

# Section G

## STEERING UNIT AND LINKAGE – ALL MODELS

### INDEX

	Page		Page
Ball joints	G-11	Relay unit	G-8
Data	G-12	Steering column thrust bearing	G-2
Defect location	G-12	Steering control tube	G-2
Drag link	G-10	Steering unit, recirculating ball type	G-6
Drop arm	G-2	Steering unit, worm and nut type	G-1
Longitudinal steering arm	G-8	Track rod	G-11
		Wheel alignment	G-11

### LIST OF ILLUSTRATIONS

Fig.		Page	Fig.		Page
G-1	Adjusting steering column thrust bearing	G-2	G-8	Relay unit	G-8
G-2	Replacing main nut in steering box	G-3	G-9	Compressing steering relay spring	G-9
G-3	Checking rocker shaft end-float	G-3	G-10	Assembling steering relay shaft assembly	G-9
G-4	Layout of steering column and linkage	G-4	G-11	Alternative method of compressing relay shaft assembly	G-10
G-5	Sectional view of steering column top	G-6	G-12	Replacing steering relay shaft and bushes in housing	G-10
G-6	Relative position of cam, bearings and main nut	G-7			
G-7	Sectioned view of rocker shaft and steering box	G-8			

### WORM AND NUT TYPE STEERING UNIT

#### Steering control tube

#### To remove Operation G/2

1. Disconnect the steering column wiring from the junction box on the dash panel.
2. Release the clip securing the wiring to the steering box and slide the rubber grommet (against the bottom of the steering box) off the wiring.
3. Remove the control tube clamp and joint washer from the control tube; pull the conical rubber washer in the cover plate off the wiring.
4. Pull the control tube and wiring up through the steering column and remove.
5. Remove the horn button and dipper switch unit from the control tube and disconnect the wiring from the unit as necessary. Section P.

#### To refit Operation G/4

1. Renew the wiring, horn button and dipper switch unit and control tube bushes as found necessary.
2. Position the felt bush at the top of the tube and the two rubber bushes at equal intervals down the tube.

3. Insert the complete assembly into the steering column and pull the wiring clear at the bottom.

4. Slide the rubber washer over the bottom of the control tube; fit the clamp and joint washer on the bottom cover plate.

5. Position the control unit with the dipper switch at the bottom and secure the tube in the clamp.

6. Slide the rubber grommet over the wiring up to the clamp.

7. Reconnect the steering column wiring to the junction box on the dash panel, Section P, and secure the wiring to the steering box with a clip.

#### Steering wheel

#### To remove Operation G/6

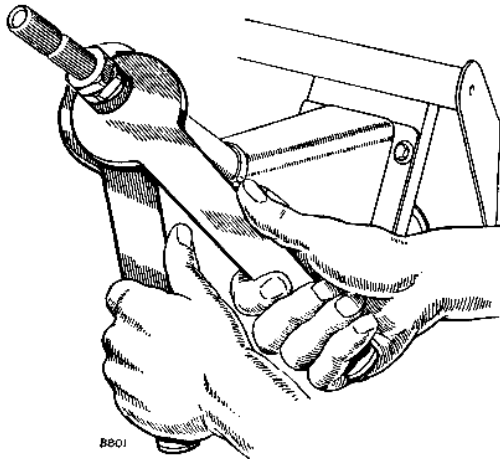
1. Remove the steering control tube. Operation G/2.
2. Remove the steering wheel from the steering inner column.

#### To replace Operation G/8

Reverse the removal procedure.

**Steering column thrust bearing****To adjust** **Operation G/10**

1. Remove the steering wheel. Operation G/6. The control tube and steering wheel need only be withdrawn as far as necessary for the adjustment to be made.
2. Pull the spring and dust cover clear of the thrust adjustment.

**Fig. G-1—Adjusting steering column thrust bearing.**

3. To remove any end-float in the inner column, unscrew the locking (upper) nut and screw down the adjusting (lower) nut until there is 7 to 9 lb./in. (0,08 to 0,10 mKg) pre-load on the thrust ball race; in practice this means that the end-float just disappears. Tighten the locking nut, using the special spanners, Part No. 263099.
4. Replace the steering wheel and control tube. Operation G/8.

**Drop arm****To renew** **Operation G/12**

1. Remove the longitudinal steering rod ball joint from the drop arm.

*Note:* If the ball joint pin is tight in the drop arm, the longitudinal steering tube and drop arm should be removed together. Operation G/22.

2. Withdraw the drop arm. Renew the drop arm if necessary.
3. Set the road wheels straight ahead and the steering unit in the midway position between full lock in each direction.
4. Fit the drop arm on the rocker shaft, selecting a suitable position on the splines, so that it lines up with the ball-joint pin.

*Note:* A suitable wedge-shaped tool must be used to open the slot in the drop arm when removing and replacing it on the splined end of the rocker shaft. This avoids damage to the splines and the side cover plate.

5. Reconnect the ball joint to the drop arm.
6. Fill the steering box with clean oil.

**Steering unit****To remove** **Operation G/14**

1. Disconnect the battery. Section P.
2. Remove the air cleaner. Section M.
3. Remove the steering control tube. Operation G/10.
4. Remove the steering wheel, dust cover and spring. Operation G/6.
5. Remove the steering column clip and rubber strip from the support bracket on the dash.
6. Remove the steering column support bracket.
7. Remove the steering column rubber grommet.
8. Withdraw the drop arm from the rocker shaft.
9. Remove the steering box from its support plate.
10. Withdraw the steering unit from under the front wing.

**To strip** **Operation G/16**

1. Remove the bottom cover plate complete with joint washer.
2. Remove the side cover plate complete with joint washer.
3. Withdraw the rocker shaft, taking care not to damage either of its bushes.
4. Rotate the inner column to unscrew the main nut and withdraw the nut.
5. Remove the locking nut and adjusting nut from the top of the inner column, using the special spanner, Part No. 263099 (Fig. G-1); remove the eighteen 7/32in. (5,5 mm) steel balls forming the thrust race.
6. Withdraw the inner column upwards through the outer column.  
*Vehicles Chassis No. 4710 series and early 5710 series.*  
Remove the rocker shaft cork sealing washer and retainer from the steering box.  
*Vehicles Chassis No. late 5710 series onwards.*  
Remove the rocker shaft rubber sealing washer and retainer from the steering box.
8. Drive or press out the two rocker shaft bushes, if necessary.

**To assemble** **Operation G/18**

1. Examine the inner column and main nut for wear, which will give rise to excessive play between the two parts; renew as necessary.
2. Examine the thrust race components and renew if badly worn.

3. Press in the new rocker shaft bushes if the original parts were removed. The bushes should be a *light drive fit* in the steering box and reamed in position to the dimension given in the data.

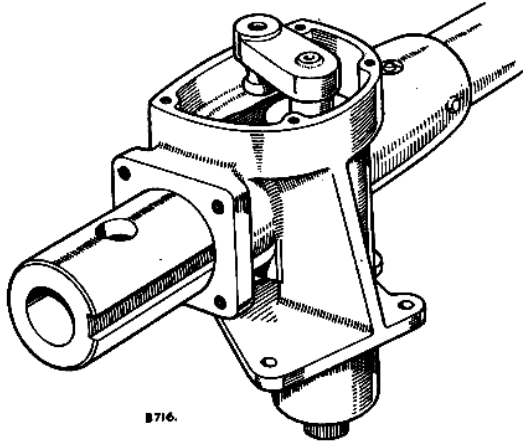


Fig. G-2—Replacing main nut in steering box.

4. Assemble the unit by reversing the stripping procedure, particular attention being paid to the following points:—
  - (a) Replace the nut in the steering box, *threaded portion first*.
  - (b) Ensure that the top face of the rocker shaft is almost flush with the top face of the side cover plate joint washer (available .010 in. and .020 in. thick) by means of a straight edge, as the rocker shaft must not have any end-float with the side cover plate in position.
  - (c) Replace the drop arm by using a wedge-shaped tool to slightly open the slot in the drop arm while replacing it on the rocker shaft, in order to eliminate any possibility of damage to the side cover plate.

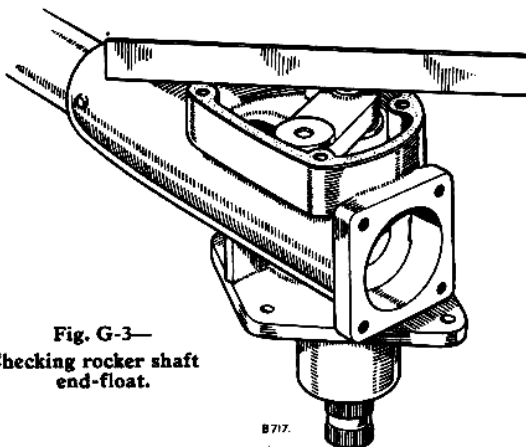


Fig. G-3—  
Checking rocker shaft  
end-float.

The thrust race should be packed with grease on assembly.

5. Adjust the thrust race. Operation G/10.

#### To refit Operation G/20

1. Reverse the removal procedure.
2. Before connecting the drop arm to the rocker shaft, set the road wheels straight ahead and the steering inner column in the midway position between full lock in each direction.
3. Fill the steering box with oil (see Instruction Manual).

#### Longitudinal steering tube

#### To renew Operation G/22

1. Raise the upper relay lever slightly to allow the ball joint pin to clear the lever and remove the longitudinal tube ball joint from the lever.
2. Withdraw the drop arm from the rocker shaft splines.
3. Withdraw the longitudinal tube and drop arm together towards the front of the vehicle under the radiator grille panel.
4. Disconnect the ball joint from the drop arm.
5. Unscrew the ball joints from the tube. (One left-hand and one right-hand thread.)
6. Examine the ball joints for wear in the body and pin, and renew the complete units as necessary; replace the rubber covers if damaged. Ball joints are supplied as complete units; only the rubber cover and retaining rings can be obtained separately. (Fig. G-1.) Renew the tube if necessary.
7. Fit the ball joints to the tube, leaving the clips slack at this stage.
8. Fit the drop arm to one ball joint.
9. Replace the tube and drop arm under the radiator grille panel.
10. Set the road wheels in the straight ahead position and the steering wheel in the midway position between full lock in each direction.
11. Fit the drop arm to the steering rocker shaft, Operation G/20, selecting a suitable position on the splines so that it is approximately vertical.
12. Fit the front ball joint to the upper relay lever, turning the tube to increase or decrease its effective length, so that the relay lever is not disturbed. Tighten the ball joint clips.
13. Check that the road wheels reach full lock (as determined by the limit stops on the swivel pin housings) in each direction.
14. Top up the steering unit.

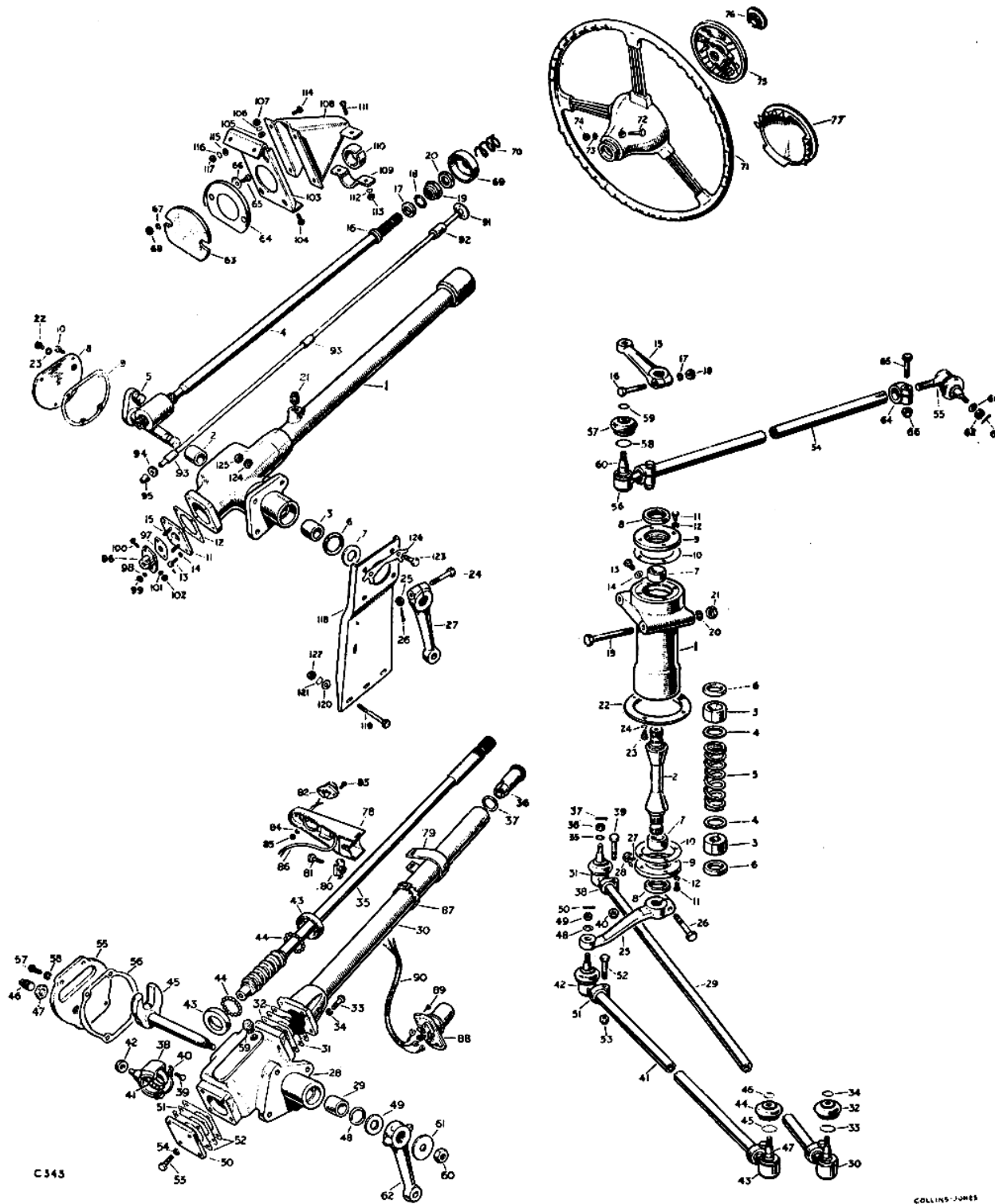


Fig. G-4—Layout of steering column and linkage.

Key to Fig. G-4

Steering Unit, Wheel and Drop Arm

1 Steering box assembly—R.H.D.	} 86 and 107 models	63 Rubber seal	} 86, 88, 107 and 109 models		
2 Bush for rocker shaft—inner, grooved		64 Cover for seal			
3 Bush for rocker shaft—outer, plain		65 Screw			
4 Inner column and nut		66 Special washer			
5 Rocker shaft for steering box		67 Spring washer			
6 Sealing washer		68 Nut	} 86 and 107 models		
7 Retaining washer		69 Dust shield			
8 Side cover plate		70 Spring for dust shield			
9 Joint washer		71 Steering wheel	} 86, 88, 107 and 109 models		
10 Bolt for cover plate		72 Bolt			
11 Bottom cover plate		73 Plain washer			
12 Joint washer		74 Nut			
13 Bolt		} For bottom cover plate	75 Horn button and dipper switch complete	} 86 and 107 models	
14 Spring washer					
15 Stud for control tube clamp		} 88 and 109 models	76 Horn button only	} 86 and 107 models	
16 Fixed ball race	77 Steering wheel centre cover				
17 Ball race ring	78 Horn push bracket				
18 Steel ball	79 Clip for horn push bracket				
19 Adjustable ball race	80 Yoke assembly for push bracket				
20 Locknut for ball race	81 Set bolt for bracket				
21 Oil filler and level plug	82 Horn push				
22 Air release plug	83 Special screw		} 88 and 109 models		
23 Washer for plug	84 Spring washer				
24 Special bolt	85 Nut				
25 Castle nut	} Fixing horn push to bracket		86 Lead—horn push to junction box		} 86 and 107 models
26 Split pin					
27 Drop arm	87 Cable cleat on steering column				
28 Steering box assembly	88 Dip switch				
29 Bush for rocker shaft	89 Drive screw for dip switch				
30 Outer column	90 Lead—dip switch to junction box				
31 Joint washer—steel	91 Control tube complete				
32 Joint washer—paper	92 Felt bush				
33 Bolt	} Fixing outer column	93 Rubber tube—intermediate			
34 Spring washer					
35 Inner column	} 88 and 109 models	94 Oil retaining washer—bottom	} 86 and 107 models		
36 Bush for inner column		95 Grommet for control tube wires			
37 Oil seal		96 Clamp for control tube			
38 Main nut assembly		97 Joint washer for clamp			
39 Set bolt		98 Spring washer		} Clamp to steering box cover	
40 Lock washer		99 Nut			
41 Steel ball		} For retainer		100 Bolt	} Control tube to clamp
42 Roller					
43 Adjustable ball race		} 88 and 109 models		101 Spring washer	} 86, 88, 107 and 109 models
44 Steel balls				102 Nut	
45 Rocker shaft				103 Support bracket on dash	
46 Adjuster screw				104 Bolt	
47 Locknut for adjuster screw				105 Plain washer	
48 Oil seal for rocker shaft				106 Spring washer	
49 Washer for oil seal				107 Nut	
50 End plate	108 Support bracket for steering column				
51 Joint washer—steel	109 Clip for steering column				
52 Joint washer—paper	110 Rubber strip for clip				
53 Bolt	} Clip to support bracket		111 Bolt		
54 Spring washer					
55 Side cover plate	} For side cover plate		112 Spring washer	} Fixing support bracket to dash bracket	
56 Joint washer					
57 Bolt	} 86 and 107 models		113 Nut	} 86, 88, 107 and 109 models	
58 Spring washer		114 Bolt			
59 Oil filler plug		115 Plain washer			
60 Special nut		116 Spring washer			
61 Lock washer		117 Nut			
62 Drop arm		118 Support bracket—86 and 107 models			
		119 Bolt			
		120 Plain washer	} Bracket to chassis frame		
		121 Spring washer			
		122 Nut	} Steering box to chassis support bracket		
		123 Bolt			
		124 Spring washer			
		125 Nut	} 86 and 107 models		
		126 Locking plate—88 and 109 models			

Relay Unit and Steering Arms

1 Housing for relay shaft	} 86, 88, 107 and 109 models	34 Spring ring and retainer, cover to ball	} 86, 88, 107 and 109 models	
2 Shaft for steering relay levers		35-37 Fixings for ball joints		
3 Split bush for housing		38 Ball joint		
4 Washer for spring		39-40 Fixings for ball joint clips		
5 Spring for bushes		41 Steering drag link assembly		
6 Thrust washer for shaft		42 Ball joint assembly R.H. thread		
7 Distance piece for shaft		43 Ball joint assembly L.H. thread		
8 Oil seal for shaft		44 Rubber cover for ball joint		
9 Retainer for oil seal		45 Spring ring, cover to body		
10 Joint washer for retainer		46 Spring ring		
11-12 Fixings for retainer		47 Retainer		} Cover to ball
13 Plug for oil hole		48-50 Fixings for ball joints		
14 Joint washer for plug		51 Clip for ball joint		} 86, 88, 107 and 109 models
15 Relay lever, upper		52-53 Fixings for ball joint clips		
16-18 Fixings for lever		54 Longitudinal steering tube assembly		
19-21 Fixings for housing	55 Ball joint assembly R.H. thread			
22 Flange plate for relay mounting	56 Ball joint assembly L.H. thread			
23-24 Fixings for flange plate	57 Rubber cover for ball joint			
25 Relay lever, lower	58 Spring ring, cover to body			
26-28 Fixings for lever	59 Spring ring			
29 Steering track rod assembly	60 Retainer	} Cover, to ball		
30 Ball joint assembly R.H. thread	61-63 Fixings for ball joints to levers			
31 Ball joint assembly L.H. thread	64 Clip for ball joint			
32 Rubber cover for ball joint	65-66 Fixings for ball joint clips			
33 Spring ring, cover to body				

### RECIRCULATING BALL TYPE STEERING UNIT

#### Steering unit—to remove Operation G/24

1. Unscrew the clamp bolt and withdraw the steering wheel.
2. Disconnect the clamp securing the horn switch and support bracket to the steering outer column, then remove the assembly complete with leads.
3. Remove the spare wheel if mounted on bonnet, disconnect the support and lift the bonnet clear.
4. R.H.D. models only—Remove the air cleaner.
5. Remove the name plate and withdraw the radiator grille.
6. Loosen the bolt securing the upper relay lever to the relay unit and prise the lever clear.
7. Turn the steering wheel to allow the longitudinal steering arm to move fully forward, then slacken the clamping bolt nearest the drop arm and unscrew the longitudinal arm complete with relay lever.
8. Remove the bolts securing the steering support bracket to chassis side-member, scuttle and wing valance.
9. The support clip, rubber strip, support brackets and seal must now be removed from the dash.
10. Withdraw the steering unit complete with support plate, drop arm and ball joint from under the front wing.
11. Remove the securing screw and extract the drop arm, using special tool (Part No. 262776).
12. Unscrew the castellated nut and remove the ball joint from drop arm by tapping the side adjacent to taper smartly with a hammer.

#### Steering unit—to refit Operation G/26

1. Refit the support plate to chassis side-member, scuttle and wing valance.
2. Mount the steering unit less drop arm, then secure at dash and support plate. Refit the horn switch and bracket assembly.
3. Turn the inner steering column lock to lock and select the intermediate position.
4. Replace the steering wheel with one series of spokes pointing forward and secure.
5. Screw the ball joint into the longitudinal arm and lock in the original position.
6. Fit the longitudinal arm complete with upper relay lever to the drop arm and insert the assembly along the top of chassis side-member. Connect the upper relay lever to relay unit.
7. With the front wheels positioned "straight ahead" and the steering wheel in the intermediate position, fit the drop arm to the rocker shaft. The longitudinal arm may require adjusting slightly to align the splines of drop arm and steering rocker shaft.
8. Check the steering, lock to lock, for correct functioning. Adjust if necessary by altering the length of the longitudinal arm.

#### Steering unit—to dismantle Operation G/28

1. Remove the side cover and drain off the oil.
2. Lift off the main nut, roller, and withdraw the rocker shaft.
3. With the outer column held in a vice, unscrew the nuts holding the steering box and tap the inner column at the steering wheel end with a hide-faced hammer to partially remove the box.
4. Withdraw the box and inner column complete. The dust cover at the top of steering column will be freed by this last operation and care must be taken to ensure that this or balls from the steering box are not inadvertently lost.
5. Make provision for catching the balls, and with a hide-faced hammer, gently tap the box away from the inner column sufficiently to remove the outer ball race.

*Note:* The main nut should be positioned approximately midway on the cam during this operation.

6. Turn the inner column to unscrew the main nut assembly and withdraw the column completely from the steering box. Remove the main nut assembly.
7. Remove the end cover, shims, ball race and any balls that may have dropped into the steering box.
8. The ball transfer tube may be removed from the main nut.
9. If oil leakage and bearing wear is excessive, remove the retaining washer, oil seal and press out the bush from steering box.
10. Remove the bush and seal from top of outer column, if excessively worn.

#### Steering unit—to assemble Operation G/30

1. Press the Tufnol bush with oil seal into the top outer steering column tube.

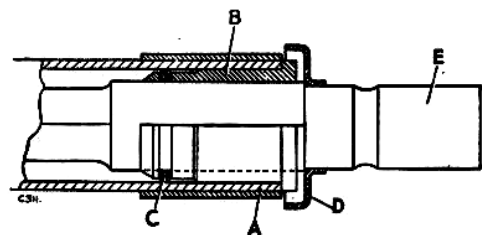


Fig. G-5—Sectioned view of steering column top.

A—Column outer tube      C—Seal  
B—Tufnol bush              D—Dust cover  
E—Inner shaft

2. If removed fit the rocker shaft bush to the steering box.
3. Locate the rocker shaft seal and retaining washer.

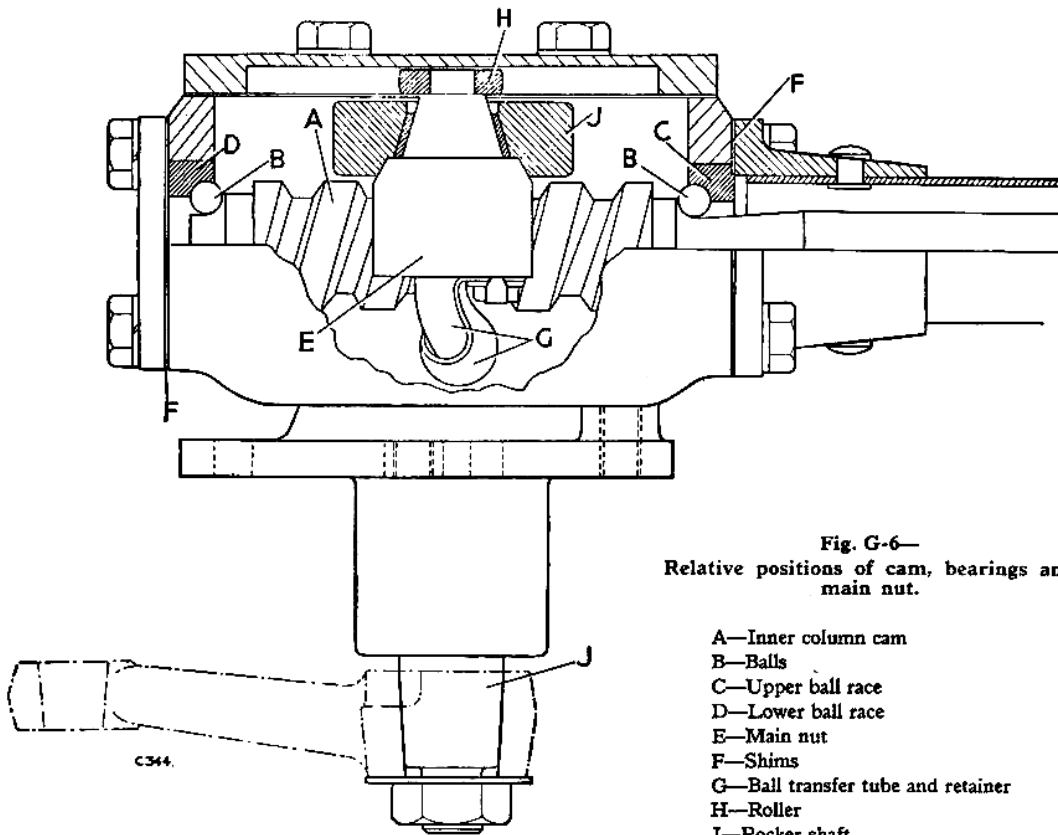


Fig. G-6—  
Relative positions of cam, bearings and main nut.

- A—Inner column cam
- B—Balls
- C—Upper ball race
- D—Lower ball race
- E—Main nut
- F—Shims
- G—Ball transfer tube and retainer
- H—Roller
- J—Rocker shaft

4. Grease any thickness shim and two paper washers each side of the shim, to the flange on the outer column, then mount the outer column in a vertical position in a vice (Tufnol bush downwards).
5. Place one of the ball races, less ball bearings, over the inner column and slide the inner column into the outer column and Tufnol bush, ensuring it is free to rotate. Lift the inner column a little, grease the ball race and load with ten ball bearings, ensuring that none fall down the inside of the outer column.
6. Assemble the main nut, replacing balls as necessary and retain them in position with grease. Locate the assembly in steering box and lower on to the cam end of the inner column.
7. Carefully rotate the inner column, ensuring that the ball bearings in the main nut are not dislodged, and the steering box is up the correct way. (Filler plug towards the outer column.)
8. Grease the lower ball race and stick ten balls in position. Locate the outer ball race, shims, joint washer and end cover, then carefully tighten, ensuring that none of the balls are dislodged.

*Note:* The inner shaft should have no end-float, but to ensure that the bearings are not over-stressed, sufficient shims must first be fitted to allow an end-float

reading and then shims equivalent in thickness to this reading, be removed.

The steering unit may now be elevated into a horizontal position.

9. Fit the main nut, roller, replace the rocker shaft, joint washer and cover, ensuring that the roller is correctly located in the cover slot.
10. With the main nut at mid-position on cam, tighten the adjusting screw on side cover by hand until resistance is felt as it contacts the rocker shaft; tighten a further tenth of a turn and lock the adjusting screw.
11. Refit the dust cover to top end of steering column.

**Steering wheel**

**To remove** **Operation G/32**

1. Unscrew the clamping bolt at hub and withdraw the wheel.

**Drop arm**

**To remove** **Operation G/34**

1. The complete steering unit must be removed before the drop arm can be extracted—see Operation G/24.

**To refit**

See Operation G/26.

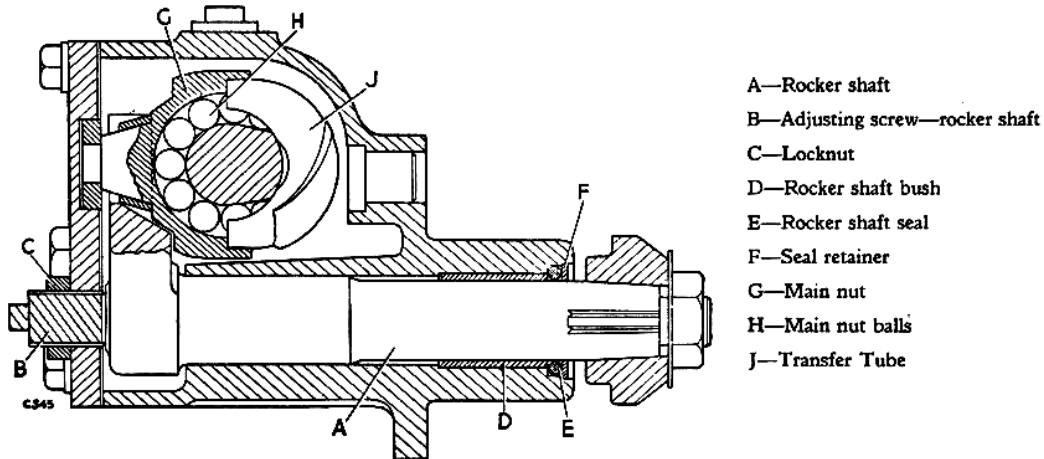


Fig. G-7—Sectioned view of rocker shaft and steering box.

**Longitudinal steering arm****To remove****Operation G/36**

1. Remove the radiator grille, loosen the clamping bolt securing the upper relay lever and prise the lever off the relay unit.
2. Turn the steering wheel to allow the longitudinal steering arm to move fully forward, loosen the clamping bolt nearest to drop arm and unscrew the longitudinal arm complete with relay lever. Withdraw the assembly from the front of vehicle.
3. Unscrew the castellated nut securing the ball joint to the drop arm, then with a solid metallic object on one side of the drop arm adjacent to the taper, tap the other side with a hammer to loosen the ball joint.
4. Turn the steering wheel to move the drop arm rearwards and remove the ball joint.

**To replace****Operation G/38**

1. Reverse the removal procedure, ensuring that the longitudinal arm is screwed back on to exactly the former position.
2. Check the "lock to lock" movement and alter if necessary by adjusting the length of the longitudinal arm.

**Steering relay unit****To remove****Operation G/40**

1. Remove the air cleaner and battery. Section P.
2. Remove the bolts securing the radiator grille panel to the front wings.
3. Remove the bolts securing the grille panel to the chassis frame; remove the front apron panel; when the bolts are clear, the rubber packing pieces between the panel and frame may also be withdrawn. It will now be possible to move the radiator assembly slightly to assist in the removal of the relay unit, but care must be taken to prevent damage to the coolant hoses.

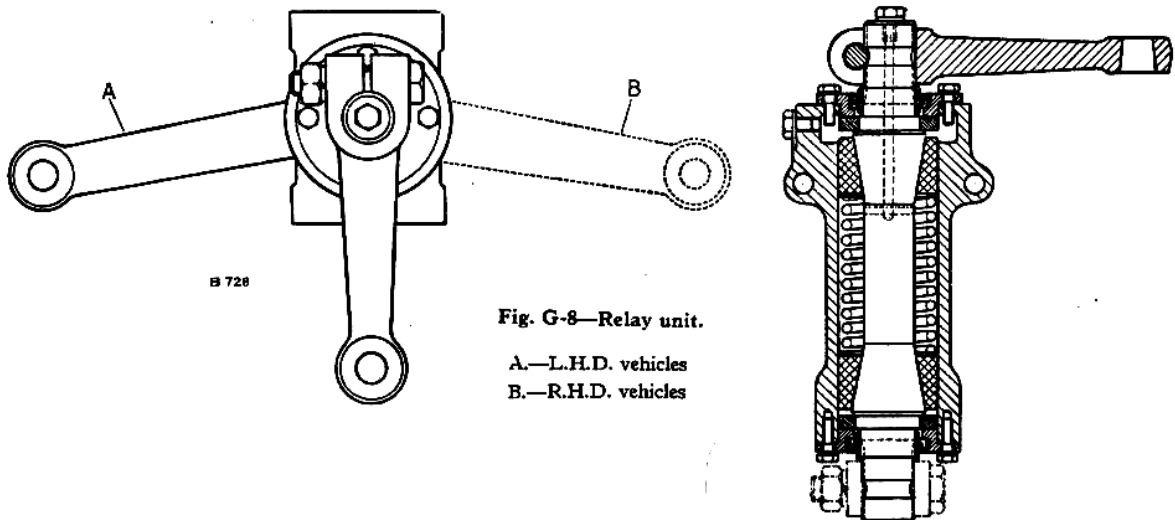


Fig. G-8—Relay unit.

- A.—L.H.D. vehicles  
B.—R.H.D. vehicles



4. Raise the upper relay lever slightly to allow the ball joint pin to clear the lever; disconnect the longitudinal tube ball joint from the upper relay lever.
5. Detach the lower relay lever from the relay unit shaft.
6. Remove the relay unit upwards, tapping gently with a hide-faced hammer, if necessary. The flange plate can be left in position on the underside of the chassis cross-member.

**To strip****Operation G/42**

1. Remove the upper relay lever.
2. Drain off as much oil as possible by removing the oil filler and bleed plugs.
3. Remove the bottom plate complete with oil seal and joint washer.

Secure a sack over the bottom half of the relay box and mount relay in a vice with the bottom pointing downwards into the sack.

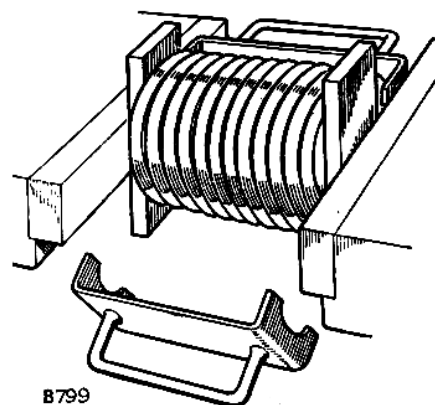
CAREFULLY tap out the shaft, Tufnof bushes and spring into the sack.

*Note:* The spring is compressed to over 100 lb. (45 kg) when in position, and will cause serious damage if care is not exercised.

4. Remove the bottom end plate and brass thrust washer.

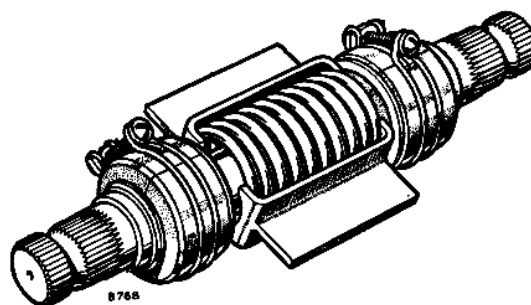
**To assemble****Operation G/44**

1. Examine the oil seals in the end caps and renew them if damaged. Examine the distance pieces on the shaft (which form tracks for the oil seals) for damage which may have caused failure of the seals; renew them as necessary.
2. Renew the split Tufnof bushes if worn or damaged.
3. Check the spring in accordance with given data. Renew the spring if necessary.
4. Fit the top end plate and joint washer to the housing.
5. Fit one split bush to the taper on the shaft and secure tightly with a suitable 2 in. hose clip (Part No. 50320).
6. Hold a suitable bar (Part No. 262768) over each end of the spring and compress it to a length of 3 in. (76 mm) in a vice, with the bars central and vertical. Place a suitable clip (Part No. 262769) over each side of the spring, as shown at Fig. G-9. Release the vice and remove the spring and clips complete.

**Fig. G-9—**

Method of compressing steering relay spring.

7. Slide a washer over the shaft and fit the spring to the shaft so that it abuts the washer and bush.
8. Slide a second washer over the shaft and fit the second split hush to the shaft, securing it with a hose clip as for the first one (Fig. G-10).

**Fig. G-10—Assembling steering relay shaft assembly.**

9. Remove the clips retaining the spring, slide the lower brass thrust washer over the top end of the shaft and carefully enter the assembly, top end first, into the housing; push the shaft into the housing, up towards the bleed plug end, so leaving the first hose clip free. Remove the clip and push the shaft home; release the second hose clip.
10. Fit a thrust washer to the bottom end of the shaft and fit the end cap and joint washer.
11. Fit the upper relay lever.
12. Fill the housing with oil, and fit the filler and bleed plugs and joint washers.
13. If the assembly is in order, it should need a force of at least 12 lb. (5,5 kg) to turn the relay lever and shaft, using a spring balance in the relay lever boss.

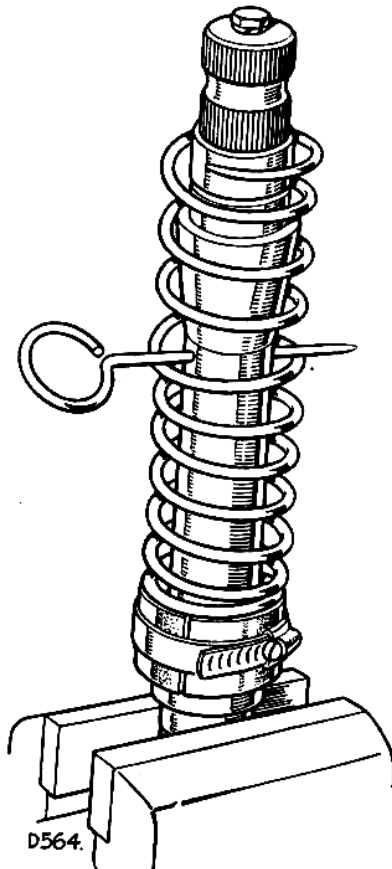


Fig. G-11—Alternative method of compressing steering relay spring

#### Alternative method to assemble relay unit

1. Examine all parts and renew as necessary.
2. Fit the top end plate and joint washer to the housing.
3. Fit one split bush to the taper on the bottom end of the shaft, and secure tightly with a suitable 2 in. hose clip (Part No. 50323).
4. Place a steel washer on to the shaft, next to the inner side of the Tufnol bush.
5. Place the spring over the shaft and insert the special tool (Part No. 510309) through the coils of the spring and right through the lubrication cross-drilling in the shaft.
6. The spring can now be wound down the tool until the steel washer and the split Tufnol bush can be secured to the taper on the other end of the shaft with a hose clip.
7. Remove the special tool (Part No. 510309).
8. Place a brass thrust washer on the top end of the shaft, lubricate the shaft and insert into the housing.

9. With a plastic hammer gently tap the shaft into the housing until the first hose clip slides off the Tufnol bush, remove the clip completely from the shaft.
10. Continue to tap the shaft into the housing until the second clip is freed and the shaft abuts the top end cover.
11. Fit the bleed and filler plugs, fill the unit with oil, replace the bottom end thrust washer, joint washer, end cover and tighten the retaining bolts.
12. Fit the upper relay lever.
13. If the unit is in order, it should require a force of at least 12 lb. (5,5 kg) to turn the relay shaft, using a spring balance in the relay lever boss.

#### To refit

#### Operation G/46

Reverse the removal procedure.

The lower relay lever must be fitted as illustrated at Fig. G-8.

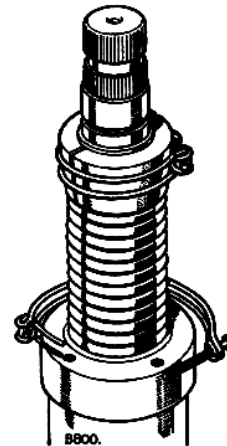


Fig. G-12—Replacing steering relay shaft and bushes in housing.

#### Drag link

#### To renew

#### Operation G/48

1. Disconnect the drag link ball joints from the lower relay lever and steering arm. Remove the drag link complete.
2. Unscrew the ball joints from the drag link tube (one left-hand and one right-hand thread).
3. Examine the ball joints for wear in the body and pin and renew the complete units as necessary; replace the rubber covers if damaged. Ball joints are supplied as complete units; only the rubber cover and retaining rings can be obtained separately. (Fig. G-1.) Renew the tube if necessary.
4. Fit the ball joints to the tube, leaving the clips slack at this stage.
5. Secure one end of the drag link to the lower relay lever.

6. Set the road wheels straight ahead and the steering wheel in the midway position between full lock in each direction.
7. Secure the other end of the drag link to the steering arm, turning the tube to increase or decrease its effective length, so that the relay lever and steering arm are not disturbed.
8. Tighten the ball joint clips.
5. If correction is required to the toe-in, slacken the clips securing the ball joints to the track rod and turn the rod to decrease or increase its effective length as necessary, until the toe-in is correct.
6. Tighten the ball joint clips.

#### Steering ball joints

#### To renew Track rod Operation G/50

1. Disconnect the track rod ball joints from the steering arms; remove the track rod complete.
2. Unscrew the ball joints from the track rod tube (one left-hand and one right-hand thread).
3. Examine the ball joints for wear in the body and pin, and renew the complete units as necessary; replace the rubber covers if damaged. Ball joints are supplied as complete units; only the rubber cover and retaining rings can be obtained separately (Fig. G-1); renew the tube if necessary.
4. Fit the ball joints to the tube, leaving the clips slack at this stage.
5. Secure the ball joints to the steering arms and adjust the toe-in. Operation G/50.

#### Wheel alignment

#### To check and adjust Operation G/52

1. No adjustment is provided for castor, camber or swivel pin inclination.
2. The toe-in is adjustable; proceed as follows:
3. Set the vehicle on level ground with the road wheels in the straight-ahead position, and push it forward a short distance.
4. Measure the toe-in with the aid of a tracking stick or suitable proprietary equipment; it should be 3/64 in. to 3/32 in. (1,2 mm to 2,4 mm).

#### To check Operation G/54

1. The steering ball joints have been designed in such a way as to retain the initial filling of grease for the normal life of the ball joint; however, this applies only if the rubber boot remains in position on the joint. The rubber boots should be checked every 3,000 miles (5,000 km) to ensure that they have not become dislodged or the joint damaged. Should any of the rubber boots be dislodged, proceed as follows:—
2. Remove the ball end from the drop arm lever by tapping smartly around the eye of the pin.
3. Remove the rubber boot.
4. Thoroughly clean all parts.
5. Place the castle nut upside down on the pin and screw on a few threads, then place the ball joint under a press or between the jaws of a vice and carefully force the pin and ball down against the spring. In this position the interior of the ball joint can be cleaned and lubricated.
6. Apply grease around the taper, and fill the rubber boot.
7. Reassemble, using new rubbers and spring rings as required.
8. When refitting track rod and ball joints to the drop arms, ensure that the ball joints are aligned with each other, in order to allow full unrestricted movement of the steering linkage.
9. When refitting longitudinal steering arm and drag link, ensure that the ball joint body is parallel with respective steering arms, in order to allow full movement.

## DEFECT LOCATION

## Symptom, Cause and Remedy

## A—EXCESSIVE LOOSENESS OR BACKLASH IN THE STEERING

1. Steering rocker shaft incorrectly adjusted or badly worn—*Adjust or renew.*
2. Steering linkage loose or worn—*Rectify or renew.*
3. Swivel pins and bearings loose or worn—*Section F.*
4. Loose or worn front wheel bearings—*Section F.*
5. Steering box securing bolts loose—*Tighten.*

## B—TIGHT STEERING

1. Low or unequal tyre pressures—*Section S.*
2. Steering box oil level low—*Replenish.*
3. Steering rocker shaft adjusted too tightly—*Adjust.*

## C—RATTLE IN STEERING COLUMN

1. Steering rocker shaft incorrectly adjusted or badly worn—*Adjust or renew.*

## D—VEHICLE PULLS TO ONE SIDE

1. *Section F.*

## E—VEHICLE WANDERS

1. *Section F.*

## F—WHEEL SHIMMY

1. *Section F.*

## GENERAL DATA

WORM AND NUT TYPE  
STEERING UNIT

Type	....	....	Worm and nut
Ratio	....	....	15 : 1
Thrust adjustment	....	7-9 lb/in. (0,08 to 0,10 mKg)	pre-load on bearing at top of column
Number of turns of steering wheel from lock to lock	....	....	2.4

RECIRCULATING BALL TYPE  
STEERING UNIT

Type	....	....	Recirculating ball
Ratio	....	Straight ahead	15.6 : 1
		Full lock	.... 23.8 : 1
Inner column end-float	....	....	Nil
Rocker shaft end-float	....	....	Nil
Number of turns of steering wheel from lock to lock	....	....	3.3

## DETAIL DATA, ALL MODELS

## Relay shaft clearances

in bushes	....	.003 to .0045 (0,08 to 0,12 mm)
-----------	------	---------------------------------

## Longitudinal steering tube

## Ball joints

Type	....	....	Non-adjustable; 7/16 in. B.S.F. thread
Tightening torque	....	....	30 lb/ft. (4 Kgm)

## Steering relay unit

## Bushes

Type	....	....	Tufnol cones
------	------	------	--------------

## Spring:

Number of working coils	....	....	10
Free length	....	....	7¼ in. (184 mm)
Fitted length	....	....	3 in. (72,2 mm)
Load at fitted length	....	....	104 lb. (47 Kg)

## Wheel alignment

Wheel camber	....	....	1½°
Wheel castor	....	....	3°
Swivel pin inclination	....	....	7°
Toe-in	....	....	3/64 to 3/32 in. (1,2 mm to 2,4 mm)

# Section J – SUSPENSION

## INDEX

	Page		Page
Bump rubber ....	J-7	Hydraulic damper ....	J-7
Data ....	J-1	Rear axle check strap ....	J-7
Front spring ....	J-6	Rear spring ....	J-6

## LIST OF ILLUSTRATIONS

Fig.		Page	Fig.		Page
J-1	Front road spring, 1948-53	J-2	J-5	Rear road spring (Land-Rover 86 and 88)	J-5
J-2	Front road spring, 1954-58	J-2	J-6	Rear road spring (Land-Rover 107 and 109)	J-5
J-3	Layout of suspension	J-3			
J-4	Rear road spring (Land-Rover 80 and 88)	J-5			

## SUSPENSION DATA

### Front road springs

#### Land-Rover 80, 1948-53

	<i>Type 1</i>	<i>Type 2</i>	<i>Type 3</i>
Fitted to vehicles numbered	Prior to 862115	862115 to 06113529 8670001 to 06200419 8680001 to 06300030	06113530 06200420 and 06300031 onwards
Number of leaves	9	9	9
Width of leaves	1¾ in. (44,45 mm)	1¾ in. (44,45 mm)	2½ in. (63,5 mm)
Thickness of leaves	6 (upper) x .203 in. (5,16 mm) and 3 x .180 in. (4,57 mm) or 2 (upper) x .218 in. (5,56 mm) and 6 x .187 in. (4,76 mm)	6 (upper) x .203 in. (5,16 mm) and 3 x .180 in. (4,57 mm) or 3 (upper) x .218 in. (5,56 mm) and 6 x .187 in. (4,76 mm)	9 x .165 in. (4,2 mm)
Static load	617 lb. (280 kg)	755 lb. (342 kg)	524 lb. (237 kg)
Camber under static load	Flat	Flat	1.63 in. (27 mm)
Rate	200 lb./in. (2,304 kg/m)	230 lb./in. (2,649 kg/m)	190 lb./in. (2,189 kg/m)
Free camber	3½ in. (89 mm)	4 in. (102 mm)	4.39 in. (102,5 mm)

#### Land-Rover 86 and 88, 1954-58

	<i>Driver</i>	<i>Passenger</i>
Number of leaves	10	10
Width of leaves	2½ in. (63,5 mm)	2½ in. (63,5 mm)
Thickness of leaves	top plate x 11/64 in. (4,36 mm) and 9 x 9/64 in. (3,57 mm)	top plate x 11/64 in. (4,36 mm) and 9 x 9/64 in. (3,57 mm)
Static load	610 lb. (277 kg)	508 lb. (230 kg)
Camber under static load	2½ in. (63,5 mm)	2½ in. (63,5 mm)
Rate	152 lb./in. (1,74 kg/m)	152 lb./in. (1,74 kg/m)
Free camber	6.5 in. (165 mm)	5.875 in. (149 mm)

Land-Rover 107 and 109, 1954-58

	Driver	Passenger	
Number of leaves	9	9	} Up to Chassis No. 57200469
Width of leaves	2½ in. (63,5 mm)	2½ in. (63,5 mm)	
Thickness of leaves	9 x .165 in. (4,2 mm)	9 x .165 in. (4,2 mm)	
Static load	750 lb. (340 kg)	636 lb. (288 kg)	
Camber under static load	2¾ in. (69,85 mm)	2¾ in. (69,85 mm)	
Rate	190 lb./in. (2,19 kg/m)	190 lb./in. (2,19 kg/m)	
Free camber	6.70 in. (170,18 mm)	6.08 in. (154,43 mm)	} From Chassis No. 57200470 onwards
Number of leaves	11	11	
Width of leaves	2½ in. (63,5 mm)	2½ in. (63,5 mm)	
Thickness of leaves	11 x 11/64 in. (4,3 mm)	11 x 11/64 in. (4,3 mm)	
Static load (vehicle unladen)	750 lb. (340 kg)	750 lb. (340 kg)	
Camber under static load	2¾ in. (69,85 mm)	2¼ in. (57,1 mm)	
Rate	260 lb./in. (46,5 kg/cm)	260 lb./in. (46,5 kg/cm)	
Free camber	5½ in. (142,9 mm)	5¾ in. (130 mm)	

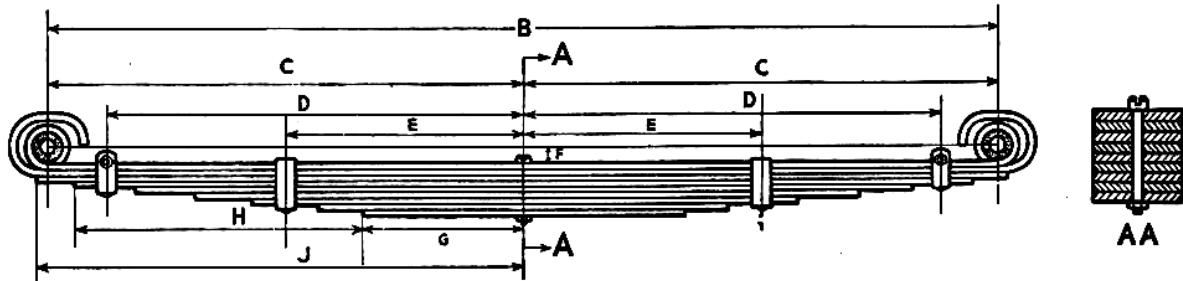
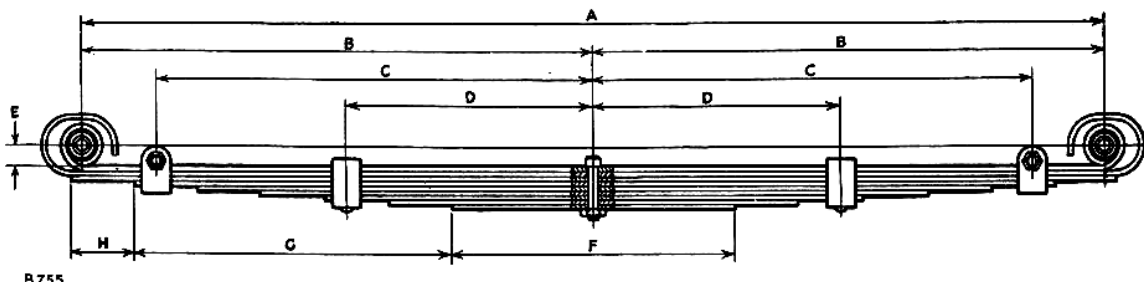


Fig. J-1—Dimensions with spring flat.  
(Land-Rover 80 and 86, 1948-53)

B—36½ in. (921 mm)	G—5 in. (127 mm)
C—18½ in. (460 mm)	H—5 x 2½ in. (5 x 60,3 mm) (Types 1 and 2) and 5 x 2¼ in. (5 x 57,2 mm) (Type 3)
D—15½ in. (403 mm)	J—18½ in. (467 mm) (Except Type 1)
E—8½ in. (222 mm)	
F—25/32 in. (19,8 mm)	



B755

Fig. J-2—Dimensions with spring flat.  
(Land-Rover 86 and 88, 1954-58—Driver and Passenger side)

A—36½ in. (921 mm)	F—86 and 88 model 10 in. (254 mm)	} Alternative
B—18½ in. (460,5 mm)	107 and 109 model 10 in. (254 mm)	
C—15½ in. (394 mm)	9¾ in. (247,7 mm)	
D—86 and 88 model 10 in. (254 mm)	G—86 and 88 model 11¼ in. (286 mm)	} Alternative
107 and 109 model 8¾ in. (222 mm)	107 and 109 model 11¼ in. (286 mm)	
10¾ in. (263,5 mm)	11¼ in. (288,9 mm)	
E—.720 in. (18,28 mm)	H—86 and 88 model 2¼ in. (54 mm)	} Alternative
	107 and 109 model 2¼ in. (54 mm)	
	2¼ in. (57,1 mm)	

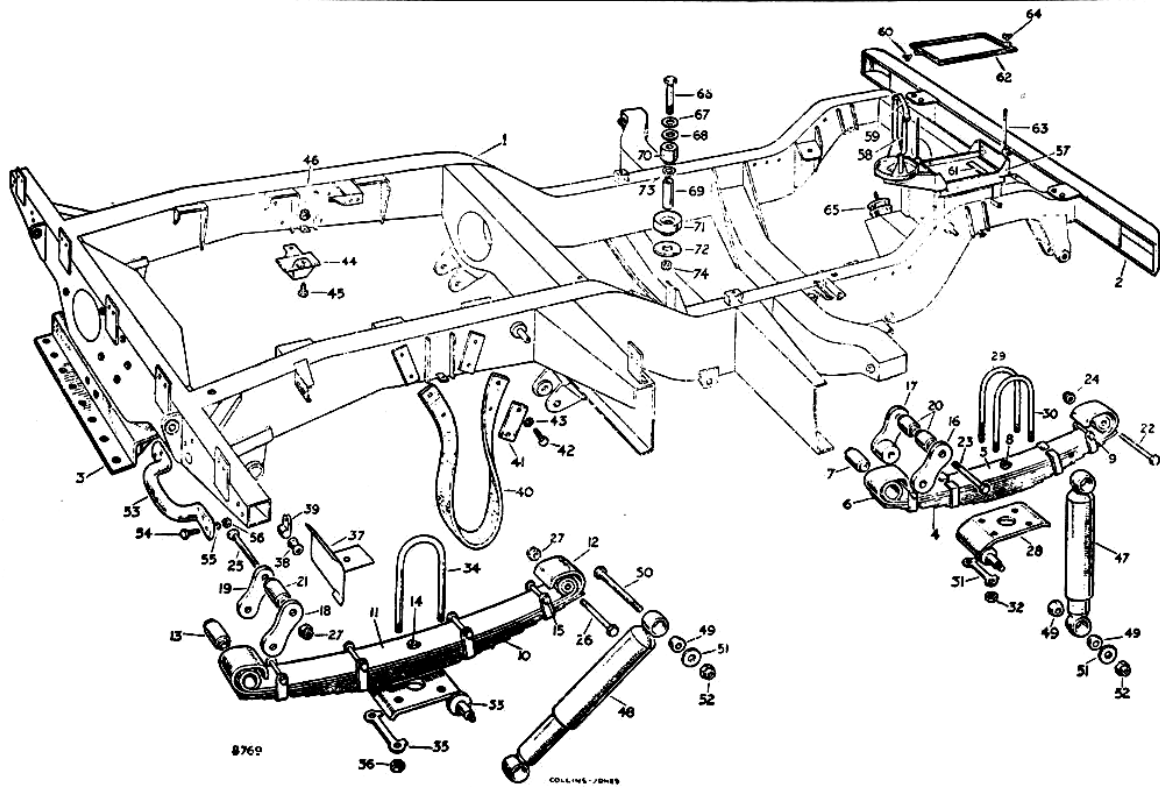


Fig. J-3—Layout of suspension.

- |       |                                       |       |   |
|-------|---------------------------------------|-------|---|
| 1     | Chassis frame                         | 37    | Shield for brake pipe, R.H.                     |
| 2     | Front bumper                          | 38    | Rubber grommet for brake pipe                   |
| 3     | Rear draw bar                         | 39    | Clip for grommet                                |
| 4     | Road spring complete, front, driver's | 40    | Check strap for rear axle                       |
| 5     | Main leaf } For front                 | 41    | Plate for check strap                           |
| 6     | 2nd leaf } spring                     | 42-43 | Fixings for check strap                         |
| 7     | Bush for front spring                 | 44    | Rubber buffer for axles, front and rear         |
| 8     | Dowel for front spring                | 45-46 | Fixings for buffers                             |
| 9     | Bolt } For spring                     | 47    | Shock absorber, front                           |
|       | Nut } clip                            | 48    | Shock absorber, rear                            |
| 10    | Road spring complete, rear, driver's  | 49    | Rubber bush for shock absorbers                 |
| 11    | Main leaf } For rear                  | 50-52 | Fixings for shock absorbers                     |
| 12    | 2nd leaf } spring                     | 53    | Lifting handle, rear                            |
| 13    | Bush for rear spring                  | 54-56 | Fixings for handles                             |
| 14    | Dowel for rear spring                 | 57    | Battery casing and air cleaner support complete |
| 15    | Bolt } For                            | 58    | Air cleaner clamp, side                         |
|       | Nut } spring clip                     | 59    | Air cleaner clamp, top                          |
| 16    | Shackle plate, tapped                 | 60    | Wing nut for clamp                              |
| 17    | Shackle plate, plain                  | 61    | Rubber strip for battery                        |
| 18    | Shackle plate, tapped                 | 62    | Battery cover                                   |
| 19    | Shackle plate, plain                  | 63    | Battery fixing rod                              |
| 20    | Bush in chassis frame, front spring   | 64    | Wing nut fixing battery                         |
| 21    | Bush in chassis frame, rear           | 65    | Suspension rubber for engine, front             |
| 22    | Shackle pin, front                    | 66    | Bolt, rear                                      |
| 23    | Shackle pin, springs to frame, front  | 67    | Plain washer, top                               |
| 24    | Self-locking nut, front               | 68    | Rubber washer                                   |
| 25    | Shackle pin, rear                     | 69    | Distance tube                                   |
| 26    | Shackle pin, springs to frame, rear   | 70    | Top rubber                                      |
| 27    | Self-locking nut, rear                | 71    | Bottom rubber                                   |
| 28    | Bottom plate for front spring, R.H.   | 72    | Plain washer bottom                             |
| 29-32 | Fixings for front springs             | 73    | Shim  |
| 33    | Bottom plate for rear spring, R.H.    | 74    | Special nut                                     |
| 34-36 | Fixings for rear springs              |       |   |
- } Fixing engine unit to chassis frame at front and rear

Rear road springs

Land-Rover 80, 1948-53

	Driver	Passenger
Number of leaves	9 or 10	9 or 10
Width of leaves	1 1/2 in. (44,45 mm)	1 1/2 in. (44,45 mm)
Thickness of leaves	10 x .203 in. (5,16 mm) or 7 x .218 in. (5,56 mm) and 2 x .187 in. (4,76 mm)	10 x .203 in. (5,16 mm) or 7 x .218 in. (5,56 mm) and 2 x .187 in. (4,76 mm)
Static load	455 lb. (206 kg)	365 lb. (165 kg)
Camber under static load	2.38 in. (51,5 mm)	2.38 in. (51,5 mm)
Rate	180 lb./in. (2.074 kg/m)	180 lb./in. (2.074 kg/m)
Free camber	4 1/2 in. (114 mm)	4 in. (102 mm)

Land-Rover 86 and 88, 1954-58

	Driver	Passenger
Number of leaves	11	11
Width of leaves	2 1/2 in. (63,5 mm)	2 1/2 in. (63,5 mm)
Thickness of leaves	top plate x 1/4 in. (6,35 mm) and 10 x 3/16 in. (4,76 mm)	top plate x 1/4 in. (6,35 mm) and 10 x 3/16 in. (4,76 mm)
Static load	690 lb. (313 kg)	580 lb. (263 kg)
Camber under static load	2.5 in. (63,5 mm)	2.5 in. (63,5 mm)
Rate	166 lb./in. (1,90 kg/m)	166 lb./in. (1,90 kg/m)
Free camber	6.67 in. (154 mm)	6 in. (152 mm)
Fit of bushes in spring and chassis bores	.0025 to .0075 in. (0,065 to 0,18 mm) interference	

Land-Rover 107 and 109

	Driver	Passenger	
Number of leaves	10	10	All 107 basic models and 109 models up to vehicles numbered 121601061, and 107 Station Wagon up to 87060061
Width of leaves	2 1/2 in. (63,5 mm)	2 1/2 in. (63,5 mm)	
Thickness of leaves	top plate x 1/4 in. (6,35 mm), 7 x 3/16 in. (4,76 mm) and 2 x 5/16 in. (7,93 mm)	top plate x 1/4 in. (6,35 mm), 7 x 3/16 in. (4,76 mm) and 2 x 5/16 in. (7,93 mm)	
Static load	840 lb. (381 kg)	720 lb. (326 kg)	
Camber under static load	2.0 in. (50 mm)	2.0 in. (50 mm)	
Initial rate	145 lb./in. (1,67 kg/m)	145 lb./in. (1,67 kg/m)	
Final rate	250 lb./in. (2,88 kg/m)	250 lb./in. (2,88 kg/m)	
Free camber	7 1/4 in. (184 mm)	6 7/8 in. (166,6 mm)	
Fit of bushes in spring and chassis bores	.0025 to .0075 in. (0,065 to 0,18 mm) interference		

Land-Rover 109 and 107 Station Wagon

	Driver	Passenger	
Number of leaves	11	11	From vehicles numbered: 109 models 121601602 up to 121700416 107 Station Wagon 87060062 up to 131700042
Width of leaves	2 1/2 in. (63,5 mm)	2 1/2 in. (63,5 mm)	
Thickness of leaves	top plate x 1/4 in. (6,35 mm), 6 x 3/16 in. (4,76 mm) and 4 x 5/16 in. (7,93 mm)	top plate x 1/4 in. (6,35 mm), 6 x 3/16 in. (4,76 mm) and 4 x 5/16 in. (7,93 mm)	
Static load	1,158.5 lb. (525 kg)	1,015 lb. (460 kg)	
Camber under static load	2.0 in. (50 mm)	2.0 in. (50 mm)	
Initial rate	160 lb./in. (184 kg/m)	160 lb./in. (184 kg/m)	
Final rate	360 lb./in. (4,15 kg/m)	360 lb./in. (4,15 kg/m)	
Free camber	7.187 in. (182,54 mm)	6.500 in. (165 mm)	
Fit of bushes in spring and chassis bores	.0025 to .0075 in. (0,065 to 0,18 mm) interference		



Land-Rover 107, 109 and 88 Fire Tender

	Driver	Passenger	
Number of leaves	8	8	} 88 Fire Tender from 111703274 onwards 109 models from 121700417 onwards 107 models from 131700042 onwards
Width of leaves	2½ in. (63,5 mm)	2½ in. (63,5 mm)	
Thickness of leaves	9/32 in. (7,1 mm)	9/32 in. (7,1 mm)	
Static load	1,158.5 lb. (525 kg)	1,015 lb. (460 kg)	
Camber under static load	2.0 in. (50 mm)	2.0 in. (50 mm)	
Rate	368 lb./in. (4,2 kg/m)	368 lb./in. (4,2 kg/m)	
Free camber	5.187 in. (130 mm)	4.75 in. (120 mm)	

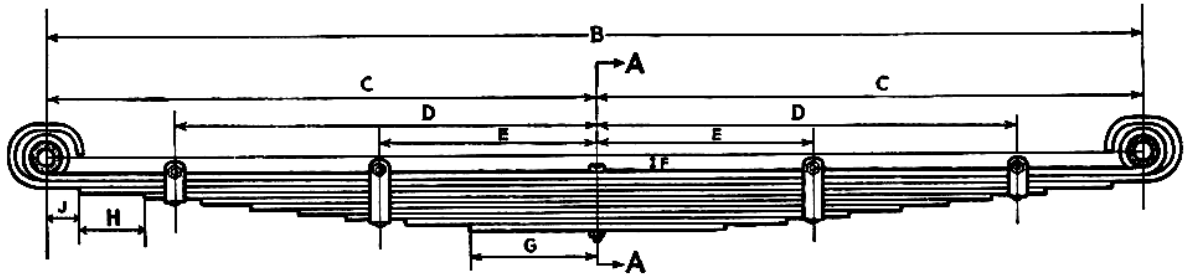


Fig. J-4—Dimensions with spring flat.

(Land-Rover 80 and 86, 1948-53)

B—42 in. (1067 mm)	E—8½ in. (216 mm) (10 leaves) or	G—5½ in. (140 mm)
C—21 in. (533 mm)	9½ in. (232 mm) (9 leaves)	H—2½ in. (57 mm)
D—16½ in. (422 mm) (10 leaves)	F—25/32 in. (19,8 mm)	J—1½ in. (32 mm)
or 16½ in. (416 mm) (9 leaves)		

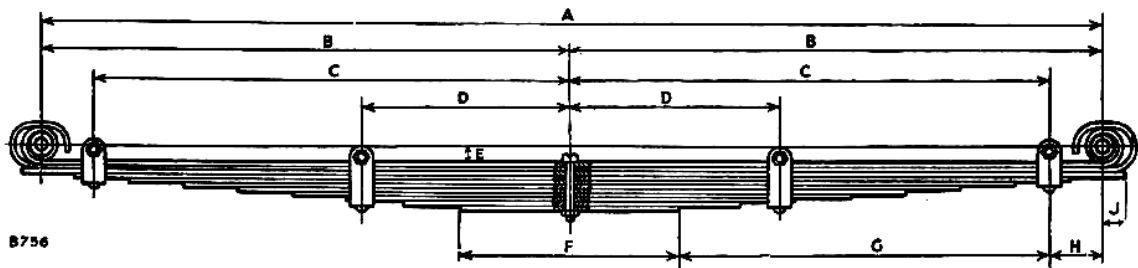


Fig. J-5—Dimensions with spring flat.

(Land-Rover 86 and 88—Driver and Passenger side, 1954-58)

A—48 in. (1,22 m)	D—9½ in. (241 mm)	G—17 1/8 in. (433 mm)
B—24 in. (610 mm)	E—.780 in. (19,81 mm)	H—1 1/8 in. (36,5 mm)
C—21 1/8 in. (543 mm)	F—11 in. (280 mm)	J—1 in. (25,4 mm)

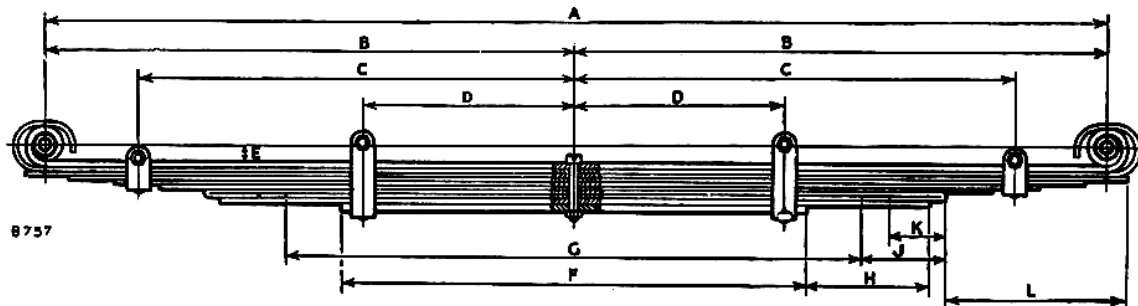


Fig. J-6—Dimensions with spring flat.

(Land-Rover 107 and 109—Driver and Passenger side, 1954-58)

A—48 in. (1,22 m)	E—.780 in. (19,81 mm)	J—3 1/8 in. (95 mm)
B—24 in. (610 mm)	F—26 in. (660 mm)	K—2 1/8 in. (63,5 mm)
C—19 1/8 in. (503 mm)	G—21 in. (533 mm)	L—8 1/8 in. (209,5 mm)
D—9 1/8 in. (241 mm)	H—5 1/8 in. (140 mm)	



**Note:**

IF THE SHACKLE PINS AND LOCKING NUTS ARE NOT TIGHTENED WITH THE SPRING IN THE MID-WAY POSITION, PREMATURE FAILURE OF THE BUSHES WILL OCCUR.

**To overhaul****Operation J/18**

1. Remove the four leaf clips; except for the inner clips on the front springs which are bent over the top leaf, all the clips are secured by bolts and nuts.
2. Remove the spring bushes. Operation J/16.
3. Remove the centre bolt and nut to release the spring leaves.
4. Clean (or preferably degrease) the leaves and carefully examine them for signs of failure or cracks. Only the main and second leaves are supplied as replacement, so that should any other leaf be faulty, the complete spring must be renewed.
5. The recambering of road springs is not advised, but if no alternative is possible, the spring should be reset, if necessary, either to a new spring or to the data set on Pages J-1 and J-3.
6. Grease each leaf with graphite grease and reassemble the spring by fitting the centre bolt and leaf clips; fit the spring bushes.

**Hydraulic dampers****To renew****Operation J/20**

If it is suspected that a shock absorber is not functioning satisfactorily, it should be removed and placed vertically in a vice, the lower eye being secured between the jaws of the vice. It should then be extended and compressed, when a uniform resistance throughout the stroke should be noted, in both directions. Should erratic or weak resistance be found, the shock absorber should be replaced.

**Note:** The resistance felt when extending the shock absorber is very much greater than that encountered when compressing it.

No attempt must be made to strip or adjust the hydraulic dampers; if any trouble is experienced, a new damper must always be fitted.

1. Withdraw the hydraulic damper complete with four tapered rubber bushes and retaining washers.
2. Renew the retaining washers as necessary.

3. Renew the rubber mounting bushes as necessary.

4. Fit the new damper with its outer sleeve uppermost.

The plain length of all shock absorber mounting tubes should be  $1\frac{3}{8}$  in. (33,34 mm), i.e., when the securing nut is fully tightened, the compressed overall length of the two rubber bushes in the damper lug must be  $1\frac{3}{8}$  in. (33,34 mm).

It is most important that this point be checked when fitting a new shock absorber or replacing the rubber bushes. If the tube is too long, suitable washers must be fitted over the tube, to reduce the compressed length of the bushes to the correct dimension.

**Note:**

IF THE RUBBER BUSHES ARE NOT CORRECTLY NIPPED OR IF THEY ARE NOT TIGHTENED WITH THE ROAD SPRING IN THE MID-WAY POSITION, PREMATURE FAILURE OF THE BUSHES WILL OCCUR.

On 1955-57 models the lower ends of the shock absorbers are secured to the spring bottom plates by means of plain washers and split pins.

With this type of fastening, the correct nip on the rubber bushes is predetermined by the position of the split pin hole.

A tubular piece of steel with a slot cut in it, will facilitate the compression of the rubber bushes and allow the insertion or removal of split pin.

**Bump rubber****To renew****Operation J/22**

1. Remove the bump rubber secured to the underside of the chassis member.
2. Fit the new bump rubber and secure with the two bolts and self-locking nuts.

**Rear axle check strap****To renew****Operation J/24**

1. Remove the fabric check strap, complete with two clamping plates.
2. Fit the new check strap by reversing the removal procedure; take care that the strap is fitted to the rear of the brake pipe protection plate.