Chapter 5 Clutch and actuating mechanism

Contents

Specifications

	2.4	3.4	3.8
Make		Borg and Beck	
Model	9A6 - G	10A6 - G	10A6 - G
Outside diameter	9.13 - 9.16 in (231 - 232 mm)	9.84 - 9.87 in (249 - 250 mm)	9.84 - 9.87 in (249 - 250 mm)
Inside diameter	6 - 12 in (153 - 154 mm)	6.75 - 6.76 in (171 - 172 mm)	6.75 - 6.76 in (171 - 172 mm)
Type		Single dry plate	
Clutch release bearing		Graphite	
Operation		Hydraulic	
Clutch thrust spring			
Number	9	12	12
Colour (early models)	6 cream/3 yellow/ light green	cream	black
(later models)	Black	Yellow/ light green	Black
Free length	2.68 in (68 mm)	2.68 in (68 mm)	2.68 in (68 mm)
Driven plate - type		Borglite	
Driven plate damper springs - number	6	6	6
- colour	White/light green	Red/cream	Brown/cream

240 and 340 models and also 3.4 litre Mk 2 and 3.8 litre commencing at engine numbers KJ.8237 and LE.2981 respectively:

Make	Borg and beck
Type	Diaphragm spring
Diameter 240	8.5 in
340, 3.4 and 3.8 litre Mk 2	9.5 in

1 General description

The clutch unit fitted to earlier produced cars is of the Borg and Beck single plate dry type which is hydraulically operated. An exploded view of the assembly is given in Fig.5.2. The clutch assembly comprises a steel cover which is bolted and dowelled to the rear face of the flywheel and contains the pressure plate, pressure plate springs, release levers and the driven plate.

The pressure plate, pressure springs and release levers are all attached to the clutch assembly cover. The driven plate is free to slide along, and is splined to, the first motion shaft of the gearbox and is held in position between the flywheel and the pressure plate by the pressure of the pressure plate springs. The driven plate is faced on both sides with friction material and has a spring cushioned hub to absorb transmission shocks.

The clutch is actuated hydraulically by a pendant clutch pedal which is connected to the combined clutch master cylinder and hydraulic fluid reservoir by a short pushrod. The master cylinder is mounted on the engine side of the bulkhead. A layout of the clutch hydraulic system is given at Fig.5.3. Depression of the clutch pedal moves the piston in the master cylinder forwards forcing hydraulic fluid through the pipe to the slave cylinder. The piston in the slave cylinder is now moved forward and actuates the clutch release arm by means of a short pushrod, the opposite end of the release arm is forked and carries the release bearing which is a graphite faced disc. As pressure on the clutch pedal continues, the release bearing bears hard on the release lever plate and pushes it forward, this movement rotates the release levers and they in turn pull back the pressure plate away from the driven plate and at the same time compress the thrust springs. The driven plate is now free of the flywheel and consequently there is no drive to the gearbox.

When the clutch pedal is released the thrust springs force the pressure plate into contact with the high friction linings of the driven plate to hold it firmly against the flywheel and so taking up the drive.

As the friction linings on the driven plate wear, the pressure plate automatically moves closer to the driven plate to compensate. This makes the inner ends of the release levers travel further towards the gearbox which decreases the release bearing clearance.

The diaphragm spring clutch fitted to later cars, which is illustrated in Fig.5.4, comprises a steel cover which is dowelled and bolted to the rear face of the flywheel and contains the diaphragm spring, the fulcrum rings and the pressure plate and the driven plate, which, as with the other type of clutch is splined to the first motion shaft of the gearbox.

The driven plate is held in position between the pressure plate and the flywheel by the pressure of the diaphragm spring. It has high friction material on both faces and has a spring cushioned hub to absorb transmission shocks.

The action on depressing the clutch pedal is similar to that which occurs with the other clutch except that in this instance the release bearing contacts the release plate which is a fixture on the diaphragm spring. Forward movement of the release plate causes a deflection of the diaphragm spring thus pulling the pressure plate away from the driven plate and freeing the clutch. When pressure on the clutch pedal is released, the diaphragm spring asserts itself to push the pressure plate hard against the driven plate to hold it in tight contact with the flywheel to transmit the drive to the gearbox.

2 Clutch system - bleeding

1 Bleeding the clutch hydraulic system (expelling air) is not a routine maintenance operation and should only be necessary when some portion of the hydraulic system has been disconnected or where, due to a leak, the level of fluid in the hydraulic reservoir has been allowed to drop too low. The presence of air in the system will result in poor clutch operation as the bubbles of air can be compressed.

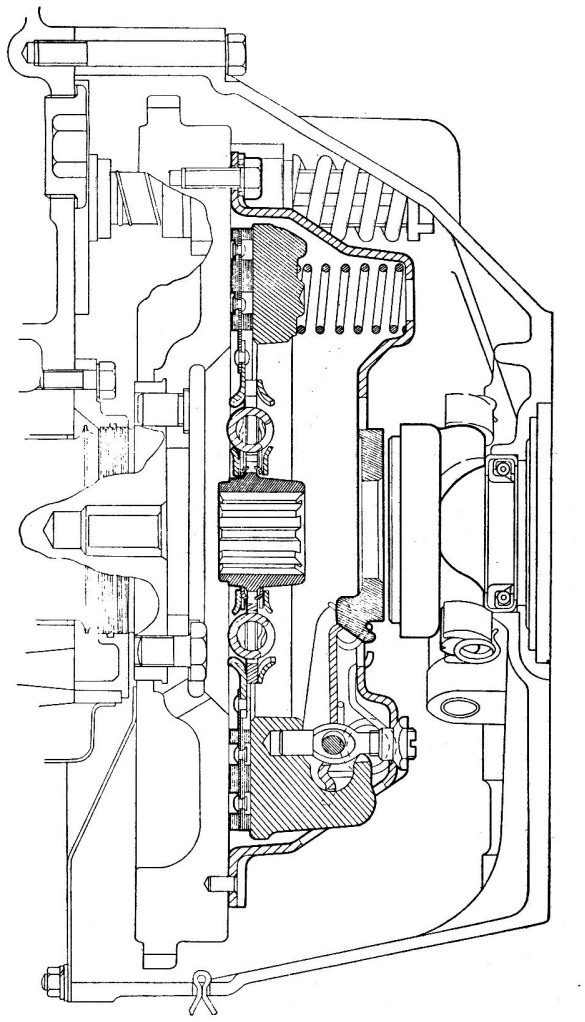


Fig.5.1. Sectional view of the 9A6–G/10A6–G clutch

2 Thoroughly clean the top of the clutch master cylinder (the difference between the clutch and the brake master cylinders on early model cars is shown in Fig 5.5) and fill the cylinder with hydraulic fluid.

Note; Castrol Girling Universal Brake and Clutch Fluid is recommended. Where this is not available, only fluid guaranteed to conform to Specification SAE 70 R3 should be used as an alternative.

3 The bleed nipple for the system is located on the slave cylinder on the right hand side of the clutch housing. Thoroughly clean the exterior of the nipple.

4 Attach a length of rubber tube to the nipple and allow it to hang in a clean glass jar partly filled with hydraulic fluid.

5 Unscrew the nipple one complete turn.

6 Have an assistant in the car to depress the clutch pedal slowly to the full extent of its travel. Tighten the nipple whilst the clutch pedal is held depressed.

7 Release pressure on the clutch pedal and repeat operations 5 and 6 until the fluid issuing from the tube is entirely free of air. Take care to replenish the reservoir frequently during these operations because if the fluid level is allowed to drop more than halfway, air will enter the system.

8 When you are satisfied that the system is clear of air, top up the master cylinder reservoir to the bottom of the filler neck.

9 Do not use the fluid which has been bled through the system as this will be aerated. Always use fresh fluid straight from the container.

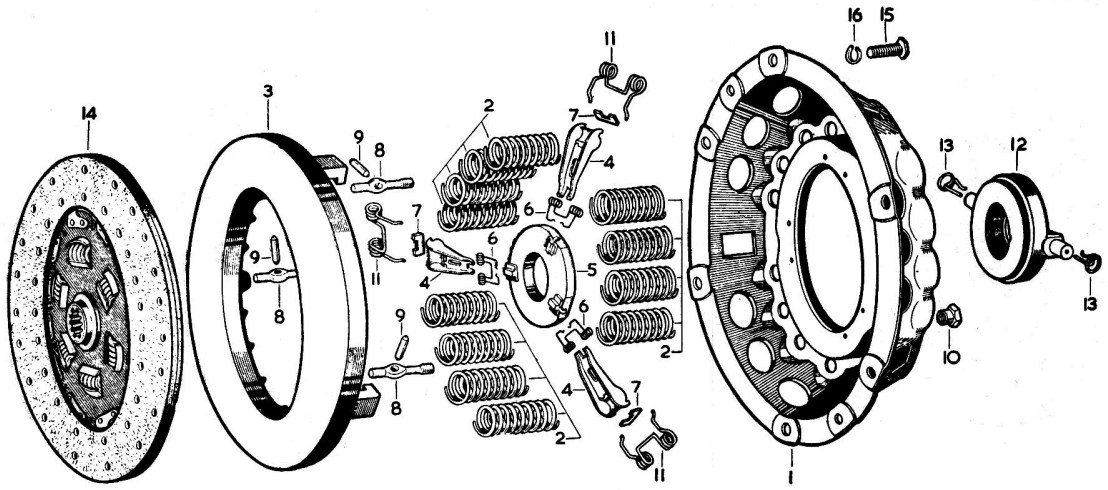


FIG.5.2. EXPLODED VIEW OF THE 9A6–G/10A6–G CLUTCH

1 Cover
2 Thrust spring
3 Pressure plate
4 Release lever
5 Release lever plate
6 Release lever retainer
7 Release lever strut
8 Release lever eyebolt
9 Eyebolt pin
10 Adjustment nut
11 Anti-rattle spring
12 Release bearing and cup assembly
13 Release bearing retainer
14 Driven plate assembly
15 Securing bolt
16 Spring washer

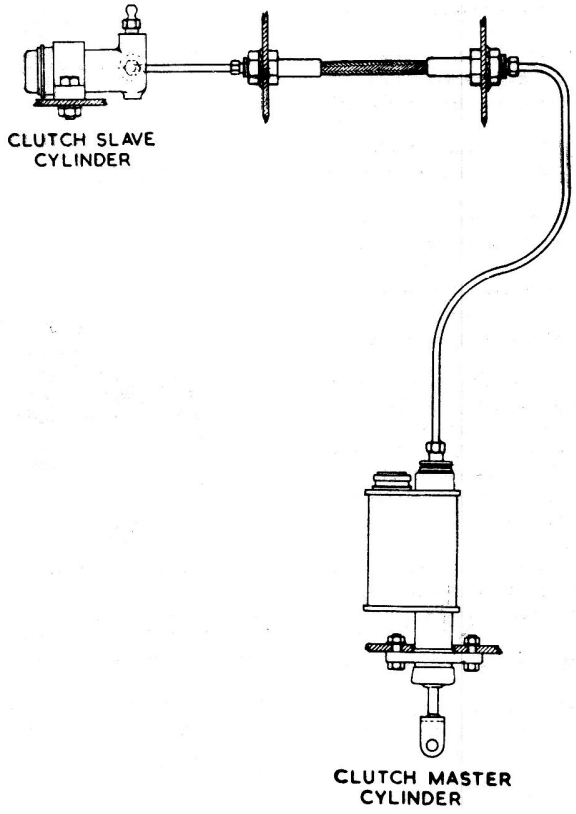


Fig.5.3. The clutch hydraulic system

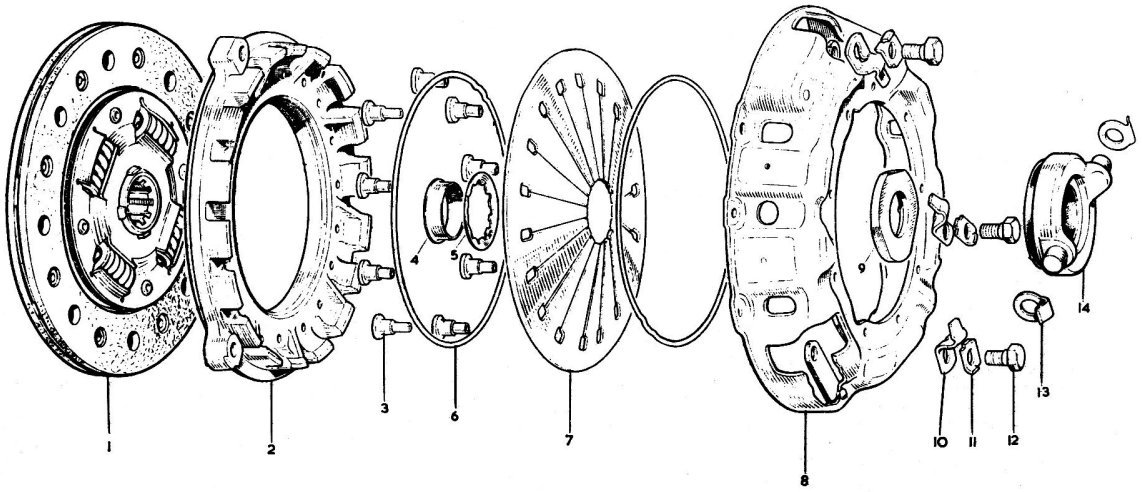


FIG.5.4. EXPLODED VIEW OF THE DIAPHRAGM SPRING CLUTCH

1 Driven plate
2 Pressure plate
3 Rivet
4 Centre sleeve
5 Belleville washer
6 Fulcrum ring
7 Diaphragm spring
8 Cover pressing
9 Release plate
10 Retainer
11 Tab washer
12 Setscrew
13 Retainer
14 Release bearing

3 Clutch pedal - removal and replacement

1 The clutch and brake pedals are an assembly on a common mounting block which also forms a base for the clutch and brake master cylinders.
2 Disconnect the pipe to the clutch master cylinder by unscrewing the union nut. Tie a piece of rag around the pipe and union nut and block the orifice in the master cylinder to prevent the ingress of dirt.
3 Disconnect the two pipes to the brake master cylinder by undoing the union nuts. Protect the pipes and the orifices in the same manner as the clutch hydraulics.
4 Push the driving seat back to its full extent on the runners.
5 Remove the carpet and the sound proofing around the pedal assembly.
6 Remove the foot plates from the clutch and brake pedals by undoing the self locking nut at the base of each pedal.
7 Remove the seven nuts and shakeproof washers securing the mounting block to the bulkhead.
8 Lift out the pedal assembly from the engine compartment complete with the clutch and brake master cylinders. Keep the assembly upright until you have drained the contents of the clutch master cylinder tank into a clean container. Note the gasket fitted between the mounting block and the bulkhead.
9 Remove the split pin securing the clevis pin connecting the clutch and brake pedals to their respective master cylinders; take off the flat washer and push out each clevis pin.
10 Remove the nuts and shakeproof washers securing the clutch and brake master cylinders respectively, to the mounting block. Remove the cylinders and store them where they will not be damaged or collect dirt.
11 Remove the nut securing the pinch bolt between the two pedals, remove the pinch bolt.
12 Note the way in which each pedal return spring is fitted.
13 Knock out the pedal axis pin. Note that it will only come out in one direction as it is fouled by one of the mounting studs in the other direction.
14 Note the fibre washers between the side of each pedal and the mounting block.
15 Replacement is a reversal of the removal procedure. The clutch and brake pedals axes and springs should be treated with grease.
16 Finally, bleed the clutch hydraulic system as described in Section 2 and bleed the brake system as described in Chapter 9.

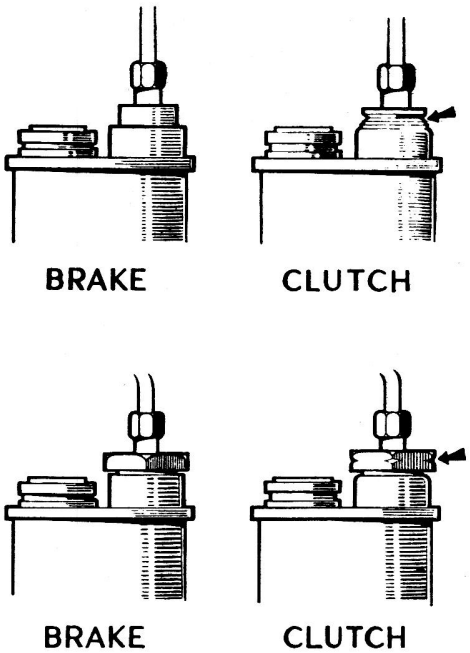


Fig.5.5. Difference between clutch and brake master cylinders (early model cars)

4 Clutch pedal - free travel

1 Commencing at the engine numbers given next, a hydrostatic clutch operating slave cylinder is fitted and normal clutch wear is automatically compensated for so no adjustment at the pedal is necessary. The later type slave cylinder is not fitted with the spring.

2.4 litre Mk. 2	BJ.5110
3.4 litre Mk. 2	KJ.7659
3.8 litre Mk. 2	Le.2533

2 There should be ¾" (19 mm) free travel or unloaded movement at the clutch pedal before feeling the resistance of the springs. This is best felt by moving the pedal by hand.
3 Refer to Fig.5.6.

4 Adjustment is effected by slackening the locknut which can be seen against the head of the pushrod. Screwing the rod into the head will increase the free pedal travel whilst screwing it out will decrease the free travel.
5 Screw up the locknut when the adjustment is correct.
6 This adjustment is most important for:
a) Insufficient free travel may cause a partly slipping clutch leading to burning out if not corrected. Over-travel of the pedal will also result and will cause undue internal strain and excessive bearing wear.
b) Too much free pedal movement results in inadequate release movement of the bearing and may produce a dragging clutch condition making clean gear changes impossible.

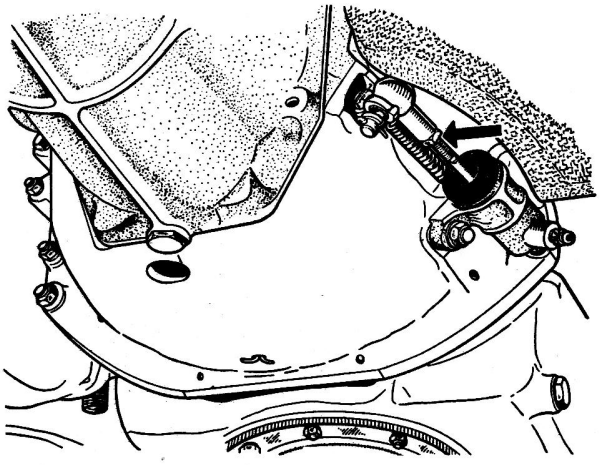


Fig.5.6. Clutch pedal adjustment

5 Clutch - removal

1 Remove the engine and the gearbox from the car and separate the gearbox from the engine in the manner described in Chapter 1.
2 Look for the balance marks stamped on the clutch housing and eel as depicted in Fig.5.7. If there are no marks make your own with a centre punch so that the clutch assembly can be replaced on the fylwheel in its original position.
3 Slacken the clutch mounting screws a turn at a time by diagonal selection until the thrust spring pressure is released. Remove the setscrews.
4 Withdraw the clutch assembly from the dowels on the flywheel at the same time taking care that the driven plate, which will not now be supported, does not fall away and get damaged.
5 Do not handle the driven plate with oily hands. If it is to be re-used, place it where it will not be dirtied or damaged.

6 Clutch - dismantling

1 The following paragraphs 2 - 8 inclusive, refer to the 9A6G and 10A6G type clutch using thrust springs for the operation of the pressure plate.
2 Before dismantling, mark all he major components for reassembly in their original positions.
3 It is now necessary to evenly compress the thrust springs and to take their weight whilst removing the adjusting nuts from the eyebolts. One way of doing this without the use of special equipment is to bolt the clutch to a flywheel in order to put pressure on the pressure plate but a press is really the answer. Place the clutch on the bed of the press with wood blocks under the pressure plate in such a manner that the cover can move downwards when pressure is applied, this set-up is shown in Fig.5.8.
4 Having compressed the clutch, unscrew the adjusting nuts (Fig.5.9). These are locked by staking and considerable torque may be necessary in order to break the lock.
5 Slowly release the clamping pressure when all the nuts are removed.
6 Lift the cover and the thrust springs off the pressure plate and remove the release lever mechanism.
7 Note the positions of the various coloured thrust springs.
8 Fig.5.10 shows how the strut is disengaged from the lever after which the threaded end of the eyebolt and the inner end of the lever are held as close together as possible so that the shank of the eyebolt clears the hole in the pressure plate.
9 The following paragraphs refer to the diaphragm spring type of clutch.
10 The Borg and Beck diaphragm spring type of clutch is serviced in this country by fitting an exchange unit and as these are readily available from your Jaguar agency it is strongly recommended that you do not attempt to dismantle the assembly.
11 However, individual parts can be obtained for the repair of the clutch and the following instructions for dismantling are given for the benefit of Overseas customers in cases where complete exchange units may not be readily available.
12 It is essential to rigidly observe the following instructions and in particular, attention is drawn to the necessary special tools required.
13 Refer to Fig.5.4.
14 The centrally mounted release plate is held in position by a centre sleeve which passes through the diaphragm spring and the belleville washer into the release plate. To free the plate, collapse he centre sleeve with a hammer and chisel as shown in Fig.5.11. Support the release plate in the locating boss of the special tool, shown at Fig.5.20, which should be held firmly in a vice.
15 Knock back the locking tabs and remove the three setscrews securing the pressure plate to the straps rivetted to the cover pressing. DO NOT detach the straps from the cover pressing.
16 Using a spot face cutter, machine the shank of the rivets securing the diaphragm spring and the fulcrum rings to separate those items. Drive out the rivets with a standard pin punch. It is essential that the thickness of the cover is not reduced in excess of 0.005" (0.127 mm) at any point (see Fig.5.12).

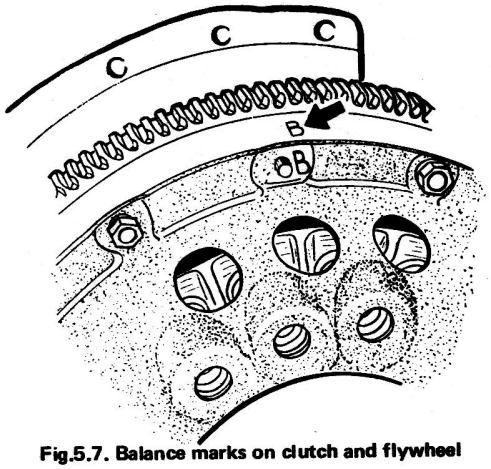


Fig.5.7. Balance marks on clutch and flywheel

7 Clutch - examination

We advise that you fit a new driven plate. But if you decide against this:
1 Examine the friction facings. They will probably be highly polished, through which the grain of the material can be clearly seen, and mid-brown in colour. The facings are satisfactory if in this condition but if there are dark, highly glazed, patches which hide the grain or if there is a resinous deposit on the facings or if they have a black soaked appearance the indication is that they

are contaminated with oil and the driven plate assembly should be renewed.

2 Examine the rivets of the driven plate. They should be well below the surface of the friction material and should be secure. Renew the driven plate if the facings are worn or if any rivets are loose.

3 Check the driven plate springs for fracture and security. Check the condition of the splines in the centre hub, excessive wear, which results from faulty alignment will mean renewing the plate.

4 Examine the thrust springs and check their length. Do not immediately discard any which are under length but check them against one which is of the correct length by placing end to end in a vice with a metal plate interposed between them, screw up the vice to put pressure on the springs but not to compress them fully. Measure their lengths and if the short spring is now undersize compared to the other, discard it.

5 The face of the pressure plate should not be ridged or pitted and this also applies to the face of the flywheel in the bearing area of the driven plate.

6 Check that the flange of the cover is not distorted.

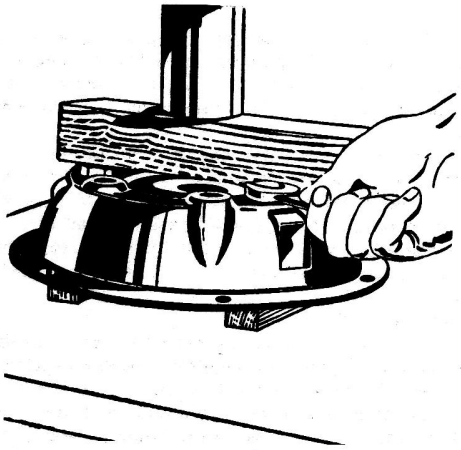


Fig.5.8. Compressing the thrust springs

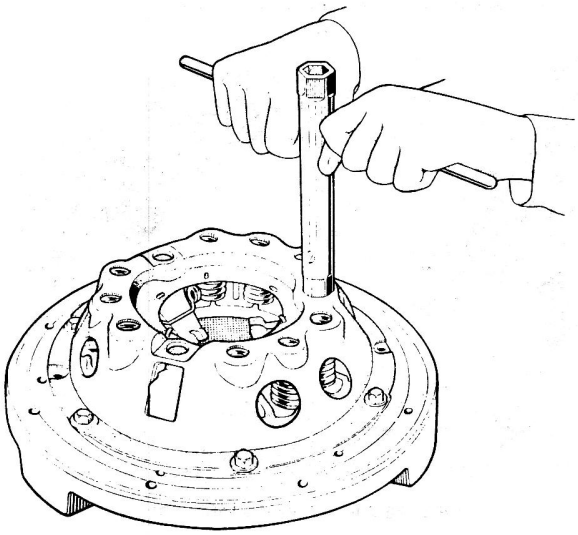


Fig.5.9. Removing the adjusting nuts

Fig.5.10. Disengaging the strut from the lever

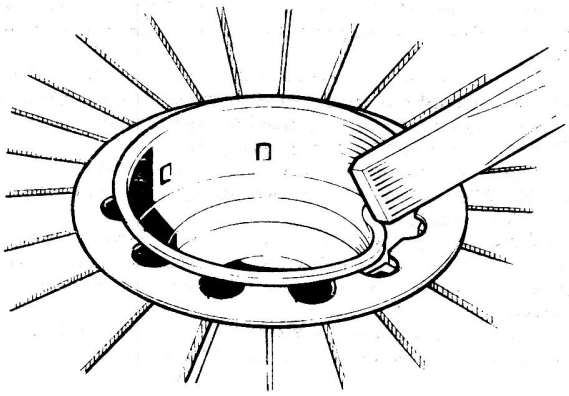


Fig.5.11. Collapsing the centre sleeve

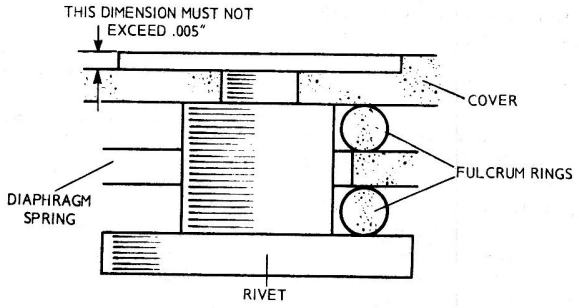


Fig.5.12. Showing maximum permissible depth for removal of rivets

8 Clutch - reassembly

1 It is essential that all major components are returned to their original positions if balance of the assembly is to be maintained.
2 The instructions contained in paragraphs 3 - 19 inclusive refer to the 9A6G and 10A6G type clutch utilising thrust springs.
3 Fit a pin into an eyebolt and locate the parts within a release lever.
4 Hold the threaded end of the eyebolt and the inner end of the lever as close together as possible, and, with the other hand, engage the strut within the slots in a lug on the pressure plate, push outwards on the other end of the strut towards the rim of the plate.
5 Offer up the lever assembly, first engaging the eyebolt shank within the hole in the plate. Now locate the strut within the groove in the lever.
6 Fit the remaining release levers in the same manner and lightly lubricate all bearing surfaces.
7 The cover now has to be assembled to the pressure plate using same method, as during dismantling, to compress the thrust springs. Assuming that a press is being used, support the pressure plate on two blocks of wood on the bed of the press.
8 Assemble the thrust springs on the bosses of the pressure plate, if the springs are not of the same colour for this particular clutch they must be arranged in a symmetrical manner.
9 Assemble the anti-rattle springs to the cover.
10 Rest the cover on the thrust springs so that the pressure plate lugs are aligned with the slots in the cover.
11 Place a wooden block across the top face of the cover and apply pressure with the press to compress the assembly.
12 Screw the adjusting nuts into an approximate correct position.
13 The release levers must now be set to their correct height and the following procedure assumes that a special setting fixture or gauge plate is not available.
14 Mount the clutch on the flywheel with the driven plate in its normal position or, alternatively, clamp the assembly to any truely flat surface having clearance for the boss of the driven plate.
15 Refer to Fig. 5.13.

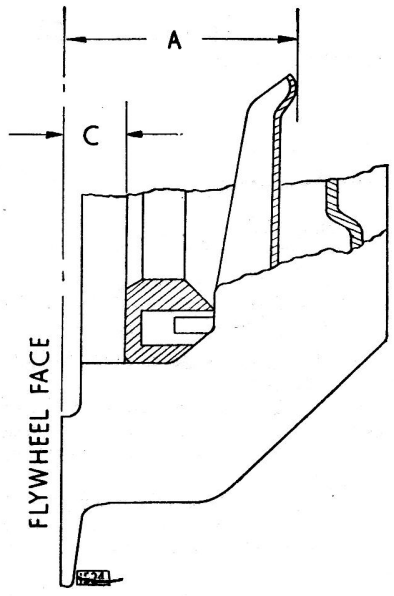


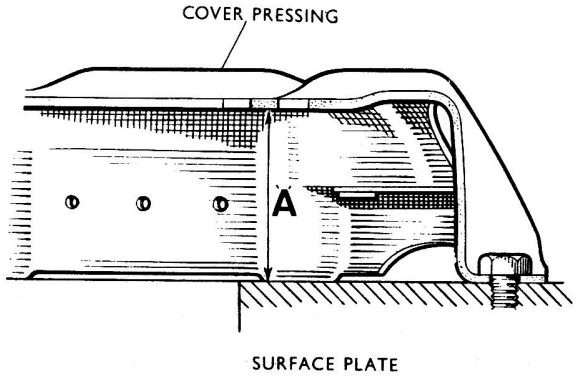
Fig.5.13. Setting the release levers

16 Adjust on the adjusting nuts until the tips of the release levers, dimension "A", are 1.895" from the flywheel face in the case of the 9 inch clutch fitted to 2.4 litre engines and are 1.955" for the 10" clutch of the 3.4 and 3.8 litre models. Dimension "C" is 0.33" for both sizes of clutch.
17 Having set the levers, slacken the clamping pressure and turn the driven plate through 90°, reclamp the cover and check the levers again as an insurance against any lack of truth in the driven plate.
18 When satisfied with the setting of the release levers, lock all adjusting nuts by staking.
19 Fit the release lever retainers and the release lever plate.
20 The following instructions apply to the diaphragm spring type clutch.
21 First check the cover pressing for distortion by bolting the cover firmly to a truely flat surface and then measuring the distance from the cover flange to the machined land inside the pressing. This, as indicated in Fig. 5.14, should not be more than 0.007" (0.2 mm). If this dimension is exceeded the cover must be replaced.
22 Make up a tool to the dimensions given in Fig.5.15. Except for the spring all parts can be made out of mild steel.
23 Place the fulcrum ring inside the cover pressing so that the location notches in the fulcrum ring engage a depression between two of the larger diameter holes in the cover pressing. See Fig.5.16.
24 Place the diaphragm spring on the fulcrum ring inside the cover and align the long slots in the spring with the small holes in the cover pressing.
25 Locate the other fulcrum ring on the diaphragm spring so that the location notches are diametrically opposed to the location notches in the first ring.
26 Fit new rivets and ensure that the shouldered portion of each seats on the machined land inside the cover.
27 Place the base plate of the tool on to the rivet heads and invert the clutch and base plate (Fig.5.17).
28 Fit the collar of the tool over the large bolt and fit the large bolt complete with spring, spider and collar into the tapped hole in the base. Position the three setscrews on the spider of the tool so that they contact the cover pressing.
29 Tighten down the centre bolt, as depicted in Fig.5.18, until the diaphragm spring is flat and the cover pressing is held firmly by the setscrews.
30 Peen over the rivets with a hand punch (Fig.5.19).
31 Before assembling the pressure plate examine it for wear or damage. If damaged or excessively scored it should be replaced but if this is not possible it is permissible to rectify it by grinding but this must be expertly done as incorrect grinding may affect operation of the clutch. The pressure plate must not be worked to a thickness of less than 1.070" (27.178 mm).
32 Position the pressure plate inside the cover assembly so that the lugs on the plate engage the slots in the cover pressing.
33 Insert the three setscrews through the straps which are rivetted to the cover pressing, tighten down and lock with the tab washers.
34 The pressure plate must now be fitted and for this a special tool is required. The tool number is SSC805 and it can be obtained from Automotive Products Ltd, Service and Spares Division, Banbury, England. The tool is shown in Fig.5.20 for information.
35 Grip the base plate of the tool in a vice and place the locating boss into the counterbore.
36 Place the release plate, face down, into the counterbore of the locating boss.
37 Apply a little high melting point grease to the tips of the diaphragm spring fingers and position the clutch, with the pressure plate friction face upwards, on to the release plate. Ensure that the diaphragm spring fingers locate between the small raised pips on the release plate.
38 Place the belleville washer, concave surface towards the spring, on to the centre of the diaphragm spring and then push the centre sleeve through the spring into the release plate.
39 Drop the special washer of the tool into the sleeve and insert

the staking guide into tthe centre of the assembly. Fit the knurled nut to the thread on the staking guide and tighten down until the whole assembly is solid.

40 Using the special punch, inserted in the slots in the staking guide, stake the centre sleeve in six places into the groove in the release plate.(Fig.5.21).

Fig. 5.14. Check for distortion of cover pressing. Maximum variation of dimension 'A' must not exceed 0.007 inch



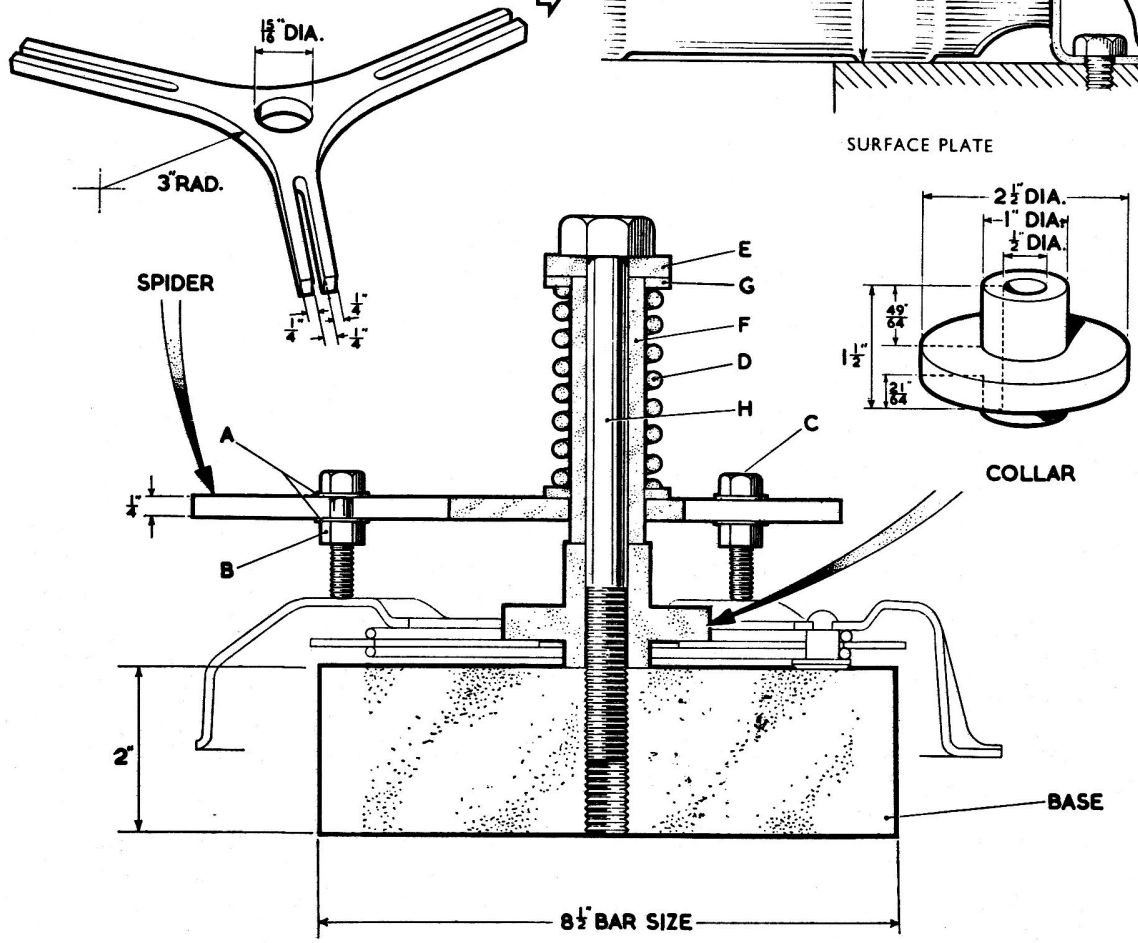


FIG.5.15. SPECIAL TOOL FOR COMPRESSING DIAPHRAGM SPRING

Ref.	Qty.	Description
A	*6*	*¼" flat washer*
B	*3*	*¼" nut*
C	*3*	*1¼" diameter setscrew*
D	*1*	*Spring (minimum load of 100 lbs. fitted length)*
E	*1*	*Washer ½" I.D. x 1½" O.D. x ¼" thick*
F	*1*	*Tube ½" I.D. x 3¼" long*
G	*2*	*Washer 7/8" I.D. x 1½" O.D. x 1/8" thick*
H	*1*	*Bolt ½" Whit. x 6" long*

9 Clutch - refitting

1 It is most important that no oil or grease gets onto the driven plate linings, or the pressure plate or the flywheel faces. It is advisable to handle all clutch components with clean and dry hands and to wipe down the pressure plate and flywheel faces with a clean, dry cloth before assembly commences.

2 Place the driven plate on the flywheel with the larger part of the splined hub facing the gearbox.

3 Replace the clutch cover assembly on the dowels with the balance marks aligned.

4 Replace the six setscrews finger tight so that the driven plate is loosely gripped and is able to move.

5 The driven plate must now be centralised on the flywheel so that when the engine and gearbox are mated, the gearbox constant pinion shaft splines will pass through the splines in the centre of the driven plate hub.

6 If you have the facilities, turn up a piece of bar to the inside diameter of the splines in the driven plate with a reduced diameter at one end to just enter the constant pinion shaft bearing at the rear of the crankshaft.

7 Insert the bar through the hole in the centre of the clutch and move it until the small diameter enters the constant pinion shaft bearing in the crankshaft. The driven plate is now correctly aligned. Leave the bar in position.

8 An old constant pinion shaft (Fig.5.22) can be used instead of the bar but failing all else, centralisation of the driven plate can be carried out by using a long screwdriver inserted from the rear of the clutch. Moving the screwdriver sideways or up and down will move the plate in whatever direction is necessary to achieve centralisation. Correct positioning of the driven plate can

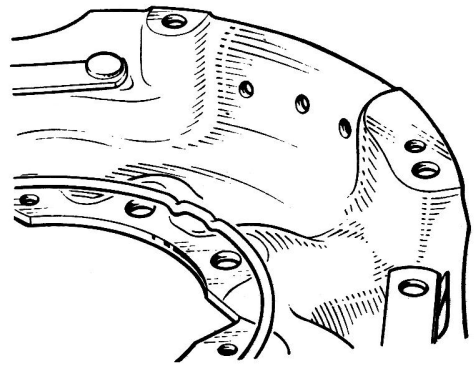


Fig.5.16. Assembly of fulcrum ring to cover pressing

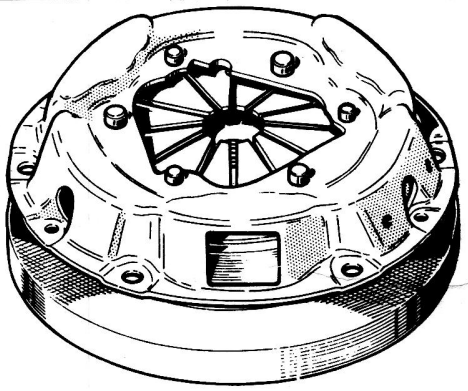


Fig.5.17. Clutch and base plate of tool inverted

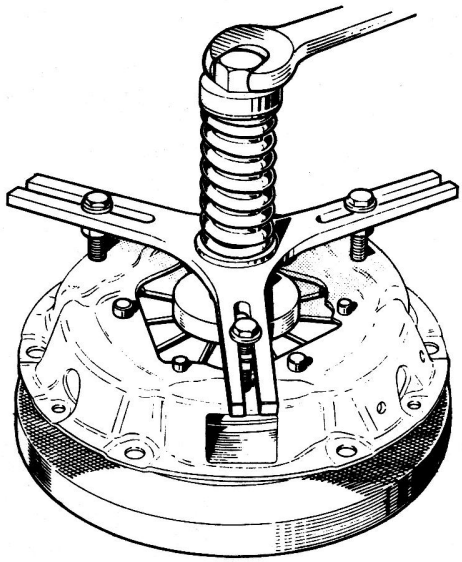


Fig.5.18. Positioning the tool for rivetting

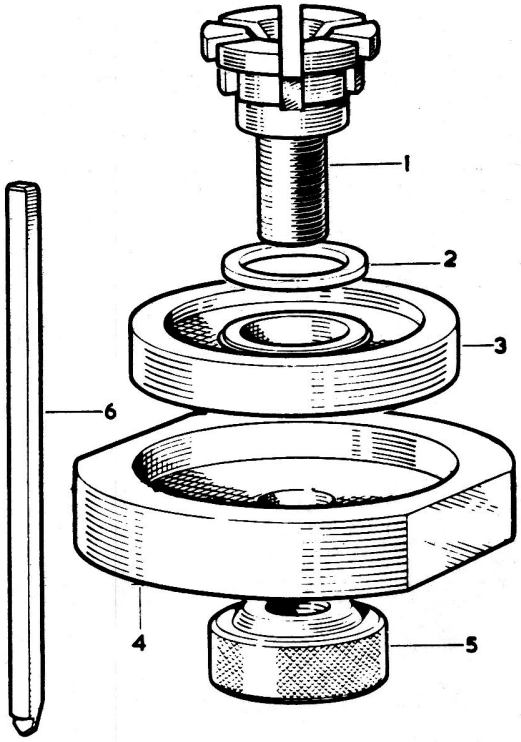


FIG.5.20. SPECIAL TOOL SSC 805

1 Staking guide
2 Washer
3 Locating boss
4 Base plate
5 Knurled nut
6 Punch

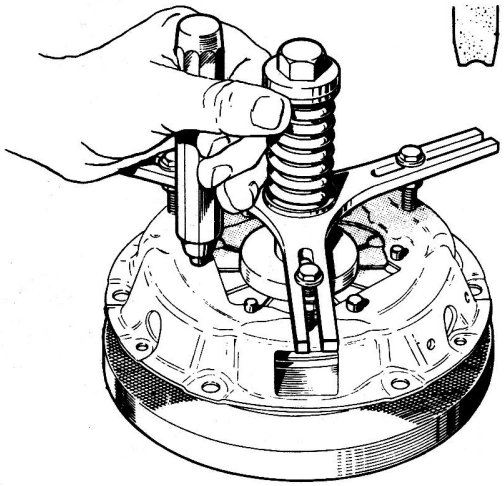


Fig.5.19. Rivet securely with a hand punch

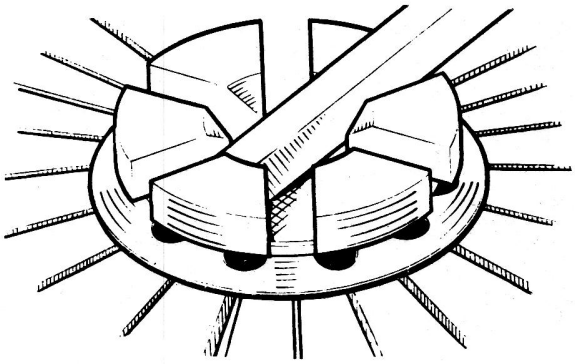


Fig.5.21. Staking the centre sleeve to the release plate

be judged by a viewing its position in relation to the hole at the rear of the clutch.

9 Tighten the setscrews a turn at a time by diagonal selection whilst the bar is still holding the driven plate in position. Tighten down fully and remove the bar. If using a screwdriver or similar tool for centralisation, re-check that the driven plate is still central as there is a tendency for it to move during the tightening operation.

10 Clutch fork and release bearing - removal, examination and refitting

1 With the gearbox and engine separated to provide access to the clutch, attention can be given to the release bearing and fork, and lever located in the gearbox bellhousing.

2 To remove the clutch release bearing, ease back the two spring clips located at the ends of the release bearing carrier and lift away the release bearing (photos).

3 Slacken the locknut and using an Allen key, remove the lever shaft retaining screw (photo).

4 Press out the release lever shaft (photo).

5 Remove the release lever (photo).

6 If the graphite release bearing ring is badly worn it should be replaced by a complete bearing assembly. Our advice is that a new release bearing is fitted irrespective of the condition of the one removed as a lot of clutch troubles start with this component.

7 Check the fork ends and the lever shaft for wear, renew as necessary.

8 Reassembling the clutch fork and lever assembly and refitting the clutch release bearing is the reverse of the dismantling procedure.

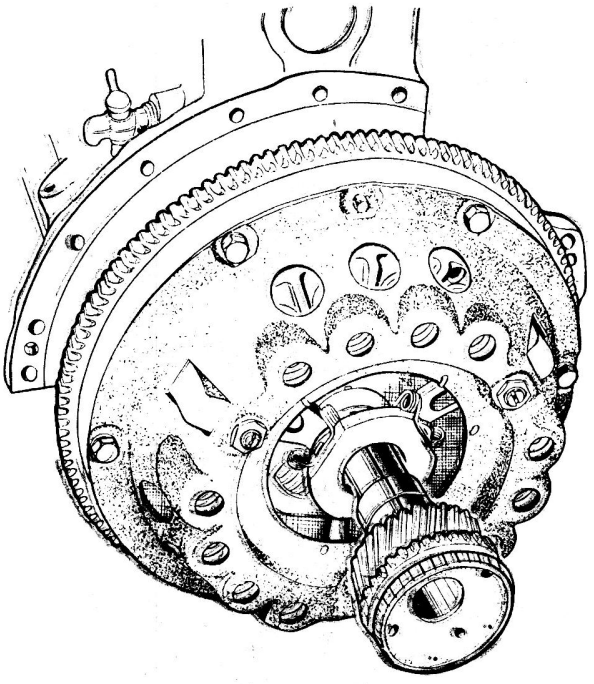
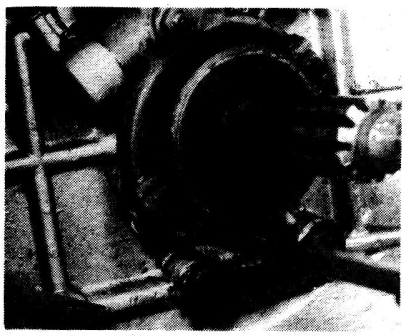
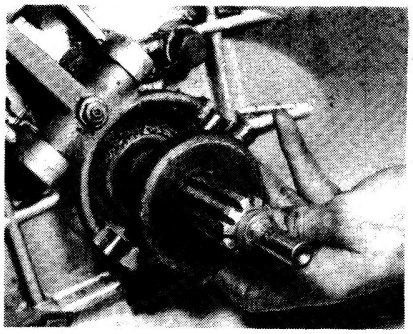


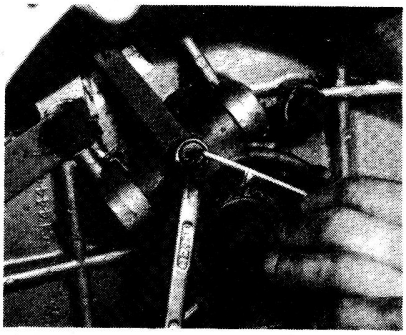
Fig. 5.22. Centralising the driven plate



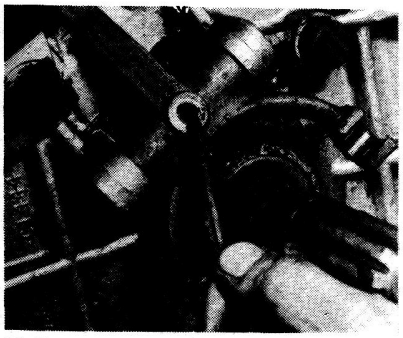
10.2a. Removing spring clips



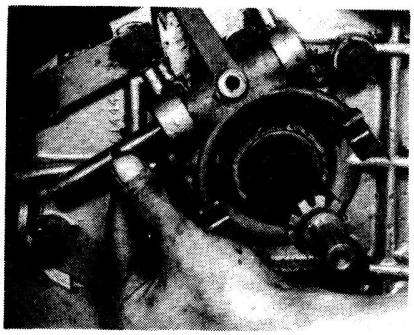
10.2b. Lift away release bearing



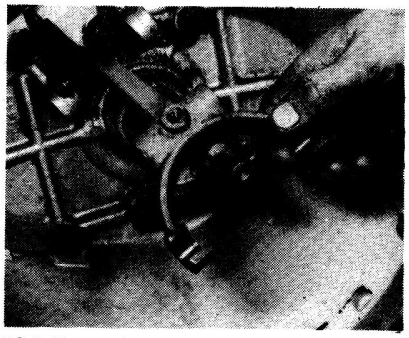
10.3a. Slacken retaining screw locknut



10.3b. Lever shaft retaining screw



10.4. Removing the release lever shaft



10.5. Removing the release lever

11 Clutch master cylinder - general description

The master cylinder consists of a combined tank and barrel assembly as depicted in Fig.5.23. The tank surrounds the barrel assembly and its purpose is to provide a reserve of fluid to make good, temporarily, any loss in the system as may arise. It also provides a reserve of fluid to fill the space created by the displacement which occurs when the clutch pedal is depressed to operate the hydraulic components. The tank is fitted with a filler cap which incorporates a baffle and which screws down against a seal.

A fixing flange is mounted at one end of the barrel assembly and contained within the assembly is a piston which has a rubber main cup spring loaded against one end. Between the cup and the piston is a thin washer which prevents the cup being drawn into the small feed holes drilled around the piston head. At the other end of the piston is a rubber secondary cup which is formed with a depression to take the spherical end of a push rod fitted with a piston stop and retained by a circlip. The push rod, which is connected to the clutch pedal, passes through a rubber boot which fits over the end of the barrel and prevents the ingress of dirt and moisture. At the opposite end of the push rod is an end plug which screws down against a gasket and forms the outlet connection.

When the clutch pedal is depressed, the push rod forces the piston along the bore of the barrel carrying with it the main cup, the fluid displaced by the main cup passes to the slave cylinder. When the clutch pedal is released, the return spring forces the piston back against its stop faster than the fluid is able to return from the slave cylinder; this creates a depression in the master cylinder and the edge of the main cup is drawn away from the head of the piston to uncover the holes. This allows fluid to flow from the tank through the feed holes to make up the temporary deficiency. Fluid, returning from the slave cylinder, under pressure of the clutch operating fork tries to re-enter the master cylinder but is unable to do so until the piston is fully back against its stop when the main cup uncovers a small by-pass hole in the barrel and allows excess fluid to escape to the tank. The by-pass hole also compensates for contraction and expansion of the fluid as the result of temperature changes; if the port becomes blocked, the excess fluid will be unable to escape and clutch slip will result.

12 Clutch master cylinder - removal

1 Disconnect the outlet pipe from the end of the master cylinder. Tie a piece of rag around the pipe and plug the inlet to the cylinder to prevent ingress of dirt.
2 Detach the fork end from the clutch pedal.
3 Unscrew the fixing nuts and detach the master cylinder.
4 Remove the filler cap and drain the fluid into a clean container.
5 Replace the cap to prevent the ingress of dirt.

13 Clutch master cylinder - dismantling

1 Thoroughly clean the exterior of the master cylinder.
2 Prepare a clean working space on the bench top and cover it with a length of clean cloth or strong paper. Clean your hands and maintain absolute cleanliness all the time you are working on the hydraulic components.
3 Detach the rubber boot from the end of the master cylinder and slide it along the push rod.
4 Depress the push rod to relieve the spring load on the circlip and remove the circlip.
5 Withdraw the push rod followed by the piston, piston washer, main cup and spring, these can be removed by vigorous shaking.
6 The secondary cup is removed by stretching it over the end of the piston. Note which way round it is fitted.

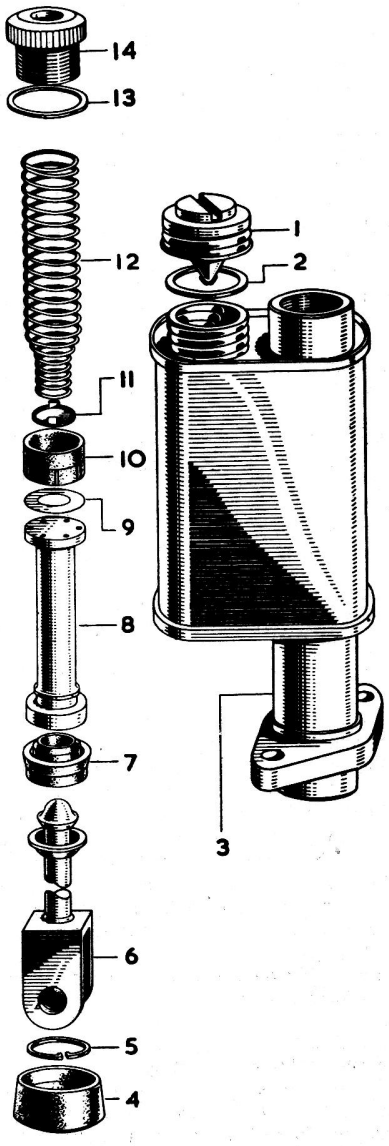


FIG.5.23. EXPLODED VIEW OF THE CLUTCH MASTER CYLINDER

1	*Filler cap*	8	*Piston*
2	*Seal*	9	*Washer*
3	*Barrel assembly*	10	*Rubber main cup*
4	*Rubber boot*	11	*Spring retainer*
5	*Circlip*	12	*Spring*
6	*Pushrod*	13	*Gasket*
7	*Rubber secondary cup*	14	*End plug*

7 There is normally no need to remove the end plug from the barrel.

14 Clutch master cylinder - examination

1 Thoroughly clean all parts in brake fluid and dry off with a non-fluffy cloth. Under no circumstances must oil, grease, paraffin etc; be allowed to come into contact with the rubber parts if you intend to use them again.
2 It is strongly recommended that all rubber seals are replaced as a matter of course but if you intend to use them again, inspect each item carefully for signs of distortion, swelling, splitting or hardening any of which faults will necessitate replacement.
3 Inspect the bore and piston for scoring evidence of which will mean replacement.
4 Make sure that the holes in the head of the piston and the by-pass port in the cylinder are clear by poking gently with a piece of thin wire.

15 Clutch master cylinder - reassembly

1 As parts are refitted to the cylinder bore make sure that they are thoroughly wetted with clean hydraulic fluid.
2 If you have removed the end plug, replace it together with a new gasket.
3 Fit the spring retainer on the small end of the spring (if it has been removed) and secure it by bending over the ears onto the spring.
4 Insert the spring, large end first, into the barrel and then insert the main cup with the lip leading, taking care not to bend back or buckle the lip.
5 Insert the piston washer with the curved end towards the main cup.
6 Stretch the secondary cup onto the piston with the small end towards the drilled head of the piston. Make sure that the groove in the cup engages the ridge on the piston and gently work round the cup, with the fingers, to make sure that it is bedded properly. Use fingers only to stretch the cup on to the piston.
7 Insert the piston into the barrel with the drilled head leading.
8 Stretch the rubber boot onto the push rod so that the open end of the boot is towards the spherical end of the push rod.
9 Offer the push rod to the barrel, push it inwards and secure in position by fitting the circlip. Ensure that the circlip is fitted correctly in its groove.
10 Stretch the rubber boot onto the end of the barrel and make sure it is in its correct position.

16 Clutch master cylinder - refitting

1 Place the master cylinder over the mounting studs on the body of the car, fit each stud with a shakeproof washer and secure the master cylinder with its nuts.
2 Attach the clutch pedal to the fork end of the master cylinder push rod by means of the clevis pin. Fit a plain washer to the end of the clevis pin and insert and open the legs of a split pin to secure.
3 Attach the outlet pipe to the end plug taking care not to cross thread the union nut.
4 Fill the master cylinder tank with clean hydraulic fluid and bleed the system in the manner described in Section 2.
5 Check for leaks by depressing the clutch pedal once or twice and examining all hydraulic connections.

17 Clutch slave cylinder - general description

The clutch slave cylinder is the link between the master cylinder and the release bearing operating lever. It is essentially a casting with an integral mounting flange and two screwed connection points, the connection for the pipe from the master cylinder is that parallel to the mounting flange whilst the other connection is for the bleeder screw.

The clutch slave cylinder is illustrated in Fig.5.24. The body is bored and coned to fine limits and accommodates a piston against the inner face of which is a rubber cup loaded by a cup filler and spring. The travel of the piston is limited by a circlip which fits into a groove at the rear of the bore. The end of the bore is protected against the intrusion of dirt by a rubber boot through which a push rod, connected to the release bearing operating lever, passes.

Hydraulic pressure from the master cylinder moves the rubber cup, and piston rearwards; the piston is bearing on the pushrod and this in turn, is moved rearwards and pivots the release bearing operating lever to which it is connected. When the clutch pedal is released, spring pressure on the operating lever moves the components back to the "at rest" position.

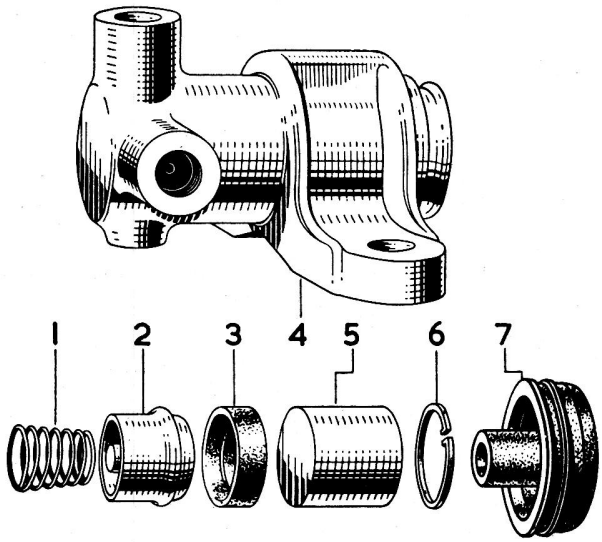


FIG.5.24. EXPLODED VIEW OF THE CLUTCH SLAVE CYLINDER

1 Spring
2 Cup filler
3 Cup
4 Body
5 Piston
6 Circlip
7 Rubber boot

18 Clutch slave cylinder - removal

1 Disconnect the pipe from the master cylinder. Cover the end of the pipe with a piece of rag and plug the connection in the body of the cylinder to prevent the ingress of dirt.
2 Unhook the return spring from its clip on those cars not fitted with a hydrostatic slave cylinder.
3 Remove the securing nuts from the studs. Remove the shake-proof washers.
4 Pull the slave cylinder away from the car and forwards leaving the push rod attached to the car.

19 Clutch slave cylinder - dismantling

1 Thoroughly clean the exterior of the cylinder.
2 Prepare a clean space on the bench and cover it with a length of clean cloth or strong paper. Clean your hands.

3 Remove the rubber from the end of the body.
4 Remove the circlip from the end of the bore.
5 Apply a low air pressure from, say, a foot pump to the open connection to expel the piston and the other parts. It is advisable to hold a piece of rag over the end of the bore to catch the parts as they are pushed out.
6 Remove the bleed screw.

20 Clutch slave cylinder - examination

1 Thoroughly clean all parts and the interior of the bore with clean hydraulic fluid. Do not allow oil, grease, paraffin etc: to come into contact with the rubber parts if you intend to use them again.
2 We strongly recommend that the rubber parts are renewed but if you intend to use them again examine them carefully for signs of distortion, swelling, splitting or hardening either of which faults will necessitate replacement.
3 Examine the bore and piston for signs of deep scoring which, if present will mean replacement.
4 Examine the body in the area of the bleeder screw connection for cracks as may result from overtightening of the bleeder screw.

21 Clutch slave cylinder - reassembly

1 Smear all parts and the bore of the body with hydraulic fluid.
2 Fit the spring in the cup filler and then insert these, with the spring leading, into the bore of the body.
3 Insert the cup with the lip leading into the bore taking care not to turn back or buckle the lip.
4 Fit the piston with the flat face leading.
5 Fit the circlip into its groove in the rear of the bore and make sure that it is seated correctly in the groove.
6 Fit the rubber boot to the rear of the body.
7 Refit the bleeder screw.

22 Clutch slave cylinder - refitting

1 Offer up the slave cylinder to the vehicle and enter the push rod into the bore through the rubber boot.
2 Hook the return spring onto its clip on those cars so fitted.
3 Fit the body of the cylinder over the studs. Fit the shakeproof washers and nuts and tighten down.
4 Reconnect the pipe from the master cylinder taking care not to crossthread the nut.
5 Bleed the system in he manner described in Section 2.
6 Have an assistant to operate the clutch pedal two or three times and check for leaks.
7 Refer to Section 23 and adjust the operating rod if appropriate.

23 Clutch slave cylinder hydrostatic type - operating rod adjustment

The hydrostatic slave cylinder as fitted to later model cars can be identified by the absence of the return spring as fitted to the previous slave cylinder body. When refitting the hydrostatic slave cylinder it is important that the operating rod adjustment dimension as shown in Fig.5.25, is obtained. Proceed as follows:
1 Extract the clevis pin securing the rod to the clutch lever.
2 Hold the head of the rod and release the locknut.
3 Push the clutch operating lever away from the slave cylinder until resistance is felt and retain it in this position.
4 Push the rod to the limit of its travel into the bore of the cylinder and adjust the fork end until a dimension of 0.75" (19 mm) between the centre of the fork end and the centre of the clutch operating lever is obtained. Tighten the locknut.
5 Release the operating rod and connect the fork end to the lever by means of the clevis pin. Fit a plain washer and split pin to the clevis pin.

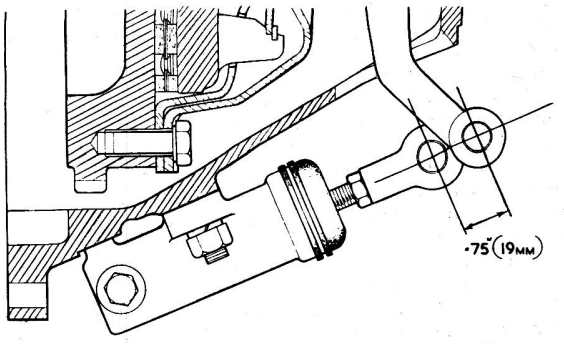


Fig.5.25. Setting dimension - Hydrostatic slave cylinder

24 Removing and refitting a flexible hose

1 Carefully remove all dirt from each union of the flexible hose.
2 Have a clean jar handy to catch any fluid which may drain when the pipe is disconnected.
3 Unscrew the tube nut from the hose union and allow hose to drain.
4 Unscrew the locknut and withdraw the hose from the bracket.
5 Undo the hose at the other connection to the rigid pipe.
6 When refitting a hose it is essential to check that it is not twisted or kinked.
7 Pass the hose union through the bracket. Hold the union with a spanner to prevent the hose from twisting. Fit a shakeproof washer and tighten down on the locknut.
8 Connect the pipe by screwing on the tube nut.
9 Repeat the above for the other end of the pipe.

25 Fault diagnosis and remedy

There are four main faults to which the clutch and the release mechanism are prone. They may occur by themselves or in conjunction with each other. They are clutch squeal, slip, spin and judder.

26 Clutch squeal

1 If, on taking up the drive or when changing gear, the clutch squeals, it is an indication of a badly worn clutch release bearing.
2 As well as regular wear due to normal use, wear of the clutch release bearing is accentuated if the clutch is ridden or held down for long periods in gear with the engine running. To minimise wear of this nature the car should always be taken out of gear at traffic lights or at similar hold-ups.
3 The clutch release bearing is not an expensive item but it is difficult to get as as its replacement requires the removal of the engine and gearbox assembly and work as detailed in Section 10.

27 Clutch slip

1 Clutch slip is a self evident condition which occurs when the clutch driven plate is badly worn or oil or grease have got onto the flywheel or pressure plate faces. It may also be that the pressure plate is faulty.
2 The reason for clutch slip is that due to one or more of the faults above, there is either insufficient pressure from the pressure plate, or insufficient friction in the driven plate to ensure a solid drive.

3 If small amounts of oil get onto the clutch, they will be burnt off under the heat of clutch engagement and in the process will gradually darken the linings. Excessive oil on the clutch will burn off leaving a carbon deposit which can cause quite bad slip or fierceness, spin and judder.
4 If clutch slip is suspected and confirmation of this condition is required, there are several tests which can be made.
5 With the engine in second or third gear and pulling lightly, sudden depression of the accelerator pedal may cause the engine to increase speed without any noticeable increase in road speed. Easing off on the accelerator will cause a drop in engine speed but not in road speed.
6 In extreme cases of clutch slip the engine will race under normal accelerating conditions.
7 If slip is due to oil or grease on the linings a temporary cure can sometimes be effected by squirting carbon tetrachloride into the clutch. The permanent cure is, of course, to renew the clutch driven plate and to investigate and to cure the cause of the oil leak.

28 Clutch spin

1 This is a condition which occurs when there is a leak in the clutch hydraulic system, when there is an obstruction in the clutch either in the first motion shaft or in the operating lever itself, or when oil may have left a resinous deposit on the driven plate causing it to stick to either the pressure plate or the flywheel.
2 The reason for clutch spin is that due to one or more of the above faults, the clutch pressure plate is not completely freeing even with the clutch pedal completely depressed.
3 The symptoms of clutch spin are difficulty in engaging a gear from rest, difficulty in changing gear, and a very sudden take up of the drive at the fully depressed end of the clutch pedal travel as the clutch is released.
4 Check the clutch master cylinder, the slave cylinder and hydraulic connections for leaks. Fluid in one of the rubber boots is a sure sign of a leaking piston seal.
5 If these points are checked and are found to be in order then the fault lies internally in the clutch which will have to be removed for examination.

29 Clutch judder

1 Clutch judder is a self evident condition which occurs when the gearbox or engine mountings are loose or are too flexible, or when there is oil on the face of the driven plate or when the pressure plate has been incorrectly adjusted.
2 The reason for clutch judder is that due to one of the above faults, the pressure plate is not freeing smoothly from the driven plate and is snatching.
3 Clutch judder is usually most noticeable when the clutch pedal is released in first or in reverse gear and the whole car judders as it moves backwards or forwards.

Chapter 6 Gearbox, overdrive and automatic transmission

Contents

Specifications

Number of forward speeds	Four	
Synchromesh		
Mk 1 and early Mk 2 models	Second, third and top gears	
Later Mk 2, 240 and 340 models	All four forward gears	
Gearbox ratios		
Prefix GB or GBN		
Suffix - none or 'O'	Top	1 : 1
	Third	1.367 : 1
	Second	1.982 : 1
	First	3.375 : 1
	Reverse	3.375 : 1
Suffix - 'CR' or 'MS'	Top	1 : 1
	Third	1.210 : 1
	Second	1.750 : 1
	First	2.980 : 1
	Reverse	2.980 : 1
Suffix - 'JS'	Top	1 : 1
	Third	1.283 : 1
	Second	1.860 : 1
	First	3.377 : 1
	Reverse	3.377 : 1
Prefix - JC or JCN	Top	1 : 1
	Third	1.328 : 1
	Second	1.973 : 1
	First	3.040 : 1
	Reverse	3.040 : 1

Axle ratio	
2.4 litre prior to chassis No.901582 RH or 940606 LH	4.55 : 1
Late 2.4 litre and 240	4.27 : 1
3.4, 3.8 litre and 340	3.54 : 1
Overdrive models:—	
2.4 litre and 240	4.55 : 1
3.4, 3.8 litre and 340	3.77 : 1
All gearboxes except JC and JCN:—	
2nd gear endfloat on mainshaft	0.002 in to 0.004 in
3rd gear endfloat on mainshaft	(0.05 to 0.10 mm)
Layshaft endfloat on countershaft	
JC and JCN gearboxes:—	
1st gear endfloat on mainshaft	0.005 in to 0.007 in (0.13 to 0.18 mm)
2nd gear endfloat on mainshaft	0.005 in to 0.008 in (0.13 to 0.20 mm)
3rd gear endfloat on mainshaft	0.005 in to 0.008 in (0.13 to 0.20 mm)
Countershaft gear unit endfloat	0.004 in to 0.006 in (0.10 to 0.15 mm)
Capacity (standard transmission)	2.5 Imp. pints (3 U.S. pints)
(with overdrive)	4 Imp. pints (4.75 U.S. pints)
Overdrive	
Make	Laycock de Normanville
Fitted to GBN gearboxes	Type A
Fitted to JCN gearboxes	Compact type A
Ratio	0.778 : 1
Clutch movement from	0.090 - 0.100 in Compact type A
Direct to overdrive	0.080 - 0.120 in Type A
Hydraulic pressure:—	
2.4 litre	350 - 370 lb/sq. in.
3.4 litre	420 - 440 lb/sq. in.
3.8 litre	540 - 560 lb/sq. in.

Dimensions (new) Type A	**Dimensions - New**	**Clearances - New**
Pump		
Plunger diameter	.3742/.3746 in	.0002/.0016 in
Bore for plunger in pump body	.3748/.3758 in	
Plunger spring fitted load at top of stroke	9.493 lb at 1.137 in	
Valve spring load	2.5/8 lb at 19/32 long	
Pin for roller	.2497/.2502 in dia.	.0008/.0023 in
Bore for pin in roller	.2510/.2520 in	
Gearbox mainshaft		
Diameter at steady bushes	1.1544/1.1553 in	.0029/.0048 in
Steady bush internal diameter	1.1582/1.1592 in	
Shaft diameter at sunwheel bush	1.1544/1.1553 in	
Sunwheel bush internal diameter	1.1582/1.1592 in	.0029/.0048 in
Shaft diameter at read steady bush	.6235/.6242 in	
Rear steady bush internal diameter	.6250/.6260 in	.0008/.0025 in
Gear train		
Endfloat of sunwheel		.008/.014 in
Piston bores		
Accumulator bore - 2.4 and 3.4 litre	1.1245/1.1255 in	
3.8 litre	1.4995/1.5005 in	
Operating piston bores	1.3745/1.3755 in	
Pump		
Plunger diameter	.3742/.3746 in)	.0002/.0016 in
Pump body bore	.3746/.2758 in)	

Pump roller bush		
Outside diameter of bush	.3736/.3745 in)	.0005/.0023 in
Inside diameter of roller	.3750/.3759 in)	
Inside diameter of bush	.2510/.2518 in)	.0007/.0020 in
Outside diameter of pin	.2497/.2502 in)	
Accumulator		
Piston diameter	1.1232/1.1241 in)	.0004/.0023 in
Bore diameter	1.1245/1.1255 in)	
Operating pistons		
Piston diameter	1.3732/1.3741 in)	.0004/.0023 in
Bore diameter	1.3745/1.3755 in)	
Operating valve		
Valve diameter	.2494/.2497)	.0003/.0012 in
Bore diameter	.2500/.2506)	
Overdrive mainshaft		
Diameter at oil transfer bush	1.1544/1.1533 in)	.0029/.0048 in
Inside diameter of bush	1.1582/1.1592 in)	
Diameter at sunwheel	1.1544/1.1533 in)	.0029/.0048 in
Inside diameter at sunwheel bush	1.1582/1.1592 in)	
Diameter at spigot bearing	.6235/.6242 in)	.0008/.0025 in
Inside diameter of spigot bearing	1.6250/.6260 in)	

Automatic transmission

Make - 2.4, 3.4 and 3.8 litre models	Borg-Warner model DG	
240 and 340	Borg-Warner model 35	
Ratios -	Model DG	Model 35
Top	1 : 1	1 : 1
Intermediate	1.435 : 1	1.45 : 1
Low	2.308 : 1	2.39 : 1
Reverse	2.009 : 1	2.09 : 1
Torque converter (max)	2.17 : 1	2.00 : 1
Capacity	15 Imp. pints (18 U.S. pints, 8.5 litres)	
Fluid type	SAE automatic transmission fluid Type 'A' or type 'A' suffix 'A'	
Torque converter	Three element	

1 General description

The manual gearbox fitted to all models is of the four speed type with, in the case of earlier models, synchromesh on the second, third and top gears. However, with effect from the following chassis numbers an all-synchromesh gearbox (prefix JC or JCN) was introduced:-

	RH Drive	LH Drive
2.4 litre Mk.2	119200	127822
3.4 litre Mk.2	169341	180188
3.8 litre Mk.2	234125	224150
240 and 340	All models	

The gears are of single helical form and are in constant mesh except in the case of the GB and GBN gearboxes, where the first and reverse gears have spur gears which slide into mesh. With the exception of the reverse, the detents for the gears are incorporated in the synchro assemblies, the synchro balls engaging with the grooves in the operating sleeve. The detent for the reverse gear of JC gearboxes, and for the first and reverse gear of the other models, is a spring loaded ball which engages in a groove in the selector rod. Two interlock balls and a pin located at the front of the selector rods prevent the engagement of two gears at the same time.

The gears of JC and JCN boxes are pressure fed at approximately 5 lb/sq in from a pump driven from the mainshaft on standard transmission cars and by the overdrive oil pump on those cars equipped with overdrive.

The gearbox number is stamped on a lug at the left hand rear corner of the box casing and on the top of the cover. The number will be preceded by the letters GB or GBN or, in the case of cars produced subsequent to the above quoted chassis numbers, JC or JCN. There may be no letters following the number but on the other hand you may find letters "O", "CR", "MS" or "JS".

The letter "N" following the prefix (ie GBN, JCN) indicates that a mainshaft suitable for the attachment of an overdrive unit is fitted.

No suffix or suffix "O" or "CR" indicates separate constant, 3rd and 2nd gear assembled on a splined sleeve and that the constant pinion shaft bearing is retained by a circlip.

Suffix "MS" indicates a one piece cluster layshaft and that the constant pinion shaft bearing is retained by a circlip. Suffix "JS" also indicates a one piece cluster layshaft but that the constant pinion shaft bearing is retained by a nut and locknut.

An exploded view of the various make up of gears and of the GB and JC gearbox casings and top covers is given in Figs.6.1 - 6.5 inclusive.

It will be appreciated from the above that when ordering spare parts for an individual gearbox it is imperative to quote the prefix and suffix letters in addition to the gearbox number.

GB, GBN and JC, JCN gearboxes **are not interchangeable.**

2 Gearbox - removal and replacement

The gearbox and engine must be removed from the car as a complete unit and full instructions for this, and for separating and refitting the box to the engine, will be found in Chapter 1.

3 Gearbox - dismantling

It is assumed that the clutch housing is still fitted to the gearbox but that the clutch release mechanism has been removed from the housing in the manner described in Chapter 5.

1 Before commencing work, thoroughly clean the exterior of the gearbox using a solvent such as paraffin or "Gunk". Finish off by wiping down the exterior of the unit with a dry non-fluffy rag.

2 The first task is to remove the clutch housing and this is held to the gearbox by eight bolts two of which are secured by locking wire and the remainder by tabbed locking plates (photo).

3 Break the locking wire, knock up the tabs and remove the bolts. The clutch housing can now be lifted off (photo).

4 Remove the locking screw which retains the speedometer driven gear bush in the extension and take out the driven gear and the bearing.

5 Place the gear lever in neutral. Remove the eight set screws (ten on GB boxes) and the two nuts securing the top cover and then lift off the cover (photo).

6 Engage first and reverse gears to lock the unit and now remove the propeller shaft flange by knocking up the tab washer and then removing the nut and flange. Place the gears back into neutral.

7 For those models fitted with an overdrive unit, refer to Section 8 and remove the overdrive unit but leave the rear housing in position on the box.

8 Remove the setscrews securing the rear extension (non-overdrive models) or the rear housing with retainer plate (overdrive models) (photo) and remove them taking care not to pull the layshaft and the reverse gear shaft out of the gearbox.

9 Remove the reverse gear pinion shaft by pulling to the rear of the gearbox.

10 Now make up a dummy countershaft to the dimensions given in Fig.6.6.

11 Insert the dummy countershaft into the countershaft bore at the front of the gearbox casing and push the layshaft out of the rear of the gearbox. Allow the dummy shaft, which is now inside the layshaft cluster, to drop into the bottom of the box thus retaining the needle roller bearings.

12 Remove the constant pinion shaft followed by the spigot roller bearings (photo).

13 Remove the circlip retaining the mainshaft bearing and then take off the washer followed by the two shims (photo).

14 Tap the mainshaft (using a hide faced hammer towards the front of the gearbox to remove the rear bearing (photo).

15 Push the reverse gear forward to clear the first speed gear on the mainshaft. Now lift the front end of the mainshaft upwards and forwards to remove it complete with all mainshaft gears (photo).

16 The layshaft cluster is now visible in the bottom of the casing (photo).

17 Push the reverse gear rearwards as far as it will go in order to clear the first speed gear on the layshaft. The layshaft gear can now be lifted out (photo). Take note of the inner and outer thrust washers fitted at each end of the gears and take care not to lose any of the needle rollers at each end of the gear unit.

18 Push the reverse gear back into position and then lift it out through the top of the case (photo).

19 The following paragraphs refer to procedures for dismantling the mainshaft of GB and GBN gearboxes.

20 Withdraw the top/third gear operating and synchronising sleeves by sliding them forward off the shaft.

21 Press the operating sleeve off the synchronising sleeve and collect the six synchronising balls and springs. Remove the interlock plungers and balls from the synchro sleeve.

22 Withdraw the second gear synchronising sleeve and the first speed gear rearwards off the shaft.

23 Press the first speed gear off the sleeve and collect the six balls and springs and now remove the interlock ball and plunger from the synchronising sleeve.

24 Refer to Fig.6.7. Press in the plunger locking the third speed gear thrust washer and then rotate the washer until the splines line up when it can be withdrawn (photo).

25 Remove the third speed gear by sliding it forward off the shaft but be very careful not to lose any of the needle rollers which will emerge as the gear is removed (photo).

26 Remove the locking plunger and spring.

27 Move to the opposite end of the shaft and remove the second speed gear in the same manner as for the removal of the third speed gear (paragraphs 24 and 25).

28 The following paragraphs refer to dismantling the mainshaft fitted to type JC and JCN mainshafts.

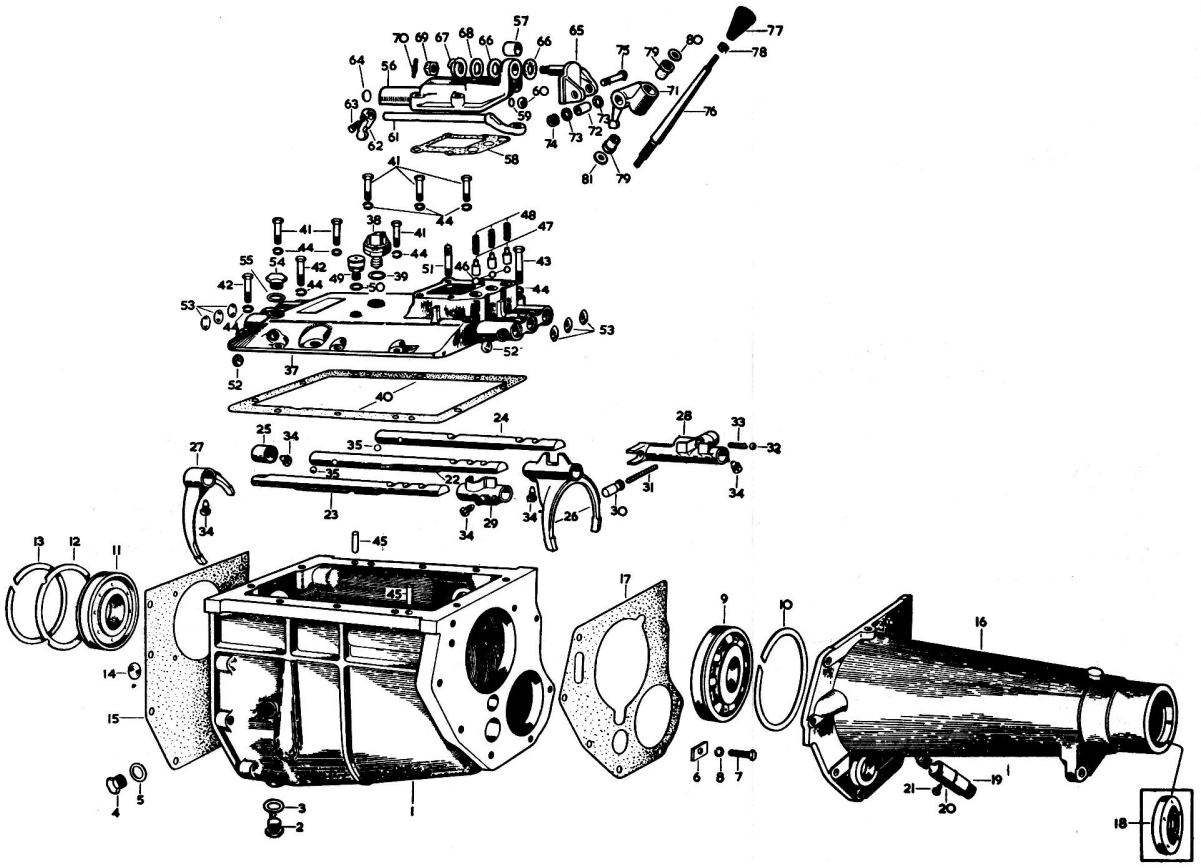


FIG. 6.1. THE GB GEARBOX AND TOP COVER

1 *Gearbox case*
2 *Drain plug*
3 *Fibre washer*
4 *Oil filler plug*
5 *Fibre washer*
6 *Locking plate*
7 *Setscrew*
8 *Spring washer*
9 *Ball bearing*
10 *Circlip*
11 *Ball bearing*
12 *Collar*
13 *Circlip*
14 *Fibre washer*
15 *Gasket*
16 *Gearbox extension*
17 *Gasket*
18 *Oil seal*
19 *Speedometer drive gear*
20 *'O' ring*
21 *Dowel screw*
22 *Striking rod, 1st/2nd gears*
23 *Striking rod, 3rd/top gears*
24 *Striking rod, reverse gear*
25 *Stop*
26 *Change speed fork, 1st/2nd gears*
27 *Change speed fork, 3rd/top gears*
28 *Change speed fork, reverse gear*
29 *Selector, 3rd/top gears*
30 *Plunger*
31 *Spring*
32 *Locking ball*
33 *Spring*
34 *Dowel screw*
35 *Ball*
37 *Top cover*
38 *Switch*
39 *Gasket*
40 *Gasket*
41 *Bolt*
42 *Bolt*
43 *Bolt*
44 *Spring washer*
45 *Dowel*
46 *Ball*
47 *Plunger*
48 *Spring*
49 *Breather*
50 *Fibre washer*
51 *Stud*
52 *Welch washer*
53 *Welch washer*
54 *Plug*
55 *Copper washer*
56 *Top cover housing*
57 *Bush*
58 *Gasket*
59 *Circlip*
60 *Oil seal*
61 *Remote control shaft*
62 *Selector lever*
63 *Bolt*
64 *Welch washer*
65 *Pivot jaw*
66 *Washer*
67 *Spring washer*
68 *D washer*
69 *Nut*
70 *Splitpin*
71 *Remote control lever*
72 *Bush*
73 *Washer*
74 *Nut*
75 *Pivot pin*
76 *Changespeed lever*
77 *Knob*
78 *Locknut*
79 *Bush*
80 *Washer*
81 *Nut*

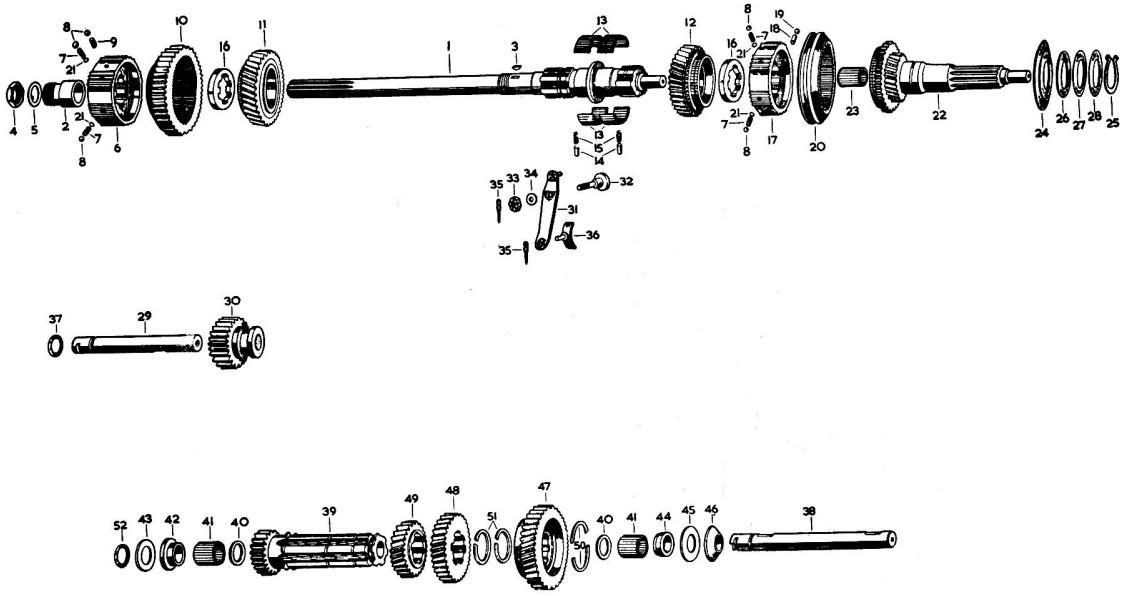


FIG.6.2. THE GEARS, 'GB' BOXES WITH NO SUFFIX, SUFFIX 'CR' OR 'MS'

1 Mainshaft
2 Speedometer driving gear
3 Key
4 Nut
5 Tab washer
6 2nd speed synchronising sleeve
7 Spring
8 Ball
9 Plunger
10 1st speed mainshaft gear
11 2nd speed mainshaft gear
12 3rd speed mainshaft gear
13 Needle rollers
14 Plunger
15 Spring
16 Thrust washer
17 3rd/top speed synchronising sleeve
18 Plunger
19 Ball
20 Operating sleeve
21 Shim
22 Constant pinion shaft
23 Roller bearing
24 Oil thrower
25 Circlip
26 Washer
27 Shim
28 Shim
29 Reverse spindle
30 Reverse gear
31 Lever
32 Fulcrum pin
33 Slotted nut
34 Plain washer
35 Split pin
36 Reverse slipper
37 Sealing ring
38 Countershaft
39 1st speed gear
40 Retaining ring
41 Needle rollers
42 Thrust washer
43 Thrust washer
44 Retaining ring
45 Thrust washer
46 Thrust washer
47 Constant wheel
48 3rd speed countershaft gear
49 2nd speed countershaft gear
50 Split ring
51 Circlip
52 Sealing ring

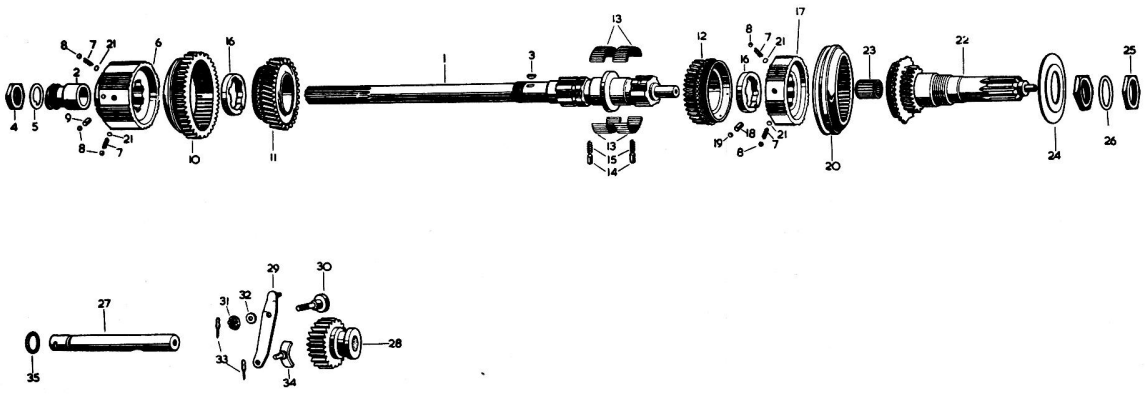


FIG.6.3. THE GEARS, 'GB' BOXES WITH 'JS' SUFFIX

1 Mainshaft
2 Speedometer driving gear
3 Key
4 Nut
5 Tab washer
6 Synchronising sleeve 2nd gear
7 Spring
8 Ball
9 Plunger
10 1st speed mainshaft gear
11 2nd speed mainshaft gear
12 3rd speed mainshaft gear
13 Needle roller
14 Plunger
15 Spring
16 Thrust washer
17 Synchronising sleeve
18 Plunger
19 Ball
20 Operating sleeve
21 Shim
22 Constant pinion shaft
23 Roller bearing
24 Oil thrower
25 Locknut
26 Tab washer
27 Reverse spindle
28 Reverse gear
29 Lever
30 Fulcrum pin
31 Slotted nut
32 Plain washer
33 Split pin
34 Reverse slipper
35 Sealing ring
36 Countershaft
37 Gear unit on countershaft
38 Retaining ring
39 Needle roller
40 Thrust washer
41 Thrust washer
42 Retaining ring
43 Thrust washer
44 Thrust washer
45 Sealing ring

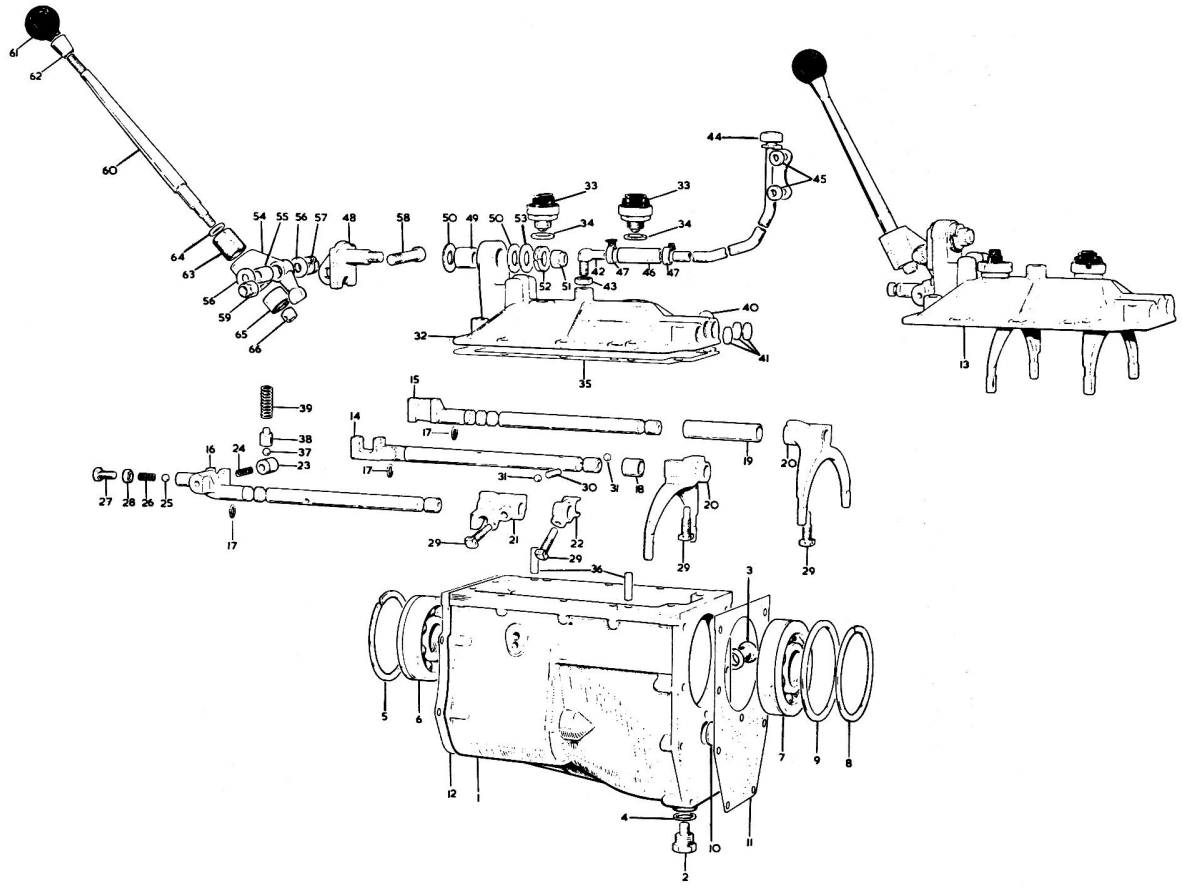


FIG. 6.4. COMPONENTS OF LATER MK 2, 240 AND 340 GEARBOX CASING

1 *Gearbox casing*
2 *Oil drain plug*
3 *Oil filter plug*
4 *Fibre washer*
5 *Circlip*
6 *Ballbearings*
7 *Ballbearings*
8 *Circlip*
9 *Collar*
10 *Fibre washer*
11 *Gasket*
12 *Gasket*
13 *Remote control*
14 *Striking rod, first/ second gears*
15 *Striking rod, third/ top gears*
16 *Striking rod, reverse gear*
17 *'O' ring*
18 *Stop*
19 *Stop*
20 *Changespeed fork*
21 *Changespeed fork*
22 *Locating arm*
23 *Plunger*
24 *Spring*
25 *Ball*
26 *Spring*
27 *Setscrew*
28 *Nut*
29 *Dowel screw*
30 *Roller*
31 *Ball*
32 *Top cover*
33 *Switch*
34 *Gasket*
35 *Gasket*
36 *Dowel*
37 *Ball*
38 *Plunger*
39 *Spring*
40 *Spring*
41 *Welch washer*
42 *Breather elbow*
43 *Nut*
44 *Gearbox breather assembly*
45 *Distance piece*
46 *Hose*
47 *Clip*
48 *Pivot jaw*
49 *Bush*
50 *Fibre washer*
51 *Self-locking nut*
52 *Spring washer*
53 *D-washer*
54 *Selector lever*
55 *Bush*
56 *Fibre washer*
57 *Spring washer*
58 *Pivot pin*
59 *Self-locking nut*
60 *Changespeed lever*
61 *Knob*
62 *Cone*
63 *Upper bush*
64 *Washer*
65 *Lower bush*
66 *Self-locking nut*

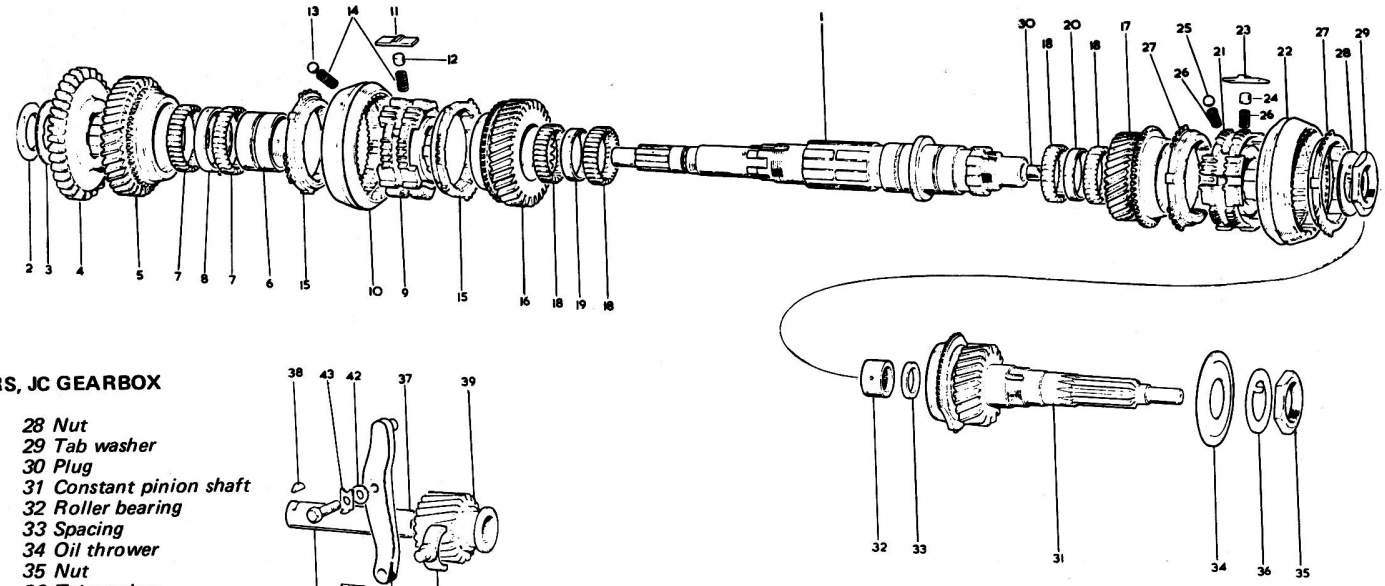


FIG.6.5. THE GEARS, JC GEARBOX

1 *Mainshaft*
2 *Nut*
3 *Tab washer*
4 *Reverse gear*
5 *1st speed gear*
6 *Bearing sleeve*
7 *Needle roller*
8 *Spacer*
9 *Synchro hub*
10 *Operating sleeve*
11 *Thrust member*
12 *Plunger*
13 *Detent ball*
14 *Spring*
15 *Synchro ring*
16 *2nd speed gear*
17 *3rd speed gear*
18 *Needle roller*
19 *Spacer*
20 *Spacer*
21 *Synchro hub*
22 *Operating sleeve*
23 *Thrust member*
24 *Plunger*
25 *Detent ball*
26 *Spring*
27 *Synchro ring*
28 *Nut*
29 *Tab washer*
30 *Plug*
31 *Constant pinion shaft*
32 *Roller bearing*
33 *Spacing*
34 *Oil thrower*
35 *Nut*
36 *Tab washer*
37 *Reverse spindle*
38 *Key*
39 *Reverse idler gear*
40 *Lever assembly*
41 *Setscrew*
42 *Fibre washer*
43 *Tab washer*
44 *Reverse slipper*
45 *Split pin*
46 *Countershaft*
47 *Key*
48 *Gear unit (cluster)*
49 *Needle roller*
50 *Retaining ring*
51 *Thrust washer (rear)*
52 *Thrust washer (front)*
53 *Thrust washer (outer)*

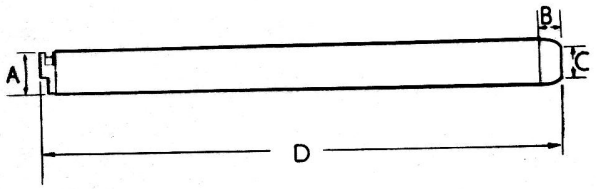
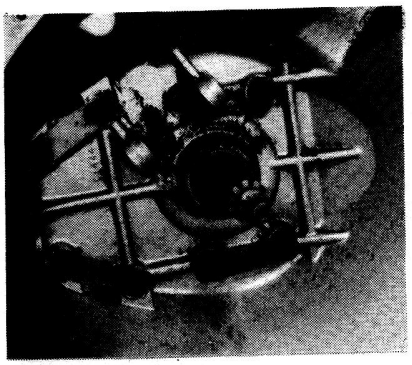


FIG.6.6. DUMMY COUNTERSHAFT

A .979" (24.86 mm)
B .5" (12.7 mm)
C .75" (19.05 mm)
D 11.125" (28.25 cm)



3.2. Attachment of clutch housing to gearbox

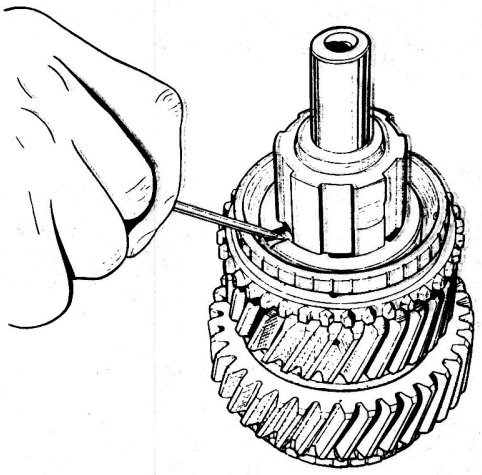
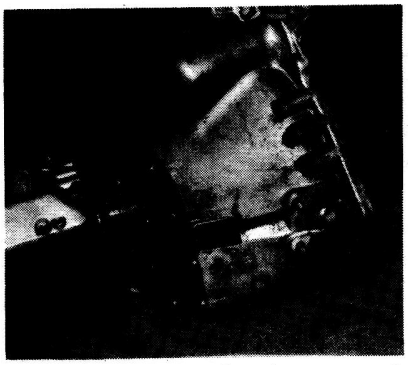
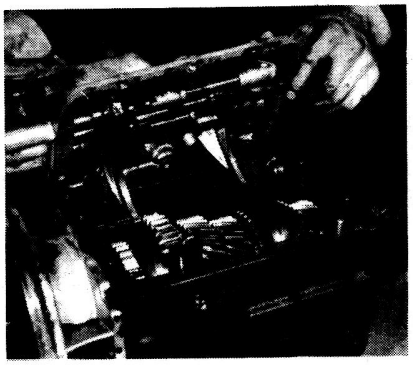


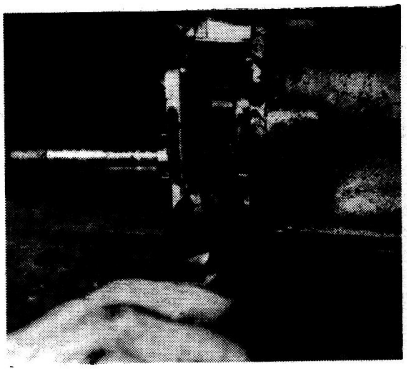
Fig.6.7. Depressing the third speed thrust washer locking plunger



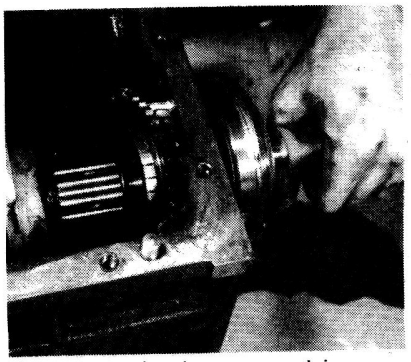
3.3. Clutch housing and gearbox separated



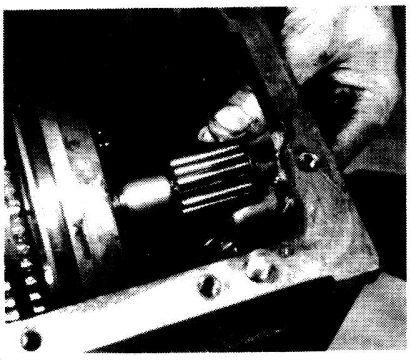
3.5. Top cover removed



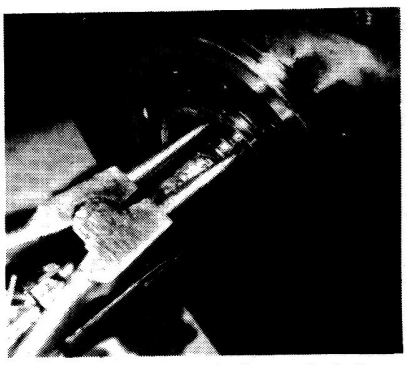
3.8. Retainer plate



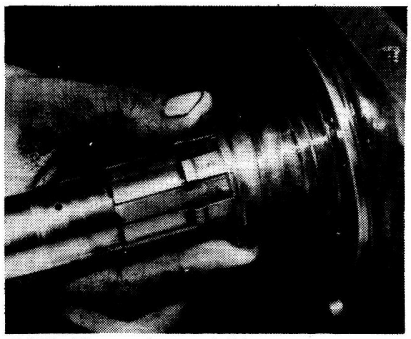
3.12a. Removing the constant pinion shaft

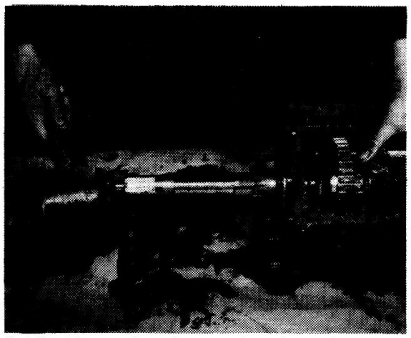


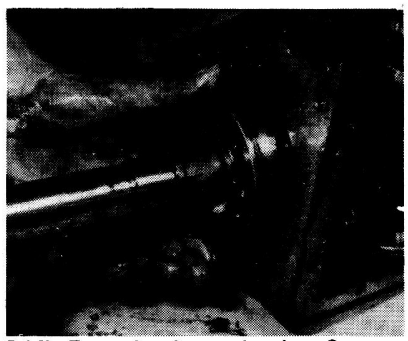
3.12b. Removing the needle roller bearing

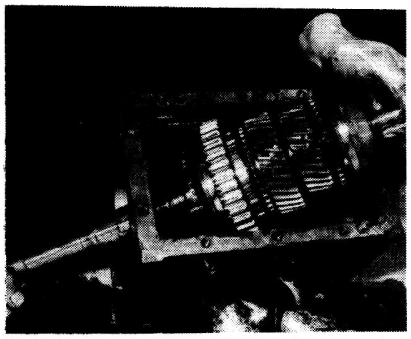


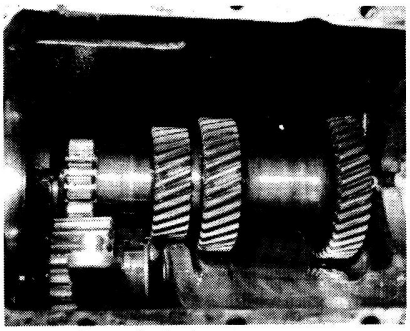
3.13a. Removing the circlip - mainshaft bearing

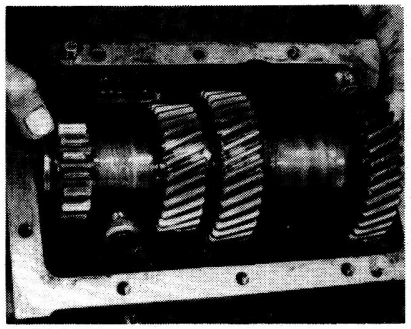

3.13b. The washer and shims

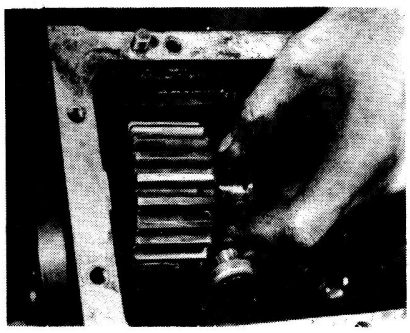

3.14a. Removing the rear bearing - 1


3.14b. Removing the rear bearing - 2

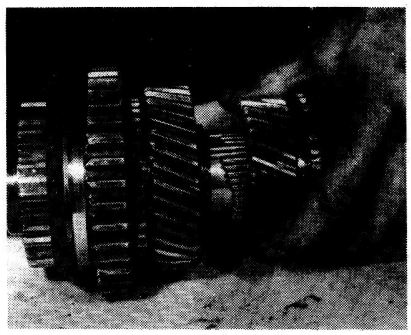

3.15. Removing the mainshaft gears


3.16. The layshaft cluster


3.17. Lifting out the layshaft cluster


3.18. Removing the reverse gear


3.24. Removing the thrust washer


3.25. Removing the 3rd speed gear

29 When dismantling the mainshaft take careful note of the positions from which sets of needle roller bearings are removed because they are graded in size and must be kept in sets for reassembly to the positions from which they were removed.
30 Slide off the reverse gear.
31 Withdraw the first gear and collect the 120 needle rollers, the spacer and the sleeve.
32 Withdraw the 1st/2nd gear synchro assembly and collect the two synchro rings.
33 Remove the second gear with its 106 needle rollers. Leave the spacer on the mainshaft.
34 Knock back the tab of the washer locking the nut securing the 3rd/top synchro assembly to the mainshaft. Remove the nut and withdraw the synchro assembly from the shaft at the same time collecting the two loose synchro rings.
35 Withdraw the third gear with its 106 needle rollers.
36 To dismantle the synchro assembly used with JC and JCN boxes, completely surround the assembly with a cloth so that none of the balls and springs are lost. Push out the hub from the operating sleeve and collect the synchro balls and springs, the thrust members, plungers and springs.
37 To dismantle the constant pinion shaft of JC gear boxes, open the tab washer and remove the large nut, tab washer and oil thrower. Tap the shaft smartly against a metal plate to dislodge the bearing and the spacer. The same procedure is followed for GB (JS) boxes except that in this case double locking is provided in the shape of a locknut in addition to the tab washer.
38 The constant pinion shaft of GB series gearboxes is dismantled by removing the circlip by the packing washer, any shims which may be fitted and then the oil thrower . Remove the bearing by tapping the shaft smartly against a metal plate.
39 To dismantle the top cover, first remove the gear lever, if this was not done at engine removal, by unscrewing the self locking nut and then taking off the double coil spring washer, flat washer and fibre washer and then the gear lever can be lifted off.
40 Break the locking wire and unscrew the selector rod retaining

screws.
41 Withdraw the 3rd/top selector rods with the selector, spacing tube and interlock ball. Take note of the loose interlock pin at the front of the 1st/2nd selector rod.
42 Withdraw the reverse selector rod and collect the reverse fork, the stop spring and detent plunger.
43 Withdraw the 1st/2nd selector rod with its fork and short spacer tube.

4 Gearbox - examination

1 It is assumed that the gearbox has been dismantled because of some malfunction, possibly excessive noise, ineffective synchromesh or failure to stay in a selected gear. The cause of most gearbox faults is failure of the needle rollers on the input or the mainshaft and wear on the synchro rings. These items can be replaced but there is always the possibility of some obscure fault remaining even after a visually unserviceable component has been renewed which means that all your work has gone for nothing as the fault, if any, will not be discovered until the gearbox has been re-installed in the car. It is worthwhile, therefore, if faults are found, to enquire about the availability of parts and their cost and it may still be worth considering, even at this stage, fitting an exchange gearbox.
2 Examine the teeth of all gears for signs of uneven or excessive wear and, of course, chipping. If a gear on the mainshaft is in doubtful condition, check that the corresponding gear on the layshaft is not equally damaged.
3 All gears should be a good running fit in the shaft with no signs of rock and the hubs should not be a sloppy fit on the splines.
4 Examine the selector forks for signs of wear or ridging on the faces which contact the operating sleeve.
5 Look for wear on the selector rods.
6 It is difficult to decide on the degree of wear on roller bearings but we advise taking no chances. Considering the work entailed in removing and dismantling the gearbox, it would be very short sighted not to replace all bearings as a matter of course and the same applies to all oil seals and synchroniser rings.

5 Gearbox - reassembly of type GB and GBM

1 On those gearboxes without a suffix or suffix "O" or "CR", the first task is to build up the layshaft. Press the 2nd and 3rd gears on to the splined extensions of the 1st gear and retain them with their circlip.
2 Fit the 2nd gear circlip below the circlip groove and press the constant mesh gear on as far as possible. Fit the split ring and then draw the gear forward onto it and finally fit the circlip behind the constant gear.
3 For both types of layshaft, liberally coat the needle roller retaining rings with vaseline and then fit one to each end of the layshaft gear unit followed, at each end, by the 29 rollers.
4 Fit the outer roller retaining ring at the front end and the inner and outer thrust washers at either end of the gear unit and then lower the gears into the case and insert a dummy countershaft to locate the layshaft gears in place.
5 The end float of the layshaft must now be checked by measuring the clearance between the thrust washer and the casing at the rear of the shaft as shown in Fig.6.8. The end float should be 0.002" - 0.004" (0.05 - 0.10 mm). Adjustment is effected by an exchange of thrust washers which are available in thicknesses of 0.152", 0.156", 0.159", 0.162" and 0.164" (3.86, 3.96, 4.04, 4.11 and 4.17 mm).
6 Remove the dummy countershaft and insert a thin rod in its place.
7 Place the reverse gear in position and draw it rearwards as far as possible to give clearance for final positioning of the layshaft gear unit.
8 Now start work on the mainshaft. Liberally coat the 41 needle rollers with vaseline and then fit them behind the shoulder on the mainshaft and slide the 2nd speed gear, with synchronising cone to the rear, on to them.
9 Fit the 2nd speed thrust washer spring and plunger into the plunger hole and then slide the thrust washer up the shaft and over the splines. Align the large hole in the synchro cone, compress the plunger and rotate the thrust washer into the locked position with the cut-away in line with the plunger.
10 Now check the end float of the 2nd gear on the mainshaft by measuring, with a feeler gauge, the distance between the thrust washer and the shoulder on the mainshaft. The clearance should be 0.002" - 0.004" (0.05 - 0.10 mm) and if this is not achieved, remove the thrust washer and replace it by one which will give the required clearance. Washers are available in the following thicknesses:-

0.471 in/0.472 in (11.96/11.99 mm)
0.473 in/0.474 in (12.01/12.03 mm)
0.475 in/0.476 in (12.06/12.09 mm)

11 The above work in respect of the 2nd speed gear is now repeated to fit the 3rd speed gear on the opposite side of the shoulder on the mainshaft. End float is checked in the same manner as for the 2nd speed gear and the same range of adjusting shims is available. The holes through which the thrust washer locking plungers are depressed are shown in Fig.6.9.
12 To assemble the 2nd gear synchro assembly, first fit the springs and balls and shims, if fitted to the six blind holes in the synchro sleeve.
13 Refer to Fig.6.10 and fit the 1st speed gear to the 2nd speed synchronising sleeve so that the relieved tooth of the internal splines in the gear are in line with the stop pin in the sleeve.
14 It may be helpful to compress the springs using a jubilee clip and then slide the operating sleeve over the synchronising sleeve until the balls can be heard and felt to engage the neutral position groove.
15 It should require 62 to 68 lbs (28 to 31 kg) pressure to disengage the synchronising sleeve from the neutral position in the operating sleeve. This can be judged, if special equipment is not available, by gripping the operating sleeve in the palms of the hands and then pressing the synchronising sleeve with the fingers until it disengages from the neutral position. It should require firm finger pressure before disengaging and, if necessary, shims can be fitted, or removed from, underneath the springs to adjust the pressure of the balls against the operating sleeve.
16 Now fit the 1st speed gear/2nd speed synchro assembly to the mainshaft using any spline position and check that the synchro sleeve moves freely on the mainshaft when the ball and plunger is not fitted. If there is any restriction, try the sleeve on different splines on the shaft and if there is no improvement, check for burrs on the splines and rectify as required.
17 Take the synchro assembly off the mainshaft, fit the ball and plunger and then refit it to the shaft in the position from which it was removed.
18 Support the shaft in a vice (with protected jaws) and check the interlock plunger by sliding the outer operating sleeve into the 1st gear position as shown in Fig.6.11. Apply slight downward pressure on the synchro assembly and at the same time rotate the 2nd speed gear. It should rotate freely without any tendency for the synchro cones to rub but if restriction is felt, a longer plunger should be fitted to the synchro sleeve. Plungers are available in the following lengths:-

0.490 in, 0.495 in and 0.500 in (12.4, 12.52 and 12.65 mm)

19 The 3rd/top synchro assembly is put together, and is tested for operation, in the same manner as the 2nd gear synchro assembly but make sure that the wide chamfer end of the operating sleeve faces the large boss end of the inner synchronising sleeve as shown in Fig.6.12 and that the two relieved teeth in the operating sleeve are in line with the ball and plunger holes as illustrated in Fig.6.13.
20 The 3rd/top synchro assembly is now ready for fitting to the mainshaft.
21 Note the following points when fitting the assembly to the mainshaft:-
a) there are two transverse grooves on the mainshaft splines and

the relieved tooth on the wide chamfer end of the outer operating sleeve must be in line with the **foremost** groove in the mainshaft as shown in Fig.6.14. Incorrect alignment will result in the locking plungers engaging the wrong grooves and so prevent full engagement of top and 3rd gear.

b) The wide chamfer end of the outer operating sleeve must face forwards, that is, towards the constant pinion shaft end of the gearbox.

c) The inner sleeve must slide freely on the mainshaft when the balls and plungers are not fitted. If there is any restriction, check the splines for burrs and rectify as necessary.

22 Fit the two balls and plungers to the holes in the inner synchro sleeve and then fit the assembly to the mainshaft in the manner indicated in the preceding paragraph.

23 Support the mainshaft in a vice (with protected jaws) and check the operation of the interlock plungers by sliding the 3rd/top operating sleeve over the 3rd speed gear dogs as shown in Fig.6.15. With 3rd gear engaged, lift and lower the synchro assembly; it should be possible to move it about 3/32" (2.5 mm) without any drag being felt. If it does not move freely, a shorter 3rd speed plunger should be fitted, this is the plunger which, when looking at the wide chamfer end of the outer operating sleeve, is not opposite the relieved tooth in the operating sleeve. Plungers are available in the following lengths:-

0.490 in, 0.495 in and 0.500 in (12.4, 12.52 and 12.65 mm).

24 Now slide the operating sleeve into the top gear position as shown in Fig.6.16 and again lift and lower the synchro assembly; it should be possible to move the assembly about 3/16" (4.5 mm) without any drag being felt and also, with slight downward pressure on the assembly, the 3rd speed gear should be free to rotate without any tendency for the cones to rub.

25 Fit a shorter top gear plunger if the synchro assembly does not move freely when lifted and lowered. A longer top gear plunger should be fitted if the 3rd gear synchro cones are felt to rub, this plunger is the one in line with the relieved tooth in the operating sleeve looking from the wide chamfer end of the outer operating sleeve. Plungers are available in the lengths quoted in paragraph 23.

26 Now for assembly of the constant pinion shaft. On "JS" suffix gearboxes, fit the oil thrower followed by the ballrace on to the shaft with the circlip and collar fitted to the outer track of the bearing. Screw on the nut and fit the tab washer and locknut. Finally fifit the roller race into the shaft spigot bore. Assemble the constant pinion shaft of other suffix gearboxes in the same manner but in this case where the oil thrower assembly is retained by a circlip, fit shims as required to eliminate all end float between the circlip and the assembly.

27 The gears are now ready for assembly to the casing in which the layshaft cluster and the reverse gear have already been positioned. Enter the mainshaft through the top of the casing and move it rearwards through the bearing hole in the case.

28 Fit a new gasket to the front face of the casing and insert the constant pinion shaft at the front of the case with the cutaway portions of the toothed driving member facing the top and bottom of the casing. Tap the shaft to the rear until the collar and circlip on the bearing butt against the casing.

29 Hold the constant pinion shaft in position and tap in the rear bearing complete with its circlip.

30 Lift the layshaft cluster into mesh using the thin rod which should still be in position and then insert the dummy countershaft through the bore in the front face of the casing as illustrated in Fig.6.17.

31 Engage top and first gears. On non-overdrive gearboxes, fit the Woodruff key and the speedometer drive gear to the mainshaft followed by the tab washer and locknut. Screw up the nut and lock with the tab washer. On gearboxes fitted with overdrive, fit as many shims as may be required to eliminate all end float from the mainshaft followed by the plain washer and circlip behind the rear bearing. Fig.6.18 illustrates the rear bearing retaining arrangements for the two gearboxes.

32 Fit a new gasket to the rear face of the gearbox and then offer up the extension complete with the counter and reverse shafts and tap it into position at the same time pushing out the dummy countershaft. Secure the extension with its seven set-screws and spring washers.

33 Fit the overdrive unit as described in Section 20.

34 Fit a new fibre washer at the front end of the countershaft.

35 Fit the speedometer driven gear and bearing to the extension.

36 Reassemble the top cover in the reverse order to the dismantling procedure given in paragraphs 39-43 of Section 3 but do not forget to fit the interlock balls and pins and it is advisable to fit new "O" rings on the selector rods. The reverse plunger will require adjustment and this is done by first fitting the plunger and spring. Now fit the ball and spring and enter the screw and locknut. Press the plunger in as far as possible and tighten the screw to lock it. Slowly slacken the screw until the plunger is released and the ball engages with the circular groove in the plunger and at this point, hold the screw from turning and tighten the locknut.

37 Fit a new gasket to the top of the gearbox.

38 Ensure that the gears and the gear selectors of the top cover are in neutral and that the reverse idler gear is out of mesh with the reverse gear.

39 Now refit the top cover making sure that the selector forks mate with the grooves in the synchro assemblies. Secure the cover with the nuts and bolts noting that the bolts are of different lengths.

40 Fit a new oil seal to the clutch housing with the lip of the seal facing the gearbox. Attach the clutch housing to the gearbox with its eignt bolts and three tabbed locking plates noting that the two bolts located adjacent to the clutch fork trunnions are secured with locking wire (use soft iron locking wire). Tighten the bolts evenly and then lock them with the tabs or locking wire, as applicable.

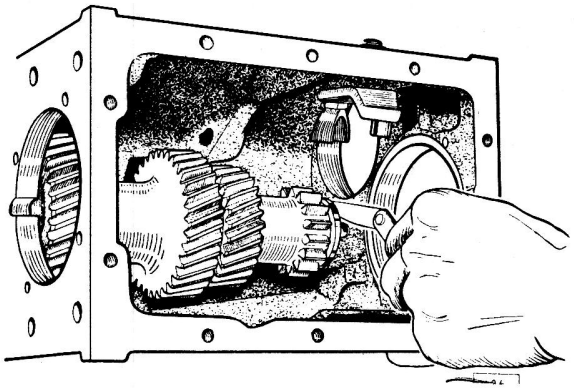


Fig.6.8. Checking layshaft end float

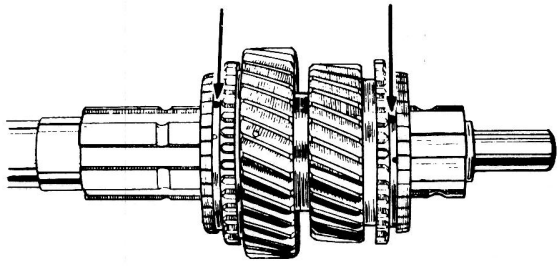


Fig.6.9. Showing the holes through which the thrust washer locking plungers are depressed

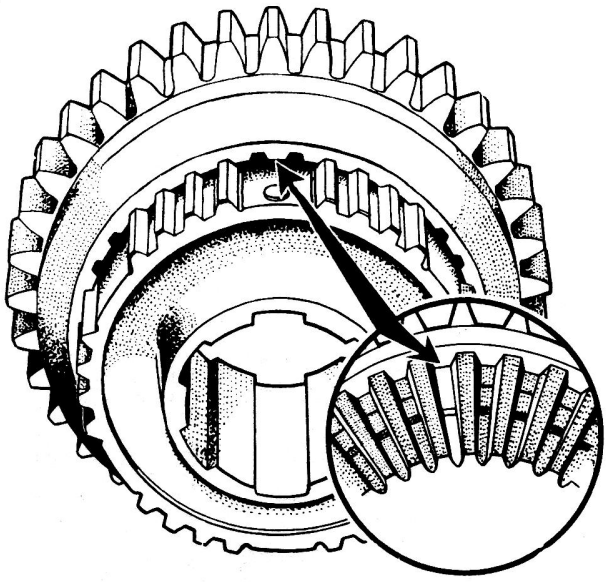


Fig.6.10. Alignment of the relieved tooth and the stop pin

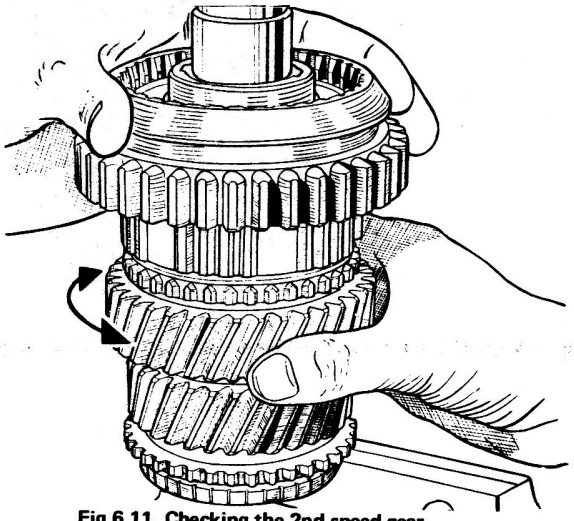


Fig.6.11. Checking the 2nd speed gear for freedom

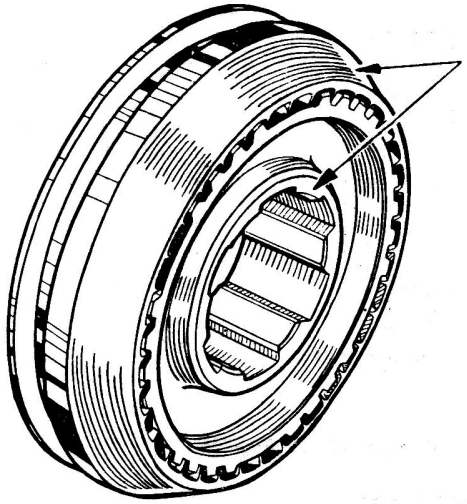


Fig.6.12. Assembly of the operating sleeve to the inner synchronising sleeve

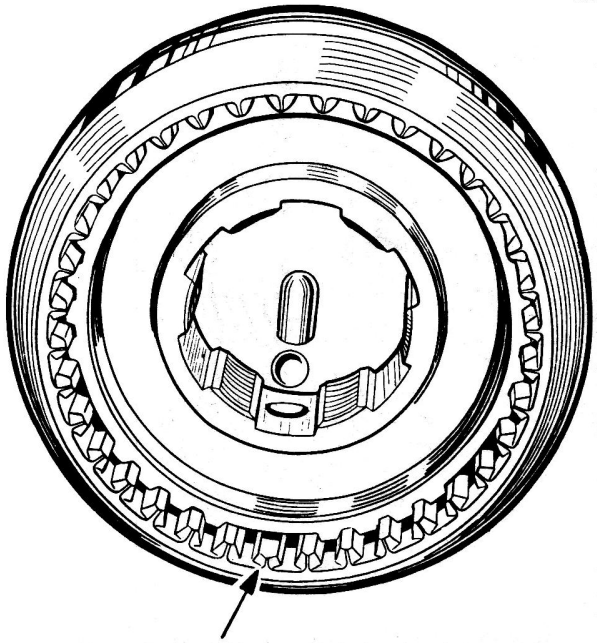


Fig.6.13. The relieved tooth must be in line with the ball and plunger holes

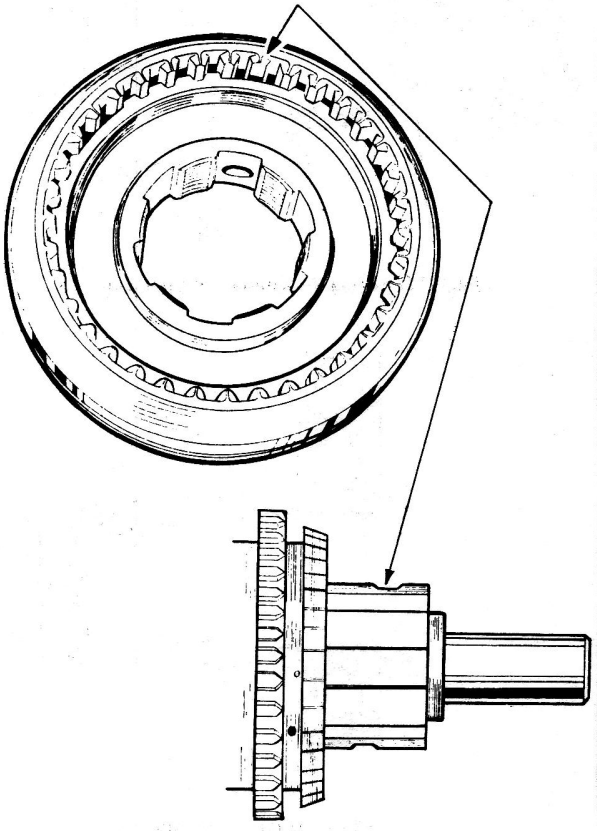


Fig.6.14. Location of the operating sleeve on the mainshaft

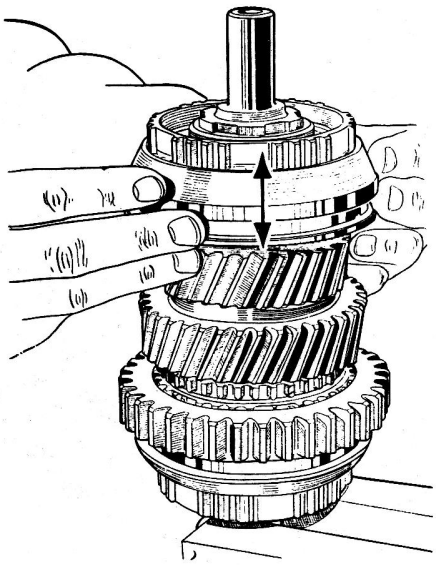


Fig.6.15. Checking operation of the interlock plungers

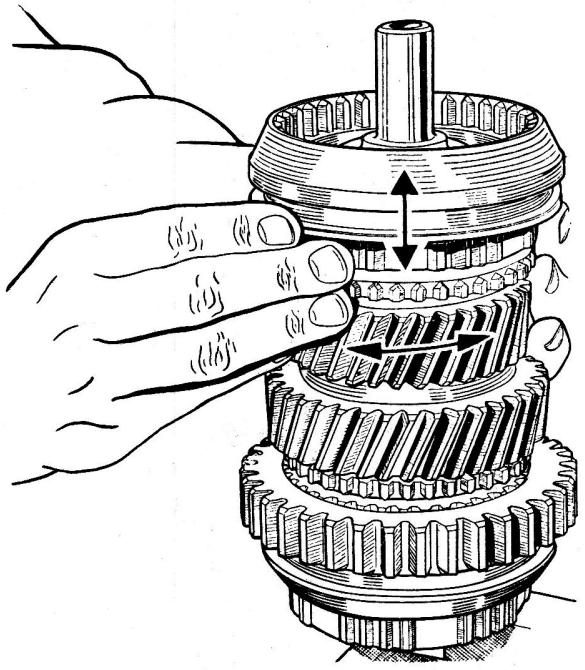


Fig.6.16. Checking 4th (top gear) interlock plunger and assembly

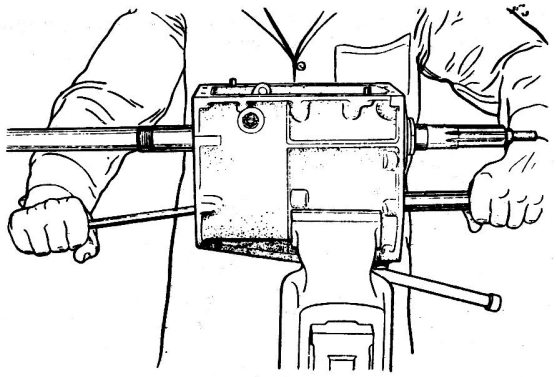


Fig.6.17. Fitting the dummy countershaft

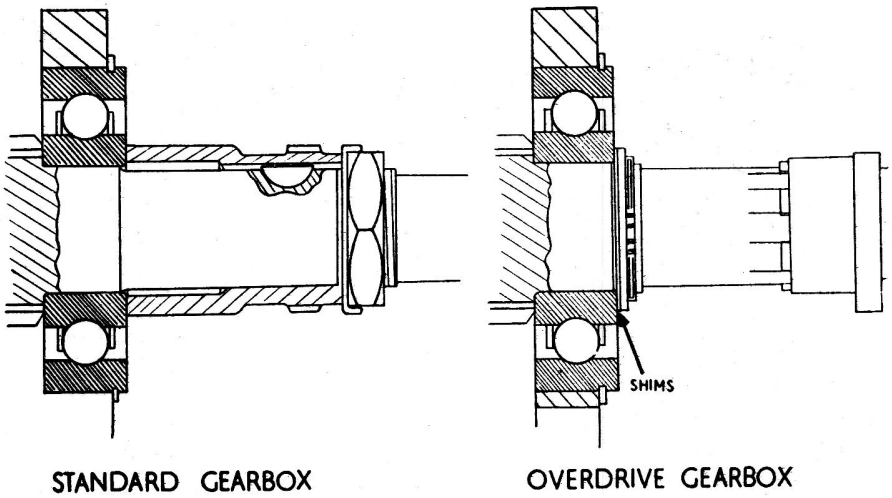


Fig.6.18. Retention of the rear bearing

41 Engage a low gear and then refit the flange for the propeller shaft securing it with its nut and tab washer.
42 Refit the gearbox and overdrive drain plugs and also the gearbox filler plug if this was removed. It is advisable to fit new fibre washers to the plugs.

6 Gearbox - reassembly of type JC and JCN

1 Start with the synchro assemblies for which the assembly procedure for 1st/2nd and 3rd/Top is the same but note that although the 3rd/Top and 1st/2nd synchro hubs are similar in appearance they are not identical. To distinguish them, a groove is cut on the edge of the 3rd/Top hub as illustrated in Fig.6.19.
2 Assemble the synchro hub to the operating sleeve so that the wide boss of the hub is on the opposite side to the wide chamfer end of the sleeve as depicted in Fig.6.20, and so that the three balls and springs will be in line with the teeth having three detent grooves (Figs.6.21 and 6.22).
3 Pack up the synchro hub so that the holes for the ball and springs are exactly level with the top of the operating sleeve as shown in Fig.6.23.
4 Fit the three springs, plungers and thrust members to their correct positions and press down the thrust members as far as possible. Fit the three springs and balls to the remaining holes. It may help to keep the plungers and balls in position if the springs are liberally coated with vaseline.
5 Compress the springs with a large jubliee clip, a piston ring clamp is ideal, as shown in Fig.6.24. Depress the hub slightly and then push down the thrust members with a screwdriver until they engage the neutral groove in the operating sleeve.
6 Tap the hub down evenly and carefully until the balls can be heard, and felt, to engage the neutral groove.
7 Now start assembling the layshaft cluster gear by fitting one retaining ring in the front end of the cluster.
8 Liberally coat the 29 needle rollers with vaseline and place them in the front position of the cluster followed by the front inner thrust washer but make sure that the peg on the washer locates in the groove machined in the front face of the cluster gear.
9 Fit the retaining ring, the 29 needle rollers and the second retaining ring to the rear of the cluster.
10 Fit the slipper to the reverse idler lever and secure it with a new split pin. Assemble the lever to the casing and secure it in position with its setscrew and lock with the tab washer.
11 Liberally coat the rear thrust washer with vaseline and then place it on its boss in the casing making sure that the peg locates correctly.
12 Coat the front outer thrust washer with vaseline and place it in position on the cluster and now lower the layshaft cluster carefully into position.
13 Insert a dummy countershaft into the bore in the casing and through the cluster gear and the next task is to check the end float of the cluster by measuring the clearance between the rear thrust washer and the cluster.
14 The end float should be 0.004" - 0.006" (0.10 - 0.15 mm). Adjustment is made by replacement of the outer front thrust washer which is available in the following thicknesses:-
0.152 in, 0.156 in, 0.162 in and 0.164 in (3.86, 3.96, 4.04, 4.11 and 4.17 mm).
15 The constant pinion shaft assembly should now be put together by fitting a new oil thrower, tab washer and locknut. Tighten down on the nut and secure with the tab. Fit the spacer to the other end of the assembly followed by the roller bearing.
16 The mainshaft is reassembled in the reverse order to the dismantling procedure given in Section 3. You may find it helpful to fit a jubilee clip to the shaft in order to prevent the reverse gear sliding off when assembling the shaft to the casing. Do make sure that the correct set of needle rollers are fitted to their individual gears; they are graded on diameter and rollers of one grade only must be used for an individual gear.
17 The end float of the gears must be checked and details of the permissible clearances will be found under "Specifications" at the beginning of this Chapter. If the end float is found to be excessive it can only be rectified by the fitment of new parts.
18 From this point onwards follow the instructions given in Section 5 paragraphs 27-42 to complete assembly of the gearbox. However, in this case the oil pump (Fig.6.25) must be refitted to the rear extension of JC boxes. Refit the gears to the

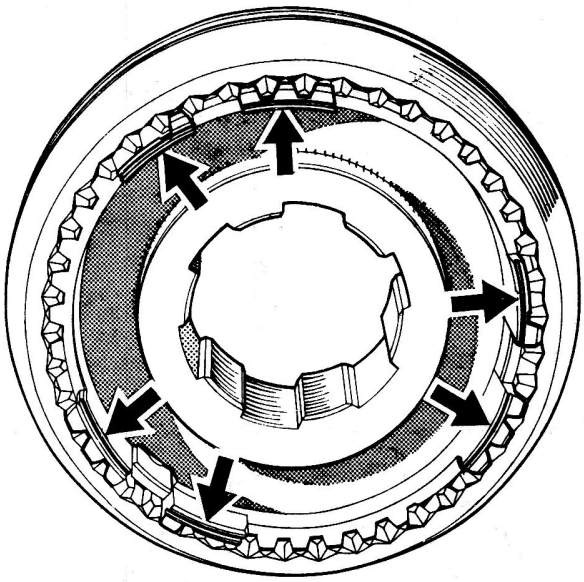


Fig.6.19. Identification grooves, 3rd/top synchro assembly

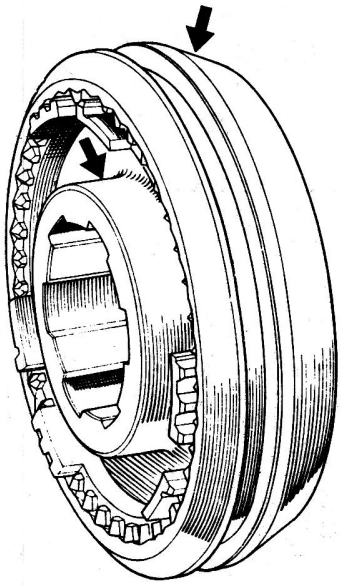


Fig.6.20. Assembly of the synchro hub and operating sleeve

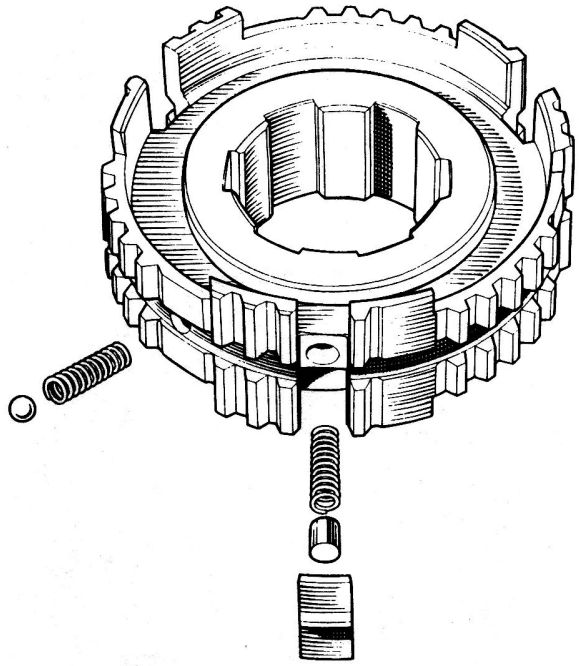


Fig.6.21. Showing the relative positions of the detent ball, plunger and thrust member

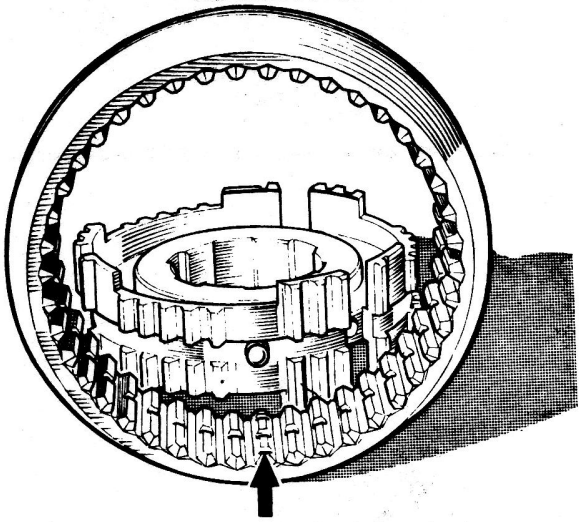


Fig.6.22. Assembling the synchro hub to the sleeve

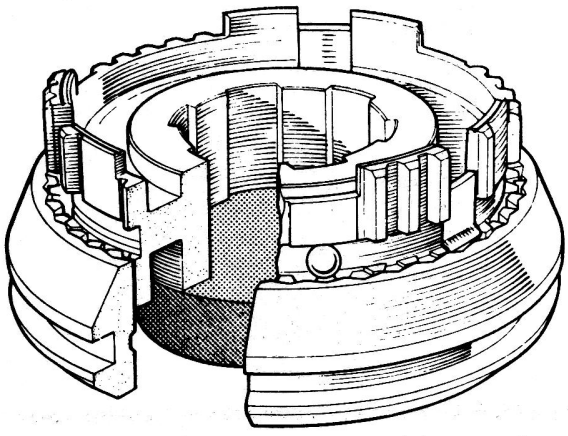


Fig.6.23. Fitting the springs, plungers and thrust members

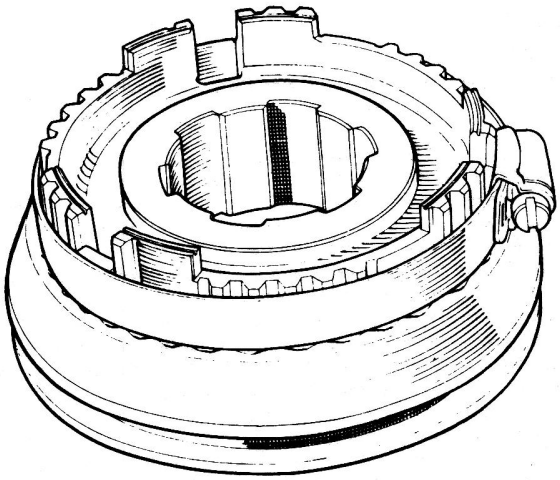


Fig.6.24. Use of a jubilee clip to compress the springs

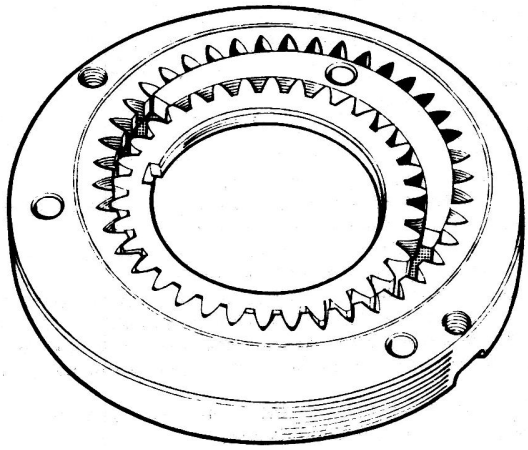


Fig.6.25. The oil pump

pump in accordance with your marks made when dismantling, coat the gears and the pump body with oil and then secure the assembly to the extension with the three setscrews and lock them by staking using a centre punch.

19 After refitting the engine and the gearbox to the car, run the car in top gear as soon as possible in order to attain the necessary mainshaft speed to prime the oil pump.

7 Overdrive unit - general description

A Laycock de Normanville "A" Type overdrive unit is used in conjunction with the GBN gearbox whilst an "A" Type Compact unit is fitted to the JCN four speed synchromesh gearbox. Although the operation, routine maintenance etc: of the two units is similar the construction differences are such that different procedures must be adopted when dismantling and reassembling them.

The overdrive unit comprises a hydraulically controlled epicyclic gear housed in a casing which is attached to an adaptor at the rear of the gearbox. The specially extended gearbox driven (or input shaft) carries at its end the inner member of a unidirectional clutch, the outer member of the clutch is carried in the combined annulus and output shaft. The input shaft also carries the planet carrier and a freely rotateable sun wheel, splined to the forward extension of which, and sliding on it, is a cone clutch member. The inner lining of the cone clutch engages the outside of the annulus whilst the outer lining engages a cast iron brake ring sandwiched between the front and rear parts of the

unit housing. This set-up is shown in Fig.6.26.

The cone clutch is held in contact with the annulus by a number of compression springs and this locks the sun wheel to the annulus so that the entire gear train rotates as a solid unit to give direct drive. With the unit in this condition, the drive is taken through the unidirectional clutch whilst the cone clutch takes over-run and reverse torque and so prevents a free wheel condition.

Operation of the overdrive switch causes oil under pressure to move two pistons, through the operating valve (Fig.6.27) housed in cylinder in the unit housing, to overcome the pressure of the springs and this causes the cone clutch to engage the stationary brake ring and bring the sun wheel to rest. This allows the annulus to over-run the unidirectional clutch and so give an increased speed to the output shaft ie "overdrive".

Exploded views of the "A" Type and the "A" Type Compact overdrive units are given in Figs.6.28, 6.29 and 6.30.

The two types of overdrive unit are not interchangeable between the GBN and the JCN gearboxes.

The oil for lubrication and operation of the overdrive is fed from the gearbox casing and so a check of the level of oil in the gearbox also checks the level of oil in the overdrive unit. However, the overdrive unit is hydraulically operated and even small particles of dirt can cause malfunctioning so absolute cleanliness must be observed when replenishing the gearbox with oil. One point to remember is that although the gearbox and the overdrive have a common lubrication system, the overdrive unit is not drained when the gearbox is drained; it has its own drain plug.

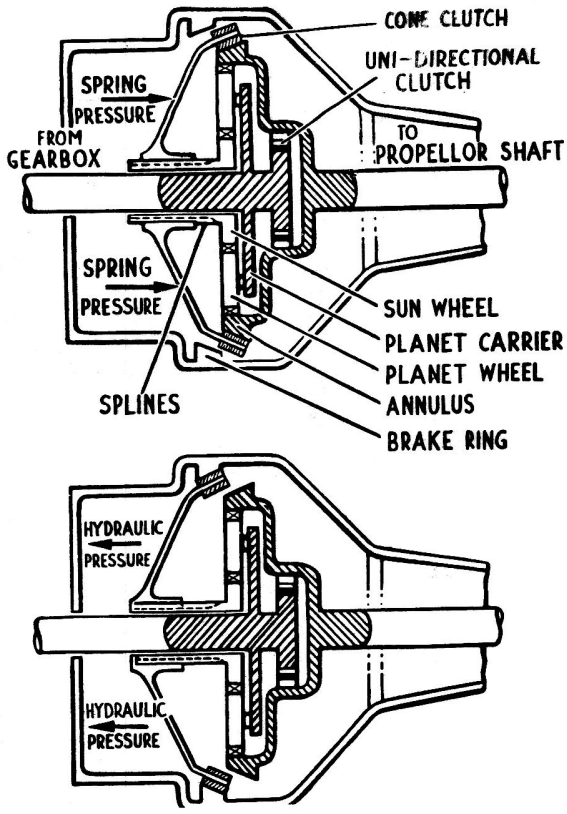


Fig.6.26. The principle of operation of the overdrive unit

8 Overdrive unit - removal from the gearbox

1 Before commencing any dismantling operations it is important that hydraulic pressure is released from the system by operating the overdrive 10 or 12 times.
2 Drain the oil from the system, if this was not done at engine removal, by removing the drain plug, and allowing the oil to drain into a container.
3 The following paragraphs refer to the "A" Type unit.
4 The unit is attached to the adaptor at the rear of the gearbox by seven studs **two of which are extra long.**
5 Remove the nuts on the short studs.
6 Slacken the two nuts on the long studs by equal amounts to release the compression of the clutch springs (photo).
7 Carry on removing the two nuts by equal amounts each until spring compression is competely released and then take off the nuts and remove the unit from the gearbox (photo).
8 The following paragraphs refer to the "A" Type Compact unit.
9 Remove the nuts from the four short studs and from the two long studs at the bottom of the unit.
10 There is no spring tension to release so after removal of the nuts, and their spring washers, the unit can be lifted off leaving the adaptor in place on the gearbox.

9 Overdrive unit "A" Type - dismantling

It is essential to maintain absolute cleanliness throughout all operations. Even minute particles of dirt or lint from cleaning cloths may cause damage or, at best, malfunctioning of the unit.
1 Thoroughly clean down the outside of the unit.
2 Prepare a clean area on which to lay out components as they are removed and have some clean containers handy to hold the smaller parts.
3 Take the clutch springs off their pins and note the positions from which they were removed. You will find that of the eight springs fitted to the 2.4 and 3.4 litre cars, the four inner springs are shorter than the four outers. Of the twelve springs fitted to 3.8 litre models, four short ones are located in the centre and the remaining eight are around the outside.
4 Knock up the tab washer locking the nuts to the two bridge

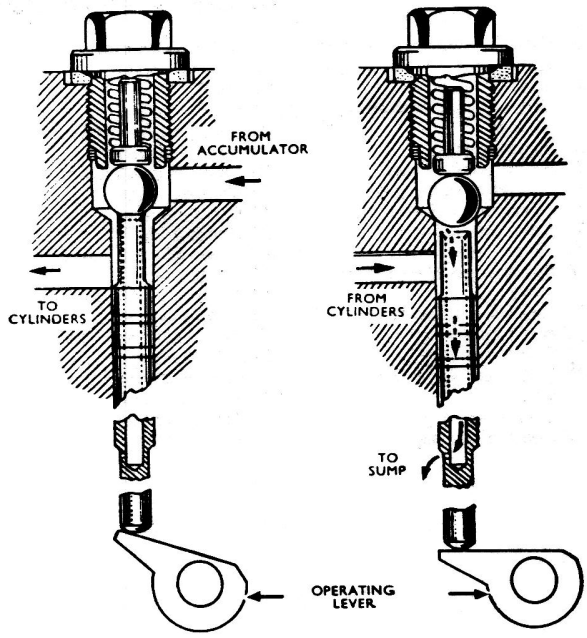


Fig.6.27. The principle of the operating valve

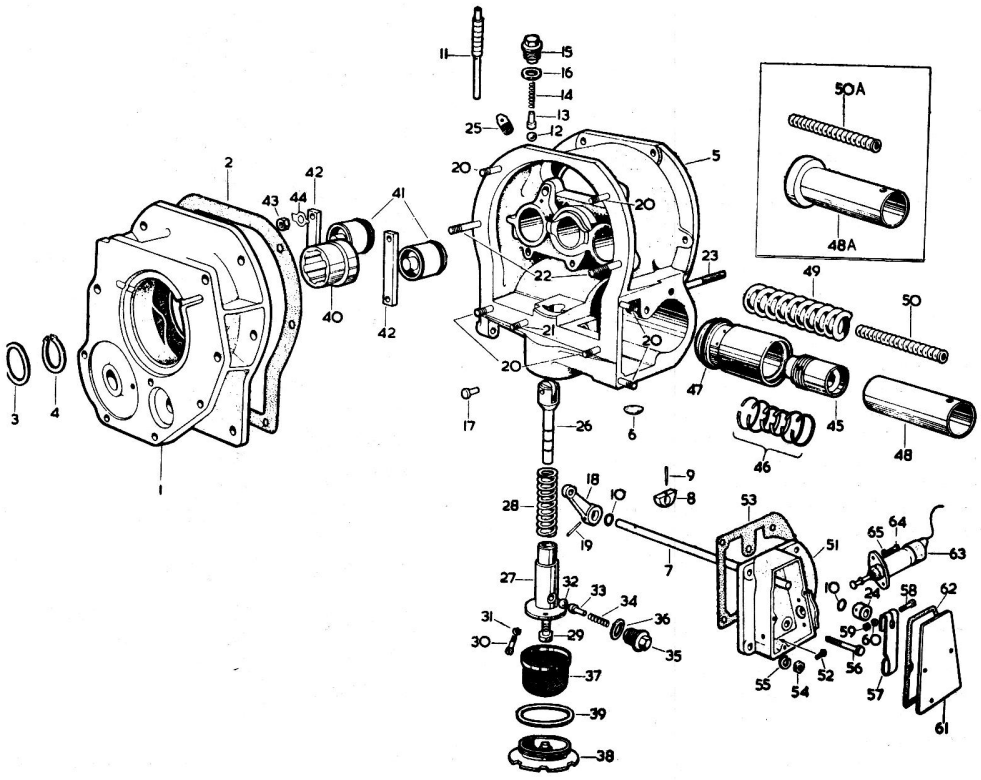


FIG.6.28. THE FRONT CASING ASSEMBLY 'A' TYPE UNIT

1 *Extension for attachment to gearbox*
2 *Gasket*
3 *Bearing spacing washer*
4 *Circlip*
5 *Front casing*
6 *Welch washer plug*
7 *Operating valve shaft*
8 *Operating valve cam lever*
9 *Cam lever pin*
10 *'O' ring seals*
11 *Operating and restrictor valve*
12 *Operating valve ball*
13 *Ball plunger*
14 *Plunger spring*
15 *Valve and pressure take-off plug*
16 *Copper washer*
17 *Pump guide peg*
18 *Valve setting lever*
19 *Setting lever pin*
20 *Stud*
21 *Stud*
22 *Long gearbox stud*
23 *Rear casing stud*
24 *Operating valve shaft collar*
25 *Breather plug*
26 *Pump plunger*
27 *Pump body*
28 *Pump plunger spring*
29 *Pump plug*
30 *Pump securing screw*
31 *Spring washer*
32 *Non-return valve ball*
33 *Ball plunger*
34 *Plunger spring*
35 *Screwed plug*
36 *Sealing washer*
37 *Gauze filter*
38 *Drain plug*
39 *Sealing washer*
40 *Pump operating eccentric*
41 *Cone clutch operating piston*
42 *Piston bridge piece*
43 *Nut*
44 *Tab washer*
45 *Accumulator piston assembly*
46 *Set of six piston rings, four narrow, two wide*
47 *Piston housing*
48 *3.8 litre spacer tube*
48a *2.4 and 3.4 litre spacer tube*
49 *3.8 litre piston spring (large)*
50 *3.8 litre piston spring (small)*
50a *2.4 and 3.4 litre piston spring*
51 *Solenoid mounting bracket assembly*
52 *Rubber buffer for solenoid plunger*
53 *Gasket*
54 *Nut*
55 *Spring washer*
56 *Bolt, holding accumulator spring in tension*
57 *Solenoid lever*
58 *Pinch bolt*
59 *Nut*
60 *Spring washer*
61 *Cover plate*
62 *Gasket*
63 *Operating solenoid*
64 *Bolt*
65 *Spring washer*

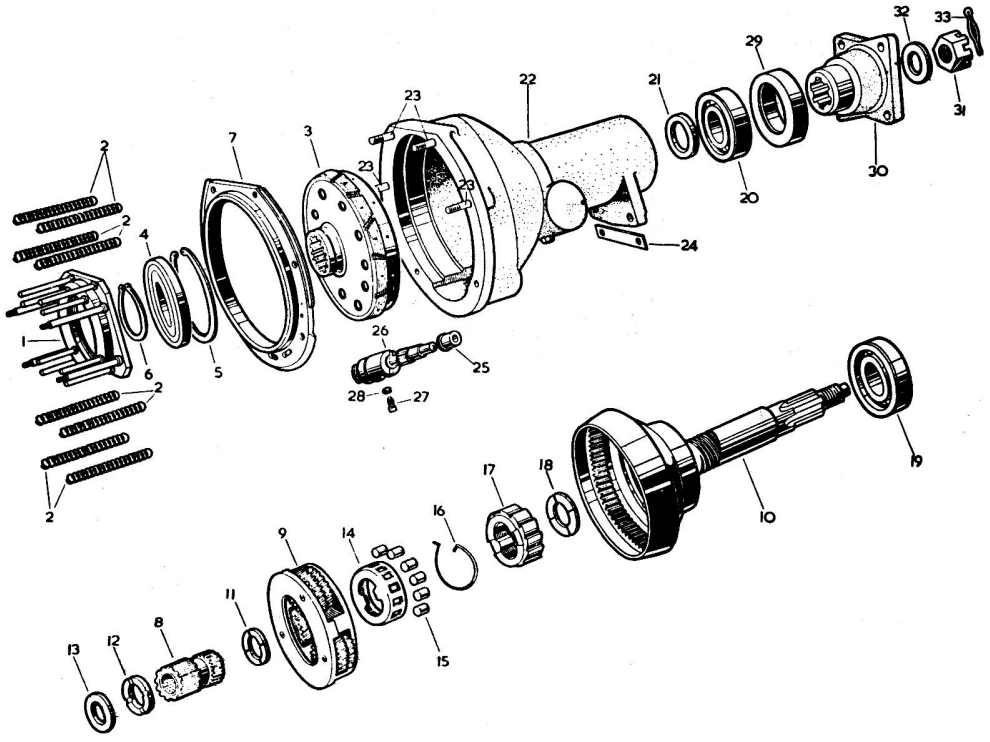


FIG.6.29. THE REAR CASING ASSEMBLY 'A' TYPE UNIT

1 Clutch thrust ring assembly
2 Springs
3 Sliding member
4 Ball bearing
5 Circlip
6 Circlip
7 Brake ring
8 Sun wheel assembly
9 Planetary carrier assembly
10 Annulus assembly
11 Thrust washer (phospher bronze)
12 Thrust washer (phospher bronze)
13 Thrust washer (steel)
14 Cage for uni-direction clutch
15 Rollers
16 Spring
17 Inner member for uni-directional clutch
18 Thrust washer
19 Ball bearing
20 Ball bearing
21 Spacing washer
22 Rear casing assembly
23 Stud
24 Packing
25 Pilot bush
26 Speedometer drive assembly
27 Locking screw
28 Spring washer
29 Oil seal
30 Flange
31 Nut
32 Plain washer
33 Split pin

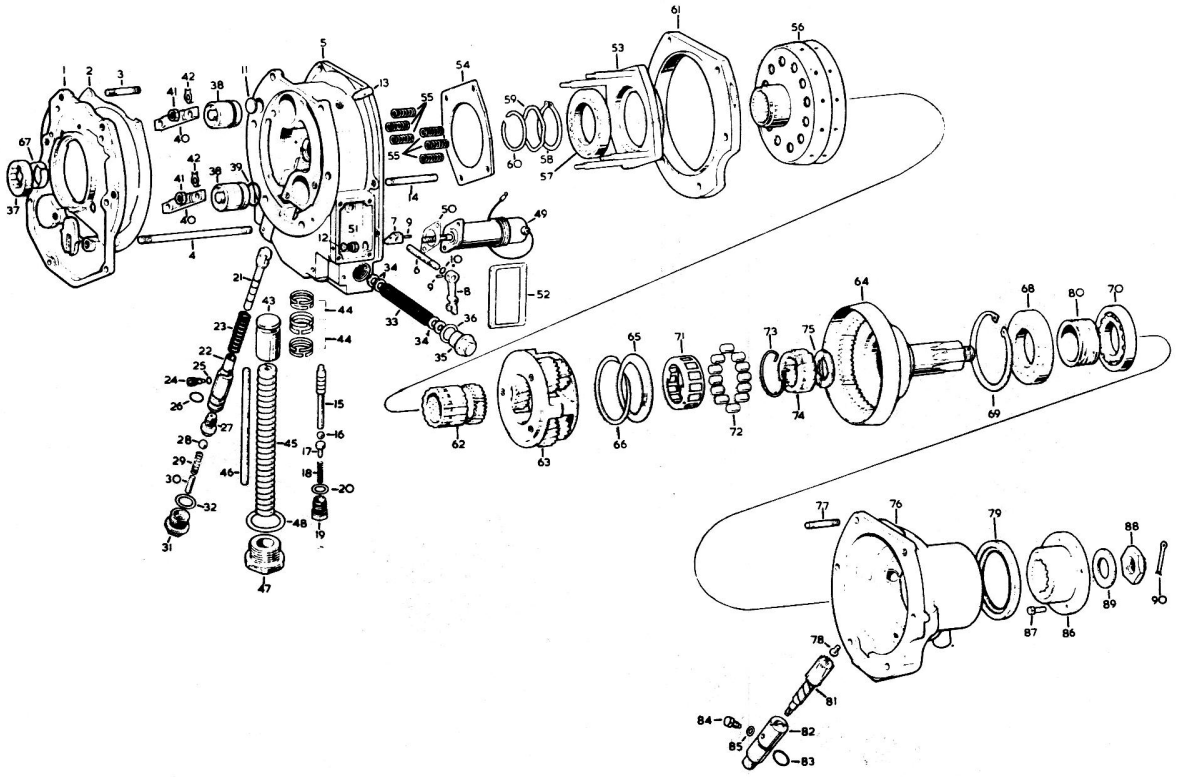


FIG.6.30. THE 'A' TYPE COMPACT OVERDRIVE UNIT

1 Adaptor plate
2 Gasket
3 Stud
4 Stud
5 Front casing
6 Main operating valve shaft
7 Cam
8 Lever
9 Roll pin
10 'O' ring
11 Welch washer
12 Rubber stop
13 Breather
14 Stud
15 Main operating valve
16 Ball 5/16" dia.
17 Plunger
18 Spring
19 Plug
20 Copper washer
21 Oil pump plunger
22 Body
23 Spring
24 Screw
25 Fibre washer
26 'O' ring
27 Non-return valve body
28 Ball 7/32" dia.
29 Spring
30 Support rod
31 Plug
32 Copper washer
33 Filter
34 Magnetic ring
35 Plug
36 Washer
37 Oil pump operating cam
38 Operating piston
39 'O' ring
40 Bridge piece
41 Nut
42 Tab washer
43 Accumulator piston
44 Piston ring
45 Spring
46 Support rod
47 Plug
48 Washer
49 Solenoid
50 Gasket
51 Nut
52 Gasket
53 Thrust ring
54 Retaining plate
55 Springs
56 Sliding member
57 Ball bearing
58 Circlip
59 Corrugated washer
60 Snap ring
61 Brake ring
62 Sunwheel
63 Planetary carrier
64 Annulus
65 Oil thrower
66 Spring ring
67 Spring clip
68 Ball bearing
69 Circlip
70 Ball bearing
71 Cage for uni-directional clutch
72 Roller
73 Cage spring
74 Inner member
75 Thrust washer
76 Rear casing
77 Stud
78 Thrust button
79 Oil seal
80 Speedometer driving gear
81 Speedometer driven gear
82 Bearing assembly
83 'O' ring
84 Screw
85 Copper washer
86 Flange
87 Bolt
88 Slotted nut
89 Washer
90 Split pin