ROUTINE MAINTENANCE
EVERY 6,000 MILES (10,000 KM.)

Steering Box

The steering box is attached to the front suspension cross member; the filler plug is situated in the top cover and is accessible from the engine compartment on the driver's side of the car. The filler plug has a plain head and should not be confused with the rocker shaft adjustment screw which is threaded externally. Top up the steering box with recommended grade of lubricant until no more oil will enter.

Steering Idler Lever Housing

The idler housing is pre-packed with grease which only requires replenishing if the idler assembly is dismantled for overhaul.

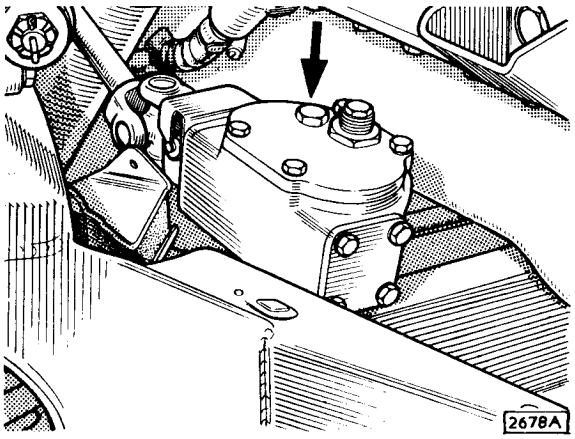


Fig. No. 2 *Steering Box Filler Plug (R.H.D.)*

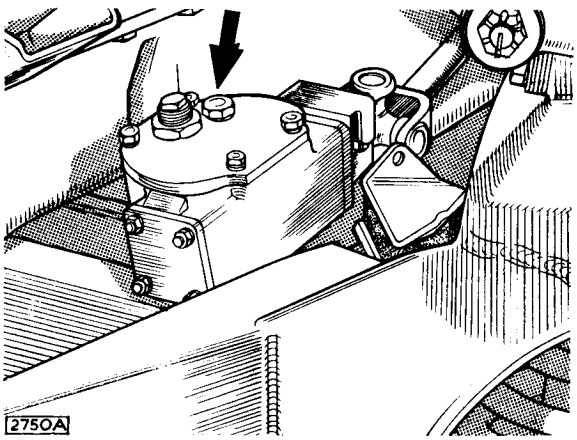


Fig. No. 3 *Steering Box Filler Plug (L.H.D.)*

Steering Tie-Rods

Lubricate the ball joints at the ends of the two steering tie-rods with the recommended lubricant. The tie-rods are situated at the rear of the front suspension cross-member. When carrying out this operation, examine

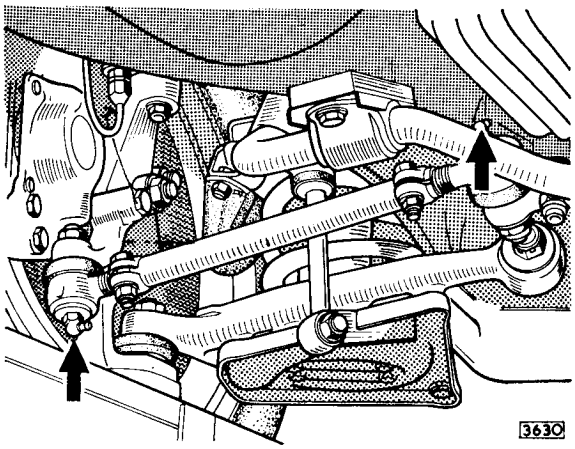


Fig. No. 4 *Steering Tie rod grease nipples*

the rubber seals at the ends of the ball housings to se
if they have become displaced or split. In this ever
they should be replaced or repositioned as any dirt c
water that enters the ball joints will cause prematur
wear.

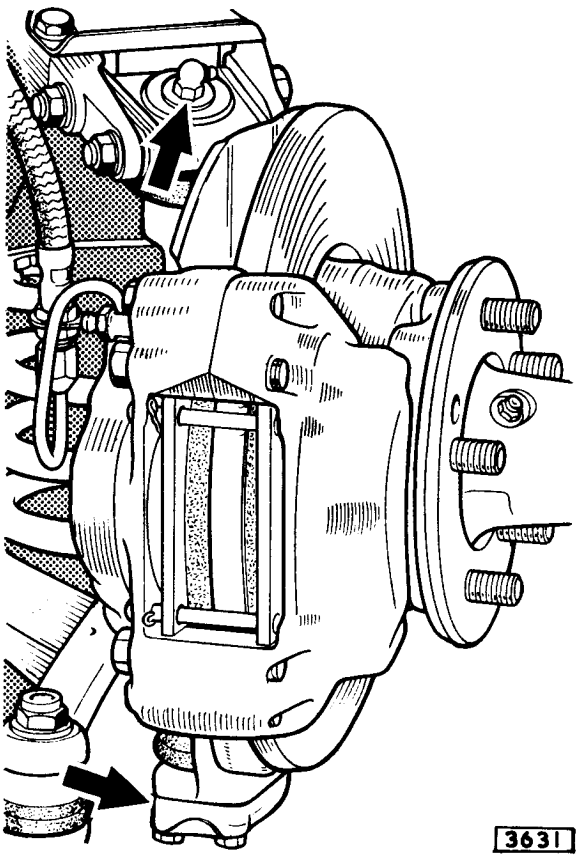


Fig. No. 5 *Wheel swivel grease nipples*

A bleed hole, covered by a circular nylon washer which lifts under pressure, indicates when sufficient lubricant has been applied.
This prevents grease from escaping past the seals when too much pressure is applied.

Wheel Swivels
Lubricate the nipples (four per car) fitted to the top and bottom wheel swivels.
The nipples are accessible from underneath the front of the car.

Front Wheel Alignment
Check the front wheel alignment as detailed on page I.11.

EVERY 12,000 MILES (20,000 KM.)
Check the condition of the rubber coupling between the upper and lower steering columns. Renew if worn or contaminated with petrol, oil or brake fluid.

RECOMMENDED LUBRICANTS

	Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent Caltex/Texaco
Steering Box	Mobilube C140	Castrol D	Shell 140 EP	Esso Gear Oil GP 90/140	Gear Oil SAE 140 EP	Nol EP 140	Multigear Lubricant 140
Steering idler housing Steering tie rods	Mobilgrease MP	Castrolease LM	Retinax A	Esso Multi-purpose Grease H	Energrease L.2	LB.10	Marfak All-Purpose

STEERING UNIT

Removal
Remove the pinch bolt securing the steering column upper universal joint to the inner column.
Pull the steering wheel and inner column upwards to clear the splines from the universal joint socket.
Using a suitable extractor, disconnect the tie-rod end assembly from the drop arm.
Knock back the tab washers; remove the two long and two short bolts securing the steering unit to the front suspension cross member.
Withdraw the steering unit complete with the lower column and drop arm from underneath the car.

Dismantling (Fig. 6)
Withdraw the pinch bolt and remove the lower steering column.
Remove the nut (22) securing the drop arm (21) to the rocker shaft (18).
Observe the line scribed on the drop arm and rocker shaft to ensure correct assembly. Using a suitable extractor, draw the drop arm off the spline on the rocker shaft. (Under no circumstances must the drop arm be hammered off otherwise indentation will be caused to the ball tracks).

Remove the four setscrews and spring washers securing the rocker shaft cover plate (24) to the steering box. Remove the cover plate and gasket, taking care not to dislodge the spring (30) from the rocker shaft adjustment screw (28). Drain the oil into a suitable receptacle. Remove the roller (5) from the top of the main nut (4).
Withdraw the rocker shaft. Remove the 'O' ring (19) from the bottom of the box.
Remove the four setscrews and spring washers securing the upper end plate and stone guard to the steering box. Remove the retainer plate (12), oil seal (13), end plate (11), gaskets (14), shims (15) and the distance piece (8).
Push the worm shaft upwards and withdraw the outer race of the upper bearing. Collect the ten balls. Unscrew the worm through the worm nut and withdraw from the box.
Remove the four setscrews and washers attaching the end plate to the bottom of the steering box. Remove the gaskets, shims and distance piece. Withdraw the outer race of the lower bearing and collect the ten balls.
Remove the two setscrews and tab washers retaining the transfer tube to the main nut and remove the clip, tube and thirty-one balls (20 balls, high ratio box).

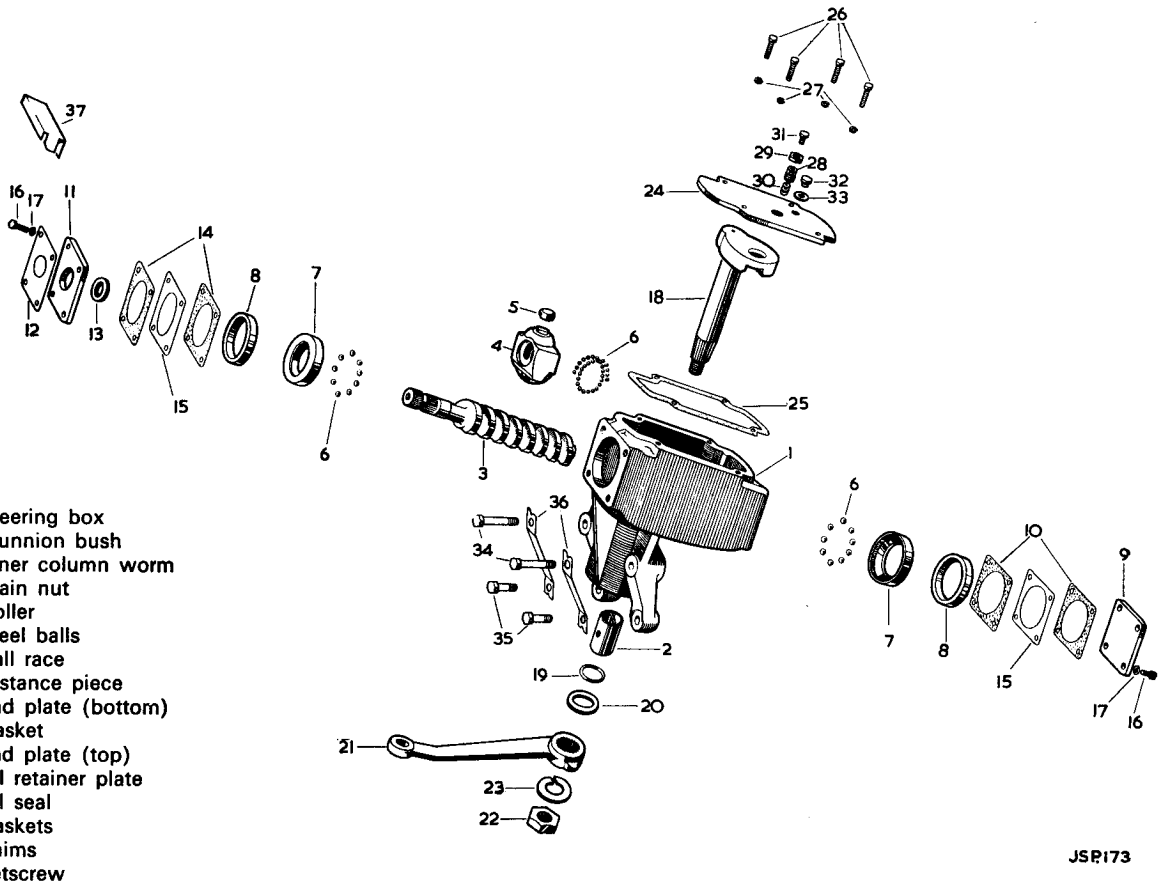


Fig. No. 6 *Exploded view of steering unit*

1 Steering box
2 Trunnion bush
3 Inner column worm
4 Main nut
5 Roller
6 Steel balls
7 Ball race
8 Distance piece
9 End plate (bottom)
10 Gasket
11 End plate (top)
12 Oil retainer plate
13 Oil seal
14 Gaskets
15 Shims
16 Setscrew
17 Spring washer
18 Rocker shaft
19 'O' ring
20 Washer
21 Drop arm
22 Nut
23 Spring washer
24 Cover plate
25 Gasket
26 Setscrews
27 Spring washer
28 Rocker shaft adjustment screw
29 Locking nut
30 Spring
31 Spring tension bolt
32 Oil filler plug
33 Washer
34 Bolt (long)
35 Bolt (short)
36 Tab washer
37 Stoneguard

Assembling

Note: When assembling the steering unit carry out adjustment of the worm shaft and rocker shaft end float as described in this section.

Fit the transfer tube and clip to the worm nut and secure with two setscrews.

Fit the circulating balls into the unit; use grease to retain the balls in position. Fit the ten ball bearings to the bottom race with grease and assemble to the bottom of the steering box together with the distance piece. Fit the gaskets, shims, distance piece and end plate to the bottom of the steering box and secure with four setscrews. Screw the worm shaft into the worm nut until the nut is halfway along the worm. Feed the worm shaft carefully into the steering box through the top cover aperture, making sure that the balls in the bottom ball race are all securely in position when the wormshaft makes contact with them.

Fit the ten balls to the top race with grease and assemble to the top of the steering box together with the distance piece.

Fit the shims with a gasket at each side to the top of the steering box. Cover the splines at the top of the worm shaft with adhesive tape to protect the oil seal when fitting the end plate.

Assemble the end plate, oil seal and oil seal retainer plate and carefully slide over the wormshaft. Remove all traces of adhesive tape from the splines. Refit the stone guard and secure the end plate with four set-screws.

Adjust wormshaft end float as follows:—
The wormshaft bearings should be adjusted to a pre-load of .002" to .003" (.05 to .08 mm.) by means of the shims and gaskets at each end of the steering box. The shims are .005" (.13 mm.) thick; the gaskets are .003" (.08 mm.) thick.
Eliminate or reduce to a minimum the end float of the worm shaft by removing shims as necessary. Check that the worm shaft turns freely.
Remove a shim and/or gasket to obtain the required pre-load. Always maintain a minimum of two gaskets at each end of the steering box, one at each side of the shim pack.
Enter the rocker shaft into its bore in the steering box and engage the slotted extension with the top portion of the main nut. Fit the roller to the top of the main nut. Fit the gasket and secure the cover plate with the four set screws.
Adjust rocker shaft end float as follows:—
When adjusting the end float, the rocker shaft must be at the centre of its travel.
Unscrew the bolt (31) (Fig. 6) and extract the spring (30). Slacken the locknut (29) securing the adjuster screw (28) in the cover plate. Screw down the adjuster screw by hand until it contacts the rocker shaft. so that all end float is eliminated.
Hold the adjuster screw firmly and tighten the locknut. Test the freedom of the movement of the wormshaft throughout its travel; if tightness exists in the centre, it will be necessary to re-adjust the end float.
Refit the spring and retaining bolt.
This operation may also be carried out with the unit on the car and the front wheels in the straight ahead position.
Fit the drop arm to the rocker shaft, ensuring that the scribed line on the rocker shaft matches the appropriate line on the drop arm, according to whether the steering unit is for right-hand or left-hand drive (Fig. 7).
Refit the lower steering column to the steering box.

Refitting
Check that the road wheels are in the straight ahead position.
Refit the steering unit to the front cross member.
Attach the track rod to the drop arm.
Refit the lower universal joint to the steering unit and secure with the pinch bolt.
Set the steering wheel so that the spokes are horizontal and the motif is upright.
Push the inner column down and connect to the universal joint socket on the lower column.
Remove the two retaining screws and detach the switch upper cover.
Pull the inner column upwards until the lower edge of the indicator switch striker is level with the bottom of the slot in the nylon trip ring.
Refit the pinch bolt and self-locking nut.

STEERING WHEEL
Removal
Withdraw the four cheese-headed screws from the underside of the steering wheel centre and detach the horn switch cover.

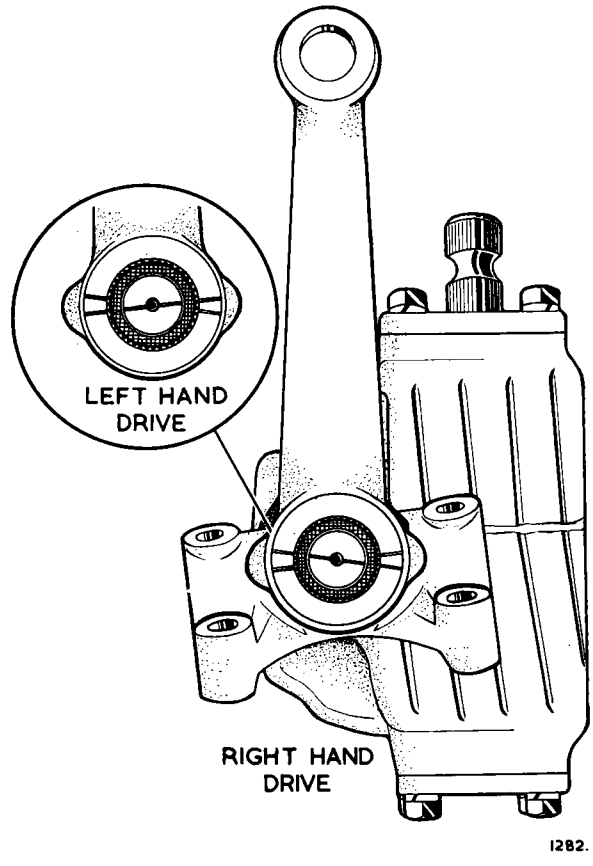


Fig. No. 7 *Showing the alignment of the drop arm/rocker shaft marks, both right-hand and left-hand steering*

Unscrew the locknut and the nut securing the steering wheel to the inner column.
Withdraw the steering wheel and collect the two halves of the split cone.

Refitting
Secure the split cone in position in the inner column shaft grooves, ensuring that the narrowest portion of the cone is towards the top of the column.
Slide the steering wheel onto the column shaft splines so that the two spokes are horizontal when the road wheels are pointing straight ahead.
Push the steering wheel fully home onto the split cone.
Fit the plain washer, securing nut and locknut. Refit the horn ring and cover.

STEERING COLUMN (UPPER)
Removal (Fig. 14)
Disconnect the battery.
Turn the road wheels to the straight ahead position. If retained in this position, this will facilitate the re-fitting procedure.
Disconnect the cables from the flashing indicator/headlamp flasher switch at the snap connectors.
If overdrive is fitted, disconnect the cables from the overdrive switch at the snap connectors.

Remove the two screws and washers securing the switch upper cover to the lower cover below the steering wheel.
Lift off the upper cover and remove the three bulb holders from the back. Note the location of the bulbs for reference when refitting.
Disconnect the four cables from the inhibitor switch located on a bracket attached to the steering column. Note the location of the cables for reference when refitting (Automatic Transmission cars only).
Disconnect the gear selector control cable ball joint from the selector lever on the steering column. (Automatic transmission cars only).
Disconnect the four cables from the steering column lock (if fitted) and ensure that the key is in the "Garage" (normal stop) position.
Note the location of the cables for reference when refitting.
Note: The switch unit cannot be removed from the outer column.
Remove the four cap nuts and detach the trim panels covering the column above the parcel tray.
Release the clip securing the bottom of the outer tube to the mounting bracket on the bulkhead.
Remove the horn switch cable from the contact at the bottom of the steering column.
Remove the pinch bolt securing the inner column to the top universal joint of the lower column. Mark the location of the inner column splines in relation to the joint for reference when refitting.
Remove two bolts, nuts and washers securing the steering column to the upper mounting bracket. Collect the shim plates which may be located between the column and body brackets.

Dismantling
Remove the steering wheel as detailed previously.
Withdraw the inner column.
Unscrew the steering wheel locking nut and withdraw the nut from the splined inner shaft.
Remove the two setscrews, serrated and plain washers securing the flashing indicator switch striking ring.
Remove the stop button and withdraw the inner shaft.
Slide off the horn pick-up ring and remove the bottom half of the rotor assembly. Remove the circlip from the end of the horn contact nipple and remove the spring and plastic sleeve.
Withdraw the horn wire and top half of the rubber rotor.
Remove the flashing indicator switch as follows:—
Release the locknut from the lower clamp screw, detach the clamp and switch. Note the distance piece fitted to the top screw.
If the car is fitted with automatic transmission proceed as follows:—
Remove the screws securing the inhibitor switch carrier bracket to the mounting bracket and outer column and detach the link.
Release the square headed screw securing the operating lever to the operating shaft.
Remove the circlip and washer from the underside of the shaft bearing. Remove the setscrew securing the gear indicator arm bearing to the bracket on the outer column.
Withdraw the shaft and bearing as an assembly.
To remove the gear selector lever from the pivot bracket, extract the split pin and washer and withdraw the clevis pin.
Detach the lever and collect the return spring and shims (if fitted).
Remove the two setscrews and lockwashers and remove the selector quadrant and spacers.
Remove the nuts and bolts securing the two rubber contact holders, fibre insulating strip, slip ring contact blade and earth contact.
Depress the retaining lugs and withdraw the bearing bushes from the top and bottom of the outer tube.
If the car is fitted with overdrive transmission, remove the overdrive switch after withdrawing two setscrews, nuts and lockwashers.

Re-assembly
Replace the two bearing bushes ensuring that the lugs register in the holes in the outer column.
If the car is fitted with automatic transmission, refit the selector control as follows:—
Refit the selector quadrant and spacers. If removed during the dismantling procedure, insert the shims and return spring in the pivot bracket, refit the gear selector lever and secure with the clevis pin, plain washer and split pin. Lightly grease the lever spring before fitting the lever.
Pass the operating shaft through the top bearing. Slide the plain washer and circlip over the shaft, fit the operating lever to the shaft and feed the shaft through the bottom bearing.
Secure in position with the circlip and plain washer.
Secure the operating lever to the operating shaft with the square headed locking screw, ensuring that the screw registers with the flat on the shaft.
Refit the gear indicator arm bearing to the bracket on the outer column.

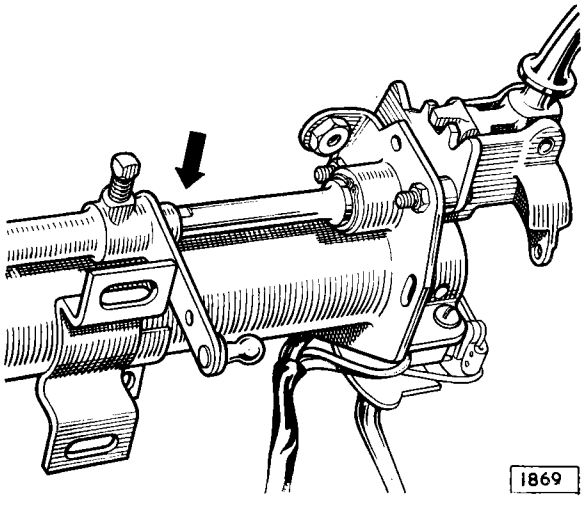


Fig. No. 8 *Align the flat on the end of the upper control shaft with the securing screw on the control lever.*

Reconnect the inhibitor switch to the operating link and secure to the mounting bracket. Do not tighten the screws at this juncture.
Refit the flashing indicator switch.
Pass the two fixing screws through the switch clamp; attach the spring washer and locknut to the lower screw and the distance piece and washer to the top screw.
Feed the screws through the column bracket and secure to the indicator switch.
Tighten the top screw fully.
If the car is fitted with overdrive transmission, refit the overdrive switch to the outer tube.
Thread the horn wire through the inner column and fit the top half of the rubber rotor. Fit the bottom half of the rotor and slide the horn slip ring over both halves with the serrations in the ring towards the bottom of the column.
Gently knock the serrations of the ring into the groove of the rubber rotors until secure.
Refit the two rubber contact holders, fibre insulating strip, slip ring contact blade and earth contact to the outer tube.
Slide the inner shaft over the horn wire into the inner column so that the slot in the shaft serrations aligns with the stop button hole in the inner column. Screw in the stop button fully until the inner shaft binds on the button. Slacken the stop button off until the inner shaft can move freely.
Fit the striker plate with the peg towards the bottom of the column and on the opposite side to the stop button.
Turn the inner column until the striker retainer bolts are in the vertical position and set the striker peg so that it is just below the horizontal position.

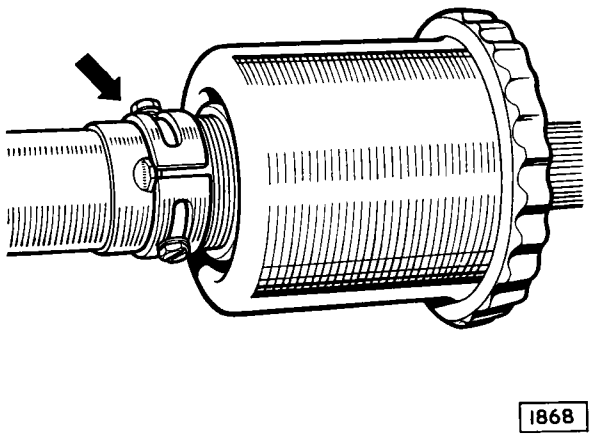


Fig. No. 9 *Centralising the flashing (turn) indicator switch striker peg*

If the car is fitted with automatic transmission set the inhibitor switch (see Fig. 10) as follows:—
Select neutral (N) on the gear selector quadrant and hold this position.
Rotate the switch in the clamp ring (C) and move the bracket in the elongated holes until the small hole in the lever (B) registers with the indent in the back of the switch (A).
Tighten the clamp ring and bracket screws.

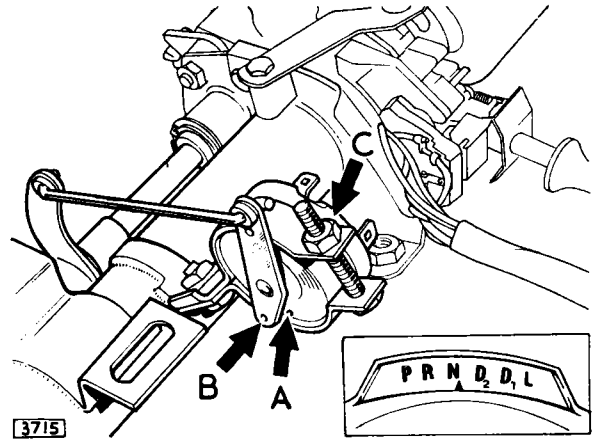


Fig. No. 10 *Setting the starter/reverse inhibitor switch. (Automatic transmission models).*

Slide the inner column into the outer tube ensuring that the earth contact is not damaged and that the horn contact does not foul on the slip ring of the inner column. The contact may be lifted slightly whilst the column is placed in position.
Attach a spring balance to the steering wheel (Fig. 11).
Tighten the bottom screw until the steering wheel will just turn with a pull of 5 ozs. (141.7 grammes) registered on the balance.
Turn the locknut towards the switch carrier bracket and lock the screw. Two thicknesses of distance piece are available to compensate for variation in the bore of the outer tube.
Grade "A" 0.188" (4.7 mm.).
Grade "B" 0.166" (4.2 mm.).

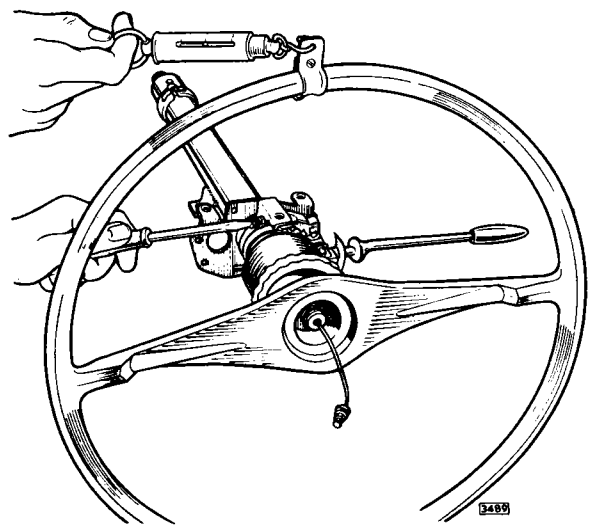


Fig. No. 11 *Upper steering column bearing adjustment points*

Refitting
Ensure that the front road wheels are in the straight ahead position.
Feed the outer tube through the bottom mounting bracket and secure to the top mounting bracket with two bolts, nuts and washers.
Tighten the clip securing the outer tube to the bottom mounting bracket.
Turn the inner column and centralise the flashing indicator striker between the two arms of the indicator switch.
Engage the splines of the inner column with the socket of the upper universal joint of the lower steering column.
Pull the inner column upwards until the lower edge of the indicator switch striker is level with the bottom of the slot in the nylon trip ring.
Reconnect the flashing indicator switch cables in their correct colour sequence.
If the car is fitted with overdrive transmission, reconnect the cables to the overdrive switch.
If fitted with automatic transmission, reconnect the four cables to the inhibitor switch in the correct sequence.
Reconnect the cables to the steering column lock (if fitted).
Attach the gear selector control cable ball joint.
Refit the plastic sleeve and spring to the horn wire and secure with the circlip.
Re-insert the bulb holders into the upper switch cover in the correct sequence.
Refit the steering wheel locking nut to the inner shaft.
Refit the covers (top and bottom), steering wheel and trim panels by reversing the removal procedures.

STEERING COLUMN (LOWER)
Removal
Turn the road wheels until the pinch bolt of the lower column is accessible.
Remove the pinch bolt.
Re-set the road wheels in the straight ahead position.
Disconnect the upper column as detailed on page I.7.
Withdraw the lower column and detach the rubber coupling.

Detaching the Rubber Coupling
Remove the four locknuts (47, Fig. 14).
Remove the plain washers and unscrew the four Allen headed screws (49) attaching the upper column joint and the lower column to the rubber coupling.
Remove the lower steady bush from the upper universal joint if worn or damaged.
Check the condition of the rubber coupling and renew if worn or contaminated with oil or petrol.

Refitting
Check that the road wheels are in the straight ahead position.
Refit the lower column joint to the steering box shaft and tighten the pinch bolt.
Refit the rubber coupling and upper column joint by reversing the removal procedure.
Refit the upper column as detailed on page I.10.

Note:
(1) Early cars will have a lower column fitted with the rubber coupling flange phased at 45° with the lower universal joint pinch bolt.
(2) Intermediate cars will have the flange and pinch bolt phased at 90°.
(3) Later cars will also have the flange and pinch bolt phased at 90° but will have bolts replacing the Allen-headed screws securing the rubber coupling.

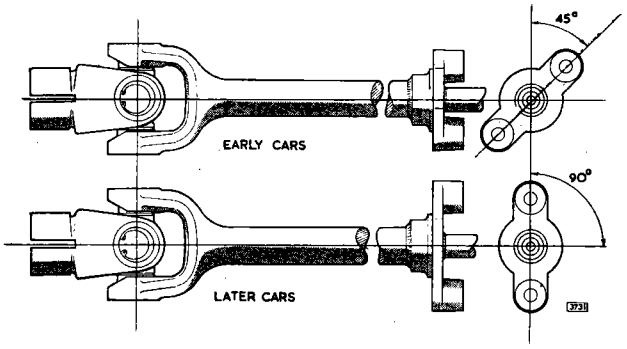


Fig. No. 12 *Showing the 45° and 90° phased lower steering columns*

Important
If the lower steering columns phased at 90° are fitted to cars which have previously had the 45° phased column fitted, it will be necessary to re-position the steering wheel on the splined shaft and also to reset the turn indicator switch striker on the inner column in order to restore the correct cancellation in the straight ahead position.

STEERING IDLER ASSEMBLY
Removal
Remove the self-locking nut securing the track rod end to the idler lever.
Extract the track rod end which is a tapered fit.
Remove the two setscrews and one long bolt attaching the steering idler bracket to the front suspension cross member and detach the assembly.
Note the location of any packing washers which may be between the idler bracket and the front cross member.

Dismantling
Prise out the dust cap from the top of the idler assembly.
Tap back the tab washer and unscrew the nut from the idler spindle.
Remove the tab washer and the "D" washer.
The spindle, arm abutment ring and felt seal can now be withdrawn.
If the bearings are to be renewed, tap out the outer races using a small drift.

Assembling
Clean the bearings and the idler housing thoroughly before re-assembling.
Repack the housing and bearings with the recommended grade of lubricant.

Fit the abutment washer, seal retainer, felt seal, abutment ring and bearing to the idler spindle and pass the spindle upwards into the housing.

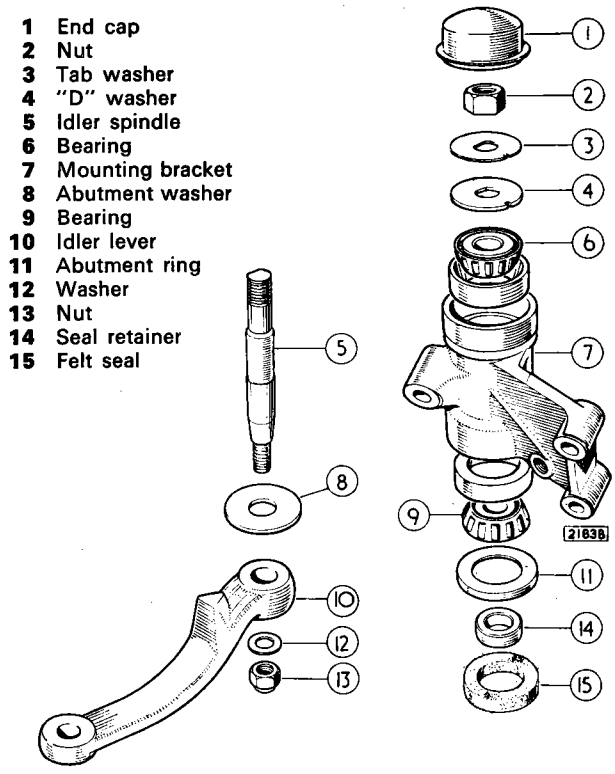


Fig. No. 13 *The steering idler components*

Fit the upper bearing, "D" washer, tab washer and nut. Tighten the nut to a torque of 5 lb. ft. (0.7 kg.m.).
If a torque wrench is not available, tighten the nut until rotation of the idler spindle by the idler arm feels "sticky" and back off the nut one flat: lock the nut with the tab washer and fit the dust cap.

Refitting
Reverse the removal procedure to refit. Ensure that the idler lever is in the straight ahead position before attaching the track rod ends.
Refit the packing washers between the idler lever bracket and the front cross member as noted on removal.
Check the height of the under-face of the idler lever from the ground against the steering drop arm measurement.
Adjust to within $\pm\frac{1}{16}$" (1.6 mm.) differential if necessary by adding or subtracting washers between the idler bracket and the front cross member at the top or bottom mounting bolts.

CENTRE TRACK ROD
The track rod ends incorporate rubber/steel bonded bushes. If the bushes show signs of deterioration they should be replaced.

Remove the self-locking nuts and washers from the inner ball joint of each tie rod. Withdraw the ball pin using Churchill Tool J.D.24.
Remove the self-locking nuts and washers securing the track rod ends to the drop arm and idler lever.
Withdraw the track rod ends from the drop arm and idler lever using Churchill Tool No. J.D.24.

Dismantling
To remove the track rod ends, slacken the clamp at each end of the centre tube; unscrew each end from the tube noting that one end has a left-hand thread and the other a right-hand thread.

Assembling
When refitting the track rod ends to the centre tube, screw in each end **an equal number of turns.** The final setting of the track rod length must be carried out after the track rod has been refitted under the heading "Front Wheel Alignment".

Refitting
Refitting is the reverse of the removal procedure.
When refitting the ball pins to the idler lever and the steering drop arm ensure that the pins are fully home in their respective tapers by means of a suitable lever applied to the top of the pins before fitting and tightening the nuts.
Failure to ensure this may introduce a bias on the rubber bushes which will affect the steering geometry.
It is essential that the steering drop arm and the idler lever are both turned to the straight ahead position before fitting the centre track rod.

OUTER TIE RODS
The tie rod ball joints cannot be dismantled and if worn, a complete tie rod assembly must be fitted.

Removal
Remove the self-locking nuts and plain washers securing the tie rod to the steering arm and track rod end.
Withdraw the tie rod ball pins out of the steering arm and track rod end using Churchill Tool No. J.D.24.

Refitting
Refitting is the reverse of the removal procedure.

FRONT WHEEL ALIGNMENT
Ensure that the tyre pressures are correct and that the car is standing on a level surface.
With the wheels in the straight ahead position, check the alignment of the front wheels with an approved track setting gauge.
The front wheel alignment should be $0 - \frac{1}{8}$" (3.2 mm.) total "toe-in" measured at the wheel rims.
Re-check the alignment after pushing the car forward until the wheels have turned half a revolution (180°).
If adjustment is required, slacken the clamp bolt at each end of the central track rod and rotate the rod in the required direction until the alignment of the front wheels is correct. Tighten the clamp bolts and re-check the alignment.

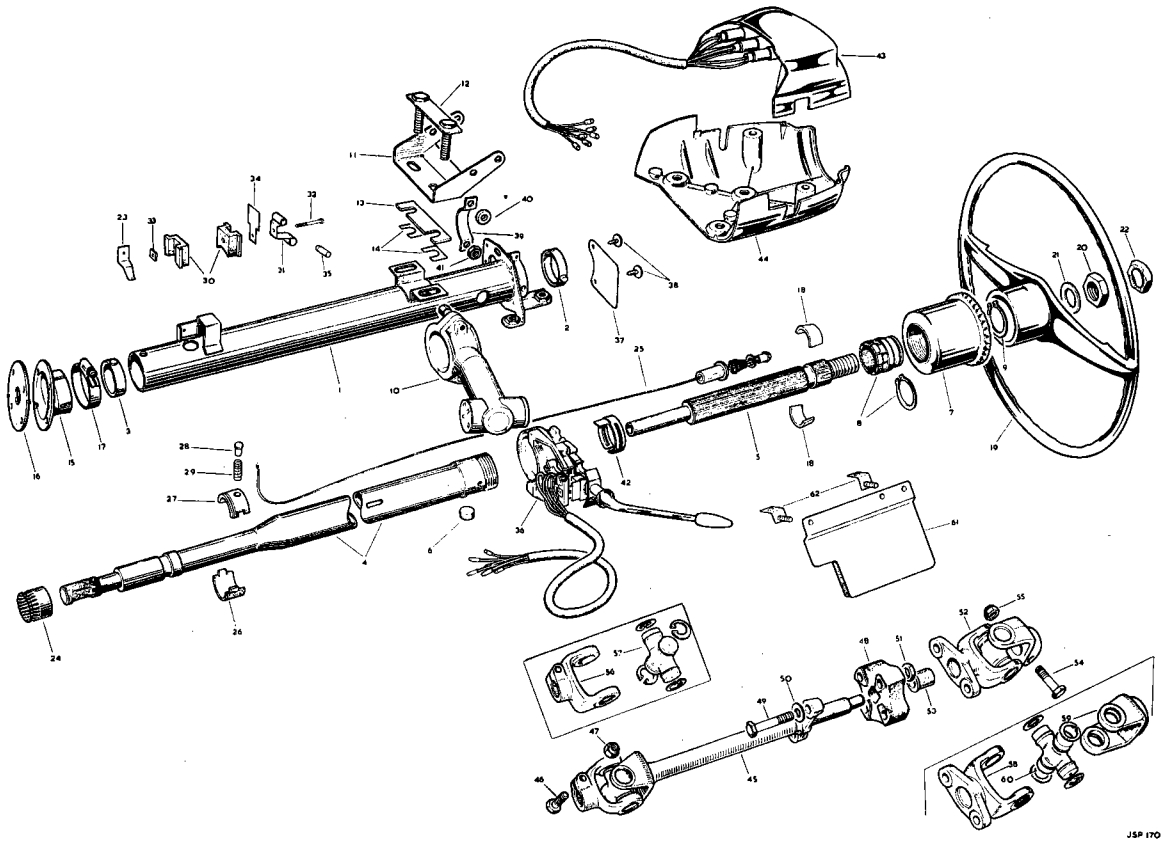


Fig. No. 14 *Exploded view of the steering column*

1 Outer assembly
2 Top bearing
3 Bottom bearing
4 Inner column
5 Inner column shaft
6 Stop button
7 Locknut
8 Split collet and circlip assembly
9 Circlip only
10 Steering column lock (when fitted)
11 Upper mounting bracket
12 Screw plate assembly
13 Spacer
14 Shims
15 Lower mounting bracket
16 Gasket
17 Clip
18 Split cone
19 Steering wheel
20 Steering wheel nut
21 Washer
22 Locknut
23 Earth contact
24 Slip ring
25 Horn switch cable
26 Rotor—bottom half
27 Rotor—top half
28 Cable contact
29 Contact spring
30 Contact holder
31 Contact
32 Contact securing bolt
33 Nut
34 Insulating strip
35 Dowel
36 Direction indicator switch
37 Insulating strip
38 Studs for insulating strip
39 Direction indication switch clamp
40 Spacer
41 Locking nut
42 Striker ring
43 Switch cover—upper
44 Switch cover—lower
45 Lower column
46 Bolt
47 Locknut
48 Rubber coupling
49 Bolt
50 Plain washer
51 Locknut
52 Upper universal joint
53 Rubber steady bush
54 Bolt
55 Locknut
56 End yoke, lower universal joint
57 Journal assembly
58 Flange yoke—upper universal joint
59 End yoke—upper universal joint
60 Journal assembly
61 Shield assembly
62 Shield bracket

LOCK STOP ADJUSTMENT

The lock stop bolts are screwed into the idler bracket and are retained in position by locknuts.

The stops are set at the factory to allow equal travel of the drop arm and idler lever each side of the central (straight ahead) position.

Normally, the lock stop bolts should not require adjustment, but if attention is found to be necessary the adjustment should be carried out in the following manner.

Slacken the locknuts and screw in the lock stop bolts as far as possible. Turn the steering until the steering unit is at the end of its travel on that lock. Screw out the lock stop bolt until the head contacts the abutment on the idler lever. Screw out the stop bolt a further two turns and tighten the locknut. Repeat for the other lock.

STEERING ARM

Removal

Raise the car by placing a jack under the front suspension cross member and remove the road wheel.
Remove the self-locking nut and plain washer securing the tie rod to the steering arm. Withdraw the tie rod ball pin using Churchill Tool No. J.D.24.
Unscrew the centre self-locking nut securing the stub axle shafts and steering arm to the carrier and remove the wired bolt attaching the steering arm to the carrier. Note the shims fitted between the steering arm and the brake caliper lower mounting point. The steering arm can now be removed.

Refitting

Refitting is the reverse of the removal procedure. Use new locking wire to secure the steering arm attachment bolt.

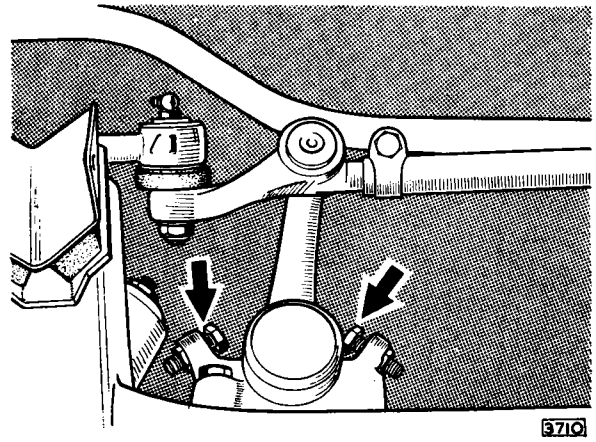


Fig. No. 15 *The steering lock stop bolts*

ACCIDENTAL DAMAGE

The following dimensional drawings are provided to assist in assessing accidental damage.
A component suspected of being damaged should be removed from the car, cleaned off and the dimensions checked and compared with those given in the appropriate illustration.

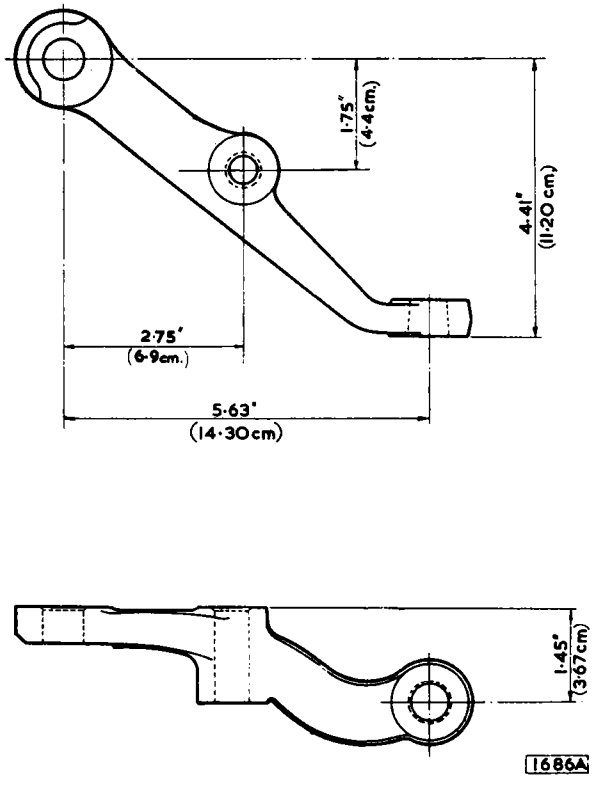


Fig. No. 16 *The steering arm*

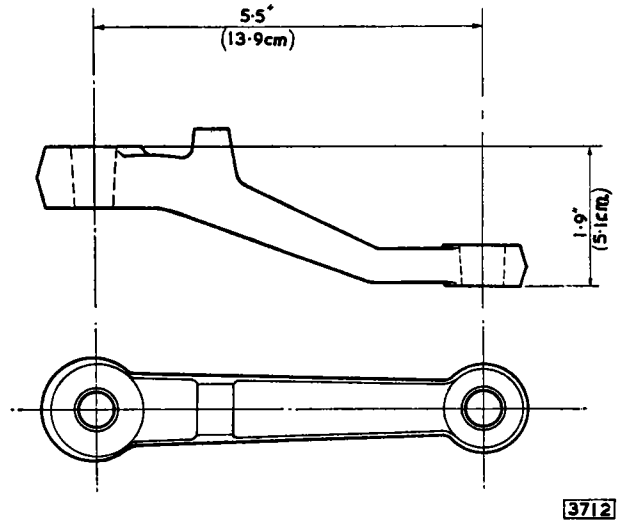


Fig. No. 17 *The steering idler lever*

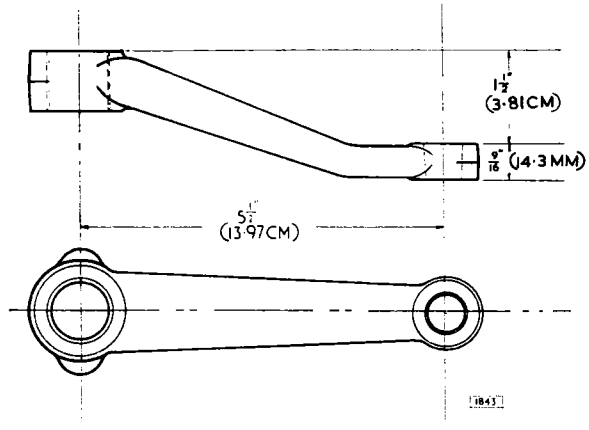


Fig. No. 18 *The steering drop arm*

STEERING
(POWER ASSISTED)

SECTION II

INDEX

STEERING (POWER ASSISTED)

DESCRIPTION

The power-assisted steering system consists of two separate components; the steering box and pump. The two are connected together by flexible hoses. The pump is contained in its own reservoir.

Oil flows from the output side of the pump to the steering box (pressure hose) and from the steering box to the pump (return hose). The feed from the reservoir to the pump occurs within the unit.

The pump is situated on the right hand side of the engine and is belt driven, tension being regulated by a spring loaded jockey pulley.

A continuous flow of oil is pumped through the system whilst the engine is running, but pressure builds up only when the steering wheel is turned.

DATA

Steering Gear	
Make	Adwest Engineering Co. Ltd.
Type	Marles Varamatic—Hour glass and roller with hydraulic servo cylinder.
Steering gear ratio on centre	21.6:1
Steering gear ratio on lock	13:1
Number of turns—lock to lock	$2\frac{7}{8}$
Turning circle	33 ft. 6 ins.
Oil Pump	
Make	Saginaw
Location	Right—front of engine.
Operating pressure	1110-1250 lb./sq. in. (77.7—87.5 kg/cm².).

RECOMMENDED LUBRICANTS

Unit	Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent/ Caltex/Texaco
Power steering reservoir	Mobil Fluid 200	Castrol T.Q.	Shell Donax T6	Esso Automatic Transmission Fluid	Automatic Trans. Fluid Type "A"	Nolmatic	Texamatic Fluid

OPERATION

STEERING GEAR

The steering gear operates on an "hour glass" cam and roller principle, with a hydraulic control valve embodied in the input shaft of the cam. The hydraulic assistance is supplied by a servo piston operating in a cylinder which is integral with the steering box casting. A rack projects from this piston and the rack teeth mesh with a sector of a spur gear which is machined on a projection from the sector shaft.

The "hour glass" cam is a hardened steel component and its track (or thread) is machined with a varying helix angle, so that the pitch is non-constant. A roller carried in the sector shaft meshes with this track and the assembly is responsible for providing the variable ratio. The ratio curve is highest (that is, lowest geared) "on centre". At this point the ratio is 21.6 : 1 and it reduces rapidly towards either lock where its value becomes 13 : 1. This drop in ratio occurs almost entirely within a half turn from the straight ahead position with the same sensitivity for all speeds.

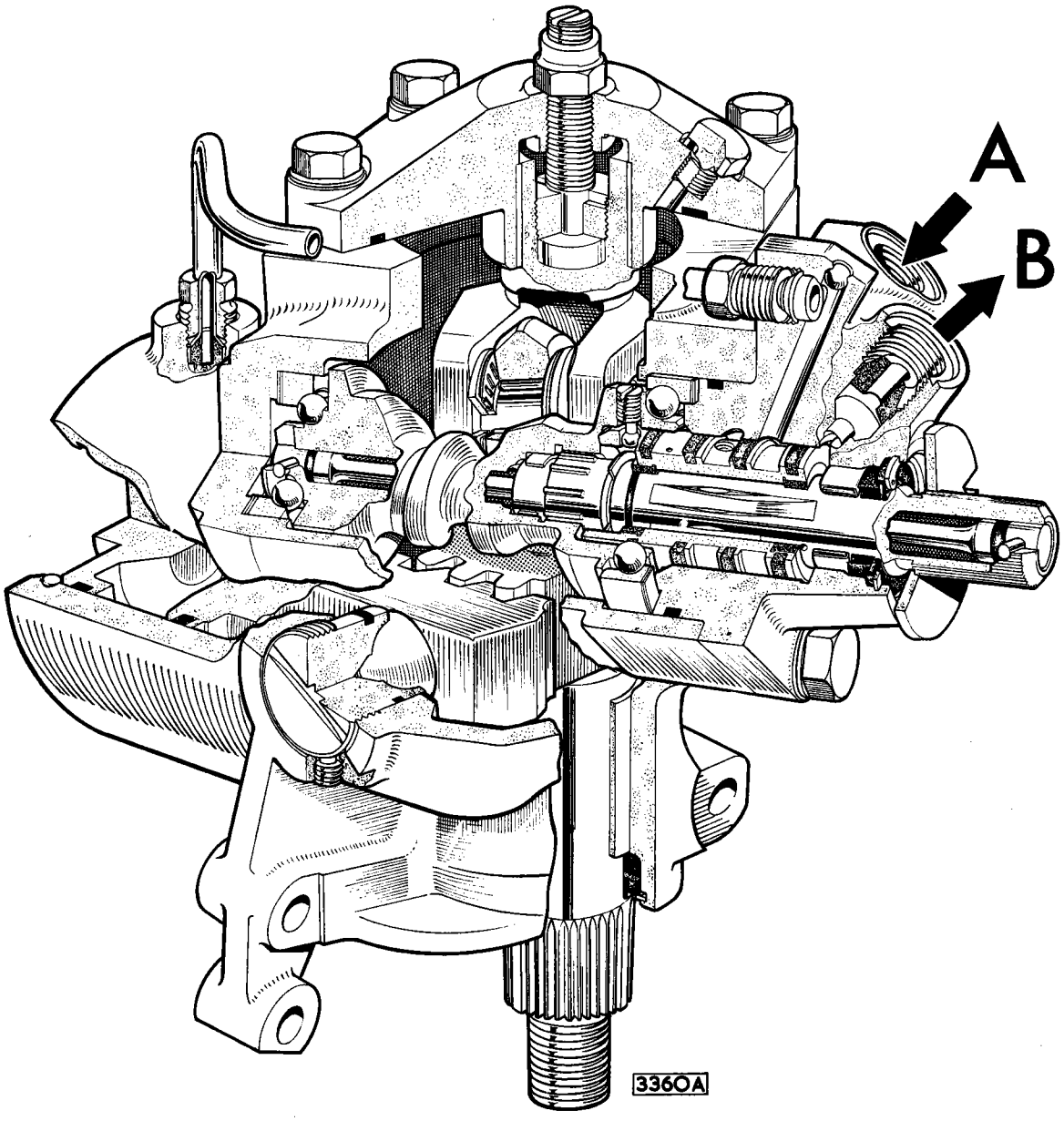


Fig. No. 1 *Cut-away section of the steering box*

A High pressure connection
B Low pressure connection

THE VALVE

This is a rotary type control valve and it is made up of two parts. The valve rotor, which is also the input shaft to the steering gear, has six grooves machined in it. These grooves lie between six grooves in the valve sleeve when no load is applied to the steering wheel, the rotor being centred in the sleeve by a torsion bar. When steering effort is applied at the wheel this is transmitted to the rotor which, in turn, transmits the effort to the hour glass cam by means of a torsion bar. The torsion bar is, however, slender and the manual effort causes it to twist, thus allowing the rotor to rotate within the sleeve. The relative movement of the grooves in the rotor to the grooves in the sleeve causes a hydraulic pressure build up on one or the other side of the servo piston and this assists in turning the steering

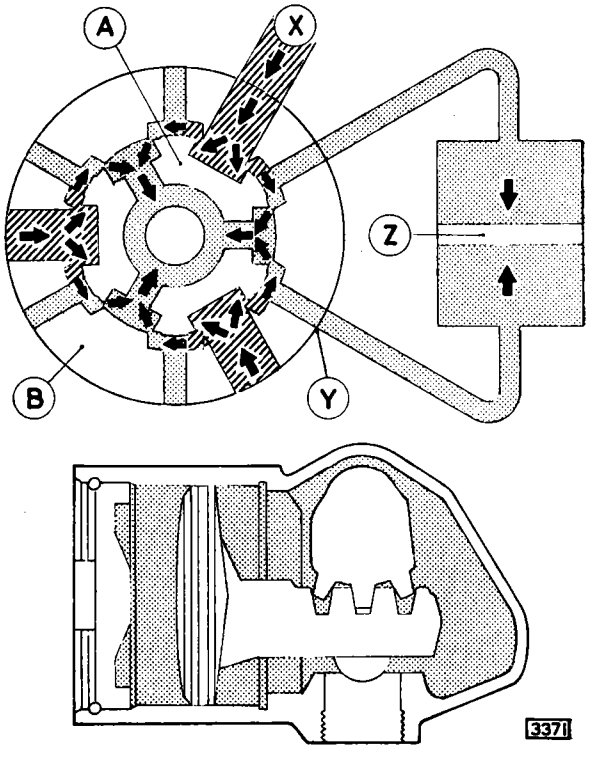


Fig. No. 2 *Operating diagram of the rotor valve (straight ahead)*

A Rotor
B Sleeve
X Pump pressure
Y Reservoir pressure
Z Equilibrium

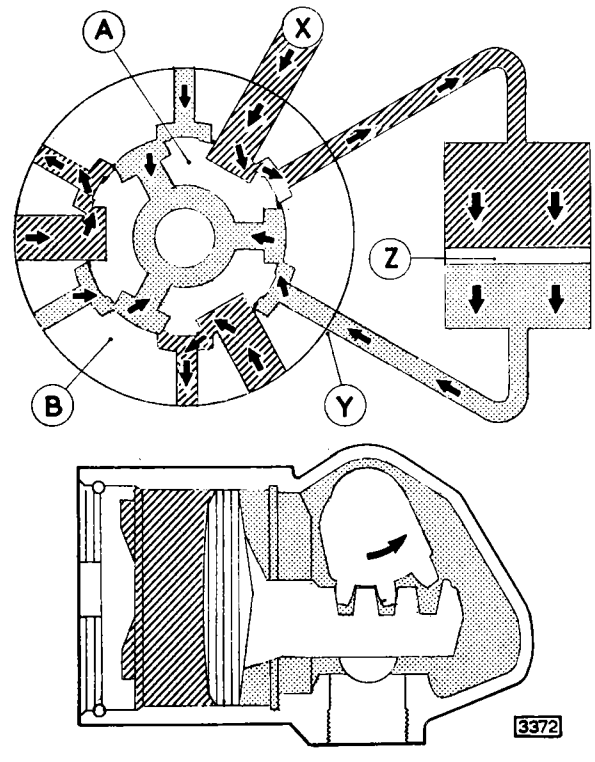


Fig. No. 3 *Operating diagram of the rotor valve (steering turned)*

A Rotor
B Sleeve
X Pump pressure
Y Reservoir pressure
Z Pressure displacement

THE PRESSURE PUMP

The pressure pump, which provides the hydraulic pressure in the system is of the vane type and incorporates a combined flow and relief valve.
The pump, which is contained within its own reservoir, is mounted on the right-hand side of the engine and is belt driven from the crankshaft pulley, the belt tension being automatically regulated by a spring loaded jockey pulley.

ROUTINE MAINTENANCE

EVERY 3,000 MILES (5,000 KM.)

Checking the Reservoir Oil Level

The only regular maintenance required for the power steering system is that of checking the oil level every 3,000 miles (5,000 km.)
The oil reservoir is mounted on the right-hand side of the engine. It is important that absolute cleanliness is observed when replenishing with oil, as any foreign matter that enters may effect the hydraulic system.
Clean the area around the filler cap and then remove the cap by turning anti-clockwise.
Check the level of oil and top up, if necessary, with the recommended grade. The level of oil must be up to the "Full" mark when the oil is warm.

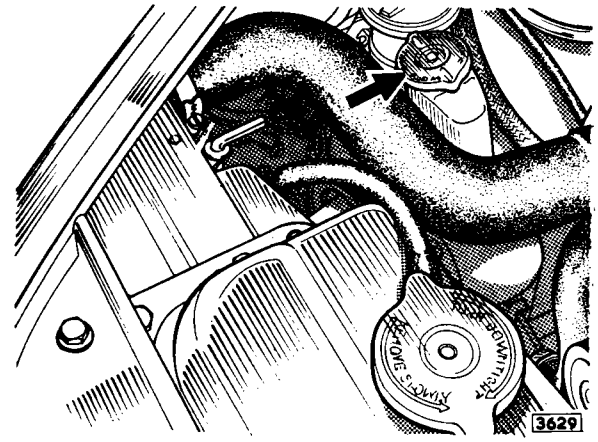


Fig. No. 4 *Power steering oil reservoir*

EVERY 6,000 MILES (10,000 KM.)

Steering Tie Rods

Lubricate the ball joints at the ends of the two steering tie-rods with the recommended lubricant.
The tie-rods are situated at the rear of the front suspension cross member.
When carrying out this operation examine the rubber seals at the ends of the ball housings to see if they have become displaced or split.
In this event, they should be repositioned or replaced, as any water or dirt that enters will cause premature wear.
A bleed hole covered by a circular nylon washer which lifts under pressure, indicates when sufficient lubricant has been applied.
This prevents grease from escaping past the seal when too much pressure is applied.

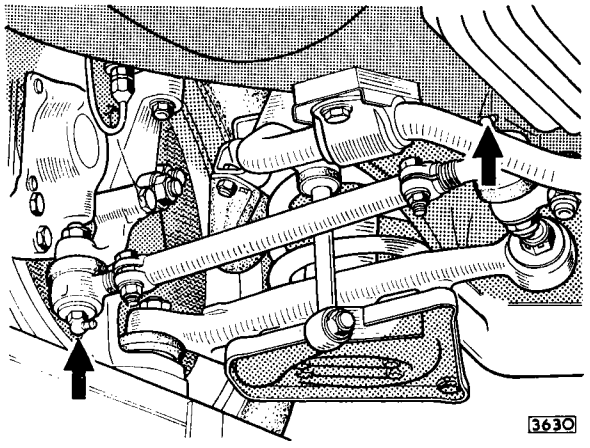


Fig. No. 5 *Steering tie rod grease nipples*

Wheel Swivels

Lubricate the nipples (four per car) fitted to the top and bottom of the wheel swivels.
The nipples are accessible from underneath the front of the car.

Front Wheel Alignment

Check the front wheel alignment as detailed on Page II.23.

EVERY 12,000 MILES (20,000 KM.)

Check the condition of the rubber coupling between the upper and lower steering columns. Renew if worn or contaminated with petrol, oil or brake fluid.

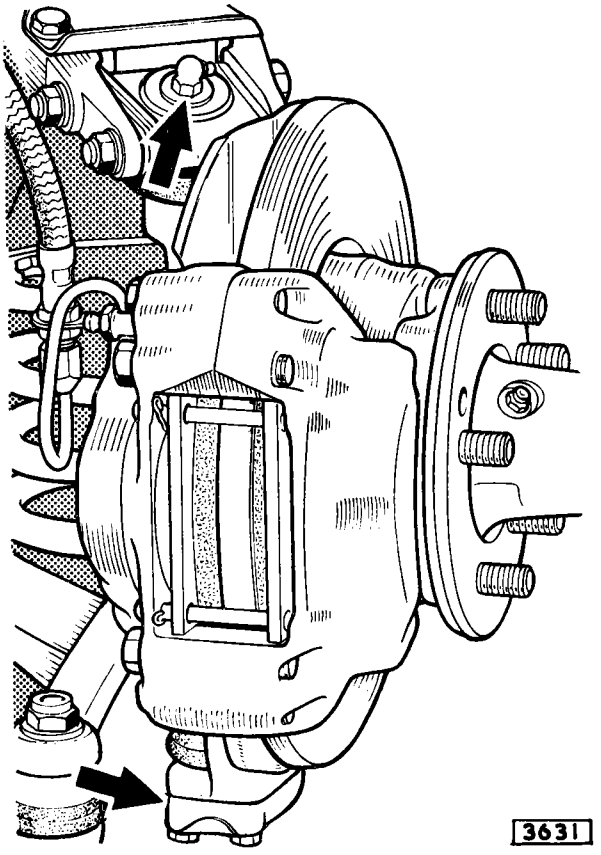


Fig. No. 6 *Wheel swivel grease nipples*

ADJUSTMENTS IN CAR

CENTRALISATION

This adjustment is carried out only when setting the front wheel alignment.
Because of the varying ratio curve, **it is most important** that the steering gear is centralised whilst the toe-in is being adjusted. Adjust the position of the steering wheel until the hole in the centralising plate on the input shaft aligns with the hole in the steering box.
Set the steering to the straight ahead position.
Check by inserting a $\frac{1}{4}$" (6.4 mm.) rod, suitably bent. (Fig. 7).

SECTOR SHAFT ADJUSTMENT

If lost motion is present in the steering box, it is probably due to wear between the hour glass cam and roller. It is unlikely that this wear will occur except after very high mileage has been covered.
To check, centralise the steering as detailed under the previous heading; disconnect the centre tie-rod from the drop arm. Rock the drop arm by hand to both sides of the centre line to feel for excessive backlash. If necessary, release the locknut at the top of the steering box; screw in the adjuster screw until only slight backlash can be felt.

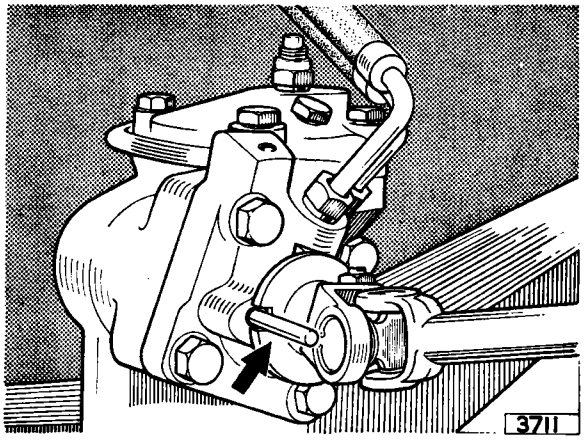


Fig. No. 7 *Centralising the steering*

Secure the locknut; refit the centre tie-rod (see note Page II.23) and road test the car.
Note: It is **IMPORTANT** that the steering gear is centralised when checking sector shaft backlash.
If this adjustment fails to remove the lost motion from the steering gear then the remedy will have to be effected with the gear removed from the car. However, before removal, it is possible to ascertain the cause of the trouble by carrying out the following test:-
With the engine switched off, oscillate the steering wheel and feel the gear input shaft for end-float, that is, it should not move in and out of the housing.
Note: If input shaft end-float exists, the steering will not only exhibit lost motion but will also rattle over rough roads.

If the steering suffers from pulling to the right or left, carry out the following preliminary tests before proceeding further:-
Check tyre pressures and change the front tyres from one side to the other.
If the pull changes direction then the trouble lies with one or both of the front tyres.
If the pull remains unchanged by the above operation, proceed as follows:-
Check the steering linkage for wear and carry out front wheel alignment procedure as detailed on page II.23.
If no improvement is apparent the fault must lie in the trimming of the valve in the steering unit.
To check, install a 2,000lb/sq.in. pressure gauge into the pressure line.
Set the steering in the straight ahead position, start the engine and allow to idle.
Turn the steering first to the left and then to the right, the pressure gauge should be watched during this operation to check that the pressures recorded are equal.
If the pressure rise is not balanced, the steering unit must be removed from the car and the worm and valve assembly renewed.

RACK ADJUSTMENT

In order to rectify certain knocking noises etc., (see Fault Finding Chart) it may be found necessary to remove any clearance between the teeth on the piston rack and the teeth on the sector shaft. New gears are built with the rack teeth pre-loaded into the sector shaft teeth and it is unlikely that its adjustment will be necessary until after considerable mileage. However, if the symptoms indicated in the Fault Finding Chart are present, then the rack can only be adjusted when the steering unit is removed from the car as detailed on Page II.8.

CHECKING THE HYDRAULIC SYSTEM

A number of faults in the steering system can be caused by inefficiencies in the hydraulic circuit, see Page II.25 for "Fault Finding" chart. The following checks can be carried out without removing any components from the car. Before starting any of this work the fluid should be checked for correct level and for lack of froth.

PUMP BLOW OFF PRESSURE

Fit pressure gauge into pressure line, start engine, run at idling speed, turn steering to full lock and continue to increase steering wheel effort until the pressure ceases to increase. The peak pressure should lie between 1,100 and 1,250 lb/sq. in. (77-87.5 kg/cm^2) and it should not increase with increased engine R.P.M. If, however, the pressure is below 1,100 lb/sq. in. at tickover but rises to the correct figure with increased engine speed then the trouble is caused either by a faulty control valve in the pump or by excessive internal leaking in the steering gear.
Fit a pressure gauge into the pressure line system with an "ON-OFF" tap in series between the gauge and the steering unit.
Start the engine; open the tap and turn the steering to full lock. Check the pressure reading on the gauge. This should read 1,200 lb/sq. in. (84 kg/cm^2).
If the pressure does not rise to this figure, **close the tap for a maximum of 5 seconds** and note the gauge reading. This should be 1.200 lb/sq. in. (84 kg/cm^2)—pump blow-off pressure.
If this reading is obtained, the leaks are confined to the steering unit which should be removed and overhauled.

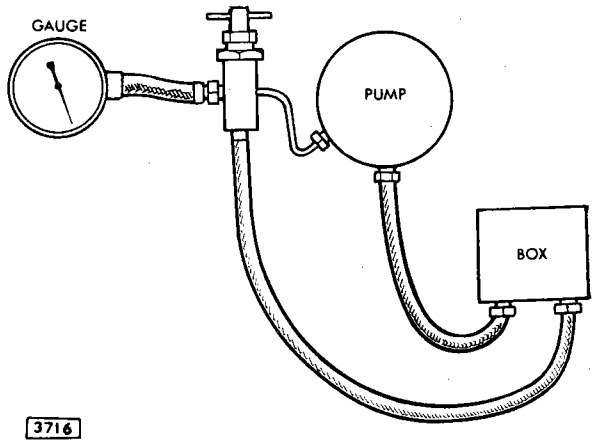


Fig. No. 8 *Checking the hydraulic system*

THE STEERING BOX

REMOVAL

The steering box can only be removed from beneath the chassis with the car on a ramp or over a pit.
Disconnect the high and low pressure pipe unions from the steering box unit and catch the oil, which will drain away, in a container.
Blank off the pipe and box unions to prevent the ingress of dirt.
Remove the nut and washer and disconnect the steering tie-rod ball joint from the drop arm using a suitable extractor.
Remove the upper steering column as detailed on Page II.18.
Withdraw three bolts and two nuts securing the steering unit to the cross member. Remove the unit complete with lower column and drop arm from beneath the car.

DISMANTLING (Fig. 9)

Withdraw the pinch bolt and remove the lower steering column.
Remove the nut (34) securing the drop arm (33) to the sector shaft (24).
Mark the location of the drop arm to the shaft to ensure correct assembly.
Using a suitable extractor, withdraw the drop arm from the spline of the shaft.
Invert the unit and drain the oil through the inlet orifice.
Remove feed pipe.
Set input shaft to straight ahead.
Slacken screw (22) and remove rack adjusting screw complete with thrust pad (23).
Undo four bolts (28) retaining top cover (25) and remove sector shaft and top cover from unit housing.

Annotations for Fig. 9 (opposite)

1 Steering box
2 Screw
3 Valve and worm
4 Ball bearing
5 Ball bearing
6 Shims
7 Valve housing
8 Bolt
9 Bolt
10 Spring washer
11 Centralising washer
12 Shims
13 Feed pipe assembly
14 Piston and rack
15 Teflon sealing ring
16 Teflon sealing ring
17 Cylinder cover
18 Seal
19 Clip
20 Plug
21 Seal
22 Screw
23 Thrust pad
24 Sector shaft and worm follower
25 Top cover
26 Bleed screw
27 Washer
28 Screw and lockwasher
29 Seal
30 Washer
31 Seal
32 Circlip
33 Drop arm
34 Nut
35 Tab washer

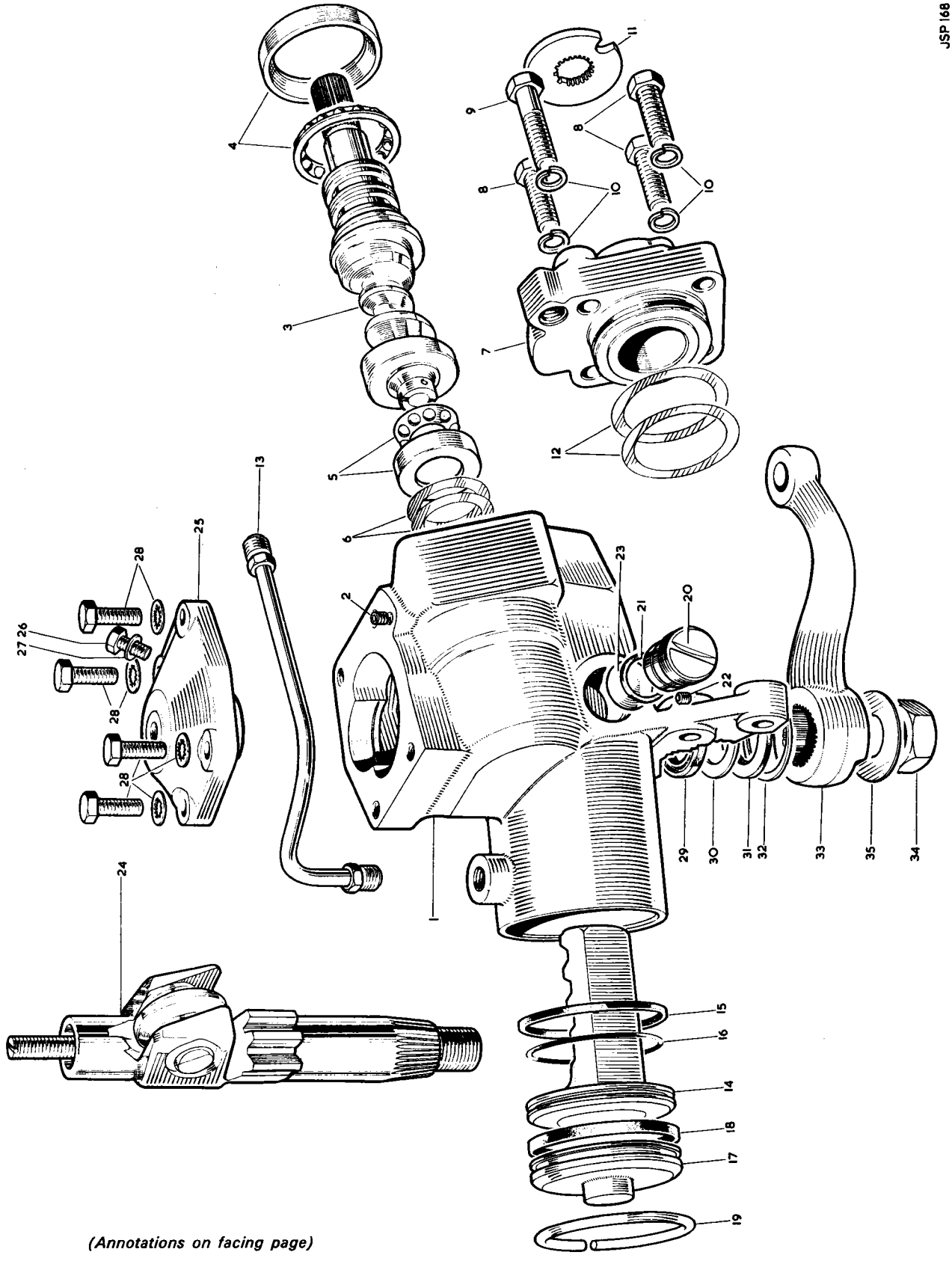


Fig. No. 9 *The steering box components*

(Annotations on facing page)

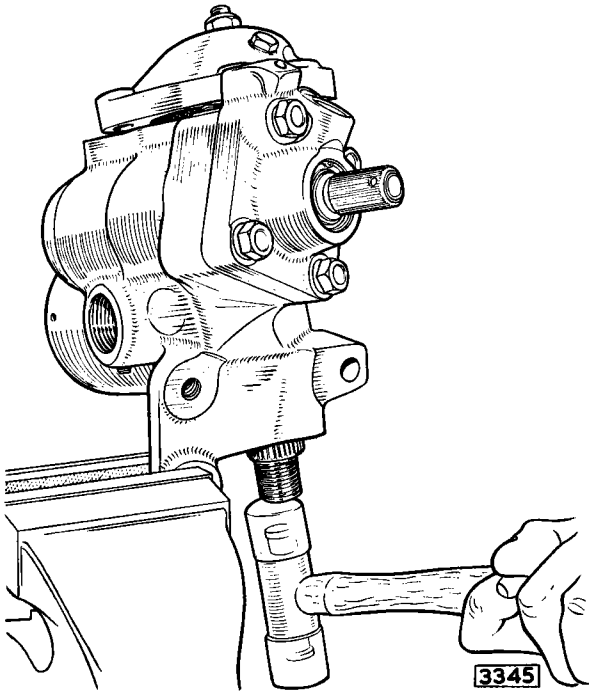


Fig. No. 10 *Removing the sector shaft and top cover*

Separate top cover from sector shaft assembly (24) by removing the self-locking locknut and screwing cover off adjusting bolt.
Withdraw the centralising washer from the input shaft.
Undo four bolts (8 and 9) and tap the valve housing (7) with a mallet.
Collect the shims (12) between the housing and the bearing outer races.
Remove the valve and worm assembly (3) complete with bearing (4).
Collect the inner race of bearing (4). If the bearing is to be replaced, withdraw the outer race with an extractor. It is important that none of the shims behind the outer race is mislaid. DO NOT remove the trim screw shown in Fig. 12.

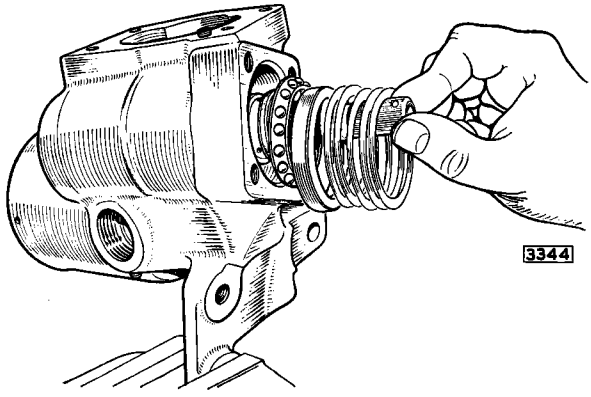


Fig. No. 11 *Removing the valve and worm assembly*

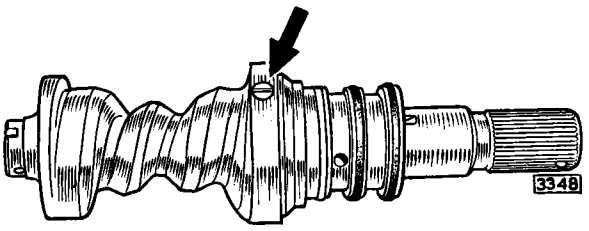


Fig. No. 12 *Location of trim screw*

Remove the cylinder cover retainer clip (19) by forcing it out of its groove with a short $\frac{3}{16}$" (4.5 mm.) steel punch. Once out of the groove a screwdriver will ease it completely clear.

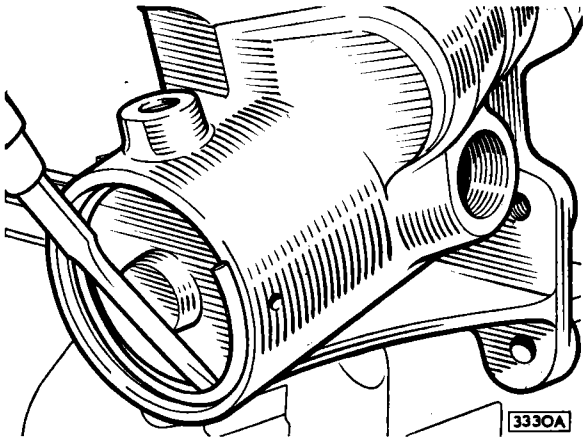


Fig. No. 13 *Removing the cylinder cover retainer clip*

Remove cylinder cover (17) complete with its seal, by pulling on the boss in the centre of the cover with grips or pliers.

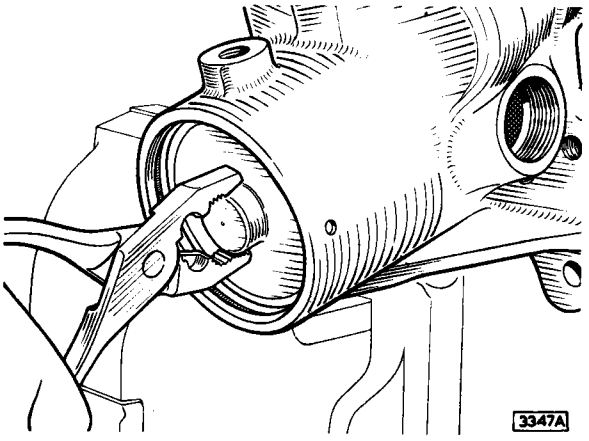


Fig. No. 14 *Removing the cylinder cover*

Screw a long ½" UNC bolt or extractor into the tapped hole in centre of piston and rack (14) and withdraw assembly through open cylinder end.

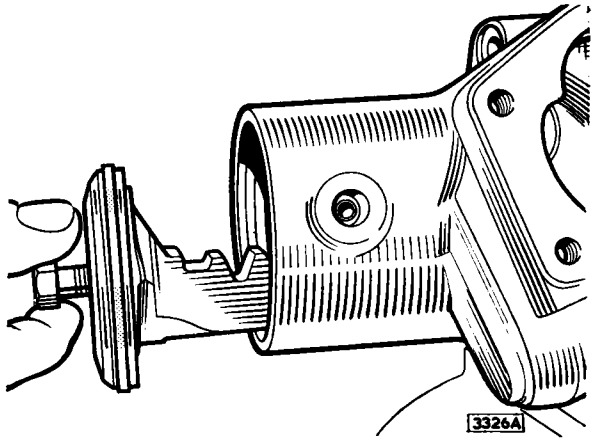


Fig. No. 15 *Withdrawing the piston and rack assembly*

The gear is now stripped down into its basic components as supplied for spares.

EXAMINATION OF COMPONENTS

Sector Shaft Assembly

If any wear or damage is found during the inspection points detailed below, the sector shaft must be replaced as an assembly.
Check roller for preload on thrust bearings, it should be free to rotate, but slightly stiff, with no side play.
Examine the three sector teeth for signs of excessive wear.
Examine bearing areas on top and bottom of sector shaft for excessive wear.
Examine seal area at bottom of sector shaft for wear, damage or grooving etc.

Cover Assembly

Examine sector shaft bush for wear. If excessive, the cover must be replaced.
Renew cover sealing ring.

Housing Assembly

Examine sector shaft bush for wear.
Examine hydraulic cylinder bore for damage, wear or scoring.
If unserviceable, the housing must be replaced.
Renew sector shaft seal.
Check the condition of the high and low pressure pipe seats in the housing and cover assemblies.
If worn, cracked or damaged, these can be renewed by tapping a suitable thread in the internal bore of the seat and inserting a setscrew with an attached nut and plain washer.
Tighten the nut down against the housing case and withdraw the seat.
Fit the new seat by inserting in the housing and tapping home square with a soft drift.

Valve and Worm Assembly

Examine the three teflon rings on the valve sleeve for damage. The rings should be a loose fit in their grooves and their outer diameter should be free from cuts, scratches and similar blemishes.
Replace any damaged rings.
Carry out the following examinations:- If, during any of these checks the condition of the valve and worm assembly proves unsatisfactory, the assembly must be replaced as a unit.
Examine valve and worm ball bearing tracks for wear or damage.
Ensure that there is no relative movement at the trim pin between valve sleeve and worm.
Check that there is no wear in the torsion bar assembly pins by ensuring that there is no free movement between the input shaft and the worm.
Examine the needle bearing area towards the outer end of the shaft for damage and wear, similarly examine the seal area.

Piston and Rack

(a) Examine teflon ring for damage, etc.
(b) Examine rack teeth for signs of undue wear.
(c) Examine back face of rack, that is, behind the teeth for signs of wear caused by the rack adjuster pad.

Valve Housing

Examine bore for signs of wear or damage, particularly on rubbing surfaces of teflon rings.
Examine the needle roller bearing for damage and replace if necessary. Renew the seal.

ASSEMBLING

Valve and Worm Assembly

It is important that the worm be centered in the gear housing to ensure the correct relationship between the ratio curve, the preload peak and the central position of the steering gear. During manufacture the critical dimension of both the worm and housing is measured in special fixtures, this dimension is effectively the distance from the small ball race to the centre of the worm. The checking fixture shows the amount in thousands of an inch that the box is deep also the amount that the worm is short. This error is etched on the worm and stamped on the box, hence, a worm which is 0.006" (0.15 mm.) short and a box which is 0.004" (0.10 mm.) deep will need a total of 0.010" (0.25 mm.) shims to bring the datum into the correct position, that is, simply add the two datum errors together to give the correct thickness of shims in "thous" (0.001's). Having determined and selected the correct number of shims, these should be placed in the bottom of the recess in the race housing.
Press the outer race of the small bearing into the recess on top of the shims.

Place the inner race of the bearing in position and lower the valve and worm assembly into place.

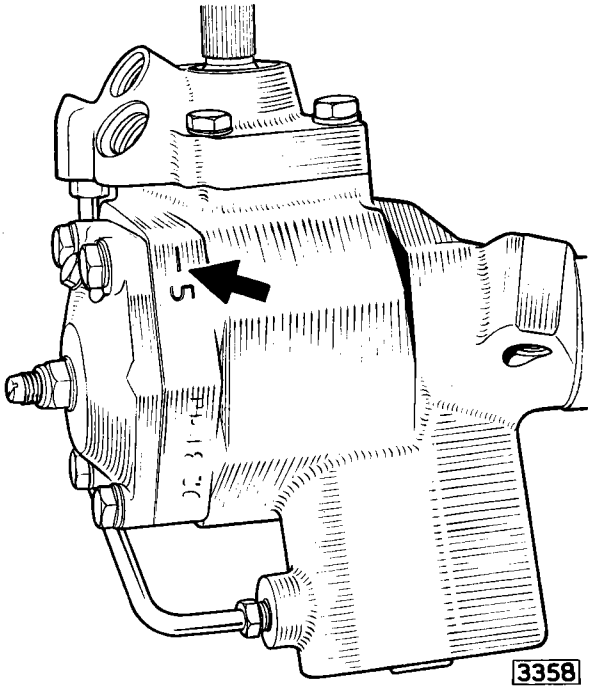


Fig. No. 16 *Location of the depth reading to facilitate the fitting of the valve shaft shims*

Fit the ball bearing assembly and cage (large) over top of worm.
Take valve housing assembly and remove large square sectioned "O" ring from the spigot.
Fit the valve housing over valve rotor, protecting rotor seal from rotor splines with seal saver and check input shaft for end-float. Remove valve housing and add shims in sufficient quantities to provide a 0.0015" (0.04 mm.) gap between the valve housing and the gear housing (see Fig. 17). This gap should be measured whilst reasonable hand pressure is applied to the valve housing. Remove the valve housing and tighten down the four bolts. The tightening down operation should increase the torque on the input shaft by 2 lb. in. (0.02 kg.m.). If this torque increase is not achieved then the shim pack should be altered accordingly.

Rack and Pinion Assembly
Always fit a new teflon piston ring with rubber "O" ring underneath it in the groove.
Screw a long $\frac{1}{2}$" UNC bolt into the tapped hole in the centre of the piston face.
Press the piston into its cylinder bore with its teeth facing the sector shaft bore so that the tips of the teeth are parallel to the sector shaft centre line. Push the piston into the bore until the piston top is 1.675" (42.5 mm.) from the mouth of the cylinder. In order to obtain this dimension it is necessary to remove the end plate.

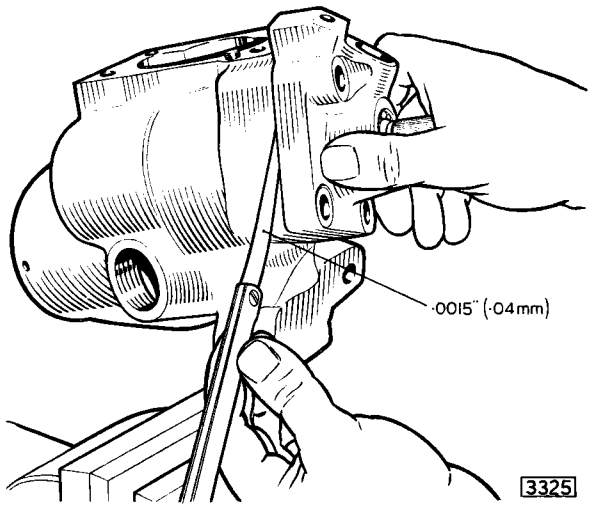


Fig. No. 17 *Checking the gap between the valve and gear housings*

Mis-align the piston in bore so that the back face of the rack is hard up against the gear casing adjacent to the rack adjuster screw bore.

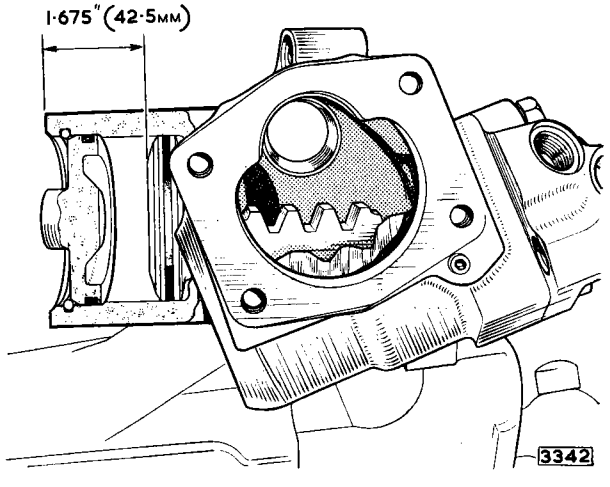


Fig. No. 18 *Rack and pinion assembly*

Sector Shaft Assembly
Remove the self-locking nut from top of adjuster screw, screw cover assembly onto adjuster screw as far as it will go.
Fit seal saver onto splined end of sector shaft and insert sector shaft into gear housing with the roller positioned towards the middle of the worm.
Manoeuvre the sector shaft to engage the rack teeth and move input shaft to and fro to engage the worm. Push sector shaft fully home.
Note: Ensure that the square sectioned 'O' ring seal is fully home in its recess before the top cover is bolted down.

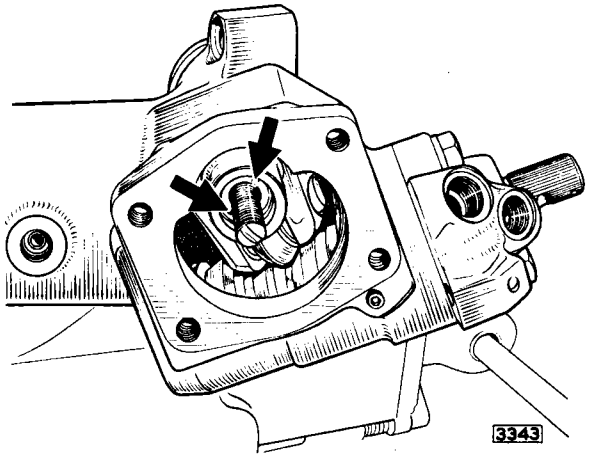


Fig. No. 19 *Positioning the roller towards the middle of the cam. The arrows indicate the adjustment slots in the top of the sector shaft.*

Fit the four screws with spring washers and tighten, at the same time ensuring that the spigot of the top cover is hard up against its recess in the casing aperture. This is done by forcing the cover away from the worm bore, possibly tapping it with a hide mallet.
Remove the long bolt from the piston face.

Rack Adjuster Screw
Position pad in its seating in rack adjusting screw. Fit a new seal into its recess and offer assembly up into screwed bore in gear housing ensuring that the pad remains in position. The gear should be laid on its side and the assembly screwed up vertically. Fit rack screw loosely and fit locking screw into its tapped hole.

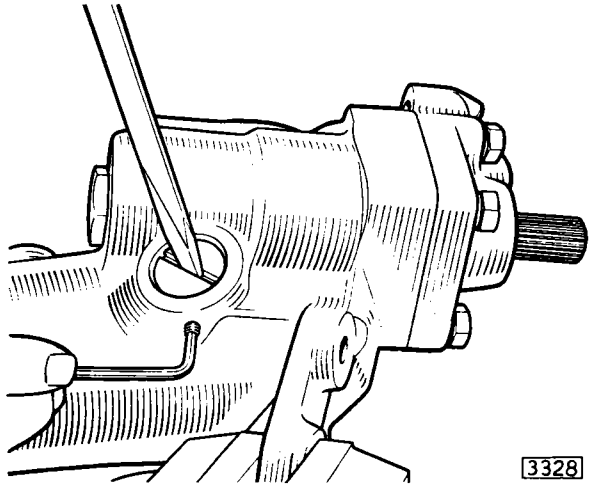


Fig. No. 20 *Tightening the rack pad locking screw*

Cylinder Cover
Fit new seal to cylinder cover and press into cylinder bore.
Fit cylinder cover retainer clip.

ADJUSTMENT OF REBUILT GEAR

Sector Shaft Adjustment
Using a torque wrench or just by "feel", turn the input shaft from lock to lock, noting the position at which the wrench arm passes through centre. Note the torque felt one full turn from centre in either position.
Using a screwdriver, turn the adjusting bolt in a clockwise direction a little at a time, turning the input shaft through the centre position until an increase of 4 lb. in. over the torque previously noted is achieved at the centre position. Hold the bolt stationary and lock in position with the nyloc nut.
Recheck the adjustment by turning from lock to lock If adjustment is correct, there will be an increase of 4lb. in. torque at centre over that of a turn from centre in either direction. N.B. The rack adjusting screw should be slackened off during this operation or false readings will result.
Excessive preloading of the sector shaft assembly into the hour glass worm will result in possible poor return efficiency in the car and should, therefore, be avoided.

Rack Adjustment
Again, with the use of a torque wrench, note the torque reading over centre of the gear (the position being found as under Sector Shaft Adjustment).
With the gear in this central position, screw in the rack adjustment screw firmly to ensure proper seating and then slacken off by about one quarter turn.
Screw in a little at a time, turning the input shaft through centre until an increase of 4 lb. in. over the previous centre torque is achieved at the centre position.
Rotate the input shaft from lock to lock and check this adjustment has not produced an increase of torque at any other point in excess of 4 lb.in. If it has, the centre torque should be reduced until this maximum is achieved.
Lock the rack adjusting screw by means of the small socket screw.
Finally, check the total torque reading for the whole assembly—this should not be more than 16 lb. in. at or near the centre position.

Remaining Parts
Fit the feed pipe assembly.
Fit the drop arm to the steering unit, noting the location marks as scribed on removal. Fit the tab washer and nut, tightening the nut to a torque of 130 lb. ft.

REFITTING

Refitting is the reverse of the removal procedure.
Reconnect the high and low pressure hoses, care being taken to ensure that the connections are perfectly clean.
Refit the upper steering column as detailed on page II.21.

Refill the reservoir to the full mark on the dipstick with the recommended grade of Automatic Transmission Fluid and bleed the system as follows:-

(a) Release the hexagon plug in the steering unit top cover and start the engine. Close the plug when the air has been expelled.
(b) With the engine running, turn the steering from lock to lock a few times to check for lumpiness.
(c) Check the fluid level in the reservoir; the correct level is to the full mark on the dipstick with the oil hot. Top up, if necessary, with the recommended grade of fluid.

REPLACEMENT OF EXTERNAL SEALS

Sector Shaft Seal

This seal can be replaced with the sector shaft in position but great care must be exercised to protect the splines of the shaft to prevent damage to the new seals.

Input Shaft Seal

This seal cannot be replaced with the steering unit in position on the car.
Remove the steering unit, as detailed on Page II.8.
Remove the valve housing, taking care not to misplace any of the large shims between the valve housing and the bearing. Withdraw the circlip and remove the seal.

REPLACEMENT OF INTERNAL SEALS

Dismantle the steering unit as described on Page II.8.,
To replace worn or damaged Teflon rings on the valve and worm proceed as follows:-
Cut the old ring through with a sharp knife and remove from the groove.
Teflon rings have poor elastic qualities. They can, however, be stretched and compressed if handled with care. To fit a ring into a particular groove, slide the ring onto the Valve Seal Expander (Tool No. J.32) and work it up to the large end. Slide the expander over the sleeve positioning the end cover over the groove. Push ring over the end of the expander into the groove.
Note: The expander will not fit over the sleeve when the rings are fitted in their grooves, so that it may be necessary to remove good rings in order to replace faulty ones.
Now, having expanded the ring it is necessary to compress it into its groove. This is achieved by gently working the sleeve assembly into the valve seal compressor (Tool number J.33) starting with the end having the shallow taper and finishing with the other end which has the steep taper.

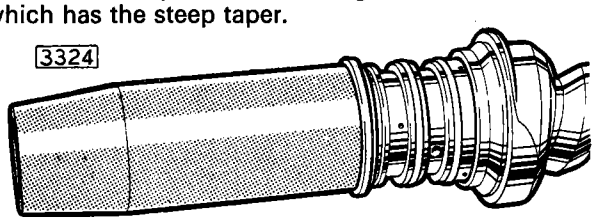


Fig. No. 21 *Fitting a Teflon ring using the valve seal expander (Tool No. J.32)*

When the compressor is withdrawn, the rings should be fitting snugly in their grooves. They should be free to rotate, free from cuts and blemishes and have slight interference with the bore of the valve housing into which they fit when the steering unit is assembled.

Replacement of Piston Rings

If the teflon piston ring is found to be damaged or worn, replace it with a new one. Cut the ring and remove from groove and remove rubber "O" ring which will be found underneath it. Expand a new rubber "O" ring and position it in the bottom of the groove. Then take a new ring and fit it into one side of the groove, working round the groove in both directions in much the same way as a tyre is fitted to a wheel rim. Care should be taken to avoid stretching the ring excessively.

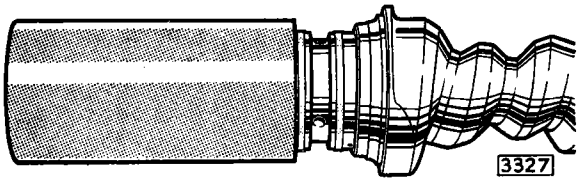


Fig. No. 22 *The valve and compressor (Tool J.33 in position)*

THE PRESSURE PUMP

REMOVAL

Release the nut securing the pump mounting bracket bottom bolt and remove the setscrew and washer securing the adjusting link to the water pump.
Swing the pressure pump inboard, lift the jockey pulley against the spring pressure and remove the drive belt from the pump pulley.
Release the hose clip and disconnect the low pressure hose from the pump. Blank off the union to prevent the ingress of dirt and catch any escaping oil in a clean container.
Disconnect the high pressure hose from the pump connection and blank off the union.
Remove the two nuts and lockwashers from the pump mounting studs and withdraw the unit from the bracket.
Note the location and number of the spacing washers between the pump and the mounting bracket for reference when refitting.

DISMANTLING

Drain the oil out of the pump and thoroughly clean the exterior.
Tap back the tab washer, remove the nut and withdraw the pulley.
Clamp the pump into a vice, taking care not to exert undue pressure on the front hub as this may distort the shaft bushing.
Remove the outlet union (4 Fig. 33) noting the "O" ring (5) in the recess. Remove the two mounting studs (3 Fig. 33).
Detach the reservoir from the pump body.
Collect the three "O" rings (6 and 7 Fig. 33) from the recesses in the pump body.
Remove the end plate retaining ring by pushing a pin through the hole in the pump body and levering out with a screwdriver.

Remove the end plate and spring (20 and 19 Fig. 33). If the end plate sticks in the pump body a light tap will free it.

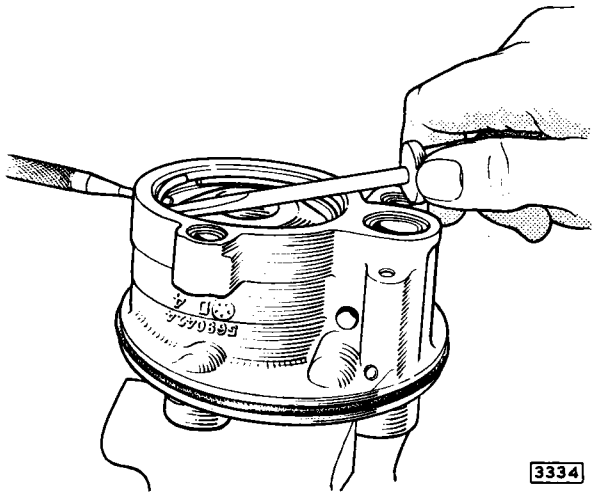


Fig. No. 23 *Removing the end plate retaining ring*

Remove the end plate "O" ring (22 Fig. 33) from the recess in the pump body.
Remove the flow control valve and spring (23 and 24 Fig. 33).
Remove the key (11 Fig. 33) from the shaft and gently tap the end until the pressure plate, pump ring, rotor and thrust plate can be removed as an assembly.

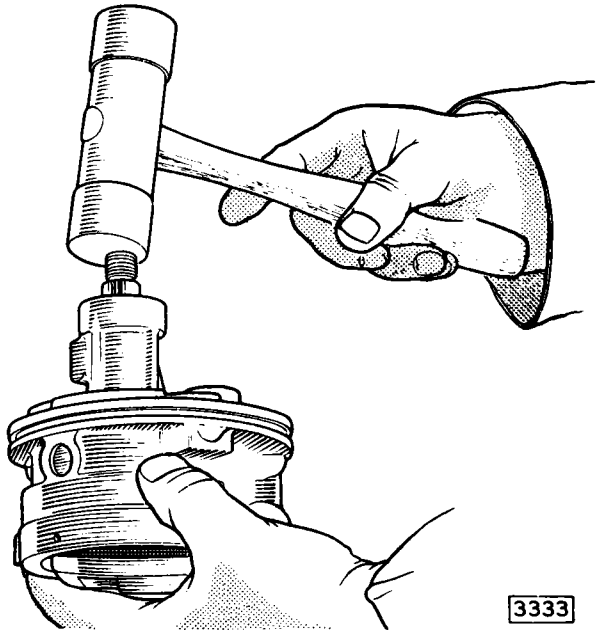


Fig. No. 24 *Removing the pressure plate assembly*

Remove the pressure plate "O" ring (22) from the pump body.
Separate the components taking care not to damage the pump rotor vanes.
Remove the clip (14 Fig. 33) and withdraw the rotor (13) and thrust plate (12).
Remove the shaft oil seal (25 Fig. 33).

INSPECTION

Carefully clean all parts except the "O" rings and shaft seal which should be replaced. Do not immerse any of the new seals in the cleaning solvent otherwise they may be damaged.
Check the pressure plate, thrust plate and rotor for scoring. A high polish is always present on the faces as a result of normal wear—do not confuse this with scoring. Light scoring can be rectified by lapping.
Examine the contour surface of the pump ring for extreme wear. There may be some scuff marks and uniform wear, but this is not detrimental. However, if chatter marks or grooves are present which can be felt with the finger, both the ring and the vanes should be replaced.
Inspect the pump shaft and bushing; the bush is not supplied as a separate part.
The flow control valve must slide freely in the bore and if the valve tends to stick, check for burrs or foreign matter.
Renew the valve if faulty.

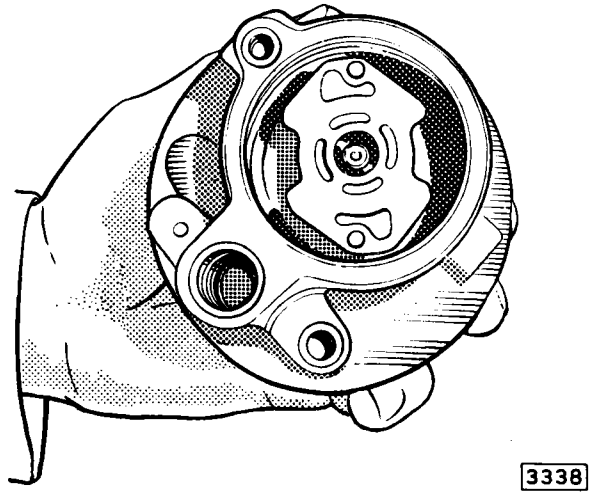


Fig. No. 25 *Fitting the thrust plate*

ASSEMBLING

Lubricate a new shaft seal with petroleum jelly and fit the seal to the pump body using a tube of suitable diameter. Insert the pump shaft, splined end first, from the hub end of the body.
Insert the dowel pins into the holes in the pump body. Fit the thrust plate over the dowel pins with the ported face uppermost (Fig. 25).

Fit the rotor to the splined shaft with the countersunk side downwards, that is, towards the thrust plate. The rotor must be free on the splines.

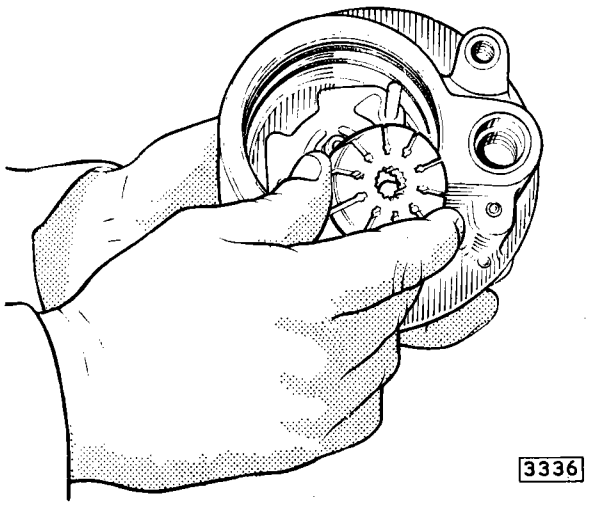


Fig. No. 26 *Fitting the rotor*

Fit the retaining clip to the groove in the end of the shaft. Fit the pump to the dowel pins with the rotation arrow uppermost.

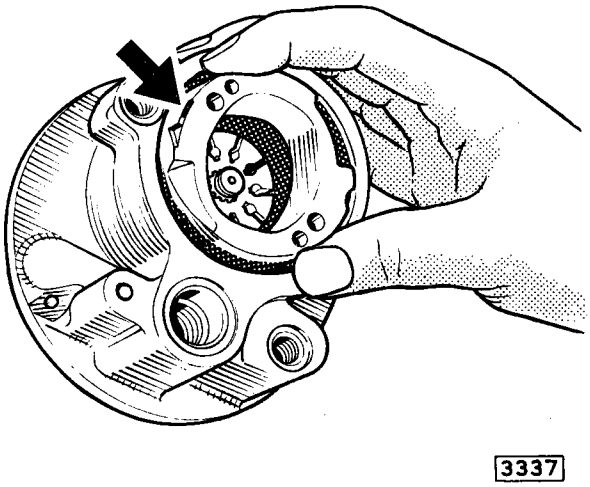


Fig. No. 27 *Fitting the pump ring*

Place the vanes in the rotor slots ensuring that the radiused edge of each vane faces towards the outside. Smear the pressure plate "O" ring with petroleum jelly and install into lowest groove in the pump body.
Lubricate periphery of pressure plate with petroleum jelly and fit to the dowel pins with the circular recess for the spring uppermost. Push the plate down by means of a piece of tube applied at the outer edge. Do NOT press or tap the plate into position.

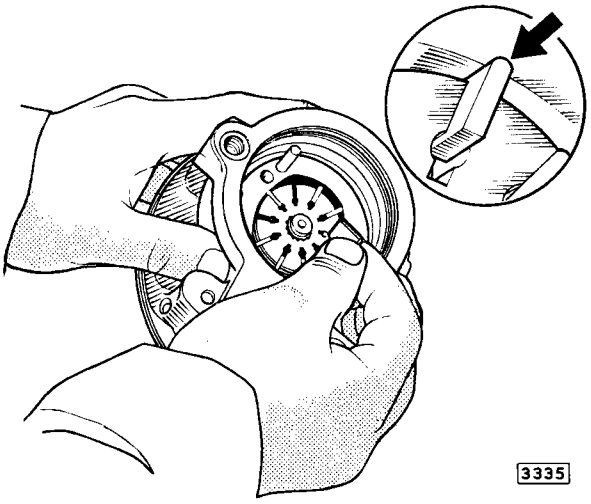


Fig. No. 28 *Placing the vanes in the rotor slots*

Smear the end plate "O" ring with petroleum jelly and install into its groove in the pump body.

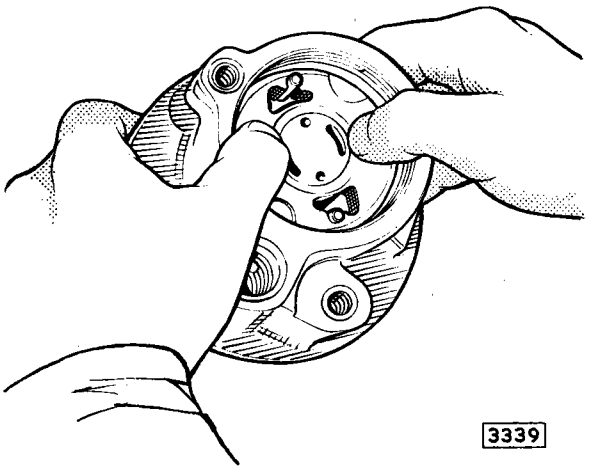


Fig. No. 29 *Placing the pressure plate in position*

Fit the spring (19 Fig. 33) into the circular groove in the pressure plate.
Lubricate the periphery of the end plate with petroleum jelly to avoid damaging the "O" ring.
Place the end plate in position with the retaining ring on top. Ensure that the gap in the clip is not opposite the hole used for removal.
Place the assembly under a press and apply pressure until the retaining clip can be sprung into the groove in the body.

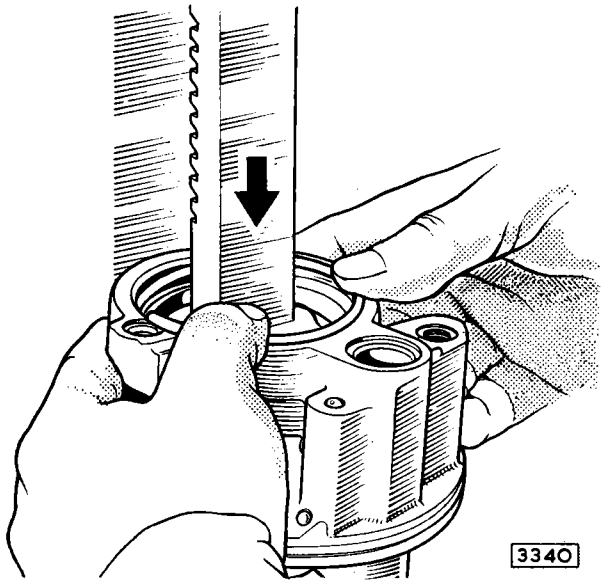


Fig. No. 30 *Compressing the spring prior to final assembly*

Ensure that the spring is fully wound onto the flow control valve and insert the valve, spring foremost, into the bore in the pump.
Place new "O" rings for the reservoir retaining bolts and outlet union in position.

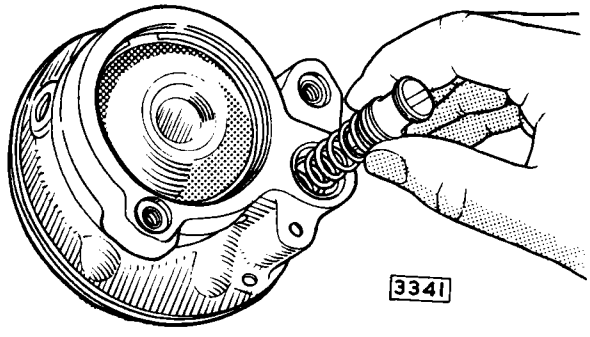


Fig. No. 31 *Inserting the flow control valve*

Smear the large reservoir "O" ring (9, Fig. 33) with petroleum jelly and fit to the groove in the pump body.
Fit the reservoir to the pump body taking care not to displace the "O" rings.
Fit the reservoir retaining studs (3 Fig. 33) outlet union (4) with "O" ring (5) located in the groove in the union.
Refit the pulley key and pulley and secure with the tab washer and nut.

REFITTING

Refitting is the reverse of the removal procedure.
Reconnect the high and low pressures hoses, care being taken to ensure that the connections are perfectly clean.

Fill the reservoir to the full mark on the dipstick with the recommended grade of Automatic Transmission Fluid and bleed by turning the pulley anti-clockwise a few times to dispel any air in the pump.

Lift the jockey pulley against the spring pressure and feed the drive belt over the jockey pulley. Move the pump outboard to the full extent of the elongated hole in the adjuster link and lock the securing screw.
Release the jockey pulley.
Bleed the complete system as follows:-

(a) Release the hexagon plug in the steering unit top cover.
(b) Start the engine and while running, turn the steering from lock to lock a few times.
(c) Retighten the hexagon plug and check the fluid level in the reservoir. The correct level is to the full mark on the dipstick with the oil hot. Top up, if necessary, with the recommended grade of Automatic Transmission Fluid.

1 Driving shaft
2 Pump vane
3 Pump ring
4 Pump body
5 Filler cap
6 Reservoir
7 Oil seal
8 End plate
9 Spring
10 Pressure plate
11 Flow control valve
12 Spring
13 Thrust plate
14 Rotor

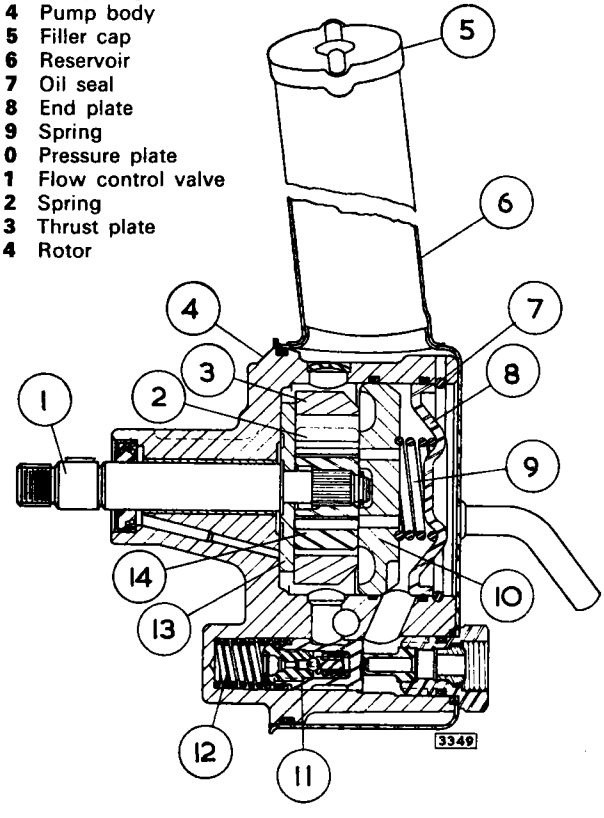


Fig. No. 32 *Section of steering pump*

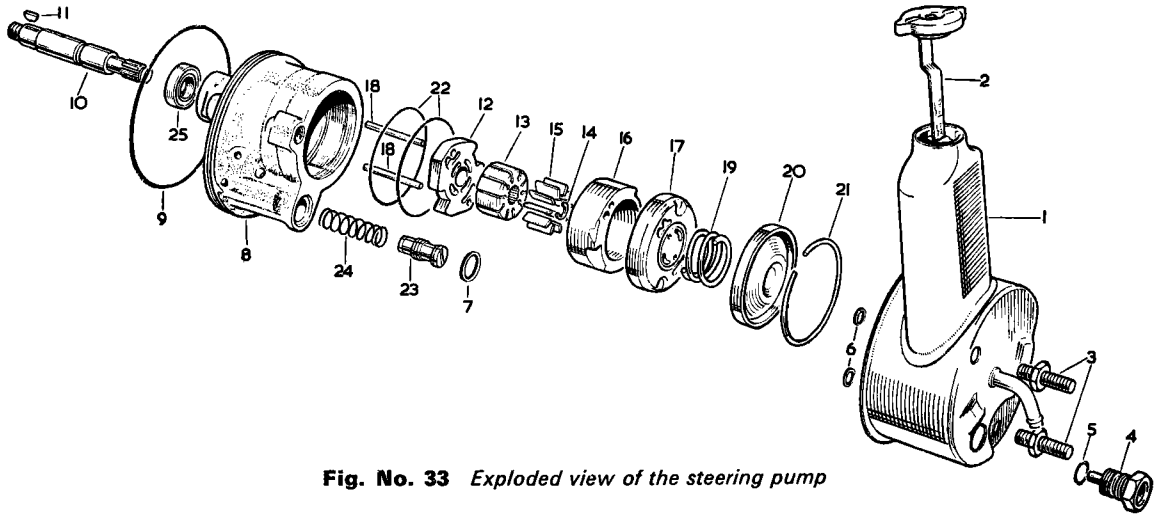


Fig. No. 33 *Exploded view of the steering pump*

1	Reservoir assembly	**10**	Shaft	**19**	Spring
2	Filler cap assembly	**11**	Key	**20**	End plate
3	Stud	**12**	Thrust plate	**21**	Clip
4	Outlet union	**13**	Rotor	**22**	"O" ring
5	"O" ring	**14**	Clip	**23**	Flow control
6	Seal (small)	**15**	Pump vane	**24**	Spring
7	Seal (large)	**16**	Pump ring	**25**	Oil seal
8	Pump body assembly	**17**	Pressure plate		
9	"O" ring	**18**	Pin		

STEERING WHEEL

Removal (Fig. 34)

Withdraw four cheese-headed screws from the underside of the steering wheel centre and detach the horn switch cover.
Remove three setscrews and washers securing the horn ring to the steering wheel and detach the ring.
Unscrew the locknut (22) and the nut (20) securing the steering wheel to the inner column.
Withdraw the steering wheel and collect the two halves of split cone (18).

Refitting

Secure the split cone (18) in position in the inner column shaft grooves, ensuring that the narrowest portion of the cone is towards the top of the column.
Slide the steering wheel onto the column shaft splines so that the two spokes are horizontal when the road wheels are pointing straight ahead.
Push the steering wheel fully home onto the split cone
Fit the plain washer, the securing nut and the locknut.
Refit the horn ring and cover.

STEERING COLUMN (UPPER)

Removal (Fig. 34)

Disconnect the battery.
Turn the road wheels to the straight ahead position. If retained in this position, this will facilitate the refitting procedure.
Disconnect the cables from the flashing indicator/headlamp flasher switch at the snap connectors.
If overdrive is fitted, disconnect the cables from the overdrive switch at the snap connectors.
Remove the two screws and washers securing the switch upper cover to the lower cover below the steering wheel.
Lift off the upper cover and remove the three bulb holders from the back. Note the location of the bulbs for reference when refitting.
Disconnect the four cables from the inhibitor switch located on a bracket attached to the steering column Note the location of the cables for reference when refitting. (Automatic Transmission cars only).
Disconnect the gear selector control cable ball joint from the selector lever on the steering column. (Automatic Transmission cars only).
Disconnect the four cables from the steering column lock (if fitted) and ensure that the key is in the "Garage" (normal stop) position. Note the location of cables for reference when refitting.
Note: The switch unit cannot be removed from the outer column.
Remove the four cap nuts and detach the trim panels covering the column above the parcel tray.
Release the clip securing the bottom of the outer tube to the mounting bracket on the bulkhead.
Remove the horn switch cable from the contact at the bottom of the steering column.
Remove the pinch bolt securing the inner column at the top universal joint of the lower column. Mark the location of the inner column splines in relation to the joint for reference when refitting.
Remove two bolts, nuts and washers securing the steering column to the upper mounting bracket. Collect any shim plates located between the column and body brackets.

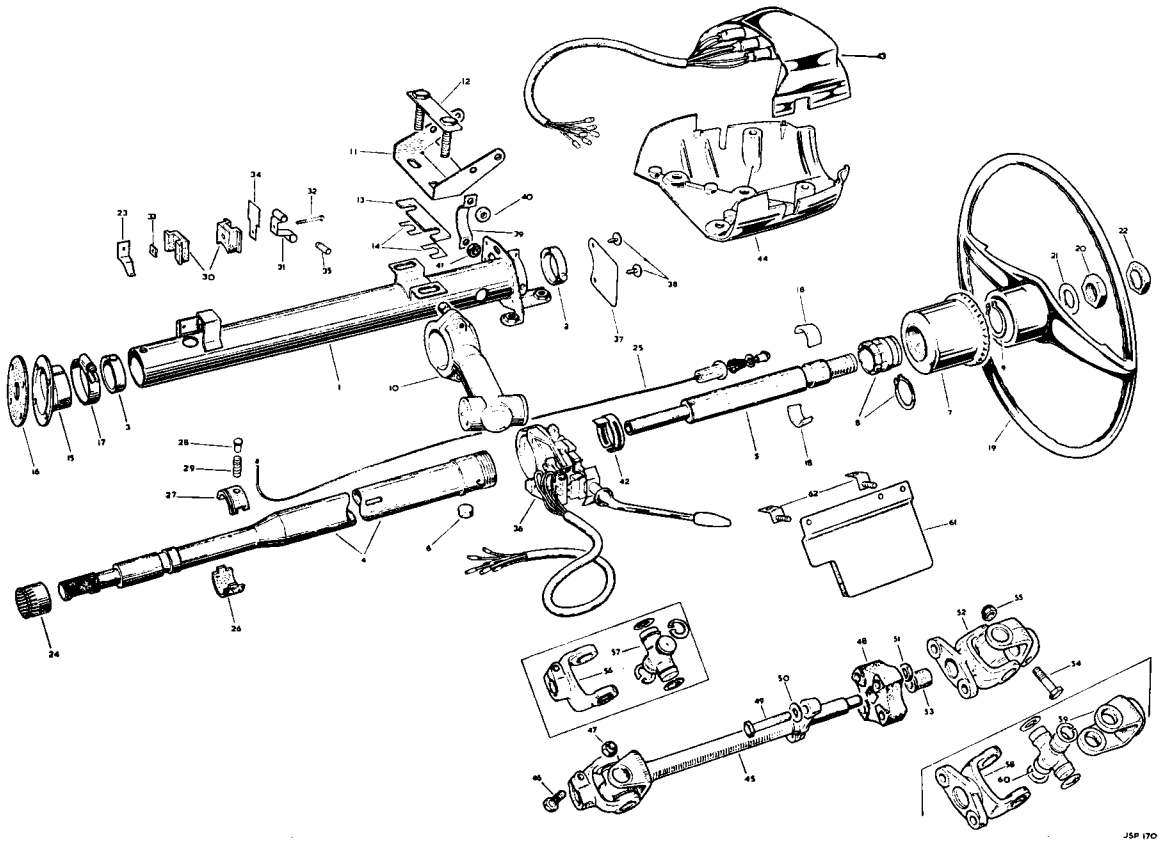


Fig. No. 34 *Exploded view of the steering column*

Dismantling

Remove the steering wheel as described previously.
Withdraw the inner column.
Unscrew the steering wheel locking nut and withdraw the nut from the splined inner shaft.
Remove the two setscrews, serrated and square washers securing the flashing indicator switch striking ring.
Remove the stop button and withdraw the inner shaft.
Slide off the horn pick-up ring and remove the bottom half of the rotor assembly. Remove the circlip from the end of the horn contact nipple and remove the spring and plastic sleeve.
Withdraw the horn wire and top half of the rubber rotor.
Remove the flashing indicator switch as follows:-
Release the locknut from the lower clamp screw. Detach the clamp and switch. Note the distance piece fitted to the top of the screw.
If the car is fitted with automatic transmission, proceed as follows:-
Remove the screws securing the inhibitor switch carrier to the mounting bracket and outer column and detach the link.
Release the square headed screw securing the operating lever to the operating shaft.
Remove the circlip and washer from the underside of the shaft upper bearing. Remove the setscrew, nut and washer securing the gear indicator arm bearing to the bracket on the outer column.

1 Outer tube assembly
2 Top bearing
3 Bottom bearing
4 Inner column
5 Shaft
6 Stop button
7 Locknut
8 Split collet
9 Circlip
10 Steering column lock
11 Upper bracket
12 Screw plate assembly
13 Spacer
14 Shim
15 Bracket assembly
16 Gasket
17 Clip
18 Split cone
19 Steering wheel
20 Steering wheel nut
21 Washer (special)
22 Locknut
23 Earth contact
24 Slip ring
25 Contact cable
26 Rotor (bottom half)
27 Rotor (top half)
28 Contact
29 Spring
30 Contact holder
31 Contact
32 Bolt
33 Nut
34 Insulating strip
35 Eyelet dowler
36 Direction indicator switch
37 Insulating strip
38 Stud
39 Clamp
40 Spacer
41 Nut
42 Drive clip
43 Upper switch cover
44 Lower switch cover
45 Lower column assembly
46 Bolt
47 Nut
48 Coupling
49 Bolt
50 Washer
51 Locknut
52 Universal joint
53 Steady bush
54 Bolt
55 Nut
56 End yoke
57 Journal assembly
58 Flange yoke assembly
59 End yoke
60 Journal assembly
61 Shield assembly
62 Bracket assembly

Withdraw the shaft and lever as an assembly.
To remove the gear selector lever from the pivot bracket, extract the split pin and washer and withdraw the clevis pin. Detach the lever and collect the return spring and shims (if fitted).
Remove two setscrews and lock washers and remove the selector quadrant and spacers.
Remove the nuts and bolts securing the two rubber contact holders, fibre insulating strip, slip ring contact blade and earth contact.
Depress the retaining lugs and withdraw the bearing bushes from the top and bottom of the outer tube.
If the car is fitted with overdrive transmission, remove the overdrive switch after withdrawing two setscrews, nuts and lockwashers.

REASSEMBLY

Replace the two bearing bushes ensuring that the lugs register in the holes of the outer column.
If the car is fitted with automatic transmission, refit the selector control as follows:-
Refit the selector quadrant and spacers.
If removed during the dismantling procedure, insert the shims and return spring in the pivot bracket, refit the gear selector lever and secure with the clevis pin, washer and split pin. Lightly grease the spring before fitting the lever.
Pass the operating shaft through the top bearing. Slide the plain washer and circlip over the shaft. Fit the operating lever to the shaft and feed the shaft through the bottom bearing. Secure in position with the plain washer and circlip.
Secure the operating lever to the operating shaft by tightening the square headed locking screw, ensuring that the screw registers with the flat on the shaft.

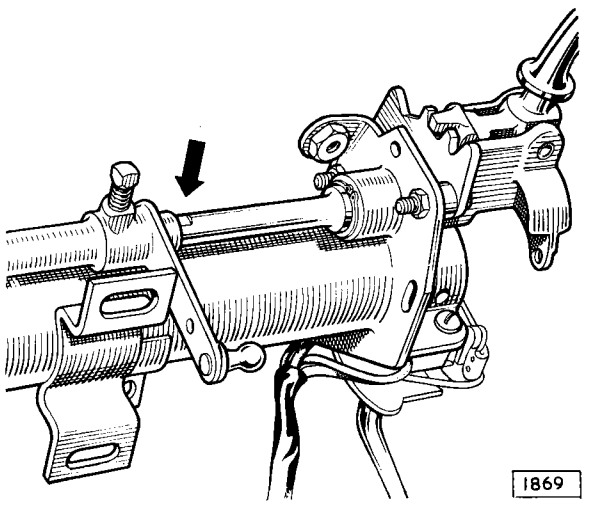


Fig. No. 35 *Align the flat on the end of the upper control shaft with the securing screw on the control lever.*

Refit the gear indicator arm bearing to the bracket on the outer column.
Reconnect the inhibitor switch to the operating link and secure to the mounting bracket. Do not tighten the screws at this juncture.

Refit the flashing indicator switch. Pass the two fixing screws through the switch clamp; attach the spring washer and locknut to the lower screw and the distance piece and washer to the top screw. Feed the screws through the column bracket and secure to the indicator switch. Tighten the top screw fully.
If the car is fitted with overdrive transmission, refit the overdrive switch to the outer tube.
Thread the horn wire through the inner column and fit the top half of the rubber rotor. Fit the bottom half of the rotor and slide the horn slip ring over both halves with the serrations in the ring towards the bottom of the column. Gently knock the serrations of the ring in the groove of the rubber rotors until secure.
Refit the two rubber contact holders, fibre insulating strip, slip ring contact blade and earth contact to outer tube.
Slide the inner shaft over the horn wire into the inner column so that the slot in the shaft serrations aligns with the stop button hole in the inner column. Screw the stop button fully into position until the inner shaft binds on the button. Slacken the stop button until the inner shaft can move freely.
Fit the striker plate with the striker peg towards the bottom of the column and on the opposite side to the stop button.
Turn the inner column until the striker retaining bolts are in the vertical position and set the striker peg so that it is just below the horizontal axis position.

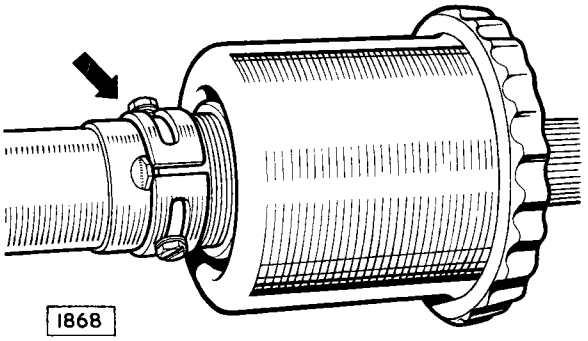


Fig. No. 36 *Centralising the flashing (turn) indicator switch striker peg*

If the car is fitted with automatic transmission set the inhibitor switch as follows:-
Select neutral (N) on the gear selector quadrant and hold in this position.
Rotate the switch in the clamp ring (C) and move the bracket in the elongated holes until the small hole in the lever (B) registers with the indent in the back of the switch (A).
Tighten the clamp ring and bracket screws.
Slide the inner column into the outer tube ensuring that the earth contact is not damaged and that the horn contact does not foul on the slip ring of the inner column. The contact may be lifted slightly with a screwdriver whilst the column is placed in position.

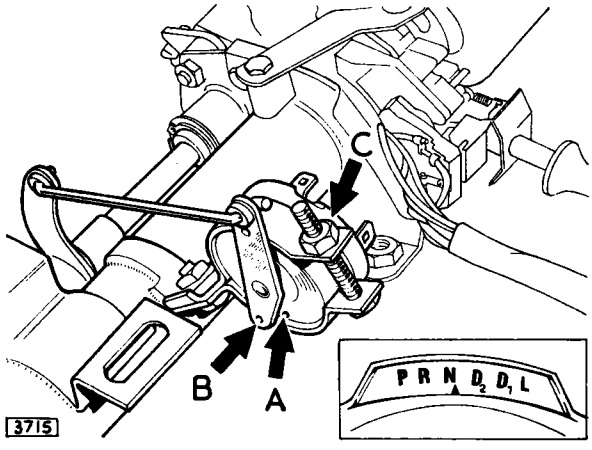


Fig. No. 37 *Setting the starter/reverse inhibitor switch striker peg*

Attach a spring balance to the steering wheel (Fig. 38) Tighten the bottom screw until the steering wheel will just turn with a pull of 5 ozs. (141.7 grammes) registered on the balance. Turn the locknut towards the switch carrier bracket and lock the screw. Two thicknesses of distance piece are available to compensate for any variation in the bore of the outer tube.

Grade "A" 0.188" (4.7 mm.).
Grade "B" 0.166" (4.2 mm.).

REFITTING

Ensure that the front roadwheels are in the straight ahead position.
Feed the outer tube through the bottom mounting bracket. Fit shim plates and secure to the top mounting bracket with two bolts, nuts and washers.

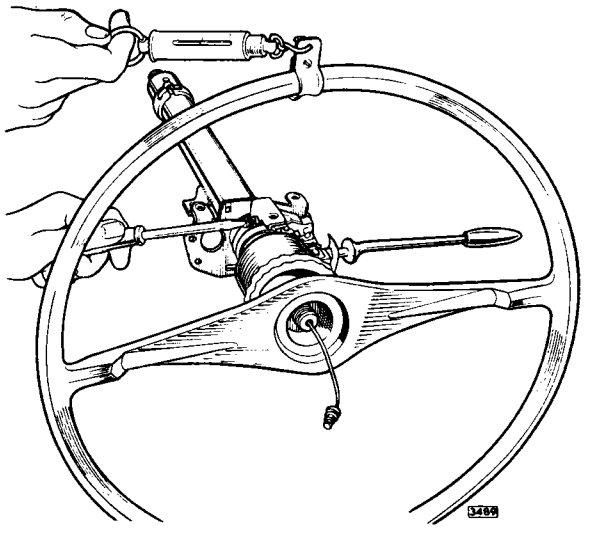


Fig. No. 38 *Upper steering column bearing adjustment points*

Tighten the jubilee clip securing the outer tube to the bottom mounting bracket.
Turn the inner column and centralise the flashing indicator striker between the two arms of the indicator switch.
Engage the splines of the inner column with the socket of the upper universal joint of the lower steering column.
Pull the inner column upwards until the lower edge of the indicator switch striker is level with the bottom of the slot in the nylon trip ring.
Reconnect the flashing indicator switch cables in their correct colour sequence.
If the car is fitted with overdrive, reconnect the cables to the overdrive switch.
If fitted with automatic transmission, reconnect the four cables to the inhibitor switch in the correct sequence.
Reconnect the cables to the steering column lock (if fitted).
Attach the gear selector control cable ball joint.
Refit the plastic sleeve and spring to the horn wire and secure with a circlip.
Re-insert the bulb holders into the upper switch cover in the correct sequence.
Refit the steering wheel locking nut to the inner shaft.
Refit the covers (top and bottom), steering wheel and trim panels by reversing the removal procedure.

STEERING COLUMN (LOWER)

Removal

Turn the road wheels until the pinch bolt of the lower column is accessible.
Remove the pinch bolt.
Re-set the road wheels in the straight ahead position.
Disconnect the upper column as detailed on Page II.18.
Withdraw the lower column and detach the rubber coupling.

Detaching the Rubber Coupling

Remove the four locknuts (51 Fig. 34).
Withdraw the plain washers and unscrew the four Allen headed screws (49) attaching the upper column universal joint and the lower column (45) to the rubber coupling.
Remove the lower steady bush from the upper universal joint if worn or damaged.
Check the condition of the rubber coupling and renew if worn or contaminated with oil or petrol.

Refitting

Check that the road wheels are in the straight ahead position and centralise the steering unit.
Refit the lower column joint to the steering unit shaft and tighten the pinch bolt.
Refit the rubber coupling and upper column joint by reversing the removal procedure.
Refit the upper column as detailed on Page II.21.

Note:- (1) Early cars will have a lower column fitted with the rubber coupling flange phased at 45° with the lower universal joint pinch bolt.

(2) Intermediate cars will have the flange and pinch bolt phased at 90°.
(3) Later cars will also be phased at 90° but will have bolts replacing the Allen-headed screws securing the rubber coupling.

Important
If lower steering columns phased at 90° are fitted to cars which have previously had the 45° phased column fitted it will be necessary to reposition the steering wheel on the splined shaft and also to reset the turn indicator switch striker on the inner column in order to restore the correct cancellation in the straight ahead position.

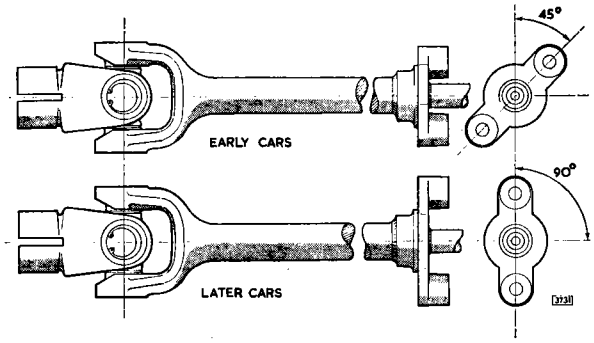


Fig. No. 39 *Showing the 45° and 90° phased lower steering columns*

1 End cap
2 Nut
3 Tab washer
4 "D" washer
5 Idler spindle
6 Bearing
7 Mounting bracket
8 Abutment washer
9 Bearing
10 Idler lever
11 Abutment ring
12 Washer
13 Nut
14 Seal retainer
15 Felt seal

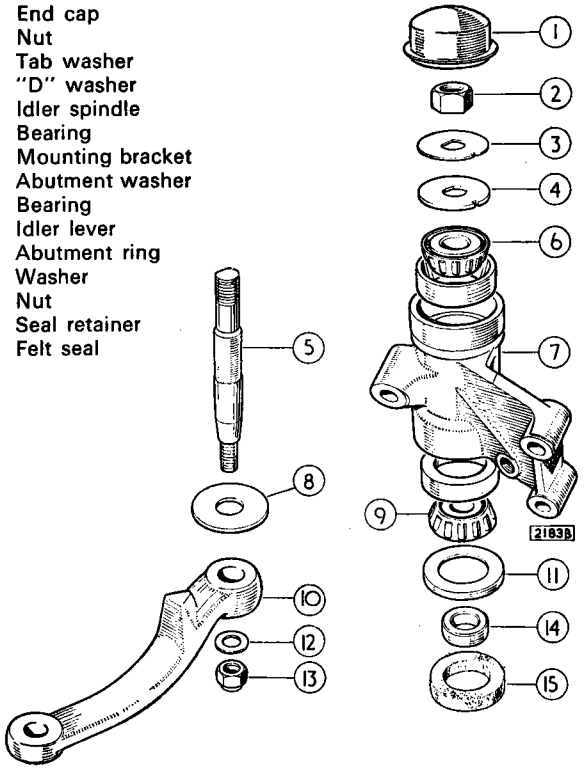


Fig. No. 40 *The steering idler components*

STEERING IDLER ASSEMBLY

Removal
Remove the self-locking nut securing the track rod end to the idler lever. Extract the track rod end which is a tapered fit.
Remove the two setscrews and one long bolt attaching the steering idler bracket to the front suspension cross member and detach the assembly.
Note the location of any packing washers which may be between the idler bracket and the front cross member.

Dismantling
Prise out the dust cap from the top of the idler assembly.
Tap back the tab washer and unscrew the nut from the idler spindle.
Remove the tab washer and the "D" washer.
The spindle, arm, abutment ring and felt seal now can be withdrawn.
If the bearings are to be renewed tap out the outer races using a small drift.

Assembling
Clean the bearings and the idler housing thoroughly before re-assembling.
Repack the housing and bearings with the recommended grade of lubricant.
Fit the abutment washer, seal retainer, felt seal, abutment ring, and bearing to the idler spindle and pass the spindle upwards into the housing.
Fit the upper bearing, "D" washer, tab washer and nut. Tighten the nut to a torque of 5 lb. ft. (0.7 kgm). If a torque wrench is not available, tighten the nut until rotation of the idler spindle by the idler arm feels "sticky" and back off the nut one flat: lock the nut with the tab washer and fit the dust cap.

Refitting
Reverse the removal procedure to refit. Ensure that the idler lever is in the straight ahead position before attaching the track rod end.
Refit the packing washers between the idler bracket and the front cross-member as noted on removal.
Check the height of the underface of the idler lever from the ground against the steering drop arm measurement. Adjust to within $\pm\frac{1}{16}$" (1.6 mm.) differential if necessary by adding or subtracting washers between the idler bracket and the front cross member at the top or bottom mounting bolts.

CENTRE TRACK ROD

Removal
The centre track rod ends incorporate rubber/steel bonded bushes. If the bushes show signs of deterioration they should be replaced.
Remove the self-locking nuts and washers from the inner ball joint of each tie-rod.
Withdraw the ball pins using Churchill Tool No. J.D 24.
Remove the self-locking nuts and washers securing the track rod ends to the drop arm and the idler lever.

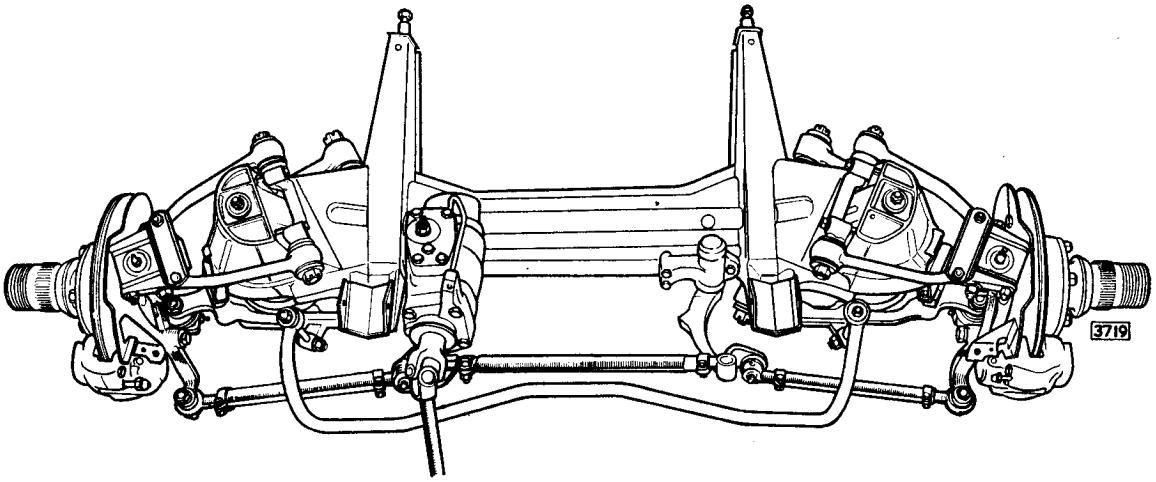


Fig. No. 41 *The steering layout*

Withdraw the track rod ends from the drop arm and idler lever using Churchill Tool No. J.D 24.

Dismantling
To remove the track rod ends, slacken the clamp at each end of the centre tube; unscrew each end from the tube noting that one end has a left hand thread and the other a right hand thread.

Assembling
When refitting the ends to the track rod, screw in each end **an equal amount** and adjust to a final length of $16\frac{7}{16}$" (41.7 mm).
Important: The centre track rod assembly must NOT be used for setting the toe-in.

Refitting
Refitting is the reverse of the removal procedure.
When refitting the ball pins to the idler lever and the steering drop arm, ensure that the pins are fully home in their respective tapers by means of a suitable lever applied to the top of the pins before fitting and tightening the nuts. Failure to follow this instruction may introduce a bias on the rubber bushes which will affect the steering geometry.

STEERING LOCK STOPS

No external lock stops are provided as stops are incorporated in the steering unit.
It is, therefore, ESSENTIAL if the steering unit has been dismantled that the centralising procedure, as detailed on page II.6 is carried out when refitting.

FRONT WHEEL ALIGNMENT

It is ESSENTIAL that the following instructions are observed when checking the front wheel alignment, otherwise steering irregularities may result.

Important
The centre tie-rod is set to a fixed length of $16\frac{7}{16}$" (41.7 mm.) and must NOT be used for setting the toe-in.
Inflate all tyres to the recommended pressures.
Each wheel must be individually adjusted by the outer tie-rod to give half the total toe-in of $0—\frac{1}{8}$" (0—3.2 mm)

Procedure
Set the front wheels in the straight ahead position.
Centralise the steering unit as detailed on page II.6.
Preferred method:- Use light beam equipment.
Alternative method:-
Place a straight edge between the front and rear wheels on one side of the car. The straight edge should be positioned as high as possible on the wheels. Owing to the car having a wider track at the front, the straight edge will not contact the rear wheel. Adjust the track of the front wheel so that the gap between the straight edge and the front and rear wall of the rear tyre is equal. The front wheel will now be parallel to the rear wheel. Repeat the operation for the opposite side.
Re-check the alignment after pushing the car forwards until the wheels have turned half a revolution.

ACCIDENTAL DAMAGE

The following dimensional drawings are provided to assist in assessing accidental damage. A component suspected of being damaged should be removed from the car, cleaned off and the dimensions checked with those given in the appropriate illustration.

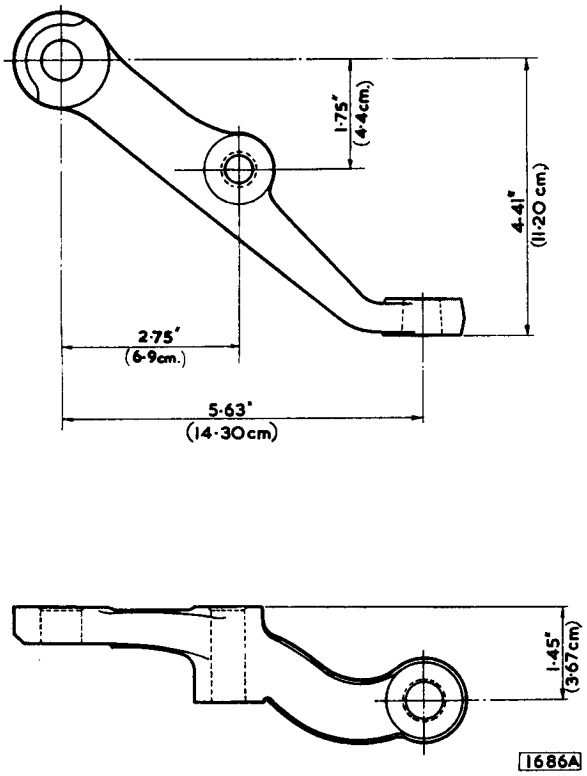


Fig. No. 42 *The steering arm*

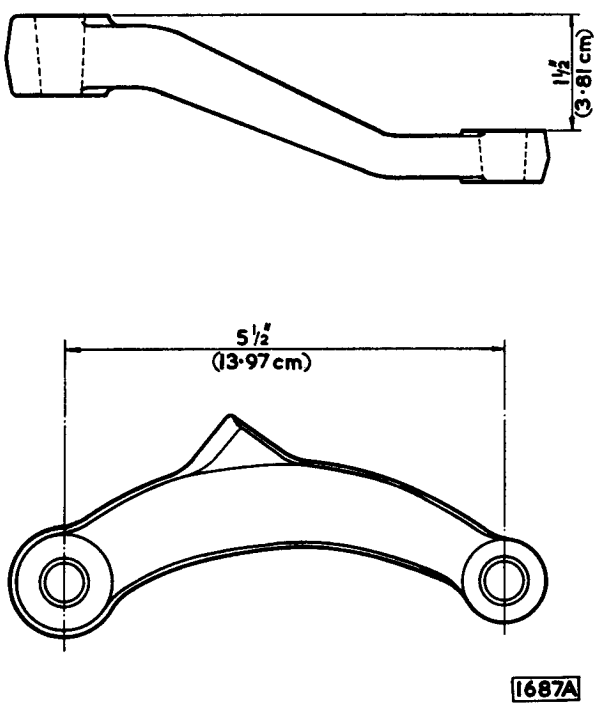


Fig. No. 43 *The idler lever*

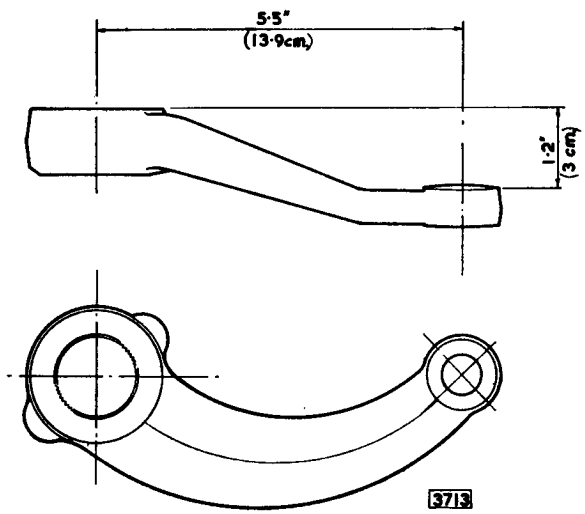


Fig. No. 44 *The steering drop arm*

FAULT FINDING CHART

Most Important: Always check that the Pump Fluid Reservoir is filled to the correct level before investigating any steering fault.

FAULT	POSSIBLE CAUSE	REMEDY
External oil leaks from steering box.	Damage or wear to seals or incorrect tightening of unions and bolts.	It is most important that the source of leak be traced before any attempt is made to rectify. Once the leak is located tighten the units or bolts or replace seals as necessary.
External oil leaks from pump.		Check that the reservoir is not over-filled.
Leak at Reservoir.	"O" Ring damaged or "O" ring improperly installed.	Replace "O" ring.
Oil leak at pressure fitting or filler cap.	Not tightened sufficiently or damaged seals or hose seats.	Tighten hoses or replace seats as necessary.
Oil leak at pump shaft.	Worn or damaged seals or damaged shaft.	Replace components as necessary.
Steering pulling to one side or the other.	Unbalanced front tyre pressures.	Adjust pressures.
	Faulty tyres. Steering gear out of trim.	See paragraph "Trimming" in service notes. **Note:** If these remedies fail to cure the pull then check steering and suspension geometry.
Steering feels different to left and right but it does not actually pull.	Incorrectly centred worm and valve means that the worm and valve assembly will be on the wrong part of the ratio curve when driving straight ahead.	Centralise as detailed on page II.8. It may be necessary to re-align the steering wheel after carrying out this operation.
Heavy Steering		
(A) Heavy steering when driving.	1. Low tyre pressure.	Inflate.
	2. Tightness or stiffness in the steering column and/or steering joints and suspension joints.	Grease or replace.
	3. Steering gear adjusted too tight.	Re-adjust steering box as necessary, see Service Notes.
(B) Heavy steering when parking.	1. Loose pump belt (nearly always accompanied by a squealing noise).	Check pump driving belt and replace if necessary.
	2. Insufficient pressure from pump due to restricted hoses or defective pump valve.	Remove restriction or check pump output pressure as described on Page II.7 Service Instructions. Check the flow control valve is not stuck open and that valve is free to move.
	3. Insufficient pressure due to high leaks in steering gear.	Confirm high internal leaks by carrying out leak tests as described on page II.7. If proven, remove gear from car and replace seals.

STEERING (POWER ASSISTED)

FAULT	POSSIBLE CAUSE	REMEDY
Steering effort too light.	Worn torsion bar dowel pins or torsion bar broken.	Remove steering box from car, remove worm and valve assembly from box and check that the valve rotor has no free play relative to the valve sleeve. Replace worm and valve assembly as necessary.
Unbalance of steering effort varying irregularly.	1. Worn or loose trim pin. 2. Rotor sticking in valve sleeve.	Remove steering box and replace worm and valve assembly. Remove steering box from car and take worm and valve assembly out. Hold worm in hand and rotate rotor to and fro feeling for stickness, Replace worm and valve assembly if necessary.
Poor straight running.	1. Incorrect tyre pressure. 2. Incorrect toe-in. 3. Steering gear requires adjustment. (a) If there is lost motion in the steering box. (b) If the steering box is too stiff due to over-adjustment.	Inflate. Check and reset if necessary. Adjust steering box as described on Page II.13. Adjust box correctly as above.
Noise Pump.	1. Belt loose indicated by squealing during parking manoeuvres. 2. Other pump noises are due to wear or damaged parts. **Note:** The pump pressure release valve is invariably noisy and it will be heard when the steering is turned hard on the lock stops.	Check driving belt and replace if necessary. Replace the pump. There is no remedy to this noise.
Noise Steering Gear.	There are hissing noises present in most power steering systems, one of the most common is a sizzling sound which is most evident when parking. This noise does not effect the performance of the steering gear in any way. If the steering gear grunts when the steering wheel is being moved this could be caused by a faulty damping ring in the valve assembly.	Remove steering box from car and replace worm and valve assembly.

FAULT	POSSIBLE CAUSE	REMEDY
Rattles		
1. General.	1. Steering column joints.	These should be checked first before investigating steering box. Remove box from car and add shims between valve housing and the bearing outer race as described on Page II.12 Assembling.
2. A sharp light rattle when running straight ahead over anything but the smoothest roads, particularly noticeable at low speed. Can be heard and felt at steering wheel.	2. Input Shaft End Float. It should be possible to feel this end float on the worm whilst steering wheel is oscillated gently.	
3. As 2 but slightly muffled and caused by slightly rougher roads.	3. Sector Shaft End Float. This is due to clearance between the head of the adjuster screw and the sector shaft. End float can be felt between the sector shaft and the gear housing whilst the steering wheel is oscillated gently. Also a pointer to this fault is the fact that the rattle will be more prevalent during left hand corners with a R.H.D. car and vice versa.	Remove steering box from car and replace sector shaft assembly.
4. A heavy muffled flutter which appears particularly when running straight ahead over bumps in the road, best detected at 20 m.p.h. (32 k.m.) Also, steering will probably thump and pulse when the direction of movement of the steering wheel is changed rapidly.	Clearance between the piston rack teeth and the sector shaft teeth.	Tighten as per Service Instructions Page II.13.

SPECIAL SERVICE TOOLS

Description
Valve seal expander (J.32)*
Valve seal compressor (J.33)*
Spline seal protector (J.34)*
Ball joint-separator (J.D 24)*
* Churchill Tool Number.

FRONT SUSPENSION

SECTION J

INDEX

FRONT SUSPENSION

FRONT SUSPENSION

DESCRIPTION

The assembly comprises a fabricated pressed steel cross member with two "turrets" welded at either end. The steering unit, idler assembly, track rod and tie-rods are also attached to the cross member. The coil springs are housed in the "turrets" and are retained at the lower end by seat pans bolted to the lower wishbone. Each coil spring is controlled by a direct acting hydraulic damper mounted in the centre of the spring. The top end of the damper is attached to the turret and the lower end is bolted to a mounting bracket which is, in turn, bolted to the coil spring seat pan.

The upper wishbone levers are steel forged ano are mounted at the fulcrum shaft end on rubber/steel bonded bushes. The outer ends of the wishbone levers are bolted to the upper wishbone ball joint which is attached to the stub axle carrier.

The lower wishbone is a one-piece forging attached at the inner ends to rubber/steel bonded bushes and at the outer ends to the lower ball joint which is also attached to the stub axle carrier.

The wheel hub is supported on two tapered roller bearings, the inner races of which fit on a shaft located in a tapered hole bored in the axle stub axle carrier.

An anti-roll bar, fitted between the two lower wishbones, is attached to the chassis side members by rubber insulated brackets.

The front suspension assembly is attached to the body underframe at four points. The two longitudinal members are attached to brackets at the front end of the chassis side members with rubber/steel bonded mountings. The transverse member is attached to the chassis side members with two "V" shaped rubber/steel bonded mountings.

DATA

Type	Independent—Coil Spring
Dampers	Telescopic hydraulic
Castor angle	$0 \pm \frac{1}{2}°$
Camber angle	$\frac{1}{2}° \pm \frac{1}{2}°$ positive
Swivel inclination	$3\frac{1}{2}°$

ROUTINE MAINTENANCE

Front Suspension

The front suspension wishbone levers and anti-roll bar are supported in rubber bushes which do not require any periodic attention.

Front Hydraulic Dampers

The front hydraulic dampers are sealed units and no provision is made for adjustment or replenishing fluid.

EVERY 6,000 MILES (10,000 KM.)

Wheel Swivels

Lubricate the nipples (four per car) fitted to the top and bottom wheel swivels.

A bleed hole is incorporated in each ball joint. This hole is covered by a circular nylon washer which lifts under pressure, allowing grease to escape and indicating when sufficient lubricant has been applied.

Front Wheel Alignment

Check and adjust if necessary, the front wheel alignment as detailed on pages I.11 (Standard Steering) and page II.23 (Power Assisted Steering).

EVERY 12,000 MILES (20,000 KM)

Front Wheel Bearings

Remove the front wheel nave plate to expose a grease nipple in the wheel bearing hubs. Lubricate sparingly with the recommended grade of lubricant.

Wheel Bearing Adjustment

Check the front wheel bearings for correct end float and adjust if necessary, as detailed on page J.6.

FRONT SUSPENSION ASSEMBLY

Removal

Jack up the car under the front suspension cross member until the road wheels are clear of the ground. Remove the wheels.

Support the weight of the car under the front jacking sockets by means of blocks not less than 16" (40 cm.) in height. Leave the jack in position.

Remove the four self-locking nuts securing the front suspension rear mountings to the chassis side members.

Remove the four bolts, washers and nuts securing the front mountings to the brackets at the front ends of the chassis side members.

ROUTINE MAINTENANCE

ROUTINE MAINTENANCE
Every 6,000 Miles (10,000 km.)
Outer Pivot Bearings
A grease nipple is located in the centre of the rear wishbone outer pivot. Lubricate sparingly with the recommended grade of lubricant. A bleed hole is provided, opposite the grease nipple, to indicate when an excess of lubricant has been applied. Always ascertain that the bleed hole is clear before carrying out this operation.

Inner Pivot Bearing
Two grease nipples are provided, one at each end of the wishbone fork. Lubricate sparingly with the recommended grade of lubricant.

EVERY 12,000 MILES (20,000 KM.)
Check rear wheel bearings for correct end float and adjust as necessary. See instructions given on page K.7.

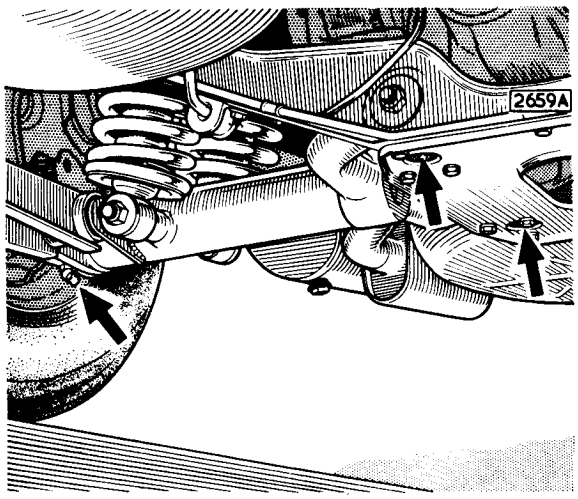


Fig. No. 2 *Inner and outer pivot bearing grease nipples*

RECOMMENDED LUBRICANTS

	Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent Caltex/Texaco
Wishbone Pivots	Mobilgrease MP	Castrolease LM	Retinax A	Esso Multi-purpose Grease H	Energrease L2	LB10	Marfak All-purpose

REAR SUSPENSION ASSEMBLY
Removal
Slacken the two clamp bolts which secure the muffler boxes to the rear silencers.
Remove the four nuts and washers retaining the muffler mounting rubbers to the underside of the car.
Withdraw the mufflers.
Remove the locking wire from the radius arm safety strap and securing bolt.
Unscrew the two bolts securing the safety strap to the body floor.
Remove the radius arm securing bolt and spring washer and remove the safety strap.
Withdraw the radius arm from the mounting post on the body.
Place a stout piece of wood approximately 9" × 9" × 1" (22.8 cm. × 22.8 cm. × 25.4 mm.) between the rear suspension tie plate and the jack.
Jack up the rear of the car and place two chassis stands of equal height under the body forward of the radius arm mounting posts. Place blocks of wood between the chassis stands and the body to avoid damage.
Remove the rear road wheels.
Disconnect the flexible brake pipe at the connection on the body.
Remove the split pin, washer and clevis pin securing the handbrake cable to the handbrake caliper actuating levers mounted on the suspension cross beam.
Slacken the locknut and screw the outer handbrake cable screw out of the adjuster block.
Remove the four bolts and self-locking nuts securing the mounting rubbers at the front of the cross beam to the body frame. Remove the six self-locking nuts and four bolts securing the rear mounting rubbers to the cross beam.
Remove the four self-locking nuts and bolts securing the propeller shaft to the differential pinion flange.

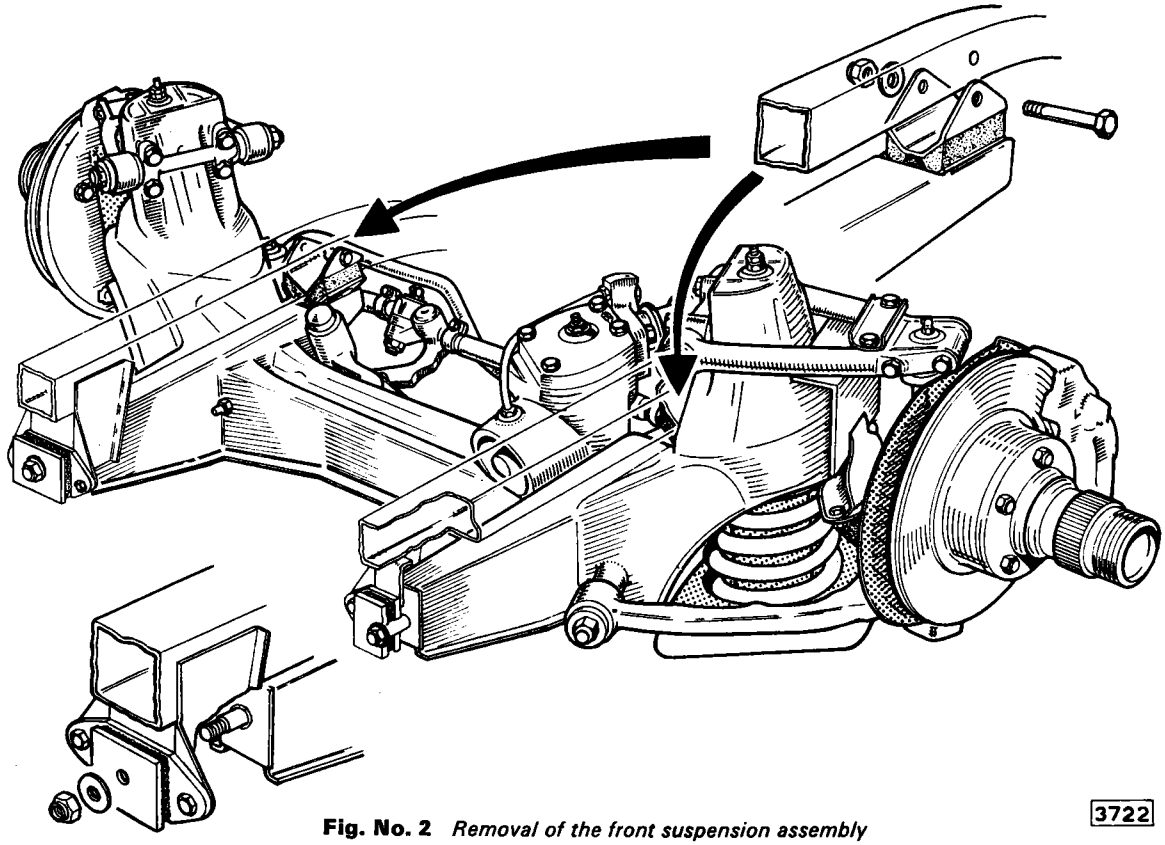


Fig. No. 2 *Removal of the front suspension assembly*

Coil Springs

The coil springs are marked with coloured paint (which may be covered by tape) to denote springs of the same static load. It is, therefore, important that the two front springs fitted to the car are of the same colour code.

Removal

Remove the hydraulic damper as detailed previously.
Insert a coil spring compressor (Churchill Tool No. JD.16) through the centre of the spring from underneath and compress the spring sufficiently to relieve the load on the spring seat pan screws.
Withdraw the nut and bolt and detach the anti-roll bar link arm from the bracket welded to the rear edge of the spring seat pan.
Remove the six setscrews and spring washers securing the seat pan to the lower wishbone.
Release the spring compressor until the load is completely relieved from the spring. Unscrew the compressor and withdraw the spring and seat pan.
Note any packing pieces which may be fitted on top of the spring. See under heading "Coil Spring Packing Pieces", page J.6.

Refitting

Align the seat pan holes with the tapped holes in the lower wishbone by using 8" (20 cm.) pilot studs as shown in Fig. 3.
Reverse the removal procedure to refit.

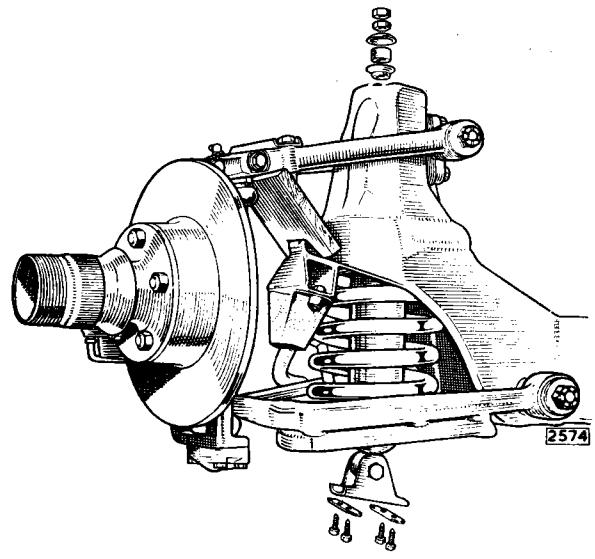


Fig. No. 3 *Removal of the front shock absorber*

Coil Spring Packing Pieces

Packing pieces may be fitted above the coil springs of some cars to accommodate manufacturing variations in the springs which are graded into three groups and

identified by a colour patch in the middle of the coil. On Right Hand Drive cars ONLY, the right hand spring has $\frac{1}{8}$" (3.2 mm.) more packing than the left hand spring to equalise the standing height of the car.

Colour Code	Packing required L.H. Drive
Red	$\frac{1}{4}$" (6.4 mm.)
Yellow	$\frac{1}{8}$" (3.2 mm.)
Purple	None

Colour Code	Packing required R.H. Drive	
	L.H. Spring	R.H. Spring
Red	$\frac{1}{4}$" (6.4 mm.)	$\frac{3}{8}$" (9.5 mm.)
Yellow	$\frac{1}{8}$" (3.2 mm.)	$\frac{1}{4}$" (6.4 mm.)
Purple	None	$\frac{1}{8}$" (3.2 mm.)

On cars fitted with air conditioning **only springs with purple colour coding may be used.** The correct packing pieces employed are given below.

Packing required L.H. Drive

L.H. Spring	R.H. Spring
$\frac{1}{4}$" (6.4 mm.)	$\frac{1}{4}$" (6.4 mm.)

Packing required R.H. Drive

L.H. Spring	R.H. Spring
$\frac{1}{4}$" (6.4 mm.)	$\frac{3}{8}$" (9.5 mm.)

WHEEL HUBS

Removal

Firmly apply the handbrake. Jack up the front of the car and remove the road wheel.

Remove the caliper from the front stub axle.

Prise off the end cap and remove the split pin retaining the hub nut.

On cars fitted with wire wheels, holes are provided in the hub through which the split pin can be withdrawn.

Remove the slotted nut and washer from the stub axle shaft and withdraw the hub by hand.

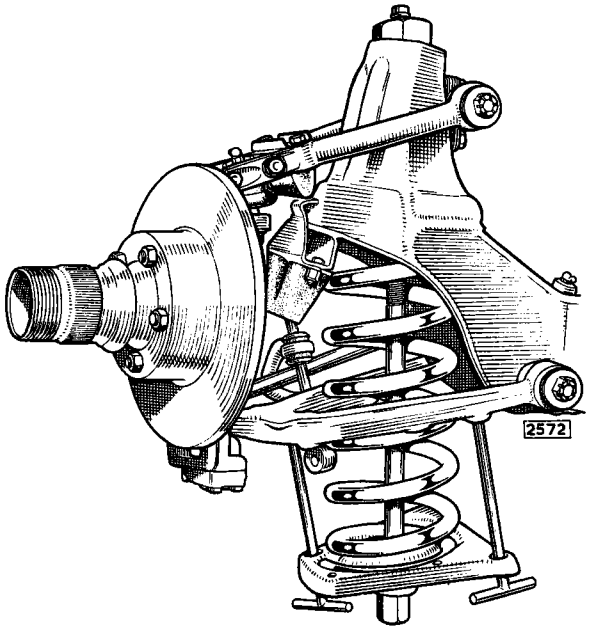


Fig. No. 4 *Refitting the coil spring*

Dismantling

Extract the grease seal. Withdraw the inner races of the taper roller bearings. If new bearings are to be fitted, the outer races may be drifted out, grooves being provided in the abutment shoulders of the hub for this purpose.

Refitting

Lubricate the bearings as detailed in "Routine Maintenance". Reverse the removal procedure to refit the hub.

Adjust the bearing end-float as described in the next paragraph.

Ensure that the brake caliper is centralised and bleed the brake system.

Bearing End-Float Adjustment

The correct end-float of the wheel bearing is .003—.005" (.08—.13 mm.).

This end-float may be measured with a dial indicator gauge mounted with the plunger against the end of the hub.

If a gauge is not available, tighten the hub nut until there is no end-float, that is, when the rotation of the hub is slightly restricted.

Slacken back the hub between one and two flats dependent upon the position of the split pin hole relative to the slots in the nut.

Temporarily attach the road wheel and check that the wheel spins freely.

If satisfactory, fit a new split pin and turn over the ends.

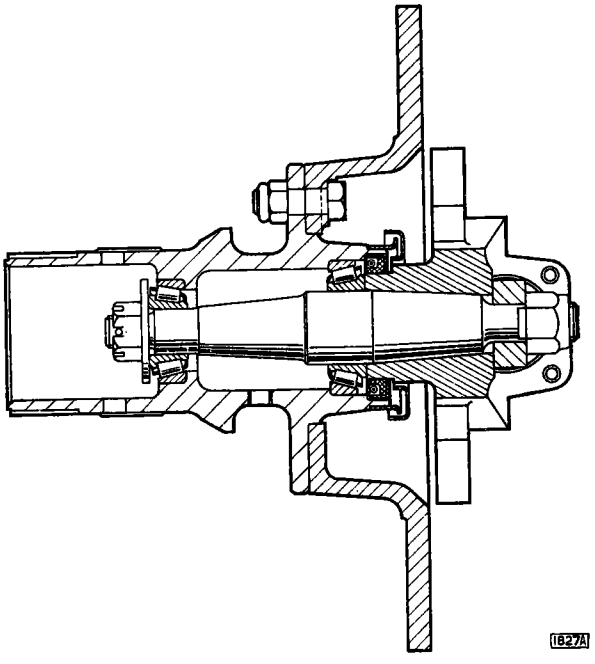


Fig. No. 5 *Sectional view of the disc brake arrangement*

STUB AXLE CARRIERS

Removal

Jack up under the lower wishbone lever and remove the road wheel.

Remove the caliper from the stub axle carrier and remove the front wheel hub complete with disc brake as described on page J.6.

Remove the self-locking nut and plain washer securing the upper ball joint to the stub axle carrier; remove the split pin, nut and plain washer securing the lower ball joint to the lower wishbone. Remove the ball joint using the extractor (Churchill Tool No. JD. 24) and remove the stub axle carrier.

Refitting

Refitting is the reverse of the removal procedure.

LOWER WISHBONE

Removal

Remove the coil spring as described on page J.5.

Remove the stub axle carrier as described above.

Withdraw the split pin, slotted nut and washer from one end of the lower wishbone fulcrum shaft. The shaft can now be drifted out.

Fitting the Rubber/Steel Bushes

Drift out or press out the bush from the wishbone eye.

Press the new bush into the eye, ensuring that the bush projects from each side by an equal amount. Fitting of the bush will be facilitated if a lubricant, made up of twelve parts of water to one part of liquid soap, is used.

Refitting

Refitting is the reverse of the removal procedure. When refitting the fulcrum shaft the car should be in normal riding position before the nuts at each end of the shaft are fully tightened. Omitting to carry out this procedure will result in undue torsional loading of the rubber bushes with possible premature failure.

LOWER WISHBONE BALL JOINT

Removal

Remove the stub axle carrier complete with the lower wishbone ball joint as described on this page.

Dismantling

Remove the retaining ring and withdraw the rubber gaiter. Withdraw the retainer from the top of the ball pin.

Tap back the tab washers and unscrew the four setscrews securing the ball pin cap to the stub axle carrier.

Remove the cap, shims, ball pin socket, spigot and ball pin.

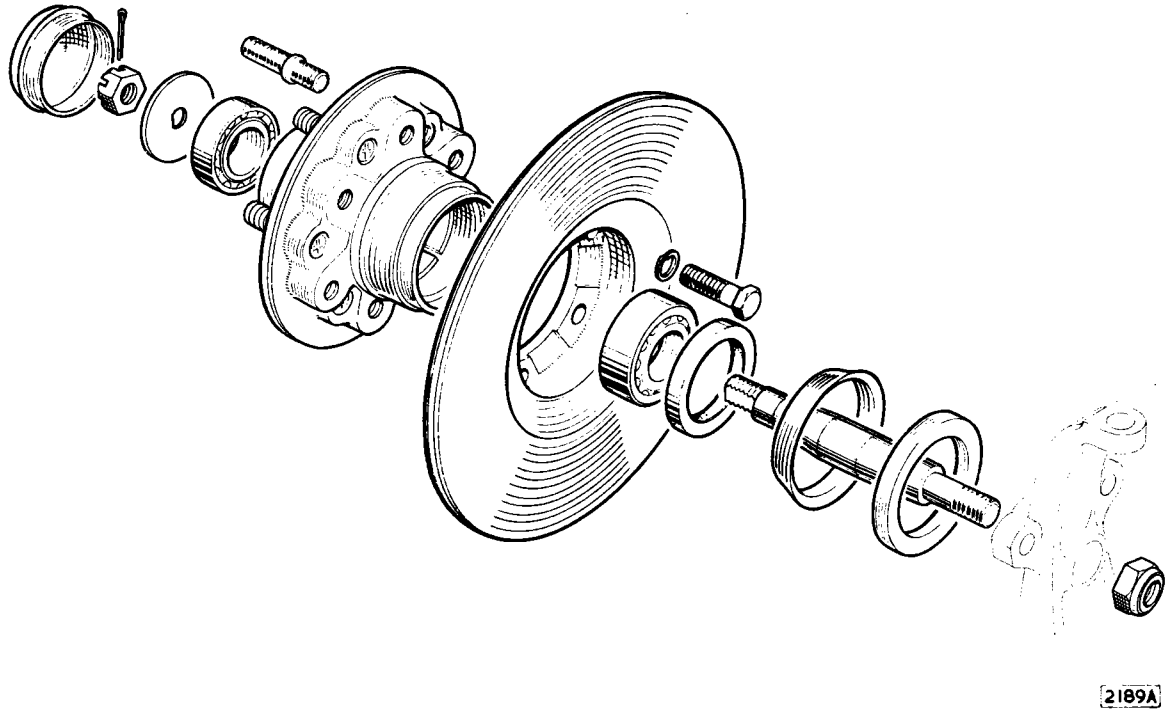


Fig. No. 6 *Exploded view of the wheel hub*

Reassembling
Reassembling is the reverse of the dismantling procedure but, if necessary, re-shim the ball joint to obtain the correct clearance of .004"—006" (.10 mm.—.15 mm.).
Note: Shims should not be removed to take up **excessive** wear in the ball pin and socket; if these parts are badly worn, replacements should be fitted.

Adjustment of the Ball Joint
The correct clearance of the ball pin in its socket is .004"—.006" (.10 mm.—.15 mm.). Shims for adjustment of the ball joint are available in .002" (.05 mm.) and .004" (.10 mm.) thicknesses.
To adjust the ball pin clearance to the correct figure, remove shims one by one until, with the ball cap fully tightened, the ball is tight in its socket. Fit shims to the value of .004"—.006" (.10 mm.—.15 mm.) which should enable the shank of the ball pin to be moved by hand.

Refitting
Refit the stub axle carrier complete with the lower wishbone ball joint as described on page J.7.

UPPER WISHBONE
Removal
Jack up under the lower wishbone and remove the road wheel.
Remove the two bolts, nuts and plain washers securing the ball joint to the upper wishbone levers. Note the relative positions of the packing piece and shims as these control the castor angle. Alternatively, remove the self-locking nut and remove the ball joint using an extractor (Churchill Tool No. JD. 24) from the sub axle carrier. Tie-up the stub axle carrier to the suspension cross member so that the flexible brake hose does not become extended.
Remove the four set bolts which secure the upper wishbone fulcrum shaft to the suspension cross-member turret. Note the relative positions of the shims as these control the camber angle.
The upper wishbone assembly can now be removed.

Dismantling
Remove the nuts, bolts and distance pieces securing the rebound stop bracket to the upper wishbone levers. Extract the split pin and remove the slotted nuts and plain washers which secure the wishbone levers to the fulcrum shaft. The wishbone levers can now be removed from the fulcrum shaft.

Fitting the Rubber/Steel Bushes
Drift out or press out the bush from the wishbone eye. Press the new bush into the eye, ensuring that the bush projects from each side by an equal amount. Fitting of the bush will be facilitated if a lubricant, twelve parts of water to one part of liquid soap, is used.

Reassembling
The reassembly of the upper wishbone assembly is the reverse of the dismantling procedure but the slotted nuts securing the wishbone levers to the fulcrum shaft

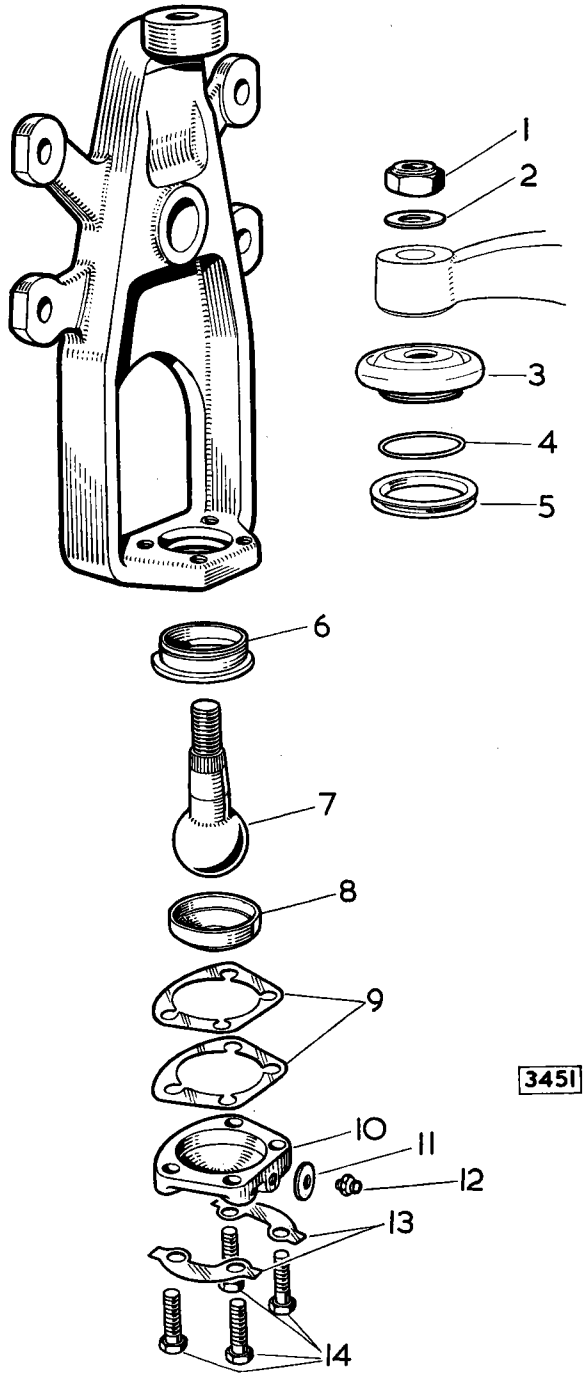


Fig. No. 7 *Exploded view of the lower wishbone ball joint*

1	Nut	**8**	Socket
2	Washer	**9**	Shim
3	Rubber gaiter	**10**	Cap
4	Ring	**11**	Washer
5	Plastic insert	**12**	Grease nipple
6	Spigot	**13**	Tab washer
7	Ball pin	**14**	Bolts

must not be tightened until the upper wishbone assembly has been refitted and the full weight of the car is on the suspension. Omitting to carry out the procedure will result in undue torsional loading of the rubber bushes with possible premature failure.

Refitting
Refitting is the reverse of the removal procedure.

UPPER WISHBONE BALL JOINT

The upper wishbone ball joint cannot be dismantled and, if worn, the complete assembly must be replaced.

Removal
Jack up the car under the lower wishbone and remove the road wheel.
Remove the two bolts, nuts and plain washer securing the ball joint to the upper wishbone levers. Note the relative positions of the packing piece and shims as these control the castor angle.
Remove the self-locking nut and plain washers which secure the ball joint to the stub axle carrier.
The ball joint can now be removed from the stub axle carrier in which it is a taper fit by using an extractor (Churchill Tool No. JD. 24).
Note: When carring out the above operation do not allow the flexible brake hose to become extended; tie up the stub axle carrier to the cross member turret.

Refitting
Refitting is the reverse of the removal procedure. Ensure that the packing piece and shims are refitted in their original positions otherwise the castor angle will be upset.

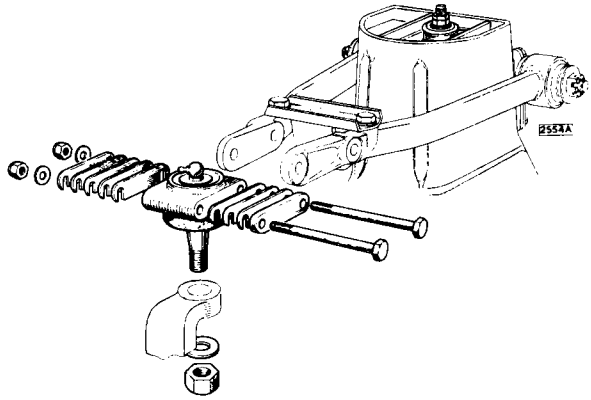


Fig. No. 8 *Removal of the upper wishbone ball joint*

CASTOR ANGLE ADJUSTMENT

Before checking the castor angle, examine all rubber/steel bushes for deterioration or distortion. Check the upper and lower wishbone ball joints for excessive play; check the shock absorbers and mountings. Ensure that the standing height of the car is satifactory.

Make up two setting blocks to the dimensions given in Fig. 9 in order to lock the front suspension in the mid-laden position. Compress the front suspension and place the setting blocks under the upper wishbone adjacent to the bump stop rebound rubber and over the bracket welded to the bottom of the "turret". See Fig. 10.
Using the special links, set the rear suspension in the mid-laden position as described on page K.15.
Ensure that all tyre pressures are correct and that the car is standing on a perfectly level surface.

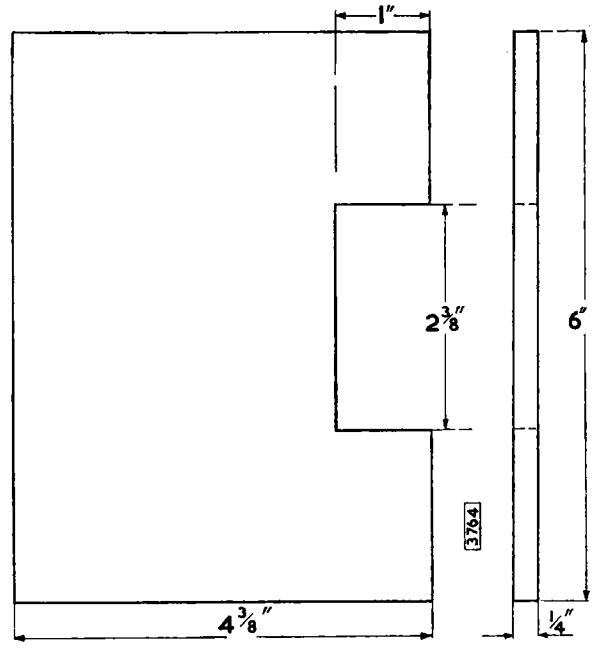


Fig. No. 9 *Dimensions for the setting block*

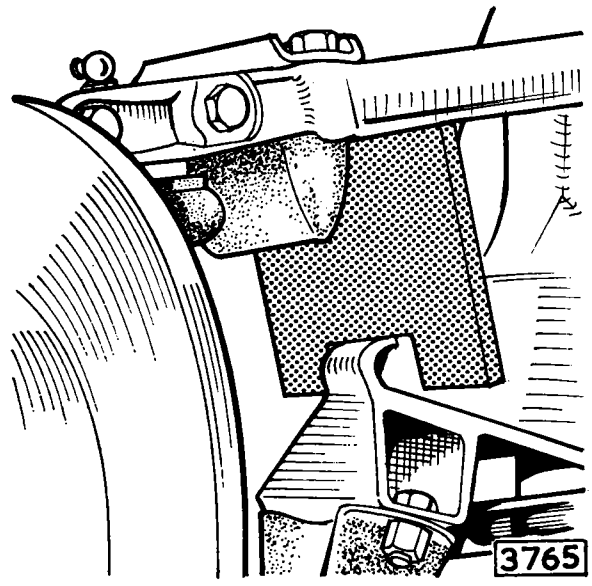


Fig. No. 10 *The setting block in position*

Using an approved gauge, check the castor angle.
Castor angle : 0° ± ½°.
Note: The two front wheels must be within ½° of each other.
Adjustment is effected by either transposing the shims from the rear of the upper wishbone ball joint to the front, or transposing the packing piece and shim(s). To decrease negative castor or increase positive castor, transpose shims from the rear to the front; the holes in the shims are slotted and therefore it will only be necessary to slacken the two bolts securing the upper wishbone members to enable the shims to be removed. To increase negative castor or decrease positive castor, transpose the packing piece and shims as necessary. As the holes in the packing piece are not slotted it will be necessary to remove the two bolts after first having placed a support under the brake disc or lower wishbone.
The shims are 1/16" (1.6 mm.) thick and it should be noted that 1/16" (1.6 mm.) of shimming will alter the castor angle by approximately ¼°.

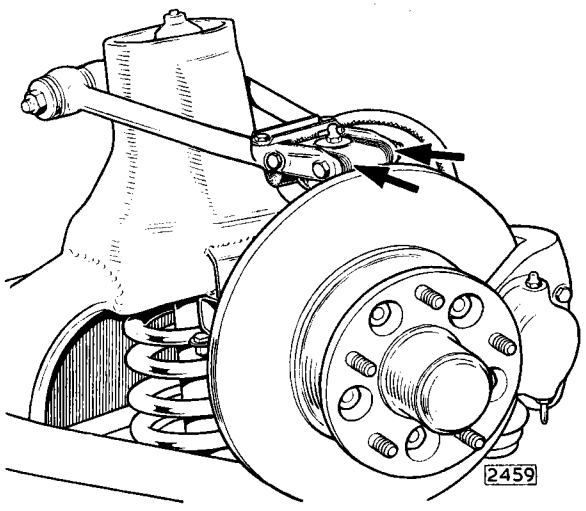


Fig. No. 11 *The castor angle is adjusted by means of shims and packing pieces indicated by the arrows*

The front of the car should be jacked up when turning the wheels from lock to lock during checking.
If any adjustment is made to the castor angle, the front wheel alignment should be checked and if, necessary, re-set.
Note: A packing piece and 8 shims must always be fitted between the wishbone levers and the upper ball joint; their relative positions may, of course, not always be the same.

CAMBER ANGLE ADJUSTMENT

Before checking the camber angle, examine all rubber/steel bushes for deterioration or distortion. Check the upper and lower wishbone ball joints for excessive play; check the shock absorbers and mountings. Ensure that the standing height of the car is satisfactory. Lock the front and rear suspensions in the mid-laden position as detailed under the heading "Castor Angle Adjustment".
Ensure that the tyre pressures are correct and that the car is standing on a level surface.
Line up the front wheel being checked parallel to the centre line of the car. Using an approved gauge, check the camber angle. Rotate the wheel being checked through 180° and re-check.
Camber angle : ½° ± ½° positive.
Note: The two front wheels must be within ½° of each other.
Adjustment is effected by removing or adding shims at the front suspension top wishbone bracket; the holes in the shims are slotted and it is therefore only necessary to slacken the set screws securing the bracket to enable the shims to be removed. Inserting shims decreases the positive camber; removing shims decreases negative camber or increases positive camber. Remove or add an equal thickness of shims from each position, otherwise the castor angle will be affected. Shims for the adjustment of camber are available in 1/32" (.8 mm.) 3/64" (1.2 mm.) and 1/16" (1.6 mm.) thicknesses and it should be noted that 1/16" (1.6 mm.) of shimming will alter the camber angle by approximately ¼°.
Check the other front wheel in a similar manner. If any adjustment is made to the camber angle, the front wheel alignment should be checked and, if necessary, reset.

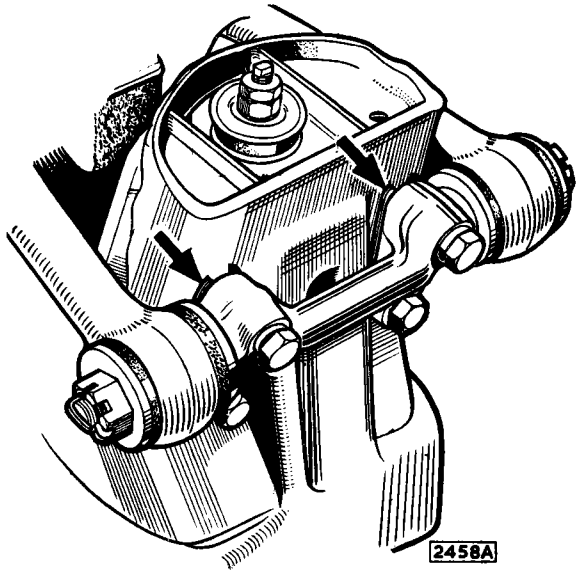


Fig. No. 12 *The front wheel camber is adjusted by means of the shims indicated by the arrows. Remove or add an equal thickness of shims from each position.*

ANTI-ROLL BAR

Removal

Raise the car on a lift to enable work to be carried out underneath. Remove the four bolts from the anti-roll bar support brackets on the chassis side members.
Remove the self-locking nut and remove the bolt attaching the link arm to the coil spring seat. Repeat for the other side.

To seperate the anti-roll bar from the link arms remove the self-locking nuts, upper cup washers and rubbers. Care should be taken to replace the distance tube when refitting.
The anti-roll bracket rubbers are split to enable them to be removed.

Fitting the Link Arm Bush
Drift out or press out the bush from the link arm eye. Press the new bush into the eye, ensuring that the bush projects from each side by an equal amount. Fitting of the bush will be facilitated if a lubricant, twelve parts of water to one part of liquid soap, is used.

Refitting
Refitting is the reverse of the removal procedure. It is important when attaching the support brackets to the chassis side members, to have the full weight of the car on the road wheels.

ACCIDENTAL DAMAGE

The dimensioned drawings are provided to assist in assessing accidental damage. A component suspected of being damaged should be removed from the car, cleaned off and the dimensions checked and compared with those given in the appropriate illustration.

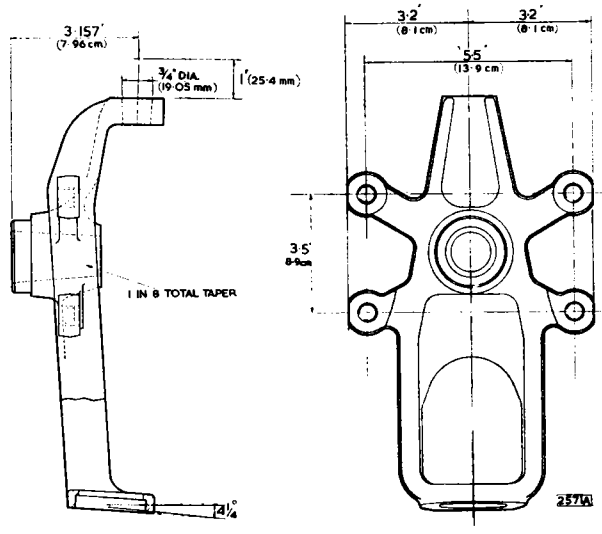


Fig. No. 13 *Stub axle carrier*

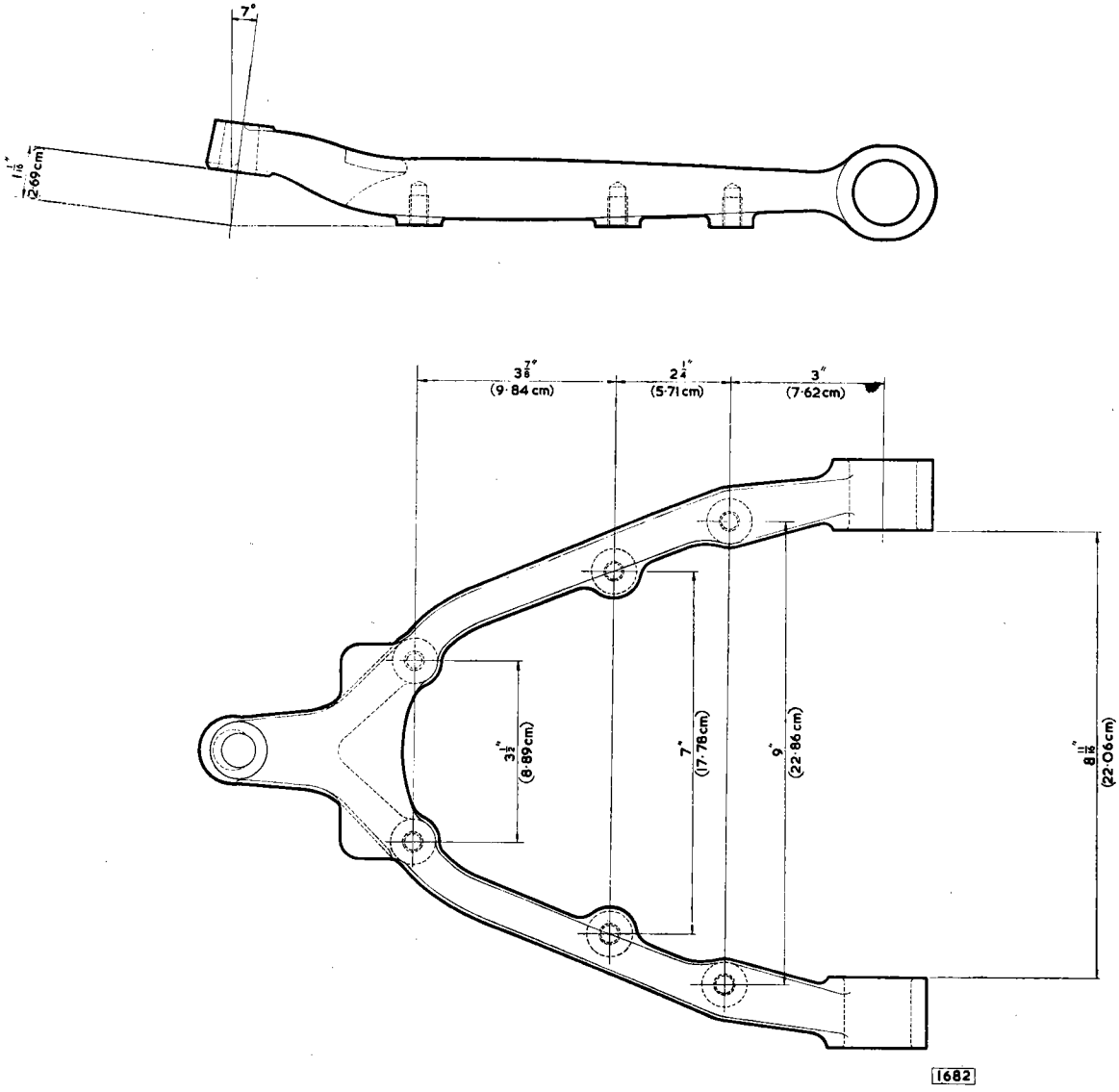


Fig. No. 14 *Lower wishbone*

REAR SUSPENSION

SECTION K

INDEX

REAR SUSPENSION

REAR SUSPENSION

DESCRIPTION

The rear wheels are located in a transverse plane by two links of which the top link is the half shaft universally jointed at each end. The lower link is pivoted at the wheel carrier and at the crossbeam adjacent to the differential casing. To provide maximum rigidity in a longitudinal plane the pivot bearings at both ends of the lower link are widely spaced. The suspension medium is provided by four coil springs enclosing telescopic hydraulic dampers, two being mounted on either side of the differential casing. The complete assembly is carried in a fabricated steel crossbeam. The crossbeam is attached to the body by four "Vee" rubber blocks and is located by radius arms. The radius arm pivots are rubber bushes mounted on each side of the car between the lower link and a mounting point on the body structure.

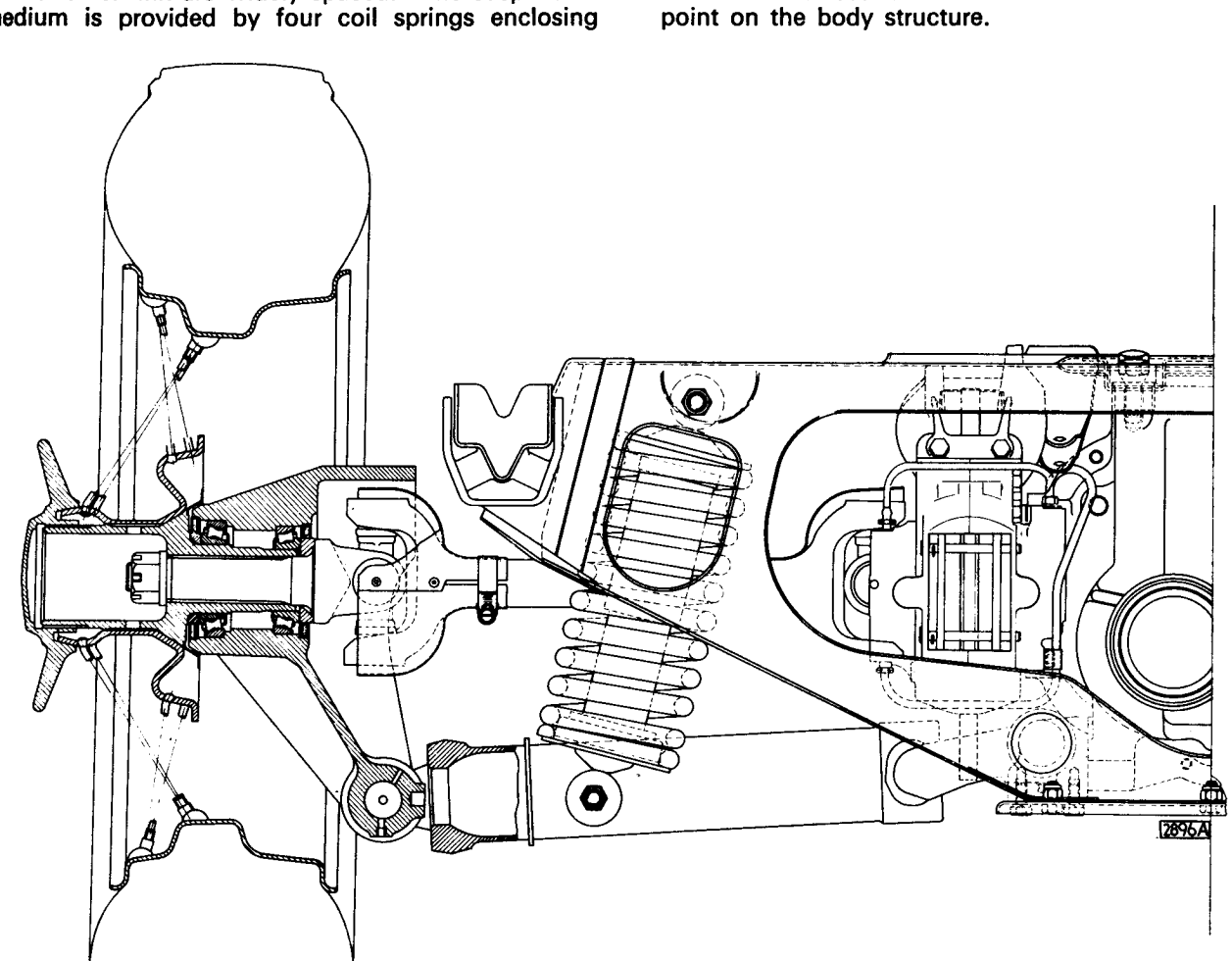


Fig. No. 1 *Sectioned view of rear suspension*

DATA

Rear Road Spring:	
Free length .	11.295" (28.9 cm.)
Identification colour .	Red/Yellow
Wire diameter . .	.475" (12.06mm.)
Dampers	Telescopic

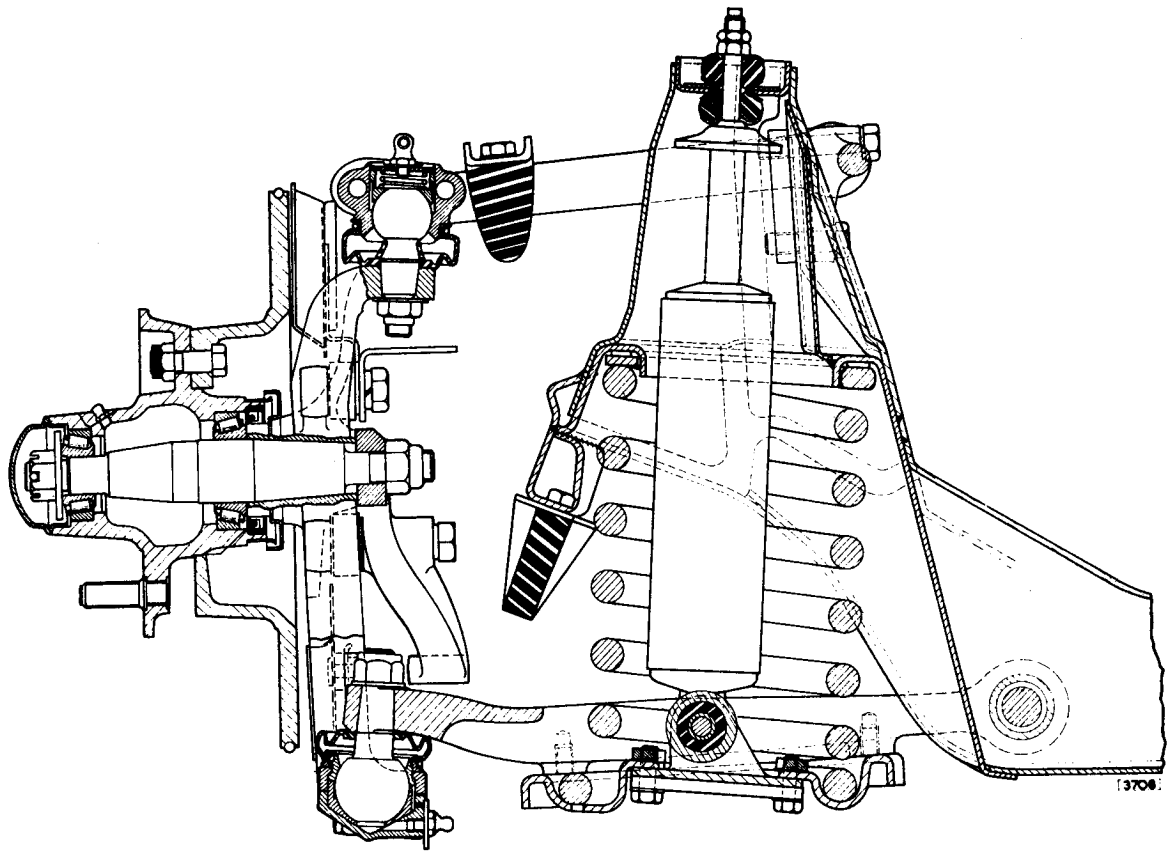


Fig. No. 1 *Sectional view of the front suspension unit*

Disconnect the two anti-roll bar mountings from the chassis underframe members.
Disconnect the flexible brake hoses at the body brackets. Seal all open hoses and connections.
Remove the two hoses from the power assisted steering unit (if fitted) and drain the fluid into a clean container Seal off the open ends of the hoses and ports.
Remove the clamping bolt securing the lower steering column universal joint to the steering unit input shaft.
Lower the front suspension assembly on the jack until it can be withdrawn forwards from the car.

Refitting
Reverse the removal procedure to refit the front suspension assembly. Ensure that the brake discs are in the straight ahead position and that the steering wheel is centralised.
Bleed the braking system as detailed on page L.6.
Bleed the steering unit as detailed on page II.14. (Power steering), if fitted.

Hydraulic Dampers
The telescopic hydraulic dampers are sealed with no provision for adjustment or replenishment with fluid. Therefore, in the event of a damper being unserviceable, a replacement unit must be fitted.

Removal
Jack up the car under the front suspension until the road wheels are clear of the ground. Remove the road wheel.
To facilitate removal, either place a packing piece between the upper wishbone and the cross member turret or place a support under the lower wishbone and lower the jack to compress the spring.
Remove the locknut and nut from the top damper mounting and withdraw the outer washer, rubber buffer and inner washer.
Knock back the tabs of the lock washer on the four serscrews securing the lower mounting bracket to the coil spring seat.
Remove the setscrews and withdraw the damper.

Refitting
Before fitting new dampers, it is advisable to "bleed" any air which may have accumulated in the pressure chamber due to the damper having been stored in the horizontal position.
Hold the damper vertically and make several strokes (not extending more than halfway) until there is no lost motion. Then extend the damper to its full length once or twice. Keep the damper upright until refitted.
Reverse the removal procedure to refit the damper unit.

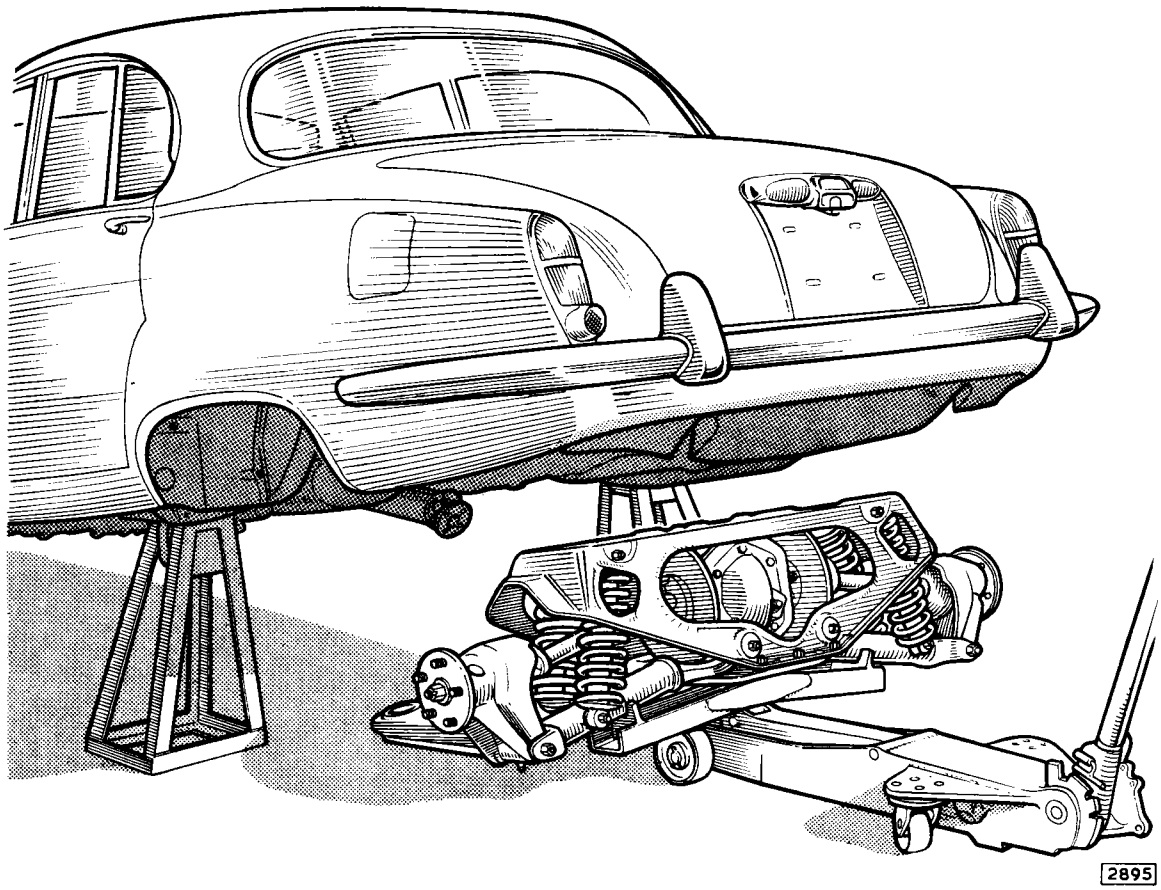


Fig. No. 3 *Removal of the rear suspension assembly from the car*

Lower the rear suspension unit on the jack and withdraw the unit from under the car as shown in Fig. 3.

Refitting
Refitting is the reverse of the removal procedure.
Check all mounting rubbers for deterioration.
Bleed the braking system as described on page L.6.
If the radius arms have been removed the rear suspension should be at the normal riding height before tightening the radius arm securing nuts on the rear suspension wishbone. Refit the radius arms as described on page K.10.

IMPORTANT
The following removal and refitting operations are described assuming the rear suspension is removed from the car. If it is possible for the operations to be carried out with the rear suspension in position on the car the fact will be noted in the text.

ROAD SPRING AND HYDRAULIC DAMPER ASSEMBLY

Removal
The road spring and hydraulic damper assembly may be removed from the car with the rear suspension assembly in position.
Remove the two self-locking nuts and washers securing the two hydraulic dampers to the wishbone.
Support the appropriate wishbone and drift out the hydraulic damper mounting pin, Fig. 5.
Remove the self-locking nut and bolt securing each hydraulic damper to the cross beam.
Withdraw the hydraulic damper and road spring assembly.

Refitting
Refitting is the reverse of the removal procedure.

THE REAR HUBS

Removal
It is not necessary to remove the rear suspension unit from the car to carry out this operation.
Jack up and support the rear end of the car and remove the appropriate road wheel. Withdraw the split pin and remove the castellated nut and washer from the half shaft. Using the extractor, Special Tool No. JD IC as shown in Fig. 6, withdraw the hub and hub carrier assembly from the splined end of the half shaft retaining the inner oil seal track and end float spacer. Remove the lower wishbone outer fulcrum shaft (as described on page K.11) and remove the hub and hub carrier assembly.

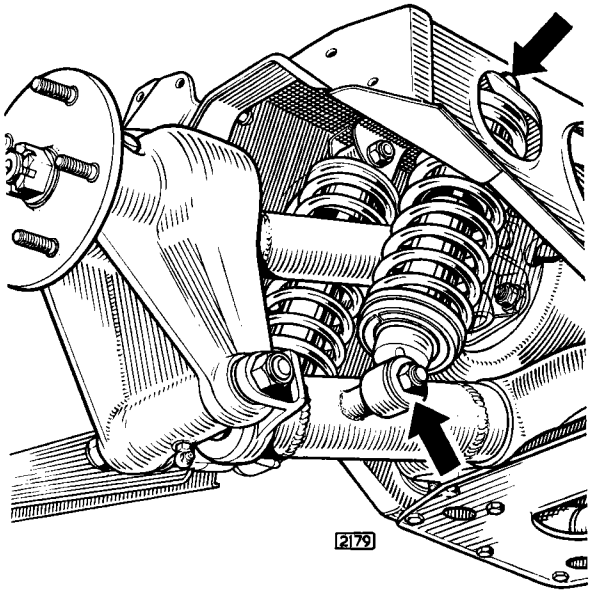


Fig. No. 4 *Hydraulic damper mounting points*

Note: Since it is necessary to press the hub assembly onto the half shaft before refitting the rear suspension assembly, remove the half shaft as follows:—
Remove the front hydraulic damper and spring unit (as described on page K.5. Remove the four steel type self-locking nuts securing the half shaft inner universal joint to the axle shaft output flange and brake disc. Withdraw the half shaft from the bolts noting the number of camber shims fitted.

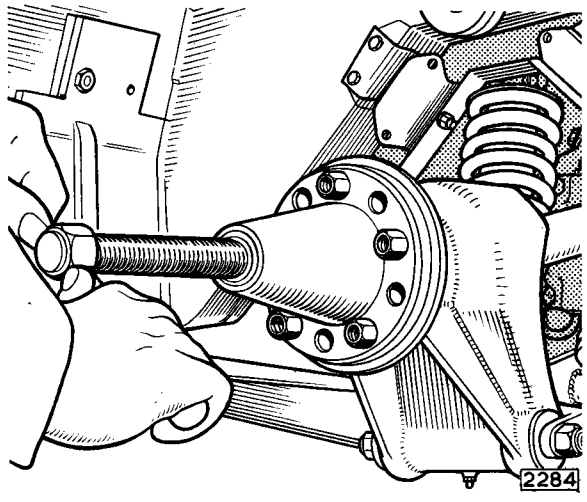


Fig. No. 6 *Removing the rear hub with the extractor (Churchill Tool No. JD. 1 C)*

Dismantling

Invert the hub carrier so that the inner hub bearing is at the top and press out the hub (Fig. 7) with the outer bearing inner race and the outer oil seal track in place, discarding the outer oil seal. Remove the three set-screws and withdraw the water deflector. Prise out the inner oil seal and remove the inner bearing inner

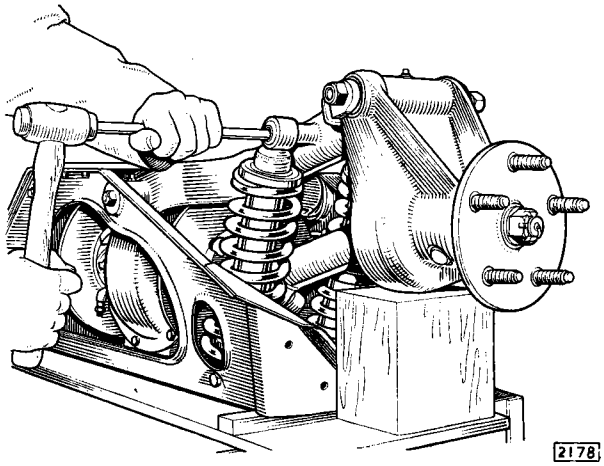


Fig. No. 5 *Drifting out the hydraulic damper mounting pin*

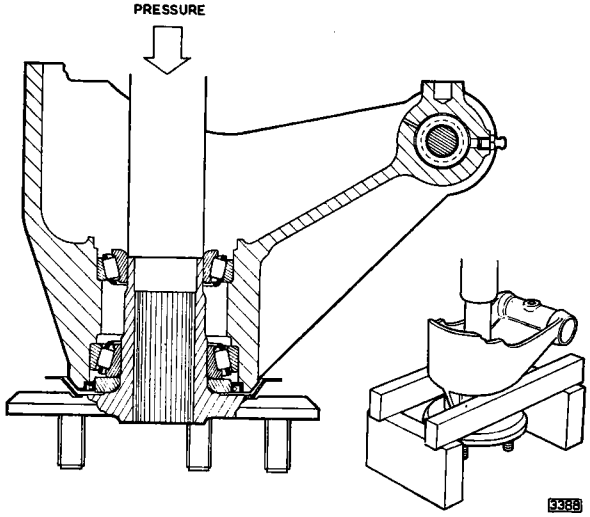


Fig. No. 7 *Pressing the hub from the hub carrier*

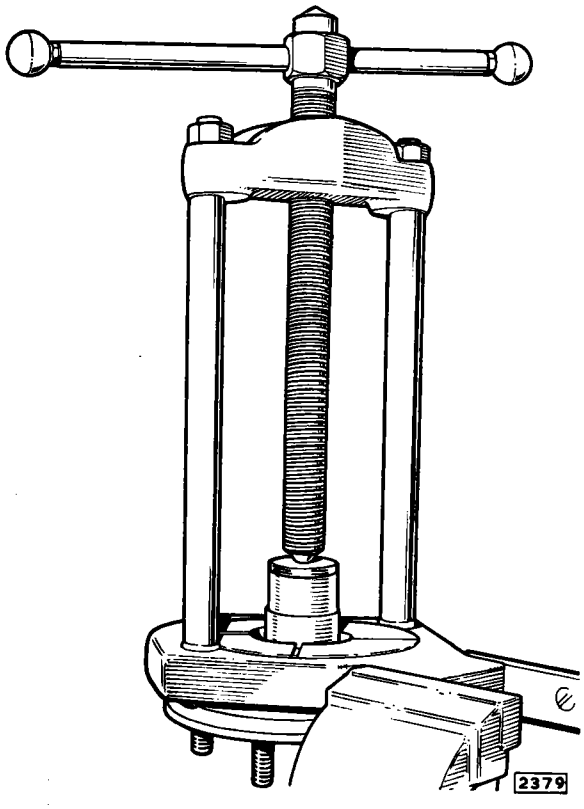


Fig. No. 8 *Removing the inner race from the hub using Churchill Tool No. J.16 B with multi-purpose hand-press, Tool No. SL.14*

race (Fig. 8). Drift out the outer races of the inner and outer bearings if necessary. Withdraw the outer bearing inner race with a suitable extractor.

Assembling

If new bearings are to be fitted, press new inner and outer bearing outer races into the hub carrier ensuring that they seat correctly in their recesses.

With the hub carrier held so that the outer bearing will be at the top, place the outer bearing inner race in position and press the outer oil seal into its recess (Fig. 9). Fit the water deflector and press the hub with the outer oil seal track In position into the outer bearing inner race until the hub is fully home.

Hub Bearing End Float

Hold the hub and hub carrier vertically in a hand press with the inner end of the hub uppermost. Place the inner bearing inner race on the hub, fit the master spacer (Special Tool No. J.15) into the race and press the race onto the hub (Fig. 10) until the master spacer contacts the hub. This will ensure a certain amount of end float. Remove the hub and hub carrier from the hand press and secure in a vice in order to measure the end float. With the inner end of the hub uppermost, and the master spacer in position as before, fit a dial gauge (Special Tool No. J.13) to the hub as shown in Fig. 11. Tap the hub carrier downwards, zero the dial gauge and using two screwdrivers or similar levers between the hub and hub carrier, move the hub carrier upwards to its fullest extent. Note the reading on the dial gauge.

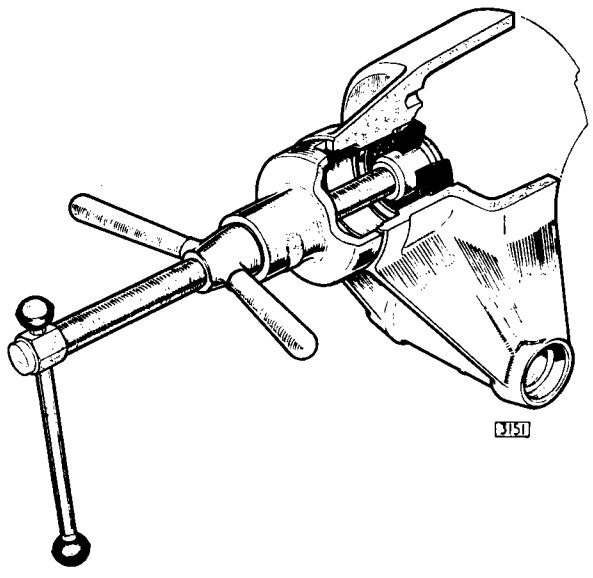


Fig. No. 9 *Replacing the hub bearing outer races using Churchill Tool No. J.20A with adaptor No. J.20A-1*

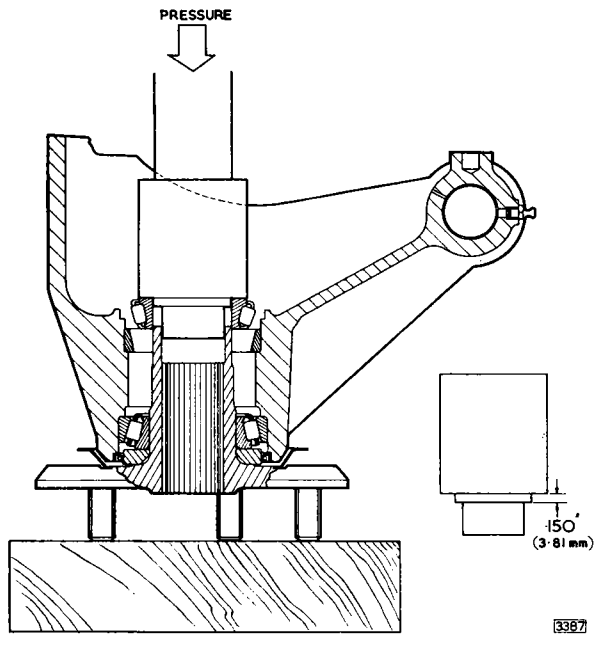


Fig. No. 10 *Pressing in the hub inner bearing inner race using Master spacer, (Churchill Tool No. J.15)*

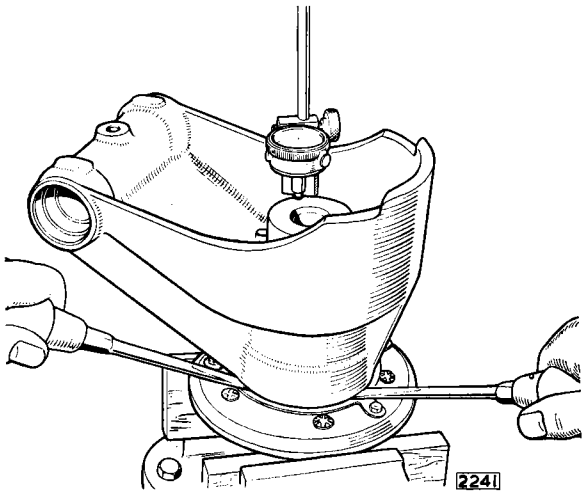


Fig. No. 11 *Checking the hub bearing end-float with a dial test indicator (Churchill Tool No. J.13)*

Having determined the measured end float, a spacer must be fitted in place of the special collar to give an end float of 0.002" - 0.006" (0.051 - 0.152 mm.). Spacers are supplied in thicknesses of 0.109" - 0.151" (2.77 - 2.87 mm.) in steps of 0.003" (0.076 mm.) as shown in the following table:—

Spacer Letter	Thickness	
	inches	mm.
A	0.109	2.77
B	0.112	2.85
C	0.115	2.92
D	0.118	3.00
E	0.121	3.07
F	0.124	3.15
G	0.127	3.23
H	0.130	3.30
J	0.133	3.38
K	0.136	3.45
L	0.139	3.53
M	0.142	3.61
P	0.145	3.68
Q	0.148	3.75
R	0.151	3.87

For example, assume the end float measured to be 0.025" (0.64 mm.). Subtract the nominal end float of 0.004" (0.10 mm.) from the measured end float giving 0.021" (0.53 mm.). Since the Master Spacer is 0.150" (3.81 mm.) thick, the thickness of the spacer to be fitted will be 0.150" - 0.021" i.e. 0.129" (3.28 mm.). The nearest spacer is 0.130" (3.30 mm.) so a letter H spacer should be fitted.

When the hub assembly and half shaft have been refitted to the rear suspension the end float should be checked using the dial indicator as shown in Fig. 13.

Fitting the Hub Assembly to the Half Shaft

To fit the hub assembly to the half shaft it will be necessary to use a hand press (see Fig. 12). Ensure that both splines of the half shaft and the hub are free of grease by using a suitable solvent. Place the inner oil seal track and end float spacer on the half shaft. Apply a drop or two of "Loctite" (available in 10 c.c. bottles, Part No. 9035) to the half shaft splines for about an inch from the threaded end using a small paint brush to ensure even spreading. Only use "Loctite" sparingly as no additional benefit will be achieved by using large amounts. Introduce the half shaft into the hub and engage the splines. Place the assembly on the hand-press and press the hub onto the half shaft. Fit the washer and castellated nut, tighten to 140 lb. ft. (19.3 kgm.) torque and fit the split pin.

Note: To obtain the best results from the "Loctite" sealant, the joint should be allowed to set for 4 to 12 hours, that is, this period should be allowed to elapse before the car is run.

Refitting

The hub assembly and half shaft are refitted to the rear suspension as described under "Half Shaft Refitting".

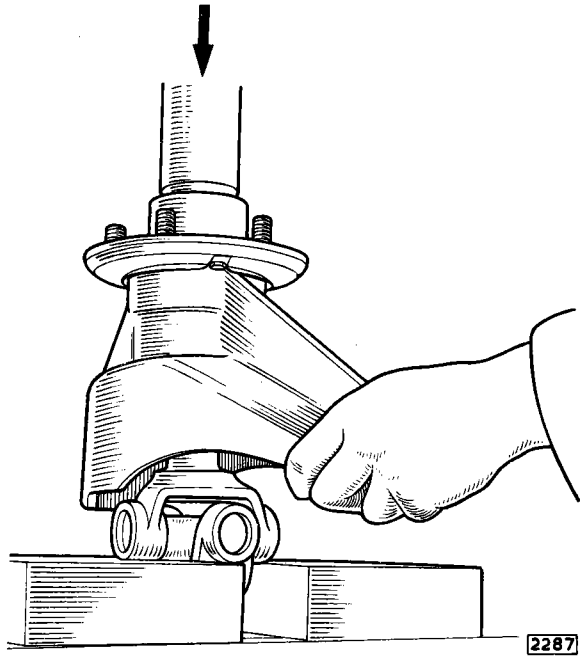


Fig. No. 12 *Fitting the hub to the half shaft using a press*

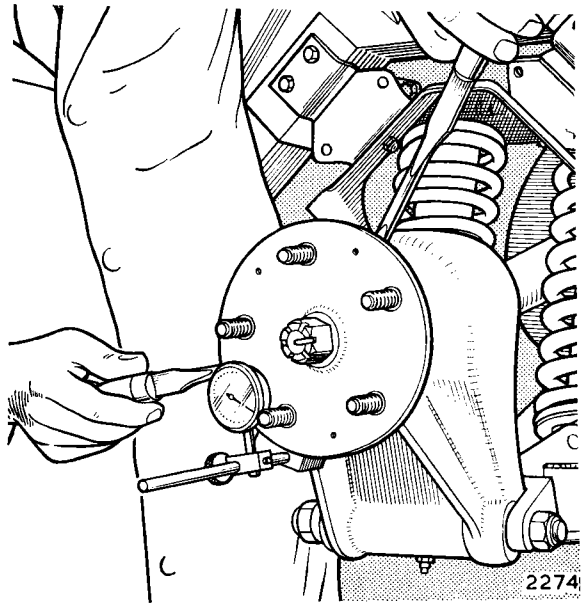


Fig. No. 13 *Checking the hub bearing end-float when in position (Churchill Tool No. J.13)*

THE HALFSHAFTS

Removal
Proceed as described under Rear Hub Removal until the hub assembly can be withdrawn. Remove the front hydraulic damper and spring unit (as described on page K.5). Remove the four steel type self-locking nuts securing the half shaft inner universal joint to the axle output shaft flange and brake disc. Withdraw the half shaft from the bolts noting the number of the camber shims fitted.

Refitting
Refit the hub assembly to the half shaft as described in the Rear Hub section and proceed as follows :—
Replace the camber shims and place the half shaft and hub into position with the half shaft inner universal joint over the four bolts. Fit the four steel-type self-locking nuts and tighten up. Refit the front hydraulic damper and spring unit (as described on page K.5). Refit the lower wishbone as described on page K.11. If the half-shaft has been renewed it will be necessary to check the rear wheel camber as described on page K.15.

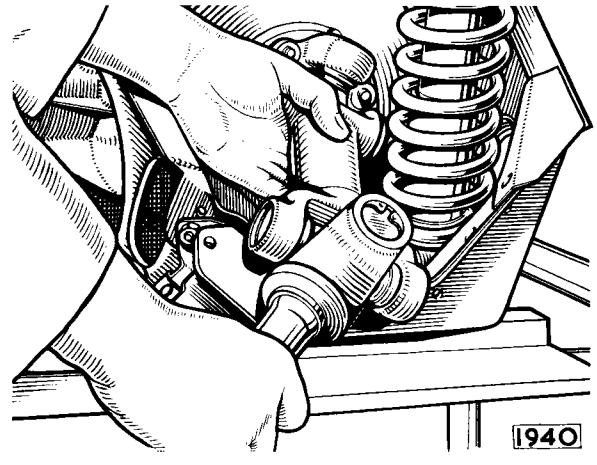


Fig. No. 14 *Withdrawing the half shaft*

THE UNIVERSAL JOINTS

Examine and Check for Wear

The parts most likely to show wear after long usage are the bearing races and spider journals. Should looseness in the fit of these parts, load markings or distortion be observed, they should be renewed as a unit, as worn needle bearings used with a new spider journal or new needle bearings with a worn spider journal will wear more rapidly, making another replacement necessary in a short time.

Dismantling and Assembling

Dismantling and assembling of the half-shaft universal joints should be carried out in accordance with the instructions given on pages G.3 and G.4.

RADIUS ARM

Removal

Remove the locking wire from the radius arm safety strap and securing bolt.
Unscrew the two bolts securing the safety strap to the body floor.
Remove the radius arm securing bolt and spring washer and remove the safety strap.
Withdraw the radius arm from the mounting post on the body.
Remove one of the self-locking nuts securing the hub bearing assembly fulcrum shaft to the wishbone.
Drift out the fulcrum shaft from the wishbone and hub assembly as described on page K.11.
Remove the self-locking nut and bolt securing the radius arm to the wishbone and remove the radius arm.
Examine the radius arm mounting rubbers for deterioration.
If the rubber bushes need replacing they can be removed and refitted by means of Churchill Tool Number J.21.
When replacing the large rubber bush the two holes should be in the longitudinal position in the radius arm.
When fitting the smaller bush ensure that an equal amount of the steel centre sleeve protrudes from each side of the radius arm.

Refitting

Refitting is the reverse of the removal procedure.
When refitting the hub bearing assembly shaft, refer to page K.8.
Refit the safety strap into position, refit the spring washer and radius arm securing bolt.
Refit the two bolts and nuts securing the safety strap to the body.
Tighten the radius arm securing bolt to 46 lb. ft. (6.36 kgm.) and pass the locking wire through the hole in the head of the bolt and secure round the safety strap.

HYDRAULIC DAMPERS

The telescopic hydraulic dampers are of the sealed type with no provision for adjustment or "topping-up" with fluid. Therefore, in the event of a damper becoming unserviceable a replacement must be fitted.

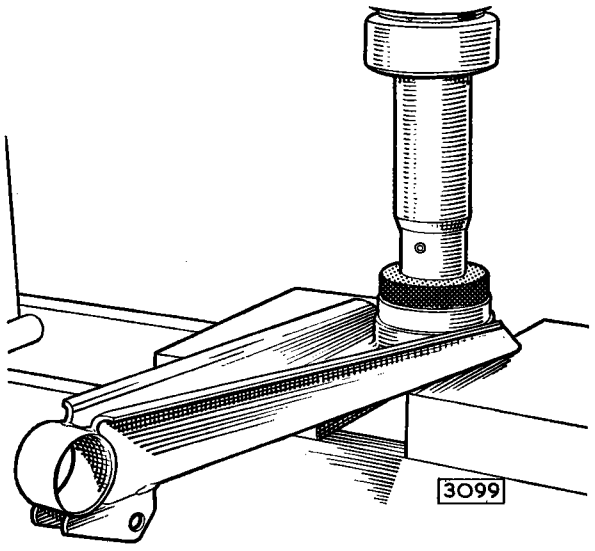


Fig. No. 15 *Showing removal of radius arm bushes (Churchill Tool No. J.21)*

Removal

Remove the road spring and hydraulic damper as described on page K.5.
Utilizing Churchill Tool No. J.11A and SL.14, Fig. 16, compress the road spring until the split collet can be removed from under the road spring retainer.
Carefully release the pressure on the road spring and withdraw the hydraulic damper.

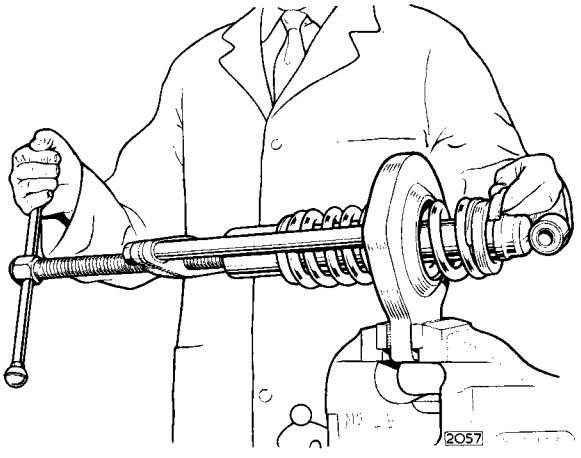


Fig. No. 16 *Removing the rear road spring from the hydraulic damper with Churchill Tool No. J.11 A in conjunction with SL.14*

Refitting
Compress the road spring, utilizing Churchill Tool No. J.11A and SL.14, sufficiently to allow the hydraulic damper to be passed through the road spring. Fit the packing ring, spring and split collet. Ensure that the split collet and spring are seating correctly. Release the pressure on the road spring.

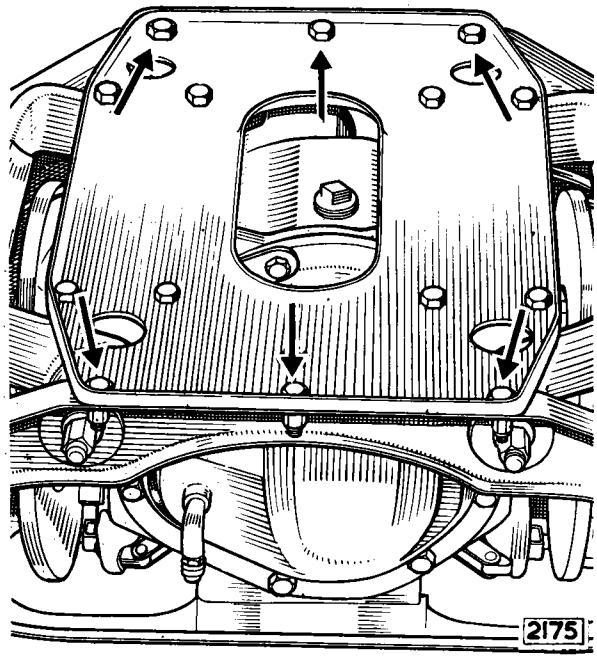


Fig. No. 17 *Showing the six bolts which secure the tie plate to the crossbeam*

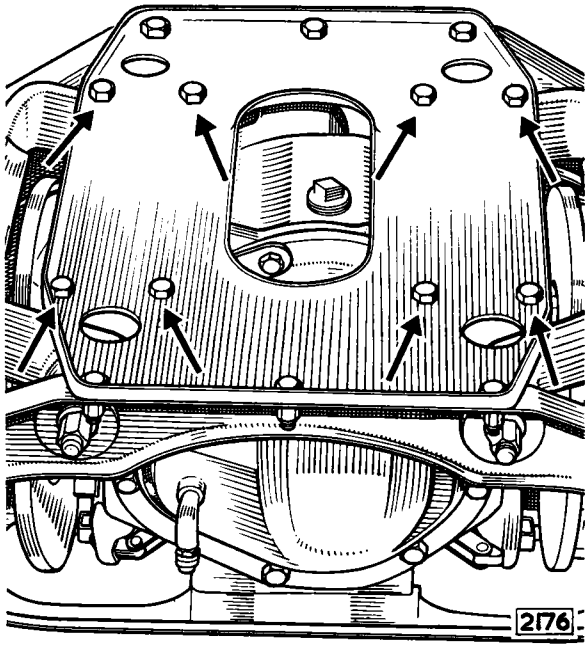


Fig. No. 18 *Showing the eight bolts which secure the tie plate to the inner fulcrum mounting bracket*

Refit the road spring and hydraulic damper assembly as described on page K.5.

WISHBONE

Removal
Remove the hydraulic dampers as described in previous paragraph.
Remove the six self-locking nuts and bolts securing the tie plate to the cross beam.
Remove the eight self-locking nuts and bolts securing the tie plate to the inner fulcrum wishbone mounting brackets and remove the tie plate, see Fig. 18.

Remove one of the self-locking nuts securing the hub bearing assembly fulcrum shaft to the wishbone and drift out the fulcrum shaft, see Fig. 19.
Separate the hub carrier from the wishbone. If any shims are fitted between the wishbone and hub assembly note the amount and position of the shims as it is essential to replace the exact amount in the correct position. To facilitate refitting, slide a dummy fulcrum shaft, Churchill Tool No. J.14 through the hub carrier.
Place a piece of sticky tape over each of the hub carrier assembly oil seal tracks to prevent them becoming displaced.
Remove the self-locking nut securing the radius arm to the wishbone. Withdraw the special thin headed bolt and remove the radius arm from the wishbone.
Remove the self-locking nut securing the wishbone fulcrum shaft to the cross beam.
Drift the inner fulcrum shaft out of the wishbone and inner fulcrum mounting bracket.
Withdraw the wishbone assembly and collect the four outer thrust washers, inner thrust washers, oil seals and retainers.
Examine the oil seals for deterioration.
Remove the two bearing tubes.
There is no need to remove the spacer fitted between the inner fulcrum mounting bracket unless the mounting bracket is to be replaced. To remove the spacer, tap out of position. To remove the needle rollers gently tap the needle cages out of the wishbone using a suitable drift. Remove the needle roller spacer.

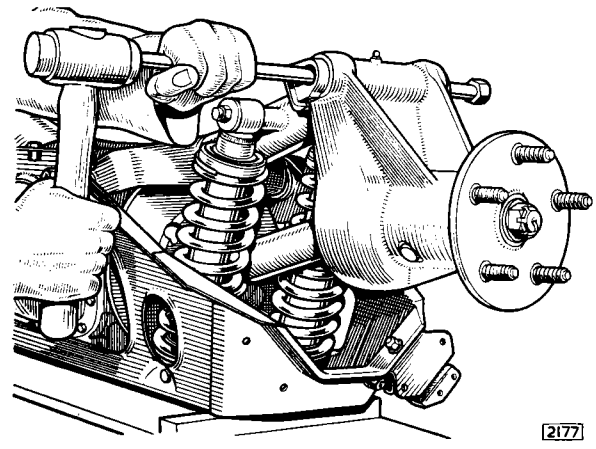


Fig. No. 19 *Drifting out the wishbone outer fulcrum shaft*

Refitting

If the needle rollers have been removed from the larger fork of the wishbone lever press one roller cage into position, with the engraving on the roller cage facing outwards.

Insert the roller spacing tube and press in the other roller cage.

Repeat for the other side.

Insert the bearing tubes. Smear the four outer thrust washers, inner thrust washers, oil seals and oil seal retainers with grease and place into position on the wishbone.

Offer up the wishbone to the inner fulcrum mounting bracket with the radius arm mounting bracket towards the front of the car. Align the holes and spacers. Press a dummy shaft Churchill Tool No. J.14 through each side of the cross beam and wishbone.

The dummy shafts locate the wishbone, thrust washers, cross beam and inner fulcrum mounting bracket and facilitate refitting of the fulcrum shaft.

Smear the fulcrum shaft with grease and gently tap the shaft through the crossbeam, wishbone and inner fulcrum mounting bracket. As the fulcrum is tapped into position, the short dummy shafts will be displaced from the opposite end. It will be found advantageous to keep a slight amount of pressure exerted on the dummy shafts as they emerge from the cross beam. This will reduce the tendency for the dummy shafts to be knocked out of position and allow a spacer or thrust washer to be displaced. If a washer or spacer becomes displaced it will be necessary to remove the fulcrum shaft, dummy shafts and wishbone and then repeat the operation.

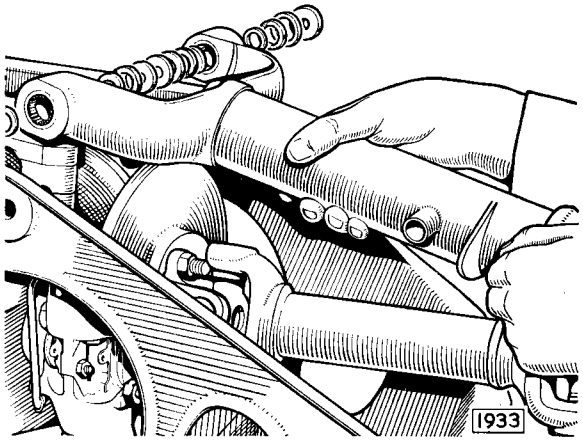


Fig. No. 20 *Showing the wishbone inner fork components*

When the fulcrum shaft is in position, tighten the two self-locking nuts to .55 lb. ft. (7.60 kgm.) with a torque wrench.

Refit the eight bolts and self-locking nuts securing tie plate to the inner fulcrum wishbone mounting bracket, see Fig. 18.

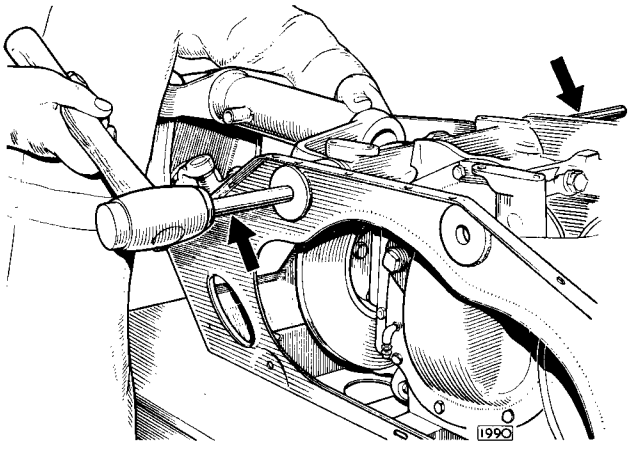


Fig. No. 21 *Tapping the dummy shafts into position at the wishbone inner fulcrum*

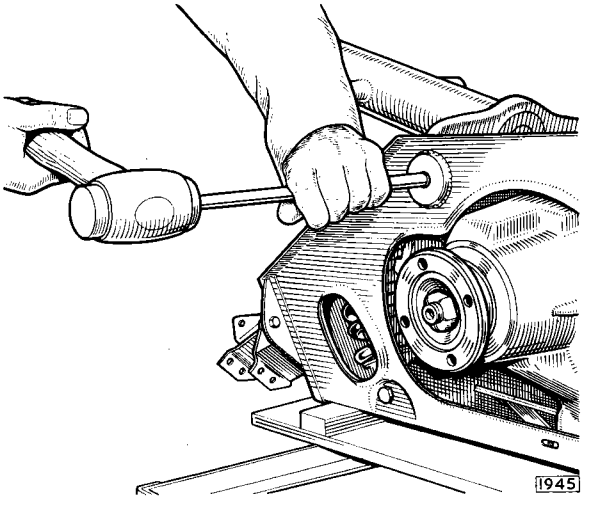


Fig. No. 22 *Drifting the inner fulcrum shaft into position and displacing the dummy shaft*

Refit the six bolts and self-locking nuts securing the tie plate to the crossbeam, see Fig. 17.

Refit the radius arm to the wishbone as described on page K.10.

Remove the two pieces of sticky tape holding the oil seal tracks in position.

Offer up the wishbone to the hub assembly.

Using a dummy shaft, Churchill Tool No. J.14, line up the wishbone hub assembly oil tracks and spacers. Smear the fulcrum shaft with grease and gently tap the fulcrum shaft into position and displace the dummy shaft.

It will be found advantageous to apply a small amount of pressure on the dummy bar against the fulcrum shaft to prevent the bar being knocked out of position and allowing a spacer to be displaced. If a spacer is displaced it may be necessary to repeat the operation. Slide the fulcrum shaft through the wishbone and hub carrier. Using feeler gauges, check the amount of clearance between the hub carrier and the wishbone lever, see Fig. 25. If necessary, fit sufficient shims between the hub carrier and the wishbone to centralize the hub carrier. Tighten the nuts on the fulcrum shaft to 55 lb. ft. (7.60 kgm.).
Check the rear suspension camber angle as described on page K.15.
Refit the hydraulic dampers as described on page K.11.
Refit the rear suspension as described on page K.5.
Re-lubricate the wishbone fulcrum shafts as described in "Routine Maintenance" at the beginning of this section.

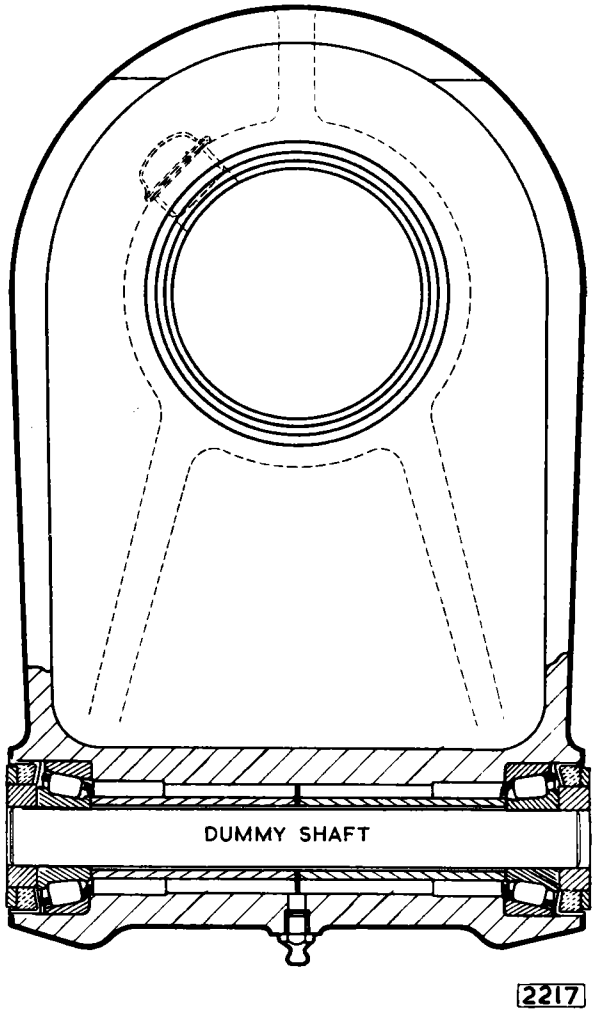


Fig. No. 23 *Showing the dummy shaft in position in the hub carrier*

WISHBONE OUTER PIVOT

Removal

Support the hub carrier and wishbone.
Remove one of the self-locking nuts securing the outer fulcrum shaft.
Drift out the fulcrum shaft, and collect the shims, if any, between the hub carrier and the wishbone.
Separate the hub carrier and wishbone.

Dismantling

Remove the oil seal track and prise out the oil seals.
Remove the inner races of the tapered roller bearings by tapping out with the aid of a drift in the grooves provided.
Remove the spacers and shims.

Reassembly

Refit the inner races for the tapered roller bearings.
Fit the spacers and a known quantity of shims, this is necessary to obtain the correct bearing adjustment as described in the following paragraphs.
Fit the tapered roller bearings and oil seal tracks.

Bearing Adjustment

If it is necessary to adjust the tapered roller bearings it will be necessary to extract the hub from the rear axle half shaft as described on page K.5.
Bearing adjustment is effected by shims fitted between the two fulcrum shaft spacer tubes. The correct bearing adjustment is .000" - .002" (.00 mm. - .05 mm.) pre-load.
Shims are available in sizes of .004" (.101 mm.) and .007" (.17 mm.) thick and $1\frac{1}{8}$" (28.67 mm.) diameter.
A simple jig should be made consisting of a piece of plate steel approximately 7" × 4" × $\frac{3}{8}$" (17.7 cm. × 10.1 cm. × 9.5 mm.). Drill and tap a hole suitable to receive the outer fulcrum shaft. Place the steel plate in a vice and screw the fulcrum shaft into the plate and slide an oil seal track onto the shaft. Place the assembly into position on the fulcrum shaft minus the oil seals and with an excess of shims between the spacers. Place an inner wishbone fork outer thrust washer onto the fulcrum shaft so that it abuts the oil seal track. Fill the remaining space in the shaft with washers and secure with a nut. Tighten the nut to 55 lb. ft. (7.60 kgm.).
Press the hub carrier assembly towards the steel plate using a slight twisting motion to settle the rollers onto the bearing surface. Maintain a steady pressure against the hub carrier and using a feeler gauge measure the amount of clearance between the large diameter washer and the machined face of the hub carrier.
Subtract the one measurement from the other which gives the amount of end float present in the bearings. Remove sufficient shims to obtain a reading of .000" .002" (.00 mm. - .05 mm.) preload.
Example:—
Correct preload .000" - .002" (.00 mm. - .05 mm.).
Mean .001" (.02 mm.).
Assume the bearing end-float to be .010" (.35 mm.).
Therefore .010" + .001" = .011" (.25 mm. + .02 mm. = .27 mm.) to be removed to give the correct preload.

Refit the hub carrier to the half shaft as described in Section H "Rear Axle".
Fit the new oil seals with the lips inwards and place the fulcrum shaft into position in the hub carrier.
Offer up the hub carrier to the wishbone. Ease the dummy shaft through the wishbone with the fulcrum shaft.
Using feeler gauges measure the gap between the oil seal track and the wishbone. Shims of .004" (.101 mm.) thickness by $1\frac{1}{8}$" (22.2 mm.) diameter should be used.
Repeat for the other end and shim as necessary to centralize the hub carrier in the wishbone fork. The above procedure is to prevent the wishbone fork ends from closing inwards. Tighten the nuts on the fulcrum shaft to 55 lb. ft. (7.60 kg.m.).

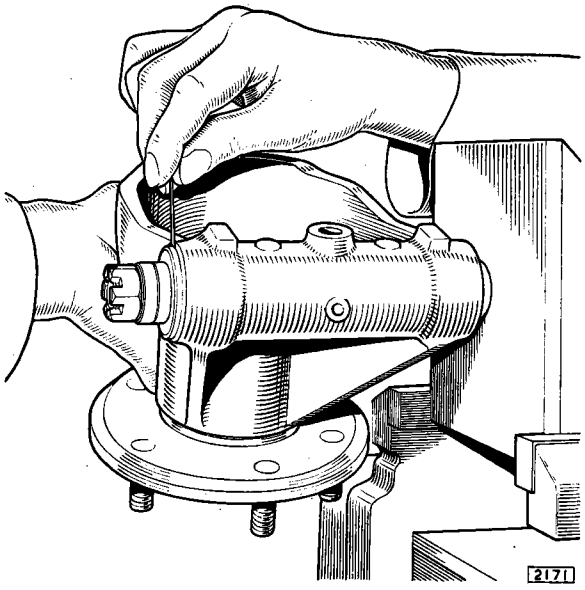


Fig. No. 24 *Measuring the amount of clearance between the hub carrier and large washer to determine the end-float of the bearings*

Refitting
To facilitate refitting, slide a dummy shaft Churchill Tool No. J.14 through the hub carrier before offering up the wishbone to the hub carrier.
Refitting is the reverse of the removal procedure.
Re-lubricate the bearings as described in "Routine Maintenance" at the beginning of the section.

INNER FULCRUM WISHBONE MOUNTING BRACKET

Removal
Remove the eight bolts and self-locking nuts securing the tie plate to the inner fulcrum wishbone mounting bracket.
Remove the six bolts and self-locking nuts securing the tie plate to the cross beam.
Remove one self-locking nut and drift out the inner fulcrum shaft.

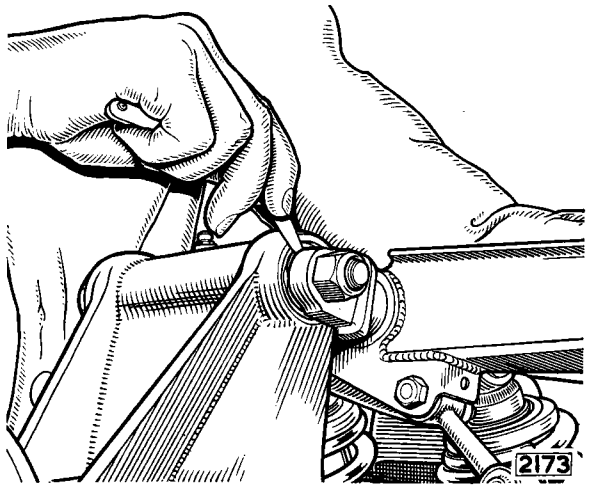


Fig. No. 25 *Using feeler gauges to measure the clearance between the hub carrier oil seal tracks and wishbone forks*

Withdraw the forks of the wishbone from between the cross beam and inner fulcrum wishbone mounting bracket.
Collect the oil seal retainers, oil seals, inner and outer thrust washers and bearing tubes.
Remove the lock wire from the two setscrews which secure the inner fulcrum wishbone mounting bracket to the differential unit.
Remove the spacer between the inner fulcrum mounting bracket.
Remove the two setscrews and note the amount of shims between the bracket and the differential.
Remove the inner fulcrum wishbone mounting bracket.

Refitting
When refitting the inner fulcrum wishbone mounting bracket, replace the same amount of shims between the differential casing and the bracket.
Shims are available in sizes of .005" (.13 mm.) and .007" (.18 mm.) thickness.
Hold the inner fulcrum wishbone mounting bracket in position between the crossbeam.
Insert the fulcrum shaft through the crossbeam and bracket. Screw the inner fulcrum bracket securing setscrews in two or three threads, enough to locate the bracket.
Insert the required amount of shims and tighten the two setscrews securing the inner fulcrum wishbone mounting bracket to the differential casing. Secure the two setscrews with locking wire.
Tap the spacer fitted between the inner fulcrum mounting bracket lugs, into position.
Withdraw the inner fulcrum shaft from the crossbeam and fulcrum bracket.
Offer up the wishbone to the inner fulcrum mounting bracket complete with bearing tubes, needle roller bearing and spacers, inner and outer thrust washers, oil seals and oil seal retainers. Ensure that the radius

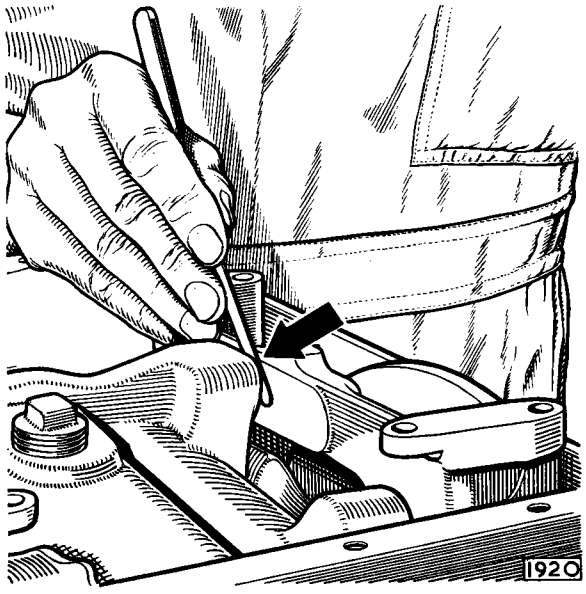
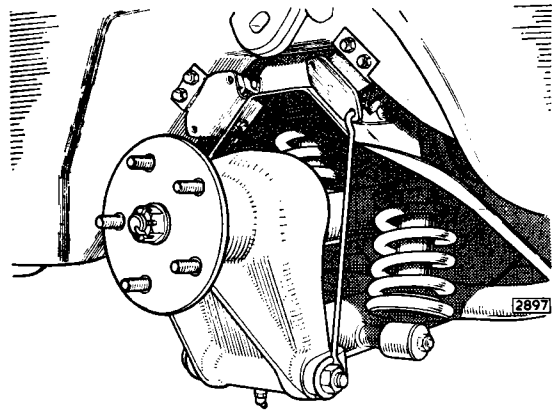


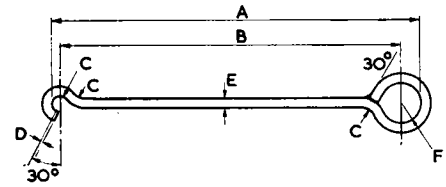
Fig. No. 26 *Measuring the clearance between the inner fulcrum mounting bracket and the differential casing*

arm mounting bracket is towards the front of the car. Align the holes and spacers. Press a dummy shaft through each side of the cross beam and wishbone.
The dummy shafts locate the wishbone, spacers, cross-beam and inner fulcrum mounting bracket and facilitate refitting of the fulcrum shaft.
Smear the fulcrum shaft with grease and gently tap the shaft through the crossbeam, wishbone and inner fulcrum mounting bracket. As the fulcrum is tapped into position the short dummy shafts will be displaced from the opposite side. It will be found advantageous to keep a slight amount of pressure exerted on the dummy shafts as they emerge from the crossbeam. This will reduce the tendency for the dummy shafts to be knocked out of position and allow a spacer or thrust washer to be displaced. If a washer or spacer becomes displaced it will be necessary to remove the fulcrum shaft, dummy shafts and wishbone and then repeat the operation.
When the fulcrum shaft is in position, tighten the two self locking nuts to 55 lb. ft. (7.60 kg.m.) with a torque wrench.
Refit the eight bolts and self-locking nuts securing the tie plate to the inner fulcrum wishbone mounting bracket.
Refit the six bolts and self-locking nuts securing the tie plate to the crossbeam.
Refit the rear suspension unit as described on page K.5.

REAR WHEEL CAMBER ANGLE — ADJUSTMENT

To check the camber of the rear wheels the car must be standing on a level surface with the tyre pressures set correctly. Owing to the variations in the camber angle with different suspension heights, it is necessary to lock the front and rear suspension in the mid-laden position: on the rear, by means of two setting links (Churchill Tool No. J.25) as shown in Fig. 27. To fit the setting links hook one end in the lower hole of the rear mounting and depress the body until the other end can be slid over the hub carrier fulcrum nut. Repeat for the other side.
Lock the front suspension in the mid-laden position as detailed on page J.9.





	INCHES	METRIC
A	9 1/32"	22·9 cm
B	8 3/16"	20·79 cm
C	1/4" RAD	6·3mm
D	1/16"	1·5mm
E	9/32"	7·1mm
F	19/32" RAD	15·0mm

Fig. No. 27 *When checking the rear camber angle, the rear suspension must be retained in the mid-laden position by means of the setting links (Churchill Tool No. J.25)*

With the car in this condition the camber angle should be $\frac{3}{4}°$ negative $\pm \frac{1}{4}°$.
Note: The two rear wheels must be within a $\frac{1}{4}°$ of each other.

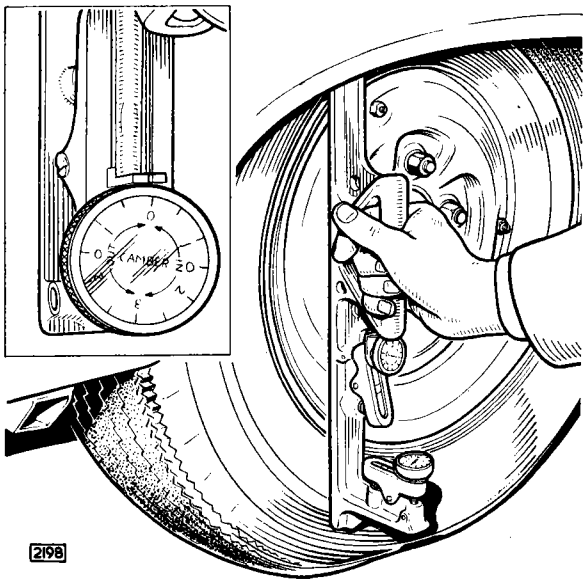


Fig. No. 28 *Checking the rear wheel camber angle*

If the reading is incorrect it will be necessary to add or subtract shims between the half-shaft and the brake disc. One shim .020" (.05 mm.) will alter the rear camber angle by approximately $\frac{1}{4}$°.
Jack up the car on the appropriate side and remove the rear road wheel.
Unscrew the four self-locking nuts securing the half shaft and the camber shims to the brake disc. Pull the hub and half shaft away from the shims sufficiently to clear the disc mounting studs. Remove or add shims as necessary.

Offer up the half shaft to the four disc mounting studs and secure with four self-locking nuts. Offer up the forward road spring and hydraulic damper assembly to the crossbeam and secure with a bolt and self-locking nut.
Align the hydraulic damper and road spring assembly bottom mounting with the mounting pin in the wishbone and drift the pin through the assembly. Replace the plain washer and secure with a self-locking nut.
Replace the road wheels and recheck the camber angle.
Warning: After completing the adjustment do not omit to remove the setting links from the suspension.

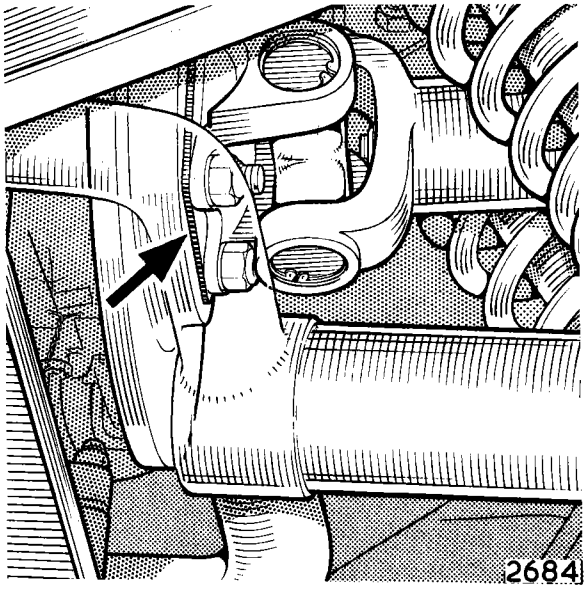


Fig. No. 29 *The rear wheel camber angle is adjusted by means of shims indicated by arrows*

SPECIAL TOOLS

Description	**Tool No.**
Shock Absorber/Spring Unit Dismantling Tool . .	J.11 A (Use with S.L.14)
Rear Wishbone Pivot Dummy Shaft	J.14 (2 off per set)
Radius Arm Bush Remover/ Replacer . . .	J.21
Rear Suspension Setting Link (for camber checking) .	J.25 (2 off per set)

BRAKES

SECTION L

INDEX

THE BRAKING SYSTEM

DESCRIPTION

The braking system consists of four wheel disc brakes hydraulically operated by a dual-line servo unit.
The dual-line servo has an integral vacuum booster with tandem slave cylinder, a master cylinder combined with a booster reaction valve and two fluid reservoirs.
The master cylinder is of conventional design having a single cast iron cylinder, housing a steel, black oxided piston sealed by a single hydraulic cup. Mounted on the end of the master cylinder is a reaction valve which consists of a pair of flow control valves controlling the flow of air to the booster.
The tandem slave cylinder, mounted on the forward face of the boost tank, consists of a single cast iron cylinder housing two pistons in tandem, each piston having its own inlet and outlet port. Either piston will, in the event of failure, operate independently.
The front wheel brake units consist of hub-mounted disc rotating with the wheels. Each disc is straddled by a caliper rigidly attached to the stub axle carrier.

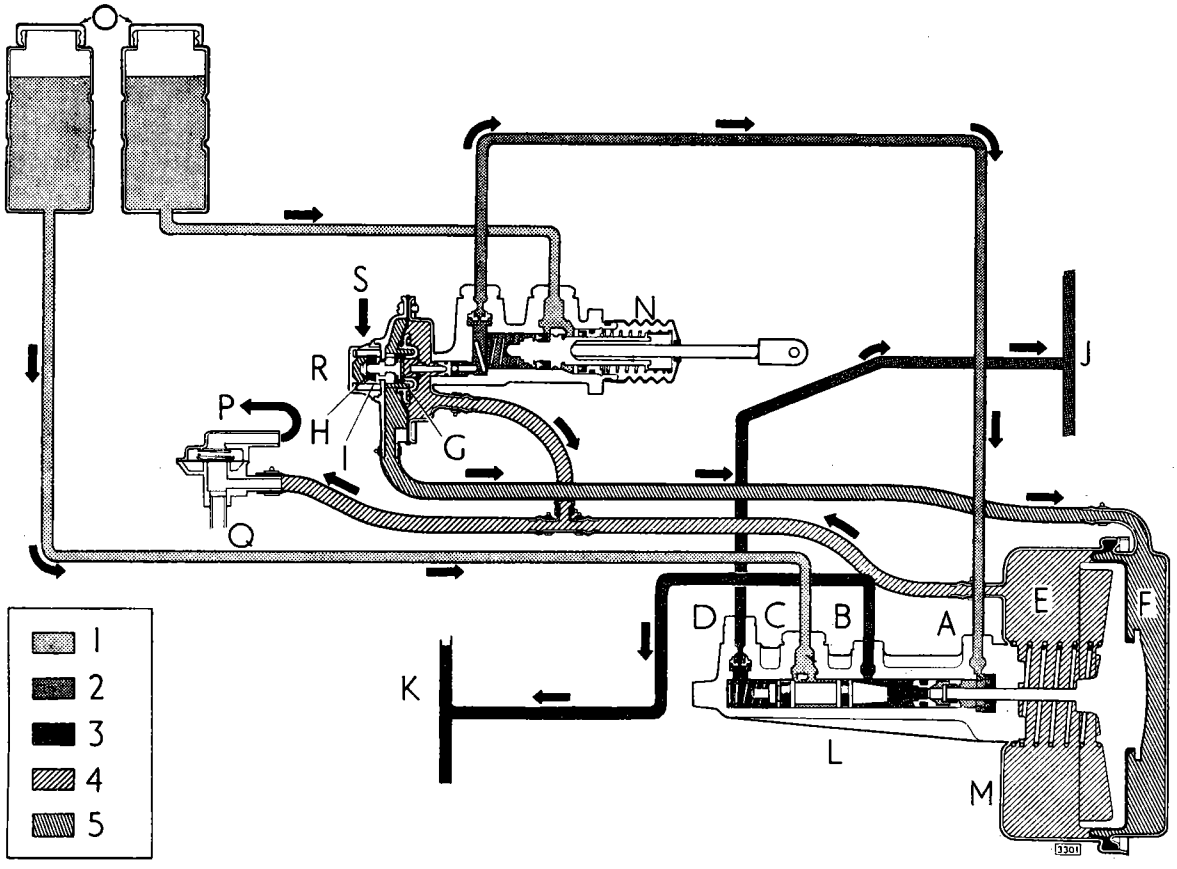


Fig. No. 1 *Dual-line servo system*

1 Fluid at feed pressure
2 Fluid at master cylinder delivery pressure
3 Fluid at system delivery pressure
4 Vacuum
5 Air at atmospheric pressure
A Primary chamber-slave cylinder
B Outlet port-front brakes
C Inlet port-Secondary piston
D Outlet port-rear brakes
E Vacuum
F Air pressure
G Diaphragm
H Filter
I Air control
J To rear brakes
K To front brakes
L Tandem slave cylinder
M Vacuum cylinder
N Master cylinder
O Fluid reservoir
P To manifold
Q To reserve
R Reaction valve

The rear wheel brakes are mounted inboard on the differential output flanges with the calipers attached to the differential housing.
Each caliper assembly is made in two paired halves bolted together by **four bolts which must not be disturbed.**
The front calipers contain two cylinders and pistons in the outer half and a single large piston and cylinder in the inner half.
In the cylinders are square sectioned sealing rings located in a groove in the cylinder bore. The pistons are protected by rubber dust covers which have one lip located in a groove in the piston and the other lip fitted in a groove in the cylinder.
The inner half of each front caliper incorporates the port for the hydraulic fluid and a bleed valve. A drilling from the inner half of the caliper to the outer half forms a passage for fluid to the outer caliper pistons and is sealed at the junction of the two halves by a rubber "O" ring.
The rear calipers have a single large cylinder and piston on each side; the two halves being interconnected by a bridge pipe.
The friction pads are located by two retaining pins which pass through the caliper body and through holes drilled in the friction pad backing plates. The pads are fully floating on the pins to allow for brake application and automatic adjustment.
Handbrakes, attached to the rear calipers, are self-adjusting to compensate for friction pad wear and automatically provide the necessary clearance between the pads and the discs.

DATA

Caliper type	Girling bridge type with quick changing pads
Brake disc diameter — Front	11.1875" (28.4 cm.)
— Rear	10.395" (26.3 cm.)
Brake disc thickness— Front	$\frac{1}{2}$" (12.7 mm.)
— Rear	$\frac{1}{2}$" (12.7 mm.)
Master cylinder bore diameter	$\frac{7}{8}$" (22.23 mm.)
Master cylinder stroke	1.30" (3.3 cm.)
Servo unit type	Lockheed Type 8 Dual Line
Brake fluid	Castrol/Girling Crimson Clutch/brake fluid
Main brake friction pad material	Mintex M33
Handbrake friction pad material	Mintex M34

ROUTINE MAINTENANCE

EVERY 3,000 MILES (5,000 KM.)
On the right hand drive cars the brake fluid reservoirs are attached to the right and left wing valances; on left hand drive cars both are attached to the left hand wing valance.
The reservoir for the master cylinder feeds the front brakes and the reservoir to the servo feeds the rear brakes.
At the recommended intervals, check the level of the fluid in the reservoirs and top up, if necessary, to the level mark which is above the fixing strap and marked "Fluid Level". **Do not overfill.**
The level can be seen through the plastic reservoir container.
Note: The fluid level will fall during service as pad wear takes place and the pistons move out correspondingly, thus enlarging the cylinder volume.
After topping up the reservoir(s), re-insert the combined filler cap and float slowly into the reservoir to allow for displacement of fluid. Wipe off any fluid from the top of the cap and re-connect the electric cables to either of the two terminals. Refit the plastic covers.
Note: A further indication that the level is getting low is provided by an indicator pin situated between the two terminals. First press in the pin and allow to return to its normal position. If the pin can then be lifted with the thumb and forefinger, the reservoir must be topped up immediately.

Brake Fluid Level and Handbrake Warning Light
A warning light (marked "Brake Fluid — Handbrake") situated on the facia behind the steering wheel, serves to indicate if the level in either of the two brake fluid reservoirs has become low, provided the ignition is on. As the warning light is also illuminated when the handbrake is applied, the handbrake must be fully released before it is assumed that the fluid level is low. If with the ignition "on" and the handbrake fully released, the warning light is illuminated, the brake fluid must be "topped up" and the reason for the loss investigated and corrected immediately. IT IS ESSENTIAL that the correct specification of brake fluid be used when topping up.

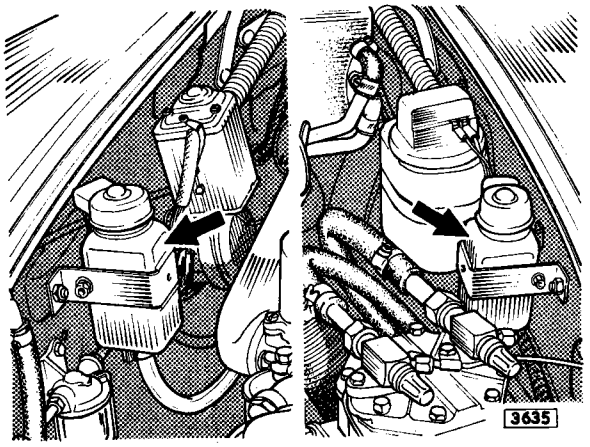


Fig. No. 2 *Brake fluid reservoirs—right hand drive*

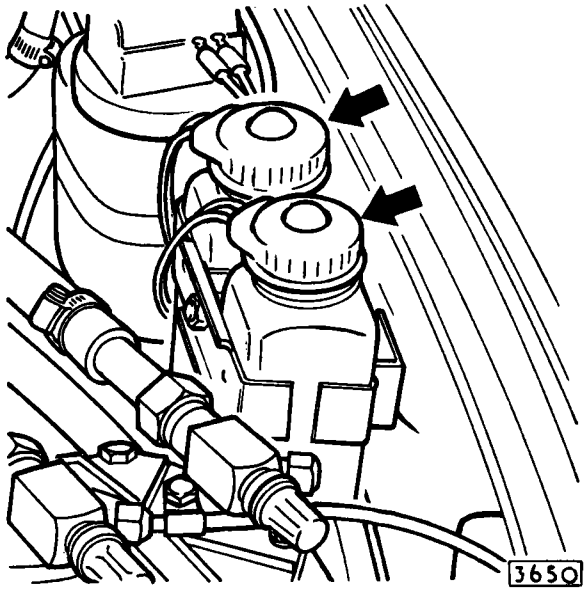


Fig. No. 3 *Brake fluid reservoirs—left hand drive*

As the warning light is illuminated when the handbrake is applied and the ignition is "on", a twofold purpose is served. Firstly, to avoid the possibility of driving away with the handbrake applied. Secondly, as a check that the warning light bulb has not "blown"; if, on first starting up the car with the handbrake fully applied, the warning light does not become illuminated, the bulb should be changed immediately.

Friction Pads — Examination for Wear

At the recommended intervals, or if a loss of braking efficiency is noticed, the brake friction pads (2 per brake) should be examined for wear: the ends of the pads can be easily observed through the apertures in the brake calipers. When the friction pads have worn down to a thickness of approximately $\frac{1}{8}$" (3.2 mm.) they need renewing.

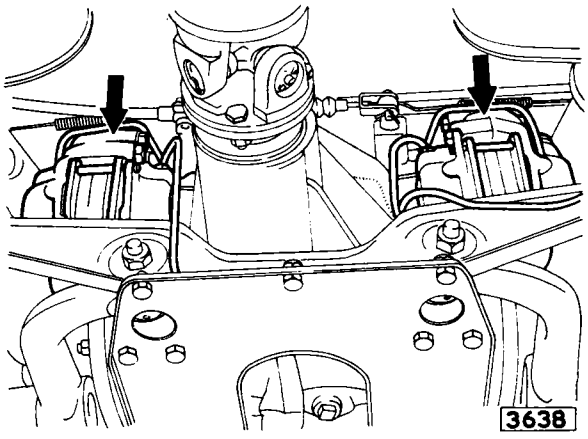


Fig. No. 4 *Location of the rear calipers*

Handbrake Cable Adjustment

The handbrake cable adjustment linkage is situated on the underside of the floor panel below the handbrake lever.

To adjust, fully release the handbrake control in the car and slacken the lock-nut at the rear of the adjustment trunnion.

Ensure that the levers at the calipers are in the "fully off" position by pressing towards the caliper and adjust the length of the cable to a point just short of where the caliper levers start to move: no attempt should be made to place the cable under tension, otherwise the handbrakes may bind.

Note: Both front and rear footbrakes and the handbrakes are so designed that no manual adjustment to compensate for friction pad wear is necessary.

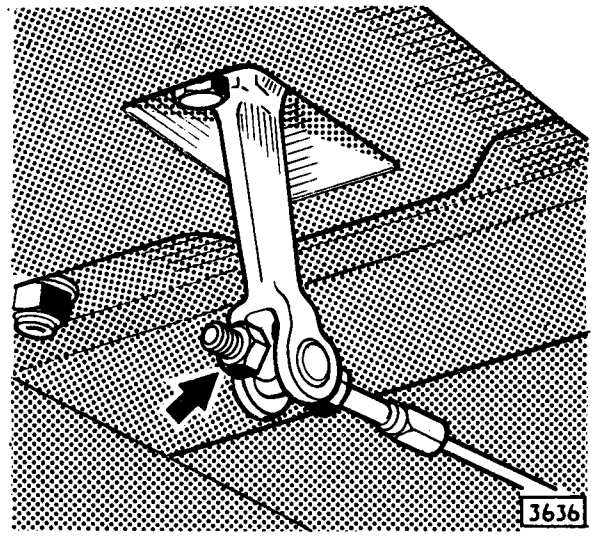


Fig. No. 5 *The handbrake adjustment*

EVERY 12,000 MILES (20,000 KM.)

Clean the air filter element attached to the reaction valve.

Remove the cover from the reaction valve on the master cylinder by inserting a thin bladed tool under the tip of the cover and prising off. Care must be taken to control the run of the valve spring.

Withdraw the filter element, wash in clean, denatured alcohol, dry in clean air and refit. DO NOT lubricate the element with oil or Brake Fluid.

FRICTION PADS

Renewal

Withdraw the hairpin clips and extract the pad retaining pins. Withdraw the pads from the calipers.

To enable the new friction pads to be inserted, it will be necessary to force the pistons back down the cylinder bores by using a lever. It is advisable to half empty the brake reservoirs, otherwise forcing the pistons back will eject fluid from the reservoirs with possible damage to the paintwork.

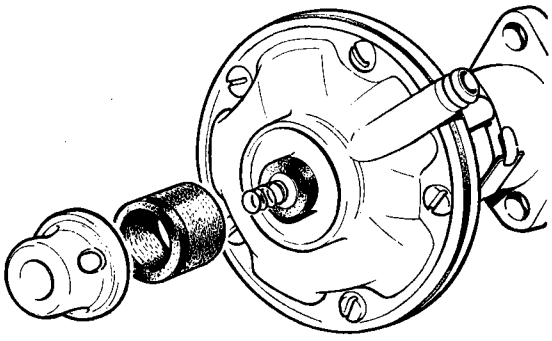


Fig. No. 6 *The reaction valve filter components*

Insert new pads. Line up the holes in the backing plates and caliper body. Fit the retaining pins and secure with the hairpin clips. The retaining pins must NOT be forced into their locating holes. Ensure that the pads are free to move slightly to allow for brake application and automatic adjustment.
Top up the reservoirs to the correct level and apply the brakes several times until the pedal feels "solid".

CALIPER OVERHAUL

In order to replace the pistons, rubber sealing rings or rubber dust covers, it will first be necessary to remove the caliper from the car as detailed on page L.13.

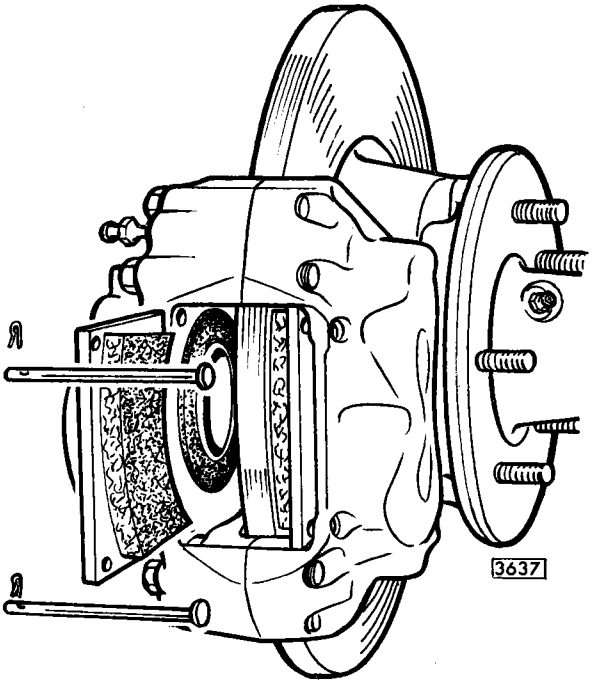


Fig. No. 7 *Friction pad removal*

Release the rubber dust cover lip from its groove in the cylinder bore.
Pack a rag between the pistons and apply air pressure through the inlet port to "blow" the pistons from the cylinder bores. Extract the cylinder sealing ring from the bore.
Examine the cylinder bore for any sign of abrasion, "scuffing" or corrosion. The bore may be cleaned up with fine steel wool but be sure to remove all traces or particles before proceeding.
It is important that, in cleaning the components, no petrol, paraffin, or any mineral fluid of any kind should be used. Use ONLY Girling Cleaning Fluid.
Lubricate the working surfaces of the bores and pistons with clean Castrol/Girling Crimson Clutch/Brake Fluid.
Fit new rubber sealing rings into the grooves of the cylinder bores. Locate the outer lip of the rubber dust cover into its groove in the cylinder bore.
Smear the piston with Girling Red Rubber Grease and insert the piston through the dust cover, closed end first, and engage the other lip of the cover in the groove in the piston. Apply even pressure to the piston and force it down the cylinder bore.
Refit the caliper to the car as detailed on page L.13.

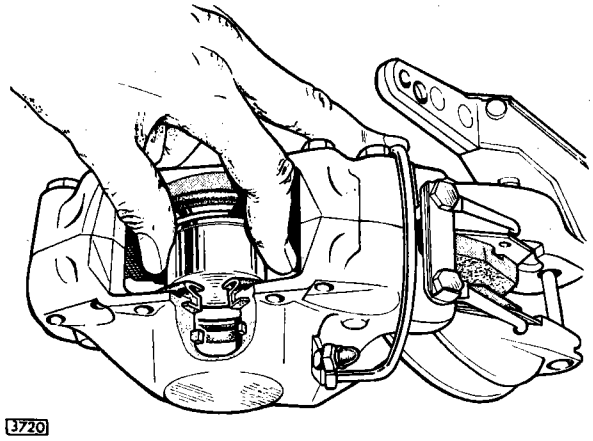


Fig. No. 8 *Fitting a caliper piston*

BLEEDING THE BRAKE SYSTEM

Bleeding the brake hydraulic system (expelling the air) is not a routine maintenance operation and should only be necessary when a portion of the hydraulic system has been disconnected, or if the fluid level has been allowed to fall. The presence of air in the system will cause the brake pedal to feel "spongy" when applied.
During the bleeding operation, **it is important** that the level in the appropriate reservoir is kept topped-up to avoid drawing more air into the system.
Check that all connections are tight and all bleed screws closed.
Fill the appropriate reservoir with the recommended brand of brake fluid.

Attach the bleeder tube to the bleed screw on the left hand rear brake and immerse the open end of the tube in a small quantity of brake fluid contained in a clean glass jar. Slacken the bleed screw and, with the assistance of another, operate the brake pedal slowly through its full stroke until the fluid pumped into the jar is reasonably free from air bubbles.
Keep the pedal depressed and close the bleed screw. Release the pedal.
Repeat the operation for the right hand rear brake and the two front brakes.
Repeat the complete bleeding sequence until the brake fluid pumped into the jar is completely free from air bubbles.
Lock all bleed screws and finally regulate the fluid level in the reservoirs.
Apply a working load to the brake pedal and examine the entire system for any sign of leakage.
Warning: Do NOT use fluid which has been bled through the system to replenish the reservoirs. It will have become aerated. Always use fresh fluid straight from the tin.

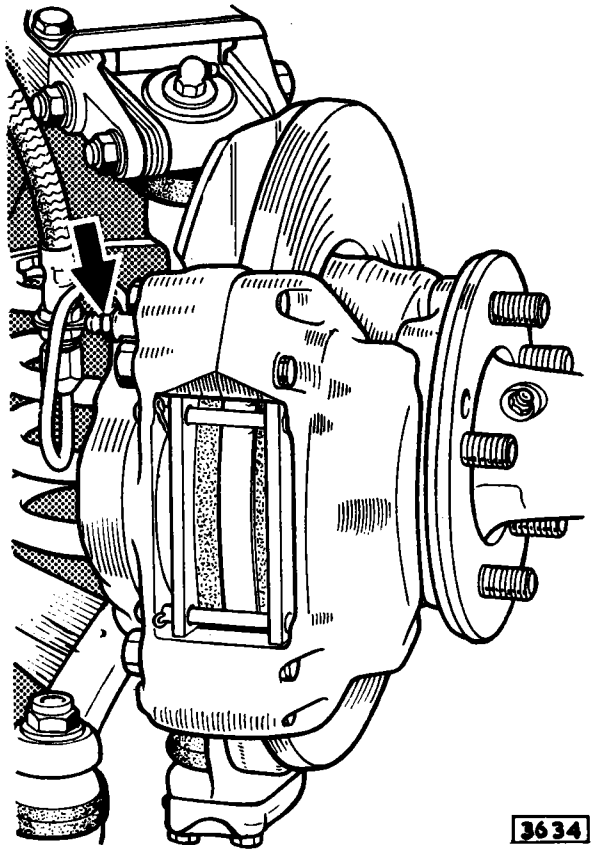


Fig. No. 9 *The brake bleed nipple*

BRAKE OVERHAUL — PRECAUTIONS

The complete brake system is designed to require the minimum of attention, provided the fluid level in the reservoirs is not allowed to fall below the correct level. A drop in fluid level will be noticed during service due to pad wear with the pistons moving outwards correspondingly, thus increasing the cylinder volume. Always top up the reservoir(s) with the recommended fluid.
If air is detected in the hydraulic system due to induction at a loose hose connection, or at a reservoir in which the fluid level has been allowed to fall, correct these defects immediately and bleed the system as detailed in the previous paragraph.
The following instructions detail the procedure for renewal of component parts and for the complete overhaul of the disc brakes, handbrakes, master cylinder and servo unit. These units should be thoroughly cleaned externally before dismantling. Girling Cleaning Fluid ONLY should be used for cleaning purposes.
Throughout every operation it is essential that the workbench is maintained in a clean condition and that the components are not handled with dirty hands.
Precision parts should be handled with extreme care and placed away from tools or other equipment likely to cause damage.
After cleaning, all components should be dried with a lint-free cloth.
When it is not the intention to renew rubber components, they must be carefully examined for serviceability. There must be no evidence of perishing, excessive swelling, cutting or twisting and, where doubt exists, comparison with new parts may be of assistance in making an accurate assessment of their condition.
Flexible pipes must not show signs of deterioration or damage and their bores should ONLY be cleaned out with compressed air. No attempt must be made to clear blockage by probing as this may damage the lining and cause serious restriction of the fluid flow.

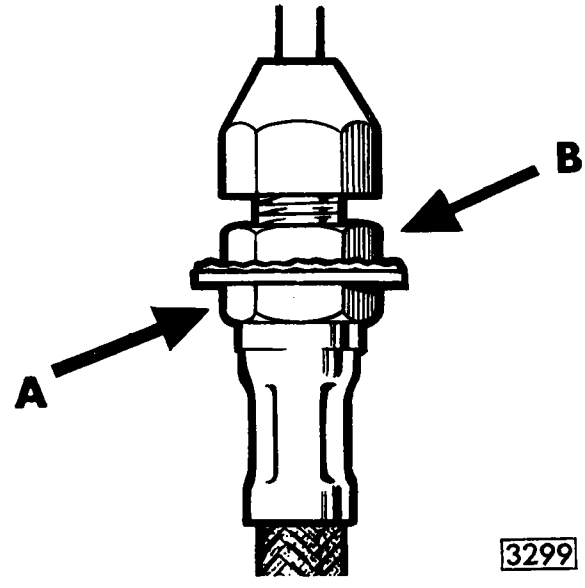


Fig. No. 10 *Flexible hose connection. Hold hexagon "A" with a spanner when removing or refitting locknut "B"*

Partially or totally blocked pipes should always be renewed.
When removing or refitting a flexible pipe, the end sleeve hexagon, "A", Fig. 10, should be held with a spanner to prevent the pipe from twisting.

FLUSHING THE SYSTEM

If the fluid in the system becomes thick or "gummy" after long service or because the vehicle has been laid up for some time, the system should be drained off, flushed and refilled. This should be carried out at least every eighteen months. The system should also be flushed if it has become contaminated by the use of unsuitable fluid.
Start the engine and permit to idle.
Pump all fluid out of the system through the bleeder screw on each of the disc brake calipers in turn, as follows:—
Connect one end of a rubber tube to the bleeder screw, insert the other end into a container; slacken the bleeder screw one complete turn and pump the brake pedal by depressing it quickly and permitting it to return without assistance. Repeat, with a pause between each operation, until no more fluid can be expelled. Discard all fluid extracted from the system.
Fill the master cylinder fluid supply tanks with industrial methylated spirits and flush the system. Continue flushing with methylated spirit until at least one quart has been passed through each disc brake caliper.
Before filling the system with the recommended brake fluid, ensure that all methylated spirit has been bled off.
Note: If the system has become contaminated by the use of mineral oil, the above process may not prove effective. In such cases it is recommended that the various hydraulic units, including the pipe line be dismantled and thoroughly cleaned. All rubber parts, including flexible hoses, should be renewed and the contaminated fluid destroyed immediately.

MASTER CYLINDER AND REACTION VALVE

Removal

Drain the brake fluid from the reservoir feeding the master cylinder.
Disconnect the two vacuum hoses from the reaction valve and the two hydraulic pipes from the master cylinder. Remove the split pin and withdraw the clevis pin securing the brake pedal to the master cylinder push rod accessible from inside the car.
Remove two nuts and washers and detach the master cylinder from the pedal housing.

Refitting

Refitting is the reverse of the removal procedure.
Renew banjo union sealing washers.
Refill the reservoir and bleed the brake system as detailed on page L.6.

Dismantling

Before dismantling, it is advisable to obtain the master cylinder and reaction valve repair kits available from a Distributor or Dealer, or from the Works' Spares Division, Coventry.

Extract the valve assembly (7) from the outlet port.
Remove the rubber boot (17) from the mouth of the cylinder bore, compress the piston return spring (16) and unwind the spirolox circlip (20) from the heel of the piston. The spring retainer (18) and piston return spring (16) can at this stage be removed.
Press the piston (15) down the bore and, with the aid of special circlip pliers (Churchill Tool number 7066), extract the circlip (21) from the mouth of the cylinder bore. Care should be taken during this operation not to damage the finely machined cylinder piston.
The piston assembly, complete with nylon bearings and rubber seals, can be withdrawn from the cylinder bore.
Remove the plastic bearing (22), complete with "O" ring (14), secondary cup (13) and rectangular section plastic bearing (12) from the piston by sliding the assembly along the finely machined portion.
Due to the plastic spring retainer (25) being an interference fit onto the piston head extension, this part is likely to become damaged during dismantling. In view of this, a new spring retainer is contained in the appropriate repair kit. To remove the spring container, hold the piston on a bench, piston head downwards, applying a downwards force to the back face of the spring retainer with a slim open-ended spanner. The piston return spring (26) pressed steel retainer (27) and lever (28) may, at this stage, be withdrawn from the cylinder bore.
Remove the filter cover (39) and collect the filter (36) sorbo washer (37), and spring (38).
Unscrew and remove the five screws securing the valve cover (42), remove the valve cover assembly from the valve housing (32) which can be dismantled further by prising off the snap-on clip securing the valve rubber (34).
The valve stem (40) complete with other valve rubber (41) can now be withdrawn from the valve housing and the valve rubber removed from the valve stem flange. The reaction valve diaphragm (1) can now be separated from the diaphragm support (33) and, by unscrewing the two hexagon-headed screws (2), the valve housing can be separated from the master cylinder body.
Removal of the valve piston assembly (31) can be effected by inserting a small blunt instrument into the master cylinder fluid outlet port and easing the valve piston assembly along its bore until it can be removed by hand.

Important: No attempt should be made to withdraw the valve piston assembly along its bore by using pliers.
When either of the units have been dismantled the component parts should be washed in denatured alcohol (industrial methylated spirits). Parts that have been washed should be thoroughly dried using a clean lint-free cloth or pressure line and then laid out on clean paper to prevent dirt being assembled into the servo or master cylinder and reaction valve assembly.
Examine all metal parts for damage.
If any of the vacuum hose connections have become loose in service these must be rectified prior to re-assembly.

1 Diaphragm
2 Screw
3 Shakeproof washer
4 Gasket
5 Banjo bolt
6 Washers
7 Trap valve body
8 Washer
9 Banjo bolt
10 Copper gasket
11 Body
12 Bearing
13 Secondary cup
14 Seal
15 Piston
16 Return spring
17 Rubber boot
18 Spring retainer
19 Push rod
20 Spirolox circlip
21 Circlip
22 Bearing
23 Piston washer
24 Main cup
25 Retainer
26 Spring
27 Retainer
28 Lever
29 Seal
30 Seal
31 Piston
32 Valve housing
33 Diaphragm support
34 Valve rubber
35 Valve cap
36 Filter
37 Sorbo washer
38 Spring
39 Filter cover
40 Valve stem
41 Valve rubber
42 Valve cover
43 Screw

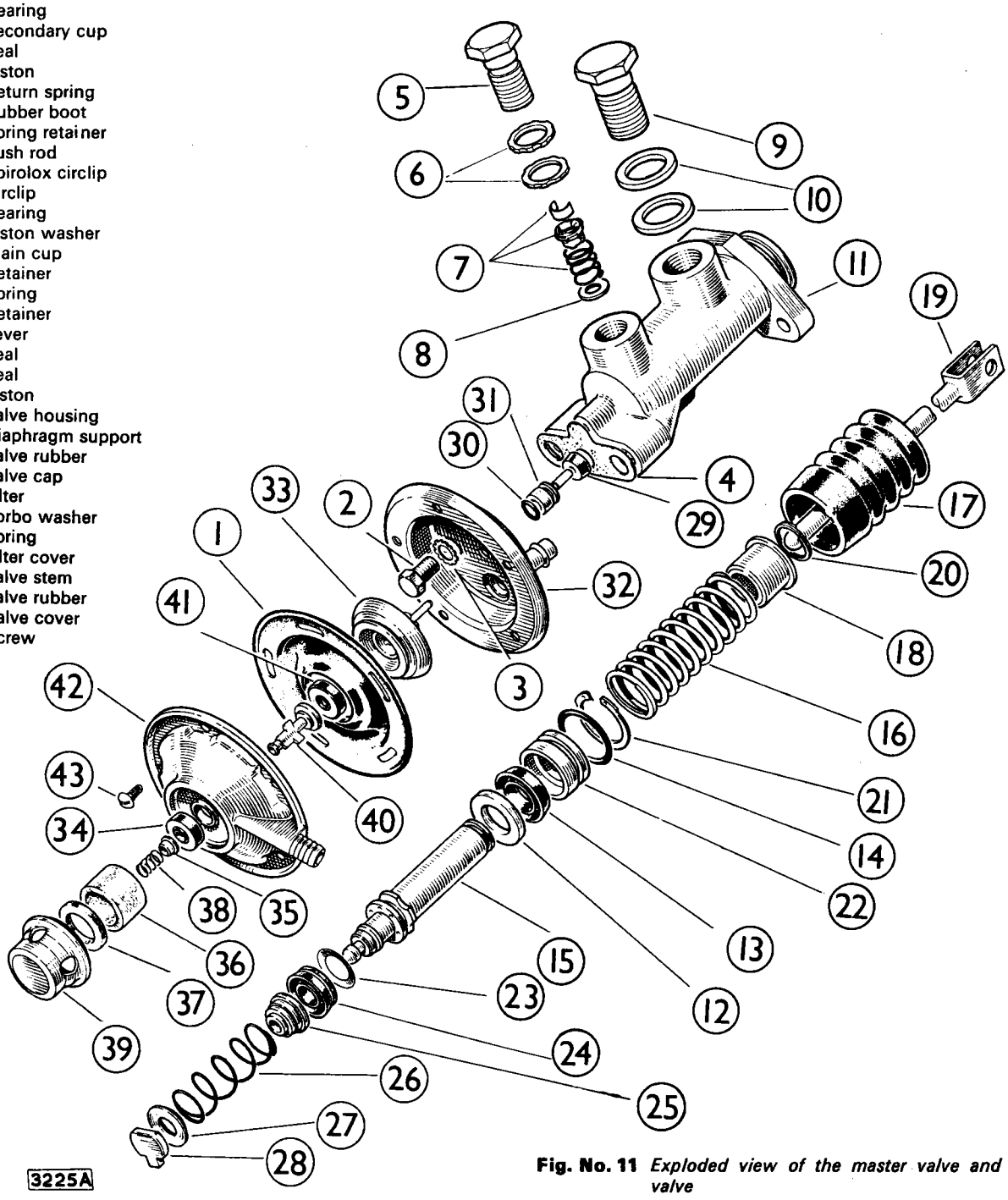


Fig. No. 11 *Exploded view of the master valve and reaction valve*

Assembling
Prior to assembly, liberally coat all rubber seals and plastic bearings, with the exception of the two valve rubbers, with Girling disc brake lubricant.
Holding the master cylinder body at an angle of approximately 25° to the horizontal, insert the lever (28), tab foremost, into the cylinder bore, ensuring that when it reaches the bottom of the bore, the tab on the lever drops into the recessed portion provided.
Place the piston washer (23) on the piston head, convex face towards the piston flange, together with a new main cup (24) and press the plastic spring retainer (25) onto the piston head extension.
Drop the pressed steel spring retainer (27) into the bottom of the bore following up with the piston return spring (26). When these two parts have been assembled it is advisable to recheck the position of the lever.
Press the piston assembly into the cylinder bore and locate the rectangular section plastic bearing (12), secondary cup (13) and bearing (22) together with seal (14) onto the mouth of the cylinder bore.
Press the assembly down the bore to its fullest extent and, with the aid of the special circlip pliers (Churchill Tool number 7066) (with "K" points), fit the circlip to retain the internal parts.
Locate the other piston return spring (16) over the heel of the piston together with the pressed steel spring retainer (18), slide the spring retainer down the finely machined portion of the piston against the load of the spring and fit the spirolox circlip (20) into the groove ground around the heel of the piston.
Using the fingers only, stretch a new valve seal (29) and "O" ring into position on the valve piston and insert the assembly into the valve box.
Secure the valve housing to the master cylinder body by fitting the two hexagon headed screws (2) complete with spring washers and tighten each screw to a torque of 160/180 lb./ins. (1.8-2 kgm.). A new gasket should be fitted between the valve housing and the master cylinder body.
Stretch the reaction valve diaphragm onto the diaphragm support through the hole in the valve housing so that it engages the depression in the valve piston.
Using the fingers only, stretch the valve rubber, which is formed with the groove around its inside diameter, onto the valve stem flange, insert the valve stem through the hole in the valve cover and secure it by placing the other valve rubber over the valve stem and fitting the snap-on clip.
The valve cover assembly can now be placed into position on the valve housing ensuring that all the holes line up and that the hose connections are in line with each other at the bottom of the unit. Secure the valve cover assembly by fitting the five self-tapping screws.
Hold the master cylinder in an upright position (valve uppermost) and place the air filter together with the rubber washer in position upon the valve cover with the small spring on the snap-on valve stem clip.
Carefully locate the air filter cover over the air filter and press it firmly home.
If the trap valve assembly has been dismantled, insert the small clip into the trap valve body ensuring that it does not become distorted and locate the spring on the reduced diameter of the trap valve body.
Assemble the trap valve complete (spring innermost) into the master cylinder fluid outlet port.
Refit the master cylinder push rod and convoluted rubber boot.

DUAL-LINE SERVO

OPERATION (Fig. 1)
When the system is at rest, both sides of the boost system are continuously exhausted by the engine manifold depression.
As the brake pedal is depressed, the master cylinder piston moves along the cylinder, building up pressure and forcing fluid out to the primary chamber of the slave cylinder (A). Simultaneously, the intermediate piston, in the end of the master cylinder, closes the diaphragm valve (G) in the reaction valve and, in so doing, isolates the vacuum (E) from the air pressure side (F) of the boost system.
Further progress of the intermediate piston along its bore will crack open the air control spool (I) in the reaction valve, thus admitting air at atmospheric pressure to the rear of the boost cylinder piston. The air enters the system through a small cylindrical filter (H) on the reaction valve.
The pressure imbalance, created by the admission of air to the pressure side of the boost system, will push the boost piston down the cylinder transmitting a linear force, through the push rod, to the primary piston of the slave cylinder.
Forward motion of the primary piston, supplemented by the output of the master cylinder, transmits hydraulic pressure to the secondary piston (C) and fluid under pressure flows simultaneously from the two output ports (B and D) to the rear and front brakes.

SAFETY FACTORS
In the event of fluid line failure in the pipe linking the master cylinder to the slave cylinder, or the pipe linking the master cylinder to the fluid supply tanks, the reaction valve will be actuated mechanically by the master cylinder piston providing the booster pressure to the front and rear brakes.
A failure in the fluid line coupling the slave cylinder to the front brakes will result in the slave cylinder secondary piston travelling to its fullest extent down the bore. This has the effect of isolating the front brake line from the rest of the system and permitting normal fluid pressure to build up in the rear brake line.
If a fault exists in the rear brake line, the slave cylinder piston will travel along the bore until it contacts the other piston and the two pistons will then travel along the bore together to apply the front brakes.

In the case of leaks in either the air or vacuum pipes, both front and rear brakes may still be applied by the displacement of fluid at master cylinder pressure.

SERVO UNIT AND SLAVE CYLINDER

Removal

Drain the fluid from the reservoir feeding the slave cylinder.
Jack up the front of the car and remove the left-hand roadwheel.
Remove the two nuts and two setscrews securing the fibreglass cover to the servo unit and mounting bracket respectively and withdraw the cover.
Disconnect the three flexible hoses and three pipe unions from their connections on the servo unit and slave cylinder. Seal all open ends of the hoses and pipes to prevent the ingress of dirt.
Remove the four setscrews securing the servo unit mounting bracket to the inner wing valance and withdraw the unit and bracket as an assembly.
Separate the servo unit from the mounting bracket by unscrewing four nuts from the retaining studs on the servo unit.

Refitting

Reverse the removal procedure to refit the servo unit and slave cylinder.
Refill the reservoir and bleed the system as detailed on page L.6.

Dismantling

Support the servo slave cylinder in the jaws of a vice, shell uppermost, with specially formed wooden blocks placed either side of the cylinder and against the jaws of the vice.
Fit the cover removal tool (Churchill Tool No. J.31) to the end cover and secure it by fitting the three nuts.
Turn the end cover in an anti-clockwise direction until the indents in the servo shell line-up with the small radii around the periphery of the end cover. At this stage the end cover may be removed from the servo.
Remove the diaphragm (11) from its groove in the diaphragm support (10) and, with the servo removed

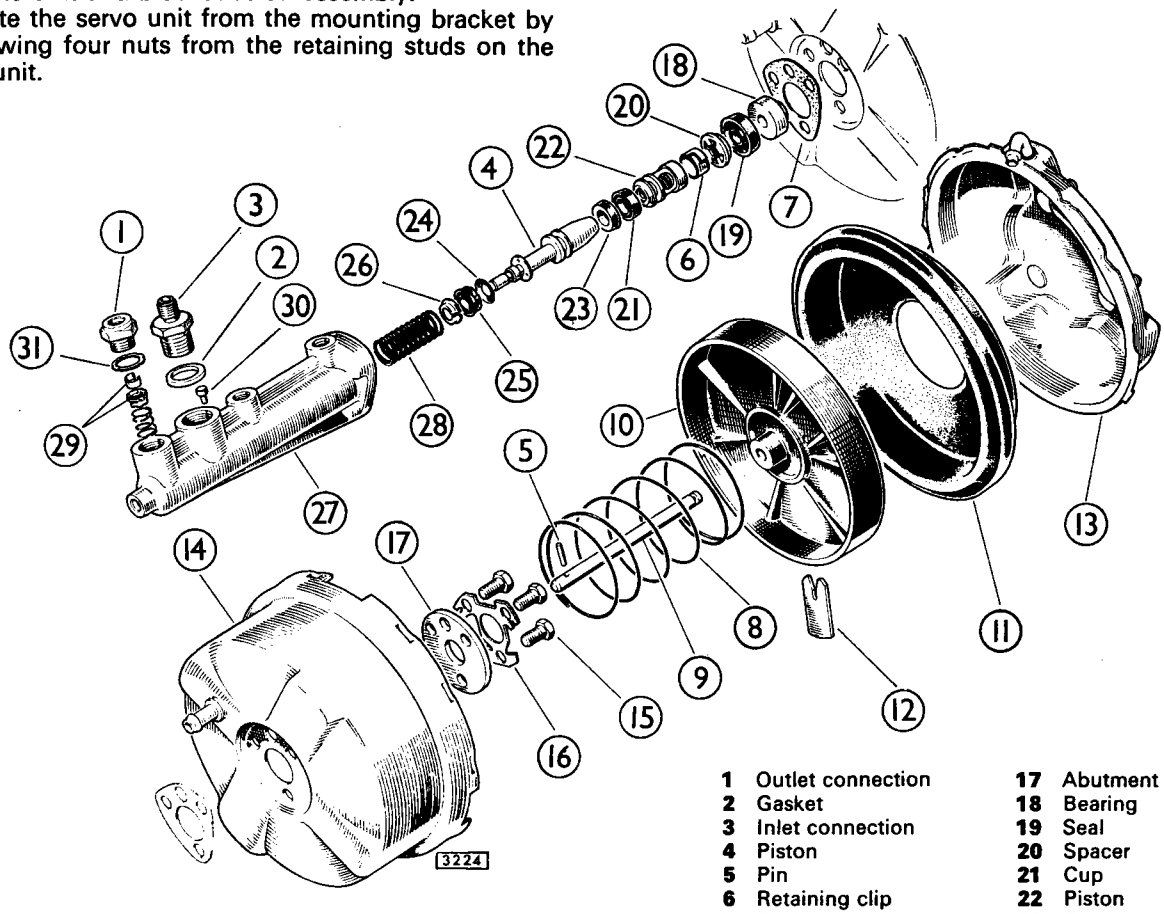


Fig. No. 12 *Exploded view of the remote servo*

1	Outlet connection	**17**	Abutment plate
2	Gasket	**18**	Bearing
3	Inlet connection	**19**	Seal
4	Piston	**20**	Spacer
5	Pin	**21**	Cup
6	Retaining clip	**22**	Piston
7	Gasket	**23**	Cup
8	Spring	**24**	Piston washer
9	Push rod	**25**	Seal
10	Diaphragm support	**26**	Retainer
11	Diaphragm	**27**	Slave cylinder body
12	Key	**28**	Spring
13	Cover	**29**	Trap wire
14	Vacuum cylinder shell	**30**	Stop pin
15	Screw	**31**	Gasket
16	Locking plate		

from the jaws of the vice, apply a gentle pressure to the diaphragm support and shake out the key (12).
The diaphragm support (10) and diaphragm support return spring (8) can then be removed.
Bend down the tabs on the locking plate (16) and remove the locking plate, abutment plate (17) and the servo shell (14) from the slave cylinder by unscrewing and removing three screws (15).
Extract the seal (19) and bearing (18) from the mouth of the slave cylinder bore which will permit the removal of the push rod (9) together with the slave cylinder piston assembly.
The push rod may be separated from the piston by sliding back the spring steel clip (6) around the piston and removing the pin (5). It is not necessary to remove the cup (21) from the piston as a new piston together with a cup are contained in the new repair kit.
Unscrew and remove the fluid inlet connection (3) and extract the piston stop pin (30) from the base of the inlet fluid port. To facilitate this operation, apply gentle pressure to the secondary piston (4).
Tap the open end of the slave cylinder body with a hide or rubber hammer to remove the secondary piston together with the piston return spring (28) from the bore.
The rubber seal (25) located in the groove adjacent to the heel of the piston may be removed, but it is advisable to first remove the spring retainer (26) from the piston head extension before attempting to remove the seal (25) and piston washer (24). Removal of the plastic spring retainer (26) is sometimes difficult, but as a new one is provided in the repair kit, this part can be replaced if damaged.
To remove the trap valve assembly, unscrew and remove the adaptor (1) from the fluid outlet port. If it is necessary to remove the shim-like clip from the body of the trap valve (29) ensure that this part is not distorted in any way.

Assembling
Assemble the trap valve (29) complete with spring and clip into the outer port and secure it by fitting the fluid outlet adaptor (1) together with the copper gasket (31).
Prior to further assembly, lightly coat the four rubber seals to be replaced in the slave cylinder bore with Girling Disc Brake Lubricant.
Locate the piston washer (24) over the piston head extension, convex face towards the piston flange and, using the fingers only, assemble the two rubber seals (23 and 25) onto the piston so that their concave faces oppose each other.
Press the spring retainer (26) onto the piston head extension with both seals in position.
Fit the piston return spring (28) to the secondary piston complete and assemble into the slave cylinder bore, spring leading.
Press the piston assembly down the cylinder bore, using a short length of brass bar, until the drilled piston flange passes the piston stop pin hole.
Insert the piston stop pin (30) into the fluid inlet port and secure it by fitting the inlet adaptor (3) complete with the copper gasket (2). Place the push rod (9) in the primary piston and, with the aid of a small screwdriver, compress the small spring within the piston to enable the pin (5) to be inserted. Prior to fitting the pin retainer (6), it is important to establish that a small coil spring is loaded between the heel of the piston and the pin. Ensure that the pin does not pass through the coils of the spring.
Fit the spring retainer by sliding it into position along the piston ensuring that no corners are left standing proud after assembly.
Using fingers only, fit a new cup (21) into the groove on the piston so that its lip (concave face) faces towards the piston head and assemble the piston into the slave cylinder bore.
Insert the spacer (20), gland seal (19) and plastic bearing (18) into the slave cylinder counterbore leaving the bearing projecting slightly from the mouth of the bore.
Place the gasket (7) in position on the end face of the slave cylinder, using the plastic bearing as a location spigot and fit the vacuum shell (14), abutment plate (17) and locking plate (16).
Insert the three securing screws (15) and tighten down to a torque of 150/170 lb./ins. (1.7-1.9 kgm.).
Bend the tabs on the locking plate against the flats on the three screws.
Locate the diaphragm support return spring (8) centrally inside the vacuum shell, fit the diaphragm support (10) to the push rod and secure it by dropping the key (12) into the slot provided in the diaphragm support.
Stretch the rubber diaphragm (11) into position on the diaphragm support ensuring that the bead around its inside diameter fits snugly into the groove in the diaphragm support.
If the surface of the rubber diaphragm appears wavy or crinkled this indicates it is not correctly seated. To ease assembly, smear the outside edges of the diaphragm liberally with Girling disc brake lubricant.
Fit the end cover using Tool No. J.31.

Note: As it is possible to fit the end cover in three different positions, ensure that the end cover hose connections line up with the slave cylinder inlet and outlet ports when assembly is complete.

THE VACUUM RESERVOIR AND CHECK VALVE

DESCRIPTION

The vacuum reservoir is incorporated in the vacuum line between the inlet manifold and the servo unit.
It is located, together with a stone guard, in the front section of the right hand front wing.
Its purpose is to provide a reserve of vacuum in the event of braking being required after the engine has stalled.
The vacuum check valve, located on the inner wing valance is in line communication with the inlet manifold, vacuum servo unit and the vacuum reservoir.
Included in the inlet port of the check valve is a flat rubber spring-loaded valve and when there is a depression in the inlet manifold the valve is drawn away from its seat against its spring loading, thus the interior of the reservoir becomes exhausted. When the depression in the reservoir becomes equal to that of the inlet manifold, the valve spring will return the valve to its seat, thus maintaining the highest possible degree of vacuum in the reservoir.

Removal

Vacuum Reservoir

Apply the handbrake and jack up the front of the car.
Remove the right hand roadwheel. Detach the vacuum reservoir and stone guard by withdrawing three nuts and bolts. Disconnect the vacuum pipe from the check valve.
Remove the stone guard from the reservoir by withdrawing the four nuts and bolts.

Check Valve

Disconnect the two pipes from inside the engine compartment and the remaining pipe from the underside of the wing valance.
Withdraw the check valve through the grommet.

Refitting

Refitting is the reverse of the removal procedure.
Note: The check valve and vacuum reservoir are sealed units and must be replaced if faulty.

FRONT CALIPERS

Removal

In order to remove the front calipers, jack up the car and remove the road wheel. Disconnect the fluid feed pipe and plug the hole in the caliper. Discard the locking wire from the mounting bolts. Remove the caliper.

Refitting

Locate the caliper body in position and secure with two bolts. Lockwire the mounting bolts.
Connect the supply pipe to the caliper body. Bleed the brakes as detailed on page L.6.
Note: No centralisation shims are fitted at the front caliper mounting points.

REAR CALIPERS

Removal

The rear suspension unit must be removed in order to withdraw the rear caliper. Proceed as described on page K.4 and support the suspension unit under its centre.
Disconnect the handbrake compensator linkage from the handbrake operating levers. Discard the split pins and withdraw the clevis pins.
Lift the locking tabs and remove the pivot bolts together with the retraction plate.
Remove the handbrake friction pad carriers from the caliper bridges by moving them rearwards round the discs and withdrawing from the rear of the rear suspension assembly.
Remove the hydraulic feed pipe at the caliper and plug the hole to prevent the entry of dirt.
Remove the friction pads from the caliper as described on page L.5.
Remove the front hydraulic damper and road spring unit (detailed on page K.5) and remove the four self-locking nuts from the half shaft inner universal joint.
Withdraw the joint from the bolts and allow the hub carrier to move outwards—support the carrier in this position.
Note the number of small circular shims fitted to the caliper mounting bolts between the caliper and the adaptor plate.
The caliper can now be removed from the aperture at the front of the cross member.

Refitting

Refit the caliper to the adaptor plate with the original shims fitted between the caliper mounting bolts and the adaptor plate.
Refit the handbrake pivot bolts but do not fit the handbrake calipers at this juncture.

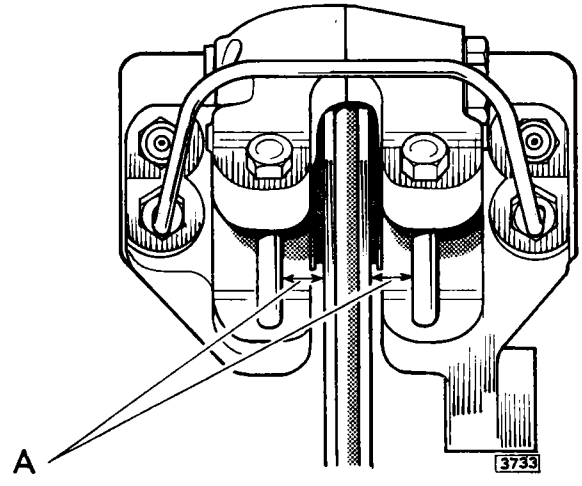
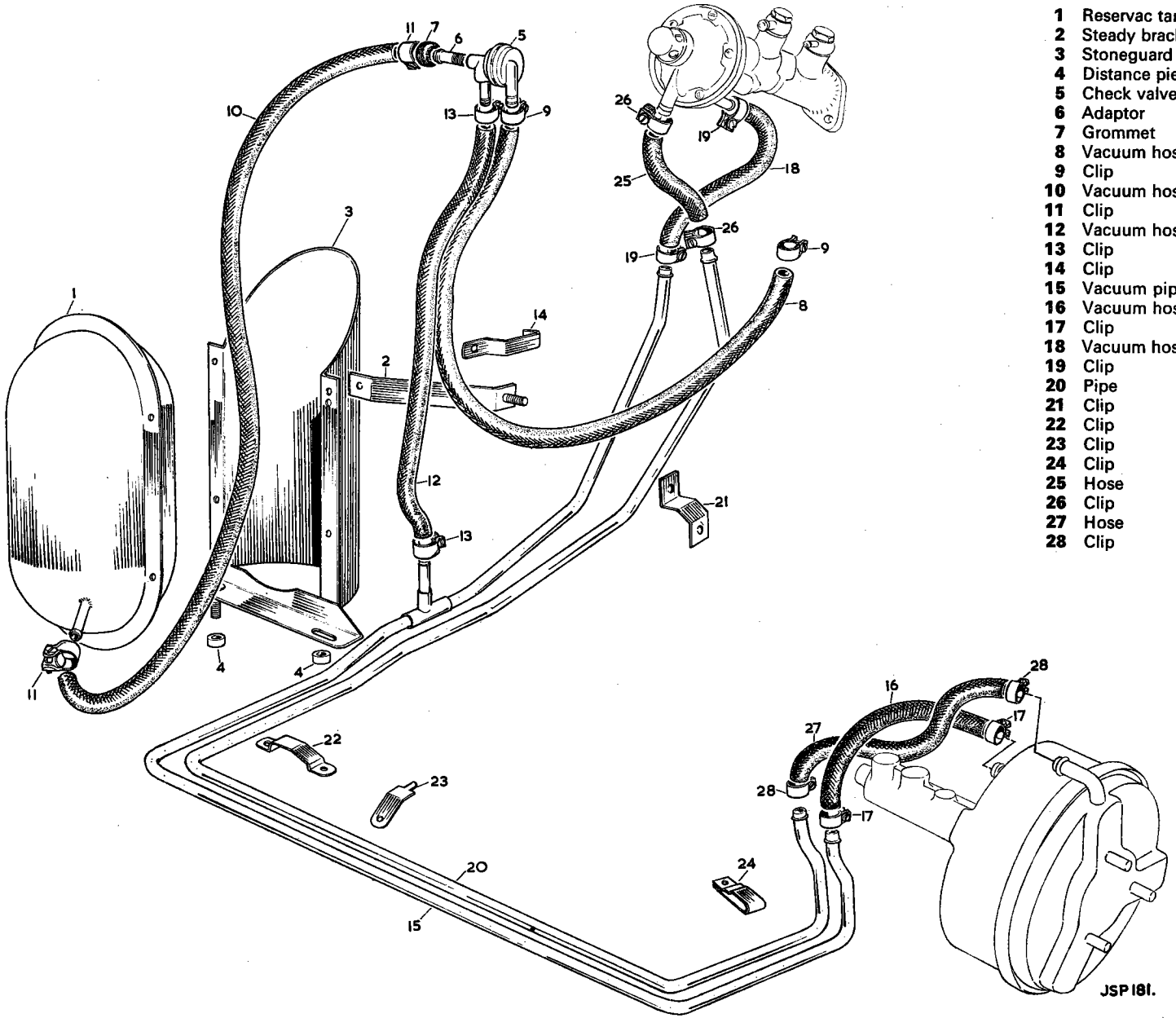


Fig. No. 13 *Checking the handbrake caliper centralisation*



1 Reservac tank assembly
2 Steady bracket
3 Stoneguard
4 Distance piece
5 Check valve
6 Adaptor
7 Grommet
8 Vacuum hose
9 Clip
10 Vacuum hose
11 Clip
12 Vacuum hose
13 Clip
14 Clip
15 Vacuum pipe
16 Vacuum hose
17 Clip
18 Vacuum hose
19 Clip
20 Pipe
21 Clip
22 Clip
23 Clip
24 Clip
25 Hose
26 Clip
27 Hose
28 Clip

Fig. No. 14 *Exploded view of the vacuum reservoir and check valve*

Check that the measurements taken from the shank of each pivot bolt to the brake disc are equal. If not, add or remove shims at the caliper mountings accordingly. This ensures correct centralisation of the handbrake calipers.
Reverse the removal procedure to complete the re-fitting. Ensure that the correct number of camber shims are refitted.
Bleed the braking system as detailed on page L.6.

THE FRONT BRAKE DISCS

Removal

Jack up the car and remove the road wheel. Disconnect the flexible hydraulic pipe from the frame connection and plug the connector to prevent ingress of dirt and loss of fluid.
Discard the locking wire and remove the two caliper mounting bolts. Remove the caliper.
Remove the hub (as described on page J.6).

THE REAR BRAKE DISCS

Removal

Remove the rear suspension unit (as described on page K.4).
Invert the suspension and remove the two hydraulic damper and road spring units (as described on page K.5).
Remove the four steel type self-locking nuts securing the halfshaft inner universal joint and brake disc to the axle output shaft flange.
Withdraw the halfshaft from the bolts, noting the number of camber shims between the universal joint and the brake disc.

1 Rear caliper assembly (R.H.)
2 Piston
3 Seal
4 Dust Seal
5 Friction pad
6 Pin
7 Clip
8 Bridge pipe
9 Bleed screw
10 Dust cap
11 Distance piece
12 Shim
13 Adaptor plate
14 Handbrake mechanism assembly
15 Pad carrier assembly (R.H. outer)
16 Pad carrier assembly (R.H. inner)
17 Anchor plate
18 Operating lever
19 Return spring
20 Pawl assembly
21 Tension spring
22 Anchor pin
23 Adjusting nut
24 Friction Spring
25 Hinge pin
26 Split pin
27 Protection cover
28 Protection cover
29 Bolt
30 Washer
31 Bolt
32 Split pin
33 Bolt
34 Retraction plate
35 Tabwasher
36 Disc assembly

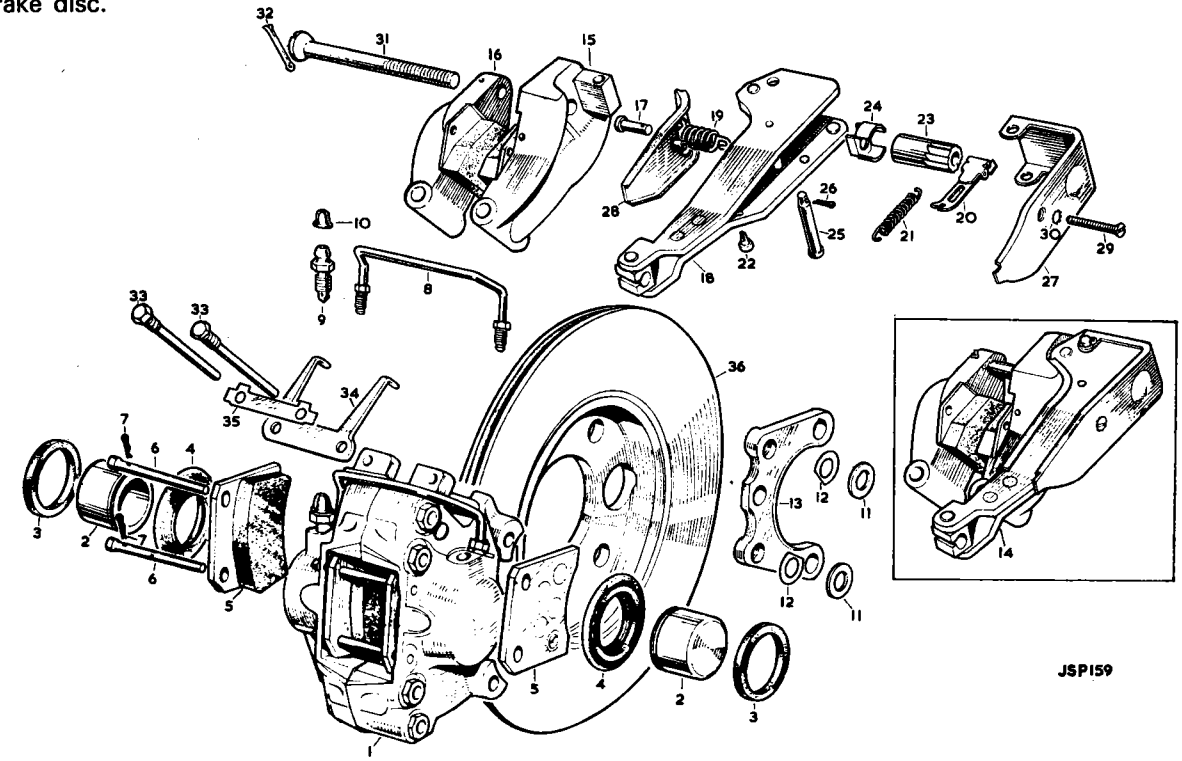


Fig. No. 15 *Exploded view of the rear brake caliper*

Knock back the tabs and unscrew the two pivot bolts securing the hand brake pad carriers to the caliper.
Remove the pivot bolts and the retraction plate (Fig. 15).
Withdraw the handbrake pad carriers from the aperture at the rear of the cross members.
Break the locking wire on the caliper mounting bolts.
Remove the hairpin clips and retaining pins and withdraw the friction pads.
Disconnect the brake fluid feed pipe at the caliper.
Unscrew the mounting bolts through the access holes in the brake disc.
Withdraw the bolts, noting the number and position of the round caliper centralising shims.
Withdraw the caliper through the aperture at the front of the cross member.
Tap the halfshaft universal joint and brake disc securing bolts back as far as possible.
Lift the lower wishbone, hub carrier and half shaft assembly upwards until the brake disc can be withdrawn from the mounting bolts.

1 Front caliper assembly (R.H.)
2 Outer piston
3 Inner piston
4 Seal
5 Dust seal (outer piston)
6 Seal
7 Dust seal (inner piston)
8 Friction pad kit
9 Pin
10 Clip
11 Bleed screw
12 Dust cap
13 Shim
14 Disc assembly
15 Shield assembly (Upper)
16 Shield assembly (Lower R.H.)
17 Shield assembly (Lower L.H.)

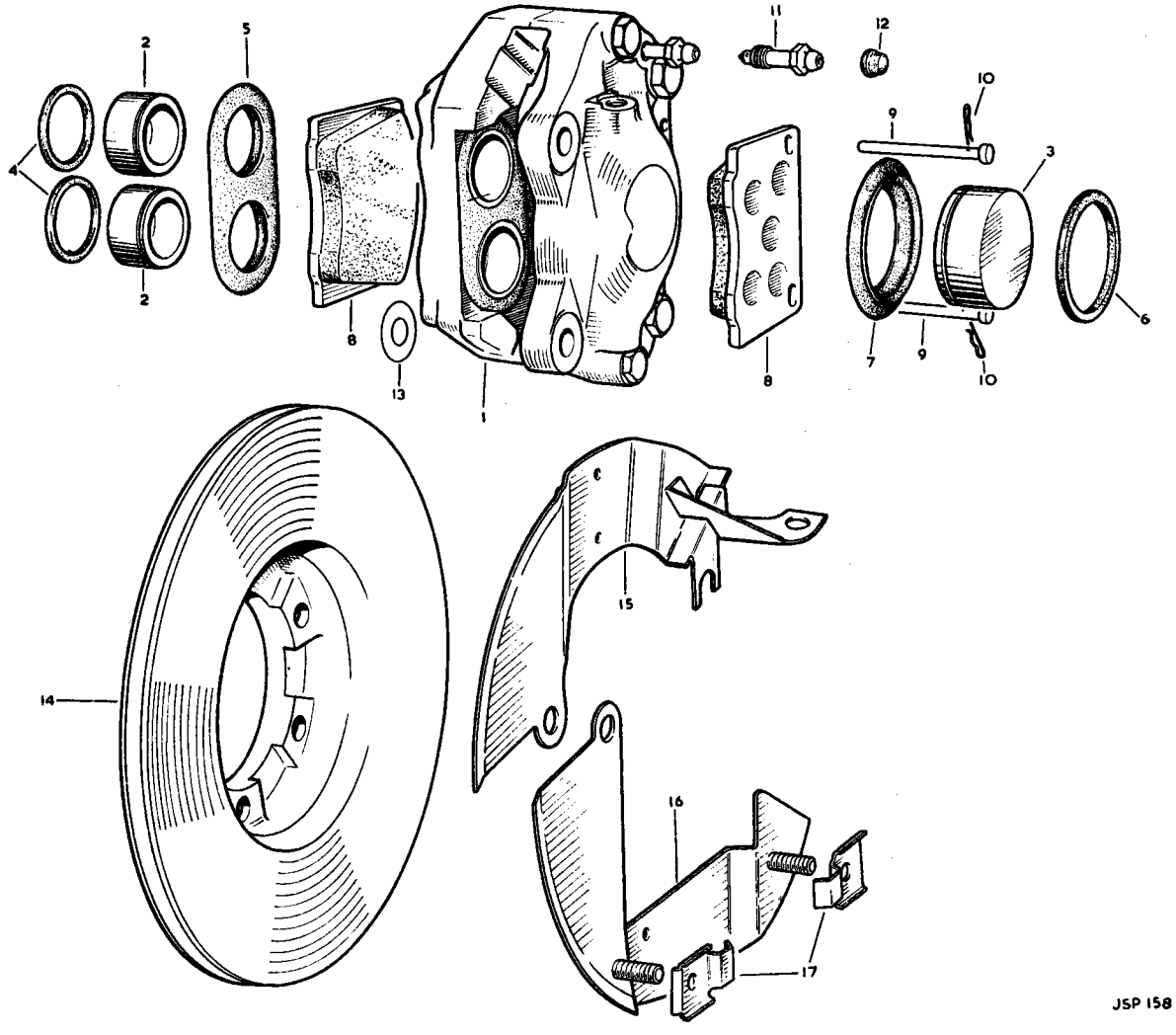


Fig. No. 16 *Exploded view of the front brake caliper*

Refitting
Refitting the brake discs is the reverse of the removal procedure. The securing bolts must be knocked back against the drive shaft flange when the new disc has been fitted.
Care must be taken to refit the caliper centralising shims in the same position. The centralisation of the caliper should be checked (as described in "Refitting the Calipers") when the half shaft has been refitted.
Refit the rear suspension (as described on page K.5.
Bleed the brakes as described on page L.6.

BRAKE DISC "RUN-OUT"
Check the brake discs for "run-out" by clamping a dial test indicator to the stub axle carrier for the front discs and the cross member for the rear discs. Clamp the indicator so that the button bears on the face of the disc. "Run-out" should not exceed .006" (.15 mm.) gauge reading. Manufacturing tolerances on the disc should maintain this truth and in the event of "run-out" exceeding this value, the components should be examined for damage.
Note: It is most important that the endfloat of the front hubs and the rear axle output shafts is within the stated limits, otherwise the brakes may not function correctly. The front hub endfloat adjustment is described on page J.6. The endfloat adjustment of the rear axle output shafts is described on page H.12.

THE HANDBRAKE

DESCRIPTION
The self-adjusting handbrakes are attached to the rear brake caliper bodies and consists of independent mechanically actuated systems complete with friction pads. Each handbrake is self-adjusting to compensate for friction pad wear to provide the necessary clearance between the brake discs and the friction pads.

OPERATION (Fig. 17)
On applying the handbrake, the operating lever is moved away from the friction pad carrier and draws the friction pads together.
Under normal conditions, when the lever is released, the pawl, in the adjusting mechanism, returns to its original position. In this manner the correct running clearance between the brake disc and the friction pad is maintained.
As the friction pad wears, the pawl will turn the ratchet nut on the bolt thread drawing the adjuster bolt inwards and bringing the friction pads closer to the brake disc until the normal running clearance is restored.

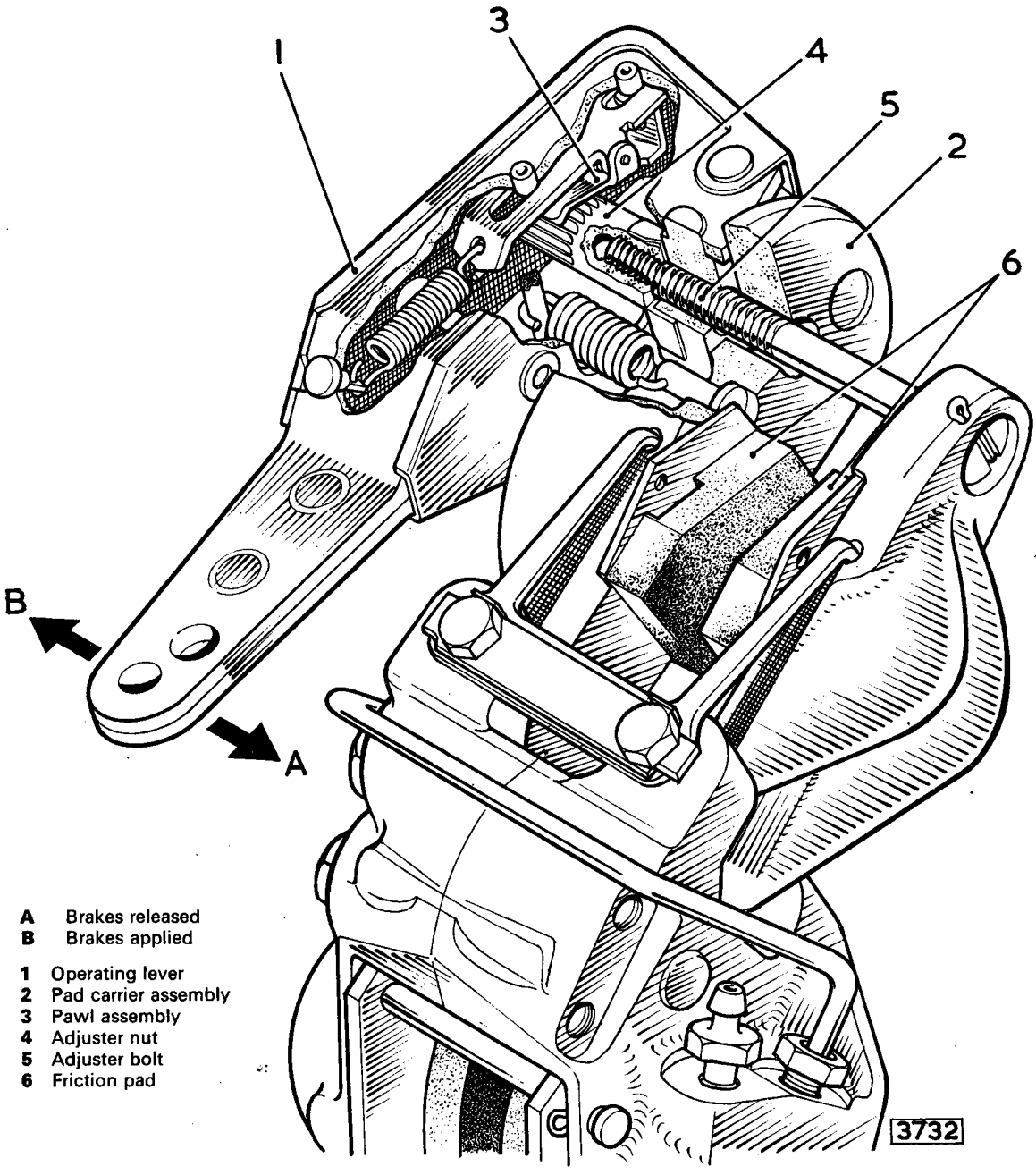
FRICTION PAD CARRIERS
Removal
With the car on a ramp, disconnect the handbrake cable from the operating levers on the handbrake mechanism as follows:
Remove the split pin, withdraw the clevis pin and disconnect the fork end on one lever and withdraw the outer cable from the trunnion on the other lever. Lift the locking tabs and remove the pivot bolts and retraction plate. Remove the friction pad carriers by moving them rearwards around the disc and withdrawing from the rear of the rear suspension assembly. Repeat for the second handbrake.

Dismantling
Remove the cover securing bolt, discard the split pin and withdraw the pivot clevis pin. Remove the dust cover and remove the split pin from the screwdriver slot in the adjusting bolt. Unscrew the adjusting bolt from the ratchet nut and withdraw the nut and bolt. Detach the pawl return spring and withdraw the pawl over the locating dowel. Detach the operating lever return spring and remove the operating lever and lower cover plate.

Assembling
Assembly is the reverse of the dismantling procedure.

Refitting
Refitting is the reverse of the removal procedure, but the handbrake should be set as follows:—
Ensure that the handbrake pivot bolts are slack.
Remove the split pin from the head of the adjuster bolt and slacken the bolt until there is approximately $\frac{1}{4}$" (6.35 mm.) free movement between the head and the outer pad carrier.
Pull the inner and outer pad carriers away from the disc, bending the brass retraction fingers until there is $\frac{1}{16}$" (1.6 mm.) clearance between each pad and the disc.
Take up the free movement of the adjuster bolt, tightening until the bolthead is in light contact with the outer pad carrier seating.
Fit a new split pin to lock the adjuster bolt.
Pull and release the handbrake lever repeatedly until the ratchet ceases to operate, which will indicate that the correct adjustment has been obtained.
With the handbrake applied reasonably hard, tighten the pivot bolts and secure with the tab washer.
Note: It is ESSENTIAL that the brass retraction fingers are in good condition, i.e. not badly distorted. The ends which fit into the pad carriers must be inserted fully into the holes to avoid the possibility of twisting the fingers.
Reconnect the handbrake compensator linkage to the operating levers and check the cable adjustment as detailed on page L.5.

HANDBRAKE FRICTION PADS — RENEWING
With the friction pad carriers removed, withdraw the old pads by slackening the nuts in the outer face of each carrier and utilizing a hooked tool in the hole of



A Brakes released
B Brakes applied

1 Operating lever
2 Pad carrier assembly
3 Pawl assembly
4 Adjuster nut
5 Adjuster bolt
6 Friction pad

Fig. No. 17 *Sectioned view of the handbrake mechanism*

each pad securing plate. Fit new pads, short face upwards, ensuring that each pad locates the head of the retaining bolt. Fit new retraction fingers and assemble the carrier to the main calipers, leaving the pivot bolts slack.
Pull and release the handbrake lever repeatedly until the ratchet ceases to operate, which will indicate that the correct adjustment has been obtained.

With the handbrake applied reasonably hard, tighten the pivot bolts and secure the tab washer.

Note: It is recommended that new retraction fingers are fitted when replacing the handbrake pads.
Reconnect the handbrake compensator linkage to the operating levers and check the handbrake cable adjustment.

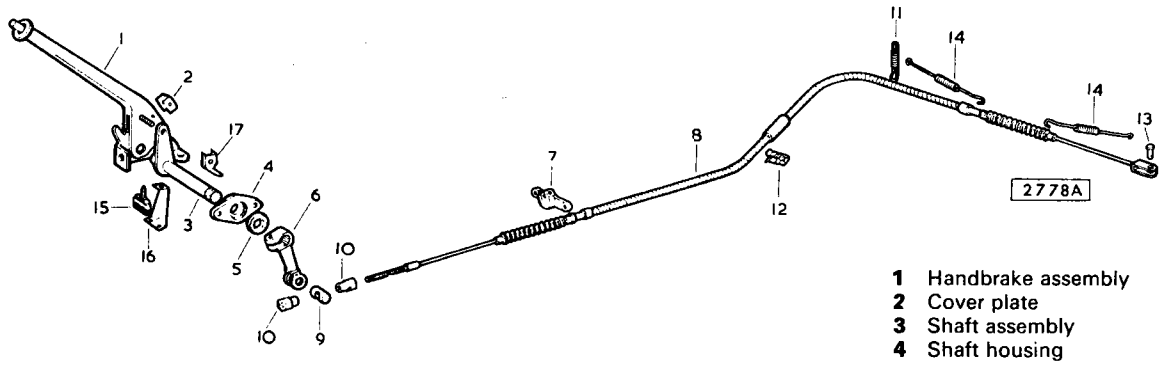


Fig. No. 18 *Handbrake components*

1 Handbrake assembly
2 Cover plate
3 Shaft assembly
4 Shaft housing
5 Rubber seal
6 Lever
7 Cable abutment bracket
8 Cable
9 Trunnion
10 Adjusting nut
11 Spring
12 Clip
13 Clevis pin
14 Return spring
15 Handbrake warning light switch
16 Bracket
17 Bracket

HAND BRAKE CABLE

Removal

Place the car over a ramp or pit.
Remove the split pin, withdraw the clevis pin and detach the fork end from the operating lever. Withdraw the outer cable from the trunnion on the other lever.
Unhook the cable from the support spring and release the cable from the spring anchor clip located forward of the rear radius arm.
Remove the two setscrews securing the intermediate cable abutment bracket to the underside of the body, withdraw the pinch bolt and detach the bracket from the cable.
Remove the brass adjuster nut and withdraw the cable from the handbrake lever trunnion.
Withdraw the cable from the rear of the car.

Refitting

Refitting is the reverse of the removal procedure. Adjust the cable as detailed in "Routine Maintenance" on page L.5.

HANDBRAKE LEVER ASSEMBLY

Removal

From beneath the car, remove the brass adjusting nut and withdraw the cable from the lever trunnion.
Mark the location of the lever in relation to the operating shaft splines; remove the pinch bolt and withdraw the lever.
Remove the front seat on the driver's side of the car. Lift the carpet locally around the lever.
Withdraw the two setscrews securing the warning light switch carrier bracket to the floor.
Remove the two setscrews securing the operating shaft bearing to the body and the two setscrews from the lever mounting bracket.
Slide the bearing along the shaft and withdraw the lever assembly.

Refitting

Refitting is the reverse of the removal procedure.
Adjust the handbrake cable as detailed in "Routine Maintenance" on page L.5.
Adjust the position of the brake warning light switch in the mounting bracket by means of the two nuts on the threaded shank until the warning light goes out with the handbrake released.

HANDBRAKE WARNING LIGHT SWITCH—ADJUSTMENT

Should the warning light fail to extinguish when the handbrake is "off", ensure that the handbrake is moving the full length of its travel and that the switch bracket has not inadvertently become off set. Examine the electrical leads for short-circuiting.
Apply the handbrake and switch on the ignition. Depress the plunger in the centre of the interrupter switch and observe the warning light: should the light continue to glow, check the brake fluid levels in the reservoirs which may be low. Top up to the correct level.
Reposition the switch, if necessary, as detailed under "Handbrake Lever Assembly".

WHEELS AND TYRES

SECTION M

INDEX

WHEELS AND TYRES

DESCRIPTION

Pressed steel disc wheels are fitted as standard equipment; wire spoke wheels are specified as an optional extra.

Dunlop SP41 tyres (with tubes) are fitted to both types of wheels.

DATA

Roadwheel:

Type—standard equipment	Pressed steel disc
—optional equipment	Wire spoke (72 spoke)
Fixing—pressed steel disc	Five studs and nuts
—wire spoke	Centre lock, knock on hub cap
Rim section —disc	5J
—wire spoke	5K
Rim diameter —all types	15" (381 mm.)

Tyres:

Make	Dunlop
Type	SP.41
Size	185 x 15 (185 x 380)

IMPORTANT

It is particularly important that tyres of different makes, types, or those having different tread patterns should not be mixed on individual cars as this may adversely affect the handling and steering characteristics.

A car should not, of course, be driven on bald tyres or on tyres which have only part of the tread left showing. Driving with badly worn tyres on wet roads also greatly increases the risk of "aquaplaning" with consequent loss of steering and braking.

The importance of having tyres that are in good condition and of the correct type cannot be overstressed. The Dunlop SP.41 tyres fitted as original equipment are specially produced to suit the performance of the model concerned and a change of make or type of tyre should not be made unless an assurance is given by the tyre manufacturer concerned that the alternative type is suitable for the particular car under maximum performance conditions.

INFLATION PRESSURES

PRESSURES SHOULD BE CHECKED WHEN TYRES ARE COLD, SUCH AS STANDING OVERNIGHT, AND NOT WHEN THEY HAVE ATTAINED THEIR NORMAL RUNNING TEMPERATURES.

DUNLOP SP.41
(185 x 15)

Pressures:	**Front**	**Rear**
For conditions where maximum performance with sustained speed is being used, or for touring conditions where the car is fully laden.	36lb./sq.in. (2.5 kg/sq.cm)	36lb./sq.in. (2.5 kg/sq.cm)
For normal motoring with maximum speed up to 100 m.p.h. (160 k.p.h.) For two up normal motoring to give maximum comfort it is permissable, and may be found desirable, to reduce the rear tyre pressures by 3lb/sq.in (0.2 kg/sq.cm.)	30lb./sq.in. (2.1 kg/sq.cm)	30lb./sq.in. (2.1 kg/sq.cm)

TYRES—GENERAL INFORMATION

The Dunlop tyres specified have been specially designed for the high speeds possible of this car.

When replacing worn or damaged tyres and tubes it is essential that tyres with exactly the same characteristics are fitted.

Due to the high speed performance capabilities of the car it is important that repair of damaged or punctured tyres should only be undertaken by a tyre specialist. All tyres which are suspect in any way should be submitted to the tyre manufacturers for their examination and report. The importance of maintaining all tyres in perfect condition cannot be too highly stressed.

CONSTRUCTION OF THE TYRE

One of the principal functions of the tyres fitted to a car is to eliminate high frequency vibrations. They do this by virtue of the fact that the unsprung mass of each tyre—the part of the tyre in contact with the ground—is very small.

Tyres must be flexible and responsive. They must also be strong and tough to contain the air pressure, resist damage, give long mileage, transmit driving and braking forces, and at the same time provide road grip, stability and good steering properties.

Strength and resistance to wear are achieved by building the casing from several plies of cord fabric, secured at the rim position by wire bead cores, and adding a tough rubber tread.

Part of the work done in deflecting the tyres on a

car is converted into heat within the tyres. Rubber and fabric are poor conductors and internal heat is not easily dissipated. Excessive temperatures weaken the tyre structures and reduce the resistance of the tread to abrasion by the road surface.
Heat generation, comfort, stability, power consumption, rate of tread wear, steering properties and other factors affecting the performance of the tyres and car are associated with the degree of tyre deflection. All tyres are designed to run at pre-determined deflections, depending upon their size and purpose.
Load and Pressure Schedules are published by all tyre makers and are based on the correct relationship between tyre deflection, tyre size, load carried and inflation pressure. By following the recommendations the owner will obtain the best results both from the tyres and the car.

Inflating

When inflating the tyre, after re-fitting to wheel, be sure that the valve core is in the valve and DO NOT EXCEED 40 POUNDS AIR PRESSURE as there is a risk of breaking the bead wires.
If it is found that the bead will not seat properly, deflate lubricate and centralise tyre before re-inflating. When the tyre bead does not inflate properly at the second attempt, the wheel rim circumference is suspect and should be checked with a rim gauge, if available, or replaced with a new wheel.
After the beads have seated properly, reduce pressure to the recommended operating pressure.
Note: Lock the wheel down when using the mounting machine and do not stand over the tyre when inflating it. Check the tyre pressure frequently to be absolutely sure that the pressure never exceeds 40 lb. sq. in. It is advisable to use an extension pressure gauge with a clip-on chuck and stand well back for maximum safety.

Inflation Pressures

It is important to maintain the tyre pressures at the correct figures, incorrect pressures will affect the steering, riding comfort, and tyre wear.

Effect of Temperature

Air expands with heating and, therefore, tyre pressures increase as the tyres warm up. Pressure increases more in the hot weather than in the cold weather and as a result of high speed. These factors are taken into account when designing the tyre and when determining recommended inflation pressures.
Pressures in warm tyres should not be reduced to standard pressures for cold tyres. "Bleeding " the tyres increases their deflections and causes temperatures to climb still higher. The tyres will be under inflated when they have cooled.
Always ensure that the valve caps are fitted as they prevent the ingress of dirt and form a secondary seal to the valve core.

Tyre Examination

Examine tyres periodically for flints, nails, etc., which may have become embedded in the tread. These should be removed with a blunt screwdriver or a similar instrument.

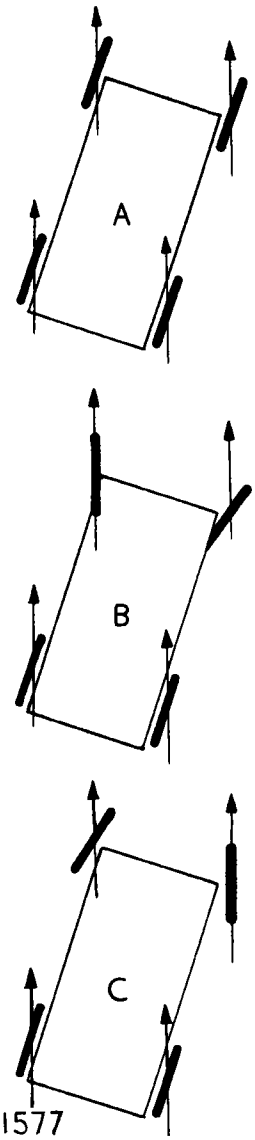


Fig. No. 1 *Exaggerated diagram of the way in which road camber affects a car's progress*

"A" Wheels parallel in motion; tyre wear equal
"B" Wheels toed-out in motion; right front tyre wears faster
"C" Wheels toed-in in motion; Left front tyre wears faster

WHEEL ALIGNMENT AND ITS ASSOCIATION WITH ROAD CAMBER

It is very important that correct wheel alignment should be maintained. Misalignment causes a tyre tread to be scrubbed off laterally because the natural direction of the wheel differs from that of the car.
An upstanding sharp "fin" on the edge of each pattern rib is a sure sign of misalignment and it is possible to determine from the position of the "fins" whether the wheels are toeing in or toeing out.
"Fins" on the inside edges of the pattern ribs—nearest the car—and particularly on the near side tyre indicate

toe in. "Fins" on the outside edges, particularly on the offside tyre, indicate toe out.

With minor misalignment, the evidence is less noticeable and sharp pattern edges may be caused by road camber even when wheel alignment is correct. In such cases it is better to make sure by checking with an alignment gauge.

Road camber affects the direction of the car by imposing a side thrust and if left to follow its natural course, the car will drift towards its near side. This is instinctively corrected by steering towards the road centre.

As a result, the car runs crabwise, diagrammatically illustrated in an exaggerated form in Fig. 1. The diagram shows why nearside tyres are very sensitive to too much toe in and offside tyres to toe out. It also shows why sharp "fins" appear on one tyre but not on the other, and why the direction of misalignment can be determined by noting the position of the "fins". Severe misalignment produces clear evidence on both tyres.

The front wheels on a moving car should be parallel. Tyre wear can be affected noticeably by quite small variations from this condition. It will be noted from the diagram that even with parallel wheels the car is still out of line with its direction of movement, but there is less tendency for the wear to be concentrated on any one tyre.

The near front tyre sometimes persists in wearing faster and more unevenly than the other tyres even when the mechanical condition of the car and tyre maintenance are satisfactory. The more severe the average road camber the more marked will this tendency be.

Precautions when Measuring Wheel Alignment

1. The car should have come to rest from a forward movement. This ensures as far as possible that the wheels are in the neutral running positions.
2. It is preferable for alignment to be checked with the car laden.
3. With conventional base-bar tyre alignment gauge measurements in front of and behind the wheel centres should be taken at the same points on the tyres or rim flanges. This is acheived by marking the tyres where the first reading is taken and moving the car forwards approximately half a road wheel revolution before taking the second reading at the same points. With the Dunlop Optical Gauge two or three readings should be taken with the car moved forwards to different positions—180° road wheel turn for two readings and 120° for three readings. An average figure should then be calculated.

Wheels and tyres vary laterally within their manufacturing tolerances or as the result of service, and alignment figures obtained without moving the car are unreliable.

TYRE AND WHEEL BALANCE

Static Balance

In the interests of smooth riding, precise steering and the avoidance of high speed "tramp" or "wheel hop" all Dunlop tyres are balance checked to predetermined limits.

To ensure the best degree of tyre balance the covers are marked with white spots on one bead and these indicate the lightest part of the cover. Tubes are marked on the base with black spots at the heaviest point. By fitting the tyre so that the marks on the cover bead exactly coincide with the marks on the tube, a high degree of tyre balance is achieved (Fig. 2). When using tubes which do not have the coloured spots it is usually advantageous to fit the covers so that the white spots are at the valve position.

Some tyres are slightly outside standard balance limits and are corrected before issue by attaching special patches to the inside of the covers at the crown. These patches contain no fabric, they do not affect the local stiffness of the tyre and should not be mistaken for repair patches. They are embossed "Balance Adjustment Rubber".

The original degree of balance is not necessarily maintained and it may be affected by uneven tread wear, by cover and tube repair, by tyre removal and refitting or by wheel damage and eccentricity. The car may also become more sensitive to unbalance due to normal wear of moving parts.

If roughness or high speed steering troubles develop and mechanical investigation fails to disclose a possible cause, wheel and tyre balance should be suspected.

A Tyre Balancing Machine is marketed by the Dunlop Company to enable Service Stations to deal with such cases.

Warning: If balancing equipment is used which dynamically balances the road wheels on the car, the following precaution should be observed.

In the case of the rear wheel always jack **both** wheels off the ground otherwise damage may be caused to the differential.

This is doubly important in the case of cars fitted with a Thornton "Powr-Lok" differential as in addition to possible damage to the differential, the car may drive itself off the jack or stand.

Fig. No. 2 *Correct position of the inner tube to outer cover to facilitate wheel balance*

Dynamic Balance

Static unbalance can be measured when the tyre and wheel assembly is stationary. There is another form known as dynamic unbalance which can be detected only when the assembly is revolving.

There may be no heavy spot, that is, there may be no natural tendency for the assembly to rotate about its centre due to gravity, but the weight may be unevenly distributed each side of the tyre centre line. Laterally eccentric wheels give the same effect. During rotation the off set weight distribution sets up a rotating couple which tends to steer the wheel to right and left alternatively.

Dynamic unbalance of tyre and wheel assemblies can be measured on the Dunlop Tyre Balancing Machine and suitable corrections made when cars show sensitivity to this form of unbalance. Where it is clear that a damaged wheel is the primary cause of severe unbalance it is advisable for the wheel to be replaced.

TYRE REPLACEMENT AND WHEEL INTERCHANGING

When replacement of the rear tyres becomes necessary, fit new tyres to the existing rear wheels and, after balancing, fit these wheels to the front wheel positions on the car, fitting the existing front wheel and tyre assemblies (which should have useful tread life left) to the rear wheel positions on the car.

If at any time this operation is carried out and the tyre of the spare wheel is in new condition, it can be fitted to one of the front wheel positions in preference to replacing one of the original rear tyres, which wheel and tyre can then become the spare.

Note: Due to the change in the steering characteristics which can be introduced by fitting to the front wheel positions, wheels and tyres which have been used on the rear wheel positions, interchanging of part worn tyres from rear to front wheel positions is not recommended.

WIRE SPOKE WHEELS
DESCRIPTION

Dunlop cross-spoked wire wheels are fitted as optional equipment and the following instructions are issued to assist in the repair and adjustment of the road wheels in the event of damage due to accident or from any other cause.

Cross-spoking refers to the spoke pattern, where the spokes radiate from the well of the wheel rim to the nose or outer edge of the hub shell, and from the tyre seat of the rim to the flanged or inner end of the shell (Fig. 3).

REMOVAL AND DISMANTLING

Detach wheel from car and remove tyre complete from wheel rim.

Remove spoke nipples and detach spokes from rim and centre.

Check wheel rims and centre; renew if damaged beyond normal repair.

Examine spokes and renew as necessary.

REBUILDING

Place the wheel centre and the rim on a flat surface with the valve hole upwards in the 6-o'clock position.

Note: All spoking operations commence in this position, and the valve hole is always the starting point for all rebuilding operations.

With the valve hole in the 6-o'clock position, fit one A,B,C. and D spoke to produce the pattern as shown in Fig. 3.

Having established the correct pattern remove the A and B spokes and proceed as follows:-

1. Attach the D spoke to the rim and screw up the nipple finger tight; leave the C spoke loosely fitted without a nipple attached.
2. Attach all D spokes with the nipples finger tight.
3. Insert all the C spokes through the hub shell without nipples.
4. Attach all the B spokes as paragraph 2 above.
5. Attach all the A spokes as paragraph 2 above.
6. Attach the nipples and finger tighten all C spokes.
7. Tighten the two C spokes and the two D spokes on each side of the valve hole until the end of the spokes are just below the slot in the nipple heads.
8. Tighten the four C and D spokes diametrically opposed to the valve hole (12 o'clock position).
9. Mark around the wheel until all the C and D spokes are similarly tightened.
10. Follow with all A and B spokes as in paragraphs 7, 8 and 9 above.
11. Work around the wheel with a spoke spanner and tighten all nipples until some resistance is felt. Diametrically opposed spokes should be tightened in sequence.

    The wheel is now ready for trueing and adjustment.

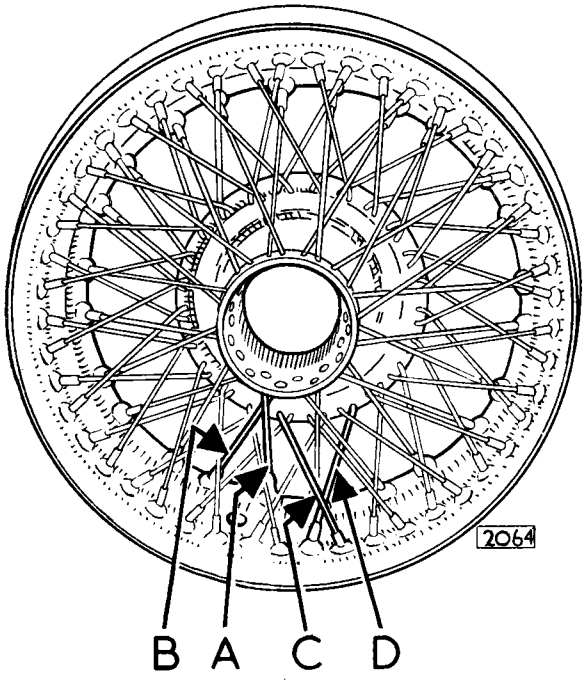


Fig. No. 3 *Showing the spoke arrangement*

TRUEING

Wheels can be out of true in a lateral or radial direction, or in a combination of both.

As a general rule, lateral out of true should be corrected first.

The wheel to be trued must be mounted on a free-running trueing stand before any adjustment can be carried out.

Lateral Correction

Mount the wheel on a trueing stand. Spin the wheel and, holding a piece of chalk near the wall of the rim flange, mark any high spots. Tighten the A and B spokes in the region of the chalk marks and slacken the C and D spokes in the area.

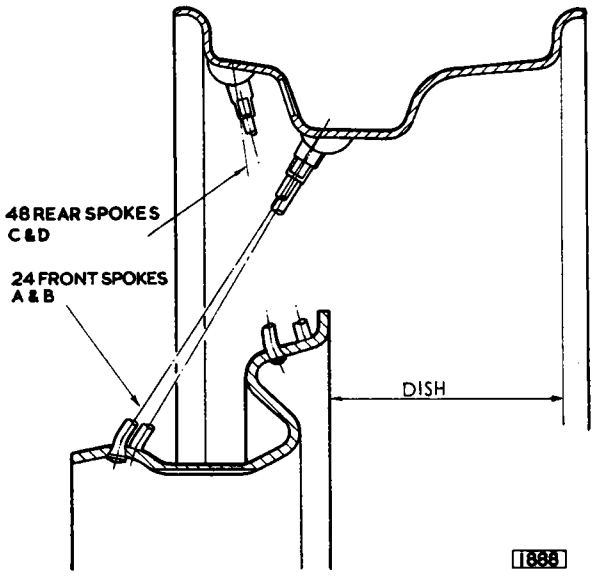


Fig. No. 4 *Location for measuring the dish and the "A" "B", "C" and "D" spokes*

Note: Throughout the trueing operations no spoke should be tightened to such an extent that it is impossible to tighten it further without risk of damage. If any spoke is as tight as it will go, all the other spokes must be slackened.

Radial Correction

When lateral out of truth has been corrected, spin the wheel on the trueing stand and, with the chalk, mark the high spots on the horizontal tyre seat. Tighten **all** spokes in the region of the chalk marks or, if the spokes are on the limit of tightness, slacken the remaining spokes.

CHECKING FOR DISH

The term "dish" defines the lateral dimension from the inner face of the flanges of the wheel centre to the inner edge of the wheel rim. To check "dish" place straight edge across the inner edge of the wheel rim and measure the distance to the inner face of the wheel centre flange (Fig. 4.). This dimension should be $3\frac{7}{16}" \pm \frac{1}{16}"$ (87.3 mm. $\pm$ 1.58 mm.)

Adjustment for "Dish"

If the "dish" is in excess of the correct dimension $3\frac{7}{16}" \pm \frac{1}{16}"$ (87.3 mm. $\pm$ 1.58 mm.) tighten all A and B spokes and slacken all C and D spokes by a similar amount.

When the "dish" dimension is less than the given tolerance slacken all A and B spokes and tighten all C and D spokes by a similar amount.

It will be necessary, after completing the "dish" adjustments, to repeat the lateral and radial trueing procedure until the wheel is not more than .060" (1.5 mm.) out of true in either direction.

It is important that after the wheel trueing operation is completed that all spokes should be tensioned uniformly and to a reasonably high degree.

Correct tension can be closely estimated from the high pitched note emitted when the spokes are lightly tapped with a small hammer.

If a spoke nipple spanner of the torque recording type is used, a normal torque figure should be in the order of 60 lb. ins. (0.7 kg/m.).

BODY AND EXHAUST SYSTEM

SECTION N

INDEX

BODY AND EXHAUST SYSTEM

BODY AND EXHAUST SYSTEM

BODY

THE INSTRUMENT PANEL

Opening

Disconnect the battery.
Remove the ignition key and cigar lighter for safe keeping. Hinge the centre instrument panel downwards on its bottom edge, after withdrawing the thumb screws situated in each top corner.

Removal

The instrument panel can be removed completely by detaching the earth lead from the battery, identifying and removing the leads from the instruments, cigar lighter and switches, removing the electrical harness together with the clips from the instrument panel and withdrawing two bolts from the extended portion of each hinge, accessible through the newspaper tray beneath.

Refitting

Refitting is the reverse of the removal procedure. Check that the leads are reconnected in accordance with their colour coding.

Closing

Closing is the reverse of the opening procedure. Care must be taken to ensure that the clips securing the main harness to the instrument panel will in no way foul any of the switch or instrument terminals, otherwise a direct short may occur when the battery is re-connected.
Note: If air conditioning equipment is fitted it will be necessary to remove the sub-panel with the controls from the stud mounting before the instrument panel can be lowered.

CONSOLE AND PARCEL TRAY ASSEMBLY

Removal

Disconnect the battery.
Remove the console and parcel tray as an assembly as follows:—
Withdraw the drive screws and detach the right hand and left hand side kick panels.
Remove the air conditioning sub-panel (if fitted) from the stud mountings.
Remove the heater control perforated guard cover from the parcel tray after withdrawing four nylon retaining pins.
Disconnect the operating cable from the heater control lever and release the clip securing the outer cable.
Disconnect the control cables from the right and left hand front air outlet ducts, located under the parcel tray, by releasing the locking screw securing the inner cable to the air duct operating spindles.
Remove the locknuts securing the outer cables to the air duct brackets. Disconnect the cables and collect the loose adaptors.
Remove the heater control button escutcheon, retained by two pegs to the control panel and unscrew the two round-headed screws now exposed.
Lift the parcel tray trimming above the control panel and withdraw the two round-headed thumb screws located in recesses in the tray.
Withdraw the control panel facia and disconnect the three rubber pipes connected to the control button unit. Note the location of the individual pipes for reference when refitting.
Disconnect the feed and aerial cables from the radio control unit (if fitted).
Disconnect the rear heater duct pipe from the front junction. Access is gained through the control panel aperture.
Remove the two drive screws on each side securing the parcel tray support bracket to the base of the screen pillar.
Remove the two drive screws securing the parcel tray back-panel to the bulkhead.
Remove the two hexagon headed drive screws securing the rear end of the console to the gearbox tunnel.
Unscrew the gear control knob and tapered nut (not applicable to automatic transmission).
Slide the assembly rearwards to clear the console front clip fixings and lift over the gear control lever to remove.
If the crash rail is to be detached from the parcel tray, remove ten dome nuts and two hexagon nuts.

Refitting

Refitting is the reverse of the removal procedure.

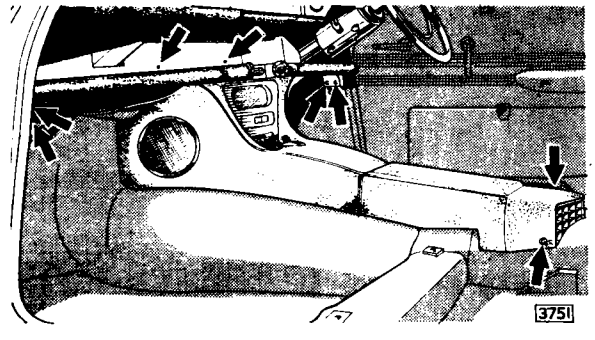


Fig. No. 1 *Showing the attachment points for the console*

THE FACIA PANEL

Removal

The two side facia panels and the screen rail are removed as a complete unit as follows:—

Remove the console and parcel tray assembly as detailed under the previous heading.

Hinge down the instrument panel as detailed on page N.5.

Disconnect the flashing indicator warning light harness at the snap connectors above the steering column and withdraw the harness through the loop bracket attached to the facia panel.

Remove the two nuts securing the steering column assembly to the mounting bracket on the body and lower the column.

Collect any packing washers which may be interposed between the steering column and body mounting brackets.

Disconnect the speedometer drive cable from the back of the instrument.

Remove the two setscrews securing the facia panel to the body below the screen pillars.

Remove four setscrews securing the facia panel to the brackets located in the instrument panel aperture.

Remove four nuts, two adjacent to each end and two central, attaching the screen rail to brackets below the windscreen. The nut situated above the glove-box is accessible through a hole in the glove-box top cover; the centre nuts are exposed with the instrument panel lowered; the fourth nut is accessible from underneath the panel.

Disconnect the earth lead from the clock fixing strap and the illumination feed from the snap connector.

Pull the panel assembly forward and disconnect the remaining cables from the map light, glove-box light, switches and warning lights. Detach the cable socket from the revolution counter. Note the cable colours and location for reference when refitting.

Withdraw the panel assembly.

If necessary, the side facia panel or glove-box can be removed after withdrawing seven screws.

BONNET

Removal

To open the bonnet pull the control knob situated under the facia panel on the right-hand side. This will release the bonnet which will still be retained by the safety catch.

Insert the fingers under the nose of the bonnet and lift the safety catch upwards when the bonnet may be raised.

The bonnet is automatically retained in the fully open position by the action of the hinge springs.

Mark the positions of the hinge brackets on the bonnet to facilitate refitting.

Remove the four setscrews and washers securing the bonnet to each hinge and lift off the bonnet.

Refitting

Position hinges on marks made before removal. Refitting is the reverse of the removal procedure.

BONNET LOCK

Removal

To remove the bonnet catch, slacken the locknut at the top of the peg. Insert a screwdriver into the slot in the peg and unscrew the peg complete with locknut, two washers and spring.

Remove the radiator grille as detailed on page N.7.

Slacken the nut securing the bonnet release cable and withdraw the cable from the release lever.

Remove the two setscrews securing the striker, plate, catch plate and base plate to the body.

Remove the striker, catch and base plates, spacers and spring.

Withdraw the release cable from the outer casing if it is to be replaced.

Adjustment of Bonnet Lock (Fig. 4)

Slacken the locknut on the striker peg and rotate the peg with a screwdriver, until there is approximately $\frac{1}{16}$" (1.5 mm.) movement between the catch plate and the peg. This is to ensure that the catch plate will fully engage with the peg.

Tighten the locknut on the striker peg.

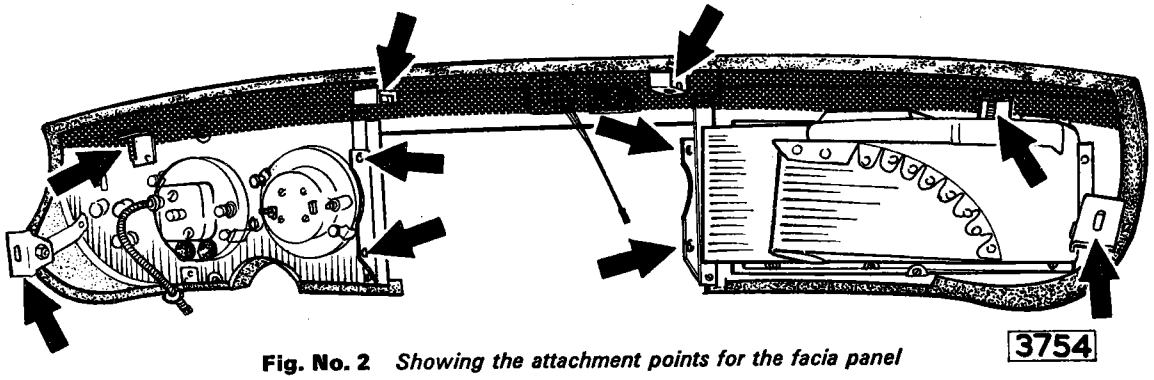


Fig. No. 2 *Showing the attachment points for the facia panel*

Refitting
Refitting is the reverse of the removal procedure.

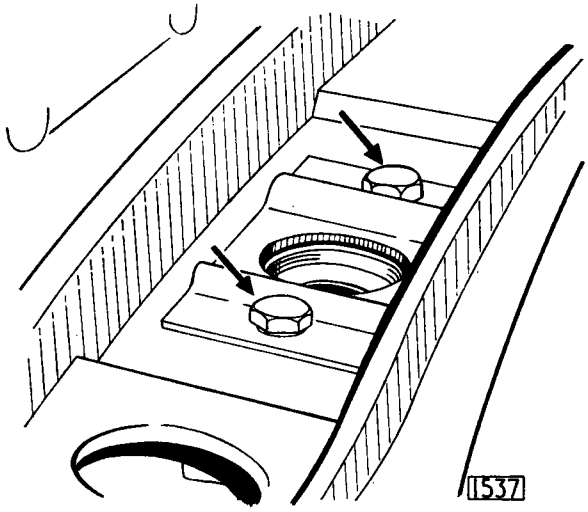


Fig. No. 3 *Showing the two setscrews which secure the bonnet catch striker plate.*

CHROME STRIP ON BONNET

Removal
Remove the nuts, plain and lock washers securing the strip to the bonnet. Detach the strip with the fixing screws.

Refitting
Refitting is the reverse of the removal procedure.

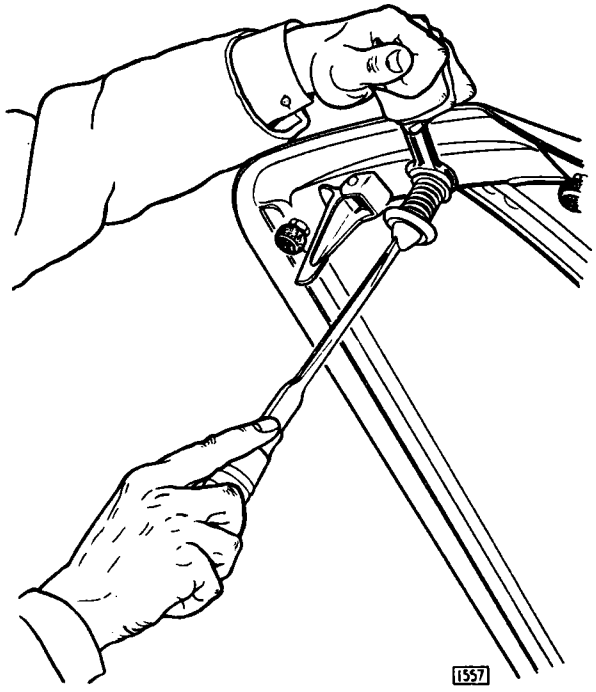


Fig. No. 4 *Adjusting the bonnet lock peg*

RADIATOR GRILLE

Removal (Early cars) (Fig. 5)
Remove five setscrews, lockwashers and plain washers from points A and C, and two nuts, plain washers and lockwashers from point B as shown in Fig. 5 and withdraw the grille.
The attachment points are accessible from beneath the car. The badge is detachable after removing two "Speed" nuts.

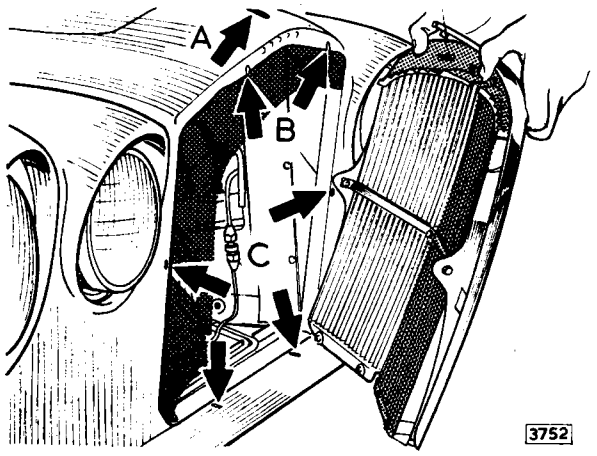


Fig. No. 5 *Showing the mounting points for the radiator grille (Early cars)*

Removal (Later cars) (Fig. 6)
Insert a thin bladed tool between the radiator badge and the grille and prise the badge upwards away from the nylon bush mountings.
The badge has two integral pegs which register in the bushes.
Withdraw the grille top securing screw from points 1 and four setscrews from points 2 and 3.
Attachment points 2 and 3 are accessible from beneath the car.
Note: Care must be taken when removing the badge that the plating on the grille is not scratched or damaged.

Refitting
Refitting is the reverse of the removal procedure.
Check that the grille lines up correctly with the aperture before finally tightening the screws.

Dismantling
Remove the two bolts, nuts, plain and lock washers from the centre retaining strap.
Remove the retainer strap and collect the rubber strips.
Remove four drive screws, plain and lock washers from the bottom of the grille and three setscrews, plain and lock washers from the top.
Withdraw the vane assembly.

Reassembling
Reassembling is the reverse of the dismantling procedure.

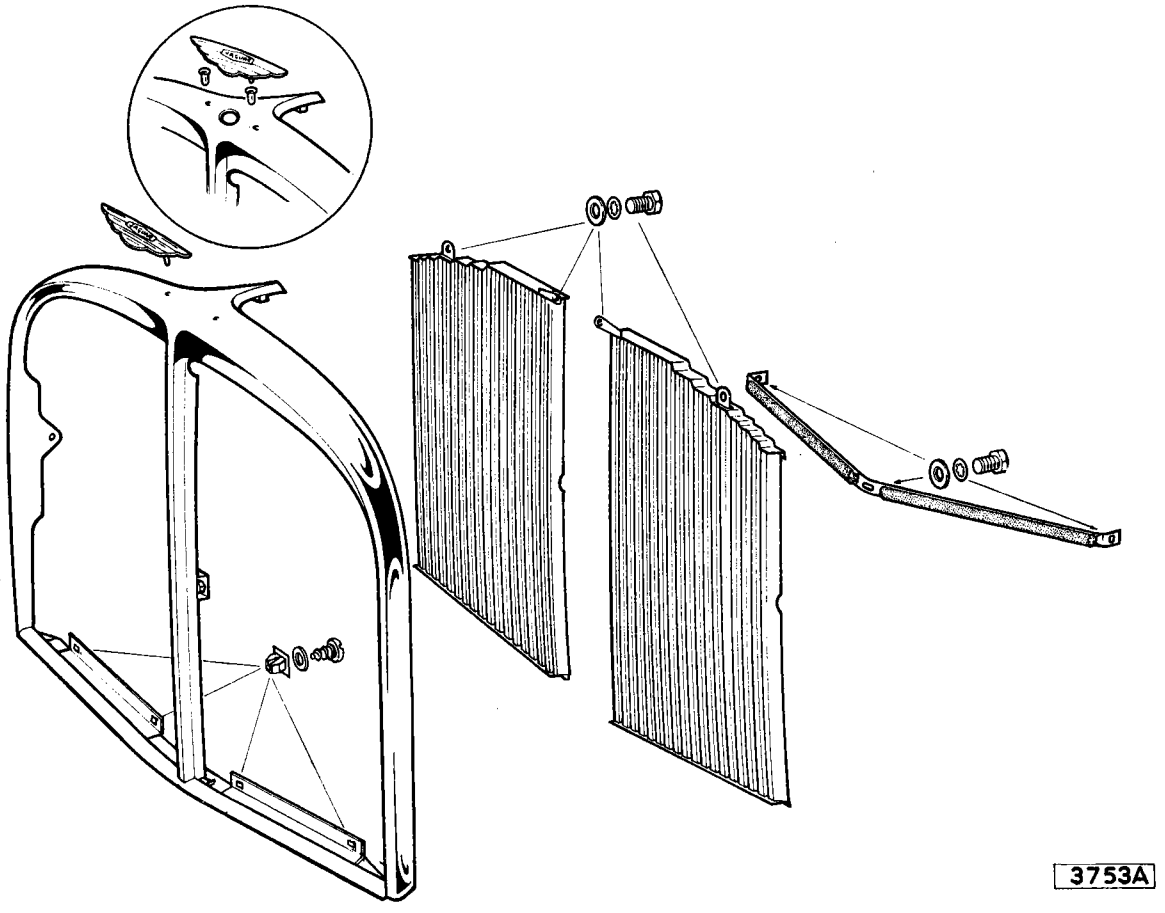


Fig. No. 6 *The radiator grille dismantled. Inset shows the top fixing on later cars.*

MASCOT

Removal

Remove the radiator grille as detailed on page N.7.
Remove the two nuts, plain and cup washers securing the mascot to the body.

Refitting

Refitting is the reverse of the removal procedure. Adjust the mascot to line up with the radiator grille and the bonnet chrome strip before finally tightening the nuts.

LUGGAGE COMPARTMENT LID AND HINGES

Removal

Open the luggage compartment and disconnect the electrical connections in the reverse lamp.
Remove the setscrew securing the earth wire to the luggage compartment lid.
Withdraw the harness from the luggage compartment lid. Remove the two metal straps securing the reverse lamp cable to the left hand hinge. Mark the position of the hinges on the luggage compartment lid.
Remove the eight setscrews, plain and serrated washers and remove the luggage compartment lid.

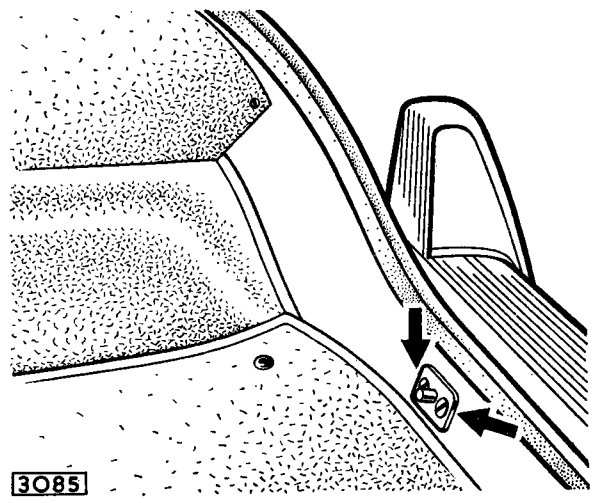


Fig. No. 7 *Showing the screws for adjustment of the luggage compartment lid strikers*

Mark the positions of the hinges on the body and remove the eight setscrews, plain and serrated washers securing the hinges to the body.
Remove the luggage compartment lid hinges.

Refitting
Refitting is the reverse of the removal procedure.

Boot Lock Adjustment
Slacken the four setscrews securing the two lock strikers. Move the striker in the elongated holes until the lock operates correctly and does not rattle. Tighten the retaining setscrews.

PETROL FILLER LIDS
Removal
Unscrew the three setscrews and washers securing the hinge to the petrol filler compartment and detach the assembly from the body.
Remove the two setscrews and washers securing the lid to the hinge.

Refitting
Refitting is the reverse of the removal procedure. When refitting the lid retain it by screwing the setscrews finger tight in the elongated holes, then align the lid to fit into the recess of the body panel. Tighten the setscrews securely.

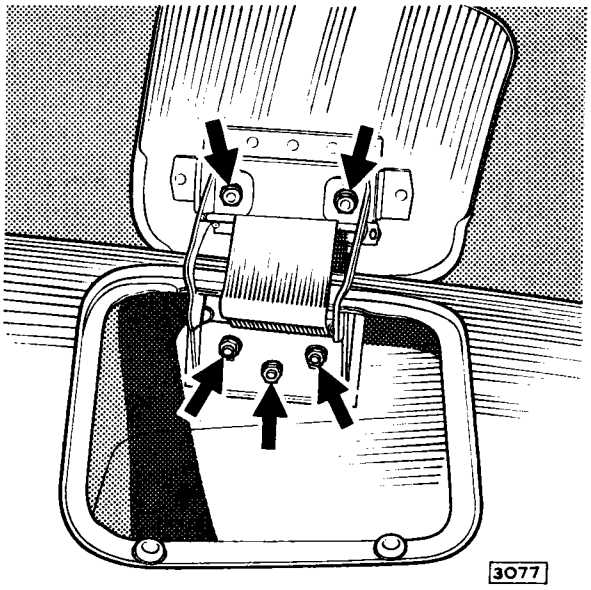


Fig. No. 8 *Removal of the fuel filler lid (R.H.)*

FRONT BUMPER
Removal
Remove two bolts, nuts and washers from the outer mountings and two setscrews and washers from the inner mountings and detach the bumper from the support brackets.

Refitting
Refitting is the reverse of the removal procedure. Adjust the position of the bumper to the body by utilising the slotted holes in the support brackets before finally tightening the bolts.

FRONT BUMPER OVER-RIDERS
Removal
Remove the two nuts, plain and serrated washers securing the over-riders to the front bumper.
Remove the over-riders and beading.

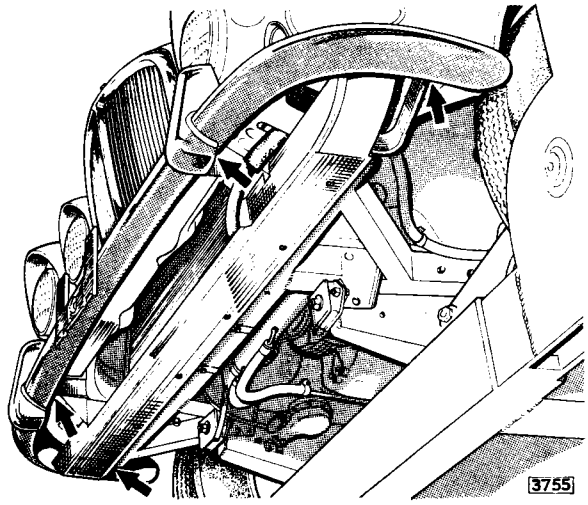


Fig. No. 9 *Showing the mounting points for the front bumper*

Refitting
When refitting the over-riders replace the beading between the over-riders and the bumper.
Refitting is the reverse of the removal procedure.

REAR BUMPER
Removal
Remove the eight setscrews, plain and serrated washers from the outer and inner mountings and detach the bumper.
Remove the nuts and washers securing the bumper mounting rubbers to the wings and reinforcement panels.

Refitting
Refitting is the reverse of the removal procedure.

REAR BUMPER OVER-RIDERS
Removal
Remove the two nuts, plain and serrated washers securing the over-riders to the rear bumper.
Remove the over-riders and beading.

Refitting
When refitting the over-riders replace the beading between the over-riders and the bumper.
Refitting is the reverse of the removal procedure.

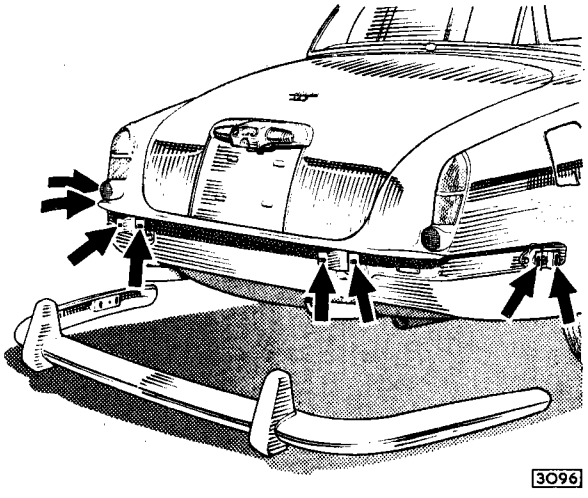


Fig. No. 10 *Showing the mounting points for the rear bumper*

WINDSCREEN

Removal

Prise off the two chrome finisher pieces securing the ends of the chrome finisher which encircles the windscreen.
Prise off the chrome finisher from the windscreen rubber. Extract one end of the rubber insert and withdraw completely.
Run a suitable thin bladed tool around the windscreen to break the seal between the rubber and the windscreen aperture flange.
Strike the glass with the flat of the hand from inside the car, starting in one corner and working towards the bottom.
Repeat this process around the complete windscreen. Withdraw the windscreen.

Refitting

Remove the old sealer from the windscreen flange. Examine the windscreen rubber for cuts. If the windscreen was of toughened glass type it is recommended that the windscreen rubber should be replaced. This is because small particles may have been impregnated in the rubber and could break the screen again. If, however, the windscreen was not broken by a projectile the windscreen aperture flange should be examined for a bump in the metal. If this is found, the bump should be filed away otherwise the glass may break again.
The rubber should be attached to the windscreen aperture with the flat side of the rubber towards the rear and the joint in the rubber preferably at the bottom. Using the special tool (A, Fig. 16) insert the screen into the rubber along the bottom edge first (Fig. 13). It is important that the glass should be fitted equally. DO NOT fit one end and then try to fit the other. Using a special tool (B, Fig. 16) insert the rubber sealing strip with the rounded wide edge to the outside.

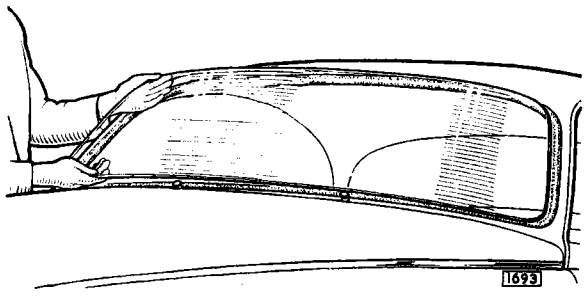


Fig. No. 11 *Removal of the windscreen*

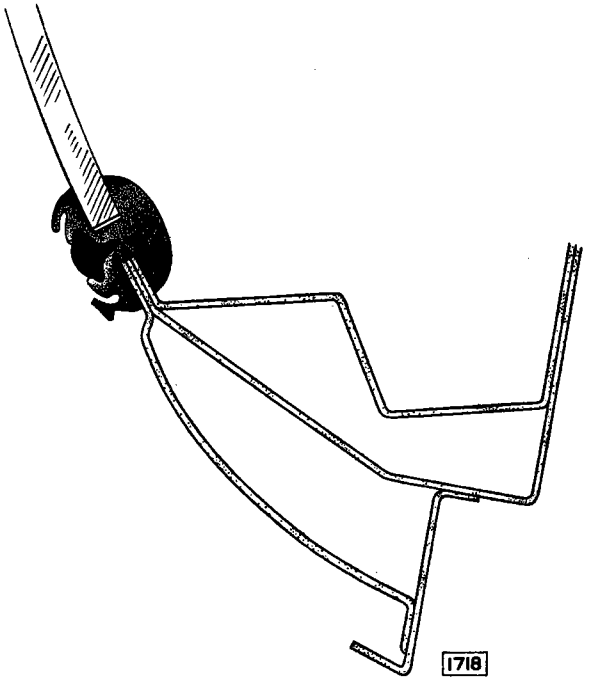


Fig. No. 12 *Section through the windscreen glass and sealing rubber*

Using a pressure gun filled with a sealing compound and fitted with a copper nozzle (so that the glass will not be scratched) apply the nozzle of the gun between the metal body flange and the rubber and fill with sealing compound. Repeat the operation between the glass and the rubber. Remove excess sealing compound with a rag soaked in white spirit. DO NOT USE THINNERS as this will damage the paintwork.

Fit the chrome strip on top of the windscreen rubber and bend to suit contour if necessary. Coat the inside of the chrome strip with a layer of Bostik 1251 and allow to become tacky. Place the chrome strip on the rubber over the rubber sealing strip and with a hook (A, Fig. 16) lip the rubber of the chrome finisher. Fit the two centre chrome clips and lip the rubber over the edges of the clips.

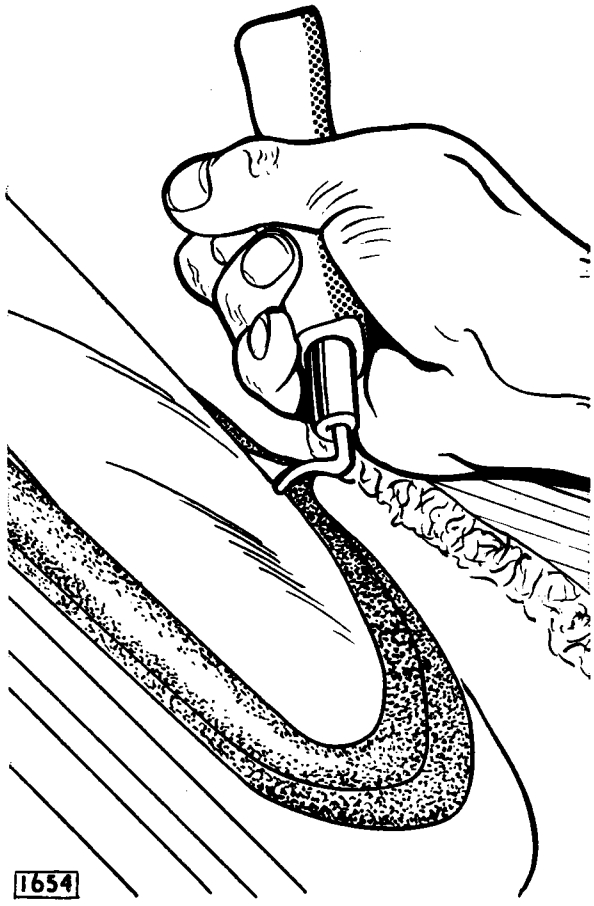


Fig. No. 13 *Using the special tool ("A" Fig. 16) for lifting the rubber over the glass*

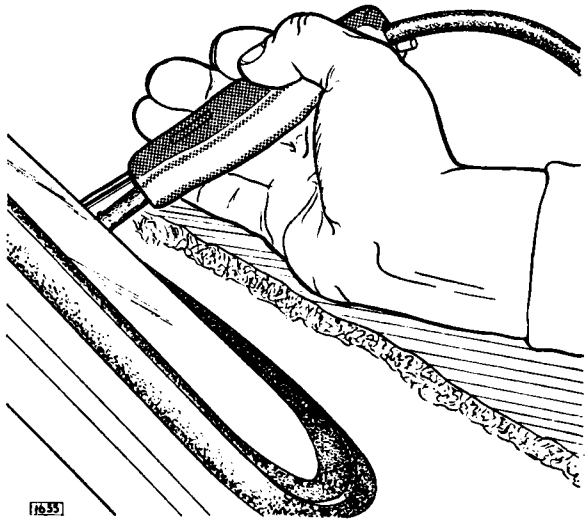


Fig. No. 14 *Using the special tool ("B" Fig. 16) for inserting the rubber sealing strip in the windscreen sealing rubber*

REAR GLASS

Removal

Prise off the two chrome finisher pieces securing the ends of the chrome finisher which encircles the backlight.

Prise off the chrome finisher from the backlight rubber.

Extract one end of the rubber insert and withdraw completely.

Run a suitable thin bladed tool around the backlight to break the seal between the rubber and the backlight aperture flange.

Strike the glass with the flat of the hand from inside the car, starting in one corner and working towards the bottom.

Repeat this process around the complete rear light glass.

If the car is fitted with a heated backlight it is necessary to disconnect the two electrical connections in the boot (page P.63 Figs. 75 and 76) and care should be taken when removing the backlight not to break the two wires which pass through the holes in the sealing rubber.

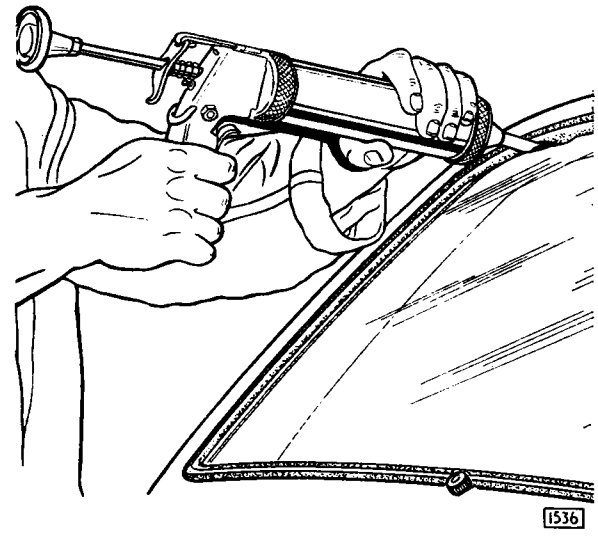


Fig. No. 15 *Using a gun to inject sealing compound between the surround rubber and the glass*

Refitting

Remove the old sealer from the backlight flange. Examine the sealing rubber for cuts. If the backlight is of the toughened glass type (i.e. all cars except those fitted with heated backlights) it is recommended that the backlight rubber should be replaced.

This is because small particles of glass may have been impregnated into the rubber and it could break the glass again. If, however, the backlight was not broken by a projectile the backlight aperture flange should be examined for a bump in the metal. If this is found the bump should be filed away, otherwise the glass may break again.

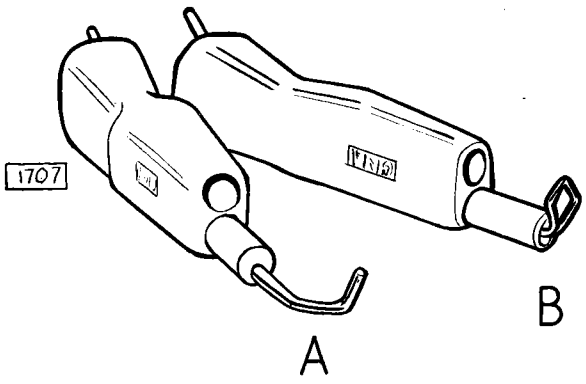


Fig. No. 16 *The two special tools (Churchill Tool No. JD 23) used when refitting a windscreen*

The rubber should be attached to the backlight aperture with the flat side of the rubber facing the inside of the car.
If the car is fitted with a heated backlight, pierce the sealing rubber in the two appropriate positions, Fig. 18, to take the wires which lead to the element.

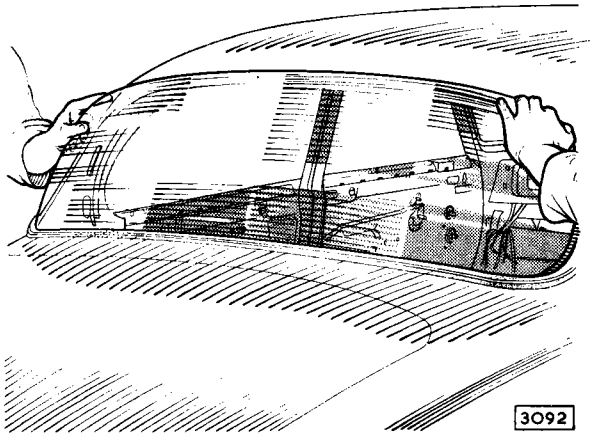


Fig. No. 17 *Removal of the rear glass*

Using the special tool (A, Fig. 16), insert the backlight into the rubber along the bottom edge first. On cars fitted with heated backlight, feed electrical wires through holes in sealing rubber first (Fig. 18). It is important that the glass is fitted equally. DO NOT fit one end and then try to fit the other. Using the special tool (B, Fig. 16), insert the rubber sealing strip with the rounded wide edge to the outside.
Using a pressure gun filled with a sealing compound and fitted with a copper nozzle (so that it will not scratch the glass) apply the nozzle of the gun between the metal body flange and the rubber and fill with sealing compound (Fig. 19). Also apply sealing compound between the rubber and the glass (Fig. 15).

Remove excess sealing compound with a rag soaked in white spirit, DO NOT USE THINNERS as this will damage the paintwork.

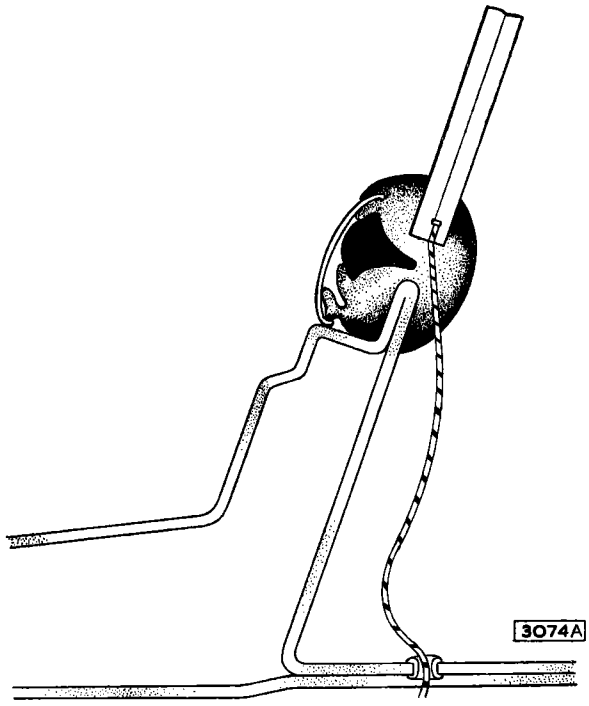


Fig. No. 18 *Section through the rear light glass and sealing rubber*

Check that there is a small gap between the sealing rubber edge and the depression for the rear glass aperture. This is necessary to allow the chrome finishing strip to seat on the sealing rubber. If the rubber bends hard onto the depression at certain points insert a small length of stiff piping cord $\frac{1}{8}$" (3.1 mm.) diameter at the required positions, this will facilitate the fitting of the chrome strip. Fit the chrome on top

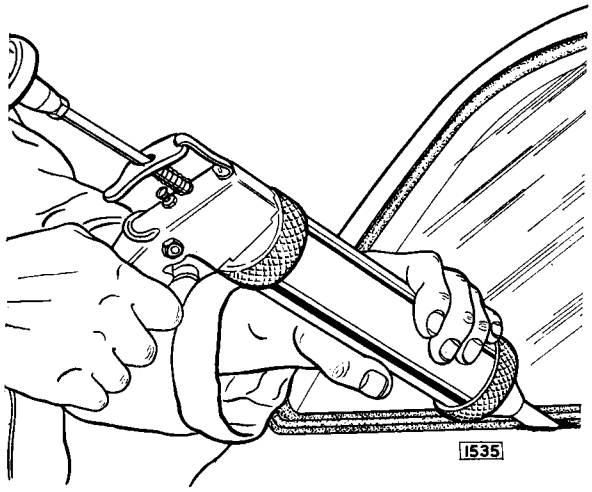


Fig. No. 19 *Using a gun to inject compound between the rubber and the rear glass aperture*

of sealing rubber and bend to suit contour if necessary. Coat the inside of the chrome strip with a layer of Bostik adhesive and allow to become tacky. Place the chrome strip onto the sealing rubber and with a hook (A, Fig. 16) lift the lip of the rubber over the chrome finisher. Fit the two centre chrome clips and lip the rubber over the edges of the clips.
Reconnect the heated backlight cables (if fitted).

FRONT DOORS AND HINGES

Removal

Remove the split pin and clevis pin on the door check strap bracket situated on the door hinge pillar.
Mark the position of the hinges on the door.
Remove the six bolts securing the hinges to the door side and remove the door.
Remove the scuttle side casing by unscrewing the three drive screws. Remove the two screws securing the aperture cover plate. Unscrew the door courtesy light switch from the bottom hinge recess. Pull out the electrical connection at the rear of the switch.
To remove the hinges unscrew the four cross headed screws and two bolts inside the hinge recess.

Refitting

Refitting is the reverse of the removal procedure.

REAR DOORS AND HINGES

Removal

Remove the split pin and clevis pin on the door check strap bracket on the door hinge pillar. Remove the door trim casing.
Mark the positions of the hinges on the door.
Remove the three bolts securing the bottom hinge to the rear door and remove the four cross headed screws securing the top hinge to the door.

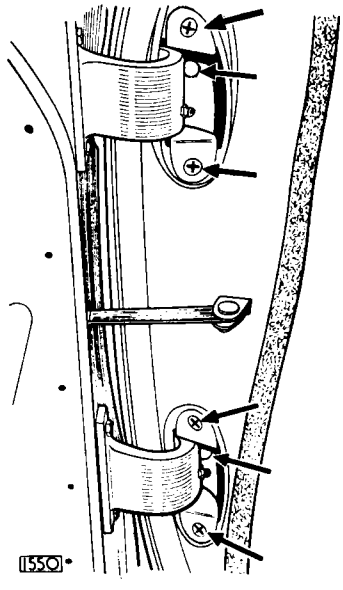


Fig. No. 20 *Showing the screws which secure the front door hinge*

Remove the rear door.
Remove the four cross headed screws securing the hinges to the rear door side of the centre pillar.
Remove the two cross headed screws from the front door side of the centre pillar.
Withdraw the hinges.

Refitting

Refitting is the reverse of the removal procedure.

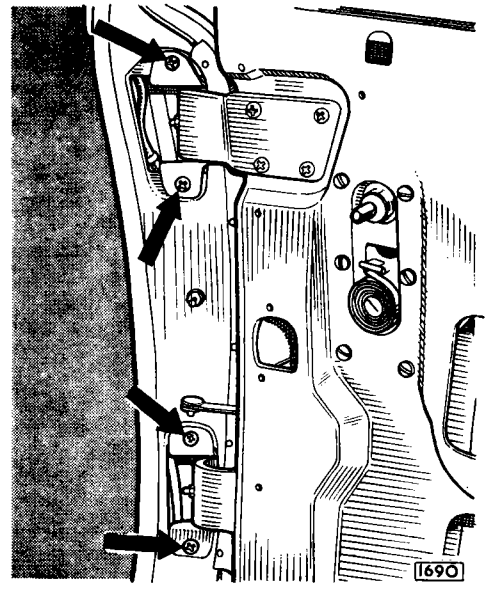


Fig. No. 21 *Showing the screws which secure the rear door hinges*

FRONT AND REAR DOOR TRIM CASINGS

Removal

Remove the four chrome screws and washers securing the wood capping to the waist rail.

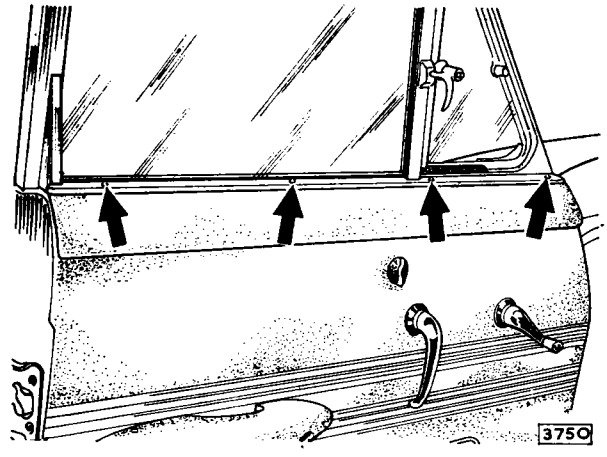


Fig. No. 22 *Showing the four screws which secure the wood capping to the waist rail*

Remove the three woodscrews now exposed and detach the padded waist rail.
Withdraw four drive screws and remove the two wooden fillets from the top of the door panel.

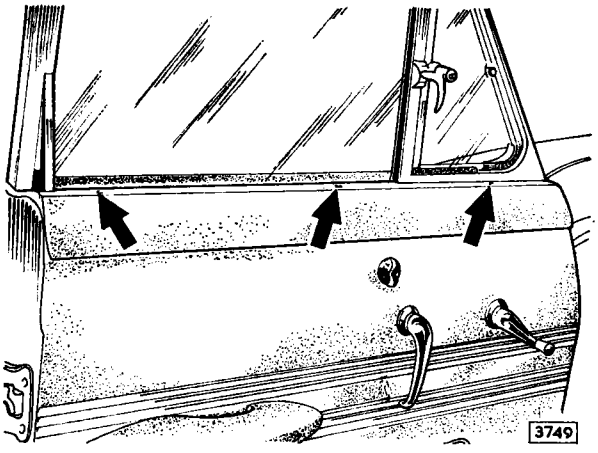


Fig. No. 23 *Showing the three screws which secure the padded waist rail to the door frame*

Ensure that the winding window is completely closed.
Insert a screwdriver between the handle and the spring cap and press the cap inwards, into the escutcheon. This will expose the retaining pin which can then be pushed out. Remove the handle, spring cap and escutcheon.
Repeat operation to remove the door handle.
Remove the central retaining screw and detach the locking turn button.
Remove two screws and washers and detach the arm rest (front doors only).
Carefully remove the door casing fabric, where secured by adhesive solution to the door inner panel at the bottom of the window aperture.

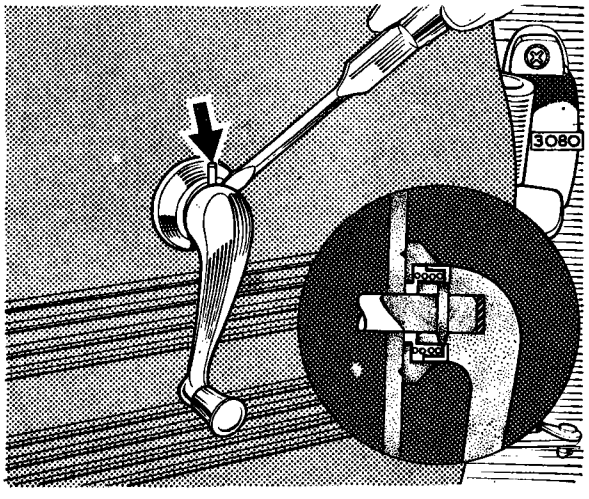


Fig. No. 24 *Showing the location of the interior door lock handle retaining pin*

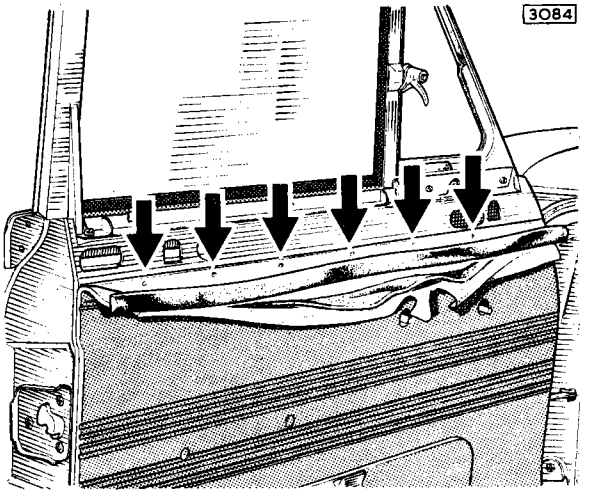


Fig. No. 25 *Showing the screws which secure the top of the door trim casing*

Remove the drive screws, five on the rear doors and six on the front doors, securing the top of the casing to the door panel.
Insert a thin bladed screwdriver between the door casing and the door panel. Prise off the casing which is secured by spring clips to the door.
On the front doors it will be necessary to unhook the two tensioning devices, which retain the map pocket in the closed position, from the inner panel before the casing can be completely detached.

Refitting
Refitting is the reverse of the removal procedure.

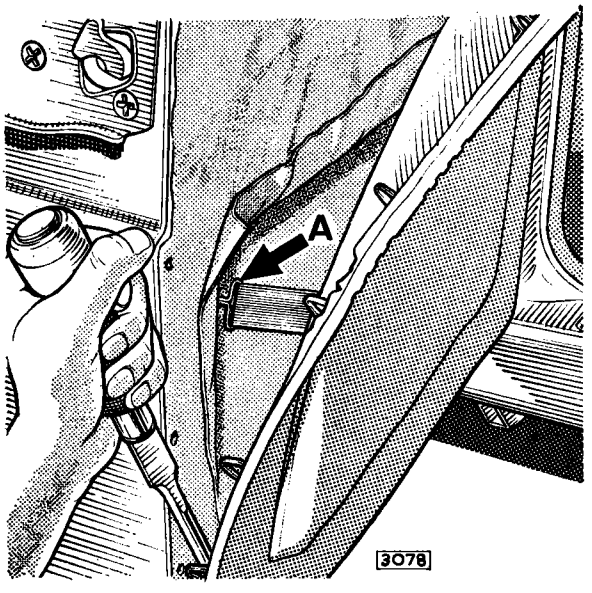


Fig. No. 26 *Removal of the door trim casing. Arrow "A" shows the location of the map pocket tensioner anchorage*

FRONT AND REAR DOOR WINDOW FRAMES AND GLASS

Removal

Remove the door trim casing as described previously.
Pull off the clear plastic sheet which is stuck to the door frame with upholstery solution.
Remove the four round headed screws, serrated and plain washers securing the window frame to the top of the door panel.

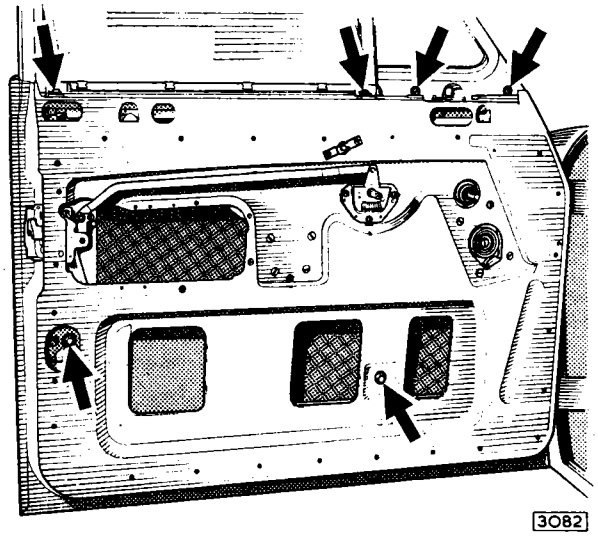


Fig. No. 27 *The location of the window frame securing screws*

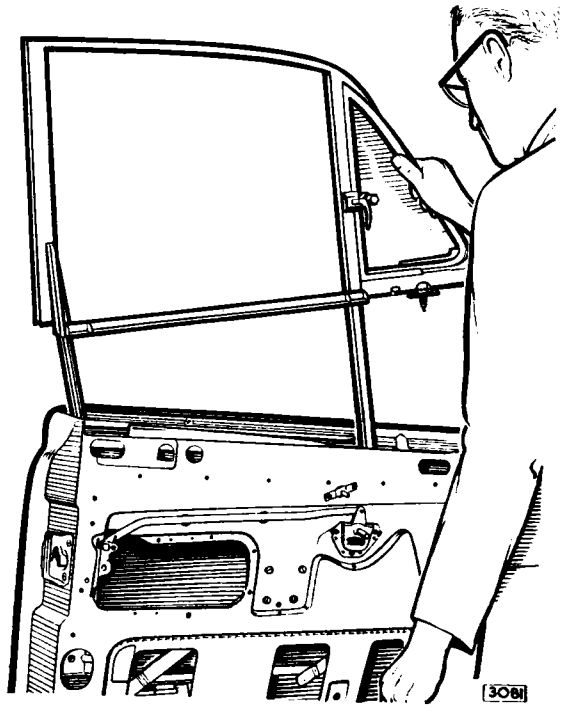


Fig. No. 28 *Removal of the front window frame*

Collect all the packing pieces.
Care should be taken to replace the same number of packing pieces under their respective screws.
Remove the two bolts, serrated and plain washers securing the two legs of the window frame to the door.
Collect the packing pieces.
Unclip the weather strip from the door frame, this is secured by four clips. Withdraw the window frame from the door frame and collect the rubber packing piece between the light frame and the door frame above the door lock.
Slide the glass out of the retaining channel.

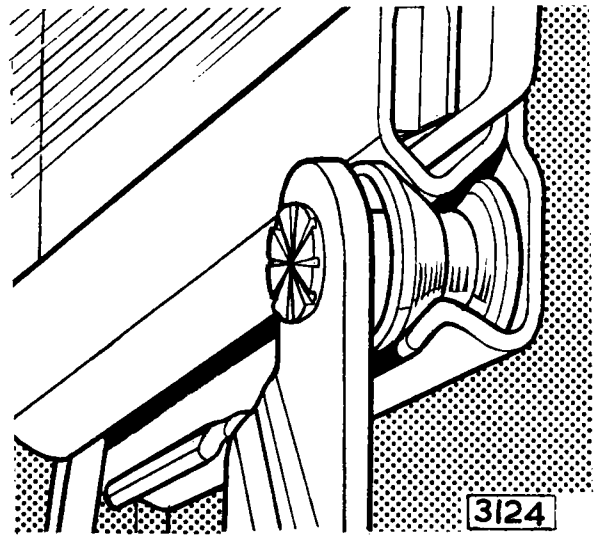


Fig. No. 29 *Showing the window regulator arm and channel*

Refitting

Refit the four clips securing the weather strip to the outer inside edge of the door frame.
Clip the weather strip in position.
Place a layer of sealing compound on the section of the door frame on to which the no draught ventilator window in the window frame seats.
Place the door glass into position on the window winding mechanism slide channel and slide the glass into position between the door frame.
Insert the window frame into the door frame. On the rear door it is necessary to wind up the window glass approximately one third of its maximum height before inserting the window frame. Insert the rubber packing piece. Refit all screws and bolts finger tight.
Insert the four round headed screws, serrated and plain washers which secure the window frame to the door.
Replace the various packing pieces under the round headed screws.
Refit the bolt, serrated and plain washers securing the window frame bracket furthest away from the door hinge and replace the fibre packing pieces.
Refit the bolt, serrated and plain washer securing the window frame bracket nearest the door hinge and replace any packing pieces.

Adjust the window frame to give an equal clearance with the door pillars with the door closed.
The front window should clear the screen pillar by $\frac{1}{16}$" (1.5 mm.).
When the correct clearance has been achieved, tighten the four round headed screws and two bolts securing the window frame to the door.
Remove any excess sealing compound from the bottom of the no draught ventilator.
Refit the door trim casings, door lock and window winder handles and capping by reversing the removal procedure.

FRONT NO DRAUGHT VENTILATOR

Removal

Remove the trim casing from the front door as described on page N.13.
The no draught ventilator adjustment and securing mechanism is visible through a small aperture in the door frame.

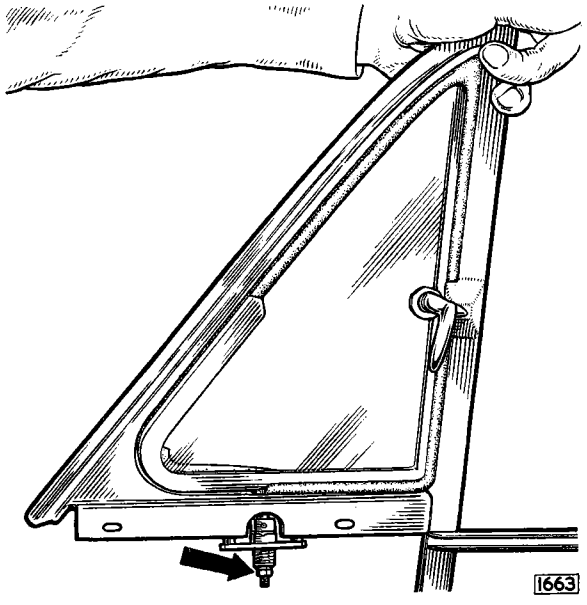


Fig. No. 30 *Showing the front N.D.V. light adjustment nut*

Remove the locknut, nut and washer securing the spring against the quadrant on the N.D.V. post.
Remove the pin and segment on the N.D.V. post.
Remove the two screws securing the front N.D.V. hinge to the window frame.
Turn the N.D.V. catch to allow it to open.
Withdraw the N.D.V. from the window frame.

Refitting

Care should be taken not to leave any parts between the inner and outer door frames.
Refitting is the reverse of the removal procedure.

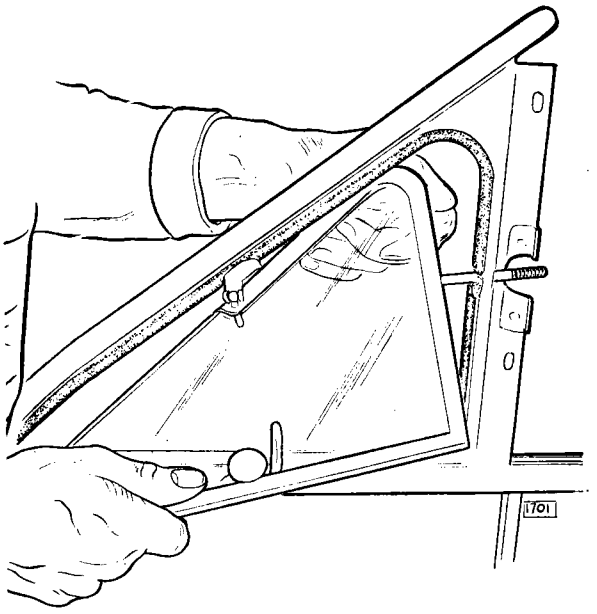


Fig. No. 31 *Removal of the front N.D.V. glass from the frame*

REAR NO DRAUGHT VENTILATOR

Removal

Remove the nut, screw and fibre washer securing the rear N.D.V. bracket to the catch arm which operates the N.D.V.
Open the N.D.V.
Remove the five screws securing the rear N.D.V. light hinge to the window frame.

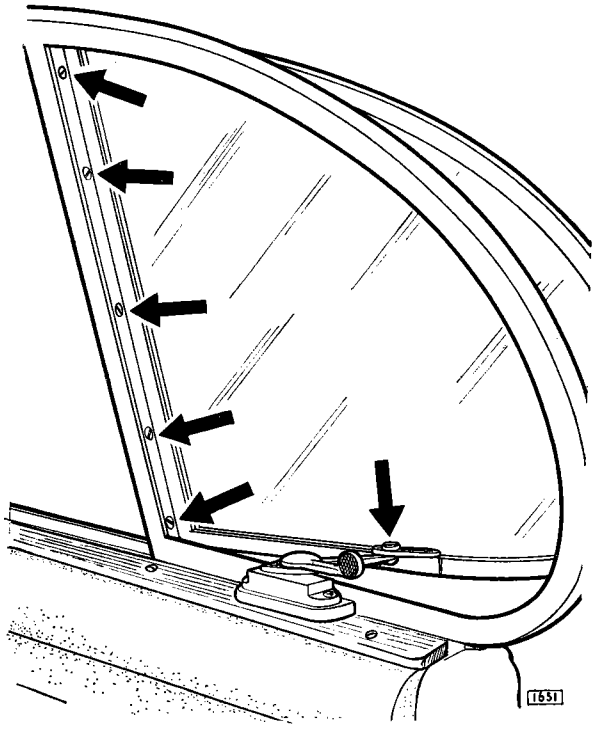


Fig. No. 32 *Removal of the rear N.D.V. glass*

Refitting
Refitting is the reverse of the removal procedure.
Coat the thread of the pivot screw with "Locktite" before fitting the nut.

FRONT WINDOW REGULATOR
Removal
Remove the door casing and window glass as described on pages N.13 and N.15.
Remove the felt placed over the window regulator spindle.

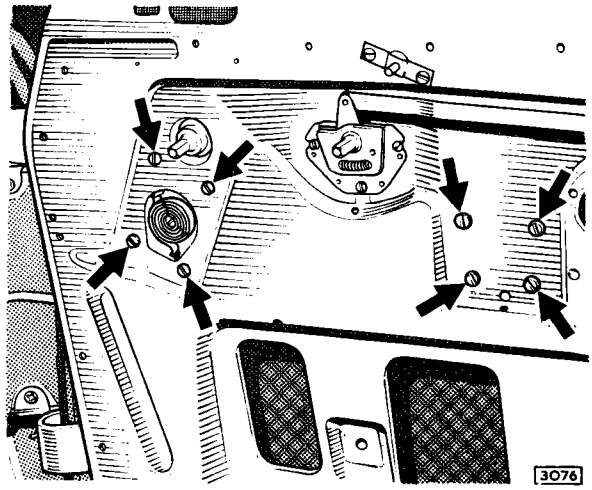


Fig. No. 33 *Showing the screws securing the window winding mechanism to the door frame*

Remove the four screws and serrated washers securing the window regulator to the door frame.
Remove the four screws and serrated washers securing the window regulator spring to the door frame.
Withdraw the window regulator mechanism from the door frame.

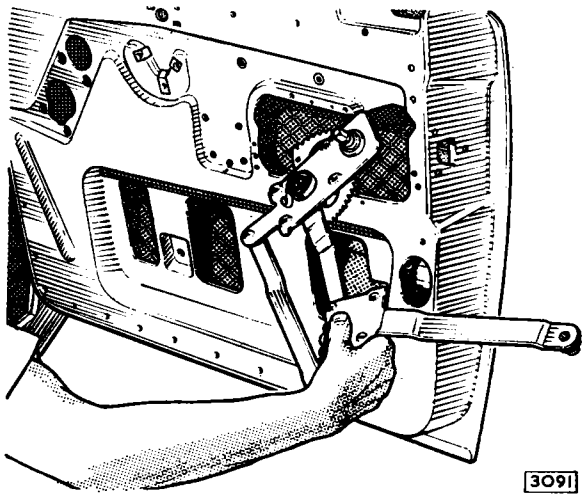


Fig. No. 34 *Removal of the window winding mechanism*

Refitting
Refitting is the reverse of the removal procedure.

REAR WINDOW REGULATOR
Removal
Remove the door casing and window as described on pages N.13 and N.15.
Remove the piece of felt placed over the window regulator spindle.
Remove the four screws and serrated washers securing the window regulator mechanism to the door frame.
Withdraw the window regulator mechanism from the door frame.

Refitting
Refitting is the reverse of the removal procedure.

FRONT SEAT AND SEAT RUNNERS
Removal
Remove the cushion from the front seat.
Slide the seat fully rearwards.
Remove the two bolts and plain washers securing the front of the seat runners to the body floor.
Remove the two bolts and washers securing the seat front support plate to the body floor; remove the seat.

Refitting
Refitting is the reverse of the removal procedure.

REAR SEAT AND SQUAB
Removal
Lift the rear seat cushion upward, off the two locating pins on the rear seat and remove the rear seat.
Remove the two round headed screws, serrated and plain washers securing the bottom of the rear seat squab to the back of the seat pan.
Lift the rear squab to disengage the three retaining hooks and withdraw the squab.

Refitting
Refitting is the reverse of the removal procedure.

POLISHED WOOD CAPPINGS
Removal of Upper and Lower Capping on the Door Pillar
Insert a thin bladed screwdriver between the trim casing and the centre door pillar. Prise off the trim casing and pull downwards to release the tongue on the casing from behind the upper capping.
Knock the wooden capping downward with the hand and remove. The wooden capping is secured by two clips.
Note: If seat belts are fitted it will be necessary to detach the anchorage plate by withdrawing the fixing bolt before removing the capping.

Removal of Screen Pillar Capping
Withdraw the rubber wedge piece located between the facia panel and the base of the capping.
Lift the sealing rubber locally down the door aperture.
Remove the two screws now exposed securing the capping to the screen pillar and withdraw the capping.

Removal of Rear Quarter and Cant Rail Capping
Lift the door aperture sealing rubber, withdraw the screws now exposed and detach the cant rail and rear quarter cappings.
It will be necessary to remove the rear quarter capping before the cant rail can be detached in order to clear the overlap joint.

Refitting
Refitting is the reverse of the removal procedure.

COURTESY LIGHT AND CAPPING

Removal
Pull off the courtesy light glass from the two plastic prongs securing it to the lamp body.
Remove the two screws securing the wooden base to the body of the car.
Disconnect the positive battery lead.
Disconnect the electrical connections at the rear of the courtesy light.

Refitting
Refitting is the reverse of the removal procedure.

REMOVAL OF LOCK MECHANISM

Front Doors (Fig. 36)
Release the spring clip holding the top of the spring loaded handle/lock connecting link (A) to the dowel on the plunger operating lever (B). This is accessible through an aperture in the inner door panel.

Rear Doors
Remove the starlock washer holding the bottom handle/lock connecting link (C) to the cross-shaft (D), together with the plain washer behind the link.

Removing Remote Opening Control
Remove the wire clip, plain washer and the wavy washer fitted between the connecting link and the latch operating lever (E). Detach the connecting link.
Remove the three screws (F) securing the remote control to the inner door panel.

Removing Turn-Button Locking Control
Detach the control wire by removing the large spring clip which secures it to the locking lever (G).
To facilitate removal, place control in the locked position.
Remove the two screws (H) together with the shakeproof washers to release the turn-button control.

Removing Lock Unit
Remove the three countersunk screws (I) which pass through the dovetail plate (J) and the door into the lock.
On the front doors it is advisable to remove the lower glass run channel bolt with its plain washers, shakeproof washers and packing pieces in order to press the lock inwards so that the projecting latch passes inside the shut face.
Remove the lock through the large aperture in the inner door panel.

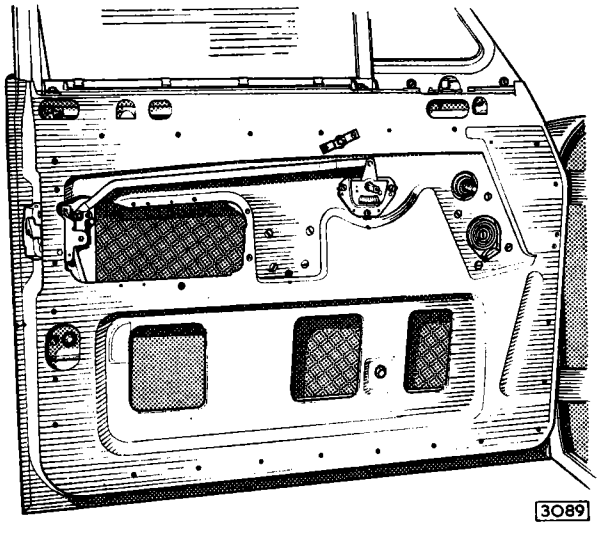


Fig. No. 35 *Showing the door lock in position*

Removing Outside Handle Base-Plate
Remove the two bolts (K) together with the shakeproof washers from the inside of the door.

Removing Striker Unit
Do not disturb the three fixing screws (L) unless making an adjustment or fitting a new striker unit.

Removing Outside Handle
When fitting a replacement, remove nut (M) together with two washers and remove the handle.
Fit the replacement handle, noting that a packing washer (N) is fitted to the front fixing stud.
On the rear doors it is desirable that the lower screw, in the shut face of the door, be removed to facilitate the removal of nut (O) together with the shakeproof and plain washers.
In the case of front doors, it is preferable to remove the window frame complete with glass to facilitate the removal of nut (O) which is in the extreme inside top rear corner of the door, unless a suitable spanner is available.
To remove the window frame, lower the glass and release the bolts, thus freeing the bottoms of the front and rear glass channels.
Remove the four screws from the window sill and lift the window frame out of the top of the door.
Raise the glass; slide it towards the lock face to release from the window regulator lifting arms and remove the glass.
Important: All window frame mounting points have spring washers, plain washers and packing pieces. Ensure that all these components are replaced in the reverse order.

Refitting
If the outside handle has been removed this should be refitted before installing the lock mechanism. It is, however, advisable to fit the window frame and glass later.

When the outside handle has not been removed, ensure that the winding window is raised to its fullest extent.
On front doors attach the bottom of the spring-loaded handle/lock connecting link (A) to the dowel on the cross-shaft (D). The link is fitted with a plain washer and it is retained with a new starlock washer.
Insert the lock through the upper aperture in the inner door panel so that the latch projects through the aperture in the shut face of the door.
On front doors it is advisable to remove the lower glass run channel bolt together with the plain washers, shakeproof washers and packing pieces in order to facilitate this operation.
The dovetail plate (J) should then be placed in position over the latch bezel and secured by means of the three countersunk screws (I) which pass through the shut face into the lock.
The base plate assemblies are stamped L.H. (Left hand) and R.H. (Right hand).
On rear doors the top of the handle/lock connecting link (C) should be located on the lug on the plunger operating lever (B).
Then the washer (P) should be fitted and retained by the plunger-bolt (Q) and the locknut (R).
Each base-plate assembly should be held in position inside the door in order that the clearance between the end of push button plunger bolt (Q) and the lock contactor (S) may be checked through the aperture in the inner door panel.

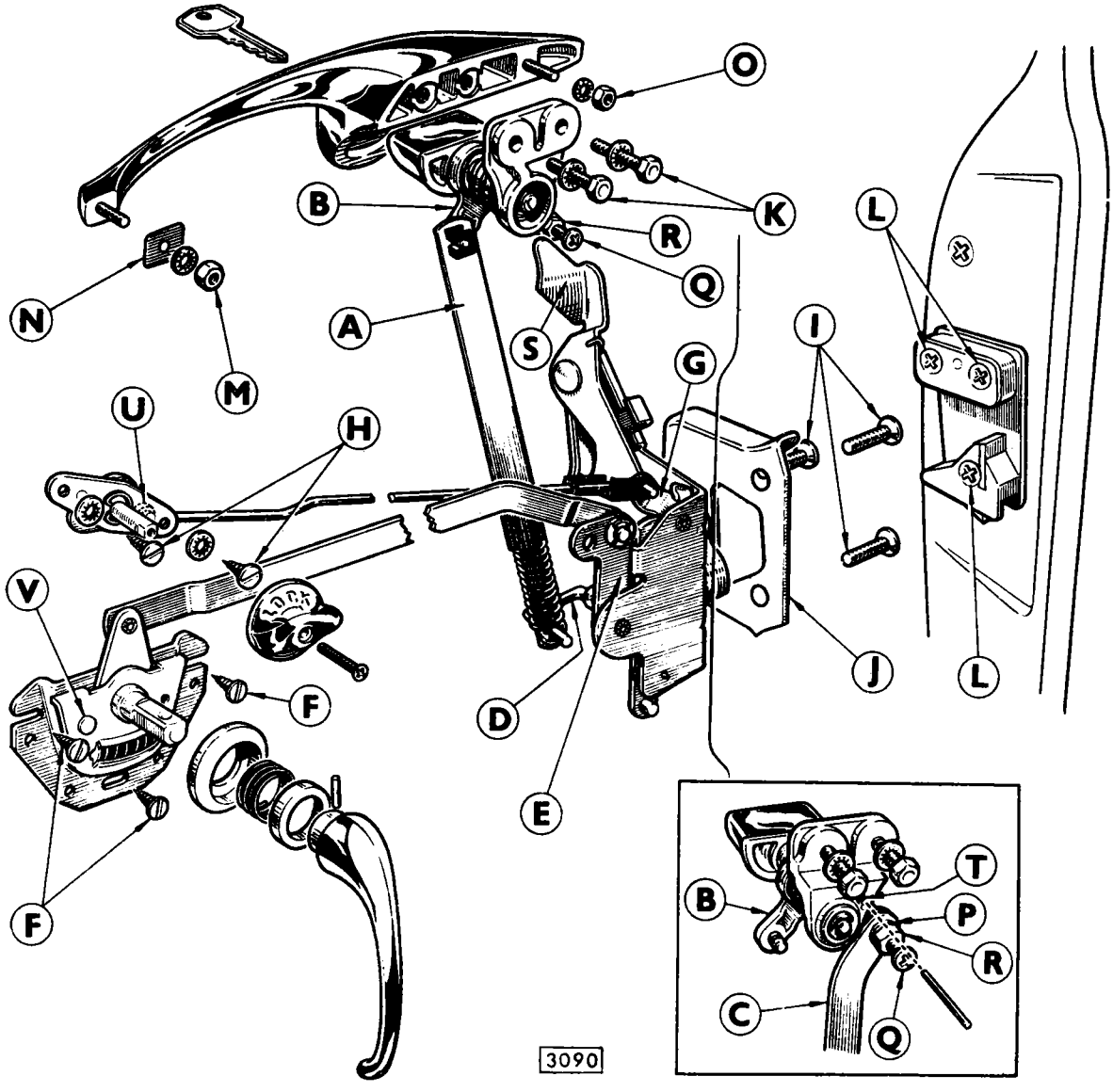


Fig. No. 36 *The door lock mechanism*

This clearance should be $\frac{1}{32}$" (.79 mm.).
To adjust, release the locknut (R), screw the plunger bolt (Q) in or out as required and retighten the locknut.
The base-plate assemblies are secured from the inside of the doors by means of two bolts (K), with shake-proof washers, which pass into the back of the inside handle.
When connecting the push-button mechanism to the lock unit, ensure that the cross shaft (D) is moved **downwards** into the locked position.
Important: On the rear doors provision is made for the plunger operating lever (B) to be pegged in the locked position prior to connecting the handle/lock link (C). This is done by inserting a short length of $\frac{1}{8}$" dia. (3.18 mm.) rod through the **rectangular** hole (T) in the base-plate assembly.
To compensate for variations in fitting, the links (A and C) are provided with three holes which are at the top end on the front links and at the bottom end on the rear links.
It will be observed that one of these holes, usually the centre one, can be used to give the correct setting.
The rear link is fitted with a plain washer underneath and it is retained by a starlock washer.
The front link is finally secured by a spring clip.
To check the locking action, remove the rod from the rectangular hole in the rear base-plate assembly, depress the push-button and check that the plunger bolt (Q) clears the lock contactor (S).
Alternatively, raise the cross-shaft (D) into the unlocked position and check that the plunger passes squarely behind the lock contactor to come in contact with it when the push button is operated.
When refitting the turn button locking control it is important to ensure that each turn button is in the unlocked position when inclined vertically and in the locked position when rotated into the horizontal plane. In the locked position the control wire is moved **away** from the lock passing over the top of the control.

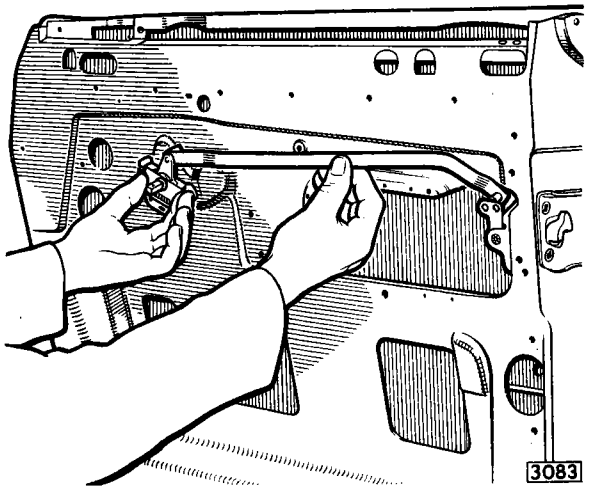


Fig. No. 37 *Showing the door lock in position*

Note: The front controls may be identified by a larger front stop (U).
To refit, the control wire is threaded through the aperture provided for the control in the inner door panel and it is connected to the locking lever (G) with the large spring clip provided.
The control is retained by two screws (H) together with shakeproof washers, which should be adjusted to provide a uniform turn button position before tightening.
When refitting the remote opening controls it must be noted that these controls are handed and a rivetted stop (V) ensures that the control can only be operated in one direction, that is, away from the lock face.
Each control should be loosely fitted to the inner door panel with its three screws (F). The dowel on the connecting link is then attached via the hole in the latch operating lever (E) nearest the lock with a wavy washer interposed. The assembly is retained by one or two plain washers and a wire clip.
The remote control is aligned by sliding it through its slots towards the lock unit until the latch operating lever (E) is in contact with the stop in the lock case and then secured by tightening the three screws (F).
To fit and adjust the striker unit, attach the striker loosely by means of the three screws (L) which pass through the door pillar into an adjustable tapping plate. Positioning is carried out by a process of trial and error until the door can be closed easily without rattling or movement up or down.
Important: The striker must be retained in the horizontal plane relative to the door axis.

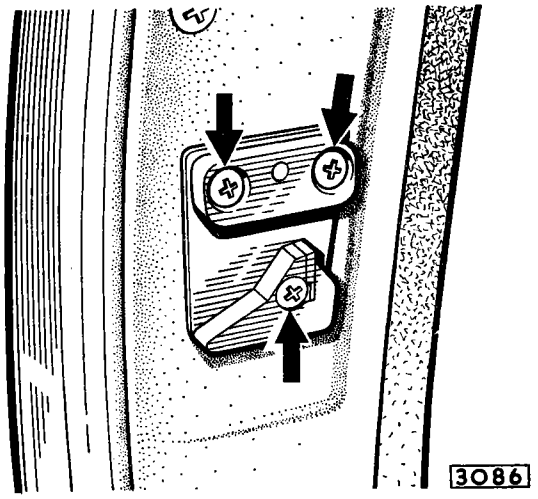


Fig. No. 38 *Location of the door striker plate securing screws*

MASTER CHECK FOR CORRECT ALIGNMENT

Front Doors

Fit an inside handle **vertically downwards** on the remote control spindle. Turn the handle rearward to open the door. Fit the appropriate locking turn-button vertically and rotate anti-clockwise on the right side door or clockwise on the left hand door into the horizontally locked position. Close the door while holding the push-button in the fully depressed position.

The door will remain locked although the push button may be freely depressed.
Insert the key in the push-button slot and turn in the appropriate direction. Push-button control will then be restored and the door can be opened.
After turning, the key will automatically return to the horizontal position when it can be removed.
Important: The key must be removed from the locking device before closing a door in the locked position.

Rear Doors
Fit the inside handle vertically upwards on the remote control spindle. Turn the handle forward to open the door. Fit the appropriate locking turn-button vertically and rotate anti-clockwise on the right side door, clockwise on the left hand side door into the horizontally locked position.
Close the door. It will then be locked although the push-button may be freely depressed.
To unlock, the turn-button is rotated to its original position when push-button control is restored.

Lubrication
Before fitting the door casing ensure that any moving parts are adequately greased.
After assembly introduce a few drops of thin machine oil into the private lock key slots. These must be lubricated once a month.
The private lock cylinders must not, under any circumstances, be lubricated with grease.

Features of Lock Operation
When the doors are locked the push-buttons may be freely depressed. No amount of wilful pressure on the outside button will force or damage the lock.
Either front door can be locked from inside or outside irrespective of which door was last used as an exit. This feature is invaluable in cases of traffic congestion and parking.
If either front door is closed after accidentally setting the turn-button in the locked position, locking is automatically cancelled. This action obviates the risk of locking oneself out of the car.
Front doors, however, can be locked from the outside without using the key, a great advantage in inclement weather or under heavy traffic conditions where instant locking is desirable. This is achieved by setting the turn-button in the locked position and, while closing the door, deliberately holding the push-button in the fully depressed position. The key will then be used for unlocking either front door in the usual way.

ACCIDENTAL DAMAGE

The repair of integral construction bodies varies in some degree, dependent upon the extent of the damage, to that of separate body and chassis construction.
Superficial damage can be rectified in a similar manner to that employed on "all steel" bodies which is familiar to all body repairers.
Repairs to rectify extensive damage affecting the main members of the underframe must be carried out so that when the repair is completed the main mounting points for the engine, front and rear suspensions, etc., are in correct relation to each other.
When checking for or rectifying distortion in the main underframe members, reference should be made to the diagrams in the section headed "Checking Body Underframe Alignment" which gives the important dimensions to be observed.

Replacement Body Panels
Where the existing panels or members are badly damaged and it is not possible to effect a satisfactory repair in position, the affected panels will have to be cut out and replacement panels welded in their place. It will frequently be found advantageous to use only part of a given panel so that the welded joint can be made in a more accessible position. Great care must, of course, be taken when cutting the mating portions of the panel to ensure that perfect matching is obtained. For example, if damage to a front wing is confined to the forward end a simpler and quicker repair can be effected by cutting the front wing off between the wheel aperture and the wing valance. If the replacement front wing is then cut to match, a simple butt weld can be made and after cleaning down with a sanding disc and filling with plumber's lead the joint should be invisible.
Any unused portions of replacement panels should be retained as it will often be found that they can be used for some future repair job.
Where a replacement panel to be fitted forms part of an aperture such as for a door or the luggage boot lid, an undamaged door or lid should be temporarily hinged into position and used as a template to assist location while the replacement panel is clamped and welded in position.
Similarly, an undamaged radiator grille can be used as a template to accurately form the aperture when fitting a replacement front wing or wings.
Before any dismantling takes place after accidental damage, a check of the underframe alignment should be carried out.

CHECKING BODY UNDERFRAME ALIGNMENT

Checking for Distortion in the Horizontal Plane
The plan view of the body on page N.24 provides the important dimensions for checking for distortion in the underframe. These dimensions can be measured actually on the underside of the body or by dropping perpendiculars from the points indicated by means of a plumb-bob on to a clean and level floor. If the latter method is adopted, the area directly below each point should be chalked over and the position at which the plumb-bob touches the floor marked with a pencilled cross.

Checking for Distortion in the Vertical Plane
For checking the underframe for distortion in the vertical plane the side elevation gives the details of the important dimensions from a datum line.
If the relative distance between two points **above** the datum line is required, one dimension should be subtracted from the other.
If the relative distance between a point above the datum line and the straight section of the chassis side member is required, assess the dimension "T" — $3\frac{3}{16}$" (9.7 cm.) — to the dimension above the datum line.
If it is required to check the dimensions from ground level, raise up the car at the front and rear and insert four blocks or stands of exactly equal height between the ground and the straight section of the chassis side members.
Do not allow the weight of the car to rest on the blocks, use them only as test pieces.

The distance from the ground to any given check point will be: height of blocks + "T" ($3\frac{3}{16}$" — 9.7 cm.) + distance from datum line to check point.

Body Alignment Jig
The use of the Churchill "700" body alignment jig is recommended. This jig with the special additional adaptors supplied also covers many other Jaguar models.
Full details of this equipment can be obtained from the manufacturers:—

Messrs. V. L. Churchill & Co. Ltd.,
London Road,
Daventry, Northants,
England,

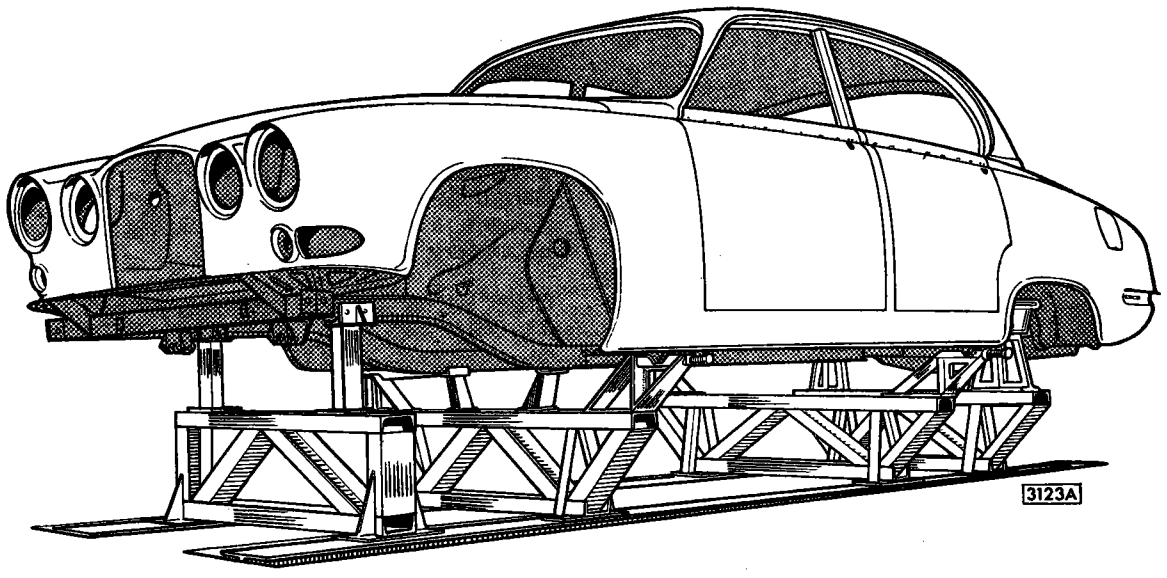
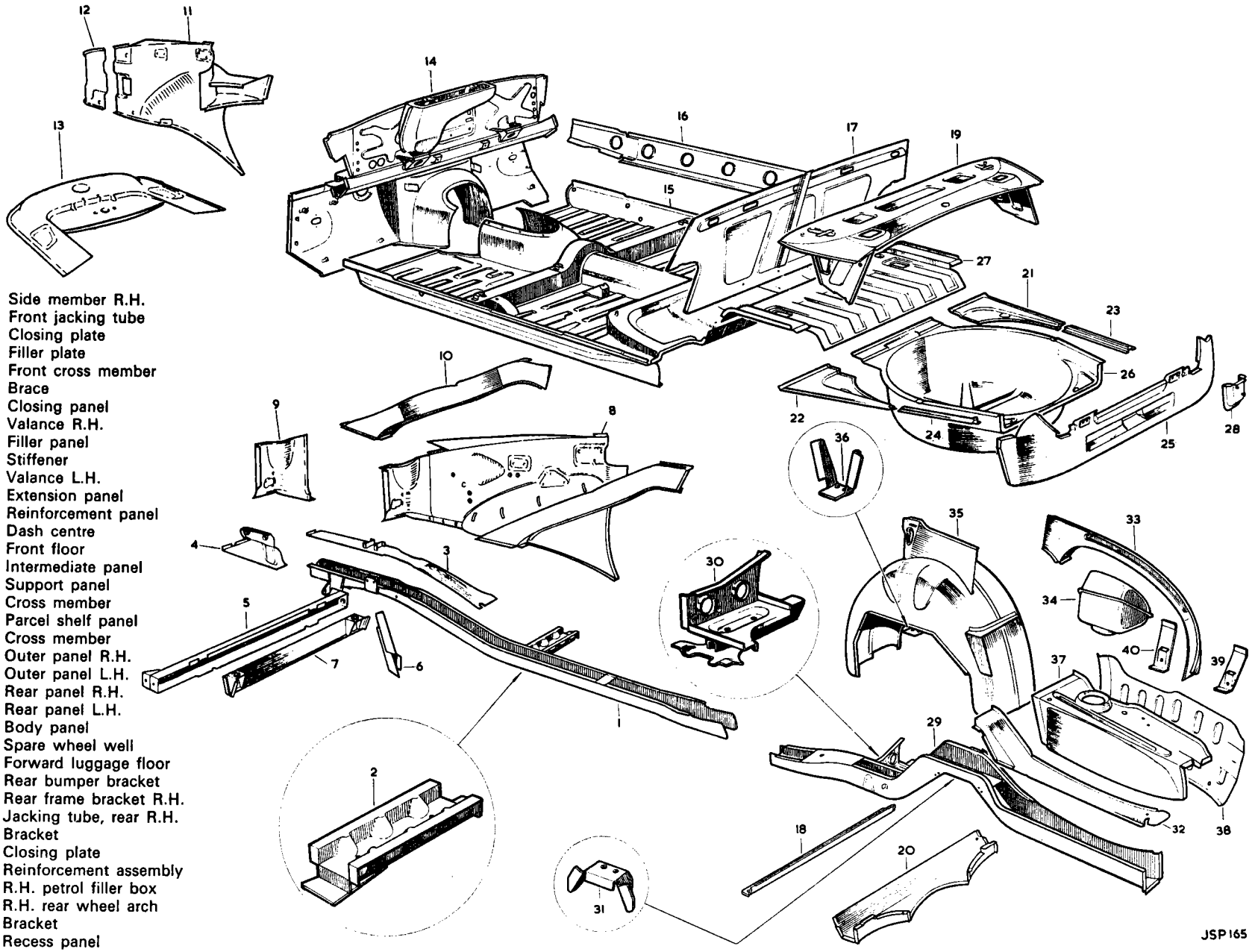


Fig. No. 39 *The Churchill "700" body alignment jig*



1 Side member R.H.
2 Front jacking tube
3 Closing plate
4 Filler plate
5 Front cross member
6 Brace
7 Closing panel
8 Valance R.H.
9 Filler panel
10 Stiffener
11 Valance L.H.
12 Extension panel
13 Reinforcement panel
14 Dash centre
15 Front floor
16 Intermediate panel
17 Support panel
18 Cross member
19 Parcel shelf panel
20 Cross member
21 Outer panel R.H.
22 Outer panel L.H.
23 Rear panel R.H.
24 Rear panel L.H.
25 Body panel
26 Spare wheel well
27 Forward luggage floor
28 Rear bumper bracket
29 Rear frame bracket R.H.
30 Jacking tube, rear R.H.
31 Bracket
32 Closing plate
33 Reinforcement assembly
34 R.H. petrol filler box
35 R.H. rear wheel arch
36 Bracket
37 Recess panel
38 Side panel
39 Bracket—petrol tank, R.H. rear
40 Bracket—petrol tank, R.H. front

Fig. No. 40 *Body under-frame components*

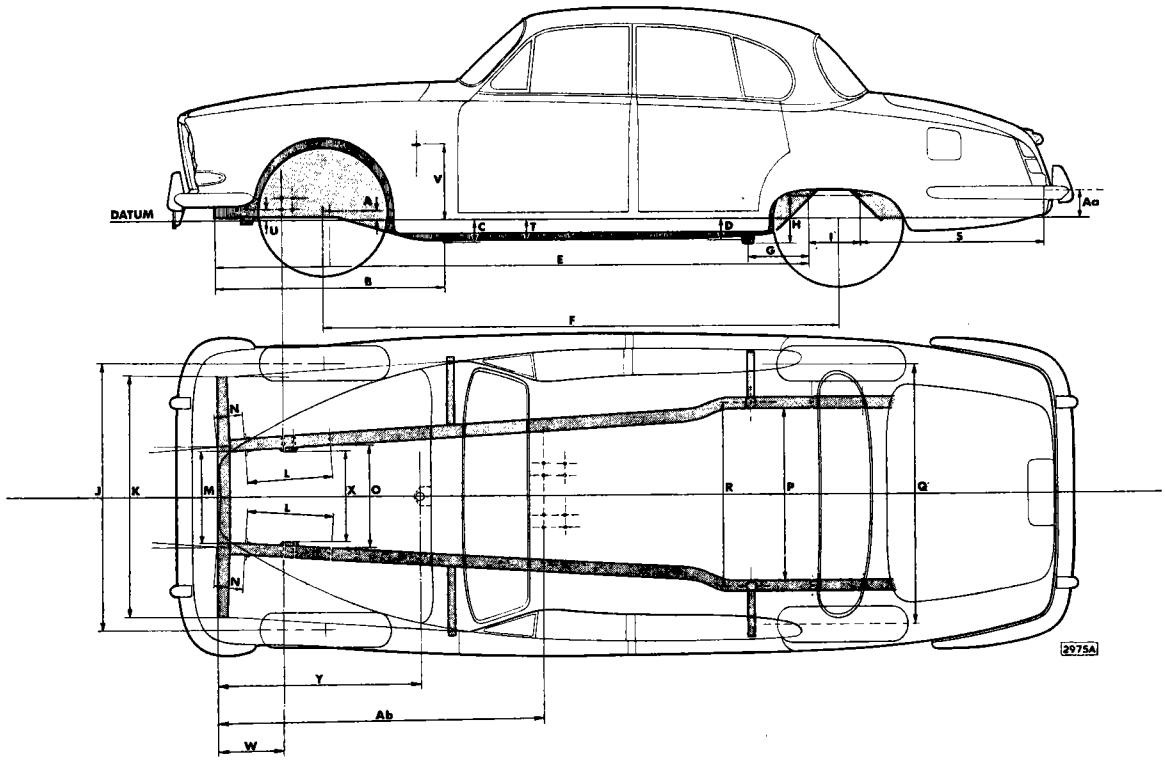


Fig. No. 41 *The under frame alignment diagram*

Symbol	Measurements taken from	Dimension
A	Datum line to centre of tube in chassis side member for front suspension cross-member mounting	$2\frac{1}{16}$" (52.4 mm.)
B	Front of jacking tube to front face of sub-frame cross-member	$47\frac{29}{32}$" (121.7 cm.)
C	Datum line to bottom face front jacking tube	$4\frac{7}{32}$" (107.16 mm.)
D	Datum line to bottom face rear jacking tube	$4\frac{9}{64}$" (105.17 mm.)
E	Forward face of front cross-member to C/L lower tube of rear suspension frame mounting	$123\frac{35}{64}$" (3.14 m.)
F	Centre of front wheel to centre of rear wheel (wheelbase)	$107\frac{3}{8}$" (2.72 m.)
G	C/L radius arm body mounting bracket to C/L lower front tube of rear suspension frame mounting	$12\frac{35}{64}$" (31.87 cm.)
H	C/L bottom of radius arm body mounting bracket to C/L lower front tube of rear suspension frame mounting	$9\frac{23}{32}$" (24.69 cm.)
I	C/L of lower front tube to C/L of lower rear tube rear suspension frame mounting	$10\frac{21}{32}$" (27.07 cm.)
J	Front track	$55\frac{3}{4}$" (1.403 m.)
K	Outer ends of front cross-member	50" (1.27 m.)
L	Forward face of front suspension mounting bracket to C/L tube in chassis side for front suspension cross-member mounting	$17\frac{27}{32}$" (45.32 cm.)
M	Inner faces of chassis side members at joints with front suspension cross-member mounting brackets	$18\frac{23}{32}$" (47.55 cm.)
N	Forward face of front cross-member to forward face of front suspension cross-member mounting bracket (measured along C/L chassis side member)	$5\frac{25}{32}$" (14.68 cm.)
O	Inner faces of chassis side members at C/L front suspension cross-member mounting tubes	$21\frac{1}{16}$" (53.49 cm.)
P	Inner faces of rear chassis side member	$35\frac{5}{8}$" (90.49 cm.)
Q	Rear track	54.2" (1.38 m.)
R	Centre of radius arm body mounting	38" (96.52 cm.)
S	C/L lower rear tube of rear suspension frame mounting to rear bumper mounting face	$38\frac{25}{64}$" (97.5 cm.)
T	Datum line to underside straight section of chassis side member	$3\frac{3}{16}$" (9.7 cm.)
U	Lower forward hole forward engine mounting above datum	$2\frac{19}{64}$" (5.83 cm.)
V	Datum line to top face engine mounting bracket (dash)	$15\frac{27}{32}$" (40.24 cm.)
W	Forward face of front cross-member to C/L lower front tube forward engine mounting	$13\frac{25}{32}$" (35 cm.)
X	Inner faces of support plates engine mounting at C/L forward lower tube	$18\frac{29}{64}$" (46.87 cm.)
Y	Forward face of front cross-member to C/L of dash centre engine mounting bracket	$42\frac{3}{16}$" (1.07 m.)
Z	Forward face of front cross-member to 'O' datum	$5\frac{5}{8}$" (14.29 cm.)
Aa	Datum line to C/L upper bumper mounting bolt hole	$5\frac{5}{8}$" (14.29 cm.)
Ab	Forward face of front cross-member to C/L of forward holes to the rear engine mounting support channel	$67\frac{31}{32}$" (1.726 m.)

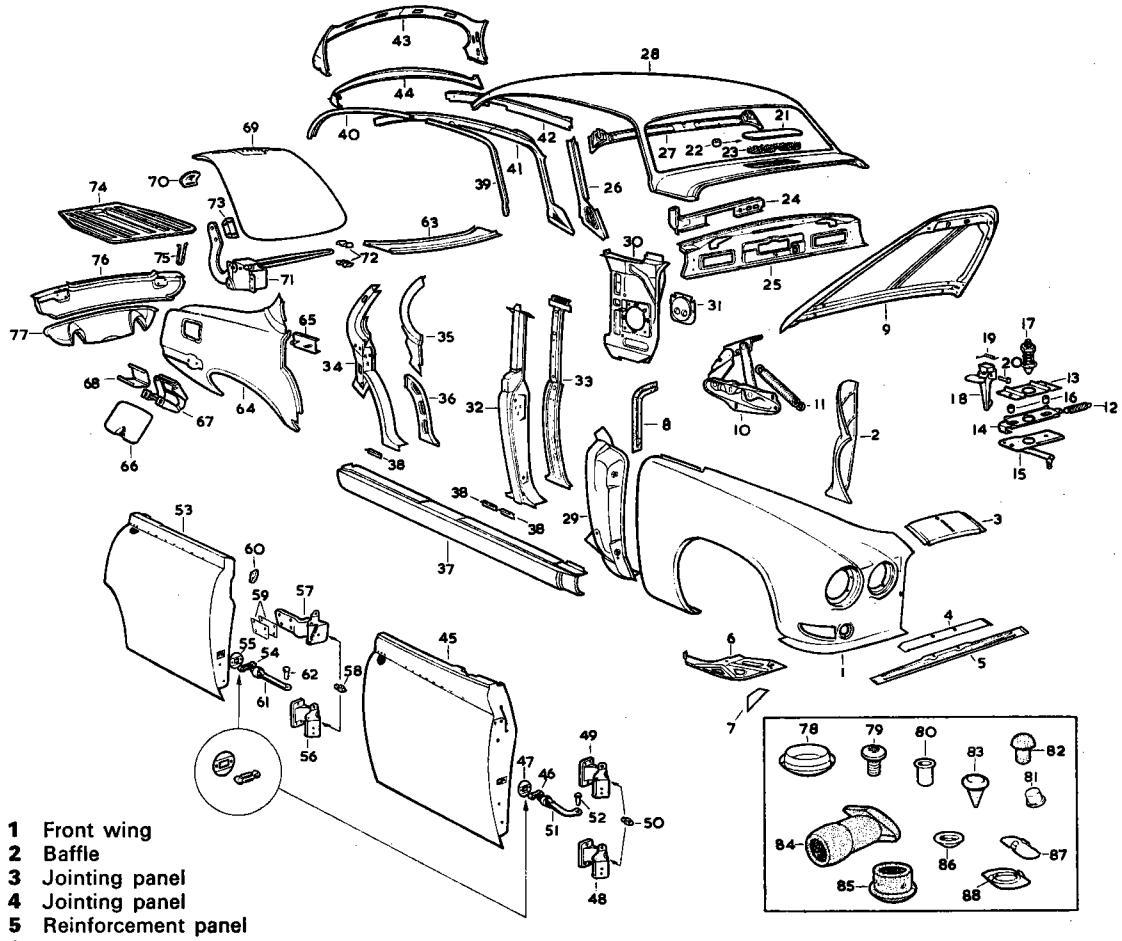


Fig. No. 42 *Exploded view of the body panels* JSP166

1 Front wing
2 Baffle
3 Jointing panel
4 Jointing panel
5 Reinforcement panel
6 Stay bracket
7 Gusset
8 Seal assembly
9 Bonnet
10 Bonnet hinge
11 Hinge spring
12 Return spring
13 Striker plate
14 Catch plate
15 Base plate
16 Spacing bush
17 Peg
18 Safety hook
19 Spring
20 Pin
21 Scuttle ventilator lid
22 Distance piece
23 Gauze
24 Windscreen rail
25 Reinforcement assembly
26 Closing panel
27 Windscreen header panel
28 Roof panel
29 'A' post panel
30 Dash side panel
31 Cover plate
32 B/C post panel
33 Spacer
34 'D' post panel
35 Reinforcement
36 Spacer
37 Door sill panel R.H.
38 Retainer
39 Drip moulding R.H. front
40 Drip moulding R.H. rear
41 Cantrail panel R.H.
42 Reinforcement
43 Reinforcement
44 Reinforcement
45 Door shell R.H. front
46 Felt
47 Reinforcement bracket
48 Lower hinge
49 Upper hinge
50 Grease nipple
51 Check arm
52 Pin
53 Door shell R.H. rear
54 Guide spring
55 Reinforcement bracket
56 Lower hinge
57 Upper hinge
58 Grease nipple
59 Shim
60 Filler piece
61 Check arm
62 Pin
63 Tonneau panel
64 Rear wing
65 Bracket
66 Petrol filler door R.H.
67 Hinge bracket
68 Spring
69 Boot lid
70 Cover plate
71 Hinge assembly L.H.
72 Clamp
73 Attachment bracket
74 Spare wheel cover
75 Prop
76 Body panel
77 Tail panel
78 Plastic plug
79 Plastic plug
80 Plastic plug
81 Plastic plug
82 Rubber plug
83 Rubber plug
84 Rubber plug
85 Rubber plug
86 Steel plug
87 Steel plug
88 Steel plug

WELDING METHODS

The following are the principle methods of welding used in the assembly of the body and underframe panels. The instructions given below for breaking the different types of welds should be adhered to when removing a damaged panel as this will facilitate the assembly of the new panel.

Spot Welding

This type of welding is used for the jointing of two or more overlapping panels and consists of passing electric current of high amperage through the panels by means of two copper electrodes.
This results in complete fusion of the metal between the electrodes forming a "spot" weld which is frequently repeated along the length of the panels to be joined. Spot welds can easily be recognised by slight indentation of the metal.
Lap joints on the outer body panels which are spot welded together are usually lead filled and in this case it will be necessary to direct the flame of an oxy-acetylene torch on the lead so that the filling can be melted and wiped off by means of a piece of cloth.

Breaking Spot Welds

Spot welds cannot be broken satisfactorily other than by drilling; any attempt to separate the panels by using a chisel will result in the tearing of the metal in the vicinity of the spot welds.
Use a $\frac{3}{16}$" (4.7 mm.) diameter drill and carefully drill out each weld. There is no necessity to drill completely through both panels; if the "spot" is drilled out of one of the panels the weld can be completely broken by inserting a thin sharp chisel between the two panels and tapping lightly with a hammer.
Where possible, drill the spot welds completely out of the panel that is to be left in position on the body. This will allow the new panel to be joined to the mating panel on the body by gas welding through the holes in the overlapping flange. (This does not apply if spot welding equipment is available).
If this is not possible, and the holes have to be drilled out in the damaged panel, new holes can be drilled in the replacement panel and the same type of weld effected.

Gas Welding

This type of welding is carried out by means of oxy-acetylene equipment and is used for the jointing of overlapping panels or the butt-welding of the edges of two panels.

Breaking Gas Welds

Gas welds may be broken either by means of a sharp chisel or by cutting through with a hacksaw; welding can be removed by grinding with a pointed emery wheel.

EXHAUST SYSTEM

Removal

Remove the two setscrews, together with the spring washers, securing each of the ring brackets (28) to the body.
Slacken the two clips (26) and remove the tail pipe and rear silencer assemblies (18) and (22).
Remove the four setscrews, together with nuts and shakeproof washers, securing the rubber mounting brackets (16 and 17) for the main silencers.
Slacken the two clips (8) and remove the main silencers (14 and 15).
Remove the intermediate exhaust pipes (6 and 7) by slackening clips (8) at the front silencer and removing the securing bolts in the rubber mounting bracket (9).
Slacken the two clips (4) and remove the front silencer (5).
Remove the four nuts, together with the washers, securing each downpipe to the exhaust manifold on the engine and remove the downpipes (1 and 2) having first separated the downpipes at the clamping strap adjacent to the flexible pipes (1A and 2A) and having removed the bolt securing the downpipe (2) to the clutch housing.
Collect the sealing rings (3) between the exhaust manifold and the downpipes.
On left hand drive cars it will be necessary to remove the steering column joint heat shield after withdrawing two setscrews, nuts and lockwashers to gain access to the downpipe flange nuts.

Refitting

Refitting is the reverse of the removal procedure.
Renew the sealing rings (3).
Check the pipe connections after running the engine for a short period and retighten as necessary.

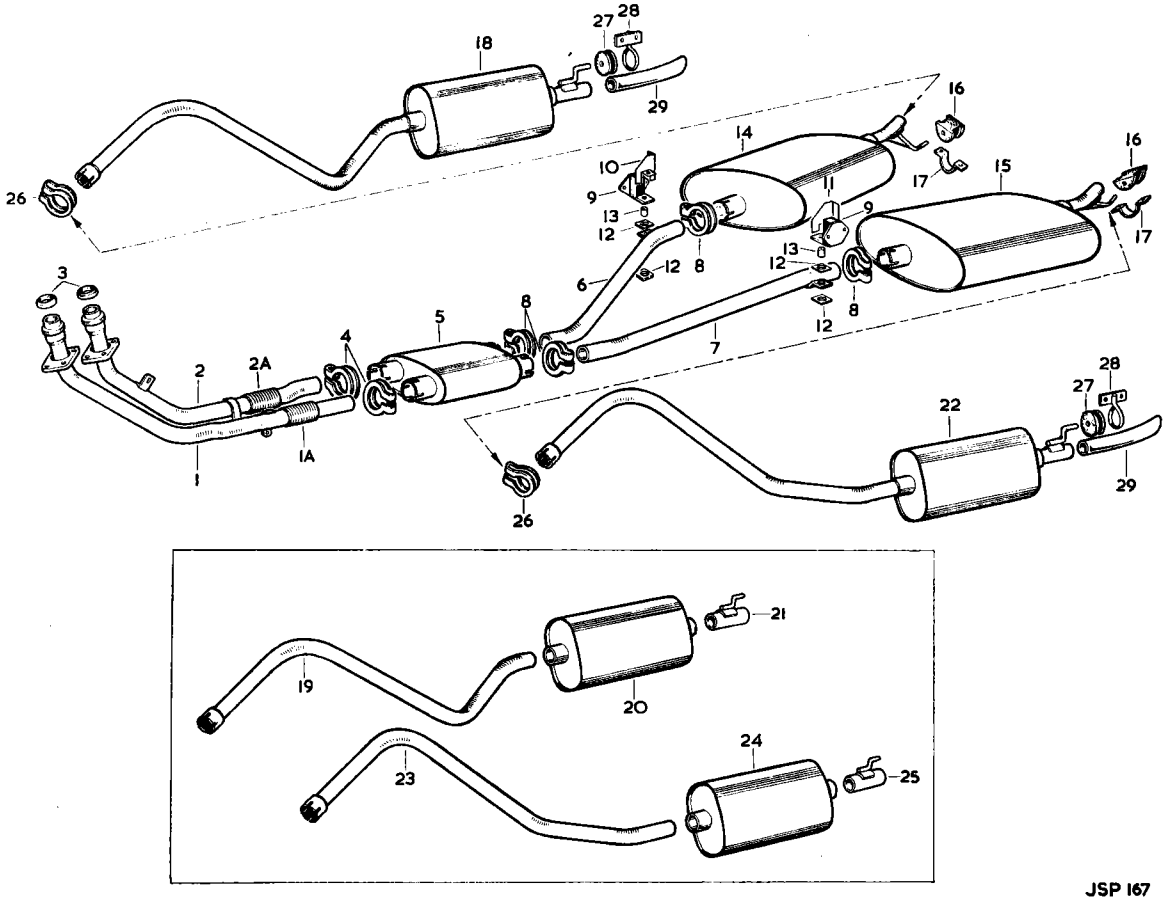


Fig. No. 43 *Exploded view of the exhaust system*

1 Front down pipe
1A Flexible pipe
2 Rear down pipe
2A Flexible pipe
3 Sealing ring
4 Clip
5 Front silencer
6 Intermediate pipe R.H.
7 Intermediate pipe L.H.
8 Clip
9 Rubber mounting
10 Heat shield
11 Heat shield
12 Washer (insulating)
13 Distance collar (insulating)
14 Main silencer R.H.
15 Main silencer L.H.
16 Rubber mounting
17 Bracket
18 Tail pipe/rear silencer R.H.
19 Rear intermediate pipe R.H.
20 Rear silencer
21 Tail pipe
22 Tail pipe and rear silencer L.H.
23 Rear intermediate pipe L.H.
24 Rear silencer
25 Tail pipe
26 Clip
27 Rubber mounting
28 Ring bracket
29 Tail pipe extension

HEATING AND WINDSCREEN WASHING EQUIPMENT

SECTION O

INDEX

CAR HEATING AND VENTILATING SYSTEM

CAR HEATING AND WINDSCREEN WASHING EQUIPMENT

WINDSCREEN WASHING EQUIPMENT

HEATING AND WINDSCREEN WASHING EQUIPMENT

CAR HEATING AND VENTILATION SYSTEM

DESCRIPTION

The car heating and ventilation system consists of a combined heating element and a two-speed electrically driven fan assembly.

Air from the heating and ventilation system is directed :-

(a) To the front of the car through outlets (one on the driver's side and one on the passenger's side) below the parcel shelf.

(b) To the rear of the car through an outlet situated on the propeller shaft tunnel cover between the two front seats.

(c) To vents at the base of the windscreen to provide demisting and defrosting.

Fresh air is introduced into the car by pressing the Air button and switching on the fan if required (see also Air Distribution).

HEATER CONTROLS

The heater control buttons marked "AIR", "HEAT", "OFF", are situated centrally below the parcel tray (Fig. 1).

These controls operate the air intake vent on the scuttle and the water valve. Operating the "OFF" button automatically cancels the "HEAT" and "AIR" buttons. The "HEAT" button also cancels the "AIR" button. If it is desired to have the "HEAT" and "AIR" buttons in operation at the same time the "HEAT" button must be pressed first.

The heater control quadrant marked "HOT-COLD" and situated centrally in the edge of the parcel shelf, regulates the temperature of the air delivered.

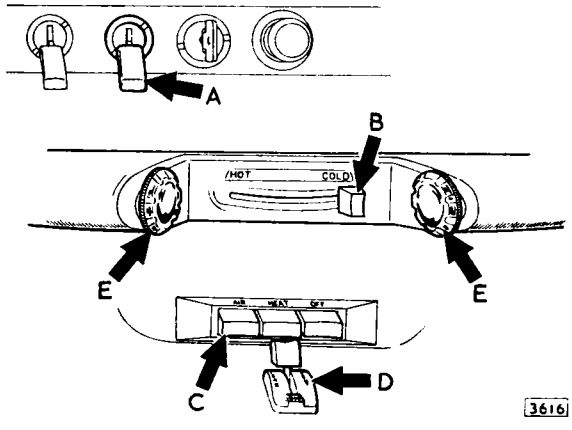


Fig. No. 1 *Heating and Ventilating Controls*

A Fan switch
B Temperature control
C Heater control switches
D Rear outlet control
E Control for front outlet

Off

When the "OFF" button is pressed the system is inoperative.

Heat

To obtain hot or warm air in the car, press the "HEAT" button which will open the water valve to supply hot water to the heater element. Before operating the "AIR" button, it is advisable to allow the engine to reach normal operating temperature, particularly in cold weather, to enable hot water to circulate through the heater unit prior to admitting cold air through the scuttle vent.

Adjust the heater control quadrant to give the required temperature.

Air

If cold fresh air is required, press the "AIR" button which will open the scuttle vent and direct the air to the outlets in the car, by-passing the heating element. The fan can be switched on if it is desired to increase the circulation. The heater control quadrant should be set at cold.

THE FAN SWITCH

The fan for the heating and ventilating system increases the flow of air through the system and is controlled by a three-position switch (marked "FAN" on the indicator strip), on the instrument panel (Fig. 1).

Lift the switch to the second position for slow speed and to the third position for fast speed, whichever is required.

Operation of the fan is required mainly when the car is stationary or running at a slow speed. At higher speeds it will be found possible to dispense with the fan due to the speed of the car forcing air through the scuttle vent.

AIR DISTRIBUTION

The demisting outlets operate whenever the system is working. To obtain the maximum amount of air at the windscreen, both the front and rear outlets should be closed.

The two front outlets are fitted with thumb operated directional controls, one each side of the heater control quadrant. Fully rotating the right hand knob clock-wise and the left knob anti-clockwise will cut off the supply of air completely. Reverse rotation of the knobs will progressively re-direct the air flow from the feet to the body.

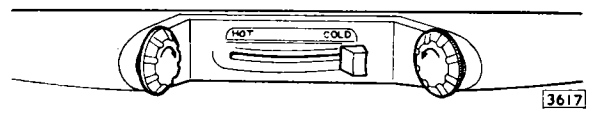


Fig. No. 2 *Rotation of the knobs in the direction of the arrows will progressively direct the flow of air out of the front outlets from the feet to the body*

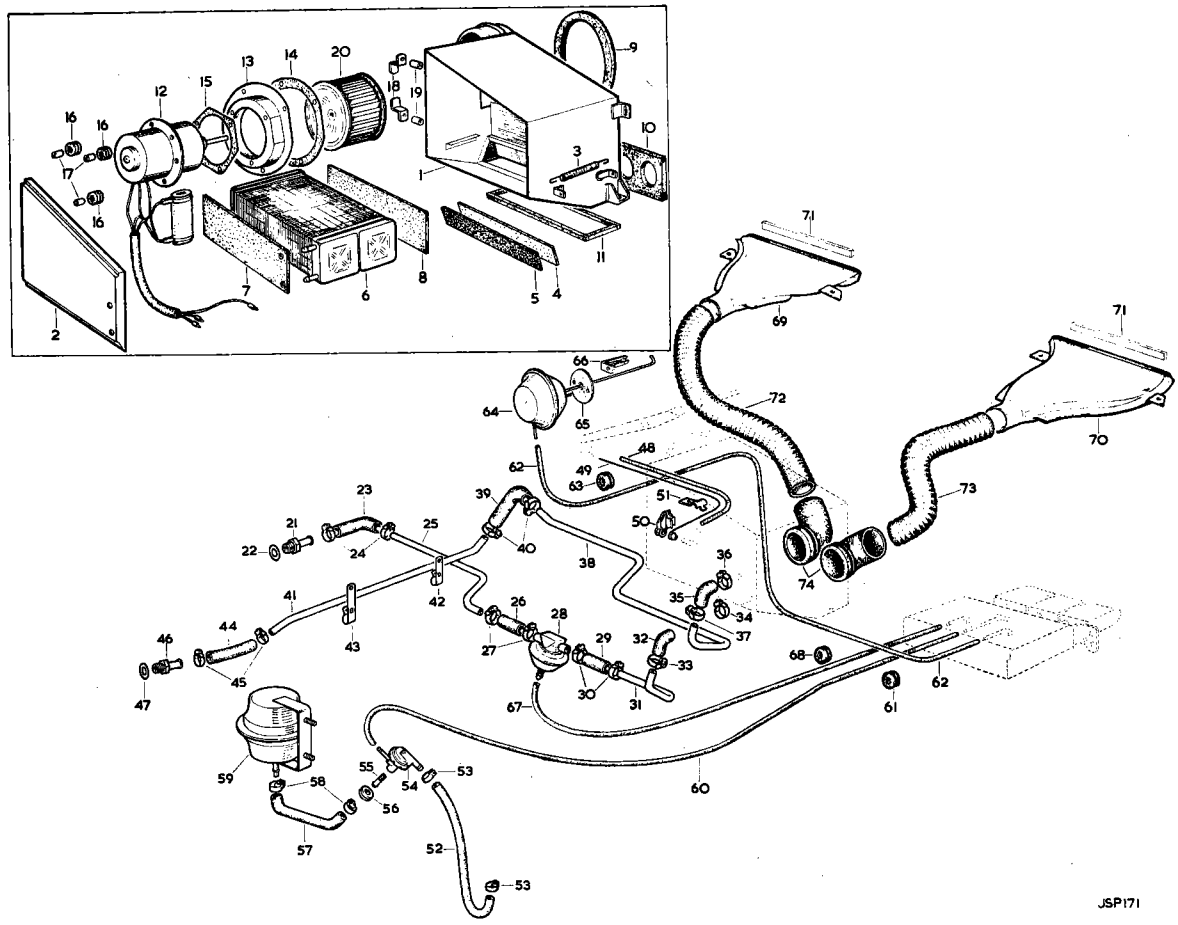


Fig. No. 3 *Exploded view of the heating equipment components*

1 Heater case
2 Lid
3 Spring
4 Seal (Polyurethane)
5 Seal (Polyurethane)
6 Radiator
7 Seal (Polyurethane)
8 Seal (Polyurethane)
9 Seal (Polyurethane)
10 Seal (Polyurethane)
11 Seal (Rubber)
12 Heater motor
13 Heater motor housing assembly
14 Seal (Polyurethane)
15 Seal (Polyurethane)
16 Grommet
17 Distance tube
18 Resistance mounting bracket
19 Distance tube
20 Heater motor fan
21 Adaptor
22 Copper washer
23 Hose (adaptor to feed pipe)
24 Clip
25 Feed pipe
26 Hose (Feed pipe to vacuum valve)
27 Clip
28 Valve
29 Hose (Vacuum valve to feed pipe)
30 Clip
31 Feed pipe
32 Hose (feed pipe to radiator)
33 Clip
34 Clip
35 Hose (radiator to rear return pipe)
36 Clip
37 Clip
38 Rear return pipe
39 Hose (Rear return pipe to front return pipe)
40 Clip
41 Front return pipe
42 Bracket
43 Bracket
44 Hose (Front return pipe to water pump)
45 Clip
46 Adaptor
47 Copper washer
48 Heater control outer cable
49 Heater cable (inner)
50 Clip
51 Clamp
52 Vacuum hose
53 Clip
54 Check valve
55 Adaptor
56 Grommet
57 Vacuum hose
58 Clip
59 Reservac tank
60 Vacuum hose
61 Grommet
62 Vacuum hose
63 Grommet
64 Vacuum diaphragm assembly
65 Packing
66 Clip
67 Vacuum hose
68 Grommet
69 R.H. Demister nozzle
70 L.H. Demister nozzle
71 Light seal
72 Hose
73 Hose
74 Rubber elbow

Operating the lever for the rear outlet (Fig.1) turns the air supply "ON" or "OFF".

COLD WEATHER

To obtain heating, demisting and defrosting

(a) Depress the button marked "HEAT" and allow a short period to elapse to permit the heater to warm up.
(b) Depress the "AIR" button.
(c) Switch the fan on at the desired speed.
(d) Open the front and rear outlets as desired.
(e) Adjust the heater control quadrant to give the required temperature.

To obtain rapid demisting and defrosting

(a) Depress the button marked "HEAT" and allow a short period to elapse to permit the heater to warm up.
(b) Depress the "AIR" button.
(c) Switch the fan on at the desired speed.
(d) Close the front and rear outlets.
(e) Move the heater control quadrant to "HOT".

HOT WEATHER

To obtain ventilation and demisting:

(a) Depress the button marked "AIR".
(b) Switch the fan ON at the desired speed.
(c) Open the front and rear outlets as desired.
(d) Move the heater control quadrant to "COLD".

To obtain rapid demisting:

(a) Depress the button marked "AIR".
(b) Switch the fan ON at the "FAST" position.
(c) Close the front and rear outlets.
(d) Move the heater control quadrant to "COLD".

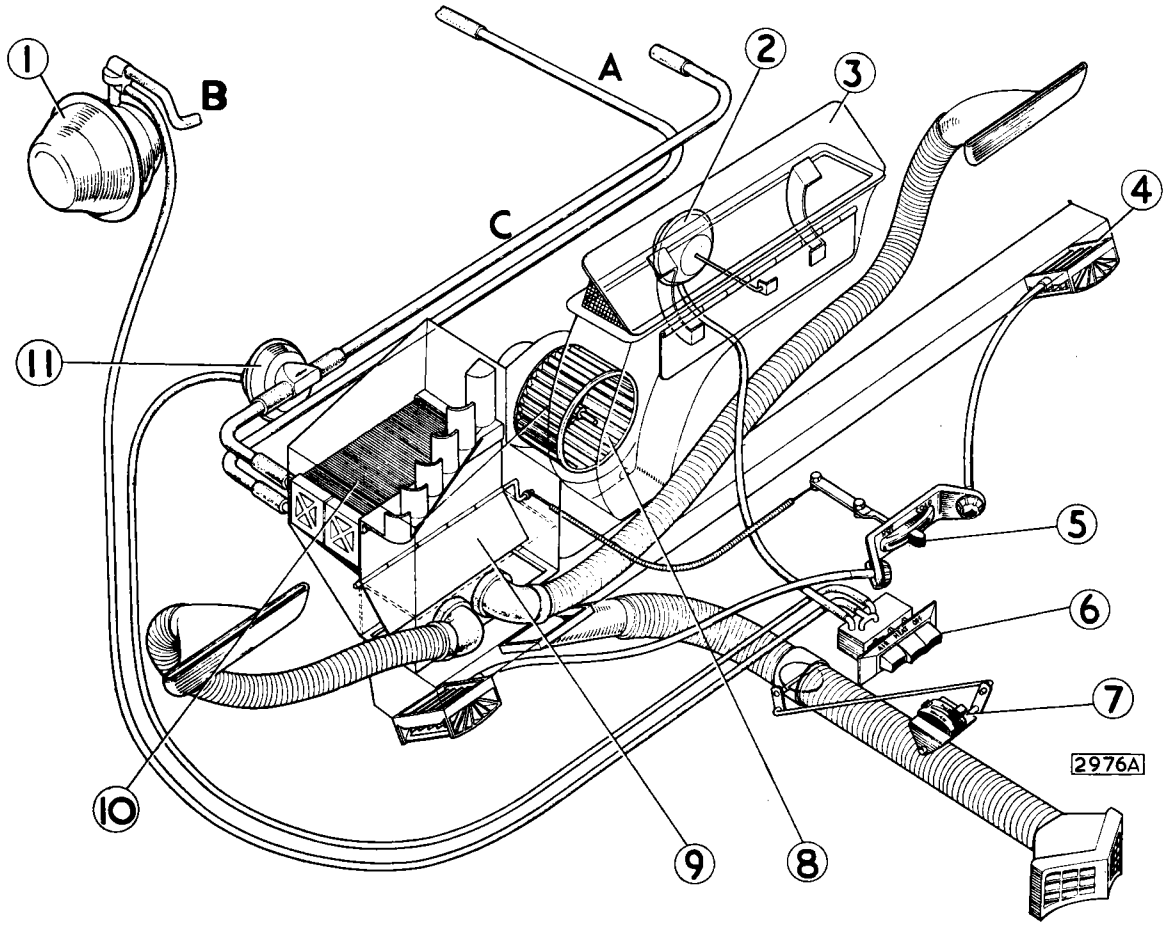


Fig. No. 4 *The Vacuum Servo System*

1 Reservac tank
2 Vacuum actuator
3 Scuttle vent
4 Air direction box
5 Heater flap control
6 Three button control
7 Rear air supply control
8 Fan
9 Flap
10 Heater box
11 Vacuum actuator

A Heater box to pump
B To induction manifold
C Water manifold to heater box

VACUUM SERVO SYSTEM

Description (Fig. 4)

The vacuum servo system controlled by the heater buttons (6) includes a vacuum supply tank (1) situated under the right hand front wing, with an attached non-return valve located in the engine compartment. Two servo units are included in the system, one serving as a heater water tap control (11) and one controlling the opening and closing of the scuttle (fresh air) vent (2).

The vacuum supply tank will provide approximately six complete operations after the ignition is switched off.

Note: In frosty weather it is advisable to close the scuttle vent by pressing the OFF button to obviate the possibility of the controls freezing.

The vacuum tank is connected via the non-return valve to the inlet manifold.

A small diameter rubber tube from the non-return valve leads directly to the air temperature control panel situated on the console.

Rubber tubing connects the "AIR" control button to the scuttle vent vacuum servo and the "HEAT" control button to the heater water tap vacuum servo.

The servo units are sealed during manufacture and must be replaced if faulty.

SCUTTLE VENTILATOR SERVO UNIT

Removal

Start the engine and depress the "AIR" button to open the scuttle vent. Switch off the ignition.

If the servo unit has failed, it will not be possible to raise the scuttle vent by this method.

Insert two thin levers under the front edge of the vent and carefully lever the vent open.

Care must be taken that the paintwork is not damaged.

Withdraw the three retaining screws and remove the scuttle ventilator gauze.

Remove the two self-locking nuts and plain washers and lift off the ventilator lid. Retain the two distance pieces attached to the fixing studs.

Remove the rubber seal, secured to the ventilator aperture with an adhesive and release the three countersunk-headed screws now exposed.

Withdraw the shroud panel from the air vent box.

Note: It is not necessary to remove the three countersunk screws completely to enable the shroud to be removed.

Release the spring clip anchoring the operating rod to the inner flap.

Remove the two nuts and washers securing the vacuum unit to the bulkhead and detach the rubber tube.

Withdraw the unit noting the sealing washer located between the unit and the bulkhead.

Refitting

Refit the unit to the bulkhead and attach the operating rod to the inner flap with the spring clip. Secure the unit with the two self-locking nuts and washers. Ensure that the sealing washer is located correctly when refitting.

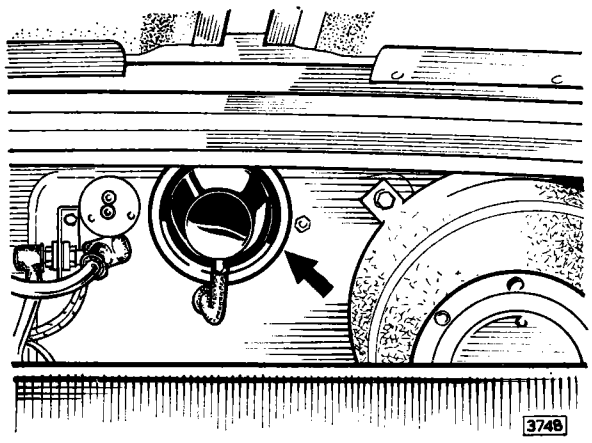


Fig. No. 5 *Showing location of scuttle vent servo retaining nuts*

Locate the shroud panel on the countersunk screws. Seal the top edge of the panel with Bostik 692 sealing compound.

Refit the rubber seal and secure with a good quality adhesive. Renew seal if worn or damaged.

Reconnect the rubber tubing to the vacuum unit, switch on the ignition, start the engine, depress the "AIR" button and raise the vent lid brackets.

Switch the engine OFF.

Refit the vent lid and secure with the two self-locking nuts and washers. Ensure that the two distance pieces are fitted before attaching the lid.

Do not fully tighten the nuts when fitting.

Lower the vent by depressing the "OFF" button and position the vent lid correctly in the aperture.

Raise the vent and fully tighten the nuts.

Refit the ventilator gauze.

HEATER TAP SERVO UNIT

Removal

Drain the coolant from the cooling system by opening the radiator tap.

Conserve the coolant if an anti-freeze is in use.

Release the hose clips and withdraw the rubber hoses from the unit. Remove the small rubber tube from the connecting nipple.

Release the nut securing the servo unit to the mounting bracket and withdraw the unit.

Note: The mounting bracket is slotted, it is therefore unnecessary to remove the nut completely unless the unit is to be replaced.

Refitting

Refitting is the reverse of the removal procedure.

Ensure when fitting that the arrow indicating the direction of the water flow points to the outside of the car.

VACUUM SUPPLY TANK

Removal

Clean off all dirt from the supply tank located under the right hand front wing at the rear.

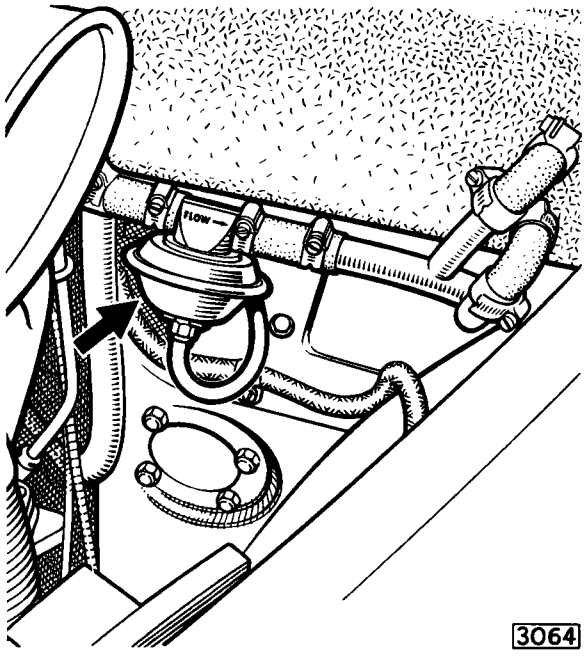


Fig. No. 6 *Showing location of tap servo unit*

Release the clip and detach the hose from the union.
Remove two nuts and washers and withdraw the tank from the mounting bracket.
To remove the non-return valve, disconnect the large hose from the valve union under the wing and the small rubber pipe from inside the engine compartment.
Withdraw the valve through the grommet in the wing.
The supply tank and the valve are sealed units and must be replaced if faulty.

Refitting
Refitting is the reverse of the removal procedure.
Check that all unions are clean before reconnecting.

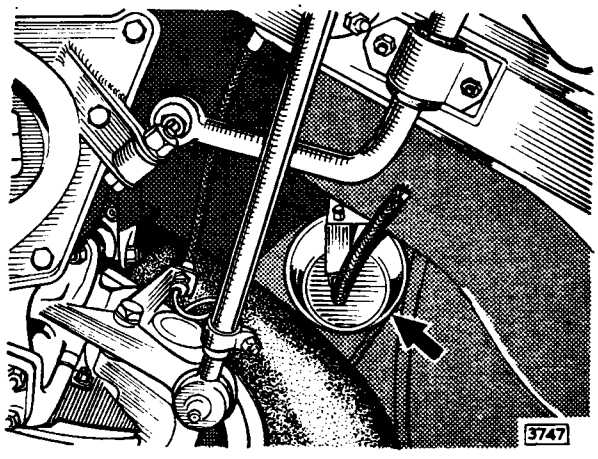


Fig. No. 7 *Showing location of vacuum supply tank*

HEATER UNIT

Removal
Drain the radiator and cylinder block. Conserve the coolant if an anti-freeze is in use.
Disconnect the battery.
Remove the bonnet as detailed in Section N.
Roll back the sealing rubbers between the carburetter elbow, air inlet pipe and the air cleaner.
Slacken the two wing nuts securing the cleaner to the brackets on the cylinder head. Remove the cleaner by pulling it towards the left-hand wing valance.
Slacken off the clips and detach the heater water pipe hoses from the heater unit. Remove the top water pipe from the support clips attached to the heater box.
Remove the electrical cables from the clip on the bulkhead and disconnect at the snap connectors. Disconnect the earth cable by removing the drive screw.
Remove the water valve vacuum unit as detailed previously.
Remove the spring clip securing the control cable to the hot/cold flap control lever and withdraw the cable.
Release the bolt and nut securing the outer casing clip.
Remove the five setscrews and washers securing the heater unit to the bulkhead and lift the unit away.

Refitting
Refitting is the reverse of the removal procedure.
Renew the sealing rings if worn or damaged.
Adjust the flap control cable to maintain full movement of the control lever.

HEATER MATRIX

Removal
Drain the radiator and cylinder block. Conserve the coolant if an anti-freeze is in use.
Slacken off the clips and detach the heater water pipe from the heater unit. Remove the top water pipe from the support bracket attached to the heater box.
Remove the two nuts and washers and withdraw the 2-speed resistance unit from the mounting studs.
Carefully prise away the plastic covered felt covering the front of the unit.
Remove the three hexagon-headed drive screws from the top edge of the front cover and three screws from the bottom edge.
Remove the cover and withdraw the matrix.

Refitting
Refitting is the reverse of the removal procedure.
When refitting the material over the cover plate use a rubber solution.

FAN MOTOR

Removal
Disconnect the battery earth terminal.
Disconnect the wires from the fan motor at the snap connectors and detach the earth wire from the bulkhead. Remove the resistance unit from the mounting studs.
Carefully prise away the plastic-covered felt on the front of the unit.

Remove the four hexagon-headed setscrews and lock-washers securing the motor mounting bracket to the water heater unit.
Withdraw the motor complete with fan, note the plastic foam joint between the mounting bracket and the heater unit.
Remove the fan after slackening off the nut on the spindle.
Note: In order to preserve the balance of the fan assembly care must be taken that the balance pieces are not displaced nor the assembly damaged on removal.
Remove the three Phillips-headed drive screws and detach the mounting bracket from the motor unit. Note the plastic foam joint between the mounting bracket and the motor.

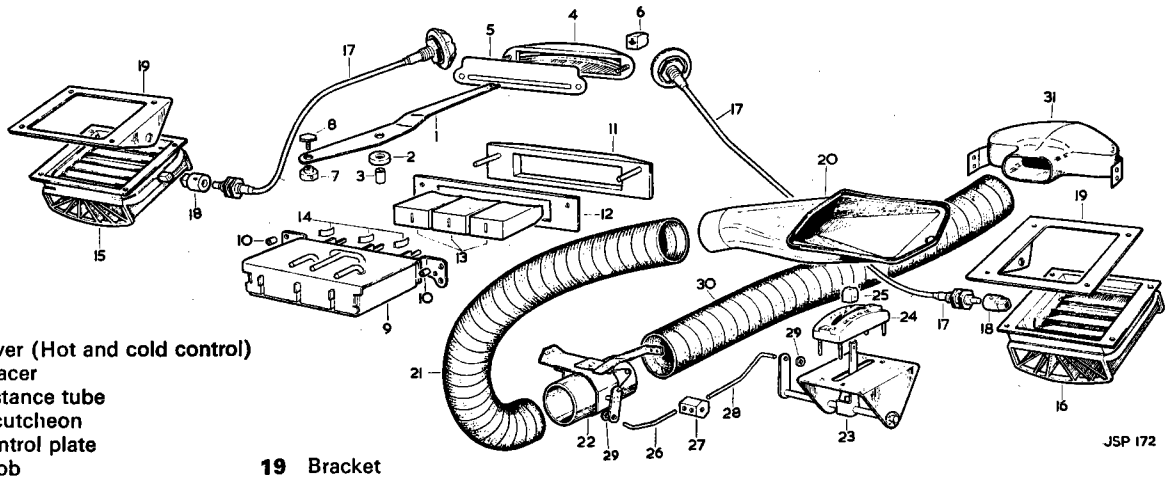
Refitting
Refitting is the reverse of the removal procedure.
When reassembling the fan to the motor spindle check that there is at least $\frac{1}{8}$" (3.2 mm.) clearance between the fan and motor mounting bracket and that the fan is running true on the spindle.

FAN SWITCH
Removal
Disconnect the battery.
Remove the two thumb-screws securing the instrument panel to the facia.
Remove the three "Lucar" connectors from the fan switch.
Unscrew the chrome bezel securing the switch to the instrument panel and withdraw the switch. Note the location of the wires on the switch before removing.

Refitting
Refitting is the reverse to the removal procedure.
Connect the switch cables to the correct terminals as noted on removal.

AIR TEMPERATURE CONTROL PANEL
Removal
Disconnect the battery.
Withdraw the control button escutcheon retained by two pegs to the control panel and unscrew the two round-headed screws now exposed.
Remove the heater control perforated guard cover from the parcel tray after withdrawing the four nylon retaining pins.
Lift the parcel tray trimming above the control panel and unscrew the two rounded-headed thumb screws located in recesses in the tray.
Withdraw the control panel facia and disconnect the three rubber pipes connected to the control button unit. Note the location of the individual pipes for reference when refitting.
Note: If a radio is fitted to the car it will be necessary to disconnect the supply feed cable from the fuse holder and the aerial and loud-speaker leads from the control unit before completing the removal of the control panel.
Remove the two wood screws from the back of the panel and withdraw the control button unit.

Refitting
Refitting is the reverse of the removal procedure.
Ensure that the rubber tubes are connected to the correct junctions as noted on removal.



1 Lever (Hot and cold control)
2 Spacer
3 Distance tube
4 Escutcheon
5 Control plate
6 Knob
7 Inner cable end fitting
8 Screw
9 Vacuum control box
10 Friction bush
11 Escutcheon
12 Backing plate
13 Knob
14 Clip
15 Air director box R.H.
16 Air director box L.H.
17 Remote control assembly
18 Adaptor
19 Bracket
20 Collector
21 Hose
22 Butterfly control assembly
23 Lever assembly
24 Escutcheon
25 Knob
26 Front control
27 Adjustment slide
28 Rear control rod
29 Retaining washer
30 Hose
31 Air distributor box

Fig. No. 8 *Exploded view of heater controls*

HEATER CONTROL LEVER

Removal

Remove the heater control perforated guard cover from the parcel tray after withdrawing four nylon retaining pins.
Pull off the heater control lever knob.
Disconnect the control lever at the forward end, unscrew the lever pivot pin, note the washer fitted between the lever and the bracket.
Withdraw the lever through the escutcheon plate.

Refitting

Refitting is the reverse of the removal procedure.
Ensure that the full movement of the lever on the heater unit is maintained when connecting the control cable.

FRONT AIR DIRECTION VENTS

Removal

Remove the four drive-screws securing the vents to the air duct.
Lower the vent and withdraw from the control cable junction.
Note on removal that the assemblies are handed.

Refitting

Refitting is the reverse of the removal procedure.

DIRECTION VENT CONTROL CABLES

Removal

Release the locknuts securing the outer cables to the vent bracket.
Disconnect the cables and collect the loose adapter.
Unscrew the cable from the centre finisher and withdraw the assemblies.
Note: A thin spanner will be required to remove the outer casing from the finisher.

Refitting

Refitting is the reverse of the removal procedure.

WINDSCREEN WASHER

Description

The Lucas 5SJ Screen Jet is an electrically operated unit comprising a small permanent magnet motor driving a centrifugal pump through a 3-piece Oldham coupling and a high density polythene water container mounted in the engine compartment. The container is connected to two water jets at the base of the windscreen.

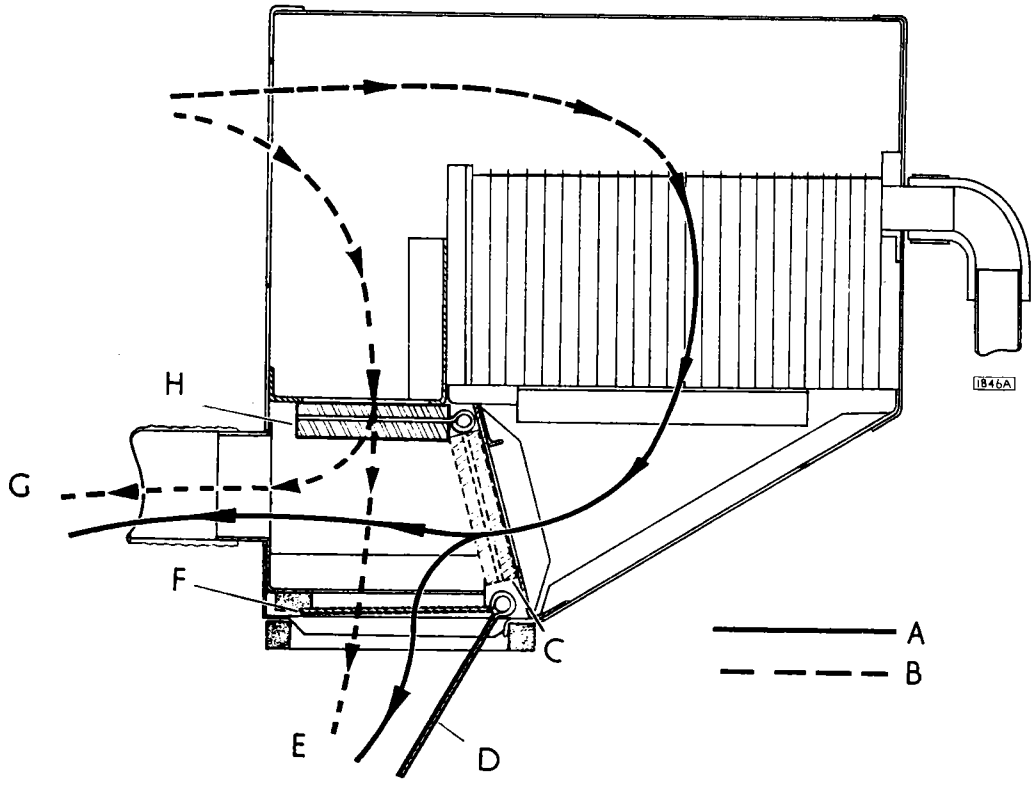


Fig. No. 9 *Cross section of the heater unit showing path of hot and cold air*

Operation
The windscreen washer should be used in conjunction with the windscreen wipers to remove any foreign matter that settles on the windscreen.
Lift the switch lever (marked "Washer" on the indicator strip) when the washer should operate at once and continue to function until the switch is released.

Warning: If the washer does not function immediately check that there is water in the container. The motor will be damaged if the switch is held pressed for more than one or two seconds if the water in the container is frozen. The washer should not be used under freezing conditions as the fine jets of water spread over the windscreen by the blades will tend to freeze up.

DATA

Nominal Voltage of Unit	12
Maximum Current Consumption	2.0 amp
Resistance between Commutator Segments	2.8-3.1 Ohm.
Minimum Water Delivery Pressure	4.5 lb/sq.in. (0.32 kg/cm.²)
Minimum Water Delivery per sec.	3.5 cc.
Container Capacity	2¼ pints (1.1 litres)
Usable Quantity of Water	2 pints (1 litre)
Diameter of Nozzle Orifice	0.25"–0.28" (6.3-7 mm.)

Filling Up
The correct water level is up to the bottom of the container neck. Do not overfill or unnecessary splashing may result. Always replace the filler cover correctly after filling up.
It is not possible to empty the container with the pump. Refilling is necessary when the water level has fallen below the level of the pump.
Keep the pump filler clean and the container free from sediment.

Cold Weather
The water container can be given a safe degree of protection down to —28 °F (—33 °C) by the use of proprietary anti-freeze solvents as marketed by Trico or Holts. Instructions regarding the use of the solvent will be found on the container.
Denatured alcohol (Methylated Spirits) must NOT be used. The use of this chemical will discolour the paintwork.

Servicing—Testing in Position
(a) Testing with a voltmeter:-
Connect a suitable direct current voltmeter to the motor terminals, observing the polarity as indicated on the moulding housing. Operate the switch. If a low or zero voltage is indicated the A4 fuse, switch and external connections should be checked and corrected as necessary.
If the voltmeter gives a reverse reading, the connections to the motor must be transposed.

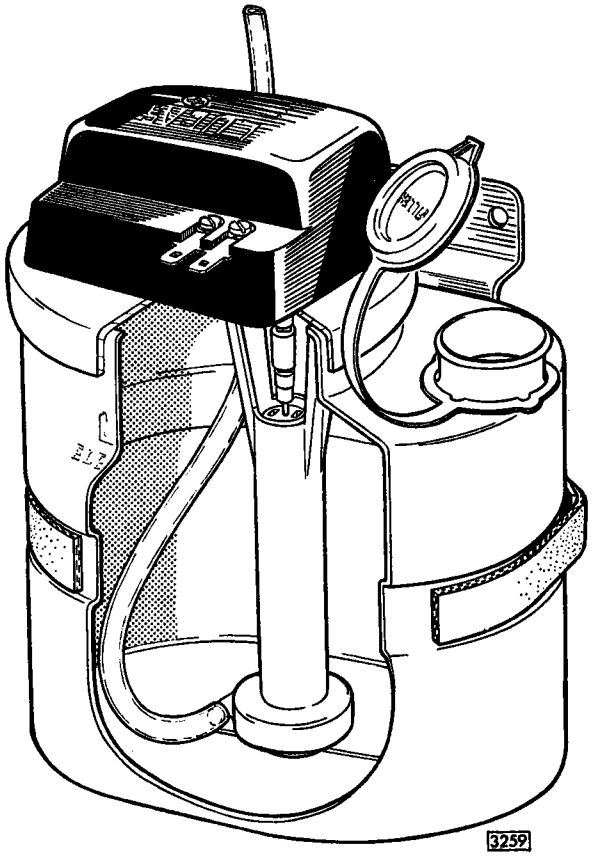


Fig. No. 10 *Windscreen washer water container*

If supply voltage is registered at the motor terminals but the unit fails to function, an open-circuit winding or faulty brush gear can be suspected. Dismantle the motor as described under the heading "Dismantling".

(b) Checking the external nozzles and tubes:-
If the motor operates but little or no water is delivered to the screen, the external tubes and nozzles may be blocked.
Remove the external plastic tube from the short connector on the container and, after checking that the connector tube is clear, operate the washer switch.
If a jet of water is ejected, check the external tubes and nozzles for damage or blockage.
If no water is ejected, proceed as detailed under the heading "Dismantling".

(c) Testing with an ammeter:-
Connect a suitable direct current ammeter in series with the motor and operate the switch. If the motor does not operate but the current reading exceeds that given in "DATA", remove the motor and check that the pump impeller shaft rotates freely.
If the shaft is difficult to turn, the water pump unit must be replaced.

If the shaft turns freely, the fault lies in the motor which must be dismantled and its component parts inspected.

Dismantling

(a) Disconnect the external tube and the electrical connections and remove the cover from the container.

(b) Remove the self-tapping screw which secures the motor to the cover and pull away the motor unit.
Take care not to lose the loose intermediate coupling which connects the armature coupling to the pump spindle coupling.

(c) Remove the armature coupling from the armature shaft as follows:-
Hold the armature shaft firmly with a pair of snipe-nosed pliers and, using a second pair of pliers, draw off the armature coupling.

(d) Remove the two self-tapping screws from the bearing plate. The bearing plate and rubber gasket can now be removed.

(e) Remove the two terminal screws. The terminal nuts and brushes can be removed and the armature withdrawn.
Take care not to lose the bearing washer which fits loosely on the armature shaft.

(f) The pole assembly should not normally be disturbed. If, however, its removal is necessary, make careful note of its position relative to the motor housing. The narrower pole piece is adjacent to the terminal locations.
Also the position of the pole clamping member should be observed. When fitted correctly, it locates on both pole pieces but, if fitted incorrectly, pressure is applied to one pole piece only.

Bench-Testing

If the motor has been over-heated, or if any part of the motor housing is damaged, a replacement motor unit must be fitted.

(a) Armature:-
If the armature is damaged, or if the winding is loose or badly discoloured, a replacement armature must be fitted.
The commutator must be cleaned with a fluffless, petrol-moistened cloth or, if necessary, by polishing with a strip of very fine glass paper.
The resistance of the armature winding should be checked with an ohm meter. This resistance should be in accordance with that given in "DATA".

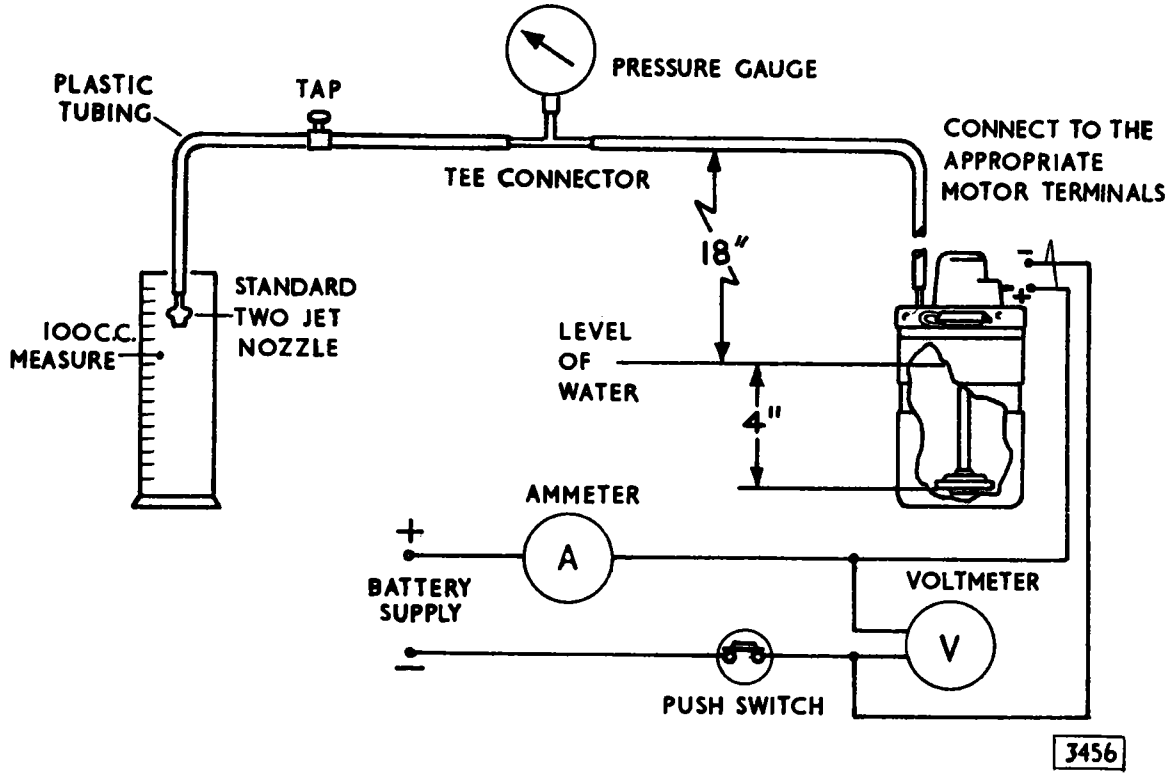


Fig. No. 11 *Performance testing equipment*

(b) Brushes :-
If the carbon is less than $\frac{1}{16}$" (1.59 mm.) long a new brush must be fitted.
Check that the brushes bear firmly against the commutator.

Re-assembling

Re-assembling of the unit is the reverse of the dismantling procedure. The following points should be observed :-

(a) Make sure the bearing recess in the motor is filled with Rocol Molypad molybdenised grease. Remove the excessive grease from the face of the bearing boss.
(b) Check that the pole piece assembly does not rock and that the pole pieces are firmly located on the circular spigot. Ensure that the pole piece assembly and the clamping member are the right way round.
(c) Before replacing the motor unit on the cover, ensure that the armature coupling is pushed fully home and that the intermediate coupling is in place.

Performance Testing

Equipment required :-
D.C. supply of appropriate voltage.
D.C. voltmeter, first grade, moving coil.
0-3 amp D.C. ammeter.
0-15 lb/in.^{2} (0-1 kg/cm.^{2}) pressure gauge.
Pushbutton with normally open contacts
Two-jet nozzle
On-off tap.
100 c.c. capacity measure.
4' 6" (1.37 m.) length of plastic tubing.

(a) Connect up the equipment as shown in Fig. 11. The water level in the container must be 4" (101.6 mm.) above the base of the pump assembly. The pressure gauge and nozzle must be 18" (457.2 mm.) above the water level.
(b) Open the tap.
(c) Depress the push button for approximately 5 seconds and check the voltmeter reading which should be the same as the supply voltage. On releasing the switch, close the tap to ensure that the plastic tubing remains charged with water.
(d) Empty the measuring cylinder.
(e) Open the tap and operate the push switch for precisely 10 seconds, after which period release the switch and close the tap.

During the 10 second test the current and pressure values should be in accordance with those given in "DATA" at least 35 c.c. of water should have been delivered.

ELECTRICAL AND INSTRUMENTS

SECTION P

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BATTERY

DISTRIBUTOR

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ALTERNATOR CONTROL UNIT

WARNING LIGHT CONTROL UNIT

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LAMPS

FLASHER UNIT

FUSE UNITS

TRAFFIC HAZARD WARNING

HORNS

WINDSCREEN WIPER

WIRING HARNESS REPLACEMENT

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ELECTRICAL AND INSTRUMENTS

BATTERY

The Lucas S11/9/8 battery is of the "cleantop" pattern, the cell filler holes being covered by a manifold vent cover.
Small sealed holes are provided over each inter-cell connector to enable the prongs of a heavy discharge tester to be inserted for testing purposes.

DATA

Battery type	S11/9/8
Voltage	12
Number of plates per cell	11
Capacity at 10-hour rate	60 ampere hours
Capacity at 20-hour rate	67 ampere hours

ROUTINE MAINTENANCE

Wipe away any foreign matter or moisture from the top of the battery and ensure that the connections and the fixings are clean and tight.
About once a month, or more frequently in hot weather, examine the level of the electrolyte in the cells. If necessary add distilled water to bring the electrolyte just level with the separator guards which can be seen when the vent cover is removed.
The use of a Lucas battery filler will be found helpful in this topping-up process, as it ensures that the correct electrolyte level is obtained automatically and also prevents distilled water from being spilled over the battery top.
Distilled water should always be used for topping-up. In an emergency, however, clean soft rain water collected in an earthenware container may be used.
Note: Never use a naked light when examining a battery, as the mixture of oxygen and hydrogen given off by the battery when on charge and to a lesser extent when standing idle, can be dangerously explosive.

REMOVAL

Unscrew the two wing nuts retaining the battery strap; remove the fixing rods and strap. Disconnect terminals and lift out the battery from the tray.

REFITTING

Refitting is the reverse of the removal procedure. Before refitting the cable connectors, clean the terminals and coat with petroleum jelly.

PERSISTENT LOW STATE OF CHARGE

First consider the conditions under which the battery is used. If the battery is subjected to long periods of discharge without suitable opportunities for recharging, a low state of charge can be expected. A fault in the generator or regulator, or neglect of the battery during a period of low or zero mileage may also be responsible for the trouble.

Manifold Vent Cover

See that the ventilating holes in the cover are clear.

Level of Electrolyte

The surface of the electrolyte should be just level with the tops of the separator guards. If necessary top up with distilled water. Any loss of acid from spilling or spraying (as opposed to the normal loss of **water** by evaporation) should be made good by dilute acid of the same specific gravity as that already in the cell.

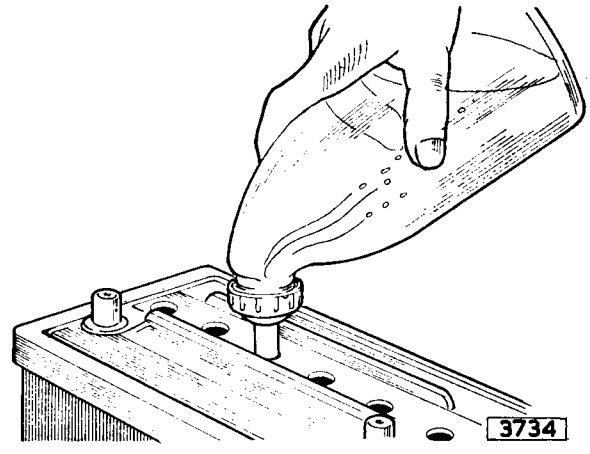


Fig. No. 1 *Using the Lucas battery filler*

Cleanliness

See that the top of the battery is free from dirt or moisture which might provide a discharge path. Ensure that the battery connections are clean and tight.

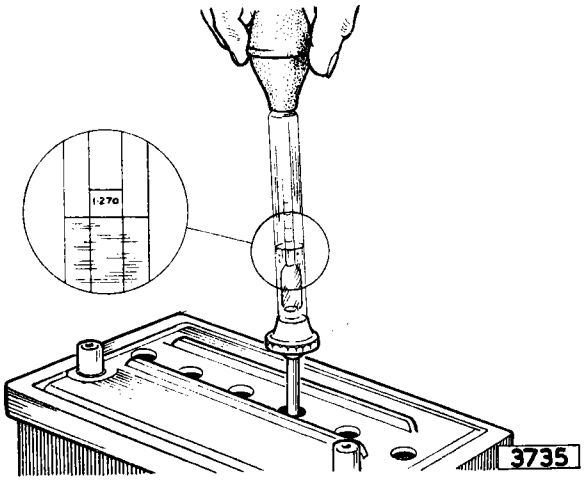


Fig. No. 2 *Testing with a hydrometer*

Hydrometer Tests

Measure the specific gravity of the acid in each cell in turn with an hydrometer. To avoid misleading readings, do not take hydrometer readings immediately after topping-up.

The readings given by each cell should be approximately the same.

If one cell differs appreciably from the others, an internal fault in the cell is indicated.

The appearance of the electrolyte drawn into the hydrometer when taking a reading gives useful indication of the state of the plates. If the electrolyte is very dirty, or contains small particles in suspension, it is possible that the plates are in a bad condition.

The specific gravity of the electrolyte varies with the temperature, therefore, for convenience in comparing specific gravities, this is always corrected to 60°F. (16°C.) which is adopted as a reference temperature. The method of correction is as follows:—

For every 5°F. (2.8° C.) below 60°F. (16°C.) deduct 0.002 from the observed reading to obtain the true specific gravity at 60°F.

For every 5°F. (2.8° C.) above 60°F. (16°C.) add 0.002 to the observed reading to obtain the true specific gravity at 60°F. (16°C.).

The temperature must be that indicated by a thermometer actually immersed in the electrolyte and not the air temperature.

Compare the specific gravity of the electrolyte with the values given in the table and so ascertain the state of charge of the battery.

If the battery is in a discharged state, it should be recharged, either on the vehicle by a period of daytime running or on the bench from an external supply, as described under "Recharging from an External Supply".

Discharge Test

A heavy discharge tester consists of a voltmeter, 2 or 3 volts full scale, across which is connected a shunt resistance capable of carrying a current of 150-160 amperes. It is important to use only a suitably rated instrument. Pointed prongs are provided for making contact with the inner-cell connectors.

Press the contact prongs against the exposed positive and negative terminal of each cell. A good cell will maintain a reading of 1.2 - 1.5 volts, depending on the state of charge, for 10 seconds.

If, however, the reading rapidly falls off, the cell is probably faulty and a new plate assembly may have to be fitted.

RECHARGING FROM AN EXTERNAL SUPPLY

If the battery tests indicate that the battery is merely discharged and is otherwise in a good condition, it should be re-charged either on the car by a period of day-time running or from an external supply.

Note correct battery polarity (NEGATIVE EARTH) and remove the battery leads when connecting the charging unit cables if charging from an external supply.

If the latter, the battery should be charged at 6 amperes until the specific gravity and voltage show no increase over three successive hourly readings.

During the charge the electrolyte must be kept level with the tops of the separator guards by the addition of distilled water.

A battery that shows a general falling-off in efficiency common to all cells will often respond to the process known as "cycling". This process consists of fully charging the battery as described above and then discharging it by connecting to a lamp board or other load, taking a current of 5 amperes. The battery should be capable of providing this current for at least 7 hours before it is fully discharged, as indicated by the voltage of each cell falling to 1.8. If the battery discharges in a shorter time, repeat the "cycle" of charge and discharge.

When using a fast charger to boost the battery it is ESSENTIAL to check that the ignition switch is in the "OFF" position.

Failure to ensure this will result in damage to the 4TR control unit.

If using the fast charger to start the engine it is **essential** to see that the 4TR control is disconnected.

On cars fitted with a steering column lock, disconnect the 6RA relay at terminal W2.

On cars not equipped with a steering lock, disconnect the cables from the control unit.

Care must be taken when reconnecting; **any wrong connections will cause irreparable damage.**

The cables must not be connected to the control unit until the charger has been disconnected and the speed reduced to tick-over.

PREPARING NEW UNFILLED, UNCHARGED BATTERIES FOR SERVICE

Preparation of Electrolyte

Batteries should not be filled with acid until required for initial charging.

Electrolyte of the specific gravity required is prepared by mixing distilled water and concentrated sulphuric acid usually of 1.835 specific gravity. The mixing must be carried out either in a lead-lined tank or in a suitable

glass or earthenware vessel. Slowly add the acid to the water, stirring with a glass rod. **Never add the water to the acid** as the resulting chemical reaction causes violent and dangerous spurting of the concentrated acid. The correct specific gravity for the filling acid and approximate proportions of acid and water are indicated in the following table:
Heat is produced by the mixture of acid and water, and the electrolyte should be allowed to cool before taking hydrometer readings — unless a thermometer is used to measure the actual temperature, and a correction applied to the reading before pouring the electrolyte into the battery.

Filling the Battery
The temperature of the acid, battery and filling-in room must not be below 32 °F. (0 °C.).
Carefully break the seals in the filling holes and fill each cell to the level of the separator guard with electrolyte of the approximate specific gravity. Allow the battery to stand for 12 hours in order to dissipate the heat generated by the chemical action of the acid on the plates and separators. Restore levels by adding more acid of the same specific gravity and then proceed with the initial charge.

Initial Charge Rate
Charge at the rate of 4 amps until the voltage and specific gravity readings show no increase over five successive hourly readings. This may take up to 80 hours, depending on the length of time the battery has been stored before charging.

Keep the current constant by varying the series resistance of the circuit or the generator output.

This charge should not be broken by long rest periods. If, however, the temperature of any cell rises above the permissable maximum (that is, 100 °F. (38 °C.) for batteries filled with 1.270 S.G. acids, 120 °F. (49 °C.) for those with 1.210 S.G. acid), the charge must be interrupted until the temperature has fallen at least 10 °F. (— 10 °C.) below that figure. Throughout the charge, the electrolyte must be kept level with the top of the separator guards by the addition of acid solution of the same specific gravity as the original filling-in acid, until the specific gravity and voltage readings have remained constant for five successive hourly readings. If the charge is continued beyond that point, top up with distilled water.

State	Home and climates with shade temperature ordinarily below 80 °F. (26.6 °C). Specific gravity of electrolyte (corrected to 60 °F.) (16 °C.).	Climates with shade temperature frequently over 80 °F. (26.6 °C). Specific gravity of electrolyte (corrected to 60 °F. (16 °C.).
Fully charged About half discharged	1.270 — 1.290 1.190 — 1.210	1.210 — 1.230 1.130 — 1.150
Completely discharged	1.110 — 1.130	1.050 — 1.070

Specific Gravity of Filling Acid (corrected to 60 °F.)

Home and climates with shade temperature ordinarily below 80 °F. (26.6 °C.). 1.260 Add 1 part by volume of acid ((1.840 S.G.) to 3.2 parts of distilled water to mix this electrolyte	Climates with shade temperature frequently above 80 °F. (26.6 °C.). 1.210 Add 1 part by volume of acid (1.835 S.G.) to 4 parts of distilled water to mix this electrolyte)
Quantity of electrolyte required per cell 1¼ pints approximately (720 c.c.).	

At each end of the charge carefully check the specific gravity in each cell to ensure that when corrected to 60 °F. (16 °C.), it lies within the specified full-charged limits.

If any cell requires adjustment, some of the electrolyte must be siphoned off and replaced by distilled water or by acid of the strength originally used for filling-in, depending on whether the specific gravity is too high or too low. Continue the charge for an hour or so to ensure adequate mixing of the electrolyte and again check the specific gravity readings. If necessary, repeat the adjustment process until the desired reading is obtained in each cell. Finally, allow the battery to cool and siphon off any electrolyte above the tops of the separator guards.

PREPARING NEW "DRY-CHARGED" BATTERIES FOR SERVICE

Filling the Cells

Carefully break the seals in the filling holes and fill each cell with correct specific gravity acid as shown in the table on page P.9 to the top of the separator guards in one operation. The temperatures of the filling room, battery and acid should be maintained at between 60 °F. (16 °C.) and 100 °F. (38 °C.). If the battery has been stored in a cool place, it should be allowed to warm up to room temperature before filling.

Freshening Charge

Batteries filled in this way are up to 90% charged and capable of giving a starting discharge one hour after filling. When time permits, however, a short freshening charge will ensure that the battery is fully charged.
Such a freshening charge should be 5 amperes for not more than 4 hours.
During the charge the electrolyte must be kept level with the top of the separators by the addition of distilled water. Check the specific gravity of the electrolyte at the end of the charge; if 1.270 acid was used to fill the battery, the specific gravity should now be between 1.270 and 1.290; if 1.210 acid, between 1.210 and 1.230.

Maintenance in Service

After filling, a dry-charged battery needs only the attention normally given to all lead-acid type batteries.

DISTRIBUTOR

DESCRIPTION

The Lucas 22D6 distributor is fitted to all engines.
All models fitted with automatic transmission have a speed limiter incorporated in the rotor. The distributor DATA remains the same irrespective of the type of transmission installed.
This device operates as a spring controlled governor plate attached to the rotor and lifts at a pre-determined maximum engine speed to earth out the H.T. circuit.
The speed limiter is necessary due to the safe maximum speed limitations of the Borg-Warner transmission unit, therefore no attempt must be made to fit the standard rotor arm which will not have the governor plate fitted, as a replacement.
A waterproof cover is incorporated in the distributor assembly and is located between the distributor cap and the body.
The cover is detachable after removing the distributor cap and disconnecting the cable from the contact breaker spring post. The distributor DATA remains the same as that stated on page P.12.

REMOVAL

Spring back the clips and remove the distributor cap.
Disconnect the low tension wire from the distributor.
Disconnect the vacuum pipe by withdrawing the elbow sleeve junction.
Remove distributor clamping plate retaining setscrew and withdraw distributor.

REFITTING

If the distributor clamping plate pinch bolt has not been slackened during removal of distributor, refitting will be the reverse of the removal procedure. Enter the distributor into the cylinder block with the vacuum advance unit connection facing the cylinder block.
Rotate the rotor arm until the driving dog engages with the distributor drive shaft.
If the distributor clamping plate pinch bolt has been slackened during removal of distributor it will be necessary to reset the ignition timing as follows:—

Ignition Timing

Set the micrometer adjustment in the centre of the scale.
Connect the low tension wire to the terminal on the distributor body.
Enter the distributor into the cylinder block with the vacuum advance unit connection facing the cylinder block.
Rotate the rotor arm until the driving dog engages with the distributor drive shaft.
Rotate the engine until the rotor arm approaches the No. 6 (front) cylinder segment in the distributor cap.
Slowly rotate the engine until the ignition timing scale on the crankshaft damper is the appropriate number of degrees before the pointer on the sump. (See Data).
Connect a 12 volt test lamp with one lead to the distributor terminal (or the CB terminal of the ignition coil) and the other to a good earth.
Slowly rotate the distributor body until the points are just breaking, that is, when the lamp lights up.
Tighten the distributor plate pinch bolt.
A maximum of six clicks on the vernier adjustment from this setting, to either advance or retard, is allowed.

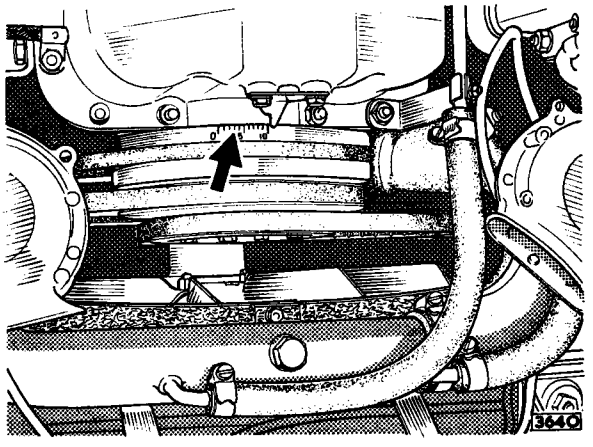


Fig. No. 3 *Ignition timing scale on crankshaft damper*

ROUTINE MAINTENANCE

Every 3,000 Miles (5,000 km.)

Distributor Contact Breaker Points

Every 3,000 miles (5,000 km.) (first 500 miles (800 km.) with new contact set), check the gap between the contact points with feeler gauges when the points are fully opened by one of the cams on the distributor shaft. A combined screwdriver and feeler gauge is provided in the tool kit.

The correct gap is 0.014 - 0.016" (0.36 - 0.41 mm.). If the gap is incorrect, slacken (very slightly) the contact plate securing screw and adjust the gap by turning a screwdriver in the nick in the contact plate and the slot in the base plate, clockwise to decrease the gap and anti-clockwise to increase the gap. Tighten the securing screw and recheck the gap (Fig. 4).

Examine the contact breaker points. If pitted, clean with a fine carborundum stone or very fine emery cloth. Afterwards wipe away any trace of grease or metal dust with petrol moistened cloth.

Contact cleaning is facilitated by removing the lever to which the moving contact is attached. To do this, remove the nut, insulating piece and electrical connections from the post to which the contact breaker spring is anchored. The contact breaker lever can then be lifted off the pivot post and the spring from the anchor post.

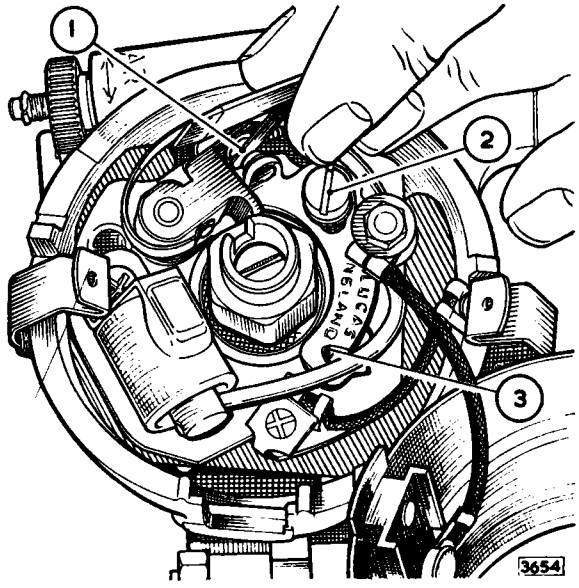


Fig. No. 4 *Checking the contact breaker gap*

After cleaning and trimming the contacts, smear the pivot post (Fig. 5) with Ragosine Molybdenised Non-creep Oil or with Mobilgrease No. 2. Reassemble the contact breaker and check the setting.

Refit the rotor arm, carefully locating its moulded projection in the spindle keyway and pushing it on as far as it will go.

Clean the moulded cover inside and outside with a soft dry cloth. Pay particular attention to spaces between the terminals. Check that the small carbon brush inside the moulding can move freely in its holder. Refit the cover and spring the two side clips into position.

Lubrication

Remove the moulded cover and withdraw the rotor arm. A tight rotor arm can be withdrawn by using a suitable pair of levers carefully applied at opposite points below the rotor moulding — never against the metal electrode.

Important: Do not allow oil or grease on or near the contacts when carrying out the following lubrication.

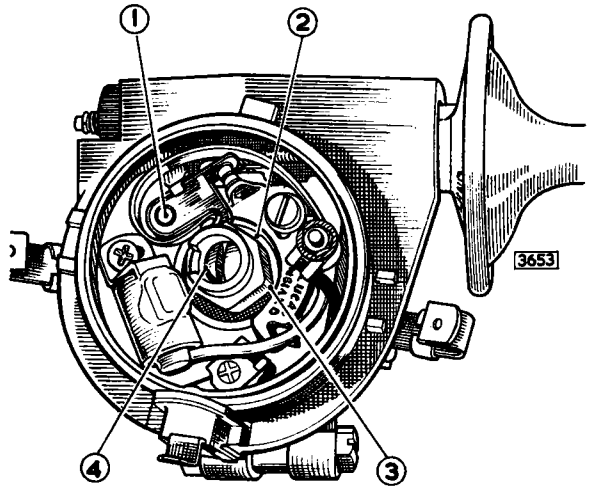


Fig. No. 5 *Distributor lubrication points*

Cam Bearing

To lubricate the cam bearing, inject a few drops of thin machine oil into the rotor arm spindle (Fig. 5). Do not remove or slacken the screw located inside the spindle — a space is provided beneath the screwhead to allow the lubricant to reach the cam bearing.

Pivot Post

Place a drop of clean engine oil on the tip of the pivot post (Fig. 5).

Cam

Lightly smear the faces of the cam (Fig. 5) with Mobilgrease No. 2 or with clean engine oil.

Centrifugal Timing Control

Inject a few drops of thin machine oil through a convenient aperture in the contact breaker base plate (Fig. 5).

SERVICING

Dismantling

When dismantling, note carefully the position in which the various components are fitted in order to simplify their re-assembly.

Bearing Replacement

The ball bearing at the upper end of the shank can be removed with a shouldered mandrel locating on the inner journal of the bearing.

When fitting a new ball bearing, the shouldered mandrel must locate on both inner and outer journals of the bearing.

The bearing bush at the lower end of the shank can be driven out with a suitable punch.

A bearing bush may be prepared for fitting by allowing it to stand completely immersed in medium viscosity (S.A.E. 30-40) engine oil for at least 24 hours. In cases of extreme urgency, this period of soaking may be shortened by heating the oil to 100 °C. for 2 hours and then allowing to cool before removing the bush. The bush is pressed into the shank with a shouldered mandrel. The mandrel should be hardened and polished and approximately 0.0005" greater in diameter than the distributor shaft. To prevent subsequent withdrawal of the bush with the mandrel, a stripping washer should be fitted between the shoulder of the mandrel and the bush.

Under no circumstances should the bush be overbored by reaming or by any other means, since this will impair the porosity and therefore the lubricating quality of the bush.

Re-assembly

When re-assembling, Ragosine molybdenised non-creep oil or (failing this) clean engine oil, should be smeared on the shaft and, more lightly, on the contact breaker bearing plate.

DISTRIBUTOR DATA

Compression Ratio	8 : 1 - 9 : 1
Lucas Ignition Distributor Type Model No.	22 D.6
Lucas Service	41060A
Cam dwell angle	34° ± 3°
Contact breaker gap	0.014 - 0.016" (0.36 - 0.41 mm.)
Contact breaker spring tension measured at free contact	18 - 24 ozs. (512 - 682 gms.)

IGNITION TIMING

8 : 1 Compression Ratio	8° BTDC
9 : 1 Compression Ratio	8° BTDC

IGNITION DISTRIBUTOR TEST DATA

			VACUUM TIMING ADVANCE TESTS The distributor must be run immediately below the speed at which the centrifugal advance begins to function to obviate the possibility of an incorrect reading being registered				CENTRIFUGAL TIMING ADVANCE TESTS Mount distributor in centrifugal advance test rig and set to spark at zero degrees at 100 r.p.m.				
Distributor Type	Lucas Service Number	Lucas Vacuum Unit Number	Vacuum in inches of mercury and advance in degrees Inches	Degrees	No advance timing below-ins. of mercury	Lucas Advance Springs Number	Accelerate to-RPM and note advance in degrees RPM	Degrees	Decelerate to-RPM and note advance in degrees RPM	Degrees	No advance in timing below-RPM
22D6	41060A (standard) (auto. trans.)	54415894	20 13 9 7½ 6	7—9 6—8½ 2½—5½ 0—3 0—½	4½	55415562	2,300	8½—10½	1,800 1,250 800 650 525	82—10½ 6½—8½ 5—7 2—4 0—1½	300

Auto advance weights Lucas number 54413073. One inch of mercury = 0.0345 kg/cm2.

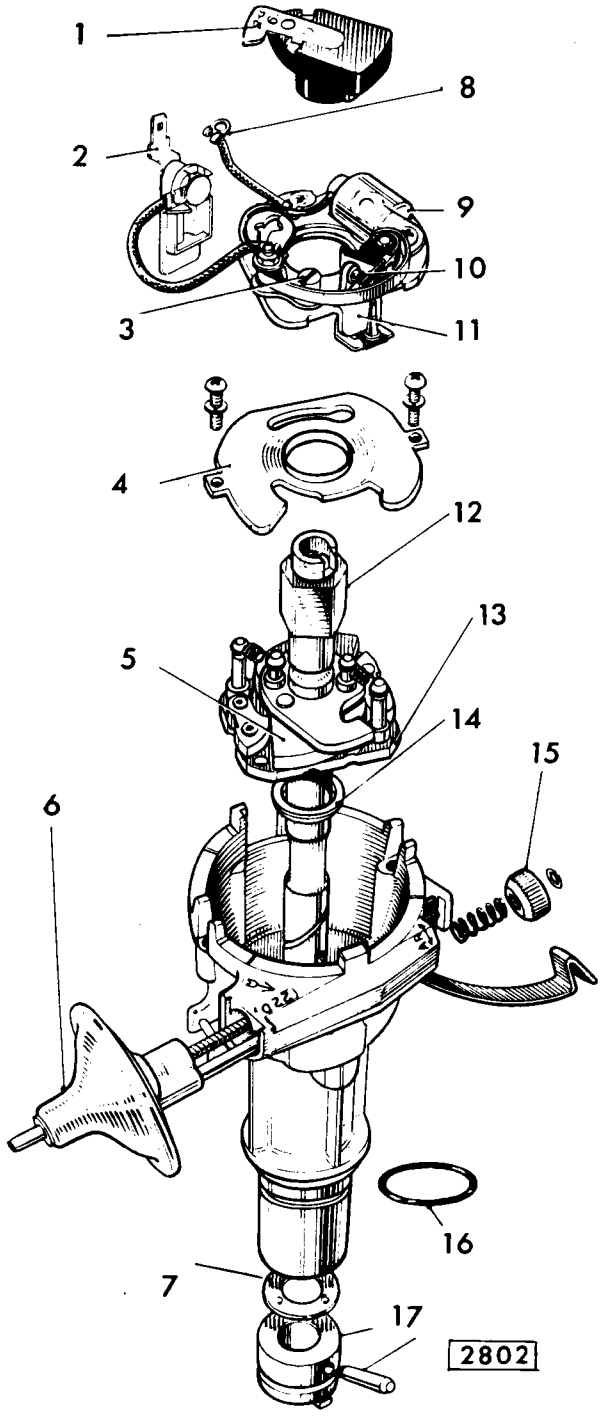


Fig. No. 6 *The distributor components*

1 Rotor arm
2 L.T. terminal
3 Fixed contact plate securing screw
4 Contact breaker base plate
5 Centrifugal timing control weights
6 Vacuum timing control unit
7 Thrust washer
8 C.B. earth connector
9 Capacitor
10 Contacts
11 Contact breaker moving plate
12 Cam
13 Action plate
14 Distance collar
15 Micrometer adjustment nut
16 Oil seal washer
17 Dog and pin

ALTERNATOR

GENERAL DESCRIPTION

The Lucas 11 A.C. alternator is a lightweight machine designed to give increased output at all engine speeds. Basically, the unit consists of a stationary output winding with built-in rectification and a rotating field winding energised from the battery through a pair of slip-rings.

The stator consists of a 24 slot, 3 phase star connected winding on a ring shaped lamination pack, housed between the slip-ring end cover and the drive end bracket.

The rotor is of 8 pole construction and carries a field winding connected to two face type slip-rings. It is supported by a ball bearing in the drive end bracket and a needle roller bearing in the slip-ring end cover. See Fig. 7.

The brushgear for the field system is mounted on the slip-ring end cover. Two carbon brushes, one positive and the other negative, bear against a pair of concentric brass slip-rings carried on a moulded disc attached to the end of the rotor.

The positive brush is always associated with the inner slip-ring.

The slip-ring end cover also carries six silcon diodes connected in a 3 phase bridge circuit to provide rectification of the generated alternating current output. See Fig. 8. The diodes are cooled by air flow through the alternator induced by a 6" (152.4 mm.) ventilating fan at the drive end.

The alternator is matched to an output control unit, Model 4 TR, see page P.19 for full details of the unit. This unit controls the alternator field current and hence the alternator terminal voltage.

A cut-out is not included in the control unit as the diodes in the alternator prevent reverse currents from flowing through the stator when the machine is stationary or is generating less than the battery voltage.

No separate current-limiting devise is incorporated; the inherent self-regulating properties of the alternator effectively limit the output current to a safe value.

A Lucas 3AW warning light control unit is incorporated in the circuit.

The output control unit and the alternator field windings are isolated from the battery when the engine is stationary by a separate pair of contacts in the ignition switch.

On cars fitted with a steering column lock the field windings are isolated by means of a relay replacing the ignition switch control.

PERFORMANCE DATA

Cutting-in speed	500 engine r.p.m. at 13.0 alternator volts
Maximum D.C. output	45 amp. at 3,000 engine r.p.m. (6,000 alternator r.p.m.) 13.5 volts
Stator phases Phase connection Resistance/phase at 68 °F. (20 °C.) ± 5%	3 Star 0.107 ohms
Resistance of field coil at 68 °F. (20 °C.) ± 5%	3.770 ohms

ROUTINE MAINTENANCE

No routine maintenance is necessary with the alternator and warning light unit.

Occasionally wipe away any dirt or oil which may collect around the slip-ring end cover.

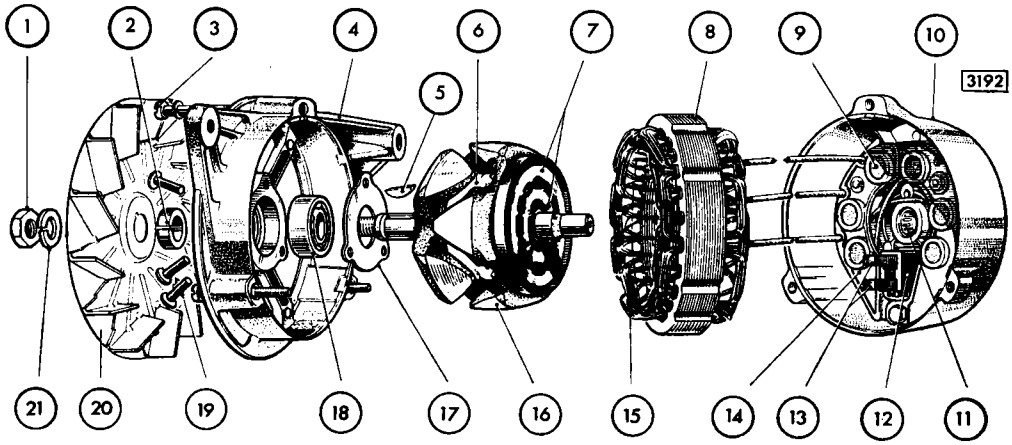


Fig. No. 7 *Exploded view of the Lucas 11AC alternator*

1 Shaft nut
2 Bearing collar
3 Through fixing bolts (3)
4 Drive end bracket
5 Key
6 Rotor (field) winding
7 Slip rings
8 Stator laminations
9 Silicon diodes (6)
10 Slip ring end bracket
11 Needle roller bearing
12 Brush box moulding
13 Brushes
14 Diode heat sink
15 Stator windings
16 Rotor
17 Bearing retaining plate
18 Ball bearing
19 Bearing retaining plate
20 Fan
21 Spring washer

REMOVAL

Disconnect the cables from the terminals on the slip ring end cover. Note the colour and location of the cables with "Lucar" termination for reference when refitting.

Remove the bolts securing the alternator to the mounting bracket and adjuster link, lift the belt over the pulley and withdraw the alternator.

Note: If air-conditioning equipment is fitted it will be necessary to remove the compressor unit and the mounting bracket as detailed on page A.32 to gain access to the alternator. **DO NOT** release or disconnect the compressor hose unions. Support the compressor in the engine compartment after removing.

REFITTING

Refitting is the reverse of the removal procedure. Replace the drive belt and adjust to the correct tension by swinging the alternator outwards away from the engine. Tighten the securing bolts.

When correctly adjusted the belt deflection should be $\frac{1}{2}$" (12.7 mm.) with pressure applied between the two pulleys.

Important: To avoid bearing damage when adjusting the belt tension, apply leverage ONLY to the drive end bracket and **not** to any other part of the alternator.

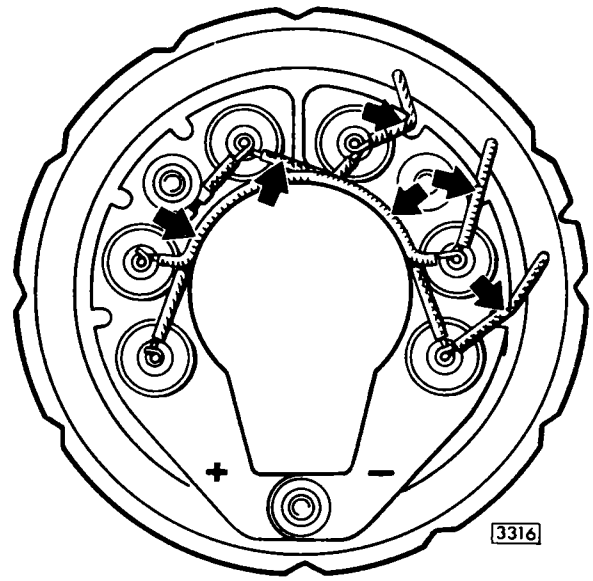


Fig. No. 8 *Showing the silicon diodes and connections in the slip ring end cover*

SERVICE PRECAUTIONS

Important: The units incorporate transistors in the control box and diode rectifiers in the alternator. The car electrical system must NOT be checked with the ohmmeter incorporating a hand driven generator until these components have been isolated.

REVERSED battery connections will damage the diode rectifiers.

Battery polarity must be checked before connections are made to ensure that the connections to the car battery are NEGATIVE earth. This is most important when using a slave battery to start the engine.

NEVER earth the brown/green cable if it is disconnected at the alternator. If this cable is earthed, with the ignition switched ON, the control unit and wiring may be damaged.

NEVER earth the alternator main output cable or terminal. Earthing at this point will damage the alternator or circuit.

NEVER run the alternator on open circuit with the field windings energised, that is with the main lead disconnected, or the diodes are likely to be damaged due to peak-inverse voltages.

SERVICING

Testing the Alternator in position

In the event of a fault developing in the charging circuit, check by the following procedure to locate the cause of the trouble.

(a) Disconnect the battery earth cable.

(b) Lower the instrument panel and disconnect the brown/white cables from the ammeter. Connect the two cables to a good quality moving-coil ammeter registering at least 75 amperes.

(c) Detach the terminal connector block from the base of the control unit and connect the black and brown/green cables together by means of a short length of cable with two "Lucar" terminals attached. This operation connects the alternator field winding across the battery terminals and by-passes the output control unit (Fig. 9).

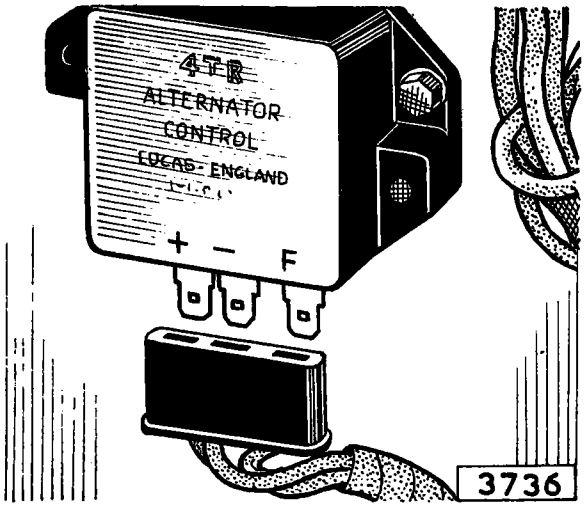


Fig. No. 9 *Showing the cable terminals disconnected from the base of the control unit*

(d) Reconnect the battery earth lead. Switch on the ignition and start the engine. Slowly increase the engine speed until the alternator is running at approximately4,000R.P.M.(2,000 engineR.P.M.). Check the reading on the ammeter which should be approximately 40 amperes with the machine at ambient temperature.

A low current reading will indicate either a faulty alternator or poor circuit wiring connections.

If, after checking the latter (especially the earth connections), a low reading persists on repeating the test, proceed to paragraph (e).

If, however, a zero reading results, switch on the ignition and check that the battery voltage is being applied to the rotor windings by connecting a voltmeter between the two cable ends normally attached to the alternator field in the field isolating contacts in the ignition switch or the wiring associated with this circuit.

Check each item in turn and rectify as necessary.

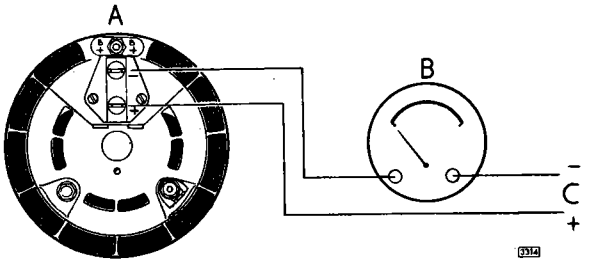


Fig. No. 10 *Testing the alternator with an ammeter*

(e) If a low output has resulted from the test described in paragraph (d) and the circuit wiring is in order, measure the resistance of the rotor coil (field) by means of an ohmmeter connected between the field terminal blades with the external wiring disconnected. The resistance must approximate to 3.77 ohms.

If an ohmmeter is not available, connect a 12 volt D.C. supply between the field terminals with an ammeter in series. The ammeter reading should be approximately 3.2 amperes. (Fig. 10).

A zero reading on the ammeter, or an "Infinity" reading on the ohmmeter indicates an open circuit in the field system, that is, brushgear, slip-rings, or windings. Conversely, if the current reading is much above or the ohmmeter is much below the values given above, it is an indication of a short circuit in the rotor-winding, in which case the rotor/slip-ring assembly must be changed.

DISMANTLING

Disconnect the battery and remove the alternator as detailed on page P.15

Remove the shaft nut and spring washer and withdraw the pulley and fan.

Unscrew the nuts and remove the three through bolts.

Note: The nuts are staked to the through bolts and the staking must be removed before the nuts are unscrewed. If the threads of the nuts or bolts are damaged new bolts must be fitted when re-assembling.

Mark the drive end bracket, lamination pack and slip ring end cover so that they may be re-assembled in correct angular relation to each other. Care must be taken not to damage the lamination pack when marking.
Withdraw the end drive bracket and rotor from the stator. The drive end bracket and rotor need not be separated unless the bearing requires examination or the rotor is to be replaced, in which case the rotor should be removed from the drive end bracket by means of a hand press, having first removed the shaft key and bearing collar.
Remove the terminal nuts, washers, insulating pieces, brush box screws and the 2 BA hexagon headed set-screws and withdraw the stator and heat sink assemblies from the slip ring end cover.
Close up the retaining tongue at the root of each field terminal blade and withdraw the brush spring and terminal assemblies from the moulded brushbox.

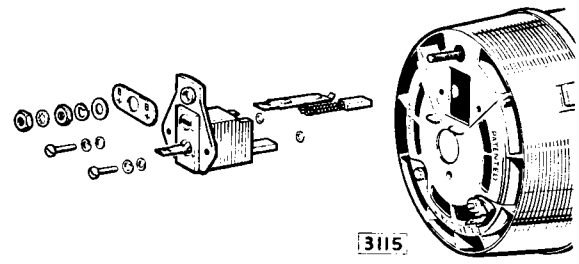


Fig. No. 11 *Showing the bush removal*

REASSEMBLY

Reassembly of the alternator is the reverse of the dismantling procedure. Care must be taken to align the drive end bracket, lamination pack and slip ring end bracket correctly.
Tighten the three "through" bolts evenly to a maximum torque of 45-50 lb. ins. (0.518-0.576 kgm.). Restake the nuts after tightening.
Tighten the brush box fixing screws to a maximum torque of 10 lb. ins. (0.115 kg/m.).

IMPORTANT

It is important to ensure that a .045" (1.28 mm.) gap exists between the non-pivotal ends of the heat sinks (see Fig. 8) when reassembling the alternator.
Check by inserting a feeler gauge through the slip ring end cover aperture.
FAILURE TO ENSURE THIS CLEARANCE WILL RESULT IN A SHORT IN THE AMMETER CIRCUIT BEHIND THE INSTRUMENT PANEL.

INSPECTION OF BRUSH GEAR

Measure brush length. A new brush is $\frac{5}{8}$" (15.88 mm.) long; a fully worn brush is $\frac{5}{32}$" (3.97 mm.) long and must be replaced at, or approaching, this length. The new brush is supplied complete with brush spring and "Lucar" terminal blade and has merely to be pushed in until the tongue registers.
To ensure that the terminal is properly retained, carefully lever up the retaining tongue with a fine screwdriver blade so that the tongue makes an angle of about 30° with the terminal blade.
The normal brush spring pressures are 4-5 oz. (113-142 gms.) with the spring compressed to $\frac{25}{32}$" (19.84 mm.) in length and $7\frac{1}{2}$ - $8\frac{1}{2}$ oz. (212 - 242 gms.) with the spring compressed to $\frac{13}{32}$" (10.31 mm.) in length. These pressures should be measured if the necessary equipment is available.
Check that the brushes move freely in their holders. If at all sluggish, clean the brush sides with a petrol moistened cloth, or if this fails to effect a cure, lightly polish the brush sides on a smooth file. Remove all traces of brush dust before re-housing the brushes in their holders.

INSPECTION OF SLIP-RINGS

The surfaces of the slip-rings should be smooth and uncontaminated by oil or other foreign matter. Clean the surfaces using a petrol moistened cloth, or if there is any evidence of burning, very fine glasspaper. On no account must emery cloth or similar abrasives be used. No attempt should be made to machine the slip-rings, as any eccentricity in the machining may adversely affect the high-speed performance of the alternator. The small current carried by the rotor winding and the unbroken surface of the slip-rings means that the likelihood of scored or pitted slip-rings is almost negligible.

ROTOR

Test the rotor winding by connecting an ammeter or 12-volt D.C. supply between the slip-rings (as described on page P.16 where this test was made with the brushgear in circuit). The readings of resistance or current should be as given in para. (e)., page P.16).
Test for defective insulation between each of the slip-rings and one of the rotor poles using a mains low-wattage test lamp for the purpose. If the lamp lights, the coil is earthing and a replacement rotor/slip-ring assembly must be fitted.
No attempt should be made to machine the rotor poles or to true a distorted shaft.

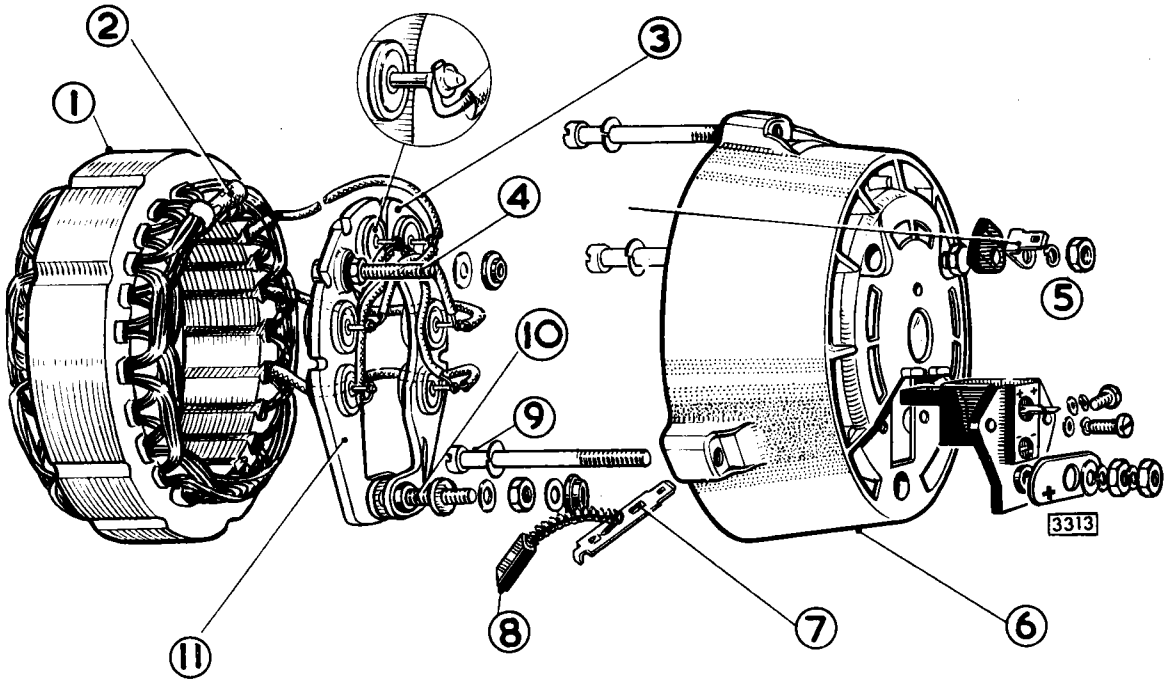


Fig. No. 12 *Exploded view of the slip ring end cover*

1 Stator
2 Star point
3 Negative heat sink and anode base diodes (black)
4 Warning light terminal "AL"
5 Field terminal
6 Slip ring end cover
7 Terminal blade retaining tongue
8 Rotor slip ring brush
9 "Through" bolts
10 Output terminals
11 Positive heat sink and cathode base diodes (red)

STATOR

Unsolder the three stator cables from the heat sink assembly taking care not to overheat the diodes. By lettering these cables A, B and C, three pairs of cables — AB, BC and AC — are available for testing the stator windings. Measure the volt drop across each of these "pairs" in turn while passing 20 amp between the cable ends. The volt drop should be approximately 4-3 volts in each of the three measurements. If any, or all, of the readings are other than these, a replacement stator must be fitted.

Test for defective insulation between stator coils and lamination pack with a mains test lamp. Connect the test probes between any one of the three cable ends and the lamination pack. If the lamp lights, the stator coils are earthing and a replacement stator must be fitted.

Before re-soldering the stator cable ends to the diode pins carry out the following test.

DIODES

Each diode can be checked by connecting it in series with a 1.5 watt test bulb (Lucas No. 280) across a 12 volt D.C. supply and then reversing the connections. Current should flow and the bulb light in one direction only. Should the bulb light up in both tests or not light up in either, the diode is defective and the appropriate heat sink assembly must be replaced.

The above procedure is adequate for service purposes. Any accurate measurement of diode resistance requires factory equipment.

Since the forward resistance of a diode varies with the voltage applied, no realistic readings can be obtained with battery-powered ohmmeters. However, should a battery-ohmmeter be used, a good diode will yield "Infinity" in one direction, and some indefinite but much lower reading in the other.

Warning: OHMMETERS OF THE TYPE INCORPORATING A HAND-DRIVEN GENERATOR MUST NEVER BE USED FOR CHECKING DIODES.

ALTERNATOR DIODE HEAT SINK REPLACEMENT

The alternator heat sink assembly comprises two mutually-insulated portions, one of positive polarity and the other negative. The diodes are not individually replaceable but, for service purposes, are supplied already pressed into the appropriate heat sink portion. The positive portion carries three cathode base diodes marked red, and the negative portion three anode base diodes marked black.

When soldering the interconnections, "M" grade 45-55 tin-lead solder should be used.

Great care must be taken to avoid overheating the diodes or bending the diode pins. The diode pins should be lightly gripped with a pair of suitable long-nosed pliers (which act as a thermal shunt) and the operation of soldering carried out as quickly as possible.

After soldering, the connections must be neatly arranged around the heat sinks to ensure adequate clearance of the rotor and be tacked down with "MM" EC1022 adhesive where indicated in Fig. 8. The stator connections must pass through the appropriate notches at the edge of the heat sink.

When reassembling the alternator care **MUST** be taken to ensure that the clearance is maintained between the positive and negative heat sinks as detailed on page P.17.

BEARINGS

Bearings which are worn to the extent that they allow excessive side movement of the rotor shaft must be renewed.

The needle-roller bearing in the slip-ring end cover is supplied complete with the end cover.

To renew the drive end ball-bearing (following withdrawal of the rotor shaft from the drive-end bracket) proceed as follows:—

File away the roll-over on each of the three bearing retaining plate rivets and punch out the rivets.

Press the bearing out of the bracket.

Before fitting the replacement bearing see that it is clean and, if necessary, pack it with high-melting point grease such as Shell Alvania No. 3 or an equivalent lubricant.

Locate the bearing in the housing and press it home.

Refit the bearing retaining plate using new rivets.

ALTERNATOR OUTPUT CONTROL UNIT
Model 4TR

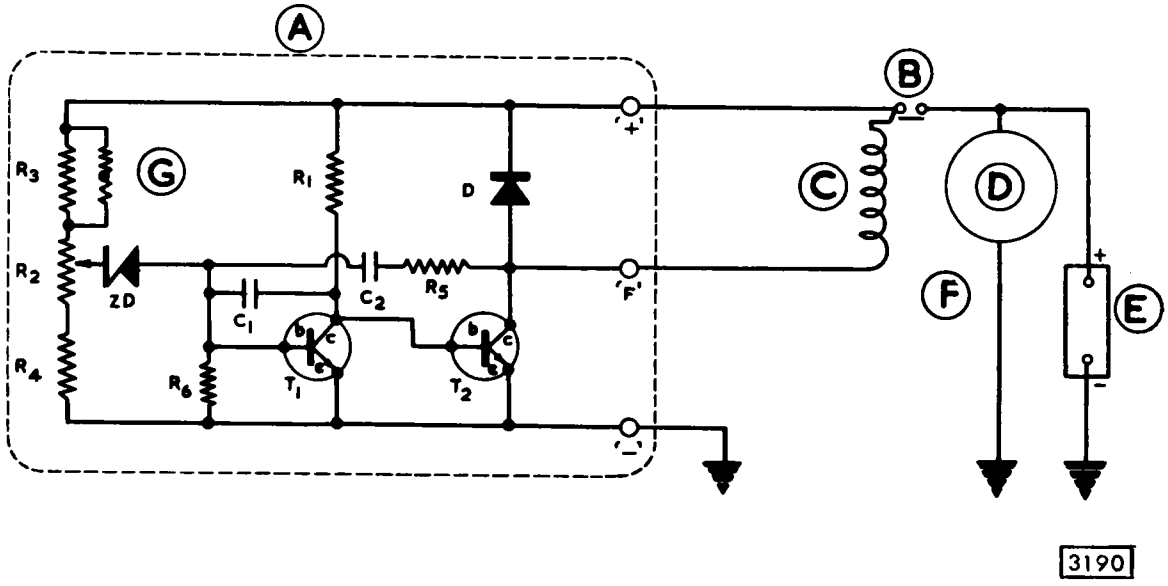


Fig. No. 13 *Alternator output control unit circuit diagram*

A Control unit
B Field isolating device
C Rotor field winding
D Alternator
E 12 volt battery
F Stator winding (rectified) output
G Thermistor

DESCRIPTION

Model 4TR is an electronic control unit. In effect its action is similar to that of the vibrating contact type of voltage control unit, but switching is achieved by transistors instead of vibrating contacts, while a Zener diode provides the voltage reference in place of the voltage coil and tension spring system. No cut-out is required since the diodes incorporated in the alternator prevent reverse currents flowing. No current regulator is required as the inherent self-regulating properties of the alternator effectively limit the output current to a safe value.

The control unit and the alternator field windings are isolated from the battery when the engine is stationary by a special double-pole ignition switch. On cars fitted with a steering column lock the field windings are isolated by means of a relay replacing the ignition switch control.

Care must be taken at all times to ensure that the battery, alternator and control unit are correctly connected. Reversed connections will damage the semiconductor devices employed in the alternator and control unit.

OPERATION

When the ignition is switched on, the control unit is connected to the battery through the field isolating switch or relay. By virtue of the connection through R1 (see Fig. 13) the base circuit of the power transistor T2 is conducting so that, by normal transistor action, current also flows in the collector-emitter portion of T2 which thus acts as a closed switch to complete the field circuit and battery voltage is applied to the field winding.

As the alternator rotor speed increases, the rising voltage generated across the stator winding is applied to the potential divider consisting of R3, R2 and R4. According to the position of the tapping point on R2, a proportion of this potential is applied to the Zener diode (ZD). This latter is a device which opposes the passage of current through itself until a certain voltage is reached, above which it conducts comparatively freely. The Zener diode can thus be considered as a voltage-conscious switch which closes when the voltage across it reaches "breakdown" voltage (about 10 volts) and, since this is a known proportion of the alternator output voltage as determined by the position of the tapping point of R2, the breakdown point therefore reflects the value of the output voltage. Thus at "breakdown" voltage the Zener diode conducts and current flows in the base-emitter circuit of the driver transistor T.1. Again, by transistor action, current will now flow in the collector-emitter portion of T1 so that some of the current which previously passed through R1 and the base circuit of T2 is diverted through T1. Thus the base current of T2 is reduced and, as a result, so also is the alternator field excitation. Consequently, the alternator output voltage will tend to fall — and this in turn will tend to reduce the base current in T1, allowing increased field current to flow in T2. By this means, the field current is continuously varied to keep the output voltage substantially constant at the value determined by the setting of R2.

To prevent overheating of T2 (due to power dissipation) this transistor is operated only either in the fully-on or fully-off condition. This is achieved by the incorporation of the positive feed-back circuit comprising R5 and C2. As the field current in transistor T2 starts to fall, the voltage at "F" rises and current flows through resistor R5 and capacitor C2 thus adding to the Zener diode current in the base circuit of transistor T1. This has the effect of increasing the current through T1 and decreasing still further through T2 so that the circuit quickly reaches the condition where T1 is fully-on and T2 fully-off. As C2 charges, the feed-back current falls to a degree at which the combination of Zener diode current and feed-back current in the base circuit of T1 is no longer sufficient to keep T1 fully-on. Current then begins to flow again in the base circuit of T2. The voltage at "F" now commences to fall, reducing the feed-back current eventually to zero. As T2 becomes yet more conductive and the voltage at "F" falls further, current in the feed-back circuit reverses in direction, in effect reducing still further the base current in T1. This effect also is cumulative and the circuit reverts to the condition where T1 is fully-off and T2 fully-on.

This condition is only momentary since C2 quickly charges to the opposite polarity, when feed-back current is reduced and current again flows in the base circuit of T1. The circuit thus oscillates, switching the voltage across the alternator field winding rapidly on and off.

Transistor T2 is protected from the high induced voltage surge which results from the collapse of the field current, by the surge quench diode D connect across the field windings. This diode also provides a measure of field current smoothing since current continues to flow in the diode after the excitation voltage is removed from the field. The elimination of radio interference is achieved by connecting condenser C1 between the base and collector terminals of T1 to provide negative feed-back. At high temperatures, a small leakage current may flow through the Zener diode even though the latter is in the nominally nonconductive state. Resistor R6 provides a path for this leakage current which otherwise would flow through T1 base circuit and adversely affect the regulator action.

A thermistor is connected in parallel with resistor R3. The thermistor is a device whose resistance increases as the temperature falls and vice versa. Any alteration in its ohmic value will modify the voltage distribution across the potential divider and thus affect the voltage value at which the Zener diode begins to conduct, so matching the changes which take place in battery terminal voltage as the temperature rises.

CHECKING AND ADJUSTING THE CONTROL UNITS

Important: The following voltage checking and setting procedure must be carried out only:—

(a) providing the alternator and associated wiring circuits have first been tested and found satisfactory, and

(b) in conjunction with a well-charged battery, i.e. with the charging current not exceeding 10 amperes.
(c) Run the alternator at charging speed for eight minutes. This operation applies when bench testing or testing on the car.

VOLTAGE CHECKING

Leave the existing connections to the alternator and control unit undisturbed. Connect a high-quality voltmeter between control unit terminals "+" and "—". If available, use a voltmeter of the suppressed-zero type, reading 12-15 volts. Switch on an electrical load of approximately 2 amperes, e.g. side and tail lighting. Start the engine and run the alternator at 3,000 r.p.m. until conditions (b) and (c) above are obtained.
The voltmeter should now show a reading of 13.9 - 14.3 volts at 68-78 °F. (20-26 °C.) ambient temperature volts. If not, but providing the reading obtained has risen to some degree above battery terminal voltage before finally reaching a steady value; the unit can be adjusted to control at the correct voltage (see "ADJUSTING").
If, however, the voltmeter reading remains unchanged (at battery terminal voltage) or, conversely, increases in an uncontrolled manner, then the control unit is faulty and as its component parts are not serviced individually, a replacement unit must be fitted.

ADJUSTING

Stop the engine and withdraw the control unit mounting screws. Invert the unit and chip away the sealing compound which conceals the potentiometer adjuster (see Fig. 14). Check that the voltmeter is still firmly connected between terminals "+" and "—". Start the engine and, while running the alternator at 3,000 r.p.m. turn the potentiometer adjuster slot — clockwise to increase the setting or anti-clockwise to decrease it — until the required setting is obtained. Use care in making this adjustment — a small amount of adjuster movement causes an appreciable difference in the voltage reading. Re-check the setting by first stopping the engine then again running the alternator at 3,000 r.p.m.
If the control unit regulates satisfactorily after the adjustment has been made, refit the unit.
No attempt should be made to reseal the potentiometer. Any undue heat applied at this point may damage the unit.

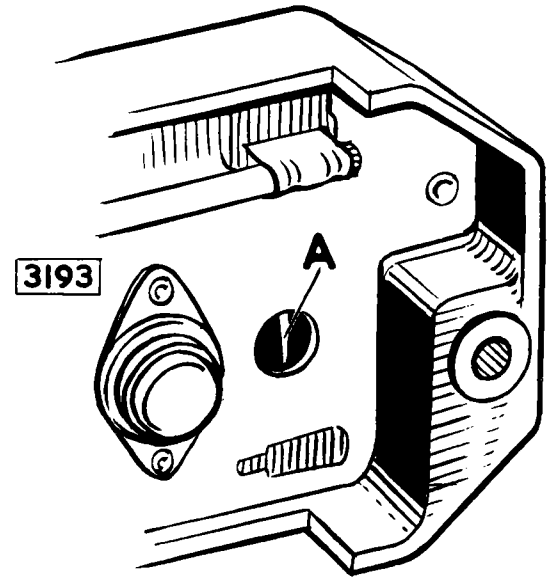


Fig. No. 14 *4TR control unit "A" indicates the poteniometer*

WARNING LIGHT CONTROL UNIT (Model 3AW)

DESCRIPTION

The Model 3AW warning light unit is a device connected to the centre point of one of the pairs of diodes in the alternator and operates in conjunction with the ignition warning light to give indication that the alternator is charging.
The unit is mounted on the wing valance adjacent to the control box and is similar in appearance to the flasher unit, but has different internal components consisting of an electrolytic (polarised) capacitor, a resistor, and a silicon diode mounted on an insulated base with three "Lucar" terminals.
The unit is sealed, therefore servicing and adjustment is not possible.
Faulty units must be replaced.
Note: Due to the external similarity of the 3AW warning light unit to the flasher unit, a distinctive green label is attached to the aluminium case of the 3AW unit.

Checking

Check by substitution after ensuring that the remainder of the charging circuit (including the drive belt) is functioning satisfactorily.

Warning: A faulty diode in the alternator or an intermittent or open circuit in the alternator-to-battery circuit can cause excessive voltages to be applied to the warning light unit. Therefore, to prevent possible damage to a replacement unit, it is important to first check the voltage between the alternator "AL" terminal and earth. Run the engine at 1,500 r.p.m. when the voltage should be 7 - 7.5 volts, measured on a good quality moving coil voltmeter. If a higher voltage is registered, check that all charging circuit connections are clean and tight, then, if necessary, check the alternator rectifier diodes before fitting a replacement 3AW unit.

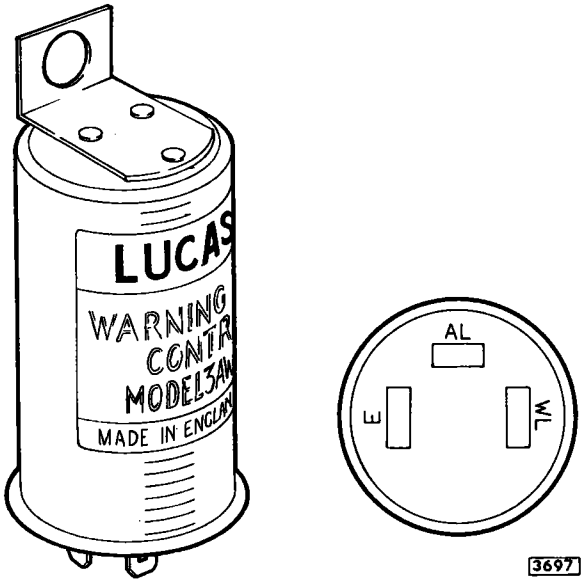


Fig. No. 15 *The 3AW warning light control unit*

THE STARTER MOTOR

DESCRIPTION

The purpose of the pre-engaged (or "positive engagement") starter motor is to prevent premature pinion ejection.

Except on occasions of tooth-to-tooth abutment, for which special provision is made, the starter motor is connected to the battery only after the pinion has been meshed with the flywheel ring gear, through the medium of an electro-magnetically operated linkage mechanism. After the engine has started, the current is automatically switched off before the pinion is retracted. On reaching the out-of-mesh position, the spinning armature is brought rapidly to rest by a braking device. This device takes the form of a pair of moulded shoes driven by a cross peg in the armature shaft and spring loaded (and centrifuged) against a steel ring insert in the commutator end bracket. Thus, with the supply switched off and the armature subjected to a braking force, the possibility is minimised of damaged teeth resulting from attempts being made to re-engage a rotating pinion.

A bridge-shaped bracket is secured to the front end of the machine by the through bolts. This bracket carries the main battery input and solenoid winding terminals, short extension cables being connected between these and the corresponding solenoid terminals.

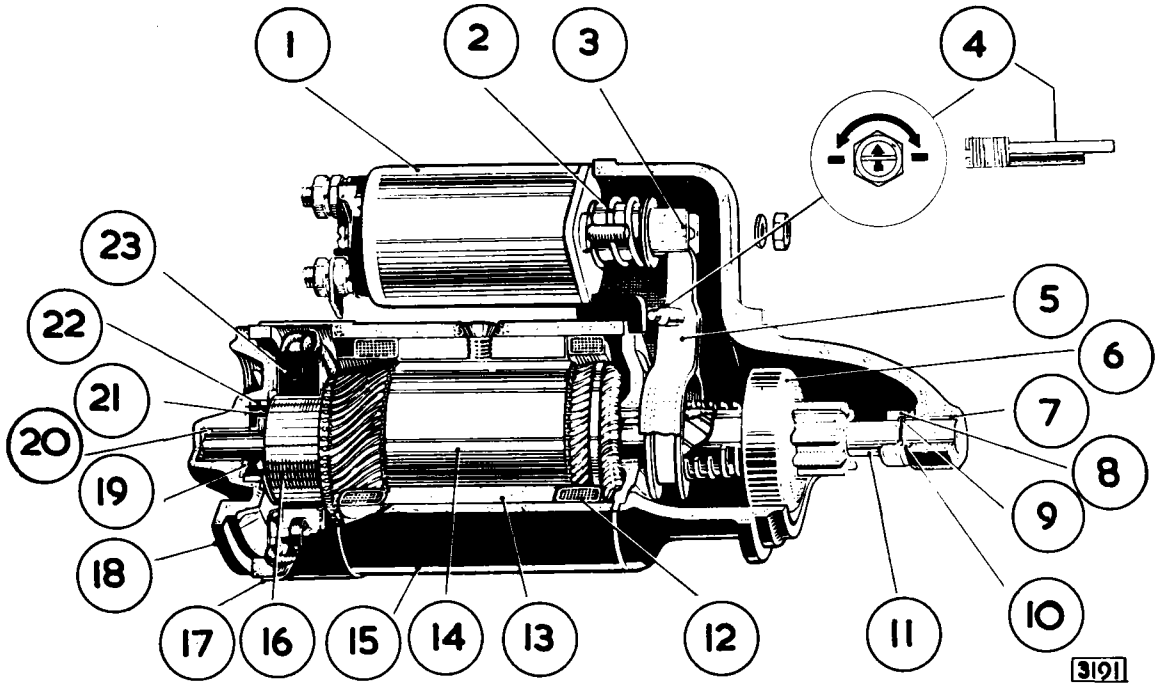


Fig. No. 16 *The Pre-engaged starter motor. Model M45G*

1 Actuating solenoid
2 Return spring
3 Clevis pin
4 Eccentric pivot pin
5 Engaging lever
6 Roller clutch
7 Porous bronze bush
8 Thrust collar
9 Jump ring
10 Thrust ring
11 Armature shaft extension
12 Field ring
13 Pole shoes
14 Armature
15 Yoke
16 Commutator
17 Band cover
18 C.E. bracket
19 Thrust washer
20 Porous bronze bush
21 Brake shoes and cross peg
22 Brake ring
23 Brushes

TOOTH-TO-TOOTH ABUTMENT

The electro-magnetically actuated linkage mechanism consists essentially of a pivoted engaging lever having two hardened steel pegs (or trunnion blocks) which locate with and control the drive through the medium of a groove in an operating bush. This bush is carried, together with the clutch and pinion assembly, on an internally splined out-board driving sleeve — the whole mechanism being housed in a cut-away flange mounting snout-shaped end bracket. This operating bush is spring loaded against a jump ring in the driving sleeve by an engagement spring located between the bush and the clutch outer cover. The system return or drive de-meshing spring is located round the solenoid plunger.

On occasions of tooth-to-tooth abutment (between the ends of the starter pinion teeth and those of the flywheel ring gear), the pegs or trunnion blocks at the "lower" end of the engaging lever can move forward by causing the operating bush to compress the engagement spring, thus allowing the "upper" end of the lever to move sufficiently rearwards to close the starter switch contacts. The armature then rotates and the pinion slips into mesh with the flywheel ring gear under pressure of the compressed engagement spring.

THE "LOST MOTION" (SWITCH-OFF) DEVICE

As it is desirable that the starter switch contacts shall not close until the pinion has meshed with the flywheel ring gear, so it is important that these same contacts should always re-open before the pinion has been retracted — or can be opened in the event of a starter pinion remaining for some reason enmeshed with the flywheel ring gear. To ensure this, a measure of "lost motion" is designed into some part of the engagement mechanism, its effect being to allow the starter switch or solenoid contacts (which are always spring-loaded to the open position) to open before pinion retraction begins.

Several methods of obtaining "lost motion" have been adopted, but each depends upon the yielding of a weaker spring to the stronger system return (drive de-meshing or disengagement) spring of the solenoid plunger.
This initial yielding results in the switch contacts being fully-opened within the first $\frac{1}{8}$" (3.18 mm.) of plunger return travel — this action being followed by normal drive retraction.
Solenoid model 10S has a weaker ("lost motion") spring located inside the solenoid plunger. Here, enclosed at the outer end by a retaining cup, it forms a plunger-within-a-plunger and is spring-loaded against the tip of the engaging lever inside the plunger clevis link.

THE ROLLER CLUTCH

Torque developed by the starting motor armature must be transmitted to the pinion and flywheel through an over-running or free-wheeling device which will prevent the armature from being rotated at an excessively high speed in the event of the engaged position being held after the engine has been started. The roller clutch performs this function.
The operating principle of the roller clutch is the wedging of several plain cylindrical rollers between converging surfaces. The convergent form is obtained by matching cam tracks to a perfectly circular bore. The rollers, of which there are three, are spring-loaded and, according to the direction of drive, are either free or wedgelocked between the driving and driven members. The clutches are sealed in a rolled over steel outer cover and cannot be dismantled for subsequent re-assembly.

THE STARTER SOLENOID

The starter solenoid is an electro-magnetic actuator mounted pick-a-back fashion on the yoke of the pre-engaged motor. It contains a soft iron plunger (linked to the engaging lever), the starter switch contacts and a coil consisting of two windings, i.e., a heavy-gauge pull-in or series winding and a lighter-gauge hold-on or shunt winding.
Initially, both windings are energised in parallel when the starter device is operated, but the pull-in winding is shorted out by the starter switch contacts at the instant of closure — its duty having been effected.
Magnetically, the windings are mutually assisting.
Like the roller clutch assembly, the starter solenoid is sealed in a rolled-over steel outer case or body and cannot be dismantled for subsequent re-assembly.

STARTER MOTOR

PERFORMANCE DATA

Model	M 45 G Pre-engaged
Lock Torque	22.6 lb. ft. (3.13 kgm.) with 465 amperes at 7.6 terminal volts
Torque at 1000 r.p.m.	9.6 lb. ft. (1.33 kgm.) with 240 amperes at 9.7 terminal volts
Light running current	70 amperes at 5,800 — 6,500 r.p.m.

SOLENOID SWITCH

Model	
Closing coil resistance (measured between terminal "STA", copper link removed and "Lucar" terminal)	0.36 — 0.42 ohms
Hold on coil resistance (Measured between "Lucar" terminal and solenoid outer case)	1.49 — 1.71 ohms

ROUTINE MAINTENANCE

EVERY 24,000 MILES (38,400 KM.)

Checking the Brushgear and Commutator

Remove the starter motor (see below) from the engine. Release the screw and remove the metal band cover and check that the brushes move freely in the brush boxes by holding back the spring and pulling gently on the flexible connection. If a brush is inclined to stick, remove it from its holder and clean its sides with a petrol moistened cloth. Replace the brushes in their original positions in order to retain "bedding". Brushes which will not bed properly or have worn to $\frac{5}{16}$" (7.94 mm.) in length must be renewed. See page P.27 for method of procedure.

Check the tension of the brush springs with a spring balance. The correct tension should be 52 ozs. (1.47 kg.) on a new brush.

Replace each existing brush in turn with a new brush to enable the tension of the brush spring to be tested accurately.

Check that the commutator is clean and free from oil or dirt. If necessary, clean with a petrol moistened cloth. If this is ineffective, rotate the armature and polish the commutator with a fine glass paper. DO NOT use emery cloth. Blow out all abrasive dust with a dry air blast.

A badly worn commutator can be re-skimmed by first rough turning, followed by diamond finishing. DO NOT undercut the insulators.

Armatures must NOT be skimmed below a minimum diameter of 1.531" (38.90 mm.).

Replace the armature if below this limit.

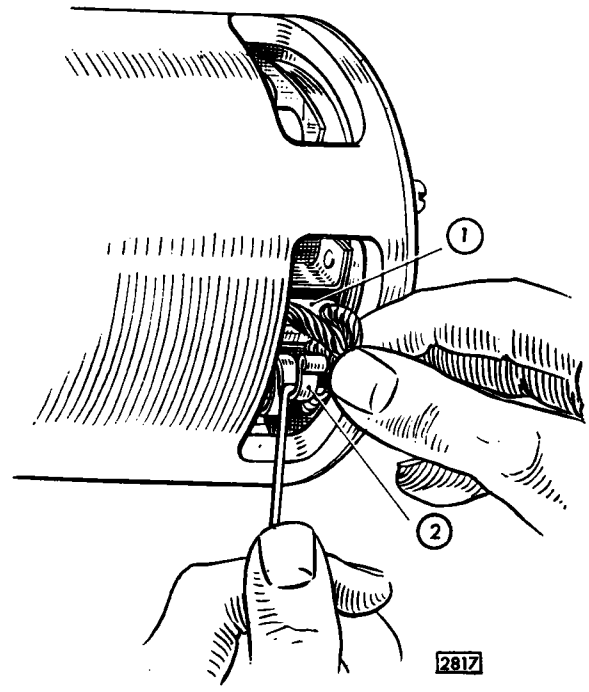


Fig. No. 17 *Checking the brush gear*

REMOVAL

Withdraw four setscrews and lockwashers and remove the bonnet. Mark the position of the hinges to the bonnet before removing the setscrews for reference when refitting.

Remove the battery.

Remove the oil filter unit from the engine, catch any escaping oil in a container.

Disconnect the battery cable and solenoid switch cable from the starter motor.

Remove the two setscrews and lockwashers securing the motor to the housing, gently bend away the carburetter drain pipes and remove the starter motor through the chassis frame.

The bottom setscrew is accessible from beneath the car. The best method of removing the setscrew is to use a socket spanner with extensions of approximately 30" (76 cms.) in length and enter the spanner from behind the transmission unit. A second operator will be needed to guide the socket spanner on to the setscrews from inside the engine compartment.

REFITTING

Refitting is the reverse of the removal procedure.

Care must be taken when refitting the two setscrews, which have a fine thread, that they are not cross-threaded.

Renew the oil filter joint when refitting the unit.

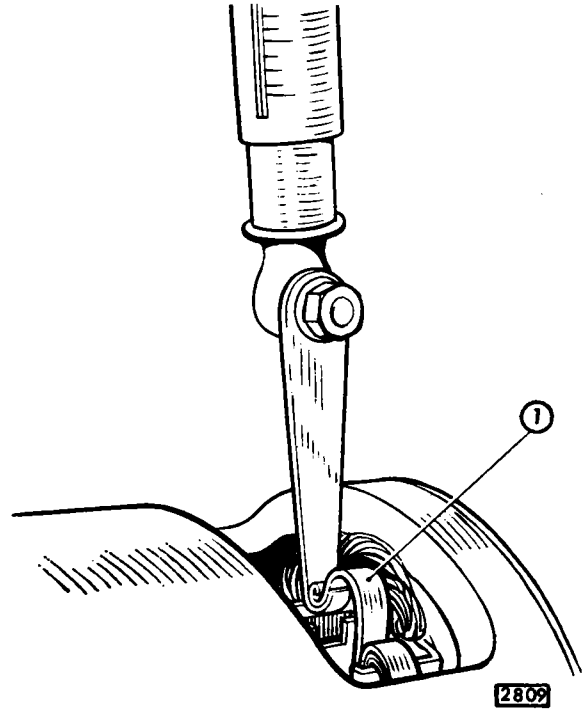


Fig. No. 18 *Testing the brush spring tension. Brush spring indicated.*

SERVICING

Testing in Position

Check that the battery is fully charged and the terminals are clean and tight. Recharge if necessary. Switch on the lamps and ignition and operate the starter control. If the lights go dim but the starter does not crank the engine, an indication is given that the current is flowing through the starter motor winding, but the armature is not rotating for some reason.
The fault is possibly due to high resistance in brush gear or open circuit in armature or field coils.
Remove the starter motor for examination.
If the lights retain their full brilliance when the starter control is operated check:
(a) the starter motor circuit for continuity.
(b) the solenoid unit for continuity.
If the supply voltage is found to be applied to the starter motor when the control is operated, the unit must be removed from the engine and checked for an internal fault.
Sluggish or slow action of the starter motor is usually due to a loose connection causing a high resistance in the motor circuit. Check as described above.
If the motor is heard to operate but does not crank the engine, indication is given of damage to the drive.

BENCH TESTING

Removing the Starter Motor from the Engine

Disconnect the battery. Disconnect and remove the starter motor from the engine. See page P.25 for removal procedure.

MEASURING THE LIGHT RUNNING CURRENT

With the starter motor securely clamped in a vice and using a 12-volt battery, check the light running current and compare with the value given on page P.24.
If there appears to be excessive sparking at the commutator, check that the brushes are clean and free to move in their boxes and the spring pressure is correct. See symptoms 7 and 8, page P.26.

MEASURING LOCK TORQUE AND LOCK CURRENT

Carry out a torque test and compare with the values given on page P.24.
If a constant voltage supply is used, it is important to adjust this to be 7.6 volts at the starter terminal when testing.

FAULT DIAGNOSIS

An indication of the nature of the fault or faults may be deduced from the results of the no-load and lock torque tests.

	Symptom	Probable Fault
1.	Speed, torque and current consumption correct	Assume motor to be in normal operating condition.
2.	Speed, torque and current consumption low	High resistance in brush gear e.g. faulty connections, dirty or burned commutator causing poor brush contact
3.	Speed and torque low, current consumption high	Tight or worn bearings, bent shaft, insufficient end play, armature fouling a pole shoe, or a cracked spigot on drive end bracket. Short circuited armature earthed armature or field coils
4.	Speed and current consumption high, torque low	Short-circuited windings in field coils
5.	Armature does not rotate, high current consumption	Open-circuited armature, field coils, or solenoid unit. If the commutator is badly burned, there may be poor contact between brushes and commutator
6.	Armature does not rotate, high current consumption	Earthed field winding or short-circuited solenoid unit. Armature physically prevented from rotating
7.	Excessive brush movement causing arcing at commutator	Low brush spring tension, worn or out-of-round commutator. "Thrown" or high segment on commutator
8.	Excessive arcing at the commutator	Defective armature windings, sticking brushes or dirty commutator

DISMANTLING

Disconnect the copper link between the lower solenoid terminal and the starter motor yoke.
Remove the two solenoid unit securing nuts. Detach the extension cable and withdraw the solenoid from the drive end bracket casting, carefully disengaging the solenoid plunger from the starter drive engagement lever.
Remove the cover band and lift the brushes from their holders.
Unscrew and withdraw the two through bolts from the commutator end bracket. The commutator end bracket and yoke can now be removed from the intermediate and drive end brackets.
Extract the rubber seal from the drive end bracket.
Slacken the nut securing the eccentric pin on which the starter drive engagement lever pivots and unscrew and withdraw the pin.
Separate the drive end bracket from the armature and intermediate bracket assembly.
Remove the thrust washer from the end of the armature shaft extension using a mild steel tube of suitable bore.
Prise the jump ring from its groove and slide the drive assembly and intermediate bracket from the shaft.
To dismantle the drive further, prise off the jump ring retaining the operating bush and engagement spring.

BENCH INSPECTION

After dismantling the motor, examine individual items.

Replacement of Brushes

The flexible connectors are soldered to terminal tags; two are connected to brush boxes and two are connected to free ends of the field coils. Unsolder these flexible connectors and solder the connectors of the new brush set in their place.
The brushes are pre-formed so that "bedding" to the commutator is unnecessary. Check that the new brushes can move freely in their boxes.

Commutator

A commutator in good condition will be burnished and free from pits or burned spots. Clean the commutator with a petrol moistened cloth. Should this be ineffective, spin the armature and polish the commutator with fine glass paper; remove all abrasive dust with a dry air blast. If the commutator is badly worn, mount the armature between centres in a lathe, rotate at high speed and take a light cut with a very sharp tool. Do not remove more metal than is necessary. Finally polish with very fine glass paper. The INSULATORS between the commutator segments **MUST NOT BE UNDERCUT.**
Armatures must NOT be skimmed below a minimum diameter of 1.531" (38.90 mm.). Replace the armature if below this limit.

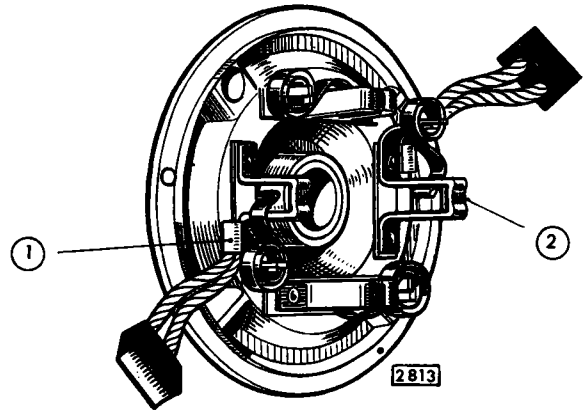


Fig. No. 19 *Comutator end bracket brush connections*

Armature

Lifted conductors

If the armature conductors are found to be lifted from the commutator risers, overspeeding is indicated. In this event, check that the clutch assembly is operating correctly.

Fouling of Armature Core against the Pole Faces

This indicates worn bearings or a distorted shaft. A damaged armature must, in all cases, be replaced and no attempt should be made to machine the armature core or to true a distorted armature shaft.

Insulation Test

To check armature insulation, use a 110-volt A.C. test lamp.
The test lamp must not light when connected between any commutator segment and the armature shaft.
If a short circuit is suspected, check the armature on a "growler". Overheating can cause blobs of solder to short circuit the commutator segments.
If the cause of an armature fault cannot be located or remedied, fit a replacement armature.

Field Coils

Continuity Test

Connect a 12-volt test lamp and battery between the terminal on the yoke and each individual brush (with the armature removed from the yoke). Ensure that both brushes and their flexible connectors are clear of the yoke. If the lamp does not light, an open circuit in the field coils is indicated.
Replace the defective coils.

Insulation Test

Connect a 110-volt A.C. test lamp between the terminal post and a clean part of the yoke. The test lamp lighting indicates that the field coils are earthed to the yoke and must be replaced.
When carrying out this test, check also the insulated pair of brush boxes on the commutator end bracket. Clean off all traces of brush deposit before testing.

Connect the 110-volt test lamp between each insulated brush box and the bracket.
If the lamp lights, this indicates faulty insulation and the end bracket must be replaced.

Replacing the Field Coils
Unscrew the four-pole-shoe retaining screws, using a wheel-operated screwdriver. Remove the insulation piece which is fitted to prevent the inter-coil connectors from contacting with the yoke.
Draw the pole shoes and coils out of the yoke and lift off the coils. Fit the new field coils over the pole shoes and place them in position inside the yoke. Ensure that the taping of the field coils is not trapped between the mating surfaces of the pole shoes and the yoke.
Locate the pole shoes and field coils by lightly tightening the retaining screws.
Replace the insulation piece between the field coil connections and the yoke.
Finally, tighten the screws by means of the wheel-operated screwdriver while the pole pieces are held in position by a pole shoe expander or a mandrel of suitable size.

Bearings and Bearing Replacement
The commutator and drive end brackets are each fitted with a porous bronze bush and the intermediate bracket is fitted with an indented bronze bearing.
Replace bearings which are worn to such an extent that they will allow excessive side play of the armature shaft.
The bushes in the intermediate and drive end brackets can be pressed out, whilst that in the commutator end bracket is best removed by inserting a $\frac{9}{16}$" tap squarely into the bearing and withdrawing the bush with the tap.
Before fitting a new porous bronze bearing bush, immerse it for 24 hours in clean engine oil (SAE.30-40). In cases of extreme urgency, this period may be shortened by heating the oil to 100°C., for two hours and then **allowing the oil to cool before removing the bush.** Fit new brushes by using a shouldered, highly polished mandrel approximately 0.0005" greater in diameter than the shaft which is to fit in the bearing. **Porous bronze bushes must not be reamed out after fitting,** as the porosity of the bush will be impaired.
After fitting a new intermediate bearing bush, lubricate the bearing surface with Rocol "Molypad" molybdenised non-creep, or similar oil.

CHECKING THE ROLLER CLUTCH DRIVE

A roller clutch drive assembly in good condition will:
Provide instantaneous take-up of the drive in the one direction.
Rotate easily and smoothly in the other.
Be free to move round or along the shaft splines without roughness or tendency to bind.
Similarly, the operating bush must be free to slide smoothly along the driving sleeve when the engagement spring is compressed.
Trunnion blocks must pivot freely on the pegs of the engaging lever.
All moving parts should be smeared liberally with Shell Retinax "A" grease, or an equivalent alternative.

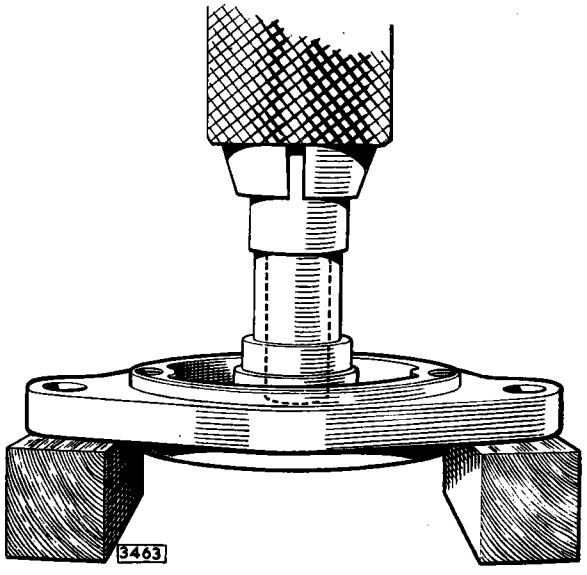


Fig. No. 20 *Method of fitting the porous bronze bush*

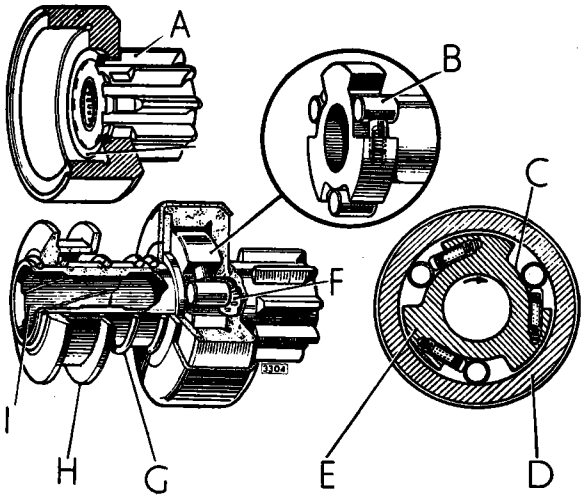


Fig. No. 21 *The roller clutch components*

- **A** Alternative construction (pinion pressed and clear-ringed into the drive member)
- **B** Spring loaded rollers
- **C** Cam tracks
- **D** Driven member (with pinion)
- **E** Driving member
- **F** Bush
- **G** Engagement spring
- **H** Operating bush
- **I** Driving sleeve

RE-ASSEMBLY

After cleaning all parts, re-assembly of the starter motor is a reversal of the dismantling procedure given in paragraph 4(c), but the following special points should be noted.

The following parts should be tightened to the maximum torques indicated:

Nuts on solenoid copper terminals:	20 lb. in. (0.23 kg.m.)
Solenoid fixing bolts:	4.5 lb. ft. (0.62 kg.m.)
Starter motor through bolts:	8.0 lb. ft. (0.83 kg.m.)

When refitting the C.E. bracket, see that the moulded bracket shoes seat squarely and then turn them so that the ends of the cross peg in the armature shaft engage correctly with the slots in the shoes.

SETTING PINION MOVEMENT

After complete assembly of the starter motor, connect the "Lucar" solenoid terminal by way of a switch to a 6-volt supply.

Connect the other side of the supply to the starter motor yoke.

Close the switch (this throws the drive assembly forward into the engage position) and measure the distance between the pinion and the thrust washer on the armature shaft extension. Make this measurement with the **pinion pressed lightly towards the armature** to take up any slack in the engagement linkage. For correct setting, this distance should be 0.005" - 0.015" (0.127 - 3.81 mm.). To adjust the setting, slacken the eccentric pivot pin securing nut and turn the pin until the correct setting is obtained. Note that the arc of the adjustment is 180° and the head of the arrow marked on the pivot pin should be set only between the arrows on the arc described on the drive end bracket casting.

After setting, tighten the securing nut to retain the pin position.

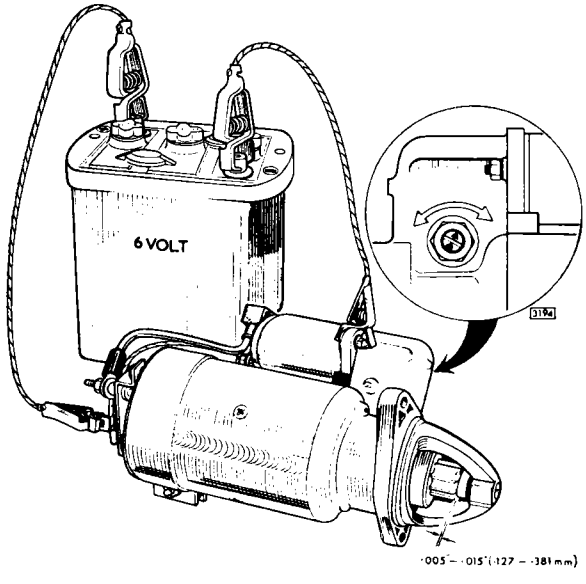


Fig. No. 22 *Setting pinion movement*

CHECKING OPENING AND CLOSING OF STARTER SWITCH CONTACTS

The following checks assume that pinion travel has been correctly set. Remove the copper link connecting solenoid terminal "STA" with the starter motor terminal.

Connect, through a switch, a supply of 10-volts D.C., to the series winding, i.e., connecting between the solenoid "Lucar" terminal and large terminal "STA". DO NOT CLOSE THE SWITCH AT THIS STAGE.

Connect a separately energised test lamp circuit across the solenoid main terminals.

Insert a stop in the drive end bracket to restrict the pinion travel to that of out-of-mesh clearance — normally, a nominal $\frac{1}{8}$" (3.17 mm.). An open-ended spanner of appropriate size and thickness can often be utilised for this purpose — its jaws embracing the armature shaft extension.

Energise the shunt winding with a 10-volt D.C. supply and then close the switch in the series winding circuit. The solenoid contacts should close fully and remain closed, as indicated by the test lamp being switched on and emitting a steady light.

Switch off and remove the stop.

Switch on again and hold the pinion assembly in the fully engaged position.

Switch off and observe the test lamp.

The solenoid contacts should open, as indicated by the test lamp being switched off.

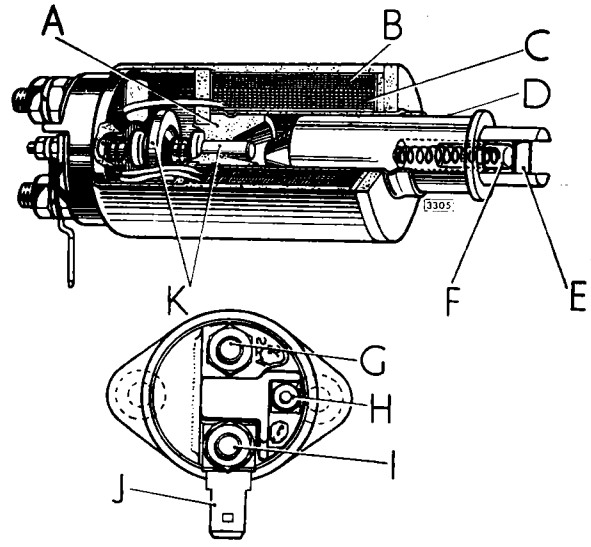


Fig. No. 23 *Checking the opening and closing of the starter switch contacts*

- **A** Core
- **B** Shunt winding
- **C** Series winding
- **D** Plunger
- **E** Clevis pin
- **F** "lost motion" Device
- **G** Starter terminal
- **H** Solenoid terminal
- **I** Battery terminal
- **J** Accessories terminal
- **K** Spindle and moving contact terminal

LAMPS
Light Bulbs

LIGHT	LUCAS BULB No.	VOLTS	WATTS	APPLICATION
Outer Headlight (Main and dip beams)	Sealed Beam Unit	12	60/45	Home and R.H.D. Export
		12	50/40	S. America & M. East
		12	37.5/50	U.S.A.
	410	12	45/40	Belgium, Holland, Sweden,Austria, Italy & Germany
	411	12	45/40 (Yellow)	France
Inner Headlight (Main beam only)	Sealed Beam Unit	12	50	Home
		12	37.5	R.H.D. Export
		12	37.5	Austria, U.S.A., Germany
		12	37.5 (Yellow)	France
	410	12	45	Italy
Side light	989	12	6	
Front and rear flashing indicators	382	12	21	
Rear brake	380	12	6/21	
Number plate	989	12	6	
Reversing lights	382	12	21	
Interior lights—pillar/rear	254	12	6	
Glovebox illumination	254	12	6	
Map light	989	12	6	
Luggage compartment illumination	989	12	6	
Heated rear window warning	987	12	2.2	Optional extra
Instrument illumination, headlight warning, Ignition warning, handbrake/fluid warning				
Sidelamp warning light				Italy only
Traffic hazard warning				U.S.A. only
Switch indicator strip, flasher warning Overdrive indicator Automatic transmission indicator	281	12	2	
Heater control panel	286	24	3	
Fog lamp	Phillips 683	12	48	Optional extra

HEADLIGHTS

DESCRIPTION

The 420 Model is fitted with the four headlight system, the standard light units fitted are of the sealed beam type having aiming pads mounted into the lenses. These pads are of use with an approved mechanical aimer (such as the Lucas Lev-L-Lite).

To obtain the best possible results from the headlights, it is essential that they are correctly adjusted. The alignment of the headlight beam is set correctly before the car leaves the factory but, if for any reason adjustment becomes necessary and an approved beam setter is not available, the following procedure should be carried out.

ROUTINE MAINTENANCE

Every 12,000 Miles (20,000 km.)

Check the headlight alignment and adjust as necessary.

HEADLAMP BEAM SETTING

Place the car on a level surface in front of a wall or board. Mark out the vertical and horizontal centre lines of both inner and outer headlight units on the wall or board and position the car 25 feet (7.6 m.) away from, and square to, the surface.

Inner Headlamp Beam Setting (All Cars)

Switch off the headlights in the full beam position and blank off the outer headlights. Set the inner headlights to the position shown in Fig. 24.

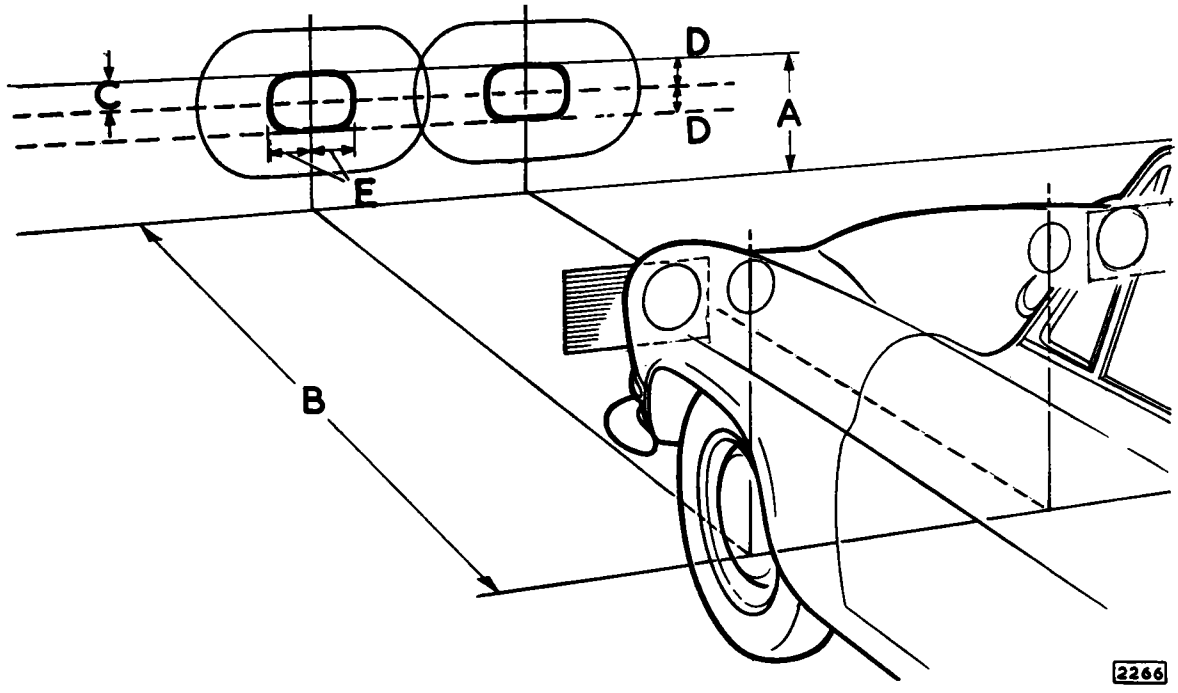
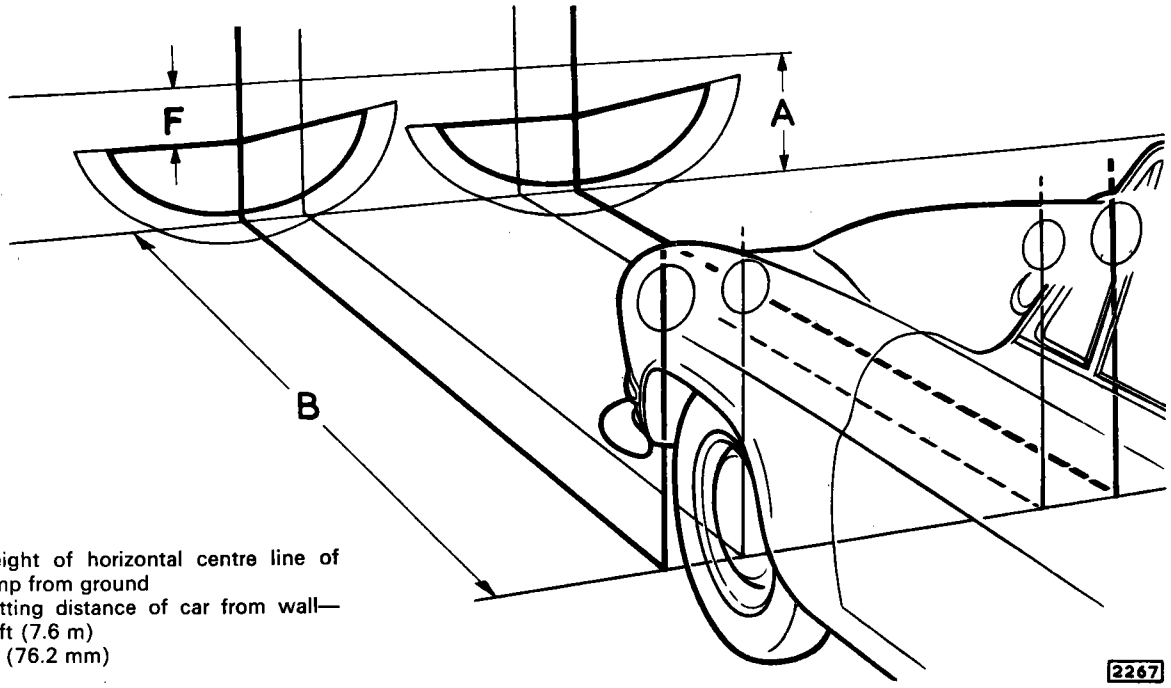


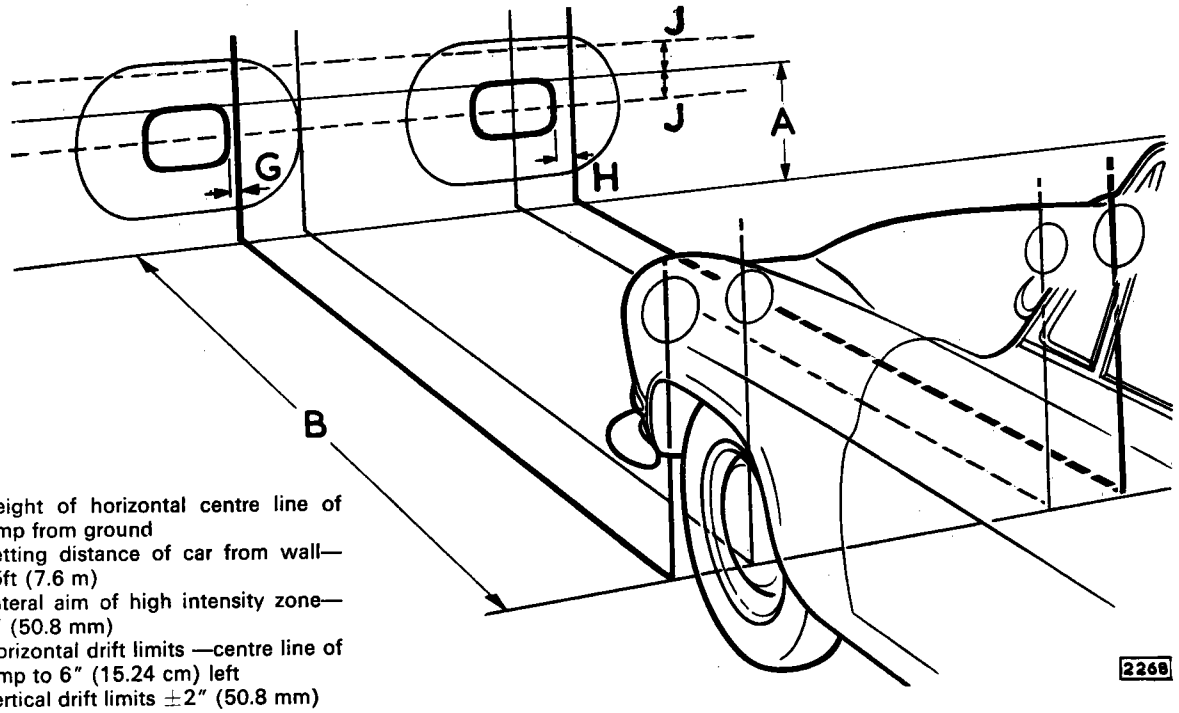
Fig. No. 24 *Inner headlight beam setting*

- **A** Height of horizontal centre line of lamp from ground
- **B** Setting distance of car from wall—25ft. (7.6 m)
- **C** Centre of "Hot Spot" below horizontal centre line 2" (50.8 mm).
- **D** Vertical drift limits ±2" (50.8 mm)
- **E** Horizontal drift limits ±6" (15.24cm)



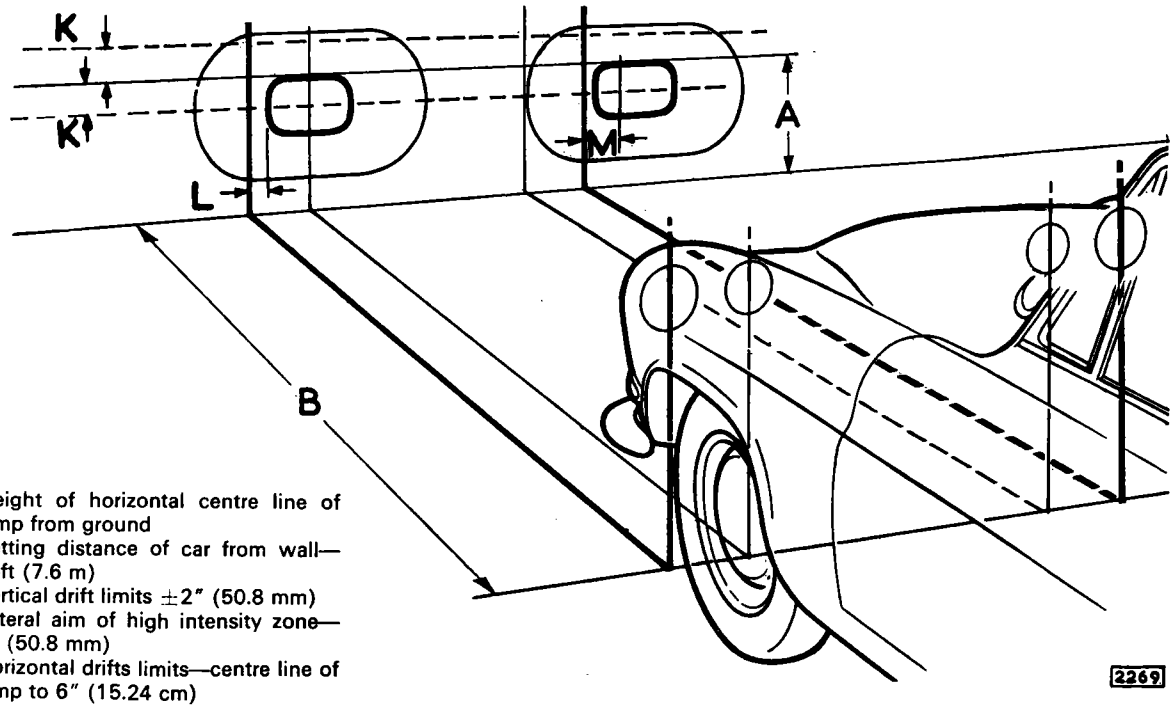
A Height of horizontal centre line of lamp from ground
B Setting distance of car from wall—25ft (7.6 m)
F 3″ (76.2 mm)

Fig. No. 25 *Outer headlight beam setting—vertical dip*



A Height of horizontal centre line of lamp from ground
B Setting distance of car from wall—25ft (7.6 m)
G Lateral aim of high intensity zone—2″ (50.8 mm)
H Horizontal drift limits —centre line of lamp to 6″ (15.24 cm) left
J-J Vertical drift limits ±2″ (50.8 mm)

Fig. No. 26 *Outer headlight beam setting (right-hand drive cars)*



A Height of horizontal centre line of lamp from ground
B Setting distance of car from wall—25ft (7.6 m)
K-K Vertical drift limits ±2" (50.8 mm)
L Lateral aim of high intensity zone—2" (50.8 mm)
M Horizontal drifts limits—centre line of lamp to 6" (15.24 cm)

Fig. No. 27 *Outer headlight beam setting (left-hand drive cars)*

Outer Headlight Beam Setting (Vertical Dip Units)

With the headlights switched on in the dip position, set the outer headlight beams to the position shown in Fig. 25.

Outer Headlight Beam Setting (Right-hand Drive Cars excluding Vertical Dip Units)

With the headlights switched on in the dip position, set the outer headlight beams to the position shown in Fig. 26.

Adjusting the Headlight Beam

Remove the headlight surround by unscrewing the retaining screw and springing the surround away from the bottom clip fixings.

The setting of the outer beams is adjusted by two screws, one being located at the top centre and the other at the centre left-hand side. The top screw is for vertical adjustment, that is, to raise or lower the beam; turn the screw anti-clockwise to lower the beam and clockwise to raise the beam. The side screw is for lateral adjustment, that is, to turn the beam to left or right. To move the beam to the right, turn the screw clockwise and to move the beam to the left, turn the screw anti-clockwise.

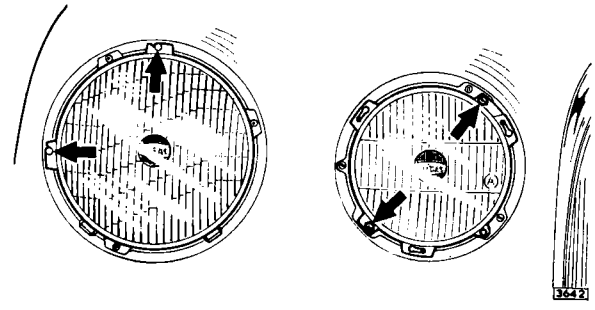


Fig. No. 28 *The inner and outer headlight beam setting screws*

The setting of the two inner beams is adjusted by two screws diagonally opposite each other. The upper screw is for vertical adjustment, turn the screw clockwise to move the beam to the right and anti-clockwise to move the beam to the left.

Note: Cars for some countries are fitted with similar light units in the inner and outer positions. The adjustment of the beam on these outer lights is the same as that described above for the inner headlights.

LIGHT BULB REPLACEMENT

OUTER HEADLAMP REPLACEMENT

Remove the top retainer screw and withdraw the headlamp embellisher noting the two retaining lugs at the lower edge. Remove the three cross headed screws and the headlight retaining rim. Withdraw the headlight unit and detach the socket from the rear of the unit. The headlight may now be replaced with a unit of the correct type.

On cars fitted with non-sealed beam headlights proceed as described above until the headlight unit is withdrawn, release the bulb retaining spring clips and withdraw the bulb. Replace with a bulb of the correct type (see page P.30). When reassembling, note that a groove in the bulb plate must register with a raised portion of the bulb retainer.

Note: Do not turn the two slotted screws or the setting of the headlights will be upset.

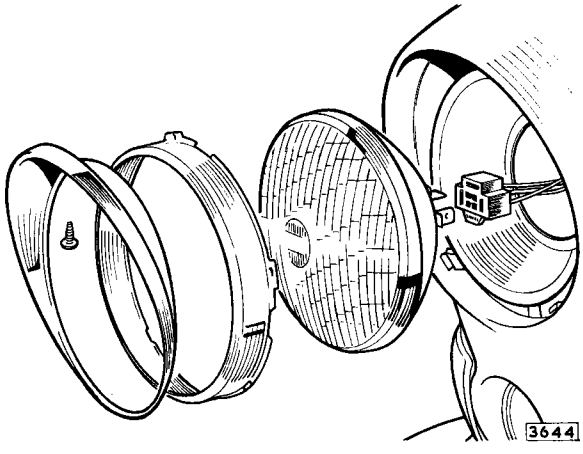


Fig. No. 29 *The outer headlight unit removal*

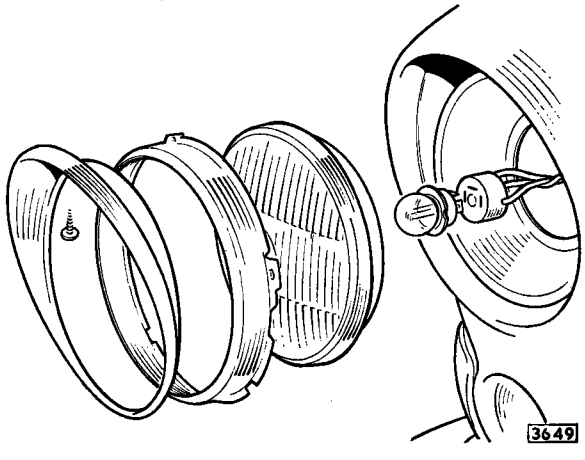


Fig. No. 30 *The outer headlight unit removal (non-sealed beam unit)*

INNER HEADLIGHT — REPLACEMENT

The procedure for replacing the inner headlight unit or bulb is the same as that described in "Outer Headlight — Replacement". However, when removing the headlight unit retaining rim, it is not necessary to remove the three cross headed screws, these should be slackened and the rim turned anti-clockwise until it can be withdrawn.

Note: Do not turn the two slotted screws or the setting of the headlight will be upset.

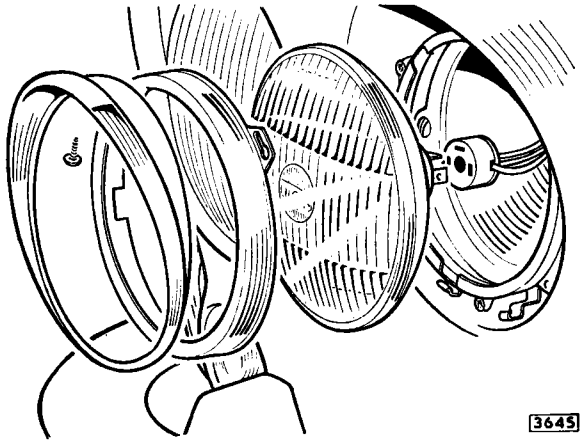


Fig. No. 31 *The inner headlight unit removal*

SIDELIGHT BULB — REPLACEMENT

Remove two screws, withdraw the embellisher and light unit.

Detach the bulb holder and remove the bulb.

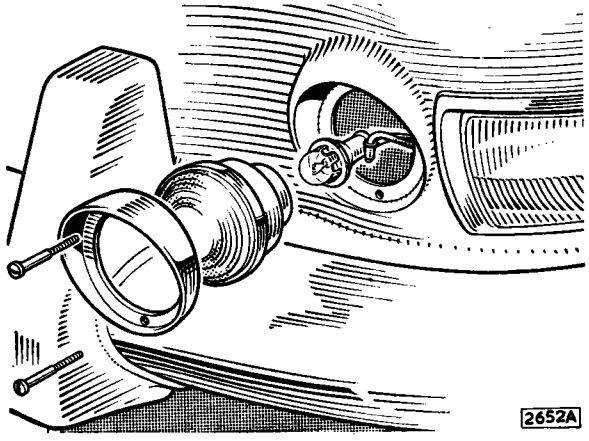


Fig. No. 32 *Side light bulb removal*

FRONT FLASHER BULB — REPLACEMENT
Remove the screw retaining the glass. Detach the glass at the three tags under the chrome surround and remove the bulb.

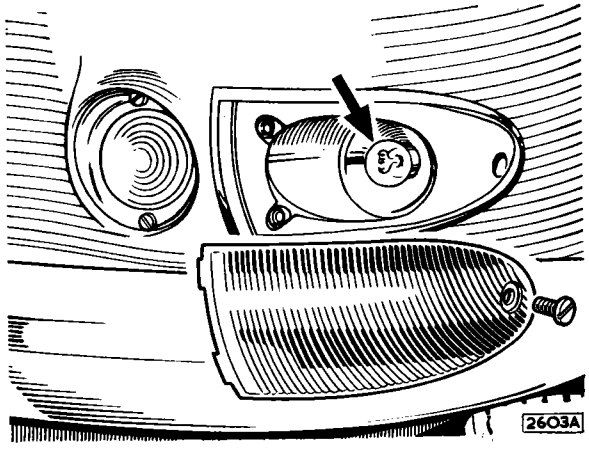


Fig. No. 33 *Front flasher bulb removal*

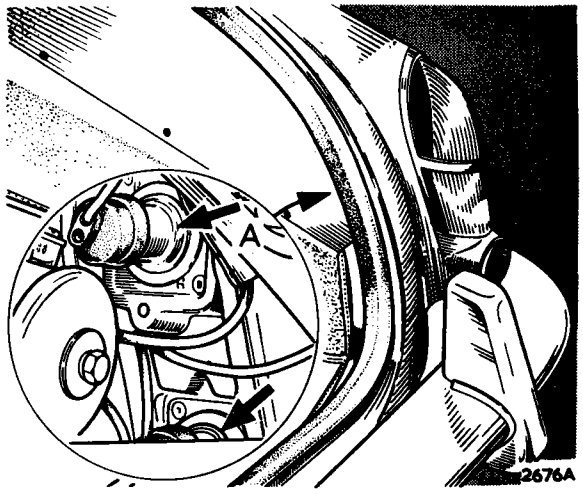


Fig. No. 34 *Rear flasher/rear light/brake light bulb removal*

REAR FLASHER BULB — REPLACEMENT
Remove the screws securing the appropriate luggage compartment casing. Withdraw the upper bulb holder from the rear of the light assembly and remove the bulb.

REAR/BRAKE LIGHT BULB — REPLACEMENT
Proceed as for Rear Flasher Bulb, but withdraw the lower bulb holder. When fitting a replacement bulb note that the pins are offset.

LUGGAGE COMPARTMENT LIGHT BULB — REPLACEMENT
The bulb is accessible through an aperture in the luggage compartment lid casing. Remove the bulb by pressing in and turning anti-clockwise.

INTERIOR LIGHT BULBS — REPLACEMENT
Using care to avoid breakages, prise the cover from the appropriate interior light noting the stud fixings. Remove the bulb by pressing in and turning through 90°. Replace the bulb with one of the correct value by pressing the bulb into the holder and turning until the notches inside the holder are located. Replace the cover by pressing onto the securing studs.

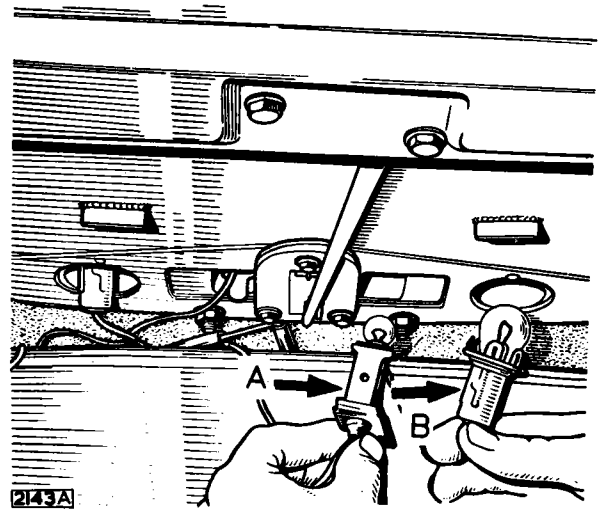


Fig. No. 35 *Number plate and reverse light bulb removal*

NUMBER PLATE LIGHT BULB — REPLACEMENT
Remove sufficient screws securing the luggage compartment lid casing to allow access to the bulb holders. The number plate bulb holders are the two in the centre of the group. Press the tag in, lift and withdraw the holder. Remove bulb.

REVERSING LIGHT BULB — REPLACEMENT
Proceed as for the number plate light bulb. The reversing light bulb holders are those on the outside of the group.

GLOVEBOX LIGHT BULB — REPLACEMENT
Open the glove box lid and remove the mauve glass from its holder. Care should be taken when removing this glass to avoid breakages. Remove the bulb from between the two contacts and replace with a bulb of the correct value. Replace the glass.

SIDELAMP WARNING LIGHT BULB — REPLACEMENT (ITALIAN MARKET ONLY)

Withdraw the bulb carrier unit only from the holder (accessible from the rear face of the side facia panel). Unscrew the bulb and replace with one of the correct value, that is, 12-volt 2.2 watts screw cap.

BRAKE FLUID AND HANDBRAKE WARNING LIGHT BULB — REPLACEMENT

Unscrew the bezel of the lamp, exercising care to control the run of the spring loaded bulb beneath. Feed the bulb into the spring-loaded bulb holder, ensure that the red transparent window is retained in the bezel by a small circlip, position the designation plate on the bulb holder and screw on the bezel.

FLASHING INDICATOR BULB — REPLACEMENT

Disconnect the earth lead at the battery.
Detach the switch cover from above the steering column by withdrawing the two most sunken screws from below. Withdraw one or both flasher indicator warning light bulb holders from the outer sockets of the upper switch cover. Remove the bulb from the holder by applying inward pressure and rotating through 90° in either direction.
The bulb is replaced by inserting into the bulb holder and rotating through 90° until the notches inside the bulb holder are located. Replacing the bulb holder and upper switch cover is the reverse of the removal procedure.

AUTOMATIC SELECTOR BULB — REPLACEMENT

Disconnect the earth cable at the battery. Detach the upper switch cover from the steering column by removing the two most sunken screws from below. Remove the bulb holder from the centre socket in the switch cover. Remove the bulb from the holder by pressing in and turning through 90° in either direction. The bulb is replaced by inserting into the bulb holder and turning until the notches inside the bulb holder are located. Replacing the bulb holder and upper switch cover is the reverse of the removal procedure.

MAP LIGHT BULB — REPLACEMENT

Remove the bulb which is situated under the centre of the screen rail in front of the instrument panel. Removal is effected by pressing the bulb inwards, rotating slightly and withdrawing outwards.
Replace the bulb by a reversal of the above procedure.

INDICATOR STRIP BULBS — REPLACEMENT

Three bulbs are provided along the bottom rear edge of the instrument panel. Withdraw the bulbs by pulling out from the sockets provided in the panel.
Replace the appropriate bulb with one of the correct value.

HEATED BACKLIGHT INDICATOR BULB (WHEN FITTED) — REPLACEMENT

Remove the chrome bezel and unscrew the bulb from the bulbholder.

FLASHER UNIT

The flasher unit is housed in a small cylindrical container behind the screen rail and is accessible after lowering the instrument panel.
The automatic operation of the flasher lamps is controlled by means of a switch, contained in the flasher unit, being operated automatically by the alternative heating and cooling of an actuating wire; also incorporated is a small relay to flash the indicator warning lights when the system is functioning correctly. Failure of either of these lights to flash will indicate a fault.
In the event of trouble occurring, the following procedure should be followed:

(a) Check bulbs for broken filaments.

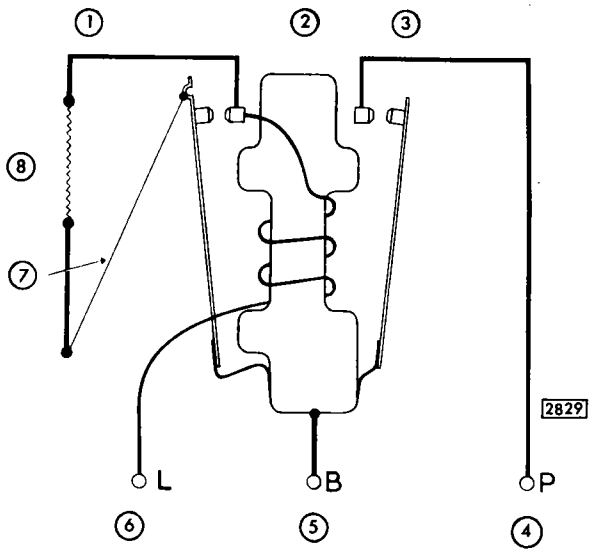


Fig. No. 36 *Flasher unit circuit diagram*

1 Main armature/contact
2 Steel core and coil
3 Secondary armature and pilot contacts
4 To pilot lamp(s)
5 From battery
6 To lamp via switch
7 Actuating wire
8 Ballast resistor

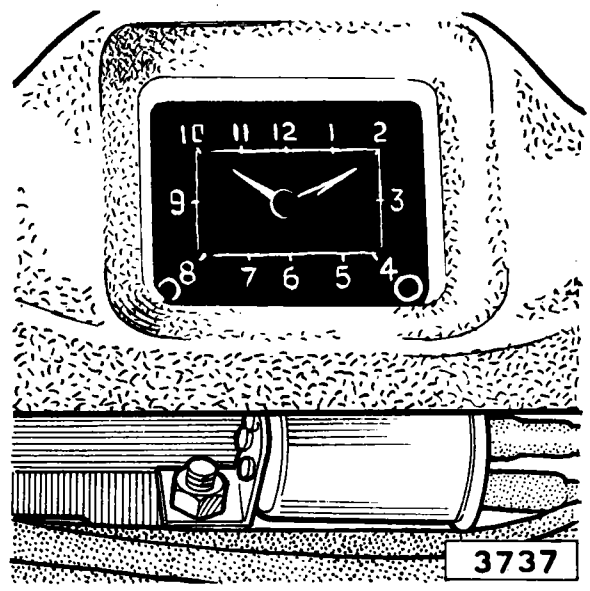


Fig. No. 37 *Location of the flasher unit behind the instrument panel*

(b) Refer to the wiring diagram and check all flasher circuit connections.
(c) Switch on the ignition and check with a voltmeter that flasher unit terminal "B" is at 12 volts, with respect to earth.
(d) Connect together flasher unit terminals "B" and "L" and operate the direction indicator switch. If the flasher lamps now light, the flasher unit is defective and must be replaced.
(e) If, after the above check, the bulb still does not light, a fault is indicated in the manual flasher switch on the steering column which is best checked by substitution.

Note: It is important that only bulbs of the correct wattage rating (that is, 21 watts) are used in the flasher lamps.

FUSE UNIT

Four Lucas Model 4 FJ fuse units each carrying two live glass cartridge type fuses and two spares are incorporated in the electrical system and are located behind the instrument panel.
Access to the fuses is obtained by removing the two instrument panel retaining screws (top left-hand and top right-hand corners). The instrument panel will then hinge downwards exposing the fuses and the fuse indicator panel. The circuits controlled by individual fuses are shown on the indicator panel and it is

essential that the blown fuse is replaced by one of the correct value.
Only one of the spare fuses is visible and they are retained in position by a small spring clip. Always replace the spare fuse as soon as possible.

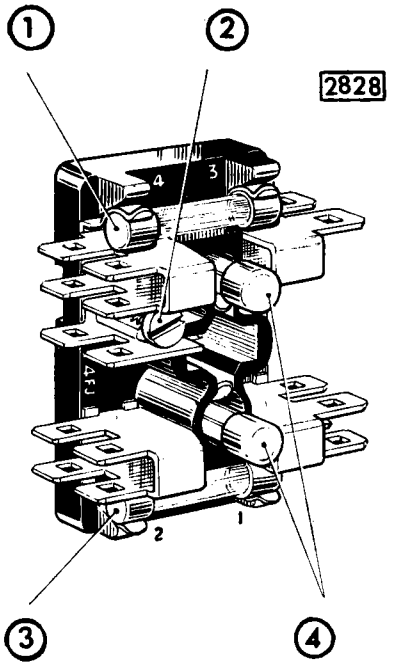


Fig. No. 38 *The 4J fuse unit*

On cars exported to Germany the tail lamps and number plate lamps are not fused.
The fuses for the heated back light and the air-conditioning equipment, both available as optional extras, are located in plastic fuse holders behind the instrument panel.

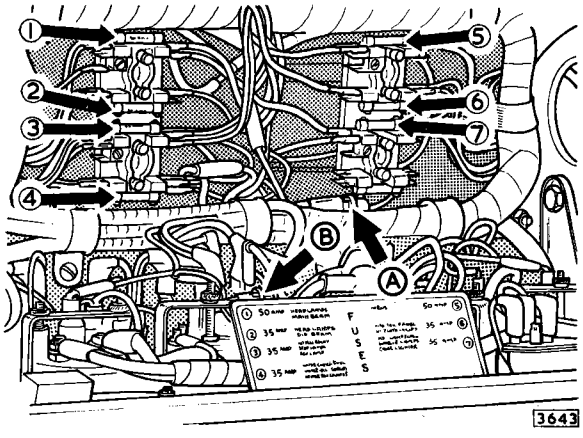


Fig. No. 39 *Location of fuses*

CIRCUITS

Fuse No.		Amps.
1	Headlamp (main beam)	35
2	Headlamp (dip beam)	35
3	Horn relay, screen washer, stop lamps, flashers, reverse lamps, overdrive solenoid	35
4	Windscreen wipers, auxiliary starting carburetter, fuel, oil and water gauges, heater motor	35
5	Horns	50
6	Side, tail, panel and number plate lamps	35
7	Headlamp flashers, interior lamps, cigar lighter	35
8	Spare	35
A	Heated backlight (optional extra)	15
	Overdrive solenoid (when fitted)	8
	Radio line fuse (when fitted)	5
	Traffic hazard warning (U.S.A. only)	35
B	Air-conditioning equipment (optional extra)	30

TRAFFIC HAZARD WARNING DEVICE U.S.A. MARKET ONLY

Description

In order to comply with the traffic regulations for the State of New York, U.S.A., all cars exported to the U.S.A., and cars sold for subsequent shipment to the U.S.A., after September 1st, 1965, will have a traffic hazard warning device fitted as standard equipment.
The system operates in conjunction with the four flashing (turn) indicator lamps fitted to the car.
The operation of a toggle switch will cause the four turn indicator lamps to flash simultaneously.
A red warning lamp is incorporated in the circuit to indicate that the hazard warning system is in operation.
A 35 amp. in-line fuse (20 amp. U.S.A. rating) is incorporated in the sub-panel circuit.
The flasher unit is located behind the sub-panel and is similar in appearance to the one used for the flashing (turn) indicators but has a different internal circuit.
A correct replacement unit must be fitted in the event of failure.
The pilot lamp bulb is accessible after removing the bulb-holder from the rear of the panel.
Failure of one or more of the bulbs due to accident or other causes will not prevent the system from operating on the other lamps.

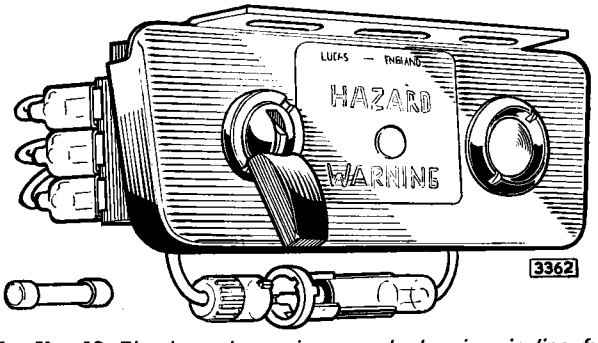
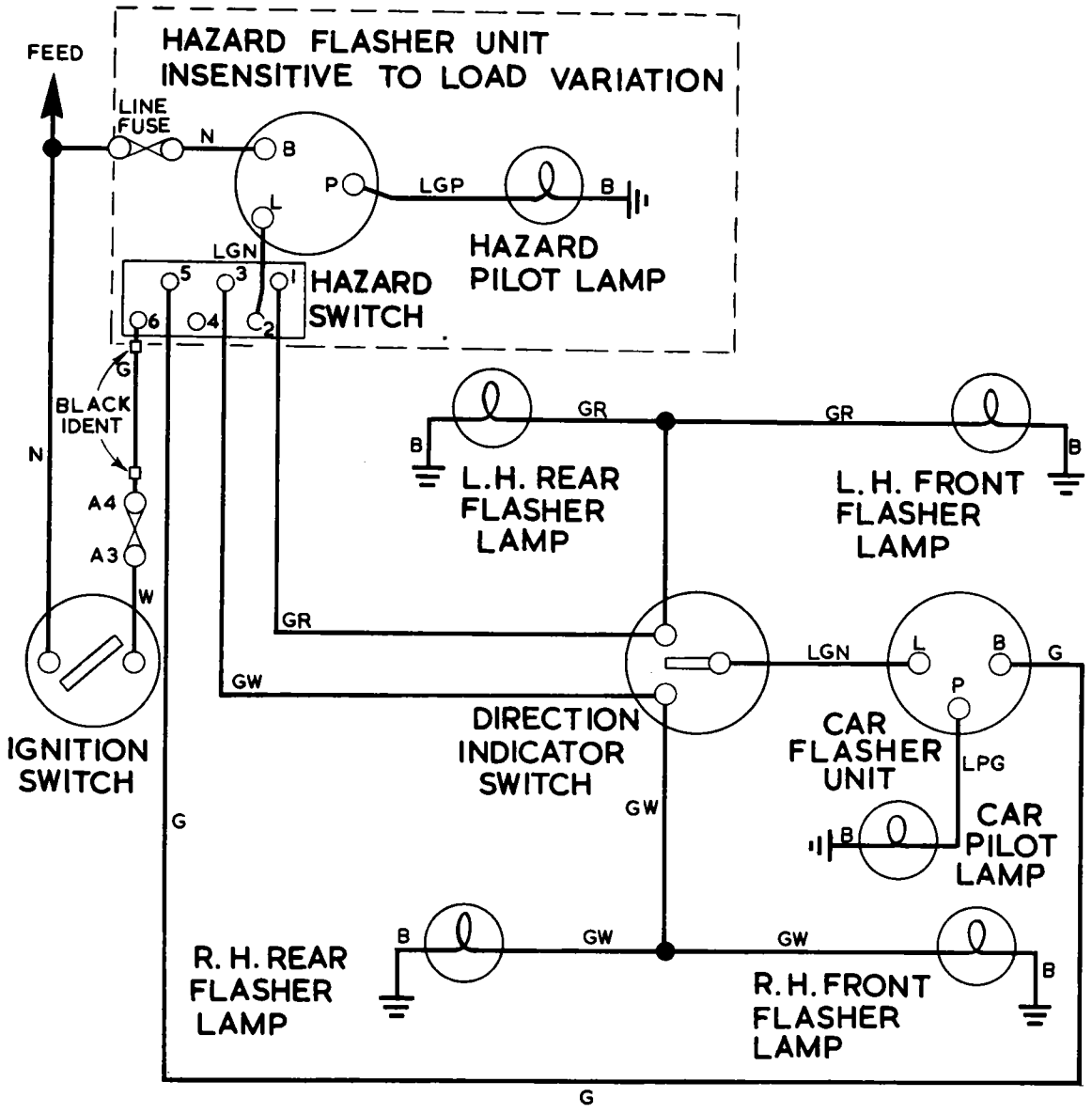


Fig. No. 40 *The haxard warning panel showing in-line fuse*



B	BLACK	LGN	LIGHT GREEN \ BROWN
G	GREEN	LGP	LIGHT GREEN \ PURPLE
GR	GREEN \ RED	N	BROWN
GW	GREEN \ WHITE	W	WHITE

3361

Fig. No. 41 *Hazard warning device wiring diagram*

HORNS — Model 9H

DESCRIPTION

The Lucas 9H horns are mounted at the front end on either side of the engine compartment immediately below the radiator. The horn circuit operates through a Lucas 6 RA relay, the contacts C1 and C2 closing when the relay coil is energised by depressing the semi-circular ring attached to the steering wheel or by pressing the centre button.

Maintenance

In the event of the horn(s) failing to sound or performance becoming uncertain, check that the fault is not due to external causes before any adjustments are made.

Check as follows and rectify as necessary:

(i) Battery condition.
(ii) Loose or broken connections in the horn circuit. Test with voltmeter at cable terminals.
(iii) Loose fixing bolts. It is important to keep the horn mountings tight and to maintain rigid the mountings of any unit fitted near the horns.
(iv) Faulty relay. Check by substitution after verifying that current is available at terminal C2 (cable colour — brown and blue) and terminal W1 (green).
(v) Check that fuse 3 (35 amperes) and fuse 5 (50 amperes) have not blown.

Note: Horns will not operate until the ignition is switched on.

Adjustment

The horns cannot be conveniently adjusted in position. Remove and securely mount on the test fixture.

A small serrated adjusting screw is provided to take up wear of moving parts only in the horn and it is located adjacent to the horn terminals. Turning this screw does not alter the pitch of the note.

Connect an 0-25 moving coil ammeter in series with the horn supply feed. The ammeter should be protected from overload by connecting an ON-OFF switch in parallel with its terminals.

Keep this switch ON except while taking the readings, that is, when the horn is sounding.

Turn the adjustment screw anti-clockwise until the horn just fails to sound.

Turn the screw clockwise until the horn operates within the specified current limits of 6.5 - 7.0 amperes.

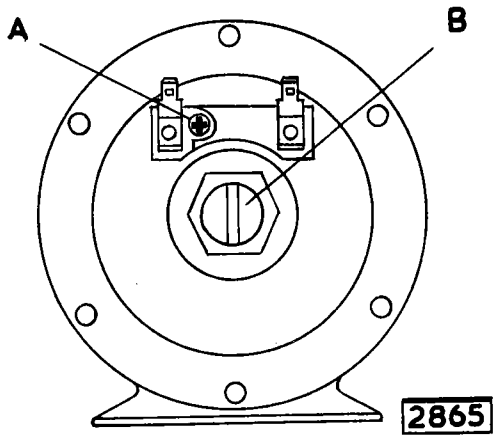


Fig. No. 42 *The Lucas 9H horn*

A Contact breaker adjustment screw
B Slotted centre core (Do not disturb)

Service Replacements

When fitting replacement horns it is essential that the following procedure be carried out.

(i) Refit the lockwashers in their correct positions, one on each side of the mounting bracket centre fixing.
(ii) Ensure, after positioning the horn, that the $\frac{5}{16}$" centre fixing bolt is secure but not overtightened. Over-tightening of this bolt will damage the horn.
(iii) Ensure that, when a centre fixing bolt or washers other than the originals are used, the bolt is not screwed into the horn to a depth greater than $\frac{11}{16}$" (17.5 mm.).

Muted Horns (Holland only)

Special horns are fitted to cars exported to Holland. These horns are muted to comply with the Traffic Regulations of that country and incorporate a rubber plug inserted in the trumpet.

Horn Relay — Checking

If the horn relay is suspected, check for the fault by substitution or by the following method:

(i) Check that fuses No. 3 and No. 5 have not blown. Replace if necessary.

(ii) Check with a test lamp that current is present at relay terminals W1 (green) and C2 (brown and purple). Switch on ignition before checking terminal W1.

(iii) Remove cable from terminal W2 (purple and black) and earth the terminal to a clean part of the frame. Relay coils should now operate and close contacts. Reconnect cable.

(iv) Remove cables from terminal C2 (brown and purple). Check for continuity by means of an earthed test lamp, the horn button or ring is depressed with the ignition ON. Replace relay if faulty.

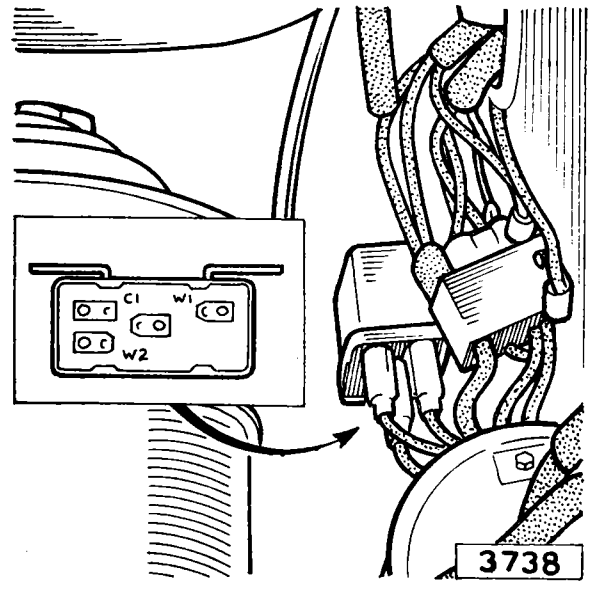


Fig. No. 43 *The 6RA relay connections*

WINDSCREEN WIPER

DATA

Wiping Speed	
Normal	45-50 cycles per minute
High	60-70 cycles per minute
Light Running	
Normal Speed	2.7 - 3.4 amperes
High Speed	2.6 (or less) amperes
Stall Current	10-11 amperes (DR3)
Control Switch	79.SA.
Pressure of Blades against Windscreen	11-13 ounces (312-369 gms.)
Maximum permissable force to move cable rack in protective tubing with motor, arms and blades disconnected	6.0 lb. (2.72 kilograms)

DESCRIPTION

The windscreen wiper assembly consists of a two speed, thermostatically protected motor coupled by a cable rack drive to two scuttle mounted wheel boxes.

The cable rack consists of a flexible inner core of steel wire wound with a wire helix. A reciprocating motion is imparted to the rack by a connecting rod in the motor gearbox and transmitted to the wiper arm spindles by the engagement of the rack with a gear in each wheelbox.

The wipers are self parking and are controlled by a switch on the instrument panel, giving Park, Slow, and Fast operation. The fast speed is intended for use when driving fast through heavy rain or light snow. It should **not** be used with heavy snow or a drying windscreen.

If overloaded, the motor windings will overheat and cause the thermostat to trip and isolate the motor from the supply. Possible causes include: packed snow or ice on the screen, over-frictional or oil contaminated blades, damaged drive mechanism or spindle units. Provided the obstruction or other cause of excessive heating is removed, normal working resumes automatically when the temperature falls to a safe level.

MAINTENANCE

Efficient wiping is dependent upon having a clean windscreen and wiper blades in good condition.
Use methylated spirits (denatured alcohol) to remove oil, tar spots and other stains from the windscreen.
Silicone and wax polishes should not be used for this purpose.
Note: The wiper blades are manufactured with special anti-smear properties. Renew only with genuine Jaguar replacement parts.
Worn or perished wiper blades are readily removed for replacement.

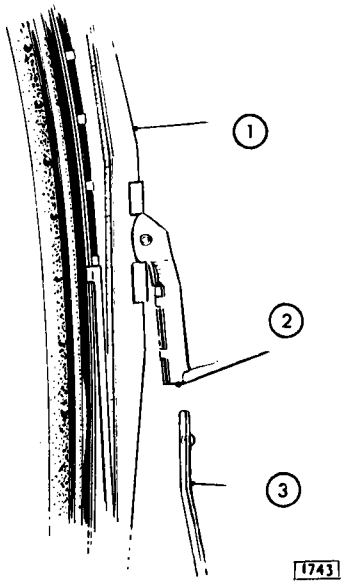


Fig. No. 44 *Wiper blade to arm attachment*

1 Blade
2 Entry slot
3 Arm

When necessary, adjustment to the self-parking mechanism can be made by turning the knurled nut located near the cable rack outlet on the wiper motor. Turn the nut only one or two serrations at a time, and test the effect on each setting before proceeding.

REMOVAL OF WIPER MOTOR AND CABLE

Withdraw the wiper arms from the spindles. Unscrew the large nut connecting cable guide to the wiper motor.

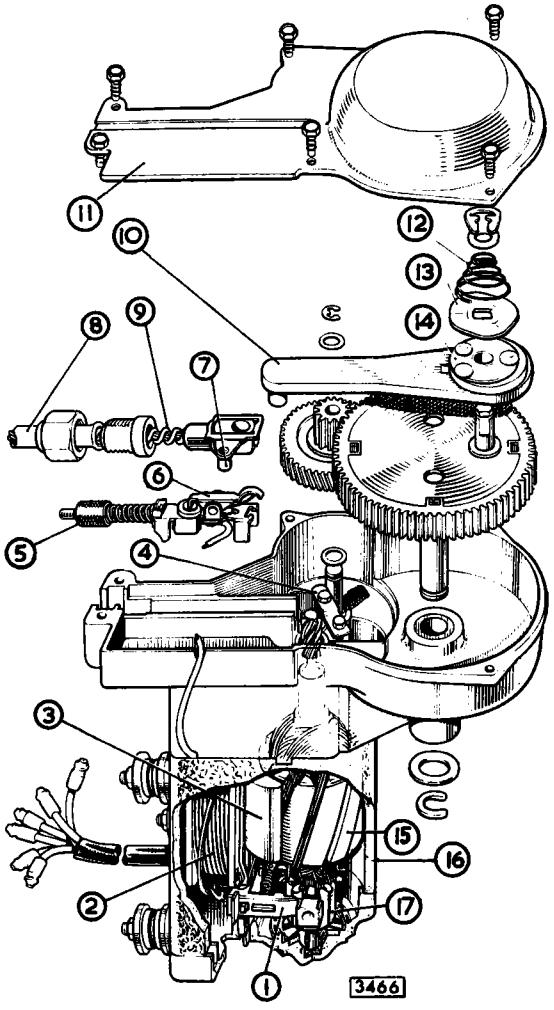


Fig. No. 45 *The DR3 wiper motor components*

1 Brush gear
2 Field coil
3 Pole piece
4 Armature end play stop plate
5 Parking adjuster
6 Crosshead-actuated limit switch
7 Switch striker pin
8 Protective tubing
9 Cable rack
10 Connecting rod
11 Gearbox cover
12 Conical spring
13 Friction plate
14 Pivoted coupling (eccentric)
15 Armature
16 Yoke
17 Commutator

Remove the setscrew securing the earth wire to the motor.
Disconnect the cable harness attached to the motor at the snap connectors noting the cable colours.
From underneath the right hand front wing, remove the three nuts securing the wiper motor to the wing valance.
The wiper motor and cable can now be removed as an assembly by drawing the cable through the guide tube.

Disconnecting the Cable
Remove the six small set bolts from the wiper motor gearbox cover.
Lift off the cover, remove the circlip from the post in the gearwheel.
Remove the washer, conical spring, friction plate and connecting rod from the crosshead.
Lift out the cable ferrule from the gear casing.

REFITTING
Refitting is the reverse of the removal procedure.
Renew grommets in the wing valance if worn or damaged.
Refit the wiper arms and blades as follows:
(a) Switch on the ignition.
(b) Switch on the windscreen wipers to slow speed and note the arc of rotation of the wheelbox spindles.
(c) Switch off the ignition when the spindles reach the left hand limit of travel.
(d) Fit the wiper arms to the spindles in the approximate left-hand position and switch on the ignition. Adjust the position of the arms to give equal movement either side of the arc central line. Lift the spindle locking catch before withdrawing the arms from the spindles.
(e) Switch off the wiper switch.
(f) Adjust the parking position of the arms by turning the knurled adjuster nut anti-clockwise to lower the arms (Right-hand drive cars) and clockwise to lower the arm (Left-hand drive cars).

WHEELBOXES
Removal
Disconnect the battery.
Disconnect the speedometer drive cable and withdraw the facia panel from the four mounting points as detailed on page N.6.

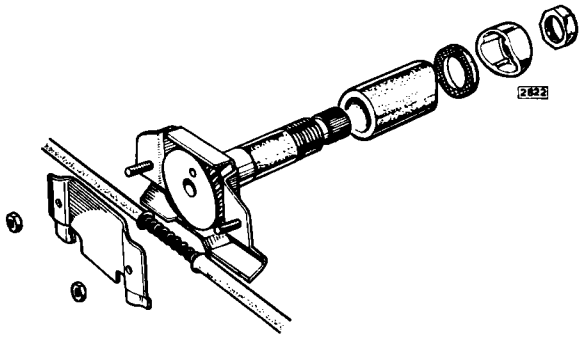


Fig. No. 46 *Exploded view of wheel boxes*

Note: It will not be necessary to disconnect the electrical cables from the panel components, but care must be taken to ensure that the panel covering is not damaged. Support the panel in a convenient position when removing the wheelboxes.

Withdraw the wiper blades and arms.
Remove the wiper motor and withdraw the drive cable from the wheelboxes.
Remove the two securing nuts and detach the back plates from the wheelboxes and withdraw the conduit tubing.
Unscrew the nuts securing the wheelboxes to the scuttle and remove the chrome distance pieces and rubber seals.
Withdraw the wheelboxes.

REFITTING
Refitting is the reverse of the removal procedure. When refitting ensure that the flared ends of tubes register with the narrow slots in the cover plate.

FAULT DIAGNOSIS
Poor performance can be electrical or mechanical in origin and not necessarily due to a faulty motor, for example:
Low voltage at the motor due to poor connections or to a discharged battery.
Cable rack binding in protective tubing;
Excessive loading on the wiper blades;
Wheelboxes loose, out of alignment or spindles binding in the bearing housing.

TESTING
Unless the origin of the fault is apparent, proceed as follows to determine the cause of the failure.

Measuring Supply Voltage
Using a first grade moving coil voltmeter, measure the voltage between the motor supply terminal (to which the green cable is connected) and a good earthing point. This should be 11.5 volts with wiper working normally. If the reading is low, check the battery, switch (by substitution) cabling and connections.

To Check the "Fast" Speed Current
Using a fully charged 12-volt battery and two test leads, connect the "GREEN" cable on the wiper motor to the "Negative" battery terminal. Join the "YELLOW" and "RED" cables together and connect to the "Positive" battery terminal. Connect the "BLUE" and "WHITE" cables together. Check the cycles per minute of the wiper spindle.

To Check the "Slow" Speed Current
Connect the "GREEN" cable to the "Negative" battery terminal. Join the "BROWN" and "RED" cables together and connect to the "Positive" battery terminal. Connect the "BLUE" and "WHITE" cables together. Check the cycles per minute of the wiper spindle.

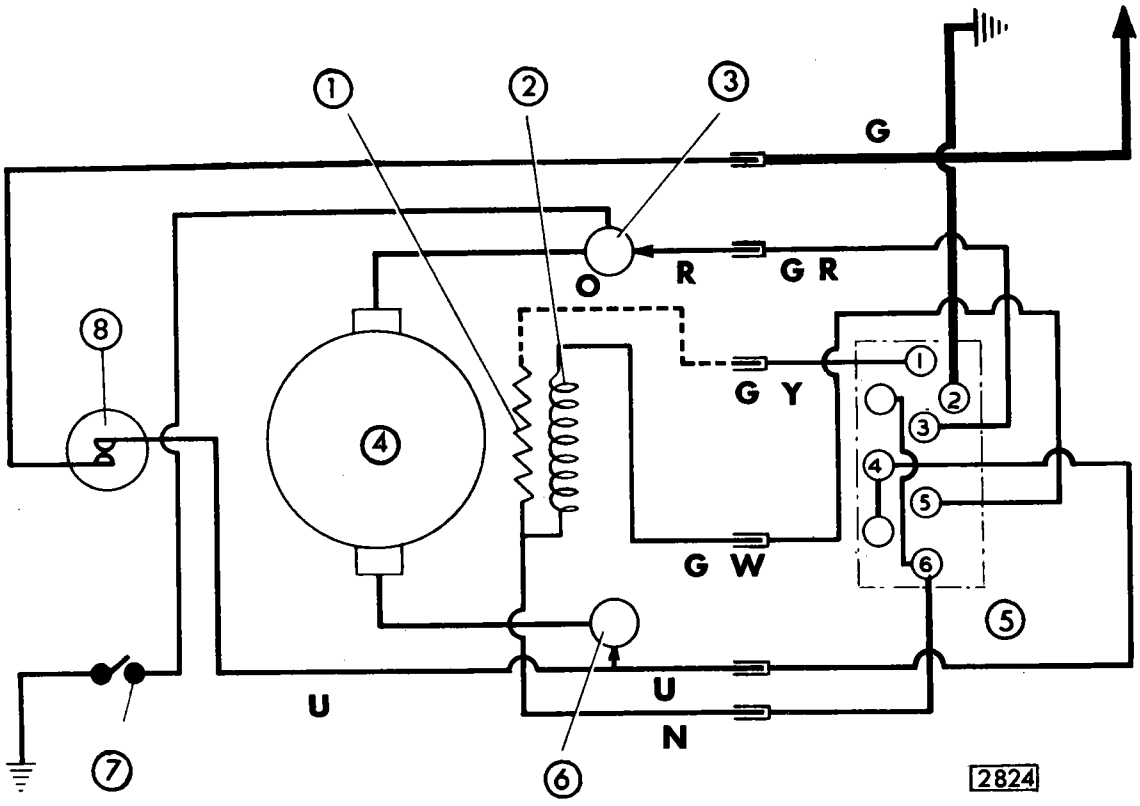


Fig. No. 47 *Wiring connections—switch to wiper*

1 Resistor	**G** Green
2 Field coil	**GR** Green with red
3 R.H. terminal	**GY** Green with yellow
4 Armature	**GW** Green with white
5 79 SA switch	**M** Brown
6 L.H. terminal	**O** Orange
7 Parking switch	**R** Red
8 Thermostatic circuit breaker	**U** Blue

Measuring the Light Running Current
The light running current must not exceed 3.4 amperes at normal speed of 45-50 r.p.m./or t.p.m. of the output motor shaft; also 2.6 amperes at fast speed 60-70 c.p.m./or r.p.m. of output motor shaft.
If the current is in excess of these figures, change the wiper motor. See DATA chart for other information.

Checking Cable Rack and Tubing
The maximum permissable force to move the cable rack in its protective tubing is 6 pounds with the wiper arms, blades and motor disconnected. The measurement can be made by hooking a spring balance in the hole in the cross-head (into which a pin on the connecting rod is normally located) and withdrawing the rack with the balance.
Before checking, disconnect the cable rack from the motor, remove the motor, wiper arms and blades.
When refitting the tubing check that they do not foul the body at any point. Failure to ensure this may result in the transmission of cable rack noise.
Binding of the rack can be due to kinked or flattened tubing or to a faulty installation.
Minor faults can be cleared with a suitable testing mandrel sold specifically for checking wiper installations. Badly kinked or flattened tubing must be renewed. Any bends of less than 9" radius must be reformed.
It is ESSENTIAL that all the flared ends of the tubing are registered in the slots provided in the wheelbox plates before tightening the wheel box cover plate securing nuts.
The cable rack should be well lubricated with Duckham's HBB grease.

Checking Wheelboxes
Check the wheelboxes for misalignment or looseness and rectify as required.
Renew seized wheelboxes.

Checking the Brush Gear
Withdraw the two through bolts and detach the end cover.
Expand the retaining spring and lift off the two brush carriers as an assembly.

Note: The two brushes are loose in the carriers and care must be taken that they are not misplaced when removed.

Refitting
Refitting is the reverse of the removal procedure. Ensure that the brushes are replaced in the same way as originally fitted.

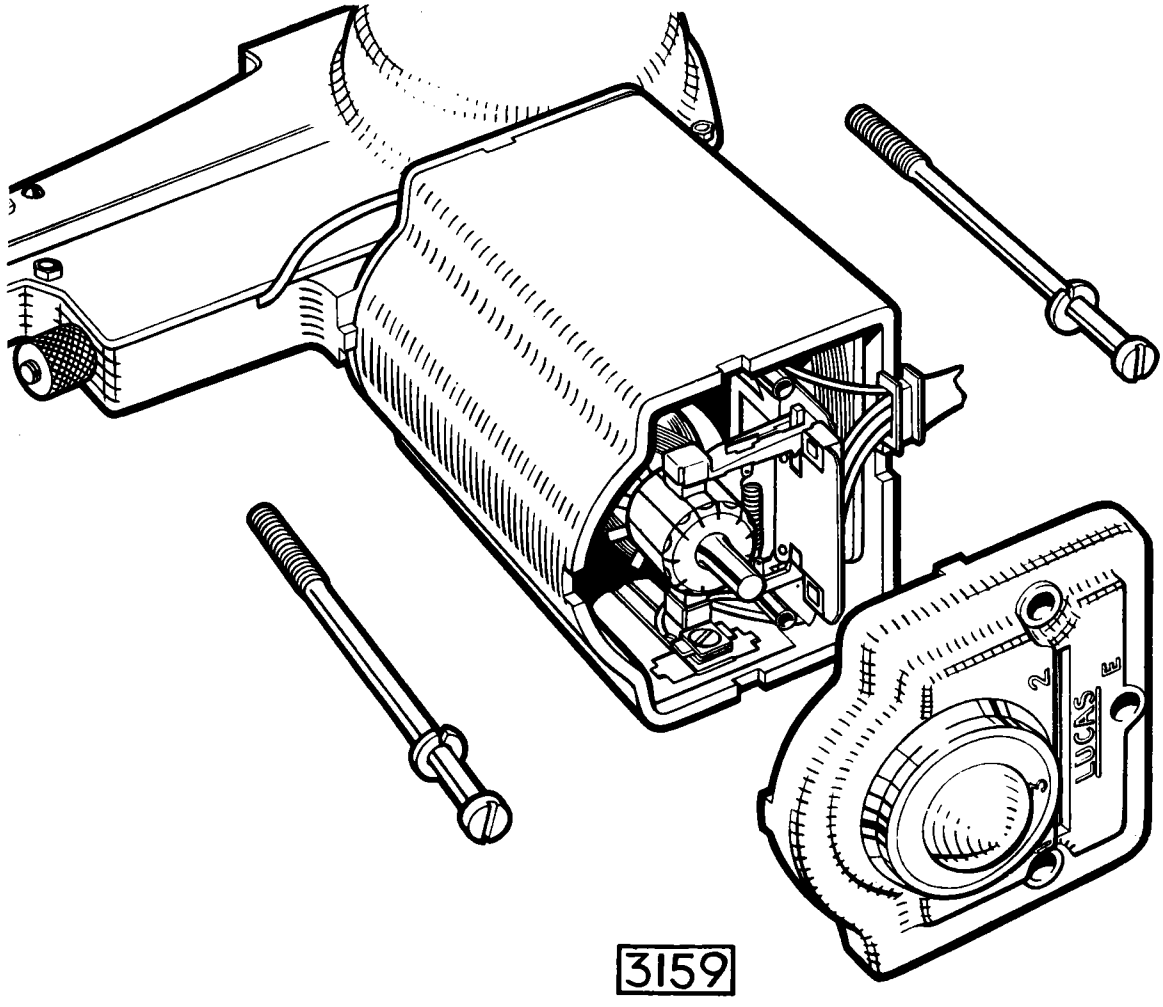


Fig. No. 48 *Showing access to bush gear*

WIRING HARNESS REPLACEMENT

GENERAL

The wiring harness consists of four main items, namely, the forward, the panel and right and left-hand body harness.
The junctions between the forward and body harnesses are behind the side facia panel and the glove box adjacent to the screen pillars.
When replacing harness, all items must be secured in the clips provided and all grommets must be renewed if worn or damaged.
The body harnesses are routed over the door sills.
Refer to the wiring diagram when making any connections (see page P.65).

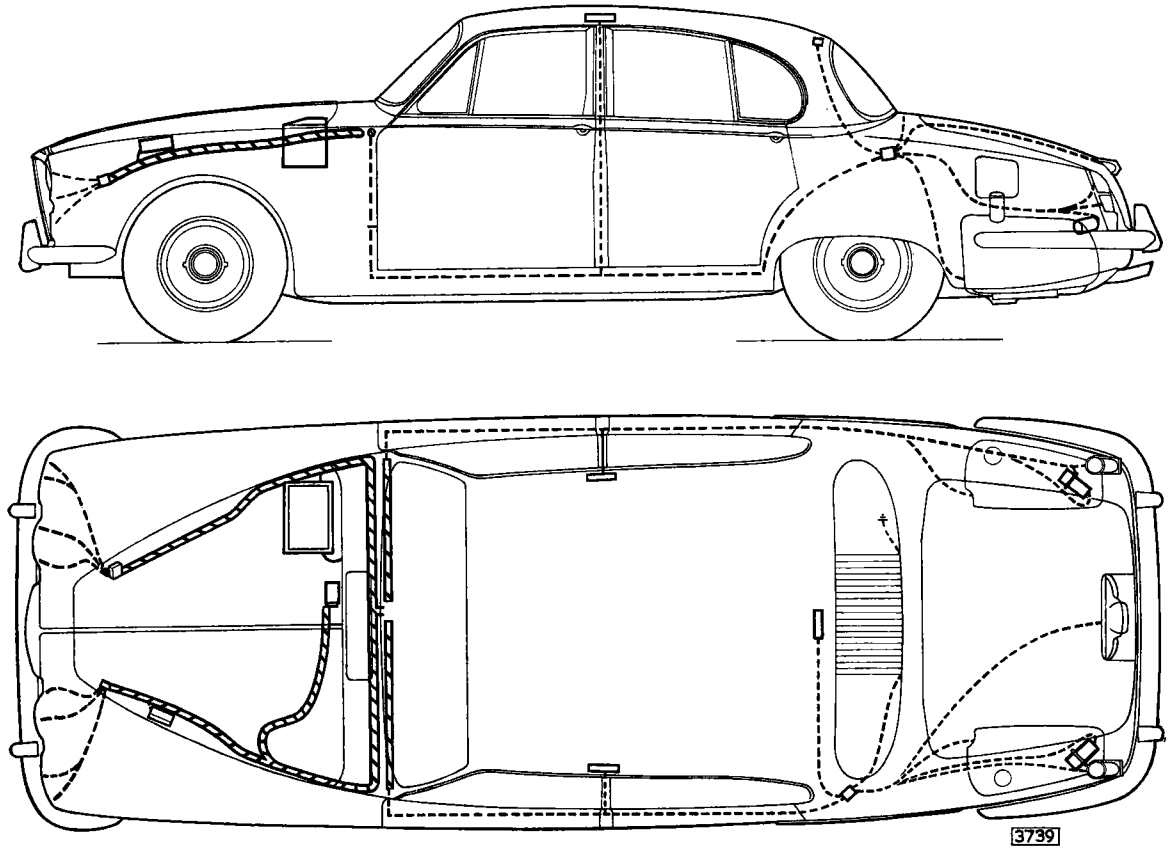


Fig. No. 49 *Layout of wiring harness*

THE INSTRUMENTS

THE INSTRUMENT PANEL

Opening

Disconnect the battery.
Remove the ignition key and cigar lighter for safe keeping.
Hinge the centre instrument panel downwards on its bottom edge, after withdrawing the thumb screws situated in each top corner.

Note: If air-conditioning equipment is fitted, it will be necessary to slide the sub-panel with the controls forward towards the bulkhead before the instrument panel can be lowered. Slacken the two knurled nuts to release the sub-panel.

Removal
The instrument panel can be removed completely by detaching the earth lead from the battery, identifying and removing the leads from the instruments, cigar lighter and switches, removing the electrical harness and clips from the instrument panel and withdrawing the two hinge pivot bolts from the instrument panel support brackets.

Refitting
Refitting is the reverse of the removal procedure.
Re-connect the leads in accordance with their colour coding, utilizing the wiring diagram as a reference.

Closing
Closing is the reverse of the opening procedure. Check that the clips securing the main harness to the instrument panel will in no way foul any of the switch or instrument terminals, otherwise a direct short will occur when the battery is connected.

THE ELECTRIC CLOCK
The electric clock fitted in the centre of the screen rail is a fully transistorised instrument powered by a mercury cell housed in a plastic holder, located at the back of the clock.
Frontal adjustment is provided by means of a small knurled knob for setting the hands and a slotted screw for time-keeping regulation.
To reset the hands, pull the knurled knob out, rotate and release.
Push in to restart the clock.
To regulate the time-keeping, turn the slotted screw with a small screwdriver towards the positive (+) sign if gaining, and towards the minus (—) sign if losing.

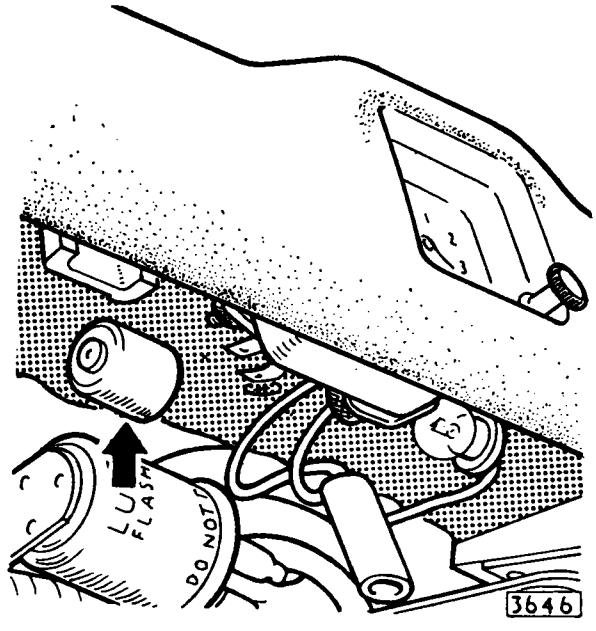


Fig. No. 50 *The electric clock battery removal*

Moving the indicator through one division will alter the time-keeping by approximately four minutes a week.
The window of the electric clock is a plastic moulding. It should only be cleaned with a cloth or chamois leather slightly dampened with water. Oil, petrol and other fluids generally associated with cleaning, are harmful and must not be used.

MAINTENANCE
The mercury cell life is in the region of 18 months throughout which it ensures a steady and continuous voltage to the clock.
Renew the cell at this period to maintain perfect time-keeping.

Battery Replacement
Remove the instrument panel retaining screws and hinge panel downwards.
Lever the battery out of the holder and discard.
Press the new battery into the holder.
Refit the panel.

Clock — Removal
Hinge the instrument panel downwards.
Remove the two nuts and the clamp strap from the back of the clock.
Withdraw the battery from the holder and remove the two cables with attached terminals.
Remove the clock and cables from the screen-rail.

Refitting
Refitting is the reverse of the removal procedure.

SPEEDOMETER
Removal
Detach the earth lead from the battery and raise the steering wheel to the highest position.
Detach the speedometer from the facia board by removing the two knurled nuts, earth lead and two retaining pieces.
Unscrew the knurled nut from the centre of the instrument and withdraw the flexible drive.
Remove the speedometer from the facia board, indentifying and removing the two warning lights and the two illumination lights from the instrument.
Unscrew the knurled nut and withdraw the odometer setting control.

Refitting
Refitting is the reverse of the removal procedure.
Replace the headlamp warning light in the right-hand aperture at the back of the instrument.
Replace the ignition warning light in the left-hand aperture.

THE SPEEDOMETER DRIVE CABLE
Removal
Disconnect the drive cable from the speedometer by unscrewing the knurled nut. Detach the opposite end of the cable from the gearbox and release from the retaining clips.

Refitting
Refitting is the reverse of the removal procedure.
Sharp bends must be avoided when installing the cable, and securing clips must retain the cable without crushing.
The original run of the cable must be maintained and the clips should **not** be repositioned

SPEEDOMETER CABLE — GENERAL INSTRUCTIONS
Flexible cable condition to a great extent affects the performance of speedometers. Poor installation or damage to the flexible drive will show up as apparent faults. It is most important that the flexible drive should be correctly fitted and maintained as illustrated in the following diagrams.

Connection
Ensure tightness of outer flex connections. They should be finger tight only. It may be necessary to clean thoroughly the point of drive before the connection can be screwed completely home.

Lubrication
Withdraw inner flexible drive (see below).
Place a blob of grease on end of outer cable and insert flex through it, carrying grease inside. Use Esso T.S.D. 119 or equivalent. Do NOT use oil. Avoid excessive lubrication. If oil appears in flexible drive, suspect faulty oil-seal at point of drive.

Connection of Inner Flexible Shaft to Gearbox
Where possible, slightly withdraw inner flex and connect outer first. Then slide inner into engagement.

Removal of Inner Shaft
Inner flexes can be removed by disconnecting the instrument end and pulling out flex. Broken inner flex will have to be withdrawn from both ends.

Examination of Inner Flexible Shaft
Check for kinked inner flexible shaft by rolling on clean flat surface. Kinks will be seen and felt.

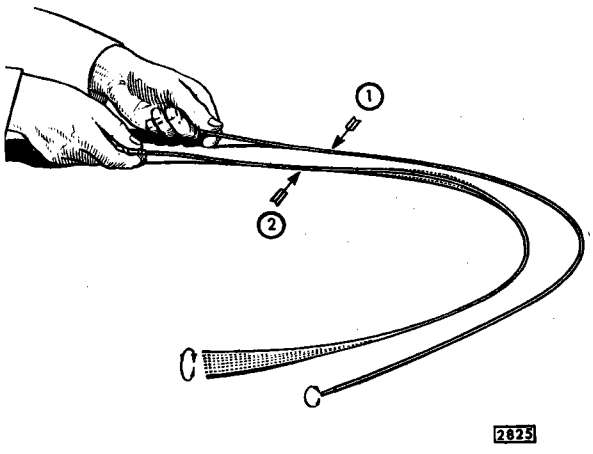


Fig No. 51 *Checking the inner flex for kinks*

Inner Shaft Projection
Check $\frac{3}{8}$" projection of inner flex beyond outer casing at instrument end. This ensures correct engagement in instrument and point of drive.

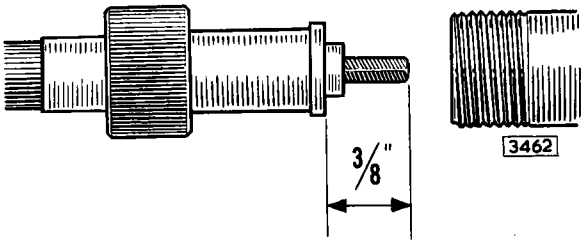


Fig. No. 52 *Showing the amount the inner flex must protrude from the outer cable*

Concentric Rotation
Check that the inner flex rotates in centre of outer cable.

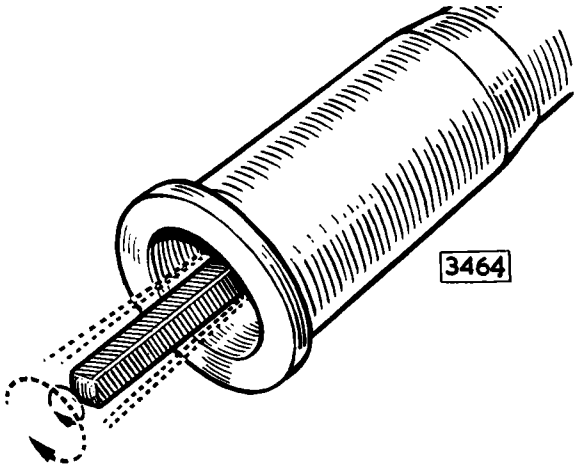


Fig. No. 53 *Checking the inner flex "run-out"*

Damaged Inner Shaft
Examine inner flex ends for wear or other damage. Before fitting new flex ensure instrument main spindle is free.

SPEEDOMETERS — GENERAL INSTRUCTIONS
Speedometer performance is dependent on the flexible drive, and apparent faults in the instrument may be due to some failure of the drive. Before returning a speedometer for service, the flexible drive should be checked, as described in the previous paragraphs. The following paragraphs show you how to check the instrument performance.

Instrument Operating
(1) Flexible cable broken/damaged — renew.
(2) Defective instrument — return for service.

Speedometer Inaccurate
Check tyre pressures. Inaccuracy can be caused by badly worn tyres. If non-standard tyres are fitted, apply to Smiths for specially calibrated instrument.
Check that the code number on the face of the instrument (Fig. 54) is correct for the final drive unit ratio as stated in the Spare Parts Catalogue.

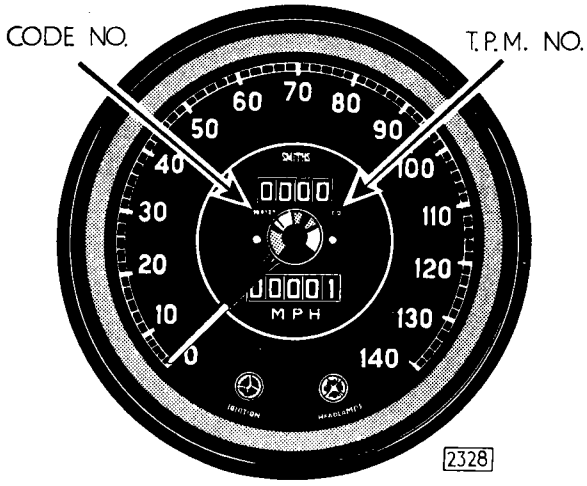


Fig. No. 54 *Showing the code numbers on the face of the instrument*

Pointer Waver
Pointer waver may be due to one or more of the following causes:
1. Oiled up instrument. Replace the oil seal if necessary; clean the flexible drive and re-lubricate.
2. Inner shaft not engaging fully. Check the inner shaft projection.
3. Kinked or crushed flexible drive. Remove and examine inner cable.
4. Instrument defective. Return for replacement.

Noisy Installation
1. Inner flex damaged. Remove and check, replace if necessary. Check for lack of lubrication.
2. General high noise level. Withdraw the inner flex and reconnect the outer flex. If the noise continues at a lower level then the source of the noise is at the point of drive.
3. Regular ticking in time with speedometer distance counter. Return the instrument for replacement.
4. Loud screeching, more prevalent in cold weather. Return the instrument for replacement.

THE REVOLUTION COUNTER (TACHOMETER)

DESCRIPTION
The revolution counter is an impulse tachometer instrument with transistors and a printed circuit, the pulse lead (coloured white) being wired in circuit with the S/W terminal on the ignition coil and the ignition switch.
Mechanical drive cables or an engine driven generator are not required with this type of instrument.
The performance of the instrument is not affected by distributor contacts setting, by corrosion of the sparking plug points or by differences in the gap setting.
Connections to the back of the tachometer is by means of a locked plug and socket, the contacts being offset to prevent incorrect coupling.

Removal
Disconnect the battery.
Remove the two knurled nuts, earth lead and instrument retaining pieces.
Withdraw the instrument from the facia panel and remove the illumination bulb holders.
Disconnect the plug and socket as follows:
Pinch together the prongs of the plastic retainer clip and withdraw from the plug and socket assembly (Fig. 55).
Detach the plug from the socket and complete the removal of the tachometer.
Note: On right-hand drive cars, remove the steering column switch lower cover to gain access to the two knurled nuts.

IMPORTANT
Do not detach the green and white cables connected to the plug from the instrument.

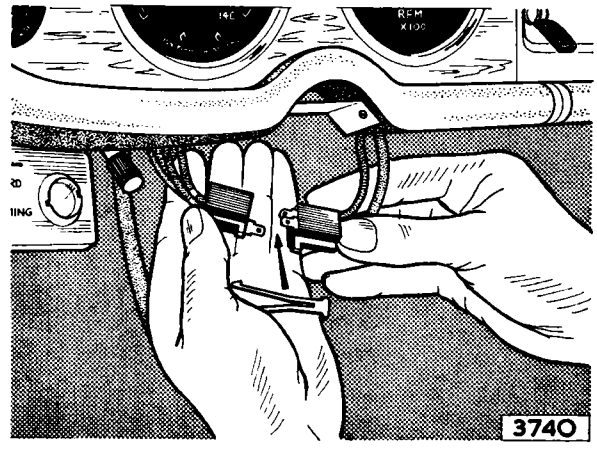


Fig. No. 55 *The tachometer plug and socket assembly*

Refitting
Refitting is the reverse of the removal procedure. Reconnect the plug and socket assembly and lock with the retaining clip.

FLASHING INDICATOR CONTROL

Removal

Disconnect the battery. Detach the upper and lower switch covers from around the column by removing the five screws from below. Disconnect the seven-cable harness at the snap connectors at the left-hand side of the column.

The indicator control mounting is utilised as a means of adjusting the steering column top bush bearing.

To remove, release the locknut from the bottom clamp screw, withdraw the two fixing screws, collect the distance pieces from the top screw and detach the switch.

Refitting

Refitting is the reverse of the removal procedure.

Reconnect the cables so that similar coloured cables are opposite each other.

Re-adjust the steering column upper bearing as detailed in Section I — Steering — Page I.9.

OVERDRIVE SWITCH

Removal

Disconnect the battery. Detach the upper switch cover from the steering column by removing the two sunken screws from below. Disconnect the two cables at the snap connectors, release the nut securing the switch to the mounting bracket and withdraw the switch.

Refitting

Refitting is the reverse of the removal procedure but ensure that the switch lever is horizontal in the "out" position when tightening the securing nut.

INHIBITOR SWITCH AND RELAY (AUTOMATIC TRANSMISSION ONLY)

On cars equipped with automatic transmission an inhibitor switch, mounted on the steering column and connected to the gear selector lever by a link, is provided to prevent the starter motor solenoid operation unless the gear lever is in the "N" or "P" positions.

A relay is incorporated in the inhibitor switch/starter solenoid circuit to obviate over-loading the inhibitor switch contacts when the starter motor is engaged.

In operation the closing of the inhibitor switch contacts by movement of the gear selector lever to the "N" or "P" positions energises the relay coil windings when the starter button is depressed with the ignition "ON". Current is then supplied to the starter solenoid through the relay main contacts (C1 and C2).

The inhibitor switch also incorporates the reverse lamp switch.

THE INHIBITOR SWITCH

Removal

Remove the steering column switch lower cover to gain access to the inhibitor switch.

Disconnect the cables from the switch, note the location of the cables for reference when refitting.

Detach the control link from the switch by withdrawing from the rubber bush, release the clamp ring setscrew and remove the switch.

Refitting

Insert the switch in the clamp ring, but do not tighten the setscrew. Reconnect the control link.

Select neutral ("N") on the gear selector quadrant and hold in this position.

Rotate the switch in the clamp ring until the small hole in the lever registers with the indent in the back of the switch.

A small mirror held at the back of the switch will enable the indent to be located correctly.

Tighten the clamp ring setscrew.

Reconnect the cables to the switch in the order noted on removal.

Refit the steering column switch lower cover.

THE INHIBITOR SWITCH RELAY

Removal

The relay is mounted behind the right-hand side facia panel and is attached to the dash structure by two drive screws.

To remove, detach the facia panel as detailed in page N.6.

Withdraw the two securing screws, disconnect the cables and remove the relay. Note the location of the cables for reference when refitting.

Refitting

Refitting is the reverse of the removal procedure.

THE INSTRUMENT PANEL COMPONENTS

REMOVAL

Disconnect the battery.

Remove the ignition key and cigar lighter for safe keeping.

Hinge the centre instrument panel downward after withdrawing the thumb screws situated in each top corner.

If air-conditioning equipment is fitted, it will be necessary to slide the sub-panel forward before the instrument panel can be lowered.

Slacken the two knurled nuts to release the sub-panel.

IGNITION SWITCH

Identify and remove the ignition switch cables. Withdraw the ignition switch from the rear of the instrument panel by removing the chrome ring and fibre washer.

Note the locating washer fitted to the threaded portion of the switch.

The lock barrel can be withdrawn by inserting a thin rod through a hole in the body of the switch and depressing the plunger in the lock. Insert the key and turn to the "ON" position to gain access to the plunger.

Refitting is the reverse of the removal procedure. When

refitting a new lock barrel, check that the number of the key is the same as that stamped on the lock barrel. Insert the key in the lock and turn the switch to the "ON" position before inserting the lock barrel. Refit the locating washer over the threaded portion of the switch before inserting in the panel and locate the tag with the cut-out portion in the panel hole.
Note: On cars not fitted with a steering column lock, the ignition switch also functions as an alternator field isolation switch. Care must be taken when reconnecting the switch that the cables are connected as shown in the wiring diagram. Use the diagram as a reference.

Cigar Lighter Element
Withdraw the cigar lighter and ensure that it is cold. Place the unit in the palm of the hand, knob first, and hold the sleeve downwards against the pressure of the spring. Unscrew the lighter element and fit a replacement. It is important **not** to omit the spring as it ejects the lighter unit when it attains the correct temperature.

Cigar Lighter Unit
Disconnect the battery. Withdraw the cigar lighter. Identify and remove the cables from the cigar lighting housing. Unscrew the outer casing at the rear of the panel and withdraw the inner section of the cigar lighter unit.
Refitting is the reverse of the removal procedure.

Starter Push Button
Remove the cables from the push button. Withdraw the push button through the face of the instrument panel by removing the nut, washer and spring washer at the rear of the instrument panel.
Refitting is the reverse of the removal procedure.

Head and Side Light Switch
Disconnect the battery.
Remove the light switch control lever from the face of the instrument panel by depressing the plunger in the right-hand side.
Identify and remove the leads from the light switch.
Remove the three nuts, shakeproof washers, washers and blade terminal from the switch mounting posts.
Withdraw the light switch. The designation plate can be removed from the instrument panel by detaching the nut on the rear of the panel.
Refitting is the reverse of the removal procedure. Reposition the designation plate on the instrument panel by allowing a flat on the threaded barrel to locate a flat in the panel.
The light switch control lever is pressed onto the light switch so that the plunger locates with a drilling in the hub of the control lever.

Tumbler Switches
Disconnect the battery.
Identify and remove the leads from the Lucar tags on the switch body. Withdraw the tumbler switch from the rear of the instrument panel by holding the switch lever in a horizontal position and removing the screwed chromium ring from the face of the instrument panel.
Refitting is the reverse of the removal procedure. The flat face of the switch lever should be facing downwards.

Ammeter and Oil Pressure Gauges
Disconnect the battery.
Withdraw the illumination bulb holder from the rear of the gauge. Remove the cables from the terminal posts. Remove the two knurled nuts and "U" clamp. Withdraw the gauge through the front face of the instrument panel.
When refitting the gauges, check that the "U" clamp does not foul any terminals or the bulb holder.

Fuel and Water Temperature Gauges
Removal and refitting of these gauges is similar to the ammeter and oil pressure gauges. But in this case, the "U" clamp is retained by one knurled nut.
The removal and replacement of the fuel gauge tank unit and water temperature transmitter unit are detailed in the "Fuel System" and "Cooling System" respectively.

Voltage Regulator (Fuel and Water Temperature Gauges)
Remove the cables (noting their respective positions) from the voltage regulator situated in the left-hand corner of the instrument panel. Withdraw the voltage regulator by removing one nut, shakeproof washer and blade terminal.
When refitting the voltage regulator, ensure that a good earth is made between the regulator and panel.

Switch Indicator Strip
Remove the indicator strip, chrome finisher and light filter from the bottom edge of the instrument panel by withdrawing four screws.
Refitting is the reverse of the removal procedure.

THE BI-METAL RESISTANCE INSTRUMENTATION

Engine Temperature, Fuel Tank and Oil Pressure Gauge

DESCRIPTION

The Bi-metal Resistance Instrumentation for engine temperature, petrol tank contents and engine oil pressure consists of a gauge unit fitted in the instrument panel, a transmitter unit fitted in the engine unit or petrol tanks and connected together to the battery, the oil pressure gauge being an exception, through a common voltage regulator.
The purpose of the latter is to ensure a constant supply of predetermined voltage, thus avoiding errors due to

a low battery voltage. In the instance of the oil pressure gauge this is not quite so critical to supply voltage. In all systems the gauge unit operates on the thermal principle utilizing a heater winding wound on a bi-metal strip, while the transmitter units of the engine temperature and petrol tank contents gauge are of the resistance type, but in both instances the system is voltage sensitive. The transmitter unit of the oil pressure gauge is of the thermal pressure principle utilizing a heater winding wound on a bi-metal strip, having contact at one end with the second contact mounted on a diaphragm which is sensitive to engine oil pressure.

OPERATION OF THE ENGINE TEMPERATURE GAUGE

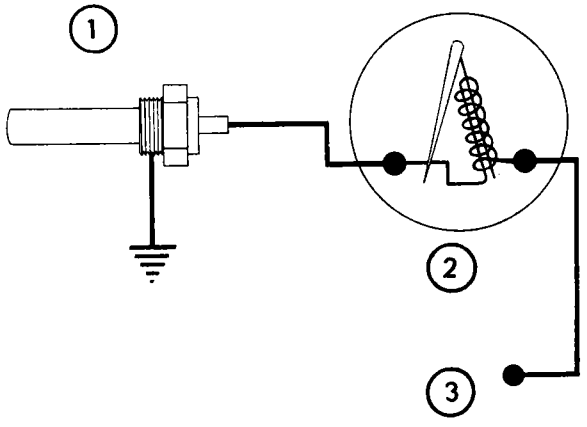
The transmitter unit of the engine temperature gauge is fitted in the water outlet pipe of the engine unit and is a variable resistance and consists of a temperature sensitive resistance element contained in a brass bulb. The resistance element is a semi-conductor which has a high negative temperature co-efficient of resistance and its electrical resistance decreases rapidly with an increase in its temperature. As the temperature of the engine unit rises the resistance of the semi-conductor decreases and increases the flow of current through the transmitter, similarly a decrease in engine temperature reduces the flow of current.

The gauge unit fitted in the instrument panel consists of a heater winding, connected at one end to the transmitter unit and at the second end to the "I" terminal of the voltage regulator, wound on a bi-metal strip which is linked to the indicator needle. The heater winding and bi-metal strip assembly is sensitive to the changes in voltage received from the transmitter unit causing the heater winding to heat or cool the bi-metal strip, resulting in the deflection of the indicator needle over the scale provided. The calibration of the scale is such that the movement of the indicator needle over it is relative to the temperature of the transmitter unit bulb and therefore the temperature of the engine unit.

OPERATION OF THE FUEL TANK GAUGE

The transmitter units of the petrol gauge are fitted in the petrol tanks and each is a variable resistance actuated by a float, the arm of which carries a contact travelling across a resistance housed in the transmitter body. The float arm takes up a position relative to the level of petrol in the tank being used and thus varies the amount of current passing through the indicator unit.

The gauge unit in the instrument panel consists of a heater winding, connected at one end to the transmitter units and at the other to the "I" terminal of the voltage regulator, wound on a bi-metal strip which is linked to the indicator needle. The heater winding and bi-metal strip assembly is sensitive to the changes in voltage received from the position of the transmitter float, causing the heater winding to heat or cool the bi-metal strip, resulting in the deflection of the indicator needle over the scale provided. The calibration of the scale is such that the movement of the indicator needle over it is relative to the position of the transmitter float actuated by the level of the contents in the petrol tank.



1738

Fig. No. 56 *The engine temperature gauge circuit*

1 Temperature transmitter
2 Rear of indicator
3 Voltage regulator terminal "I"

Exaggerated indicator needle movement due to petrol swirl in either tank is considerably reduced as there is a delay before current changes from the transmitter can heat or cool the bi-metal and heater winding assembly in the indicator unit, which causes the deflection of the needle.

Similarly the indicator needle will take a few moments to register the contents of the petrol tank being used when the ignition is switched on.

OPERATION OF THE OIL PRESSURE GAUGE

The transmitter unit of the oil pressure gauge, fitted in the head of the engine oil filter, is a voltage compensated pressure unit and consists of a diaphragm, a bi-metal strip with a heater winding wound thereon, a resistance and a pair of contacts. One contact is attached to the diaphragm, while the second is mounted on one end of the bi-metal strip, the second end of which is connected through the resistance and the gauge unit to the battery supply; the heater winding is also connected to the battery supply but not through the resistance. Engine oil pressure will close the contacts causing current to flow through the gauge unit, bi-metal strip and contacts to earth resulting in the heating of the heater winding which will, after a time, open the contacts.

The gauge unit fitted in the instrument panel consists of a winding, connected at one end to the battery supply and at the second to the transmitter unit wound on to a bi-metal strip which is linked to an indicating needle. The heater winding and bi-metal strip assembly is sensitive to the continuity changes received from the thermal pressure unit, fitted in the oil filter, causing the heater winding to heat or cool the bi-metal strip, resulting in the deflection of the indicating needle over the scale provided.

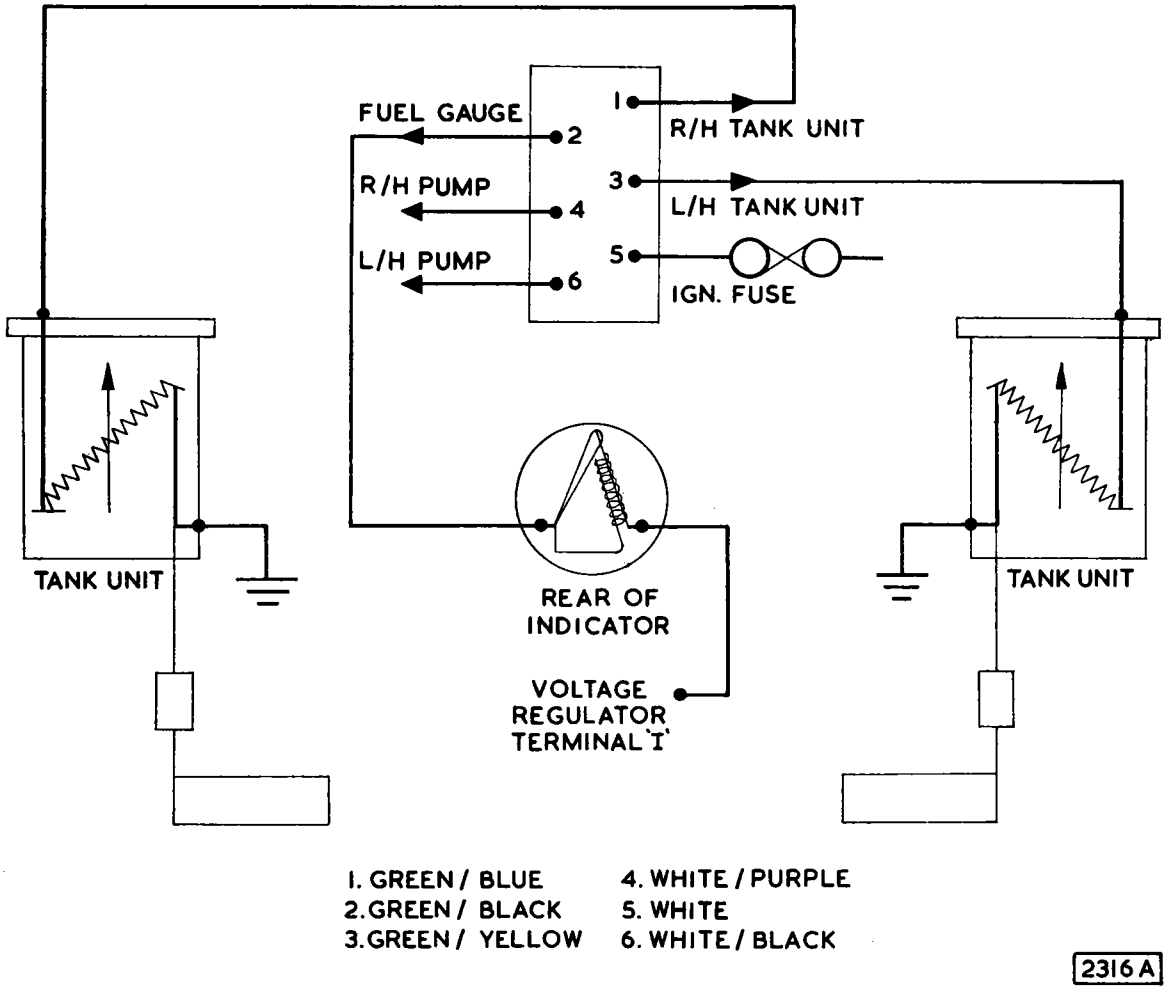
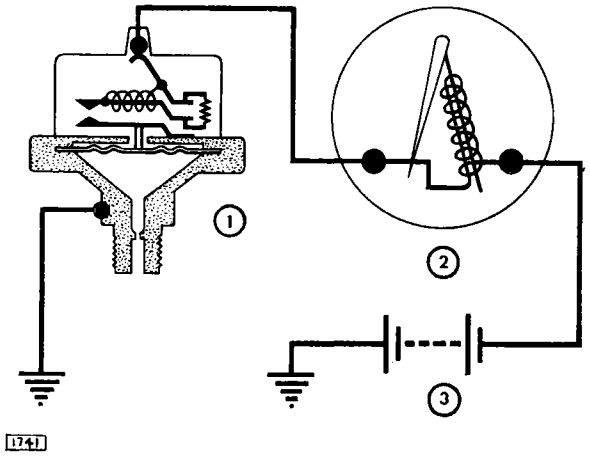


Fig. No. 57 *The fuel tank contents gauge circuit*



The changes in continuity of current from the transmitter unit will vary according to the amount of oil pressure, for as the latter rises the outward moving diaphragm contact limits the return travel of the bi-metal strip contact, thus allowing a longer continuity period.
This results in a greater heating of the heater winding in the gauge unit and increased deflection of the indicating needle over the scale showing a greater oil pressure.
The opening and closing of the transmitter unit contacts is continuous, thus the temperature of the heater winding in the gauge unit is kept within close limits and the calibration of the scale is such that the movement of the indicating needle over it is relative to the opening of the transmitter unit contacts and therefore the oil pressure of the engine is recorded.

Fig. No. 58 *The engine oil pressure gauge circuit*

1 Transmitter unit
2 Gauge
3 Battery

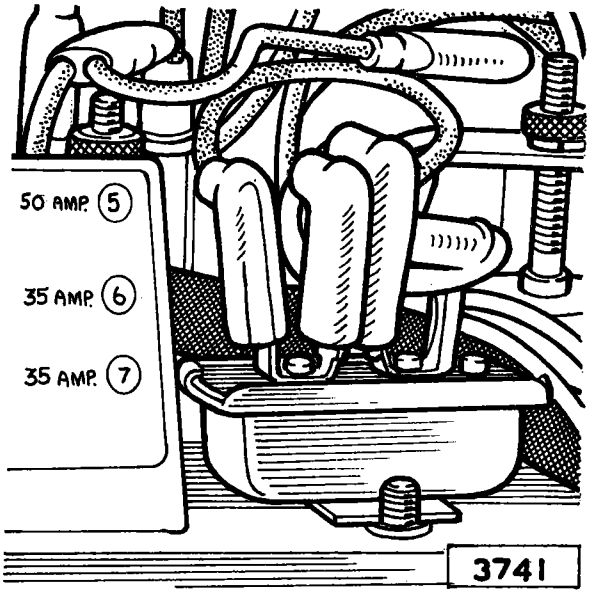


Fig. No. 59 *The location of the voltage regulator*

ANALYSIS OF THE ENGINE TEMPERATURE AND PETROL TANK GAUGE FAULTS

NOTE: THE INSTRUMENT PANEL GAUGES MUST NEVER BE CHECKED BY SHORT-CIRCUITING THE TRANSMITTER UNITS TO EARTH.

SYMPTOM	UNIT POSSIBLY AT FAULT	ACTION
Instrument panel gauge showing a "zero" reading	Voltage regulator	Check that output voltage at terminal "I" is 10 volts
	Instrument panel gauge	Check for continuity between the gauge terminals with the leads disconnected.
	Transmitter unit in petrol tank or engine unit	Check for continuity between the terminal and the case with lead disconnected.
	Wiring	Check for continuity between the gauge, the transmitter and the voltage regulator, also that the transmitter is earthed.
Instrument panel gauge showing a high/low reading when ignition switched on	Voltage regulator	Check output voltage at terminal "I" is 10 volts.
	Instrument panel gauge	Check by substituting another instrument panel gauge.
	Transmitter unit in petrol tank or engine	Check by substituting another transmitter unit in petrol tank or engine unit.
	Wiring	Check for leak to earth.
Instrument panel gauge showing a high reading and overheating	Voltage regulator	Check output voltage at terminal "I" is 10 volts.
	Wiring	Check for short circuit on wiring to each transmitter unit.
Instrument panel gauge showing an intermittent reading	Voltage regulator	Check by substituting another voltage regulator.
	Instrument panel gauge	Check by substituting another instrument panel gauge.
	Transmitter unit in petrol tank or engine unit	Check by substituting another transmitter unit in petrol tank or engine unit.
	Wiring	Check terminals for security, earthing and wiring continuity.

ANALYSIS OF THE OIL PRESSURE GAUGE FAULTS

SYMPTOM	UNIT POSSIBLY AT FAULT	ACTION
Instrument panel gauge showing a "zero" reading	Wiring	Check for continuity between the gauge and the transmitter unit and that the latter is earthed.
	Instrument panel gauge	Check for continuity between the gauge terminals with leads disconnected. If satisfactory replace the transmitter unit.
Instrument panel gauge showing a reading with ignition switched on but engine not running	Transmitter unit on oil filter head	Check by substituting another transmitter unit.
Instrument panel gauge showing a high reading and overheating	Transmitter unit on oil filter head	Check by substituting another transmitter unit
Instrument panel gauge showing a below "zero" reading with ignition switched off	Instrument panel gauge	Check by substituting another instrument panel gauge.

OPTIONAL EXTRAS

This section covers the installation of the equipment available as optional extras.

THE STEERING COLUMN LOCK

DESCRIPTION

A "WASO-WERKEN" combined ignition switch/ steering column lock is available as an optional extra, and replaces the normal ignition switch in the instrument panel.
The switch/lock unit is mounted on an extension arm attached to the steering column, below the steering wheel and has three operative positions — Drive, Garage and Stop as listed below; the fourth position "Start" not being used.
The normal ignition, which becomes inoperative, is retained in the instrument panel.

OPERATION OF SWITCH

(1) Drive

This is the normal driving position.. The key cannot be withdrawn in this position and the ignition is "ON".

(2) Garage

This is the normal stop position. The key can be withdrawn leaving the car capable of being steered with the ignition "OFF".

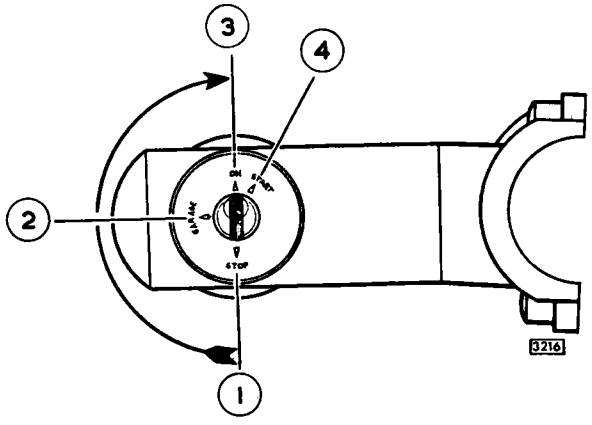


Fig. No. 60 *The switch positions (steering column lock)*

1 Stop	**3** On
2 Garage	**4** Start

(3) Stop

This is the locked stop position. They key can be removed leaving the steering locked and the ignition "OFF".
To unlock the steering, insert the key in the lock and turn to Garage or Drive position.

FITTING THE STEERING COLUMN LOCK

The normal ignition switch, which becomes inoperative also functions as a field isolation switch. Modifications are therefore necessary to the wiring system to the alternator and the 4TR control unit and includes the fitting of a Lucas 6RA relay.
Disconnect the battery.
Withdraw the five securing screws and remove the steering column upper and lower switch covers. Withdraw the warning light bulb holders from the upper cover.
Position the lock on the column covering the oval register hole and secure with the clamp and clamp bolts, but do not tighten the bolts. Note the location of the terminals on the lock before fitting, for reference when connecting the cables.
Note: On cars equipped with Automatic Transmission it will be necessary to withdraw the selector control shaft as detailed on page H.19, before the clamp can be fitted.
Refit the steering column switch lower cover.
Check that the switch/lock assembly is correctly aligned in the lower cover cut-out. Insert the key and turn to the Stop position. Remove the key and check that the lock bolt is entering the register holes in the outer and inner columns and the steering is locked.
Tighten the clamp bolts evenly until the heads shear off.
Important: IT IS IMPORTANT THAT THE CORRECT OPERATION OF THE LOCK IS ENSURED BEFORE THE CLAMP BOLTS ARE FULLY TIGHTENED. AFTER THE HEADS OF THE BOLTS HAVE BEEN SHEARED OFF THE LOCK CANNOT BE REMOVED.

Modify the Wiring as follows:

Lower the instrument panel to gain access to the fuses and panel switches. Disconnect the brown/purple, brown/white and brown cables from the ignition switch and tape into harness.
Disconnect the brown and brown/white cables, feeding the ignition switch, from the ammeter and tape into the harness.
Disconnect the brown/purple cable from the alternator and tape into the harness.
Detach the plug socket from the 4TR control unit and withdraw the brown and purple cable in the harness.
Tape the steering lock connector harness (C.27187) into the panel harness. Connect the single white cable to the A3 (white) side of the ignition controlled fuse (No. 3).

Connect the single brown/white cable to the ammeter.
Connect the white and brown/white cables at the junction to the steering column lock switch.
Connect the white cable to terminal No. 15 and the brown/white cable to terminal No. 30.

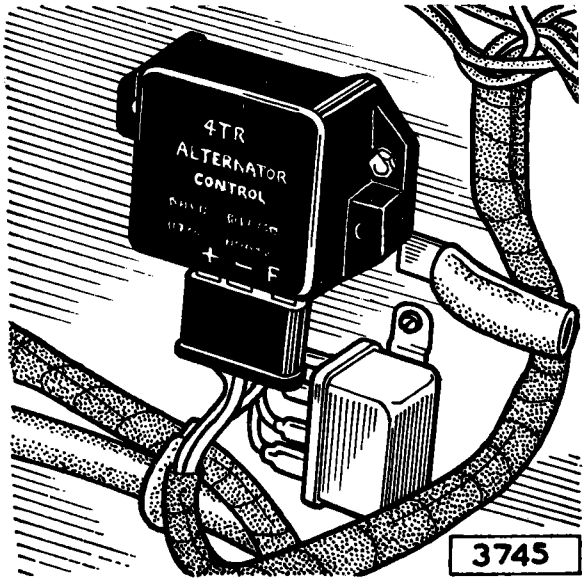
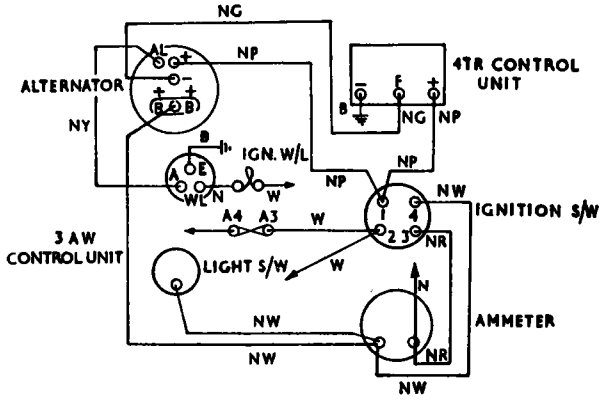


Fig. No. 61 *Location of the steering lock relay*

Place the relay on the left-hand wing valance adjacent to the rear of the control box.
Mark the position of the holes in the fixing bracket on the valance.
Drill two $\frac{7}{32}$" (5.5 mm.) holes in the valance and mount the relay with the terminals at the bottom.
Tape the relay harness (C.27188) into the forward harness over the left-hand wing valance.
Feed the white and brown/red harness junction through the main harness grommet and connect the white cable to the ignition controlled fuse (3).
Connect the brown/red cable with the eyelet to the ammeter in conjunction with the brown cable.
Connect the long brown/purple cable to the vacant terminal marked (+) on the alternator.
Insert the short brown/purple cable into the control unit plug socket, replacing the cable previously removed and reconnect the socket.
Connect the cables to the relay as follows:—

Brown/red to terminal .	C.1
Brown/purple to terminal .	C.2
White to terminal . .	W.1
Black to terminal . .	W.2
Black with eyelet to earth	

Refit instrument panel, reconnect battery and test through.



CABLE	COLOUR CHART
N	BROWN
R	RED
G	GREEN
W	WHITE
P	PURPLE
B	BLACK

3221A

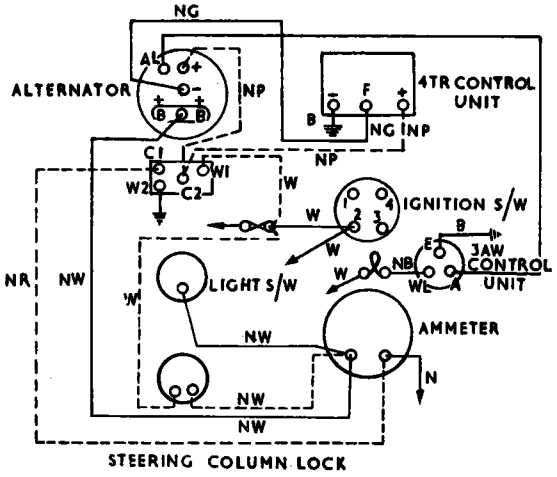


Fig. No. 62 *Circuit diagram for steering column lock*

RADIO

GENERAL

SMITHS "Radiomobile" radio sets are available in the following models to suit the broadcasting requirements of different countries. Rear extension speakers are also available if required.

980T — Long and medium wave band.
982T — Medium wave band.
530T — Medium and Short wave band.

This instruction covers both left-hand and right-hand drive cars.

Warning: Before connection to battery supply is made, it is essential to ensure that the receiver is connected for NEGATIVE GROUND. DAMAGE TO TRANSISTORS IS INEVITABLE IF POLARITY IS INCORRECT.

The radio and front loudspeaker are fitted in the console situated centrally below the parcel tray.

The aerial is fitted on the **drive side** front wing.

AERIAL MOUNTING

Warning: When removing trim secured by adhesive, extreme care must be taken.

Disconnect battery.

Remove the drive side trimmed scuttle casing.

Remove the cover plate secured by four screws.

Drill $\frac{7}{8}$" dia. hole in drive side front wing, as shown in Fig. 63.

From inside the car, pass aerial mast assembly up through the hole in the wing and secure base of aerial to the bracket provided in car. See Fig. 64.

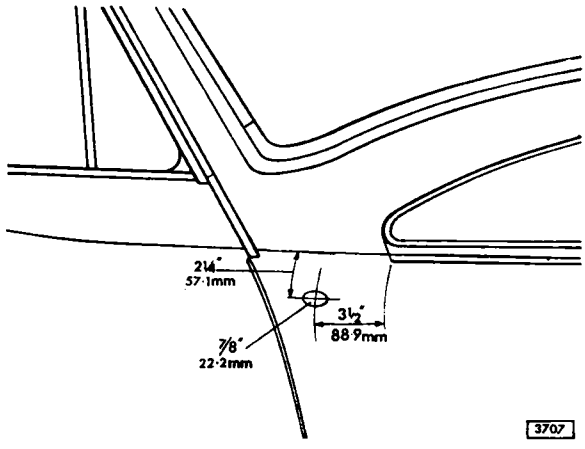


Fig. No. 63 *Location of hole for aerial mounting*

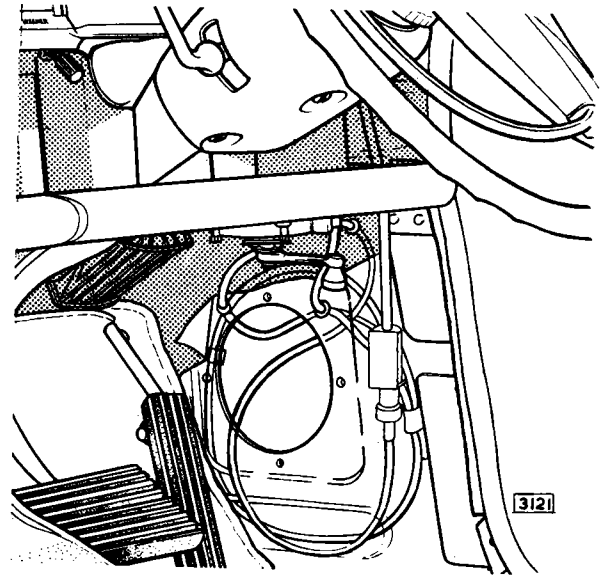


Fig. No. 64 *Aerial base mounting and run of operating cable*

Fit aerial grommet to wing.

Wind up aerial mast to maximum height and remove the drive cable from the winder mechanism, as shown in Fig. 65.

Route the drive cable via hole inside scuttle, as shown in Fig. 64. Fit the grommet provided and refit cable to winder box.

Secure the winder box to underside of parcel tray, as shown in Fig. 64.

Note: On right-hand drive cars, the three fixing holes are provided as shown. On left-hand drive cars, two fixing studs and one hole are provided.

Fit grommets provided for aerial lead and reservoir cable.

Route aerial lead and drive cables as shown in Fig. 64. Drive cable should be routed to maximum radius. Clip and tape up cables as shown.

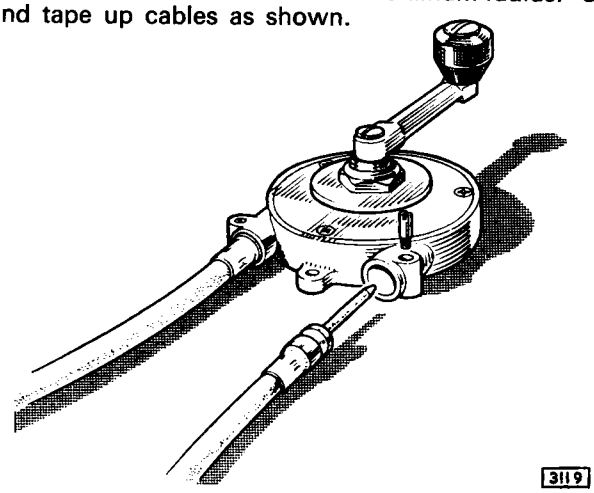


Fig. No. 65 *The aerial winder*

RADIO UNIT AND FRONT LOUDSPEAKER MOUNTING (FIG. 66)

Carefully pull out escutcheon surrounding heater push button controls.
Remove two screws which are covered by escutcheon.
Remove the perforated cover plate in centre tray. This plate is secured to tray with nylon studs and should be eased off.
Carefully pull back parcel tray trim to expose two fixing screws.
Remove fixing screws and pull out veneered wooden radio panel.
Remove the escutcheon secured by wood screws from behind radio aperture in panel. Discard the grille and remove excess material covering scale aperture and holes in escutcheon.
Note: Model 530T: An escutcheon with piercing to suit is supplied in the kit for this model.
Assemble radio unit to panel as shown.
Connect fuse lead to feed side (brown-lead) of fuse panel, No. 7, located on bulkhead behind the centre instrument panel. Connect other end to battery fly lead from radio unit.

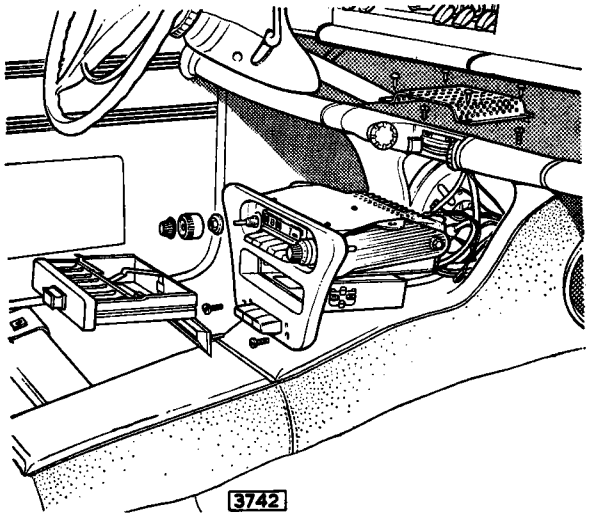


Fig. No. 66 *Fitting the receiver to the console*

Attach the loud speaker lead to loudspeaker.
Secure the loudspeaker to the fixing studs provided inside the console as shown in Fig. 67. The excess studding securing the loudspeaker bezel and grille must be cut flush with the securing nuts.
Note: If the car is equipped with Automatic Transmission, check that the gear control outer casing is not in contact with the loudspeaker case or speaker leads.

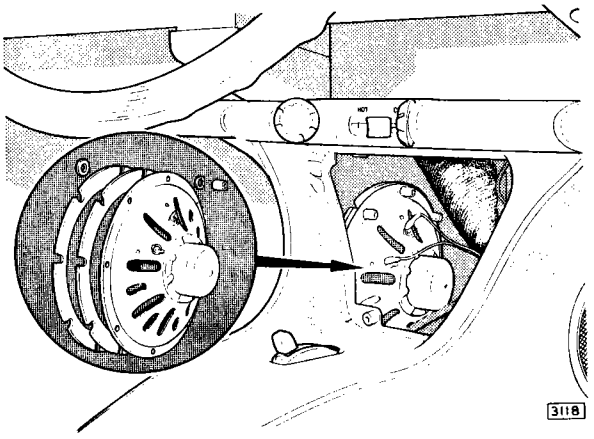


Fig. No. 67 *Fitting the front speaker*

Connect loudspeaker to radio unit.
Connect the aerial lead to radio unit.
Re-connect battery.
Switch on the radio and tune to a weak signal on 1200 kc/s (approx. 250 metres) and adjust aerial trimmer for maximum volume.
Replace wooden radio panel assembly.
Note: It is important that the area underneath and behind the heat sink is well ventilated. Felt should be removed from this area if necessary.

Suppression

It is important to scrape bare metal all points at which an earth connection is made.
Fit 1 mfd. capacitor to dynamo output terminal. Earth to dynamo fixing bolt.
Fit 1 mfd. capacitor to (SW) terminal on coil. Earth under coil fixing screw.
Fit 1 mfd. capacitor to each petrol pump feed. Earth under pump fixing bolt.
Fit .15 mfd. capacitor to oil pressure indicator transmitter. Earth under suitable filter fixing bolt ensuring that bolt is re-tightened securely.
Fit the bonding straps supplied in the kit of parts between (1) the power-assisted steering pump and the coil bracket and (2) the steering box and the engine mounting.

REAR SPEAKER FITTING

1. Disconnect battery.
2. Remove rear seat.
3. Remove two $\frac{1}{4}$" U.N.F. screws retaining the attached brackets at the bottom of the rear squab to body of car.
4. Remove rear squab in an upward and forward direction disengaging from the retaining clips attached to the front edge of the metal parcel shelf.
5. Break adhesive bond of parcel tray trim to body of car and locate and remove two PK screws retaining trimmed parcel tray to metal parcel shelf.

6. Disengage retaining clips on underside of the combined trimmed parcel tray and lower rear light finisher from metal parcel tray. Remove trimmed parcel tray.
7. Remove the felt packing on top of metal parcel shelf.
8. Cut away painted "DEDSHETE" in area of left-hand depression in metal parcel shelf to expose metal cover plate. See Fig. 68.

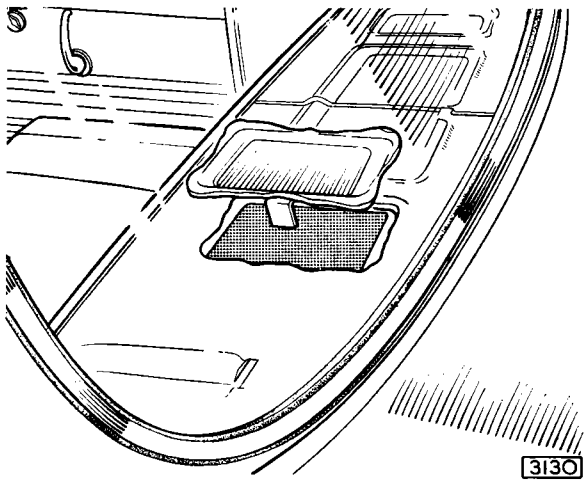


Fig. No. 68 *Cut away "Dedshete" to expose depression in parcel tray*

9. From inside boot, remove sufficient felt on underside of metal parcel shelf in the area of metal cover plate to expose welded retaining tabs.
10. Remove and discard metal cover plate.

On cars not equipped with air-conditioning equipment proceed as follows:—

11. Secure loudspeaker mounting board, and loudspeaker to metal parcel shelf using fixings provided.
12. Locate in top left-hand corner of boot, twin plastic loudspeaker lead in wiring harness.
13. Bare the ends of the loudspeaker lead in wiring harness and connect to the two way terminal block provided. Connect bare ends of the short loudspeaker lead provided to the two way terminal block. Connect loudspeaker lead to loudspeaker.
14. Locate the square pre-pierced cut-out portion on the left-hand underside of the trimmed parcel tray. Carefully remove this portion with a sharp knife, cut the trimming and secure to the underside of the tray with a good quality adhesive.
15. Assemble bezel and masking cloth to the parcel tray using fixings provided.
16. Replace felt packing and trimmed parcel tray assembly. Secure trim of parcel tray to the body of car with a suitable adhesive.
17. Replace rear squab and rear seat.
18. From inside the boot, on the underside of metal parcel shelf and using suitable adhesive, replace felt, trimming around outline of loudspeaker mounting board as required.
19. From behind centre instrument panel, locate twin plastic loudspeaker lead in weaved cotton covering, routed with main wiring harness above fuses.
20. In vertical rear face of front parcel tray, on drive side of steering column, drill a $\frac{3}{8}$" diameter (9.5 mm.) hole to dimensions as shown in Fig. 69 for balance control.
21. Remove the radio from console unit.
22. Remove existing lead from receiver to front loudspeaker. Replace with long loudspeaker lead terminated at one end with small "Lucar" type connectors and bare ends at the other.

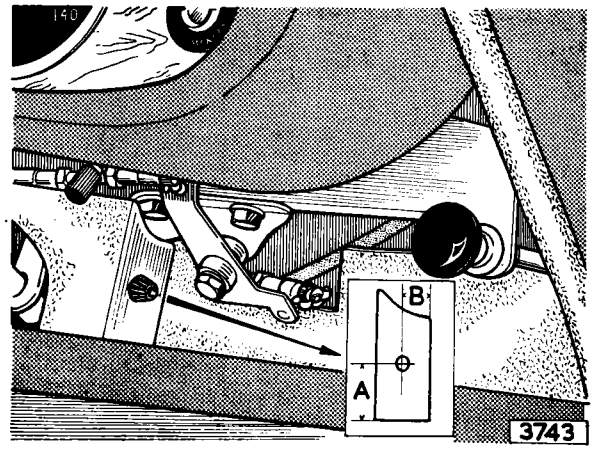


Fig. No. 69 *Drilling the front parcel tray for balance control mounting*

23. Connect new loudspeaker lead terminated with two pin plug to appropriate socket in receiver.
24. Connect the twin plastic lead from rear loudspeaker to two-way terminal block provided. Bare the ends of unterminated lead provided and connect to two-way terminal block.

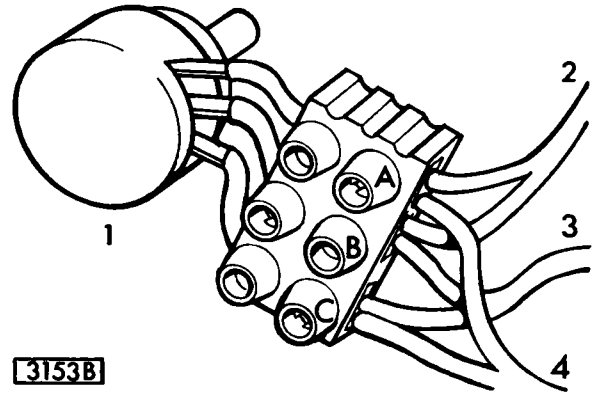


Fig. No. 70 *Showing connections to balance control*

1 Balance control
2 To front speaker
3 To rear speaker
4 Radio output

25. Bare other ends of unterminated lead and connect to points "B" and "C" on terminal block of the balance control assembly — see Fig. 71.
26. Connect the loudspeaker lead from front loudspeaker to points "A" and "B" on the terminal block of balance control assembly — see Fig. 71.
27. Connect loudspeaker lead from receiver to points "A" and "C" on terminal block of balance control assembly — see Fig. 71.
28. Affix the balance control assembly to vertical rear face of front parcel tray.
29. Replace receiver into console unit.
30. Re-connect battery.

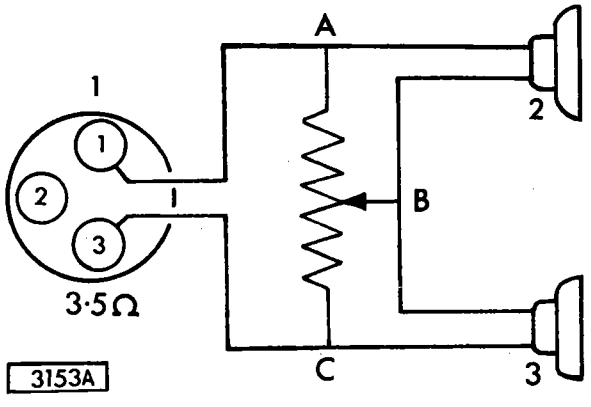


Fig. No. 71 *Rear loudspeaker circuit diagram*

On Cars fitted with Air-Conditioning Equipment proceed as follows:
Twin rear loudspeakers are fitted when air-conditioning equipment is installed, replacing the normal single rear speaker installation.
The speakers are mounted in the right and left hand corners of the parcel tray, the necessary holes being exposed on removal of the "DEDSHETE" insulation.
The parcel tray trim board has two pre-pierced portions. Installation instructions remain basically the same as that stated for the single rear speaker.
The twin rear speakers are wired in series and it is essential that they are phased when connecting the leads (see Fig. 72).
Note: Early models may not have the metal parcel tray pierced. These cars should have the necessary portions removed as illustrated in Fig. 73.

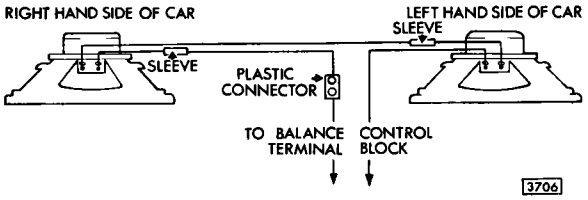


Fig. No. 72 *Twin rear speaker circuit diagram*

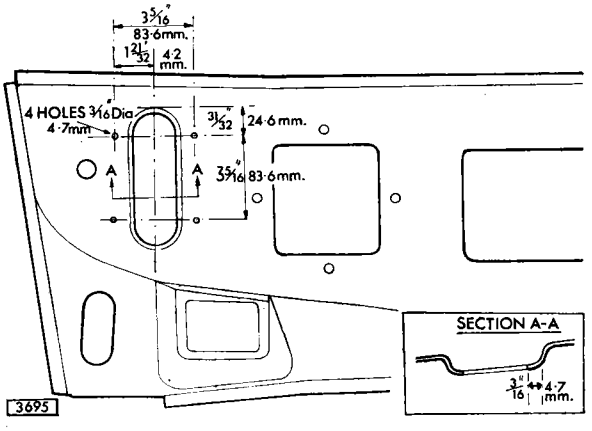


Fig. No. 73 *Twin rear speaker installation*

ELECTRICALLY-HEATED BACKLIGHT

Description
An electrically heated backlight to provide demisting and defrosting of the rear window is available as an optional extra.

Operation
The heating element consisting of a fine wire mesh between laminations of the glass is connected to the main wiring harness.

The element will come into operation only when the ignition and the rear window switches are in the "ON" position.
An amber warning light, situated in the facia panel, lights up when the backlight heater is switched on.
A resistance in the circuit through the side lamp switch automatically dims the warning light for night driving.
The current consumption is approximately 5 amperes.
A 15 amp fuse contained in a plastic holder, located in a clip behind the instrument panel, is provided in the circuit as a safety precaution.

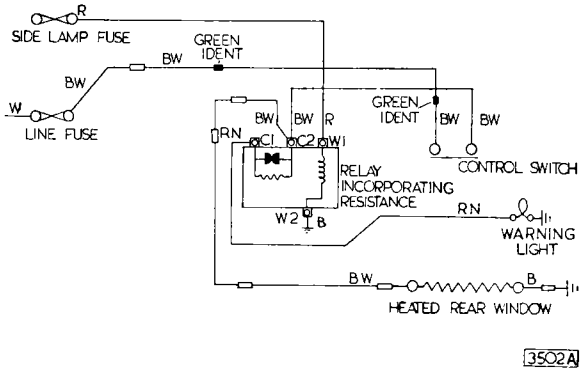


Fig. No. 74 *The heated back light switch and warning light circuit*

Fitting Instructions

Remove the backlight as detailed on Page N.11.
Remove the rear seat cushion and squab as detailed on page N.17.
Lift the rear parcel tray trimming where stuck to the rear squab panel and remove the two drive screws, now exposed, securing the parcel tray trim board. Pull the board away from the rear edge.
Drill two $\frac{1}{4}$" (6.4 mm.) holes in the parcel tray 17" (43.2 cm.) from either side of the centre line of the backlight and 6" (15.2 cm.) from the front edge. Fit the two small grommets in the holes.
Fit the backlight as detailed on Page N.11.
Feed the two cables attached to the backlight through the grommets.
Connect the left-hand cable to the black and white cable located in the luggage compartment behind the left-hand hinge bracket.
Attach the earth contact to the right-hand hinge bracket and connect the black cable.
Refit the parcel tray trim board.
Refit the squab and seat cushion.
Disconnect the battery.
Lower the centre instrument panel.

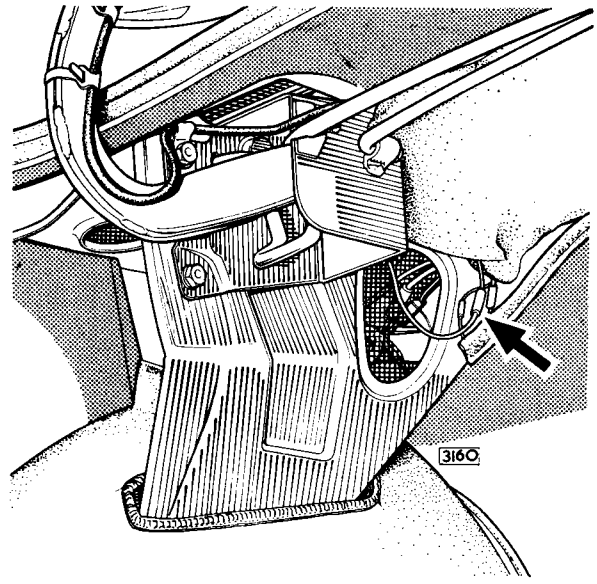


Fig. No. 75 *Location of black/white cable in the boot*

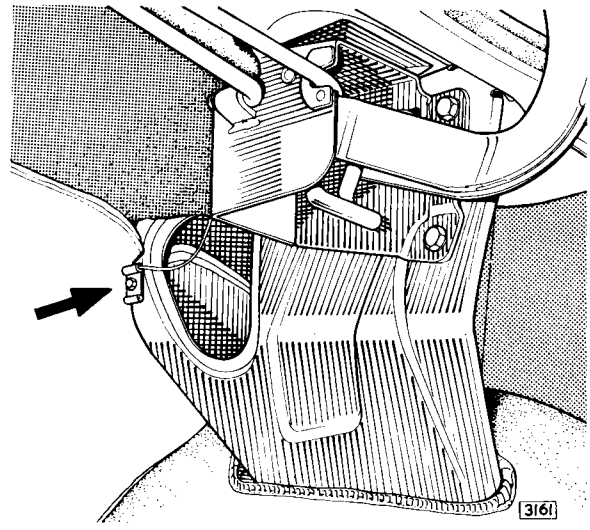


Fig. No. 76 *Location of earth tab in boot*

Drill a $\frac{7}{64}$" (2.78 mm.) hole in the top left-hand corner of the metal back plate of the instrument panel.
Important: EXTREME CARE must be taken to ensure that the drill does not penetrate the wooden facia panel. Fit a stop or sleeve over the drill shank to allow the drill to pierce the back plate only.
Attach the spring clip with the small drive screw to the panel and clip in the fuse holder.
Connect the white cable to the vacant A3 terminal on the fuse block along with the existing white cables.
Remove the side facia panel as detailed on Page N.6.
Note: If care is taken to ensure that the polished woodwork and the facia covering cannot be damaged, it will not be necessary to disconnect the switches and remove the panel completely from the car.

Locate the two semi-drilled holes in the back face of the side facia panel above the handbrake warning light. Complete the drilling of these holes through the panel, taking care that the polished face of the panel is not damaged.
Fit the switch warning light bulb holder and escutcheon.
Fit the relay to the scuttle reinforcement panel with the two drive screws as shown in Fig. 77.

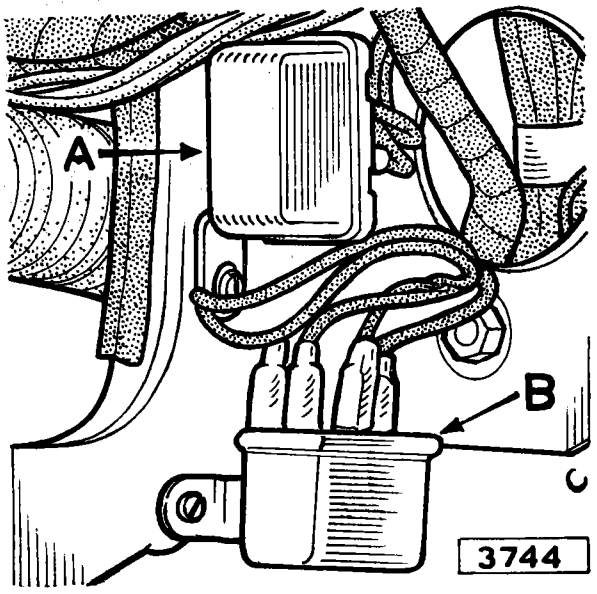


Fig. No. 77 *Location of the relay for the heated backlight*

Route the switch connector harness (C.26472) behind the facia panel with the panel harness.
Connect the connector harness as follows:—
1. Connect the left-hand side of the harness to the relay as shown in the wiring diagram on page P.65.
2. Connect the two black/white cables on the right-hand side of the harness to the operating switch and insert the warning light adaptor into the holder.

Refit the facia panel.
Complete the wiring details by connecting the black/white cable in the centre of the connector harness to the corresponding cable in the main panel harness, the black/white cable with the green indent to the corresponding cable in the fuse connector and the red cable to the side lamp fuse.
Connect the black/white cable in the main panel harness on the left-hand side to the corresponding cable at the base of the screen pillar.
Refit the instrument panel.
Reconnect the battery and test through.

Fault Diagnosis
Check that the fuse has not blown. Replace if necessary by one of the correct value.
Check the rear light element by disconnecting the cable connectors in the luggage compartment and reconnecting the backlight cables to a 12-volt battery with a 0-20 moving coil ammeter in series.
If no reading is apparent on the meter replace the backlight glass.
If a reading is shown on the meter, check the feed cables connection in the luggage compartment for continuity with a volt meter. Insert fuse and switch on ignition before checking.
The relay, which incorporates a resistance only controls the warning light circuit. It should, therefore, not be necessary to change the relay unless the warning light is suspect.

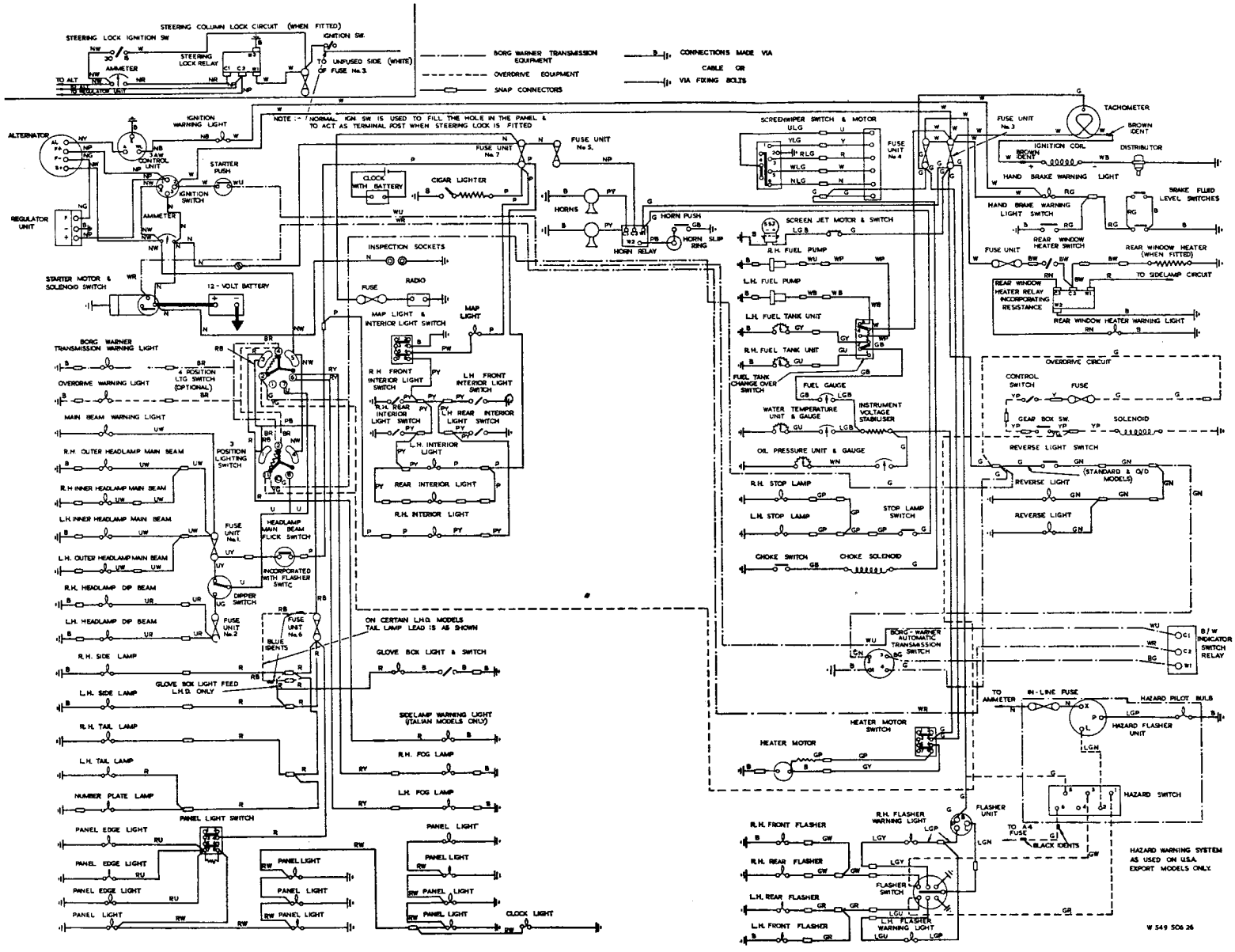


Fig. No. 78 *Wiring diagram*

CABLE COLOUR CODE

B	BLACK
U	BLUE
N	BROWN
G	GREEN
K	PINK
P	PURPLE
R	RED
S	SLATE
W	WHITE
Y	YELLOW
D	DARK
L	LIGHT
M	MEDIUM