crankcase housing measurement

- 4 Fit the previously determined shims to the respective gearshafts and refit the gears to the casing leaving out the differential unit and the crankshaft. The synchromesh units should then be inspected as follows:
 - (a) Move the friction rings with a screwdriver to ensure that they are free to move along their axes.
 - (b) Check that when the outer shift gear has the same movement from one position to the other the friction rings are still free to move. If not fit a thicker shim on

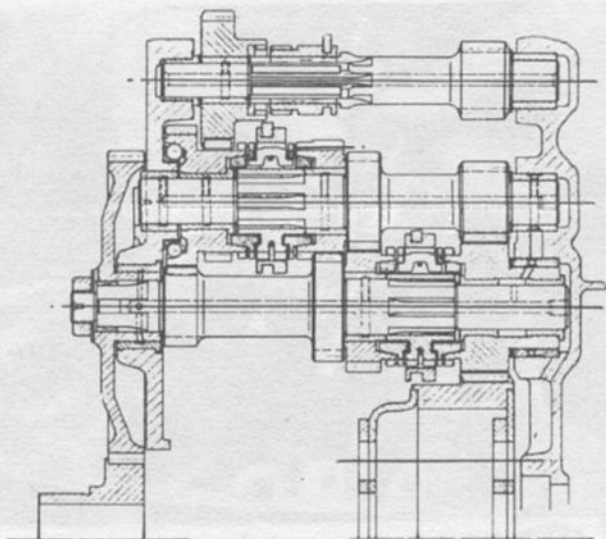


FIG 6:6 Cross section of gearbox

the lesser gear movement engagement side to increase the movement. The difference must be adjusted to the other shim by subtracting the additional thickness used on the first shim. If this is not carried out correctly rapid wear on the friction rings will result with the possibility of the gears automatically jumping out of mesh on drive or overrun conditions.

- 5 During refitting the mainshaft first refit the third-speed gear which has 26 teeth. Take care that when installing the three keys from the synchromesh unit the spring ring is not bent. The splined end of the inner shift gear and the thicker collar of the outer shift gear face must face towards the right with the thrust washer placed between the synchromesh unit and the drive gear as shown in FIG 6:7.
- 6 Ensure that the splined part of the layshaft faces towards the left as shown in FIG 6:6. Refit to the inner shaft gear the spring, three keys, friction rings and outer shift gear in this order and check the clearance between the friction rings and the synchromesh unit. The clearance must be .7 mm, if not the rings must be renewed (see FIG 6:8).

6:3 Synchromesh transmission (dismantling and overhaul), Prinz 4 and Sport Prinz

The transmission fitted to Prinz 4 models is identical to that of the Prinz 3 except that the shift lock for the reverse gear is now situated in the combined engine/transmission unit. When selecting reverse speed a reverse detent spring must be overcome before reverse can be actually engaged. During dismantling the reverse shift lock control as shown in FIG 6:9 may be removed or refitted as follows:

- 1 Refer to FIG 6:10 and it should be noted that the lock-spring can only be removed or refitted together with the two washers when the spring is under tension. It is recommended that during tensioning before refitting this should be done using the spring holder and a vice. Note that the longer washer should point towards the BENZING lock ring.
- 2 To remove the bellcrank lever both wire springs should be removed in addition to the lock ring.

6:4 Synchronizer rings replacement

In order to complete this job satisfactorily the engine unit must be removed from the car, full details of which are given in Chapter 1, Sections 1:3 or 1:4.

Dismantling:

- 1 Refer to FIG 1:11 and FIG 1:12 and remove the air cooling funnel and coverplate. Also remove the clutch and housing, details of which are given in Chapter 1, Section 1:5 and finally withdraw the transmission drive gear from the mainshaft.
- 2 Undo the six retaining bolts for the bearing cover and using a parallel pin punch as shown in FIG 6:11 carefully drive out both the shift fork shafts from the bearing cover and replace these into the housing. Take note that the long shaft is for the reverse gear whilst the short shaft is on the mainshaft.
- 3 Screw an M5 bolt onto the shift fork shaft of the countershaft and remove the shaft using a pair of pliers (see FIG 6:12). Lift away the compensation washer on the mainshaft and the reverse gearshaft. Also remove the double gearwheel on the layshaft and the gearwheel on the reverse gearshaft (see FIGS 6:13 and 6:14). Note that there is a thrust washer that must not be misplaced.
- 4 Insert a piece of non-fluffy rag to catch any displaced parts and then engage reverse gear by pressing the synchronizer ring on the layshaft with the thumb towards the inside. Raise the shift fork towards the top and press the shift sleeve with fork from the carrier and swing out carefully as shown in FIGS 6:13 and 6:14.

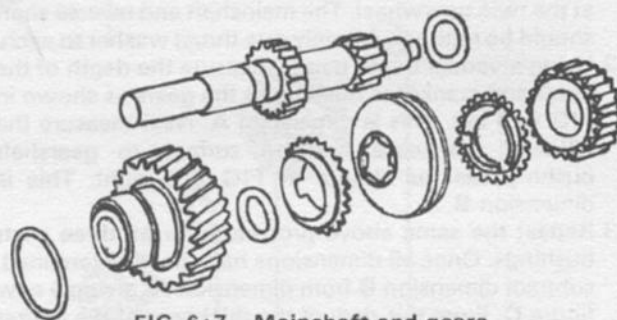


FIG 6:7 Mainshaft and gears

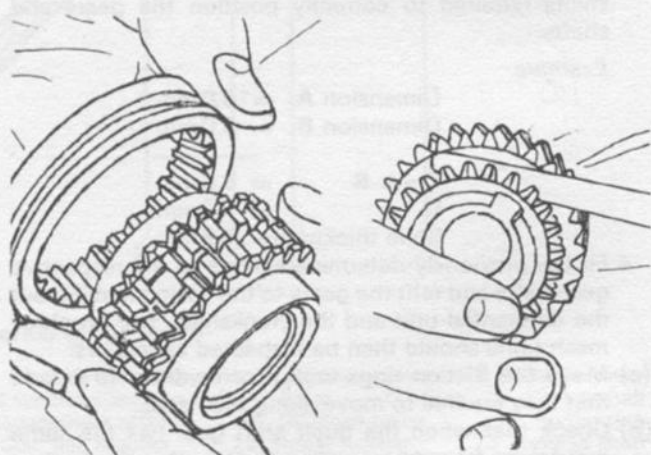


FIG 6:8 Friction ring and synchromesh unit measurement

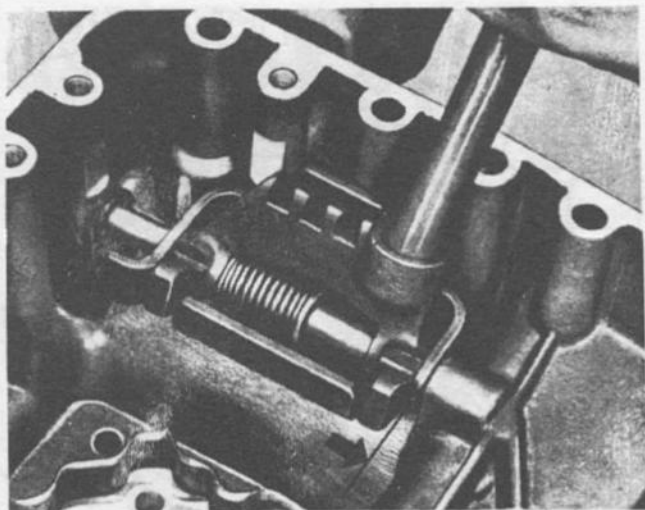


FIG 6:9 Reverse shift lock control

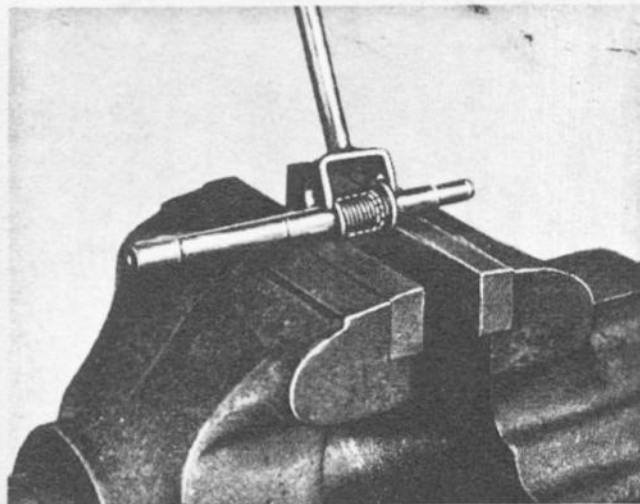


FIG 6:10 Lock spring assembly

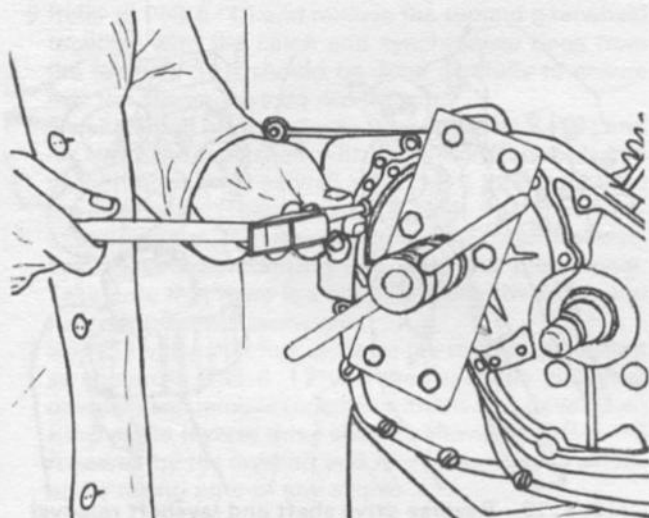


FIG 6:11 Bearing cover and removal of shift fork shafts

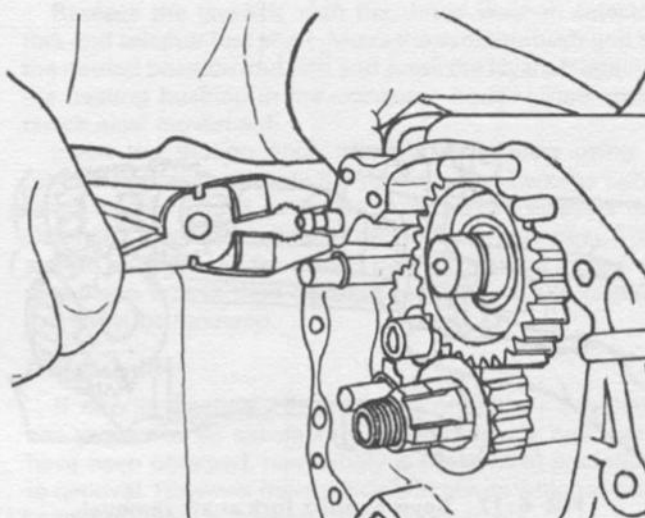


FIG 6:12 Shift fork shaft removal

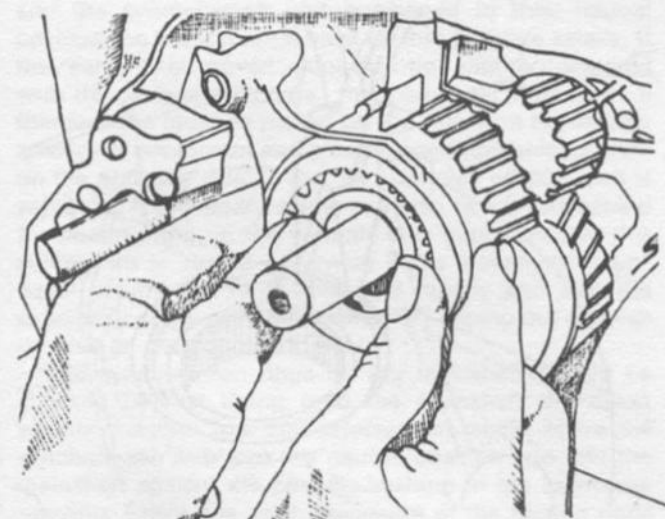


FIG 6:13 Layshaft double gearwheel removal

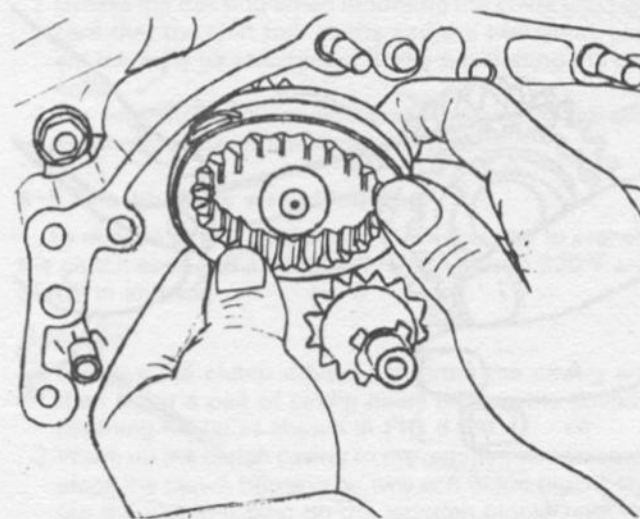


FIG 6:14 Synchro hub removal

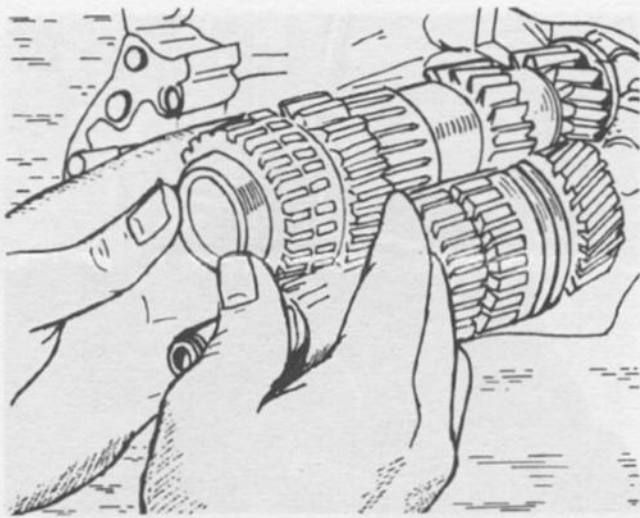


FIG 6:15 Second gearwheel removal

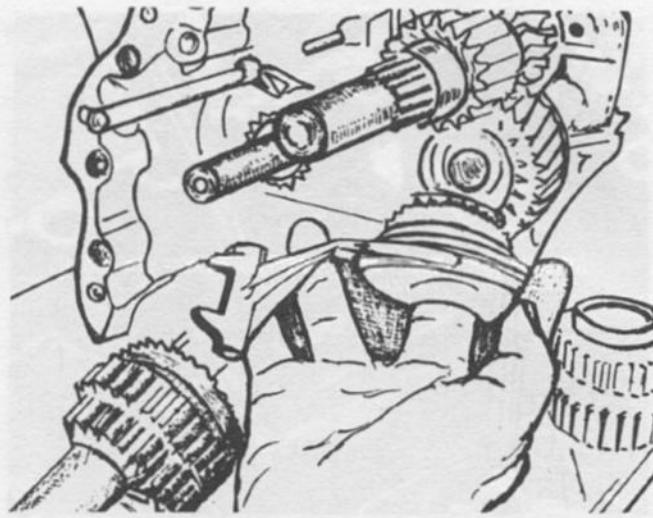


FIG 6:16 Synchro unit removal

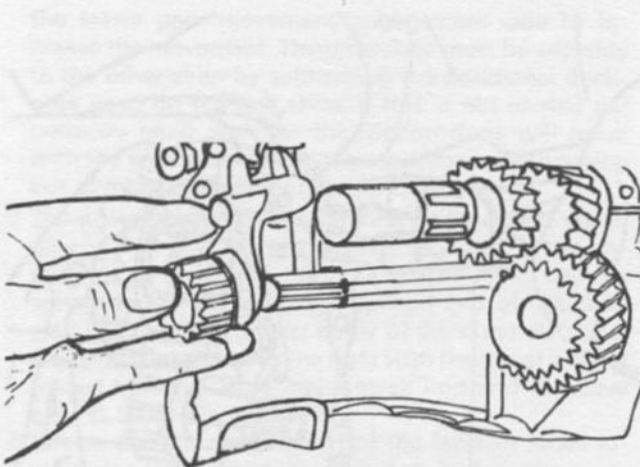


FIG 6:17 Reverse shift fork shaft removal

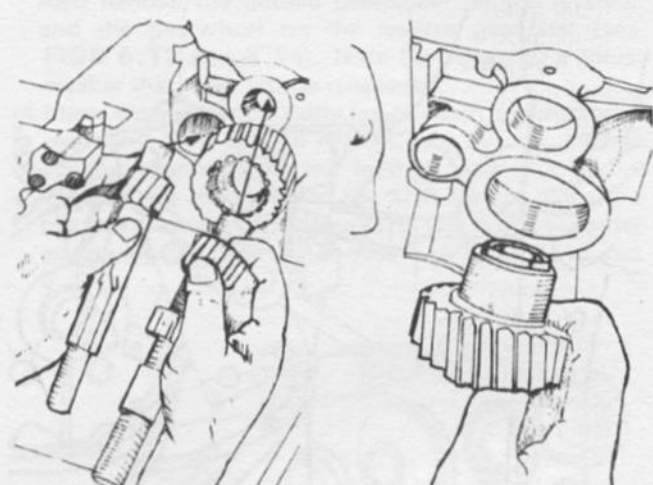


FIG 6:18 Reverse drive shaft and layshaft removal

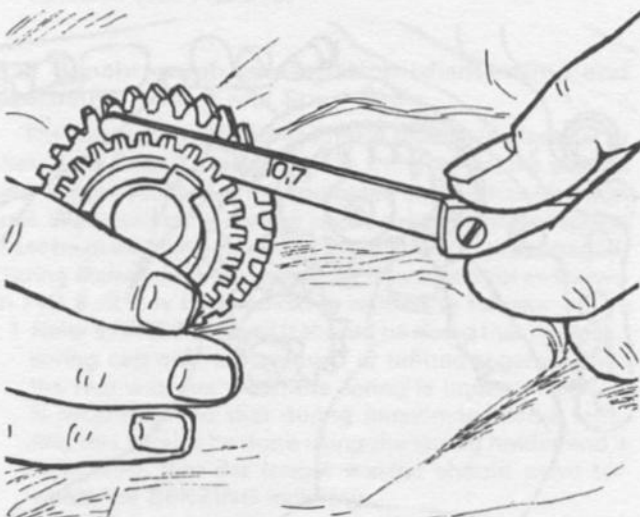


FIG 6:19 Shift gear and friction ring measurement

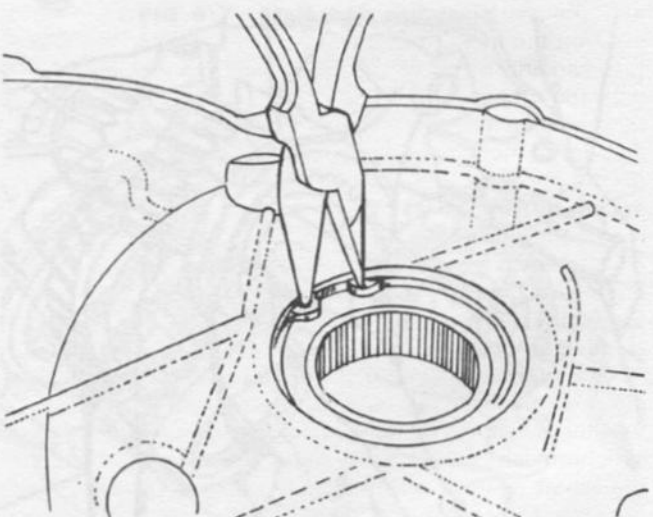


FIG 6:20 Ball race retaining circlip removal

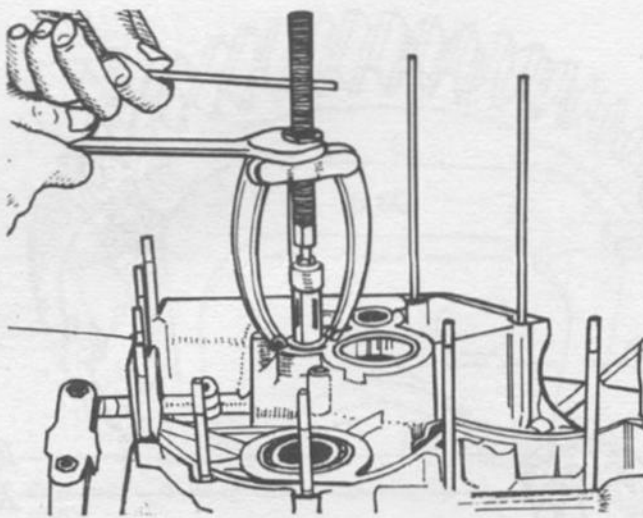


FIG 6:21 Transmission bushing removal

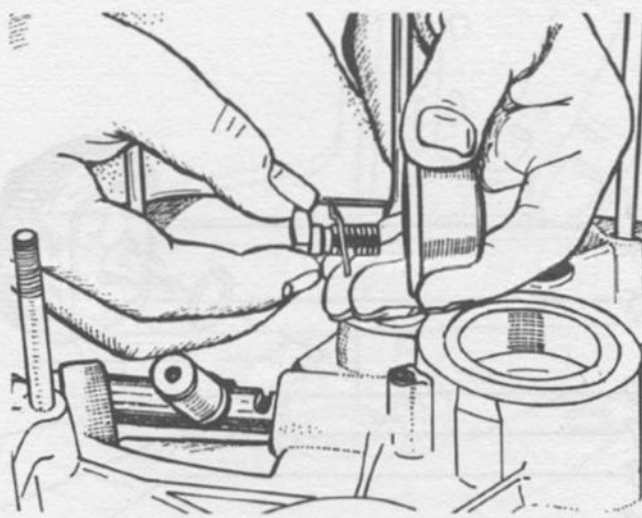


FIG 6:22 Transmission bushing cover removal

- 5 Refer to FIG 6:15 and remove the second gearwheel together with the catch and synchronizer rings from the layshaft. This should be done carefully to ensure that the spacer keys do not fall out.
- 6 Carefully pull off the reverse gear (see FIG 6:16) and lift away the mainshaft with the third gearwheel and synchronizer rings as well as the shift fork shaft from the mainshaft. Then move the shaft into the third-speed position. Remove the shift fork with shift sleeve, catch and synchronizing ring from the fourth gear. Take note that there is a shim between the catch and the fourth-speed gearwheel.
- 7 Withdraw the shift fork shaft for the reverse drive shaft as shown in FIG 6:17 and then turn the shift fork upwards and remove together with the dog drive. Then remove the reverse drive shaft as shown in FIG 6:18 followed by the layshaft and fourth-speed gearwheel, again taking note of any shims.

Inspection:

With the various parts assembled onto the mainshaft and the synchromesh unit positioned in their neutral position the friction rings must be free to move axially. If they can only be moved in one direction slightly compared with the other direction, i.e., the movement is unequal, a thinner shim must be placed on the side with the smaller amount of movement and a correspondingly thicker shim on the opposite side so that an axial play of .008 inch is achieved. If necessary shims can also be placed behind the bearing ring on the layshaft. It is important that this adjustment is correct otherwise if the movement is unequal the friction rings will wear rapidly and also the possibility of the gears automatically jumping out of mesh on drive or overrun conditions.

The synchromesh rings on the mainshaft should be checked by first fitting onto the mainshaft the thrust washer, selector fork and selector fork shaft. Move the synchromesh hub into the neutral position and refit the mainshaft against the bearing bushing in the crankcase housing. Check the axial movement of the friction rings using a little mirror for assistance.

Replace the layshaft with the thrust washer, selector fork and selector fork shaft. Move the synchromesh unit to the neutral position and refit and press the layshaft against the bearing bushing in the crankcase housing and again check axial movement.

Insert the friction rings into the shift gears using a rotational movement until the friction rings become tight. Using a feeler gauge as shown in FIG 6:19 measure the distance between the friction ring and the shift gear. This should be .028 inch for correct operation. If the measured dimension is less than the required amount the friction ring must be renewed.

Reassembly:

If after inspection of the friction rings their condition has proved to be satisfactory or alternatively new parts have been obtained, reassembly is the reverse procedure to removal. However there are certain points which should be noted which will assist during reassembly.

- 1 Always use a little grease on the shims when they are being placed in their correct positions to ensure that they do not drop out easily.
- 2 Grease the ball ring when mounting the cover and take care that the shift fork shafts and the two guide pins are correctly located before finally positioning the end cover.
- 3 For reference the correct location of the gears and synchromesh units are shown in FIG 6:1.

6:5 Clutch drive wheel bearing

To remove or refit the bearing it is necessary to preheat the clutch casing to a temperature of between 320°F and 356°F in an oven.

Removal:

- 1 Remove the clutch drive wheel from the casing and then using a pair of circlip pliers remove the ballrace retaining circlip as shown in FIG 6:20.
- 2 Warm up the clutch casing to the required temperature, place the clutch housing on two soft wood blocks and tap the clutch casing on the wooden blocks until the oil seal and ballbearing fall out.

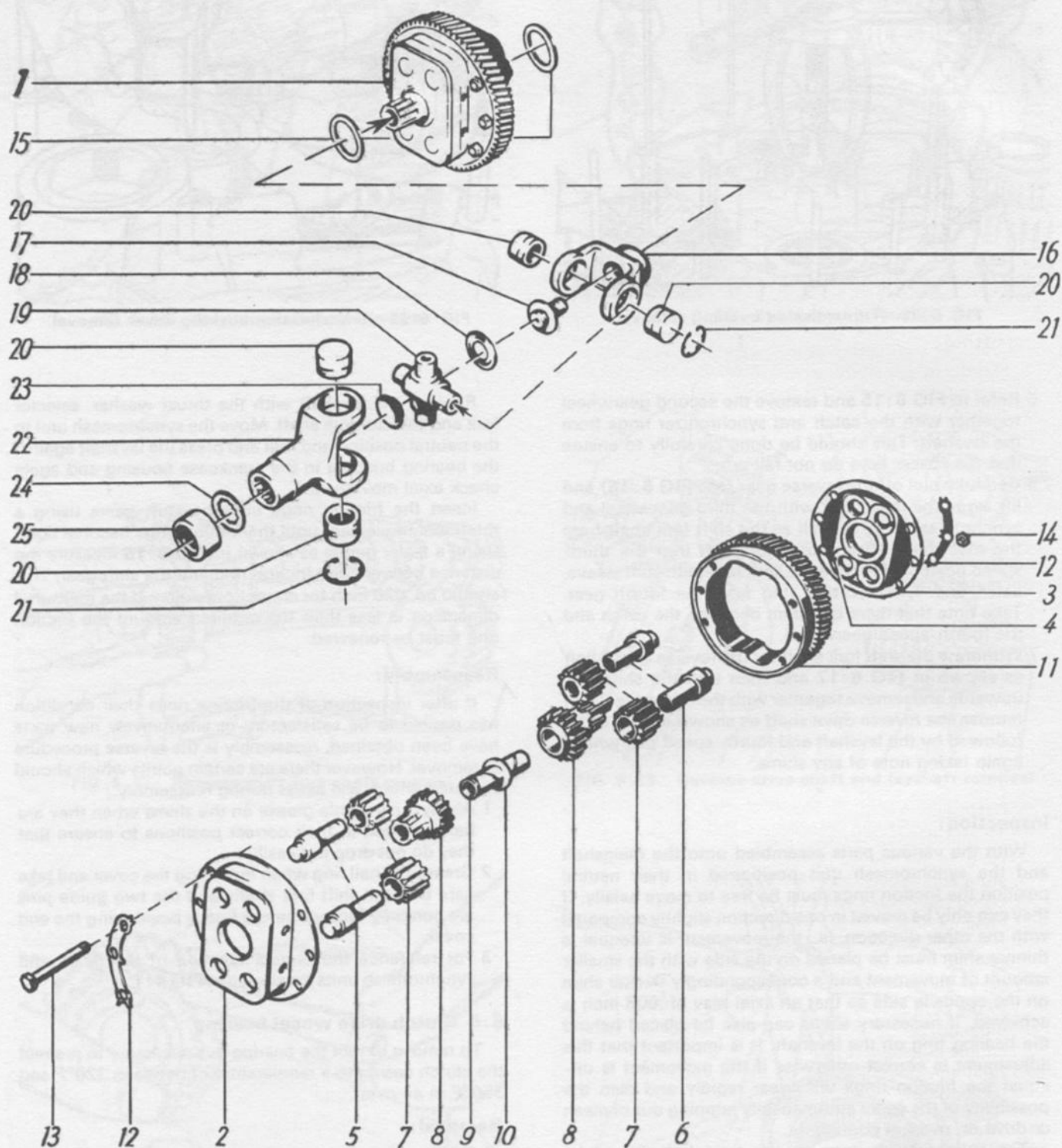


FIG 6:23 Differential unit component parts

Key to Fig 6:23 1 Differential 2 Housing half 3 Housing cover 4 Cylindrical peg 5 Pin 6 Pin 7 Planetary wheel
 8 Drive gear for rear wheel 9 Shaft 10 Shoulder 11 Differential drive gear 12 Locking plate 13 Bolt 14 Nut
 15 Compensating washer 16 Fork link, inner 17 Tapered bolt 18 Locking plate 19 Spider 20 Needle bearing bush
 21 Seeger locking washer 22 Fork link, outer 23 Plug 24 Sealing washer

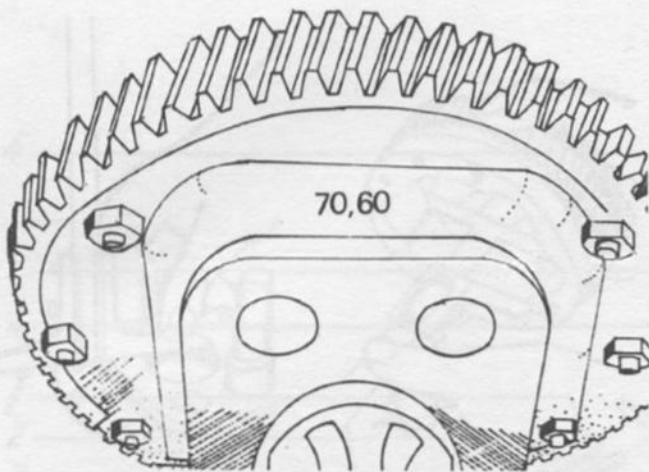


FIG 6:24 Driving wheel clearance identification in mm's

Refitting:

In order to refit a new bearing and oil seal it is necessary to heat up the clutch casing to the required temperature and then using a suitably sized drift, carefully tap the bearing and oil seal into position making sure that they are fitted the correct way round.

6:6 Transmission bearings

To enable the transmission bearings to be removed or replaced it is necessary for the crankcase housing to be preheated to a temperature of 320°F to 356°F in an oven.

Removal:

- 1 Using a bearing puller as shown in FIG 6:21 carefully withdraw the bushing.
- 2 The bushing for the driving wheel on transmission units fitted with non-synchromesh type of gears can only be removed once the bolt, locking washer and cup have been removed as shown in FIG 6:22.

Refitting:

To refit the bushings it is necessary for the crankcase housing to be heated to the required preheated temperature and then proceed as follows:

- 1 Using a suitably sized drift carefully replace the bushes ensuring that they are correctly positioned first time as they cannot be moved once the casing has been allowed to cool.
- 2 When the driving wheel bushing has been reamed out to the correct size using a compressed air jet carefully blow out all signs of swarf or dust especially from the engine oil channels.
- 3 Refit the driving wheel bushing cup and secure in position with the lockbolt and tabwasher.

6:7 Differential unit

Removal:

With the two halves of the transmission unit separated the differential unit may be lifted out by very carefully striking the underside of the unit with a rubber faced hammer whilst lifting upwards as shown in FIG 1:46.

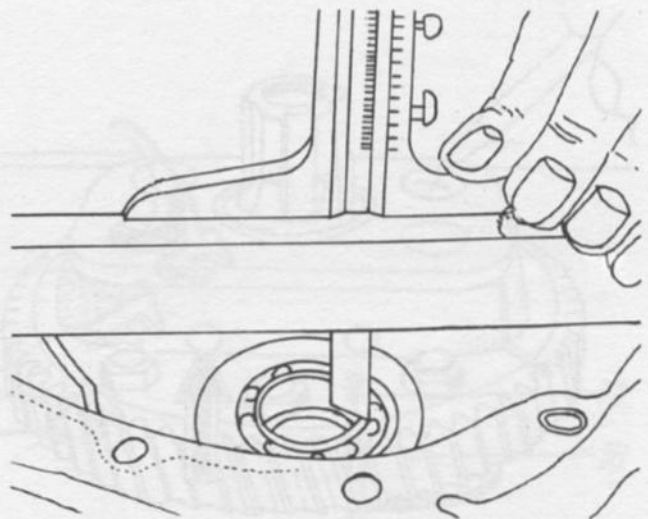


FIG 6:25 Determination of casing half depth

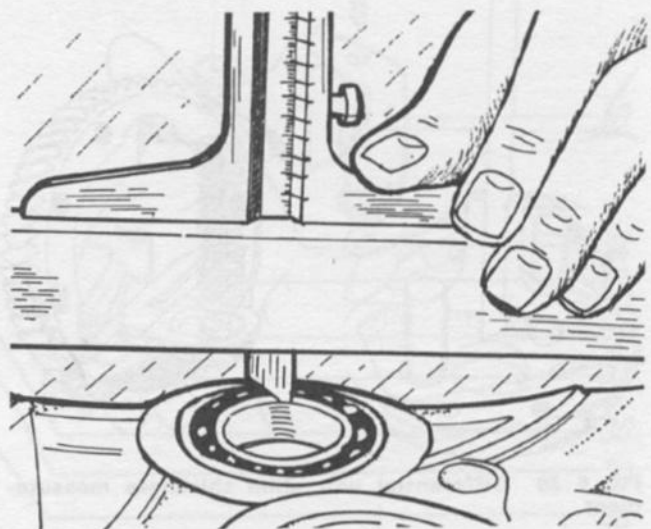


FIG 6:26 Determination of casing half depth

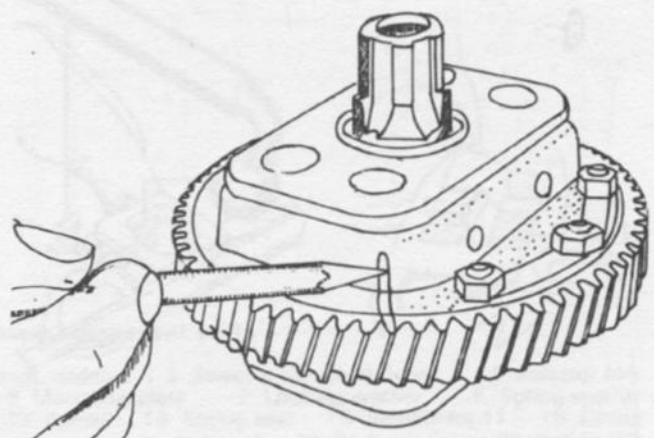


FIG 6:27 Ring gear and housing mating marks

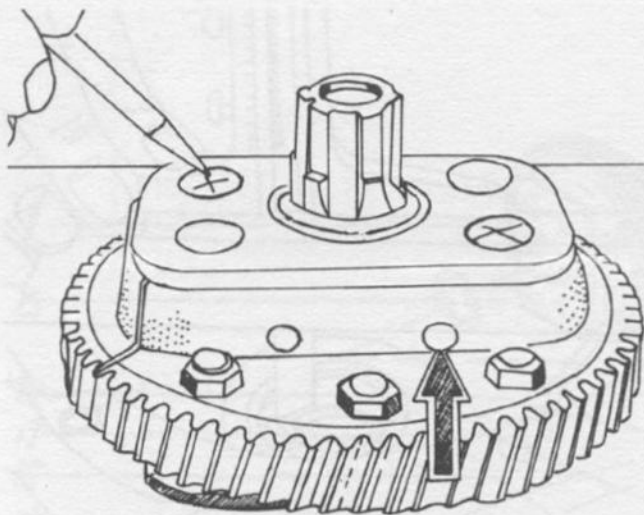


FIG 6:28 Pinion gear shaft identification marks

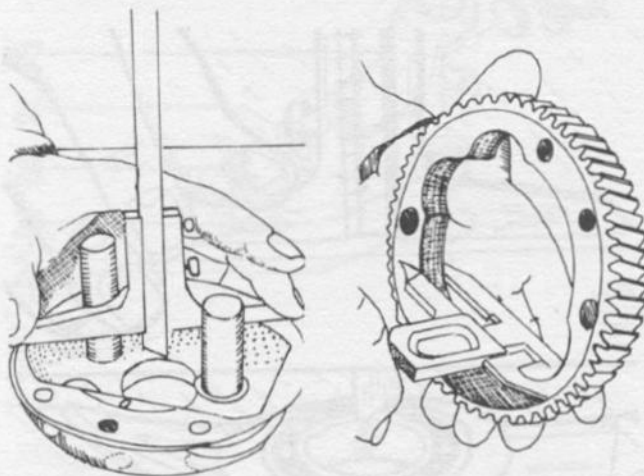


FIG 6:29 Differential unit shim thickness measurement

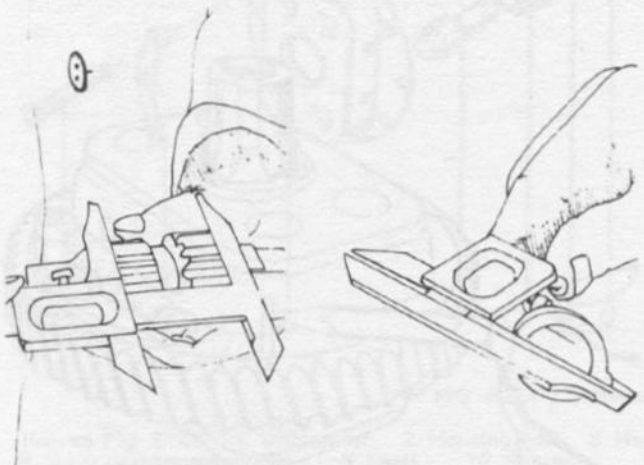


FIG 6:30 Differential side gears and shim measurement

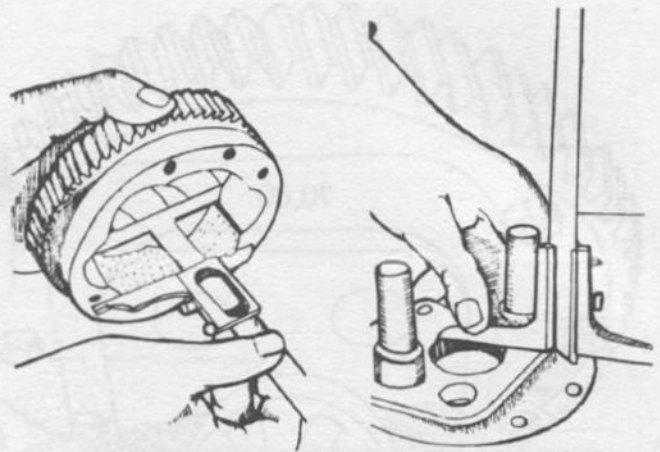


FIG 6:31 Differential unit cover measurement

Refitting:

- 1 Upon refitting the differential unit it is most important that the nuts on the differential must face upwards. Should new parts be fitted the differential axial play must be reset. Reference to FIG 6:24 shows the clearance in millimetres between the driving wheels marked on the differential casing. This figure represents the distance between the thrust faces of the differential unit allowing an axial play of approximately .012 inch on the differential shaft. This dimension should be measured by using a vernier depth gauge, the depth of the two halves of the casing as shown in FIG 6:25 and FIG 6:26.

The dimension must correspond to the measurement on the differential casing and any variation as measured should be adjusted by using shims. The thickness of the gasket should be allowed for in this determination and this is normally .008 inch thick.

6:8 Differential overhaul (non-synchromesh transmission only)

- 1 Refer to FIG 6:27 and mark the ring gear and housing so that they may be replaced in their same respective positions during reassembly. Open the locking washers for the nuts and bolts and remove the nuts and carefully drift out the bolts.
- 2 Refer to FIG 6:28 and mark the pinion gearshafts on the side where the pinion gears are located. This is the side where there are drill holes as shown by the arrow. Using a suitably sized parallel punch drive out the pinion gearshafts. Once the shafts have been removed mark the pinion gears and the differential side gears to ensure correct reassembly.

Inspection:

Carefully inspect the gears, bushing and shafts and replace any parts that show signs of excessive wear or damage. Check that the axial play is not greater than .3mm.

It will be observed on dismantling that several shims are used and it is advisable to recheck that the correct size shims are to be fitted as follows:

- 1 Measure the distance between the surface of the left-hand housing and the face of the bushing as shown in FIG 6:29 left.

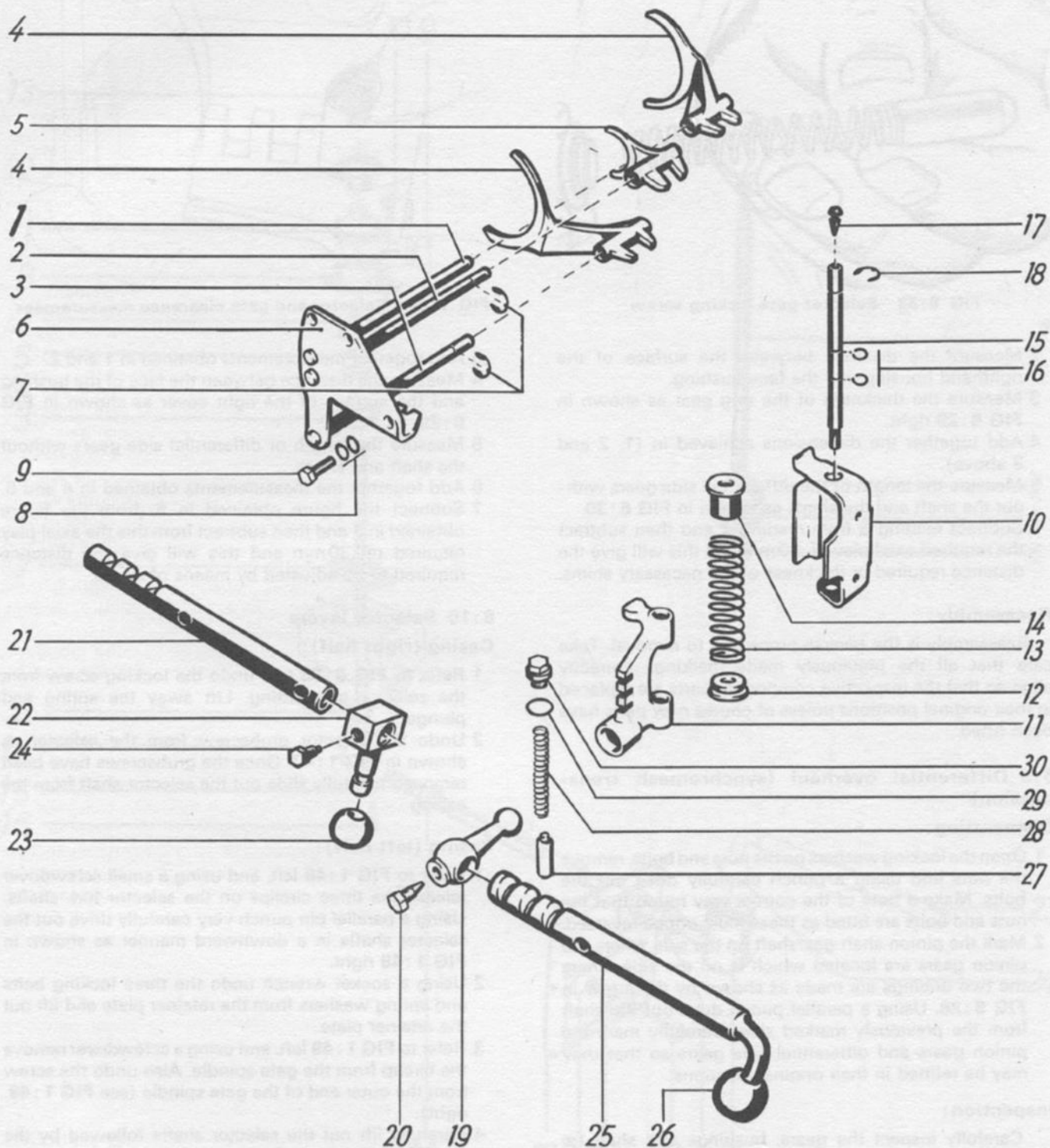


FIG 6:32 Gear selector system component parts

Key to Fig 6:32 1 Selector fork shaft, upper 2 Selector fork shaft, middle 3 Selector fork shaft, lower 4 Selector fork for 1st, 2nd, 3rd and 4th gear 5 Selector fork for reverse gear 6 Mounting plate 7 Locking washer 8 Spring washer 9 Hexagon screw 10 Stop 11 Bracket lever 12 Spring cup 13 Spring 14 Spring seat 15 Spindle for 11 16 Circlip 17 Rubber stop 18 Locking washer 19 Shift rod link 20 Pointed screw 21 Shift rod 22 Shift rod link 23 Ball for 22 24 Pointed screw for 22 25 Gearshift lever 26 Ball knob 27 Stop bolt 28 Stop spring 29 Sealing ring 30 End plug

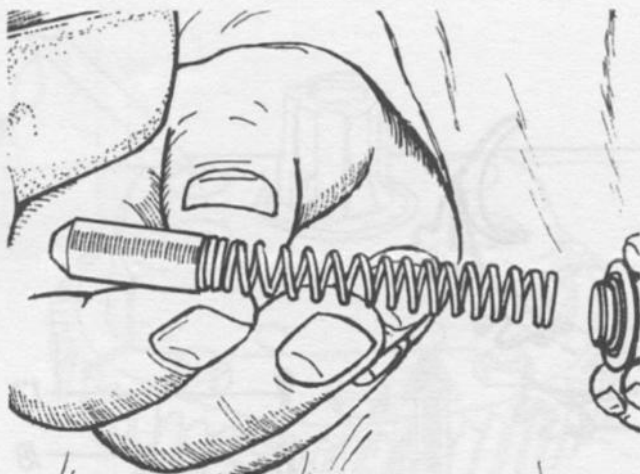


FIG 6:33 Selector gate locking screw

- 2 Measure the distance between the surface of the righthand housing and the face bushing.
- 3 Measure the thickness of the ring gear as shown in FIG 6:29 right.
- 4 Add together the dimensions achieved in (1, 2 and 3 above).
- 5 Measure the length of the differential side gears without the shaft and the shims as shown in FIG 6:30.
- 6 Subtract reading 5 from reading 4 and then subtract the required axial play of .30mm and this will give the distance required or thickness of the necessary shims.

Reassembly:

Reassembly is the reverse procedure to removal. Take care that all the previously made markings correctly align so that the respective component parts are replaced in their original positions unless of course new parts have been fitted.

6:9 Differential overhaul (synchromesh transmission)

Dismantling:

- 1 Open the locking washers on the nuts and bolts, remove the nuts and using a punch carefully drive out the bolts. Make a note of the correct way round that the nuts and bolts are fitted as these must not be reversed.
- 2 Mark the pinion shaft gearshaft on the side where the pinion gears are located which is on the side where the two drillings are made as shown by the arrow in FIG 6:28. Using a parallel punch drive out the shaft from the previously marked side. Carefully mark the pinion gears and differential side gears so that they may be refitted in their original positions.

Inspection:

Carefully inspect the gears, bushings and shaft for signs of wear or damage and refit new parts as necessary.

It is important that the axial play is .3mm and this may be adjusted by using shims the size of which may be determined as follows:

- 1 Refer to FIG 6:31 and measure the distance between the surface of the left cover and the face of the bushing using a depth gauge.
- 2 Measure the thickness of the ring gear.

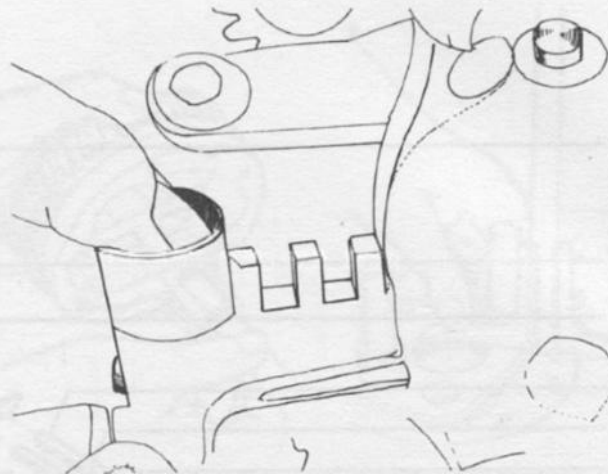


FIG 6:34 Selector and gate clearance measurement

- 3 Add together measurements obtained in 1 and 2.
- 4 Measure the distance between the face of the bushing and the surface of the right cover as shown in FIG 6:29.
- 5 Measure the length of differential side gears without the shaft and shims.
- 6 Add together the measurements obtained in 4 and 5.
- 7 Subtract the figure obtained in 6, from the figure obtained in 3 and then subtract from this the axial play required of .30mm and this will give the distance required to be adjusted by means of shims.

6:10 Selector levers

Casing (right half):

- 1 Refer to FIG 6:33 and undo the locking screw from the selector gate fitting. Lift away the spring and plunger.
- 2 Undo the selector grub screw from the selector as shown in FIG 1:47. Once the grub screws have been removed carefully slide out the selector shaft from the casing.

Casing (left half):

- 1 Refer to FIG 1:48 left, and using a small screwdriver release the three circlips on the selector fork shafts. Using a parallel pin punch very carefully drive out the selector shafts in a downward manner as shown in FIG 1:48 right.
- 2 Using a socket wrench undo the three locking bolts and spring washers from the retainer plate and lift out the retainer plate.
- 3 Refer to FIG 1:49 left, and using a screwdriver remove the circlip from the gate spindle. Also undo the screw from the outer end of the gate spindle (see FIG 1:49, right).
- 4 Carefully lift out the selector shafts followed by the selector arm, gate and the three forks.

Refitting:

Refitting is the reverse procedure to removal but the following points should be noted:

- 1 Using a feeler gauge determine the clearance between the selector and the gate as shown in FIG 6:34 and this must have a clearance of approximately .006 inch.