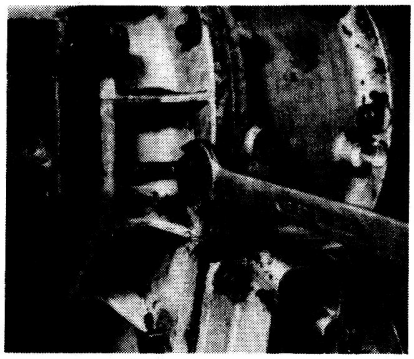
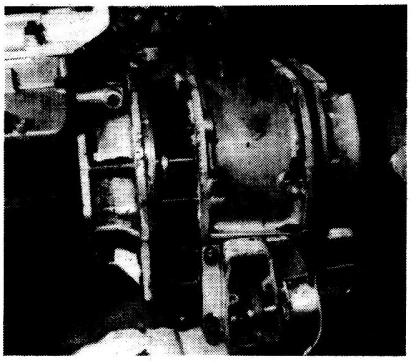
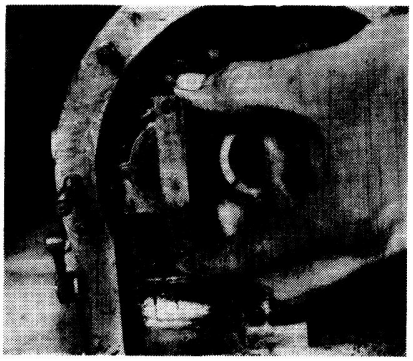
pieces against which the two pistons bear. Remove the nuts and take off the bridge pieces (photo).
5 Withdraw the two operating pistons (photo).
6 Remove the six nuts securing the two halves of the housing and then separate them (photo).
7 Remove the brake ring which is located over the studs securing the two halves of the unit (photo).
8 Now lift off the extension, with its studs, which locate the unit on the gearbox (photo) together with the clutch sliding member assembly.
9 Lift off the steel and phosphor bronze thrust washers from the sunwheel assembly (photo).
10 Take out the sunwheel and the planet carrier assembly (photo).
11 The annulus assembly complete with the cage and roller bearing for the unidirectional clutch and the inner member of the unidirectional clutch with thrust washer can now be taken out by tapping through the bearing at the rear of the unit (photo).



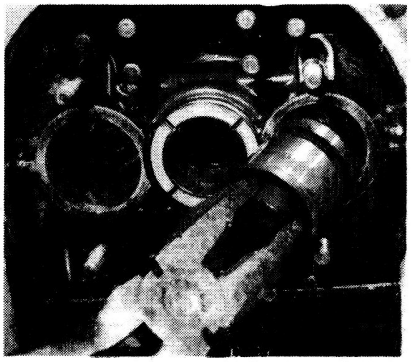
8.6. Remove the nuts from the long studs



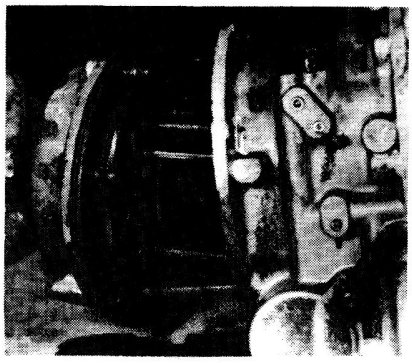
8.7. Separating the gearbox and the 'A' type unit



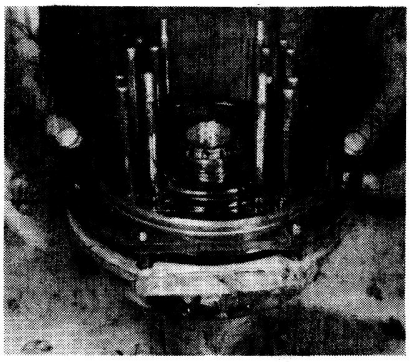
9.4. Removing the bridge pieces



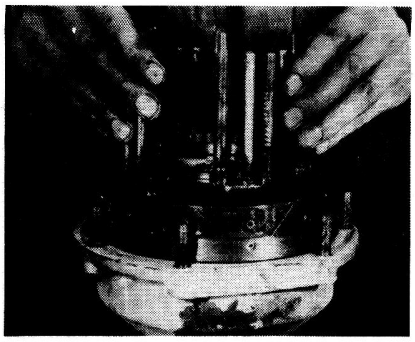
9.5. Removing the pistons



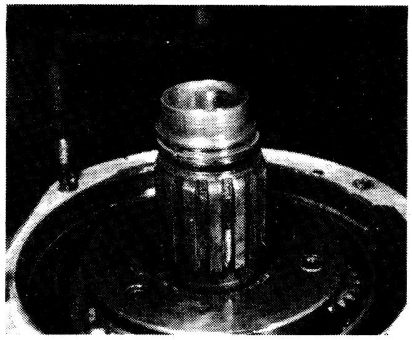
9.6. Separating the front and rear casing



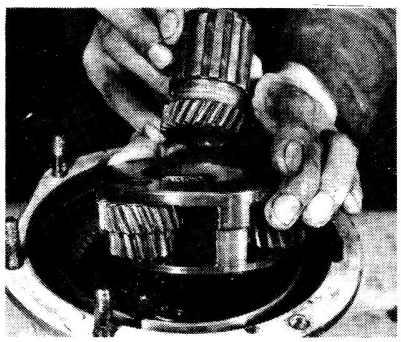
9.7. Taking off the brake ring



9.8. Taking off the extension

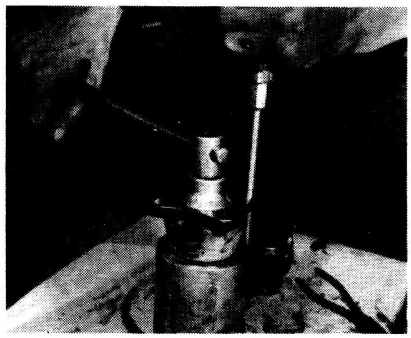


9.9. The steel and bronze washers on the sun wheel



9.10. The sun wheel and planet carrier assembly

9.11. Removing the annulus assembly



9.12. Removing the propeller shaft flange

12 However, if the propeller shaft flange was not previously removed, this will have to be taken off before the annulus assembly etc can be taken out. Knock up the tab washer securing the flange nut, hold the flange from moving and then remove the nut (photo). Tap the flange off the shaft of the annulus to remove it.

13 The overdrive unit is now dismantled to major components, directions for the removal of all other items, which can be removed from the unit when installed in the car, will be found under their individual Sections later in this Chapter.

10 Overdrive unit - "A" Compact Type - dismantling

The warning given at the beginning of Section 9 concerning the necessity for maintaining absolute cleanliness during servicing operations is equally applicable to this unit.

1 Knock up the tab washers locking the four nuts which secure the piston bridge pieces. Remove the nuts and the bridge pieces.

2 Loosen the two screws securing the solenoid so that the front casing can be removed.

3 Remove the four nuts on the studs securing the front and rear casings and then separate the casings.

4 Remove the brake ring, if still attached to the rear casing, by tapping it with a hide faced mallet to release it from the studs.

5 Lift out the clutch sliding member complete with the thrust ring, bearing and sun wheel.

6 Lift out the planet carrier and the gear train.

7 Remove the operating pistons by gripping the centre boss with a pair of pliers and rotating gently whilst pulling outwards.

8 Remove the circlip from the sun wheel and slide off the corrugated washer and the sliding member.

9 Lift out the planet carrier assembly.

10 Move to the rear casing. Take off the circlip and the oil thrower and then remove the unidirectional clutch and roller bearing. A special tool (Churchill Tool No.1.178) is available for use when removing the clutch and it ensures that the rollers do not fall out of their retaining cage. The tool is used by placing it centrally over the front face of the annulus and then lifting the inner member of the clutch up to it.

11 Remove the phosphor bronze thrust washer fitted between the hub of the clutch and the annulus.

12 Remove the speedometer dowel screw and withdraw the drive bush and the pinion.

13 Take out the split pin locking the nut securing the propeller shaft flange. Hold the flange from moving and remove the nut. Take off the flange.

14 Remove the oil seal behind the propeller shaft flange and now press the annulus forward out of the rear bearing.

15 We suggest that the front and rear bearings are not removed from the casing unless they are suspect, but to remove them, take out the circlip and then drive out the speedometer drive gear and the rear bearing. Drive out the front bearing.

16 The overdrive unit is now dismantled to major components, directions for the removal of all other items, which can be removed from the unit when installed in the car, will be found under their individual Sections later in this Chapter.

11 Overdrive unit - examination

The following instructions apply to both types of unit but owing to differences in construction some items may apply to one unit and not the other.

1 Examine the front casing for cracks or damage. The most likely place in which cracks may occur is in the region of the securing holes.

2 Look at the bores of the operating cylinders for scores or wear. Wear will probably show up as a ridge.

3 Look for signs of oil leakage at the plugged ends of the oil passages.

4 Make sure that the sealing disc in the front face of the casing is tight and is not leaking.

5 Inspect the centre bush for wear or damage. If the bush of the planet carrier is worn a complete new gear must be fitted.

6 Inspect the operating pistons for scoring, replace the sealing ring if there is any sign of damage or distortion.

7 Check the pump roller, and especially the bush, for wear.

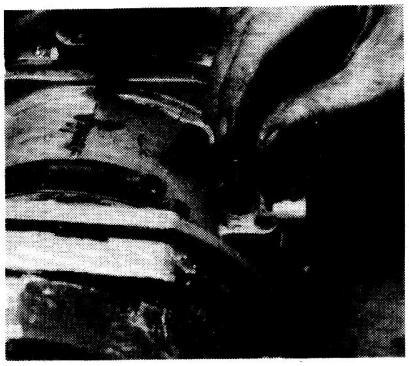
8 Look at the pump plunger and make sure it is worn or scored.
9 Check the pump body for wear and score and also check the spring for distortion.
10 Look closely at the valve seat and the ball and make sure they are not damaged.
11 Check the accumulator piston for wear, scores and broken rings.
12 Check the accumulator spring for distortion.
13 Make sure that the operating valve slides easily in the bore of the front casing.
14 Check that the restriction jet is clear and also check the spring for distortion.
15 Clean the filter throughly in petrol and removal all metallic particles from the magnetic rings.
16 Check the brake rings for wear, scoring or cracks.
17 Make sure that the clutch linings on the sliding member are not worn or charred and if either fault is present, the complete sliding member must be replaced.
18 Make sure that the pins for the bridge pieces on the thrust ring are a tight fit.
19 Inspect the ball race of the sliding member for noisy rotation. This can be a source of noise when running in direct gear.
20 Check the clutch springs for distortion or signs of collapse by comparing the length of one with another.
21 Make sure that the rollers of the unidirectional clutch are not chipped and that the inner and outer members are not worn or damaged. Check that the cage, the two ears in particular, is not damaged and that the spring is not distorted or broken.
22 Check the phosphor bronze spigot bearing fitted in the annulus under the unidirectional clutch, if it is damaged a new annulus and bearing must be fitted.
23 Check the rear casing ball races for smooth running.
24 Inspect the rear oil seal, if this was removed a new seal must be fitted on reassembly.
25 Examine the teeth of the speedometer pinion for wear.

12 The operating valve - removal and refitting

1 The operating valve of "A" Type units is located on the top of the unit and access to it, when the engine is installed, is obtained by removing the gearbox cowling as decribed in Chapter 1.
2 Remove the plug (photo) and then lift out the plunger and spring.
3 Removal of the ball presents a bit of a problem but, with patience, this can be taken out by using a blob of vaseline on the end of a matchstem. Remove the restrictor valve by inserting the point of a pencil in the hole in its end.
4 The operating valve of the JCN unit is located at the bottom of the box.
5 Place the car over a pit or on a ramp or raise the car on a jack to give access to the underside of the unit. If the car is raised on a jack, make sure it is properly supported before starting work.
6 Remove the plug and then take out the spring followed by the plunger, ball and the main operating valve.
7 Refitting, in each case is the reverse of the removal sequence but it is advisable to fit new copper washers under the plug.

13 The operating valve - adjustment

1 The ball should be lifted 1/32" (0.79 mm) off its seat when the overdrive control is operated and if the ball does not lift by this amount, adjustment is required.
2 Look on the right hand side of the unit and you will see the valve setting lever which is pivotted on the operating cross shaft. In one end of the lever is a 3/16" (4.76 mm) diameter hole which should correspond with a similar hole when the unit is in



12.2. The operating valve plug

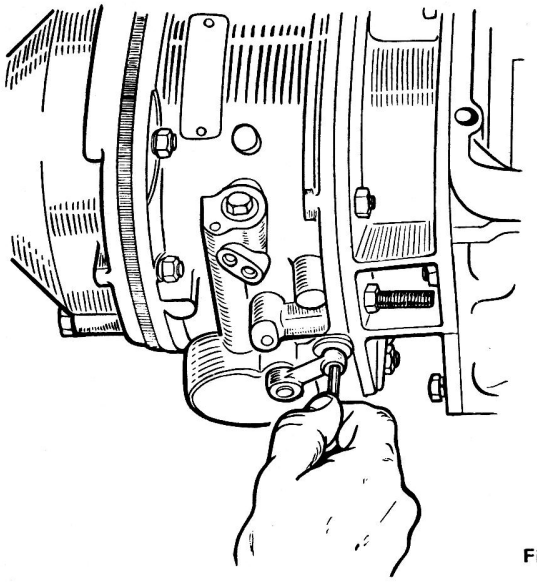


Fig.6.31. Alignment of the hole in the operating lever and in the casing

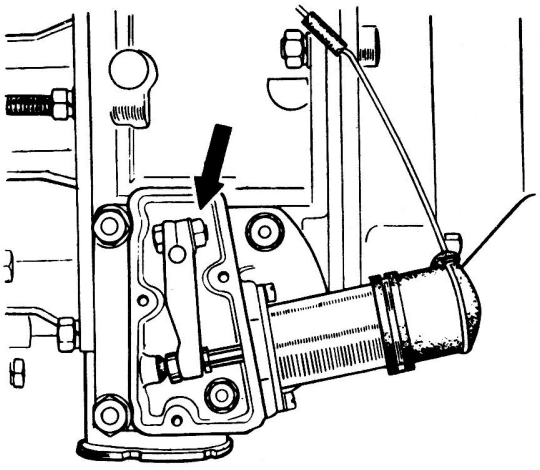


Fig.6.32. The valve operating lever clamp bolt

13.3. The solenoid with bracket cover removed

'overdrive" (Fig.6.31).
3 If the holes do not line up, remove the solenoid bracket cover (photo) on the opposite side of the casing and slacken the clamp bolt shown in Fig.6.32. Rotate the shaft until a 3/16" (4.76 mm) rod (use the shank of a drill) can be passed through the hole in the lever and the hole in the casing as illustrated in Fig.6.31.
4 Tighten the clamp bolt and check on your adjustment by putting the unit out of overdrive and then switch in again and recheck on the alignment of the holes. When the solenoid is energised, its consumption should be about 1 amp. A reading of 15-20 amps indicates that the plunger is not moving far enough to switch from the operating to the holding coil and that your adjustment of the lever is incorrect.

14 The hydraulic system - faulty operation

1 If the unit fails to operate, first check that the ball valve is seating and lifting correctly.
2 Next check that the pump is operating by jacking up both rear wheels, remove the valve plug, start the engine and then engage top gear. With the engine ticking over, watch for oil being pumped into the valve chamber, if none appears it indicates that the pump is not functioning.
3 Possible sources of trouble are failure of the non-return valve due to bad seating or to a broken valve spring or breakage of the spring holding the pump plunger in contact with the cam. Either fault will entail removal of the pump valve and/or the pump. If the operating pressure is low, it may mean that the accumulator will have to be removed. All the above can be removed and refitted with the unit installed but follow the same procedure when the unit is on the bench.

15 Pump valve - removal and refitting

1 Drain the unit.
2 The valve is removed from JCN boxes by taking out the centre plug in the bottom of the unit.
3 Take out the support rod, the spring and the ball.
4 Unscrew the valve body. A special tool (Churchill Tool No.L.213) is available for this task.
5 Removal of the valve from "A" Type units is a little more complicated.
6 Remove the cover from the solenoid bracket and then remove the solenoid body by taking out the two setscrews.
7 Slacken the clamping bolt of the operating lever and remove the lever complete with the solenoid plunger.
8 Remove the distance collar from the valve operating shaft.
9 The solenoid bracket is secured by two nuts and two bolts the heads of the latter are painted red.
10 **Remove the nuts from the studs before touching the bolts.**
This is important as, after removing the nuts, the two bolts should be slackened off together to release tension on the accumulator spring.
11 Remove the solenoid bracket.
12 Unscrew the valve cap and take out the spring, the plunger and the ball.
13 Refitting is the reverse of the removal sequence in each case but it will be necessary as a final step, to adjust the operating lever in the manner described in Section 13.

16 Pump - removal and refitting

1 Remove the pump valve in the manner described in Section 15.
2 Unscrew the securing bolt and remove the filter fitted to the "A" Type unit.
3 Take out the two cheese headed screws securing the pump body flange.

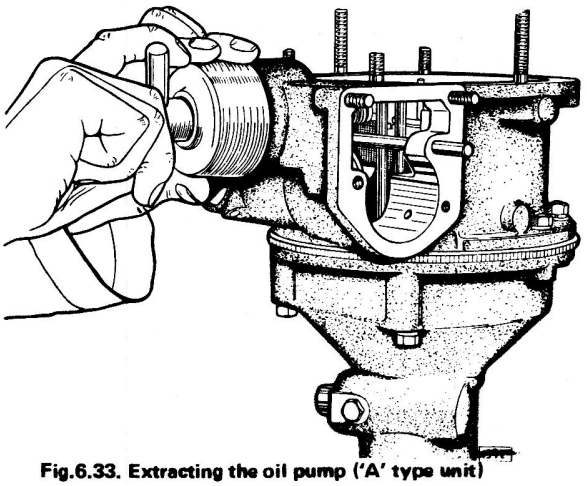


Fig.6.33. Extracting the oil pump ('A' type unit)

4 Now extract the pump and for this a special tool (Churchill Tool No.L 183A with adaptor L.183A-2) is required. Removal is illustrated in Fig.6.33.
5 The pump plunger and spring will come out when the body is removed.
6 When refitting, first replace the plug in the bottom of the pump body and make sure that it is tight.
7 Align the pump body so that the inlet port and the holes for the securing screw register with the corresponding holes in the housing and then gently tap the pump body home.
8 You will find the pump plunger is prevented from rotating when in position, by a guide peg located in the front of the casing. The plunger should be inserted with the flat on its head facing the rear of the unit. It will be helpful to use a screwdriver passed through the side of the casing to guide the plunger past the guide peg.

17 Accumulator piston and spring - removal and refitting

1 For "A" Type units, first refer to Section 15 and follow the instructions covering the removal of the solenoid bracket paying particular attention to paragraph 10.
2 Now refer to Fig.6.28 and 6.30 and remove the components of the accumulator piston assembly applicable to your car.
3 Withdraw the piston housing assembly and then separate the piston from the piston housing.
4 Refitting is the reverse of the above procedure but it is important to note that correct fitting of the piston rings is essential to the correct operation of the unit. Make sure that the rings are not gummed up and do not have excessive clearance in the grooves. The "O" sealing rings should be renewed.
5 The accumulator fitted to JCN units is held in position by a large nut at the bottom of the unit. Unscrew the nut and you will find that the length of its thread is such that all tension on the accumulator spring is relieved before the nut is clear of the casing.

6 Take out the spring, the support pin and the washer.
7 The accumulator piston can be removed by hooking a piece of stiff wire in the groove machined inside the bore.
8 Refitting is the reverse of the above sequence for removal but here also, make sure that the piston rings are in good condition.

18 Overdrive unit, "A" Type - reassembly

1 Make sure that all parts are in a thoroughly clean condition before starting to reassemble the unit.
2 Assemble the annulus into the casing but do not forget the spacing washer which fits between a shoulder on the shaft and the rear ball race. The washers are available in the following thicknesses for the elimination of all end float of the annulus and for ensuring there is no pre-loading of the bearing:-

0.146" ± 0.0005" (3.70 ± 0.013 mm)
0.151" ± 0.0005" (3.83 ± 0.013 mm)
0.156" ± 0.0005" (3.95 ± 0.013 mm)
0.161" ± 0.0005" (4.07 ± 0.013 mm)
0.166" ± 0.0005" (4.20 ± 0.013 mm)

3 Replace the thrust washer and the unidirectional clutch inner member with the rollers and cage. Fitting of the rollers will be made easier if a fixture on the pattern of that shown in Fig.6.34 is used. Ensure that the spring is fitted correctly and that the cage pushes the rollers up the ramp on the inner member.
4 Fit the pump cam to the mainshaft of the gearbox and then offer up the front housing to the gearbox adaptor and secure it in position, as a temporary measure, with two nuts.
5 The end float of the sun wheel which should be 0.008" to 0.014" (0.20 to 0.35 mm) must now be determined. This is done by fitting an extra thrust washer of known thickness with the two normally used in front of the sunwheel.
6 Now fit the planet carrier, with its gears, over the sun wheel so that the marked teeth of the gears are facing outwards as shown in Fig.6.35. With the assembly in this condition, fit it to the annulus.
7 Assemble the brake ring to the front casing followed by the front and rear assemblies but leave out the clutch sliding member and springs.
8 Measure the gap between the rear flanges of the brake ring and the rear casing. The gap will be less than the thickness of the extra thrust washer by the amount of the end float of the sun wheel. If the gap is within the specified limits of end float, strip the unit to remove the extra thrust washer and then reassemble but this time fit the sliding member, bridge pieces etc.
9 If the gap is outside the limits, remove the steel thrust washer at the front of the sun wheel and replace it with one of appropriate thickness to produce the required end float.
Washers are available in the following thicknesses:-

0.113 in - 0.118 in (2.87 - 2.99 mm)
0.107 in - 0.104 in (2.71 - 2.64 mm)
0.101 in - 0.102 in (2.55 - 2.58 mm)
0.095 in - 0.096 in (2.41 - 2.44 mm)

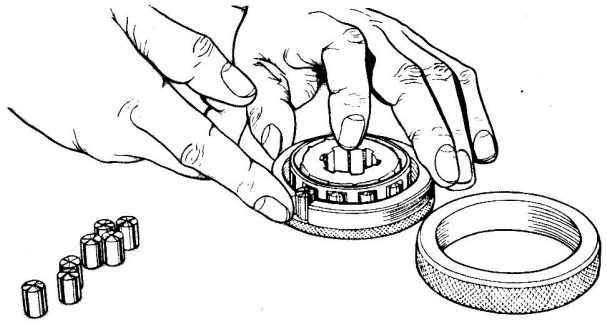


Fig.6.34. Assembly of the uni-directional clutch rollers

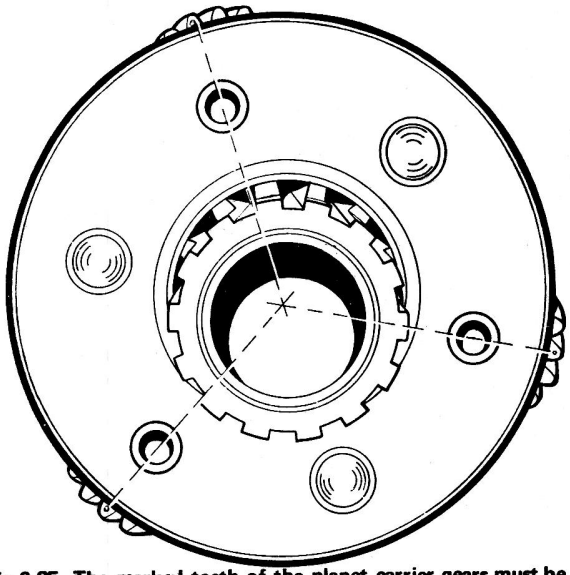


Fig.6.35. The marked teeth of the planet carrier gears must be positioned as shown for assembly

0.089 in - 0.090 in (2.25 - 2.28 mm)
0.083 in - 0.084 in (2.10 - 2.13 mm)
0.077 in - 0.078 in (1.95 - 1.98 mm)

10 It is essential that the thrust washers at the front and rear of the sun wheel are fitted in their correct positions. At the front of the wheel the steel washers are fitted next to the head of the support bush in the housing and the bronze washer goes between the steel one and the sun wheel. At the rear, the steel washer fits between the two bronze washers; the bronze washers are similar and it does not matter in which position they go. After replacement of the washer, if applicable, assemble the gear train but do make sure that the planets are turned to their correct relative positions (Fig.6.35).
11 From this point onwards the remainder of the components can be reassembled in the reverse order to that in which they were removed.

19 Overdrive unit, "A" Type Compact - reassembly

1 Fit the operating pistons in the bores making sure that the centre bosses face towards the front of the unit.
2 Press the front bearing into the rear casing and secure with the circlip.
3 Support the inner race of the bearing and then press the annulus into position until the locating shoulder abuts the bearing.
4 Fit the speedometer driving gear.
5 Press the rear bearing on to the tail shaft and into the casing.
6 Press in a new rear oil seal until it is flush with the end of the rear casing.
7 Fit the propeller shaft coupling flange, fit the plain washer and the slotted nut, hold the flange from turning and then tighten the nut to a torque of 1200-1560 lb f in and lock with the split pin.
8 Insert the speedometer pinion gear and bush fitted with a new "O" ring and now turn the annulus to engage the gear and align the holes in the casing and bush. Fit the locating screw and copper washer.
9 Assemble the spring into the roller cage of the unidirectional clutch. Fit the inner member into the cage and engage it with the spring.
10 Engage the slots of the inner member with the torque of the roller cage and check that the spring rotates the cage anti-clockwise when viewed from the front.

11 Place the assembly, front end downwards, into an assembly ring made up for the purpose (or use Churchill Tool No. L178) and fit the rollers.
12 Fit the thrust washer and then assemble the unidirectional clutch to enter the rollers into the outer member in the annulus.
13 Fit the oil thrower and its retaining circlip.
14 Turn each planet gear until a dot marked on one tooth of the large gear is positioned radially outwards. **THIS IS IMPORTANT.** (See Fig.6.35).
15 Now insert the sunwheel to mesh with the planet gears but keep them in the correct position. Fit this assembly to mesh with the internal gear in the annulus.
16 Press the thrust bearing into the thrust ring and then fit them to the hub of the clutch sliding member, but take care not to damage the linings, and secure with the circlip.
17 Now slide the assembly on to the sun wheel splines until the inner lining contacts the annulus and fit the corrugated washer and the circlip.
18 Fit the retaining plate over the studs of the thrust ring bearing assembly.
19 Coat both faces of the brake ring flange with jointing compound and tap the flange home into the front casing.
20 Fit the clutch return springs into the recesses in the front casing and then offer the front casing and brake to the rear casing. Fit the four nuts and tighten them progressively against the clutch spring pressure until the two faces meet.
21 Fit and secure the two bridge pieces with their nuts and lock them with new tab washers.
22 Complete the assembly by fitting the operating valve, the pump valve, the pump and the accumulator piston and spring as described in previous Sections in this Chapter.

20 Overdrive unit - refitting to the gearbox

1 The refitting of both types of unit to the gearbox is generally similar except in the case of the "A" Type Compact unit there are no clutch springs to worry about.
2 You will find that this task is made easier if the overdrive unit is held, upside down, in a vice (with protected jaws).
3 Fit the oil pump operating cam to the gearbox mainshaft so that the plain end faces the gearbox and so that the back of the cam is towards the bottom of the casing.
4 Make sure that the splines in the unidirectional clutch and in the planet carrier are in alignment, you will be able to see these through the bore in the overdrive unit.
5 Engage a gear and then enter the mainshaft into the overdrive unit and turn the constant pinion shaft until the splines engage.
6 Check that the clutch springs are seated on their respective bosses on the gearbox extension. Check that the splines are correctly aligned by pressing down the gearbox until it meets the overdrive unit.
7 Fit the nuts to the long studs and tighten them until there is about ¾" (19.05 mm) gap between the overdrive unit and the gearbox rear extension. Take care during this work that the oil pump cam does not drop down off the splines on the mainshaft.
8 Refer to Fig.6.36. Enter two screwdrivers into the gap and use one of them to compress the oil pump plunger and the other to lever the cam into alignment with the plunger roller.
9 Tighten the two nuts by equal amounts until the other nuts can be started and then tighten down evenly all round.

21 The overdrive control system

The solenoid which actuates the overdrive is controlled by two switches, a manual switch on the facia panel and a switch, mounted on the gearbox cover, which will only close when top gear is selected. So, to enable a change into overdrive to be made:—
a) The car must be in top gear
b) The driver must operate the manual switch
A diagram of the wiring circuit is given in Fig.6.37.

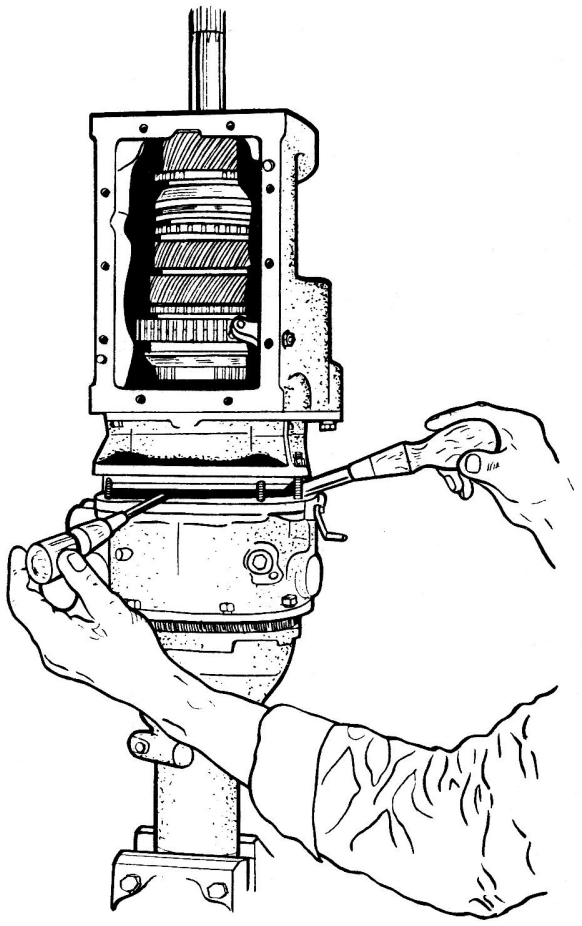


Fig.6.36. Aligning the cam and the pump plunger roller

22 Overdrive - fault finding

In the event of faults arising in the operation of the overdrive unit, first check the level of oil in the gearbox and, if it is below the low mark, top up and road test the unit before making any further investigation.

If the solenoid is not heard to operate, check the circuit from the diagram at Fig.6.37.

Overdrive does not engage
1 Leaking operating valve due to dirt on the seat or broken valve spring.
2 Pump not working due to choked filter.
3 Leaking pump non-return valve due to dirt on the seating or broken spring.
4 Insufficient hydraulic pressure due to leaks or broken accumulator springs.
5 Damaged gears, bearings or moving parts within the unit which will entail removal and examination of components.

Overdrive does not release
If the overdrive does not release, **do not reverse the car,** otherwise extensive damage may be caused.
1 Blocked restrictor jet in operating valve.
2 Sticking clutch.
3 Electric control not operating. Listen for operation of solenoid.
4 Damaged parts within the unit entailing removal and examination of components.

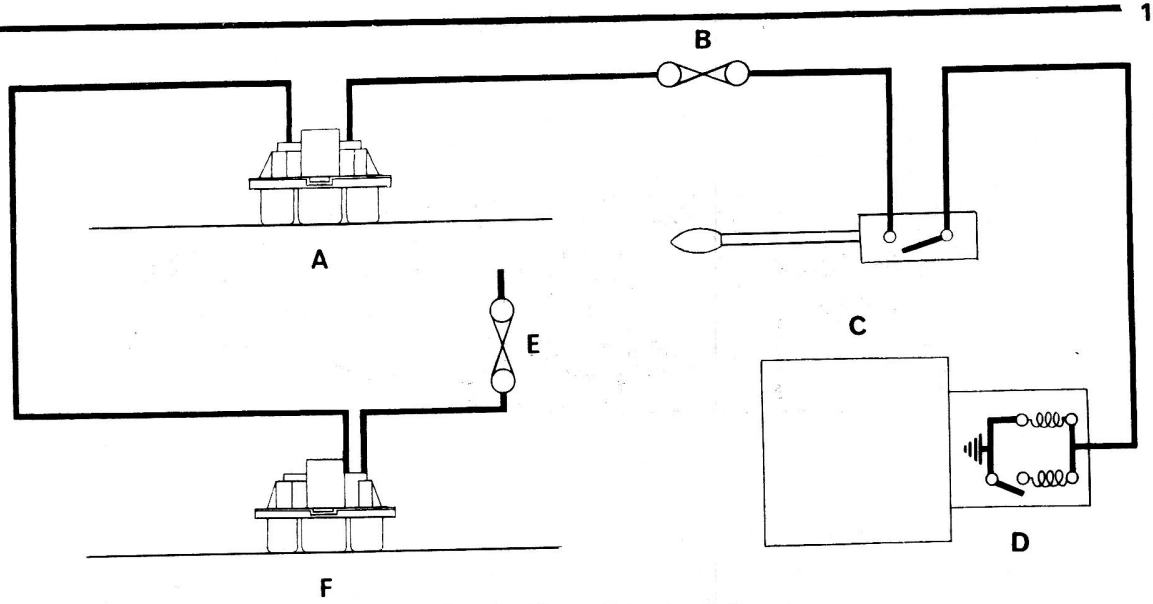


Fig.6.37. The overdrive circuit diagram

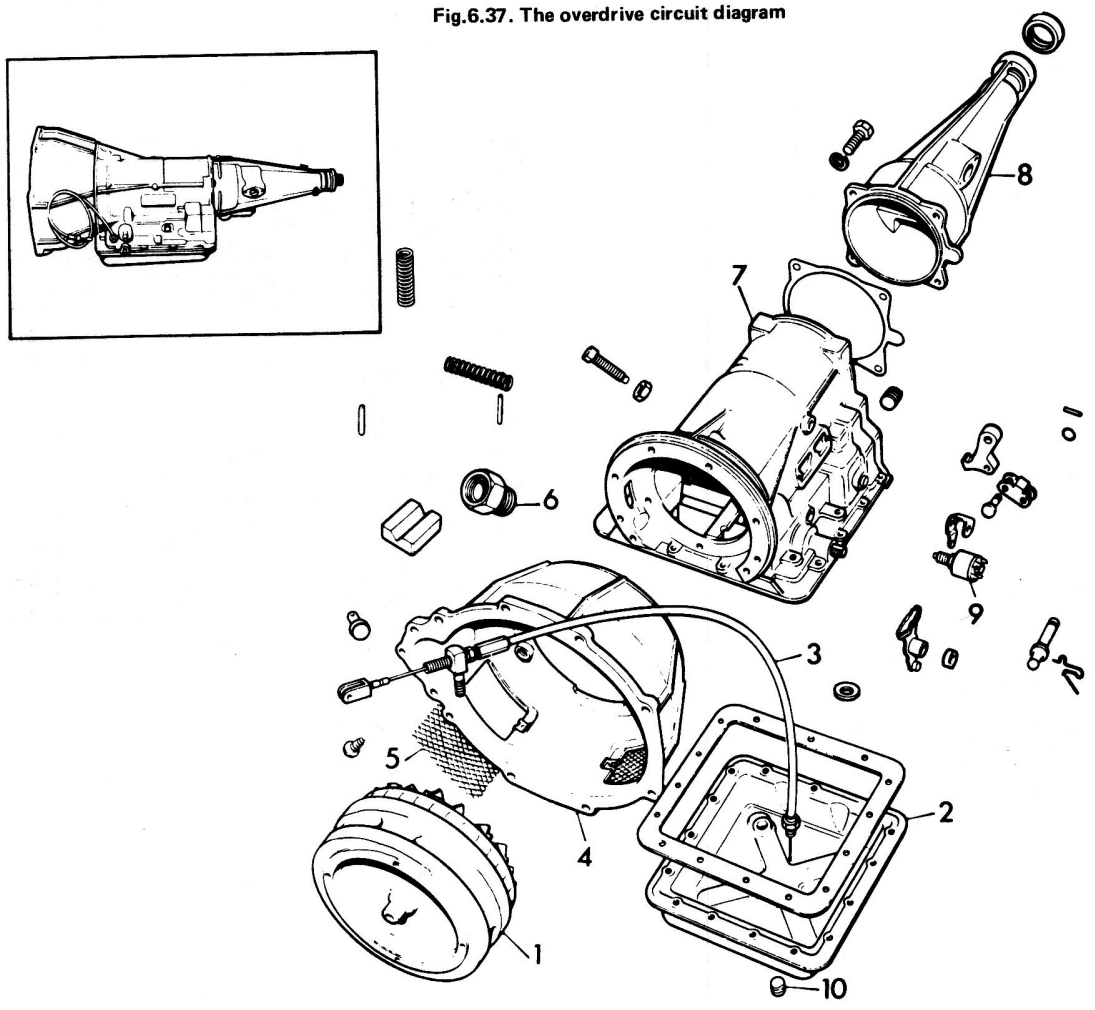


FIG.6.38. MAIN COMPONENTS OF EXTERNAL CASING WITH TORQUE CONVERTER

1 *Torque converter*
2 *Oil pan*
3 *Downshift cable*
4 *Converter housing*
5 *Stone guard*
6 *Dipstick tube adaptor*
7 *Case assembly*
8 *Rear extension housing*
9 *Inhibitor switch*
10 *Sump drain plug*

Inset: Borg Warner Type 35 (assembled)

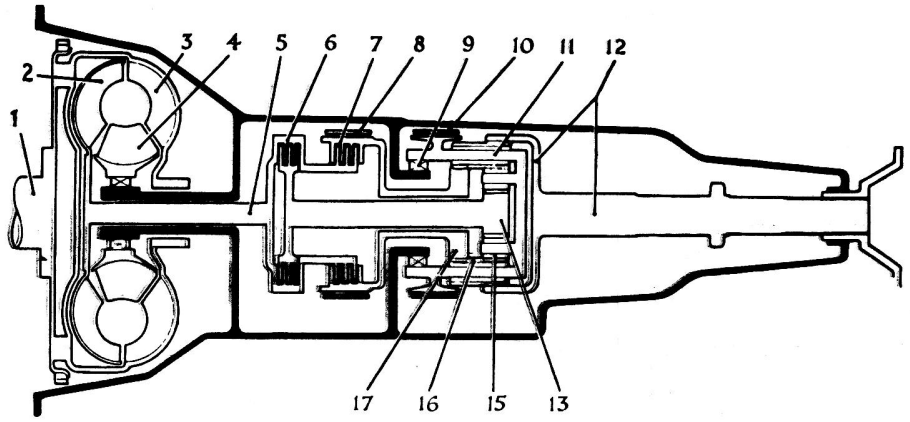


FIG.6.39. SECTIONAL VIEW OF THE MAIN MECHANICAL COMPONENTS

1 Engine crankshaft
2 Turbine
3 Impeller
4 Stator
5 Input shaft
6 Front clutch
7 Rear clutch
8 Front brake band
9 Uni-directional clutch
10 Rear brake band
11 Plant pinion carrier
12 Ring gear and output shaft
13 Forward sun gear and shaft
14 Parking pawl teeth
15 Short planet pinion
16 Long planet pinion
17 Reverse sun gear

Clutch slip in overdrive
1 Insufficient oil in gearbox.
2 Worn clutch lining.
3 Insufficient hydraulic pressure due to leaks.

Freewheel condition on over-run
1 Worn clutch lining.
2 Blocked restrictor jet in operating valve.
3 Insufficient pressure on clutch due to broken clutch springs.

23 Automatic transmission - general description

A Borg Warner Automatic Transmission Unit type "DG" or type 35 on later models, can be supplied as an optional extra. The units consist of a three element hydrokenetic torque converter and a hydraulically operated gearbox comprising a planetary gear set giving three forward gears and reverse. The main components of the unit are shown in Figs. 6.38 and 6.39.

Operation is controlled by positioning a selector lever in one of six positions (five positions on early models):- D.1 and D.2 the drive positions - D.1 is used when maximum acceleration below 25 m.p.h. (20 k.p.h.) is required whilst D.2 is used for all normal driving with 2nd gear start.

R - the reverse position
N - neutral
L - to hold gear in which selected
P - park. The engine can be run in this position and when the ignition is switched off the gears are locked.

Gear changes up or down are made automatically and are entirely dependant on road speed but if a rapid change down is required for a sudden burst of acceleration this can be achieved by a "kick-down" change made by fully depressing the accelerator. An anti-creep switch is provided and this prevents the car from creeping forward when stopped on level ground or on a slight slope with the engine running. The anti-creep solenoid holds brake pressure on the rear wheels whenever the circuit is closed; the circuit is opened by a pressure control switch operated by the transmission rear pump.

Due to the complexity of the automatic transmission unit, if the performance is not up to standard or if a fault develops, it is imperative that rectification work is undertaken by a Jaguar dealer who will have the necessary special equipment for fault diagnosis and rectification.

The contents of the following Sections is, therefore, confined to solely general and servicing information.

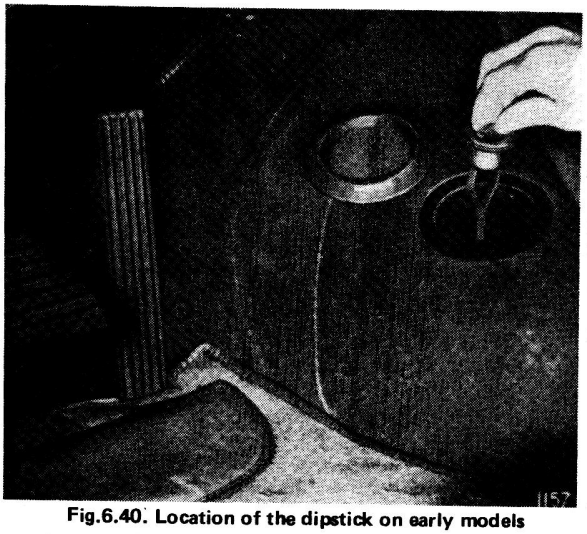


Fig.6.40. Location of the dipstick on early models

24 Automatic transmission - fluid level

It is important that only the correct type of transmission fluid is used. This is S.A.E. Automatic Transmission Fluid type "A" or type "A" Suffix "A" (AQ-TF). The transmission and torque converter oil capacity is 15 imperial pints (18 US pints, 8.5 litres). The fluid level should be checked at regular intervals, and in the manner, as described in Routine Maintenance at the beginning of the Manual.

Access to a combined filler/dipstick plug on early models is obtained by removing the carpet over the transmission cover in the car and then removing a rubber bung to expose the filler plug as shown in Fig. 6.40. On later model cars the filler tube/dipstick will be found forward of the carburettor adjacent to the radiator top water hose and on the latest models it is located at the rear of the engine just forward of the bulkhead.

25 Automatic gearbox - removal and refitting

1 Any suspected faults should be referred to a Jaguar dealer

before any attempt is made to remove the transmission unit as it is necessary to diagnose and to confirm the fault before the unit is disturbed.
2 The automatic gearbox can be removed with the engine installed leaving the converter and housing in position.
3 As the unit is relatively heavy it is best that the car is positioned over a pit or is raised on a lift or a ramp. It is possible to remove the unit if the car is raised on high axle stands but it makes for awkward working. If the car is raised on axle stands, do make sure that it is safely supported before starting work underneath it.
4 Drain the unit but if the car has just come in from a run, wait for it to cool down as the unit operates at a temperature in the region of 100°C (212°F) an d you will run considerable risk of being scalded.
5 Refer to Chapter 1 and slacken the nuts of the engine stabiliser in the manner described.
6 Slide the front seats as far as possible to the rear and then remove the carpet from the transmission unit cover. Ease up the sound proofing far enough to give access to the screws holding the cover to the body floor. Remove the screws and lift off the cover.
7 Disconnect the downshift cable from the carburettor linkage and the outer cable adjuster from the bracket.
8 Disconnect the battery.
9 Mark the relative positions of the propeller shaft and gearbox flanges. Remove the split pins locking the nuts on the securing bolts, remove the nuts and separate the flanges. Some models may have self locking nuts to the flange securing bolts. Tie the propeller shaft up out of the way.
10 Remove the speedometer drive gear from the extension housing.
11 Identify the position of the cables to the starter inhibitor switch and then disconnect them.
12 Disconnect the selector lever cable from the selector bracket on the side of the gearbox.
13 Sling the engine to take the weight off the rear mounting.
14 Place a wheeled jack in position and take the weight of the gearbox (distribute the weight if the oil pan is used as a jacking point).
15 Refer to Chapter 1 and remove the rear mounting bracket as described.
16 Lower the engine, and gearbox, slightly to give access, on later models, to the hexagonal nut securing the filler tube. Remove the upper retaining clip and then unscrew the tube.
17 Remove the nuts securing the gearbox to the housing starting with the two lower ones.
18 Place a container under the transmission to catch any fluid from the converter when the gearbox is withdrawn.
19 Slide the gearbox rearwards until the mainshaft is clear of the converter. Lower the gearbox and then move it clear of the car.
20 Check to see if the oil transfer tube came away with the mainshaft, it it did not, remove it from the centre of the converter using a pair of long nosed pliers.
21 The first step in refitting is to align the splines on the transmission shaft with the internal splines in the converter. A special alignment fixture, J4283, which uses one of the studs as a datum, is available for this task. In the absence of the fixture you will have to align the splines by eye but do not, under any circumstances, use force during assembly in the hope that this will bring the two items into correct relationship with each other.
22 Fit the oil transfer tube to the mainshaft.
23 Now carry on to refit the gearbox in the reverse order to that in which it was removed from the car, making sure that the gearbox and propeller shaft flanges are assembled to the marks you made before dismantling and that the engine stabiliser is adjusted correctly (see Chapter 1).

26 Torque converter - removal and refitting

1 If diagnosis procedure has established the need for removal of the converter it means that the engine also has to be removed. If desired, the gearbox can first be removed as described in the previous Section, on the other hand it can be left in place and the engine and transmission unit then removed as a complete assembly.
2 Refer to Chapter 1 and follow the procedure described for removal of the engine and gearbox (standard transmission) with the differences, as indicated, to cater for automatic transmission.
3 Wash down the engine and the transmission unit to remove all surface dirt.
4 Remove the gearbox unit in the manner described in Section 25.
5 Remove the starter motor and the earth strap attached to the top bolt.
6 Take off the cover plate from the front face of the converter.
7 Remove the nuts and bolts securing the converter housing to the engine crankcase and withdraw the housing.
8 Take off the six self locking nuts, and washers, which attach the converter to the engine driven plate and withdraw the converter assembly. However, first check for the alignment marks on the converter and the plate. Make your own if necessary.
9 When refitting, the alignment mark "O" on the converter must align with the similar mark on the engine driven plate.
10 Fit the converter to the engine driven plate and screw down the nuts finger tight.
11 The converter must now be centred on the driven plate and this is done by first fitting the housing and the starter motor making sure that the earth strap is fitted to the top bolt.
12 An alignment fixture, J4286, is required to do the job properly. This is entered into the bore of the converter housing and over the pump drive fingers on the converter, and is held in position by the two top gearbox securing nuts. Now rotate the converter through two complete revolutions to centralise it and then fully tighten the nuts securing the converter to the engine driven plate. Take off the fixture.
13 Refit the cover plate to the front face of the housing.
14 Refit the gearbox.
15 Follow the instructions given in Chapter 1 for reinstallation of the engine.

27 Starter inhibitor/reverse light switch - check and adjustment

This switch, besides operating the reverse light, prevents the engine being started when the selector lever is in any position other than N or P.
1 Firmly chock all wheels and apply the handbrake.
2 Make a note of the electrical connections to the switch which is located on the steering column below the upper and lower switch covers, and then disconnect them from the terminals. The starter terminals on most models are the narrow ones and the reverse the wide ones.
3 Connect a test lamp and battery across the starter terminals and then select P, N, D.1, D.2, L and R in turn. The test lamp should only come on in the P and N positions of the selector lever. If it lights in any other position adjust the position of the switch as follows:
4 Refer to Fig. 6.41.
5 Place the selector lever in the "D" position and then slacken the switch securing nut shown arrowed in the drawing.
6 Adjust the position of the switch until the hole in the lever is in line with the hole in the switch base plate. Check for correct alignment by inserting a piece of wire through the holes and then tighten the securing nut.
7 Now recheck with the test lamp as indicated in paragraph 3.
8 The above adjustment should automatically adjust for correct operation of the reverse light. Check this by connecting the test lamp to the reverse terminals and now select P, N, D.1, D.2, L and R in turn. If the switch is correctly adjusted the lamp should light on "R" only.
9 Re-mark the electrical connections to the switch.

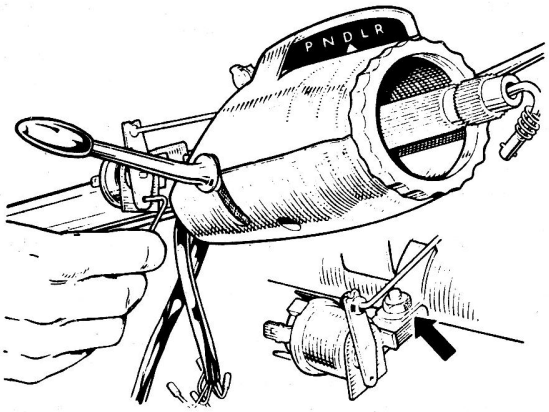


Fig.6.41. Setting the starter inhibitor/reverse light switch

28 Downshift cable - adjustment

Accurate adjustment of this cable is essential for reliable operation of the transmission. Maladjustment can be identified as follows:-

Outer cable too short - Clutch "squawk" on take off in D or R, or difficulty in obtaining 3-2 kickdown shift at high speed.

Outer cable too long - Delayed and bumpy minimum and part throttle upshifts or a 3-2 downshift at 25 m.p.h. (40 k.p.h.) occurs before the full throttle position (resistance point). Note: The cable is impregnated with silicone grease and there is no need for other lubrication.

1 The adjustment is preset at the factory by means of a cable stop crimped to the inner cable at the carburettor end and this stop should be just clear of the outer cable adjuster.

2 If the indications are that adjustment is necessary, first check that the outer cable at the carburettor end is correctly located in the adjuster.

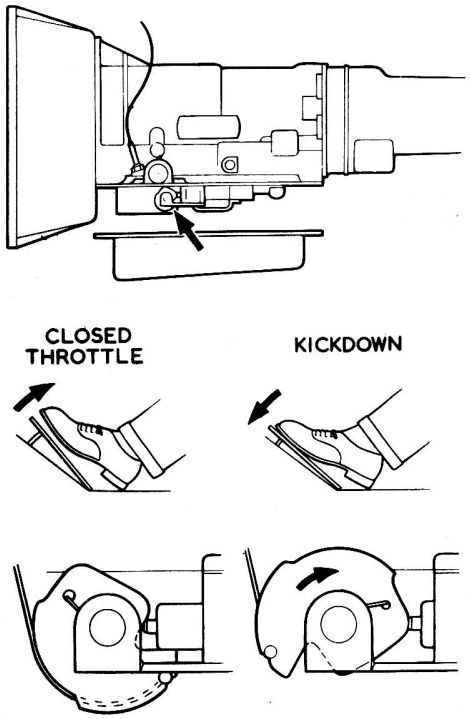


Fig.6.42. Position of the downshift valve with the accelerator in the fully released and fully depressed position

3 The most satisfactory method of effecting adjustment is to connect a line pressure gauge to the rear of the transmission unit and to note the change in pressure when the engine is running. This method, of course, requires the use of special equipment and it is better to leave the work to a Jaguar dealer.

4 The cable can also be adjusted to produce manually the conditions shown in Fig. 6.42. First drain off the transmission fluid and then remove the oil sump by taking out the fourteen bolts.

5 With the accelerator pedal fully released and the carburettor butterflies fully closed, the heel of the cam should contact the full diameter of the downshift valve, as illustrated, with all the slack of the inner cable taken up.

6 Now depress the accelerator pedal through the "resistance" point. The carburettors should be at the full throttle stops and the constant radius area of the cam should be in contact with the downshift valve as shown.

7 If the above conditions are not obtained, slacken the locknut on the outer cable adjuster and adjust as necessary.

8 When refitting the oil sump it is advisable to fit a new gasket between the sump and the transmission case.

9 Refill with transmission fluid and road test.

29 Selector linkage - adjustment

1 The components of the selector lever and linkage are shown in Figs. 6.43 and 6.44. Normally, adjustment will only be required if the gearbox or linkage has been removed from the car.

2 First of all, check correct assembly and make sure that the flat on the control shaft is aligned with the securing screw as shown in Fig. 6.45.

3 Disconnect the cable or tie rod, as applicable, at the selector valve lever on the side of the transmission case.

4 For models without both D.1 and D.2 selection, select N on the quadrant in the car.

5 Place the selector valve in the centre of the five possible positions (see Fig. 6.44) and now slacken the locknut at the lower end of the cable and adjust the length of the cable to line up with the hole in the lever.

6 Tighten the locknut and refit the cable to the lever.

7 For those models with D.1 and D.2 selection, make the adjustment of the tie rod with the selector lever in the car in the L position on the quadrant and with the selector valve in its highest position.

8 After adjustment and reconnection, check the operation of the selector by moving it to all positions on the quadrant when a definite "click" should be felt in each position. The linkage must not be allowed to over-ride the detent in each position.

9 Check also that the quadrant gating is correct. N and the D positions on the quadrant should be on the same level, lift for L, R and P and also for disengagement of P.

10 If the indicator does not line up exactly with the lettering on the quadrant, a small amount of adjustment is provided on the nylon block at the back of the indicator arm.

30 Front brake band - adjustment

1 A 0.25 inch (6.35 mm) gauge block (which you can make up out of any suitable material) and a torque screwdriver are needed for this task.

2 Drain off the transmission fluid and then remove the gearbox oil pan.

3 Refer to Fig. 6.46. Slacken the locknut and move the servo lever outwards so that the gauge block can be inserted between the adjusting screw and the servo piston pin.

4 Now tighten the servo adjusting screw, using the torque screwdriver, to a torque of 10 lb f. in. (0.12 kg fm).

5 Hold the screw from turning and then tighten the locknut.

6 Remove the gauge block, refit the oil pan with a new gasket and refill with transmission fluid.

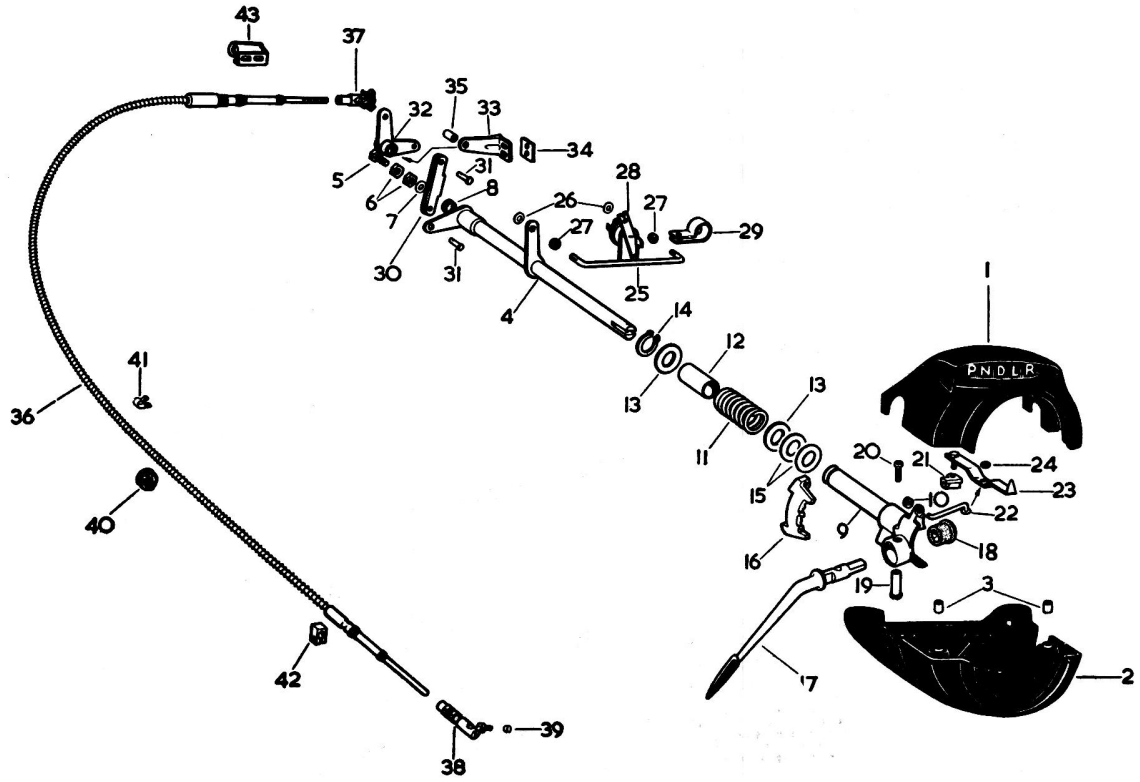


FIG.6.43. EXPLODED VIEW OF THE SELECTOR LEVER ASSEMBLY – TYPE DG UNIT

1 Upper switch cover
2 Lower switch cover
3 Ring dowel
4 Operating shaft assembly
5 Setscrew
6 Nut
7 Plain washer
8 Felt washer
9 Housing
10 Grommet
11 Return spring
12 Distance tube
13 Washer
14 Circlip
15 Shim
16 Selector lever gate
17 Lever assembly
18 Rubber bush
19 Fulcrum pin
20 Screw
21 Indicator arm bracket
22 Connecting link
23 Gear indicator arm
24 Grommet
25 Connecting link for starter/ reverse light inhibitor switch
26 Plain washer
27 Grommet
28 Starter/reverse light inhibitor switch
29 Clip
30 Bell crank connecting link
31 Clevis pin
32 Bell crank control cable lever
33 Support bracket for bell crank lever
34 Securing plate
35 Distance tube
36 Gear selector cable
37 Ball joint
38 Ball joint
39 Steel bush
40 Rubber grommet
41 Clip
42 Abutment clamp
43 Dash panel abutment bracket

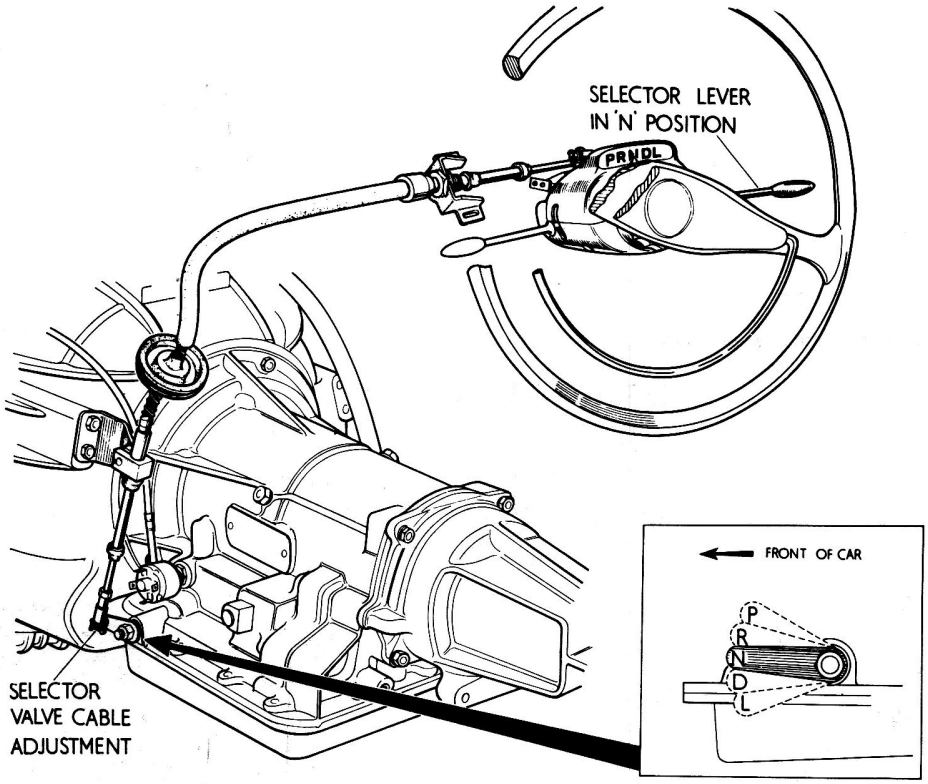


Fig.6.44. The selector lever assembly - type 35 unit

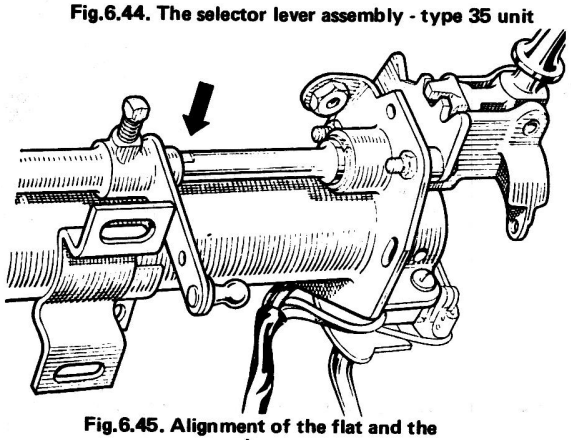


Fig.6.45. Alignment of the flat and the securing screw

Fig.6.46. Adjusting the front brake band

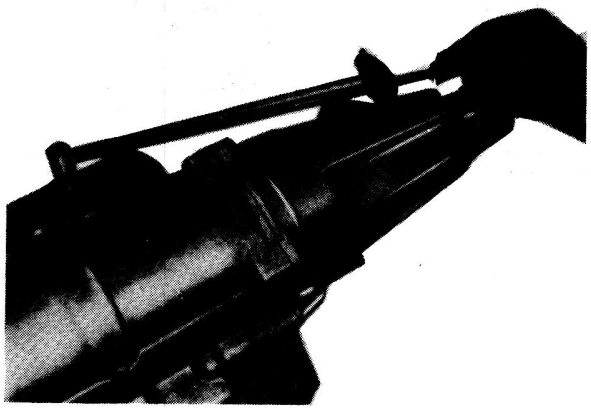


Fig.6.47. Adjusting the rear brake band

31 Rear brake band - adjustment

1 The rear brake band has an external adjusting screw on the right hand side of the transmission case (Fig. 6.47) and access to it is gained by removing the carpet and felt on the right hand side of the transmission tunnel and then by removing a rubber plug which will be uncovered.
2 Slacken the locknut of the adjusting screw, using a box spanner, and now tighten the adjusting screw to a torque of 10 lb f. ft (1.38 kg fm).
3 Now back off the adjusting screw by one complete turn and, holding the screw from turning, tighten down on the locknut.
4 Refit the rubber plug and replace the felt using a suitable adhesive.

32 Automatic transmission - fault diagnosis

In all cases the following road test procedure should be completely carried out as there may be more than one fault, if the checks show up a fault its possible cause will be found in the Section dealing with road test fault diagnosis. Before carrying out the test procedure, it is important that the car is run long enough for the transmission fluid to attain its normal running temperature and also that the fluid in the unit is at the correct level.
1 Check that the starter will operate only with the selector in the P or N position.
2 Apply the brakes and with the engine at normal idling speed, select N-D, N-L and N-R. Engagement should be felt in each position selected.
3 Check the stall speed as described later in this Section.
4 Select D. Release the brakes and accelerate with minimum throttle opening. Check for 1-2 and 2-3 shifts. These may be difficult to detect so confirmation can be obtained by selecting L, when a 3-2 downshift should be felt.
5 At speeds over 30 m.p.h. (48 k.p.h.) select N, switch off the ignition and coast until the road speed has dropped to 30 m.p.h. Switch on the ignition and select D, the engine should start indicating that the rear oil pump of the transmission is working.
6 From a standing start and using full throttle opening (ie. past the resistance point), check that 1-2 and 2-3 shifts are 39-43 m.p.h. (63-69 k.p.h.) and 58-64 m.p.h. (93-103 k.p.h.) respectively.
7 At 25 m.p.h. (40 k.p.h.) in 3rd gear, depress the accelerator to the resistance point. The car should accelerate in top gear without a downshift.
8 At 30 m.p.h. (40 k.p.h.) in 3rd gear depress the accelerator past the resistance point. The transmission should downshift to 2nd gear.
9 At 40 m.p.h. (64 k.p.h.) in top gear, select L. Check for 3-2 downshift and engine braking. Check for "roll-out" 2-1 downshift and engine braking.
10 Stop with L engaged, release the brakes and using full throttle accelerate to 20 m.p.h. (32 k.p.h.). Check for slip or clutch break-away noise and no upshift.
11 Stop and select R. Release the brake and reverse using full throttle if possible. Check for slip and/or clutch break-away noise.
12 Stop the car on a gradient facing down hill and select P. Release the brakes and check that the parking pawl will hold the car. Repeat with the car facing uphill.

Converter diagnosis

If the general vehicle performance is below standard, check the stall speed as described later.

Inability to start on steep gradients combined with poor acceleration from rest is an indication that the converter stator one-way clutch is slipping or that the stator support is fractured, this will permit the stator to rotate in an opposite direction to the turbine and so prevent torque multiplication. Check the stall speed and if it is more than 650 r.p.m. below normal the converter assembly must be replaced.

Below standard acceleration in top gear at speeds above 30 m.p.h. (48 k.p.h.) combined with a substantially reduced maximum speed, indicates that the stator one-way clutch has locked in the engaged position. The stator cannot rotate with the turbine and impeller and so the fluid flywheel phase of the converter performance cannot occur. This condition will be associated with severe overheating of the transmission but stall speed will be normal.

A stall speed substantially higher than normal indicates that the converter is not receiving its required fluid supply or that slip is occurring in the clutches of the gearbox. The torque converter is a sealed unit and, therefore, cannot be dismantled, any faults that arise will entail replacement of the complete unit.

Stall speed test

This test provides a rapid check on the correct functioning of the converter as well as the gearbox. The stall speed is the maximum speed at which the engine can drive the torque converter impeller whilst the turbine is held stationary.

As the stall speed is dependant on both engine and torque converter characteristics, it will vary with the condition of the engine and this must be taken into account in order to correctly interpret a low stall speed.

Allow the engine and transmission to attain their normal working temperature, set the handbrake, chock the wheels and apply the footbrake. Start the engine, select L or R and then fully depress the accelerator. Take a quick reading on the revolution counter and release the accelerator.
To avoid overheating, the duration of each stall test must not exceed 10 seconds

Stall speed engine r.p.m.	Condition
1650	Normal
1350—1550	Engine not developing full power
Below 1000	Converter stator free-wheel slipping or stator support fractured
Over 1800	Slip in the gearbox

Fault diagnosis through road test

The following is a comprehensive list of faults which may be shown up when carrying out the road test procedure; the figures shown opposite each fault are the actions required to cure it and details of these will be found under the heading "Remedial Actions" carry out the actions in the sequence shown. It is appreciated that in many cases you will not have the facilities to do the necessary remedial work, nevertheless they are quoted in order to give you some idea of what rectification entails.

Fault	Remedial action
Starter does not operate in P or N	19
Starter operates in all positions of selector	20
Excessive bump when D, L or R are engaged	4,3
If stall speed higher than specified:-	
With slip and break-away noise in L	1,2,3,13,11
With slip and break-away noise in R	1,2,3,13,12
If stall speed lower than specified	Check engine performance
If stall speed 600 r.p.m. lower than specified	21
No drive in D	1,2,3,13,11,16
No drive in D but drive in L normal	1,2,3,16
No drive in D. L and R	1,2,3,13,11,17,16
Delayed or no 1-2 shift	3,14,13,5,6
Slip on 1-2 shift	2,3,5,6,7,13
Delayed or no 2-3 shift	3,14,13,5,6,12
Delayed or no 2-3 shift but normal in R	3,14,13,5,6
Slip or engine run-up on 2-3 shift	2,3,5,13,12
Bumpy gear shifts	3

Drag in D.2 and D.3	8
Drag or binding on 2-3 shift	5,6
Engine does not start through rear wheels	22
Slip, break-away noise or judder on full throttle take off in D	1,2,3,13,11
Loss of performance and overheating in D.3	21
Transmission downshifts too easily	3
Transmission will not downshift	3,13,14
No 3-2 downshift or engine braking	8,9,10
Slip, break-away noise or judder on take off in L	1,2,3,13,11
Transmission upshifts with L selected	1
Slip, break-away noise or judder on take off in R	1,2,3,13,12
Slip but no judder on take off in R	1,2,3,8,9,10
As above but with engine braking available in L	1,2,3
Drag in R	5
No drive in R	1,2,3,8,13,9,10,12
As above but with engine braking available in 1st gear when L selected	1,2,3,13,12
Car not held when P selected	1,15
Screech or whine increasing with engine speed	17
Grinding and grating noise from gearbox	18
Knocking noise from torque converter area	23
D.3 changes to D.2 and immediately back to D3 at high speeds	12

Remedial actions

These actions should be carried out in the order quoted above.

1 Check adjustment of manual linkage.
2 Check level of transmission fluid.
3 Check adjustment of the downshift cable.
4 Reduce the engine idling speed.
5 Check adjustment of the front band.
6 Check the front servo seals and the fit of the tubes.
7 Check the front band for wear.
8 Check the adjustment of the rear band.
9 Check the rear servo seal and fit of the tubes.
10 Check rear band for wear.
11 Examine the front clutch and seals and also the forward sun gear shaft sealing rings. Check that the cup plug in the driven shaft is not leaking or misplaced.
12 Examine the rear clutch valve and seals. Check fit of the tubes.
13 Strip and clean the valve bodies.
14 Strip and clean the governor valve.
15 Examine the parking pawl, gear and internal linkage.
16 Examine the one-way clutch.
17 Strip and examine the front pump and drive tangs.
18 Strip and examine the gear train.
19 Adjust the starter inhibitor switch inwards.
20 Adjust the starter inhibitor switch outwards.
21 Fit new torque converter.
22 Check the drive pin of the rear pump.
23 Examine the torque converter drive plate for cracks or fractures.

Chapter 7 Propeller shaft and universal joints

Contents

Specifications

Universal joints	Hardy Spicer with needle roller bearings.	
Length (dimension "A" in the figures given)	2.4 litre Mk 1 and early Mk 2	3.4, 3.8 litre and 240, 340 *
Cars fitted with synchromesh gearbox only	37 5/8 in (95.55 cm)	36 7/8 in (93.65 cm)
Overdrive model	34 25/32 in (88.35 cm)	34 1/32 in (86.45 cm)
Automatic transmission - front shaft	10½ in (26.65 cm)	10½ in (26.65 cm)
rear shaft	27 7/8 in (70.5 cm)	27 1/8 in (68.9 cm)

* With the introduction of the type 4HA rear axle for the 2.4 litre model with effect from the following chassis numbers, the length of the propeller shaft for 2.4 litre cars are identical with those quoted for the 3.4, 3.8, 240 and 340 models.

	RH Drive	LH Drive
Standard transmission	103511)	
Overdrive models	103507)	125693
Automatic transmission models	103381)	

Consequent upon the introduction of the all-synchromesh gearbox, standard transmission cars are fitted with identical propeller shafts to that used on overdrive models with effect from the following chassis numbers

	RH Drive	LH Drive
2.4 litre	119200	127822
3.4 litre	169341	180188
3.8 litre	234125	224150

1 General description

Drive is transmitted from the gearbox to the rear axle by means of a finely balanced Hardy Spicer tubular propeller shaft. In the case of standard transmission and overdrive models the shaft is in one piece but for automatic transmission models it is split in two halves and is supported at the centre on a rubber mounted bearing.

Fitted to the front and rear, and at the centre for automatic transmission, are universal joints which allow for vertical movement of the rear axle and for movement of the complete power unit on its rubber mountings. Each universal joint comprises a four legged centre spider, four needle roller bearings and two yokes.

For and aft movement of the rear axle is catered for by a sliding spline at the front of the propeller shaft assembly which mates with a corresponding splined extension of the gearbox mainshaft.

The yoke flange of the front universal joint is fitted to the gearbox mainshaft flange with four bolts which, in some cases, may be secured with plain washers, nuts and split pins and in others with self locking nuts and plain washers. A similar arrangement is used to secure the rear yoke flange to the pinion flange on the rear axle.

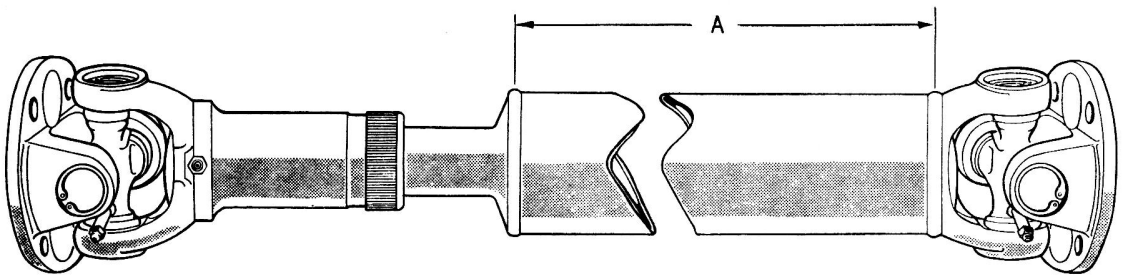


Fig.7.1. Propeller shaft lengths

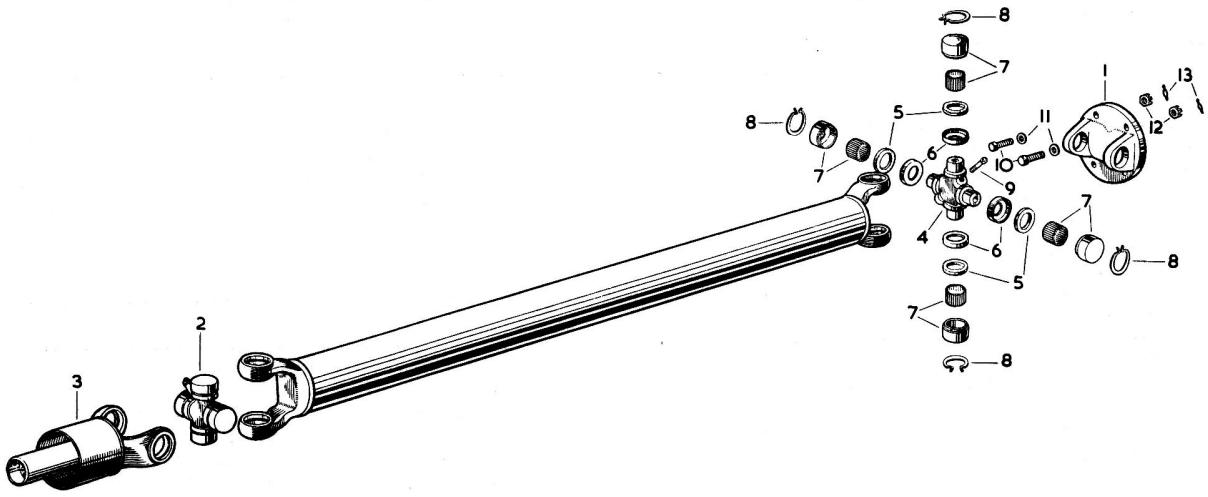


FIG.7.2. EXPLODED VIEW OF PROPELLER SHAFT (STANDARD TRANSMISSION)

1 Flange yoke
2 Journal assembly
3 Sleeve yoke assembly
4 Journal spider
5 Gasket
6 Gasket retainer
7 Needle bearing assembly
8 Circlip
9 Grease nipple
10 Bolt
11 Special washer
12 Slotted nut
13 Split pin

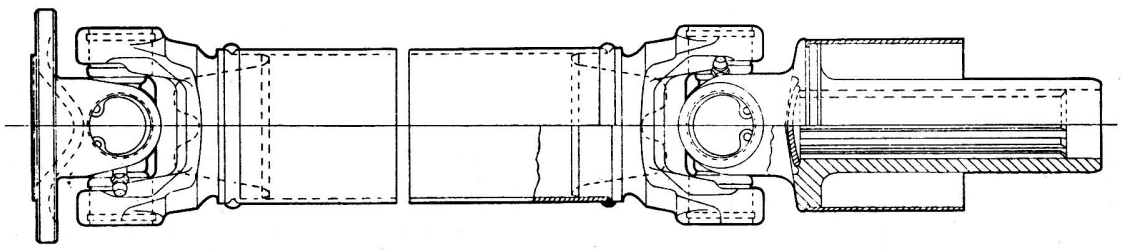


Fig.7.3. Propeller shaft assembly - standard transmission

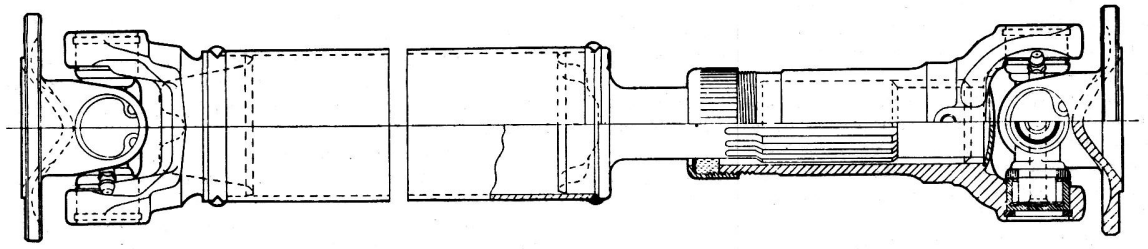


Fig.7.4. Propeller shaft assembly - overdrive model

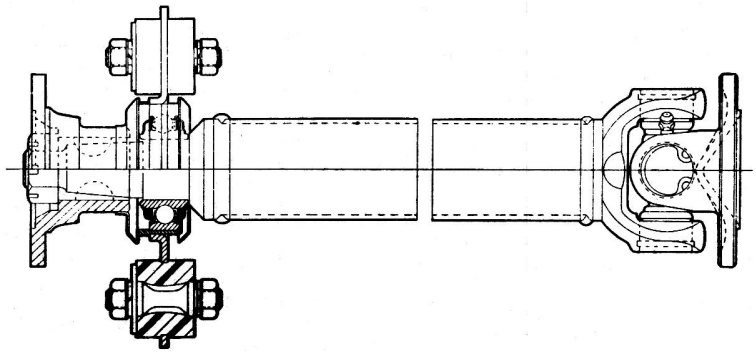


Fig.7.5. Front propeller shaft and centre bearing - automatic transmission

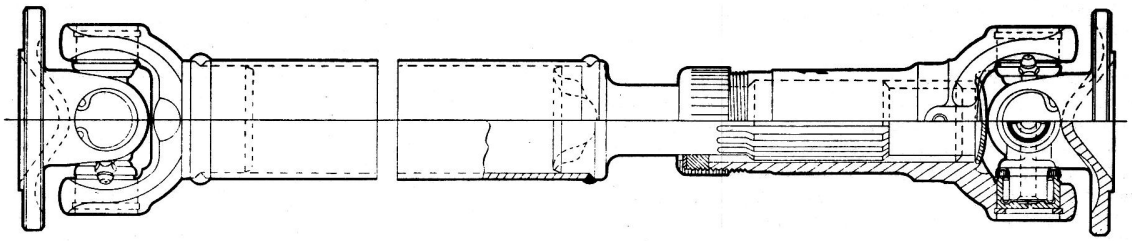


Fig.7.6. Rear propeller shaft - automatic transmission

2 Propeller shaft - removal and replacement

1 Place the car over a pit or raise it, preferably on a ramp, to give access to the propeller shaft. If you have to crawl underneath the car do make sure that it is firmly supported, do not trust the jack alone.
2 One of the rear wheels will have to be raised clear of the ground so that the propeller shaft can be turned to bring the yoke securing bolts into an easy position for removal.
3 Mark the propeller shaft and gearbox or rear axle flanges so that the shaft can be reassembled to the car in its original position.
4 For standard transmission models, remove the four nuts and washers from the bolts attaching the shaft to the rear axle flange. Separate the two flanges and withdraw the propeller shaft from the splines at the rear of the gearbox mainshaft.
5 For overdrive models, remove the nuts and washers from the bolts securing the propeller shaft to the gearbox and rear axle flanges. Compress the sliding joint and remove the propeller shaft.
6 A divided propeller shaft is fitted to automatic transmission models. The rear of the front shaft is supported in a ball bearing housed in a rubber mounted plate. Follow the operation in paragraphs 7 - 17 inclusive to remove the front propeller shaft.
7 Remove the six set bolts securing the ventilated cover plate to the bottom of the torque converter housing.
8 Place a piece of wood under the torque converter housing and make sure that it does not foul the torque converter.
9 Jack under the piece of wood to take the weight of the engine and gearbox.
10 Mark the position of the centre bearing and the rear engine mounting brackets relative to the body floor so that they can be put back in their original positions.
11 Remove the six bolts and the packing washers from the rear engine support bracket. Take special care to note the number and positions of the various packing washers fitted between the bracket and the body floor.
12 Remove the two nuts and shakeproof washers attaching the rear engine support bracket to the two mounting rubbers at the rear of the gearbox.
13 Remove the nuts and washers from the bolts securing the shaft and gearbox flanges, leave the bolts in position for the time being to act as a support for the shaft.
14 Mark the rear flange of the front shaft and the front flange of the rear shaft for reassembly in their original position.
15 Make provision for the support of the front end of the rear shaft.
16 Remove the nuts and washers from the bolts securing the flanges of the front and rear shafts.
17 Remove the two set bolts securing the propeller shaft centre bearing bracket to the body of the car and remove the front shaft. Note the number and position of the shims between the bracket and the body of the car.
18 The rear shaft complete may now be removed by undoing the nuts to the bolts securing the rear axle and shaft flanges, remove the bolts and drop the rear propeller shaft. Alternatively, the front universal joint assembly by itself can be removed by disengaging the sliding joint at the front of the rear shaft.
19 Replacement of the propeller shafts for standard transmission and overdrive models is a straightforward reversal of the removal procedure making sure, of course, that the flanges are mated to their reassembly marks.
20 For reassembly of the shafts to automatic transmission models, first offer up the front shaft flange to the gearbox flange and secure with a bolt and nut.
21 Assemble the centre bearing mounting to the body together with the shims in the positions from which they were removed, and secure with the two set bolts and spring washers.
22 Fit the remaining nuts and bolts at the gearbox flange and tighten down.
23 Secure the rear shaft to the rear axle flange with one nut and bolt and offer the sliding joint flange to the front shaft and secure in position with the four nuts and bolts.
24 Fit the remaining bolts to the rear axle flange and tighten down.
25 Refit the four washers and the two nuts attaching the two rubbers on the rear of the gearbox to the mounting bracket.
26 Place the rear engine mounting in position and refit the set bolts and spring washers with the correct packing washers interposed between the body and the engine rear mounting bracket.
27 Lower the jack from under the converter housing. Replace the cover plate and secure it with the set bolts and spring washers.
28 The alignment of the front and rear shafts must now be checked in case any misalignment has occurred due to disturbing the position of the centre bearing. The alignment must also be checked if the engine has been removed because there is no guarantee that it will go back in exactly the same position as before removal. Misalignment of the propeller shaft will result in transmission judder when taking up the drive from a standing start.

3 Divided propeller shaft alignment

1 Make up a jig to the dimensions shown in Fig.7.7. We made up a jig, using materials ready to hand which did the job admirably. It consisted of a length of wood 3" x 1½" (but any size of wood will do as long as it is not flexible), into the edge of which was knocked three 6" nails, to a depth of about 1", at the spacing shown on the drawing, this meant that the 8" vertical dimension was undersize but clearance proved to be adequate. The nails were checked for vertical alignment and then a straight edge was placed along the heads to make sure that they were aligned in the horizontal plane.
2 Disconnect the engine stabiliser by unscrewing the self locking nut clear of the mounting bracket and then screw down the lower washer until it also is clear of the bracket.
3 Check that the rear engine mounting rubbers are not distorted, rectify if necessary by adjusting in the slotted holes in the rear engine mounting cradle.
4 Refer to Fig.7.8.
5 Offer up the jig to the propeller shaft in the manner shown; for the 3.8 litre model the clearance between the second leg of the jig and the rear ofthe front shaft should be 9/64" (3.6 mm). There would be no clearance on all other models, each leg of the jig should bear evenly on the shaft.
6 Misalignment can be corrected by aiding or subtracting shims between the centre bearing bracket mounting and the body. (See Fig.7.9).
7 Now check that the shafts are in a straight line fore and aft. Place the legs of the jig on the side of the shaft (Fig.7.10), each leg should bear evenly but do make sure, if you use the home made jig described above, that the nails are indeed correctly aligned. As an alternative, drop three plumb bobs, two from the front and one from the rear shaft and sight along the cords.
8 Misalignment in this plane can be corrected by elongating the two holes through which the set screws pass to secure the bracket to the body floor and then adjust the position of the centre bearing bracket as necessary.
9 When satisfied with the alignment of the propeller shafts, adjust the engine stabiliser by screwing the lower flanged washer up the stabiliser pin until the flange contacts the bottom of the rubber mounting. The washer is slotted on its upper face and if it is tight it can be screwed up the pin by engaging a thin bladed screwdriver through the centre hole of the rubber mounting. Now tighten down on the upper flanged washer with the self locking nut.

4 Centre bearing - general description

The centre bearing consists of a ball bearing race pressed into a housing having an oval plate attached. The assembly is mounted at the rear of the front propeller shaft by a flange

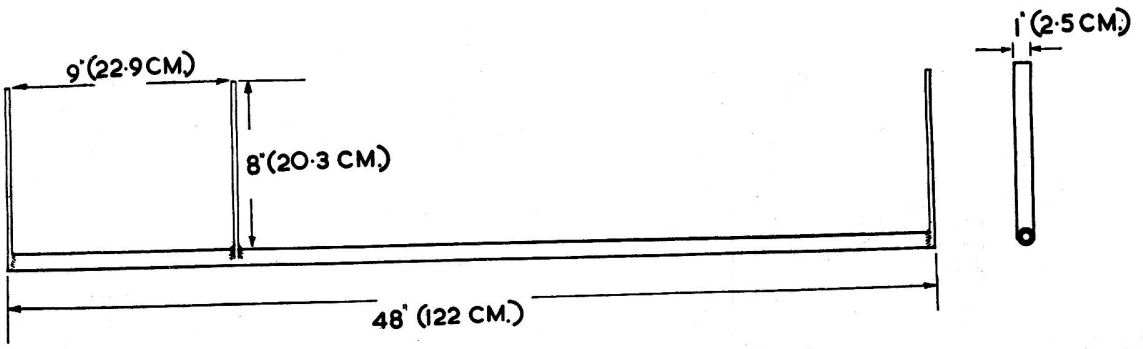


Fig.7.7. Jig for checking alignment of divided propeller shaft

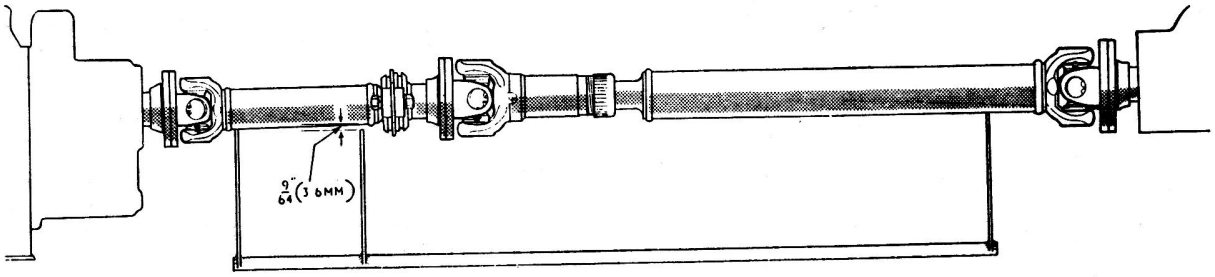


Fig.7.8. Checking vertical alignment of the shaft

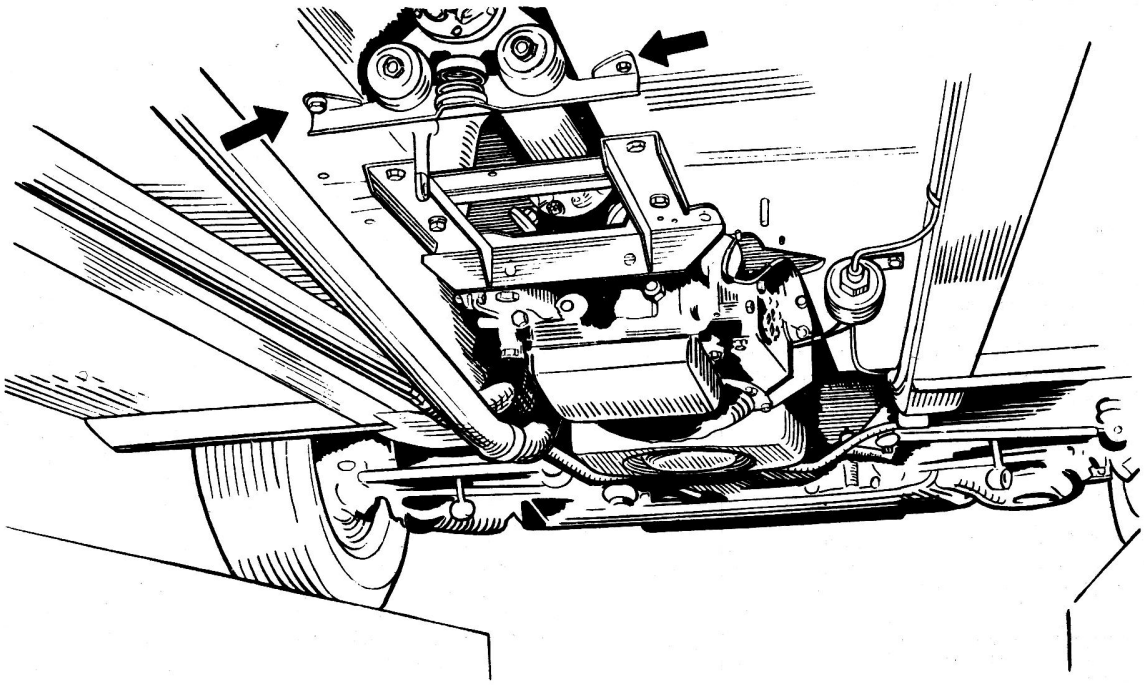


Fig.7.9. Showing location of the adjusting shims

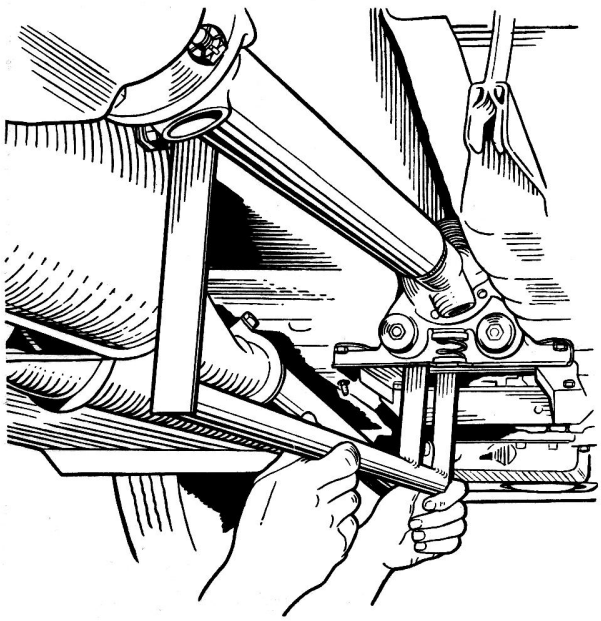


Fig.7.10. Checking horizontal alignment of the shaft

coupling which bolts to the mating flange on the rear shaft. A dust shield is interposed between the housing and the shaft tubing to give protection.

5 Centre bearing - dismantling

1 Remove the front propeller shaft as described in Section 2.
2 The flange coupling is secured on the shaft by a slotted nut and split pin and is retained by two Woodruff keys.
3 Remove the split pin and the slotted nut. Drive the flange coupling off the taper of the shaft and collect the Woodruff keys.
4 Remove the dust shield.
5 Drive the shaft through the bearing and housing and press the bearing out of the housing, and collect the front dust shield.
6 Separate the body mounting from the rubbers by removing the two nuts and spring washers.
7 Press the rubbers out of the oval bearer plate and remove the rubbers from the studs.

6 Centre bearing - overhaul

1 Examine the ball race. Make sure there is no play in the outer cage and clean and re-lubricate with grease as necessary.
2 Check that the rubbers are not perished, renew as necessary.

7 Centre bearing - refitting

1 Refitting is the reverse to the dismantling procedure given in Section 5.
2 The front propeller shaft is refitted to the car as outlined in Section 2 after which the alignment of the shafts must be checked in the manner described in Section 3.

8 Sliding joint - dismantling, overhaul and reassembly

1 Refer to Section 2 and remove the propeller shaft assembly or, in the case of automatic transmission, remove the rear half of the propeller shaft.
2 Where appropriate, roll back the rubber rings attaching the gaiter to the shaft and then slide off the sleeve yoke assembly.
3 Remove the gaiter from the sleeve yoke by detaching the steel ring and then slide the gaiter off the yoke.
4 Your car may be an older model fitted with a knurled dust cap instead of a rubber gaiter. Unscrew the cap to separate the sleeve yoke assembly.
5 The male and female splines can now be cleaned as may be necessary to allow close examination.
6 Check that the shaft and yoke assembly slide freely together, investigate any sign of stiffness which may be due to tightness in the splines resulting from burring, rectify as may be required but be careful not to reduce the overall width of the spline or splines.
7 Visually examine the splines for wear and if they appear to be satisfactory, assemble the yoke to the shaft and check that there is no rotary movement in excess of 0.004" (0.1 mm) between the two items. If there is any wear it will be necessary to replace the assembly.
8 Reassembly is the reverse of the dismantling procedure. However, first grease the splines and then assemble the sleeve yoke on the splines so that the fixed yoke is aligned with the fixed yoke on the shaft, arrows are stamped on the two parts to facilitate alignment (see Fig.7.16).

9 Universal joints - general

1 Wear in the needle roller bearings is characterised by judder and vibration in the transmission on over-run, 'clonks' on taking up the drive, and in extreme cases of lack of lubrication, metallic squeaking and ultimately grating and shrieking sounds as the bearings break up.
2 It is easy to check if the needle roller bearings are worn; with the propeller shaft in position, try to turn the shaft with one hand and with the other hand hold the rear axle flange and repeat this procedure for the other joints. Any movement between the shaft and the front, centre or rear couplings is indicative of bearing failure and/or wear in the spider. The old bearings will have to be discarded and replaced by a new universal joint assembly.

10 Universal joints - dismantling

1 Remove the propeller shaft, or that part of the shaft applicable in the case of a divided shaft, in the manner described in Section 2.
2 Thoroughly clean all dirt from the rings and the top of the bearing surfaces.
3 Remove all the snap rings by pinching with a pair of pliers and at the same time prising out with a screwdriver. If a ring proves difficult to remove it may be because it is jammed by the end of the bearing race so lightly tap the end of the race to relieve the pressure.
4 Hold the joint in the hand and with a hide faced or other type of soft hammer, tap the yoke lug as shown in Fig.7.11. This will cause the top bearing to work outwards until it can finally be removed with the fingers (Fig. 7.12). If the top bearing proves obstinate it can be tapped out from inside (Fig.7.13) with a small diameter punch or piece of bar but be careful you do not damage the bearing if this is not being replaced.
5 Repeat the above procedure for the opposite bearing.
6 The splined sleeve yoke or flange can now be separated from the shaft yoke as depicted in Fig.7.14.
7 Rest the two trunnions which are now exposed, on wood blocks and tap the yoke with a soft nosed hammer to remove the two remaining races.
8 It is now advisable to look carefully at the yoke cross holes. It is a very rare event but these holes have been known to wear to a certain degree of ovality. If this has occurred the defective item will have to be replaced and if it is a fixed yoke on a shaft the complete assembly will have to be renewed.

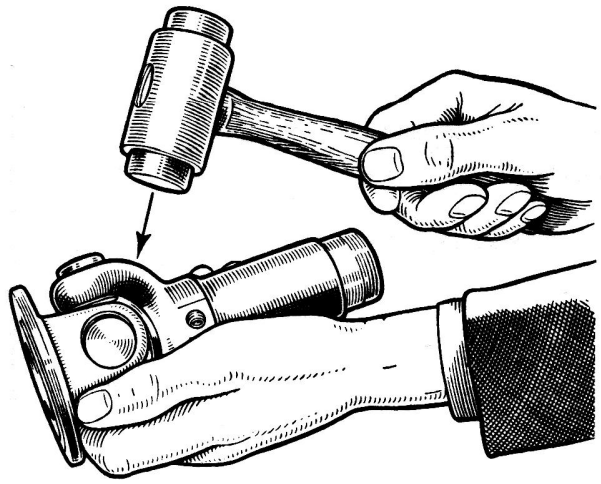


Fig.7.11. Removing a universal joint bearing

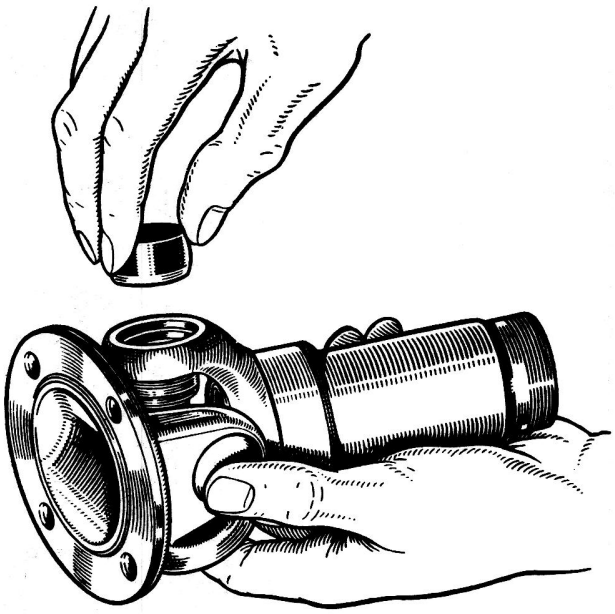


Fig.7.12. Withdraw the bearing

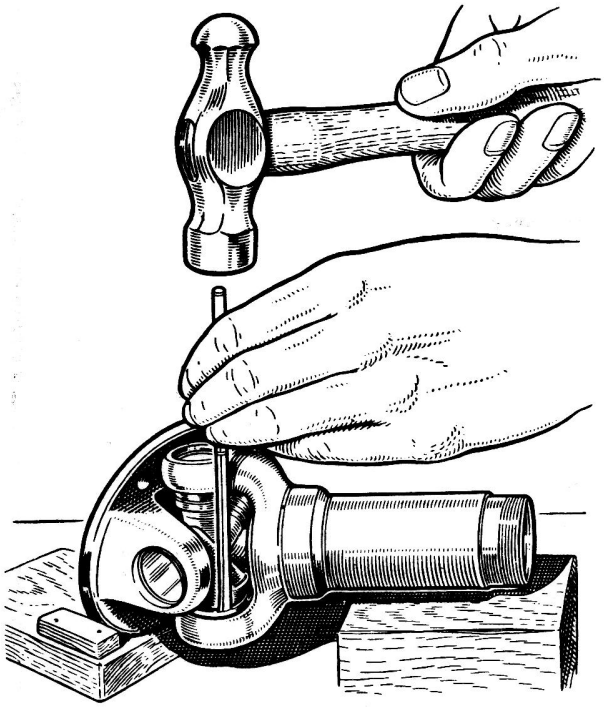


Fig.7.13. Tapping out a bearing

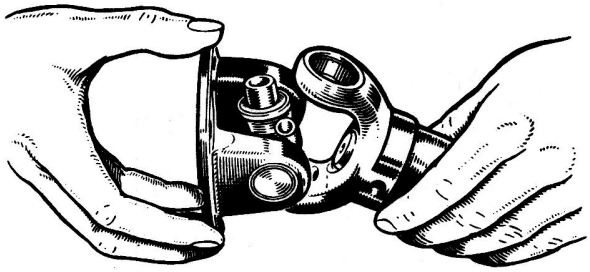


Fig.7.14. Separating the yokes

11 Universal joint - reassembly

1 On early model cars it is advisable to fit new cork gaskets and gasket retainers on the spider using a tubular drift as illustrated in Fig.7.15.

2 It is a good tip to smear the wall of the race with vaseline to keep the rollers in position in the housing for assembly.

3 Insert the spider in the yoke holes, place the bearings in position and then lightly tap it home using a soft flat faced drift slightly smaller than the yoke hole in diameter.

4 Repeat the above for the opposite bearing in the yoke.

5 Fit new snap rings to the bearings and ensure they correctly located in the grooves.

6 Now place the mating yoke in position on the spider and fit the bearings and snap rings in the same manner as described above. It is essential that the sliding joint is refitted with its fixed yoke in line with the fixed yoke at the end of the propeller shaft; arrows are stamped on the two items to facilitate alignment (see Fig.7.16).

7 Make sure that the joint moves freely in all directions, if it appears to bind tap lightly with a wooden mallet to relieve any pressure of the bearings on the end of the spider.

8 Refit the propeller shaft to the car as described in Section2.

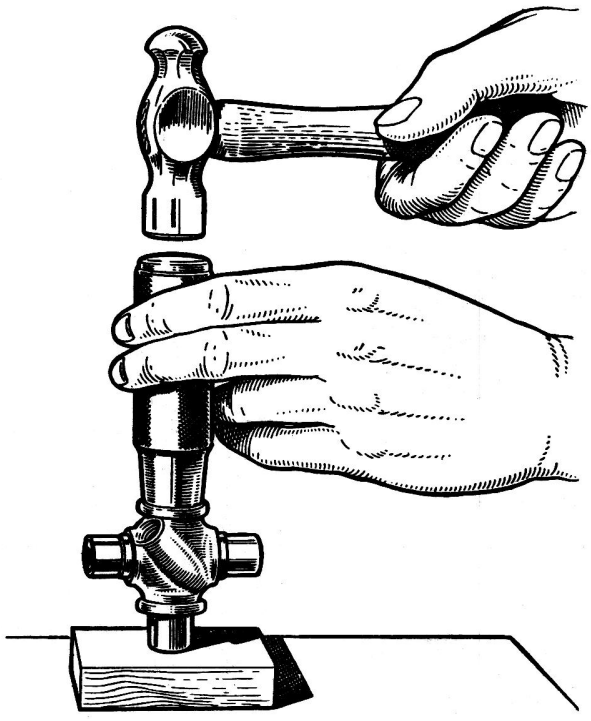


Fig.7.15. Replacing a gasket retainer

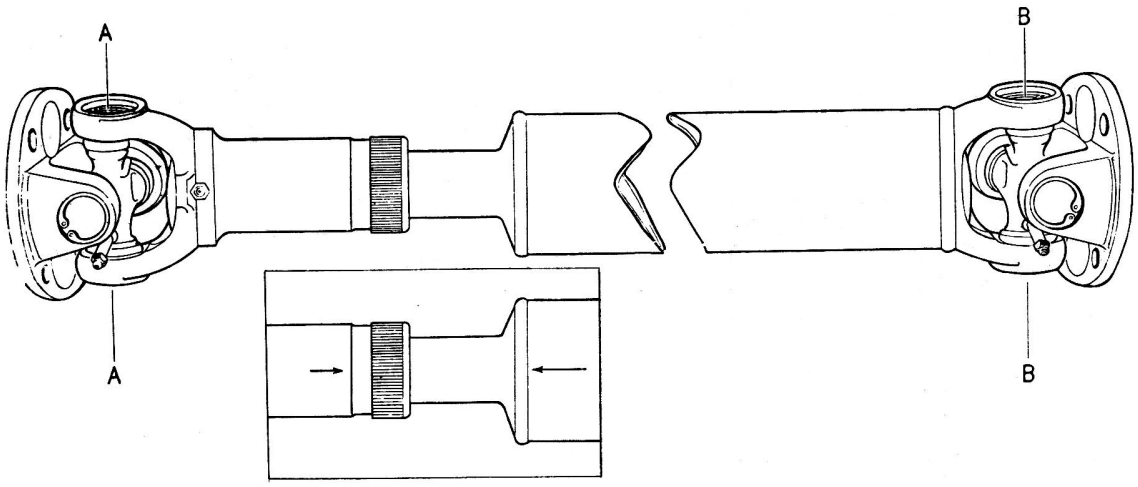


Fig.7.16. Alignment of yokes
A and B fixed yoke must be in the same plane

Chapter 8 Rear axle

Contents

Specifications

Axle shaft endfloat	
Drum brake cars	0.006 to 0.008 in. (0.15 to 0.20 mm)
Disc brake cars	0.003 to 0.005 in. (0.08 to 0.13 mm)
Differential bearing preload	0.005 in. (0.13 mm) shim allowance
Pinion bearing preload	.8 to 12 lbs f in. (0.09 to 0.14 kg f m)
Backlash	As etched on drive gear - minimum 0.004 in. (0.10 mm)

Lubricant capacity	**Imp. pints**	**U.S. pints**	**Litres**
2.4 litre Mk 1 and early Mk 2 with type 3HA axle	2¼	2¾	1.3
All other models fitted with type 4HA axle	2¾	3¼	1.6

Torque wrench settings	
Drive gear bolts:	
3/8 in. (9.5 mm) diameter bolts	50 to 60 lbs f ft (6.9 to 8.3 kg f m)
7/16 in. (11.1 mm) diameter bolts	70 to 80 lbs f ft (9.7 to 11.1 kg f m)
Differential bearing cap bolts	60 to 65 lbs f ft (9.3 to 9.0 kg f m)
Pinion nut	120 to 130 lbs f ft (16.6 to 18.0 kg f m)
Thornton "Powr-Lok" differential bolts	35 to 45 lbs f ft (4.8 to 6.2 kg f m)

Special tools

The following special tools are required for the efficient overhaul of the axle, alternatives, where suitable, are suggested in the text of this Chapter, but your attention is drawn to the note at the end of this Section.

Tool	Churchill tool number
Axle shaft extractor	SL.13
Pinion and differential bearing cone puller	SL.14 with SL.14–1
Gear carrier stretching fixture	S1.1
Pinion bearing cup extractor ... ...)	SL.550–4 with 550 handle
Bearing cup installation tool ... ...)	
Pinion cone setting gauge	SL.3
Pinion oil seal installation collar	SL.4
Rear hub extractor (for disc wheel hubs)	JD.1
Rear hub extractor (for wire wheel hubs)	JD.7
Multi-purpose hand press	SL.14

Note

Full servicing instructions for the rear axle are given in this Chapter but in view of the intricate adjustments and the number of special tools required, we advise that you take advantage of the factory reconditioning scheme and obtain a replacement axle on an exchange basis, if the need arises.

1 General description

All models are fitted with a Salisbury axle, early 2.4 litre cars were equipped with the 3.HA type whilst all other models have the 4.HA type. Both types are basically similar. The rear axle assembly, illustrated in Fig. 8.1 is of the semi-floating type with shim adjustment for all bearings and meshing of the hypoid crown wheel and pinion matched assembly. The axle shafts are splined at their inner ends and engage with splines in the differential side gears whilst the outer ends have tapers to fit the rear wheel hubs to which they are keyed. The hubs are supported on taper roller bearings which are pressed to the axle shafts and located in the ends of the axle tubes. Outward thrust on the wheels is taken by the adjacent hub bearing, inward thrust is transmitted through the axle shafts and slotted axle shaft spacer to the opposite bearing. The 3.8 litre car is fitted with a Thornton "Powr-Lok" differential as standard equipment (optional extra for North America) and is supplied to special order for the 2.4 litre Mk.2 and the 240 model. Cars fitted with this item have a metal tag stamped P/L attached by a rear cover axle bolt. If a tag is not fitted, remove the filler plug and if the differential case can be seen close to the filler hole it can be assumed that a Thornton differential is fitted.

The Thornton "Powr-Lok" differential, an exploded view of which is given in Fig.8.2, is a limited slip differential which differs from the conventional type in that on slippery surfaces it will not allow the wheel with the lesser traction to spin, gain momentum and swerve the car when a dry surface is regained. In turns, the differential applies the major driving force to the inside rear wheel thus improving stability and cornering and under conditions of poor traction it enables the wheel with the better traction to apply the major driving force to the road. Bumps do not adversely affect wheel action when the wheels are controlled by a limited slip differential as the free wheel does not spin and gain momentum and thus there is no sudden wheel stoppage to cause tyre scuffing or to cause the car to swerve.

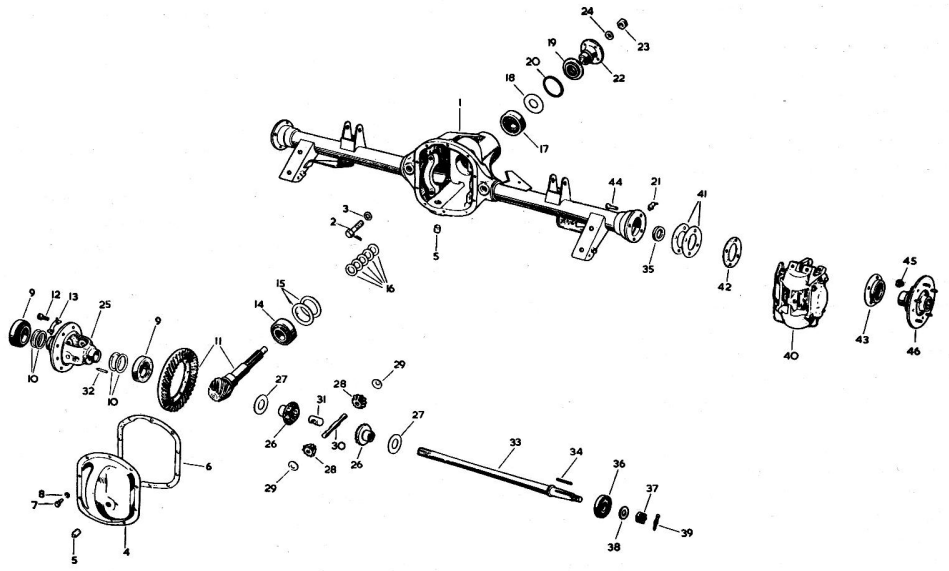


FIG.8.1. EXPLODED VIEW OF THE REAR AXLE (DISC BRAKES)

1 *Carrier and tube assembly*
2 *Setscrew*
3 *Shakeproof washer*
4 *Rear cover*
5 *Drain and filler plug*
6 *Gasket*
7 *Setscrew*
8 *Lockwasher*
9 *Roller bearing*
10 *Shim*
11 *Drive gear and pinion*
12 *Setscrew*
13 *Lock strap*
14 *Roller bearing*
15 *Shim (inner)*
16 *Shim (outer)*
17 *Roller bearing*
18 *Oil slinger*
19 *Oil seal*
20 *Gasket*
21 *Grease nipple*
22 *Universal joint flange*
23 *Nut*
24 *Washer*
25 *Differential case*
26 *Side gear*
27 *Thrust washer*
28 *Differential pinion mate gear*
29 *Thrust washer*
30 *Pinion mate gear shaft*
31 *Spacer*
32 *Pinion mate shaft lock pin*
33 *Axle shaft*
34 *Key*
35 *Oil seal*
36 *Taper roller bearing*
37 *Slotted nut*
38 *Washer*
39 *Split pin*
40 *Rear brake assembly*
41 *Shim*
42 *Gasket*
43 *Retainer*
44 *Bolt*
45 *Self-locking bolt*
46 *Rear hub*

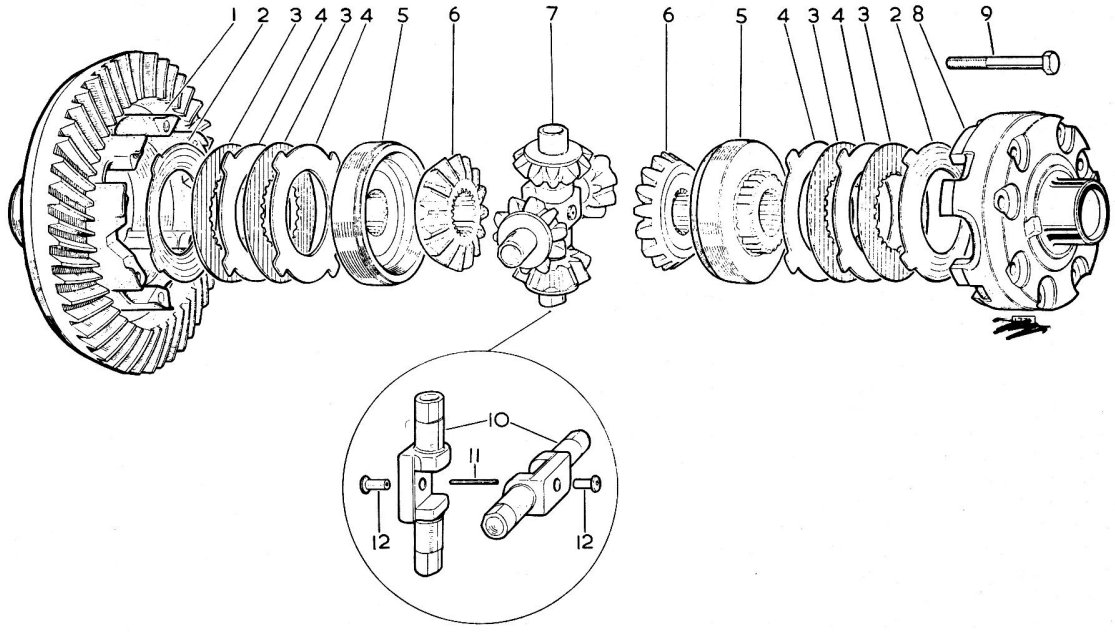


FIG.8.2. EXPLODED VIEW OF THE THORNTON 'POWR-LOK'

1 *Differential casing - flange half*
2 *Dished clutch friction plate*
3 *Clutch friction disc*
4 *Clutch friction plate*
5 *Side gear ring*
6 *Bevel side gear*
7 *Bevel pinion mate gear assembly*
8 *Differential case - button half*
9 *Differential case - screw*
10 *Pinion mate cross shaft.*
11 *Axle shaft spacer roll pin*
12 *Axle shaft spacer*

Because of this, the engine of a car fitted with a Thornton "Powr-Lok" differential must never be run with the car in gear and with one wheel jacked up off the ground otherwise, owing to the action of the differential, the car may drive itself off the jack or stand. If it is desired to run the transmission with the car stationary, both wheels must be jacked up clear of the ground.

2 Rear axle - removal and replacement

1 Chock the front wheels, jack up the car under the rear axle and place substantial blocks at a strong point under the chassis forward of the road spring front mounting.
2 Remove the rear road wheel cover assembly and remove the wheels.
3 Remove the axle drain plug and drain the oil.
4 Release the handbrake. Remove the split pin and plain washer of the clevis pin attaching the handbrake primary cable to the compensator assembly on the rear axle. Remove the clevis pin and detach the cable.
5 Undo the union of the rigid brake hydraulic pipe attaching it to the flexible pipe at the bracket at the right hand side of the body. Allow the fluid to syphon out into a clean container and then tie a piece of rag around the nut and the end of the pipe to prevent ingress of dirt.
6 Hold the nut attached to the flexible pipe at the bracket. Slacken the locknut and remove it, holding the pipe all the time to prevent it turning. Withdraw the pipe from the bracket and tie a piece of rag around the end to prevent the ingress of dirt.
7 Remove the nuts and bolts securing the rear axle pinion flange to the flange of the propeller shaft. Push the shaft forward on its sliding joint away from the pinion flange.Tie the shaft up out of the way at any convenient position on the underbody of the car.
8 Remove the two nuts, the inner and outer washers and the rubber buffers from the damper attachment bracket on the rear axle. Compress the hydraulic damper clear of the axle.
9 Release the torque arm by removing the self locking nuts from the bolts securing the arms to the axle, take off the plain washers and drift out the bolts. To prevent damaging the thread of the bolt, if they prove to be tight it is advisable to have the nut in position to protect the end of the bolt when drifting it out, partially unscrewing the nut as the bolt moves out and then finally finish knocking out the bolt with a punch on its centre.
10 Remove the nuts securing the panhard rod to the axle and withdraw the rubber buffers and washers.
11 A decision must now be made concerning the manner in which you propose to remove the axle. You can either disconnect the exhaust tail pipe(s) at the rear bracket and undo the clamps attaching the pipe(s) to the silencers and remove the tail pipe assembly so that the axle can be dropped straight down after final disconnection. Or you can disconnect the tail pipe(s) at the rear bracket, remove the nuts and bolts attaching the silencers to their brackets on the body and then allow the exhaust assembly to drop down as may be allowed by the flexible section at the front of the pipes but support the pipes so that too much strain is not put on the flexible joints. Use of the latter method means working the axle towards the rear of the car and over the top of the exhaust tail pipes.
12 Lower the axle as far as possible on the jack.
13 Remove the nuts securing the road springs eyebolts and drift out the bolts using the same precautions as advised in paragraph 9 to avoid damage to the thread.
14 The rear axle is now completely disconnected from the car and may either be lowered to the floor or worked out to the rear of the car as applicable.
15 Replacing the rear axle is the reverse of the above procedure but it will be necessary to bleed the brake system as described in Chapter 9 and to check the setting of the panhard rod according to the instructions given in Chapter 11. Not forgetting to replenish the axle with one of the recommended lubricants.

3 Rear axle - dismantling for replacement

Reconditioned axles supplied on an exchange basis are complete less hubs and brake assemblies so these items must be removed before the item is returned.
1 Take out the split pins and remove the clevis pins attaching the handbrake cables to the brake assembly.
2 Remove the two setscrews attaching the handbrake compensator bracket to the rear axle and remove the compensator with the right and left hand brake cables attached.
3 Clean all dirt from the hydraulic pipe unions to the right and left hand brake assembly. Undo the unions and cover the end of the pipes with rag to prevent the ingress of dirt and also plug the connections at the brake cylinders.
4 Remove the nut and bolt securing the 3-way adaptor to the rear axle and remove the adaptor with the two rigid pipes and the flexible pipe attached. Remove the brake pipe clips from the axle.
5 Remove the brake assemblies as described in Chapter 9.
6 Withdraw the split pin and remove the slotted nut securing each hub to the axle shaft.
7 Remove each hub using a suitable extractor, Fig.8.3, (see list of tools under Specifications). It is known that the hub may prove to be extremely difficult to remove and if you cannot shift it with the tools available to you we suggest that you seek expert help.
8 Detach the brake caliper mounting plate from the end of the axle tube by removing the four nuts and bolts.
9 Lift out the key on the axle shaft and store in a safe place.
10 Replacement of items on the new axle is the reverse of the above.

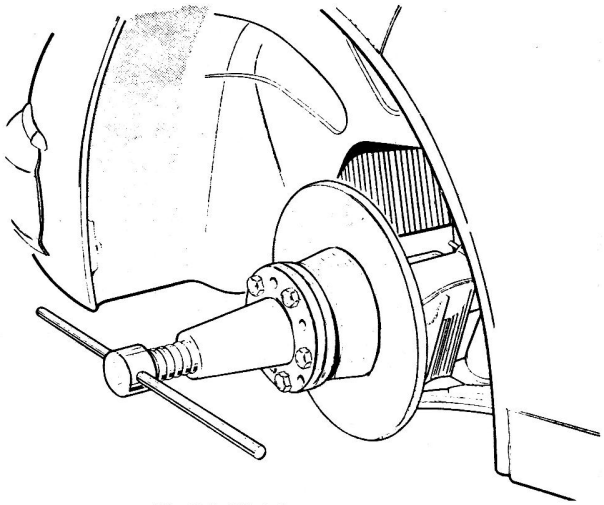


Fig.8.3. Withdrawing the rear hub

4 Axle shaft, bearing and oil seal - removal and replacement

1 Apply the handbrake, chock the front wheels, jack up the rear of the car and take the weight on firmly based axle stands.
2 Remove the rear road wheel cover assembly and remove the wheel.
3 Remove the clevis pin securing the handbrake cable to the brake operating lever.
4 Clean all dirt from the area of the brake hydraulic pipe unions. Disconnect the hydraulic pipes and blank off all unions to prevent the ingress of dirt.
5 Remove the handbrake and foot brake caliper assemblies (disc brakes) or the brake drum, brake shoes and cylinder assembly for those cars with drum brakes, as described in Chapter 9.

6 Remove the split pin and the slotted nut securing the rear hub.
7 Withdraw the hub from the axle shaft using a suitable extractor. (But see Section 3 para.7).
8 For those cars fitted with drum brakes, remove the four nuts and bolts securing the back plate to the end of the axle tube and withdraw the back plate. Note the bearing retainer plate, two gaskets and the oil seal at the front of the backplate and the shims fitted between the back plate and the flange of the axle tube. Do not lose or transpose these shims if the other end of the axle is being worked on, as they control the end float of the axle shaft.
9 For disc brake models, remove the four nuts and bolts securing the brake caliper mounting plate to the end of the axle tube, remove the plate and the oil seal retainer and preserve any shims which may be fitted between the mounting bracket and the axle tube.
10 Remove the key from the axle shaft and put it in a safe place.
11 Withdraw the axle shaft with its taper roller bearing from the end of the axle tube using tool number SL.13 (see special tools under Specification) as illustrated in Fig.8.4. An alternative method of removing the axle shaft is to fit the retaining nut, grip the nut with a mole wrench and pull outwards. If the axle proves stubborn, it can usually be started to move by tapping on the wrench but make sure you do not load the bearing unduly.
12 If a replacement hub bearing is required, withdraw the inner race from the axle shaft using tool number SL.14 with SL.14-1. Alternatively, the bearing may be removed from the shaft by placing the bearing on the top of the jaws of a vice, fit the axle shaft nut to protect the thread and then drive the shaft through the race using a soft faced hammer.
13 Examine the oil seal which is pressed inside the axle tube, if it appears to be satisfactory and no trouble has been experienced with oil leaks, leave it in position as once the seal has been removed it must be replaced with a new item. The seal can be removed by using a piece of metal bar shaped in the form of a hook. Pull on the seal and draw it from the axle tube.
14 Refitting is the reverse of the above procedure, but in addition, the following operations must be carried out.
15 Wash the bearing in clean paraffin to remove all grease. Clean all grease from the bearing retainer, the shims and the face of the axle tube.
16 Assemble the new oil seal, if applicable, and make sure it is bedded down properly.
17 Assemble the bearing to the axle shaft keeping it square on the shaft, push it on to the shaft as far as possible by hand and then, with a piece of tube of suitable diameter against the inner cage, tap it home gently until it is bearing hard against the shoulder on the shaft.
18 Enter the shaft in the axle tube taking care not to damage the oil seal. Taking the weight of the shaft, push it home and rotate in either direction to engage the splines in the differential.
19 Examine the retainer gasket and if there is any doubt as to its condition, fit a new one. We advise that a new item should be fitted as a matter of course.
20 Fit the bolts to the retainer and then place the gasket in position over them followed by the shims. You will find it easier to assemble the retainer in this manner rather than try to line up the thin and flimsy shims with the bolts. Assemble the retainer to the axle tube and tighten down.
21 The end float of the axle shaft must now be checked and this should be 0.006" to 0.008" (0.15 to 0.20 mm) for those cars equipped with drum brakes and 0.003" to 0.005" (0.08 to 0.13 mm) for disc brake models. It will be appreciated that this amount of movement is hardly perceptible by hand and so the only satisfactory method of checking the movement is to use a Dial Test Indicator either clamped to the axle tube as illustrated in Fig.8.5 or attached to it by a magnetic base. Set the indicator to give a reading on the end of the shaft and then move the shaft inwards and outwards and record the range of movement.
22 Add or subtract adjusting shims, which are available in thicknesses of 0.003", 0.005", 0.010" and 0.030" (0.08, 0.13, 0.25 and 0.76 mm), until the correct end float is obtained. Adding shims increases and subtracting decreases, the float, the aim should be to install approximately an equal thickness of shims at each axle shaft in order to maintain the spacer in a central position.
23 When adjustment of the end float is complete, grease the hub bearings via the grease nipple with the recommended lubricant until the grease exudes from the bleed hole.

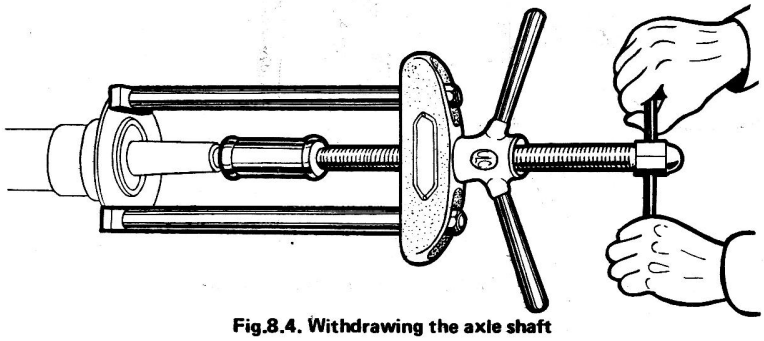


Fig.8.4. Withdrawing the axle shaft

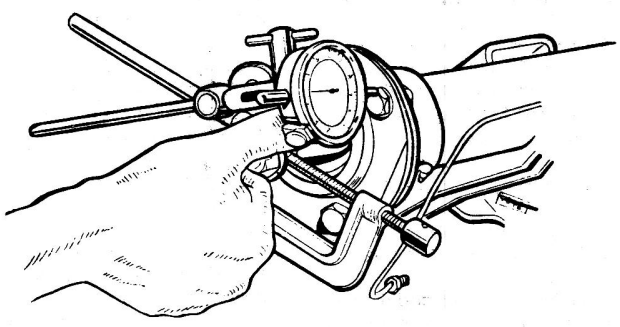


Fig.8.5. Checking end float of the axle shaft

5 Pinion oil seal - removal and replacement

1 Apply the handbrake, chock the front wheels, jack up the rear of the car and support on firmly based axle stands.
2 Mark the relative positions of the pinion and propeller shaft flanges for reassembly in their original position.
3 Remove the four nuts and bolts securing the flanges, push the propeller shaft forward on its sliding spline to disengage the flanges. Tie the propeller shaft up to the underbody out of the way.
4 Make sure that the handbrake is really firmly applied.
5 Remove the split pin locking the nut securing the pinion flange. Remove the nut and plain washer.
6 Place a container under the pinion end of the rear axle to catch any oil which may escape when the pinion flange and oil seal underneath it are removed.
7 Using a universal puller and thrust block, draw the flange off the pinion.
8 The old oil seal may now be prised out using a screwdriver or a thin piece of metal bent into a hook.
9 Fitting the new oil seal and final reassembly is the reverse of the above procedure but the following additional points should be noted.
10 Place the oil seal with the dust excluder flangeuppermost (not forgetting the oil seal gasket used with the metal cased type seal used on later models) in position. Fit the installation collar, Tool number SL.4, fit the pinion nut and washer and then tighten down on the nut to drive the asssembly home as illustrated in Fig.8.6. Remove the nut and washer and the installation collar.
11 Now fit the pinion flange making sure it enters the splines correctly, assemble the plain washer and screw on the nut to a torque of 120 to 130 lbs f ft (16.6 to 18 kg f m).

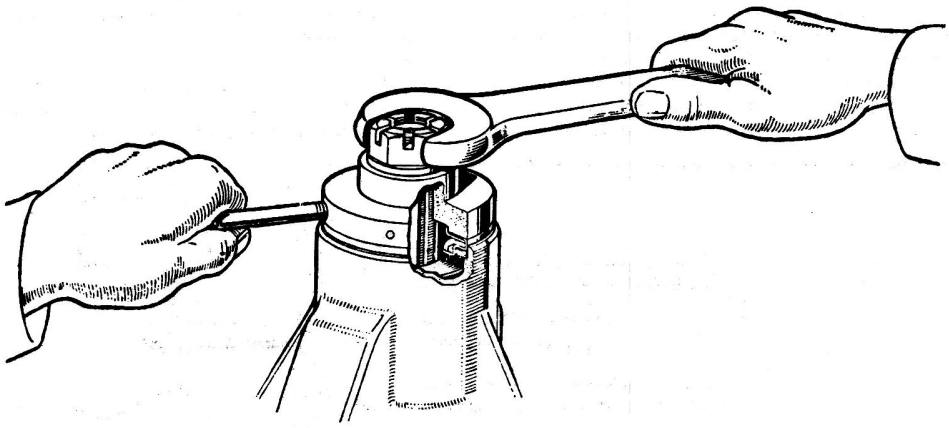


Fig.8.6. Fitting the pinion oil seal

6 Differential assembly (conventional and Thornton "Powr-Lok") - removal

1 Before stripping an axle fitted with a Thornton "Powr-Lok" differential carry out a check for wear in the assembly. With one axle shaft and the pinion locked, the other axle shaft should not turn radially more than ¾" (19 mm) measured on a 6" (152 mm) radius.
2 Remove the rear axle from the car and remove the axle shafts as described in Sections 2 and 4.
3 Take out the ten setscrews, with their spring washers, securing the gear carrier cover and remove the cover and its gasket.
4 Take out the bolts securing the differential caps and remove the two caps after marking them, if necessary, for reassembly to their original positions.
5 It is now necessary to cancel out the differential preload and for this a stretching fixture, Tool No: SL.1, is available. Adjust the fixture to suit the model being worked on and then fit it to the casing as shown in Fig.8.7, open the fixture by means of the turnbuckle until it is hand tight and then use a spanner to take it up a further half turn only, do not exceed this amount otherwise the axle casing will be damaged. The differential assembly may now be prised out using a lever on each side of the differential case opening but use packing between the levers and the gear carrier to prevent damage to the carrier. If a stretching fixture is not available, you will find it possible, although a little more difficult, to prise out the assembly using the levers only but take care not to tilt the assembly and do wedge it more tightly than it is held by the preload.

7 Pinion - removal

1 Take out the split pin locking the pinion nut, remove the nut and the plain washer.
2 Withdraw the propeller shaft companion flange using a suitable puller.
3 Remove the differential assembly as described in Section 6.
4 Press the pinion out of the outer bearing and remove from the gear carrier housing, collect all shims (and the distance washer) and keep them intact as a set. The pinion must not be driven out as this will damage the outer bearing.
5 The pinion oil seal may now be removed together with the oil slinger and the outer bearing cone.
6 If the outer bearing is to be replaced it may be driven out and this also applies to the inner bearing but watch for the pinion adjustment shims fitted between that bearing and the housing abutment face. However, if the inner bearing is to be removed to allow adjustment of the pinion there is no alternative to the use of the correct tool for its removal and installation (Fig.8.8 and 8.9) see list of tools under Specifications).

8 Differential assembly, conventional type - dismantling

1 Refer to Fig.8.10.
2 Tap down the tabs of the locking straps to the crown wheel setscrews and remove the screws and the locking straps.
3 Tap the crown wheel off the differential case using a hide faced hammer.
4 Drive out the pinion mate shaft locking pin. This pin is secured by peening to the case and can only be driven out in one direction as illustrated in Fig.8.11.
5 Remove the axle shaft spacer.
6 Turn the side gears by hand to bring the pinions opposite to

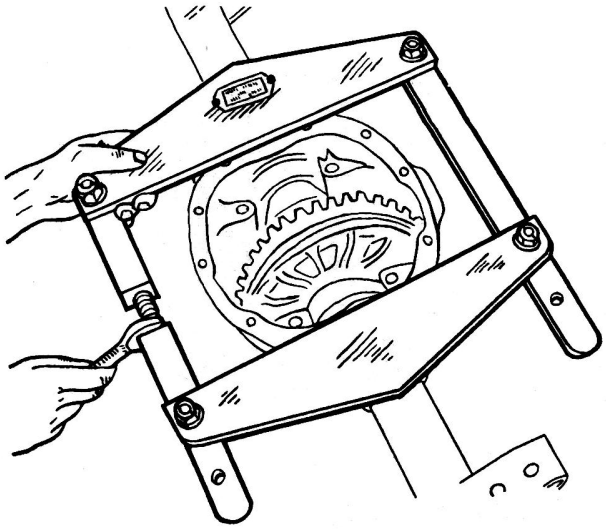


Fig.8.7. Stretching the gear carrier

the openings in the differential case and then remove the differential gears. Be careful not to lose the thrust washers fitted behind the gears.

7 If the setting of the crown wheel is to be adjusted it will be necessary to take out the differential bearings using Tool No: SL.14 and SL.14-1 (see Fig.8.12) in order to get at the shims which are located between the bearing and their mating face on the differential case.

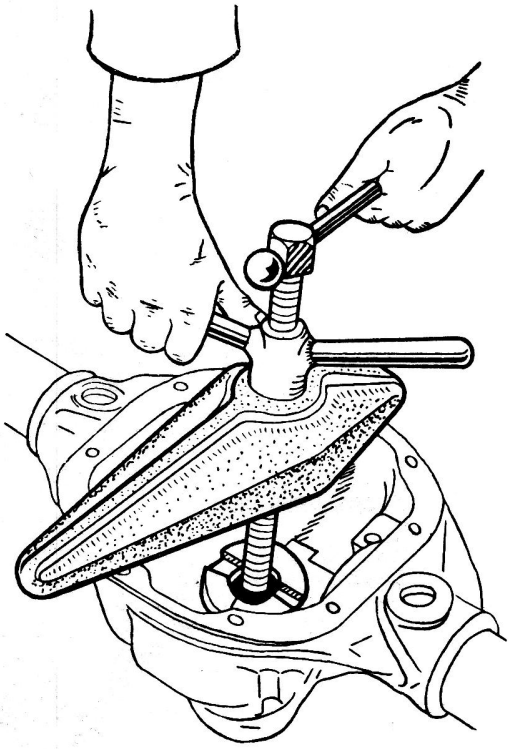


Fig.8.9. Removing the pinion inner bearing cup

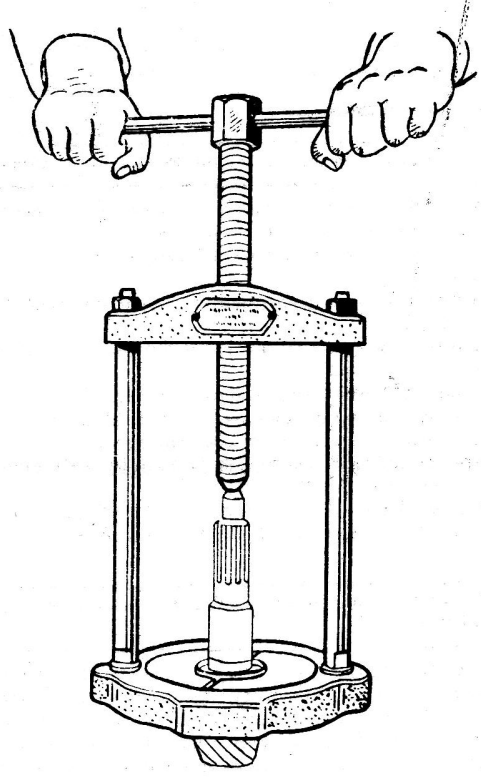


Fig.8.8. Withdrawing the pinion inner bearing

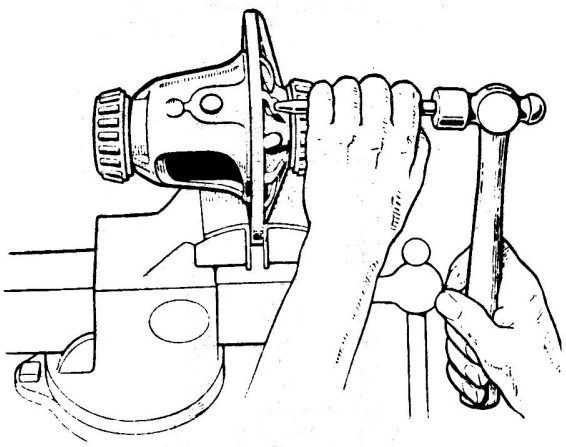


Fig.8.11. Driving out the pinion mate shaft locking pin

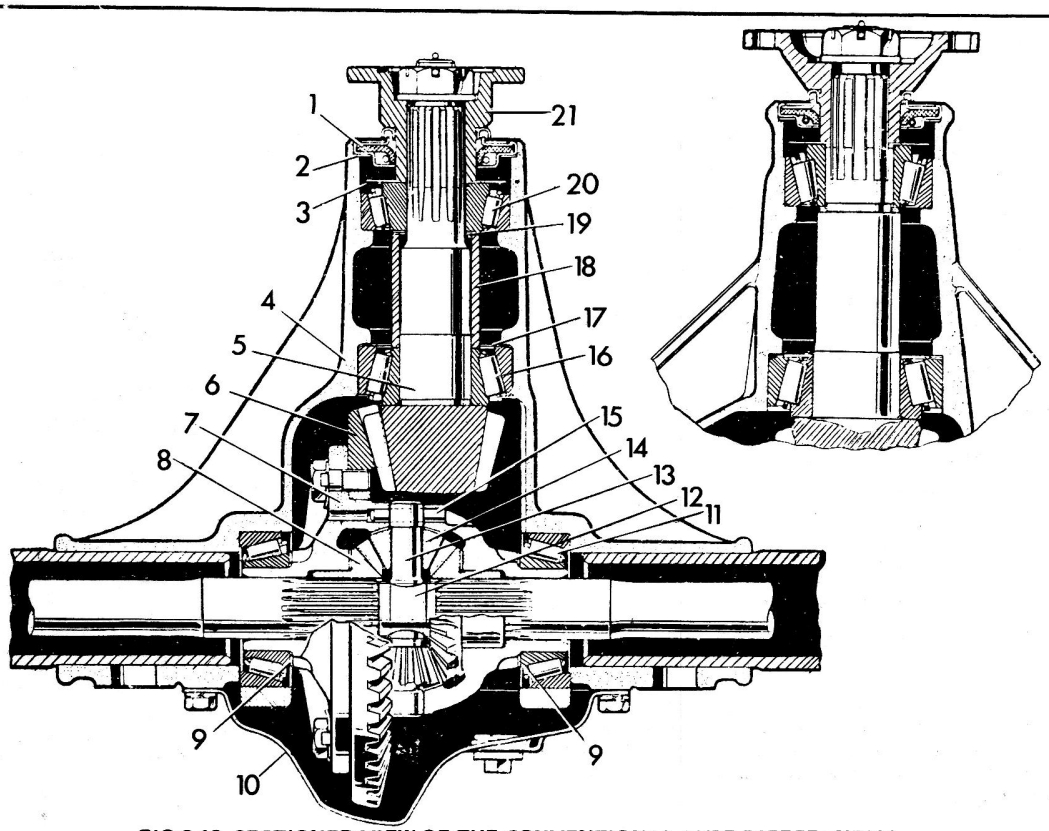


FIG.8.10. SECTIONED VIEW OF THE CONVENTIONAL TYPE DIFFERENTIAL

1 Drive pinion oil seal
2 Drive pinion oil seal gasket
3 Drive pinion oil slinger
4 Gear carrier
5 Hypoid drive pinion) matched
6 Hypoid drive gear) assembly
7 Differential case
8 Differential side gear
9 Differential bearing shim
10 Gear carrier cover
11 Differential bearing
12 Axle shaft spacer
13 Pinion mate shaft
14 Differential bevel pinion mate
15 Pinion mate shaft lock pin
16 Drive pinion bearing (inner)
17 Drive pinion bearing shim (inner)
18 Drive pinion bearing spacer
19 Drive pinion bearing shim (outer)
20 Drive pinion bearing (outer)
21 Universal joint flange

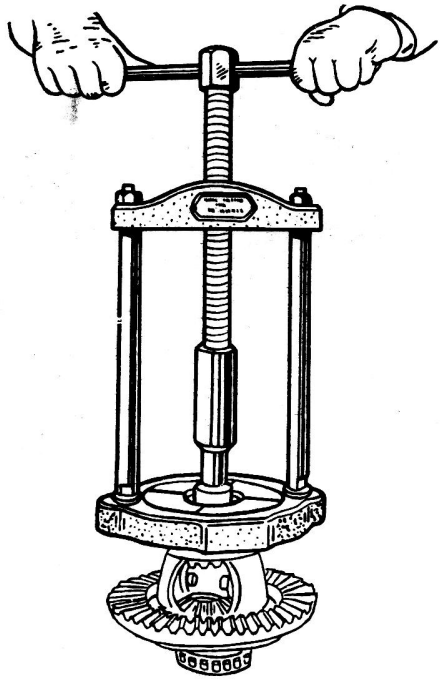


Fig.8.12. Removing a differential bearing

9 Differential assembly, Thornton "Powr-Lok" - dismantling

1 Before dismantling commences, check for mating marks on the two halves of the casing (Fig.8.13). Make your own marks with a centre punch or a scriber if none are visible.
2 Refer to Fig.8.2.
3 Remove the eight bolts securing the two halves of the differential casing.
4 Split the casing and remove the clutch discs (3) and the plates (2) from one side.
5 Remove the differential side gear ring (5).
6 Remove the pinion side gear (6) and the pinion mate cross shafts (7) complete with the pinion mate gears.
7 Separate the cross shafts (10) by extracting the shaft spacers (12) from the spacer roll pin (11).
8 Remove the remaining side gear and the side gear ring.
9 Take out the remaining clutch discs and plates.

10 Differential unit, conventional type - reassembly, adjustment and refitting

1 Assemble the side gears complete with thrust washers.
2 Assemble the differential pinions through the openings in the differential case and mesh them with the side gears. Hold the pinion thrust washers on the spherical thrust faces of the pinions and at the same time turn the differential gear assembly by hand into its operating position.
3 After lining up the pinions and thrust washers, install the pinion mate shaft together with the axle shaft spacer.
4 Align the cross hole in the shaft with the hole in the differ-

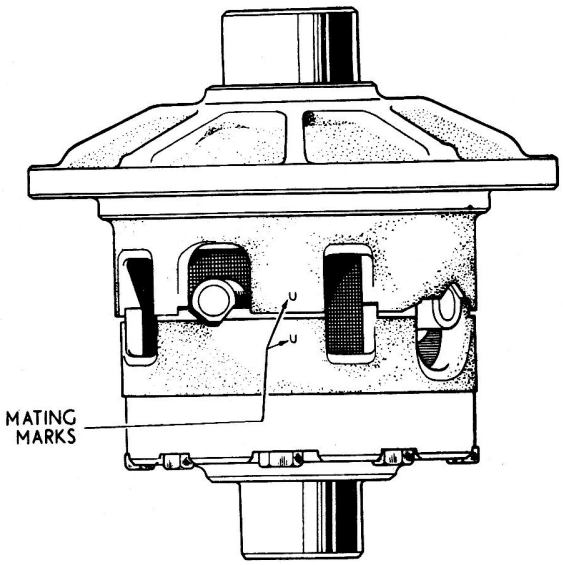


Fig.8.13. Mating marks on the differential case

ential case and fit the pinion mate shaft lock pin. Peen some of the metal of the differential case over the end of the lock pin to prevent it working loose.

5 Clean the mating surfaces of the crown wheel and differential case, carefully examine the faces for burrs and remove as necessary.

6 Line up the crown wheel attachment holes with those in the flange of the case and, keeping it square, gently tap the crown wheel home on the case using a hide faced hammer.

7 Assemble the crown wheel attachment bolts, use new locking straps, and tighten down to a torque of 50 to 60 lbs f ft (6.9 to 8.3 kg f m).

8 Now make sure that the differential bearings, the bearing cones and cups and the seatings in the housing are perfectly clean.

9 Fit the differential bearings, without the shims, on the differential case.

10 Place the differential assembly, with the bearing cups in their housing, in the gear carrier. The pinion must not be in position at this stage.

11 Mount a Dial Test Indicator on the gear carrier as shown in Fig.8.14 in such a position as to take a reading on the back face of the crown wheel. Lever the differential assembly to one side of the carrier and set the indicator to zero at this position.

12 Move the assembly in the opposite direction and note the reading on the indicator, this represents the total clearance between the bearings as now assembled and the abutment faces of the gear carrier housing. Add 0.005" (0.13 mm) to the reading to give the desired degree of preload, the total amount (i.e. 0.005" plus recorded clearance) will be the thickness of shims to be used for installations of the differential bearings. The pack of shims will have to be divided to give the gear position with correct backlash as detailed in paragraph 37.

13 Remove the differential assembly from the gear carrier.

14 If you have removed the pinion outer bearing cup, reassemble it using Tool No: SL.550-4 with handle 550.

15 Refit the pinion bearing inner cup, if removed, complete with the original pack of adjusting shims.

16 Press the inner bearing into position on the pinion using a length of tube contacting the inner cage only.

17 The pinion must now be correctly adjusted and extreme care must be taken to ensure accuracy.

Note: The crown wheel and pinion are a matched assembly, they are lapped together at production and must be kept together as a set. The matched assembly serial number is stamped on the ground end of the pinion and on the crown wheel.

18 Refer to Fig.8.15 which shows typical markings found on the ground end of a pinion. The figures at the top are the matched assembly number; the letter on the left is for production purposes only; the letter and figure on the right refer to the tolerance on offset or pinion drop dimension "A" in Fig.8.16 and this is also stamped on the cover facing of the gear carrier housing. Finally, the figure at the bottom gives the cone setting distance of the pinion from the centre line of the crown wheel and may be marked as Zero (O) or Plus (+) or Minus (-) followed by a figure; the figure represents thousandths of an inch to be added or subtracted from the Zero Cone Setting "B" shown at Fig.8.16.

19 Having assembled the pinion bearing cups with the original inner bearing adjusting shims, place the pinion, with the inner bearing assembled, in the gear carrier.

20 Turn the carrier over and support the pinion with a suitable block of wood.

21 Install the pinion bearing spacer (if fitted).

22 Fit the outer bearing shims on the shank of the pinion so that they seat on the shoulder of the pinion shank or on the spacer as may be applicable for the particular model.

23 Fit the outer bearing, the pinion flange for the propeller shaft and its washer and nut. Leave the oil slinger and the oil seal out at this stage. Tighten down on the nut.

24 The pinion cone setting distance must now be checked using the gauge, Tool No:SL.3, applied as shown in Fig.8.17.

25 Adjust the bracket carrying the indicator to suit the assembly and then set the indicator to zero with the setting block.

26 Place the indicator assembly on the fixed spindle of the gauge body.

27 Fit the fixed spindle of the gauge body into the centre hole in the face of the pinion, slide the moveable spindle into position locating in the centre hole with the gauge body underneath the gear carrier, lock the spindle with the screw.

28 Now check the pinion setting by taking a reading on the differential bore with the bracket assembly seated on the end face of the pinion. The correct reading will be the minimum obtained ie when the indicator spindle is at the bottom of the bore. Slight movement of the assembly will enable the correct reading to be easily ascertained, the reading will be the deviation of the pinion setting from the zero cone setting and note must be taken of the direction as well as the magnitude of any such deviation.

29 If the pinion setting is incorrect (see paragraph 18 and Fig.8.16) you will have to dismantle the pinion assembly to add or remove shims as required from under the bearing cup. Adjusting shims are available in thicknesses of 0.003", 0.005" and 0.010".

30 When the correct pinion setting is obtained, check the pinion bearing preload which should afford a slight drag or resistance to turning and there should be no end play on the pinion. The correct preload is 8 to 12 lbs f in (0.09 to 0.14 kg f m), less than this amount will result in excessive deflection of the pinion under load whilst too much preload will lead to failure of the bearings.

31 To adjust the preload, add or remove shims from between the outer bearing cone and the pinion shank or the spacer, as applicable. Do not touch the shims behind the inner bearing as these control the position of the pinion.

32 The position of the crown wheel must now be adjusted.

33 Place the differential assembly with bearing cups, less shims, in the housing but first make sure the bearing faces, cups and housing are perfectly clean.

34 Mount a Dial Test Indicator on the housing with the indicator button on the back face of the crown wheel as illustrated in Fig.8.14.

35 Lever the differential assembly away from the pinion until the opposite bearing cup is seated against the housing.

36 Now set the indicator to zero whilst bearing on the crown wheel and then move the assembly towards the pinion until the crown wheel is fully meshed with the pinion. The indicator reading at that position denotes the thickness of shims, less the

backlash allowance marked on the crown wheel ie B/L .005, B/L .007 etc, which must be fitted between the differential case and the bearing cone on the crown wheel side of the differential.

37 Install the thickness of shims, determined in the above operation, on the crown wheel side of the differential taking them from the pack determined in the operations at paragraph 12.

38 As an example of differential and crown wheel adjustment, assume that the indicator reading obtained at paragraph 12 is 0.070", add to this 0.005" for the recommended preload which makes the required pack of shims to be 0.075" in thickness. Also assume that the clearance, determined at paragraph 36, between the crown wheel and pinion is 0.040" and that the backlash etched on the crown wheel is 0.005"; subtracting 0.005" from 0.040" gives a figure of 0.035" which is the thickness of shims required to be fitted between the differential case and the bearing cone on the crown wheel side of the differential. Now subtract the 0.035" thickness of shims inserted on the crown wheel side from 0.075" (the total required) and the 0.040" difference is the thickness of shims to be fitted on the opposite side of the case.

39 The differential assembly can now be fitted into position. If you are using the stretching fixture as shown in Fig.8.7, fit it into position to stretch the gear carrier taking care not to exceed the specified half turn on the gear carrier.

40 Lower the differential assembly into position and lightly tap the bearings home using a hide faced hammer and at the same time ensuring that the gear teeth are led into mesh with those of the pinion.

41 It is possible to install the differential by slightly tilting the bearing cups and then tapping them into position with a hide faced hammer. We cannot really recommend this method as it increases the possibility or damage to the gear teeth and extreme care is necessary to avoid damage to the differential bearings.

42 Now fit the differential bearing caps but do ensure that the position of the numerals marked on the gear carrier housing face and the caps correspond as indicated in Fig.8.18.

43 Tighten the bearing cap bolts to a torque of 60 to 65 lbs f ft (8.3 to 9.0 kg f m).

44 The run out on the back face of the crown wheel must now be checked and this is done with a Dial Test Indicator mounted in the same manner as that employed for the differential bearing adjustment (paragraph 12 and Fig.8.14). Set the indicator button against the back face of the crown wheel and turn the pinion by hand and at the same time watch the indicator to see that there is no movement in excess of 0.005" (0.13 mm), if there is, remove and strip the assembly and rectify by cleaning the surfaces locating the crown wheel and make absolutely sure there are no burrs on these surfaces.

45 Now transfer the indicator to give a reading on the teeth of the crown wheel as nearly in line with the direction of tooth travel as possible as illustrated in Fig.8.19. Move the crown wheel by hand to check the backlash which should be in accordance with that etched on the wheel. If the backlash is incorrect, trip the asssembly to transfer the necessary shims from one side of the case to the other in order to obtain the required setting. Transfer shims from the crown wheel side of the differential and install on the opposite side to increase backlash and vice versa.

46 When satisfied with all settings, mark a number of the crown wheel teeth very sparingly with a marking compound, engineer's blue is suitable, and move the painted teeth into mesh with the pinion until a good impression of tooth contact is obtained. Refer to Fig.8.20 and take remedial action as may be necessary.

47 All the necessary adjustments have now been completed and final assembly can commence.

48 Remove the pinion nut, washer and the propeller shaft flange.

49 Install the oil slinger, the gasket as used with the metal cased type seal on later models and the oil seal with the dust excluder flange uppermost using Tool No: SL.4. Fit the installation collar of the tool (Fig.8.6) and then tighten down the pinion nut and washer to drive the assembly home. Remove the pinion nut and washer and the collar of the tool.

50 Fit the propeller shaft flange followed by the washer and pinion nut. Tighten the nut to a torque of 120 to 130 lbs f ft. (16.6 to 18.0 kg f m) and lock it with a new split pin.

51 Fit the rear cover gasket (we advise use of a new item) followed by the rear cover. Secure with the ten set bolts and spring washers but do not forget to replace the ratio/differential type indicator tag on one of the bolts.

52 Refit the axle shaft and hub bearings etc as described in Section 4.

53 Refit the drain plug.

54 Grease the hub bearings through the grease nipple on the axle case with a recommended lubricant.

55 Check for oil leaks after filling the axle with the appropriate quantity of lubricant and rectify as necessary.

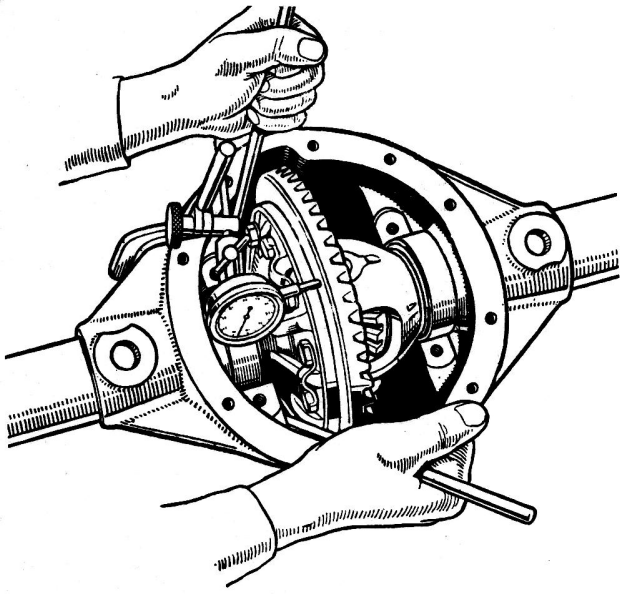


Fig.8.14. Adjusting the differential bearings

Fig.8.15. Markings on pinion

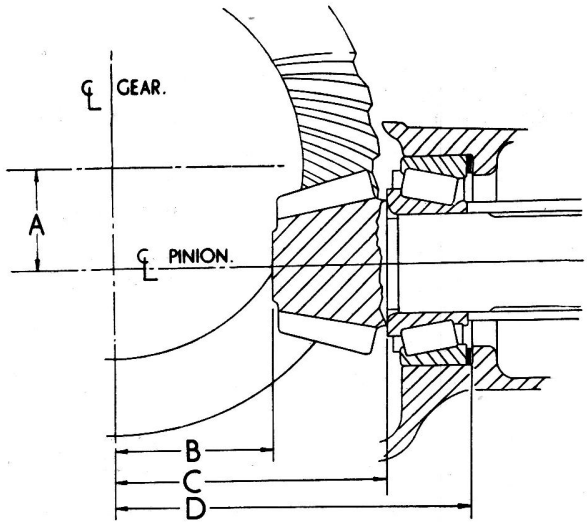


FIG.8.16. PINION SETTING DISTANCES

		3 HA Axle	4 HA Axle
A	*Pinion drop*	*1.375" (34.92 mm)*	*1.5" (38.1 mm)*
B	*Zero cone setting*	*2.250" (31.75 mm)*	*2.625" (66.67 mm)*
C	*Mounting distance*	*3.937". (100.00 mm)*	*4.312" (108.52 mm)*
D	*Centre line to bearing housing*	*5.120" (130.05 mm) to 5.130" (130.30 mm)*	*5.495" (139.57 mm) to 5.505" (139.83 mm)*

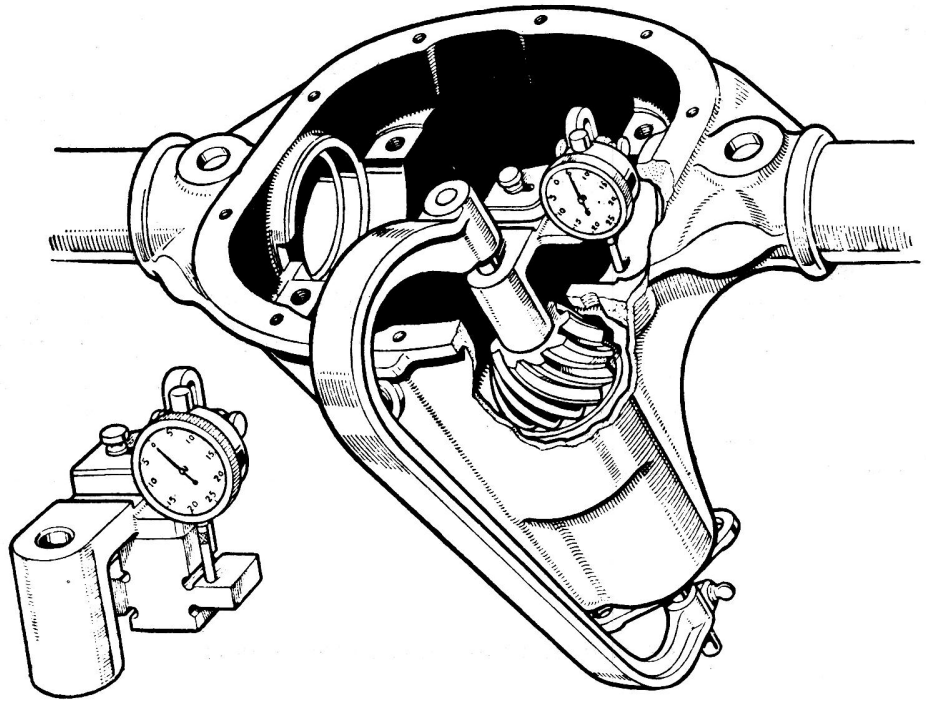


Fig.8.17. Checking the pinion cone setting

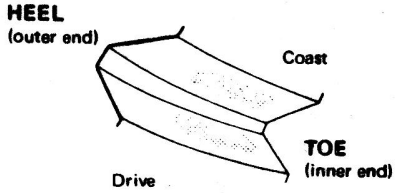
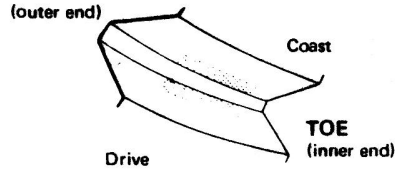
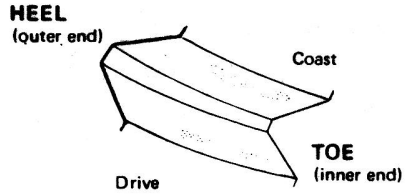
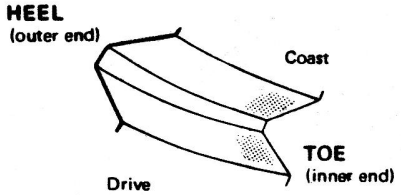
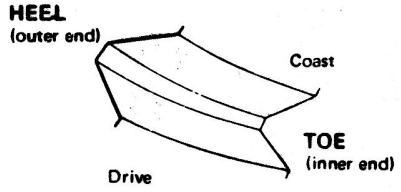
	'TOOTH CONTACT' (CROWN WHEELS)	CONDITION	REMEDY
A		**IDEAL TOOTH CONTACT** Evenly spread over profile, nearer toe than heel.	o — o
B		**HIGH TOOTH CONTACT** Heavy on the top of the drive gear tooth profile.	Move the DRIVE PINION DEEPER INTO MESH. i.e., REDUCE the pinion cone setting.
C		**LOW TOOTH CONTACT** Heavy in the root of the drive gear tooth profile.	Move the DRIVE PINION OUT OF MESH. i.e., INCREASE the pinion cone setting.
D		**TOE CONTACT** Hard on the small end of the drive gear tooth.	Move the DRIVE GEAR OUT OF MESH. i.e., INCREASE backlash.
E		**HEEL CONTACT** Hard on the large end of the drive gear tooth	Move the DRIVE GEAR INTO MESH i.e., DECREASE backlash but maintain minimum backlash as given in "Data"

FIG.8.20. CONTACT MARKINGS ON CROWN WHEEL

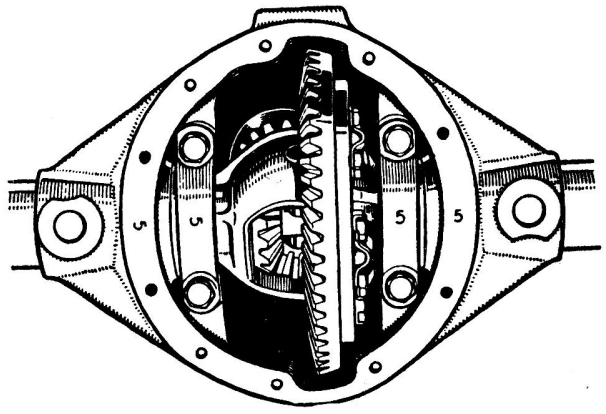


Fig.8.18. Markings on differential bearing caps

11 Differential unit Thornton "Powr-Lok" type - reassembly, adjustment and refitting

1 Refit the clutch plates and discs alternatively into the flange half of the casing (Fig.8.21).
2 Fit the side gear rings so that the serrations on the gear mesh with those in the two clutch discs.
3 Place one of the side gears into the recess of the side gear ring so that the splines are both in line.
4 Fit the cross shafts both at the same time.
5 Use a new spacer roll pin, attach one axle shaft spacer to it and enter them through the hole in the cross shafts. Now press the other spacer on to the roll pin.
6 Refit the pinion mate cross shafts complete with their gears and ensure that the ramps on the shafts coincide with the mating ramps in the differential case.
7 Assemble the remaining side gear and side gear ring so that the splines are in alignment.
8 Fit the remaining clutch plates and discs to the side gear ring.
9 Check the alignment marks on the two halves of the differential case and offer up the bottom half to the flange half and position the tongues of the clutch friction plates so that they align with the grooves in the differential case.
10 Assemble the eight securing bolts but do not tighten down at this stage.
11 Check the alignment of the splines in the side gear rings and side gears by inserting the axle shafts and whilst they are in position, tighten the eight bolts to a torque of 35 to 45 lbs f ft (4.8 to 6.2 kg f m). If the bolts are tightening without the axle shafts in position it will be difficult, if not impossible, to enter them later.
12 The bearing preload and crown wheel and pinion adjustments for this type of differential are exactly the same as set out in Section 10 for the oonventional type of differential.
13 Fit the rear cover gasket (we advise use of a new item) followed by the rear cover. Secure with the ten set bolts and spring washers but do not forget to replace the ratio/differential type indicator tab on one of the bolts.
14 Refit the axle shaft and hub bearings etc; as described in Section 4.
15 Refit the drain plug.
16 Grease the hub bearings through the grease nipple on the axle case with a recommended lubricant.

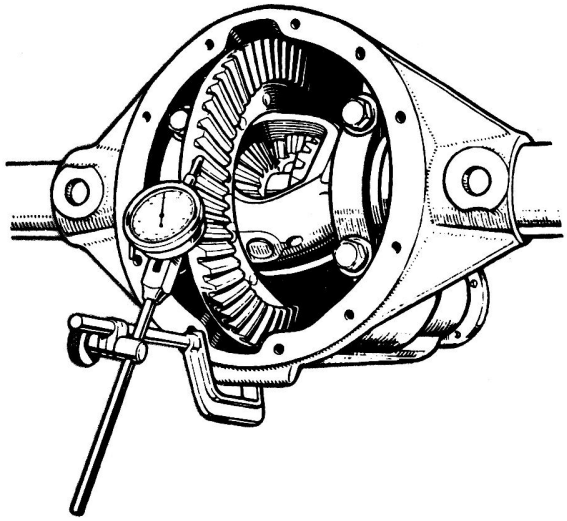


Fig.8.19. Checking backlash between the gears

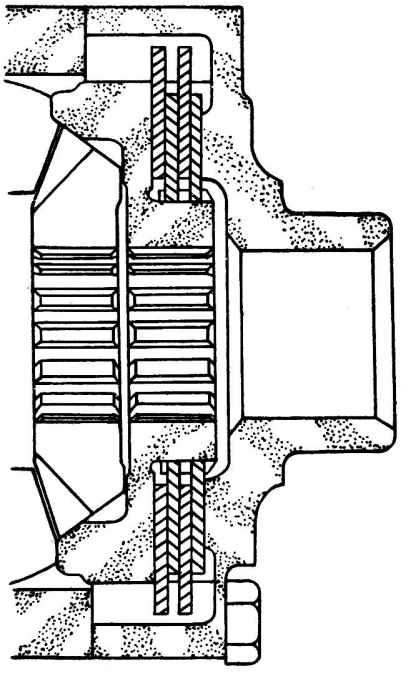


Fig.8.21. Sectioned view showing friction discs and plates

Chapter 9 Braking system

Contents

Specifications

Make	
Early cars	Lockheed 'Brakemaster'
Later cars	Dunlop
Type	
Early cars	Drum type
Brake drum diameter	11.1/8 in. (28.25 cm)
Brake linings	
Length	8½ in. (21.6 cm)
Width	2¼ in. (57.1 mm)
Thickness	¼ in. (6.3 mm)
Material	Ferodo MS3
Identification	2 blue and 2 yellow paint stripes on edge of lining (must be fitted to all four brakes, this material replaces Ferodo DM52 originally used)
Later cars	Disc type
Disc diameter	
Front	11 in. (27.9 cm)

Rear	11.3/8 in. (28.9 cm)
Main friction pad	
Material	Mintex M.33
Handbrake friction pad	
Material	Mintex M.34
Servo unit type	Lockheed 5½ in. up to chassis numbers:—
	RH drive LH drive
2.4 litre	909060 942676
3.4 litre	971731 987405
	Lockheed 6.7/8 in. all other models.

1 General description

The braking system comprises a master cylinder operated by the brake pedal, a vacuum servo unit connected to the inlet manifold and self adjusting front and rear brake assemblies.

The drum type system illustrated in Figs. 9.1 and 9.2, consists of a leading and trailing shoe which are of the internally expanding type whereby the shoes are moved outwards into contact with the rotating brake drum. One wheel cylinder per drum is provided but that of the front assembly is a differential area wheel cylinder so arranged that it applies greater thrust to the trailing shoe than to the leading shoe and so overcomes the inherent inefficiency of the trailing shoe, improves braking performance and ensures reasonably even wear on both shoes.

The disc type brake, illustrated in Figs. 9.3 and 9.4 comprises a disc mounted on the wheel hub and a braking unit (caliper) rigidly fixed to the front suspension member or to the rear axle as the case may be. The braking units are of fixed caliper design, each half of the caliper containing a piston which operates in a bore, both being interconnected so that under hydraulic pressure their pistons move towards each other and by this action bear on the rotating disc between two friction pads. The method of self adjustment is illustrated in Fig. 9.5 and a layout of the whole system is shown at Fig. 9.6.

Both drum and disc type systems are fitted with an independant mechanical handbrake unit operating on the rear wheels. The handbrake operates the brake shoes in the drum type system but for disc brakes it is entirely separate from the main brake assembly and has its own calipers and friction pads. The handbrakes of later cars fitted with disc brakes are self adjusting to compensate for friction pad wear.

The vacuum servo unit provides a degree of assistance when applying the footbrake and is installed in the hydraulic system between the master cylinder and the wheel cylinders. It consists of a servo piston, a hydraulic slave cylinder and an air control valve. Power for its operation is supplied by matching atmospheric pressure against partlal vacuum from the inlet manifold.

2 Bleeding the hydraulic system

Whenever the brake system has been overhauled to the extent of disconnecting a hydraulic union, or the level of hydraulic fluid in the reservoir becomes too low, air will have entered the system and bleeding (expelling the air) will be necessary. During the following operations, the level of fluid in the reservoir should not be allowed to fall below half full, otherwise air will be drawn into the system again. The recommended brake fluid is Castrol Girling Universal Brake and Clutch Fluid. This conforms to SAE 70 R3 and where this is not available, only fluid guaranteed to conform to that specification should be used.

1 Obtain a clean and dry glass jar, a length of plastic tubing of suitable diameter to fit tightly over the bleed screw, and a supply of hydraulic fluid.

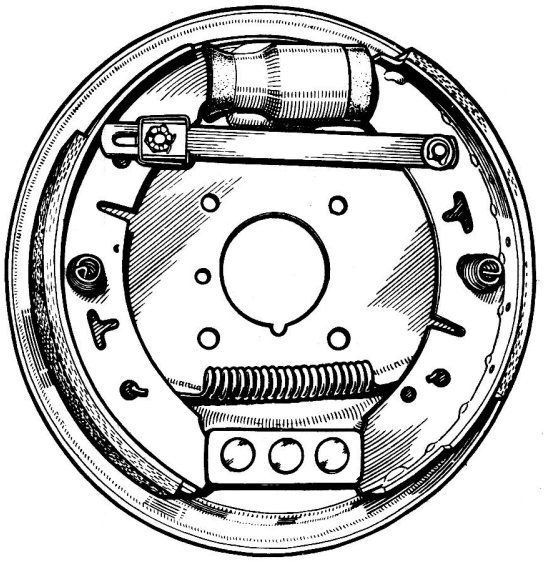


Fig.9.1. Drum brake front left hand (right hand similar but opposite way round)

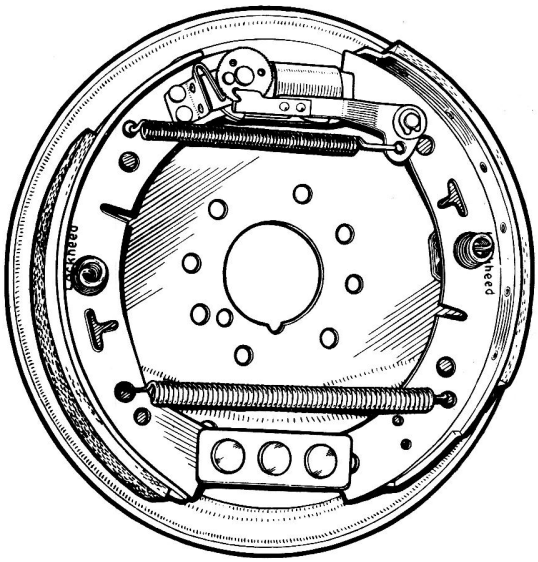


Fig.9.2. Drum brake rear left hand (right hand similar but opposite way round)

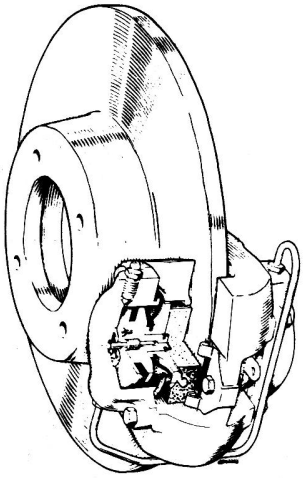


Fig.9.3. Sectioned view of the front disc brake

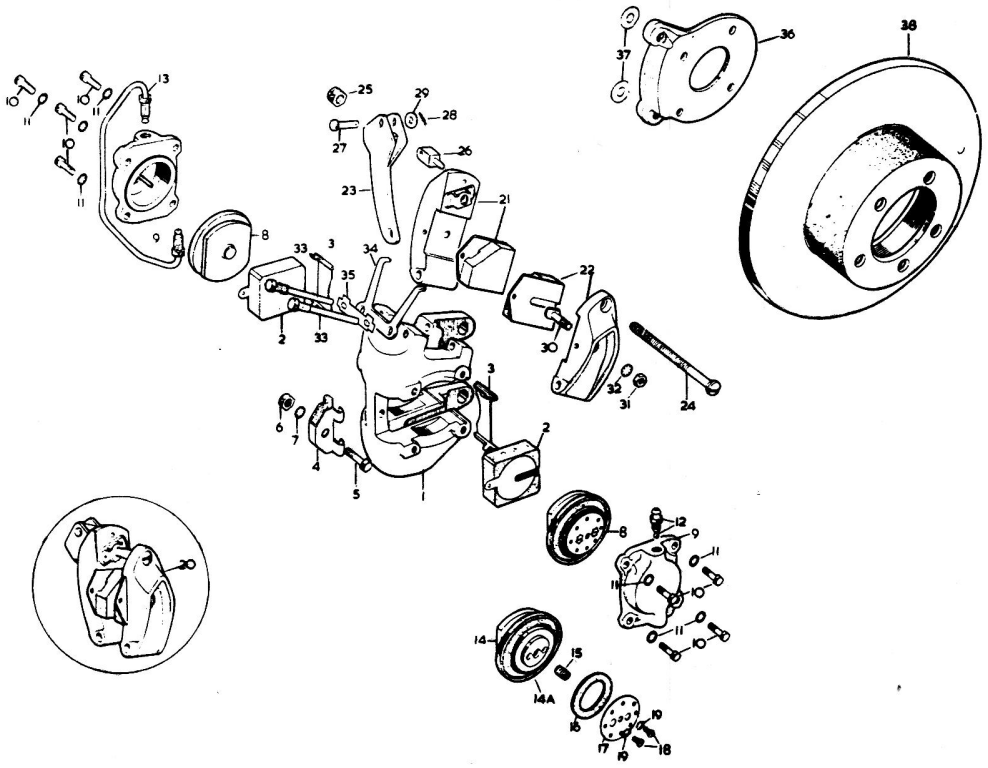


FIG.9.4. EXPLODED VIEW OF TYPICAL REAR DISC BRAKE CALIPER ASSEMBLY

1 *Brake caliper body*
2 *Friction pad*
3 *Support plate*
4 *Retaining plate*
5 *Retaining bolt*
6 *Nut*
7 *Shakeproof washer*
8 *Piston assembly*
9 *Cylinder block*
10 *Cylinder bolt*
11 *Shakeproof washer*
12 *Bleed screw and ball*
13 *Bridge pipe*
14 *Piston and backing plate*
14a *Rubber dust excluder*
15 *Retractor bush*
16 *Piston seal*
17 *Piston seal plate*
18 *Screw*
19 *Shakeproof washer*
20 *Handbrake pad carriers*
21 *Inner pad carrier and friction pad*
22 *Outer pad carrier and friction pad*
23 *Operating lever*
24 *Adjuster bolt*
25 *Self-locking nut*
26 *Pivot seat*
27 *Clevis pin*
28 *Split pin*
29 *Washer*
30 *Handbrake friction pad securing bolt*
31 *Nut*
32 *Shakeproof washer*
33 *Pivot bolts*
34 *Retraction plate*
35 *Tab washer*
36 *Caliper mounting plate*
37 *Caliper centring shim*
38 *Brake disc*

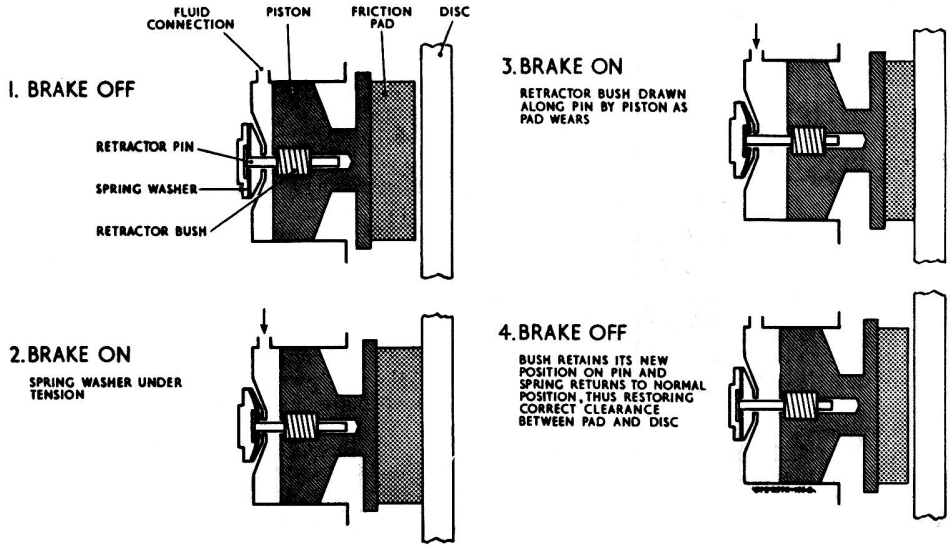


Fig.9.5. Self adjusting mechanism - disc brakes

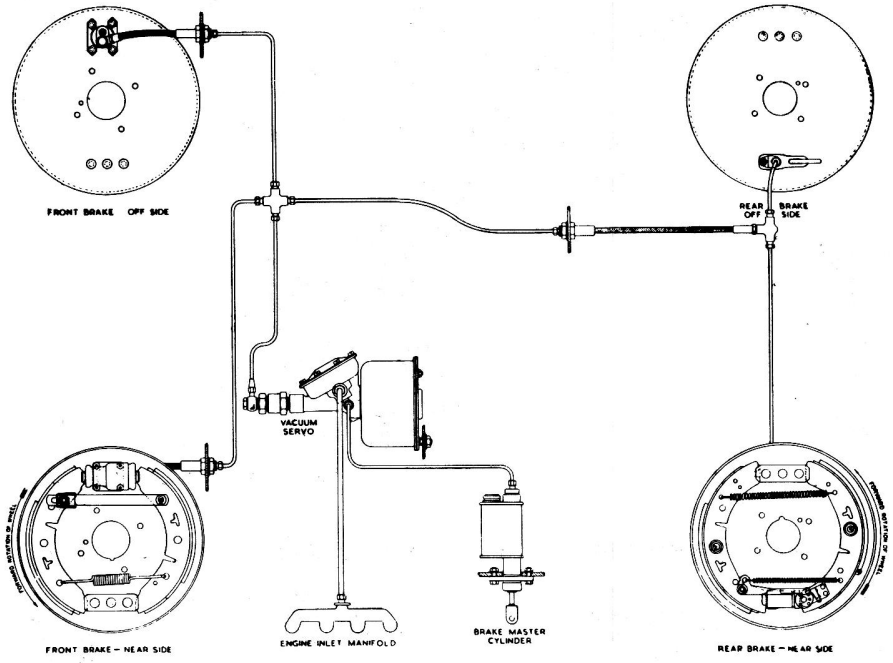


Fig.9.6. Layout of drum brake system (disc system similar except for connection at wheels)

2 Fill the master cylinder reservoir and the bottom inch of the jar with hydraulic fluid. Take extreme care that no fluid is allowed to come into contact with the paintwork as it acts as a solvent and will damage the finish.
3 Place the car over a pit or alternatively jack up each wheel to be worked on, in turn, commencing with the front nearside wheel. Ensure that the wheels are firmly chocked and that the raised wheel is adequately supported, preferably on an axle stand. Release the handbrake.
4 For those cars fitted with drum brakes, observe the position of the bleeder screws in the front brake assemblies; if they are not on the centre line it will be necessary to remove the road wheel and brake drum. Now remove the circlip securing the adjuster bar at one end and prise the bar off the anchor pin to allow the pull-off spring to close the pistons. Now clamp the brake shoes in same manner, wiring is recommended, to prevent the wheel cylinder pistons moving outwards when the brake pedal is depressed during the bleeding operation.
5 Remove the rubber dust cap (if fitted) from the bleed screw of the wheel being worked on, clean the bleed screw, and slide one end of the plastic tube over the screw and insert the other end of the tube in the jar of fluid. The location of the bleed screw on the disc brake caliper is shown in Fig. 9.7.
6 Use a suitable open ended spanner and unscrew the bleed screw about half a turn.
7 Have an assistant to depress the brake pedal slowly, allowing it to return and repeat the pumping action with a slight pause between each depression.
8 Watch the flow of fluid in the jar and when air bubbles cease to emerge with the next down stroke of the pedal hold the pedal at the bottom of its stroke and tighten the bleed screw when the pedal is in that position.
9 If it was found necessary to remove the front brake drums etc., as detailed in paragraph 4, remove the clamps from the shoes and reconnect the adjuster bars to the anchor pins and secure with the circlip. Refit the brake drum and the road wheel and now pump the brake pedal a few times in order to take up the adjustment.
10 Repeat the foregoing operations (where applicable) for all four wheels.
11 An illustration of the set up for bleeding the brakes (drum type brake illustrated) is given.
12 If after the above operation, the brake pedal still feels spongy, this is an indication that there is still air in the system or that the master cylinder is faulty and should be overhauled as detailed later in this Chapter.
13 Check and top up the reservoir with fresh hydraulic fluid. Never re-use once used old brake fluid.

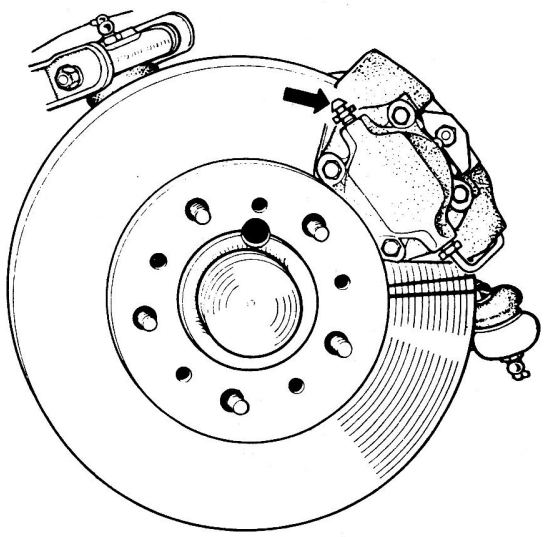


Fig.9.7. Location of bleed screw - disc brakes

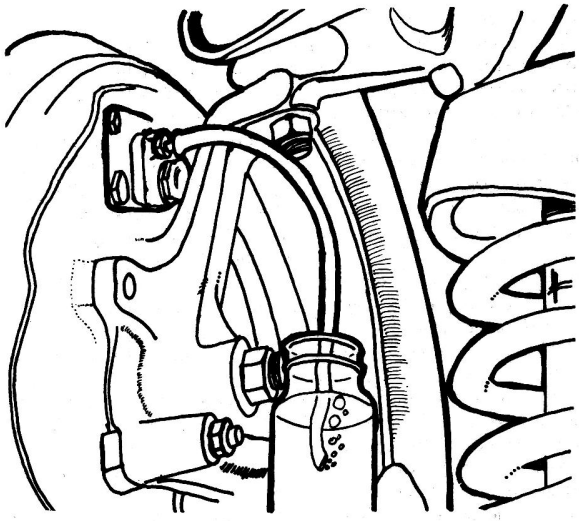


Fig.9.8. Bleeding the brakes

3 Front brake shoes and wheel cylinder (drum brakes) - removal and refitting

1 Chock the rear wheels, apply the handbrake, jack up the front of the car and support on firmly based axle stands. Remove the road wheel.
2 Remove the two screws securing the brake drum to the hub and remove the drum.
3 Refer to Fig. 9.9. Remove the circlip and plain washer at one end of the adjuster bar. Take out the split pin and remove the slotted nut at the other end of the bar. Lift off the plate and the top friction pad. Now remove the adjuster bar, the ratchet spring, the rear friction pad, the enclosing plate and the washer behind it. Be careful when taking off the ratchet spring to avoid straining it.
4 Now look at Fig. 9.1. Disengage the toe of the leading shoe from the wheel cylinder piston and pull the heel of the shoe out of its housing. As the load on the pull off spring is now released, the trailing shoe will come away.
5 Detach the hydraulic flexible hose from the frame connector (see Fig. 9.10) and now unscrew the hose from the banjo fitting on the wheel cylinder (on early models the hose screws directly into the wheel cylinder).
6 Remove the banjo bolt and take off the banjo noting the position of the two gaskets.
7 Knock back the tabs of the locking plates to the four bolts securing the wheel cylinder to the backplate. Remove the bolts and lift out the wheel cylinder noting which way round it is fitted.
8 Thoroughly clean all dust from the shoes, the backplate and the drum using a stiff wire brush. Do not use compressed air as this will raise dust which must not be inhaled as it is of an asbestos nature. As the dust can cause brake judder and squeal it is important to clean away all traces.
9 Check that each piston is free in its cylinder, the rubber dust covers are not perished or damaged and that there are no hydraulic fluid leaks.
10 Refitting is generally the reverse of the above procedure but particular attention must be paid to the following points.
11 Offer the wheel cylinder to the hole in the backplate so that the smaller rubber boot is pointing in the direction of forward rotation of the wheel. Secure it with the four bolts using new locking plates, tighten down on the bolts and lock with the tabs.
12 Place the large gasket under the head of the banjo bolt followed by the banjo and the smaller gasket, and assemble to the inboard connection on the wheel cylinder.
13 Screw the hose into the banjo, use a new gasket and connect the other end of the hose to the frame connector. Make sure, by holding the union with a spanner, that the hose does not twist

whilst you are tightening the locknut.
14 The brake shoes can now be assembled. Look at the shoes and you will see that the linings are shorter in length than the platforms on which they are rivetted. The end with the greater length of platform exposed is known as the "toe" and the other end is known as the "heel" of the brake shoe. When installed on the backplate, the tow of the leading shoe is to be against the smaller rubber boot of the wheel cylinder whilst the heedl of the shoe engages the slot in the fixed housing at the bottom of the backplate. The correct condition is plainly shown in Fig. 9.1.
15 Place in position on the brake shoe the bolt, and its coil spring, securing the adjuster plate.
16 Hook the pull-off spring into the correct holes so that it is on the underside of the shoes.
17 Offer up the shoes to the backplate with the spring inside and engage the tips of one shoe with the respective slots in the wheel cylinder and the fixed housing. Now engage the tip of the other shoe in one of the slots and lift the other tip into position against the load of the spring.
18 Assemble the ratchet spring to the toothed end of the adjuster bar.
19 Assemble the inner plate pad followed by the friction pad to the adjuster plate bolt. It will be noted that the holes through the friction pads and the plates are off centre, they must be fitted so that the hole is nearer to the closed end of the ratchet spring.
20 Assemble the adjuster bar with teeth to the bottom and so that the ratchet spring encloses the inner friction pad.
21 Place the outer friction pad and pad plate in position and then fit the slotted nut hand tight.
22 Gently ease the ratchet spring away from the teeth on the adjuster bar and then adjust the position of the bar so that the anchor pin in the trailing shoe can enter the hole in the bar, the pin must abut the inner edge of the hole.
23 Fit the washer and circlip to the anchor pin.
24 Tighten the slotted nut hard down and now slacken back two flats and lock with the split pin.
25 Check the operation of the adjuster by pulling on the heel of the trailing shoe so that the anchor pin moves to the outer edge of the hole. When released from this position the shoe must return smartly to the fully off position.
26 Refit the brake drum and the road wheel.
27 Bleed the system in the manner described in Section 2.
28 Pump the brake pedal a few times to take up all adjustment in the brake.

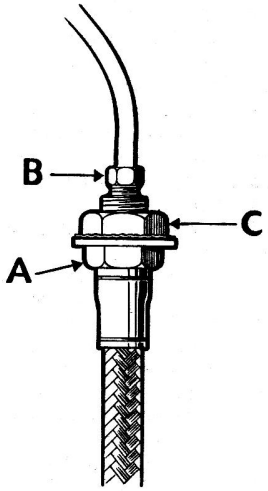


Fig.9.10. Hold 'A' when unscrewing or tightening 'B' or 'C'

4 Rear brake shoes and wheel cylinder (drum brakes) - removal and refitting

1 Securely chock the front wheels. Jack up the rear of the car and remove the road wheel. Place a firmly based axle stand in position.
2 Release the handbrake. Remove the split pin and the clevis pin securing the handbrake cable to the lever at the wheel cylinder, pull the cable away from the lever and place it out of the way.
3 Remove the four screws securing the brake drum to the hub and pull off the drum.
4 Pull on the tip of the adjustment lever to disengage it from the ratchet wheel, allow the lever to rotate to relieve tension on the spring and then unhook the spring from the lever and the brake shoe.
5 Remove the circlip from the lever axis pin and take off the washer underneath it and then take off the lever.

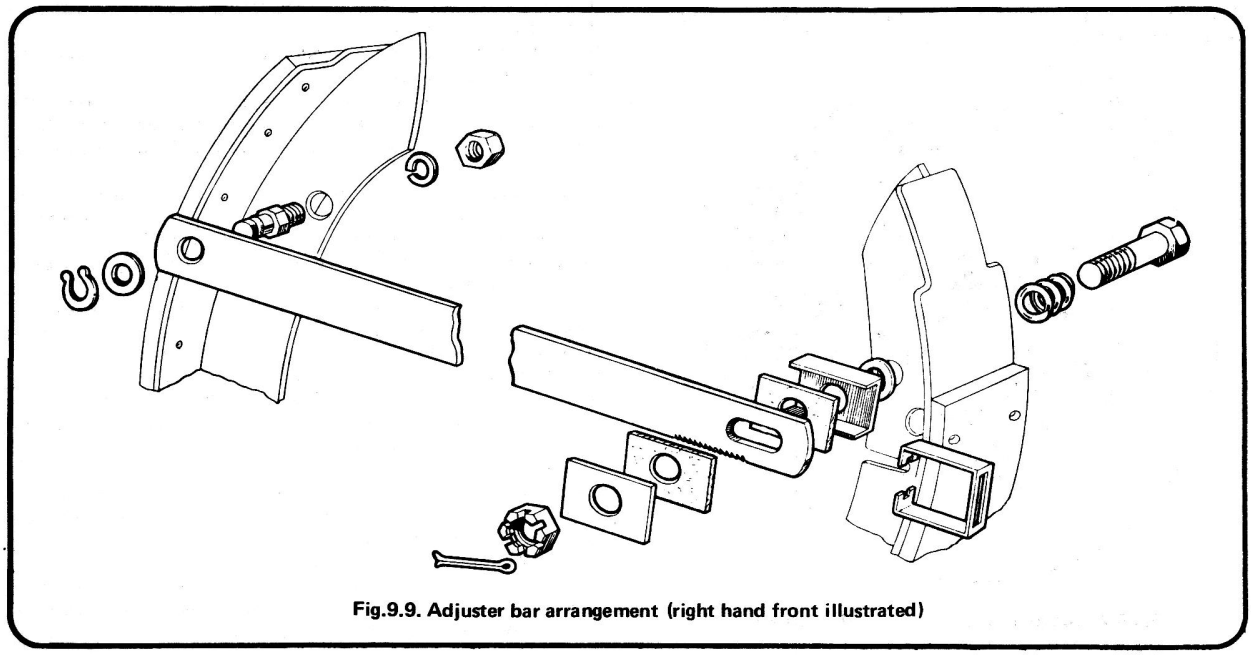


Fig.9.9. Adjuster bar arrangement (right hand front illustrated)