

Chapter 7 Driveshafts and universal joints

For modifications, and information applicable to later models, see Supplement at end of manual

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Specifications

Type	Solid shaft reverse spline, with constant velocity outer joint and rubber coupling, Hardy-Spicer, or offset sphere type inner joint – depending on model and year of production
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Torque wrench settings

Driveshaft retaining nut:

All models except Cooper S and 1275 GT	60
Cooper S and 1275 GT	150
Rubber coupling U-bolts	10
Swivel hub balljoint nuts	38
Track rod end balljoint nut	22

lbf ft	Nm
60	83
150	207
10	14
38	52
22	30

1 General description

Drive is transmitted from the differential to the front wheels by means of two equal length driveshafts. A constant velocity joint is fitted to the outer end of each shaft to cater for steering and suspension movement. The constant velocity (CV) joint comprises a driving member (splined to the driveshaft), six caged steel balls, and a driven member (splined to the wheel hub flange). The driven member pivots freely on the steel balls, to any angle, thus allowing the drive to be smoothly transmitted to the front wheels throughout the full range of steering and suspension travel.

To allow for vertical movement of the driveshaft with the suspension, models equipped with manual transmission incorporate either a flexible rubber drive coupling or an offset sphere type joint, similar to a CV joint, at the inner end of each driveshaft. A Hardy-Spicer universal joint is used at each driveshaft inner end on Cooper S Mk III models and vehicles equipped with automatic transmission. On models fitted with offset sphere type inner joints, lateral movement of the driveshaft is catered for by the sliding components within the joint. On all other models each driveshaft incorporates a sliding spline at the inner end.

The CV joint, offset sphere joint and the driveshaft sliding spline are all protected by rubber boots. Other than a periodic inspection of the rubber boots, the driveshafts are maintenance-free.

2 Driveshaft assembly – tests for wear/fault diagnosis

1 The driveshaft assembly consists of the outer constant velocity joint, the inner sliding spline and rubber coupling on early models, the inner offset sphere joint on later models and the Hardy-Spicer universal joint on Cooper S Mk III and automatic transmission models. All of these components are subject to wear after high mileages, and the following tests can be used to isolate a suspect unit.

Constant velocity joint

2 This is a well publicised weak spot on Minis. Wear is easily recognised as a metallic clicking from the front of the car as it is driven

slowly in a circle with the steering on full lock. The noise is caused by excessive clearance between the balls in the joint and the recesses in which they operate. If the noise is only slight it may be nothing more serious than a lack of grease in the joint due to a split or damaged rubber boot. The best course of action if a clicking noise is apparent is to remove the joint as described in Section 5 and carry out a visual inspection. If wear is excessive the joint must be renewed.

Inner sliding splines

3 To check for wear on these components it will be necessary to position the car over a ramp or pit, or to jack it up and support it on axle stands. Grasp the driveshaft with one hand and the inner flange with the other and attempt to turn them in opposite directions. If this is possible to any appreciable degree then wear has taken place and both the driveshaft and flange will need renewal. Also check the condition of the rubber boot; if damaged or split it should be renewed.

Inner rubber coupling

4 Wear in the rubber coupling can often be experienced on the road as a thumping, consistent with road speed and felt through the steering and body, usually on the overrun. A closer inspection can be carried out from beneath the vehicle with it over a ramp or pit, or jacked up and supported on axle stands. Check for swelling or deterioration of the rubber or for oil contamination. Place a flat bar or stout screwdriver between the flanges and apply gentle leverage. Appreciable movement indicates wear in the joint. In more advanced stages of wear the rubber may have worn to such an extent that the inner metal spider will be visible. If the rubber is swelling due to oil contamination, the joint will rub on the rear face of the gearbox casing, with the obvious disastrous results if this is allowed to continue.

Offset sphere joint

5 These joints are quite reliable and seldom give trouble. However, a vibration felt through the car, particularly during acceleration, may indicate wear in the joint. If the vibration is only slight it may be due to a lack of grease caused by a damaged rubber boot. If the joint is suspect it should be removed from the car and carefully inspected as described in Section 9. It is possible to renew the rubber boot separately, but if the internal components of the joint are worn it will

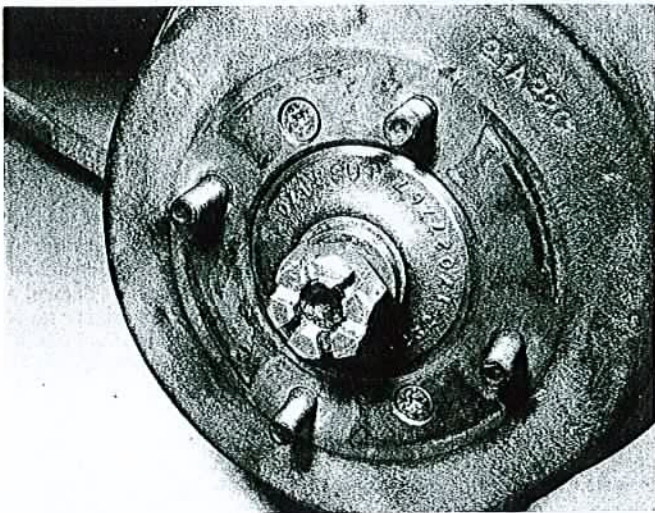
be necessary to renew the complete unit.

Hardy-Spicer universal joint

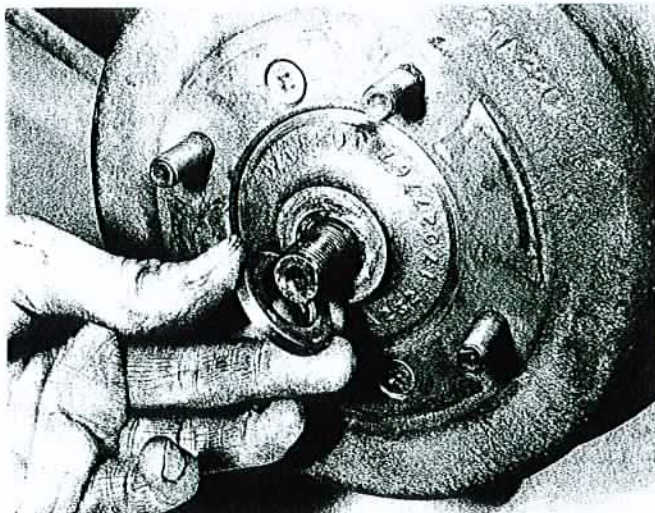
6 Wear in the needle roller bearings of these joints is characterised by vibration in the transmission, clonks on taking up the drive, and in extreme cases of lack of lubrication, metallic squeaking, and ultimately grating and shrieking as the bearings break up. With the car over a ramp or pit, or jacked up and supported on axle stands, attempt to turn the shaft with one hand while holding the inner drive flange with the other. If any movement exists this indicates considerable wear has taken place. Also try lifting the joint and noting if any movement takes place. If the joint is worn it may be overhauled using a repair kit consisting of a new spider, bearings, seals and circlips. This is described in detail in Section 7.

3 Driveshaft – removal and refitting

- 1 Remove the wheel trim and slacken the front roadwheel retaining nuts.
- 2 Extract the split pin and, using a large socket undo and remove the driveshaft retaining nut and washer (photos).
- 3 Working under the wheel arch, undo and remove the single retaining screw and lift out the upper suspension arm rebound rubber. Position a solid packing piece of approximately the same thickness in



3.2a Removing the driveshaft retaining nut...



3.2b ...and thrust washer

its place.

4 Jack up the front of the car and support it on axle stands placed under the subframe. Remove the front roadwheel.

5 The procedure now varies slightly according to the type of inner joint fitted to the driveshaft.

Models with inner rubber coupling or Hardy-Spicer universal joint

6 From underneath the car, suitably mark the driveshaft flanges to ensure correct reassembly. Undo and remove the four outer locknuts from the U-bolts securing the driveshaft flange to the rubber coupling. On models fitted with Hardy-Spicer Universal joints, undo and remove the four locknuts securing the two flanges together.

7 Undo and remove the steering tie-rod balljoint retaining locknut and then release the balljoint tapered shank from the steering arm in the following manner.

8 If a universal balljoint separator is available, use the separator to release the tapered shank and then lift the balljoint off the steering arm. Alternatively refit the locknut to the balljoint and screw it on two or three turns. Using a medium hammer, sharply strike the end of the steering arm until the shock separates the taper (photo). Now remove the locknut and lift the joint off the arm.

9 Undo and remove the nuts and spring washers securing the upper and lower suspension arms to the swivel hub balljoints.

10 Using the method described in paragraph 8, separate the upper and lower suspension arms from the tapered shanks of the balljoints.

11 Support the swivel hub to avoid stretching the flexible brake hose. Tap the end of the driveshaft with a soft-faced mallet to free the shaft from the hub.

12 Slide the driveshaft fully out of the hub and then withdraw it from the car outwards through the aperture in the subframe. With the driveshaft removed refit the swivel hub balljoint to the upper suspension arm and screw on the retaining nut two or three turns.

Models with offset sphere type inner joint

13 Release the driveshaft from the swivel hub, and the swivel hub from the suspension and steering arms, using the procedure described in paragraphs 7 to 11 inclusive.

14 Withdraw the swivel hub off the end of the driveshaft (photo) and then tie the hub assembly out of the way from a convenient place

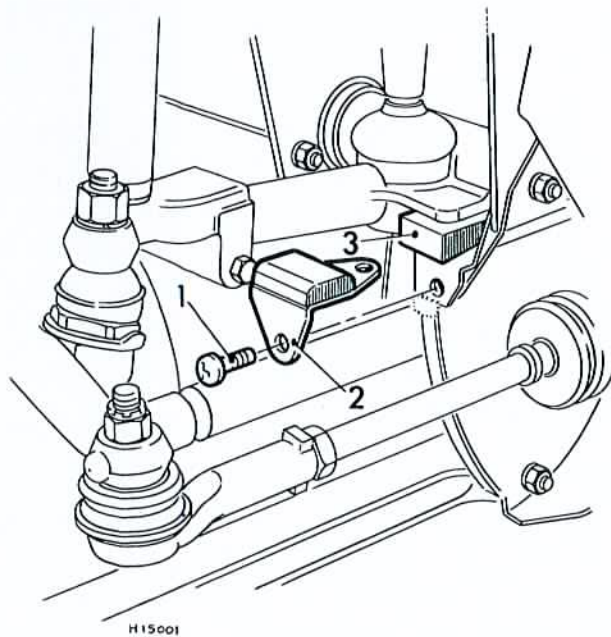


Fig. 7.1 Fitting a solid packing wedge in place of the suspension rebound rubber (Sec 3)

- 1 Screw
- 2 Rebound rubber
- 3 Packing piece

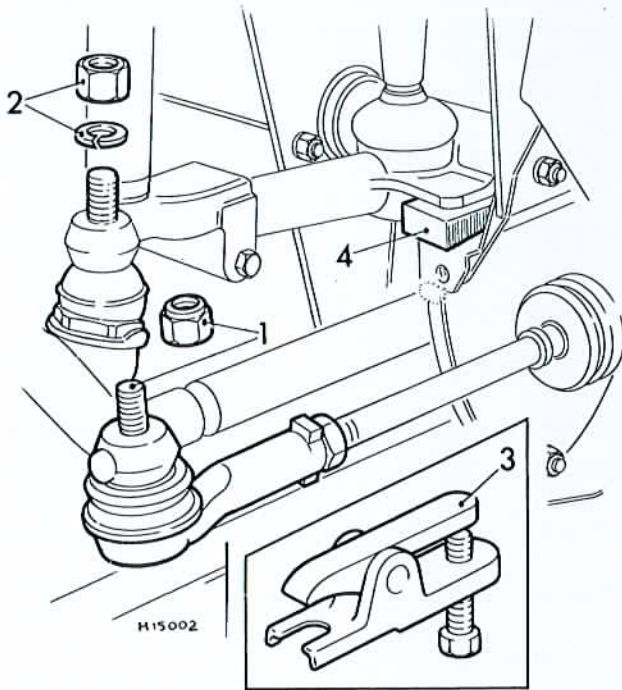
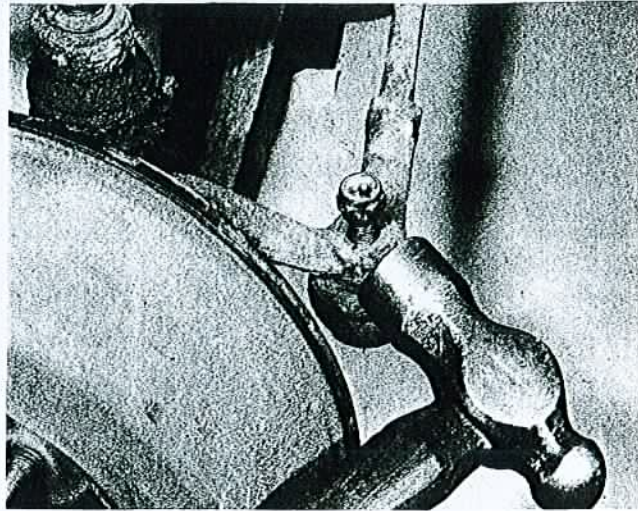


Fig. 7.2 Releasing the tie-rod and swivel hub balljoints (Sec 3)

- | | |
|--------------------------------------|---------------------------------|
| 1 Tie-rod balljoint and nut | 3 Universal balljoint separator |
| 2 Swivel hub upper balljoint and nut | 4 Solid packing piece |



3.8 Alternative method of releasing the balljoint taper

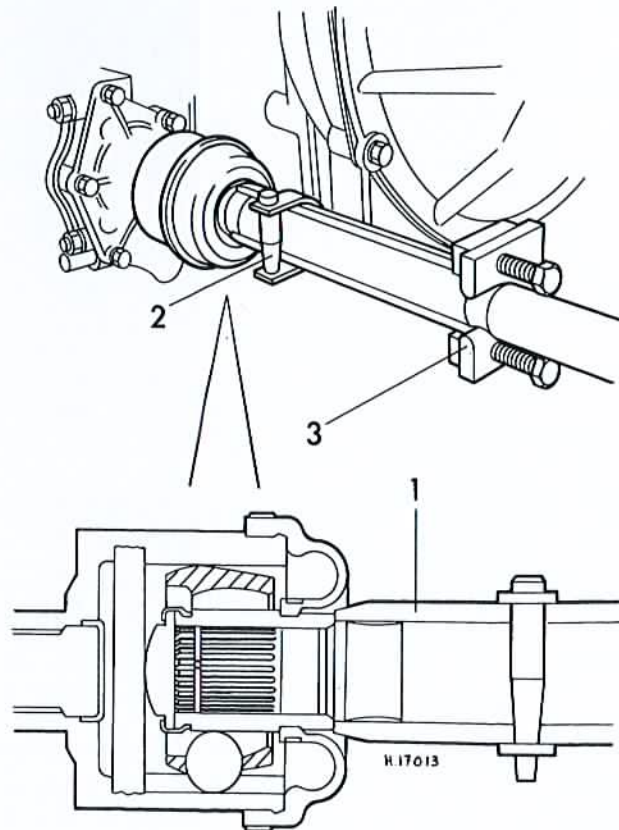
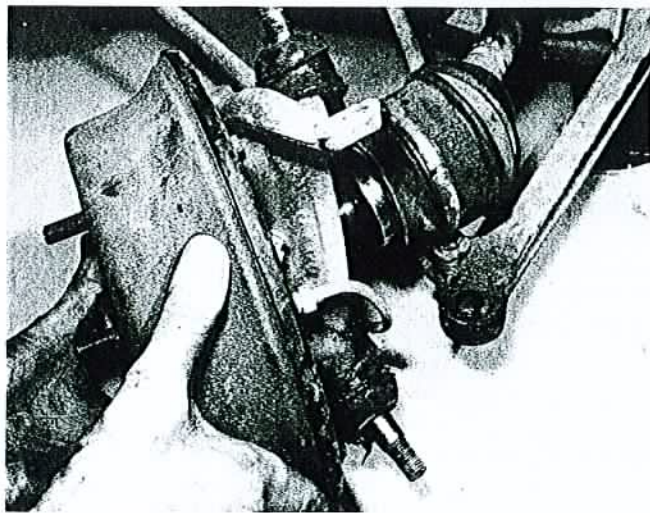


Fig. 7.3 Removal of driveshaft inner end from offset sphere joint (Sec 3)

- | |
|---|
| 1 Special tool 18G1243 |
| 2 Tool in contact with joint flange |
| 3 Tool plate engaged with driveshaft groove |



3.14 Withdraw the swivel hub from the end of the driveshaft...

under the wheel arch. Avoid placing excessive strain on the flexible brake hose.

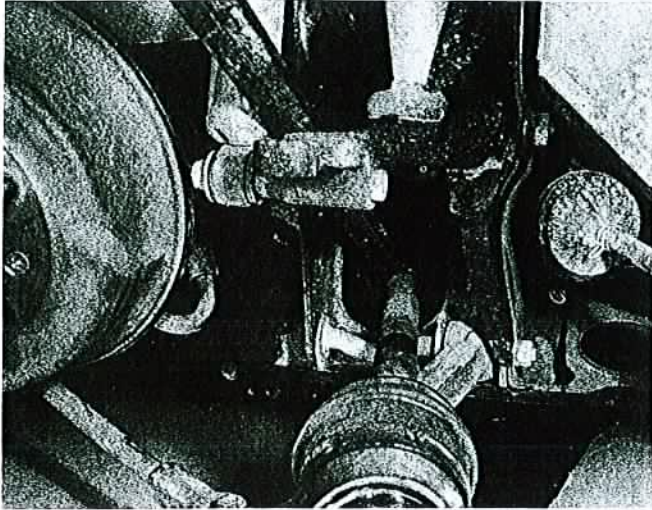
15 The inner end of the driveshaft must now be removed from the offset sphere joint. If BL special tool No 18G 1243 can be obtained this will greatly simplify the task of removing the driveshaft from the joint. If this tool is not available the following procedure should be used.

16 Insert a flat metal bar or similar tool through the aperture in the subframe so that it rests on the driveshaft and is in contact with the flange of the joint (photo). Take care not to pinch the rubber boot with the bar as it is easily punctured.

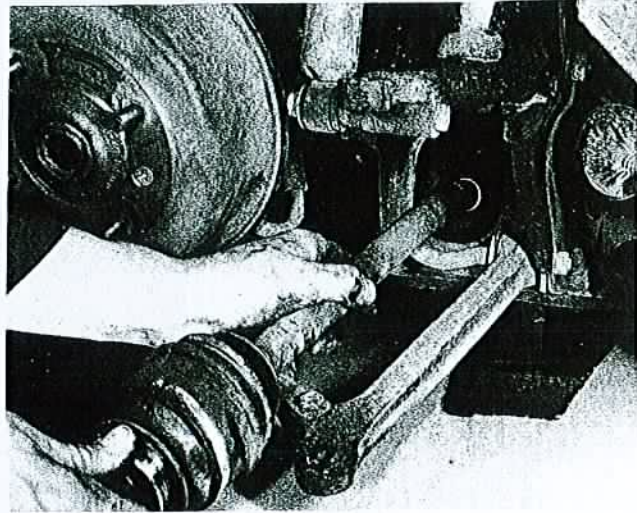
17 Pull the driveshaft outwards approximately 1 in (25 mm) and

firmly hold it in this position. The help of an assistant may be useful here.

18 Strike the end of the bar with a few sharp hammer blows. This will force the flange of the joint inwards and release it from the end of the driveshaft. The driveshaft can now be withdrawn from the car (photo).



3.16 ...release the inner end from the offset sphere joint...



3.18 ...and withdraw the driveshaft assembly

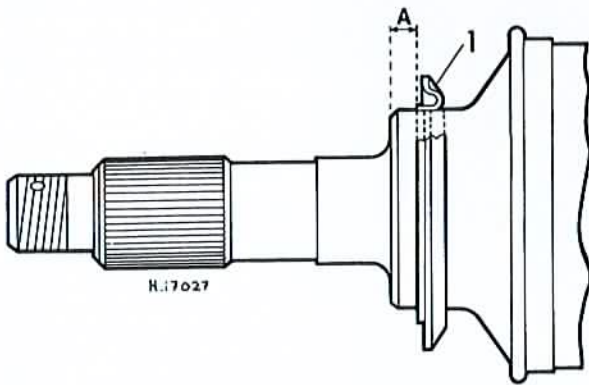


Fig. 7.4 Correct positioning of water shield on CV joint (Sec 3)

1 Water shield
Dimension A = 0.25 in (6 mm)

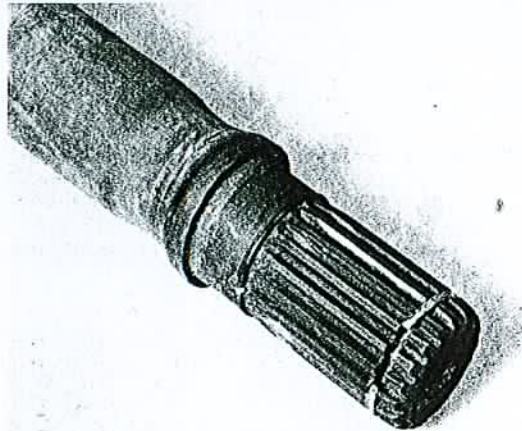
All models

19 In all cases refitting the driveshaft is the reverse sequence to removal, bearing in mind the following points:

- Ensure that the hub bearing water shield is in place on the driveshaft CV joint and positioned approximately 0.25 in (6 mm) from the shoulder of the joint
- When refitting the driveshaft to the offset sphere type inner joint, ensure that the circlip is in position on the shaft (photo) and lubricate the splines with a graphite-based grease. Push the driveshaft smartly into the joint to lock the shaft in position
- Tighten all nuts and bolts to the specified torque

4 Constant velocity joint rubber boot – removal and refitting

- If a rubber boot on one of the CV joints has split or been damaged, it should be renewed as soon as possible otherwise water and grit will enter the joint, causing rapid wear.
- To renew the rubber boot, begin by removing the driveshaft from the car as described in Section 3.
- On models equipped with a rubber drive coupling or universal joint at the inner end of the driveshaft; remove the retaining clips or wire



3.19 Ensure that the circlip is in position before refitting the driveshaft

from the small inner rubber boot and then slide the flange and boot off the end of the driveshaft.

4 Now remove the retaining clips or wire from the constant velocity joint rubber boot. Slide the boot along the shaft and off the splined end.

5 Thoroughly clean all traces of rubber, old grease and dirt from the shaft and CV joint.

Note: If the car has been operated for a considerable length of time with a defective rubber boot, or if the grease appears contaminated with grit, it is essential that the CV joint is thoroughly washed out with petrol or paraffin.

6 New CV joint rubber boots are available in the form of a repair kit from your local dealer. The kit comprises the CV joint boot, the boot retaining clips and a tube of Duckhams Q5795 grease. It is most important that only this type of grease is used.

7 Thoroughly pack the CV joint using the grease supplied in the repair kit. Manipulate the joint from side to side and ensure that the grease is worked well into the balls and ball recesses.

8 Now slide the new CV joint boot over the splined end of the driveshaft and position it onto the joint. Ensure that the moulded lips of the boot fit into the shallow depressions machined in the outer circumference of the joint and on the driveshaft.

9 Place the larger retaining clip supplied in the repair kit over the CV joint with the end containing the tabs facing away from the forward

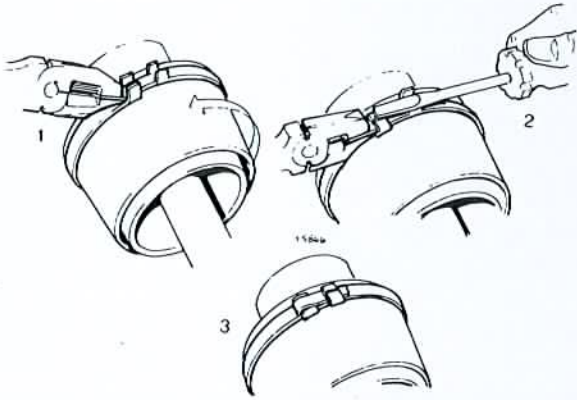


Fig. 7.5 When clips are used to secure rubber boot, pull clips tight and secure in order shown (Sec 4)
Arrow indicates forward rotation of shaft

direction of shaft rotation. Using pliers, pull the other end of the clip over the end containing the tabs and press down the first set of tabs using a screwdriver. Pull the free end tight and fold it over the compressed tabs. Now bend over the second set of tabs, trapping the free end of the clip underneath.

10 Alternatively secure the boot using two or three turns of soft iron wire. Twist the ends of the wire together and bend them over to face away from the forward direction of rotation of the shaft. Ensure that the wires are correctly located on the area of the boot directly over the shallow depressions in the joint.

11 Secure the smaller diameter of the CV joint boot to the driveshaft using the same method as described in paragraphs 9 and 10 above.

12 The remaining operations only apply to models fitted with a rubber drive coupling or universal joint at the inner end of the driveshaft.

13 Slide the smaller rubber boot over the splines until the moulded lip fits in the shallow depression on the shaft.

14 Liberally smear the splines on the driveshaft and the flange with the remains of the grease supplied in the repair kit.

15 Slide the flange onto the end of the shaft and pull the larger lip of the rubber boot over the end of the flange, engaging the lip into the shallow depression on the flange.

16 Secure the rubber boot using soft iron wire as described in paragraph 10.

17 The driveshaft can now be refitted to the car as described in Section 3.

5 Constant velocity joint – removal, inspection and refitting

1 Begin by removing the driveshaft from the car as described in Section 3, and the rubber boots from the driveshaft as described in Section 4.

2 Firmly grasp the driveshaft or support it in a vice. Using a hide or plastic mallet, sharply strike the outer edge of the joint and drive it off the shaft. The CV joint is retained on the driveshaft by an internal circular section circlip, and striking the joint in the manner described forces the circlip to contract into a groove, so allowing the joint to slide off.

3 With the CV joint removed from the driveshaft, thoroughly wash out the joint using petrol or paraffin and dry it, preferably using compressed air. Carry out a careful visual inspection of the CV joint, paying particular attention to the following areas.

4 Move the inner splined driving member from side to side to expose each ball in turn at the top of its track. Examine the balls for cracks, flat spots or signs of surface pitting.

5 Inspect the ball tracks on the inner and outer members. If the tracks have widened, the balls will no longer be a tight fit. At the same time check the ball cage windows for wear or for cracking between the balls. Wear in the balls, ball tracks and ball cage windows will lead to the characteristic clicking noise on full lock described previously.

6 It is no longer possible to obtain a CV joint overhaul kit consisting of a new ball cage and associated components. Therefore, if wear is apparent in the above mentioned areas, it will be necessary to renew

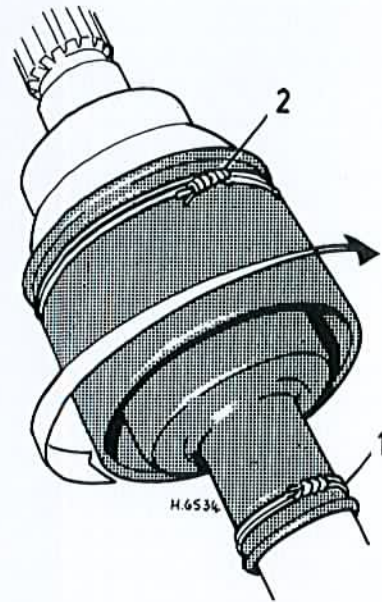


Fig. 7.6 When securing rubber boot with soft iron wire, ensure that the wire ends (1 and 2) are bent away from forward direction of rotation – arrowed (Sec 4)

the CV joint.

7 If a new joint has been obtained, or if the original joint was found to be in a satisfactory condition and is being refitted, a repair kit comprising a new CV joint rubber boot, boot retaining clips and a tube of Duckhams Q5795 grease should be obtained from your local dealer. Only use this type of grease in the CV joint.

8 The help of an assistant will be necessary whilst refitting the CV joint to the driveshaft. Ensure that the circlip is correctly located in its groove in the driveshaft. Position the CV joint over the splines on the end of the shaft until it abuts the circlip.

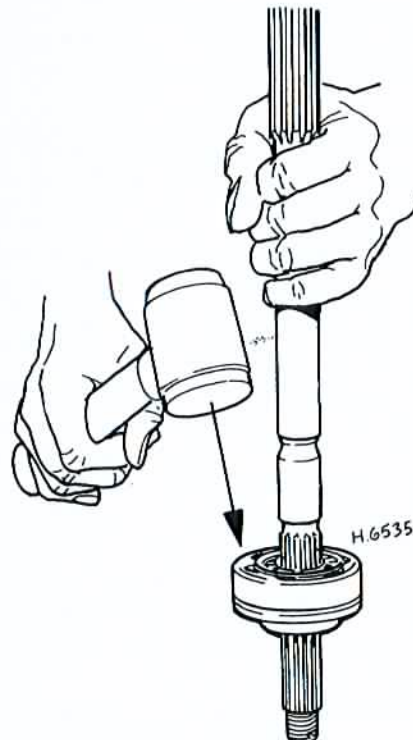


Fig. 7.7 Using a soft-faced mallet to remove CV joint (Sec 5)

9 Using two small screwdrivers placed either side of the circlip, compress the circlip and at the same time have your assistant firmly strike the end of the CV joint with a hide or plastic mallet.

10 The joint should slide over the compressed circlip and into position on the shaft. It will probably require several attempts before you achieve success. If the joint does not spring into place the moment it is struck, remove it, reposition the circlip and try again. Do not force the joint otherwise the circlip will be damaged.

11 With the CV joint in place and in contact with the spring collar on the shaft, the joint should now be lubricated and the rubber boots refitted as described in Section 4, paragraphs 7 to 16 inclusive. The assembled driveshaft can then be refitted to the car as described in Section 3.

6 Inner rubber drive coupling – removal and refitting

1 Remove the wheel trim and slacken the roadwheel retaining nuts.
2 Working under the wheel arch, undo and remove the single retaining screw and lift out the upper suspension arm rebound rubber. Place a solid packing piece of approximately the same thickness in its place.

3 Jack up the front of the car and place axle stands under the subframe. Remove the front roadwheel.

4 Undo and remove the nut and spring washer securing the upper suspension arm to the swivel hub balljoint.

5 If a universal balljoint separator is available, use the separator to release the tapered shank of the balljoint from the upper suspension arm. Alternatively, refit the nut to the balljoint and screw it on two or three turns. Using a medium hammer, sharply strike the end of the suspension arm until the shock separates the taper. Now remove the nut and detach the balljoint shank from the arm.

6 With the upper balljoint disconnected, pull the upper part of the hub assembly away from the car and allow it to hang in this position. Avoid placing undue strain on the flexible brake hose.

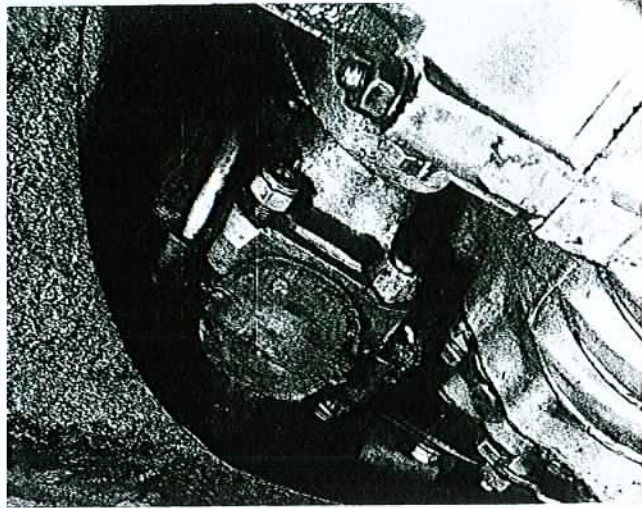
7 From underneath the car, undo and remove the eight locknuts securing the retaining U-bolts to the coupling flanges (photo).

8 Withdraw the U-bolts from the flanges, using a screwdriver to lever them out, and then lift off the rubber coupling.

9 Refitting the coupling is the reverse sequence to removal. Ensure that the U-bolt locknuts and swivel hub balljoint retaining nut are tightened to the specified torque.

7 Hardy-Spicer universal joint – dismantling, overhaul and reassembly

1 Remove the driveshaft from the car as described in Section 3.
2 Remove the retaining wire securing the sliding spline protective rubber boot to the yoke flange and slide the yoke off the end of the driveshaft.



6.7 Remove the rubber coupling U-bolt locknuts

3 Thoroughly clean the exterior of the universal joint and yoke in petrol or paraffin and dry with a lint-free cloth.

4 Using circlip pliers, remove the four circlips securing the universal joint bearing cups to the yokes. If the circlips are tight, tap the bearing cups downward to relieve the tension on the circlip using a hammer and brass drift.

5 Referring to Fig. 7.8 support the underside of the yoke on the top of a vice. Tap the outer circumference of the other yoke with a soft-faced mallet until the bearing cup emerges from the top of the yoke.

6 Turn the assembly over and grip the exposed bearing cup between protected vice jaws. Now tap the yoke upwards until the bearing cup is released.

7 Repeat paragraphs 5 and 6 on the opposite bearing cup and then lift the yoke off the spider.

8 Position the two exposed bearing trunnions on the spider over the top of the protected vice jaws. Tap the yoke downwards until the bearing cup emerges from the top of the yoke.

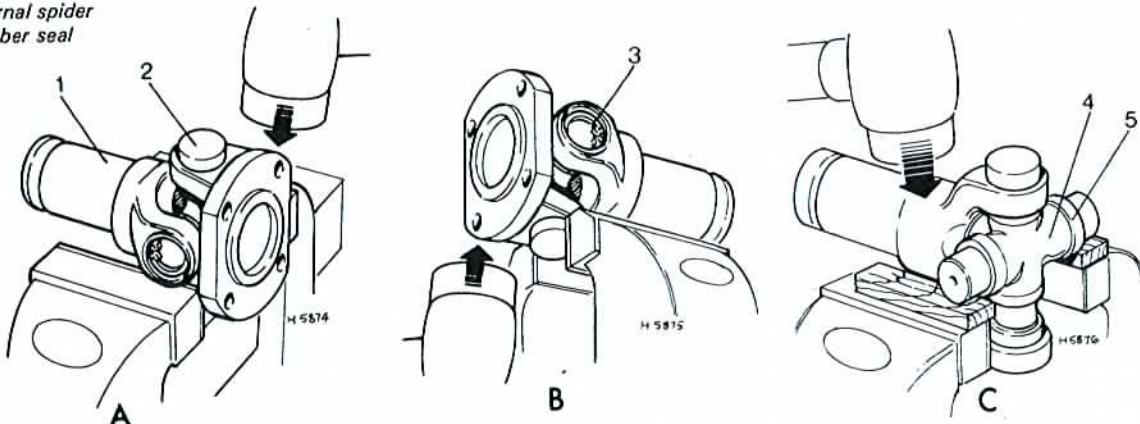
9 Turn the yoke over and grip the exposed bearing cup between the protected vice jaws. Tap the yoke upwards until the bearing cup is released.

10 Repeat paragraphs 8 and 9 on the opposite bearing cup and then lift the spider out of the yoke.

11 Inspect the needle roller bearings, spider and bearing cups for lack of lubrication, surface pitting or load markings. If wear is apparent a new universal joint must be fitted.

- 1 Yoke
- 2 Needle bearing race
- 3 Circlip in position
- 4 Journal spider
- 5 Rubber seal

Fig. 7.8 Universal joint removal procedure (Sec 7)



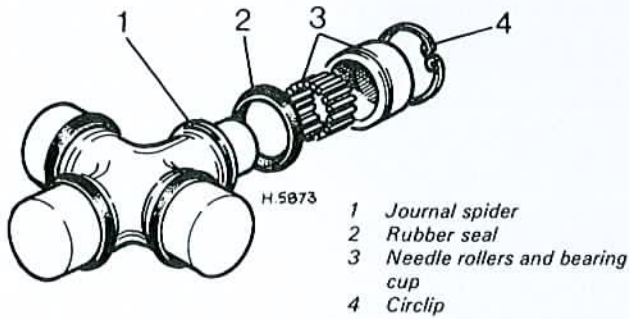


Fig. 7.9 Universal joint compound parts (Sec 7)

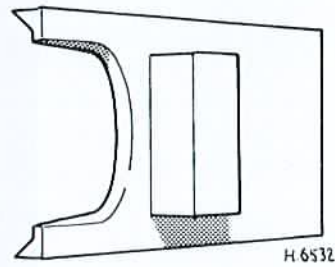


Fig. 7.10 Special tool 18G1240 for removing offset sphere joint (Sec 8)

12 Before refitting the universal joint, ensure that each bearing cup contains a complete set of rollers and that the rubber seals are in position on the bearing cups. Smear the inside of each cup with general purpose grease to retain the needle roller bearings in position.

13 Check that the bearing cup apertures in the yokes are clean and dry, paying particular attention to the circlip grooves. Remove any burrs that may exist using a small file.

14 Insert one of the bearing cups into the yoke aperture and then place the spider in position pushing it up into the cup to hold the needle bearings in place.

15 Using a hammer and soft drift, tap the bearing cup fully into the yoke and then refit the circlip.

16 Place the bearing cup in the opposite side of the yoke in position and move the spider up slightly until it just engages the needles.

17 Now tap the bearing cup fully into the yoke and refit the circlip.

18 Repeat paragraphs 14 to 17 inclusive for the remaining two bearing cups.

19 If the assembled joint appears to bind, tap the top of the bearing cups lightly using the soft drift to relieve the pressure of the bearing cups on the spider.

20 Smear the splines on the driveshaft and yoke with grease, preferably Duckhams Q5795, and then refit the yoke to the driveshaft.

21 Engage the lip of the rubber boot over the yoke and secure with two or three turns of soft iron wire. Twist the ends of the wire together and then bend them down to face away from the forward direction of rotation of the driveshaft.

22 Refit the driveshaft to the car as described in Section 3.

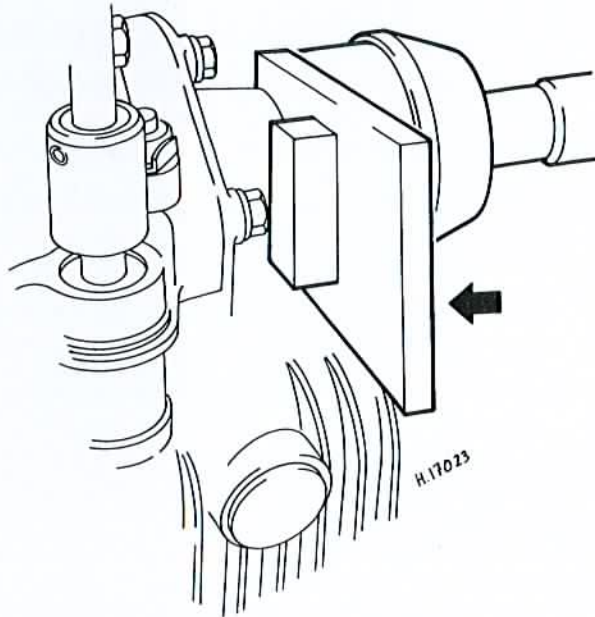


Fig. 7.11 Using the special tool to release the joint from the differential (Sec 8)

8 Inner offset sphere joint – removal and refitting

1 Working under the wheel arch, undo and remove the single retaining screw and lift out the upper suspension arm rebound rubber. Position a solid packing piece of approximately the same thickness in its place.

2 Jack up the front of the car and support it on axle stands placed under the subframe. Remove the front roadwheel.

3 Undo and remove the steering tie-rod balljoint retaining locknut, and then release the balljoint tapered shank from the steering arm in the following manner.

4 If a universal balljoint separator is available, use the separator to release the tapered shank, and then lift the balljoint off the steering arm. Alternatively, refit the locknut to the balljoint and screw it on two or three turns. Using a medium hammer sharply strike the end of the steering arm until the shock separates the taper. Now remove the locknut and lift the joint off the arm.

5 Undo and remove the nut and spring washer securing the upper suspension arm to the swivel hub balljoint. Using the method described in the previous paragraph, separate the upper suspension arm from the tapered shank of the balljoint.

6 The inner end of the driveshaft must now be removed from the offset sphere joint. If BL special tool No 18G1240 can be obtained this will greatly simplify the task of removing the driveshaft from the joint. If this tool is not available the following procedure should be used.

7 Tip the swivel hub outwards slightly, pivoting it on the lower balljoint. Take care not to stretch the flexible brake hose. Have an

assistant hold the hub and driveshaft in this position.

8 Insert a flat metal bar or similar tool through the aperture in the subframe so that it rests on the driveshaft and is in contact with the flange of the joint. Take care not to pinch the rubber boot with the bar, as it is easily damaged.

9 Strike the end of the bar with a few sharp hammer blows. This will force the flange of the joint inwards and release it from the end of the driveshaft.

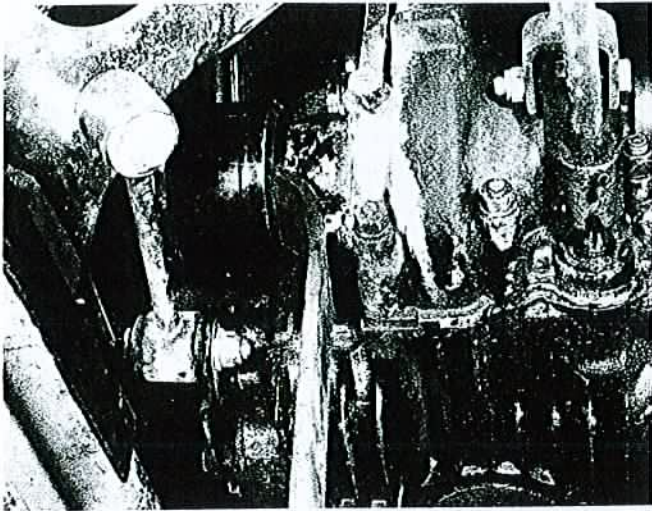
10 Fully withdraw the driveshaft from the joint flange and temporarily position the end of the shaft over the differential housing out of the way.

11 Working underneath the car, remove the engine/transmission oil drain plug and allow the oil to drain into a suitable container. When the oil has drained, refit the drain plug.

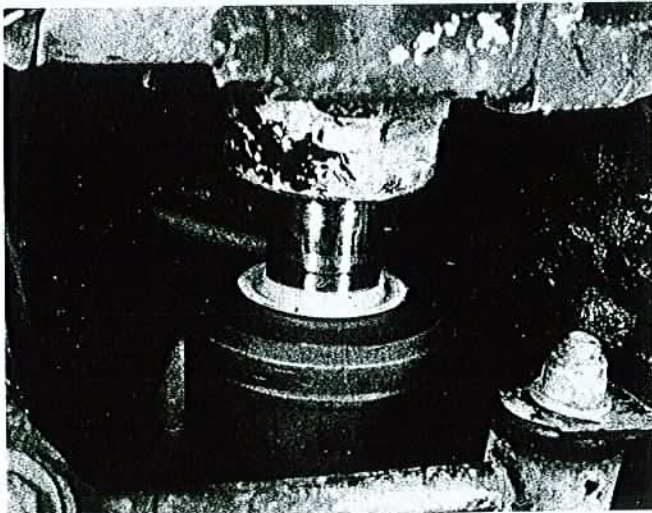
12 Using BL special tool 18G1240, release the offset sphere joint from the differential. Alternatively, use a suitable cranked bar with a flattened end such as a tyre lever. Insert the flattened end of the bar between the joint inner face and the differential end cover. Pivot the bar against the end cover lower retaining bolt head. If the bar is not sufficiently cranked to reach the bolt head, use suitable spacers. *Do not lever against the end cover.* Strike the bottom of the bar with a few sharp hammer blows towards the centre of the car. This will release the joint from the retaining circlip on the differential shaft. Once the joint has moved outward slightly it can be removed the rest of the way by hand (photos).

13 With the offset sphere joint removed, recover the oil flinger, noting the direction of fitting.

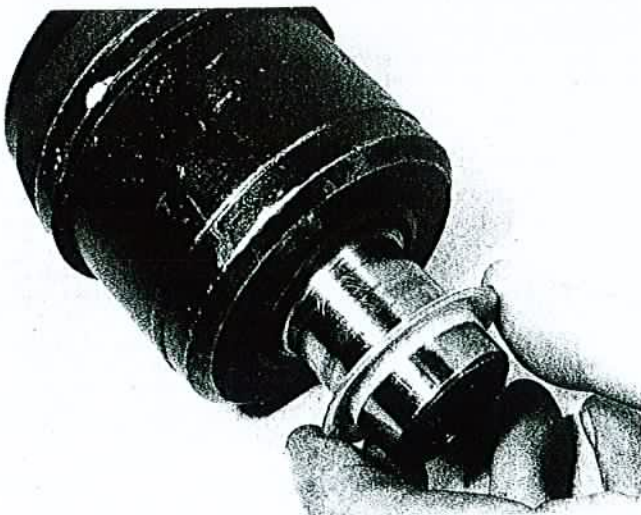
14 Refitting the joint is the reverse sequence to removal, bearing in



8.12a Using a cranked bar to release the offset sphere joint from the differential



8.12b Once the joint is released it can be slid off by hand



8.14 Ensure that the oil flinger is in position before refitting

mind the following points:

- (a) Ensure that the oil flinger is in position before refitting the joint to the differential (photo)
- (b) Position a large worm drive hose clip (or two joined together) around the joint and strike the head of the clip to force the joint fully into the differential
- (c) When refitting the driveshaft, ensure that the circlip is in position on the shaft, and lubricate the splines with a graphite-based grease. Push the driveshaft smartly into the joint to lock the shaft in position.
- (d) Tighten all nuts and bolts to the specified torque
- (e) Don't forget to refill the engine with oil

9 Inner offset sphere joint – dismantling and reassembly

- 1 With the joint removed from the car as described in the previous Section, remove and discard the two retaining rings and the rubber boot.
- 2 Withdraw the joint inner member and ball cage assembly from the outer members.
- 3 Using a screwdriver inserted between each ball in turn and the joint inner member, release the balls from the ball cage.
- 4 Turn the ball cage until the grooves on the inside of the cage are aligned with the lands on the inner member and then lift off the ballcage.
- 5 Wash off all the parts in petrol or paraffin and dry with a lint-free cloth.

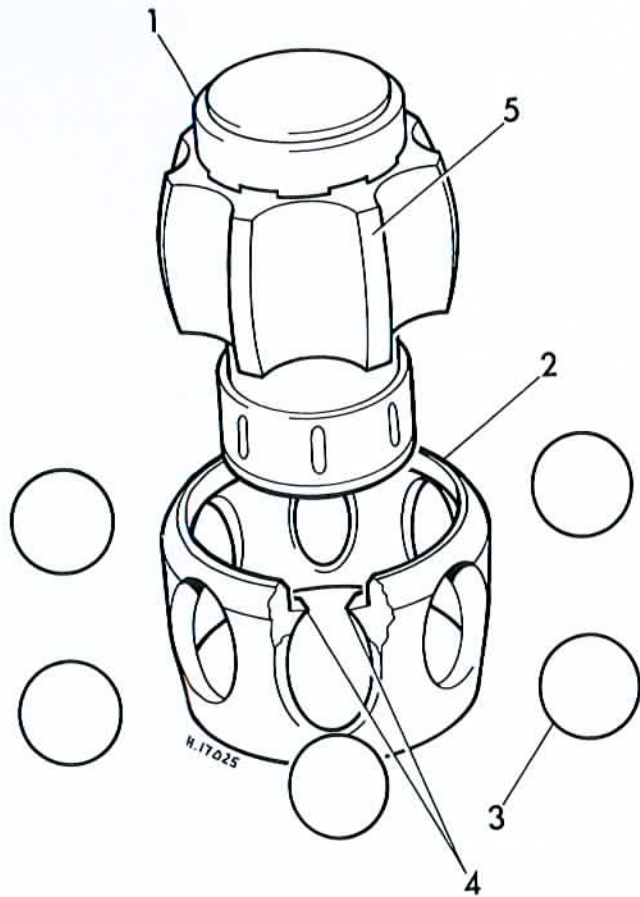


Fig. 7.12 Dismantling the offset sphere joint (Sec 9)

- | | |
|----------------|------------------------------|
| 1 Inner member | 4 Ball cage internal grooves |
| 2 Ball cage | 5 Inner member lands |
| 3 Balls | |

6 Carefully inspect the balls and the inner and outer members for signs of pitting, scoring, wear ridges or breakdown of the surface hardening. Examine the ball cage for elongation of the ball locations. If any of the components are worn, it will be necessary to renew the complete joint, as the internal parts are not available separately. If the joint is in a satisfactory condition, obtain a new rubber boot, boot retaining clips and a tube of the special lubricant from your BL dealer.

7 Begin reassembly by refitting the ball cage to the inner member, noting that the long tapered end of the ball cage faces the driveshaft end of the inner member.

8 Press each of the balls in turn into the locations in the ball cage.

9 Slide the assembled inner member into the joint outer member.

10 Position a new retaining ring onto the inner neck of the rubber boot with the chamfered end of the ring toward the inside of the boot.

11 Fold back the boot and, using a tube of suitable diameter, push the boot onto the inner member.

12 Pack the assembled joint with the contents of the tube of special lubricant, working it well into the ball tracks and cage.

13 Position the larger diameter of the rubber boot over the joint outer member. Place the retaining clip over the boot with the end containing the tabs facing away from the forward direction of joint rotation. Using pliers, pull the other end of the clip over the end containing the tabs and press down the first set of tabs using a screwdriver. Pull the free end tight and fold it over the compressed tabs. Now bend over the second set of tabs, trapping the free end of the clip underneath.

14 The offset sphere joint can now be refitted to the car as described in the previous Section.