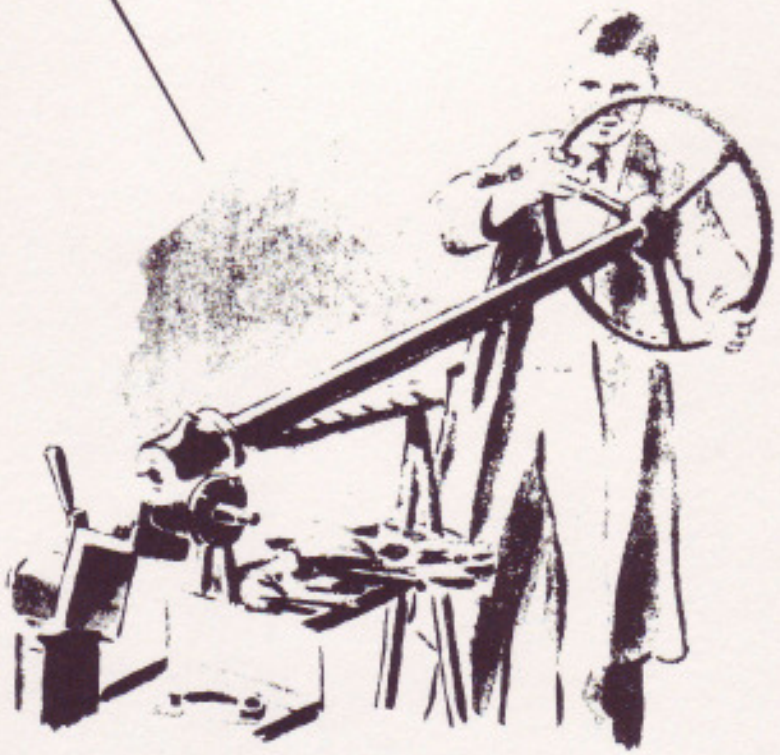
STEERING



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STEERING.

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THE STEERING COLUMN AND BOX.

STEERING.

The steering is of the cam and roller type. A double toothed follower roller mounted in the jaws of the rocking shaft, engages with the cam. The cam portion takes the form of a modified worm gear. All working parts are carried in anti-friction bearings and are immersed in oil.

TO REMOVE STEERING COLUMN AND BOX.

(i) Slacken off Jubilee clip securing the air silencer to the air intake. Remove the two nuts and spring washers securing air silencer to inlet manifold, and remove air silencer.

(ii) Disconnect throttle control rod, (D, Fig.1) from lever (A) of the throttle connecting shaft.

(iii) Remove bell-crank control lever (F) from its anchorage on the air intake casting by removing the nut and washers. Collect bush.

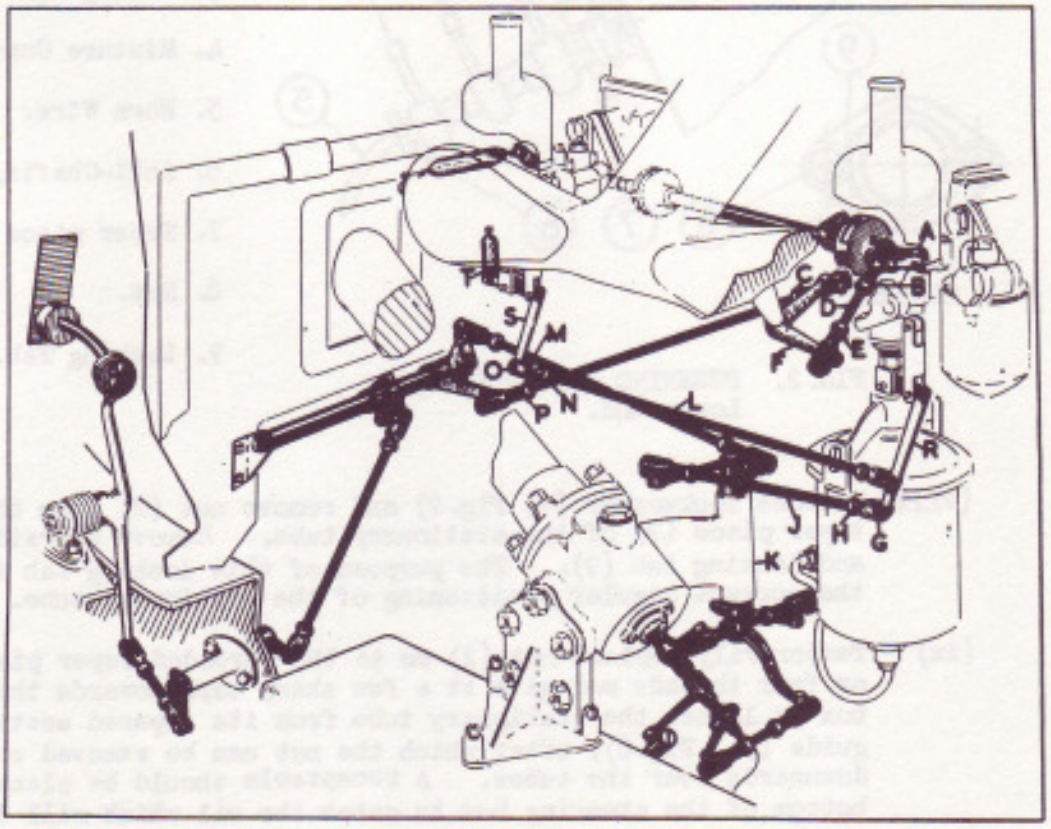


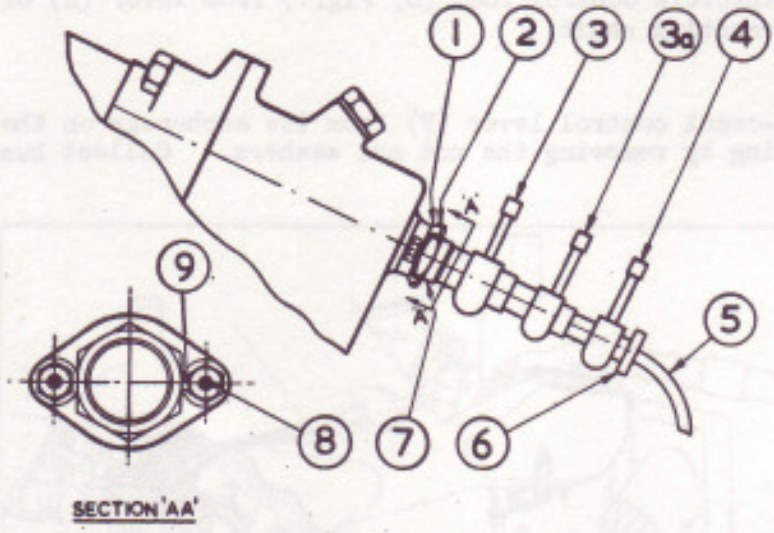
FIG. 1. CONTROL LEVERS AND RODS.

(iv) Remove pin (G) from the jaw of the mixture control rod.

(v) Disconnect petrol feed pipe from carburetters by removing the two banjo bolts complete with the C & A washers. Temporarily replace banjo bolts and washers in the float chamber covers, to retain the petrol filters.

(vi) Remove the four nuts and spring washers securing carburetters to induction pipe, and remove carburetters.

(vii) With the master switch on the instrument panel switched off, remove clip fastening the horn wire (5, Fig.2), to the off-side valance plate. Disconnect wire from its terminal on the horn relay, and remove same from the conduit tube. Remove anti-chafing bush (6) from the mixture control tube at the bottom of the steering column. Remove the pinch bolts from levers (3, 3a and 4. Fig.2), then slide them downwards off their respective tubes.



1. Locking Washer.
2. Nut.
3. Throttle Control Lever.
3a. Riding Control Lever.
4. Mixture Control Lever.
5. Horn Wire.
6. Anti-Chafing Bush.
7. Taper piece (threaded).
8. Nut.
9. Locking Tab.

FIG. 2. STEERING COLUMN (BOX) - Lower End.

(viii) Release lockwasher (1, Fig.2) and remove nut (2) from the threaded taper piece (7) of the stationary tube. Remove nearside nut (8) and locking tab (9). The purpose of this locking tab is to ensure the correct angular positioning of the stationary tube.

(ix) Temporarily replace nut (2) on to the threaded taper piece three or four threads and give it a few sharp taps towards the steering box to loosen the stationary tube from its tapered seating in the guide (34, Fig.6), after which the nut can be removed and slipped downwards over the tubes. A receptacle should be placed at the bottom of the steering box to catch the oil which will flow from the box during the next operation.

(x) Remove the control tube assembly complete, from the top of the steering column, taking care not to lose felt packing strip (65, Fig.8) from the stationary tube.

(xi) Remove the five screws (14, Fig.3) from hub of steering wheel, then remove locking plate (13), nut (12) and washer (11). Lightly mark hub of the steering wheel and steering cam tube so that they can be refitted in the same relative position, and then remove the wheel from the tapered splines of the steering tube by means of the special extractor, Tool No.3243/T1006.

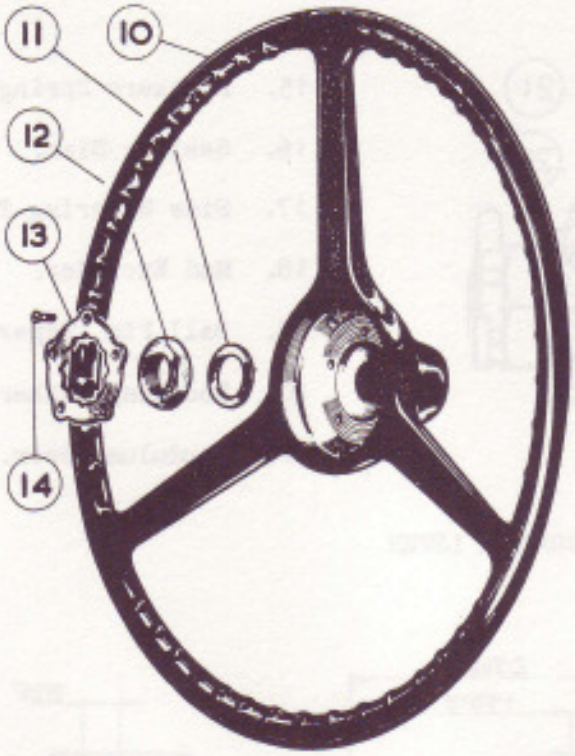


FIG. 3. STEERING WHEEL.

10. Steering Wheel.
11. Plain Washer.
12. Nut.
13. Locking Plate.
14. Screw.

(xii) Remove the two nuts and washers securing bracket (K, Fig.1) to steering box, and detach it from the box. Remove clip, attached to the oil feed pipe, from the stud of the steering box end cover

(xiii) Remove the four screws and washers securing rubber gas seal (fitted around the steering column) and its retaining plate to the dashboard, then detach the gas seal from dashboard.

(xiv) Remove the front R.H. undershield.

(xv) Jack up the front of the car - jack under and in the centre of the front 'pan' - then remove the side steering tube (17, Fig.4) from the pendulum lever (21). A suitable extractor can be made from the detail drawing shown in Fig.5, or the side steering tube can be removed from the pendulum lever, as described in sub-paragraph (b). If an extractor is available, proceed as follows:-

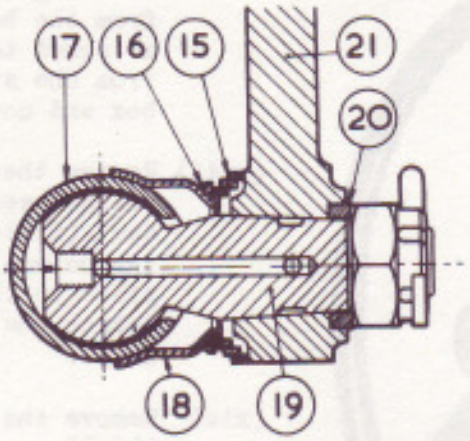
(a) Remove split pin and nut from taper ball pin (19, Fig.4) at the bottom of the pendulum lever and also the locating washer (20). Place the extractor (Fig.5) in position and ease taper ball pin from pendulum lever. If the steering is turned on full R.H. lock, the ball pin will probably come clear of the pendulum lever. If not, it will be easily freed when the steering box and bracket are disconnected from the frame as described in sub-paragraph (xvi), i.e. after the removal of the three bolts (41, Fig.6). After disconnecting side steering tube, take care not to lose the flat pressure spring (15), sealing disc (16) and mud excluder (18).

If an extractor is not available, then proceed as follows:-

(b) Remove split pin, nut and locating washer as described in (a), then give the bottom of the pendulum lever a sharp tap upwards, i.e. at

right-angles to the axis of the ball pin. This should release ball pin. To carry out the above, the car should be placed on a ramp or over a pit.

A substantial steady block should be placed on the upper end of the pendulum lever to absorb the shock and a drift should be used on the lower end of the pendulum lever to prevent damage to adjacent parts.



15. Pressure Spring.
16. Sealing Disc.
17. Side Steering Tube.
18. Mud Excluder.
19. Ball Pin (Tapered).
20. Locating Washer.
21. Pendulum Lever.

FIG. 4. SECTION THROUGH PENDULUM LEVER BALL PIN.

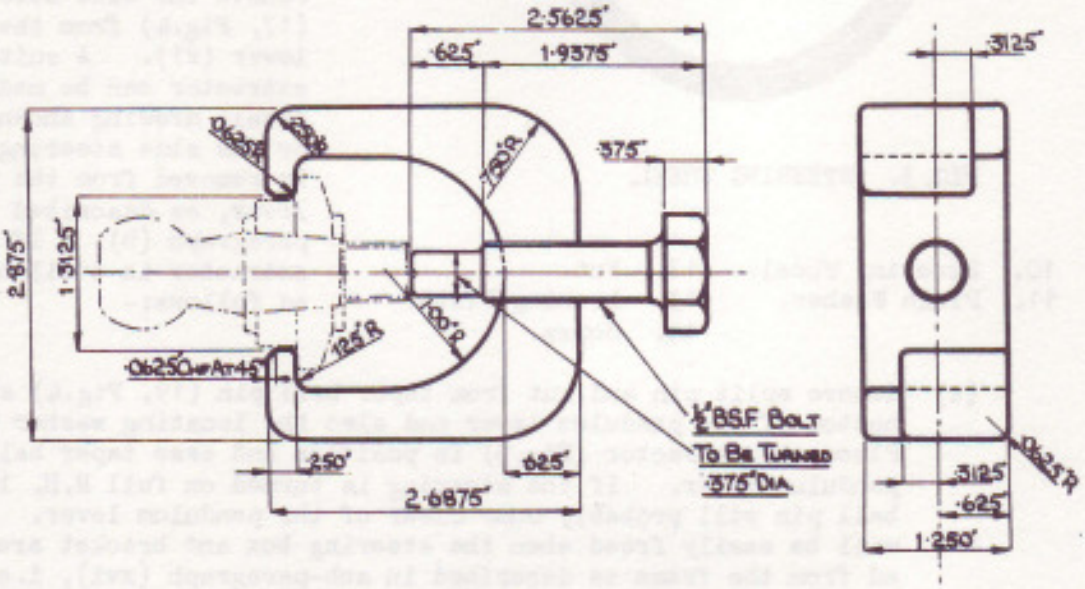


FIG. 5. DETAILS OF EXTRACTOR - PENDULUM LEVER BALL PIN.

(xvi) Disconnect steering box complete with its mounting bracket (42, Fig.6), by removing the three nuts, plain washers, distance pieces and bolts which retain bracket to the frame.

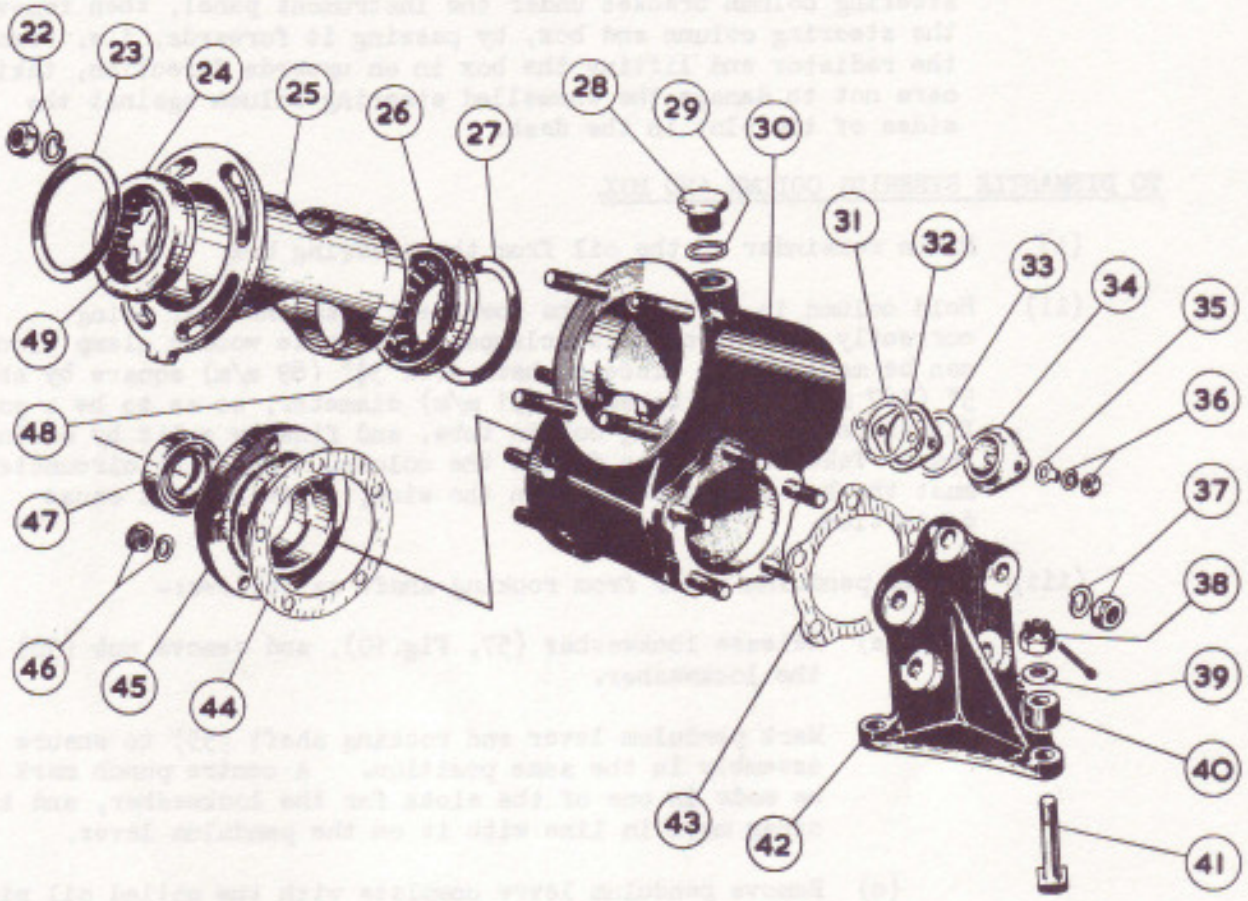


FIG. 6. "EXPLODED" VIEW OF STEERING BOX.

22. Nut and Spring Washer.
23. Adjusting Washer (Range of).
24. Roller Bearing Cup.
25. Adjusting Sleeve.
26. Roller Bearing Cup.
27. Adjusting Washer (Range of).
28. Oil Filler Plug.
29. Washer.
30. Steering Box.
31. Joint Washer.
32. Adjusting Washer (Range of).
33. Joint Washer.
34. Guide.
35. Locking Tab.
36. Nut and Spring Washer.
37. Nut and Spring Washer.
38. Nut.
39. Plain Washer.
40. Distance Piece.
41. Bolt.
42. Bracket.
43. Joint Washer.
44. Joint Washer.
45. Cover.
46. Nut and Spring Washer.
47. Oil Seal.
48. Roller and Cage Assembly.
49. Roller and Cage Assembly.

(xvii) Disconnect oil feed pipe (to the ball pin of the pendulum lever) from the four-way junction on the frame beneath steering column.

(xviii) While steering column is being held, remove the two bolts from steering column bracket under the instrument panel, then remove the steering column and box, by passing it forwards, i.e. towards the radiator and lifting the box in an upwards direction, taking care not to damage the enamelled steering column against the sides of the slot in the dash.

TO DISMANTLE STEERING COLUMN AND BOX.

(i) Drain remainder of the oil from the steering box.

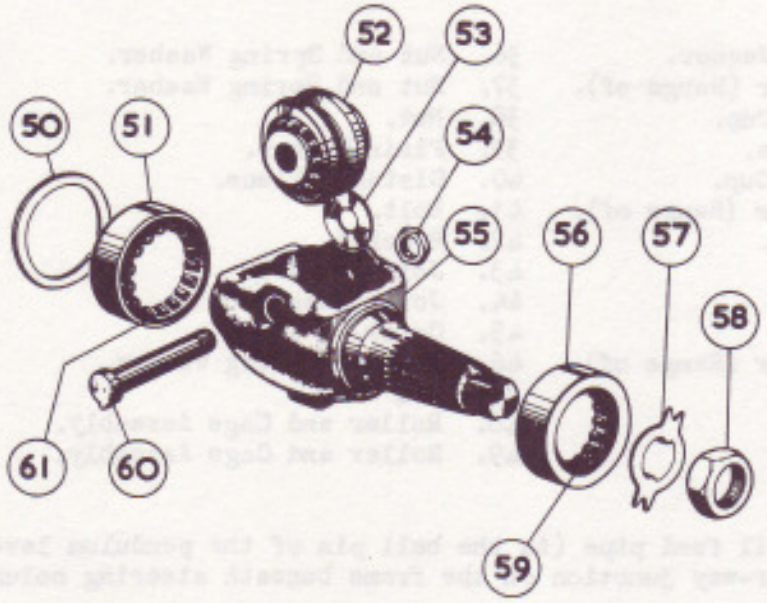
(ii) Hold column in a vice at the lower end near the box, using correctly shaped wood vice clamps. Suitable wooden clamp blocks can be made from a piece of hard wood 3½" (89 m/m) square by about 5" (127 m/m) long, bored 2" (51 m/m) diameter, so as to be a good fit around the steering column tube, and finally split by sawing in two. Take care not to damage the column. Under no circumstances must the box itself be held in the vice, as this would cause distortion.

(iii) Remove pendulum lever from rocking shaft as follows:-

(a) Release lockwasher (57, Fig.10), and remove nut (58) and the lockwasher.

(b) Mark pendulum lever and rocking shaft (55) to ensure re-assembly in the same position. A centre punch mark may be made in one of the slots for the lockwasher, and the other mark in line with it on the pendulum lever.

(c) Remove pendulum lever complete with the coiled oil pipe from the rocking shaft, by means of extractor Tool No.: 3243/T100.



50. Adjusting Washer (Range of).
51. Roller Bearing Cup.
52. Cam Roller Assembly.
53. Adjusting Washer (Range of).
54. Nut.
55. Rocking Shaft.
56. Roller Bearing Cup.
57. Lock Washer.
58. Nut.
59. Roller & Cage (Assembly).
60. Bolt.
61. Roller & Cage (Assembly).

FIG. 7. "EXPLODED" VIEW OF ROCKING SHAFT ASSEMBLY.

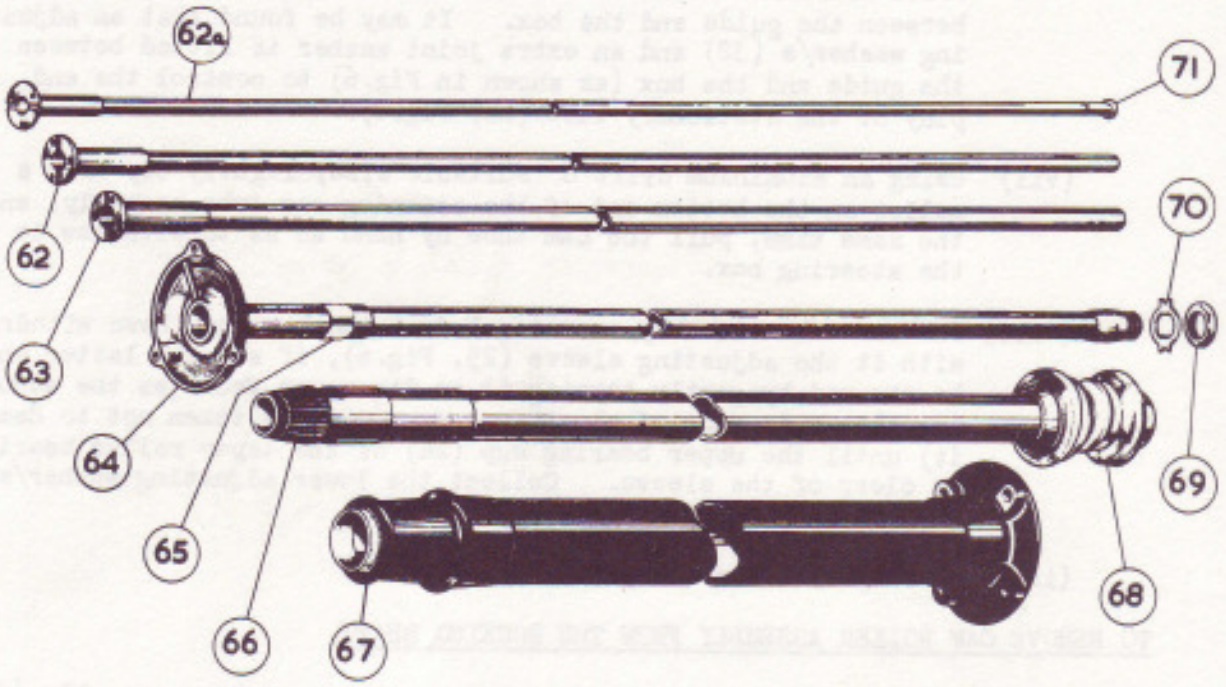


FIG. 8. "EXPLODED" VIEW OF STEERING COLUMN.

62a. Mixture Control Tube (Assy).
62. Riding Control Tube (Assy).
63. Throttle Control Tube (Assy).
64. Stationary Tube (Assy.
65. Felt Packing Strip.
66. Steering Cam Tube (Assy).
67. Steering Column (Assy).
68. Steering Cam.
69. Nut.
70. Locking Washer.
71. Anti-Chafing Bush.

NOTE:- Should there be evidence of an oil leakage past the oil seal (47, Fig.10) which would be indicated by the presence of oil inside the cover (73) and on the pendulum lever, or should the oil seal be found to be worn, then a new one should be fitted.

(iv) Remove rocking shaft from steering box as follows:-

Mark cover (45, Fig.10) and steering box, by lightly centre punching, to ensure re-assembly of cover in the same position.

Remove the three remaining nuts securing cover to the box, then remove cover complete with oil seal (47) and roller bearing (56). The rocking shaft can now be removed together with the roller and cage assembly (61).

(v) Remove the four nuts which retain steering column (67, Fig.8) to box and remove the steering column.

(vi) Remove the remaining 2-BA nut securing stationary tube guide (34, Fig.6) to the box, carefully remove the guide by means of a small aluminium drift or screwdriver. A joint washer is fitted between the guide and the box. It may be found that an adjusting washer/s (32) and an extra joint washer is fitted between the guide and the box (as shown in Fig.6) to control the end play of the stationary tube (64, Fig.8).

(vii) Using an aluminium drift of suitable size, lightly tap with a mallet on the bottom end of the steering cam tube assembly, and at the same time, pull the cam tube by hand so as to withdraw it from the steering box.

(viii) The cam tube assembly, on removal from the box, may have withdrawn with it the adjusting sleeve (25, Fig.6), if so, the latter should be removed by gently tapping it on its upper face (as the adjusting sleeve is made of aluminium, care must be taken not to damage it) until the upper bearing cup (24) of the taper roller bearing is clear of the sleeve. Collect the lower adjusting washer/s (27) from the box.

(ix) Thoroughly clean all parts.

TO REMOVE CAM ROLLER ASSEMBLY FROM THE ROCKING SHAFT.

It should only be necessary to remove the cam roller assembly (52, Fig.7) from the rocking shaft in the event of:-

(a) Wear in the cam roller assembly.

(b) End float of the cam roller assembly in the rocking shaft.

(c) A "flat" on cam track of roller, caused by shock.

(i) Remove the nut (54, Fig.7) from the bolt retaining the cam roller assembly to the rocking shaft. As the bolt end is peened over the nut, the peened over portion should be chipped away with a small chisel before attempting to remove the nut.

Remove bolt (60), the cam roller assembly and adjusting washer/s (53) from the rocking shaft. Discard the nut and bolt, owing to damage from the peening over operation, a new nut and bolt must be used for re-assembly.

(ii) Thoroughly clean all parts.

TO FIT A NEW CAM ROLLER ASSEMBLY TO THE ROCKING SHAFT.

(i) First, determine the thickness of the adjusting washer (53, Fig.7) required to ensure contact of the inner end faces of the two inner races of the cam roller assembly, in order to give the necessary pre-loading on the roller, as explained subsequently.

(ii) It will be observed upon reference to Fig.9, that the inner race of the cam roller assembly is in two halves, held together by a

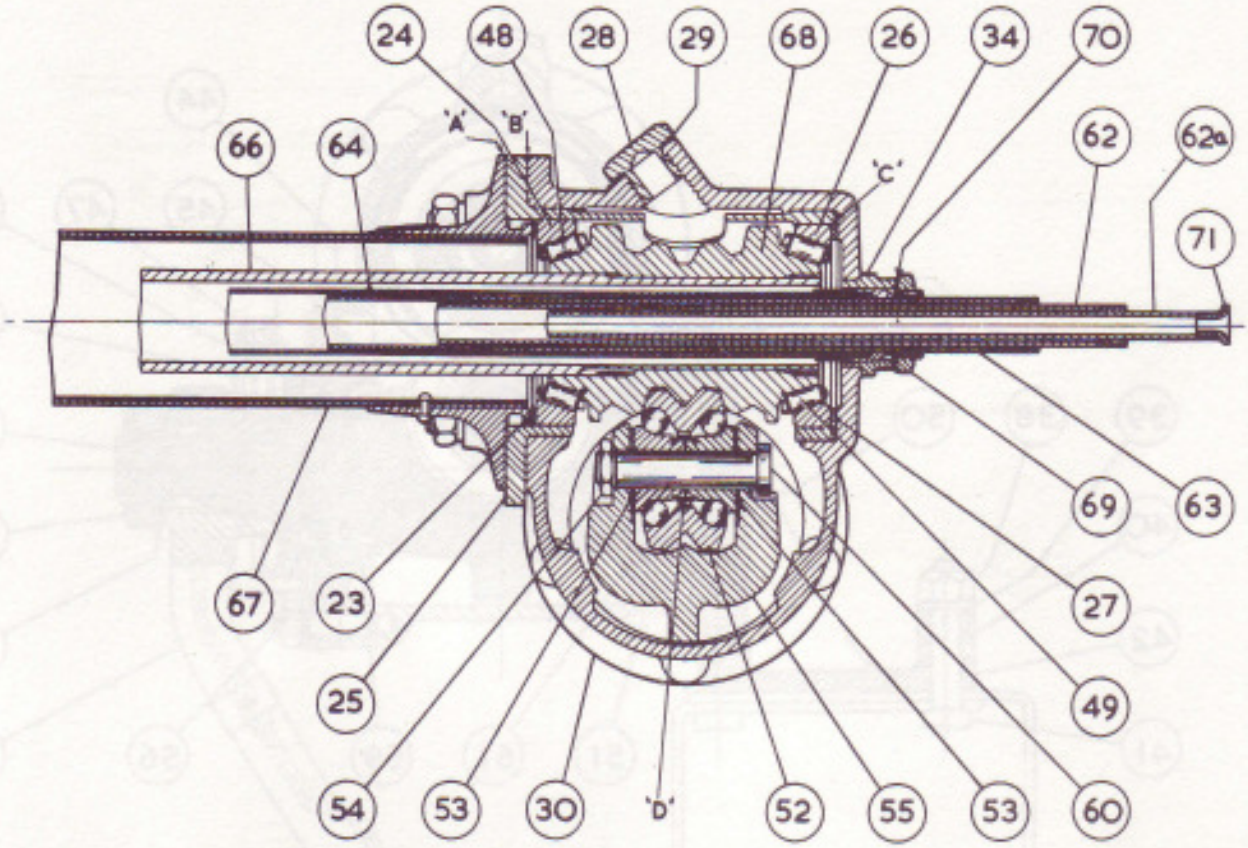


FIG. 9. SECTION THROUGH CAM AND ROLLER.

retaining ring (D). When the inner faces of the two halves of the inner race are brought into contact as explained below, this will give a pre-load on the roller of 2 to 8 ozs. (56 to 227 gr.) at a radius of 3" (76 m/m), and it will be found that the roller will be a little stiff to turn by hand. This pre-load is determined by the makers and cannot be altered.

(iii) Before fitting cam roller assembly to rocking shaft, make and place on the bolt (60, Fig.7), a suitable temporary distance piece 7/16" (11 m/m) thick by about 11/16" (18 m/m) outside diameter by 7/16" (11 m/m) inside diameter, or failing this, make use of suitable plain washers. This is in order to compensate for the thickness of the walls of the rocking shaft. Pass the bolt through the inner races and then tighten up the nut so as to bring firmly into contact the inner faces of the two halves of the inner race.

NOTE:- As the original nut and bolt (54 and 60) were discarded after the dismantling operations, a new nut and bolt must be used, and ultimately fitted to the rocking shaft. With the nut tightened

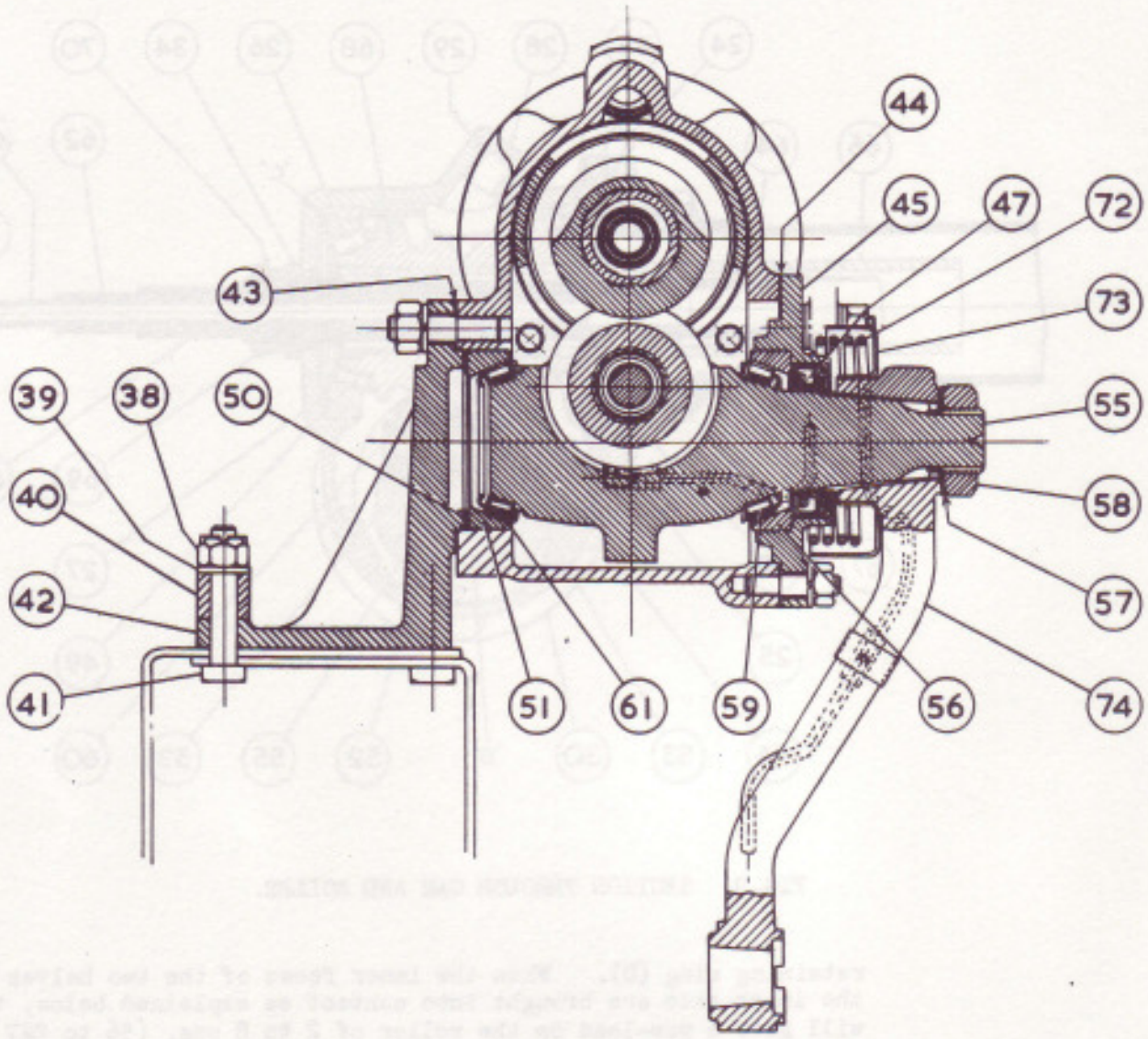


FIG. 10. SECTION THROUGH ROCKING SHAFT.

72. Coiled Oil Pipe. 73. Cover. 74. Pendulum Lever.

up, measure with the aid of a micrometer, the width across the outer faces of the inner races, which will probably be found to be within the range 1.257" plus or minus 0.003" (31.93 m/m) plus or minus 0.08 m/m), then measure with the aid of a pair of inside calipers and a micrometer, the width across the inner machined faces of the rocking shaft gap which will probably be within the range 1.262" plus 0.005" (32.05 m/m plus 0.13 m/m).

The difference between the two measurements will determine the size (thickness) of the adjusting washer or washers required.

EXAMPLE:

(a) Width across inner machined faces of rocking shaft gap. 1.263" (32.08 m/m)

(b) Width across outer faces of inner races. 1.258" (31.95 m/m)

Difference equals: 0.005" (0.13 m/m)

The thickness of the washer required will therefore be 0.005" (0.13 m/m).

(iv) Remove the bolt, distance piece or plain washers, fit the roller assembly into the rocking shaft ensuring that the adjusting washer/s makes the roller assembly a good push fit in the rocker shaft gap. Insert the bolt, making sure that the lug on the head is located in the recess provided in the rocking shaft and tighten up the nut. If more than one adjusting washer is required, they can both be fitted to the same side.

(v) The roller should now be checked for freedom of rotation. It should be just a little tight to turn on account of the pre-load. If it spins freely, it indicates that the adjusting washer or washers are not of sufficient thickness to ensure contact of the inner races and the measuring operations described above should be repeated. When the preload is correct, finally tighten up nut and peen over end of bolt to lock.

TO FIT THE ROCKING SHAFT TO THE STEERING BOX TEMPORARILY IN ORDER TO CHECK THE PRE-LOAD OF THE ROCKING SHAFT.

(i) Place one of the two roller and cage assemblies (59 or 61, Fig.10) on to the bearing cup (51), the bearing cup having been left in position in the steering box.

(ii) Drop the rocking shaft into position in the box.

(iii) Place the other roller and cage assembly on the rocking shaft and fit a new joint washer (44) to the cover (45).

(iv) Should there have been evidence of an oil leakage past the oil seal (47) during the dismantling operations, or, should the oil seal be found to be worn, then fit a new oil seal to the cover. The seal must be fitted with the tip pointing towards the steering box as shown in Fig.10.

(v) Carefully place the cover complete with bearing cup (56) and oil seal over the splined end of the rocking shaft (taking care not to damage the tip of the seal while entering it on to the shaft), ascertaining that the centre punch marking on the cover and box are in line. Fit a spring washer to the three short studs and temporary additional washers to the two long studs, and progressively tighten up the nuts to secure.

(vi) Slip the pendulum lever on to the splines of the rocking shaft with the centre punch marking on lever and shaft in line.

(vii) For checking the various pre-loads, a support will be required for the steering box, this should consist of a 6" (152 m/m) length of angle iron not less than 3½" x 3½" (89 m/m x 89 m/m) section and drilled to the same centres as the three frame bolt holes in the steering box mounting bracket (42, Fig.6). It will be preferable to drill the three holes in the angular support a little larger in diameter than those in the steering box mounting bracket. It is most important that the bracket is not used as a jig for drilling purposes because the holes in the bracket are reamed in order to be a good fit on the three retaining bolts (41).

The reason for this support is that under no circumstances must the steering box be held in a vice, as this would cause distortion. Any distortion to the box would alter the pre-loading and make correct adjustments impossible.

With the steering box (bracket) attached to the support by suitable bolts, place the support in a vice, and with both the rocking shaft and pendulum lever horizontal, check the pre-load at the end of the pendulum lever which should be within the limits of 3 to 12 ozs. (85 to 340 gr.). The best way to carry out this check, is as follows:-

(a) First, have at hand six 2 oz. (57 gr.) weights. Circular weights with a small hole in the centre are the most suitable for the job.

(b) Ascertain the weight required to move the pendulum lever, attaching the weights to the end of the lever by means of a piece of hooked wire. If it is found that the pre-load is not correct, i.e. less than 3 ozs. (85 gr.), then it will be necessary to fit a thicker adjusting washer as follows:-

(viii) Mark the mounting bracket (42, Fig.6) and steering box for re-assembly purposes, then remove the five nuts and washers (37), which retain the bracket to the box. Remove bracket, joint washer (43) and adjusting washer/s (50, Fig.10).

With a micrometer, measure the thickness of the adjusting washer/s removed, and select a washer/s 0.001" (0.025 m/m) thicker from the range available. It is usual for a change of this magnitude, i.e. 0 001" (0.025 m/m) to alter the pre-load by approximately 8 ozs. (227 gr.).

Place adjusting washer/s against the outer face of the bearing cup (51, Fig.10). Fit a new joint washer (43) and refit the bracket (42) to the steering box with the marking on the bracket and box in line with each other. Refit the spring washers and progressively tighten up the five nuts to secure. Check the pre-load at the end of the pendulum lever as previously described.

When the correct pre-load has been obtained, there will be no further need to disturb the adjusting washer/s or the five nuts securing the bracket to the steering box.

Remove the pendulum lever, the cover (45, Fig.10), taking care not to damage the new joint washer (44), as this washer must be retained so as not to upset the pre-load. Remove the rocking shaft from the box. The next operation is to centralise the cam with respect to the rocking shaft as described in the following paragraph:-

TO CENTRALISE THE STEERING CAM WITH THE ROCKING SHAFT.

(i) Should the cam tube assembly upon removal from the steering box, have withdrawn with it the adjusting sleeve (25, Fig.6), then proceed as follows:-

(a) With all parts in a perfectly clean condition, lightly smear with grease the two outer machined diameters of the adjusting sleeve and fully enter it into position in the steering box, i.e. so that the two faces at point 'B', Fig.9, make contact.

(b) Lightly smear with grease the original lower adjusting washer (27) and with the steering box in a vertical position, place in position in the bottom of the box. If two adjusting washers were found to be fitted, then the thinner of the two washers must be fitted so that it is adjacent to the lower face of the lower bearing cup (26), because if the thinner washer was fitted behind the thicker washer, there would be a risk of it being trapped behind the gap (i.e. at point 'C', Fig.9) which exists between the inner end of the adjusting sleeve and the lower inner end of the steering box.

(c) Fit the lower bearing cup (26) in position against the adjusting washer/s taking care not to disturb the position of the latter for the reason explained.

(ii) Place one of the two roller and cage assemblies (49 or 48) on to the lower bearing cup, and then place cam tube assembly on to the roller bearing. Place the other roller and cage assembly on to the cam and push or lightly tap the other bearing cup (24) squarely into position in the adjusting sleeve and on to the roller bearing.

(iii) Select an adjusting washer (23) from the range available, too thick to enable the flange of the steering column to be pulled right down on to the adjusting sleeve. Place the adjusting washer (two washers can, if necessary, be fitted) against the outer face of the upper bearing cup (24) and then place steering column into position.

Replace the spring washers on the four studs, and nip up the steering column retaining nuts evenly, just sufficiently to make the cam tube moderately stiff to turn by hand before the steering wheel is slipped on.

There should now, at this stage, be a gap at point 'A', Fig.9, i.e. between the face of the flange of the steering column and the adjusting sleeve. It is possible, however, for the adjusting sleeve to "lift", creating the gap at point 'B', but this must be avoided, otherwise the lower adjusting washer/s (27) could slip out of position and become trapped at point 'C'. If there is no

gap at point 'A', then a thicker adjusting washer/s (23) will have to be fitted until a gap is obtained.

(iv) Slacken the four steering column nuts just sufficiently to allow the adjusting sleeve to be rotated. A lug is provided on the sleeve for this purpose.

NOTE:- The purpose of the eccentric adjusting sleeve is for adjusting the mesh between the cam and roller. Looking at the steering box from the steering column end, rotating the sleeve in a clockwise direction, will "free" the cam from the roller, i.e. there will be slackness between the cam and roller. The sleeve is provided with elongated stud holes which also limit the amount by which it can be rotated in the box. Rotate the sleeve by the lug provided in a clockwise direction, so as to "free" the cam from the roller and then evenly nip up the steering column nuts again.

(v) Temporarily refit the rocking shaft to the steering box as previously described, and secure in position by refitting the cover (45, Fig.10) securing the latter with the five retaining nuts and washers as necessary.

NOTE:- If the steering cam had not been "freed" from the roller by rotating the adjusting sleeve, then it would not be possible to refit the rocking shaft to the box. The next operation is to centralise the cam with the rocking shaft.

(vi) With the support (angle iron) attached to the steering box mounting bracket as previously described, place the steering (support) in a vice and slip on the steering wheel.

Starting from one full lock position, rotate the wheel very slowly towards the other lock, and while this is being done, hold the end of the pendulum lever with the other hand, simultaneously lightly shaking it to and fro until the position of minimum slack between the cam and roller has been found. With the cam in this position and without moving it, again slacken back the four steering column nuts slightly, i.e. only just sufficiently to allow the adjusting sleeve to be rotated. Rotate sleeve in an anti-clockwise direction, until all slack between the cam and roller is just eliminated. Evenly retighten the four steering column nuts.

(vii) The next step is to set the cam approximately in the straight ahead position, by rotating the steering wheel about one-and-seven-eighth's of a turn from either lock. Now set the cam tube in the exact straight ahead position by rotating it slightly as required to bring the keyway in the cam tube (visible from the bottom end of the box) into its lowest position, i.e. nearest to the rocking shaft.

It will have been noticed that the tightest meshed position extends over possibly half a turn of the steering wheel. By suitably rotating the steering wheel, determine how much it has to be turned to move it from the straight ahead position to the centre of the tightest meshed position. If the tightest meshed position is to the right of the straight ahead position (turning the steering wheel to the right), a thinner adjusting washer/s (27, Fig.9) should be fitted to the lower roller bearing; if to the left, then a thicker

washer will be required. If it is found necessary to fit two washers to make up the desired thickness, then the thinner of the two washers must be fitted against the lower face of the bearing cup, for the reason explained in sub-paragraph (i) b. The washer/s should be lightly smeared with grease to keep them in position against the cup during the erecting operation. The amount by which the thickness of the washer should be changed may be roughly estimated on the basis that a change of 0.007" (0.18 m/m) moves the tight place along half a turn of the steering wheel. When the centre of the tightest meshed place is at the straight ahead position, that is with the cam tube assembly keyway at its lowest point, and the rocking shaft in its central position, the next step is to adjust the pre-load on the cam bearings.

TO ADJUST THE PRE-LOAD ON THE CAM ROLLER BEARINGS.

(i) The pre-load should be from 12 to 20 ozs. (340 to 567 gr.) measured at the rim of the steering wheel, and this operation should be carried out with the steering box mounted, so that the steering column is in a horizontal position. The pre-load is obtained by selecting from the range of adjusting washers (23, Figs. 6 & 9) available, a washer/s of suitable thickness to fit behind the lowest face of the steering column flange and the outer face of the upper bearing cup (24). Proceed as follows:-

(a) Measure with feeler gauges the gap at two opposite points between the adjacent flange faces of the adjusting sleeve and the steering column flange (i.e. at point 'A', Fig.9) and make a note of the average gap.

Loosen the four nuts retaining the steering column to the box and rotate the adjusting sleeve (25) in a clockwise direction to produce slack between the cam and roller.

(b) Remove the steering column and then remove the adjusting washer/s (23).

(c) To determine the thickness of the adjusting washer/s required, measure with a micrometer the thickness of the washer/s removed, and subtract from this figure, the average gap, measured as described above.

EXAMPLE:

(d)	Total thickness of adjusting washer/s removed, say	0.088" (2.23 m/m)
(e)	Average gap at point 'A', Fig.9, say	0.041" (1.04 m/m)
(f)	Required thickness of adjusting washer/s to be fitted	0.047" (1.19 m/m)

Theoretically, the fitting of a 0.047" (1.19 m/m) thick adjusting washer should give zero pre-load, but owing to the possibility of very slight discrepancies in the manufacture of the washers, the adjusting sleeve and the flange of the steering column etc. it may be found that when checking the pre-load as described below, that

there is either too much or too little.

(ii) Fit the new washer/s as determined above, then replace the steering column on to the box and fully tighten the four retaining nuts. Again slip on the steering wheel and attach a piece of string to the steering wheel rim, to this tie on 2 oz. (57 gr.) weights as required to determine the pre-load. During this operation, the imaginary line joining the upper end of the string to the centre of the steering wheel must be kept as near the horizontal as possible.

(iii) If the weight required to move the steering wheel exceeds 20 ozs. (567 gr.), try decreasing the thickness of the upper adjusting washer/s by 0.001" (0.025 m/m), but if the pre-load is below 12 ozs. (340 gr.), increase the thickness of the washer/s by 0.001" (0.025 m/m) so as to bring the pre-load to within the limits of 12 to 20 ozs. (340 to 567 gr.).

(iv) When the pre-load is correct, rotate the steering wheel to the straight ahead position, as previously described, and bring the cam into mesh by rotating the eccentric adjusting sleeve until the total pre-load is increased by 8 ozs. (227 gr.).

NOTE:- It is of course necessary to loosen the four steering column nuts before attempting to rotate the adjusting sleeve for mesh adjustments. It is equally necessary to fully retighten these nuts before checking the pre-load.

TO REFIT THE STEERING COLUMN AND BOX.

(i) Before refitting the steering column and box, place a new joint washer (31, Fig.6) on to the bottom of the steering box, followed by the guide (34).

Should it have been found when dismantling the steering column and box, that an adjusting washer/s (32) was fitted between the guide and the box (as shown in Fig.6), then a new joint washer (31 and 33) must be fitted either side of the adjusting washer/s to prevent oil leakage. Secure the guide to the box by placing one of the two 2-BA spring washers and nuts on the off-side stud and tightening up. Do not at this stage fit the other 2-BA nut (8, Fig.2) or the locking tab (9).

(ii) With the coiled lubricating pipe and its protection cover in position on the pendulum lever, fit the lever to the rocking shaft in the same angular position as originally fitted, i.e. with the centre punch mark on the lever in line with the mark on one of the two slots in the rocking shaft. Place a new lockwasher (57, Fig.10) on the shaft, securely tighten the nut (58) and bend over the tabs of the lockwasher to lock.

NOTE:- During the intial build and with the road wheels in track, the cam roller of the steering box is placed central with the cam, and the pendulum lever is set, $\frac{3}{4}^{\circ}$, from the vertical centre line towards the rear of the chassis.

(iii) With the rubber gas seal and its retaining plate in position on the steering column, and with the lip of the retaining plate facing towards the steering box, place the steering column and box in position and then re-attach the side steering tube to the pendulum lever as follows:-

With the mud excluder (18, Fig.4), the sealing disc (16) and the flat pressure spring (15) in position on the ball pin (19), enter the pin into the pendulum lever. Place the locating washer (20) on to the threaded end of the ball pin, ascertaining that the flats and lugs of the washer correctly engage with the corresponding flats and slots on the pin and in the lever. The purpose of the locating washer, is to ensure alignment of the oil holes in the ball of the pin with the axis of the side steering tube. Screw on the nut sufficiently to hold the locating washer in position, but do not tighten up the nut at this stage.

(iv) Line up the bolt holes of the bracket (42, Fig.6) with those in the frame and place the three bolts (41) in position. Refit to each bolt, the distance piece (40), plain washer (39) and nut (38), screwing on the nuts two or three threads only at this stage.

(v) Replace steering wheel in position, care being taken to match the markings previously made, so that the spoke nearest the oil hole in the steering wheel hub is diametrically opposite to and in line with the keyway in the bottom of the cam tube, i.e. the steering wheel being fitted (with road wheels in track) so that the spoke nearest the oil hole in the hub is at the top. Fit the plain washer (11, Fig.3) and nut (12) and tighten up. Fit the locking plate (13) over the nut and secure with the five countersunk screws (14).

(vi) With the felt packing strip (65, Fig.8) in position on the stationary tube and lightly greased, replace control tube assembly in position. Rotate the control tube assembly until the 0.200" (5.08 m/m) diameter hole in the threaded taper piece (7, Fig.2) of the stationary tube is in line with the slot in the guide (34, Fig.6). Fit the locking tab (9, Fig.2) to the near-side stud on the bottom of the steering box and into the slot in the guide, making sure that it enters the hole in the threaded taper piece. The purpose of this locking tab is to ensure the correct angular positioning of the stationary tube. Fit the spring washer over the tab and secure with the remaining 2-BA nut (8).

(vii) Place a new lockwasher (1, Fig.2) on to the threaded taper piece (7), tighten up the nut (2) and bend back the tabs of the lockwasher to lock.

(viii) While the steering column is being held against the upper half of the steering column bracket under the instrument panel, tighten up the three nuts (38, Fig.6) which hold steering box mounting bracket to the frame, and secure each nut with a new split pin of the correct size.

(ix) Now fully tighten the nut which retains the ball pin (19, Fig.4) to the pendulum lever and secure with a new split pin of the correct size.

(x) Re-attach the steering column to the bracket under the instrument panel. Line up the four holes in the rubber gas seal with those in the dashboard, place the retaining plate in position, the lip of which should be at the bottom and secure with the four screws and washers.

(xi) Place the bracket (K, Fig.1) in position. Thread the horn wire through the three control levers (3, 3a and 4, Fig.2), and then secure them to their respective control tubes. The ball end pin of the levers should face downwards as shown in Fig.1. Fit the two spring and plain washers and nuts to bracket (K) to secure. Check the three control tubes for freeness by moving the hand levers on the top of the steering column.

(xii) Refit the anti-chafing bush (6, Fig.2). Thread the horn wire (5) into the conduit tube and reconnect it to the rear end of the horn relay unit, and then fasten the wire to the off-side valance plate by tightening up the clip.

(xiii) Refit the clip attached to the oil feed pipe to the stud of the steering box end cover, reconnect the pipe to the four-way junction on the frame below the column and then re-attach the wire from the electric oil gauge instrument on the crankcase lower half to the oil pipe, providing a clip exists for this purpose.

(xiv) Clean the joint faces of the carburetters and the induction manifold and fit two new Klingerite joint washers if found necessary. Place the carburetters in position. Fit the four spring washers on to the studs and screw on the nuts a few threads only at this stage.

(xv) Refit the air silencer to the air intake and the inlet manifold, secure the silencer to the manifold, tighten up the four nuts securing the carburetters to the manifold and then retighten the Jubilee clip between the silencer and the air intake.

(xvi) Refit the bell-crank control lever (F, Fig.1) to its anchorage on the air intake casting, and reconnect the throttle control rod (D) to the throttle connecting shaft. Do not refit the pin (G) to the mixture control rod until the "Mixture" controls have been checked as described later.

(xvii) Refit the front R.H. engine undershield.

(xviii) Remove the oil filler plug from the steering box and fill the casing with correct oil to the mouth of the plug orifice - refer to Sub-Section BD.1.

(xix) Finally, inspect that no split pins and locking plates have been omitted and also that there is no oil leakage from the steering box.

TO CHECK, AND ADJUST IF NECESSARY, THE THROTTLE, RIDE AND MIXTURE CONTROLS AFTER REFITTING THE STEERING COLUMN AND BOX.

Owing to the possibility that the throttle control lever (3, Fig.2), the ride control lever (3a) and the mixture control lever (4), since their

removal from the control tubes may not have been refitted in the same angular position relative to the tube, the following checks, and adjustments if necessary, should be carried out:-

Throttle Control.

The hand throttle lever on the steering column should move from the fully closed position, approximately ¾" (19 m/m) before starting, to open the throttle. If the free travel is found to be more or less than ¾", then while the hand throttle lever is being held in the fully closed position, slacken off the pinch-bolt securing the lever, (3, Fig.2) to its control tube and ease the lever either forward or backward as required to the full extent of travel permitted by the pinch-bolt. Tighten up the bolt and re-check. Adjustment can also be made if necessary at points 'B', 'E', 'C' and 'P', Fig.1.

Ride Control.

Ascertain that the ride control lever on the steering column can be moved from the "hard" to the "soft" position or vice-versa without any signs of strain or "springyness". If either of these positions cannot easily be obtained, then slacken off the pinch-bolt securing the lever (3a, Fig.2) to its control tube, and ease the lever either forward or backward as required, to the full extent permitted by the pinch-bolt. Tighten up the bolt and re-check. If the desired result cannot be obtained, then adjust as necessary the control rod connected to the countershaft at the front end of the gearbox and the curved lever of the oil damper pump, situated on the left-hand side of the gearbox.

Mixture Control.

The mixture control must be checked as follows:-

Slacken the locknuts 'H' and 'N' of the mixture control rods 'J' and 'L', Fig.1. Remove the two pins 'G' and 'O'. Place the hand controlled mixture lever on the steering column to the full extent of the "Run" position. Should it now be found that the hole in the jaw of the rod 'J' does not line up with the corresponding hole in the jet lever 'R' of the front carburetter, then while lightly pressing the lower end of the jet lever 'R' towards the dashboard, in order to keep the jet head against the adjusting nut of the front carburetter, adjust the jaw until the pin holes are in line. Fit the pin 'G' and secure with a new split pin and tighten the locknut 'H'.

Next, ascertain whether the hole in the jaw 'M', lines up with the hole in the jet lever 'S' of the rear carburetter, if not, then adjust the jaw 'M' until the holes are in line, fit the pin 'O' and secure with a new split pin and tighten up locknut 'N'. The action of the jet return spring 'T' will, through the medium of the jet lever 'S', keep the jet head against the adjusting nut of the rear carburetter.

STEERING GEOMETRY

General Description

The independent front wheel suspension system is of the double wishbone and exposed coil spring type. Each lower triangle lever (wishbone) consists of a front lever operating in a Silentbloc rubber bearing at its inner end and a torque arm operating in a spherical rubber bearing at the rear end. The upper triangle levers also constitute the arms for the double acting piston type hydraulic shock dampers which are an integral part of the suspension. The bearings which support the yokes on the outer ends of the triangle levers are of the needle roller type at the lower end while Silentbloc rubber bushes are used at the upper ends.

It will thus be seen that the front wheels and hubs are entirely rubber insulated in relation to the rest of the chassis, and it is therefore important to adhere to the procedure described in the following paragraphs, otherwise misleading results may be obtained due to the rubber bushes etc. not being in their normal state of compression.

Toe-in of Front Wheels:

The importance of the correct degree of toe-in cannot be over emphasised, and serious tyre wear and tyre scream will result if the correct adjustment is not maintained. Reference to the fault finding table will assist in the location and correction of any mal-alignment or other fault. It would be as well to point out that the results of normal wear and tear and the settling down of the rubber bushes etc. in the suspension system will tend to make the front wheels toe-out, therefore when adjustment is required, it will usually consist of increasing this toe-in.

Toe-in, which is the amount by which the rims of the front wheels are closer together at the front than the rear, can be measured by an adjustable trammel or by an optical gauge as described in the following paragraphs, or by other type of checking equipment which accomplish the same purpose.

The correct front wheel alignment is from 1/16" to $\frac{1}{8}$" (1.6 mm. to 3.2 mm.). toe-in, but it is preferable to set the toe-in nearer the $\frac{1}{8}$" end of the limit as it will then take longer before a state of toe-out exists for reasons described above. Divergence from these limits by as little as 1/32" (0.8 mm.) should not be permitted.

In the case of cars having a complete overhaul of the front suspension system in which all the rubber bearings are being replaced, then the toe-in should be adjusted to the factory setting for new cars which is $\frac{1}{8}$" to $\frac{1}{4}$" (3.2 mm. to 6.5 mm.) toe-in. This allows for the settling down of the various rubber bushes.

Measuring Toe-in with an Adjustable Trammel:

(i) Remove the wheel discs from the front wheels.

(ii) With the car on a level floor and the tyre pressures correct, jack up the front of the car until the wheels are just clear of the ground.

(iii) Spin the wheels and test for sideways run-out ("high-spot") of the rim on the outer side of the wheels. It is important that this check is made on the flat side of the rim of each wheel, i.e. at point 'D' Fig. 11 and not on the extreme edge (turned over lip) of the wheels. Mark each tyre with a chalk mark in line with the "high-spot" on the wheel. This operation will tend to correct for errors which might otherwise occur due to wheel run-out.

(iv) Place the front wheels in the exact straight ahead position and then turn each wheel so that the chalk mark on the tyre is at the top or the bottom. Lower the wheels to the ground.

(v) Roll the car forwards for one full revolution of the wheels until the chalk marks are again at the top or bottom. This will allow the suspension to settle down to its normal working position.

(vi) With an adjustable trammel, measure the toe-in, make sure that the measurement is carried out at hub height and that the points of the trammel are placed against the flat side of the rim (point 'D' Fig. 11) and not against the turned over lip. It is important that no person should be in the car when the toe-in is being measured.

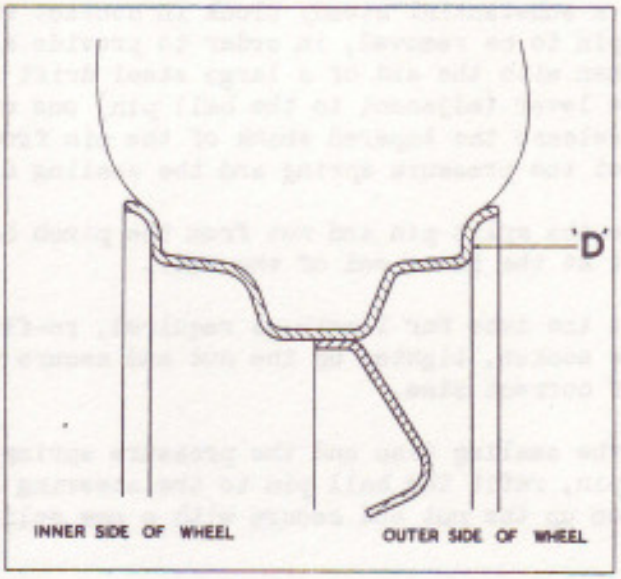


Fig. 11. Section through wheel rim showing flat face 'D'.

Measuring Toe-in with an Optical Wheel Alignment Gauge:

(i) Remove the wheel discs from the front wheels.

(ii) Carry out operations (ii), (iii), (iv) and (v) described in previous paragraph.

(iii) Proceed according to the instructions issued by the manufacturers of the optical gauge.

NOTE: It is recommended that Main Service Stations should be in possession of a pair of specially trued up wheels to be used exclusively for alignment checking purposes. This would obviate the necessity of checking wheels for sideways run-out as previously described, and would give more accurate results.

To Adjust Toe-In:

Both the cross-steering tubes are adjustable for length. Each tube has a R.H. thread (26 T.P.I.) and is screwed into a socket. One complete turn of one tube in relation to its socket, will alter the toe-in by 0.090"(2.3 m/m) Unscrewing a tube will increase the toe-in. Should more than one turn be required in order to correct the toe-in, then the adjustment should be divided between each cross-steering tube.

To Adjust, proceed as follows:-

(i) Remove the split pin and then remove the nut securing the outer end of the tube to the cross steering lever.

(ii) Place a substantial steady block in contact with the lever near the ball pin to be removed, in order to provide a solid re-action point and then with the aid of a large steel drift and hammer, give the eye of the lever (adjacent to the ball pin) one or more sharp blows which will release the tapered shank of the pin from its location in the lever. Collect the pressure spring and the sealing disc.

(iii) Remove the split pin and nut from the pinch bolt fitted to the socket at the inner end of the tube.

(iv) Adjust the tube for length as required, re-fit the pinch bolt to the socket, tighten up the nut and secure with a new split pin of correct size.

(v) With the sealing disc and the pressure spring in position on the ball pin, refit the ball pin to the steering lever, fully tighten up the nut and secure with a new split pin of the correct size.

Camber, Castor and Pivot Pin Inclination:

As a result of the particular geometry of the suspension system, the camber angle and the pivot inclination vary according to the load, this also applies to the castor angle to a lesser degree.

The figures given for these angles in sub-paragraphs (a), (b) and (c), are in no way critical and are provided for information and as a guide for checking purposes should it be suspected that there is some fault in the suspension system.

No adjustments are provided for altering these angles, but if an appreciable variation from the quoted figures or between one side of the car and the other occurs, then it is an indication that one or more of the following points may be at fault.

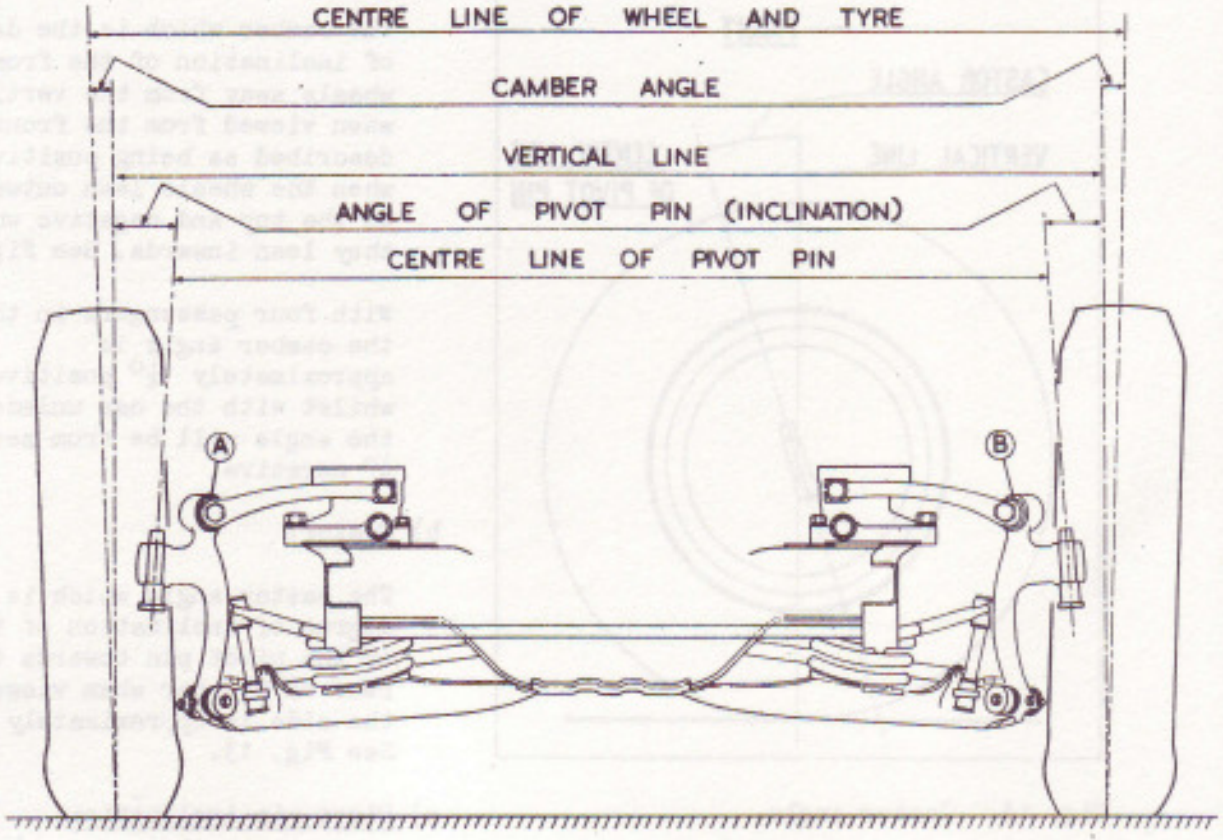


Fig. 12. Camber angle and pivot pin inclination.

(i) The Silentbloc rubber bush (A & B. Fig. 12) at the upper end of the yoke may have collapsed.

(ii) The spherical rubber bearing at the rear end of the torque arm may require renewing. If the rear end of the torque arm can be moved up and down by hand; it indicates that the rubber bearing has collapsed.

(iii) The Silentbloc rubber bearing at the inner end of the lower triangle lever may have collapsed or the bracket supporting the inner ends of the two lower triangle levers may be damaged (bent).

(iv) Damage to the triangle levers, the yoke or the frame due to accident. Looseness of the front dampers on the frame.

(v) Slackness in wheel bearings, pivot pins etc. due to fair wear and tear.

The checking of the camber, castor and pivot pin inclination may be carried out by one of the proprietary gauges, and the instructions issued with it should be carefully followed. In addition, compensation for run-out of the wheel rims as previously described, should be carried out except that the "high-spots" marked by chalk should be placed to the front or rear. The 'feet' of the gauge should be placed on the flat side of the rim.

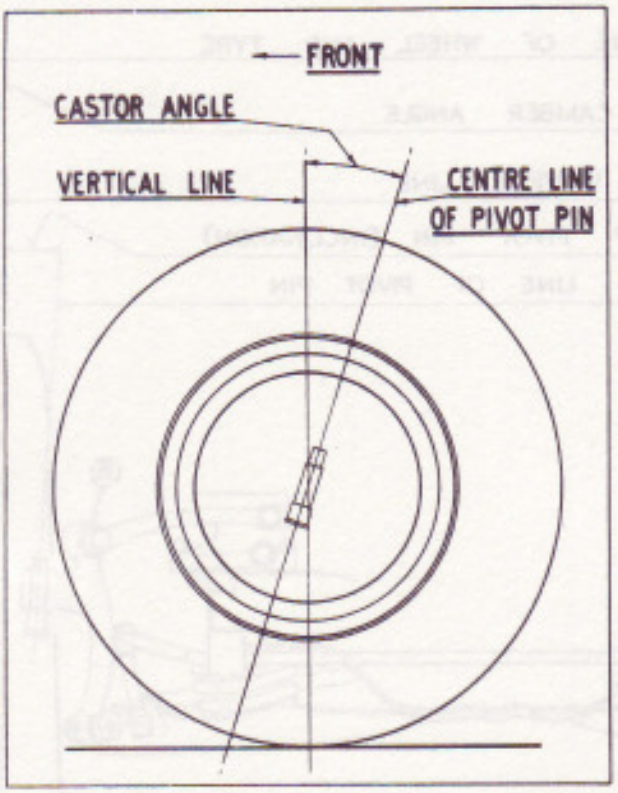


Fig. 13. Castor angle.

a) Camber:

The camber which is the degree of inclination of the front wheels away from the vertical when viewed from the front, is described as being positive when the wheels lean outwards at the top and negative when they lean inwards. See Fig.12.

With four passengers in the car, the camber angle is approximately $1\frac{1}{4}^{o}$ positive, whilst with the car unladened, the angle will be from zero to $\frac{1}{2}^{o}$ negative.

b) Castor:

The castor angle which is the degree of inclination of the top of the pivot pin towards the rear of the car when viewed from the side is approximately $\frac{1}{4}^{o}$. See Fig. 13.

c) Pivot pin inclination:

The pivot (king) pin inclination, which is the angle by which the top of the pins are inclined away from the vertical towards the centre of the car when viewed from the front, is approximately $3\frac{1}{4}^{o}$. See Fig. 12.

Fault Location:

Symptom:	Possible Cause:	Remedy:
Excessive wear of inner-side of R.H. front tyre (or of L.H. front tyre in countries in which cars are driven on R.H. side of road).	Insufficient toe-in of front wheels.	Adjust.
Excessive wear of outerside of L.H. front tyre (or of R.H. front tyre in countries in which cars are driven on R.H. side of road.)	Excessive toe-in of front wheels.	Adjust.

Symptom:	Possible Cause:	Remedy:
Excessive or uneven front tyre wear.	Incorrect toe-in	Adjust.
	Tyres under inflated	Correct.
	Shock dampers not functioning correctly.	Check oil level - Replenish. Examine for oil leaks and remedy. See Sect: 'K'
	Incorrect camber.	See appropriate paragraph.
	Wheels or tyres out of true.	If maximum run-out of wheel rim exceeds 0.100" (2.5 m/m), replace.
		See appropriate paragraph.
Excessive tyre scream when cornering.	Tyres under inflated.	Correct. Inflate front tyres to 27-lbs/sq in.
	Incorrect toe-in.	Adjust.
Steering pulls to one side.	Low or uneven tyre pressures.	Correct.
	Incorrect toe-in.	Adjust.
	Uneven tyre wear.	Change-over front wheels.
	Camber angles not equal	See appropriate paragraph.
	Damage to frame or suspension.	
Wheel wobble or road reaction on steering wheel.	Front wheels out of balance.	Re-balance. See Owners Handbook.
	Tyre pressures incorrect.	Correct.
	Front dampers not functioning correctly.	Check oil level - replenish. Examine for oil leaks and remedy. If necessary, increase loading See Section 'K'
	Tyre pressures too high.	Correct.
	Insufficient oil in steering box.	Replenish.
	Wheels or tyres out of true.	If maximum run-out of wheel rim exceeds 0.100" (2.5 m/m), replace.
	Failure of spherical rubber bearing fitted to rear of torque arm.	Replace.
	Insufficient damping provided by cross-steering tube joints.	Increase the loading as described in Sub-Section BQ.3.
Front wheel tramp or patter	Front wheel out of balance.	Re-balance. See Owners Handbook.

Symptom:	Possible Cause:	Remedy:
	Front shock dampers not functioning correctly.	Check oil level - Replenish. Examine for oil leaks and remedy. If necessary increase loading. See Section 'K'.
Car wanders.	Low or uneven tyre pressures.	Correct.
	Front wheels toe-out.	Adjust.
	Excessive stiffness in steering mechanism.	Jack up and check for stiffness in steering box.
	Damage to frame or suspension.	
	Failure of spherical rubber bearing fitted to rear of torque arm.	Replace.

THE SIDE AND CROSS STEERING TUBES.

GENERAL - SIDE STEERING TUBE.

The ball joints are lubricated from the centralised chassis lubrication system. No adjustment is provided for the poundage (friction load) on the ball joint at the front end of the tube, as a coil spring exerts a constant pressure on the joint (See Fig.15). The tube can be adjusted for length, but it should seldom, if ever, be necessary to alter it. Its length is fixed by the makers during the build of the chassis. The tube has a right-hand thread, 26 T.P.I. and is screwed into a socket, the latter, attached to the centre steering lever. Should damage occur to a tube as the result of an accident which necessitates its replacement, then the new tube will have to be adjusted for correct length as described later.

NOTE:- The following is the correct procedure to adopt when removing the ball joint (ball pin) at the front end of the side steering tube from the centre steering lever. This method also applies when removing the ball joints of the cross steering tubes from their respective levers.

Place a substantial steady block in contact with the lever near the ball pin to be removed, in order to provide a solid re-action point, and then with the aid of a large steel drift and hammer, give the eye of the lever (adjacent to the ball pin) one or more sharp blows which will release the tapered shank of the pin from its location in the lever.

Before refitting a ball joint (ball pin) to a lever, clean the tapered shank of the pin and corresponding hole. Do NOT use a hammer when refitting a ball pin to a lever, but rely on tightening the nut to draw the mating parts together.

TO REMOVE A SIDE STEERING TUBE.

(Front End).

(i) Remove front right-hand undershield.

(ii) Jack up front wheels, and turn the wheels to full right-hand lock.

(iii) Remove split pin and nut (12, Fig.14) from the ball pin at the front end of tube. Carefully remove ball pin (8) from the centre steering lever and collect the pressure spring (13) and sealing disc (11).

(Rear End).

(iv) Remove the side steering tube (ball pin) from the pendulum lever as described in the section "The Steering Column and Box", but in this case do not attempt to disconnect the steering box and bracket from the frame, as this only applies when removing a steering column and box.

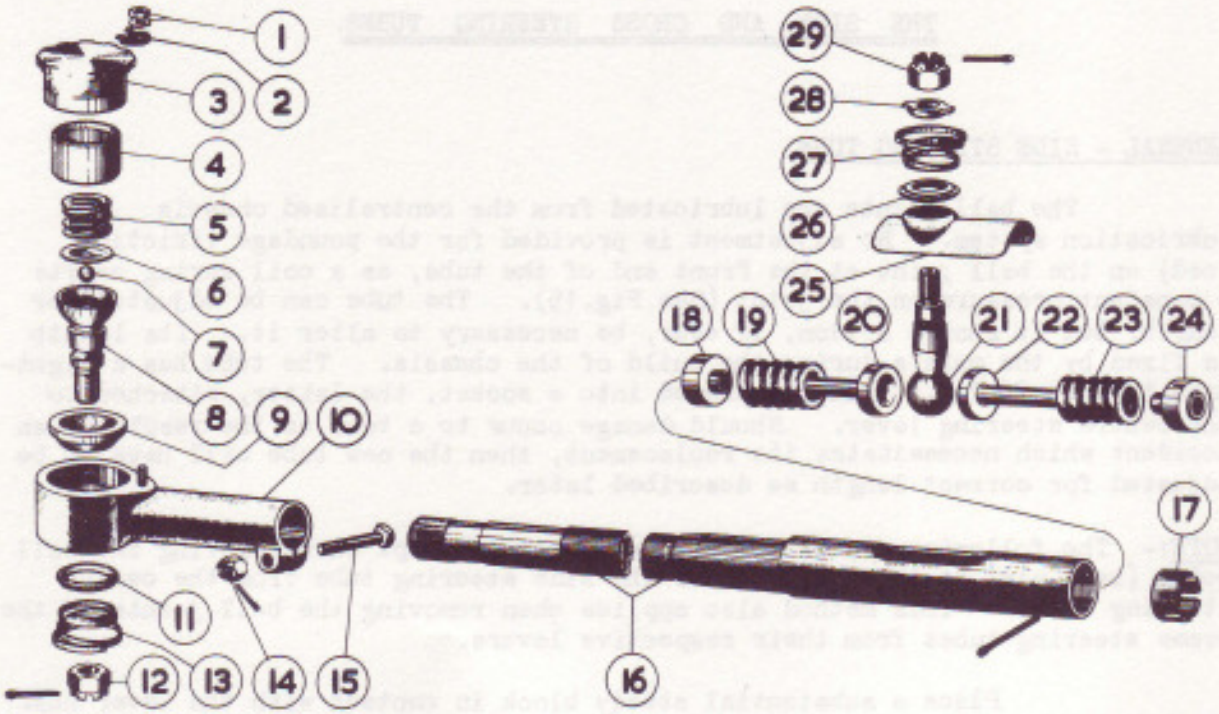


FIG. 14. "EXPLODED" VIEW OF SIDE STEERING TUBE.

Notation for Fig. 14.

1. Nut and Spring Washer.
2. Locking Plate.
3. Cap Nut.
4. Sleeve.
5. Spring.
6. Spring Pad.
7. Ball, hardened 0.3125" dia.
8. Ball End Pin.
9. Ball Pad.
10. End Socket.
11. Sealing Disc.
12. Nut.
13. Pressure Spring.
14. Nut.
15. Pinch Bolt.
16. Side Steering Tube.
17. End Nut (Internal).
18. Guide.
19. Spring.
20. Ball Pad.
21. Ball Pin (Tapered).
22. Ball Pad.
23. Spring.
24. Guide.
25. Mud Excluder.
26. Sealing Disc.
27. Pressure Spring.
28. Locating Washer.
29. Nut.

(v) Should it be found that insufficient clearance exists to allow the ball pin to come clear of the pendulum lever, then it will be necessary to remove the pendulum lever from the rocking shaft of the steering box, as follows:-

(a) Disconnect the oil feed pipe (to the ball pin of the pendulum lever) from the four-way junction on the frame beneath the steering column and remove the clip, attached to the oil feed pipe, from the steering box end cover.

(b) Release lockwasher from nut securing pendulum lever to rocking shaft, and remove the nut.

(c) Before removing pendulum lever from rocking shaft, both these items should be marked so that they can be fitted together again afterwards in the same relative position, for if the pendulum lever is refitted on a different serration, it would restrict the angular movement of the rocking shaft in one direction or the other. One centre punch mark may be made in one of the slots for the lockwasher and the other mark in line with it on the lever.

(d) Remove pendulum lever complete with the coiled oil pipe from the rocking shaft by means of the extractor, Tool No.3243/T1001.

(e) After removal of side steering tube from the pendulum lever, collect the pressure spring (27, Fig.14), sealing disc (26), and mud excluder (25).

TO REMOVE BALL END PIN FROM FRONT END OF THE SIDE STEERING TUBE.

(i) Remove nut and spring washer (1) and locking plate (2).

(ii) With a 'C' spanner, remove the cap nut (3) which will probably withdraw with it the sleeve (4). Remove the spring (5), spring pad (6), ball (7) and the ball pin (8). The ball pad (9) can be removed if necessary.

(iii) Clean all dismantled parts.

TO REMOVE BALL END PIN FROM REAR END OF THE SIDE STEERING TUBE.

(i) Remove the split pin and then remove the internal end nut (17) with a suitable tool. Remove the guide (24), the spring (23), ball pad (22) and the ball pin (21). Remove remaining ball pad, spring and guide.

(ii) Clean all dismantled parts.

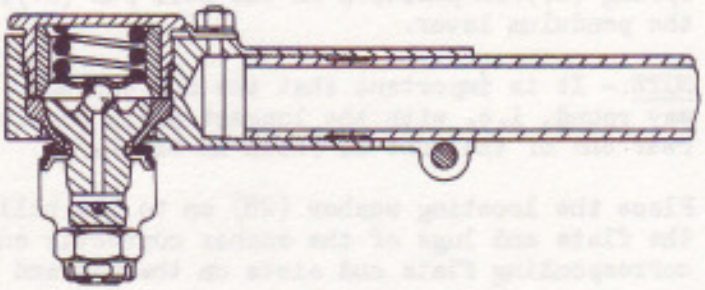


FIG.15. SECTION THROUGH BALL JOINT AT FRONT END OF SIDE STEERING TUBE.

TO REFIT BALL END PIN TO FRONT END OF THE SIDE STEERING TUBE.

(i) Reverse the instructions for removal. (Refer to Fig.15). The ball joint and cap must be packed with a soft type of grease, such as Duckham's HBB grease, during re-assembly, to prevent oil leaking.

(ii) Screw down the cap nut as far as it will go, fit the locking plate (2) and secure with spring washer and nut (1). Wipe away surplus grease from joint.

TO REFIT BALL END PIN TO REAR END OF THE SIDE STEERING TUBE.

(i) Reverse the instructions for removal. Prior to refitting the parts, liberally smear them with oil.

(ii) Screw in the end nut (17) until the ball pads, spring and guide assemblies are choc-a-bloc. Slacken the nut back 0.180" (4.6 m/m) in order to restore the original standard working clearance of 0.090" (2.3 m/m) at points 'A' and 'B', Fig.16, i.e. between the

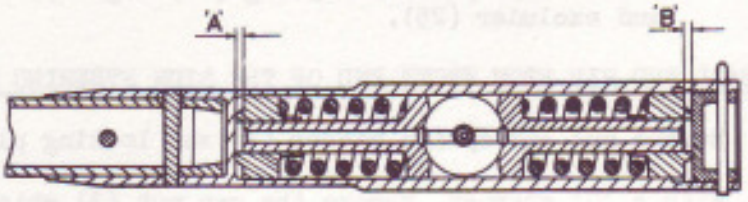


FIG.16. SECTION THROUGH BALL JOINT AT REAR END OF SIDE STEERING TUBE.

end of each stem of the ball pads (20 and 22 Fig.14), and the inner end of the tube and the inner face of the end nut. Secure end nut with a new split pin of the correct size.

TO REFIT THE SIDE STEERING TUBE.

(Rear End)

(i) With the mud excluder (25, Fig.14), sealing disc (26) and pressure spring (27) in position on the ball pin (21), enter the pin into the pendulum lever.

NOTE:- It is important that the mud excluder is placed the correct way round, i.e. with the longest plain portion pointing towards the rear end of the tube as shown in Fig.14.

Place the locating washer (28) on to the ball pin, making sure that the flats and lugs of the washer correctly engage with the corresponding flats and slots on the pin and in the lever. The purpose of the locating washer, is to ensure alignment of the oil holes in the ball of the pin with the axis of the side steering tube. (See Fig.16).

(ii) Fully tighten the nut (29) and secure with a new split pin.

(iii) Should it have been found necessary to remove the pendulum lever from the rocking shaft, then refit the ball pin of the side steering tube to the pendulum lever (as previously described) on the bench.

With the coiled lubrication pipe and its protection cover in position on the pendulum lever, fit the lever to the rocking shaft in the same angular position as originally fitted, i.e. matched to the markings previously made. Fit a new lockwasher on to the shaft and securely tighten up the nut and bend over the tabs of the lock-washer to secure.

(iv) Refit clip of the lubrication pipe to the stud of the steering box end cover, and reconnect pipe to the four-way junction or the frame.

(Front End)

(v) Place the spherical face of the sealing disc (11) against the ball pad (9, Fig.15), and then place the small diameter end of the pressure spring (13) on to the spigot of the sealing disc, and without disturbing the position of them, enter the ball pin into the centre steering lever. Fully tighten up the nut (12) and secure with a new split pin.

TO FIT A NEW SIDE STEERING TUBE.

NOTE:- It is assumed that if the steering column and box have been dismantled for any reason, that all parts will have been correctly assembled with the pendulum lever in its correct angular position in relation to the rocking shaft.

(i) With all parts (front and rear ball joints) assembled to the new tube, the front end cap nut (3, Fig.14) locked, and the rear end nut (17) securely split pinned, fit the tube (ball pin) to the pendulum lever as previously described.

Proceed as follows to adjust the tube for correct length:-

(a) While the front end of the tube is being held, rotate the steering wheel about one and seven eighths of a turn from either lock so as to place the cam tube approximately in the straight-ahead position (i.e. the cam roller of the steering central with the cam).

The spoke nearest to the oil hole in the hub of the steering wheel should now be at the top or very near to it. Place the spoke at the top as necessary so as to set the cam tube in the exact straight-ahead position.

(b) Place the front wheels in the exact straight-ahead position.

(c) Without moving the position of either the steering wheel or the front wheels, remove the pinch bolt (15) from the side steering tube and adjust for length by screwing the end socket (10) in or out as required. After obtaining the correct length, refit the pinch bolt, tighten up the nut (14) and secure with a new split pin.

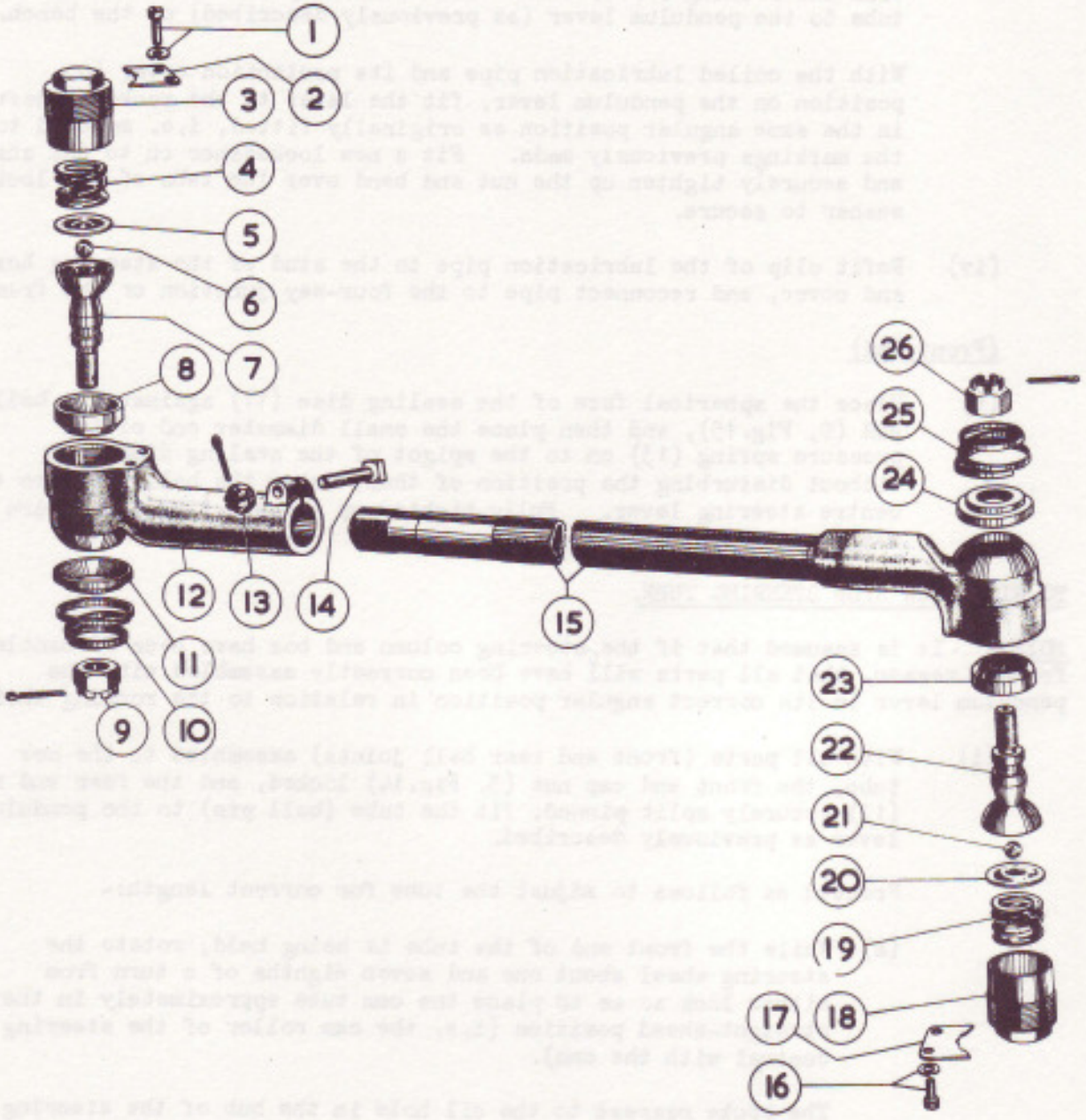


FIG. 17. "EXPLODED" VIEW OF A CROSS STEERING TUBE.

Notation for Fig. 17.

1 & 16. Setscrew & Spring Washer.
2 & 17. Locking Plate.
3 & 18. Cap Nut.
4 & 19. Spring.
5 & 20. Spring Pad.
6 & 21. Ball, Hardened, 0.3125" dia.
7 & 22. Ball End Pin.
8 & 23. Ball Pad.
9 & 26. Nut.
10 & 25. Pressure Spring.
11 & 24. Sealing Disc.
12. Socket (Inner).
13. Nut.
14. Pinch Bolt.
15. Cross Steering Tube & Outer Socket.

(d) Finally fit the front end of the tube (ball pin) to the centre steering lever as previously described.

(e) Inspect that no split pins have been omitted.

GENERAL - CROSS STEERING TUBES.

The four ball joints are identical and are lubricated from the centralised chassis lubrication system. No adjustment is provided for the poundage (friction load) on the ball joints, because a coil spring exerts a constant pressure on the joint. (See Fig.18). It is permissible, however, in the event of complaints of wheel wobble or of road reaction transmitted to the steering wheel to increase the loading of the two outer ball joints providing that all normal methods of overcoming these complaints as described in "Steering Geometry" have failed to overcome the trouble. To increase the loading, fit a packing washer or shim between the coil spring (19, Fig.17) and the cap nut (18). It must be assured, however, that the thickness of the packing washer is such that when the cap nut is full screwed up, the spring is not choc-a-bloc.

The cross steering tubes are adjustable for front wheel alignment (toe-in) purposes as described in "Steering Geometry".

TO REMOVE A CROSS STEERING TUBE.

(i) The method of removal of the outer and inner ball joints of a cross steering tube from the cross and centre steering levers is the same for either end of the tube and for both the tubes. It will be observed on reference to Fig.17 that although the various parts which form the two ball joints of a cross steering tube, bear different reference numbers, they are identical with one another.

To remove the outer ball joint from a cross steering lever:-

Remove split pin and nut (26, Fig.17) from the ball pin (22) and carefully remove ball pin from the lever. (Refer to "NOTE" "Side Steering Tube". Collect pressure spring (25) and sealing disc (24).

TO REMOVE A BALL END PIN FROM A JOINT.

(i) Remove the two setscrews and spring washers (1, Fig.17) and the locking plate (2).

(ii) Remove cap nut (3), spring (4), spring pad (5), ball (6) and ball pin (7). The ball pad (8) can be removed if necessary.

(iii) Clean all dismantled parts.

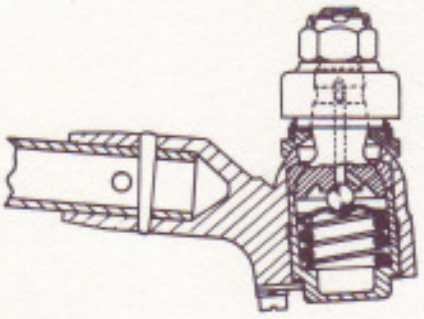


FIG.18. SECTION THROUGH A BALL JOINT (OUTER) OF A CROSS STEERING TUBE.

TO REFIT A BALL END PIN TO A JOINT.

(i) Reverse the instructions for removal (See Fig.18). The ball joint and cap must be packed with a soft type of grease such as Duckham's HBB grease during

re-assembly to prevent oil leaking.

(ii) Screw down the cap nut as far as it will go, fit locking plate and secure with the two spring washers and setscrews. Wipe away surplus grease from joint.

TO REFIT A CROSS STEERING TUBE.

With the ball end pins fitted to the two joints place the sealing disc (11 or 24, Fig.17) and the pressure spring (10 or 25) in position on the ball pin and refit the ball pins to the centre and cross steering levers. Fully tighten up the nuts and secure with new split pins.

THE CENTRE STEERING LEVER AND SWIVEL PIN HOUSING ASSEMBLY.

METHOD OF LUBRICATION OF THE SWIVEL PIN BUSHES OF THE CENTRE STEERING LEVER, THE INNER BALL JOINTS OF THE CROSS STEERING TUBES AND THE BALL JOINT AT THE FRONT END OF THE SIDE STEERING TUBE:

Oil under pressure from the centralised chassis lubrication system is delivered by an external brass pipe to a non-restricted straight junction (7 Figs. 19 & 20), fitted to the top cover (20). The oil then passes through drillings in the cover, down the passage in and through the two small diameter holes in the stem of the spring loaded restrictor (17) and supplies the upper and lower bushes (18 & 13) of the swivel pin (16) through the clearance between the loose fitting restrictor and the smaller of the three internal bores in the swivel pin, the clearance being so arranged to meter the correct amount of oil. The swivel pin is also provided with two oil holes as shown in Fig. 20 which register through the medium of annular grooves, with the two small oil holes in the stem of the restrictor and an oil passage in the centre steering lever (15). By this means, oil is also delivered under pressure, via brass pipes without restrictors, to the inner ball joints of the cross steering tubes and the ball joint at the front end of the side steering tube.

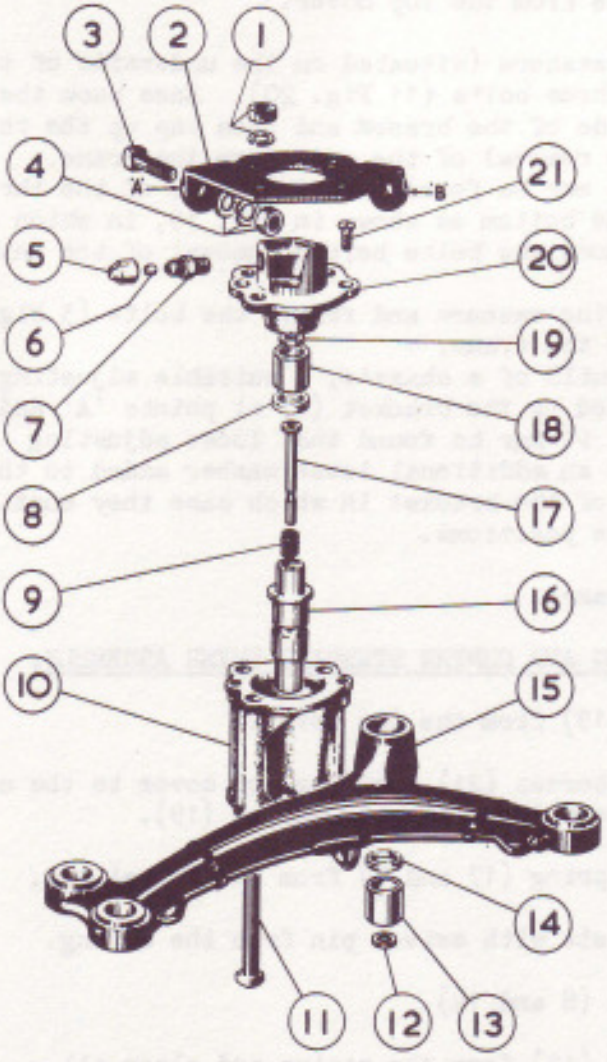


Fig.19. "Exploded" view of swivel pin housing & centre steering lever.

1. Nut & spring washer.
2. Bracket.
3. Bolt.
4. Nut, spring & plain washer.
5. Nut.
6. Compression Sleeve.
7. Junction (straight).
8. Felt Washer.
9. Spring.
10. Housing.
11. Bolt.
12. Adjusting Washer,(range of)
13. Bush.
14. Felt Washer.
15. Centre steering lever.
16. Swivel pin.
17. Restrictor.
18. Bush.
19. Adjusting Washer.(range of)
20. Top Cover. 21. Screw.

From the above, it will be observed that the oil supply to the upper and lower bushes of the swivel pin is controlled, whereas the oil supply to the inner ball joints of the cross steering tubes and the ball joint at the front end of the side steering tube is not controlled other than by the fit of the ball end contact piece against the ball pin. The bushes are a press fit in the top cover and the casing and reamed to size. The swivel pin is also a press fit in the centre steering lever having an interference fit of 0.0005" to 0.0015" (0.012 to 0.038 m/m.)
NOTE: The two bushes (18 and 13), the two felt washers (8 and 14) and the adjusting washers (19 and 12), of which a range of the latter is available, are identical.

TO REMOVE A SWIVEL PIN HOUSING AND CENTRE STEERING LEVER ASSEMBLY:

(i) Remove the ball joint (ball pin) of the side steering tube from the centre steering lever as described in "The side and cross steering tubes".

(ii) Remove the two inner ball joints (ball pins) of the cross steering tubes from the centre steering lever as described in "The Side and Cross Steering Tubes".

(iii) Disconnect the oil feed pipe from the top cover.

(iv) Remove the nuts and spring washers (situated on the underside of the "jacking" plate) from the three bolts (11 Fig. 20). Ease back the two nuts (4 Fig. 19) on each side of the bracket and then tap up the three bolts sufficiently to allow removal of the unit from the frame.
NOTE: In isolated cases, it may be found that the heads of the three bolts (11) are fitted at the bottom as shown in Fig. 19, in which case it will be necessary to remove the bolts before removal of the unit.

(v) Remove the two nuts and spring washers and remove the bolts (3 Fig.19) securing the bracket (2) to the frame.
NOTE: During the original build of a chassis, a suitable adjusting washer is selected and welded to the bracket (2) at points 'A' and 'B', Fig 19, but in some cases, it may be found that loose adjusting washers have been fitted or an additional loose washer added to the welded washer on each side of the bracket in which case they must be refitted in their respective positions.

(vi) Remove the unit from the frame.

TO DISMANTLE THE SWIVEL PIN HOUSING AND CENTRE STEERING LEVER ASSEMBLY:

(i) Remove the bracket (2 Fig. 19) from the top cover.

(ii) Remove the two countersunk screws (21) securing top cover to the casing. Lift off top cover and collect the adjusting washer (19).

(iii) Remove oil restrictor and spring (17 and 9) from the swivel pin.

(iv) Remove steering lever complete with swivel pin from the casing.

(v) Remove the two felt washers (8 and 14).

(vi) Remove the adjusting washer (12) from the casing and clean all dismantled parts.

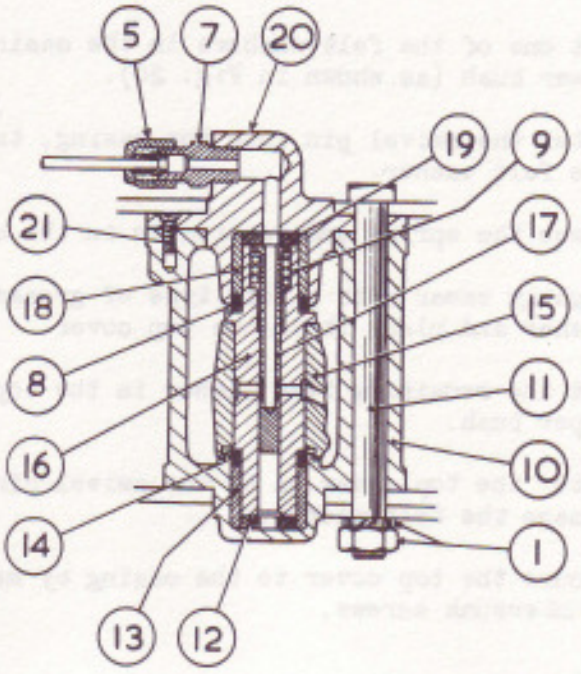


Fig.20. Section through swivel pin
Housing - Centre steering lever.

TO RE-ASSEMBLE THE SWIVEL PIN HOUSING AND CENTRE STEERING LEVER:

(i) Ascertain that the swivel pin is a tight fit in the steering lever. In the unlikely event of the pin being slack in the lever, this should be rectified by either fitting a new pin or having the original pin chromium plated to the necessary depth on the portion of the pin which makes contact with the lever in order to restore the original interference fit of 0.0005" to 0.0015". The diameter of the bore of the lever should be 0.750 + 0.0005" (19.05 + 0.01 m/m) and the corresponding diameter of the swivel pin should be 0.751 + 0.0005" (19.08 + 0.01 m/m)

(ii) The next operation is to temporarily re-assemble the unit minus the felt washers, restrictor and spring, in order to ascertain the amount of end float between the ends of the swivel pin and the upper and lower adjusting washers.
Fit adjusting washers as necessary to allow from 0.002" to 0.006" (0.05 to 0.15 m/m) end float of the swivel pin and steering lever sub-assembly. It should be noted that if the end float is appreciably in excess of the above figure, it will cause the swivel pin to knock or rattle which would be transmitted up the steering column. Slackness between the swivel pin and the centre steering lever, would also produce the same effect.

(iii) Dismantle the unit and finally re-assemble as follows:-

NOTE: Renew the felt washers if found necessary.

a) Lubricate parts as necessary with engine oil.

b) Place the lower adjusting washer in position in the casing.

c) Fit one of the felt washers in the casing i.e. against the lower bush (as shown in Fig. 20).

d) Enter the swivel pin into the casing, taking care not to damage the felt washer.

e) Place the spring and restrictor in the swivel pin.

f) Lightly smear with a soft type of grease, the upper adjusting washer and place it in the top cover.

g) Fit the remaining felt washer in the top cover i.e. against the upper bush.

h) Enter the top cover on to the swivel pin, taking care not to damage the felt washer.

j) Secure the top cover to the casing by means of the two countersunk screws.

TO REFIT THE SWIVEL PIN HOUSING AND CENTRE STEERING LEVER ASSEMBLY:

(i) Reverse the instructions for removing.

(ii) Refit the two inner ball joints (ball pins) of the cross steering tubes to the centre steering lever as described in "The side and cross steering tubes."

(iii) Refit the ball joint (ball pin) of the side steering tube to the centre steering lever as described in "The side and cross steering tubes."

(iv) Finally inspect that the three ball joints (ball pins) are securely split pinned.