



- (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 carburettors and the induction manifold and fit two new Klingerite joint washers if found necessary. Place the carburettors 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 carburettors 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 ED.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 $\frac{3}{4}$ " (19 mm) before starting, to open the throttle. If the free travel is found to be more or less than $\frac{3}{4}$ ", 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 $1/8"$ (1.6 mm. to 3.2 mm.) toe-in, but it is preferable to set the toe-in nearer the $1/8"$ 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 $1/8"$ to $1/4"$ (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.

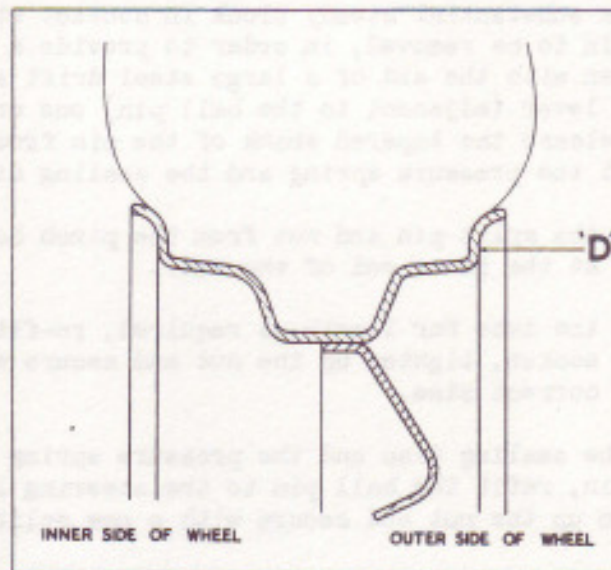


Fig. 11. Section through wheel rim showing flat face 'D'.

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 mm). 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.

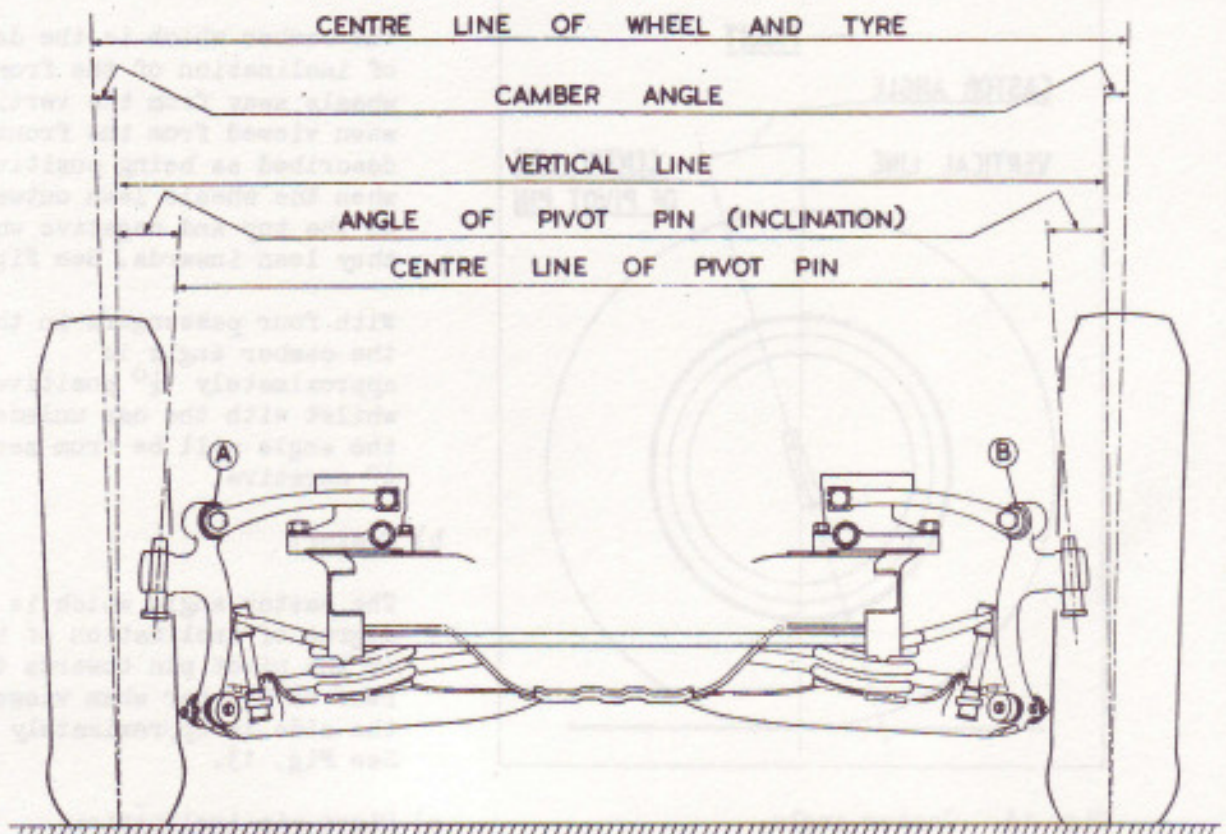


Fig. 12. Camber angle and pivot pin inclination.

- (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.

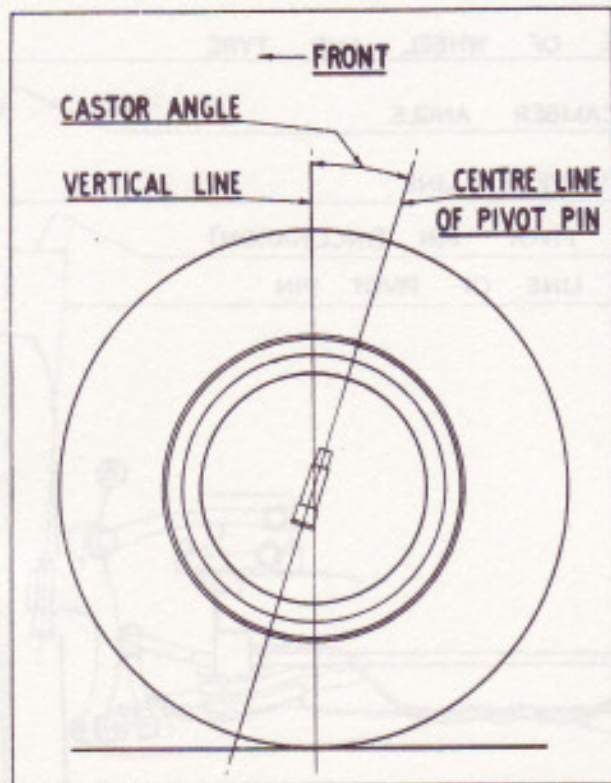


Fig. 13. Castor angle.

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 $1\frac{1}{4}^{\circ}$ positive, whilst with the car unladen, the angle will be from zero to $\frac{1}{2}^{\circ}$ 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 $\frac{3}{4}^{\circ}$. 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 $\frac{3}{4}^{\circ}$. See Fig. 12.

Fault Location:

<u>Symptom:</u>	<u>Possible Cause:</u>	<u>Remedy:</u>
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 outside 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.



<u>Symptom:</u>	<u>Possible Cause:</u>	<u>Remedy:</u>
Excessive or uneven front tyre wear.	Incorrect toe-in Tyres under inflated Shock dampers not functioning correctly.	Adjust. Correct. Check oil level - Replenish. Examine for oil leaks and remedy. See Sect: 'K'
	Incorrect camber. Wheels or tyres out of true.	See appropriate paragraph. 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. Incorrect toe-in.	Correct. Inflate front tyres to 27-lbs/sq in. Adjust.
Steering pulls to one side.	Low or uneven tyre pressures. Incorrect toe-in. Uneven tyre wear. Camber angles not equal Damage to frame or suspension.	Correct. Adjust. Change-over front wheels. See appropriate paragraph.
Wheel wobble or road reaction on steering wheel.	Front wheels out of balance. Tyre pressures incorrect. Front dampers not functioning correctly.	Re-balance. See Owners Handbook. Correct. Check oil level - replenish. Examine for oil leaks and remedy. If necessary, increase loading See Section 'K'
	Tyre pressures too high. Insufficient oil in steering box.	Correct. 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:

Car wanders.

Front shock dampers not functioning correctly.

Check oil level - Replenish. Examine for oil leaks and remedy. If necessary increase loading. See Section 'K'.

Low or uneven tyre pressures.

Correct.

Front wheels toe-out. Excessive stiffness in steering mechanism.

Adjust. 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.

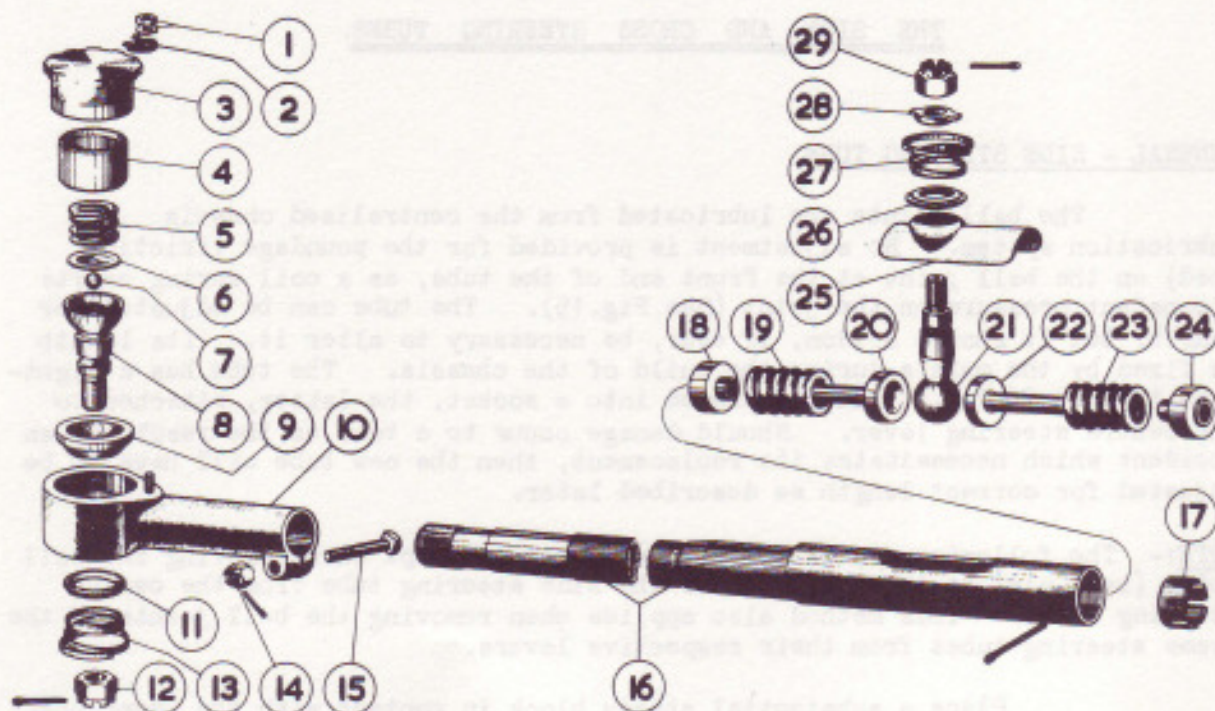


FIG. 14. "EXPLODED" VIEW OF SIDE STEERING TUBE.

Notation for Fig.14.

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

(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.

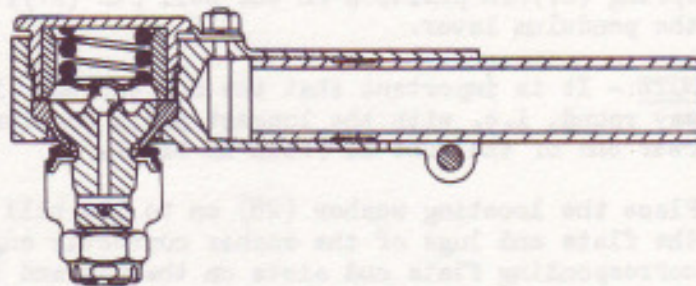


FIG. 15. SECTION THROUGH BALL JOINT AT FRONT END OF SIDE STEERING TUBE.

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 mm) in order to restore the original standard working clearance of 0.090" (2.3 mm) 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)

- (1) 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 lockwasher 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.

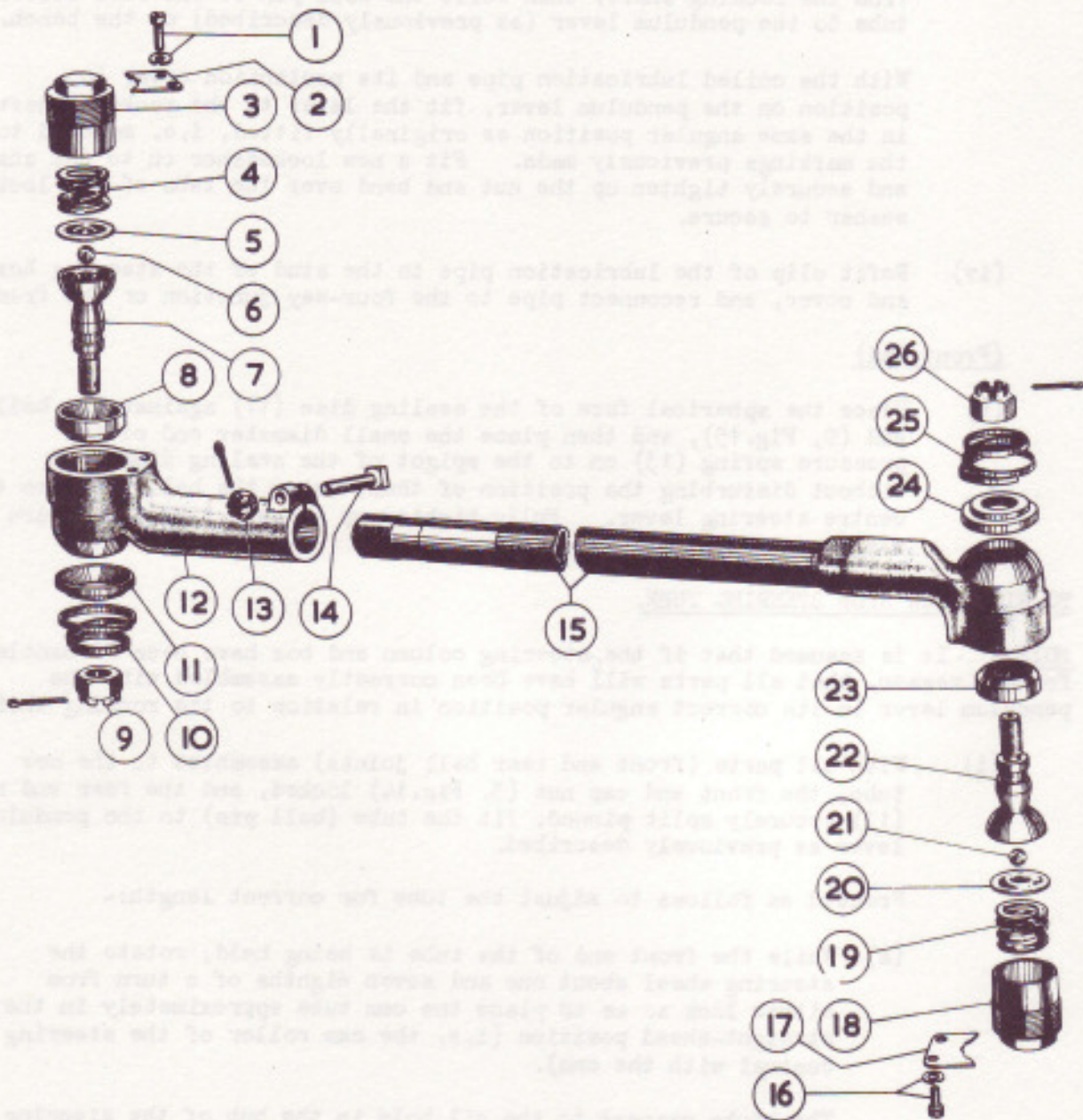


FIG. 17. "EXPLODED" VIEW OF A CROSS STEERING TUBE.

Notation for Fig. 17.

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



- (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.

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

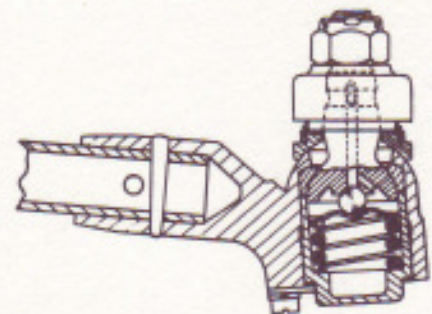


FIG.18. SECTION THROUGH A BALL JOINT (OUTER) OF A CROSS STEERING TUBE.



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.

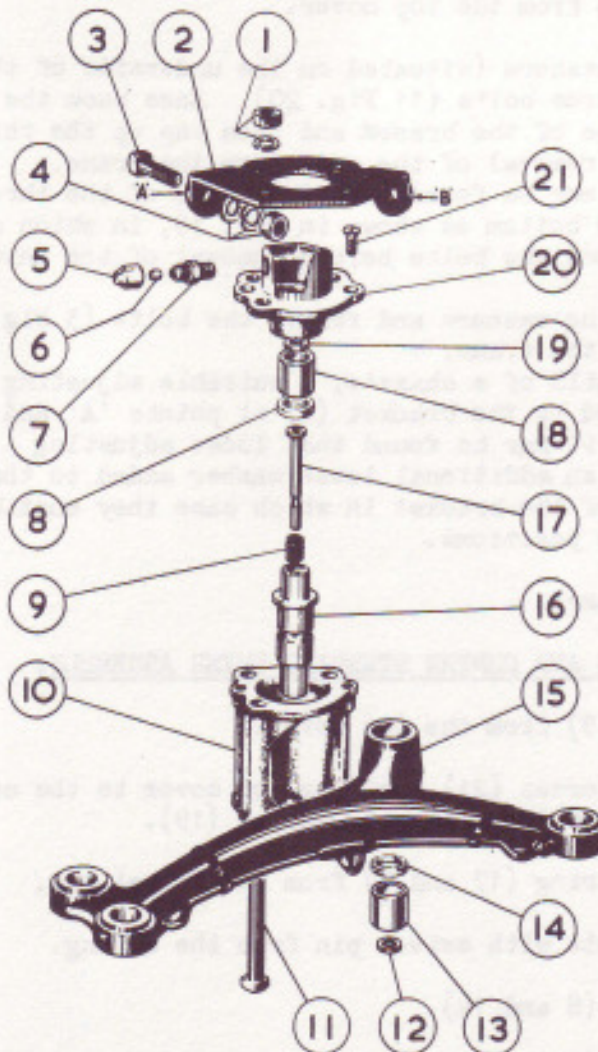
With the ball end pins fitted to the two joints place the sealing disc (11 or 24, Fig.17) and the pressure spring (10 or 25) in position on the ball pin and refit the ball pins to the centre and cross steering levers. Fully tighten up the nuts and secure with new split pins.



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.



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.

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



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.

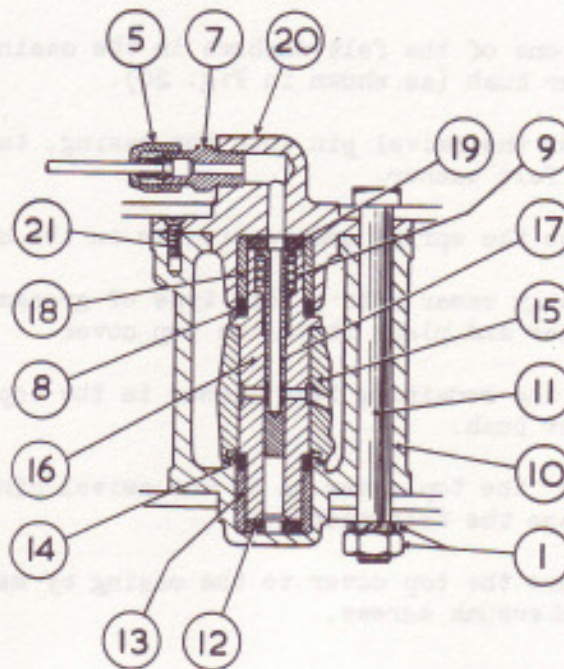


Fig.20. Section through swivel pin
Housing - Centre steering lever.

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.