CHAPTER 6

THE GEARBOX

6:1 Construction and operation

The gearbox has four forward gears and one reverse, all the forward gears being engaged through blocker synchromesh units. The constant mesh gears between the countershaft, mainshaft and main-drive are helical to ensure quiet operation and reverse gear is the only spur cut gear in the box.

An exploded view of the mainshaft assembly is shown in **FIG 6:1** and the drive through the gearbox is illustrated in **FIG 6:2**.

Each synchronizer assembly consists of a hub which is splined to the mainshaft and a sleeve which is free to slide on splines on the outside of the hub. Three blocker bars are fitted in equally spaced slots around the outer circumference of the hub and are retained by two light springs.

A forged blocker ring is interposed between each syncrhonizer and forward gear. The blocker ring has dog teeth on its external diameter and is cutaway at three points to locate around the blocker bars in the synchronizer assemblies. A clearance of approximately half a pitch of a dog tooth exists between these cutouts and the blocker bars to allow the blocker ring a slight rotational movement in relation to the synchronizer assembly.

When engaging a forward gear the frictional drag between the blocker ring and the cone face on the gear will keep one side of the cut-outs against the blocker bars so that the blocker ring dog teeth are out of line with those on the synchronizer assembly. This prevents gear engagement until the speeds of the gear and synchronizer assembly are the same and the blocker bars become central in the cut-outs so that the dog teeth are in line.

Refer to **FIG 6:2**. In neutral the main drive gear rotates, driving the countershaft gear which in turn drives the first, second and third gears which are free to rotate on the shaft. The mainshaft, first/second gear synchronizer, third/top gear synchronizer and reverse idler are, of course, stationary.

To engage first gear the first/second gear synchronizer sleeve moves rearward over the blocker ring and its dog teeth engage with the dog teeth on the first gear. This locks the first gear to the mainshaft via the dog teeth coupling and splined fitting of the synchronizer hub on the mainshaft. Power is then transmitted from the main drive gear through the countershaft to the first gear and thus to the mainshaft.

To engage second, third and top gear the procedure is the same, the first/second and third/top gear synchronizer sleeve moves either forward or backward over the blocker rings to engage with the selected gear.

Reverse is engaged by moving the reverse idler forward, engaging with the spur gear on the countershaft and the spur gear machined on the outer diameter of the first/second gear synchronizer sleeve.

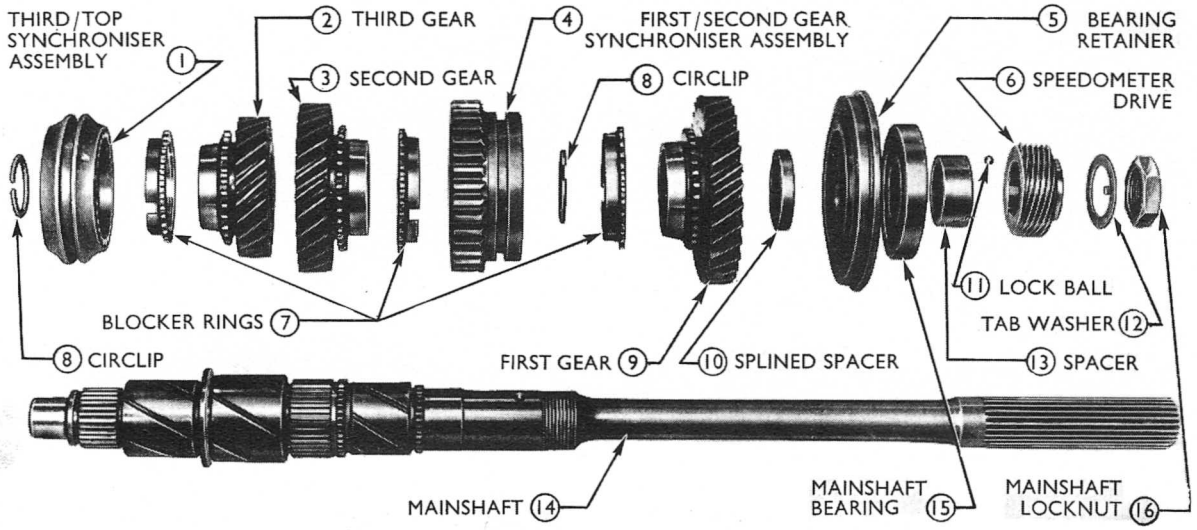


FIG 6:1 The mainshaft assembly—exploded view

6:2 Gearbox removal

1 Open the bonnet and disconnect the battery earth strap.
2 Remove the air cleaner.
3 Disconnect the throttle linkage at the carburetter by prising the black spring clip from the throttle lever.
4 (a) Column gearchange. Disconnect the gate selector cable and pivot arm which are located beneath the brake servo unit. The outer cable is secured by two locknuts and the pivot arm is retained by a locknut with a flat washer.
(b) Floor gearchange. Remove the centre console complete with upper rubber gaiter from between the front seats after unscrewing the four retaining screws and also the gearlever knob. Remove the lower rubber gaiter from around the gearlever. Slacken the lock bolt on the lower end of the gearlever and then remove the large through-bolt on which the lever pivots. Lift out the gearlever.
5 Jack-up the car and fit stands all round.
6 From beneath the car remove the two bolts securing the starter motor to the clutch housing. The starter motor may be moved to one side whilst still connected electrically.
7 (Column gearchange only) Disconnect the two rods (one each end), joined to the gear selector cross-shaft, by removing the special spring clips. Remove the gear selector cross-shaft. At one end it is secured to a pivot pin on the clutch housing by a spring clip with a flat and wave washer. At the other end it is secured to the body by a bracket held with two bolts.
8 If an overdrive or reversing light is fitted, disconnect the wiring from the switch at the front of the gearbox selector cover. Mark the wires for ease of reassembly.
9 Remove the clutch operating cylinder (see **Section 5:3**).
10 Remove the drive shaft (see **Chapter 7**).
11 Unscrew the speedometer gear retaining bolt from the extension housing. Remove the forked retainer and the speedometer cable.
12 Disconnect the exhaust pipes from the manifolds by removing the four securing bolts. Unscrew the clamp bolt securing the righthand exhaust pipe to the left-hand exhaust pipe and muffler assembly. Remove the righthand pipe. Pull the lefthand pipe to one side and hold it over with a piece of wire or string.
13 Fit a jack beneath the rear of the engine sump.
14 Remove the gearbox crossmember by unscrewing the centre bolt securing it to the gearbox and the two self-locking nuts and bolts securing it to the body.
15 Remove the six bolts securing the gearbox to the clutch housing.
16 Support the gearbox and slide it rearwards out of the clutch housing. During this operation do not allow the weight of the gearbox to hang on the clutch driven plate or serious damage may be done to the clutch. Lower the jack as necessary so that the gearbox clears the body.
17 Remove the clutch housing, if required, by first unscrewing the four bolts holding the lower dust cover to the front of the housing. Then remove the six bolts securing the clutch housing to the engine and detach the clutch housing. Note that one bolt also retains an earth strap.

6:3 Dismantling the gearbox

1 Remove the selector housing from the top of the gearbox casing by unscrewing the four bolts and washers. Remove the gasket and detent springs (see **FIG 6:3**).
2 Remove the extension housing as follows:
(a) Remove the speedometer driven gear and bearing.
(b) Unscrew the four bolts and spring washers securing the extension housing to the gearbox case.

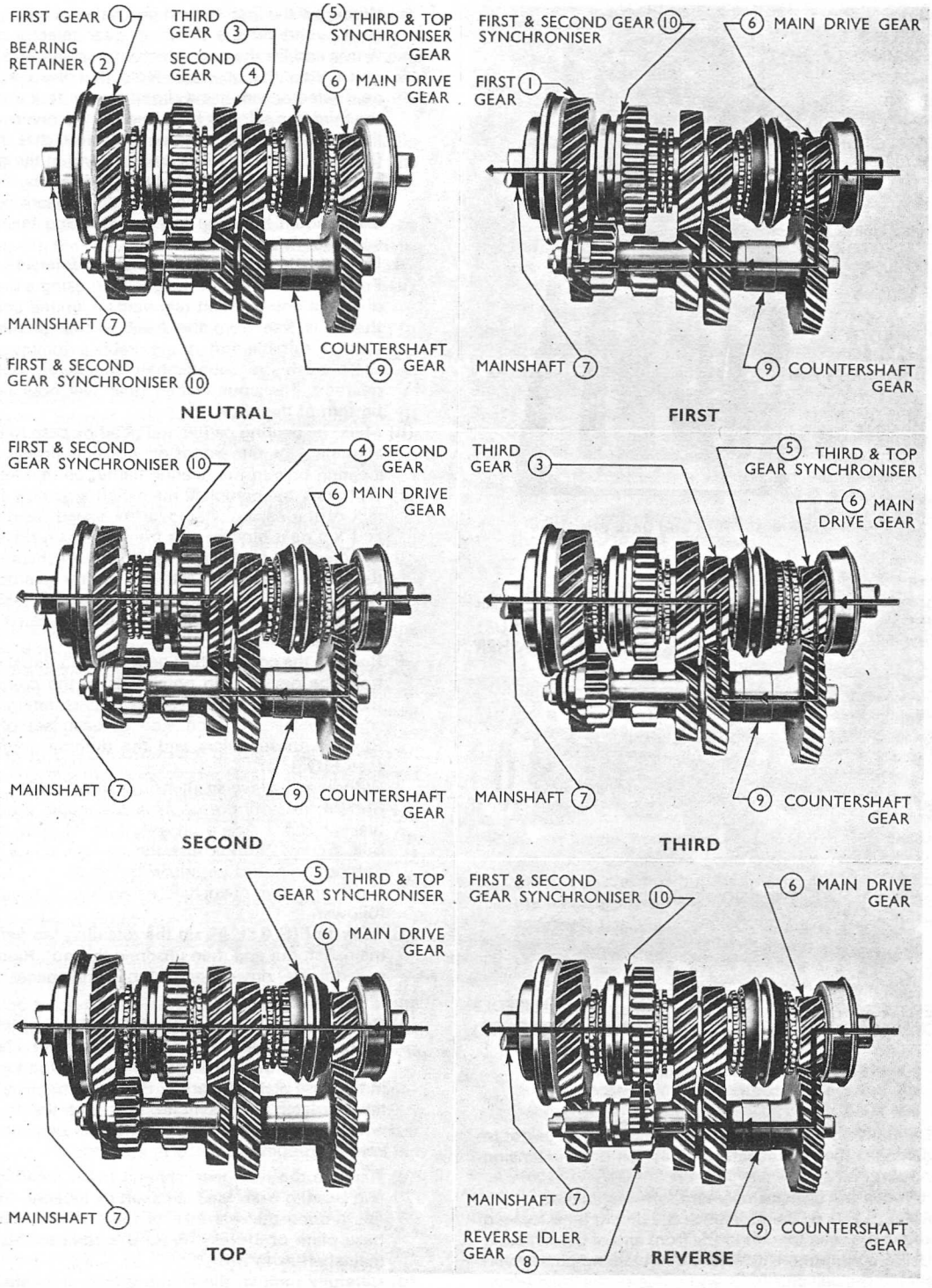


FIG 6:2 Power flow through the gearbox

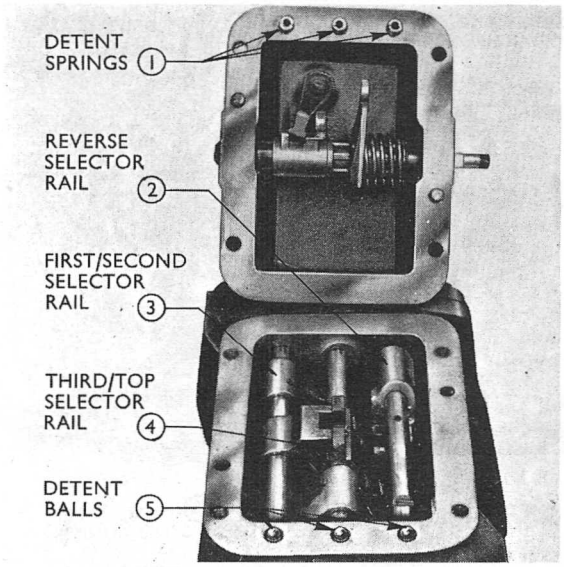


FIG 6:3 Selector fork and gate positions

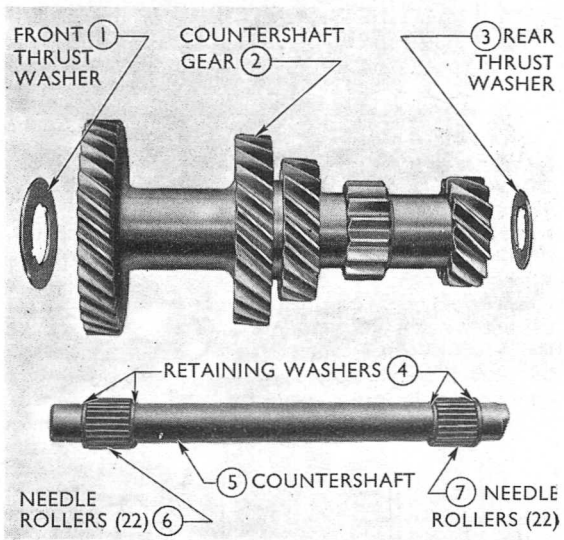


FIG 6:4 The countershaft assembly

(c) Carefully withdraw the extension housing so as not to damage the mainshaft splines or the extension housing oil seal.

3 Remove the selector rails and forks as follows:

(a) Refer to **FIG 6:3** and remove the detent balls located above the selector rails at the front end of the gearbox.

(b) Using a pin punch, drive out the retaining pins which secure the selector forks and gates to the rails. When carrying out this operation, hold the lower end of the pins with a piece of wire to prevent them falling into the gearbox.

(c) Withdraw the first/second gear selector rail rearwards. Now withdraw the third/top gear selector rail rearwards and lift the two selector forks and two selector gates from the gearbox. Note that the first/second gear selector fork has a slightly larger fork width than the third/top selector fork. Remove the reverse rail and lift out the reverse selector fork. Note that there is a floating pin located in a cross drilling in the third/top selector rail and two interlock plungers between the selector rail bores in the front of the gearbox casing. Care should be taken to prevent losing them during subsequent operations.

4 Remove the mainshaft assembly as follows:

(a) From the front face of the gearbox, using a brass drift, drive the countershaft rearwards a limited amount so that it is free from the front of the gearbox case. Using a suitable drift, or preferably a dummy countershaft, push the countershaft completely out of the gearbox. The countershaft gear will now lie at the bottom of the case.

(b) Mark the bearing carrier and gearbox case to facilitate alignment of the extension housing dowel and the locating hole in the bearing carrier on reassembly.

(c) Withdraw the complete mainshaft assembly from the rear of the casing. Remove the caged needle rollers and top gear blocker ring from the main drive gear.

5 Unscrew the four bolts and spring washers securing the main drive gear retainer to the gearbox case. Withdraw the retainer and paper gasket, taking care not to damage the seal. Carefully tap out the main drive gear.

6 Remove the countershaft gear and two thrust washers from the gearbox. In both ends of the countershaft there are twenty-two needle rollers retained by a small washer on each side of each set of rollers. Remove these rollers and the dummy countershaft (see **FIG 6:4**).

7 Withdraw the reverse idler shaft with Tool No. P.7043. Should this tool not be available locate a nut, a flat washer and a sleeve on a $\frac{5}{16}$ inch 24 UNF threaded bolt. Screw the bolt into the reverse idler shaft and tighten the nut to withdraw the shaft.

8 Dismantle the mainshaft assembly, if required, as follows:

(a) Refer to **FIG 6:1**, lift up the retaining tab behind the mainshaft nut and then unscrew this nut. Remove the speedometer drive gear, lock ball and spacer from the mainshaft.

(b) Remove the circlip from the forward end of the mainshaft and discard it. Locate an adapter (Tool No. P.4090-7) around the rear face of the third gear and in the base plate of a press. Press the mainshaft out of the third/top gear synchronizer and the third gear whilst supporting the mainshaft from beneath to prevent it dropping.

(c) Remove the first gear, splined collar, bearing carrier and bearing from the mainshaft by locating the adapters around the rear face of the first gear and in the base plate of a press. Press the components off the mainshaft as in 8(b).

(d) Carefully remove the circlip which is located in the mainshaft behind the first/second gear synchronizer hub and discard it.

(e) Press the second gear and the first/second gear syn-

chronizer from the mainshaft in a similar manner to 8(b) and (c).

The synchronizer hubs and sleeves are mated together and also to the mainshaft. Mating marks are etched on the corresponding splines of the hub, the sleeve and adjacent to the spline on the mainshaft.

9 Dismantle the main drive gear by removing the circlip securing the main drive gear bearing. Support the bearing in adapters (Tool No. P.4000-32 if available) and press out the main drive gear.

10 Overhaul the main drive gear bearing retainer by removing the oil seal and driving in a new seal with the lips of the seal facing the gearbox.

6:4 Reassembling the gearbox

When reassembling the gearbox new circlips and gaskets must be used.

1 Reassemble the mainshaft:

(a) Slide the second gear along the mainshaft onto its bearing so that the dog teeth face the rear.

(b) Locate a blocker ring on the cone face of the second gear.

(c) Assemble the first/second gear synchronizer:

(i) If a new unit is being installed, slide the synchronizer sleeve off the splined hub. Clean all preservative from the hub, sleeve, blocker bars and springs. Lightly oil them.

(ii) Fit the synchronizer sleeve over the hub with the mating marks aligned. Locate a blocker bar in each of the three slots cut in the hub

(iii) Install a blocker bar spring to run around, clockwise or anticlockwise, inside the synchronizer sleeve beneath the blocker bars. The tagged end of the spring must locate in the 'U' section of a blocker bar. Fit the other spring to the opposite face of the synchronizer unit ensuring that the spring tag locates in the same blocker bar as the spring previously fitted and runs in the same rotational direction. View direct on to one side of the synchronizer assembly and note the direction of rotation of the spring. View direct onto the other side of the synchronizer assembly—the direction of rotation should be the same as for the first spring, when viewed straight on.

(d) Locate the first/second gear synchronizer assembly on the mainshaft and engage it on the splines as far as it will go. Fit a suitable adaptor (tool No. P.4090-7) behind the synchronizer assembly and locate it in the bed of a press. Press the mainshaft into the synchronizer assembly, taking care that it does not tilt as it moves over the circlip groove.

(e) Carefully fit a new circlip to the groove in the mainshaft behind the first/second gear synchronizer.

(f) Fit a blocker ring in the first/second gear synchronizer so that the cut-outs in the blocker ring fit over the blocker bars.

(g) Slide the first gear onto the mainshaft so that the dog teeth are located adjacent to the blocker ring on the first/second gear synchronizer.

(h) Fit the splined collar behind the first gear.

(i) Position the bearing carrier on the mainshaft with the dowel hole to the rear. Fit the mainshaft bearing. Slightly withdraw the bearing carrier rearwards to fit over the bearing.

(j) Locate an adapter (tool No. P.4090-7) over the bearing and insert the assembly in a slave ring in a bed of a press. Press the bearing home onto its journal on the mainshaft.

(k) Slide the third gear onto the front end of the mainshaft with the dog teeth away from the integral thrust collar. Locate a blocker ring on the taper face of the gear.

(l) Place a blocker bar spring in position on the rear face of the third/top gear synchronizer hub and note its direction of rotation. Ensure that the mating marks on the hub and mainshaft correspond and engage it on the splines as far as possible.

Press the hub fully home and then fit a new circlip on the mainshaft in front of the hub.

(m) Locate the blocker bars in position and fit the synchronizer sleeve onto the hub with the back angling on the splines facing the third gear and the mating marks in line.

(n) Install the remaining blocker bar spring in the synchronizer hub in the same way as described in para (c) (iii).

(o) Place the spacer and lockball on the mainshaft and slide on the speedometer gear and locktab. Screw on the mainshaft nut and torque load it to 25 lbft. Bend the locktab to lock the nut.

2 Reassemble the countershaft gear:

Fit a retaining washer to abut the machined shoulder inside the gear. Grease the needle rollers and locate twenty-two in the recess in the gear. Fit a retaining washer over the rollers and slide the dummy countershaft through the gear. Repeat the procedure for the rollers at the other end. Grease the thrust washers and locate them in position inside the gearbox with the tongues in the machined recesses.

3 Position the countershaft gear in the bottom of the gearbox case, taking care not to displace the thrust washers.

4 Assemble the main drive gear. Position the main drive gear bearing on the gear with the external circlip groove on the bearing away from the gear. Support the assembly with the adapter (Tool No. P.4090-7) and press the bearing home on the gear. Fit the small circlip in the groove in the shaft.

5 Fit the large circlip to the groove in the main drive gear bearing and then fit the main drive gear to the gearbox.

6 Fit the main drive gear bearing retainer to the gearbox. First fit a new gasket on the gearbox front face. Ensure that the oil groove in the retainer is in line with the oil passage in the gearbox casing and that the gasket does not cover this passage. Coat the four retaining bolts with a sealer and fit them, complete with spring washers.

7 Install the caged needle rollers in the bore in the main drive gear and position a blocker ring over the cone of the gear. Fit a new gasket over the rear face of the gearbox.

8 Pass the mainshaft assembly through the rear of the gearbox, locating the spigot in the caged bearing in the main drive gear. As the mainshaft is tapped in, the mainshaft gear retainer will fit into the recess provided in the gearbox. Align the marks made when dismantling

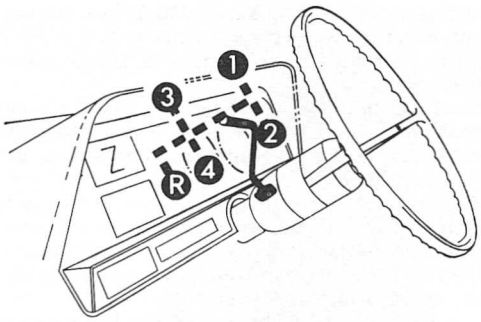


FIG 6:5 Column gearchange lever positions

which will position the dowel hole ready for the assembly of the extension housing.

9 Complete the assembly of the countershaft gear by first lifting it into mesh with the mainshaft and main drive gear, taking care not to displace the thrust washers in the casing. Refit the countershaft from the rear and push it through whilst keeping it in contact with the dummy countershaft. Tap the countershaft finally into the case so that the front face is flush with the front of the gearbox. Ensure that the flats on the rear of the countershaft are positioned to mate with the recess in the extension housing.

10 Position the reverse idler gear inside the gearbox with the selector fork groove towards the rear. Fit the shaft through the case and gear so that the flats will be positioned to mate with the recess in the extension housing.

11 Replace the selector forks and rails:

(a) Ensure that the interlock plungers are correctly located in the rear face of the box.

(b) Locate the selector forks on the gears, the reverse fork and first/second fork must be fitted with the long boss facing forward (see **FIG 6:3**). Locate the third/top gear fork with the long boss facing to the rear.

The selector rails can be identified in the following manner:

One rail has two grooves at one end to mate with a selector ball. This is the reverse selector rail.

Of the two remaining rails, each with three grooves at one end, the third and top gear selector rail can be identified by the interlock floating pin hole at the opposite end to the grooves.

Ensure that the gearbox is in neutral and install the first and second gear selector rail from the rear of the gearbox. As this rail is pushed in, locate first, the selector fork, then the first/second gear gate with the aperture in the gate facing the centre of the gearbox. Align the hole in the rail with the hole in the selector fork and fit the tension pin. Align the hole in the first/second gear gate with the small hole in the selector rail then fit a tension pin to secure.

(c) Insert the third and top gear selector rail from the rear of the gearbox, and, as this rail is pushed forward fit the third/top gear gate then the third/top selector fork to the shaft in that sequence.

Before this rail is pushed fully home check that the floating pin is located in the rail and then set the rail in the neutral position. Secure the fork and the gate to the rail with tension pins.

(d) Install the reverse selector rail in the gearbox; fitting the selector fork. Secure the fork with a tension pin.

(e) Position a new gasket on the top face of the gearbox and install the selector shaft detent balls and springs. Fit the gearbox top cover, ensuring that the springs are correctly located in the drillings and secure it with the four bolts and lockwashers.

12 Ensure that the rear face gasket is not damaged, and that the oilway in the extension housing will not be obstructed. Pass the extension housing over the mainshaft and ensure that the dowel engages in the hole in the mainshaft bearing retainer. Coat the four bolts with sealer and secure the extension housing to the gearbox.

13 Refit the speedometer driven gear and bearing assembly to the extension housing.

6:5 Refitting the gearbox

Refitting the gearbox to the car is the exact reversal of the removal operations detailed in **Section 6:2**, but note the following points:

After fitting the clutch housing assembly but before offering up the gearbox ensure that the gate selector cable is already connected to the lever on top of the selector housing.

When offering up the gearbox to the clutch housing, insert the main drive gear through the aperture, ensuring that the clutch release bearing slides over the main drive gear retainer. Push the gearbox fully home and install the six securing bolts and spring washers.

For cars with column gearchange the gate selector cable must be readjusted as described in **Section 6:6**.

6:6 Gearchange servicing and adjustment

A common gearbox is used on both right and lefthand drive cars and either a steering column or floor mounted lever is used for gear selection.

The steering column gearchange uses a rod and cable mechanism for transmitting movement while the floor gearchange uses a rod mechanism.

Column gearchange:

The column gearchange consists of two tubes which are concentric with the steering shaft. They are termed the outer and inner gearchange tubes: the outer one is fixed and the inner one is free to rotate or slide inside it on nylon bushes.

At the steering wheel end the gearlever is pivoted in the outer tube and actuates the inner tube with the lever tip.

At the lower end the outer tube has a pivot arm which engages on the inner tube and actuates a cable connected to the gearbox. The inner tube in turn has an arm welded to it which actuates a rod mechanism connected to the gearbox.

The gearlever positions are illustrated in **FIG 6:5**. Movement of the gearlever is transmitted to the gearbox in two distinct sequences. With the gearlever in neutral position, movement of the lever towards or away from the steering wheel moves the inner gearchange tube upwards or downwards in line with the outer tube. A raised track welded onto the lower end of the inner tube actuates an

arm pivoted on the outer tube, to which is attached a cable, the other end being connected to the gate selector lever on top of the selector housing. Therefore, the gear-lever movement is transmitted to the gate selector lever and the appropriate gear plane is selected (i.e. first/second, third/top or reverse selector rail in the gearbox).

Movement of the gearlever upwards or downwards parallel to the steering wheel rotates the inner gearchange tube about the steering shaft. A lever, welded to the bottom of the gearchange inner tube, is connected to a gear selector lever on the side of the selector housing by a pivot rod mechanism. Therefore, movement of the gear-lever causes the individual gear required to be selected.

Maintenance:

All the bushes in the linkage are made of polyurethane. No periodic lubrication is required, although a general purpose molybdenum disulphide grease should be used when reassembling any components.

Adjustment of column gearchange:

Adjustment will normally only be necessary when the gearbox or linkage is removed or when a new gate selector cable is fitted. The adjusting nuts and linkage can be seen in **FIG 6:6**. To adjust proceed as follows:

1 Place the gearlever in the neutral position and ensure that it lies in the third and fourth plane.
2 Slacken the adjusting nuts on the end of the gate selector cable beneath the brake servo unit.
3 By screwing up the appropriate adjusting nut obtain a gap of .68 to .64 inch between the arm on the inner tube and the end of the outer tube. Lock up the adjusting nuts against their bracket and recheck the gap.

Floor gearchange mechanism:

The floor gearchange mechanism consists of a cast iron pedestal, bolted to the extension housing, which has three arms pivoting on it controlled by direct movement of the gearlever.

Two of the arms are connected to the gearbox selector mechanism by rods to engage the gears.

A spring between the pedestal and the gate selector lever gives the gearlever bias towards third/top gear.

Movement of the gearlever is conveyed to the gearbox selector mechanism in two distinct movements.

The gearlever is bolted to an arm which pivots on a pin in a bore in the pedestal parallel with the extension housing. Sideways movement of the lever causes the pivot pin to rotate and moves a second vertical lever attached to it.

The vertical lever has a finger on its lower end which engages in a slot in another lever which pivots on a stud in the extension housing. The lever then rotates in proportion to sideways gear lever movement and this is transmitted to the gate selector arm on top of the selector cover. The correct gear plane is thus selected (i.e. first/second, third/top or reverse selector rail in the gearbox).

Movement of the gearlever forwards and backwards causes it to pivot about its mounting arm and the lever tip pushes up a separate gear selector pivot arm backwards and forwards. The gear selector pivot arm is connected by a rod to the gear selector lever on the side of the selector housing and the appropriate individual gear is engaged.

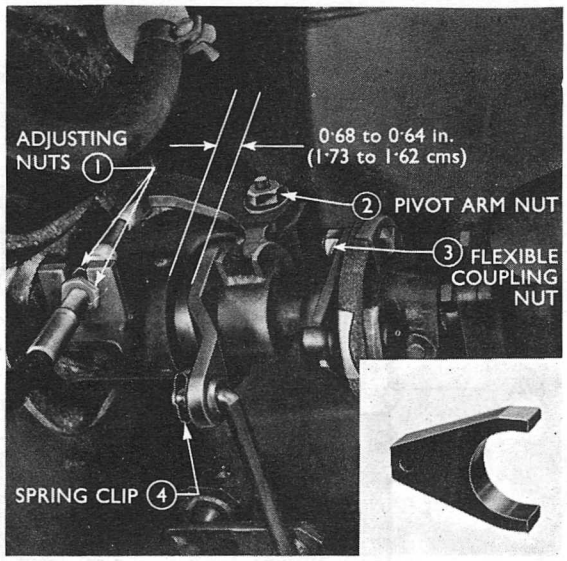


FIG 6:6 Column gearchange linkage setting

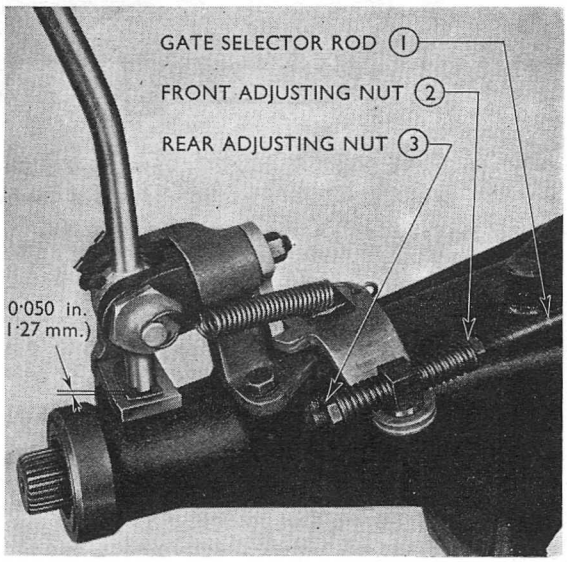


FIG 6:7 Floor gearchange linkage adjustment

Maintenance:

All the bushes in the linkage are made of polyurethane and no periodic lubrication is required. When replacing or reassembling any gearchange components, a general purpose molybdenum disulphide grease should be used on all pivot points and linkage connections.

Adjustment of the floor gearchange:

Adjustment will normally only be necessary when the linkage is dismantled. Proceed as follows:

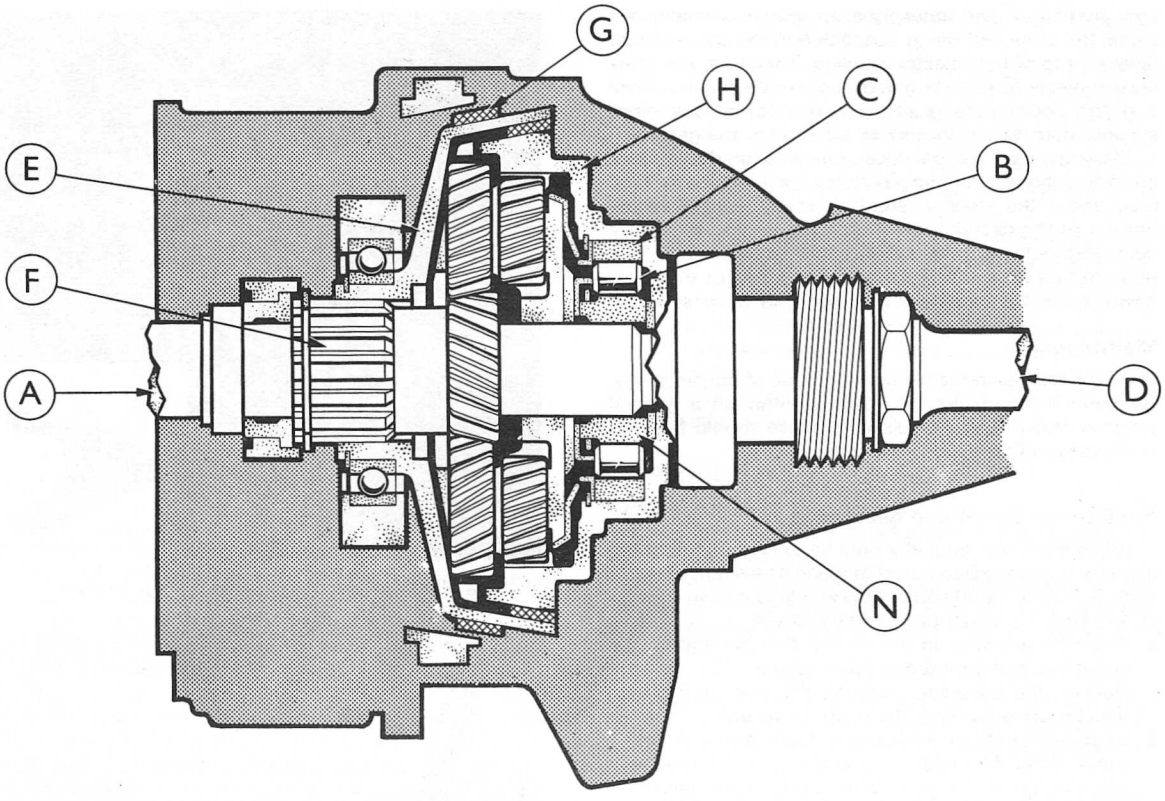


FIG 6:8 The overdrive diagrammatic

Key to Fig 6:8 **A** Input shaft **B** Rollers **C** Outer member of unidirectional clutch **D** Output shaft **E** Cone clutch **F** Extension shaft **H** Annulus **N** Inner member of the unidirectional clutch

1 Refer to **FIG 6:7**. Hold the gearlever towards the first/second gear plane so that there is a .050 inch gap between the gearlever tip and the insert in the gear selector pivot lever.
2 Push the gate selector lever on top of the selector housing fully forward towards the front of the car.
3 Screw up the front adjusting nut until it just touches the spring but does not compress it.
4 Tighten the rear adjusting nut to 50 lb in.

6:7 The overdrive unit

The overdrive available as a production option on Zodiac, Zephyr V6 and Zephyr is the Laycock LH type operating on third and top gears only.

The overdrive is an additional gear unit between the gearbox and the propellor shaft. To accommodate the unit and to facilitate use of the standard length drive shaft, a shorter extension housing is employed.

When operating it provides a higher overall gear ratio than that given by the final drive crownwheel and pinion and gearbox ratios.

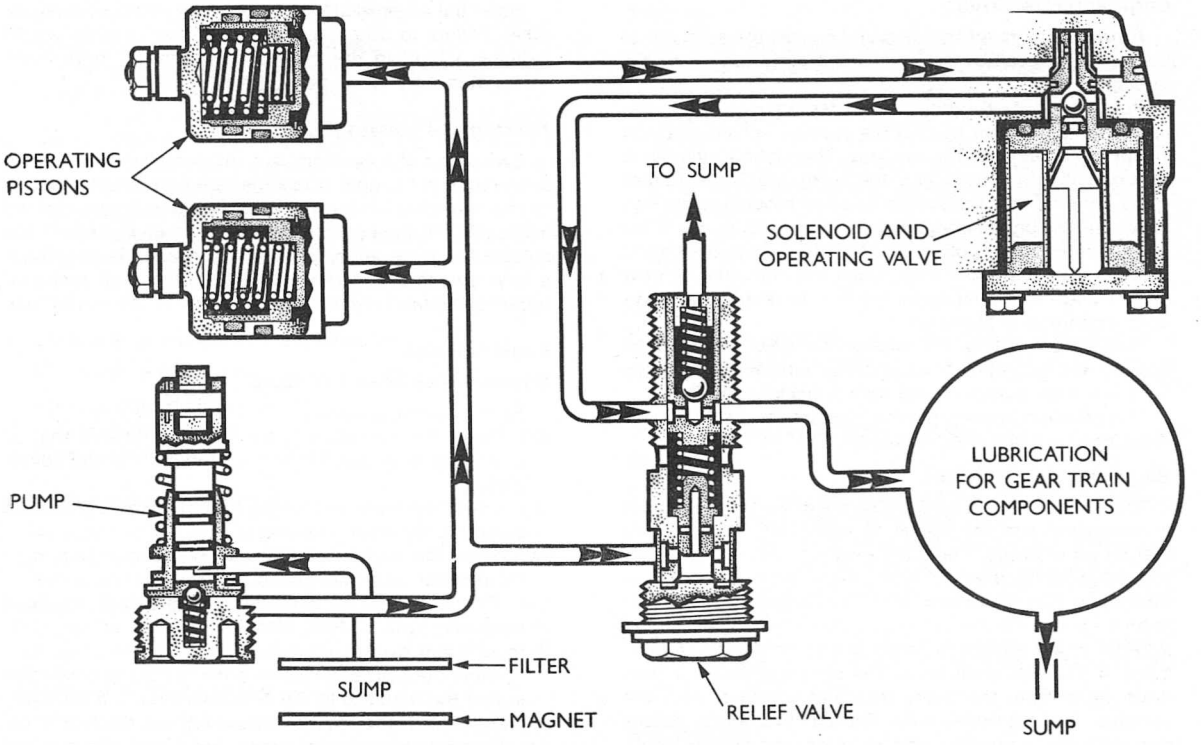
The primary object of the overdrive is to provide open road cruising at an engine speed lower than it would be in normal top gear. Overdrive can also be used on an indirect gear to enhance performance or to provide easy and clutchless gear changes, e.g. from overdrive fourth to direct fourth or from direct third to overdrive third, etc.

The overdrive is engaged or disengaged by an electric solenoid controlled by a switch mounted on the steering column indicator housing. An inhibitor switch is incorporated in the electrical circuit to prevent the engagement of overdrive in reverse, first or second gears. Since the unit is designed to be engaged and disengaged when transmitting full engine power it can be operated at will without the use of the clutch pedal at any throttle opening or road speed. The only precaution necessary is to avoid disengaging the overdrive at too high a road speed, since this would cause excessive engine revolutions.

The overdrive gears are epicyclic and consist of a central sunwheel meshing with three planet gears. The planet/gears in turn mesh with an internally toothed annulus. The planet carrier is splined to the input shaft, the input shaft being the main shaft of the gearbox, and the annulus is integral with the output shaft. The unit is shown diagrammatically in **FIG 6:8**.

Operation:

In direct drive, i.e. with the overdrive disengaged, power is transmitted from the input shaft 'A' (see **FIG 6:8**), to



6:9 The overdrive hydraulic circuit

the inner member of a uni-directional clutch 'N' and then to the outer member of the clutch 'C' via the rollers 'B' which are driven up the inclined faces and wedge between the inner and outer members. The outer member 'C' forms part of the combined annulus 'H' and output shaft 'D'. Thus, the gear train is inoperative and the drive is direct, i.e. 1 to 1 through the overdrive.

A cone clutch 'E' is mounted on the externally splined extension shaft 'F' of the sungear and is loaded onto the annulus by a number of springs which have their reaction against the casing of the overdrive unit. The spring load is transmitted to the clutch member through a thrust ring and ballbearing. This arrangement causes the inner friction lining of the cone clutch to contact the outer cone of the annulus 'H' and rotate with the annulus, whilst the springs and thrust ring remain stationary. Since the sunwheel is splined to the clutch member, the whole gear train is locked together, permitting over run and torque in reverse gear to be transmitted. Additional load is imparted to the clutch, during over run and reverse, by the sunwheel, which due to the helix angle of its gear teeth, thrusts rearwards and has for its reaction member the cone clutch.

When overdrive is engaged, the cone clutch takes up a position where it is no longer in contact with the annulus but has moved forward so that its outer friction lining is in contact with the brake ring forming part of the overdrive casing. The sunwheel to which the clutch is attached is therefore held stationary. The planet carrier rotates with the input shaft 'A' and the planet wheels are caused to rotate about their own axis and drive the annulus at a faster speed than the input shaft. The uni-directional clutch allows this since the outer member can over run the inner member.

Movement of the cone clutch in a forward direction is effected by means of hydraulic pressure which acts on two pistons when a valve is opened, due to the operation of the driver controlled selector switch. The hydraulic pressure overcomes the spring pressure holding the clutch member onto the annulus and causes the clutch to engage with the brake ring and hold the sunwheel at rest.

The hydraulic circuit:

Oil which is common to the gearbox and overdrive is contained in an air-cooled sump at the base of the unit. The sump incorporates a magnet and filter to remove foreign matter.

A cam operated plunger pump draws oil from the sump and delivers it to the operating piston chambers, the ball type operating valve and the relief valve. Oil is further circulated to lubricate the various overdrive components (see **FIG 6:9**).

Engaging overdrive:

A switch operated by the driver causes the solenoid to become energized by battery current and thus closes the operating valve.

Pressure built-up within the system causes the operating pistons to move against the springs, which hold the sliding member onto the annulus. The sliding member is thus moved into contact with the brake ring. Oil continues to be pumped into the system causing modulator springs inside the pistons to compress, giving a cushioning effect by the progressive application of load between the sliding member and the brake ring. Since the sunwheel is now locked and the planet gears are free to revolve an overdrive condition is obtained.

Further delivery of oil causes the relief valve to be opened and allows oil to pass to the various components for lubrication purposes and thence back to the sump.

The solenoid operating valve also acts as a safety valve if the pressure becomes excessive.

Engaging direct drive:

When the switch is reversed by the driver the solenoid is de-energized and the operating valve ball blown off its seat by oil pressure. Thus, the exhaust port is uncovered and the spring load on the sliding member forces oil to flow from the piston chambers. At the same time oil continues to be pumped into the circuit and the two flows are mixed in order to act against each other and control the movement of the sliding member. The sliding member is thus disengaged from the brake ring and engaged with the annulus at a controlled rate. The oil flow again passes through the exhaust port and lubricates the moving components.

A low pressure safety valve is also incorporated in the system which allows oil to pass directly to the sump should the pressure build up to too high a level in the lubricating system.

Routine maintenance:

At the first 600 miles top up the gearbox/overdrive oil level as necessary.

At 3000 miles, drain the gearbox/overdrive oil, clean the overdrive sump filter and magnet and refill with clean oil.

At 9000 miles and then at every 6000 miles top up the oil level as necessary.

On no account should any form of additive be used in gearboxes with overdrive fitted.

6:8 Tests and fault finding

Testing hydraulic pressure:

First ensure that the oil level in the gearbox and overdrive unit is correct. Remove the relief valve and replace it with a suitable adapter and pressure gauge calibrated from 0 to 600 lb/sq in. Jack-up the rear wheels of the car and fit body stands or supports.

Start the engine, engage top gear and run at a speed in excess of 30 mph on the speedometer with overdrive engaged. The correct pressures for these conditions are as follows:

Serial No.	*Model*	*Hydraulic pressure*
22/61749	2 litre	380–400 lb/sq in
22/61750	2.5 litre	400–420 lb/sq in
22/61751	3 litre	420–440 lb/sq in

Note that no pressure reading will be recorded in direct drive. Failure to obtain a correct pressure reading would indicate a fault in the hydraulic system, i.e. non-return valve, operating valve, relief valve or pump.

Testing the solenoid operation:

Switch on the ignition, but do not start the engine. Select third or top gear. Move the overdrive selector switch to the overdrive position. As the switch closes a distinct 'click' should be heard as the relay is energized. If the solenoid is inoperative, i.e. no 'click' is audible, substitute a new solenoid and repeat the test. This will ascertain whether the fault lies with the solenoid or the wiring to it.

Fault finding:

Overdrive does not engage:

1 Faulty electrical system:

(a) Check the operation of the solenoid. Ensure that all anodizing is removed from the inner face of the cover-plate.

(b) Check the relay and wiring from the steering column switch to the overdrive unit.

(c) Check the operation of the drivers control switch.

2 Insufficient oil in gearbox/overdrive.

Check the oil level in the gearbox and top up if necessary with SAE 80 EP lubricant.

3 Insufficient hydraulic pressure:

Carry out a pressure test in order to ascertain whether in fact the fault lies in the hydraulic circuit. If the pressure is below the specified figures check the following:

(a) Remove the operating valve and check that the ball valve seat is free from foreign matter. Check that the valve spring is not broken or damaged.

(b) Remove the pump and non-return valve and check that the ball seat is free from dirt or foreign matter. Check the valve spring for breakage or damage. Examine the pump spring for damage, replace the pump and check its operation. Clean the pump filter.

4 Damaged components:

If neither the electrics or hydraulics prove faulty, the overdrive must be removed and dismantled and checked for component damage and wear.

Overdrive does not disengage:

If the overdrive will not disengage, do not reverse the car since extensive damage may result from this action.

1 Faulty electrical system:

(a) Check the operation of the solenoid. Ensure that all anodizing is removed from the inner face of the cover-plate.

(b) Check the relay and wiring from the steering column switch to the overdrive unit.

(c) Check the operation of the drivers control switch.

2 Sticking clutch:

This trouble might be experienced on a new unit due to insufficient 'bedding in' of the clutch. The clutch can usually be freed by giving the brake ring several sharp taps with a hide mallet. This can be done from beneath the car.

3 Damaged components:

If neither the electrics or hydraulics prove faulty, the overdrive must be removed and dismantled and the components checked for damage and wear.

Clutch slip in overdrive:

1 Insufficient oil in gearbox/overdrive:
Check the oil level and top up as necessary.
2 Insufficient hydraulic pressure:
Carry out a pressure test and if the pressure is below the specified figures check the operating valve and the pump and non-return valve as described under 'Overdrive does not engage'.
3 Damaged components:
If the hydraulics are not proved faulty the overdrive must be removed and dismantled to check the components for wear and damage.

Clutch slip in reverse or on overrun:

Dismantle the overdrive and check the following.

1 Worn or glazed clutch linings.
2 Broken clutch springs.
3 Broken circlip on the sunwheel.

6:9 Component removal

In order to carry out the previous tests it may be necessary to remove the solenoid and operating valve, the relief and low-pressure valve or the pump and non-return valve, without removing or dismantling the overdrive unit itself. This can be done after draining the oil from the gearbox and overdrive unit.

Solenoid and operating valve:

The solenoid and operating valve are located at the bottom of the unit and are removed as follows:

1 Remove the four setscrews securing the name plate and remove the name plate.
2 Remove the assembly by gently pulling on the solenoid lead.

Dismantling:

1 Withdraw the plunger and remove the ball.
2 Re-insert the plunger and lightly tap the end with a suitable drift in order to remove the operating valve body from the solenoid outer case.
3 Remove the end plate by applying slight pressure with the fingers to the top of the solenoid coil. The coil can now be withdrawn from the solenoid outer case.

Reassembling:

1 Insert the coil into the solenoid outer case and replace the end plate, pushing it lightly into place until it abuts the casing.
2 Replace the operating valve body in the solenoid outer case and tap it into position with a copper mallet.
3 Reseat the ball by tapping it very lightly with a suitable punch and replace the plunger.

Replacing:

1 Insert the assembly into the casing with the solenoid lead protruding from the casing.
2 Replace the name plate and secure it with the four setscrews.

Relief and low pressure valve:

This is located at the bottom of the unit adjacent to the name plate.

Removal:

1 Unscrew the plug and remove the valve assembly by hooking a piece of stiff wire into the centre drilling of the valve and carefully withdrawing the assembly. Care must be taken not to damage the filter during this procedure.

If a washer is fitted care must be taken not to displace this since it is fitted to obtain the correct hydraulic pressure.

The low pressure valve cannot be serviced as it is a sealed unit and if faulty must be replaced.

Replacing:

1 Insert the assembly into the casing, ensure that a copper washer is fitted and replace the plug. Tighten securely.

The pump and non-return valve:

Removal:

1 Remove the overdrive unit sump and filter by unscrewing the six bolts securing it to the casing.
2 Unscrew the pump plug and remove the spring and steel ball. A special Tool No. L.354 is supplied for undoing the pump plug but it is possible to use a suitable peg spanner.
3 The pump body complete with the non-return valve and plunger will be forced out of the main housing by the pump plunger spring.

Replacing:

1 Insert the pump plunger, spring and body in the main casing, ensuring that the flat machined side of the plunger is towards the rear of the unit.
2 Press the pump body home onto its abutment and hold in position by using Tool No. L.355 and then refit the non-return valve seat.
3 The non-return valve spring is then positioned in the pump plug and the non-return valve ball is held onto its seat by screwing the plug home and finally tightening.
4 Refit the overdrive sump and filter and tighten the six retaining bolts.

6:10 Fault diagnosis

(a) Jumping out of gear

1 Broken spring on gate selector lever
2 Worn coupling dogs
3 Fork to selector rod tension pin loose

(b) Noisy gearbox

1 Insufficient oil
2 Worn or damaged bearings
3 Worn or damaged gear teeth

(c) Difficulty in engaging gear

1 Incorrect gate selector adjustment
2 Worn synchromesh assembly

(d) Oil leaks

1 Damaged joint washers
2 Worn or damaged oil seals