FRONT SUSPENSION
AND
SHOCK ABSORBERS

CONTENTS

FRONT SUSPENSION

SCREW THREADS OF THE UNIFIED SERIES ARE USED ON THIS UNIT

GENERAL DESCRIPTION

Series I to IIIA Models

The front suspension is of the coil spring and unequal length wishbone type, employing long inner fulcrum pins threaded at each end to carry the bushes of the upper and lower links. Provision for camber adjustment is made by the insertion of shims between the upper fulcrum pin and its bracket location on the crossmember (Fig. 1, inset, and Fig. 13, inset).

The stub axle is located, by means of a ball socket assembly, directly into the outer end of the upper link and by means of a short swivel pin into the trunnion. A short threaded eyebelt completes the connection between trunnion and lower link. Thrust is taken via a nut and thrust washer to the lower face of the stub axle swivel.

This design obviates the necessity for a separate stub axle carrier, thus affording a saving in unsprung weight. A sectional view of the near side of the front suspension is shown in Fig. 1.

On Alpine Series II and III Models onwards the top swivel bearing assembly is self-lubricated and requires no attention. No grease nipple is fitted.

In the following paragraphs detailed instructions are given for checking and correcting such items as track (toe-in) and wheel camber and for checking the castor and steering axis inclination angles. To avoid inaccuracies in steering geometry, and consequent excessive tyre wear, it is most important that these procedures are observed.

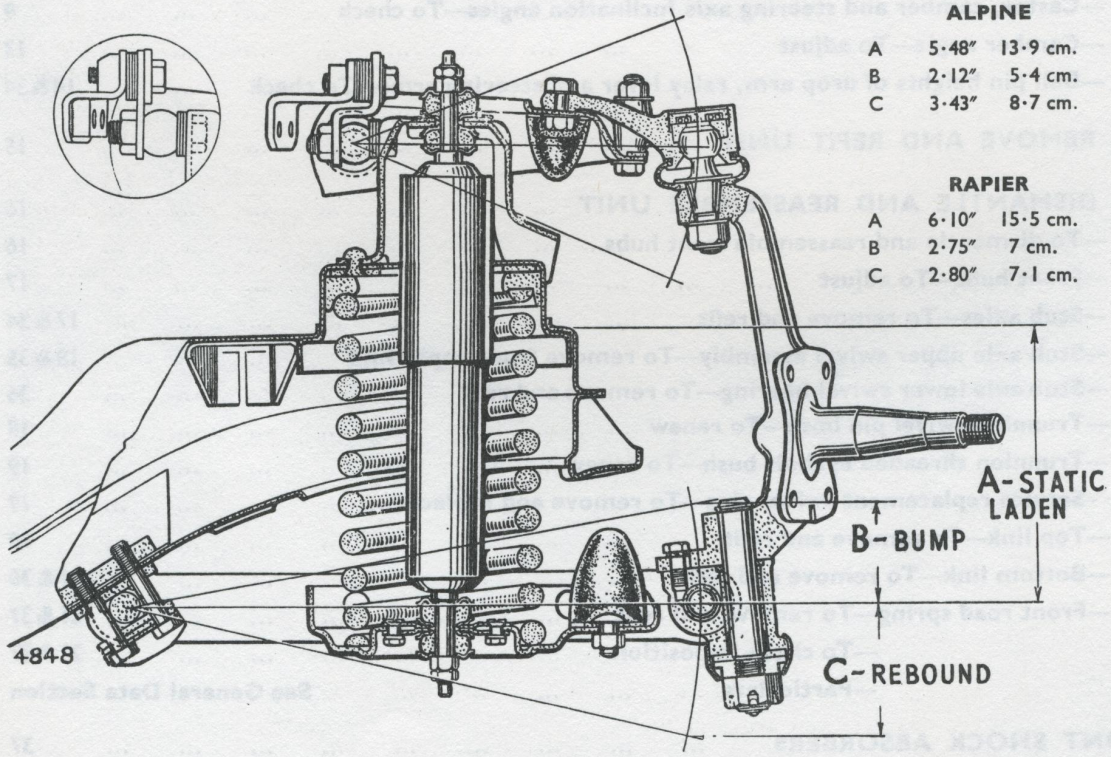


Fig. 1. *Sectional view of front suspension on near side*

TO CHECK AND ADJUST FRONT SUSPENSION DIMENSIONS AND SETTINGS

The following settings and dimensions will require checking in the event of early tyre wear, tyre squeal or accident damage. When accident damage has occurred the underframe alignment should be checked.

1. **Wheel camber angle.** This angle is adjustable and is the angle of inclination of the road wheel from the vertical when viewed from the front. Inclination outwards is termed positive camber and inclination inwards negative camber.
   The correct camber angle is given in the Data Section. It is most important that this angle is obtained whenever it is necessary to adjust wheel camber.

2. **Castor angle.** This is the rearward tilt of the axle carrier pivot and is not adjustable. The castor angle varies with the vehicle load and is greatest when the rear of the vehicle is heavily laden.

3. **Steering axis inclination (K.P.I.)** or the angle at which the axle carrier centre line is inclined from the vertical as viewed from the front of the car. This angle is not adjustable, and provided the stub axle assembly is undamaged it is correct when the camber angle is correctly adjusted.

4. **Front wheel toe-in or track.**

5. **Ackerman angles or toe-out on turns.** This is important as incorrect wheel alignment under these conditions gives rise to excessive tyre wear and tyre squeal when cornering.

6. **Ball pin heights.** These are:—
   (*a*) The dimensions between the lower link outer fulcrum pin centre and the centre of the taper hole in the underside end of the steering arm.
   (*b*) The lower link inner taper fulcrum pin centre line and the underside centre of the taper hole in the end of the drop arm or relay lever.

   The method of checking and adjusting these settings is given in the following paragraphs.

Tools and appliances

In addition to the tools listed in Section 'S', the following equipment will be required:—

Camber, castor and steering axis inclination gauge with 2 turntables.

Front wheel track alignment gauge (1 required).

Any reputable brand of equipment may be used but the use of Weaver and Churchill gauges is described herein.

Should the equipment locate on the wall of the tyre or wheel rim, it is necessary to ensure that the tyre and road wheel run "true" within the specified limit, and that the gauge is held on that part of the tyre having no extremes of run-out.

When the instrument locates on the stub axle itself, it is essential that it is firmly fixed, after removal of the hub cap, to the hub retaining nut, so that there is no relative movement between the gauge and the stub axle.

The equipment described may be obtained from:—

Messrs. V. L. Churchill & Co. Ltd.,
Great South West Road,
Bedfont, Feltham,
Middlesex,
England.

and

Weaver Manufacturing & Engineering Co. Ltd.,
Bedford,
England.

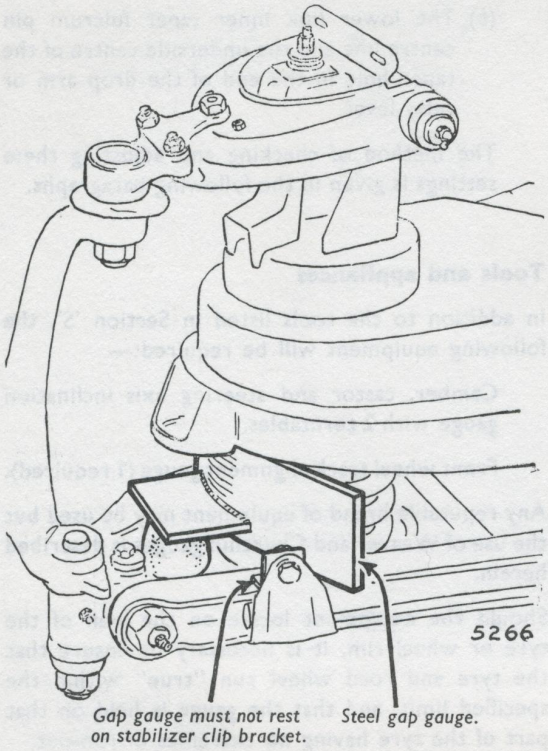


Fig. 2. *Front suspension loaded down onto steel gap gauge*

The Churchill equipment consists of tracking gauge and camber/castor and steering axis inclination checking gauge.

The Weaver equipment consists of turntable and wheel alignment indicator.

The Weaver wheel alignment indicator will be found to be unsuitable for cars fitted with centre lock wire wheels due to recessing of the stub-axle end nut within the hub. The Churchill camber gauge should therefore be used.

Illustrations of the various tools in use are given in the following pages.

PREPARATION OF VEHICLE

When carrying out checks on the front suspension and steering dimensions, the following requirements must be met. It should be noted that item 5 entirely supersedes previous methods of obtaining the static laden condition.

1. The car must be placed on a perfectly level floor or level ramp.

2. Tyres must be inflated to their correct pressures and have the same amount of wear.

3. For checking the front wheel track the car should be in a normally laden condition.

4. Both front wheels must be checked for "run-out". To do this, spin each wheel, holding a piece of chalk close to the sidewall of the tyre.

   By moving the chalk progressively nearer the tyre until it makes contact, the point of greatest "run-out" will be marked.

   Always set the wheels so that the points of "run-out" are well away from the points of contact of any gauges which may be used.

   Therefore when checking camber, castor and steering axis inclination set the "high-spots" horizontally opposite one another, and when checking toe-in set them vertically.

5. The car is loaded on to four gap gauges by placing weights at the front of the car. The amount required is approximately 300 lb. (136 kg.) evenly distributed on a platform, comprising of a wooden plank supported by two suitably cranked steel bars $\frac{7}{8}$ in. (22 mm.) square inserted into the front jacking sockets.

   At the front, steel gap gauges are used, see Fig. 2 or 28. At the rear, hardwood gap gauges are used; these are shaped to clear the hydraulic pressure pipes, the bump rubbers and fit round the axle casing, see Fig. 3. Normally the rear end of the car is lifted by hand to enable the rear

gap gauges to be positioned and suubseqently gripped in position by the lowering of the car. When these gap gauges are a slack fit, a small weight is placed on the rear end of the car to bring it on to the gap gauges.

6. Keep the front wheels in the straight ahead position and gently move the car forward; the front wheels on to the turntable gauges and the rear wheels on to wooden ramps the same thickness as the turntable gauges. Stop the car without applying the brakes, so the free condition of the turntable gauges is not disturbed. Lock all four wheels by blocking the brake pedal in the " on " position.

To check toe-in

IMPORTANT: If the tyre wear is excessive, a complete steering geometry check should be made.

The correct toe-in is given in the General Data Section and it is of the utmost importance that this adjustment is maintained. The steering unit and steering wheel must be in the mid position and the front wheels must, at the same time, be in the straight ahead position. The alignment gauge demonstrated herein is the Churchill Tracking Gauge 95 B.

Lock the vertical arms parallel by means of the knurled locking collars. (See Fig. 5).

Push the dial pointer back into its sheath and retain it there with the clamping screw under the dial head. (See Fig. 6).

Loosen knobs B and C (Fig. 5) so that the gauge can be adjusted to the width of the car.

Place the gauge in front of the front wheels with the dial at the right-hand side of the car, and adjust for width so that the fixed pointer is resting against the outer wall of the left-hand front tyre and the sheath of the dial pointer is approximately $\frac{3}{4}$ in. (19mm.) from the outer wall of the right-hand front tyres.

Tighten knobs B and C.

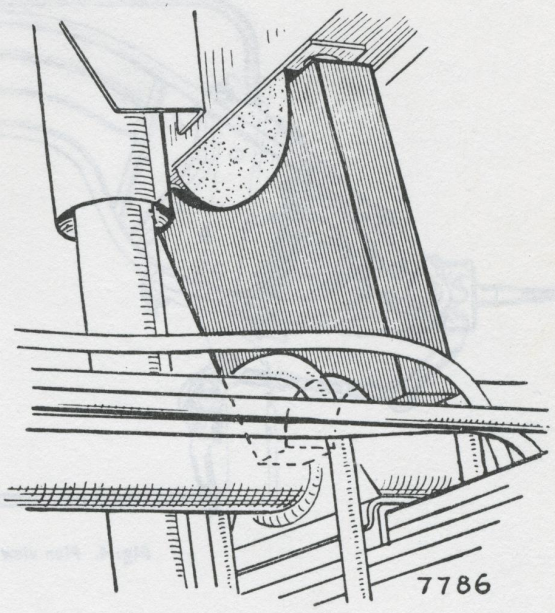


Fig. 3. *Rear gap gauge in position, ensure that the rear bottom corner is clear of the hydraulic pressure pipes*

Adjust the vertical pointer arms, by slackening knobs D and E, so that both pointers are at hub height.

Mark each tyre where the pointers make contact, with chalk.

Release the dial pointer from its sheath.
Release the knurled locking collars.

Rotate the dial to "Zero" and secure in that position with clamp screw at the side of the dial. Retract the dial pointer and lock in its sheath.

Lock the vertical pointer arm with the knurled locking collars.

Remove the tracking gauge, and place it to one side of the car.

Roll the car forward so that the wheels turn through 180°, bringing the chalk marks to the hub height at the rear of the front wheels.

Place the gauge under the car at the REAR of the FRONT wheels with the dial pointer to the left-hand side of the car. (See Fig. 6).

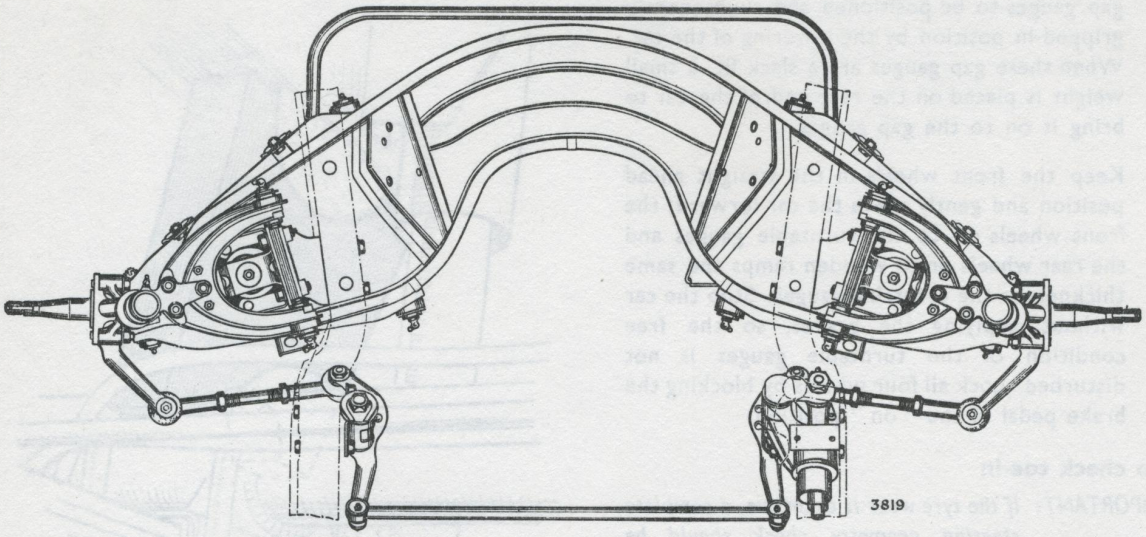


Fig. 4. *Plan view of steerage linkage*

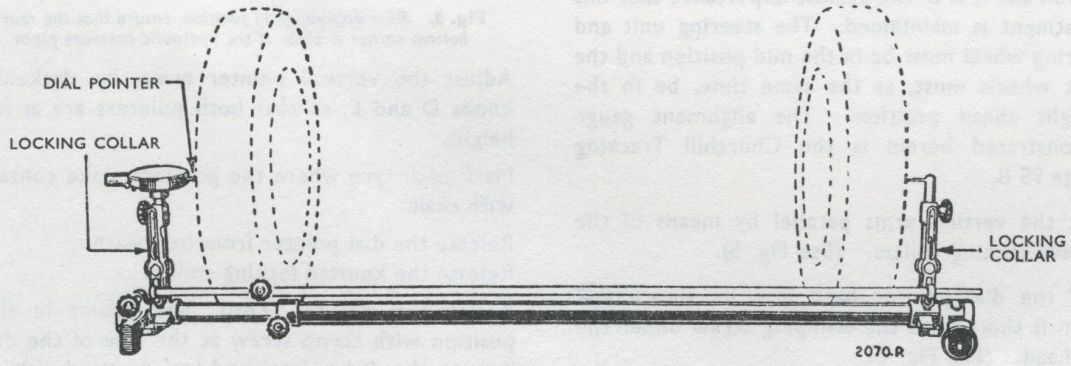


Fig. 5. *Churchill tracking gauge in position at front of front wheels*

Release dial pointer so that it comes into contact with the chalk mark on the tyre wall, and check the free movement of the gauge.

Take the reading on the dial. (See Fig. 6).

If correct, retract the dial pointer and remove the gauge.

To adjust track (toe-in) setting

Leave the gauge in position.

Slacken the locknuts at each outer track rod ball joint.

Note the difference between the dial reading and the recommended setting and HALVE this figure. Adjust the track by rotating each track rod equally until the pointer on the dial has moved the amount of this final figure in the required direction. (Any adjustment made at the rear of the wheels is duplicated at the front of the wheels in the opposite direction so that the effective adjustment made to

the track is double the amount shown on the dial). Re-tighten the track rod end lock-nuts.

When tightened, it is important that the sockets at either end of each track rod are centrally disposed with the ball pins so that the track rod may be free to turn slightly.

If the wheels are badly out of alignment, this may be due to a track rod (cross tube) having bent through accidental damage. In such cases the track rod should be renewed.

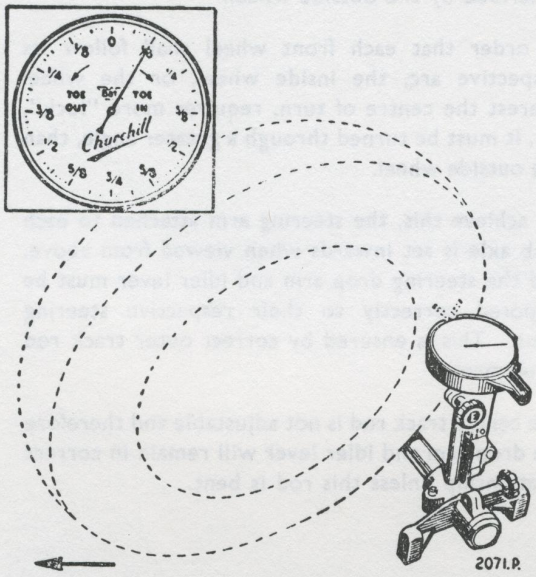


Fig. 6. *Tracking gauge in position at rear of front wheels. Inset shows reading of $\frac{1}{8}$" toe-in. Track must be adjusted to the toe-in figure given in the General Data Section under Front Suspension*

Example of correction to track setting, using the Churchill 95 B track gauge:

If required track setting is $\frac{3}{16}$" (4·7 mm.) toe-in.
Gauge shows $\frac{5}{16}$" toe-in.
Excess is ($\frac{5}{16}$"—$\frac{3}{16}$") $\frac{1}{8}$".
Half of $\frac{1}{8}$" is $\frac{1}{16}$".
$\frac{5}{16}$" less $\frac{1}{16}$" is $\frac{1}{4}$".

Adjust track until indicator shows $\frac{1}{4}$" toe-in.

Re-check track toe-in setting after adjustment.

Important

With optical gauges or any type that does not require the road wheels to be turned through 180° it is vital that the wheel run-out should be checked and the points of maximum run-out set in the vertical position.

Setting of outer track rods

If new track rods are being fitted after accident damage, or if excessive tyre wear is present, the following procedure should be observed to ensure correct Ackerman (toe-out on turns) when the wheel track is correct.

1. Disconnect each outer track rod inner ball joint from the drop arm and idler lever.
2. Count the number of steering wheel turns from lock to lock (in the steering unit).
3. Obtain the midposition of the steering unit by turning the wheel back half this amount from full lock, **and keep it in this position.** N.B. It is most important that great accuracy is observed when carrying out items 2 and 3, and it is recommended that the steering unit is marked appropriately and a datum line or pointer is used to achieve this.
4. If necessary, reposition the steering wheel on its splines so that the spokes are straight across.
5. Reconnect track rods to drop arm and idler lever.
6. Prepare the car for a steering geometry check as described in this section under TO CHECK AND ADJUST FRONT SUSPENSION DIMENSIONS AND SETTINGS.
7. Check the measurement at the front of the car between the centre of each tyre tread and the greaser on the lower link inner fulcrum pin.
8. These measurements should be equal on each side with the steering unit and idler lever in the straight ahead position.
9. Adjust each outer track rod until these measurements are equal. **The track rods**

may not necessarily be of equal length when this has been done—ignore this.

10. Check the front wheel toe-in before tightening the track rod lock nuts and adjust both outer track rods EQUALLY to obtain the correct toe-in.

Important

Attention is drawn to the vital importance of maintaining correct alignment of steering ball joints.

If any misalignment exists, angular deflection of the pins under conditions of bump and rebound may cause the sides of the pins to contact the necks of the ball joint housings. This condition is liable to promote a high rate of wear resulting in early failure.

Therefore the importance of checking this point, after track rod adjustment, cannot be over-emphasized.

When track has been adjusted or the ball joint lock nuts slackened for any purpose, it is essential to make sure that the pins are CENTRAL IN THEIR HOUSINGS when the vehicle is in the static laden condition.

It is recommended that the ball joint alignment is checked as a routine measure during the 12,000 miles (19,200 km.) service.

Ackerman angles (toe-out on turn)

When the front wheels are turned from the straight ahead position to negotiate a left- or right-hand bend the arc described by the front wheel nearest the inside of the bend is of smaller radius than the arc described by the outside wheel.

In order that each front wheel shall follow its respective arc, the inside wheel, or the wheel nearest the centre of turn, requires more "lock", *i.e.*, it must be turned through a greater angle, than the outside wheel.

To achieve this, the steering arm attached to each stub axle is set inwards when viewed from above, and the steering drop arm and idler lever must be disposed correctly to their respective steering arms. This is ensured by correct outer track rod adjustment.

The centre track rod is not adjustable and therefore the drop arm and idler lever will remain in correct relationship unless this rod is bent.

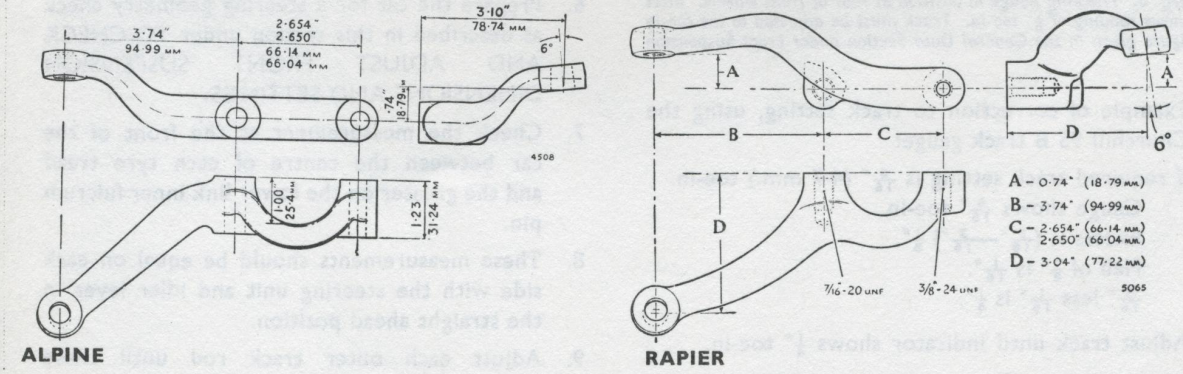


Fig. 7. *Steering arm dimensions*

To check Ackerman angles

Prepare the car as described in "Preparation of vehicles", THIS IS IMPORTANT. Check the front wheel camber angle, front wheel alignment and correct as necessary.

Set the front wheels in the straight ahead position on two turntable gauges. Level the car by raising the rear wheels with packing pieces the same thickness as the turntable gauges.

Move the right hand front wheel through a 20° turn to the left and note the gauge reading of the turntable gauge under the left hand front, wheel. Move the left hand front wheel through the 20° turn to the right and note the gauge reading of the turntable gauge under the right hand front wheel.

When these gauge readings are outside the specified "inner wheel" figure given in the "General Data Section", one or more of the following faults can be suspected which must be corrected.

(*a*) The outer track rod lengths are not correctly set. They should be adjusted as described in earlier paragraphs under "Setting of Outer Track Rods".

(*b*) A track rod is bent.

(*c*) A steering arm or arms are bent.

Fig. 7 gives the correct dimensions of the steering arm.

Bent parts should be renewed as it is not advisable to straighten them.

Wheel lock angles—To adjust

Set the front wheels in the straight ahead position on two turntable gauges. Move the right hand front wheel through a 24° turn to the left. Adjust the lock stop, located on the top face of the lower link trunnion, on the LEFT hand side of the car. The bolt must be slackened off and the eccentric disc beneath its head rotated until it contacts the stub axle lug and retighten the bolt.

Move the left hand front wheel through a 24° turn to the right.

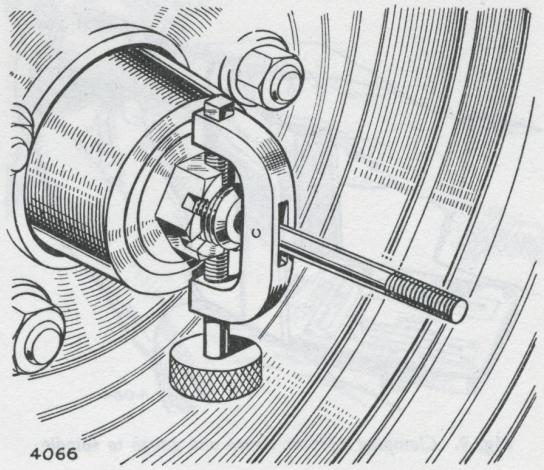


Fig. 8. *Gauge fixing method*

Adjust the lock stop, located on the top face of the lower link trunnion, on the RIGHT hand side of the car. The bolt must be slackened off and the eccentric disc beneath its head rotated until it contacts the stub axle lug and retighten the bolt.

CASTOR, CAMBER and STEERING AXIS INCLINATION ANGLES

To check

IMPORTANT—The vehicle must be loaded on to gap gauges as described under "Preparation of Vehicle".

Application of the Weaver gauge

(See Figs. 8, 9 and 10)

Loosely assemble the adaptor clamp, spring and sleeve into the bracket of the gauge. Wipe away grease from spindle nut and thrust washer.

Ensure that split pin ends do not overlap thrust washer face. Secure the adaptor clamp to the spindle nut by locating the clamp point and tapered adjusting screw in opposite castellations. Finally tighten the knurled adjusting screw.

Hold the gauge and adaptor sleeve against the bearing thrust washer, making sure that the sleeve is centred on the washer.

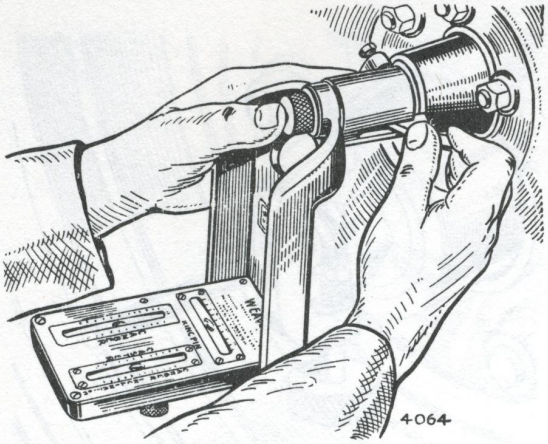


Fig. 9. *Clamping adaptor sleeve and gauge to spindle*

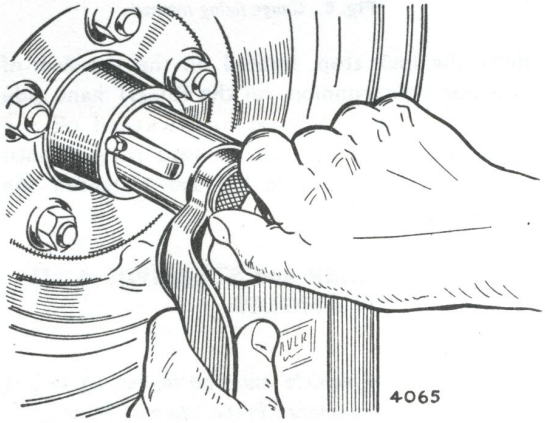


Fig. 10. *Tightening knurled centre nut*

If the outer diameter of the washer does not fully locate the bore of the sleeve, slip a suitable adaptor washer (provided) over the slotted nut, between the adaptor sleeve and bearing thrust washer.
Tighten knurled centring nut until it holds the gauge firmly against the bearing thrust washer. Level the gauge panel by adjusting the steering axis inclination scale flush with the panel and moving gauge until bubble is at zero.

Reading camber

Note the position of the spirit bubble in relation to the scale.

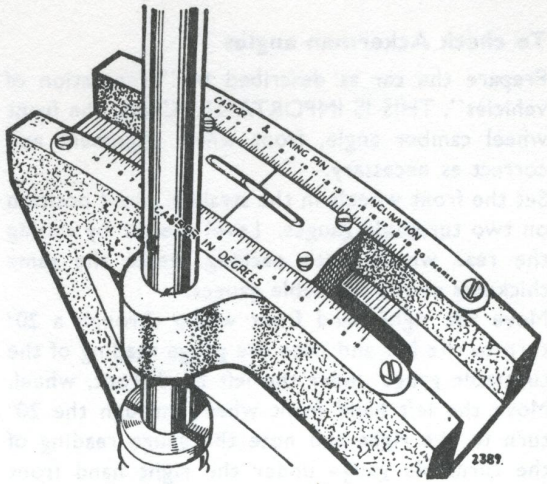


Fig. 11. *Churchill camber checking gauge No. VLC.121L showing a typical reading of $\frac{3}{4}$° positive camber*

Camber is POSITIVE if the bubble is in black figures, and NEGATIVE if in red figures.

For the correct camber angle, see General Data Section.

Reading castor and steering axis inclination

Turn the wheel to which the gauge is fitted, to a 20° back turn (nearside wheel to the left, offside wheel to the right) as indicated on the turntable.

Set adjustable castor and steering axis scales with spirit level bubbles to zero.

Turn the wheel to a 20° forward turn as indicated on the turntable.

Read castor and steering axis scales in relation to their spirit level bubbles.

The correct steering axis inclination angles see General Data Section. For castor angle see under following heading of "CASTOR ANGLE READINGS".

Make a note of all readings.

Proceed as above with the gauge on the other wheel

Castor inaccuracies are seldom encountered, unless major accident damage is involved.

CASTOR ANGLE READINGS

Vehicle loaded on to gap gauges

The designed castor angle given in the "General Data Section" can only be obtained by loading the vehicle down to the static laden condition, front and rear. A considerable weight is needed to do this which makes this method of checking the castor angle too difficult to use in Service Repair Shop.

To overcome this difficulty the gap gauges illustrated in Figs. 2 and 3 are used and these require only a reasonable amount of weight for loading down purposes.

With the vehicle loaded onto gap gauges the following castor angles should be obtained:

Alpine + 3° 10′ ($3\frac{1}{6}$°)
Rapier + 0° 25′ (approx. $\frac{1}{2}$°)

This figure differs from that given in the Data Section because of the higher rear end condition obtained when the car is loaded onto the gap gauges.

CASTOR ANGLE

To check, using Churchill camber gauge (see Fig. 12).

Jack up the front of the car (using a block of wood between the jack and the front crossmember).

Check wheels for "run-out" and position with maximum "run-out" in the horizontal as described in "To Check and Re-set Wheel Camber".

Place turntables under each front wheel and wood packing of the same height as the turntables under each rear wheel, to keep the vehicle level.

Remove the locking pins, one from each turntable.

The wheels must be in the straight ahead position. Slide the turntable scales (degrees of turn) round so that the "zero" is in line with the pointer and lock the scales (see Fig. 12).

Apply the Castor, Camber, Steering Axis Inclination Checking Gauge (Churchill 121L and U is illustrated) to the wall of the tyre of the left-hand front wheel, **making sure that the contact points of the gauge to the tyre are clear of the normal bulge of the tyre, above the contact area of tyre to ground.**

Turn the scale of the gauge on its pillar so that it is parallel with the road wheel and set the spirit level slide to the mid-way position on the castor and steering axis scale.

Set the gauge vertically on the road wheel by moving the top of the pillar backwards or forwards until the air bubble is central between the hair lines on the spirit level.

Turn the scales at right angles to the road wheel with the scale to the **front** of the pillar of the gauge (to front of the pillar in relation to the car). In this position the gauge will measure the outward "tilt" of the stub axle on each 20° lock.

Turn the road wheels to 20° in the left-hand lock.

Move the spirit level slide until the air bubble is central between the hair lines on the spirit level.

Take the reading shown on the Castor and Steering Axis Inclination scale.

Turn the road wheels to 20° in the right-hand lock.

Move the spirit level slide until the air bubble is central between the hair lines on the spirit level.

Take the reading shown on the Castor and Steering Axis Inclination scale.

Deduct the first (left lock) reading from the second (right lock) reading to obtain the castor angle in degrees.

The gauge must now be transferred to the right-hand front wheel and set up vertically as previously described with **wheels in the straight ahead position** (turntable scales reading "zero").

The castor angle check is carried out on the right-hand side in exactly the same way as described for the left-hand side. Turn the scale at right angles to the road wheel and to the **front** of the pillar of the gauge. First take the left lock reading and then the right lock reading and deduct the **first** reading **from** the **second** reading.

WHEEL CAMBER

To check, using the Churchill camber gauge (See Figs. 11 and 12)

The correct wheel camber angle is given in the Data Section.

Jack up car and check each front wheel for 'run-out' (see "Preparation of Vehicle").

After lowering the front of the car, and removing the jack, and having set the wheels in the required position, the car must be rolled backwards two or three yards in a straight line and then forward until the front wheels are again in the required set position.

Apply wheel camber checking gauge to the wall

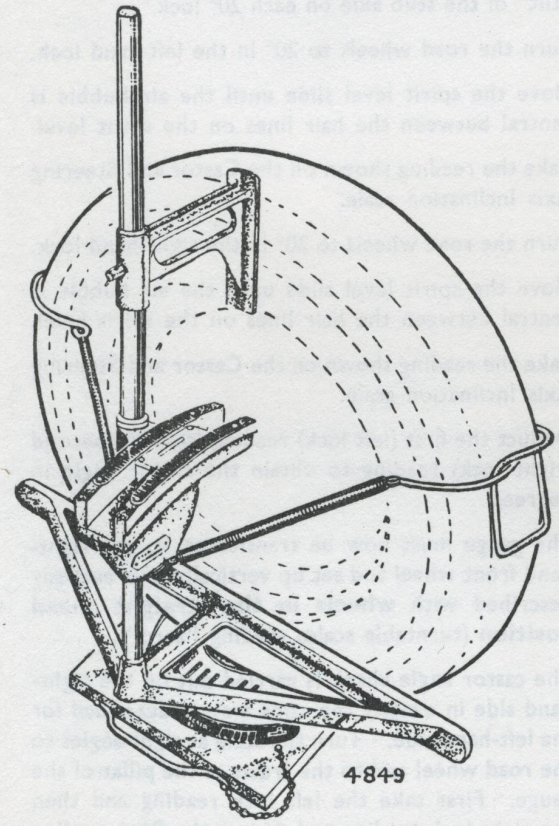


Fig. 12. *Churchill camber/castor gauge and turntable VLC.121U in position*

of the tyre, **ensuring that the contact points of the gauge to the tyre are clear of the normal bulge of the tyre, above the contact area of the tyre to ground.** When using the Churchill Camber Gauge VLC.121L, check the camber angle by moving the slide until the bubble registers accurately between the two indicator marks on the spirit level glass; then note the camber reading in the camber scale, indicated by the scribed line on the slide (see Fig. 11).

For camber readings the indicator carrier may be used either side of the main pillar of the gauge, *i.e.*, 180° apart.

Regardless of which side of the main pillar the indicator happens to be, the camber reading will be positive if, in order to bring the bubble between the indicator marks, the slide is moved towards the road wheel side of the zero mark (see Fig. 11).

If after checking it is found that the camber angle is incorrect, no adjustments should be made until the castor and king pin inclination angles have also been checked.

This is because a bent stub axle carrier or other damaged part can be the cause of incorrect camber angle.

To check the accuracy of the camber gauge VLC.121L hold the instrument against any known upright and take two readings, one with the spirit level carrier on the right-hand side of the pillar and the other reading with the carrier on the left-hand side of the pillar. If the two readings do not agree, then the instrument has suffered damage and a correction will have to be applied to all future readings or the instrument returned to the makers for rectification.

STEERING AXIS INCLINATION

To check

The correct steering axis inclination is given in the Data Section.

It is important that the camber check is carried out before making a check of the steering axis inclination

Jack up the front of the car (using a block of wood between the jack and the front crossmember).

Check the wheels for "run-out" and position with the maximum "run-out" in the horizontal as described in "Preparation of Vehicle".

Lock the wheels by applying the footbrake, and keep the brake applied by wedging a wooden spar between the pedal and the front seat.

It is most important that the wheels are properly locked when they are moved from lock to lock during the actual check.

Place turntables under each front wheel, and wood packing of the same height as the turntables under each rear wheel, to keep the vehicle level.

Remove the locking pins one from each turntable (see Fig. 12).

The wheels must be in the straight ahead position. Slide the turntable scales (degrees of turn) round so that the "zero" is in line with the pointer and lock the scales.

Apply the gauge (Churchill 121L and U is illustrated) to the wall of the tyre of the left-hand front wheel **making sure that the contact points of the gauge to the tyre are clear of the normal bulge of the tyre, above the contact area of the tyre to the ground.**

Turn the scale of the gauge on its pillar so that it is parallel with the road wheel and set the spirit level slide to the mid-way position.

Note. This is not zero on the castor and steering axis inclination scale.

Set the gauge vertically on the road wheel by moving the top of the pillar backwards or forwards until the air bubble is central between the hair lines on the spirit level.

For checking the steering axis inclination the scale must be **parallel** to the road wheel and will measure the angle through which the stub axle moves downwards from the straight ahead position on each 20° lock.

Turn the road wheels to 20° in the left-hand lock. Move the spirit level slide until the air bubble is central between the hair lines on the spirit level.

Take the reading shown on the Castor and Steering Axis Inclination scale.

Turn the road wheels to 20° in the right-hand lock. Move the spirit level slide until the air bubble is central between the hair lines on the spirit level. Note the reading shown on the Castor and Steering Axis Inclination Scale.

Deduct the **first** (left-hand) reading **from** the **second** (right-hand) reading to obtain the steering axis inclination in degrees.

The steering axis inclination is checked on the right-hand side in the same way as described for the left-hand side, with the scale **parallel** to the road wheel.

First take the left lock reading and then the right lock reading; deduct the **first** reading **from** the **second** reading.

CAMBER ANGLE

To adjust (See Figs. 13 and 14)

If, on checking, it is found necessary to effect an adjustment to the wheel camber, proceed as follows:—

Remove the front wheel.

The upper link inner attachments can now be seen.

SLACKEN the nuts retaining the upper fulcrum pin (32) to the crossmember.

SLACKEN the bolts between brackets (33 and 35) to permit the selection of shims. On later Series IV Cars onwards these brackets are not used therefore this operation is unnecessary.

To increase the camber angle move the required number of shims from position (A) to position (B) (See Fig. 13).

To decrease the camber angle remove the required number of shims from position (C) and add a similar thickness of shims to position (A)—OR if shims are found in position (B) remove from this position and insert in position (A).

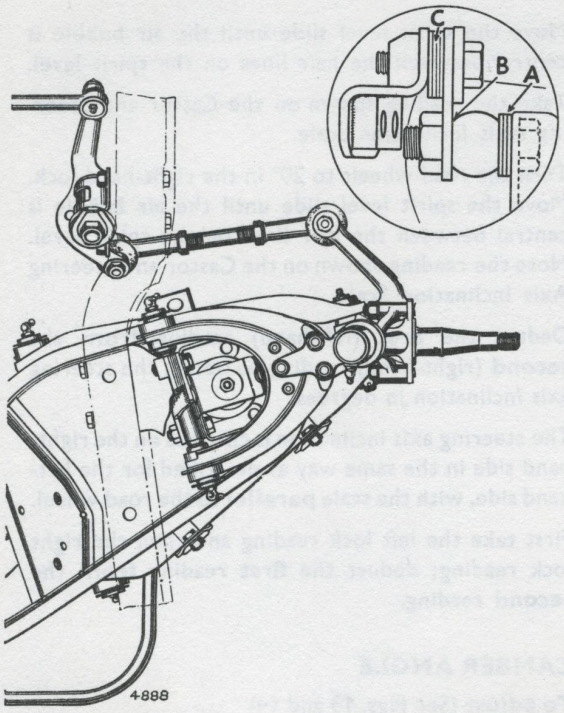


Fig. 13. *Plan view of front suspension showing camber shim positions*

On later Series IV Cars onwards, the fulcrum pin bracket is not used thus Position C is not evident; therefore the shims are added to or removed from Position A to decrease or increase the wheel camber respectively.

Note. Small shims are somtimes found at either end of these shim locations, and should be placed in their previous positions.

The purpose of these small shims is to ensure correct alignment of the upper and lower link, which is necessary to give free movement of the axle carrier, or to deal with any lack of parallelism between the frame bracket and frame.

It is most important to ensure that all shim fixing bolts are properly tightened and not in any way thread bound and giving false impression of tightness.

The relationship of the wheel camber angle to track or "toe-in" is such that the track setting must always be checked following a wheel camber re-set.

After correcting the camber figure by adjustment, the steering axis inclination angle should be again noted, to ensure that the stub axle is not bent or damaged.

This particularly applies when accident repairs are being undertaken.

Checking steering ball pin heights

After accident damage, or in a case of excessive tyre wear, these dimensions should be checked. If they are outside of the limits shown in Fig. 23 the wheels will not remain in track as the suspension system reacts to rough road surfaces.

The dimensions are taken between the following points after removing both outer track rods:

(*a*) The lower link outer fulcrum pin centre and the underside centre of the taper hole in the end of the steering arm.

(*b*) The lower link inner fulcrum pin centre and the centre of the taper hole in the Swing and Idler Levers on their underside face.

Steering ball pin heights are checked by means of a scribing block used on the simple tool illustrated in Figs. 21 and 23. This tool is necessary as it enables measurements to be taken from the lower link fulcrum pin centres which are the correct datum points.

The tool can be cheaply and easily made from angle iron and bright strip steel. Its details are shown in Fig. 22 with convenient alternative metric dimensions.

Note. It is impossible to check ball pin height dimensions from a level surface plate because the fulcrum pins lie at the castor angle and not in a horizontal plane.

The following procedure should be followed when making these checks:—

1. Ensure that the wheels are in a straight ahead position noting steering wheel position. Remove both outer track rods and check that front wheels and steering wheel positions remain unaltered.

2. Remove greasers from both ends of each lower link inner fulcrum pin.

3. Fit up tool as illustrated in Fig. 21 making sure that no slackness exists between centres and greaser holes.

4. The centres of the large end of the taper holes are found by means of the adjustable adaptor which can be made on any small lathe. This item is shown in Fig. 24. Alternatively the taper part of a discarded ball socket can be put into the taper hole and cut off and filed flush at the largest end of the taper hole. It is then a simple matter to mark the centre of the now flush fitting taper shaft.

5. Using scribing block measure the height of the scribed lines immediately behind the centres on brackets, item 3, from the measuring surface, item 4, see Fig. 21. These heights should be equal.

6. Measure the height of the centre made on the drop arm and idler lever (See Fig. 23).

7. From these dimensions subtract those taken of the respective centre heights. If the ball pin heights are correct the results should be the dimensions shown in Fig. 23.

8. The steering arm ball pin heights are checked in a similar manner except that the centre height is taken from the greaser centre at the rear of the lower link outer fulcrum pin. Owing to the nearly level underside face of the steering arm outer end, it is possible to check the steering arm dimension without plugging its taper hole.

TO REMOVE AND REFIT UNIT

(See Fig. 14)

Raise the car by placing a jack with a block of wood or other suitable packing under the front crossmember.

Place stands under the sidemembers of the underframe.

Remove the road wheels.

Disconnect the main hydraulic fluid pipe at the right-hand side front connector. Wherever it is necessary to disconnect the brake hoses, do not allow hydraulic brake fluid to come in contact with the bodywork, otherwise damage to paint will result.

Place wooden blocks under the sump to support the engine.

Disconnect front engine mountings from crossmember.

Remove the two outer track rods from the steering arms by discarding the split pins, removing the castellated nuts and using a suitable extractor. DO NOT DISTORT THE STEERING ARMS IN ANY WAY.

Detach the two fulcrum pin brackets from the underframe by withdrawing two bolts each and indentifying any shims. On later Series IV Cars onwards, this operation is unecessary as the fulcrum pin brackets are not used.

Withdraw the four crossmember bolts and washers, access to these bolts is gained through the holes in the underside of the crossmember, remove the front suspension from under the car by lowering the jack.

Reverse this procedure for refitting, ensuring that all location points are clean and free from rough edges and burrs.

After reconnecting the hydraulic brake hoses it is essential to bleed the brake system in order to remove air.

TO DISMANTLE AND REASSEMBLE UNIT (UNIT ATTACHED TO CHASSIS)

To dismantle and reassemble the front hubs (See Fig. 14)

Slacken the road wheel nuts.

Jack up the front end of the car (using a block of wood under the front crossmember).
Remove the road wheel.

When removing centre-lock wheels it will be advisable to note the condition of the O-ring (synthetic rubber sealing ring) positioned just inward of the splines on the hub. This ring prevents lubricant from the hub getting on to the brake disc.

Remove the disc brake caliper, (See Section K, Brakes).
Remove the hub cap (2).

Remove the split pin from the castellated nut (3).
Remove the castellated hub retaining nut.
Remove the large special plain washer (4).

Pull the hub off the stub axle (6), at the same time holding a hand under the hub to catch the bearing cage of the outer taper bearing (7).

Remove the bearing cage of the inner taper bearing (8), and seal (10).

The outer shells for each of the hub bearings can now be removed from the hub by tapping them out with a suitable drift.

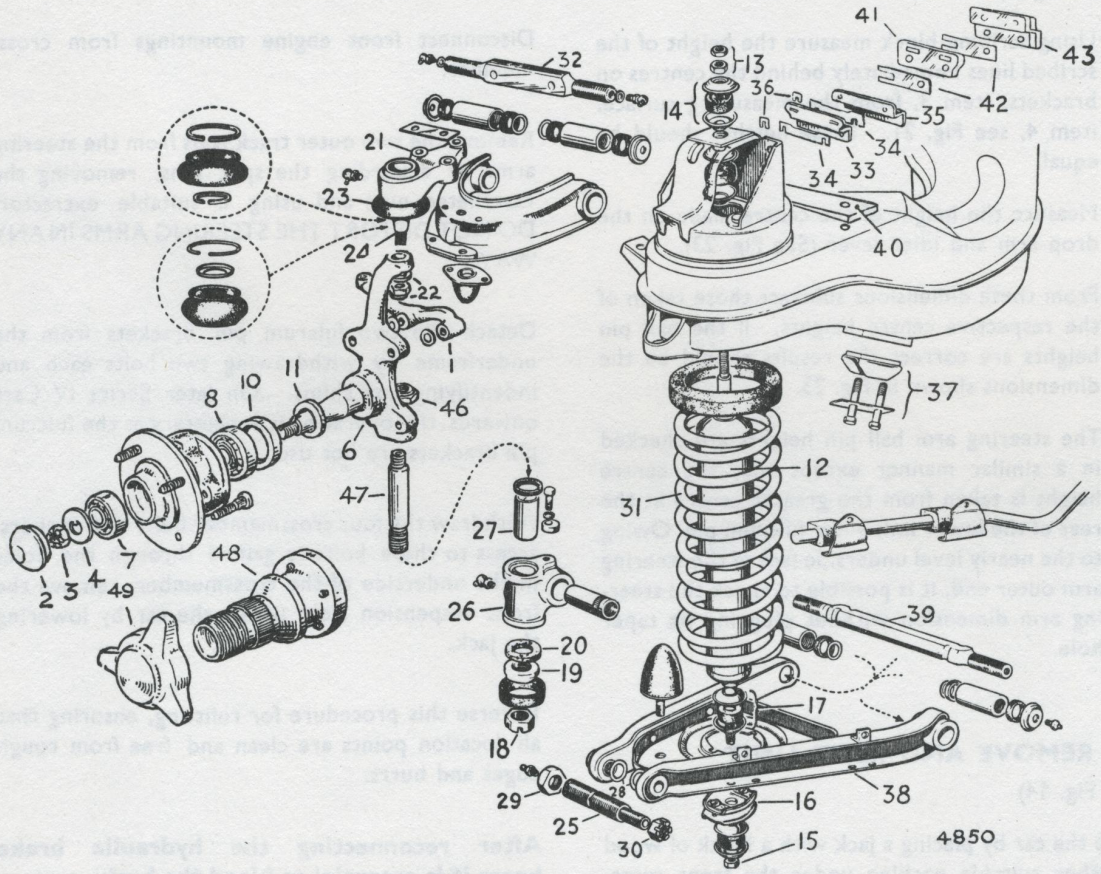


Fig. 14. *Exploded view of components*

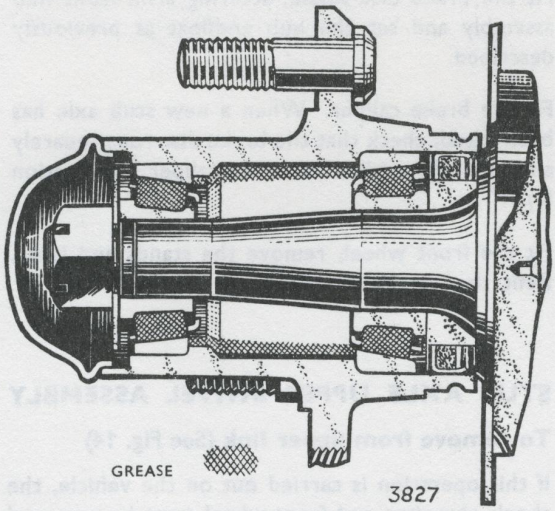


Fig. 15. *Correctly packed hub*

It should be noted that the hub distance piece is a press fit on the stub axle on Alpine cars; on Rapier cars it is loose and may be removed.

To reassemble the front hub and to refit to the stub axle (6), particular attention must be given to points such as greasing and adjustment, and the following procedure should be adopted:

Press into the hub the outer shells of each of the two taper bearings (7 and 8). (In each case, the larger internal diameter must be outwards from the respective ends of the hub).

Pack the hub and bearings with grease of the correct grade (see Section P). The amount required is one capful distributed evenly within the hub shell as shown in Fig. 15.

THE HUB DUST CAP WHEN FITTED MUST NOT CONTAIN GREASE.

From Chassis No. 9008452a $\frac{1}{16}$" (1·5 mm.) diameter hole is drilled in the centre of the hub grease cap and wire wheel locknut, to relieve any build up to pressure that may occur within the hub.

The hub should then be fitted to the stub axle, the hub outer bearing roller race, washer and nut fitted, and the bearings adjusted.

To adjust

It is important that the following procedure be used. Tighten the hub nut using a torque spanner to obtain a reading of 15—20 lbs. ft. (2·07—2·76 kg.m.). Release the nut 1 to 1½ flats in order to provide end float, and to line up one of the two split pin holes in the stub axle with the slots in the nut.

Using a dial test indicator, check the hub endfloat which should be within the figures given in the "General Data Section".

When the endfloat is not within these figures, the castellated nut must be further adjusted and the endfloat again checked with the dial test indicator.

When the correct adjustment has been obtained, lock the nut with a **new split pin of correct diameter.**

Fit hub cap (2), tapping firmly into position with a hammer.

Refit disc brake caliper and bleed brakes.
Refit the road wheel.

To remove and refit stub axle (See Fig. 14)
Removal

Remove front shock absorber (12) as follows:—
Load the vehicle to a laden condition. This is important to avoid straining the shock absorber and its mountings.

Undo the two nuts (13) at the upper spindle fixing and remove upper rubber and cup washers (14). Slacken the two nuts at the lower spindle fixing (15), (but do not remove).

Remove the nuts around the shock absorber lower plate (16) lift the lower plate to clear the studs and revolve it through 90°, when, due to its shape, it will pass downwards, complete with shock absorber and its remaining upper rubber and cup washers (17), through the lower link spring pan.
Jack up car.

Remove the road wheel.

Undo the bolts securing the steering arm, caliper and dust shield to the axle carrier. Note the position of any shims.

Remove the front hub assembly from the axle (see "To Dismantle and Reassemble the Front Hubs").

Using spring compressor (VLC Special Tool RG.195) passed up through the coil spring in place of the shock absorber, take the "load" off the spring to enable the stub axle assembly to be released from the upper and lower links.

Remove split pin, castelated nut (18), adjusting nut (19) and thrust washer (20) from base of lower swivel pin.

Remove the nut and washer (22) securing the upper swivel assembly to the stub axle.

Remove the upper swivel assembly (21) from the stub axle, using a suitable extractor.

Lift out stub axle and swivel pin from its bushing in the lower link, leaving the upper swivel on the link.

Refitting

Fit the sealing ring to the swivel pin (47) and feed the swivel pin into the lower link trunnion (26) and refit the upper swivel assembly (21) to the top end of the stub axle (6) with a nut and washer (22).

Fit the thrust washer (20) and adjusting nut (19) to the protruding swivel pin (47) and follow with the castellated nut (18). Set the endfloat to the figure given in the "General Data Section" with the adjusting nut (19).

Holding the adjusting nut with one spanner, tighten the castellated nut (18) until the two nuts (18 and 19) are locked together and fit a new split pin. Fit the rubber seal around the adjusting nut (19) and thrust washer (20).

Remove the spring compressor but do not fit the shockabsorber until the car is standing on the roadwheels.

Fit the brake disc shield, steering arm, front hub assembly and set the hub endfloat as previously described.

Fit the brake caliper. When a new stub axle has been fitted, check that the brake disc runs squarely and centrally within the brake caliper (see Section K).

Fit the front wheel, remove the stands and jacks. Refit the shockabsorber.

STUB AXLE UPPER SWIVEL ASSEMBLY

To remove from upper link (See Fig. 14)

If this operation is carried out on the vehicle, the shock absorber and front wheel must be removed and the spring compressor used, as already described.

Remove rebound rubber to give access to the head of the inner securing bolt.

Remove the three nuts and bolts securing the upper swivel assembly (21) to the upper link.

TRUNNION (See Fig. 14, No. 26)

To renew swivel pin bush

This involves removal of the lower link eyebolt (25), thrust washer (20) and nuts (18 and 19) at the bottom of the swivel pin (47).

Remove trunnion (26) from stub axle.

Press out bush (27) from lower trunnion and press in new bush using the necessary parts of the broaching kit (see Section S).

Broach bush and reassemble all parts.
The bush should be pressed in so that the bottom edge is ·38" (9·65 mm.) from the thrust face on the trunnion and the hole aligns with the greaser-tapping.

To renew threaded eyebolt bush (Fig. 14)

The threaded bush is externally knurled at one end, and pressed in with the knurling to the front on new cars. It follows that the bush must be pressed out towards the front of the trunnion assembly, i.e., the reverse way to which it went in, as otherwise the knurling will damage the parent bore of the trunnion.

When a new bush is fitted in service, it must be pressed in from the rear end of the trunnion, with the knurling to the rear, so that the knurling engages a plain portion of the parent bore.

Reassemble stub axle to upper and lower links as previously described, using new thrust and sealing washers.

Before fitting the lower eye bolt, place the sealing rings (28) on the bosses of the trunnion, one each side; when the eye bolt is properly located, the rings can be slid outwards along the bosses into position. If these sealing rings show any signs of deterioration, they should be renewed.

The eye bolt must be screwed in from the rear until the shoulder of the bolt butts firmly against the front inner face of its link, but care must be taken to ensure that the arms of the link are not stressed by "spreading".

The locknut (29) must be fitted **before** the castellated nut, and tightened very securely, at the same time holding the eye bolt (25) from turning.

The castellated nut (30) should be tightened to the figure given in the "General Data Section". When the castellations do not align with the split pin hole, tighten the nut to the next castellation.

SERVICE REPLACEMENT SWIVEL PINS

Stub axle, to renew lower swivel pin

As the design of the stub axle and swivel pin calls for a very high degree of interference fit, it is essential that a press, having a capacity of at least ten tons, is available. A special service swivel pin pack P.48890 is supplied, in which the circlip is replaced by two locknuts.

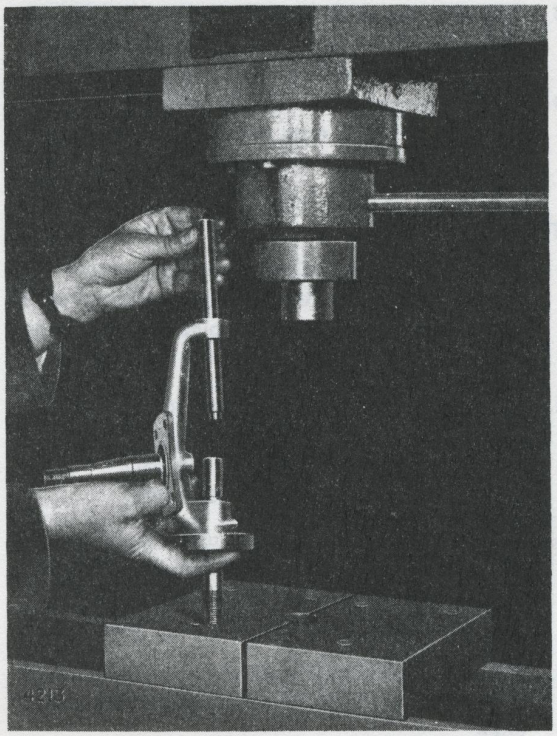


Fig. 16. *Preparation for removing pin, using special tool RG.193*

Swivel pin removal and replacement tools, to be used with the press, are provided by Messrs. V. L. Churchill to the following numbers:—

R.G. 193—Swivel pin remover.
R.G. 192—Swivel pin replacer.

Swivel pin
To remove

1 Pass the large abutment collar over the swivel pin and place the stub axle assembly on the bed plate of the press, with the stub axle supported by the collar (Fig. 16).

2. Remove the circlip from the upper end of the pin and place the short drift, with deep recess upwards, over the pin end (from which the circlip is removed).

3 Pass the long drift through the tapered hole in the upper yoke and insert its spigoted end in the deep recess of the short drift.
4 Carefully press out the swivel pin, ensuring that the assembly does not become tilted while pressing.

To refit

1. Assemble the two halves of the jacking tool and insert it between the upper and lower yokes of the stub axle, locating the spigoted end in the tapered hole of the upper yoke.
2. Ensure that the counterbored end of the jack sleeve is concentric with the swivel pin hole in the lower yoke. Tighten the jack with a tommy bar to hold the assembly rigid.
3. Locate the upper face of the upper yoke on the bed of the press, pass the smaller threaded end of the swivel pin through the lower yoke (now uppermost) and start the pin in its hole.
4. Pass the hollow drift over the pin and press in the pin until the hollow drift abuts the lower yoke.
5. This will press the pin the correct distance into the yoke. The pin should project 3·27/3·26" (83/82·8 mm.). This dimension is important and should be checked.
6. Remove assembly from press and remove jack.
7. Fit and tighten one locknut. Fit second locknut and tighten.

TO REMOVE AND REFIT TOP LINK

(See Fig. 14)

Remove front shock absorber (see "Stub axle removal").

Jack up the car under the front crossmember, (using a block of wood between the jack and the crossmember). Place the car on stands below each sidemember.

Remove the road wheel.

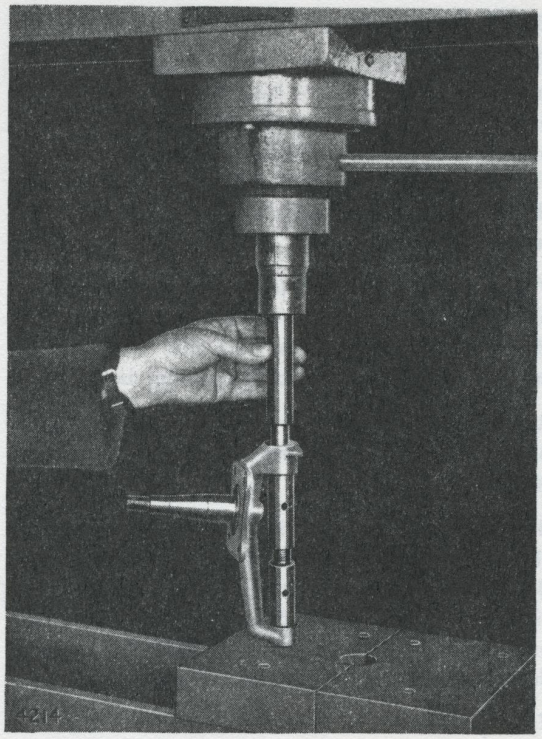


Fig. 17. *Pressing swivel pin into position*

Fit the road spring compressor tool and compress the road spring sufficiently to take the load of the spring (31).

Remove upper swivel from axle carrier (VLC tool).

Remove the top link, fulcrum pin bracket and shims from between the crossmember, fulcrum pin and underframe by withdrawing four bolts and washers and indentifying any shims to their respective positions.

On later Series IV Cars onwards, the fulcrum pin bracket is not used thus it will only be necessary to withdraw the two fulcrum pin to crossmember bolts.

Refitting is a reversal of the above procedure.

Check camber, castor and Steering Axis Inclination.

Check toe-in.

TO REMOVE AND REFIT BOTTOM LINK
(See Fig. 14)

Remove front shock absorber (see "Stub axle removal").

Jack up the car under the front crossmember (using a block of wood between the jack and the crossmember). Place the car on stands below each sidemember, and remove road wheel.

Fit the road spring compressor tool and compress the road spring sufficiently to take the load of the spring (31).

Remove the lower link eyebolt (25).
Disconnect stabilizer bar and remove four bolts securing bottom link fulcrum pin to the crossmember.

Release spring compressor gradually until road spring and bottom link can be removed.

Refitting the bottom link (38) is a reversal of these operations except for the following:—

Ensure that the rubber insulating ring is in place when placing the road spring in position.

Compress the spring until the fulcrum pin can be rebolted to the crossmember. The bolts should be tightened to the figure given in the "General Data Section" and secured with new lockwashers.

Ensure that sealing rings are correctly fitted when replacing the eyebolt.

The stabilizer bar bushes should be assembled with graphite as this prolongs their life.

TO REMOVE AND REFIT FRONT ROAD SPRING (See Fig. 14)

Remove front shock absorber.

Jack up the car under the front crossmember, (using a block of wood between the jack and the crossmember). Place the car on stands below the sidemember, and remove road wheel.

Fit the spring compressor tool and compress the road spring sufficiently to take the load of the spring (31).

Remove lower link eyebolt (25).

Disconnect stabilizer bar and remove four bolts securing bottom link fulcrum pin to the crossmember.

Release spring compressor gradually until road spring and bottom link can be removed.

Refitting the road spring (31) is a reversal of these operations except for the following:—

Ensure that the rubber insulating ring is in place when placing the road spring in position.

Compress the spring until the fulcrum pin can be rebolted to the crossmember. The bolts should be tightened to the figure given in the "General Data Section" and secured with new lockwashers.

Ensure that sealing rings (28) are correctly fitted when replacing the eyebolt.

TO CHECK FRONT SPRINGS

If required the front springs can be roughly checked in position by the following method:

Place a load of 300 lbs. (136 kgs.) evenly across the front compartment of the car.

Each spring is now checked by measuring the height between the crossmember top fixing face and the centre of the greaser at the forward outer end of the lower link eye bolt. On Alpine cars this distance should be 5·48″ ± ·125″ (13·9 cm. ± ·32 cm.); on Rapier cars it should be 6·10″ ± ·125″ (15·5 cm. ± ·32 cm.).

Full details of the loadings and lengths for checking these springs on a spring testing rig, are given in the Data Section.

NOMENCLATURE

Upper link	—	Upper control arm.
Lower link	—	Lower control arm.
Fulcrum pins	—	Control arm shafts.
Eye bolts	—	Pivots.
Stub axle	—	Steering knuckle.
Stub axle carrier	—	Knuckle support assembly.
Track rod	—	Tie rod.
Steering arms	—	Steering knuckle arms.

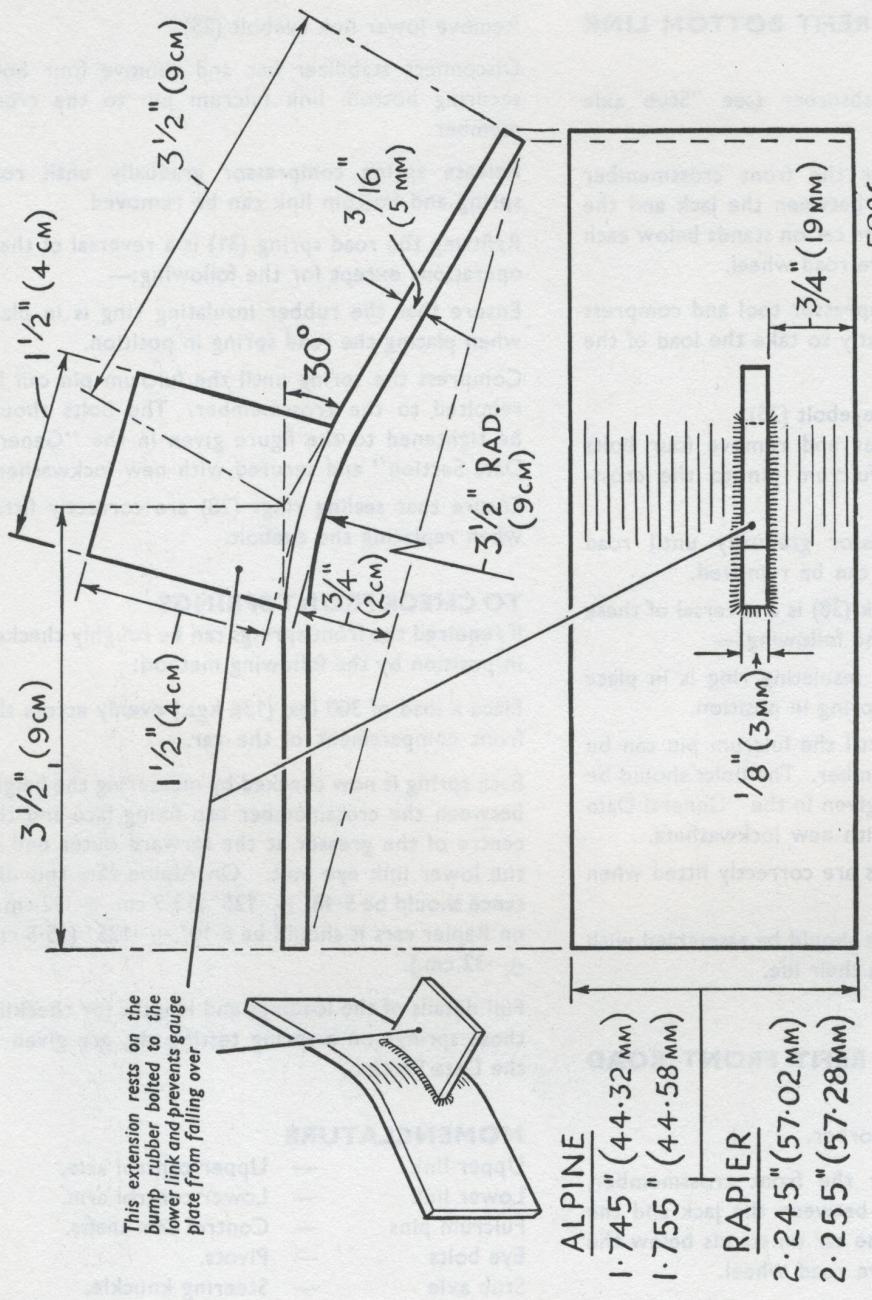


Fig. 18. *Details of front gap gauge, Alpine and Rapier*

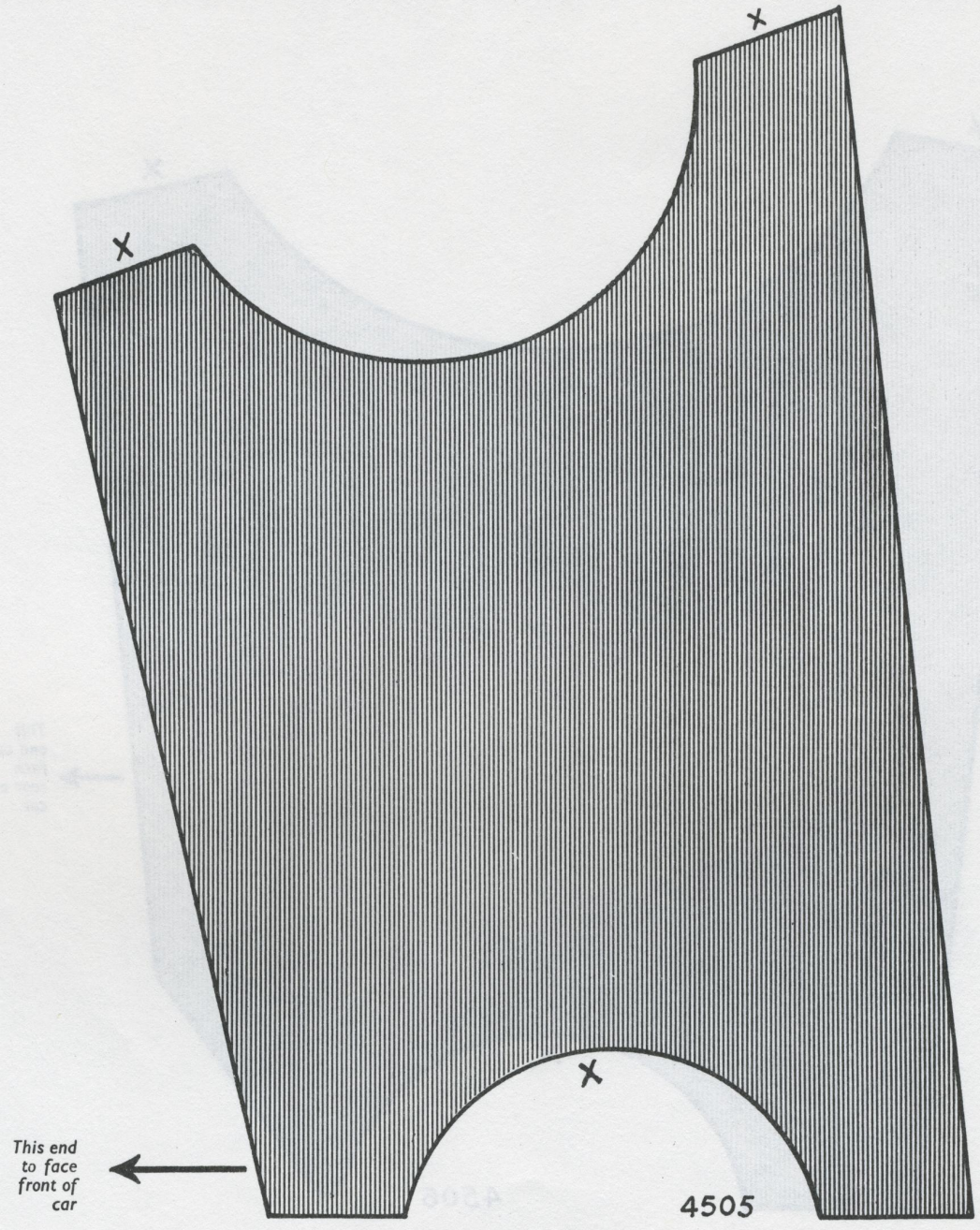


Fig. 19. *Rear gap gauge, Rapier*

This item should be made from 1″ (25mm.) thickness hardwood by glueing a carefully-made tracing of this illustration to the wood. The important faces are marked with an "X".

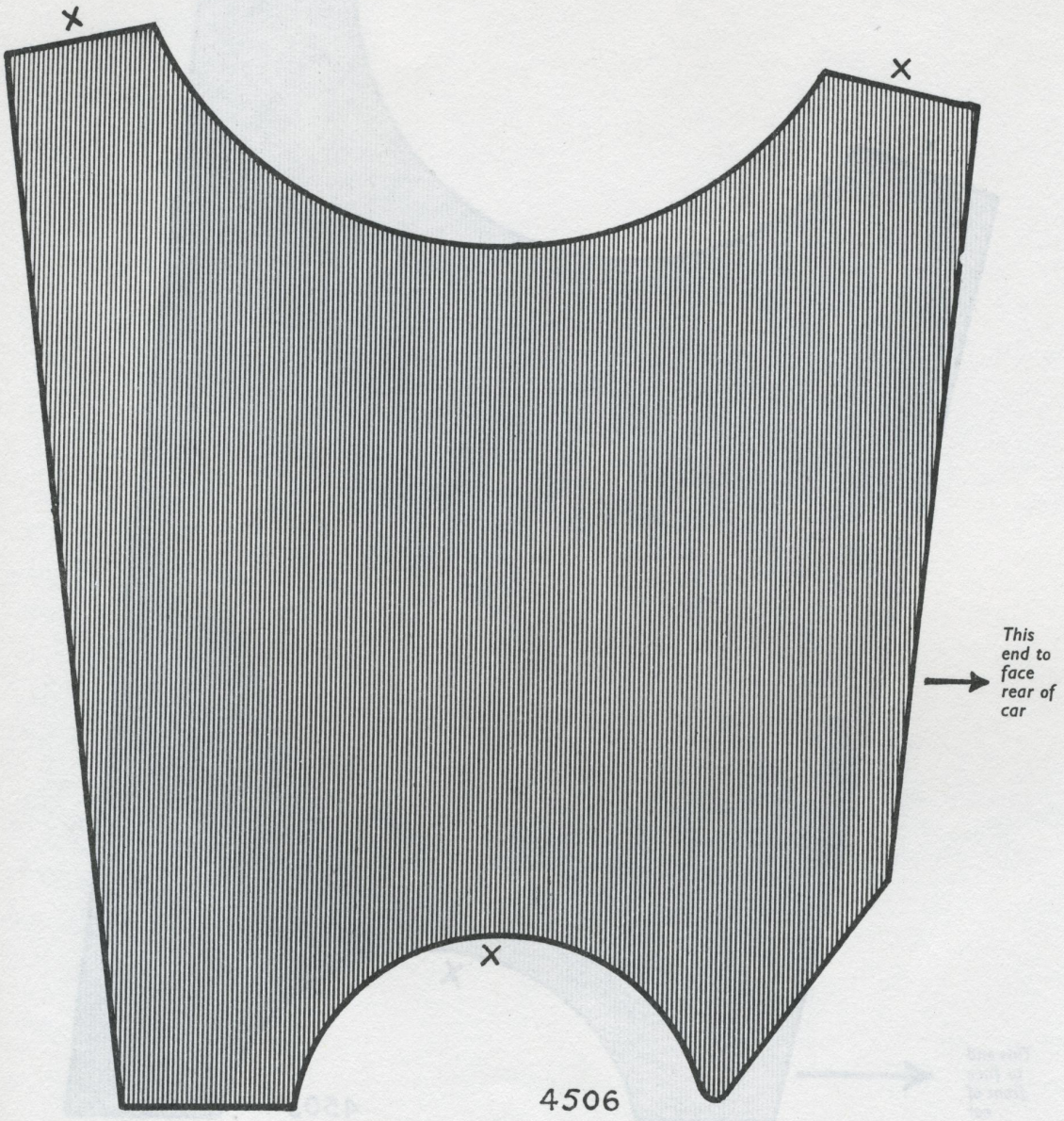


Fig. 20. *Rear gap gauge, Alpine*

This item should be made from 1" (25mm.) thickness hardwood by glueing a carefully-made tracing of this illustration to the wood. It can then be cut to shape on a bandsaw. The important faces are marked with an "X".

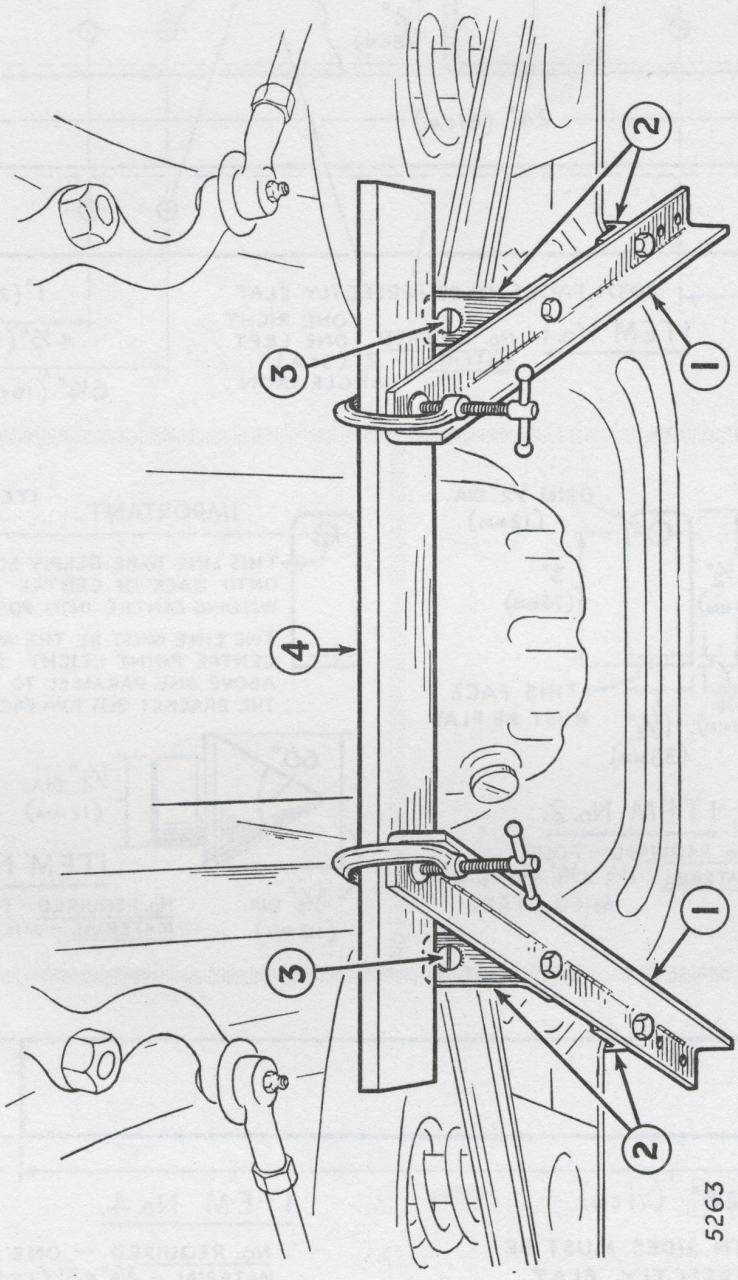


Fig. 21. *Ball pin height checking fixture in position. Details of items 1 to 4 in Fig. 22*

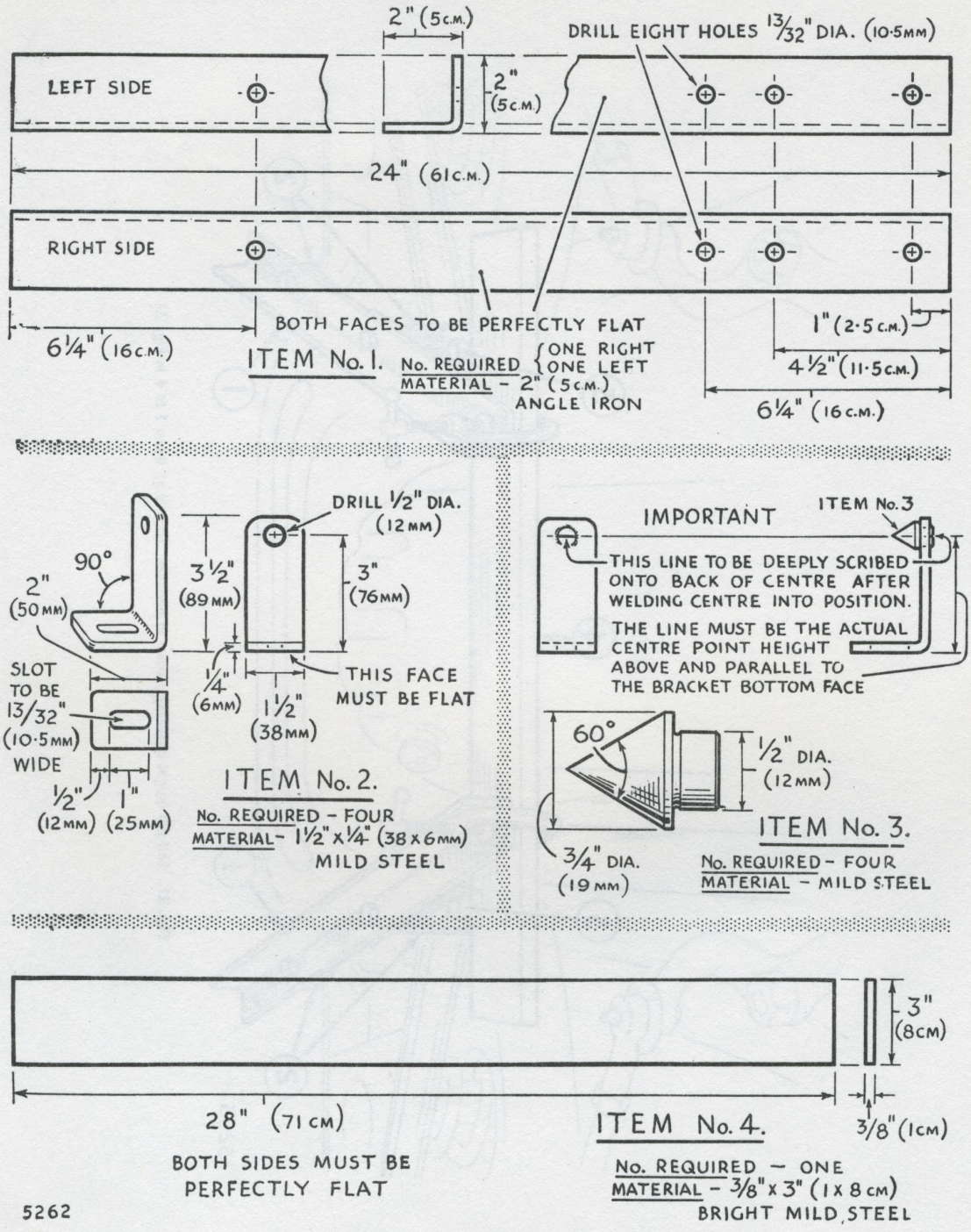
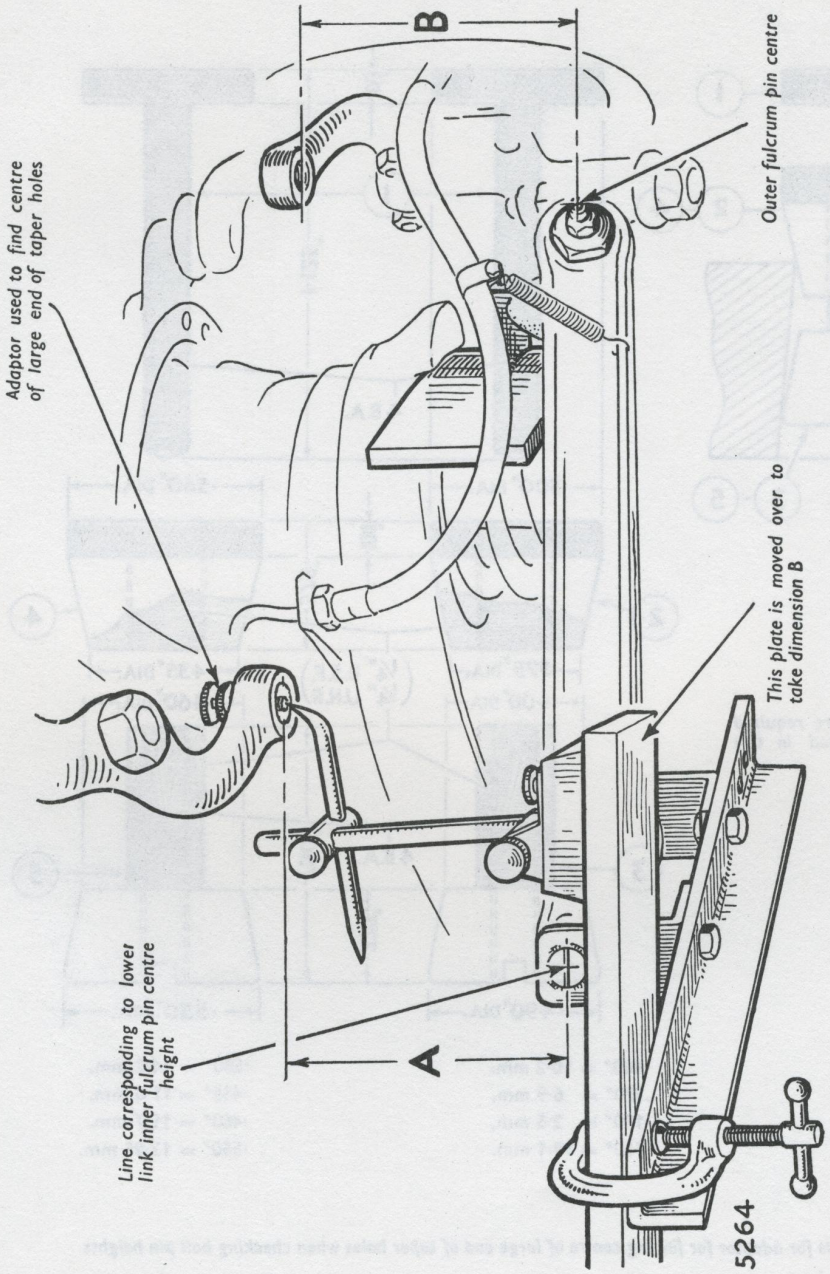


Fig. 22. *Details of ball pin height checking fixture parts*

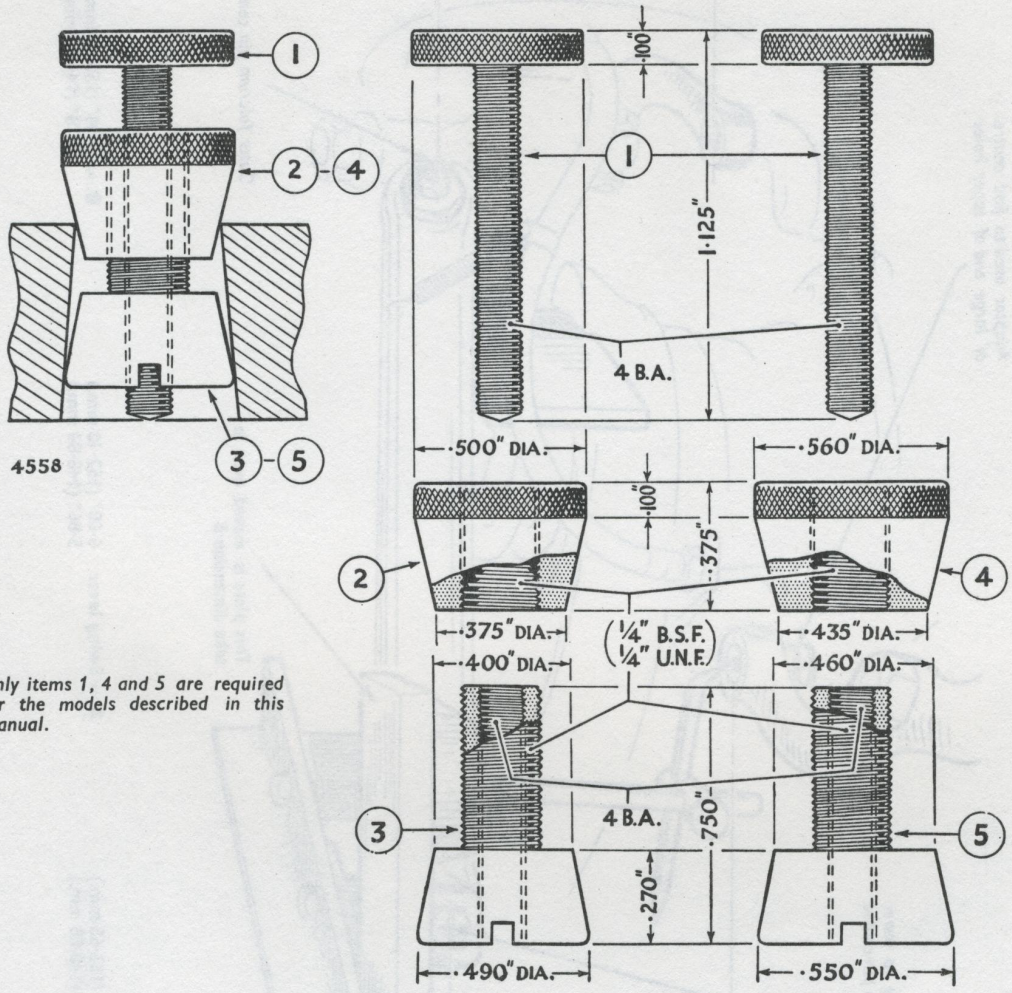


A = Idler lever 6·01″ (152·65 mm.) 5·83″ (148·08 mm.)

A = Swing lever 6·00″ (152·40 mm.) 5·86″ (148·84 mm.)

B = 5·94″ (150·87 mm.) 5·78″ (146·81 mm.)

Fig. 23. *Ball pin height checking fixture in use*



Only items 1, 4 and 5 are required for the models described in this manual.

1·125" = 28·5 mm.
·500" = 12·7 mm.
·490" = 12·45 mm.
·375" = 9·5 mm.

·400" = 10·2 mm.
.270" = 6·9 mm.
·100" = 2·5 mm.
·750" = 19·1 mm.

·560" = 14·2 mm.
·435" = 11·0 mm.
·460" = 11·7 mm.
·550" = 13·95 mm.

Fig. 24. *Details for adaptor for finding centre of large end of taper holes when checking ball pin heights*

FRONT SHOCK ABSORBER

Armstrong Direct-Acting Telescopic Dampers are fitted.

The body of the shock absorber is telescopic and is mounted more or less vertically through the coil spring between the suspension cradle and wishbone spring pan on the front member. It is therefore direct-acting, no links or levers being required.

SERVICING

Unless proper facilities are available including a shock absorber testing machine, it is almost invariably found that to attempt repairs to the modern telescopic shock absorbers is neither practical nor economical.

These units are completely sealed, no topping up, adjustment, or other service is required apart from periodical checks of mountings and rubber bushes, which can be carried out without the aid of special tools.

In the event of any shock absorbers requiring attention, it is strongly recommended that the faulty unit should be removed and a replacement shock absorber fitted.

Removal and refitting instructions for front shock absorbers are contained in this section.

CONSTRUCTION

The assembly consists mainly of a piston rod (C) attached to the upper mounting (A) with a piston incorporating the piston valve (M) attached to the lower end. This is housed in a cylinder (H and P) with a larger diameter concentric to form a reservoir (Q) and a lower mounting (S). In detail the piston rod has a former and dust shield (B) attached immediately below the upper mounting stem, and is suitably machined at the lower end with the piston to house the piston valve (M). The cylinder is located at the lower end by a spigot on the piston rod guide which in turn is housed in the outer tube.

This piston rod guide forms a bearing for the piston rod, holds the rebound valve and drain tubes in position and contains the spring-loaded piston rod seal (D). The cylinder, piston rod guide and reservoir seal are retained in the outer tube. Baffles (K and N) are sprung on to the outside of the cylinder (P) to prevent aeration of the fluid in the reservoir (Q) by the rapid movements of the suspension.

The cylinder is completely filled and the reservoir about half-filled with fluid when the piston rod is extended.

Operation

The functioning of the shock absorber with its unique principle of "one-way" oil circulation, is described below with references to the illustration.

As the wheel rises on fast bump strokes, when the piston is moving relatively towards the base valve (R) fluid pressure opens the piston valve (M) against the coil spring load and fluid passes through the ports in the piston valve (M) from the lower half of the cylinder (P) to the upper part of the cylinder (H). The excess fluid displaced from the cylinder by the piston passes via the ports (F) in the piston rod guide (E) through the filter (G) and down the rebound valve tube (L) opening the rebound valve (O) against the coil spring load into the reservoir (Q).

On the slow bump strokes, damping is controlled by calibrated bleed grooves on the face of the base valve (R).

On the fast rebound strokes when the piston is moving relatively towards the piston rod guide (E) the piston valve (M) closes and again fluid passes through the ports (F) in the piston rod guide (E) through the filter (G) down the rebound valve tube (L) opening the rebound valve (N) against the coil spring load and into the reservoir (Q). At the same time the lower part of the cylinder (P) is replenished with fluid as the base valve (R) opens to allow recuperation from the reservoir (Q).

On slow rebound strokes, fluid passes through a calibrated bleed groove in the face of the piston valve seat.

Any fluid which passes between the piston rod and the piston rod guide bearing is prevented from escaping by the multi-lip piston rod seal (D). Undue internal fluid pressure on this seal is relieved as the fluid passes through a port to the drain tube (J), the lower end of which is immersed in the reservoir fluid to prevent aeration.

TESTING

When there is any question of suspension not being adequately damped, the condition of the following should be considered: road springs, tyre pressures, bump rubbers and bump rubber seats, as these carry the full bump load of the suspension. If a shock absorber does not appear to function satisfactorily an indication of its resistance can be obtained by carrying out the following check:—

Remove the shock absorber from its mounting. Place the shock absorber vertically in a vice, holding by the lower spindle between two pieces of wood.

Grip the dirt shield firmly with the hands and prime the shock absorber by working it up and down several times to expel the air.

Move the piston (free top half) up and down through one complete cycle to check the nature of the movement.

Moderate and even resistance throughout the outward and inward stroke should be felt. If, however, the resistance is slight, erratic, or free movement cannot be eliminated by priming, then the shock absorber should be changed.

As only the "bleed" incorporated in the valves can be felt when operating the shock absorber manually even when new, no amount of hand testing will provide a true indication of the resistance of the shock absorbers at speeds obtained on bumpy roads. It will, therefore, be appreciated that a new shock absorber may appear to be weak when operated by hand, but this should not be taken as evidence of a fault. Air will bleed into the working parts of a shock absorber when not in use, particularly if it is stored in any position other than vertical, and this air must be expelled before the shock absorber is tested.

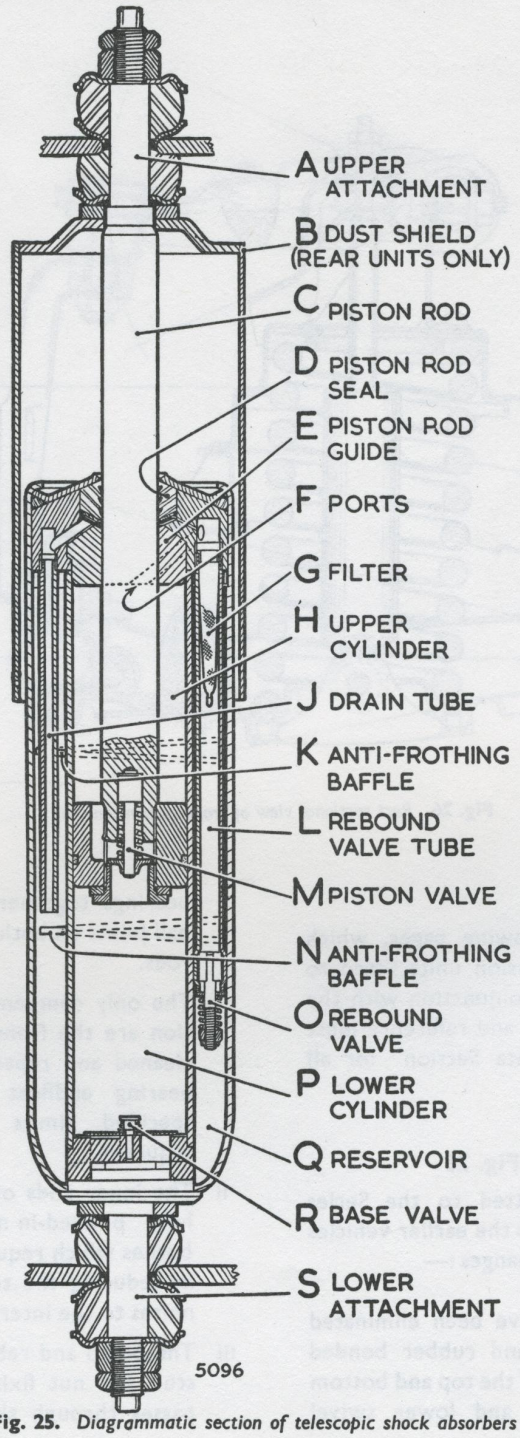


Fig. 25. *Diagrammatic section of telescopic shock absorbers*

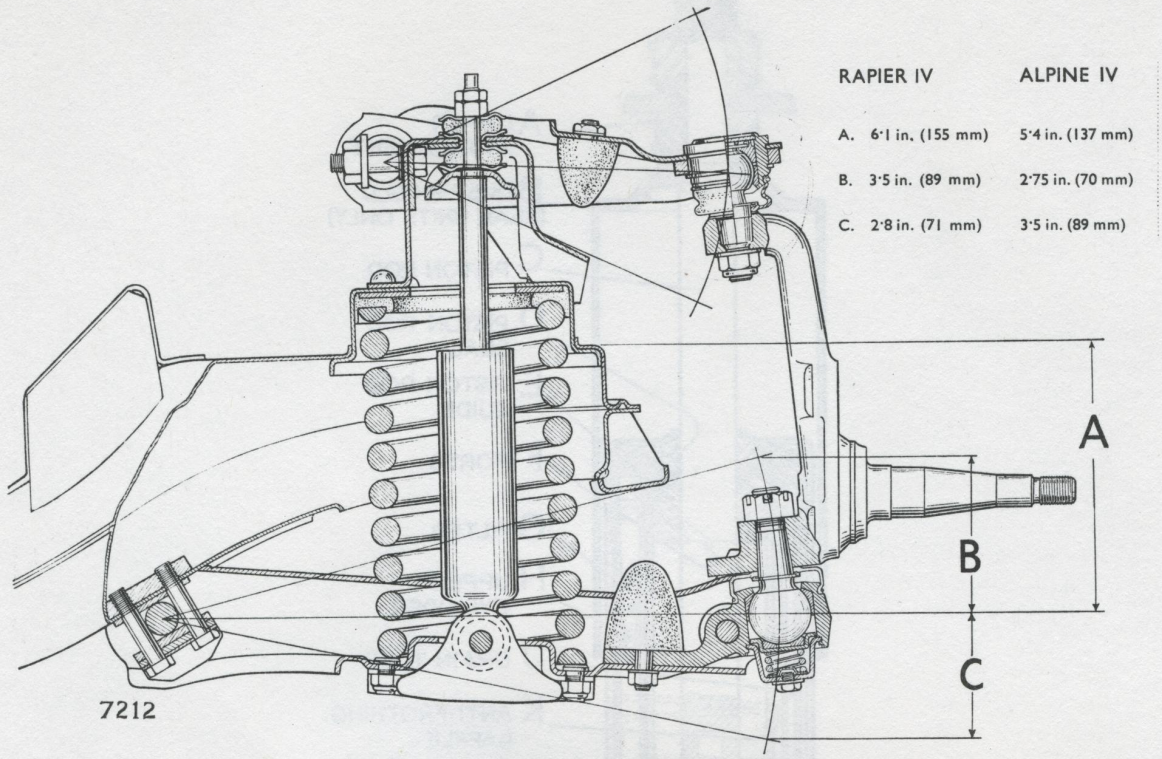


Fig. 26 *Part sectional view of front suspension unit*

SERIES IV MODELS

It is important that the following pages, which concern the new front suspension units fitted to Series IV Models are read in conjunction with the foregoing pages of this Section and reference must be made to the "General Data Section" for all dimensions.

GENERAL DESCRIPTION Fig. 26

The front suspension unit fitted to the Series IV Models is similar in design to the earlier vehicles but there are the following changes :—

i All lubrication nipples have been eliminated by the fitting of metal and rubber bonded bushes to the inner ends of the top and bottom links, pre-packed upper and lower swivel bearings together with similarly pre-packed ball joints on both ends of the two outer track rods.

The only components which require lubrication are the front hubs; these are removed, cleaned and repacked with new grease, the bearing endfloat checked and set within specified limits during the reassembly sequence.

ii The inner ends of the top and bottom links have pressed-in metal and rubber bonded bushes which require no lubrication and assist in reducing the transmission of road surface noises to the interior of the car.

iii The bump and rebound rubbers have a single stud and nut fixing, the bump rubber stud passes through the cast body of the lower

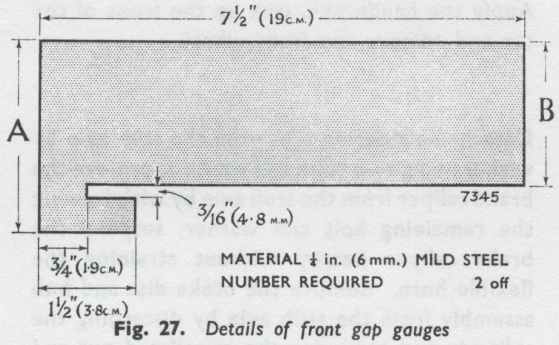


Fig. 27. *Details of front gap gauges*

ALPINE IV. A = 2¾ in. (7·0 cm.), B = 2 in. 5·1 cm.)
RAPIER IV. A = 3 in. (7·6 cm.), B = 2¼ in. 5·7 cm.)

swivel bearing while the stud of the rebound rubber passes only through the pressing of the top link.

iv The swivel bearings are both of the ball type and are pre-packed with lubricant during manufacture and subsequent lubrication is unnecessary, thus no lubrication nipple is provided.
The upper swivel bearing is splined and pressed into the outer end of the top link and locked in position with a circlip.
The lower swivel bearing is fitted into the outer end of the bottom link and secured by one horizontal bolt and the stud of the bump rubber mounted inside the bottom link.

v The steering lock stops have been redesigned to accommodate the fitting of the new lower swivel bearings; they are not adjustable.

vi The shock absorbers have eye type attachments at their lower ends with rubber bushes inserted into the eye and a horizontal bolt secures the shock absorber to a bracket which, in turn, is attached to the underside of the bottom link by nuts and washers.
The upper shock absorber attachment remains unchanged.

PREPARATION OF VEHICLE

Gap gauges

New front gap gauges will be required and these can be made locally to the dimensions given in Fig. 27.

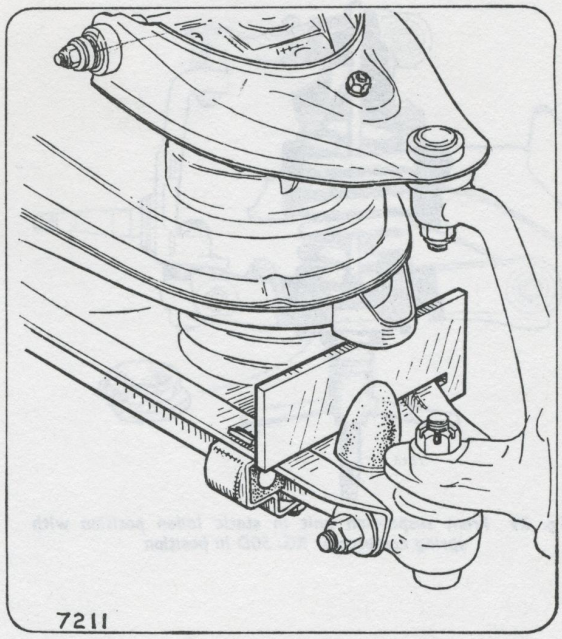


Fig. 28 *Front gap gauge in position with front suspension unit loaded down*

The new gap gauges are used in a similar manner to those described earlier in this section being fed in vertically into the suspension units from the rear between the coil springs and bump rubbers until the cut-out in the gap gauges locate the rear edge of both bottom links. See Fig. 28.

The rear gap gauges remain unchanged and dimensions for their manufacture will be found in Fig. 19 for the Rapier Series IV Models.

The suspension must be loaded down on to the gap gauges.

A loading platform can be built with a stout plank of wood supported by two suitably cranked steel bars ⅞ in. (22 mm.) square inserted one in each front jacking bracket.

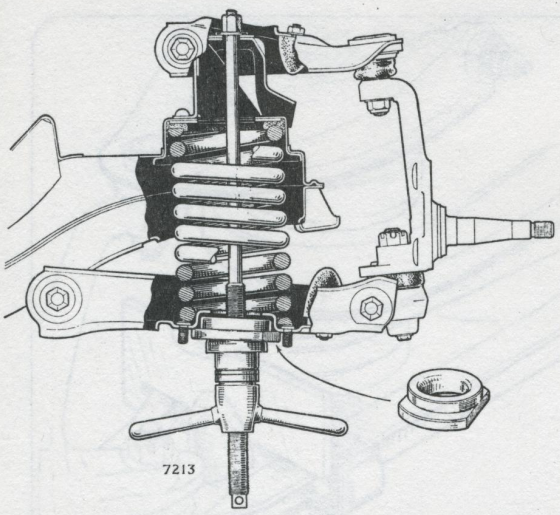


Fig. 29 *Front suspension unit in static laden position with spring compressor RG. 50D in position*

WHEEL LOCK ANGLES

The steering lock stops are small levers welded to the upper face of each bottom link, adjacent to its outer end and a cast lug in the base of each stub axle.

BALL PIN HEIGHTS—To check

It has been found possible, in practice, to determine any inaccuracies that may exist in the front suspension unit by checking camber, castor, king pin inclination angles, front wheel alignment and Ackerman angles; thus rendering a steering ball pin height check unnecessary.

STUB AXLE—To remove and refit

1. Remove the shock absorber from the suspension unit, see under "Shock absorber—To remove and refit"; fit and tension the spring compressor RG. 50D to bring the bottom link to the horizontal position (Fig. 29).
2. Apply the handbrake, jack up the front of the car and remove the front wheel.
3. Detach the steering arm from the stub axle by withdrawing two bolts and washers, remove the brake caliper from the stub axle by withdrawing the remaining bolt and washer, suspend the brake caliper nearby without straining the flexible hose. Remove the brake disc and hub assembly from the stub axle by discarding the split pin and removing the castellated nut and "D" washer. Remove the brake disc guard from the stub axle by withdrawing three bolts and washers.
4. Remove the stub axle from the upper and lower swivel bearings by detaching the nuts from the tapered ball pins and using a suitable extractor, RG. 191A.
5. Refitting is the reverse of the removal sequence but particular attention must be given to the following:—

   i The nuts of the tapered ball pins are tightened to the torque given in the " General Data Section ".

   ii Pack the hub and bearings with grease of the correct grade (see Section P), the amount required is one capful, distributed evenly within the hub shell as shown by the cross hashings in Fig. 15. The bearing endfloat is set, see under "Front Hubs—To adjust" and a new split pin is used to lock the castellated nut.

   iii The brakes are adjusted, by pumping the brake pedal until solid resistance is felt.

   iv A full front suspension and steering check is carried out.

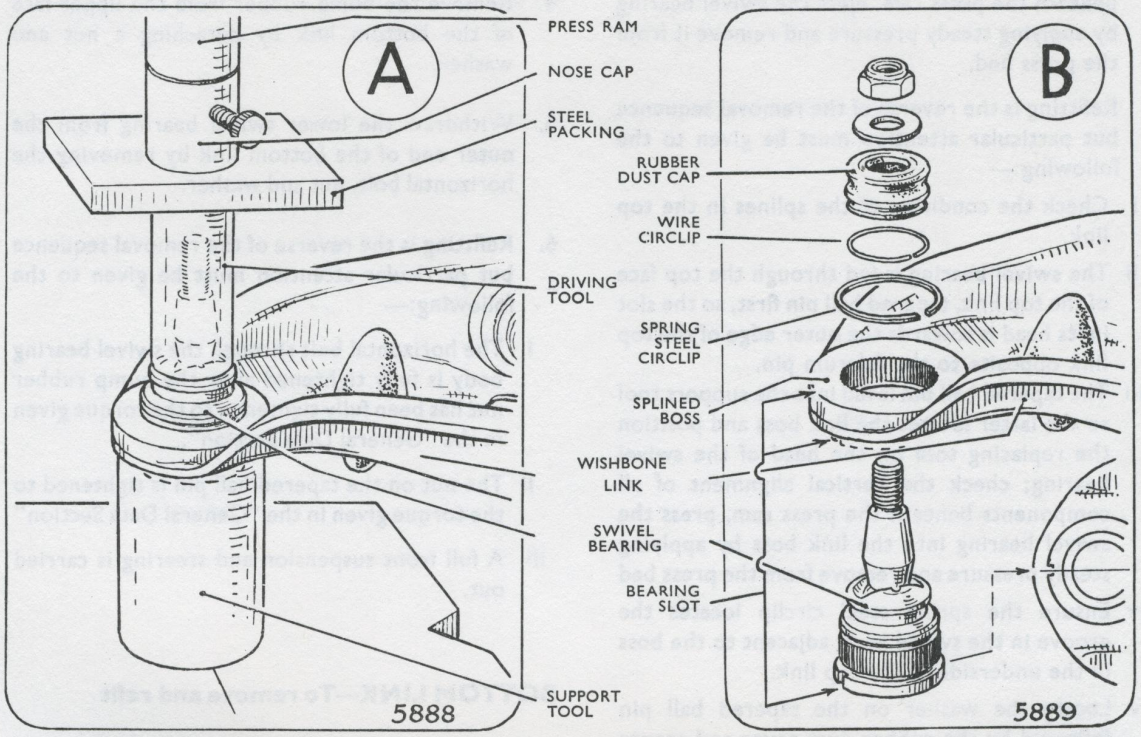


Fig. 30 *"A" pressing out swivel bearing from top link and "B" showing correct position of alignment slot when refitting swivel bearing*

STUB AXLE UPPER SWIVEL BEARING—

To remove and refit (Fig. 30)

The upper swivel bearing cannot be removed and refitted without first removing the top link from the stub axle and crossmember. The head of the swivel bearing body carries a slot which indicates the maximum angular travel of the tapered ball pin and must always be positioned towards the outside of the link boss furthest from the fulcrum pin.
A workshop press is used in conjunction with the special tool RG. 319 which consists of:—

i Drive tool ii Support tool
iii Replacing tool

1. The top link and camber shims are removed from the crossmember as described earlier in this Section.
2. Remove the rubber dust cover and washer from the swivel bearing body and tapered pin respectively by releasing the wire circlip.
3. Release the spring steel circlip from the groove in the swivel bearing body adjacent to the boss in the outer end of the top link.
4. Stand the support tool on the press bed and mount to top link above so the tapered ball pin points upwards and the support tool locates the link boss around the swivel bearing body.
5. Position the driving tool over the tapered ball pin so it locates the swivel bearing body; check the vertical alignment of all components

beneath the press ram, eject the swivel bearing by applying steady pressure and remove it from the press bed.

6. Refitting is the reverse of the removal sequence but particular attention must be given to the following:—
   i Check the condition of the splines in the top link.
   ii The swivel bearing is fed through the top face of the top link, tapered ball pin first, so the slot in its head is towards the outer edge of the top link opposite to the fulcrum pin.
   iii The tapered ball pin is fed into the support tool so the latter locates the link boss and position the replacing tool on the head of the swivel bearing; check the vertical alignment of all components beneath the press ram, press the swivel bearing into the link boss by applying steady pressure and remove from the press bed
   iv Ensure the spring steel circlip locates the groove in the swivel body adjacent to the boss in the underside of the top link.
   v Locate the washer on the tapered ball pin followed by the rubber dust cover and secure with the wire circlip.

STUB AXLE LOWER SWIVEL BEARING—To remove and refit

1. Remove the shock absorber from the suspension unit, see under "Shock absorber—To remove and refit"; fit and tension the spring compressor RG. 50D to bring the lower link to the horizontal position. (See Fig. 29).
2. Apply the handbrake, jack up the front of the car and remove the front wheel.
3. Detach the lower swivel bearing from the stub axle by removing the nut from the tapered ball pin and using a suitable extractor RG. 191A; support the stub axle and hub assembly by positioning a block of wood between the rebound rubber and its abutment face on the crossmember.
4. Remove the bump rubber from the upper face of the bottom link by detaching a nut and washer.
5. Withdraw the lower swivel bearing from the outer end of the bottom link by removing the horizontal bolt, nut and washer.
6. Refitting is the reverse of the removal sequence but particular attention must be given to the following:—
   i The horizontal bolt through the swivel bearing body is fully tightened after the bump rubber nut has been fully tightened to the torque given in the "General Data Section".
   ii The nut on the tapered ball pin is tightened to the torque given in the "General Data Section"
   iii A full front suspension and steering is carried out.

BOTTOM LINK—To remove and refit

1. Remove the shock absorber, compress the front spring with the special tool RG. 50D and detach the tapered ball pin of the lower swivel bearing from the stub axle, see under "Stub axle lower swivel bearing—To remove and refit". (See Fig. 29.)
2. Remove the stabiliser bar from the bottom link by removing two nuts, bolts, washers and clips
3. Detach the fulcrum pin of the bottom link from the underside of the crossmember by withdrawing four bolts, washers and two clamps.
4. Progressively release the spring compressor and remove the bottom link, front spring and insulator.
5. Refitting is the reverse of the removal sequence but particular attention must be given to the following:—

i The insulator is fitted to the top of the front spring and then fed into the crossmember.

ii Compress the front spring until the fulcrum pin of the bottom link can be fitted to the underside of the crossmember.

iii Tighten the four fulcrum pin bolts and the nut of the tapered ball pin to the torque given in the "General Data" Section.

iv A full front suspension and steering check is carried out.

FRONT SPRING—To remove and refit

The front spring is removed as described under "Bottom Link— To remove and refit" but in this instance there is no necessity to detach the lower swivel bearing from the bottom link.

The spring compressor is slackened off and removed from the crossmember, then the stub axle and bottom link are moved outward and downward so the front spring with its insulator can be withdrawn from below the crossmember.

The refitting is the reverse of the removal sequence and the fulcrum pin bolts tightened to the torque given in the "General Data Section".

To check front springs

Full details of the lengths and loadings for checking the front spring on a spring testing rig are given in the "General Data Section".

While it is possible to check the front spring heights by taking the height of the car and comparing it with one known to be in excellent condition, the possibility of incorrect spring(s) or packing piece(s) that may be fitted, particularly to unknown second-hand cars, makes this method of checking very unreliable.

SHOCK ABSORBERS—To remove and refit

A change has been made to the shock absorber attachment to the bottom link but can be removed from the crossmember in a similar manner to that described under "Stub axle—To remove and refit" earlier in this section but particular attention must be given to the following:—

i After detaching the upper shock absorber attachment from the crossmember, remove the two nuts and washers which secure the lower shock absorber mounting bracket to the underside of the bottom link and withdraw the shock absorber downward.

ii Remove the lower mounting bracket from the shock absorber eye by withdrawing a nut, washer and bolt; eject the tubular distance piece from the centre of the rubber bushes and withdraw the latter from the shock absorber eye.

iii Refitting is the reverse of the removal sequence but the rubber bushes are inserted into the shock absorber eye, long tapered end first and the mounting bracket set at an angle.

iv The shock absorber is fed into the bottom link in its fully extended condition and so the mounting plate is inclined downward and outward.

LINK BUSHES—To renew

To carry out this operation a workshop press is required and no attempt must be made to remove or refit the link bushes without supporting the arms of the top or bottom links. Special tools are available for this purpose, as follows:—

i Plain support tube ii Slotted support tube
iii Driving tube iv Mushroom driver

which comprises Churchill Special Tool Set Number—RG. 318.

Two of the tubes are plain and one is slotted. The slot allows the fitting of the tube around the fulcrum pin when fitting the link bushes. The operational procedures are the same for the top and bottom links.

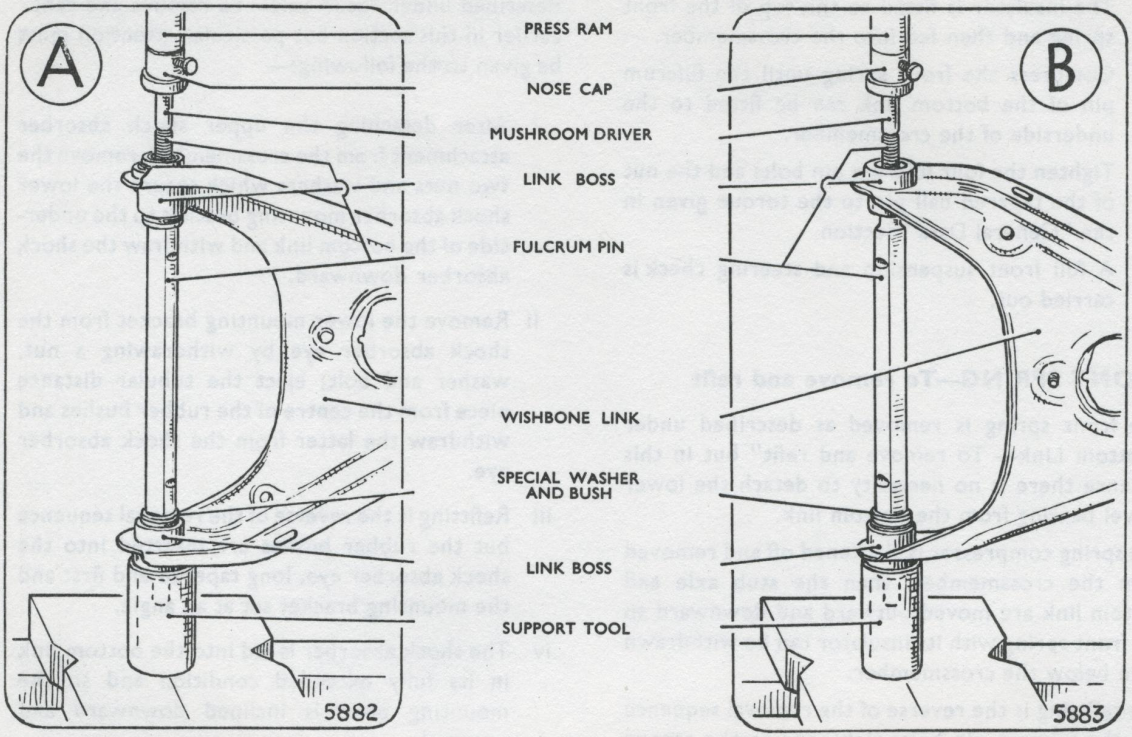


Fig. 31 *Illustrating method of removing bushes from the links in a workshop press using special tool RG. 318*

To remove link bushes (Fig. 31)

1. Remove the link from the crossmember as described under the appropriate heading; in the instance of the bottom link identify one end of the fulcrum pin to the link arm.
2. Remove the self-locking nuts and plain washers from both ends of the fulcrum pin.
3. Stand the link on its side in the press, as illustrated at " A ".
4. Place the plain support tube under the lower arm of the link, ensuring that the tube is correctly located around the outside of the link bush.
5. Position the mushroom driver between the nose cap of the press ram and the upper end of the fulcrum pin, at the same time applying a little pressure on the ram to enable the assembly to be supported.
6. After making sure the fulcrum pin is in the vertical position, apply further pressure on the ram until the bush is pressed out clear of the link.
7. The link bush complete with fulcrum pin and two special washers are now separated from the link and can be drawn clear.
8. Proceed to remove the bush from the opposite side of the link. The procedure is similar to the first link but it will be necessary to temporarily refit the fulcrum pin with one of the special washers positioned between the link bush and the shoulder of the fulcrum pin, see Fig. 31 at "B."

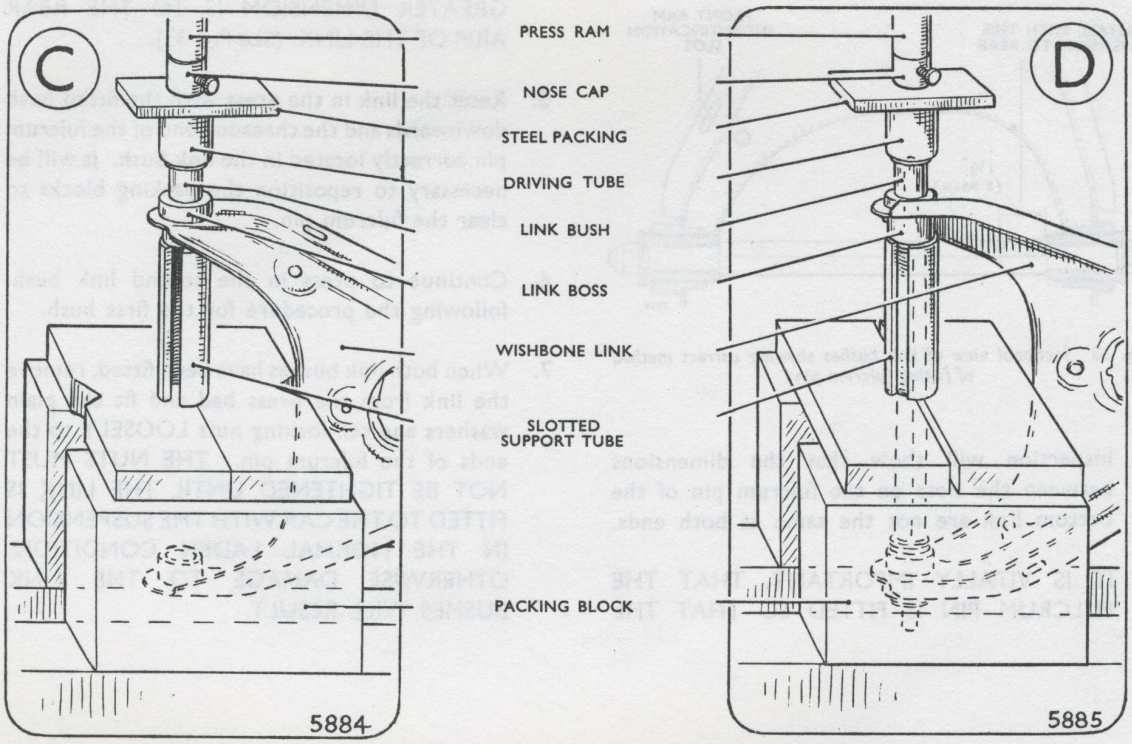


Fig. 32 *Illustrating method of fitting bushes to a link in a workshop press using special tool RG. 318*

To fit link bushes (Fig. 32)

It is strongly recommended that new bushes and new special washers are fitted and the old link bushes and washers discarded. It will be necessary to use the slotted support tube and the driving tube in the manner illustrated.

The procedure is as follows:—

1. With the aid of packing blocks, set up the link in the press with the upper arm supported by the slotted tube as shown at "C". Ensure that the slotted tube is properly located below the boss of the link.

2. Place the link bush and driving tube in position between the nose cap of the press ram and the entrance of the boss, at the same time lowering the ram a little to support the assembly.

3. After making sure the assembly is vertical and the link bush is centrally located in the entrance of the boss, apply pressure gradually, preferably in stages, to the press ram until the link bush is fully home in the boss.

4. Remove the link from the press and install the fulcrum pin complete with two new special washers in the link according to the identification markings, ensuring that the special washers are correctly seated with their chamfered sides inwards towards the shoulders of the fulcrum pin.

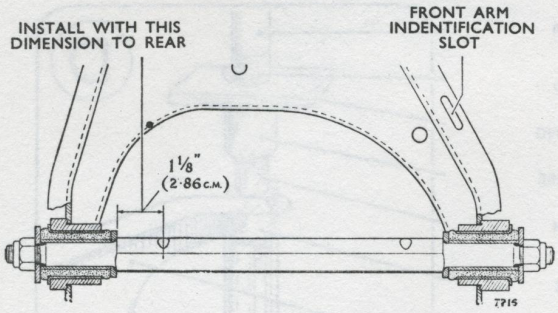


Fig. 33 *Sectional view of link bushes showing correct method of fitting fulcrum pin*

Inspection will show that the dimensions between the slots on the fulcrum pin of the bottom link are not the same at both ends.

IT IS VITALLY IMPORTANT, THAT THE FULCRUM PIN IS FITTED SO THAT THE GREATER DIMENSION IS TO THE REAR ARM OF THE LINK. (See Fig. 33).

5. Reset the link in the press with the fitted bush downwards and the threaded end of the fulcrum pin correctly located in the link bush. It will be necessary to reposition the packing blocks to clear the fulcrum pin.

6. Continue to press in the second link bush, following the procedure for the first bush.

7. When both link bushes have been fitted, remove the link from the press bed and fit the plain washers and self-locking nuts LOOSELY to the ends of the fulcrum pin. THE NUTS MUST NOT BE TIGHTENED UNTIL THE LINK IS FITTED TO THE CAR WITH THE SUSPENSION IN THE NORMAL LADEN CONDITION, OTHERWISE DAMAGE TO THE LINK BUSHES WILL RESULT.