LAYCOCK OVERDRIVE SERVICE MANUAL

Ferrari

250 GTE

330 GT MK1

SECTION ONE

WORKING PRINCIPLES, MAINTENANCE, AND FAULT FINDING

The overdrive is an additional gear unit between the gearbox and propeller shaft. When in operation it provides a higher overall gear ratio than that given by the final drive crown wheel and pinion.

The primary object of an overdrive is to provide open road cruising at an engine speed lower than it would be in normal top gear. This reduced engine speed gives a considerable reduction in petrol consumption and increase in engine life. Overdrive may also be used on the indirect gears to enhance performance or to provide easy and clutchless gear changing for example in town traffic.

Two basic sizes of unit are produced, known as 'A' and 'D' illustrated in Figs. 1 and 2 respectively. The former is the larger unit and is used on cars having engine capacities of about 2 litres and upwards and the 'D' type on smaller cars.

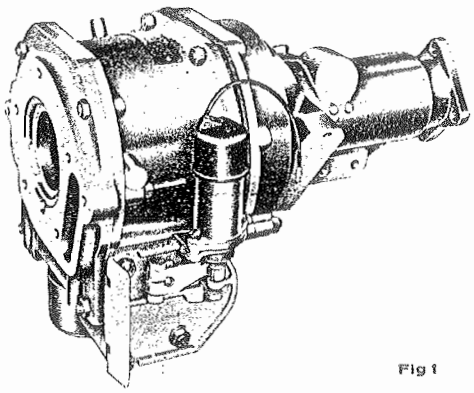


Fig 1

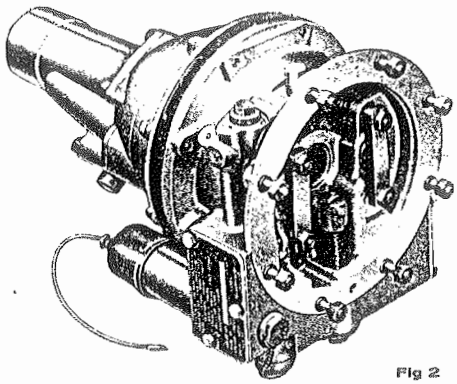


Fig 2

The 'A' type is available with gear ratios of either 0·778 or 0·820 to 1 and the 'D' type with ratios of either 0·756 or 0·802 to 1.

The overdrive is operated by an electric solenoid controlled by a switch, usually mounted on the steering column or fascia panel. An inhibitor switch is invariably fitted in the electrical circuit to prevent engagement of overdrive in reverse and some or all of the indirect gears.

Overdrive can be engaged or disengaged at will at any speed but usually above, say 30 m.p.h. in top gear. It should be operated without using the clutch pedal and at any throttle opening because the unit is designed to be engaged and disengaged when transmitting full power. The only precaution necessary is to avoid disengaging overdrive at too high a road speed, particularly when using it in an indirect gear, since this would cause excessive engine revolutions.

WORKING PRINCIPLES ('A' and 'D' TYPES)

The overdrive gears are epicyclic and consist of a central sunwheel meshing with three planet gears which in turn mesh with an internally toothed annulus. The planet carrier is attached to the input shaft and the annulus is integral with the output shaft.

The unit is shown diagrammatically in Fig. 3.

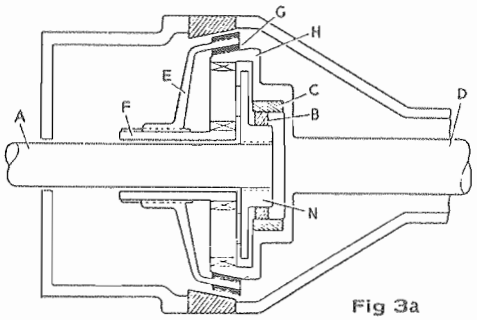


Fig 3a

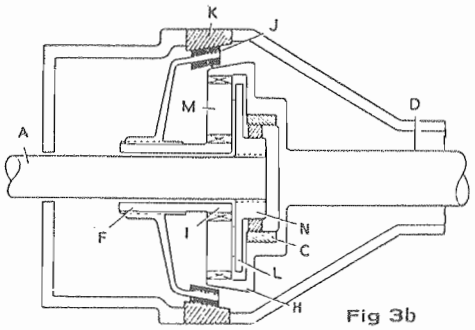


Fig 3b

An extension of the gearbox mainshaft forms the overdrive input shaft. In direct drive (Fig. 3a) power is transmitted from this shaft A to the inner member of a uni-directional clutch N and then to the outer member C of this clutch through rollers B which are driven up inclined faces and wedge between the inner and outer members. The outer member C forms part of the combined annulus H and output shaft D. The gear train is inoperative. A cone clutch E is mounted on the externally splined extension F of the sunwheel and is loaded on to the annulus by a number of springs which have their reaction against the casing of the overdrive unit. The spring load is transmitted to the clutch member through a thrust ring and ball bearing. This arrangement causes the inner friction lining G of the cone clutch to contact the outer cone of the annulus H and rotate with the annulus, whilst the springs and thrust ring remain stationary. Since the sunwheel is splined to the clutch member the whole gear train is locked, permitting over-run and reverse torque to be transmitted. In 'D' type units additional load is imparted to the clutch member, during over-run and reverse, by the sunwheel which, due to the helix angle of its gear teeth, thrusts rearward and has for its reaction member the cone clutch.

Fig. 3b shows the position of the cone clutch when overdrive is engaged. It will be seen that it is no longer in contact with the annulus, but has moved forward so that its outer friction lining J is in contact with a brake ring K forming part of the overdrive casing. The sunwheel I to which the clutch is attached, is therefore held stationary. The planet carrier L rotates with the input shaft A and the planet wheels M are caused to rotate about their own axes and drive the annulus at a faster speed than the input shaft. The uni-directional clutch allows this since the outer member C can over-run the inner member.

Movement of the cone clutch in a forward direction is effected by means of hydraulic pressure which acts upon two pistons when a valve is opened by operating the driver-controlled selector switch. This hydraulic pressure overcomes the springs which load the clutch member on to the annulus and causes the clutch to engage the brake ring with sufficient load to hold the sunwheel at rest.

Hydraulic pressure is developed in the system by a plunger pump, cam operated, from the input shaft. The pump draws oil through a wire mesh filter, in which is incorporated a magnet, and delivers it to the operating valve of the unit. 'A' type units incorporate a hydraulic accumulator in the circuit but in the 'D' type units the working pressure is controlled by a relief valve.

Pressure varies according to the installation but in 'A' type units is usually between 360-520 lbs/sq.ins. and in 'D' type units between 470-520 lbs/sq.ins. Appendix A gives the correct hydraulic pressure for various production units.

OPERATION OF OPERATING VALVE 'A' AND 'D' TYPES

Fig. 4a shows the position of the operating valve in direct drive. In this position the ball C is on the seat in the casing and isolating the supply D from the operating cylinders E. Fig. 4b shows the position of the operating valve in the overdrive position: here the valve has been lifted, by action of the solenoid causing the cam A to rotate, lifting the ball off the seat in the casing and sealing off the top of the valve. This allows oil under pressure to transfer from port D to the operating cylinders E. On returning to direct drive, Fig. 4a the oil from the operating cylinders is exhausted down the hollow stem of the valve and through the restrictor G. On some 'D' type units there is no pressure in direct drive since a port D below the ball seating allows the oil to exhaust to the sump via the hollow operating valve. In overdrive this is sealed off by the ball valve and hence the pressure builds up.

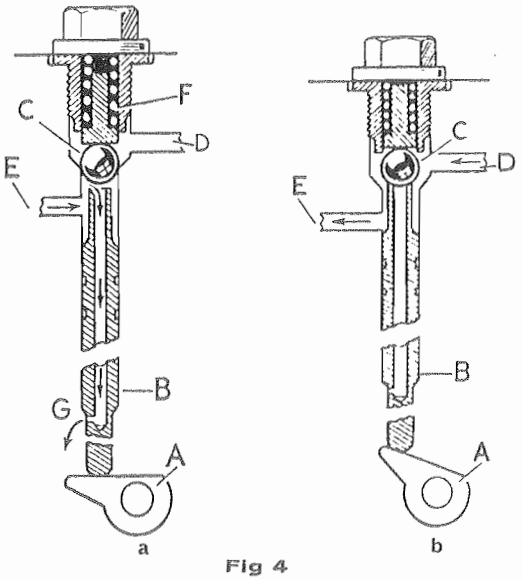


Fig 4

LUBRICATION

The gearbox and overdrive unit, being adjacent, usually have a common oil supply and the oil level is indicated by a level plug or dipstick in the gearbox. In certain applications the overdrive unit may have an independent supply, in which case a separate filler plug is provided. Separate drain plugs are provided for the gearbox and overdrive unit and both must be removed when draining the oil even though the two systems may be connected. The gauze filter in the overdrive unit should be removed and cleaned whenever the oil is changed. In 'A' type units the filter is accessible when the drain plug is removed. On 'D' type units remove the rectangular plate Ref. A on Fig. 6 which is secured by four setscrews.

Later 'D' type units have lubrication via a drilling in the mainshaft; the spill oil from the relief valve is diverted through drilled passages to a bush in the front casing, and from this into the shaft and along the centre drilling to the rear bearing in the annulus. From here the oil passes due to centrifugal force through the uni-directional clutch to an oil thrower from which it is picked up by a catcher on the planet carrier and to the planet bearings via the hollow planet bearing pins.

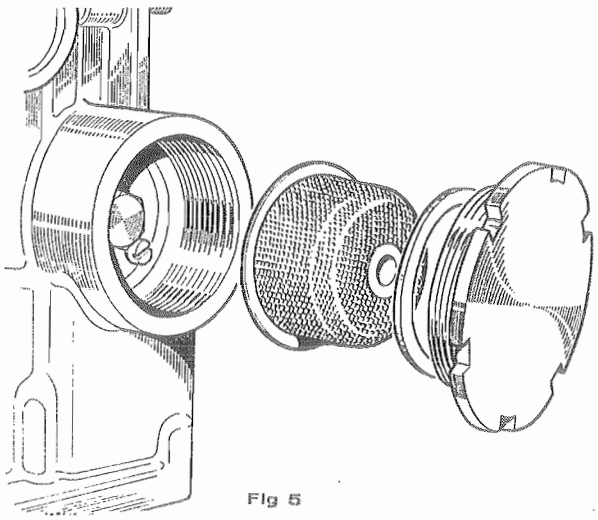


Fig 5

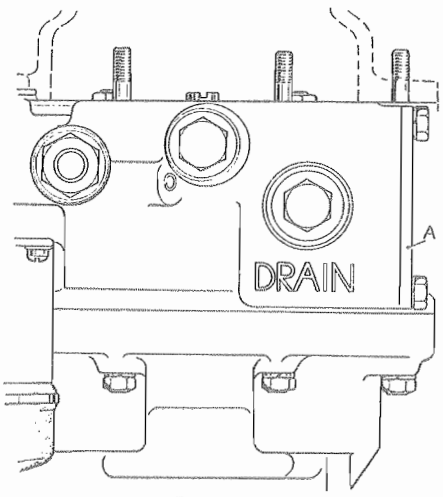


Fig 6

It is essential that an approved lubricant be used when refilling, preferably a straight mineral oil with a viscosity between SAE.30 and SAE.50 with no E.P. additives.

ON NO ACCOUNT SHOULD ANY ANTI-FRICTION ADDITIVES BE PUT INTO THE OIL.

After refilling the gearbox and overdrive, re-check the oil level after the car has been run for a short distance as a certain amount of oil will be distributed round the hydraulic system. It is most important to use clean oil at all times and great care must be taken to avoid the entry of dirt whenever any part of the casing is opened. Dirt, or even lint from a wiping cloth, which finds its way into a valve, will cause trouble. If the hydraulic valves are dismantled, care should be taken to prevent scratches or nicks since these might cause leakage.

FAULT FINDING 'A' and 'D' TYPES

Overdrive does not engage

1. Insufficient oil in gearbox.
2. Electrical system not working. See page 7 - The Electrical Circuit.
3. Solenoid operating lever out of adjustment.
4. Insufficient hydraulic pressure due to pump non-return valve incorrectly seating (Probably dirt on seat).
5. Insufficient hydraulic pressure due to worn accumulator on 'A' types, sticking or worn relief valves 'D' types.
6. Pump not working due to choked filter.
7. Pump not working due to damaged pump roller or cam.
8. Leaking operating valve due to dirt on ball seat.
9. Damaged parts within the unit requiring removal and inspection.

Overdrive does not disengage

NOTE IF OVERDRIVE DOES NOT DISENGAGE DO NOT REVERSE THE CAR OTHERWISE EXTENSIVE DAMAGE MAY RESULT.

1. Fault in electrical control system.
2. Solenoid sticking.
3. Blocked restrictor jet in operating valve.
4. Solenoid operating lever incorrectly adjusted. See page 5 - Adjustment of Solenoid Operating Levers.
5. Sticking clutch. See page 7 - Sticking Clutch.
6. Damaged gears, bearings, or sliding parts within the unit.

Clutch slip in overdrive

1. Insufficient oil in gearbox.
2. Solenoid lever out of adjustment.
3. Insufficient hydraulic pressure due to pump non-return valve incorrectly seating. (Probably dirt on seat).
4. Insufficient hydraulic pressure due to worn accumulator on 'A' types, sticking or worn relief valve 'D' types.
5. Operating valve incorrectly seated.
6. Worn or glazed clutch lining.

Clutch slip in reverse or free wheel condition on overdrive

1. Solenoid operating lever out of adjustment.
2. Partially blocked restrictor jet in operating valve.
3. Worn or burnt inner clutch lining.

NOTE Before removing any of the valve plugs it is essential to operate the solenoid several times in order to release all hydraulic pressure from the system. To do this, engage top gear, switch on the ignition and operate the overdrive control switch several times.

THE OPERATING VALVE ('A' and 'D' TYPES)

The valve plug is located on top of the unit and access to it is through the floor of the car, a cover plate usually being provided for this purpose. Operate the solenoid several times to release hydraulic pressure from the system. Unscrew the valve plug with a 7/16" A/F spanner. If very tight, a sharp tap on top will help. Remove the spring, plunger and ball. A small magnet will be found useful for this operation. The operating valve can be removed by inserting a piece of stiff wire down its centre and drawing it up, but care must be taken to avoid damaging the seating at the top of the valve. Near the bottom of the valve will be seen a small hole, breaking through to the centre drilling. Fig. 4a - G. This is for the exhaust of oil from the operating cylinders. Ensure that this is not choked.

If necessary the ball can be re-seated on top of the operating valve by placing the ball on a block of wood and sharply tapping the valve after positioning it on the ball. Clean the valve seat in the casing and if necessary re-seat the ball by tapping it gently on its seat with a copper drift. Do not tap the ball too hard or the mouth of the hole will be closed up so that the valve cannot be re-assembled.

ADJUSTMENT OF SOLENOID OPERATING LEVERS

The operating valve referred to above is lifted by a cam on a transverse shaft. The solenoid operates a lever attached to this shaft. When the solenoid operates the valve must be fully opened.

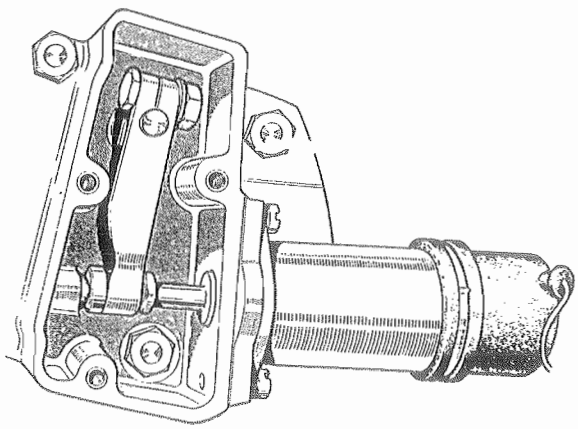


Fig 7

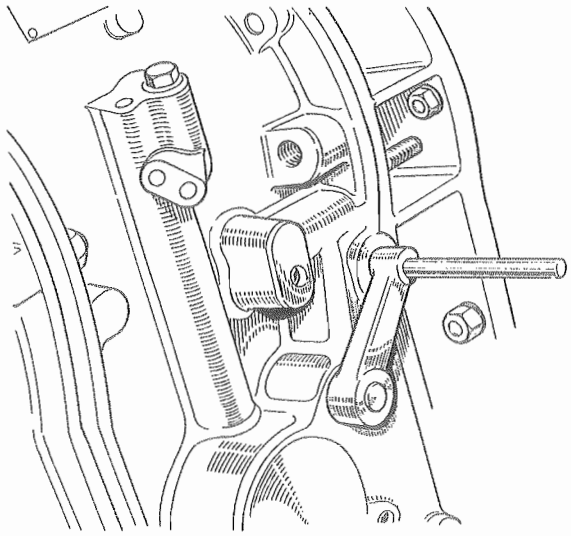


Fig 8

ADJUSTMENT FOR 'A' TYPE UNITS

In this unit the transverse shaft passes right through the casing; where it protrudes there is a setting lever attached. This has a 3/16" hole in its outer end, (Fig. 8). This hole should align with a similar hole in the overdrive casing when the solenoid is energised. For the purpose of checking the setting of the solenoid lever a 3/16" diameter pin, such as a drill shank, should be inserted through the hole in the lever and should register in the hole in the casing when the solenoid is energised. If the pin will not register in the casing the solenoid lever requires adjustment — proceed as follows. Remove the cover plate from the solenoid housing (not fitted on some models). Loosen the clamp bolt on the lever, then rotate the shaft until the pin inserted in the lever, registers in the hole in the casing. Push the solenoid plunger as far home as it will go, and hold the lever fork lightly against the collar on the plunger. Tighten the clamp bolt; remove the pin from the setting lever, then re-check by energising the solenoid and checking the alignment of the holes.

ADJUSTMENT FOR 'D' TYPE UNITS

First remove the rectangular solenoid cover plate which is secured by three screws. Now the solenoid lever can be observed. This also has a 3/16" hole for setting purposes. The procedure is similar to the 'A' type but there is no clamp bolt on the lever. Move the lever until the 3/16" pin pushed through the hole in the lever registers in the hole in the casing, then screw the nut on the plunger until, when the plunger is pushed right home the nut just contacts the forks of the lever. Remove the 3/16" pin. Re-check by energising the solenoid and checking the alignment of the holes. When the solenoid is energised the current consumption should be about 1 ampere. If it is 15-20 amperes it is an indication that the solenoid plunger is not moving far enough to switch from the operating to the holding coil of the solenoid and the lever must be adjusted.

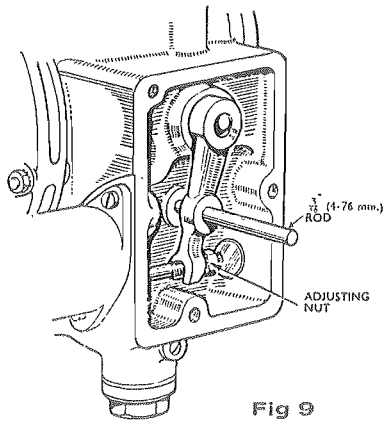


Fig 9

THIS IS IMPORTANT AS HIGH CURRENT WILL CAUSE SOLENOID FAILURE.

TESTING OIL PRESSURE

Release the hydraulic pressure by switching on the ignition, engaging top gear and operating the overdrive switch several times. Remove the operating valve plug and replace it with the hydraulic test equipment (Churchill tool L.188) which has a pressure gauge reading to 800 p.s.i.

Jack up the rear wheels of the car securely, start the engine, engage top gear and run up to about 20 m.p.h. on the speedometer. Hydraulic pressure should then be recorded. Check the pressure in direct and overdrive. See Appendix A.

NOTE On some 'D' type units there is no hydraulic pressure in direct drive but pressure will be recorded when the overdrive is engaged.

Failure to register pressure with overdrive selected may indicate that the pump non-return valve requires cleaning and re-seating.

On those units which normally have pressure in direct drive as well as overdrive, variation in pressure between the two conditions may indicate that the operating valve requires cleaning and re-seating.

THE PUMP VALVE

If the unit fails to operate after re-seating the operating valve, check that the pump is working. Jack up the rear wheels of the car securely, remove the operating valve plug referred to above and start the engine. Engage top gear and with the engine running slowly, watch for oil being pumped into the valve chamber. If none appears the pump is not functioning and its non-return valve should be cleaned. A flow of oil does not necessarily mean that the hydraulic pressure is correct.

Access to the non-return valve in 'A' type units requires removal of the accumulator end cover. On most units this is also the solenoid bracket. Proceed as follows : Drain off the oil; remove the cover from the solenoid bracket and remove the solenoid. Slacken off the clamp bolt in the solenoid lever and remove the lever and solenoid plunger. Remove the distance collar under the lever. The solenoid bracket is secured by two 5/16" studs and two bolts. Remove the nuts from the studs before unscrewing the bolts; this is important. Now unscrew the bolts together, releasing the compression on the accumulator spring. Remove the spring and guide tube. The pump valve plug will then be seen inside the cavity. The valve consists of a spring, plunger and ball similar to those used for the operating valve, except that the steel ball is $\frac{1}{4}$" diameter. Carefully clean the ball and the valve seating; if necessary re-seat the ball by tapping it sharply on to its seating. When re-assembling, the solenoid lever must be correctly set as already described. See page 6 - Adjustment for 'A' Type Units.

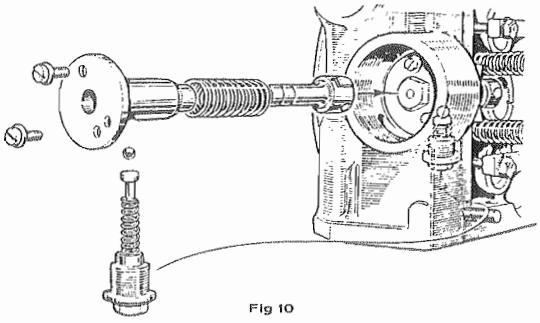


Fig 10

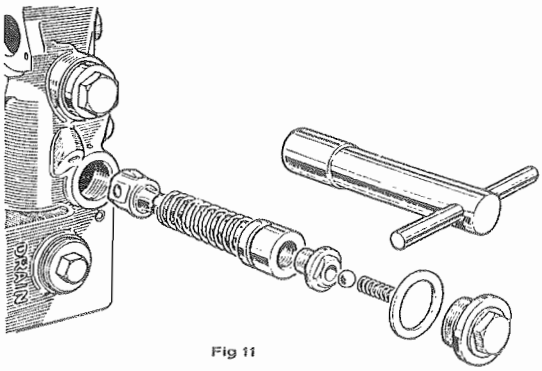


Fig 11

The pump valve of 'D' type units is accessible from underneath the unit when the centre plug is removed, Fig. 6. Unscrew the valve body, carefully clean the ball and the valve seating and re-seat the ball by tapping it sharply on to its seating.

STICKING CLUTCH

If overdrive cannot be disengaged after carrying out the procedure outlined on page 4, the trouble is probably caused by a sticking cone clutch. This trouble might be experienced on a new unit due to insufficient "bedding in" of the clutch, but is unlikely to occur on a unit which has been in service for some time.

The clutch can usually be freed by giving the brake ring several sharp blows with a hide mallet. On most cars this can be done from underneath when the car is on a hoist. On some cars, where the gearbox cover is removable, it can be done from above.

THE ELECTRICAL CIRCUIT

Before embarking on the full procedure for fault location, it will be found helpful to keep the following points in mind.

Many operational failures are due to corroded terminals and faulty wiring, so make a point of checking over the wiring and connections first.

Good earth connections are essential on all earthed components. This applies particularly to the solenoid because of the heavy current passed momentarily each time the overdrive is engaged.

Incorrect adjustment of the solenoid, resulting in failure of the main winding contacts to open, may cause damage to the solenoid and to the relay.

The method of controlling the overdrive unit differs according to the requirements of the car manufacturer, but the basic system is illustrated in Fig. 12. If overdrive fails to operate and the wiring has been checked, proceed as follows :-

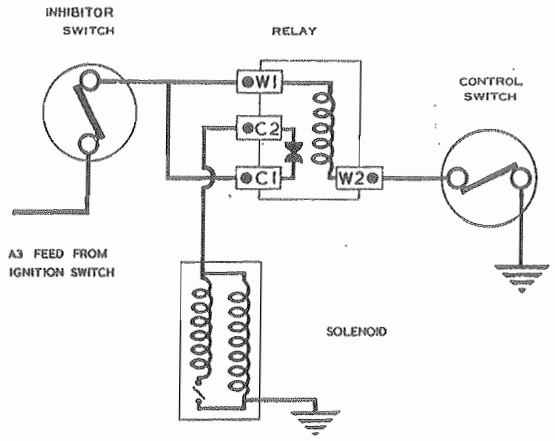


Fig 12

1. Short out terminals of C1 and C2 of the relay, switch on ignition and engage top gear. If the solenoid fails to operate suspect faulty inhibitor switch. If the solenoid operates the inhibitor switch and solenoid are in order. Proceed to Test 4.
2. Connect terminal C1 to A3. If solenoid operates the inhibitor switch is faulty. If it does not operate suspect faulty solenoid.
3. Connect solenoid terminal to A3. If solenoid fails to operate or is sluggish, it is faulty.
4. Connect W1 of relay to A3 with the control switch closed. If solenoid operates, relay and control switch are satisfactory. If solenoid does not operate proceed to Test 5.
5. Link W2 of relay to earth. If solenoid fails to operate the relay is faulty. If solenoid operates, control switch may be faulty. Proceed to Test 6.
6. Connect feed terminal of control switch to earth with switch closed. If solenoid operates, control switch is faulty.

SECTION TWO

OVERHAUL INSTRUCTIONS

D TYPE

OVERDRIVE REMOVAL

The overdrive may be removed from the gearbox without taking the latter out of the car, provided that sufficient clearance 5.7" (145 mm) exists to allow the overdrive to be moved rearwards. The overdrive is removed by undoing the eight nuts on the studs which point forward through the adapter casing. There is no spring tension to release, and after removing the nuts the overdrive can be drawn off, leaving the adapter in place.

The overdrive can be divided into four main assemblies.

1. FRONT CASING AND BRAKE RING
2. CLUTCH SLIDING MEMBER
3. PLANET CARRIER AND GEAR TRAIN
4. REAR CASING AND ANNULUS

DISMANTLING

IMPORTANT SCRUPULOUS CLEANLINESS MUST BE MAINTAINED THROUGHOUT ALL SERVICE OPERATIONS. EVEN MINUTE PARTICLES OF DUST OR DIRT, OR LINT FROM CLEANING CLOTHS MAY CAUSE DAMAGE, OR AT BEST INTERFERE WITH CORRECT OPERATION.

Prepare a clean area in which to lay out the dismantled unit, and some clean containers to receive the small parts.

In installations where the oil supply is common with the gearbox, it follows that high standards of service cleanliness must also be maintained, when servicing the gearbox.

SPECIAL TOOLS

A complete range of special tools can be obtained. These are listed in Appendix 'B'.

For initial examination dismantle into the four main assemblies, proceeding as follows :-

Hold the overdrive with front casing uppermost in a vice fitted with suitable soft jaws.

Release the tabwashers locking the four $\frac{1}{4}$" nuts retaining the operating piston bridge pieces. Remove the nuts, tabwashers and bridge pieces. Loosen the solenoid by the two screws, to allow the front casing to be removed.

Some units have a copper breather balance pipe. This should be removed at this stage.

Loosen and progressively remove the eight $\frac{1}{4}$" nuts around the centre flange of the casing. This will gradually release the load from the four clutch return springs. The brake ring may come away with the front casing; if not, tap gently to remove from spigot. Lift off the front casing and brake ring. Remove the four clutch return springs. Lift out the clutch sliding member complete with the thrust bearing and sunwheel. Lift out the planet carrier. The overdrive is now in four main assemblies.

FRONT CASING AND BRAKE RING

If on road test the hydraulic system was performing correctly and there has been no major failure causing metal dust etc., it should not be necessary to dismantle this assembly. If necessary proceed as follows :-

Remove operating valve plug Ref. 7 and lift out spring, Ref. 8, plunger Ref. 9 and ball Ref. 10, then remove operating valve Ref. 11 by inserting a stiff piece of wire in the centre hole (taking care not to damage the seating) and withdraw valve. Place all these components in a clean container.

The operating pistons Ref. 12 can then be removed by gripping the centre bosses with a pair of pliers. In the case of VITESSE units use special tool No. L 252.

The Solenoid

To take off the solenoid, first remove the rectangular name-plate by undoing the three screws. Remove the two screws securing the solenoid: pull off the solenoid and then ease the plunger out of the yoke of the valve operating lever.

The Pump

To remove the plunger oil pump, first take out the central plug Ref. 14 at the bottom of the front casing: lift out the non-return valve spring Ref. 15 and ball Ref. 16. Then using special tool No. L 213, unscrew non-return valve body Ref. 17. REMOVE THE LOCATING SCREW SITUATED AT THE BOTTOM CENTRE OF THE FRONT FLANGE.

The pump body can now be extracted, using Tool No. L 183A, L 183A-2 and adapter L 205 as follows :-

Screw the short threaded portion of the spindle in pump body from where the non-return valve body was removed, then place the adapter in position against the casing and screw up the wing nut, thereby pulling the body out of the casing: the plunger and spring will also come out.

The Relief Valve

Access to the relief valve is gained by removing the plug Ref. 23 at the bottom of the front casing, adjacent to the solenoid cover plate. Remove the spring. The relief valve body Ref. 25 can then be withdrawn by inserting a piece of stiff wire bent into a hook, in the hole in the side of the body and pulling out. After removal of the body the relief valve plunger can be pushed out.

Oil Filter

The last remaining removable item is the filter: this is located under the rectangular plate Ref. 27, secured by four $\frac{1}{4}$" setscrews. After removing this plate, lift out the filter, at the bottom of which is a sealing washer, and on later units 3 magnetic plastic rings.

CLUTCH SLIDING MEMBER

Remove the sunwheel by withdrawing the circlip from its groove in the forward end of the hub.

Remove the thrust bearing and the thrust ring by extracting the large circlip and pressing out the cone clutch hub from the thrust ring and bearing. Remove bearing from thrust ring assembly using special tool L 210A.

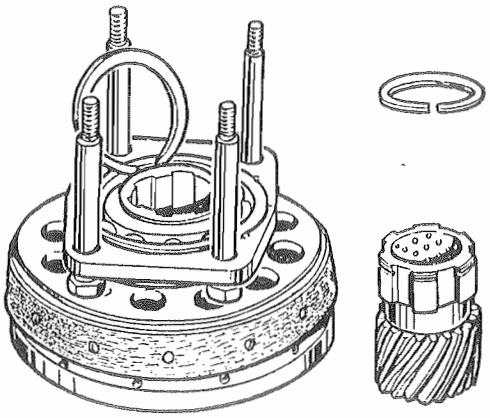


FIG 14

CLUTCH SLIDING MEMBER ASSEMBLY AND SUNWHEEL

PLANET CARRIER ASSEMBLY

At this stage inspect all the gear teeth for any signs of damage or chipping, and assess the fit of the assembled bearing for any excessive clearance.

For models where replacement planet gears are not available separately for servicing, a complete planet carrier sub assembly should be substituted if damage or wear necessitates replacement.

Replacement planet shafts and bearings (except for caged type) are, however, available for all models.

NOTE Caged bearings can only be supplied together with new gears. In cases where planet gears are available separately, they must be installed in sets of three, even though only one or two of the original planet gears were damaged.

To extract the pins proceed as follows :-

IMPORTANT Remove one gear at a time and mark by scribing the individual gear, planet pin and relative planet hole location in the carrier to ensure that each gear is refitted into its original location.

NOTE Overdrive units of 0.802 to 1 ratio (25%) have each gear marked with a dot by the manufacturer. This is for angular relationship in assembly of the compound gears. See Page for re-assembly of planet carrier and gear train.

Some units have central lubrication, see Fig. 13 and these have an oil catcher Ref. 63 on the planet carrier. Take care not to damage this in removing the pins.

Support the planet carrier on a suitable hollow abutment through which the pin will pass. Using a drift, drive out the pin, shearing the small Mills pin which secures it. Knock or drill out the broken end of the Mills pin from the carrier and planet pin.

TO EXTRACT THE NEEDLE BEARINGS (USING TOOL L 203).

Secure the square ended shank of the tool vertically in a vice and remove the wing nut and all the collars. Slide the gear over the spindle and allow the bearing to abut against the spindle shoulder. Fit the main body and wing nut and press the gear off the bearings.

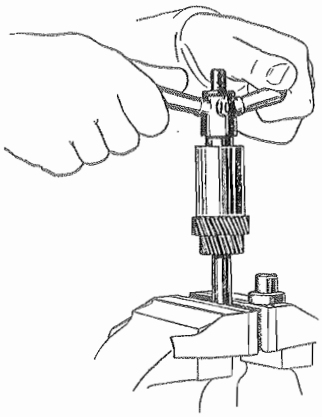


FIG 15 REMOVING DRAWN CUP NEEDLE BEARINGS

REAR CASING AND ANNULUS

To dismantle this assembly proceed as follows :-

The uni-directional clutch Ref. 43-46 is retained by a brass washer Ref. 47. On some units the brass washer is retained by a circlip and on others the annulus is peened to retain the washer. Remove this brass washer, then place special assembly ring (Tool No. 178) centrally over the front face of annulus and lift the inner member of the uni-directional clutch up into it. This will ensure that the rollers do not fall out of the retaining cage. Place the parts in a suitable container. Alternatively if dismantling further, remove the assembly ring and allow the rollers to come out and the hub will readily come from the cage exposing the spring.

Remove the bronze thrust washer fitted between the hub of the uni-directional clutch and the annulus.

Removal of Annulus

There are two main types of rear casing and annulus, namely :-

1. Annulus for fixed flange type propeller shaft.
2. Annulus for sliding reverse spline type propeller shaft.

To remove the annulus from the fixed flange type casing 1. proceed as follows :-

Remove speedometer dowel screw Ref. 40 then withdraw speedometer drive bush and pinion Ref. 38 and 39 using tool No. L 214 to prevent damaging the thread. Remove the coupling flange Ref. 69. Remove oil seal (if necessary) by screwing the taper thread of the outer member of the special tool (L 176) into it and tightening the centre bolt against the rear of the tail shaft. Press annulus forward out of the rear casing. The front bearing, together with the speedometer gear and adjustable spacing collar will come out with the annulus, leaving the rear bearing in the casing.

To remove the annulus from the reverse spline type casing 2. proceed as follows : remove speedometer pinion as previously described.

Split the intermediate casing Ref. 3 and rear casing Ref. 4 by removing the six nuts. After removing the rear casing (taking care not to lose the bearing shim) remove the circlip in the annular groove of the bearing : this will allow the annulus to be removed from the intermediate casing.

To remove the bearing Ref. 36 and speedo driving gear Ref. 35 undo the special retaining nut by using tool No. L 211. The bearing can then be withdrawn by using special tool No. L 202 together with handpress No. R.G. 4221 B.

A drawn cup needle bearing Ref. 41 is fitted in the annulus for the mainshaft spigot. This bearing is removed by using the special tool No. L 208 as follows :-

Withdraw the central bolt from the tool. Insert the outer part of the tool inside the bearing ensuring that the four tangs register behind it. Insert the centre bolt and tighten it against the annulus, the bearing will then be drawn out as the screw is tightened.

INSPECTION

Each part should be thoroughly cleaned and examined after the unit is dismantled.

FRONT CASING AND BRAKE RING

Inspect the front casing for cracks, damage etc. Examine the bores of the operating cylinders for scores or wear.

Check operating pistons Ref. 12 for signs of scores and replace sealing rings Ref. 13 if there is any sign of damage or distortion, using tool No. L 207.

Check for signs of leaks from the plugged ends of the oil passages.

Check that the centre lubrication bush Ref. 66 is tight in the casing.

Check pump roller Ref. 21 for any undue wear. The roller pin Ref. 22 is secured by a Mills pin 1/16" dia. driven vertically in the curved portion of the pump plunger fork. This pin can be sheared by driving the roller pin through the fork. Later units have floating bronze bush in the pump roller.

Check the pump spring Ref. 20 for distortion.

Inspect non-return valve seat and ball Ref. 16 to ensure that they are free from nicks and scratches.

Check relief valve plunger Ref. 26 and body Ref. 25 for scores or wear. Check relief valve spring Ref. 24 for distortion or collapse. Inspect the 'O' ring on the body for damage. Inspect the operating valve Ref. 11 for distortion and damage and see that it slides easily in the bore of the front casing. Check that the seating at the top is clean and free from scratches. Check the ball Ref. 10 and the spring Ref. 8 for distortion.

Clean filter Ref. 29 thoroughly in petrol. Remove all metallic particles from the magnetic ring.

Inspect clutch springs Ref. 60 for any sign of distortion, or collapse.

Check brake ring Ref. 2 for signs of wear, scoring, or cracks.

CLUTCH SLIDING MEMBER

Inspect the clutch linings Ref. 61 on the clutch sliding member Ref. 53 for any signs of excessive wear or charring; if there is any sign of this at all the sliding member complete must be replaced. It is not possible to fit new linings because they have to be finish machined to accurate angle, after rivetting. Inspect the bolts Ref. 54 locating the clutch springs, and the bridge pieces Ref. 59 for signs of distortion.

Inspect the ball race Ref. 55 and ensure that it rotates smoothly as this can otherwise be a source of noise when running in direct gear.

Inspect the teeth on the sunwheel Ref. 52 for signs of damage or chips. If the bush is worn a new gear complete must be fitted as the bore has to be machined concentric with gear teeth after sub-assembly.

PLANET CARRIER AND GEAR TRAIN

To fit new planet bearings using tool No. L 203. Secure the square ended shank of the tool vertically in a vice, remove the wing nut and the collars, fit guide bush, flange downwards over the shank of the tool. Place gear over guide bush followed by one bearing, spacing collar, and wing nut, press the bearing right home, see Fig. 16.

To fit second bearing, remove wing nut, collars and gear, fit guide bush, inverted, also gear and proceed as before, see Fig. 17.

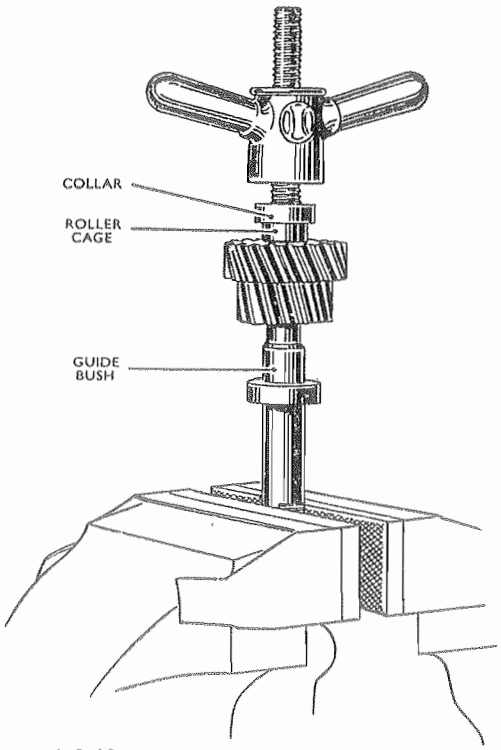


FIG 16 FITTING FIRST DRAWN CUP NEEDLE BEARING

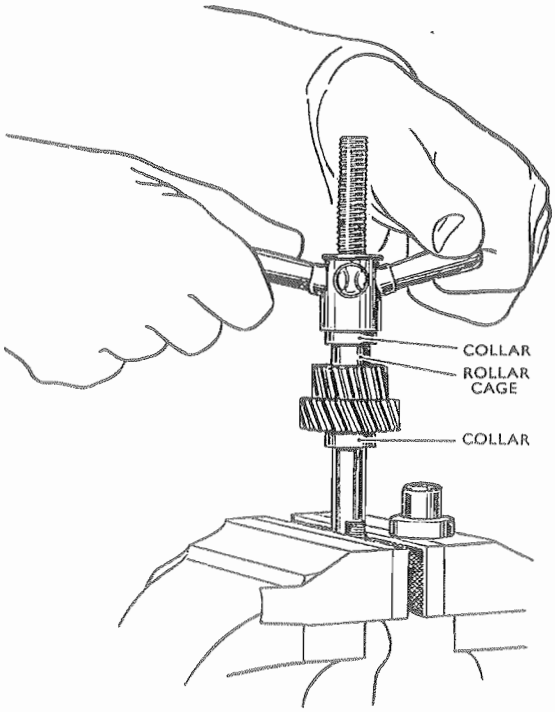


FIG 17 FITTING SECOND DRAWN CUP NEEDLE BEARING

Treat the others similarly and refit planets to the carrier, ensuring that the thrust washers are in good condition. Fit new 3/32" diameter Mills pins, ensuring that they are a good driving fit, in their holes. If not shorten the pin slightly, drive below the surface of the planet carrier, and peen the hole in the carrier over to retain the pin. It is not practicable to fit individual new gears because they are matched in sets.

Some units have central lubrication, see Fig. 13 and these have an oil catcher Ref. 63 on the planet carrier. Care must be taken not to damage this.

REAR CASING AND ANNULUS

Ensure that the rollers of the uni-directional clutch Ref. 44 are not chipped and that the inner and outer members are free from damage. Check that the cage, particularly the two ears, is not damaged. Check that the spring is not distorted or broken.

Inspect the gear teeth of the annulus Ref. 37 for damage. Inspect conical surface for signs of wear. Inspect the output shaft ball race Ref. 36 and see that it rotates smoothly.

Fixed Flange Type Annulus

Inspect the rear oil seal Ref. 5. If it is necessary to remove it, a new one will have to be fitted. Check that the splines on the annulus are not twisted.

Rear Casing for Reverse Spline Type Annulus

Inspect the two bushes in this casing which support the sliding sleeve of the propeller shaft and check that they are in good condition; try the propeller shaft in them to determine the amount of wear. If the bushes are worn a new rear casing complete must be fitted because the bushes are bored after fitting by the manufacturers.

After this inspection of each part it will be possible to determine the replacement parts that will be needed.

RE-ASSEMBLY

FRONT CASING AND BRAKE RING

Pump

Insert the pump plunger, spring and body in the central hole at the bottom of the casing, (see Fig. 11): locate the flat of the plunger against the thrust button Ref. 67 near the central bush of the casing; tap the pump body home, using tool No. L 206a, until the annular groove lines up with the locating screw hole in the bottom of the front casing flange face; insert this screw and tighten same, ensuring that the dowel locates in the groove. Re-seat non return valve ball by lightly tapping it with a copper drift then screw in non return valve body using tool L 213. Fit spring, plug and copper washer ensuring that the spring locates in the recess in the plug and tighten.

Relief Valve

Fit new 'O' ring if necessary to relief valve body, insert plunger into body; insert this assembly in the orifice adjacent to the solenoid. Insert spring, locating it on boss of plunger. Screw in the relief valve plug with copper washer, (this is the only hollow plug).

Filter

If the magnetic rings are fitted, insert in the rim of filter. Fit the rubber/steel sealing washer in the filter housing in the casing, steel side against casing. Fit the open end of the filter against the rubber side. Fit the filter cover plate, using a new joint if necessary. Screw in the drain plug together with the copper washer and tighten.

Operating Pistons

Fit these, carefully easing the rubber sealing rings into the cylinder bores. The centre bosses of the pistons face towards the front of the unit, except in the case of Vitesse units where the centre bore of the pistons face towards the front of the unit.

Operating Valve

Insert the operating valve in the casing, ensuring that the hemispherical end engages on the flat of the small cam on the operating shaft. Drop in the 5/16" ball, plunger and spring. Screw in and tighten the operating valve plug ensuring that the copper washer is located correctly.

With the exception of the solenoid, the front casing is now complete and ready for assembly to the rest of the unit, when ready.

REAR CASING AND ANNULUS

1. Fixed Flange Type Annulus

Assuming the rear casing has been completely dismantled proceed as follows :-

Fit ball bearing on to annulus tailshaft, pressing it into position against the locating shoulder behind the annulus. Fit speedometer driving gear and distance piece.

Fit the annulus into the rear casing. Check the dimension between the distance piece and the face for the rear bearing in the casing. Fit a spacing washer to give .005" - .010" end float between the bearings and the casing.

NOTE This selection of the spacing washer is only necessary when new parts have been fitted, (especially the rear casing).

Press the rear bearing on to the tail shaft, and into the casing simultaneously. Fit the oil seal using tool No. L 212. Press on the rear coupling flange and then fit the washer and nut together with a split pin if applicable. Insert the speedometer pinion gear and bush after ensuring that the 'O' ring is serviceable. Turn the annulus to engage the gear if necessary, align the holes in the casing and the bush, fit the dowel screw and copper washer.

2. Reverse Spline Type Annulus

Fit ball bearing circlip groove uppermost, over the output shaft, pressing it into position against its locating shoulder behind the annulus. Fit speedometer driving gear, lock washer and slotted nut, tightening latter with special tool No. L 211. Fit the annulus into the intermediate casing and fit the circlip into the bearing outer track. Ensure that the circlip is located against the rear face of the casing. The bearing is located at its rear end by the tail shaft cover assembly, and a shim is inserted into the recess of the cover to ensure the bearing is trapped. If any new part is fitted, and it becomes necessary to assess the thickness of the shims required, proceed as follows :- place several shims into the rear cover recess and offer the rear cover to the intermediate casing with the bearing and circlip in place; measure with a feeler

gauge the amount by which the rear cover fails to meet the casing. Remove the rear casing again, measuring the thickness of shims used, subtract the gap already checked by feeler gauge from the total thickness of the shim. This will be the actual thickness required. Fit the rear cover with the selected shim after smearing the joint faces lightly with a liquid jointing compound. Fit the speedometer pinion and bush as already described above.

Annulus Spigot Bearing

If this bearing has been removed, fit a new one as follows: Holding the rear casing and the annulus vertically in a vice, press in the needle bearing, using special tool No. L 209. Leave the rear casing in this position for further assembly. Fit the bronze thrust washer in the recess in the annulus.

Assembling and Fitting Uni-Directional Clutch

Assemble the spring into the roller cage of the uni-directional clutch. Fit the inner member into the cage and engage it on the other end of the spring. Engage the slots in the inner member with the tongues on the roller cage, and see that the spring rotates the cage to urge the rollers, when fitted, up the inclined faces of the inner member. The cage is spring loaded anti-clockwise when viewed from the front.

Place this assembly, front end downwards, into the special assembly ring, tool No. L 178 and fit the rollers through the slot in the tool, turning the clutch clockwise, until all the rollers are in place. Replace the uni-directional clutch assembly, using the special tool to enter the rollers into the outer member in the annulus.

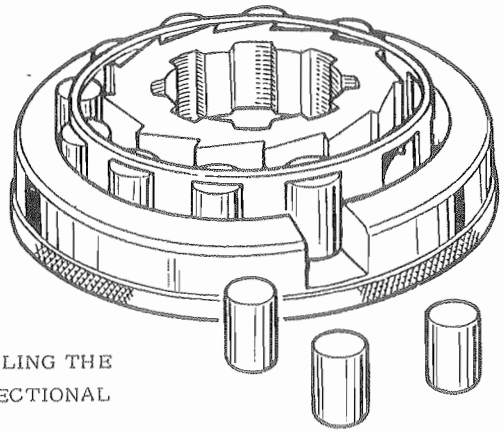


FIG 18

ASSEMBLING THE UNI-DIRECTIONAL CLUTCH

Fit the retainer ring or oil thrower Ref. 47 or 62 over the roller clutch assembly, peen over the edges of the recess to secure the ring or fit the circlip, whichever is applicable.

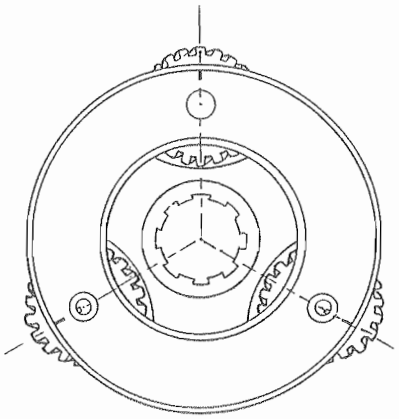
PLANET CARRIER AND GEAR TRAIN

Overdrive units of 0.802 to 1 ratio (25%) have compound planet gears and special care must be taken when re-assembling the planet set, to the annulus and sunwheel. It will be seen that there are three etched lines on the planet carrier, adjacent to each of the planet gears, and that one tooth of each gear has a line etched on it. It is most important that these marks should correspond when the sunwheel is assembled to

the planet carrier. The planet carrier complete with the sunwheel is then assembled to the annulus. See Fig. 19. Failure to align the gears correctly may make assembly difficult, but more important, if the unit is run in this condition serious damage will result.

FIG 19

PLANET CARRIER AND GEAR TRAIN SHOWING ETCHED LINES



Units of 0.756 to 1 ratio (32%) have simple, not compound planet gears, and they may be assembled in any position.

Having fitted the planet carrier assembly into the annulus, insert dummy mainshaft tool No. L 201 engaging in the planet carrier and uni-directional clutch splines.

CLUTCH SLIDING MEMBER

Press the clutch bearing into the thrust ring, fit the four bolts of the thrust ring and press this assembly on the hub of the clutch member, securing the assembly in place by fitting the large circlip on the hub. Remove the sunwheel from the planet gears and fit it to the clutch member ensuring that the splines slide easily and then fit the circlip.

FINAL ASSEMBLY

Fit the clutch sliding member assembly complete with the sunwheel on to the annulus engaging the sunwheel and planets. (See note on previous page regarding 25% gear train). Fit the retaining plate over the bolts of the thrust ring bearing assembly. Fit the clutch return springs, one on each bolt. Now fit the front casing, smearing liquid jointing compound on both faces of the brake ring and sandwiching it between the front and rear casings. Carefully position the thrust ring bolts, which are shouldered, through the holes in the front casing. The clutch spring pressure will now be felt as the two halves of the casing go together, and it will probably be necessary to push down on the front casing, in order to start the nuts on the studs. Tighten the eight nuts progressively until the two faces meet. Ensure that the two halves of the casing go together easily and check that the thrust ring bolts are not binding in their holes. Fit the two bridge pieces, nuts and lock washers. Fit the solenoid plunger to the operating lever fork; it may be necessary to unscrew the operating valve plug slightly to allow the lever to move back sufficiently. Then fit the solenoid and tighten the two screws.

Adjust the solenoid operating lever as already described on Page 6 of section I.

Fit cover plate with the three screws.

Where a copper breather balance pipe is fitted, this should be connected now.

The overdrive is now complete and ready for fitting to the gearbox.

REFITTING TO GEARBOX

Check that the cam is not unduly worn. Check that the flat spring ring on the gearbox main shaft is not distorted, and does not protrude above the crown of the splines.

Turn the shaft to position the cam with its highest point uppermost. The lowest point will then coincide with the overdrive pump roller. The mainshaft should not be turned again until the overdrive has been fitted.

Remove the dummy mainshaft from the overdrive, the splines will then be correctly lined up and it is most important that the propeller shaft coupling flange is not turned until the unit has been fitted to the gearbox.

Fit a new paper joint to the overdrive front face.

Fit the overdrive carefully to the gearbox, ensuring that the pump roller 'rides' on the cam which is chamfered for this purpose, and that the overdrive pushes right up to the face of the adapter by hand pressure only. If the overdrive will not meet the faces by .625" it means that the splines have become misaligned. Remove the overdrive again and re-align the spline by rotating the inner member of the uni-directional clutch in an anti-clockwise direction; this can be done with a long screw driver.

Re-check by inserting the dummy mainshaft again.

When the overdrive has been fitted, tighten the eight nuts evenly.

SECTION THREE

OVERHAUL INSTRUCTIONS

A TYPE

KEY TO FIGURE 20

1. Clutch Thrust Ring Assy.
2. Clutch Return Springs
3. Clutch Sliding Member
4. Thrust Ballrace
5. Circlip
6. Circlip
7. Brake Ring
8. Sunwheel Assy.
9. Planet Carrier Assy.
10. Annulus Assy.
11. Bronze Thrust Washer
12. Bronze Thrust Washer
13. Steel Thrust Washer
14. Cage (Uni-Directional Clutch)
15. Rollers (Uni-Directional Clutch)
16. Spring (Uni-Directional Clutch)
17. Inner Member (Uni-Directional Clutch)
18. Thrust Washer
19. Annulus Front Ballrace
20. Annulus Rear Ballrace
21. Selective Spacing Washer
22. Rear Casing
23. Studs
24. Speedometer Pinion
25. Speedometer Pinion Pilot Bush
26. Speedometer Pinion Support Bush
27. Dowel Screw
28. Copper Washer
29. Rear Oil Seal
30. Coupling Flange
31. Coupling Flange Nut
32. Plain Washer
33. Overdrive Joint Washer
34. Pump Operating Cam
35. Bridge Piece
36. Operating Pistons
37. Sealing Ring
38. Operating Valve
39. Breather
40. Operating Valve Plug
41. Operating Valve Spring
42. Operating Valve Spring Plunger
43. Operating Valve Ball
44. Support Bushes
45. Main Casing
46. Guide Peg
47. Pump Plunger
48. Pump Roller
49. Pump Roller Pin
50. Pump Plunger Spring
51. Pump Body
52. Pump Body Screws
53. Pump Body Base Plug
54. Oil Filter
55. Sealing Washer
56. Drain Plug
57. Non Return Valve Ball
58. Non Return Valve Plunger
59. Non Return Valve Spring
60. Non Return Valve Plug
61. Valve Setting Lever
62. 'O' Ring
63. Cam Lever
64. Operating Lever Shaft
65. Solenoid Bracket Joint
66. Solenoid Bracket
67. Rubber Stop
68. Distance Collar
69. Operating Lever
70. Solenoid Cover Joint
71. Solenoid Cover
72. Solenoid
73. Sealing Disc
74. Accumulator Sleeve
75. 'O' Ring
76. Piston Rings
77. Accumulator Piston
78. Accumulator Spring
79. Accumulator Tube

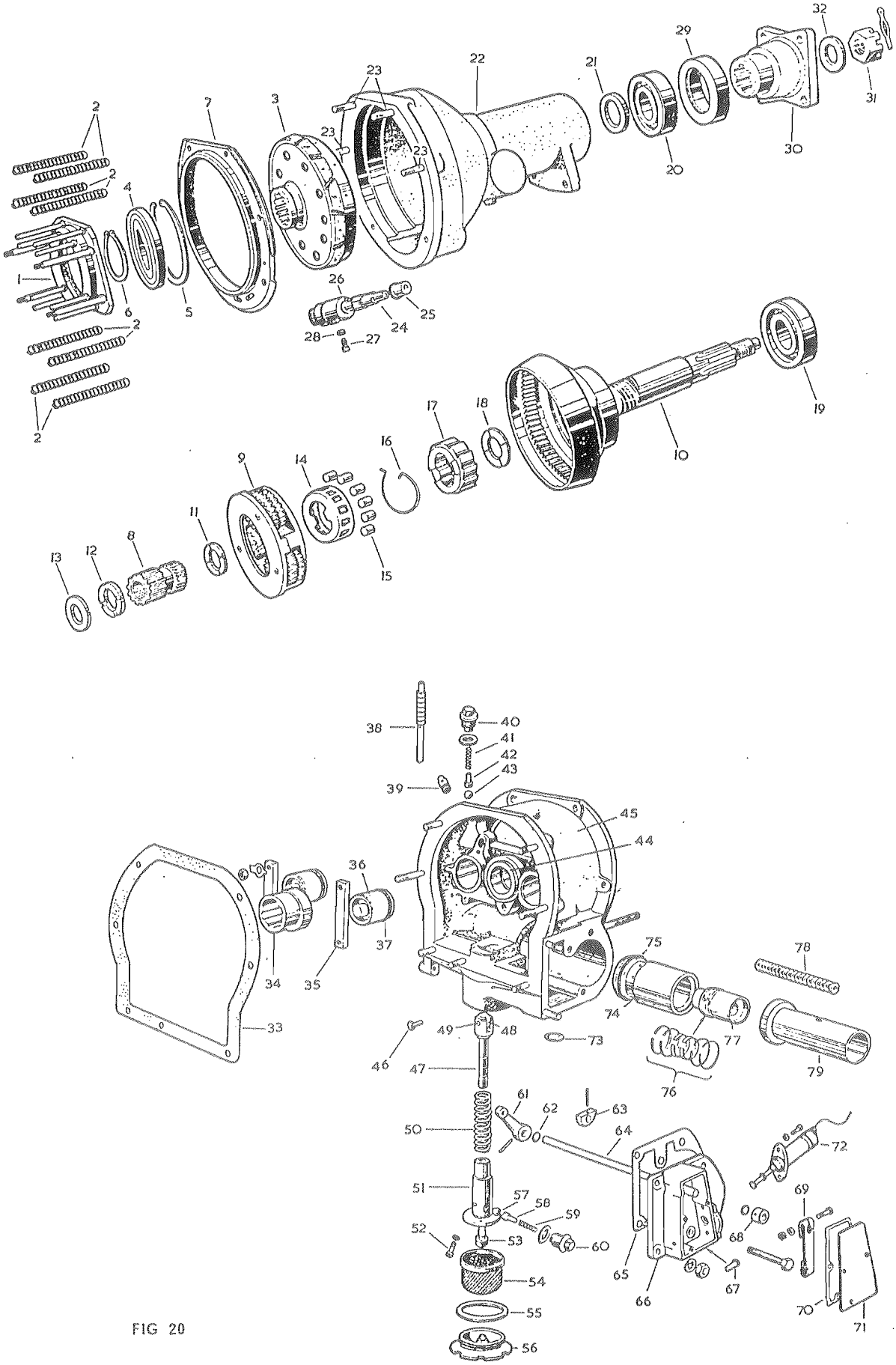

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FIG 20

OVERDRIVE REMOVAL

The overdrive unit may be removed without taking the gearbox from the car providing that sufficient clearance 7.0" (177 mm) exists to allow the overdrive to be moved rearwards. However, it is usually more convenient to remove the gearbox and overdrive complete. Whichever means is adopted proceed as follows:-

The unit is split at the rear face of the adapter casing. It will be seen that there are four or five short studs and two long studs (or in some cases bolts). Remove the nuts from the short studs first, then simultaneously loosen the nuts on the long studs, thus releasing the pressure on the clutch return springs. Pay attention to the degree of stiffness which is given to these two nuts by the pressure of the clutch springs, so that extra pressure required to re-tighten these nuts later on will be anticipated. Remove the two nuts, then the overdrive unit can be withdrawn off the mainshaft.

The overdrive can be divided into four main assemblies :-

1. FRONT CASING AND BRAKE RING
2. CLUTCH SLIDING MEMBER
3. PLANET CARRIER AND GEAR TRAIN
4. REAR CASING AND ANNULUS

DISMANTLING

IMPORTANT

SCRUPULOUS CLEANLINESS MUST BE MAINTAINED THROUGHOUT ALL SERVICE OPERATIONS. EVEN MINUTE PARTICLES OF DUST OR DIRT, OR LINT FROM CLEANING CLOTHS MAY CAUSE DAMAGE, OR AT BEST INTERFERE WITH CORRECT OPERATION.

Prepare a clean area in which to lay out the dismantled unit, and some clean containers to receive the small parts.

In installations where the oil supply is common with the gearbox, it follows that the same high standards of cleanliness must be maintained, when servicing the gearbox.

SPECIAL TOOLS

A complete list of special tools can be obtained, as listed in Appendix 'B'.

For the initial examination, dismantle into the four main assemblies proceeding as follows :-

Hold the overdrive with front casing uppermost in a vice fitted with suitable soft jaws.

Remove all the clutch return springs from their pins, noting that the four springs nearest to the centre of the unit are shorter than the outside springs.

Release the tabwashers locking the four $\frac{1}{4}$" nuts, retaining the operating piston bridge pieces. Remove the nuts, tabwashers and bridge pieces.

Remove the six nuts which secure the front and rear casings. (On some units it may be necessary to remove the solenoid in order to gain access to one of the nuts). Separate the two casings. The brake ring is spigoted into each half and may remain attached to the front half, if not a few taps with a mallet around its flange will remove the brake ring from the rear casing.

Remove one steel and one bronze thrust washer from the forward end of the sunwheel, noting their positions.

Lift out the clutch sliding member complete with the thrust ring and bearing.

Lift out the sunwheel and the bronze washer situated in the recess in the planet carrier.

NOTE In the case of the 22% unit, it is not possible to remove this washer because the planet gears overlap it. Lift out the planet carrier assembly.

The overdrive is now divided into the four main assemblies.

FRONT CASING AND BRAKE RING

If on road test the hydraulic system was performing correctly and there has been no major failure causing metal dust etc., it should not be necessary to dismantle this assembly any further, but if it is, proceed as follows :-

Remove the operating valve plug, lift out the spring, plunger and ball, remove the operating valve by lifting from underneath and grasping it as it protrudes from the casing. Place all the components in a clean container, taking care not to damage the valve seating.

Remove the operating pistons by gripping the centre bosses with a pair of pliers and applying a rotary pull.

The Solenoid

To remove the solenoid, first take off the solenoid cover plate (when fitted). Remove the two screws and pull off the solenoid, ease the plunger out of the yoke of the valve operating lever.

Release the clamp bolt on the valve operating lever; remove the lever and the collar under it from the valve operating shaft.

The Accumulator

Access to the accumulator is gained by removing the solenoid bracket as follows. First remove the nuts from the studs then simultaneously loosen the two setscrews painted red, securing the bracket to the casing.

The setscrews are of sufficient length to allow the accumulator spring to be completely released, AND SHOULD ALWAYS BE REMOVED AFTER THE NUTS.

After removing the bracket, the accumulator spring is exposed.

There are three alternative sizes of accumulator piston, namely, $1\frac{1}{8}$" diameter, $1\frac{1}{2}$" diameter and $1\frac{3}{4}$" diameter.

The $1\frac{1}{8}$" diameter has one spring and a tube.

The $1\frac{1}{2}$" diameter has two springs and a tube.

The $1\frac{3}{4}$" diameter has two springs and no tube.

Remove the springs and tube, whichever is applicable.

The accumulator sleeves for the $1\frac{1}{8}$" diameter and $1\frac{1}{2}$" diameter piston are removed with the aid of special tools L 182 and L 216 respectively. Insert the special tool into the accumulator sleeve and tighten the lower wing nut. Withdraw the accumulator sleeve and piston complete by applying a rotary pull to the upper wing bolt of the tool Fig. 21. Place the assembly into a clean container to avoid soiling or damaging the rubber sealing rings.

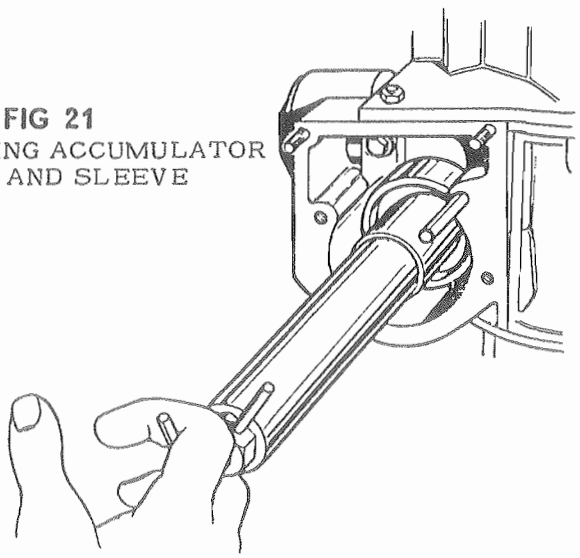


FIG 21
REMOVING ACCUMULATOR PISTON AND SLEEVE

The $1\frac{3}{4}$" diameter piston is removed by screwing a $\frac{3}{8}$" UNF screwed rod into the piston and withdrawing it with a rotary pull.

The Pump Non-Return Valve

This valve is located in the cavity exposed by removing the solenoid bracket and is adjacent to the accumulator bore. Remove the hexagon plug Ref. 60, and lift out the spring plunger and $\frac{1}{4}$" diameter ball.

The Filter

Remove the brass drain plug, Ref. 56, lift out the filter Ref. 54. Located in the recess of the plug, are 3 magnetic plastic rings.

IMPORTANT

IT IS IMPERATIVE THAT THE PUMP NON-RETURN VALVE IS REMOVED BEFORE ATTEMPTING TO REMOVE THE PUMP

Pump

To remove the pump, remove the filter and pump non-return valve as described on page 4. Remove the two pump retaining screws Ref. 52 and the base plug Ref. 53. The pump body can now be extracted, using Tool No. L 183 as follows :-

Screw the short threaded portion of the spindle into the pump body from where the base plug was removed then place the adapter in position against the casing and screw up the wing nut, thereby pulling the body out of the casing: the plunger and spring will then be removed during this process Fig. 22.

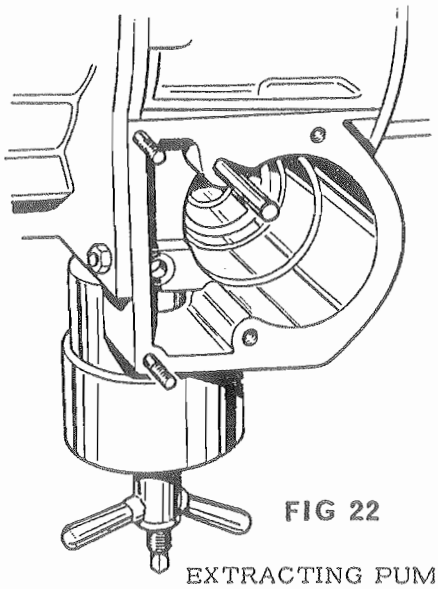
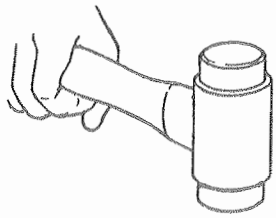


FIG 22

EXTRACTING PUMP



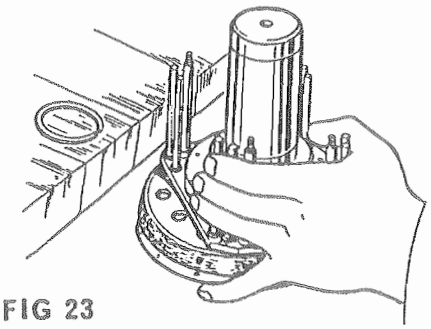


FIG 23

DISMANTLING CONE CLUTCH AND THRUST RING ASSEMBLY

CLUTCH SLIDING MEMBER

Remove the thrust ring complete with bearing from the sliding cone clutch member by withdrawing the circlip from its groove in the forward end of the clutch hub and pressing out the clutch member. Care must be taken not to distort the clutch member or damage the linings.

Remove the thrust bearing Ref. 4 from the thrust ring by removing the large circlip Ref. 5 and pressing out the bearing Fig. 23.

PLANET CARRIER ASSEMBLY

At this stage inspect all the gear teeth for any signs of damage or chipping, and assess the fit of the assembled bearing for any excessive clearance.

For models where replacement planet gears are not available separately for servicing, a complete planet carrier sub assembly should be substituted if damage or wear necessitates replacement.

Replacement planet shafts and bearings (except for caged type) are, however, available for all models.

NOTE Caged bearings can only be supplied together with new gears.

In cases where planet gears are available separately, they must be installed in sets of three, even though only one or two of the original planet gears were damaged.

To extract the pins proceed as follows :-

IMPORTANT Remove one gear at a time and mark by scribing the individual gear, planet pin and relative planet hole location in the carrier to ensure that each gear is refitted into its original location.

NOTE Each gear is marked with a dot by the manufacturer. This is for angular relationship in assembly of the compound gears and is also used to obtain the correct angular position of the Planet Carrier and Gear Train before assembly with the Annulus. See Page 14 for re-assembly of the Planet Carrier and Gear Train.

Support the planet carrier on a suitable hollow abutment through which the pin will pass. Using a drift, drive out the pin, shearing the small Mills pin which secures it. Knock or drill out the broken end of the Mills pin from the carrier and planet pin.

Some units have an oil catcher rolled on to the rear face of the planet carrier making it impossible to drive the planet pins out in the aforementioned manner. In this case a new planet carrier assembly complete must be fitted.

To Extract the Needle Bearings (Using Tool No. L 203)

Secure the square ended shank of the tool vertically in a vice and remove the wing nut and all the collars. Slide the gear over the spindle and allow the bearing to abut against the spindle shoulder. Fit the main body and wing nut, and press the gear off the bearings.

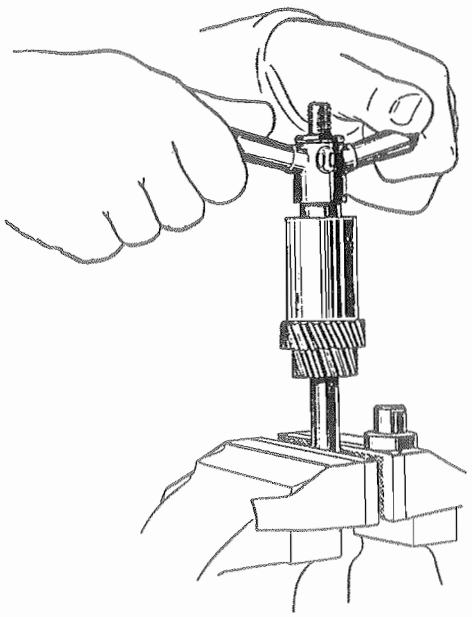


FIG 15 REMOVING DRAWN CUP NEEDLE BEARINGS

REAR CASING AND ANNULUS

To dismantle this assembly proceed as follows :-

Remove the uni-directional clutch Ref. 14 to 17 by placing the special assembly ring (Tool No. L 178) centrally over the front face of the annulus and lifting the inner member of the uni-directional clutch up into it. This will ensure that the rollers do not fall out of the retaining cage. Place the parts in a suitable container. Alternatively, if dismantling further, remove the assembly ring and allow the rollers to come out, and the hub will readily come from the cage, exposing the spring.

Remove the bronze thrust washer fitted between the hub of the uni-directional clutch and the annulus.

Removal of Annulus

Remove speedometer dowel screw Ref. 27, then, using Tool No. L214 to prevent damaging the thread, withdraw the speedometer drive bush and pinion Refs. 26 and 24. Remove the coupling flange Ref. 30.

Remove oil seal (if necessary) by screwing the taper thread of the outer member of the special tool (L176) into it and tightening the centre bolt against the rear of the tail shaft. Press annulus forward out of the rear casing. The front bearing should remain assembled to the annulus, leaving the rear bearing in the casing. Remove the distance collar from its shoulder in front of the splines. Withdraw the front bearing from the annulus, using Tool No. L187 in conjunction with handpress No. RG4221B (See Fig. 24). Drive out the rear bearing from the rear casing.

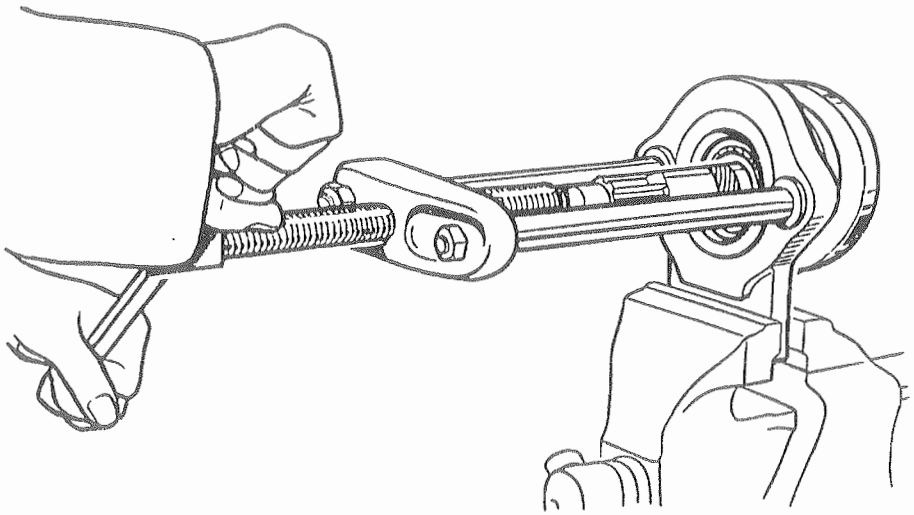


FIG 24 REMOVING FRONT BEARING FROM ANNULUS

INSPECTION

EACH PART SHOULD BE THOROUGHLY CLEANED AND EXAMINED AFTER THE UNIT IS DISMANTLED

FRONT CASING AND BRAKE RING

Inspect the front casing for cracks, damage etc. Examine the bores of the operating cylinders and accumulator for scores or wear.

Check for signs of leaks from the plugged ends of the oil passages. Ensure that the sealing disc beneath the accumulator is tight and not leaking. Inspect the centre bore of the support bushes Ref. 44 for wear and damage. Inspect the bronze and steel thrust washers Ref. 12 - 13.

Check operating pistons Ref. 36 for signs of scores and replace sealing rings Ref. 37 using tool No. L 180 if there is any sign of damage or distortion.

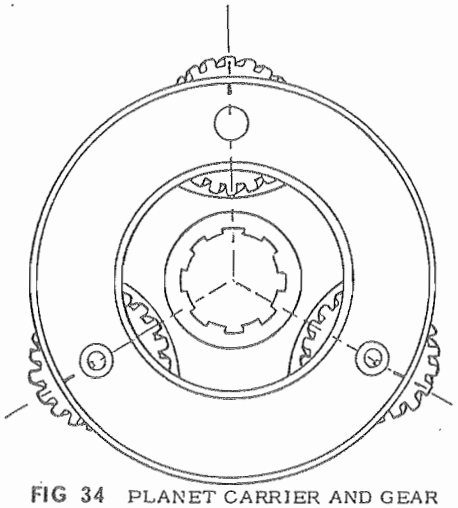


FIG 34 PLANET CARRIER AND GEAR TRAIN SHOWING ETCHED LINES

into the correct angular position before re assembly to the annulus, in accordance with the following procedure. Turn each gear respectively until a dot marked on one tooth of the large gear is positioned radially outwards, Fig. 34. Fit the bronze washer Ref. 11 in the recess in the planet carrier. Insert the sunwheel meshing with the planet gears and keeping the dots in the same position, insert this assembly, meshing the gears in the annulus.

Insert the dummy mainshaft tool No. L 185A at this stage, turning the sunwheel until the shaft engages in both the planet carrier and the uni-directional clutch splines. If any new parts have been fitted in connection with the gear or casings, it becomes necessary to check the end float of the sunwheel which should be between .008" and .014" (.20 - .35 mm). To do this proceed as follows :- Fit an extra thrust washer of known thickness on top of the sunwheel, over the dummy shaft, then fit the original bronze and steel thrust washers in that order.

Fit the brake ring to the front casing and tap fully home. Fit the front casing over the dummy mainshaft and offer it up to the rear casing. Due to the extra thrust washer mentioned above, the two casings will not meet fully at their flanges. Measure this gap which will represent the thickness of the extra thrust washer, minus the end float of the sunwheel. If the indicated float is more or less than that required it must be adjusted by replacing the steel thrust washer at the front of the sunwheel by one of less or greater thickness as required.

When the correct thickness washer has been ascertained, remove the front casing and the thrust washers and continue with the main assembly.

CLUTCH SLIDING MEMBER

Re-assemble as follows :- Press the thrust bearing evenly into the thrust ring and fit the large circlip.

Press this assembly on to the hub of the clutch sliding member taking great care not to damage the linings and fit the smaller circlip to the clutch sliding member.

Fit this assembly over the sunwheel splines and engage the inner linings on to the annulus.

Fit the bronze washer on the top of the sunwheel, also the steel selective washer of the correct thickness as previously determined.

Smear liquid jointing compound on both sides of the brake ring flange, and tap this home on the front casing.

Fit the front casing and the brake ring to the rear casing, carefully positioning the Thrust Ring pins, through the four holes in the front casing. Fit and tighten nuts on to the six studs.

NOTE If the unit has a vertically mounted solenoid, a thin nut is fitted to the stud adjacent to the solenoid cap to provide clearance.

Fit the operating piston bridge pieces Ref. 35 using new tabwashers and nuts.

Fit the distance collar Ref. 68 to the operating lever shaft.

Fit the operating lever Ref. 69. Insert the solenoid plunger into the yoke of the valve setting lever; fit the solenoid with the new joint and tighten the two screws.

Adjust the solenoid operating lever as already described on page 5 of Section 1.

Fit the solenoid cover plate (if applicable) and tighten the appropriate screws, ensuring that the joint washer is in good condition.

The overdrive is now complete and ready for fitting to the gearbox.

Inspect the gearbox mainshaft for nicks and burrs. See that all the oil holes are open and clean.

Check the oil pump operating cam for any undue wear.

Fit the cam to the gearbox mainshaft with the long plain end of the cam towards the gearbox.

If the gearbox has been removed from the car, adopt the following procedure :-

Hold the overdrive vertically in a vice with the front casing uppermost.

Fit the clutch return springs to the respective pins on the thrust ring i.e. the longer springs to the outer pegs. This is most important or the springs will become coilbound thus preventing the correct operation of the overdrive.

Remove the dummy mainshaft; the splines will then be correctly lined up.

Fit a new joint to the front face of the overdrive.

Engage top gear, stand gearbox on end, and enter the mainshaft into the overdrive unit. Turn the primary shaft in the gearbox until the splines engage and then turn further until the lowest portion of the cam coincides with the oil pump roller. Position the clutch springs on the respective bosses on the gearbox rear extension. Press the gearbox down to test the cushioning of the springs.

Fit two nuts to the long studs and tighten, evenly compressing the springs, until there is a gap of approximately $\frac{1}{4}$" between the overdrive casing and the gearbox rear extension, meanwhile ensuring that the oil pump cam does not drop off the splines or the key fall from the mainshaft.

Enter two screw drivers into the gap between the overdrive casing and the gearbox rear extension, with one, compress the oil pump plunger spring and with the other, lever the cam down into alignment with the plunger roller.

Continue tightening the two nuts on the long studs until the faces meet. If the faces fail to meet by about $\frac{5}{8}$" and the nuts become tight, misalignment of the splines is indicated, in which case remove the gearbox from the overdrive again and re-align the splines by rotating the inner member of the uni-directional clutch in an anti-clockwise direction; this can be done by probing with a long screwdriver. Re-check by inserting the dummy mainshaft again.

Re-fit the gearbox to the overdrive following the above procedure.

If the gearbox has been left in the vehicle, the method of fitment remains the same, but particular care must be taken to ensure that the clutch springs are correctly located.

APPENDIX 'A'

HYDRAULIC PRESSURES

'A' TYPE UNITS

Serial No.	Model	Hydraulic Pressure P.S.I.
28/1547	A.C.	470 - 490
28/3067	Alvis TD.21	500 - 520
22/3307	Aston Martin DB.4	470 - 490
28/3049	Aston Martin DB.4	540 - 560
28/1464	Aston Martin DB.2/4	420 - 440
28/1360	Armstrong Siddeley	510 - 530
22/3087	Austin Healey 3000	470 - 490
28/1292	Austin Healey	420 - 440
28/1447	Austin Healey 100 - 6	470 - 490
22/3009	Austin Healey 3000	470 - 490
28/1434	Bristol	470 - 510
28/1305	Bristol 405 C	470 - 510
28/3015	Bristol 405 C	470 - 510
28/3027	Ferrari 250 GT	490 - 510
22/3059	Ferrari 250 GT	490 - 510
28/3072	Ferrari 400 SA	530 - 540
22/3039	Ferrari 400 SA	530 - 540
28/3062	Ferrari 400 SA	530 - 540
28/3079	Ford Consul & Zephyr - Phase II	510 - 530
28/1286	Ford Consul & Zephyr - Phase I	540 - 560
28/3309	Ford Consul	330 - 350
28/3094	Ford - Phase II	510 - 530
28/3023	Ford - Phase II	510 - 530
28/3057	Humber Hawk	380 - 400
28/3323	Humber Hawk	440 - 460
28/1302	Humber Hawk	350 - 370
28/1463	Humber Hawk	380 - 400
28/3058	Humber Super Snipe	570 - 590
28/3088	Humber Super Snipe	440 - 460
28/3322	Humber Super Snipe	525 - 575
28/1289	Humber Super Snipe	470 - 490
28/3007	Humber Super Snipe	570 - 590
28/1369	Jaguar 2.4 litre Mk II	350 - 370
28/1474	Jaguar 3.4 litre Mk II	420 - 440
28/3028	Jaguar 3.8 litre Mk II	540 - 560
28/1482	Jaguar XK 140	480 - 500
28/3034	Jaguar XK 150	540 - 560
28/1516	Jaguar XK 150	480 - 500
28/3020	Jaguar XK 150	480 - 500
28/1270	Jaguar Mk VII & VIII	480 - 500
28/3018	Jaguar Mk IX	540 - 560

Serial No.	Model	Hydraulic Pressure P.S.I.
25/3117	Hillman Minx & Singer Gazelle	470 - 490
32/1526	Hillman Minx & Singer Gazelle	470 - 490
32/1536	Hillman Minx & Rapier II	470 - 490
32/3004	Hillman Minx & Rapier II	470 - 490
25/3314	Sunbeam Alpine III Sunbeam Rapier III a Humber Sceptre	470 - 490
25/3315	Sunbeam Alpine II Singer Gazelle III a Singer Vogue I	470 - 490
32/3017	Hillman Minx Series II	470 - 490
32/3065	Supplied to Rootes as	470 - 490
32/3074	Service Unit	470 - 490
32/3075	Hillman Minx & Singer Gazelle	470 - 490
25/3316	Triumph Vitesse	510 - 530
25/3330	Triumph Vitesse	510 - 530
32/1454	Standard 10	470 - 490
32/1554	Standard 10	470 - 490
25/3085	Vauxhall Victor	470 - 490
32/1531	Vauxhall Victor	470 - 490
25/3086	Vauxhall Victor Estate Car	470 - 490
32/3012	Vauxhall Victor Estate Car	470 - 490
32/3051	Volvo P.1800	480 - 500
32/3302	Volvo 122 S	480 - 500
32/3324	Volvo 122 S	480 - 500
32/3325	Volvo P 1800	480 - 500
32/3328	Volvo 122 S	480 - 500
32/3333	Volvo P.1800	480 - 500

Serial No.	Model	Hydraulic Pressure P.S.I.
28/3005	Jensen 541 R	510 - 530
28/1337	Jensen 541	480 - 500
28/3014	Jensen 541 R	480 - 500
28/1502	Rover 60, 75, 90	350 - 370
28/1487	Rover 75, 90	350 - 370
28/3068	Rover 80 and 100	350 - 370
28/2002	Rover P.5	420 - 440
28/3078	Rover 3 litre	420 - 440
28/1506	Rover T.C.	420 - 440
28/1327	Standard Vanguard	490 - 510
28/1427	Standard Vanguard	490 - 510
28/1553	Standard Vanguard (3 speed gearbox)	350 - 370
22/3092	Standard Vanguard (4 speed gearbox)	370 - 390
22/2001	Standard Ensign	380 - 400
28/1296	Sunbeam Alpine	350 - 370
28/1307	Sunbeam Talbot MK III	350 - 370
22/1374	Triumph TR2, TR3, TR4	380 - 400
28/3045	Vauxhall Velox and Cresta PA	510 - 530
28/3073	Vauxhall PA	510 - 530
28/1257	Vauxhall Velox	490 - 510
28/1300	Vauxhall Wyvern	490 - 510
28/3313	Vauxhall Velox and Cresta PB	510 - 530
28/3331	Vauxhall Velox and Cresta PB	510 - 530
'D' TYPE UNITS		
32/3055	Fiat 2300	520 - 540
32/3303	Fiat 1800	480 - 500
32/1594	Ford 100E	470 - 490
32/1525	M.G. Magnette	470 - 490
25/3308	M.G.B.	540 - 560
32/1450	Sunbeam Rapier I	470 - 490
32/1509	Sunbeam Rapier I	470 - 490
25/3082	Sunbeam Alpine II Singer Vogue	470 - 490
25/3010	Sunbeam Alpine I	470 - 490
25/3036	Sunbeam Alpine I	470 - 490
25/3046	Sunbeam Alpine I	470 - 490
25/3083	Sunbeam Rapier III a Singer Gazelle III a	470 - 490
25/3013	Sunbeam Rapier III	470 - 490
25/3037	Sunbeam Rapier III	470 - 490
25/3047	Sunbeam Rapier III	470 - 490
25/3076	Sunbeam Rapier III	470 - 490

APPENDIX 'B'

SPECIAL TOOLS FOR 'A' TYPE OVERDRIVE

Tool No.	Description
L 176 A	Drive shaft oil seal remover adapters. (used with Main Tool 7657)
L 177 A	Drive shaft oil seal replacer
* L 178	Assembly ring for uni-directional clutch
L 179	Piston ring fitting tool $1\frac{1}{8}$" diameter
L 180	Piston ring fitting tool $1\frac{3}{8}$" diameter
L 181	Accumulator O ring replacer
L 182	Accumulator Piston Housing remover
* L 183 A	Oil Pump Body remover (Main Tool)
L 183 A-1	Oil Pump Body remover adapter
* L 183 A-2	Oil Pump Body remover adapter
L 184	Pump Barrel replacer
L 185 A	Dummy drive shaft
L 186	Mainshaft Bearing replacer
L 187	Annulus and Tailshaft Bearing remover and replacer - Adapters (used with hand press RG 4221 B)
* L 188	Hydraulic Test Equipment (pressure gauge)
L 190 A	Tailshaft End Float gauge

* These tools are also suitable for 'D' Type Overdrive.

TOOLS FOR 'D' TYPE OVERDRIVE

L 201	Dummy Mainshaft
L 202	Annulus Tailshaft Remover and replacer adapters (use with hand press RG 4221B).
* L 203	Planet Gear Needle Bearing remover and replacer
L 204	Tailshaft Oil Seal remover adapters (use with Main Tool 7657).
L 205	Oil Pump Body remover - use L 183A and L 183 A-2.
L 206 A	Pump Body replacer
L 207	Operating Piston O ring fitting tool
L 208	Annulus Spigot Bearing remover
L 209	Annulus Spigot Bearing replacer
L 210 A	Clutch Thrust Ring Bearing remover adapter (used with No. 55 Adjustable Puller)
L 211	Tailshaft bearing Nut Wrench
L 212	Tailshaft Oil Seal replacer
L 213	Oil Pump Body Key
L 214	Speedo Drive Gear and Bearing remover
L 215	Clutch Thrust Ring Bearing replacer

* This tool is also suitable for 'A' Type Overdrive