# SECTION H

## REAR AXLE

The rear axle (final drive unit) remains identical to that stated in the 3·8 "E" Type Service Manual with the exception of the following details:—

**Axle Ratios**

| | |
|---|---|
| U.S.A., CANADA (Manual transmission only) | 3·54:1 |
| All other countries (Manual transmission only) | 3·07:1 |
| Automatic Transmission (2+2 only, U.S.A. and CANADA) | 3·31:1 |
| Automatic Transmission (2+2 only, all other countries) | 2·88:1 |

**HALF SHAFT UNIVERSAL JOINTS**

Grease nipples (see the 3·8 "E" Type Service Manual—Page H8—Early cars) were reintroduced from the commencement of production of Series 2 cars.

Access to the nipples of the outer joints is gained by removing the plastic sealing plugs from the joint covers. The universal joints should be greased every 6,000 miles (10.000 km.).

# SECTION I

## STEERING

### GENERAL DESCRIPTION

The upper and lower steering columns and the mountings are of the collapsible type designed to comply with the U.S.A. Federal Safety Regulations.

The collapse points are retained by nylon plugs which will shear on impact, allowing the steering wheel and columns (upper and lower) to move forward.

NO ATTEMPT must be made to repair the units if damaged due to accident.

NEW replacement items MUST be fitted.

### UPPER STEERING COLUMN

**Description**

The upper steering column (inner) is composed of two separate sliding shafts retained to a fixed length by nylon plugs, the outer column being pierced in a lattice form.

The inner shaft assembly is supported in the outer column by two pre-lubricated taper roller bearings.

A gaiter covers the pierced portion of the outer column to seal against the ingress of dirt.

**Removal**

Disconnect the battery.

Withdraw the self-tapping screws and remove the under-scuttle casing above the steering column.

Disconnect the cables contained in the direction indicator switch harness.

Note the location of the connections for reference when refitting.

Withdraw the ignition key, remove the ring nut and detach the ignition switch from the mounting bracket on the steering column.

**Note :** If the car is fitted with air-conditioning equipment the switch will be mounted on a bracket attached to the evaporator unit and need not be removed.

Release three grub screws in the steering wheel hub and remove the steering wheel motif.

Remove the locknut, hexagon nut and flat washer and withdraw the steering wheel from the splines on the inner column.

Disconnect the cables from the steering column lock (if fitted). Note the location of the cables for reference when refitting.

Remove the nut, lockwasher and pinch bolt securing the upper universal joint to the lower steering column.

Remove two nuts and lockwashers securing the upper column lower mounting bracket to the underside of the scuttle.

Remove two bolts, nuts, lockwashers and distance pieces securing the upper mounting bracket to the support bracket on the body.

Withdraw the upper column from the splines on the lower column.

**Note :** If the steering column has not been damaged by impact, i.e., if the nylon plugs in the inner column or the top mounting bracket have not sheared, excessive force must NOT be used to separate the upper universal joint from the lower column.

**Refitting**

Refitting is the reverse of the removal procedure.

Set the road wheels in the straight ahead position and check that the bolt holes in the lugs of the upper column universal joint register correctly with the groove machined in the lower column splines. Tighten the pinch bolt to a torque of 16-18 lb. ft. (2.2-2.5 kgm).

### IMPORTANT

Excessive force as noted under 'Removal' must not be used when reassembling the universal joint to the column.

**UNDER NO CIRCUMSTANCES** should a mallet or similar tool be used when engaging the splines in the joint and column.

If the splines will not engage freely, inspect for damage or burrs and remove with a fine file.

NO ATTEMPT must be made to repair any nylon plugs which have sheared due to impact.

**Dismantling**

Dismantling is confined to removing the steering column adjuster locknut, the splined shaft and the direction indicator switch as detailed on page I.8.

### LOWER STEERING COLUMN

**Description**

The lower steering column comprises two sliding shafts retained to a fixed length by nylon plugs.

# STEERING

**Removal**

Remove the upper steering column as detailed previously.

Remove the nut, lockwasher and bolt securing the column to the lower universal joint and withdraw the column rearwards through the grommet.

**Note :** If the steering column has not been damaged by impact, i.e., if the nylon plugs in the column have not sheared, excessive force must NOT be used to separate the column and the lower universal joint.

**Refitting**

Refitting is the reverse of the removal procedure.

Check that the bolt holes in the universal joint register correctly with the groove machined in the column splines. Tighten the pinch bolt to a torque of 16 - 18 lb. ft. (2.2 - 2.5 kgm).

**IMPORTANT**

Excessive force as noted under 'Removal' must not be used when reassembling the universal joint to the column. **UNDER NO CIRCUMSTANCES** should a mallet or similar tool be used when engaging the splines in the joint or the column.

If the splines will not engage freely, inspect for damage or burrs and carefully remove with a fine file. NO ATTEMPT must be made to repair any nylon plugs which have sheared due to impact.

**STEERING HOUSING**

The rack and pinion assembly is identical to that shown in Fig. 3—page I5 of the 3·8 "E" Type Service Manual with the exception of the rack pre-load components.

The belleville washer and disc are replaced by a spring and retaining cap.

The method of adjustment and the rack and float figure remain as stated on page I7.

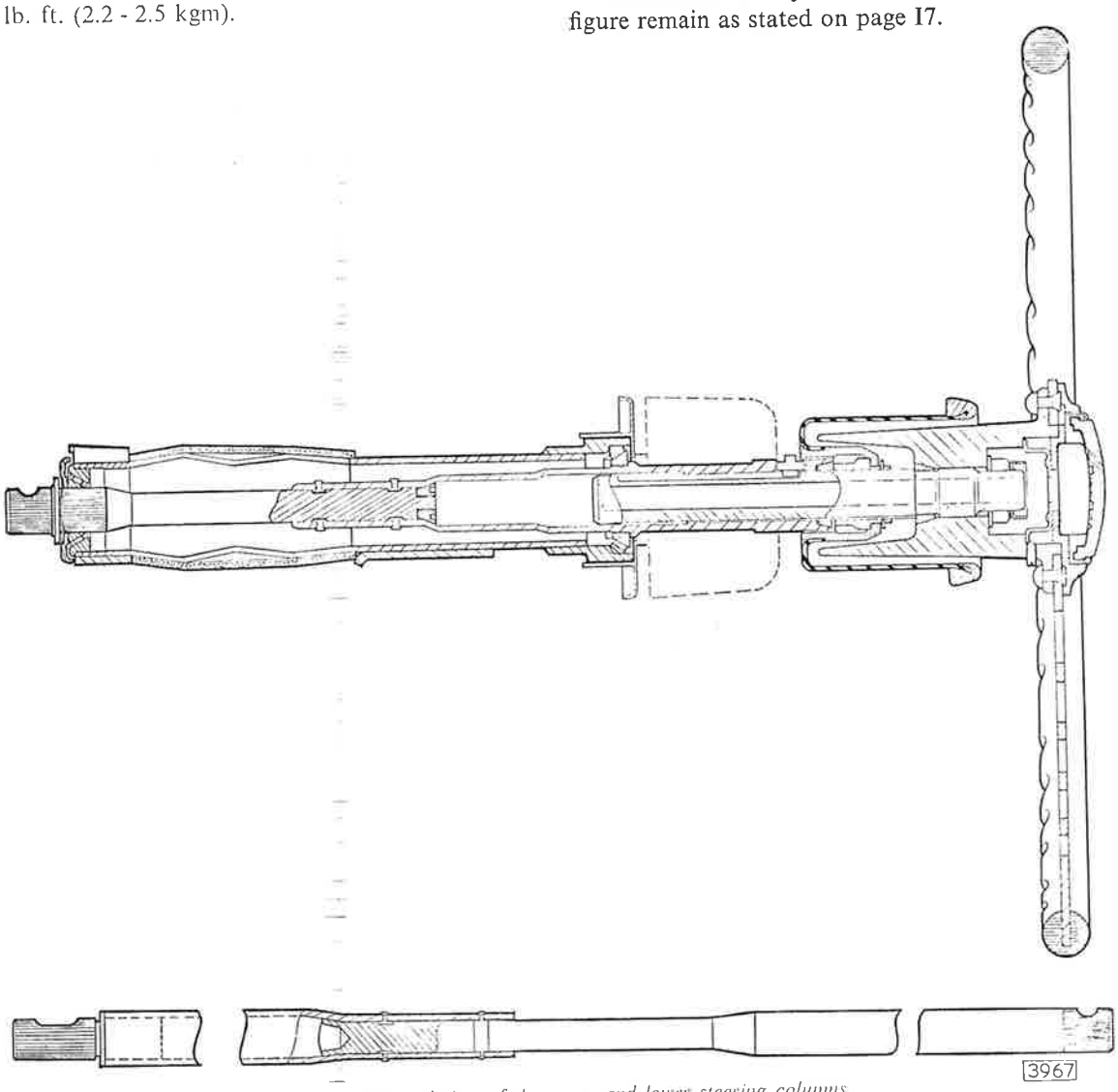


*Fig. 1. Sectioned view of the upper and lower steering columns showing the nylon plugs.*

# SECTION II

## STEERING

### (Power assisted)

**DESCRIPTION**

The power-assisted steering system, available as optional equipment, consists of three main components; the rack and pinion steering unit, the pump, and the reservoir interconnected by flexible hoses.

The pump is mounted on the left-hand side of the engine, the reservoir being attached to brackets secured to the left-hand sub-frame.

A shield protects the reservoir on left-hand drive cars from the exhaust manifold heat.

The upper and lower columns remain the same in detail as stated in Section I, page IY.s.1.

## DATA

**Steering Gear**

| | |
|---|---|
| Make | Adwest Engineering Co. Ltd. |
| Type | Rack and Pinion |
| Number of turns—lock to lock | |
| Turning circle | |

**Oil Pump**

| | |
|---|---|
| Make | Hobourn Eaton |
| Location | Left-front of engine |
| Operating Pressure | 1,000 lb./sq. in. (70·3 kg./cm.²) |

**Front Wheel Alignment** $\frac{1}{16}$–$\frac{1}{8}$" (1·6–3·2 mm.) toe-in

# OPERATION

### STEERING GEAR

Oil is supplied from the reservoir via the output side of the pump to the steering unit (pressure hose) and is then returned from the steering unit to the reservoir (return hose).

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.

The steering gear is basically a normal rack and pinion manual steering with a torsion bar controlled rotary value embodied in the input shaft and a hydraulic cylinder.

The piston in the hydraulic cylinder is connected to the rack.

Steering lock stops are incorporated in the gear unit.

### THE VALVE UNIT

This is a rotary type control valve. The valve rotor, which is also the input shaft to the steering gear, has three grooves machined in it.

These grooves lie between three 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 via the torsion bar to the rotor. The torsion bar is, however, slender and the manual effort causes it to twist, thus allowing the rotor to rotate in the sleeve.

The relative movement of the grooves in the rotor to the grooves in the sleeve allows hydraulic pressure from the pump to operate on either side of the piston thus assisting the movement of the rack.

### THE PRESSURE PUMP

The pressure pump is a roller type, belt driven unit. The relief valve is set to operate between 950 and 1,000 lb./sq. in. (66·8–70·3 kg./cm.$^2$). The flow control valve is set at 2·2 Imp. galls. per min. (10 litres/min.) (21 U.S. pints per min.).

No servicing or adjustment is possible with the pump. Replacement units can be obtained on an exchange basis from:—

THE SPARES DIVISION,

JAGUAR CARS LTD.,

COVENTRY,

ENGLAND.

# SERVICING

**Checking The Reservoir Oil Level**

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 affect the hydraulic system.

Remove the filler cap, check the oil level and top up if necessary with the recommended grade of fluid. The correct level of the oil is just above the filter element.

**Rack and Pinion Housing**

The rack and pinion housing is attached to the front suspension crossbeam.

A grease nipple, located in the rack adjuster pad for the lubrication of the rack and pinion assembly, is accessible from underneath the front of the car from the driver's side.

Lubricate sparingly with the recommended grade of lubricant. Do not over-lubricate the housing to the extent where the bellows at the end of the housing become distended. Over-lubricating may also block the air transfer pipe.

Check that the clips at the ends of the bellows are fully tightened, otherwise the grease will escape from the housing.

**Steering Tie-Rods**

Lubricate the ball joints of the two steering tie-rods with the recommended lubricant. When carrying out this operation, examine the rubber seals at the bottom of the ball housing to see if they have become displaced or split. In this event they should be repositioned or replaced as any dirt or water that enters the joint will cause premature wear.

Do not over-lubricate the ball joints to the extent where grease escapes from the rubber seal.

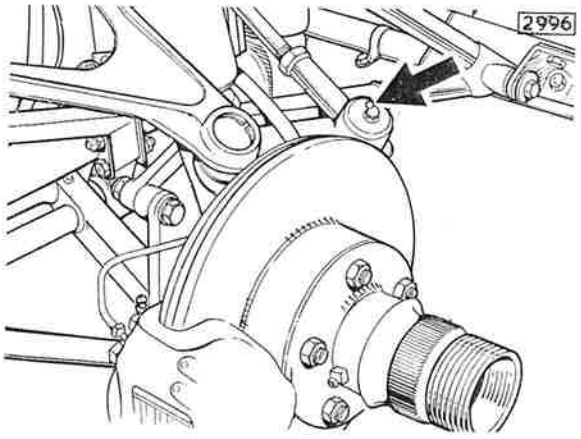


Fig. 1.

**Front Wheel Alignment**

Check the front wheel alignment as detailed on page IIY.s.9. if uneven wear is evident on the tyres.

# CHECKING AND ADJUSTMENT ON CAR

The following adjustments can be carried out on the car; all others which may develop require the removal of the unit from the chassis.

**RACK RATTLE**

This is usually apparent when travelling on rough surfaces.

Adjust as follows:—

(1) Release the locknut retaining the rack pad adjusting screw.

(2) Screw the rack adjusting screw until a firm resistance is felt, and back off $\frac{1}{16}$th of a turn ($22\frac{1}{2}°$) maximum.

Firmly grip the ball pin arm protruding from the pinion end of the steering gear and by moving it towards the rack back-up pad, a spring resistance should be felt.

The total amount of play at the rack pad should not exceed ·010" (·254 mm.). Check by removing the grease nipple and inserting a dial indicator through the rack pad and rack adjusting screw until the stem contacts the back of the rack. By pulling the rack against the spring the total amount of end play can be measured.

If the spring resistance is negligible, remove the

rack pad screw and check that the spring is not broken.

The clearance should be the minimum that will allow smooth operation of the steering unit with no binding at any point throughout the full travel.

### STEERING VEERING TO RIGHT OR LEFT

If the car steers to the right or left when being driven in the straight ahead position, or if unequal efforts are required to turn the steering to the right or left, carry out the following preliminary tests before proceeding further:—

Check the tyre pressures and tyre wear 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, check the steering geometry.

If no improvement is apparent, the fault must be in the trimming of the valve in the steering unit.

Fit a 100 lb. per sq. in. (7 kg./cm.$^2$) pressure gauge in the return line, start engine and allow to idle. Note the pressure gauge reading which should be 40 lb. per sq. in. (2·8 kg./cm.$^2$) approximately.

Turn the steering to the left and right by a small equal amount. The pressure should increase by an equal amount irrespective of the direction the steering is turned.

If the pressure is not balanced as indicated by a slight fall in pressure on one side before rising, the valve and the pinion assembly must be replaced.

If, on starting the engine, the steering kicks to one side, replace valve and pinion assembly as detailed on page IIY.s.6, under "Dismantling and Re-assembling".

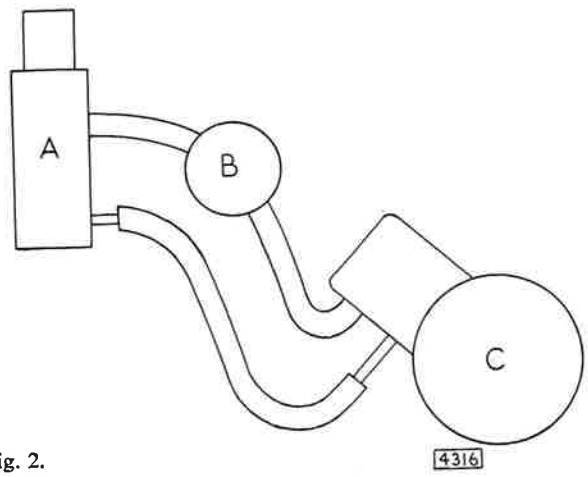


Fig. 2.

The pinion assembly can be removed without detaching the rack housing assembly from the car, if necessary.

Back off the rack adjuster pad fully before removing the pinion housing and readjust to give ·010" (·254 mm.) end play as detailed under "Rack Rattle" after refitting.

Note the position of the pinch bolt slot in the input shaft before removing, and ensure that the slot is in the same position after refitting. Allow for the spiral in the pinion when reassembling.

### BALL PIN KNOCK

Ball pin knock, evident when turning to left or right, is due to wear in the inner ball assembly.

This will only be apparent after long periods of service, and on no account must any adjustment be attempted to reduce wear which may have developed.

**A new ball pin/track rod assembly must, in ALL cases, be fitted.**

The new assembly will be supplied less the outer ball pin and bellows which must be ordered separately if required.

The ball pin/track rod assembly can be removed with the rack *in situ* as follows:—

Disconnect the track rod on the side to be removed, from the steering arm.

Remove the bellows retaining clip from the rack housing. Fold the bellows back until the inner ball joint is exposed.

Knock back the ears of the tab washer which locks the inner ball joint assembly to the rack shaft, remove the ball joint and track rod as a unit and collect the spring.

Check the length of the track rod between the inner and outer ball pin centres.

Release the outer ball joint locknut, remove the joint and nut and withdraw the bellows after releasing the clip.

Check the outer ball joint and replace if necessary. Re-assemble to the track rod and adjust the length between the ball pin centres to the figure as noted on removal. This should be 8·75" (22·2 cm.). IT IS IMPORTANT that both track rods are of equal length.

Refit the inner ball joint and spring to the rack shaft and tighten fully. Secure with new tabwasher.

Apply a generous coating of the recommended grade of grease to the inner ball housing and refit the bellows and tighten the clips.

Reconnect the track rod to the steering arm and check the front wheel alignment as detailed on page IIY.s.9,

# CHECKING THE HYDRAULIC SYSTEM

A number of faults in the steering system can be caused by inefficiencies in the hydraulic circuit, see page IIY.s.10 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 Pressures**

Fit a pressure gauge into the return line, start the engine and run at idling speed.

Turn the steering to full lock and continue to increase the steering wheel effort until the pressure ceases to increase. The peak pressure should lie between 950 and 1,000 lb./sq. in. (66·8–70·3 kg./cm.$^2$) and should not increase with engine r.p.m.

If however, the pressure is below 950 lb./sq. in. (66·8 kg./cm.$^2$) at tickover but rises to the correct figure with increased engine speed, then the trouble is caused either by a faulty relief valve in the pump or by excessive internal leakage in the steering gear.

Fit a pressure gauge into the pressure line with an "ON–OFF" tap in series with 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 1,000 lb./sq. in. (70·3 kg./cm.$^2$).

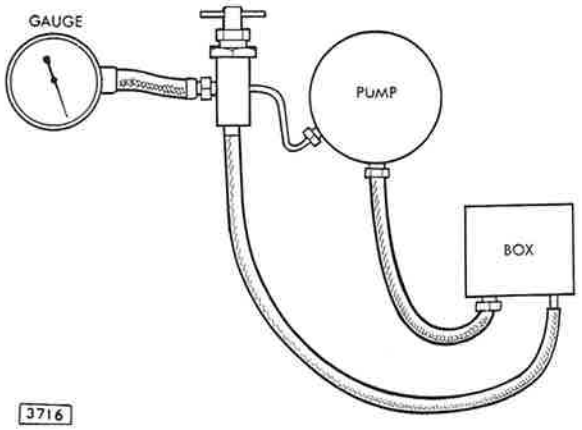


Fig. 3.

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 1,000 lb./sq. in. (70·3 kg./cm.$^2$) —relief valve pressure.

If this reading is obtained, the leaks are confined to the steering unit which should be removed and overhauled. If the reading is not obtained the fault lies in the pump.

Faulty pumps cannot be serviced. New replacement units can be obtained on an exchange basis from:—

The Spares Division,
Jaguar Cars Ltd.,
Coventry,
England.

# STEERING GEAR

**Removal**

Remove the bonnet as detailed in Section N—page NY.s.3.

Remove the radiator as detailed in Section C—page DY.s.1.

Turn the steering wheel until the Allen screw in the lower column universal joint is accessible, insert an Allen key and remove the screw.

Disconnect the hoses from the steering unit and catch the oil which will drain away. Blank off the connections and unions to prevent the ingress of dirt.

Remove the nuts and washers and disconnect the track rod ball joints from the steering levers using a suitable extractor.

Remove the bolts, nuts and washers securing the steering gear unit to the frame assembly as detailed under "Steering Housing—Removal", on page I.6 and withdraw the unit.

**Note:** If the steering column has not been damaged by impact, i.e. if the nylon plugs in the column have not sheared, excessive force must NOT be used to separate the pinion shaft and the lower universal joint.

**Dismantling**

Thoroughly clean the outside of the unit before attempting to dismantle.

Remove the sub-assemblies or components as follows:—

(a) Remove the external pipes.

(b) Remove the wire clips retaining the bellows to the steering unit and fold back the bellows to expose the ball joints.

(c) Knock back the tab washer securing the inner ball pin to the rack shaft.
Remove the inner ball pin and track rod as a unit. DO NOT dismantle the ball pin assembly.
Collect the thrust spring and spacer.

(d) Release the locknut retaining the rack adjusting pad screw, remove screw, spring and pad.

(e) Mark the location of the pinion housing in relation to the rack housing. Remove three nylon locking nuts retaining valve body assembly to the rack housing. Withdraw the assembly and discard the joint. Note the location of the pinch bolt slot before withdrawing the housing.

(f) The unit is now separated into its two major components, that is, valve and pinion assembly and the rack and tube assembly.
Depending on the fault, either of these or both can be dismantled and the faulty component replaced.

Do not disturb the outer ball joints unless these are to be removed for replacement. If the ball joints are removed for any purpose, check the total length of the tie rods before releasing the locknut.

Tie rods must be re-assembled to an equal length of 8·75″ (22·2 cm.).

## EXAMINATION OF COMPONENTS

**Valve and Pinion/Housing Assembly**

The valve and pinion/housing assembly will be available for Service Replacement purposes as a complete unit only, with the exception of the top seal and the associated back-up seal, the housing gasket and the pipe union seats.

With the assembly removed from the rack tube, carry out the following checks:—

With a soft mallet drift out the valve and pinion assembly from the housing.

Examine the teflon rings. These should be a loose fit in their grooves and the outer diameter should be free from cuts, scratches or similar blemishes.

Ensure that there is no relative movement at the trim pin between the valve sleeve and the shaft.

Check that there is no wear in the torsion bar assembly pins by ensuring that there is no free movement between the input and output pinion shafts.

Examine the housing bore for signs of wear, particularly on the rubbing surfaces of the teflon rings.

Examine the needle roller bearings for damage or wear.

If, during the above checks, any fault is found, the complete assembly must be replaced as a unit.

**Replacing the Top Seal**

Drift out the shaft assembly as detailed above.

Remove the circlip and extract the top and back-up seals.

Replace with the new seals contained in the seal kit and refit the circlip.

Refit the shaft assembly and reassemble the housing to the rack tube with a new gasket.

**Renewing the Pipe Union Seats**

If worn or damaged, the pipe union seats 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 down the nut against the housing base and withdraw the seat.

Fit new seat by inserting in the housing and tapping home square with a soft drift.

**Rack and Rack Housing**

The following items will be available as replacement parts:—

1. Rack
2. Rack Housing
3. "Clevite" Bearing
4. Seal (contained in Seal Kit).

Replacement rack housings will be complete with end cap, seals, "Clevite" bearing and needle bearing.

1 Remove the valve and pinion housing as detailed 1 previously.

Mark the location of the end cap in relation to the rack tubing.

Unscrew the ring nut retaining the end cap to the rack tube and withdraw the cap.

Remove the union from the rack tube and push out the centre seal housing from the pinion housing end of the tube.

Check the condition of the piston and ring and if worn or scratched renew complete.

Remove the outer circlip and withdraw the piston. Note any shims which may be fitted between the inner circlip and the piston.

Remove the "O" ring from the shaft and replace with the new part contained in the Seal Kit. Refit the piston and secure with circlips.

Check that end float between piston and circlip does not exceed ·010". If this condition exists reduce end float by adding a shim.

**IMPORTANT:** Check that the piston rotates freely between the circlips on completion.

Remove the "O" rings and seal from the centre seal housing and discard. Replace with new parts contained in the Seal Kit.

Insert the housing into the tube with the lips of the seal facing towards the centre.

Line up the hole in the housing with the hole in the tube and secure with the union.

Insert the rack in the rack housing. Extreme care must be taken to ensure that the oil seal in the housing is not damaged by the rack teeth.

Remove the "O" ring and oil seal from the end cap. Check the condition of the "Clevite" bearing and replace if worn or damaged with a new bearing. A mandrell machined to the internal diameter of the bearing should be used when refitting to prevent the bearing collapsing.

Renew the oil seal and "O" ring and refit the end cap. Line up the location marks made during removal and secure with the ring nut. Care must be taken to ensure that the end cap does not turn when tightening the ring nut. Any movement will place the mounting brackets out of phase with each other.

Refit the rack adjuster pad, spring, adjuster screw and locknut, but do not attempt to carry out any rack adjustment at this stage.

**Final Assembly**

Place a new seal joint over the three studs in the rack housing.

Refit the pinion housing, noting the position as marked on removal.

Check that the pinch bolt slot is in the same relative location as noted on removal when engaging the pinion with the rack teeth.

Allow for the spiral in the pinion assembly when reassembling. Fit the self-locking nuts and tighten down evenly.

Refit the inner ball joints and track rods as an assembly as detailed on page IIY.s.4 under "Ball Pin Knock". If the inner ball joint is to be replaced due to wear, a new unit complete with track rod must be obtained. **ADJUSTMENT OF THE JOINT IS NOT PERMISSIBLE.**

Refit the outer ball joints if removed; adjust the length of each track rod to 8·75"(22·2 cm.) between the ball joint centres. IT IS IMPORTANT that the track rods are of equal length.

Adjust the rack back-up pad as detailed on page IIY.s.3.

Refit the grease nipple and the external pipes.

Coat both rack ball housings with 2 oz. (56·7 grammes) of the recommended grade of grease, fit the bellows and secure with the clips to the track rod and steering housing.

Apply a grease gun to the nipple in the back-up adjuster pad and inject 1 oz. (28·35 grammes) of the recommended lubricant.

Do not lubricate the housing to the extent where the bellows become distended. Over-lubrication may also block the air transfer pipe.

**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 lower and upper steering columns as detailed on page IIY.s.8.

Refill the reservoir to the full mark of the dipstick with the recommended grade of Automatic Transmission Fluid.

Bleed the system as follows:—

(a) With the engine running, turn the steering from lock to lock a few times to expel any air which may be present, indicated when all lumpiness has disappeared.

(b) Check the fluid level in the reservoir and top up if necessary with the recommended grade of fluid. The correct level is just above the filter element.

# STEERING COLUMN

The upper and lower steering columns and mountings are of the collapsible type designed to comply with U.S.A. Federal Safety Regulations.

The collapse points are retained by nylon plugs which will shear on impact, allowing the steering wheel and columns (upper and lower) to move forward.

NO ATTEMPT must be made to repair the units if damaged due to accident. NEW replacement items MUST be fitted.

## UPPER STEERING COLUMN

### Description

The upper steering column (inner) is composed of two separate sliding shafts retained to a fixed length by nylon plugs, the outer column being pierced in a lattice form.

The inner shaft assembly is supported in the outer column by two pre-lubricated taper roller bearings.

A gaiter covers the pierced portion of the outer column to seal against the ingress of dirt.

### Removal

Disconnect the battery.

Withdraw the self-tapping screws and remove the under-scuttle casing above the steering column.

Disconnect the cables contained in the direction indicator switch harness.

Note the location of the connections for reference when refitting.

Withdraw the ignition key, remove the ring nut and detach the ignition lock from the mounting bracket on the steering column.

**Note:** If the car is fitted with air-conditioning equipment, the switch will be mounted on a bracket attached to the evaporator unit and need not be removed.

If the car is fitted with a steering column lock, removal of the lock will not be possible, and it will be necessary to disconnect the attached cables at the snap connectors.

Release three grub screws in the steering wheel hub and remove the steering wheel motif.

Remove the locknut, hexagon nut and flat washer, and withdraw the steering wheel from the splines on the inner column.

Remove the nut, lockwasher and pinch securing bolt the upper universal joint to the lower steering column.

Remove two nuts and lockwashers securing the upper column lower mounting bracket to the underside of the scuttle.

Remove two bolts, nuts, lockwashers and distance pieces securing the upper mounting bracket to the support bracket on the body.

Withdraw the upper column from the splines on the lower column.

**Note:** If the steering column has not been damaged by impact, i.e. if the nylon plugs in the inner column or the top mounting bracket have not sheared, excessive force must NOT be used to separate the upper universal joint from the lower column.

### Refitting

Refitting is the reverse of the removal procedure.

Set the road wheels in the straight ahead position and check that the bolt holes in the lugs of the upper column universal joint register correctly with the groove machined in the lower column splines. Tighten the pinch bolt to a torque of 16–18 lb. ft. (2·2–2·5 kgm.).

### IMPORTANT

Excessive force as noted under "Removal" must not be used when reassembling the universal joint to the column.

UNDER NO CIRCUMSTANCES should a mallet or similar tool be used when engaging the splines in the joint and column.

If the splines will not engage freely, inspect for damage or burrs and remove with a fine file.

NO ATTEMPT must be made to repair any nylon plugs which have sheared due to impact.

### Dismantling

Dismantling is confined to removing the steering column adjuster locknut, the splined shaft and the direction indicator switch as detailed on page IIY.s.8.

## LOWER STEERING COLUMN

### Description

The lower steering column comprises two sliding shafts retained to a fixed length by nylon plugs.

### Removal

Remove the upper steering column as detailed

previously.

Remove the nut, lockwasher and bolt securing the column to the lower universal joint and withdraw the column rearwards through the grommet.

**Note:** If the steering column has not been damaged by impact, i.e. if the nylon plugs in the column have not sheared, excessive force must NOT be used to separate the column and the lower universal joint.

**Refitting**

Refitting is the reverse of the removal procedure.

Check that the bolt holes in the universal joint register correctly with the groove machined in the column splines. Tighten the pinch bolt to a torque of 16–18 lb. ft. (2·2–2·5 kgm.).

**IMPORTANT**

Excessive force as noted under "Removal" must not be used when reassembling the universal joint to the column. UNDER NO CIRCUMSTANCES should a mallet or similar tool be used when engaging the splines in the joint or the column.

If the splines will not engage freely, inspect for damage or burrs and carefully remove with a fine file. NO ATTEMPT must be made to repair any nylon plugs which have sheared due to impact.

**FRONT WHEEL ALIGNMENT**

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

**Important**

Inflate all tyres to the recommended pressures.

Each wheel must be adjusted individually by means of the tie-rods to give half the total toe-in of $\frac{1}{16}$" to $\frac{1}{8}$" (1·6 to 3·2 mm.).

**Procedure**

Set the front wheels in the straight ahead position.

Centralise the steering by removing the grease nipple from the rack adjuster pad and inserting the centralising tool (Jaguar Part No. 12297).

Check the alignment of the front wheels by using light beam equipment or an approved tract setting gauge.

If adjustment is required, slacken the locknuts at the outer end of each tie-rod, release the outer clips securing the rack housing bellows to avoid distortion after turning the tie-rods.

Turn the tie-rods by an equal amount in the necessary direction until the alignment is correct. Tighten the locknut and re-check.

Ensure that the bellows are not twisted and tighten the clips.

REMOVE THE CENTRALISING TOOL and refit the grease nipple to the rack adjuster pad.

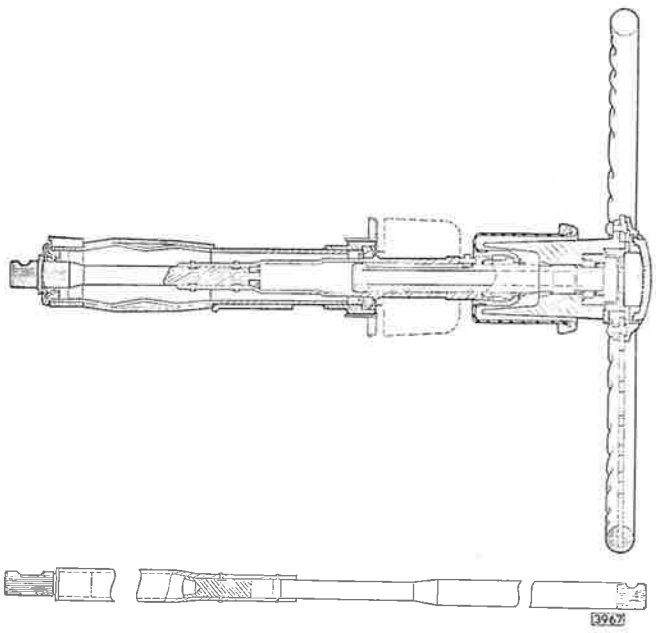


Fig. 4.

# FAULT FINDING CHART

| FAULT | POSSIBLE CAUSE | REMEDY |
|---|---|---|
| External oil leaks from Rack and Pinion unit. | Damage or wear to seals or incorrect tightening of unions or bolts. | It is most important that source of the leak is traced before any attempt is made to rectify. Once the leak is located, tighten the unions or bolts or replace the seals as necessary. |
| Leak at reservoir. | Cover gasket damaged.<br>Hose connection loose. | Renew gasket.<br>Tighten hoses. |
| Leak at pump shaft. | Worn or damaged seals on shaft. | Replace pump. |
| Steering veering to right or left. | Unbalanced tyre pressures or faulty tyres. Steering gear out of trim. | Check as detailed on Page IIY.s.4. |
| Heavy steering when driving. | Low tyre pressures.<br>Tightness or stiffness in column and/or steering and suspension joints. | Inflate tyres.<br>Grease or replace components. |
| Heavy steering when parking. | Loose pump belt (nearly always accompanied by a squealing noise).<br>Insufficient pressure from pump due to defective pump valve or restricted hoses.<br>Insufficient pressure due to high leaks in steering gear. | Check pump belt, replace if necessary.<br>Remove restriction or check pump pressure as detailed on Page IIY.s.5.<br>Replace pump if faulty.<br>Confirm high internal leaks. If proven, remove the rack unit from the car and replace seals. |
| Steering effort too light. | Worn torsion dowel pins or torsion bar broken. | Remove valve housing and fit new unit. |
| Poor straight running. | Incorrect tyre pressures.<br>Incorrect toe-in. | Inflate.<br>Check and reset as necessary. |
| Noise from pump. | Belt loose, indicated by squealing during parking manoeurvres.<br>Other pump noises are due to wear or damage. | Check belt and replace as necessary.<br>Replace pump. |
| Rattle when travelling on rough roads. | Wear between rack and pinion assembly.<br>Wear at ball joints at the ends of the rack.<br>Wear in the rack housing bush. | Adjust rack pad adjuster screw as detailed on Page IIY.s.3.<br>Renew ball joint and track rod as an assembly.<br>Remove the rack and renew the bush. |

# SECTION J

## FRONT SUSPENSION

The front suspension remains basically the same as that detailed in Section J—3·8 "E" Type Service Manual with the exception of the removal of the wheel hubs when steel spoked wheels are fitted and the torsion bar settings.

The routine maintenance periods are increased from those stated previously.

**Wheel Swivels**

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

A bleed hole is provided in each ball joint; The hole being covered by a nylon washer which lifts under pressure and indicates when sufficient lubricant has been applied.

The nipples are accessible from underneath the car.

**Wheel Bearings**

Removal of the wheel bearings will expose a grease nipple in the wheel hubs.

Lubricate sparingly with the recommended grade of lubricant. If excess grease is pumped into the bearing the grease will exude into the bore of the hubs (Wire wheels) or through a small hole drilled centrally in the hub end cap (Pressed steel wheels).

### TORSION BAR SETTING

Check that the car is full of petrol, oil and water and that the tyre pressures are correct.

Place the car on a perfectly level surface, with the wheels in the straight ahead position.

Check the measurement from the centre line of the inner fulcrum of each lower wishbone assembly to the ground. This should be 9" (22·86 cm.) minimum.

If any adjustment is required this should be carried out in accordance with the instructions given in Section J—Page J.15 of the 3·8 "E" Type Service Manual.

The correct dimensions for the hole centres for setting links are as follows:—

**Without air-conditioning equipment**

| | |
|---|---|
| 4·2 "E" Type—Open Sports | $17\frac{25}{32}$" (45·16 cm.) L.H.D. |
| 4·2 "E" Type—F.H.C. | $17\frac{25}{32}$" (45·16 cm.) L.H.D. |
| 4·2 "E" Type—Open Sports | $17\frac{31}{32}$" (45·6 cm.) R.H.D. |
| 4·2 "E" Type—F.H.C. | $17\frac{31}{32}$" (45·6 cm.) R.H.D. |
| 4·2 "E" Type—2+2 | $18\frac{1}{8}$" (46·06 cm.) L.H.D./R.H.D. |

**With air-conditioning equipment**

| | |
|---|---|
| 4.2 "E" Type—Open Sports | $17\frac{31}{32}$" (45·6 cm.) L.H.D./R.H.D. |
| 4·2 "E" Type—F.H.C. | $17\frac{31}{32}$" (45·6 cm.) L.H.D./R.H.D. |
| 4·2 "E" Type—2+2 | $18\frac{5}{16}$" (46·5 cm.) L.H.D./R.H.D. |

This method ensures that the headlamps centres are maintained at the correct height from the ground level necessary to conform to U.S.A. Federal Regulations which is 24" (60·9 cm.).

### FRONT HUBS (Pressed Steel Wheels)

If the car is fitted with pressed steel wheels, available as optional equipment, the hub nut and split pin retaining the hub to the stub axle is accessible after prising off the end cap.

Further removal, dismantling, bearing end float and refitting details remain as stated on Page J.13 of the 3·8 "E" Service Manual.

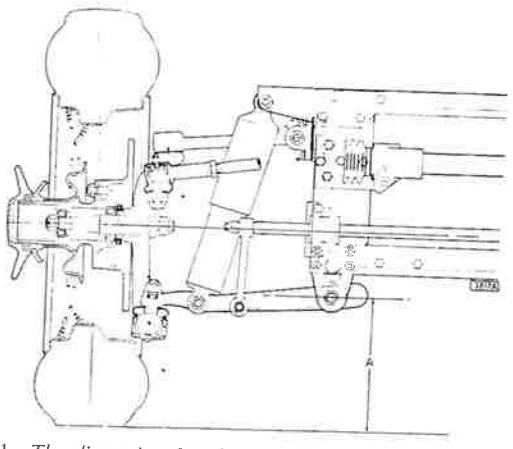

Fig. 1. *The dimension for checking the front suspension riding height.*
A—9" (22.8 cm.)

# SECTION L

## BRAKES

## DATA

| | |
|---|---|
| Caliper type | Girling bridge type with quick change pads |
| Brake disc diameter—front | 11″ (27·9 cm.) |
| —rear | 10″ (25·4 cm.) |
| Master cylinder bore diameter | $\frac{7}{8}$″ (22·23 mm.) |
| Master cylinder stroke | 1·30″ (3·3 cm.) |
| Servo unit type | Lockheed Dual—line |
| Main friction pad material | Mintex M.59 |
| Handbrake friction pad material | Mintex M.34 |

*Key to Figs. 1*

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 Slave cylinder primary chamber
B Outlet port—front brakes
C Inlet port for secondary piston
D Outlet port—rear brakes
E Vacuum
F Air pressure
G Diaphragm
H Filter
I Air control spool
J To rear brakes
K To front brakes
L Dual slave cylinder
M Servo unit
N Master cylinder
O Brake reservoirs
P To manifold
Q To reservac
R Reaction valve
S Atmospheric pressure

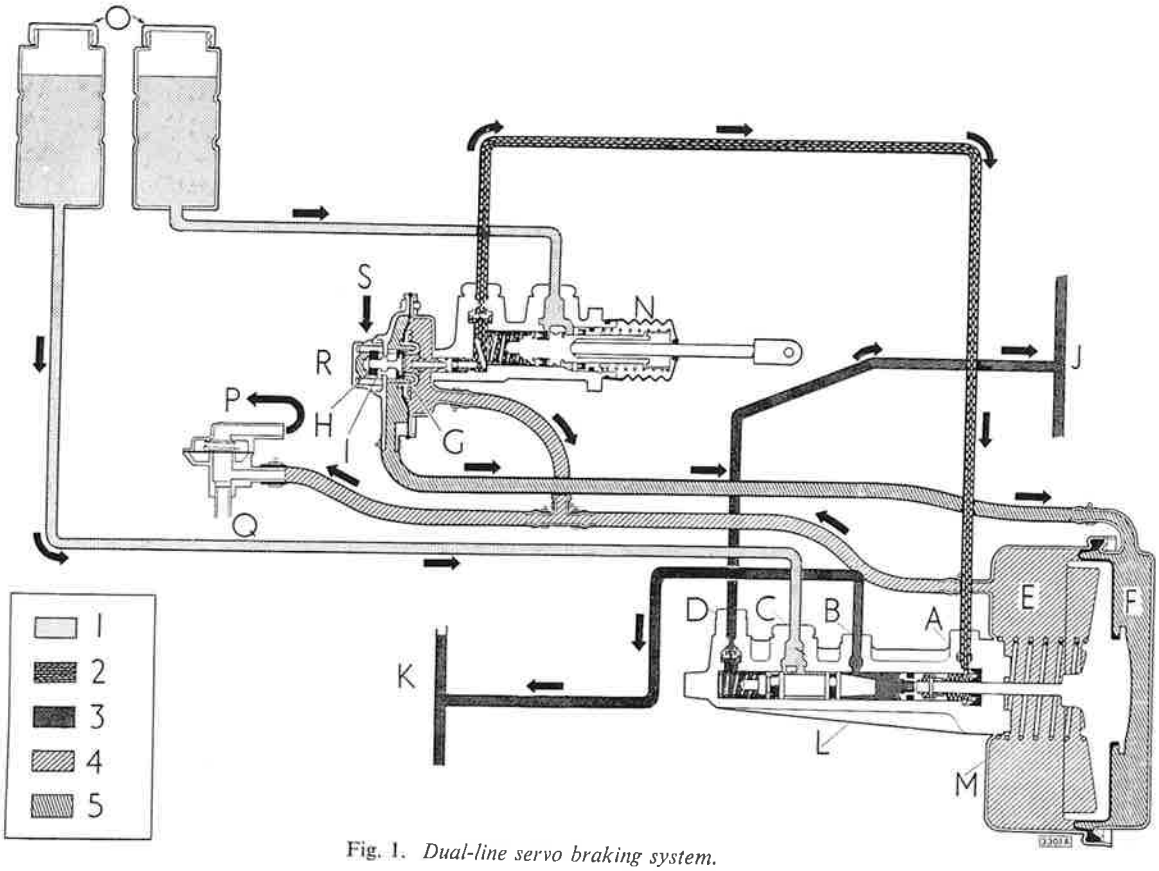


Fig. 1. *Dual-line servo braking system.*

## DESCRIPTION

The dual-line servo braking system consists of 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 consisting of a single cast iron cylinder housing a steel, black oxided piston sealed by a single hydraulic cup. This piston is deeply skirted to engage the operating push rod. The smaller intermediate piston, housed in its own bore in the nose of the master cylinder, is actuated by hydraulic pressure generated within the main chamber.

Mounted on the end of the master cylinder, the reaction valve consists of a pair of flow control valves which sequence the flow of air to the booster. Both control valves are operated by the intermediate piston in the master cylinder. A flat plate, interposed between the two master cylinder pistons, enables the intermediate piston to function mechanically in the event of an hydraulic failure.

The booster portion of the integral booster slave cylinder assembly consists of a pressed tank which houses a moulded phenolic resin p and a rubber rolling diaphragm. A push rod, secured to the piston, extends through the forward face of the tank into the slave cylinder. This push rod provides the principal motive force for the tandem pistons.

On the forward face of the boost tank is mounted the tandem slave cylinder which 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 a failure, operate independently.

## 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 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 front and rear brakes.

### SAFETY FACTORS

In the event of a 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 rear brakes will result in the slave cylinder secondary piston travelling to its fullest extent, down the bore. This has the effect of isolating the rear brake line from the rest of the system and permitting normal fluid pressure to build up in the front brake line.

If a fault exists in the front 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 rear 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.

## REMOTE SERVO AND SLAVE CYLINDER

**Removal**

Remove the trim on the floor recess panel on the left-hand side of the car. This will disclose the three nuts securing the remote servo to the bulkhead. Withdraw the three nuts.

Drain the fluid from the system.

Disconnect the four brake pipe unions and the two flexible hoses.

Remove the battery and carrier bracket for the battery tray.

Withdraw the bolt securing the slave cylinder to the mounting bracket on the outer side member. Remove the servo together with the slave cylinder.

**Refitting**

Refitting the servo is the reverse of the removal procedure. Bleed the system after replenishing with fresh fluid.

## MASTER CYLINDER AND REACTION VALVE

**Removal**

Drain the fluid from the system. Disconnect the two hydraulic pipes from the master cylinder. Disconnect the vacuum hose from the reaction valve.

Remove the clevis pin, which is retained by a split pin, securing the brake pedal to the master cylinder push rod from inside the car. In the case of right-hand drive cars, remove the top of the air cleaner and reaction valve prior to removing the two nuts securing the master cylinder to the mounting.

On left-hand drive cars the master cylinder and reaction valve can be removed as a complete unit.

**Refitting**

Refitting is the reverse of the removal procedure. Bleed the system after replenishing with fresh fluid.

## SERVICING THE UNIT

### General

Prior to dismantling either the remote servo or the master cylinder reaction valve assembly, it is advisable to obtain repair kits containing all the necessary rubber parts required during overhaul. Three separate repair kits are available as follows:—

(a) Remote servo repair kit.

(b) Reaction valve repair kit.

(c) Master cylinder repair kit.

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, with particular reference to those listed below and make renewals where necessary:—

(a) the reaction valve piston and bore.

(b) the master cylinder piston and bore.

(c) the servo slave cylinder pistons and bore.

(d) the servo push rod stem.

If any of the vacuum hose connections have become loose in service these must be rectified prior to reassembly.

The vacuum non-return valve is a sealed unit and, if faulty, it must be replaced by a new assembly.

## THE REMOTE SERVO (Fig. 2)

### 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. Remove the end cover from the servo.

Remove the diaphragm (11) from its groove in the diaphragm support (10) and, with the servo removed 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 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 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 should be replaced.

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.

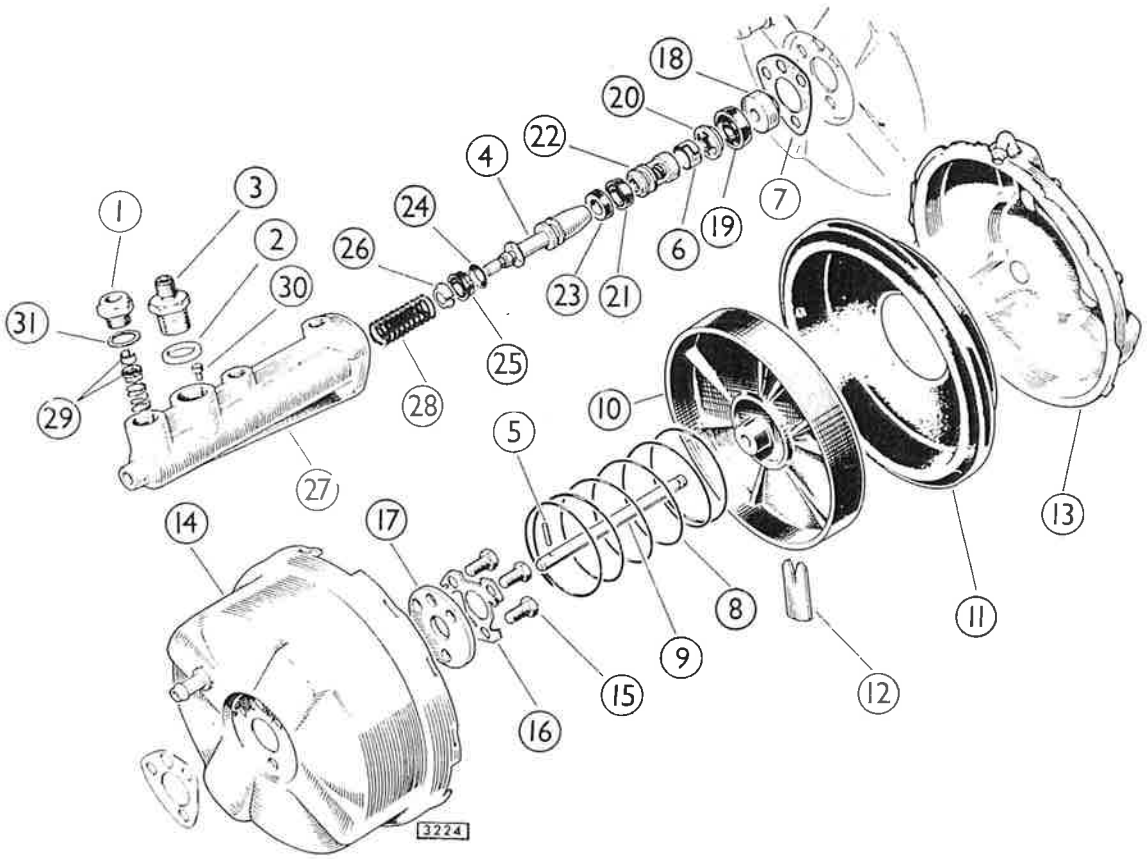


Fig. 2. *Exploded view of the remote servo.*

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

**Assembling**

Assemble the trap valve (29) complete with spring and clip into the outlet 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 Lockheed 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 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 the 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 kg/m.).

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 that it is not correctly seated. To ease assembly, smear the outside edges of the diaphragm liberally with Lockheed disc brake lubricant.

Fit the end cover using Churchill 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.

1. Diaphragm.
2. Screw.
3. Shakeproof washer.
4. Gasket.
5. Bolt.
6. Outlet adaptor.
6A. Copper gasket.
7. Trap valve body.
8. Washer.
9. Banjo.
10. Copper gasket.
11. Body.
12. Bearing.
13. Secondary cup.
14. Seal.
15. Piston.

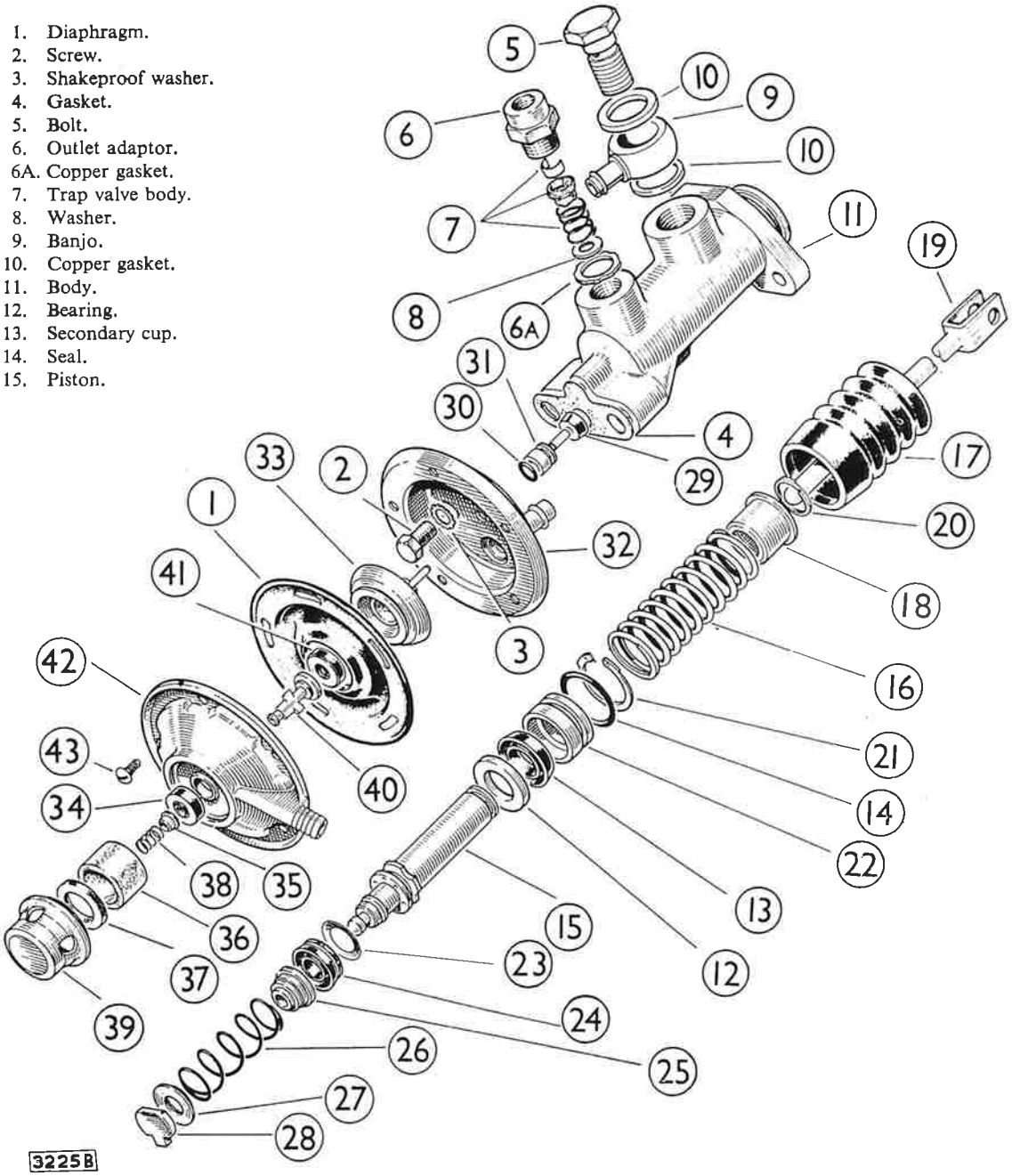


Fig. 3. *Exploded view of the master cylinder and reaction valve.*

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.

## MASTER CYLINDER AND REACTION VALVE

**Dismantling** (Fig. 3)

Unscrew and remove the fluid outlet adaptor (6) and extract the trap 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 (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 retainer, 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 the 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 (31) assembly 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.

**Assembling**

Prior to assembly liberally coat all rubber seals and plastic bearings, with the exception of the two valve rubbers, with Lockheed 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) into 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 (Tool number 7006 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.

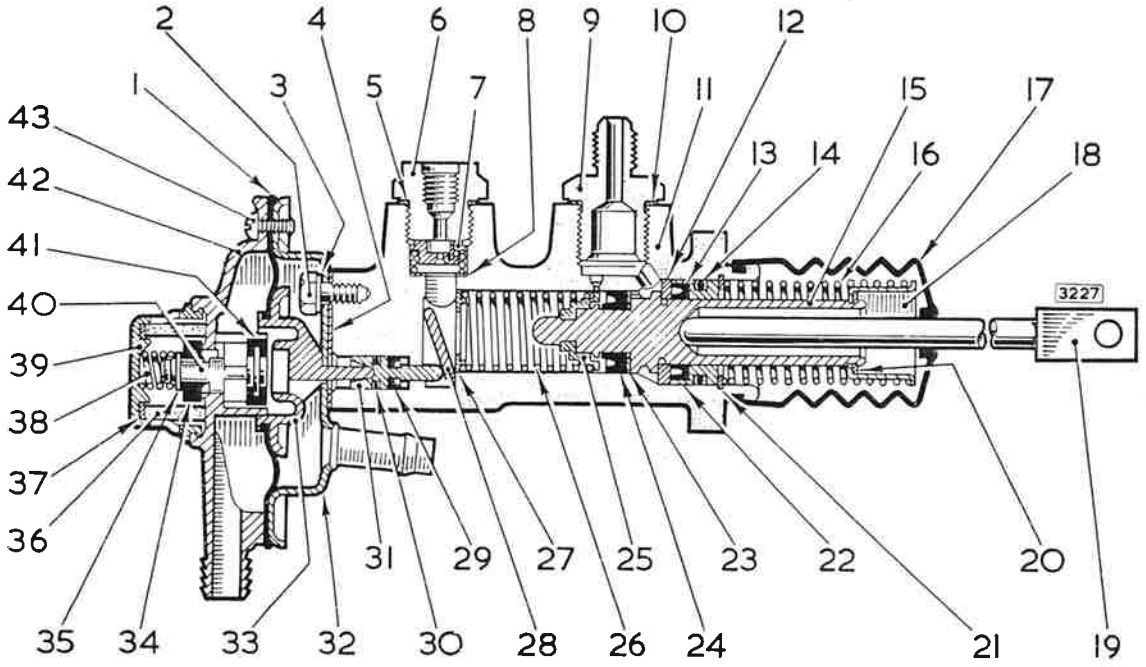


Fig. 4. *Sectioned view of the master cylinder and reaction valve.*

1. Diaphragm.
2. Screw.
3. Shakeproof washer.
4. Gasket.
5. Gasket.
6. Outlet adaptor.
7. Trap valve body.
8. Washer.
9. Inlet adaptor.
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.

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 kg/m.). 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.

Place a copper gasket under the head of the fluid outlet adaptor and screw the adaptor into the fluid outlet port. If the fluid inlet adaptor has been removed, this must be replaced in the same manner using a copper gasket under the head.

The master cylinder push rod and convoluted rubber boot can best be fitted during the installation of the assembly.

## FRICTION PADS

### Renewal

Friction pads should be renewed if it is found, on visual examination through the caliper apertures, that they have worn down to an approximate thickness of $\frac{1}{8}$" (3·2 mm.).

Withdraw the hairpin clips and extract the pad retaining pins. On front brakes, remove the anti-chatter clips from around the retaining pins and pad backing plates. Withdraw the pads.

To enable new pads to be inserted it will be necessary to lever the pistons back down the cylinder bores. It is advisable to half empty the brake fluid reservoirs otherwise forcing the pistons back will eject fluid from the reservoirs with possible resultant paint damage.

Insert new pads. Line up the holes in the backing plates and caliper bodies. Fit the retaining pins and hairpin clips: fit the anti-chatter clips to front pads. Ensure that the pads are free to move on the pins to allow for brake application and automatic adjustment.

Top up the reservoirs to the correct level and apply the brake several times until the pedal feels "solid".

## FRONT CALIPERS

### Removal

Jack up the car and remove the front wheel(s).

Disconnect the caliper fluid feed pipe from the union and seal the pipe and union.

Remove the locking wire, withdraw the mounting bolts and lockwashers and detach the caliper.

Locate the caliper in position and secure with the mounting bolts and lockwashers. Lockwire the bolts after fully tightening.

Reconnect the caliper feed pipe to the union and bleed the braking system as detailed on page L10.

## REAR CALIPERS

### Removal

The rear suspension unit must be removed in order to withdraw the rear calipers.

Proceed as described in Section K "Rear Suspension" 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 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 previously.

Remove the front hydraulic damper and road spring unit (as described in Section K "Rear Suspension")

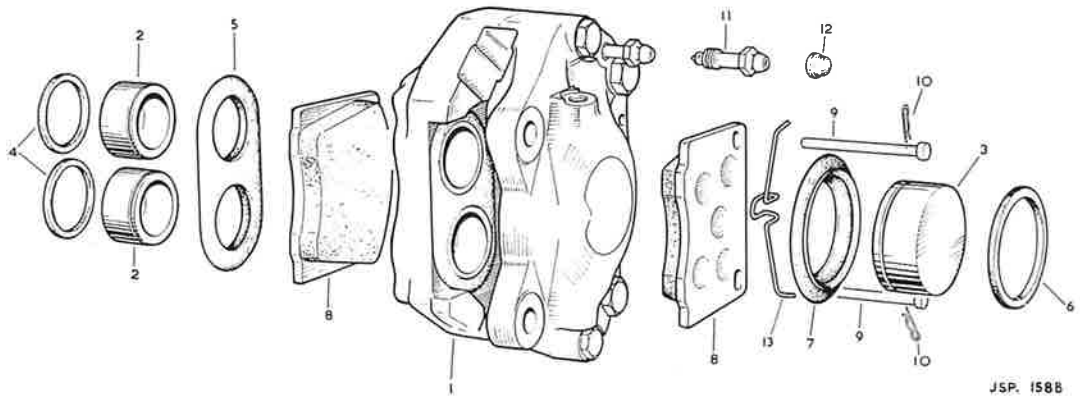


Fig. 5. *Exploded view of front caliper.*

1. Caliper body
2. Outer piston
3. Inner piston
4. Seal
5. Dust seal
6. Seal
7. Dust seal
8. Friction pad
9. Retaining pin
10. Clip
11. Brake bleed nipple
12. Dust cap
13. Anti-chatter clip

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.

The caliper can now be removed from the aperture at the front of the cross-member.

**Refitting**

Refitting is the reverse of the removal procedure.

Fit the fluid supply pipe and the bridge pipe. Bleed the braking system.

## 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 in Section J "Front Suspension").

## THE REAR BRAKE DISCS

**Removal**

Remove the rear suspension unit (as described in Section K "Rear Suspension").

Invert the suspension and remove the two hydraulic damper and road spring units (as described in Section K "Rear Suspension").

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 shins between the universal joint and the brake disc.

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.

Withdraw the handbrake pad carriers from the aperture at the rear of the cross members.

Knock back the tabs at the caliper mounting bolts.

Remove the keeper plate on the caliper and using a hooked implement, withdraw both brake pads.

Disconnect the brake fluid feed pipe at the caliper.

Unscrew the mounting bolts through the access holes in the brake disc. Remove the bolts.

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 halfshaft assembly upwards until the brake disc can be withdrawn from the mounting bolts.

**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.

Refit the rear suspension (as described in Section K "Rear Suspension").

Bleed the brakes.

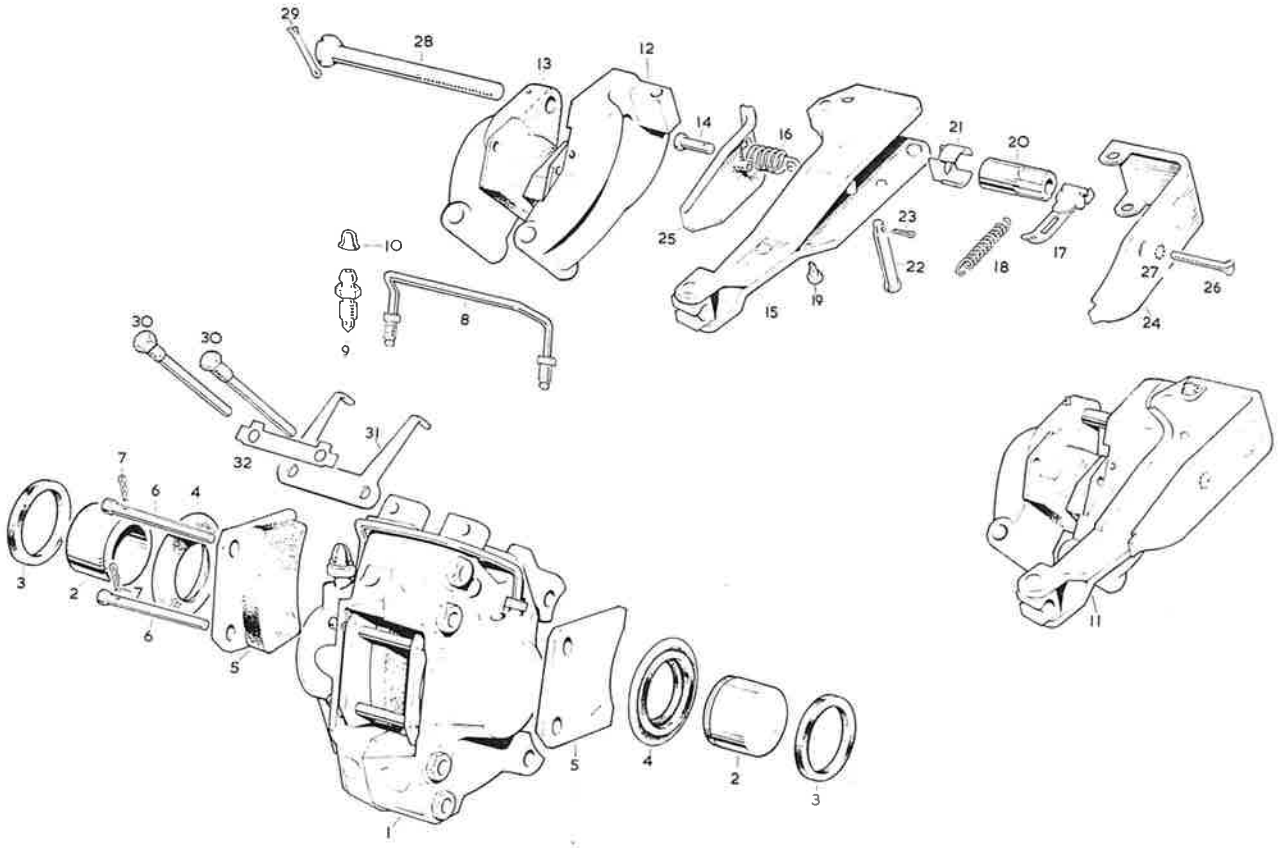


Fig. 6. *Exploded view of a rear brake caliper.*

JSP159A

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. Handbrake mechanism assembly
12. Pad carrier assembly (R.H. outer)
13. Pad carrier assembly (R.H. inner)
14. Anchor pin
15. Operating lever
16. Return spring
17. Pawl assembly
18. Tension spring
19. Anchor pin
20. Adjusting nut
21. Friction spring
22. Hinge pin
23. Split pin
24. Protection cover
25. Protection cover
26. Belt
27. Washer
28. Bolt
29. Split pin
30. Bolt
31. Retraction plate
32. Tab washer

## BRAKES

### THE BRAKE/CLUTCH PEDAL BOX ASSEMBLY

**Removal** (L.H. Drive)

Remove the servo vacuum pipe and clips.

Drain the brake and clutch fluid reservoirs.

Remove fluid inlet pipes from the clutch and brake master cylinders. Plug the holes.

Remove the brake fluid warning light wires.

Remove the brake and clutch reservoirs.

Remove the fluid outlet pipes from the brake and clutch master cylinders. Plug all holes.

Remove the brake and clutch pedal pads from inside the car.

Remove the dash casing in accordance with the instructions contained in Section N (Body and Exhaust). The nuts securing the pedal box assembly to the bulkhead are now exposed and can be removed together with two distance pieces and the brake pedal stop plate. Note that there are six self-locking nuts and one plain nut with a shakeproof washer. The plain nut is located on the bottom centre stud.

Remove the brake/clutch pedal box assembly by turning it through approximately 90° to allow the pedals to pass through the hole in the bulkhead.

**Removal** (R.H. Drive)

Remove the air cleaner elbow and the carburetter trumpets.

Remove the servo vacuum pipe and clips.

Drain the brake and clutch fluid reservoirs.

Remove the fluid inlet pipes from the clutch and brake master cylinders. Plug the holes.

Slacken the rear carburetter float chamber banjo nut and bend the petrol feed pipe towards the float chamber.

Remove the brake fluid warning light wires.

Remove the brake and clutch reservoirs.

Remove the fluid outlet pipes from the brake and clutch master cylinders. Plug all holes.

Remove the five screws securing the reaction valve assembly to the valve housing and withdraw the complete assembly. The valve housing can be removed by unscrewing the two setscrews, together with the shakeproof washers, which secure the housing to the body of the master cylinder.

Remove the throttle bell crank bracket.

Remove the brake and clutch pedal pads from inside the car.

Remove the dash casing in accordance with the instructions contained in Section N (Body and Exhaust). The nuts securing the pedal box assembly to the bulkhead are now exposed and can be removed together with two distance pieces and the brake pedal stop plate. Note that there are six self-locking nuts and one plain nut with a shakeproof washer. The plain nut is located on the bottom centre stud.

Remove the brake/clutch pedal box assembly by turning it through approximately 90° to allow the pedals to pass through the hole in the bulkhead.

**Refitting**

Refitting is the reverse of the removal procedure.

When refitting the securing nuts inside the car ensure that the plain nut and the shakeproof washer are fitted on the short stud in the bottom centre position.

Ensure that the brake fluid warning light wires are fitted with one feed wire (red and green) and one earth wire (black) to each reservoir cap.

When tightening the banjo union nut ensure that the petrol feed pipe is clear of the rear float chamber.

Bleed the brake and clutch hydraulic systems.

# SECTION M

## WHEELS AND TYRES

### DESCRIPTION

Pressed spoke or wire spoke wheels, the latter in spray painted form, are available as alternative standard equipment.

Chromium plated wire spoke wheels are fitted as Special Equipment only.

Dunlop 185VR15 SP. SPORT tubed tyres are fitted as standard equipment, whitewall tyres being available to special order only.

Whitewall tyres only will be fitted to cars sold in U.S.A. or CANADA.

These tyres will have the "MAXIMUM LOADING" and "MAXIMUM PRESSURE" information moulded on the wall of the tyre, necessary to conform to U.S.A. FEDERAL REGULATIONS.

This information, together with Seating Capacity, Seating Distribution and Recommended Tyre Size data is also quoted on a panel attached to the inside of the glove box lid.

| | |
|---|---|
| Type—standard equipment | Pressed spoke |
| | Wire spoke—spray painted |
| —special equipment | Wire spoke—chromium plated |
| Fixing—Pressed spoke | Five studs and nuts |
| —Wire spoke | Centre lock, knock-on hub cap |
| Rim Section—Pressed spoke | 6 JK |
| —Wire spoke | 5 K |

**Tyres**

| | |
|---|---|
| Make | Dunlop |
| Type | 185VR15 SP. SPORT |

### IMPORTANT

It is particularly important that tyres of different makes or 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 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 of the correct type cannot be overstressed. The Dunlop 185VR15 SP. SPORT tyres fitted as original equipment are specially produced to suit the performance of the car, and a change of make or tyre should not be made unless an assurance is given by the tyre manufacturer concerned that the alternative type is suitable for the car under maximum performance conditions.

## INFLATION PRESSURES

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

| **Dunlop SP Sport 185VR15** | Front | Rear |
|---|---|---|
| For speeds up to 125 m.p.h. (200 k.p.h.) | 32 lb/sq. in. (2.25 kg/cm²) | 32 lb/sq. in. (2.25 kg/cm²) |
| For speeds up to maximum | 40 lb/sq. in. (2.81 kg/cm²) | 40 lb/sq. in. (2.81 kg/cm²) |

**Tyres for Winter Use**

(When snow conditions make the use of special tyres necessary).

**Dunlop Weathermaster SP. 44.185x15**

(For use on rear wheels to replace SP. Sports tyres)

Maximum permitted speed 100 m.p.h. (160 k.p.h.) — 32 lb/sq, in. (2.25 kg/cm²)

### TYRES

**General Information**

The Dunlop tyres specified have been specially designed for the high speeds possible with 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 no attempt is made to

repair damaged or punctured tyres.

All tyres which are suspect in any way should be submitted to the tyre manufacturer for their examination and report. The importance of maintaining all tyres in perfect condition cannot be too highly stressed.

**IMPORTANT**

The use of standard inner tubes with Weathermaster tyres is NOT permissible.

Special tubes are available and are identified by the size and lettering "Weathermaster Only".

These special tubes should NOT be used with standard tyres.

## WIRE SPOKE WHEELS

**Description**

Dunlop cross-spoked wheels are fitted as optional equipment.

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 rim to the flanged or inner end of the shell.

Dismantling, reassembling, and adjustment details remain the same as that detailed in the 3.8 'E' Type Service Manual Section M.

**Warning**

Chromium plated wire wheels are protected by a clear lacquer which, under normal circumstances, should never be removed. Should removal become necessary, due to dismantling the wheel, however, the best results can be obtained by using British Domolac L10–12 Cellulose Thinners.

UNDER NO CIRCUMSTANCES SHOULD A WIRE SPOKED WHEEL BE FITTED TO THE CAR IN AN UN-LACQUERED CONDITION.

To re-lacquer, the wheels should be treated with "NECOL" which is an I.C.I. clear cellulose air-drying lacquer. This will obviate rust stains originating at the unprotected threaded portion of the spokes.

# SECTION N

## BODY AND EXHAUST

### SIDE FACIA PANEL

**Removal**

Disconnect the battery.

Remove the screen rail facia.

Withdraw all warning light and panel illumination bulb holders. Note the location for reference when refitting.

Remove the chrome ring nut and withdraw the dipper switch from the panel.

Disconnect the speedometer drive cable from the instrument head.

Withdraw the plastic retaining clip and seperate the plug and socket connection attached to the tachometer cables.

Disconnect the brake fluid warning light cables.

Disconnect the control cable from the heater air outlet ducts after releasing the locking screw securing the inner cable to the air duct operating spindle.

Remove the locknut securing the outer cable to the air duct bracket. Withdraw the cable and collect the loose adaptor.

Remove the two thumbscrews and lower the centre instrument panel.

Release two setscrews securing the two heater inner control cables to the control levers and withdraw the cables.

Withdraw two slotted screws and one setscrew, nut, and washer securing the side facia panel to the centre panel support bracket and two nuts and washers securing the panel to the support bracket at the base of the screen pillar and remove the panel.

**Refitting**

Refitting is the reverse of the removal procedure.

Reconect the heater and air outlet control cables ensuring that the full movement of the levers is maintained.

Reconnect the warning and panel light illumination bulb holders as noted on removal.

### GLOVE BOX

**Removal**

Disconnect the battery.

Remove the screen rail facia.

Withdraw two screws and nuts and detach the grab handle from the mounting brackets.

Withdraw the choke warning light bulb holder from the socket at the rear of the glove box panel.

Release the locking screw and disconnect the choke operating cable from the lever (cars equipped with Exhaust Emission Control only).

Lower the centre instrument panel.

Remove the securing setscrews, nuts and washers as detailed for the side facia panel and detach the glove box.

**Refitting**

Refitting is the reverse of the removal procedure.

Check when reconnecting the choke control cable that the full movement of the lever is maintained when the choke is operated.

### SCREEN RAIL FACIA

**Removal**

Disconnect the battery and lower the centre instrument panel.

Remove two nuts, lock and plain washers securing the facia to the centre panel supports.

Remove two drive screws securing the facia to the demister panel (2+2 cars only).

Remove two nuts, lock and plain washers securing the facia to the body side panels at the base of the screen pillars.

Detach the flexible demister conduit pipes from the demister nozzles.

Disconnect the two cables from the map light.

Remove the facia complete with demister nozzles.

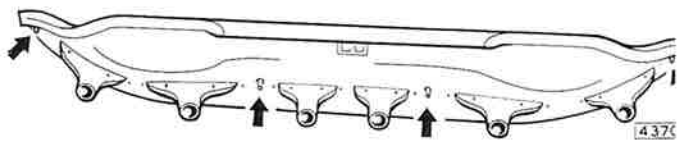


Fig. 1. *Screen rail facia.*

**Refitting**

Refitting is the reverse of the removal procedure.

Utilizing the elongated holes in the mounting brackets adjust the forward edge of the facia to the screen rail.

## DEMISTER PANEL (2+2 cars only)

**Removal**

Remove the screen rail facia as detailed previously.

Remove four setscrews, nuts and lockwashers securing the panel support brackets to the instrument panel support brackets.

Detach the conduits from the four demister nozzles.

Remove the panel complete with the demister nozzles.

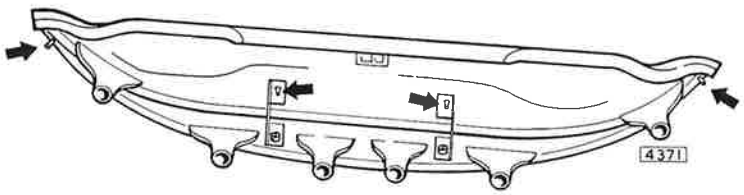


Fig. 2. *Demister panel (2+2 cars).*

**Refitting**

Refitting is the reverse of the removal procedure.

Utilising the elongated holes in the centre brackets adjust the forward edge of the panel to the screen.

## FRONT BUMPER

**Removal**

The front bumper is comprised of three components, right and left hand outer sections and a centre section.

Sections are detachable after removing the bumper as a complete assembly.

Remove the four setscrews, lock and plain washers securing the outer sections to the bonnet. The setscrews are accessible through cut-out portions in the underside of the sections.

Dismantle the bumper after removing the two setscrews, lock and plain washers securing the outer sections to the centre and the two setscrews securing the over-riders.

Remove the motif, if required, after withdrawing two drive screws, spring clip, and the backing plate.

**Refitting**

Reassembly and refitting is the reverse of the removal procedure.

Renew the beading between the bumper sections and the over-riders if worn or damaged.

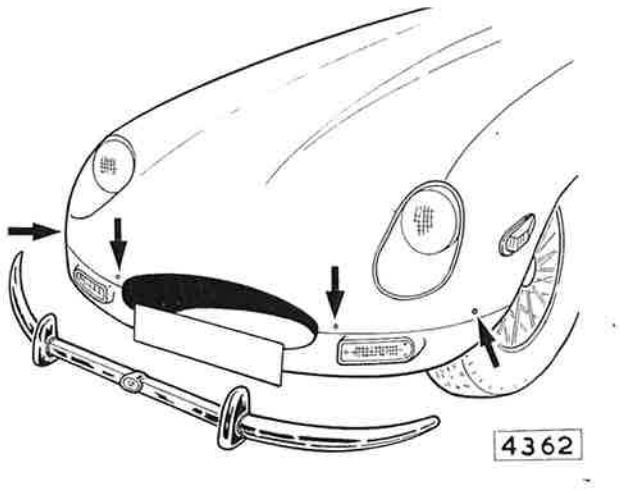


Fig. 3. *Front bumper removal The arrows indicate the mounting points.*

## REAR BUMPER

**Removal**

The rear bumper is comprised of three components, right and left hand and centre sections.

Sections are detachable after removal of the bumper as an assembly.

Remove the two setscrews, lock and plain washers and two nuts securing the bumper outer sections to the body; the setscrews are located within the wheel arch.

Release the two setscrews located above the rear lamps. Withdraw the two setscrews securing the reverse lamp carrier brackets and remove the bumper assembly.

Dismantle the bumper after removing the two setscrews, lock and plain washers securing the outer sections to the centre and the two setscrews securing the over-riders.

**Refitting**

Refitting is the reverse of the removal procedure.

Renew the beading between the bumper sections and the over-riders if worn or damaged.

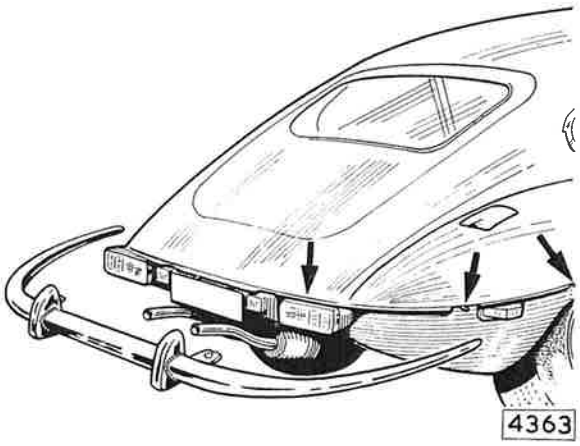


Fig. 4 *Rear bumper removal. The arrows indicate the mounting points.*

## BONNET

The removal and refitting procedure remains identical to that stated in the 3·8 "E" Type Service Manual—Page N8—with the addition of the following:—

Withdraw the split pin, washer and clevis pin and detach the front number plate tie-rod fork end from the chassis front cross tube.

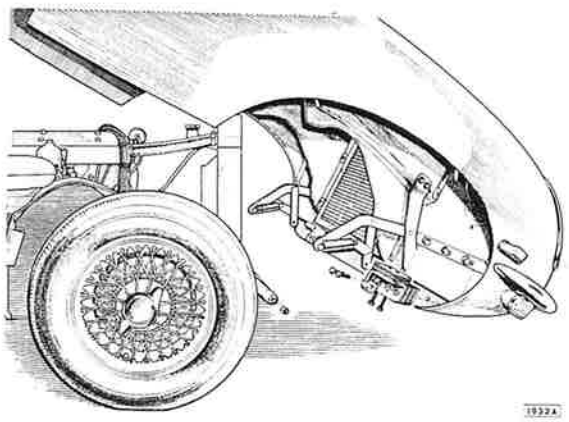

Fig. 5. *Bonnet hinge mounting points.*

## WINDOW REGULATOR

The window regulator remains the same basically as that detailed on Page N21 of the 3·8 "E" Type Service Manual with the exception of the method of securing the regulator handle.

This is now secured to the control unit by a central fixing screw and not by a pin. Removal of this screw will permit the handle to be withdrawn.

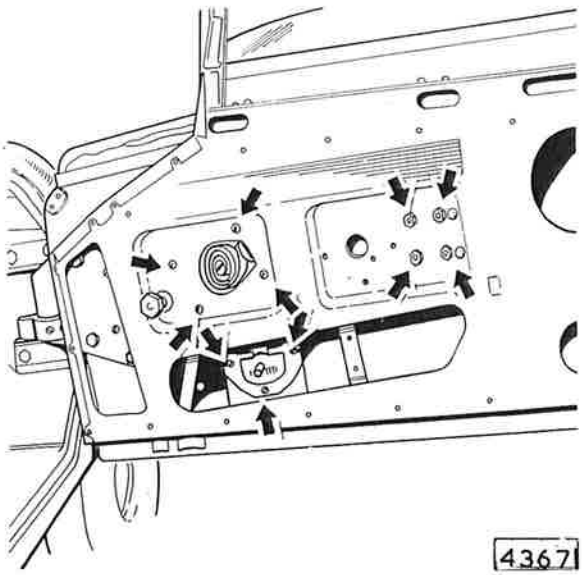


Fig. 6. *Location of the screws and nuts securing the window regulator to the door panel.*

## DOOR LOCK MECHANISM

Door locks fitted to the "E" Type Series 2 cars incorporate an anti-burst feature, while the remote control units have recessed handles.

The removal, refitting and adjusting details remain the same as those quoted in the "E" Type Service Manual with the exception of the following details:—

The recessed handle is secured to the remote control unit by a central fixing screw and not by a pin.

Removal of the screw will permit the handle to be withdrawn.

The remote control unit is not supplied in the locked position as was the previous model and no provision is made for the insertion of a pin when refitting (see Page N23 under "Locating the Remote Control Unit").

Any adjustment necessary when reconnecting the link can be made by utilising the elongated holes in the control unit mounting plate.

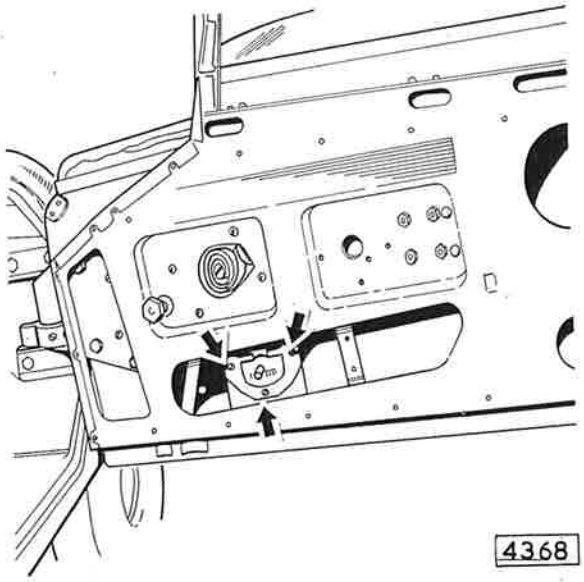


Fig. 7. *Location of the screws securing the door lock control.*

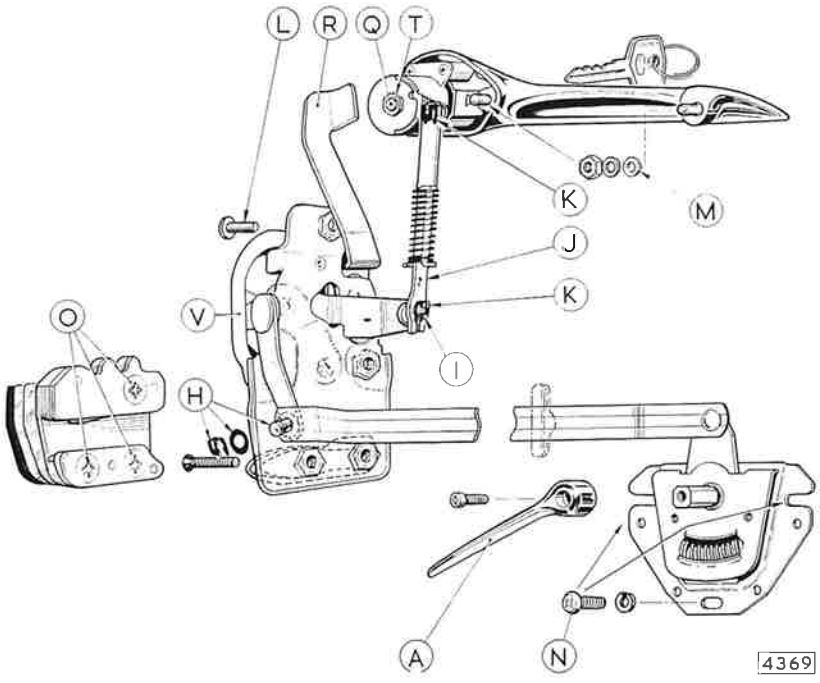


Fig. 8. *Exploded view of the door lock mechanism.*

A Interior handle.
H Lever pin, wave washer and clip.
I Spring clip.
J Adjustable link.
K Dowel.
L Latch fixing screw.
M Exterior handle fixings.
N Remote control fixing screw.
O Striker fixing screws.
Q Striker.
R Striker lever.
T. Locknut.

# SECTION O

## HEATING AND WINDSCREEN WASHING EQUIPMENT

### HEATER

The heater unit remains the same as that stated in the 3·8 "E" Type Service Manual with the exception of the following items:—

1. Heater air controls.
2. Heater temperature controls.
3. Heater fan switch.
4. Air distributor controls.

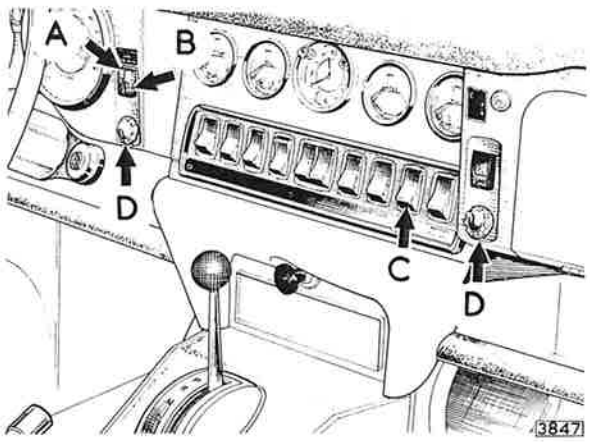


Fig. 1. *Heating and ventilating controls.*

A Heater air controls.
B Heater temperature controls.
C Heater fan switch.
D Heater outlet controls.

The outlets situated under the duct behind the facia panel, are fitted with finger operated direction controls.

Fully rotating the right-hand knob clockwise and the left-hand knob anti-clockwise will cut off all air to the interior of the car and direct the supply to the ducts at the base of the windscreen. Reverse rotation of the knobs will re-direct air progressively from the windscreen to the car interior.

### VENT CONTROL CABLES

**Removal**

Withdraw the parcel tray on each side of the dash by removing four drive screws and four thumb screws.

Release the locknuts securing the outer cables to the vent bracket. Disconnect the cables and collect the loose adaptor. Unscrew the cable from the centre finisher and withdraw the assemblies. A thin spanner will be required to remove the outer casing from the finisher.

**Refitting**

Reverse the removal procedure to refit the cables.

### AIR/TEMPERATURE CONTROLS

**Removal**

Remove the screen rail facia as detailed in Section N Page NY.s.1.

Withdraw two small screws and detach the knobs from the levers.

Release the locking screws and disconnect the control cables.

Remove the self locking nut and withdraw the lever pivot pin. Note the plain washer located between the levers.

**Refitting**

Refitting is the reverse of the removal procedure. Check that full movement of the levers is maintained when connecting the cables.

### WINDSCREEN WASHER

**Description**

The Lucas 5SJ windscreen washer replaces the unit detailed in the 3·8 Service Manual.

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 type coupling. The water container is moulded in high density polythene.

### DATA

| | |
|---|---|
| Minimum water delivery pressure .. | 4·5 lb./sq. in. (0·32 kg./sq. cm.). |
| Minimum water delivery per second .. | 3·5 c.c. |
| 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.). |
| Nominal voltage of unit .. .. | 12 |
| Maximum current consumption .. | 2 amps. |
| Resistance between commutator segments .. .. .. .. | 2·8–3·1 ohms. |

**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 filter 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 antifreeze solutions such 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 No. 6 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.

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 "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 turns 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**

Disconnect the external tube and the electrical connections and remove the cover from the container. 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.

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.

Remove the two self-tapping screws from the bearing plate. The bearing plate and rubber gasket can now be removed. Remove the two terminal screws. The terminal nuts and brushes can now be removed and the armature withdrawn. Take care not to lose the bearing washer which fits loosely on the armature shaft.

The pole assembly should not normally be disturbed. If, however, its removal is necessary, make a 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 overheated, or if any part of the motor housing is damaged, a replacement motor unit must be fitted.

Armature:—

If the armature is damaged or if the windings are loose or badly discoloured, a replacement armature must be fitted.

The commutator must be cleaned with a fluffless cloth moistened in petrol, or, if necessary, polished with a strip of very fine glass paper.

The resistance of the armature winding should be checked with an ohmmeter. This resistance should be in accordance with that given in "Data".

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. However, the following points should be noted:—

Make sure the bearing recess in the motor is filled with Rocol Molypad molybdenised grease. Remove excessive grease from the face of the bearing boss.

Check that the pole piece assembly does not rock and that the pole pieces are firmly located in the circular spigot. Ensure that the pole piece assembly and clamping member are the right way round.

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. sq. in. (0–1 kg. sq. cm.) pressure gauge.

Pushbutton with normally open contacts.

Two-jet nozzle.

On-off tap.

100 c.c. capacity measure.

4 ft. 6 in. (1·37 m.) length of plastic tubing.

Connect up the equipment as shown in Fig. 1. 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" (45·72 cm.) above the water level.

Open the tap. Depress the button for approximately five 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. Empty the measuring cylinder.

Open the tap and operate the push switch for precisely ten seconds after which period release the switch and close the tap.

During the ten-second test, the current and pressure values should be in accordance with those given in Data and at least 35 c.c. of water should have been delivered.

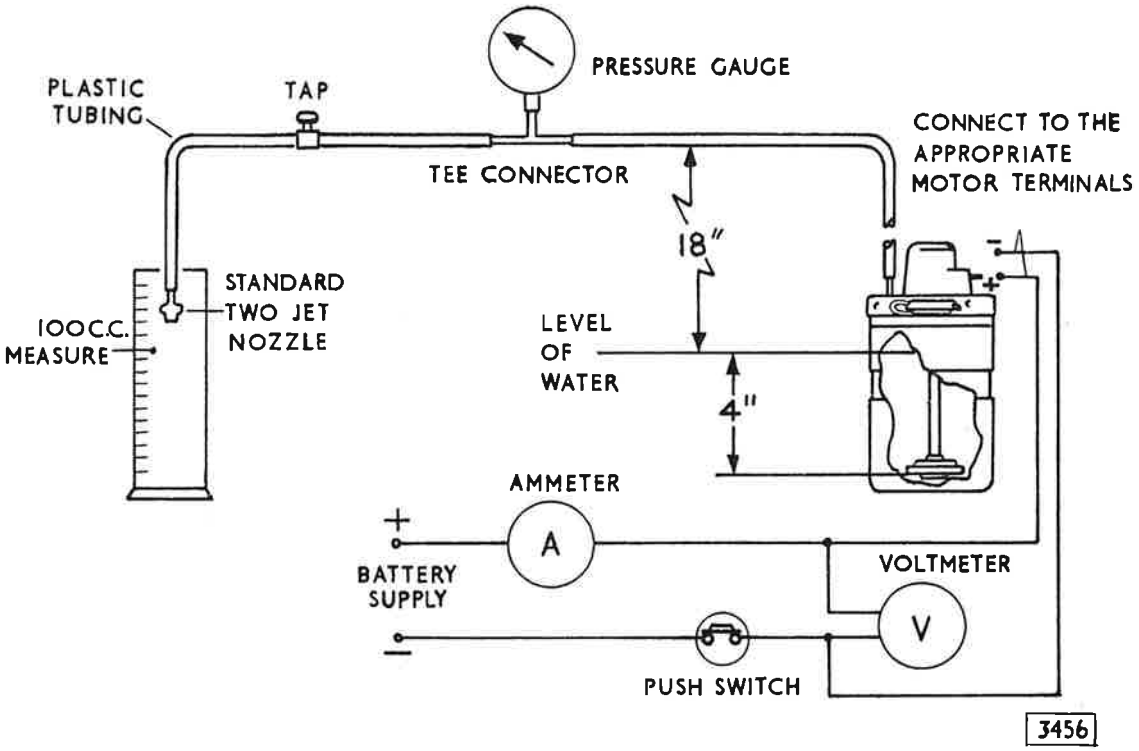


Fig. 1. *Performance testing the windscreen washing equipment.*

# SECTION P

## ELECTRICAL AND INSTRUMENTS

## BATTERY

## LUCAS CA11/7

**Description**

The Lucas Model C.A. battery, as listed above, is a new type fitted with an air lock device (Aqualok) which simplifies the topping up procedure. This device consists of a one-piece vent cover and six sliding tubes, perforated to act as air valves and fitted one to each cell aperture.

The tubes are automatically raised when the vent cover is removed and depressed when the cover is refitted.

Air or added water is admitted to the cell venting chamber (via the tube perforations) only while the tubes are in the depressed position.

No provision is provided in the battery top cover for the insertion of the prong of a heavy discharge tester.

**DATA**

| | |
|---|---|
| Battery type | CA11/7 |
| Voltage | 12 |
| Number of plates per cell | 11 |
| Capacity at 10-hour rate | 53 |
| Capacity at 20-hour rate | 60 |

**Maintenance**

Wipe away any foreign matter or moisture from the top of the battery and ensure that the connections and fixings are clean and tight.

Check the electrolyte level weekly. In extreme cold conditions the battery should be topped up immediately prior to driving the car so that the electrolyte mixing can occur to prevent freezing of the added water.

Topping up the battery should be carried out with the car on a reasonably level surface.

Remove the vent cover. If the acid level is below the bottom of the tubes pour distilled water into the trough until all the tubes are filled.

Replace the vent cover. The electrolyte level is now correct.

DO NOT, under any circumstances, top up the battery by using the normal type of battery filler which incorporates a plunger valve in the filler neck.

The use of this type of filler will depress the sliding tubes and allow the battery to be overfilled.

**Important:** The vent cover must be kept in position at all times except when topping up.

Distilled water should always be used for topping-up. In an emergency, however, clean soft rain water collected in an earthernware 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.

Clean off any corrosion from the battery cable terminals and coat with vaseline before re-connecting.

**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.

**WARNING:** Rubber sealing plugs are not incorporated in the manifold filler cover.
When removing the battery it is ESSENTIAL that extreme care is taken to ensure that it is NOT tipped to any degree.
Failure to ensure this will result in acid spillage which may cause severe acid burning to the operator and to the car.

**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 alternator or control unit, 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 as detailed on page PY.s.1. 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.

**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.

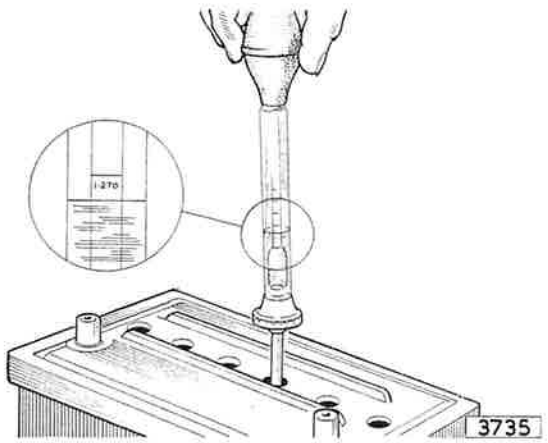


Fig. 1. *Method of topping up the Lucas C.A. battery.*

**Hydrometer Tests**

Measure the specific gravity of the acid in each cell in turn with a hydrometer. To avoid misleading readings, do not take hydrometer reading immediately after topping-up.

The reading 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 (16°C).

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 in 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".

All Service procedure concerning the following items remains as detailed on pages P8–P9 of the 3.8 'E' Type Service Manual.

(1) Recharging from an external supply

(2) Preparing new unfilled, uncharged batteries for Service

(3) Preparing new "Dry-charged" batteries for Service.

# DISTRIBUTOR

## (NOT U.S.A. AND CANADA)

A waterproof cover is incorporated in the distributor assembly, located between the distributor cap and body. This cover is detachable after removing the distributor cap and disconnecting the cable from the contact breaker spring post.

### DATA

| | |
|---|---|
| Ignition Distributor Type | 22D6 |
| 8 to 1 Compression Ratio | 41060A |
| 9 to 1 Compression Ratio | 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 to 1 Compression Ratio | 9° BTDC |
| 9 to 1 Compression Ratio | 10° BTDC |

### IGNITION DISTRIBUTOR TEST DATA

| | | | VACUUM TIMING ADVANCE TESTS<br>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<br>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 in timing below-ins. of mercury | Lucas Advance Springs Number | Acelerate 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 |
| 22 D6 | 41060A | 54415894 | 20<br>13<br>9<br>7½<br>6 | 7—9<br>6—8½<br>2½—5½<br>0—3<br>0—½ | 4½ | 55415562 | 2,300 | 8½—10½ | 1800<br>1250<br>800<br>650<br>525 | 8½—10½<br>6½—8½<br>5—7<br>2—4<br>0—1½ | 300 |
| Auto advance weights Lucas number 54413073. | | | | | | | One inch of mercury = 0·0345 kg/cm² | | | | |

## FUSE UNITS

| Fuse No. | CIRCUITS | Amps |
|---|---|---|
| 1 | Headlamps—Main Beam .. .. .. .. .. .. | 35 |
| 2 | Headlamps—Dip Beam .. .. .. .. .. .. | 35 |
| 3 | Horns .. .. .. .. .. .. .. .. .. | 50 |
| 4 | Traffic Hazard Warning System .. .. .. .. .. | 35 |
| 5 | Side, Panel, Tail and Number Plate (not Germany) Lamps .. | 35 |
| 6 | Horn Relay, Washer, Radiator Fan Motor and Stop Lamps .. | 35 |
| 7 | Flashers, Heater, Wiper, Choke, Fuel, Water and Oil Gauges .. | 35 |
| 8 | Headlamp Flasher, Interior Lamps and Cigar Lighter .. .. | 35 |
| In line | Heated Backlight (when fitted) .. .. .. .. .. | 15 |
| In line | Radio, Optional Extras .. .. .. .. .. .. | 5 |

## THE ALTERNATOR

### MODEL 11AC (43 AMP)

#### DESCRIPTION

The Lucas 11 AC 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 pad 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. 2).

The brushgear for the field system is mounted on the slip ring end cover. Two carbon brushes, one positive and one 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. There are also six silicon diodes carried on the slip ring end cover, these being connected in a three phase bridge circuit to provide rectification of the generated alternating current output (see Fig. 2). The diodes are cooled by air flow through the alternator induced by a 6″ (15·24 cm.) ventilating fan at the drive end.

The alternator is matched to an output control unit, Model 4TR, which is described on page PY.s.11.

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 device 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 Lucas 6RA relay incorporated in the circuit.

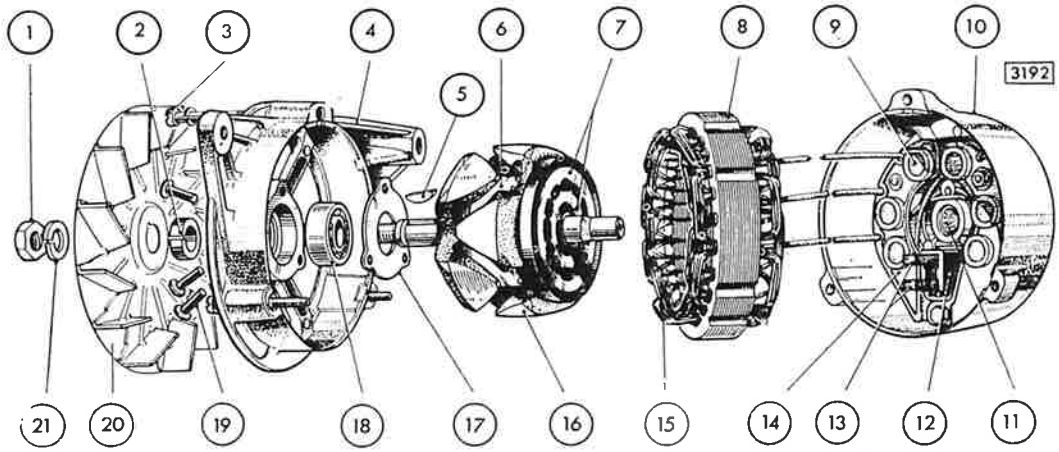


Fig. 2. *Exploded view of the Lucas 11 AC alternator.*

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 rivets.
20. Fan.
21. Spring washer.

## PERFORMANCE DATA

| | |
|---|---|
| Nominal voltage | 12 volts |
| Nominal d.c. output (hot) in amperes | 43 amperes |
| Stator phases | 3 |
| Phase connections | Star |
| Resistance/phase at 68°F (20°C) ± 5% | 0.107 ohms |
| Resistance of rotor winding in ohms at 68°F (20°C) | 3.8 ± 5% |

## 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 drive belt by pushing the spring loaded jockey pulley inwards and lifting the belt over the alternator pulley.

Remove the two bolts securing the alternator to the mounting bracket and adjuster link. Withdraw the alternator.

## REFITTING

Refitting is the reverse of the removal procedure.

When replacing the alternator belt, hold the spring loaded jockey pulley in towards the block and only release when the belt is sitting securely in the "vee" tracks.

## SERVICE PRECAUTIONS

**Important**

4·2 "E" Type cars are equipped with transistors in the control box unit and diode rectifiers in the alternator.

The car electrical system must NOT be checked with an 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 for 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, otherwise the rectifier diodes are likely to be damaged due to peak inverse voltages.

**WARNING:** When using electric welding equipment for car accident repair it is advisable to carry out the following precautions.

1. Disconnect the battery.
2. Disconnect the main output and AL cables at the alternator.
3. Disconnect all cables at the 4TR control unit.

## 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.

1. Disconnect the battery.
2. Disconnect the cable (brown) from the alternator output terminal and connect a good quality moving-coil ammeter between the disconnected cable and the output terminal.

3. 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. 3).

4. Reconnect the battery earth lead. Switch on the ignition and start the engine. Slowly increase the engine speed until the alternator is running at approximately 4,000 r.p.m. (2,000 engine r.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, in particular the earth connections, a low reading persists on repeating the test refer to paragraph (5).

   In the case of a zero reading, 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 terminals. No reading on this test indicates a fault in the field isolating relay or the wiring associated with this circuit. Check each item in turn and rectify as necessary.

5. If a low output has resulted from the test described in paragraph (4) 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 3·8 ohms.

When a ohmmeter is not available connect a 12 volt DC supply between the field terminals with an ammeter in series. The ammeter reading should be approximately 3·2 amperes Fig. 4.

A zero reading on the ammeter, or an infinity reading on the ohmmeter indicates an open circuit in the field system, that is, the brush gear slip rings or winding. Conversely, if the current reading is much above, or the ohmmeter is much below, the values given then it is an indication of a short circuit in the rotor winding in which case the rotor slip ring assembly must be changed.

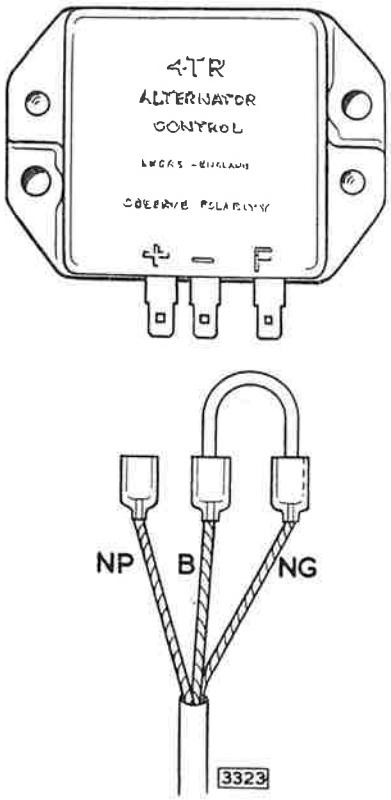


Fig. 3. *Detach the terminal connectors from the base of the control unit.*

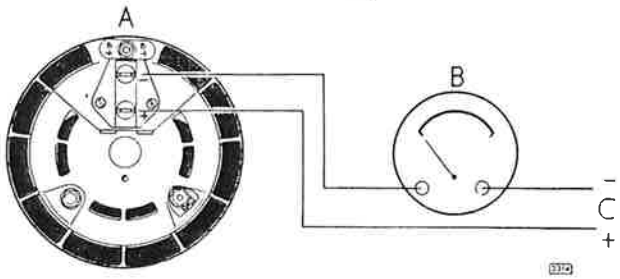


Fig. 4. *Testing the alternator with an ammeter.*
A—*Alternator.* B—*Ammeter.* C—*Battery.*

## DISMANTLING THE ALTERNATOR (Fig. 2).

Disconnect the battery and remove the alternator as detailed on page PY.s.6.

Remove the shaft nut (1) and spring washer (21). Withdraw the pulley and fan (20).

Remove bolts (3) noting that the nuts are staked to the through bolts and that 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 reassembling.

Mark the drive end bracket (4), lamination pack (8) and slip ring end bracket (10) so that they may be reassembled in correct angular relation to each other. Care must be taken not to damage the lamination pack when marking.

Withdraw the drive end bracket (4) and rotor (16) from the stator (8). The drive end bracket and rotor need not be separated unless the bearing requires examination or the rotor is to replaced.

In the latter case the rotor should be removed from the drive end bracket by means of a hand press having first removed the shaft key (5) and bearing collar (2).

Remove the terminal nuts, washers and insulating pieces brush box screws and the 2 B.A., hexagon headed setscrew. Withdraw the stator and diode 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 together with the terminal assemblies from the moulded brushbox.

## REASSEMBLY

Reassembly of the alternator is the reverse of the dismantling procedure. Care must be taken to align the drive end bracket, lamination pack, slip ring and bracket correctly.

Tighten the three through bolts evenly to a maximum torque of 45 to 50 lb./ins. (0·518 to 0·576 kgm.). Restake the nuts after tightening.

Tighten the brush box fixing screws to a maximum torque of 10 lb./ins. (0·115 kgm.).

## IMPORTANT

It is important to ensure that a .045″ (1.28 mm.) gap exists between the non-pivotal end of the heat sinks (see Fig. 15) when reassembling the alternator.

## INSPECTION OF BRUSHGEAR (EARLY MODELS)

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.) 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 30° with the terminal blade.

The normal brush spring pressures are 4–5 oz. (113 to 142 gms.) with the spring compressed to $\frac{25}{32}$″ (19·84 mm.) in length and 7½ to 8½ oz. (212 to 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.

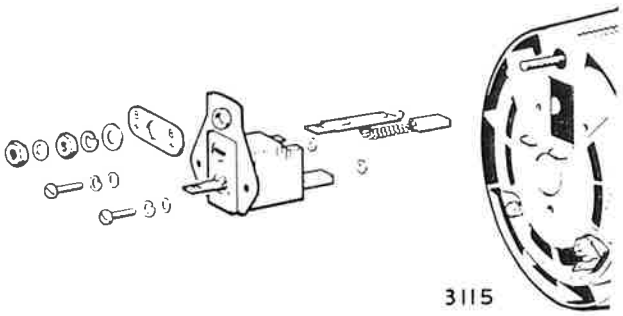


Fig. 5. *Showing the brush removal (early cars).*

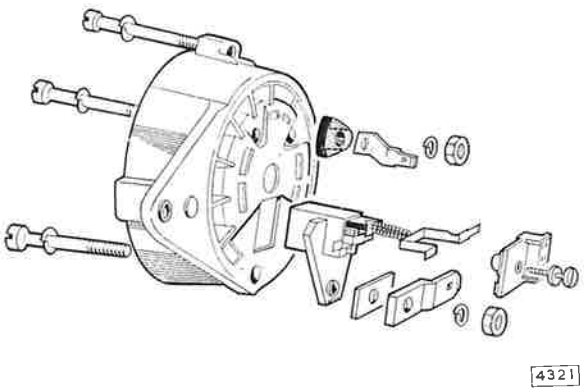


Fig. 6. *Showing the brush removal (later cars).*

## INSPECTION OF BRUSHGEAR (LATER MODELS)

Later model alternators will have side entry cables. The characteristics of the alternator remain the same as the previous model (side entry cables) with the exception of the method of inspection and the fixing of the brush gear as detailed below:—

The brush length when new is $\frac{5}{8}$″ (15.9 mm.). The serviceability of the brushes may be gauged by measuring the amount by which they protrude beyond the brushbox moulding when in the free position. For a brush to remain serviceable this should exceed 0.2″ (5 mm.).

Renew the brush assemblies if the brushes are worn to or below this length.

The new brush is supplied complete with brush spring and 'Lucar' terminal blade and is retained in position by a plate secured with a single fixing screw.

Check the brush spring pressure by using a push type spring gauge. Push each spring back against its spring until the brush face is flush with the housing.

The gauge should then register 8–16 oz. (227–454 grammes). Replace a brush assembly which gives a reading appreciably outside these limits where this is not due to the brush movement being impeded for any reason.

## INSPECTION OF SLIP RINGS

The surfaces of all 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 together with the unbroken surface of the slip rings mean that the likelihood of scored or pitted slip rings is almost negligible.

## ROTOR

Test the rotor winding by connecting an ohmmeter (Fig. 7) or 12 volt D.C. (Fig. 8) supply between the slip rings. The readings of resistance or current should be as given on page PY.s.6.

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 therefore 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.

## STATOR

Unsolder the three stator cables from the heat sink assembly, taking care not to overheat the diodes—(see 4h page 6). Check the continuity of the stator windings by first connecting any two of the three stator cables in series with a test lamp of not less than 36 watts and a 12-volt battery as shown in Fig. 10. Repeat the test, replacing one of the two cables by the third cable. Failure of the test lamp to light on either occasion means that part of the stator winding is open-circuit and 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 check the diodes.

## DIODES

Each diode can be checked by connecting it in series with a 1·5 watt test bulb (Lucas No. 280)

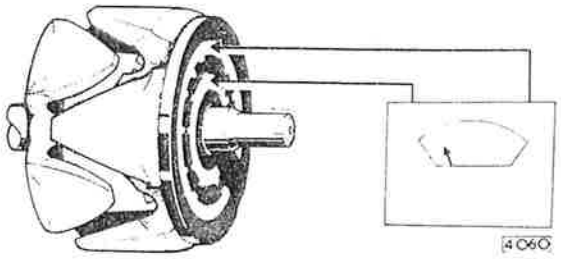


Fig. 7. *Measuring the rotor winding resistance with an ohmmeter.*

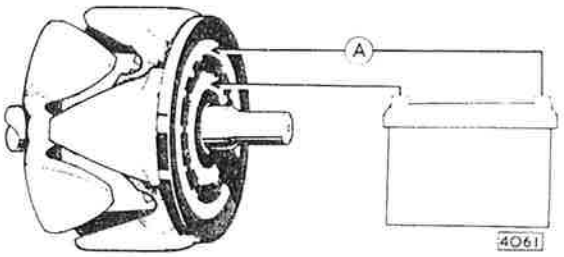


Fig. 8. *Measuring the rotor winding resistance with an ammeter and battery.*

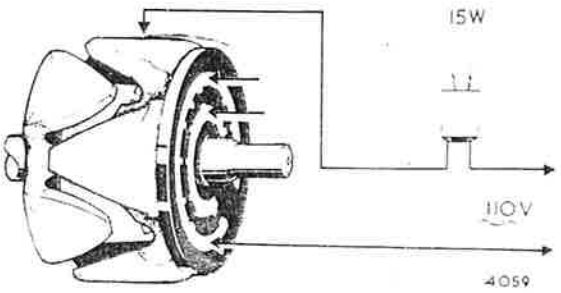


Fig. 9. *Insulation test of rotor winding.*

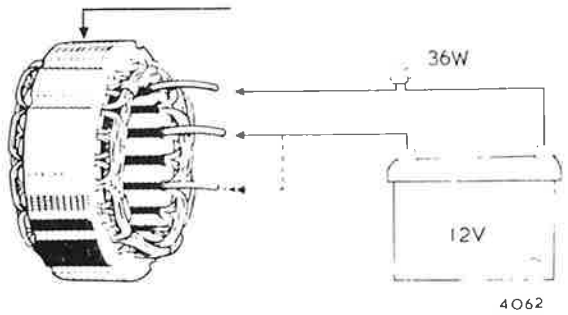


Fig. 10. *Stator winding continuity test.*

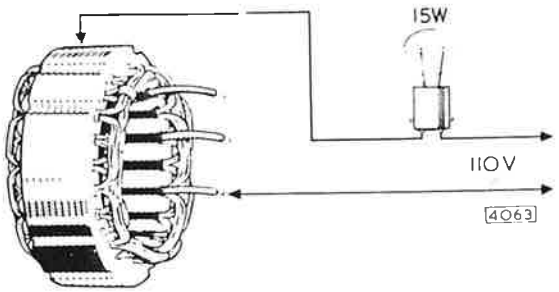


Fig. 11. *Stator winding insulation test.*

across a 12 volt D.C. supply and then reversing the connections.

Current should flow and the bulb light in one direction only. If the bulb lights up in both tests or does not light up in either then 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.

If a battery—ohmmeter is used, a good diode will yield "Infinity" on 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.

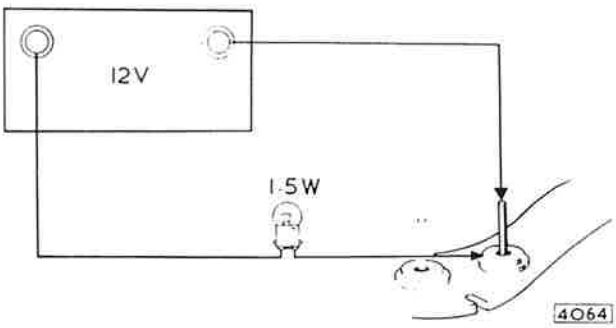


Fig. 12. *Method of testing diodes.*

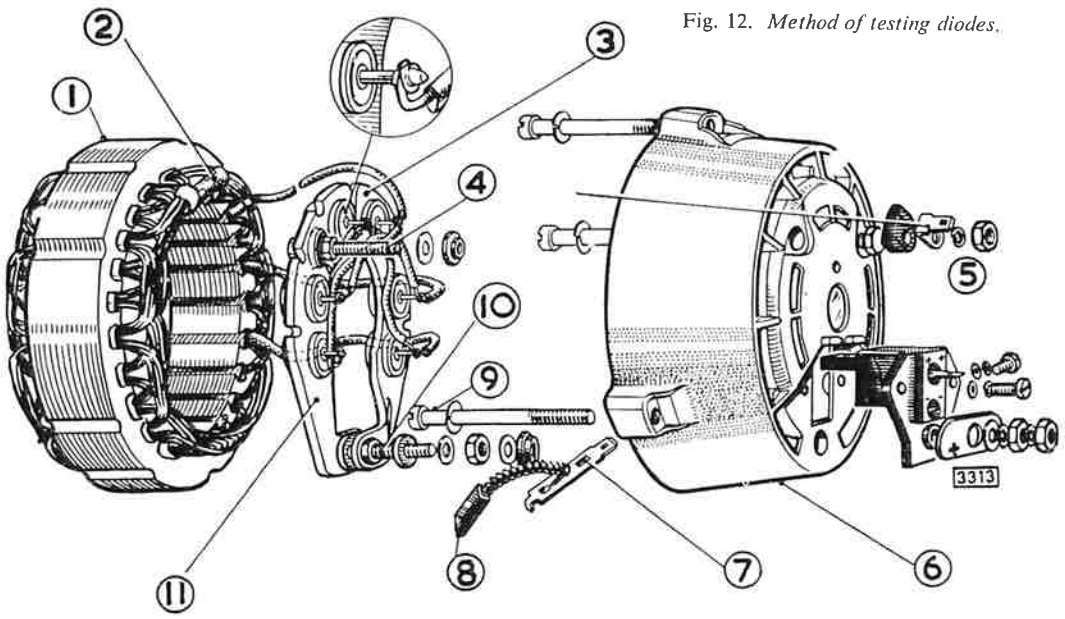


Fig. 13. *Exploded view of the slip ring end cover.*

1. Stator.
2. Star point.
3. Negative heat sink anode base diodes (black).
4. Warning light terminal 'AL'.
5. Field terminal (2)
6. Slip ring end cover.
7. Terminal blade retaining tongue.
8. Rotor slip ring brush (2).
9. "Through" bolts (3).
10. Output terminal (+).
11. Positive heat sink and cathode base diode (red).

### ALTERNATOR DIODE HEAT SINK REPLACEMENT

The alternator heat sink assembly consists of two mutually insulated portions, one of positive and the other of negative polarity. The diodes are not individually replaceable but, for service purposes, are supplied already pressed into the appropriate heat sink portion. The positive carries three cathode 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, acting as a thermal shunt and the operation of soldering carried out as quickly as possible.

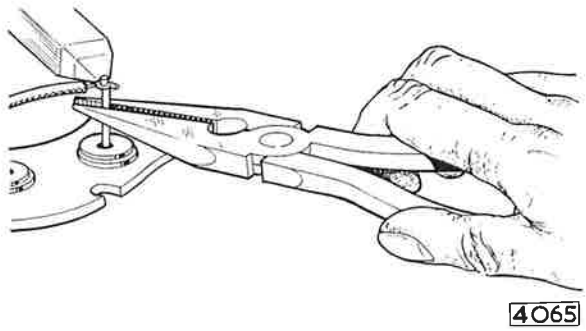


Fig. 14. *Use of thermal shunt when soldering diode connections*

After soldering to ensure adequate clearance of the rotor, the connections must be neatly arranged around the heat sinks and tacked down with "MMM" EC 1022 adhesive where indicated in Fig. 15. The stator connections must pass through the appropriate notches at the edge of the heat sink.

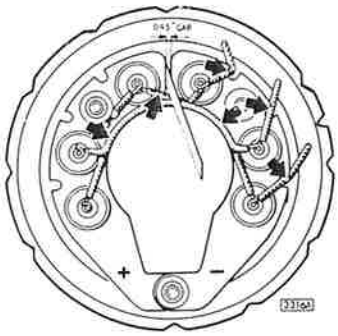


Fig. 15. *Showing the silicon diodes and connection in the slip ring end cover.*
*The feeler gauge inserted between the diode carriers.*

### 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 the withdrawal of the rotor shaft from the drive-end bracket, proceed as follows:—

(a) File away the roll-over on each of the three bearing retaining plate rivets and punch out the rivets.

(b) Press the bearing out of the bracket.

(c) Locate the bearing in the housing and press it home. Refit the bearing retaining plate using new rivets.

**Note:** 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.

## ALTERNATOR OUTPUT CONTROL UNIT MODEL 4 TR.

### GENERAL

Model 4 TR 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. 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 semi conductor 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. 16), the base circuit of the power transistor T2 is conducted 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). The 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 its "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 on 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 T1. Also, by transistor action, current will 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 consisting of 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, the current 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 thus reducing, still further, the base current in T1.

This effect is cumulative and the circuit reverts to the condition where T1 is fully-off and T2 is fully-on.

The above condition is only momentary since C2 quickly charges to the opposite polarity when feed-back current is reduced and current again flows in

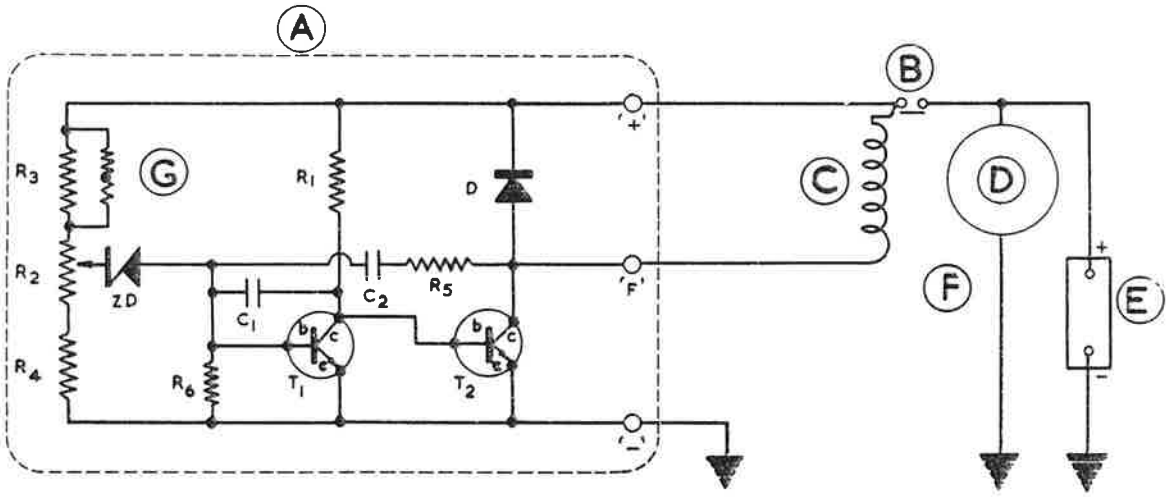


Fig. 16. *4TR Control Unit Circuit Diagram.*

3190

A—Control unit.
B—Field isolating device.
C—Rotor field winding.
D—Alternator.
E—12-volt battery.
F—Stator winding (rectified) output.
G—Thermistor.

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 connected 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 feedback. At high temperatures, a small leakage current may flow through the Zener diode even though the latter is in the nominally non-conductive 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 verse. 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:**

Voltage checking and setting procedure may be carried out only if the alternator and associated wiring circuits have been tested and found satisfactory in conjunction with a well-charged battery, (i.e., charging current not exceeding 10 amperes).

## VOLTAGE CHECKING

Run the alternator at charging speed for eight minutes. This operation applies when bench testing or testing on the car.

Leave the existing connections to the alternator and control unit undisturbed. Connect a high quality voltmeter between control unit terminals positive and negative. If available, use a voltmeter of the suppressed-zero type, reading 12 to 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. (1,500 engine r.p.m.).

The voltmeter should now show a reading of 13·9 to 14·3 volts at 68° to 78° F. (20° to 26° C.) ambient temperature. 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. 7).

Check that the voltmeter is still firmly connected between terminals +ve and —ve. 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 as a small amount of adjuster movement causes an appreciable difference in the voltage reading.

Recheck the setting by first stopping the engine then again running the alternator at 3,000 r.p.m.

Remount the control unit and disconnect the voltmeter.

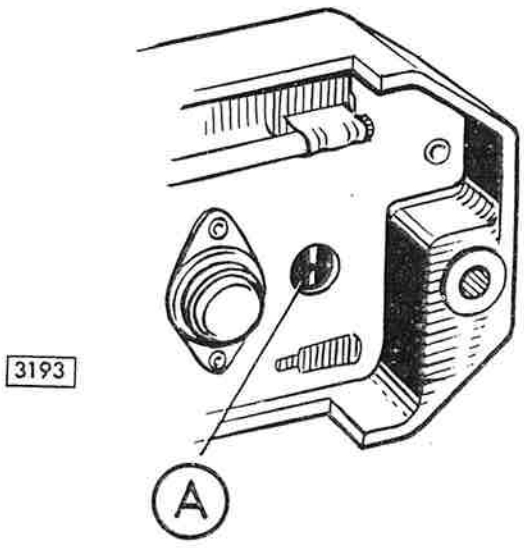


Fig. 17. *4 TR Alternator Control.*
A *Potentiometer adjuster.*

# 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 bulkhead 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 silicone 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. Due to external similarity of the 3AW warning light unit and 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.

**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.

### TRAFFIC HAZARD WARNING DEVICE (OPTIONAL EQUIPMENT)

**Description**

The system operates in conjunction with the four flashing (turn) indicator lamps fitted to the car. The operation of the dash panel 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 incorporated in the sub-panel circuit.

The flasher unit is located and is similar in appearance to the one used for the flashing turn indicators but has a differenti internal circuit. A correct replacement unit must be fitted in the even 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 an accident or other cause will not prevent the system operating on the remaining lamps.

# THE STARTER MOTOR

## DESCRIPTION

The purpose of the pre-engaged, or positive engagement, starting 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

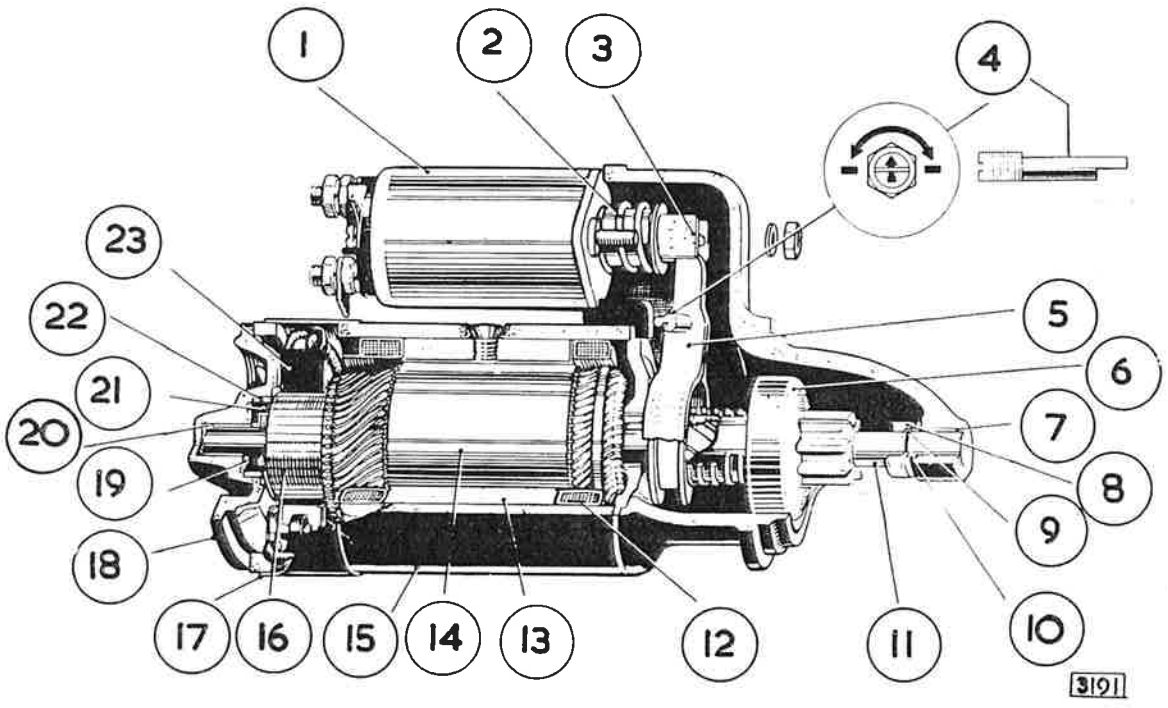


Fig. 18. *The Pre-engaged Starter Motor Model M45G.*

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 washer.
11. Armature shaft extension.
12. Field coils.
13. Pole shoe.
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.

terminals, short extension cables being connected between these and the corresponding solenoid terminals.

### 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 outboard 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 demeshing spring is located round the solenoid plunger.

On the occurrence 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 therefore 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 demeshing or dis-engagement) 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 it 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 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 wedge-locked between the driving and driven members. The clutches are sealed in a rolled over steel outer cover and cannot be dismantled for subsequent reassembly.

### THE STARTER SOLENOID

The starter solenoid is an electro-magnetic actuator mounted pick-a-back fashion on the yoke of the pre-engaged starter motor. It contains a soft iron plunger (linked to the engaging lever), the starter switch contacts and a coil consisting of 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 purpose 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 reassembly.

## STARTER MOTOR PERFORMANCE DATA

| Model | M45G Pre-engaged |
|---|---|
| Lock Torque | 22·6 lb./ft. (3·13 kg./m.) with 465 amperes at 7·6 terminal volts |
| Torque at 1,000 r.p.m. | 9·6 lb./ft. (1·33 kg./m.) with 240 amperes at 9·7 terminal volts |
| Light running current | 70 amperes at 5,800 to 6,500 r.p.m. |

## SOLENOID SWITCH DATA

| Model | 10 S |
|---|---|
| Closing Coil Resistance (measured between terminal STA with copper link removed and Lucar terminal) | 0·36 to 0·42 ohms |
| Hold on Coil Resistance (measured between Lucar terminal and solenoid outer case) | 1·49 to 1·71 ohms |

## REMOVAL

DISCONNECT THE BATTERY EARTH LEAD.

Disconnect and remove the transmitter unit from the top of the oil filter.

Disconnect the battery cable and solenoid switch cable from the starter motor.

Remove the distributor clamping plate retaining screw and withdraw the distributor.

Remove the two setscrews and lock washers securing the motor to the housing, gently bend away the carburetter drain pipes and remove the starter motor through the chassis frame.

The two setscrews are accessible from beneath the car or through an access panel in the right-hand side of the gearbox tunnel. Remove the front carpet to expose the panel.

### 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.

Insert the distributor and rotate the rotor until the drive dog engages correctly and secure with the clamping plate setscrew.

**Note:** If the clamping plate has been removed from the distributor or its position altered, the engine must be re-timed as detailed in Section B.

## SERVICING

### Checking the Brushgear and Commutator

Remove the starter motor from the engine.

Release the screw and remove the metal band cover.

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 position 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 PY.s.20 for renewal 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 springs to be tested accurately.

Check that the commutator is clean and free from oil or dirt. If necessary clean with a petrol moistened cloth or, if this is ineffective, rotate the armature and polish the commutator with fine glass paper. DO NOT use emery cloth. Blow out all abrasive dust with a dry air blast.

A badly worn commutator can be reskimmed by first rough turning, followed by diamond finishing. DO NOT undercut the insulation. Commutators must not be skimmed below a diameter of $1\frac{17}{32}$" (38·89 mm.). Renew the armature if below this limit.

## SERVICING

### Testing in position

Check that the battery is fully charged and that the terminals are clean and tight. Recharge if necessary.

Switch on the lamps together with the ignition and operate the starter control. If the lights go dim and the starter does not crank the engine this indicates that the current is flowing through the starter motor windings but the armature is not rotating for some reason. The fault is due possibly to high resistance in the brush gear or an open circuit in the armature or field coils. Remove the starter motor for examination.

If the lights retain their full brilliance when the starter switch is operated check the starter motor and the solenoid unit for continuity.

If the supply voltage is found to be applied to the starter motor when the switch is operated the unit must be removed from the engine for examination.

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

**Remove the starter motor from the engine**

Disconnect the battery. Disconnect and remove the starter motor from the engine (see page PY.s.18 for the 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.X.s.15. If there appears to be excessive sparking at the commutator, check that the brushes are clean and free to move in their boxes and that the spring pressure is correct.

**Measuring lock torque and lock current**

Carry out a torque test and compare with the values given on page PY.s.17. 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 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 circuit solenoid unit. Armature physically prevented from rotating. |
| 7. Excessive brush movement causing arcing at commutator. | Low brush spring tension 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. |
| 9. Excessive noise when engaged. | Pinion does not engage fully before solenoid main contacts are closed. Check pinion movement as detailed under Setting Pinion Movement. |
| 10. Pinion engaged but starter motor not rotating. | Pinion movement excessive. Solenoid main contacts not closing. Check pinion movement as detailed under Setting Pinion Movement. |

## DISMANTLING

Disconnect the copper link between the lower solenoid terminal and the starting motor yoke.

Remove the two solenoid unit securing nuts. Detach the extension cables 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. 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. Commutators must not be skimmed below a diameter of $1\frac{17}{32}$" (38·89 mm.).

### 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 connecting 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 bracket is best removed by inserting a $\frac{9}{16}$" (14·29 mm.) 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 to 40). In cases of extreme urgency, this period may be shortened by heating the oil to 100° C. for 2 hours and then **allowing the oil to cool before removing the bush.** Fit new bushes by using a shouldered, highly polished mandrel approximately 0·0005" (·013 mm.) 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 conditio will:—

(i) Provide instantaneous take-up of the drive in th one direction.

(ii) Rotate easily and smoothly in the other.

(iii) Be free to move round or along the shaft spline without roughness or tendency to bind.

Similarly, the operating bush must be free to slid smoothly along the driving sleeve when the engage ment spring is compressed. Trunnion blocks mus pivot freely on the pegs of the engaging lever. A moving parts should be smeared liberally with She Retinax "A" grease or an equivalent alternative.

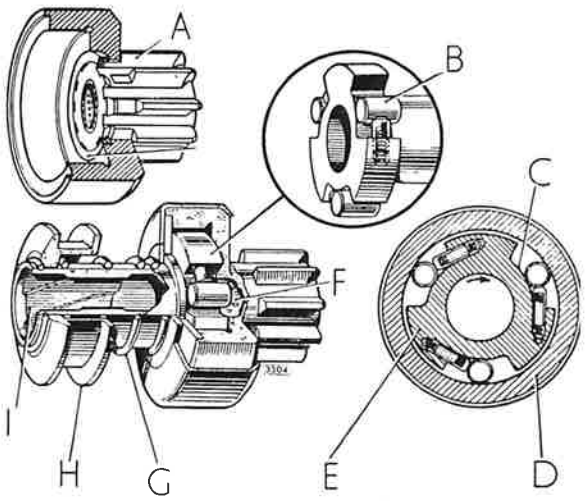


Fig. 19. *The roller clutch drive components.*

A—*Alternative contruction (pinion pressed and clear-ringed into driven 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.*

## REASSEMBLY

After cleaning all parts, reassembly of the starting motor is a reversal of the dismantling procedure given on page PY.s.20 but the following special points should be noted:—

(i) The following parts should be tightened to the maximum torques indicated:—

| | |
|---|---|
| Nuts on solenoid copper terminals .. .. | 20 lb./in. (0·23 kgm.) |
| Solenoid fixing bolts .. | 4·5 lb./ft. (0·62 kgm.) |
| Starting motor through bolts .. .. .. | 8·0 lb./ft. (0·83 kgm.) |

(ii) When refitting the C.E. bracket see that the moulded brake 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** (Fig. 10)

Connect the solenoid Lucar terminal to a 6-volt supply. DO NOT use a 12-volt battery otherwise the armature will turn.

Connect the other side of the supply to the motor casing (this throws the drive assembly forward into the engage position).

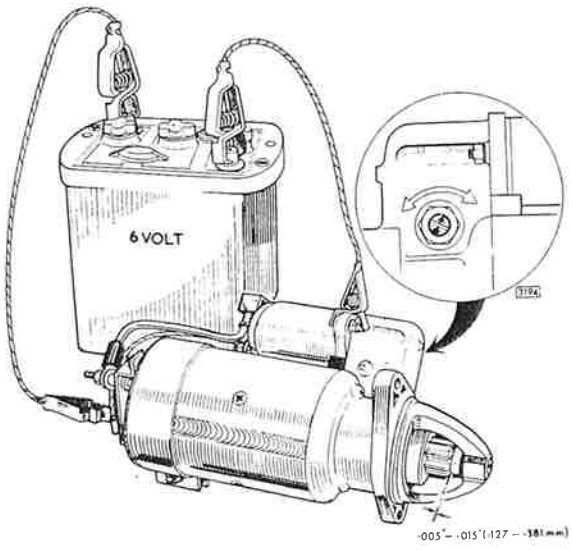


Fig. 20. *Setting pinion movement.*

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.

For correct setting the dimension should be 0·005" to 0·015" (0·13 to 0·38 mm.).

Disconnect the battery.

Adjust the setting by slackening the eccentric pivot pin securing nut and turning the pin until the correct setting is obtained.

**Note:** The head of the arrow stamped on the end of the eccentric pivot pin should be set only between the ends of the arrows cast in the drive end bracket.

Turning the screw to the left (anti-clockwise) will increase the gap between the pinion and the thrust washer, turning to the right (clockwise) will decrease the gap.

Reconnect the battery and recheck the setting.

After setting tighten the securing nut to retain the pin position.

## 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 starting motor terminal.

Connect, through a switch, a supply of 10 volts d.c., to the series winding, that is, 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 the out of mesh clearance, normally a nominal $\frac{1}{8}$" (3·17 mm.). An open-ended spanner or spanners 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.

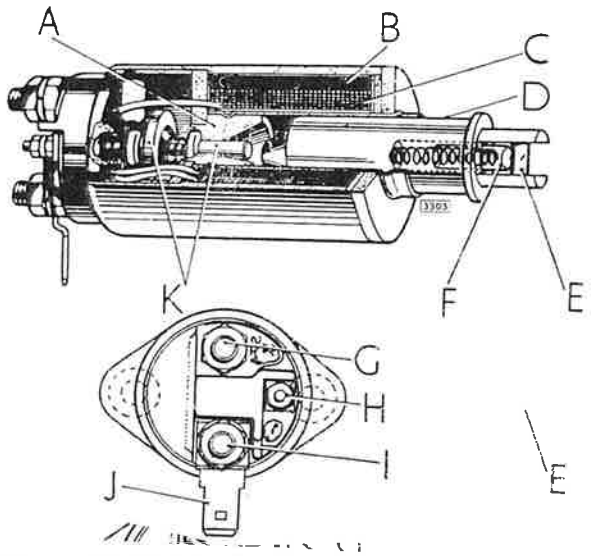


Fig. 11. *Checking the opening and closing of the starter switch contacts.*

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 assembly.*

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.

# WINDSCREEN WIPER

## (LUCAS MODEL 15W)

### DESCRIPTION

The windscreen wiper assembly consists of a two-speed motor coupled by connecting rods to three wiper arm spindle bearings (Open Sports and F.H.C.) or two spindles (2+2).

Windshield wiper motor model 15W is designed to operate a link-type wiper installation. The motor is self-switching to the OFF (or park) position. A two-pole permanent magnet field is provided by two ceramic magnets which form part of the yoke assembly. Inside the motor gearbox a worm gear on the armature shaft drives a shaft-and-gear assembly comprising a moulded gearwheel assembled to a location-plate-and-shaft. Power from the motor is transmitted through the gearwheel, location-plate-and-shaft to, finally, a rotary link which serves as a coupling between the motor and the links which operate the wiper arm spindles.

Associated with the terminal assembly is a two-stage plunger operated limit switch. The plunger is actuated by a cam on the underside of the moulded gearwheel inside the gearbox. When the manually-operated control switch is moved to OFF (or park) the motor continues to operate under the automatic control of the limit switch. As the wiper blades near the parked position the first-stage contacts open and the motor is switched off but continues to rotate under its own momentum. The second-stage contacts, to which are connected the positive and negative brushes, then close and regenerative braking of the armature takes place to maintain consistent parking of the blades.

Two-speed operation is provided by a third (stepped) brush incorporated in the brushgear assembly. When the main control switch is moved to the high speed position, the positive feed to the normal brush is transferred to the third brush, and a higher-than-normal wiping speed is obtained. (The higher speed should not be used in heavy snow or on a partially wet windshield).

The blades and arms fitted to the two models are of different lengths and are individually cranked for Right-hand and Left-hand drive cars.

**Note:** The wiper blades are manufactured with special anti-smear properties. Renew only with genuine Jaguar replacement parts.

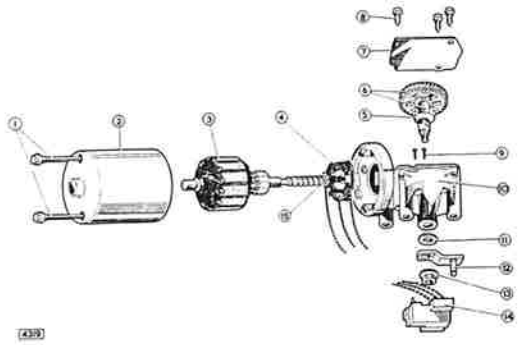

Fig. 22. *Exploded view of the 15W windscreen wiper motor.*

1—*Yoke fixing bolts.*
2—*Yoke assembly comprising two permanent-magnet poles and retaining clips and armature bearing bush.*
3—*Armature.*
4—*Brushgear, comprising insulating plate and brushboxes, brushes, springs and fixing bolts.*
5—*'Dished' washer.*
6—*Shaft and gear.*
7—*Gearbox cover.*
8—*Cover fixing screws.*
9—*Limit switch fixing screws.*
10—*Gearbox.*
11—*Flat washer.*
12—*Rotary link.*
13—*Link fixing nut.*
14—*Limit switch assembly.*
15—*Nylon thrust cap.*

## MAINTENANCE

All bearings are adequately lubricated during manufacture and require no maintenance.

Oil, tar spots or similar deposits should be removed from the windshield with methylated spirits (denatured alcohol). Silicone or wax polishes must not be used for this purpose.

Efficient wiping is dependent upon keeping wiper blades in good condition. Worn or perished blades are easily removed for replacement.

## DATA

### MOTOR

| | | |
|---|---|---|
| (i) Typical light running current (i.e. with the rotary link disconnected from the transmission) after 60 seconds from cold: | 1.5 amp. (normal speed) | |
| | 2.0 amp. (high speed) | |
| 4.2 'E' Type RHD | $10\frac{1}{2}$" (R.H. crank) | 12" |
| LHD | $10\frac{1}{2}$" (L.H. crank) | 12" |

## SERVICING

**Note:** Since the motor is of permanent magnet design, the direction of rotation of the armature depends on the polarity of the supply of its terminals. If it is necessary to run the motor while it is removed from the vehicle, the negative supply cable must be connected to motor terminal number 1 and the positive supply cable to terminal number 5 for normal speed or terminal number 3 for high speed (see Fig. 23).

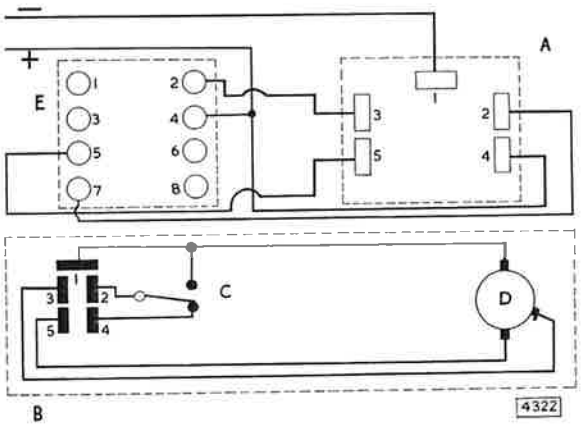


Fig. 23. *15W Wiper wiring diagram.*

A—*Moulded terminal connector on cable harness.*
B—*Terminal connector on wiper motor.*
C—*Limit switch.*
D—*Armature.*
E—*152 SA switch.*
*Switch internal connections.*

| OFF | NORMAL SPEED | HIGH SPEED |
|---|---|---|
| (5–7) | (4–5) | (2–4) |

**Systematic Check of Faulty Wiping Equipment**

Unsatisfactory operation (if the supply voltage to the motor is adequate) may be caused by a fault that is mechanical or electrical in origin. Before resorting to dismantling, consideration should be given to the nature of the fault.

The symptoms and remedial procedure associated with the more common causes of wiper failure (or poor performance) are described in (i) and (ii) below.

(i) **Frictional Wiper Blades**

Excessive friction between apparently satisfactory wiper blades and the windshield may result in a marked reduction in wiping speed when the blades are operating on a windshield that is only partially wet. A further symptom is that the blades become noisy at each end of the wiping arc. When possible, the blades should be temporarily replaced with a pair known to be in good condition. If this rectifies the fault, fit new blades.

(ii) **Low Wiping Speed or Irregular Movement of the Blades**

To determine whether a low wiping speed is due to excessive mechanical loading or to poor motor performance, the rotary link must first be disconnected from the transmission linkage and the light running current and speed of the motor can then be checked under no load conditions.

**Measuring Light Running Current and Speed**

Connect a first-grade moving coil ammeter in series with the motor supply cable and measure the current consumption. Also check the operating speed by timing the speed of rotation of the rotary link or moulded gearwheel. The current consumption and speed are given in Data.

If the motor does not run, or current consumption and speed are not as stated, an internal fault in the motor is indicated and a replacement unit should be fitted or the motor removed for detailed examination.

If current consumption and speed are correct, check for proper functioning of the transmission linkage and wiper arm spindles

**Removal**

**4.2 litre Open Sports and F.H.C.**

Disconnect the battery.

Remove the two thumbscrews and lower the instrument panel.

Remove two drive screws and detach the hazard warning unit carrier plate. Disconnect the drive link from the ball joint on the centre wheelbox.

Remove the P.V.C. cable strap from the body of the windscreen wiper motor and disconnect the cables by withdrawing the cable plug from the socket.

Mark the position of the throttle fulcrum lever bracket relative to the bulkhead, remove two setscrews, and detach the bracket. It is not necessary to disconnect the throttle control pads.

Remove four setscrews securing the motor mounting plate to the bulkhead and withdraw the motor with the attached drive link.

**4.2 litre 2+2**

Disconnect the battery.

Remove the top facia panel as detailed in Body and Exhaust System—Section N, page NY.s.1.

Disconnect the motor drive link from the ball joint on the L/H wheel box.

Remove the cable strap and plug as detailed above.

Remove the setscrews securing the mounting plate to the bulkhead and withdraw the motor.

**Dismantling**

Remove the gearbox cover.

The rotary link may be fitted to the gearwheel shaft in one of two positions (180° apart) depending on the parking requirement of the windshield installation. To ensure that the original parking position is maintained, the position of the rotary link in relation to the zero mark on the gearwheel location plate must be noted before removing the link.

**Important:** The moulded gearwheel inside the gearbox must be prevented from moving while the rotary link fixing nut is slackened (or, on reassembly, tightened). This is most easily achieved by securing the rotary link in a vice while the nut is turned.

Remove the fixing nut and withdraw the rotary link and flat washer.

Remove the shaft-and-gear from the gearbox, taking care not to lose the dished washer fitted beneath the gearwheel. It is not normally necessary to dismantle the shaft-and-gear assembly since this is serviced only in an assembled condition. However, should it become necessary to assemble the moulded gearwheel

to the location-plate-and-shaft, it is essential to fit the gear wheel in the correct one of the two alternative positions to maintain the original parking position of the wiper blades. The gearwheel is correctly fitted to the location-plate-and-shaft when the 'zero' mark on the location plate is positioned furthest away from the gearwheel cam.

Unscrew and remove the two fixing bolts from the motor yoke and carefully remove the yoke assembly and armature. While removed, the yoke must be kept well clear of swarf, etc., which may otherwise be attracted to the pole pieces.

Undo the two sets of fixing screws and remove from the gearbox the brushgear and the terminal and switch unit assemblies, linked together by the connecting cables.

**Bench Inspection**

After dismantling, examine individual items.

(i) **Brush replacement**

The original specified length of the brushes is sufficient to last the life of the motor. If, due to accidental damage to the brushes, or faulty commutator action, it becomes necessary to renew the brushes, the complete brushgear service-assembly must be fitted. The brushgear assembly must be renewed if the main (diametrically-opposed) brushes are worn to $\frac{3}{16}$ in. (4.8 mm.), or if the narrow section of the third brush is worn to the full width of the brush. Check that the brushes move freely in the boxes.

(ii) **Check Brush Springs**

The design of the brushgear does not allow for easy removal of the brush springs. This is due to the fact that, similar to the brushes, the springs are expected to last the life of the motor and should not normally require renewing. In the unlikely event of the spring pressure failing to meet the specified requirements, the complete brushgear service-assembly must be renewed in a similar manner to that necessary for servicing the brushes.

Note the location of the cables before unsoldering for reference when refitting.

To check the spring pressure on the end face of the brush with a push-type spring gauge push until the bottom of the brush is level with the bottom of the slot in the brush box, when the spring pressure reading should be 5–7 oz.f. (140–200 gf).

(iii) **Testing and Servicing the Armature**

Use armature testing equipment to check the armature windings for open and short circuits. Test the insulation by using a mains test lamp (Fig. 24). Lighting of the lamp indicates faulty insulation.

If the commutator is worn, it can be lightly skimmed while the armature is mounted in a lathe.

Afterwards, clear the inter-segment spaces of copper swarf.

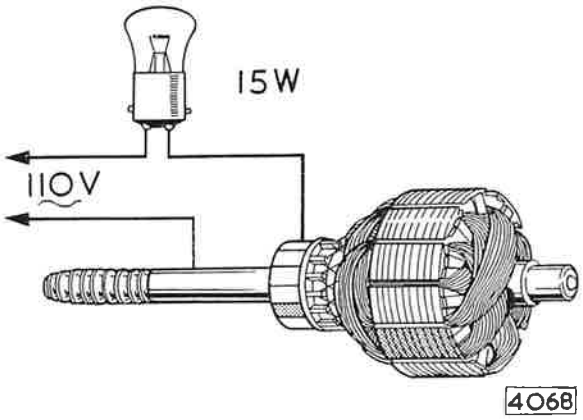


Fig. 24. *Armature insulation test.*

(iv) **Inspection of Moulded Gear**

Examine the gearwheel, especially the teeth, for signs of wear or damage. If the gearwheel needs renewing, a shaft-and-gear service replacement assembly will have to be fitted.

**Re-assembly**

Reassembly is the reverse of the dismantling procedure.

A liberal quantity of Ragosine Listate grease is necessary for lubrication of the gearwheel teeth, the gearwheel cam and the worm gear on the armature shaft. The total quantity of grease must not be less than 15 cc.

Apply Shell Turbo 41 oil to the bearing bushes, armature shaft bearing surfaces (sparingly), gearwheel shaft, and the felt-oiler washer in the yoke bearing (thoroughly soak).

**Reassembly of Yoke**

Before refitting the armature to the yoke, inspect the inside of the yoke and ensure that the thrust disc and the felt-oiler washer are in place in the yoke bearing.

The correct method of assembly is with the thrust disc flat against the end face of the bearing, followed by the felt-oiler washer which must have a hole in the centre to allow the captive ball bearing in the end of the armature shaft to contact the thrust disc.

If the felt-oiler is renewed, check that the replacement is provided with the necessary hole and, if not, make a $\frac{1}{8}$" (3 mm.) diameter hole in the centre of the felt. (A felt-oiler without a hole could result in the armature end-float becoming excessive in service due to the ball bearing wearing away the felt after the end-float adjustment has been made). Soak the felt-oiler in Shell Turbo 41 oil.

The yoke fixing bolts should be tightened to a torque of 12–16lb in. (0.138–0.184 kg.m.). If a service replacement armature is being fitted, it is advisable to first slacken the armature end-float thrust screw before tightening the yoke fixing bolts. Afterwards, reset the thrust screw.

**Armature End-Float Adjustment**

Armature end-float is 0.002–0.008" (0.05–0.2 mm.).

To obtain a satisfactory end-float adjustment with the motor and gearbox completely assembled, position the unit with the thrust screw uppermost, tighten the thrust screw until abutment takes place and then slacken it off one quarter turn and secure it in this position by tightening the locknut.

## WINDSCREEN WIPER SPINDLE HOUSINGS

**2+2 Models**

**Removal**

Disconnect the battery. Remove both windscreen wiper arms.

Lower the instrument panel and remove the screen rail facia assembly. Disconnect the motor link rod from the ball joint on the left-hand spindle lever.

Unscrew the large nuts securing the housings to the scuttle and remove the distance pieces and rubber seal washers. Withdraw the twin spindle and carrier plate assembly through the scuttle panel and complete the removal through the left-hand aperture in the bulkhead inner panel.

Housings are replaceable only as a complete assembly comprising both housings and carrier plate.

**Open Sports and F.H.C. Models**

**Removal (Right or Left Hand Housing)**

Disconnect the battery.

Withdraw the wiper arm from the spindle housing to be removed. Unscrew the large nut securing the housing to the scuttle and remove the distance piece and rubber seal washer.

Lower the instrument panel after removing the two retaining screws in the top corners. Remove the four nuts and washers retaining the screen rail facia assembly. Two are accessible from the centre aperture and one each at the outer edges below the screen rail.

Disconnect the ball joint from the spindle lever.

From inside the car remove two nuts and washers securing the housing bracket to the base plate and withdraw the housing.

**Removal (Central Housing)**

Disconnect the battery. Remove all wiper arms from the spindles.

Lower the instrument panel, remove the screen rail facia and outer housings as detailed previously.

Remove the large nut, distance piece and rubber seal washer from the central housing. Withdraw the housing and carrier plate assembly through the scuttle panel and complete the removal through the left-hand aperture in the bulkhead inner panel.

## WIPER MOTOR LINKAGE SETTING (2+2 cars)

It is essential that the wiper motor primary linkage (motor to wheelbox) is adjusted as detailed below if the link length is altered from the original dimension or, if a new link is fitted. Failure to carry out these instructions will result in a knock when the wiper arms are operating.

**R.H.D. Cars**

Disconnect the primary link (motor to wheelbox) from the ball joint on the wheelbox spindle.

Manually operate the non-adjustable link, connecting the two wiper spindles, to the extreme left position.

Adjust the ball joint socket on the link until it fits on the ball whilst maintaining the position of the lever to the left.

Disconnect the socket and turn to the **right (clockwise) four complete** turns, i.e. shorten the length of the rod between the socket and the motor.

Refit the socket on the ball and secure with the locknut.

**L.H.D. Cars**

Proceed as for R.H.D. cars, but for the following exceptions.

Manually operate the non-adjustable link to the extreme right and after adjustment turn the ball socket four complete turns to the left (anti-clockwise) to increase the length of the rod.

# THE INSTRUMENTS

## ELECTRIC CLOCK

### Description

The electric clock, fitted in the centre of the instrument panel, is a fully transistorised instrument powered by a mercury cell housed in a plastic holder attached to 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 out the knurled knob, rotate and release.

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.

Moving the indicator scale through one division will alter the time-keeping by five minutes per week.

The action of resetting the hands automatically restarts the movement.

The window of the clock is a plastic moulding, and should only be cleaned with a cloth or chamois leather slightly dampened with water. Oil, petrol or other fluids associated with cleaning, are harmful and must not be used.

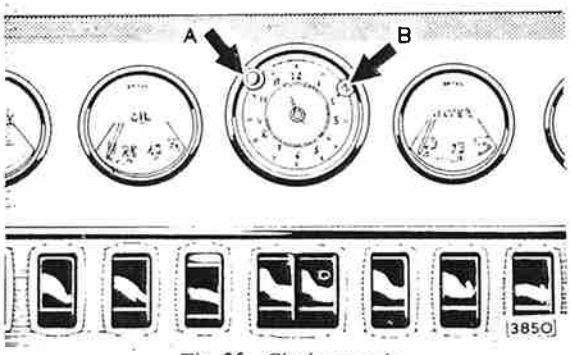


Fig. 25. *Clock controls.*
*A — Handsetting. B — Time regulator.*

## 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 lower the panel.

Lever the battery out of the holder and discard.

Press the new battery into the holder.

Refit the panel.

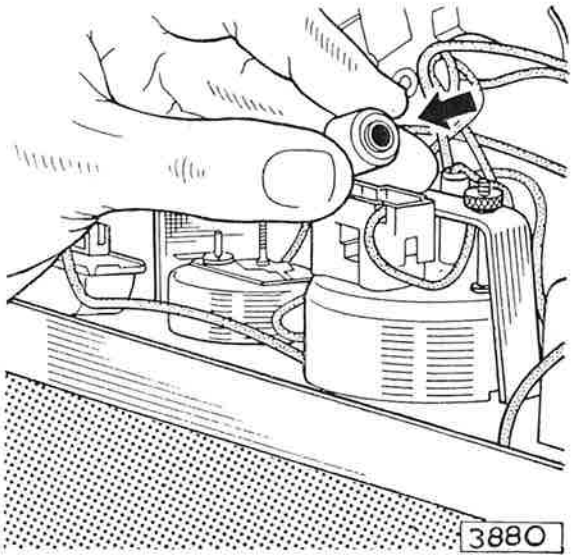


Fig. 26. *Renewing the electric clock battery.*

### Clock—Removal

Lower the instrument panel.

Withdraw the illumination bulb holder from the back of the clock.

Remove the two nuts and the clamp strap from the back of the clock.

Withdraw the clock, complete with the battery holder, from the instrument panel.

### Refitting

Refitting is the reverse of the removal procedure.

## THE REVOLUTION COUNTER (TACHOMETER)

### Description

The revolution counter is an impulse tachometer instrument incorporating 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 this instrument is not affected by the distributor contact setting, by corrosion of the sparking plug points, or by differences in the gap settings.

Connection to the back of the instrument is by means of a locked plug and socket, the contacts being offset to prevent incorrect coupling.

**Removal**

Disconnect the battery.

Remove the screen rail facia assembly as detailed on Page NY.s.1 to gain access to the instrument.

Remove the two knurled nuts, earth lead and instrument retaining pieces.

Withdraw the tachometer from the facia panel and remove the illumination bulb holders.

Disconnect the plug and socket as follows:—

Pinch together the prongs of the plastic retaining clip and withdraw from the plug and socket assembly (Fig. 27).

Detach the plug from the socket and complete the removal of the instrument.

**IMPORTANT**

Do not detach the green and white cables connected to the plug and the instrument.

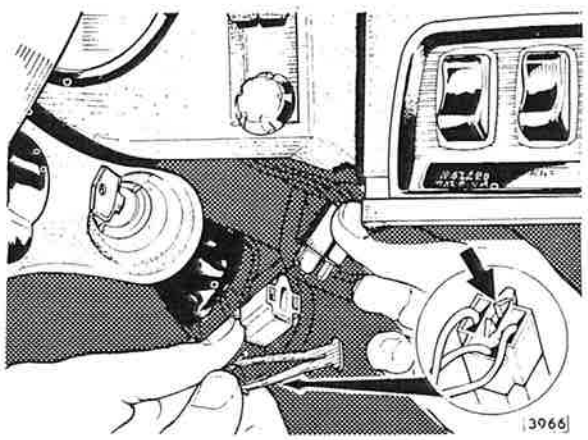


Fig. 27. *The tachometer plug and socket assembly. (Inset shows the clip in its fitted position).*

**Refitting**

Refitting is the reverse of the removal procedure.

Reconnect the plug and socket assembly and lock with the retaining clip.

## THE INSTRUMENT PANEL

The instrument panel differs from that fitted to all previous cars in respect of the following items:—

(1) Rocker Switches—Replacing tumbler switches.
(2) Battery Indicator—Replacing Ammeter.
(3) Panel Light Dimming Resistance—Replacing resistance previously attached to the panel light switch.
(4) The combined Ignition/starter switch which is now mounted on a separate sub-panel. These switches were previously two separate items mounted in the instrument panel.
(5) The Cigar Lighter—Now located in the console below the instrument panel, was previously part of the instrument panel assembly.

## THE SWITCHES

The rocker switches are mounted in a sub-panel which is attached to the instrument panel by four self-tapping screws.

Individual switches may be removed without detaching the sub-panel cluster as follows:—

**Removal**

Disconnect the battery.

Lower the instrument panel.

Remove the cables from the switch, noting location for reference when refitting.

Press in the two locking tabs located at the bottom and the top faces of the switch body and push the switch through the aperture.

**Refitting**

Press the switch into the panel aperture until the nylon locking tabs register.

Reconnect the cables as noted on removal.

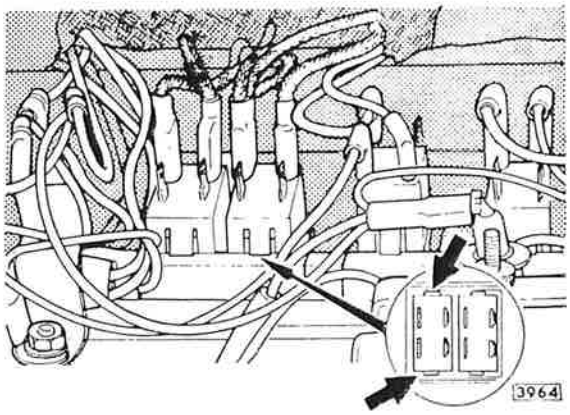


Fig. 28. *Instrument panel rocker switch removal (Inset shows arrowed the nylon locking tabs).*

## THE IGNITION/STARTER SWITCH

A Lucas 47SA combined ignition/starter switch replaces the separate switches previously used.

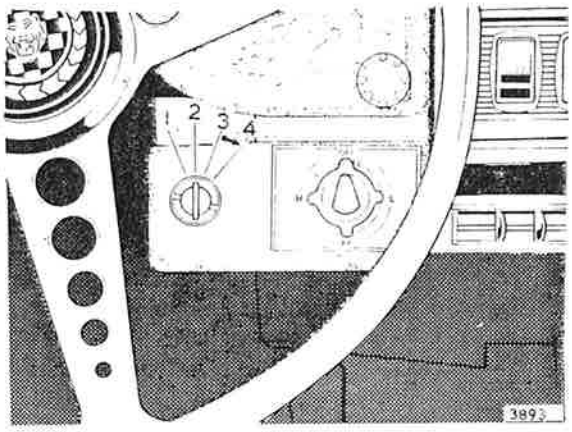


Fig. 29. *The ignition/starter switch location when air-conditioning system is fitted.*
*1 — Auxiliaries. 2 — Ignition "OFF"*
*3 — Ignition "ON". 4 — Starter.*

The switch is mounted on a bracket attached to the steering column (if Air-conditioning equipment is installed the bracket is attached to the evaporator unit).

In conjunction with the 47SA ignition/starter switch a Lucas 6RA relay is included in the alternator circuit. This functions as a field isolating relay, the relay coil being energised by operation of the ignition switch.

**Removal**

Remove the locking ring and withdraw the switch through the bracket with the brass locknut and wave washer.

Disconnect the cables and remove the switch. Note the location of the cables for reference when refitting.

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 'OFF' position to gain access to the plunger.

**Refitting**

Refitting is the reverse of the removal procedure.

When refitting a new lock barrel, check that the number on the face of the barrel and the key is the same as that on the barrel removed. This will be identical to the door locks.

Insert the key in the lock and turn the switch to the 'OFF' position before inserting the barrel.

## PANEL LIGHT DIMMING RESISTOR

The resistor unit is comprised of a wire resistance attached to two 'Lucar' cable contact blades mounted on an insulating carrier plate.

The plate is secured to two studs on the back face of the instrument panel by means of distances peices, nuts and lockwashers.

Excessive force should not be used when connecting the cable terminals to the blades.

This may force the blade retaining tongues through the insulating plate and allow the resistor to make contact with the metal face of the panel, resulting in a short circuit in the side light feed line.

## BATTERY INDICATOR

This instrument is a voltmeter with a specially calibrated dial which indicates the condition of the battery. It does not register the charging rate of the alternator.

The position of the needle with a charged battery will be within the area marked 'Normal'.

**Removal**

Disconnect the battery and lower the instrument panel.

Disconnect the cables, noting the location for reference when refitting.

Detach the illumination bulb holder.

Remove two nuts and clamp strap and withdraw the instrument forward through the panel.

**Refitting**

Refitting is the reverse of the removal procedure.

Check the condition of the battery by means of the panel shown below

| RED (Off Charge) | | NORMAL | | | RED (On Charge) |
|---|---|---|---|---|---|
| BATTERY CHARGE EXTREMELY LOW | BATTERY CHARGE LOW | WELL CHARGED BATTERY | CHARGING VOLTAGE LOW | CHARGING VOLTAGE SATISFACTORY | CHARGING VOLTAGE TOO HIGH |
| If with the ignition and electrical equipment e.g. headlamps etc., switched on, but with the engine not running the indicator settles in this section—your battery requires attention. | | Ideally the indicator should settle in this section when the ignition and electrical equipment e.g. headlamps etc., are switched on and the engine is not running. | This condition may be indicated when the headlights and other equipment are in use. | The indicator should point to this section when the engine is running above idle. | If the indicator continues to point to this section after 10 minutes running either your voltage regulator requires adjustment or some other fault has developed. |

**IMPORTANT** All readings on the indicator should be ignored when the engine is idling, since readings may vary at very slow engine speeds due solely to operation of the voltage regulator.

**OFF CHARGE**
This means more energy is being used from your battery than is being replaced by the alternator on your car. This condition is satisfactory provided it does not persist for long periods, when the engine is running above idle or at speed. If the indicator remains in the section, it may mean that you have a broken or slipping fan belt, a faulty alternator, a badly adjusted voltage regulator or some other fault.

**ON CHARGE**
This means your battery is having more energy put into it than is being taken out of it. In the ordinary way this condition predominates and your battery is continuously being recharged by the alternator whenever the engine is running above idle. If however the engine is continually running slowly as may be the case in traffic—or when, in winter, lights and cold starting make extra demands on the battery—you may find the rate of discharge exceeds the rate of charge—that is to say the battery is running down, as will be indicated on your Battery Condition Indicator and you may need an extra charge if "battery charge low or extremely low" is indicated by the instrument.

## LAMPS

### HEADLAMP

Sealed beam units are fitted to all cars with the exception of certain European Countries which retain the pre-focus bulb (see Bulb Data Chart).

The beam setting and unit replacement instructions differ from those stated on Page P.24 as follows:—

**Beam Setting**

If beam setting adjustment is required, prise off the headlamp rim (retained by spring clips). Switch on the headlamps and check that they are on Main beam.

The setting of the beams is controlled by two screws 'A' and 'B' on Fig. 30.

The top screw 'A' is for vertical adjustment, i.e. to raise or lower the beam; turn the screw anti-clockwise to lower the beam or clockwise to raise the beam.

The side screw 'B' is for horizontal adjustment, i.e. to turn the beam to right or left. To move the beam to the right, turn the screw clockwise. To move the beam to the left, turn the screw anticlockwise.

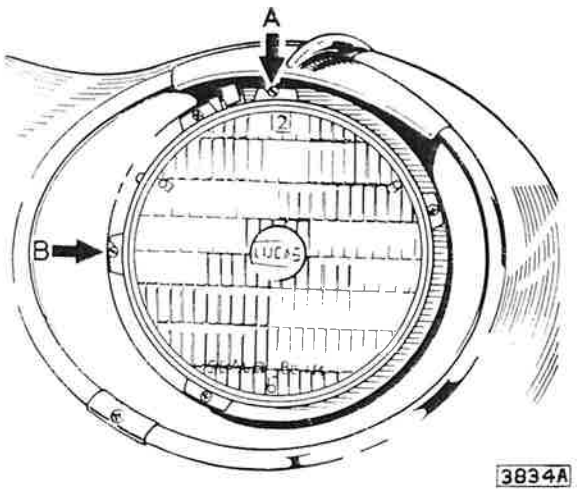


Fig. 30. *Adjustment of the screw 'A' will alter the headlamp beams in the vertical plane; adjustment of the screw 'B' will alter the headlamp beams in the horizontal plane.*

**Sealed Beam Unit — Replacement**

Prise off the headlamp rim (retained by spring clips).

Remove the three cross-headed screws and detach the retaining ring.

**Note:** Do not disturb the two beam setting screws.

Withdraw the sealed beam unit and unplug the adaptor.

Replace the sealed beam unit with one of the correct type (see 'Lamp Bulbs').

On cars fitted with bulb light units, proceed as directed above until the unit is removed. Release the bulb retaining clips and withdraw the bulb. Replace with a bulb of the correct type (see 'Lamp Bulbs').

When reassembling, note the groove in the bulb plate which must register with the raised portion on the bulb retainer.

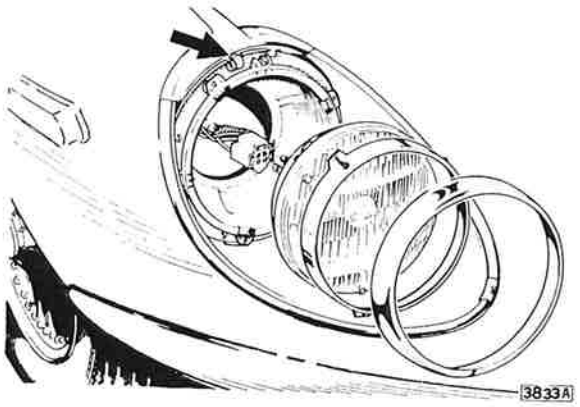


Fig. 31. *Headlamp sealed beam unit removal. The arrow indicates one of the spring clips retaining the rim.*

**SIDE LAMP BULB—REPLACEMENT**

Remove three screws and detach the lens. Remove the bulb by pressing inwards and rotating outwards. Check the condition of the lens seal when refitting.

On cars for certain European countries the side lamp bulb is mounted in the headlight unit and is accessible after removing the light unit as detailed under 'Headlamps'.

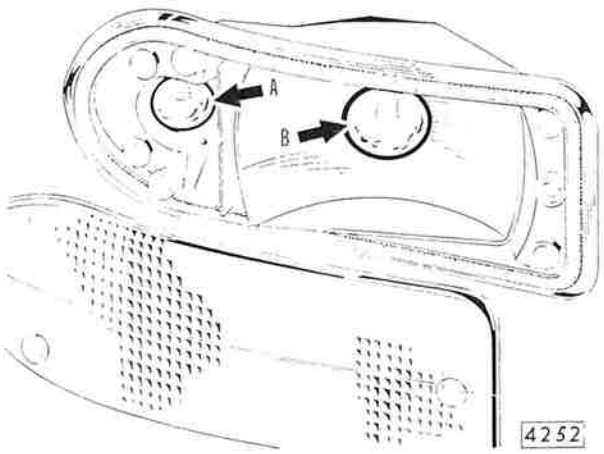


Fig. 32. *A—Side lamp bulb.*
*B—Flasher bulb.*

**FRONT FLASHER BULB—REPLACEMENT**

Proceed as detailed for 'Side Lamp Bulb'.

**REAR/BRAKE LIGHT BULB—REPLACEMENT**

Remove the four screws and detach the glass. The rear/braking light bulb is the lower one of the two exposed and is removed by pressing inwards and rotating anti-clockwise. When refitting a replacement bulb note that the pins are offset.

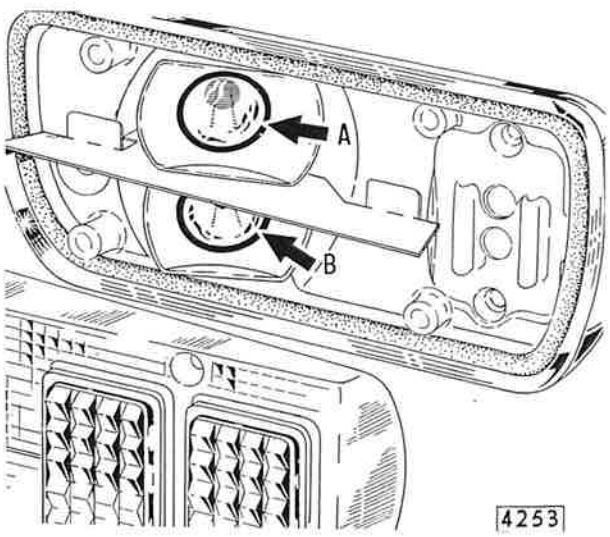


Fig. 33. *A—Rear flasher bulb.*
*B—Rear/Brake bulb.*

### REAR FLASHER BULB—REPLACEMENT

Proceed as detailed for 'Rear/Brake Light Bulb —Replacement.' The flasher bulb is the top one of the two exposed.

### INTERIOR LIGHT BULB—REPLACEMENT (2+2).

Release the spring side clip and withdraw the retaining tongue on the glass cover from the slot in the lamp base. Remove the faulty bulb and replace with one of the correct value.

When refitting ensure that the retaining tongue is inserted in the slot in the base before locking into position.

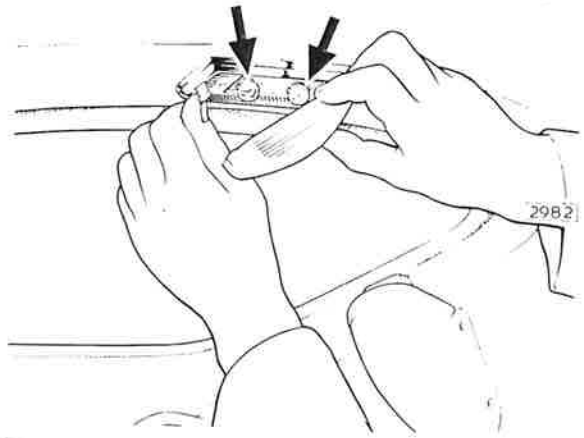


Fig. 34. *Interior lamp bulb removal (2+2).*

### INTERIOR/LUGGAGE LIGHT BULB—REPLACEMENT (Open 2 seater)

Proceed as detailed in the 3.8 'E' type Service Manual—page P.26.

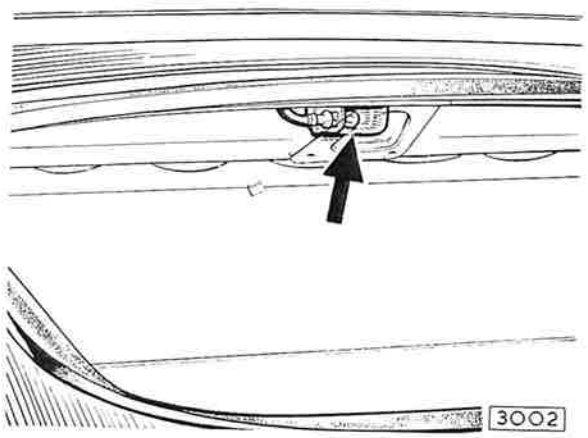


Fig. 35. *Interior lamp bulb removal (open 2 seater).*

### NUMBER PLATE LAMP BULB—REPLACEMENT

Remove two screws and detach the glass and rim. Replace the faulty bulb with one of the correct value. Check the condition of the seal before refitting.

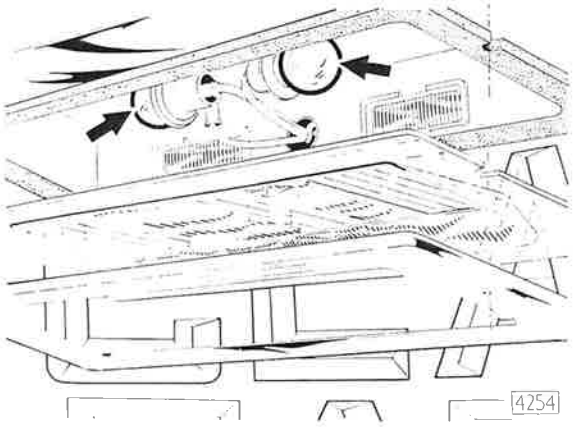


Fig. 36. *Number plate lamp bulb removal.*

### REVERSE LAMP BULB—REPLACEMENT

Remove the two retaining screws and detach th lamp glass. Lift the upper contact and withdra the bulb. Check the condition of the lens seal befor refitting.

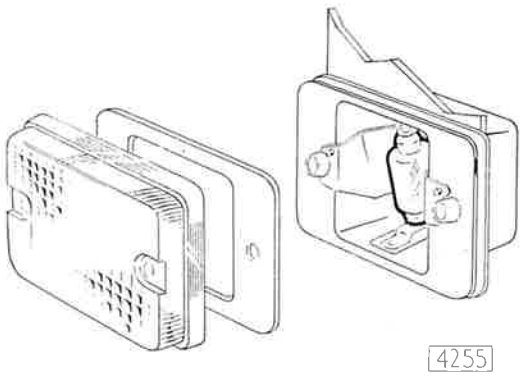


Fig. 37. *Reverse lamp bulb removal.*

### TRAFFIC HAZARD INDICATOR BULB—REPLACEMENT

Remove the chrome bezel and unscrew the bulb from the holder.

### HEATED BACK LIGHT INDICATOR BULB—REPLACEMENT

Proceed as detailed under 'Traffic Hazard Indicator Bulb'.

### AUTOMATIC TRANSMISSION INDICATOR BULB—REPLACEMENT

Remove the drive screws, detach the arm rest and transmission unit cover.

Unscrew the gear control knob. Withdraw two screws and remove the gear indicator cover. Replace the bulb with one of the same value (24 volts).

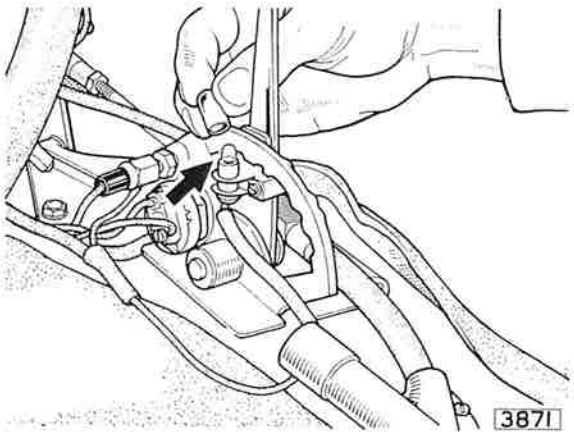


Fig. 38. *Automatic transmission indicator bulb removal.*

## HORNS—MODEL 9H

### DESCRIPTION

The horns are mounted on brackets attached to the sub-frame lower cross-member.

The horns are now mounted on brackets attached to the sub-frame lower cross-member.

The horn circuit operates through a Lucas 6RA relay, the contacts C1 and C2 closing when the relay coil is energised by depressing the horn switch button located in the direction (turn) indicator switch lever.

**Maintenance**

In the event of the horns failing to sound or performance becoming uncertain, check before making adjustments that the fault is not due to external causes.

Check as follows and rectify as necessary:

(i) Battery condition.

(ii) Loose or broken connections in the horn circuit.

(iii) Loose fixing bolts. It is important to keep the horn mountings tight and to maintain rigid the mounting 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/purple) and terminal W1 (cable colour—Green).

(v) Check that fuse No. 3 (50 amperes) and fuse No. 6 (35 amperes) have not blown.

**Note:** Horns will not operate unless the ignition is switched on.

**Adjustment**

As the horns cannot conveniently be adjusted in position, remove and mount securely on a test fixture.

A small serrated adjusting screw located adjacent to the horn terminal is provided to take up wear of moving parts in the horn. Turning this screw does not alter the pitch of the horn note.

Connect a moving coil ammeter in series with the horn supply feed. The ammeter should be protected from overload by connecting on ON-OFF switch in parallel with its terminals.

Keep this switch ON except when taking readings, that is when the horn is sounding.

Turn the screw clockwise until the horn operates within the specified limits of 6.5-7.0 amperes.

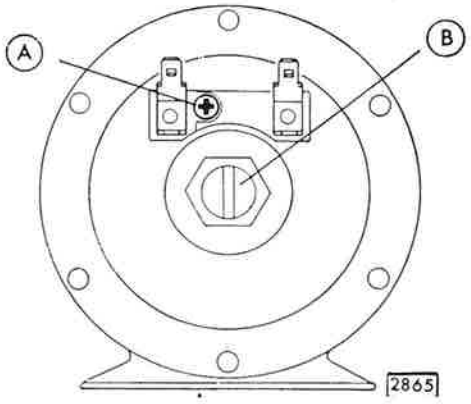


Fig. 39. *The Lucas 9H horn.*
*A — Contact breaker adjustment screw.*
*B — Slotted centre core (Do not disturb).*

**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 at each side of the mounting bracket centre fixing.

(ii) Ensure, after positioning the horn, that the $\frac{5}{16}$" centre fxing bolt is secure but not over-tightened. 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)**

These horns are muted to comply with the Dutch Traffic Regulations and incorporate a rubber plug inserted in the trumpet.

**Horn Relay—Checking**

If the horn relay is suspected, check for fault by substitution or by the following method:—

(i) Check that fuses No. 3 and No. 6 have not blown. Replace if necessary.

(ii) Check with a test lamp that current is present at the relay terminal W1 (Green) and C2 (Brown/Purple). Switch on the ignition before checking terminal W1.

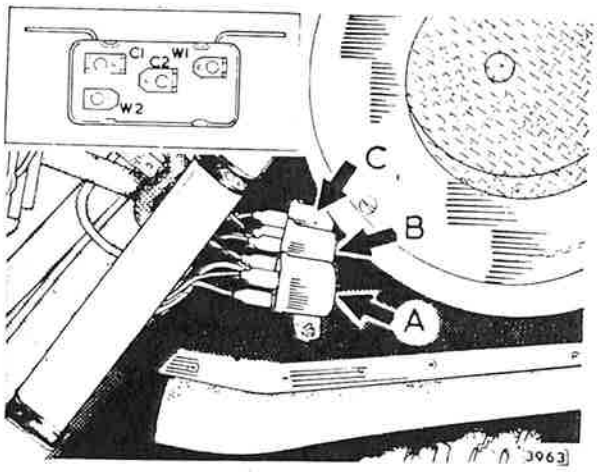


Fig. 40. *Location of horn and alternator relays.*
*A — Horn relay.*
*B — Alternator/Ignition relay.*
*C — Air conditioning equipment relay (when fitted).*
*(Inset shows the connections).*

(iii) Remove the cable from terminal W2 (Purple/Black) and earth the terminal to a clean part of the frame. The relay coils should now operate and close the contacts.

Reconnect cable.

(iv) Remove cable from terminal C2 (Brown/Purple). Check for continuity by means of an earthed test lamp. Check with the horn button depressed and the ignition 'ON'. Replace the relay if faulty.

## RADIATOR COOLING FANS

Twin electrically motor driven cooling fans are fitted, automatic operation being controlled by a thermostat switch mounted in the radiator header tank.

A Lucas 6RA relay is incorporated in the circuit to prevent over-loading the thermostat switch contacts.

When air-conditioning is fitted a second relay is also included to over-ride the thermostat switch when the car is stationary and the air-conditioning system is working.

### THERMOSTAT

**Checking**

Check by substitution or by the following test procedure:—

Drain off sufficient water from the radiator and remove the switch from the header tank.

Wire the switch in series with a 12 volt battery and a 1.5 watt bulb and suspend in water with a thermometer.

Heat the water and note the temperature at which the contacts close and the bulb lights up. Cool the water and note the temperature at which the contacts open. Replace if faulty.

Renew the joint between the tank and the thermostat switch if damaged.

**TEST DATA**

| | |
|---|---|
| Closing temperature .. .. | ..75°C±2°C |
| Opening differential .. .. | ..3°–5° |

### FAN MOTOR

**Checking**

Disconnect the cables and check the fan motors by connecting to a 12 volt battery.

Remove for inspection if faulty.

**Inspection**

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 brushes are loose in the carriers and care must be taken that they are not misplaced when removed.

Examine the commutator and clean with a petrol moistened cloth or fine glass paper if dirty or scored.

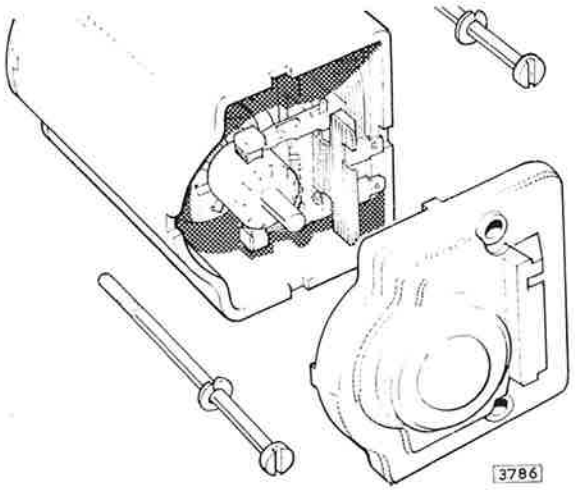


Fig. 41. *Exploded view of the fan motor.*

**FAN RELAY**

**Checking**

Check that fuse No. 6 has not blown. Replace if necessary.

Check that the current is present at terminal C2 (Green) with the ignition 'ON'.

Earth the terminal W1 (Black/red), switch on the ignition and check by means of an earthed test lamp that current is available at terminal C1 (Black/green).

If air-conditioning system is fitted, check the over-riding relay as detailed under 'Horn relay'. Ignore reference to horn button.

Refer to the wiring diagram when checking.

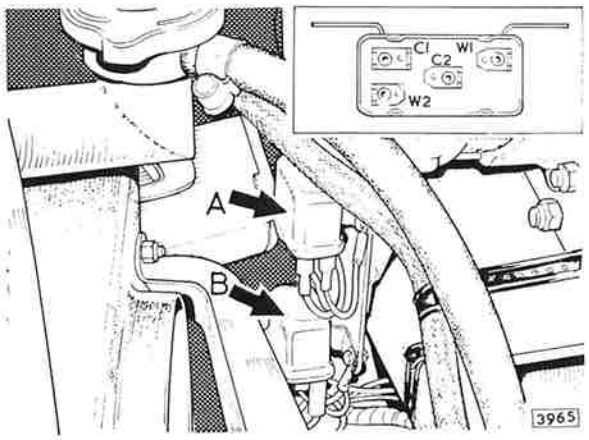


Fig. 42. *The radiator fan relays.*
*A—Fan relay.*
*B—Over-riding relay.*

## STEERING COLUMN LOCKS

**Description**

Steering column locks, if fitted, replace the normal Starter/Ignition Switch.

The lock, mounted on a bracket attached to the steering column, has five operative positions as follows:—

(1) Lock, (2) Park, (3) Accessories, (4) Ignition, (5) Start.

During the assembly of the switch/lock to the column, the hexagon portions of the lock securing bolts which are of the necked type, are sheared when fully tightened and cannot subsequently be removed, thus preventing unauthorised removal of the lock.

**IMPORTANT**

The steering column lock is brought into action when the key is turned to the 'LOCK' position and then removed.

IMMEDIATELY THIS IS DONE IT BECOMES IMPOSSIBLE TO STEER THE CAR.

It is, therefore, important to remember that if the ignition is switched off whilst the car is in motion the key should not be turned past the 'PARK' position. The ignition key should NEVER be removed from the lock whilst the car is moving.

**OPERATION**

**(1) Lock**

This is a locked stop position. The key can be removed leaving the steering locked by engagement of the lock bolt with the register in the inner steering column.

**(2) Park**

This is the normal stop position. The key can be removed leaving the car capable of being steered with the ignition "OFF".

**(3) Accessories**

This position will allow the operation of accessories such as Radio and Electric Window Lift control (when either is fitted) with the ignition 'OFF'.

The key cannot be removed.

**(4) ON**

This is the normal starting position. On release, the key will automatically return to the ignition 'ON' position.

**IMPORTANT**

Re-engagement of the starter (cranking) motor will not be possible until the key is returned to the 'Park' position. This is a safety device introduced to prevent damage to the starter drive through accidental engagement when the engine is running.

**SERVICING**

No servicing is possible with the exception of the switch carrier contact plate which can be replaced if faulty as follows:—

(1) Disconnect the cables at the connectors.
(2) Remove two hexagon headed screws and plain washers and withdraw the contact plate with attached harness.
(3) Refit by reversing the removal procedure.

**Note:** The contact plate is indexed and cannot be fitted incorrectly.

Two Lucas 6RA relays are incorporated in the circuits controlled by the ignition switch to prevent overloading of the switch contacts.

Both units are located under the screen rail facia.

Operation of the individual relays should be checked when testing for a fault in the ignition/starter switch circuits.

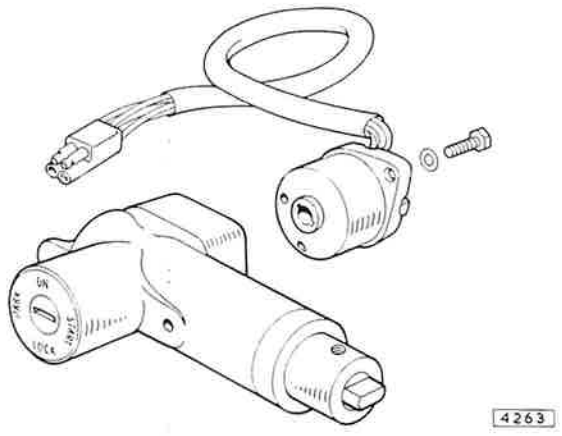


Fig. 43. *The steering column lock dismantled.*
*(The lock is shown removed from the column for clarity).*

# SECTION Q

## EXHAUST EMISSION CONTROL

To meet U.S.A. Federal and Canadian engine emission requirements, the Jaguar 4·2 Litre engine has been modified in relation to carburation, induction system and ignition as follows.

The Duplex Manifolding System employs the metering system of the carburetters to feed fuel mixture to the combustion chambers through two manifolds. Two throttles are employed—the primary being in its normal position in the carburetter and the secondary located in the water-jacketed secondary throttle housing. The linkage between the two throttles is so arranged that on part throttle opening (employed during most city driving and cruising) the secondary throttle remains closed, routing the mixture through the primary mixture pipe and returning it to the inlet manifold downstream of the secondary throttles.

This circuit ensures complete homogeneity of fuel mixture resulting in a constant air/fuel ratio being distributed to the cylinders so that an overall leaner mixture can be employed. It also avoids the deposition of wet fuel in the inlet manifold which is a major cause of engine emissions.

After approximately 25° of primary throttle opening, the secondary throttle comes into operation until, at full throttle, both butterflies are fully opened and the mixture passes straight through both manifolds so that maximum power is maintained.

A modified distributor with redesigned power curve is fitted in conjunction with this system, the ignition timing being 5° B.T.D.C. static (10° B.T.D.C. at 1,000 r.p.m.).

## ROUTINE MAINTENANCE

**Owing to the critical emission limits which must be maintained throughout the lifetime of the engine, it is imperative that the following routine maintenance instructions are carried out conscientiously at the recommended mileage intervals.**

**Failure to comply with these recommendations may result in engine emissions falling outside U.S.A. Federal or Canadian limitations.**

### 1,000 MILES FREE SERVICE

After the car has completed 1,000 miles from delivery, the following checks relating to Engine Emission Control should be carried out together with other Free Service details as shown in the Service Maintenance Voucher Booklet.

**Engine Oil**

Change the engine oil.

**Distributor Contact Breaker Gap**

Adjust contact breaker points to ·014"-·016" gap as detailed in the Service Manual. Verify correct dwell angle—see Diagnosis Chart.

**Distributor Lubrication**

Lubricate the distributor as detailed in the Service Manual.

**Sparking Plugs**

Clean the sparking plugs and adjust the gap to ·025".

**Engine Idle Speed**

Allow the engine to warm up to normal operating temperature. **Adjust the idle speed by turning each adjuster screw an equal amount** to give slow running speed of 750 r.p.m. on standard transmission cars; 650 r.p.m. on cars with automatic transmission with the selector lever in the neutral position.

Check the synchronisation of the carburetters by using a balance meter.

**Fast Idle Speed**

Ensure that the choke control cam on the rear carburetter is in the "fully off" position.

Release the locknut and turn the fast idle abutment screw until the gap between the cam and the screw is ·067". Tighten the locknut and re-check the gap.

## EXHAUST EMISSION CONTROL

**Carburetter Hydraulic Piston Damper**

Unscrew and withdraw the hydraulic piston damper from the piston cover.

Top up the hollow guide rod of the piston with Zenith Lube Pack, or, if this is not available, use SAE 20 engine oil, to within $\frac{1}{4}$" of the top of the rod. Replace the damper securely.

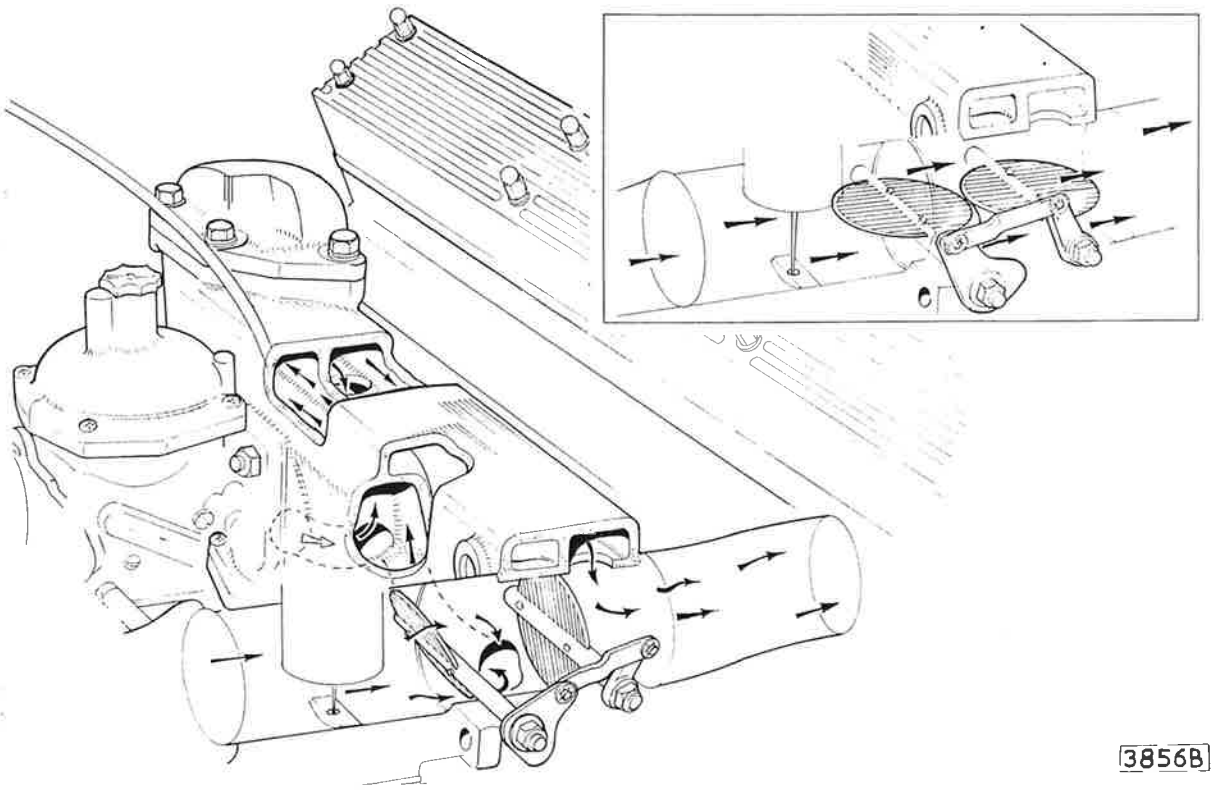


Fig. 1. *Schematic layout of the carburetters and linkage showing the direction of the gas flow.*

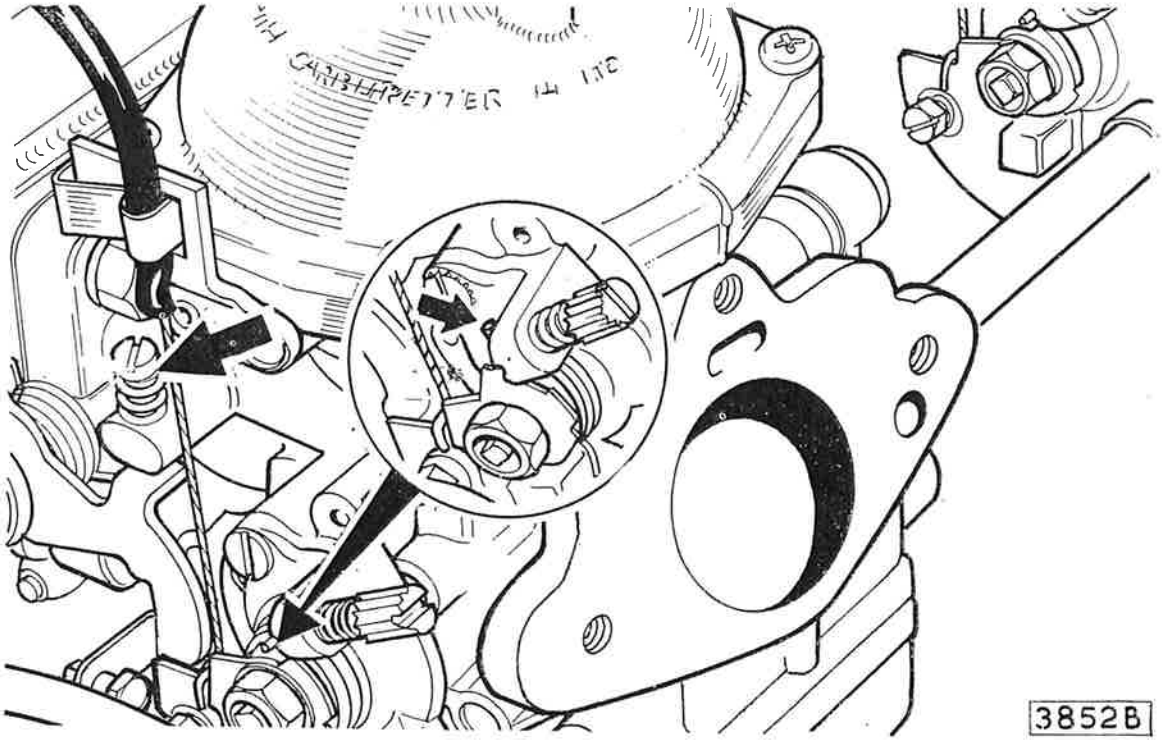


Fig. 2. *Slow running adjustment screw.*

**Ignition Timing**

**As the ignition timing of an emission controlled engine is critical, the greatest possible care must be taken to ensure that the correct figure is obtained.**

Adjust the distributor vernier scale to the central position. With the engine running at exactly 1,000 r.p.m. check the timing with a stroboscope and adjust by means of the vernier control on the distributor to 10° B.T.D.C.

The timing scale is located on the rim of the crankshaft damper.

To check the distributor advance characteristics at higher r.p.m., refer to Distributor Test Data on page QY.s.5.

**Cylinder Head Nuts**

Check the torque of the cylinder head nuts (Torque 696 lbs. ins.) tightening in sequence as detailed in the Service Manual.

**Inlet Manifolds**

Check the tightness of all inlet manifold system securing nuts.

Tighten the carburetter mounting nuts.

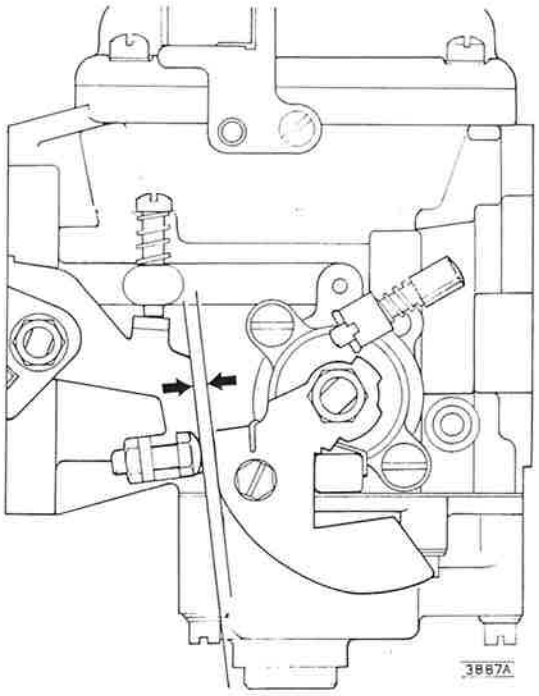


Fig. 3. *Fast idle adjustment. Gap between screw and cam should be ·067".*

## EXHAUST EMISSION CONTROL

**It is important to ensure that no air leaks exist at any of these joints otherwise the mixture will be weakened to a point where idling will be effected.**

**Idle "Trim" Screw**

Screw in the idle "trim" screw to obtain the optimum quality of idling.

**EVERY 3,000 MILES**

**Engine Oil**

Change the engine oil.

Low speed city driving in hot dusty territory or in very cold weather may produce conditions conducive to oil dilution and sludge formation. In these conditions the engine oil and the filter should be changed every 1,000 miles.

**Distributor Contact Breaker Gap**

Clean points and adjust the contact breaker gap as detailed in the Service Manual.

Adjust the gap to ·014"-·016". Verify correct dwell angle—see Diagnosis Chart.

**Ignition Timing**

Check ignition timing as detailed in the 1,000 miles Free Service.

**Distributor Lubrication**

Lubricate the distributor as detailed in the Service Manual.

**Sparking Plugs**

Clean and adjust and test the spark plugs. Check on an oscilloscope and renew any doubtful plugs. Set the gap between the side wire and the centre electrode to ·025".

**NOTE: Misfiring of a plug will cause incomplete combustion of the mixture and raise the engine emission levels above the specified limits.**

**Engine Idle Speed**

Adjust the engine idle speed as detailed in the 1,000 miles Free Service.

**Fast Idle Speed**

Adjust the fast idle speed as detailed in the 1,000 miles Free Service.

**Carburetter Hydraulic Damper**

Top up the hydraulic piston damper as detailed in the 1,000 miles Free Service.

**EVERY 12,000 MILES**

Fit Emission Pack Part No. 11549 (coloured Yellow) to the carburetters. See page QY.s.11 for details.

**Air Filter**

Renew the air filter element as detailed in the Service Manual. If the car is operating in dusty territory inspect at 6,000 miles and renew if necessary.

**Crankcase Breather**

Disconnect the breather pipe from the front of the engine and the air filter. Remove the pipe. Remove the nuts securing the breather and withdraw the flame trap. Wash the flame trap and pipe in gasoline and refit. Renew the gaskets located on each side of the flame trap. Examine all hoses, renew if necessary. Check that all clamps are tight allowing no air leakage.

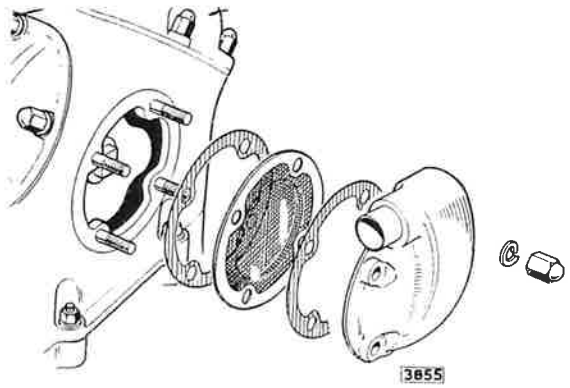


Fig. 4. *The crankcase breather.*

**Inlet Manifolds**

Check tightness of all secondary throttle housing and inlet manifold securing nuts. Check tightness of nuts securing primary mixture pipe to secondary throttle housing.

**It is important to ensure that no leaks exist at any of these joints.**

**Exhaust System**

Check the exhaust system for leaks. Renew any parts showing signs of deterioration.

**Spark Plugs**

Renew the spark plugs with the recommended grade.

**Cylinder Head**

Check the torque of the cylinder head securing nuts (696 lb. ins.) and check the cylinder head gasket for leaks.

**Fuel Line Filter**

At the recommended interval, or more frequently if sediment build-up is evident, slacken the locknut, swing the retaining clip to one side and remove the glass bowl, sealing washers and filter.

Wash the glass bowl in gasoline. Fit a new filter element with new sealing washers and re-assemble.

**Distributor Contact Breaker Gap**

Clean points and adjust contact breaker gap as detailed in the Service Manual. Adjust the gap to ·014"-·016". Verify correct dwell angle—see Diagnosis Chart.

**Ignition Timing**

Check ignition timing as detailed in the 1,000 mile Free Service.

**EVERY 24,000 MILES**

**Carburetters**

Remove lead seal and fit Red Emission Pack Part No. 11791 to carburetters. See pages QY.s.12 to QY.s.13. Fit new lead seal after completion.

**Valve Clearances**

Check the valve clearances as detailed in the Service Manual. Clearances (cold)—inlet ·004"; exhaust ·006"

**Valve Timing**

Check valve timing as detailed in the Service Manual.

**Contact Breaker Points**

Renew contact breaker points as detailed in the Service Manual. Adjust points gap to ·014"-·016". Check ignition timing as detailed in the 1,000 Miles Free Service. Verify correct dwell angle—see Diagnosis Chart.

**Compression Pressures**

Compression pressures must be checked with all spark plugs removed, carburetter throttles wide open and the engine at normal running temperature.

Disconnect the black/white low tension lead from the coil before operating the ignition/starter switch to check pressures. All cylinders should be even and approximately 150 p.s.i.

If one or more cylinders show low compression, a full investigation into engine condition must be made on an Electronic Engine Tester such as a Sun 1020. See diagnosis chart.

## DISTRIBUTOR TEST DATA

**CENTRIFUGAL TIMING ADVANCE**

With a stroboscopic timing light, check the advance characteristics of the distributor at the following r.p.m.

| R.P.M. | DEGREES |
|---|---|
| 1200 | 13—17 |
| 1600 | 22—26 |
| 2900 | 29—33 |
| 4400 | 37—41 |

## THE STROMBERG 175 CD2SE EMISSION CARBURETTER

**DESCRIPTION**

The STROMBERGE 175 CD2SE carburetter is a development of the constant depression carburetter which operates on the principle of varying the effective areas of choke and jet orifice in accordance with the degree of throttle opening, engine speed and engine load. A number of special features have been introduced to meet the needs of engine emission control.

Fuel passes into the float chamber via a needle valve where flow is controlled by the needle valve and twin floats mounted on a common arm. Fuel in the jet orifice is controlled at the same level as that in the float chamber by means of cross drillings in the jet assembly.

Clearance around the piston in its vertical bore permits air to "leak" into the mixing chamber and thus lower the depression. A drilling is taken from the atmospherically vented region beneath the diaphragm to meet a further drilling that breaks into the mixing chamber downstream of the piston. An adjusting screw with a conical tip is inserted into the drilling and is adjusted by the manufacturer to bring each carburetter to a common "leak" datum and sealed with a plug **which must not be disturbed in any circumstance.**

## COLD STARTING

Pulling out the choke control on the instrument panel operates a lever at the side of each carburetter which rotates a disc in the starting device in which a series of holes of different diameters are drilled. In the fully rich position all these holes will be in communication with the starting circuit and will provide the richest mixture. Gasoline is drawn from the float-chamber via a vertical drilling adjacent to the central jet, through the starting device and into the throttle body between the piston and the throttle disc. Simultaneously the cam on the choke lever will open the throttle disc beyond the normal idle position to ensure a faster idle speed and prevent stalling.

As the choke is gradually pushed to the "OFF" position, fewer and smaller holes will limit the gasoline feed from the float chamber thereby progressively weakening the mixture to a point where the choke is fully home and the mixture strength is governed by the Factory setting of the main jet and the idling speed determined by the setting of the throttle stop screw.

**NOTE: DO NOT DEPRESS THE ACCELERATOR PEDAL WHEN STARTING FROM COLD.**

A control in each carburetter enables the choke to be varied for summer and winter operation, and takes the form of a spring loaded plunger operating against the cam. To check the setting, note the position of the stop cross-pin. If lying in the horizontal slot in the casting the choke is set for winter operation. To adjust for summer running depress the spring loaded pin and turn through 90°. Release and check that the cross-pin is at right angles to the slot.

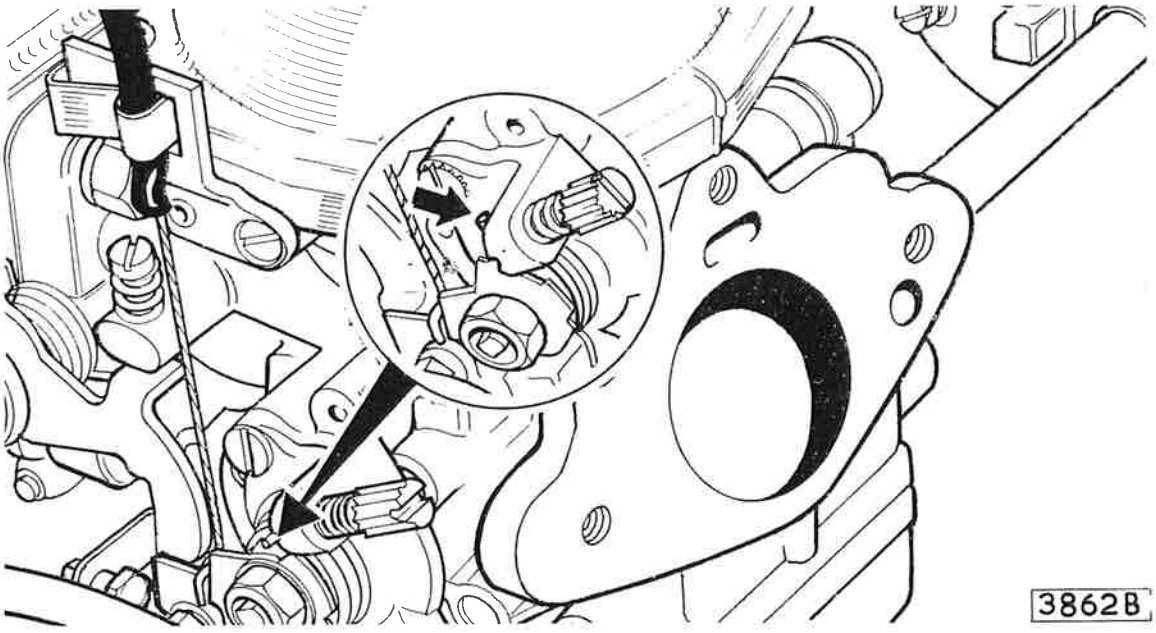


Fig. 5. *The choke limiting spindle in the Winter setting (inset shows the Summer setting).*

## IDLING

There is no separate circuit for idling. The fuel is provided by the jet orifice (the amount being controlled by jet/needle relationship established during manufacture) and the speed of idle by adjustment of the throttle stop screw which limits the closure of the throttle when the accelerator pedal is released.

To cater for variations in engine "stiffness" when manufactured, an idle "trim screw" is provided. Engine stiffness dictates idling air consumption and a new and very stiff engine will require more air than one which has become "free". The trim screw may be adjusted to provide a slightly leaner mixture for any engine found to be extremely stiff on production engine test. When fully seated, the maximum enrichment is achieved and emission figures will be within requirements, the engine having freed to a value equivalent to the datum at which the original trim screw setting was carried out.

**Finger pressure only should be used when tightening the trim screw, care being taken not to over-tighten.**

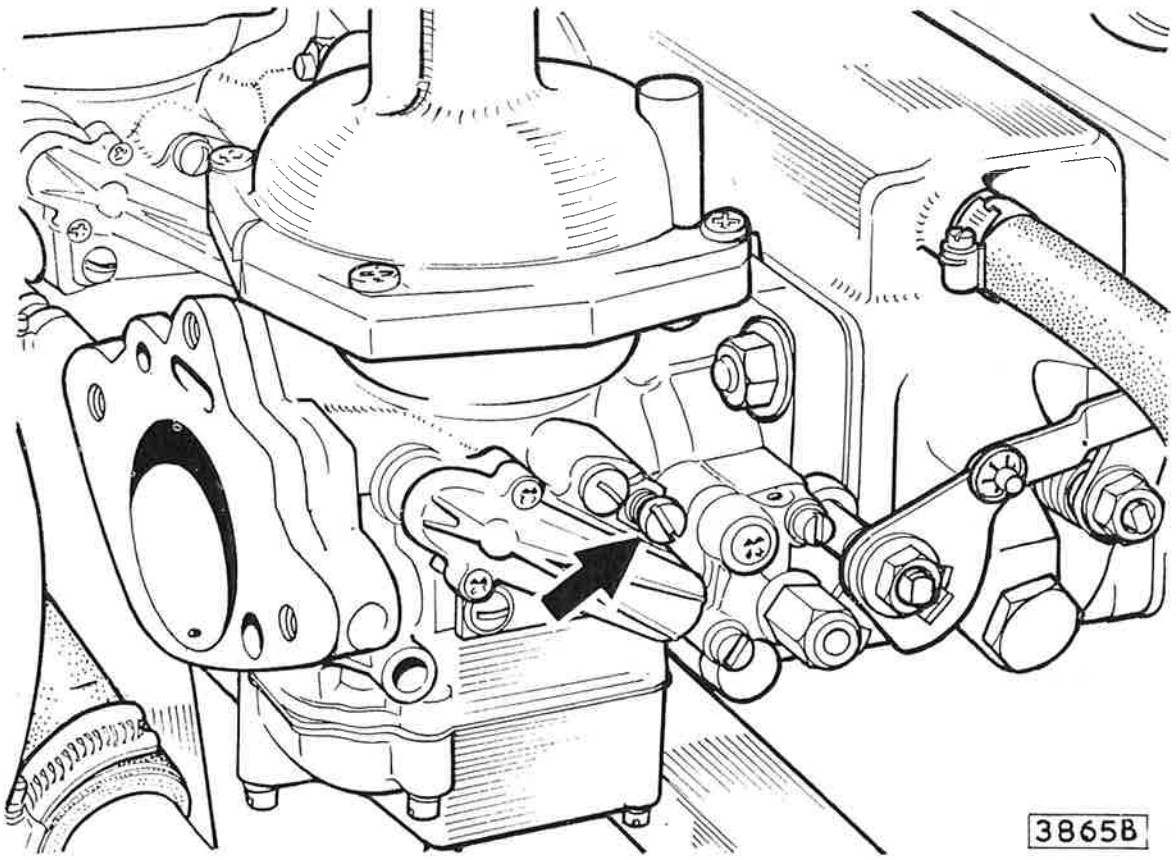


Fig. 6. *The idle trim screw.*

## JET/NEEDLE RELATIONSHIP

The jet/needle relationship not only governs the correct idle mixture but also the correct mixture strength throughout the range. During development, it was found desirable to have the needle central in the jet. This not being practicable to achieve the needle has been biased permanently on one side of the jet to rub lightly against the jet orifice.

The needle profile has been evolved to compensate for the known air leak (consistency being obtained by manufacturer's setting of the "leak adjuster screw") and therefore a constant fuel/air ratio is maintained. All carburetters therefore, produce a consistent flow from the given needle profile.

To meet emission control requirements, carburetters must be kept within very narrow "flow bands". Exhaustive testing on Jaguar engines decided the optimum jet position in the orifice and, therefore, all carburetters have the jets pressed into position to a predetermined depth thereby eliminating any possible maladjustment in service. Every unit is flow tested by the carburetter manufacturer ensuring that all carburetters are supplied within the desired limits.

On throttle opening, the piston rises withdrawing the tapered jet metering needle, held in its base, from the jet orifice so that the fuel flow is increased proportionate to the greater air flow.

The metering needle is variable along its length and has been machined to very close limits.

## EXHAUST EMISSION CONTROL

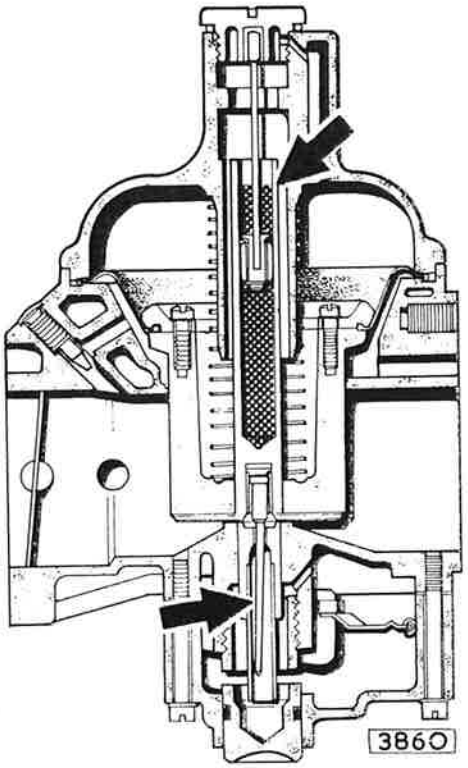


Fig. 7. *Cut-away view showing the Jet/Needle relationship.*

**As the needle profile has been developed from exhaustive testing, it is vitally important, to maintain correct results in regard to engine emission control, that only the recommended needle is used.**

**For correct identification the needle is stamped with the figure B1E on the shank.**

Variations in mixture strength caused by heat transfer to the carburetter castings are significant in the context of the extraordinary precision demanded by emission requirements. A temperature compensator is incorporated to cater for this condition.

An air flow channel permits air passing through the carburetter to by-pass the bridge section. A bimetallic blade regulated the movement of a tapered plug which adjusts the quantity of air by-passed to the mixing chamber. Two screws attach the temperature compensator assembly to the body and two seals are provided to ensure that no leakage can occur at the joint with the body.

The assmbly is preset, and unless necessary due to the tapered plug sticking, should not be readjusted in service. If malfunctioning of the compensator is suspected and the tapered plug moves freely when tested carefully by hand with the engine hot or cold, the compensator assembly must be changed for a new unit.

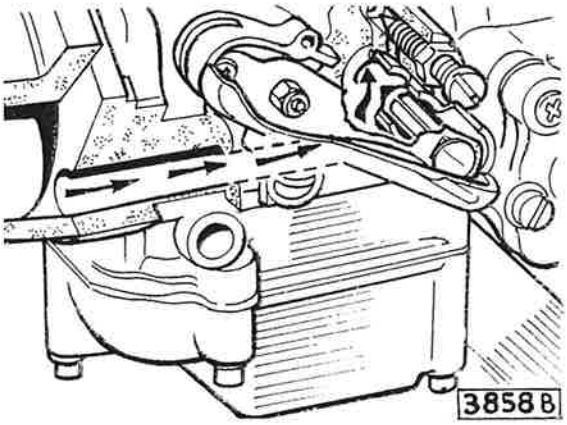


Fig. 8. *Cut-away view of the temperature compensator.*

### THROTTLE BY-PASS

During periods of engine over-run, high emissions will occur if the fuel/air mixture in the combustion chambers is not of sufficient strength, when diluted by exhaust gas, to support combustion. To overcome this problem, a device is fitted to the carburetters which consists of a by-pass formed in the carburetter around the primary throttle under the control of a vacuum operated valve. The vacuum signal to the valve is via an internal drilling in each carburetter. The flow of this circuit is determined by the size of the ports, the valve always lifting to full travel. As the throttle remains on its stop, the primary induction circuit only is in use ensuring that even mixture is fed through the primary system to all six combustion chambers. This valve is pre-set and provided it is free from air leaks, requires no adjustment. It is possible however, that small particles of foreign matter may lodge under the valve seating causing leakage and consequent high idling speed. In these circumstances the valve cover should be removed and the valve and seating cleaned.

Manifold depression acting on the valve diaphragm will cause the valve to open when the value is reached that will overcome the valve spring tension.

This allows fuel to feed from the mixing chamber to the downstream side of the primary throttle enriching the gases in the combustion chamber to a combustible level.

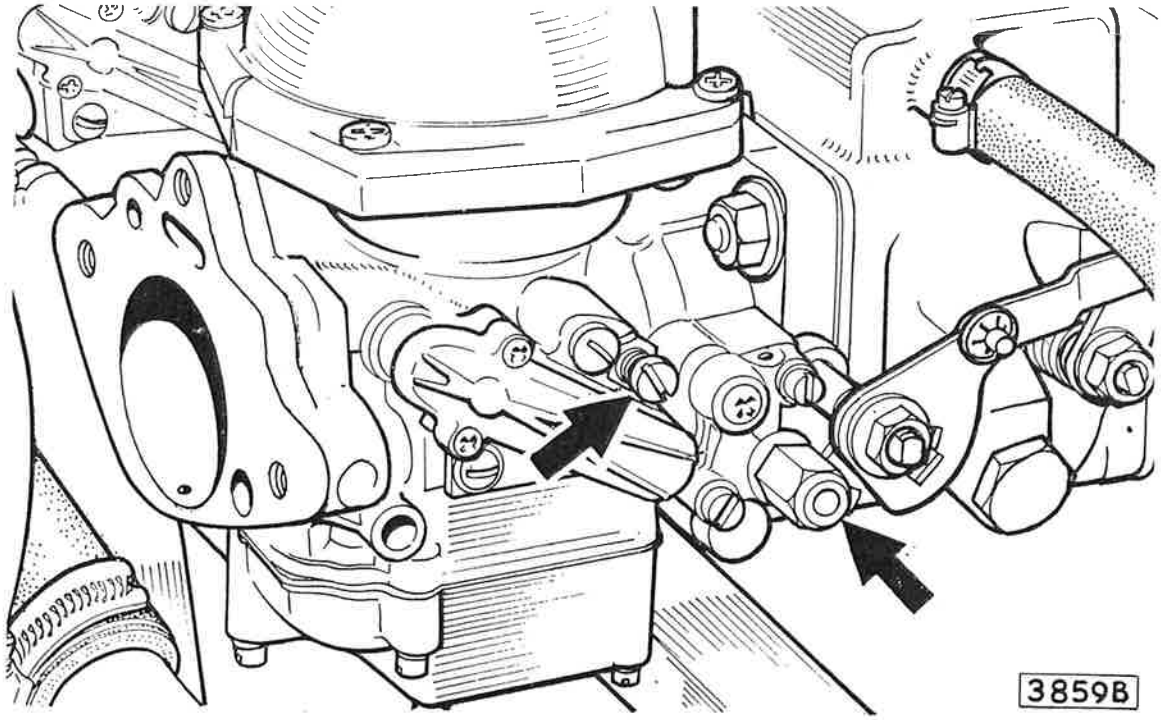


Fig. 9. *The throttle by-pass valve.*

## HYDRAULIC DAMPER

At any point in the throttle range, a temporary enrichment is required when the throttle is suddenly opened. A hydraulic damper is arranged inside the hollow guide rod of the piston to provide this.

The guide rod itself is filled with "Zenith Lube Pack" or SAE 20 engine oil to within $\frac{1}{4}$" of the end of the rod.

When the throttle is suddenly opened the immediate upward motion of the piston is resisted by the damper. For this brief period a temporary increase in the depression over the jet orifice is achieved and the mixture is enriched. Downward movement of the piston is assisted by a coil spring.

## RECOMMENDED SERVICE PROGRAMME

It is necessary to maintain the carburetters at peak efficiency to control engine emission, therefore the following service recommendations should be carried out.

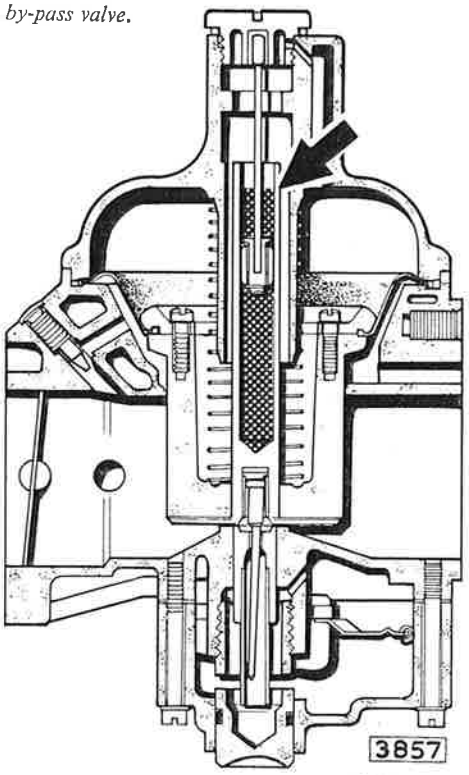


Fig. 10. *The hydraulic damper. Sectioned view showing the oil level in the piston guide.*

## EXHAUST EMISSION CONTROL

1. Hydraulic damper.
2. "O" ring.
3. Cover.
4. Diaphragm securing ring.
5. Piston return spring.
6. Needle securing screw.
7. Butterfly.
8. Bush.
9. Pick-up lever.
10. Floating lever.
11. Washer.
12. Shakeproof washer.
13. Nut.
14. Diaphragm.
15. Idle trim screw.
16. Gasket.
17. By-pass valve.
18. Gasket.
19. Spring.
20. Cover.
21. Seal.
22. Seal.
23. Gasket.
24. Temperature compensator housing.
25. Tapered plug.
26. Bi-metallic blade.
27. Plastic cover.
28. Jet assembly.
29. Float assembly.
30. Float chamber.
31. Pivot pin.
32. "O" ring.
33. Needle valve.
34. Special washer.
35. Choke assembly.
36. Needle.
37. Spring.
38. Throttle stop screw.
39. Throttle spindle assembly.
40. Piston.
41. Diaphragm.

Inset—Lead seal.

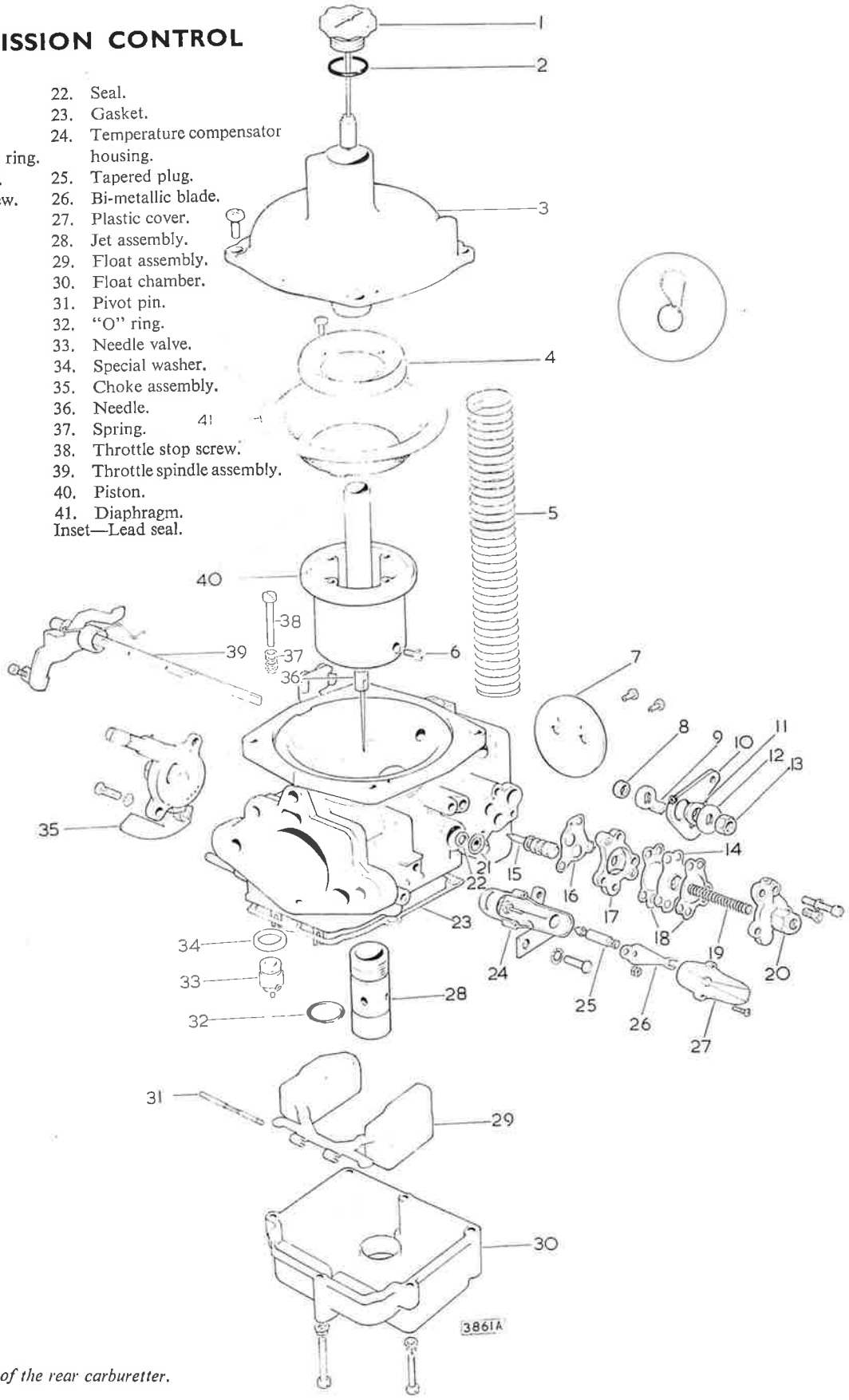


Fig. 11. *Exploded view of the rear carburetter.*

**12,000 Miles Service**

For this service period, one Yellow Emission Pack (Part No. 11549) is required for the two carburetters. This pack contains 2 float-chamber gaskets, 2 "O" rings for the float-chamber plugs and 2 needle valve washers.

Additionally, 4 manifold/carburetter gaskets and 2 spacers will be required.

Remove the carburetters as follows:

Remove three setscrews securing the air trumpet to each carburetter and withdraw the engine breather pipe from the air box. Lift off the air cleaner. Thin gaskets are fitted between each trumpet and carburetter and these should be carefully placed to one side for use when refitting.

Remove the gasoline pipes from the float-chambers.

Remove the nut, lock washer and plain washer, securing the linkage from the primary to the secondary throttles, at the primary spindles of the rear carburetter.

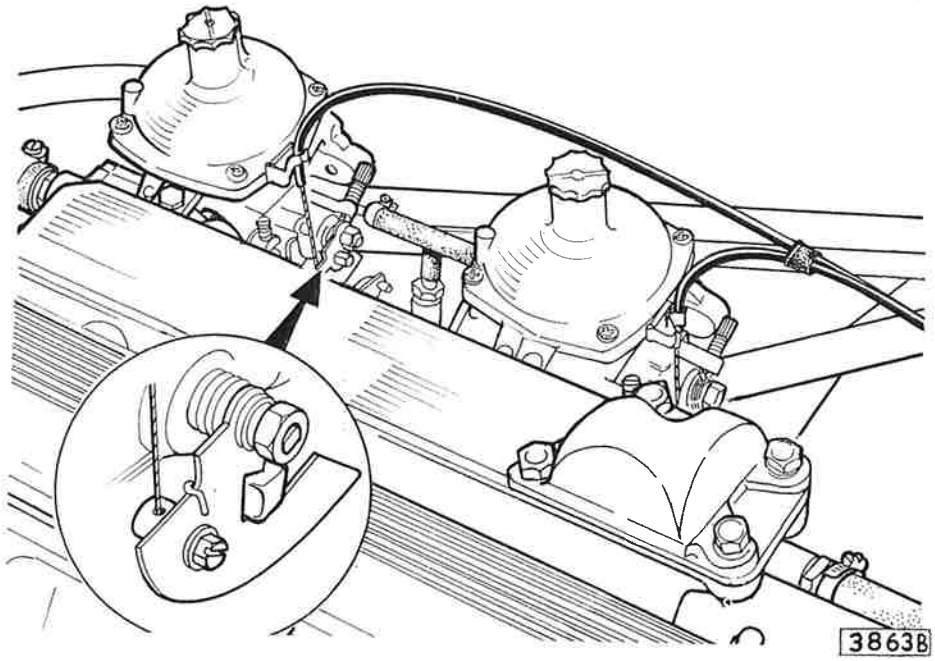


Fig. 12. *The choke cable connections.*

Detach the link. Replace the washers and nuts on the spindle for safe-keeping.

Repeat the operation for the front carburetter.

Release the bolts securing the inner cables to the choke levers and withdraw the outer casings from the clips at the sides of the carburetters.

Remove four nuts, spring washers and plain washers securing each carburetter to the studs on the primary inlet manifold. Disconnect the central link between the throttle slave shaft and the carburetter spindles. Withdraw both carburetters as an assembly.

Separate the units by slackening the clamps on the throttle spindles.

**It is important to dismantle and assemble each carburetter individually to avoid the possibility of similar parts being interchanged between carburetters.**

Unscrew the float-chamber fixing screws and withdraw the float-chambers vertically away from the body to clear the float mechanism. Remove the float-chamber gaskets.

Unclip the float pivot pin.

Note the fitted position of the float assembly. The flat portion of the float must be uppermost when refitted, with the carburetter in an inverted position.

Unscrew the hexagon-bodied needle valve from the float-chamber body.

Remove the "O" ring from the centre plug and wash all metal parts in cleansing solvent.

Re-assemble the carburetters as follows:

Refit the needle valve with the new washer to the float-chamber body and screw home tightly. Replace the float assembly, after inspecting for distortion or damage.

To ensure correct float level, measure the float height as follows.

Invert the carburetter so that the float tag closes the needle valve. Measure from the face of the carburetter body (with the gasket removed) to the top of each float.

The correct height should be 16·5 ± ·5 mm.

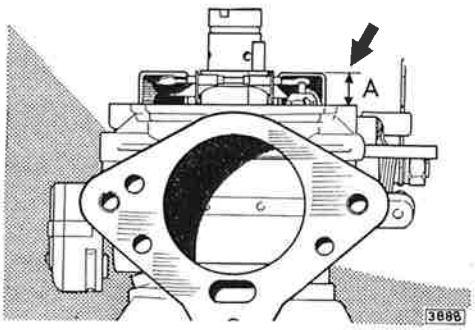


Fig. 13. *Checking the float height. Dimension A should be* 16·5 ± ·5 mm.

Fit a new "O" ring to the centre plug.

With the new gasket in position refit the float chamber and tighten the securing screws from the centre outwards.

Refit the carburetters to the manifold with the new gaskets and spacers. Reconnect the carburetter linkage. Reconnect the gasoline pipes and top up the hydraulic piston damper of each carburetter with "Zenith Lube Pack" or SAE 20 engine oil to within ¼" of the top of the centre rod.

Leaving the clamping bolts on the throttle spindles loose, unscrew the throttle stop screws to permit the primary throttles in each carburetter to close completely. Screw in the stop screws to the point where the ends of the screws are just contacting the casting. Rotate each screw 1½ turns to open the throttles an equal amount and to provide a basis from which the final idling speed can be set.

Ensure that the fast idle screw is clear of the choke cam otherwise incorrect synchronising will result.

Check that both choke cams are in contact with the stops. With the instrument panel choke control pushed home fully, reconnect the choke cables to the cams.

Check that both cams operate simultaneously.

Start the engine and warm up to the normal operating temperature.

Check the synchronising of the throttles with a balance meter, and tighten the clamping bolts on the throttle spindles. Set the throttle stop screws to give the correct idling speed as stated in "Routine Maintenance". Turn each screw by an equal amount.

Adjust the fast idle as detailed on page QY.s.6.

If care is exercised in setting each throttle opening to the same extent, no difficulty should be encountered in obtaining satisfactory idling and smooth acceleration.

Refit the vacuum pipe to the by-pass valve.

Refit the air cleaner and the engine breather pipe.

**NOTE: The idling quality and acceleration depend to a large extent upon general engine condition and it is therefore essential to check the engine on an Electronic Engine Tester such as the Sun 1020 or other make of similar capacity. See Diagnosis Chart for test procedure.**

**24,000 Miles Service**

This is a more comprehensive service for which one **RED Emission Pack,** Part No. 11791 will be required for each carburetter. This Pack contains 2 float-chamber gaskets, 2 "O" rings, 2 needle valves and washers, 4 throttle spindle seals, 4 temperature compensator seals, 2 by-pass body gaskets, 2 piston diaphragms, and 2 hydraulic damper seals.

Additionally, the following will also be required 4 secondary throttle housing/carburetter gaskets and spacers, 1 secondary throttle housing/manifold gasket. 1 primary mixture pipe/secondary throttle housing gasket.

**IMPORTANT: Dismantle and assemble each carburetter individually to avoid the possibility of interchanging similar parts between carburetters.**

Remove the carburetters as detailed under the 12,000 miles service.

Drain sufficient water from the cooling system to allow the level of coolant to fall below the throttle housing.

Disconnect the water pipes from the housing.

Remove four nuts and washers securing the primary mixture pipe to the secondary throttle housing.

Release the four nuts securing the secondary throttle housing to the inlet manifold; these are located behind the manifold.

Disconnect the clamping bolt securing the front throttle slave shaft to the rear throttle slave shaft.

If automatic transmission is fitted, disconnect the link between the automatic transmission throttle control shaft and the front throttle slave shaft.

Withdraw the secondary throttle housing together with the front throttle slave shaft.

For each carburetter, carry out the instructions detailed under 12,000 miles Service.

In addition to this service however, fit the new needle valve assemblies with new washers.

Remove the damper assembly from the top cover and break the wire seal.

Unscrew the four cover fixing screws and carefully lift off the cover. Remove the piston return spring and lift out the piston assembly.

Drain off the oil from the damper reservoir (centre of guide rod). Slacken the metering needle clamping screw and withdraw the needle from the piston.

Place the needle carefully to one side to avoid damage.

Remove the four screws attaching the diaphragm retaining ring to the top of the piston.

Lift off the ring and diaphragm.

Fit the new diaphragm into the top of the piston ensuring that the locating tag is recessed into the aperture provided. Secure in position with the retaining ring and the four screws.

Check the spring action of the needle in its housing at the top of the shank. Fit the needle into the base of the piston lining up the flat portion with the locking screw. Using a straight edge placed lightly against the small shoulder on the needle, (not the casing) press the assembly into the piston until the straight edge aligns the shoulder of the needle with the flat surface of the piston. Lightly tighten the locking screw, taking care not to collapse the needle housing. Shoulder alignment of the needle is critical and great care must be taken during this operation. Correctly fitted, the needle will be baised towards the throttle and the shoulder of the needle will be exactly flush with the piston face.

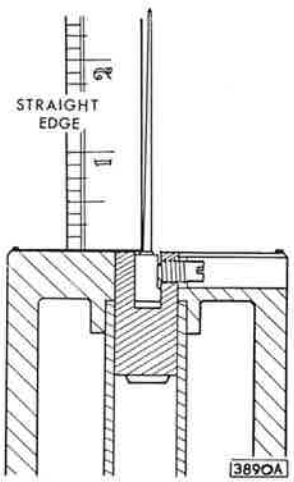


**Fig. 14.** *Positioning the needle in the piston.*

Carefully enter the piston and diaphragm assembly into the main body, guiding the needle into the jet with a finger in the air intake. Locate the outer tag of the diaphragm into the recess at the top of the body. Check the assembly by looking down the piston to ascertain that the two depression transfer holes are towards and in line with the throttle spindle and that the needle is biased towards the throttle.

Replace the piston spring, hold the piston against the spring with a finger through the air intake and fit the cover. This method will prevent the piston from moving out of position. The cover must be fitted with the damper ventilation boss towards the air intake.

Replace the four cover screws and tighten down evenly.

Check the movement of the piston; freedom of movement over the full travel is essential and when released from the uppermost position, the piston should fall with a sharp click onto the bridge of the carburetter.

Top up the piston damper, fit new seal and refit the damper assembly.

Remove the two screws securing the temperature compensator unit to the body and withdraw the assembly. Take out the inner seal from the carburetter body and remove the outer seal from the valve. Renew both seals and refit the assembly to the carburetter body.

Tighten the two screws evenly.

Remove the two screws and detach the compensator cover. Check for free movement of the valve by lifting the plug from its seat. On releasing, the valve should return freely.

Do not strain the bi-metal strip, or attempt to alter the adjustment. It is permissible to ensure that there is consistent radial clearance around the valve to allow for thermal expansion. If the valve is sticking, remove the securing nut and screw. Lightly clean the bore and the plug with a gasoline moistened cloth. Refit the bi-metal strip and re-tension by tightening the nut until the valve is just seated. DO NOT TIGHTEN BEYOND THIS POINT.

Unscrew the three setscrews securing the by-pass valve body and lift the assembly from its seat. Prise out the throttle spindle seal and renew before replacing the by-pass body with a new gasket. Renew the throttle spindle seal on the other side of the carburetter spindle. Repeat this operation on the rear carburetter.

Refit the secondary throttle housing and mixture pipe with new gaskets. Refit the water pipes to the secondary throttle housing and top up the coolant to the correct level.

Refit the carburetters to the secondary throttle housing with new gaskets and spacers. Fit new wire and seal to the dashpot. Re-connect the throttle spindles controls and set the carburetters as detailed in the 12,000 Miles Service.

**Check the engine performance on an Electronic Engine Tester such as the Sun 1020 or other make of similar capacity. See Diagnosis Chart for test procedure.**

## CARBURETTER FAULT FINDING

Service complaints can generally be broken down into three main categories:—

(a) Erratic or poor idling.
(b) Hesitation or flat spot.
(c) Heavy fuel consumption.

Under these headings, possible causes are put forward together with suggestions.

**Erratic or Poor Idling**

(1) Incorrect fuel level caused by maladjustment of the floats and/or worn or dirty needle valves. Check the float level. Wash the needle valve in clean gasoline, replace the valve if worn.
(2) Piston sticking. Check for free movement of the spring loaded metering valve needle. Clean the piston rod and guide. Lubricate the rod and guide with a few drops of light oil.
(3) Metering needle incorrectly fitted. Check that the shoulder of the needle is flush with the face of the piston and that the needle is biased towards the throttle. Check the needle identification and ascertain that the correct needle is fitted. Check that the needle housing has not been distorted by over-tightening of the securing screw.
(4) Partially or fully obstructed diaphragm ventilation holes. Check that the air cleaner element and casing are correctly fitted and that the air trumpet/carburetter gaskets are not causing obstruction.
(5) Diaphragm incorrectly fitted or damaged. Check the location with the depression chamber cover removed. The two depression holes at the base of the piston should be in line with and towards the throttle spindle. Replace the diaphragm if damaged. When replacing the depression chamber cover, the damper ventilation boss must be towards the air intake.
(6) Throttles not synchronised. Reset correctly using a balance meter.
(7) Temperature compensator not working properly. With the engine and the carburetters cold, remove the cover from the temperature compensator assembly. The tapered valve should be seated in this instance. Check the operation by carefully lifting of the valve off its seat. When released, the valve should return freely. If damage prevents the mechanical operation functioning correctly, renew the compensator unit.
(8) If high mileage has been covered, inspect the throttle spindles and end seals for wear. Check the spindles for fractures: renew if suspect.

**Hesitation or Flat Spot**

Possible causes are as enumerated for "Erratic or Poor Idling" but with the addition of the following:

(1) Damper inoperative. Check the oil level and top up with light engine oil.
(2) Piston return spring omitted.

**Heavy Fuel Consumption**

Points covered under the two previous headings may contribute to heavy fuel consumption. Additionally, check that there is no fuel leakage from the float-chambers or centre plug "O" ring. Replace as necessary.

## SPECIAL PARTS

In an endeavour to maintain engine emission within the legislated limits, the following parts must not be changed in service.

## ITEMS THAT MUST NOT BE CHANGED

(a) The jet assembly.
(b) The piston.
(c) The depression chamber cover.
(d) The **position** of the metering needle.

If any of the above items require changing, the sub-assemblies or the complete carburetter(s) must be renewed. In the case of the metering needle it is quite permissible to replace the needle providing the procedure outlined previously is carefully followed.

## EQUIPMENT

The recommended equipment for servicing should include at least the following:

| | |
|---|---|
| Ignition Analyser oscilloscope | Cam Angle Dwell Meter |
| Ohmeter | Ignition Timing Light |
| Voltmeter | Engine Exhaust Combustion Analyser |
| Tachometer | Cylinder Leak Tester |
| Vacuum Gauge | Distributor Advance Tester |
| Carburetter Balance Meter | |

It is important that test equipment has regular maintenance and calibration.

The following equipment covers most of the requirements for engine testing and tuning of vehicles fitted with exhaust emission control devices.

Equipment made by other suppliers may also be adequate.

| **Equipment** | **Type/Model** | **Manufacturer** |
|---|---|---|
| Oscilloscope engine tuning set and exhaust gas analyser | 1020 or 720 | Sun Electric Corp |

# SECTION R

## AIR-CONDITIONING REFRIGERATION EQUIPMENT

### DESCRIPTION

Air conditioning equipment is available as an optional extra, and is fitted in addition to the car heating and ventilating system standard on all cars.

The air-conditioning equipment is comprised of the following components:—

A compressor, magnetic clutch, condenser unit, a receiver drier, and evaporator unit, and expansion valve, a thermostatic control and interconnecting lines.

The expansion valve and thermostatic control are contained in the evaporator case.

The refrigerant used as to Specification R.12 (Refrigerant 12) which is a halogenated hydrocarbon (dichlorodifluoromethane).

A basic knowledge of refrigeration systems and the use of the special tools required is necessary before any Service operations can be attempted. It is, therefore, ESSENTIAL that only qualified Refrigeration Service Engineers should carry out any repair work necessary.

IT IS DANGEROUS FOR ANY UNQUALIFIED PERSON TO ATTEMPT TO DISCONNECT OR REMOVE ANY PART OF THE AIR-CONDITIONING SYSTEM.

If, during repair work on the car, it becomes necessary to remove any part of the air-conditioning system, DO NOT DISCONNECT THE HOSE CONNECTIONS until the system has been "pumped down", that is, until all the refrigerant has been removed.

**WARNING:**

EXTREME CARE SHOULD BE EXERCISED IN HANDLING THE REFRIGERANT. LIQUID REFRIGERANT AT ATMOSPHERIC PRESSURE BOILS AT −20°F (−29°C). SERIOUS INJURY MAY OCCUR IF ALLOWED TO CONTACT THE EYES. DO NOT SMOKE WHILST CHARGING THE SYSTEM.

For operating details refer to page RY.s.13 under "The Electrical System".

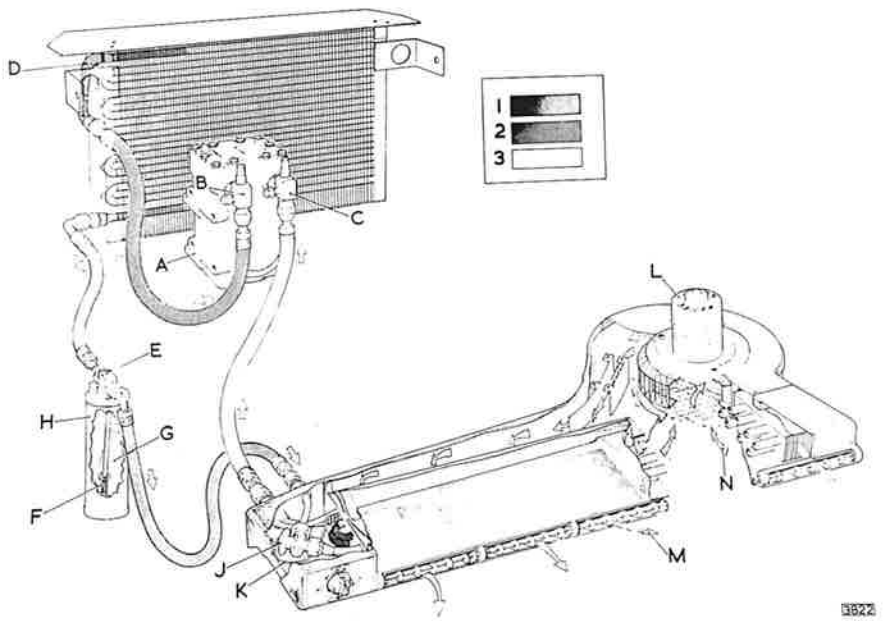


Fig. 1. *The schematic refrigeration circuit*

A. Compressor.
B. Discharge valve.
C. Suction valve.
D. Condenser.
E. Sight glass.
F. Cotton bobbin.
G. Dessicant.
H. Receiver drier assembly.
J. Expansion valve.
K. Capillary tube.
L. Blower assembly.
M. Air flow (outlet).
N. Air flow (inlet).

1. HOT VAPOUR. 2. LIQUID. 3. COLD VAPOUR.

## PERIODICALLY

**Compressor Drive Belt—Adjusting**

Periodically check the compressor drive belt and adjust to the correct tension by means of the adjuster pulley.

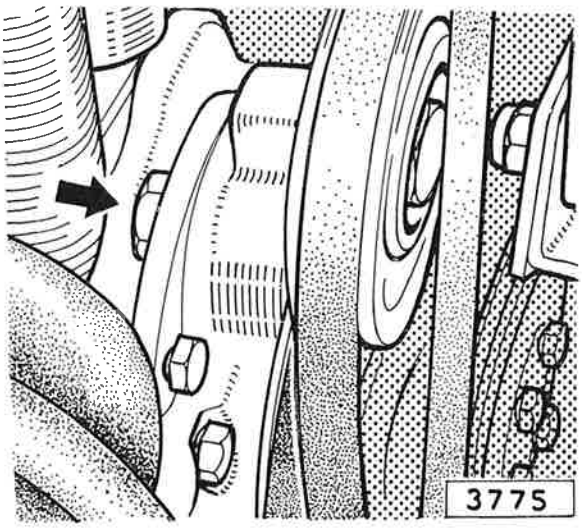


Fig. 2. *The compressor drive belt adjustment point.*

**Every 12 Months**

**Compressor Oil Level—Checking**

A manifold gauge set must be available before this maintenance operation can be carried out.

At every 12 monthly period check the oil level in the compressor as follows:—

Operate the system until the desired interior body temperature is obtained and the crankcase is warm.

Stop the engine and connect the manifold gauge set

Start the engine and note the gauge readings.

**Slowly** forward seat (turn clockwise) the suction service valve until the compressor gauge reads 2 lb. per sq. in. (0·1406 kg./cm.F).

Stop the engine at this point and quickly **fully** close the suction valve.

Forward seat the discharge service valve.

**Note:** It is important that the suction service valve is closed slowly when pumping the system down, otherwise an abnormal amount of oil may leave the compressor due to the sudden pressure of reduction on the refrigerant oil in the crankshaft case.

Unscrew the oil level plug slowly and bleed off the remaining pressure in the crankcase until the gauge reads zero. Complete the removal of the plug. The oil level plug is located in the rear face of the crankcase. Two plugs are fitted but one only need be removed.

Insert the dipstick, made from a piece of wire suitably bent, through the plug-hole until it contacts the bottom of the crankcase. Withdraw the dipstick and measure the wetted portion.

The oil depth obtained should be approximate to the figure shown in the Oil Level chart below.

The oil should not be allowed to fall below the "Minimum" level shown in the chart.

If oil is added, do not exceed the figure shown in the chart.

It is essential that only oil of the correct specification and grade is used.

The oil level should also be checked after placing a new compressor in operation, charging or repairing a compressor, or after adding refrigerant to the system.

**OIL LEVEL**

| | |
|---|---|
| Factory charge of 11 fluid ounces | $1\frac{5}{16}$" (33·3 mm.) |
| Minimum height .. .. .. | $\frac{7}{8}$" (22·2 mm.) |
| Maximum height .. .. .. | $1\frac{3}{8}$" (34·9 mm.) |

**RECOMMENDED LUBRICANTS**

| | |
|---|---|
| SUN OIL CO. .. | "3 G "3 G dual-inhibited" Oil |
| TEXACO .. | "Cappela B dual-inhibited" Oil |
| SHELL .. .. | Clavus 53 |
| B.P. .. .. | Energol LPT.100 |

## CHARGING AND SERVICING A REFRIGERATION SYSTEM

Charging an air-conditioning system will not be necessary unless leaks develop in the system resulting in loss of the refrigerant, or in the event of any components being disconnected or removed.

This service can only be performed by a fully qualified Refrigeration Service Engineer who will have the necessary equipment.

**IMPORTANT:** The air-conditioning equipment is manufactured for use only with Refrigerant 12 (dichlorodifluoromethane) and **extreme care** must be taken **never** to use methylchloride refrigerants.

**The chemical re-action between methylchloride and the aluminium parts of the compressor will result in the formation of products which burn spontaneously on exposure to air, or decompose with violence in the presence of moisture.**

To ensure efficient operation of a refrigeration unit, all air and non-condensable gases must be completely evacuated from the system before inserting the refrigerant charge.

A sufficient quantity of refrigerant should be obtained before commencing operations, and should be available from any qualified Refrigerant Service Suppliers under the following trade names:—

FREON 12
ARCTON 12
ISCEON 12

or any refrigerant to specification R.12. The refrigerant is available in 1, 2, 10, 25, or 145 lb. (0·454, 0·907, 4·536, 11·34 or 65·7 kgm.) containers. The lower weight being in canisters, the higher weights being in steel cylinders.

1 lb. 9 oz. (0·862 kgm.) will be the approximate weight of refrigerant 12 required to complete the charging operation.

## SERVICE DIAGNOSIS

The following Service Diagnosis chart is included to assist the Service Engineer in fault finding:—

### SERVICE DIAGNOSIS CHART

CAUSE

| SYMPTOM | Low refrigerant charge (a) | Very light heat load (b) | Partial restriction in expansion valve (c) | Low capillary charge in expansion valve (d) | Defective expansion valve (e) | Evaporator coil blocked with ice (f) | Excessive refrigerant charge (g) | Very high heat load (h) | Loose capillary tube connection at evaporator coil outlet (i) | Restriction in high pressure side (j) | Insufficient air over condensers (k) | Unusually hot running engine (l) | Air or non-condensible gases in system (m) | Defective compressor head gasket (n) | Defective compressor plate gasket (o) | Defective compressor plate (p) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unusually low reading of compound gauge | X | X | X | X | X | X | | | | | | | | | | |
| Unusually high reading of compound gauge | | | | | X | | X | X | X | | | | | X | X | X |
| Unusually low reading of high pressure gauge | X | X | X | X | X | X | | | | | | | | X | X | X |
| Very low reading on high pressure gauge coupled with very high reading on compound gauge | | | | | | | | | | | | | | X | X | X |
| Unusually high reading of high pressure gauge | | | | | | | X | X | | X | X | X | X | | | |

**Preliminary Check**

Carry out preliminary checks as detailed below, before proceeding with any further tests:—

(1) Check that the fan is operating and that the blades are not fouling.

(2) Check that the compressor clutch is engaging or releasing satisfactorily when the air-conditioning system is switched on.

(3) Check that air is not present in the system by observing the sighting glass attached to the receiver/drier unit.
Run the engine at fast idle speed (1,000 r.p.m.) and check the sighting glass.
Repeat at 1,800 r.p.m.
Gradually increase the speed of the engine to the high range and check the sighting glass at intervals.
Bubbles in the sighting glass will indicate that air is present in the system.

(4) Check for frosting on the compressor valves.

(5) Check by feel for varying temperatures in the various pipe lines indicating blockage in the line system.

(6) Place a thermometer in the air duct, run the car on the road and note the drop in temperature with the system on or off or, if available, place a cooling fan in front of the condenser.
Check that the condenser is clear of mud, road dirt or flies, preventing the free passage of air over the condenser unit.

If the fault persists after carrying out these tests, the services of a qualified Refrigerant Engineer should be obtained.

# THE COMPONENTS

The following pages contain the General Description, Removal and Refitting details for the components used in the system.

# THE COMPRESSOR UNIT

**Description**

The compressor unit used in the JAGUAR Air-conditioning system is the "TECUMSEH" H.G.500.

The compressor is a completely sealed unit with the exception of the suction and discharge ports to which are attached the service valves.

The cold low pressure refrigerant is pulled into the suction service valve, indicated by the word "SUCTION" stamped on the cylinder head, through the valve plate and into the suction chamber.

The compression stroke of the piston closes the valve and forces the compressed vapour into the discharge chamber.

The vapour is them pumped through the discharge service valve, indicated by the word "DISCHARGE" stamped on the cylinder head, and so into the system.

**Removal**

It will only be necessary to remove the compressor from the engine if any major repair work is carried out. Servicing to the cylinder head, valve and valve plate can be done with the unit in situ.

Remove the aluminium cap from the suction service valve, close the valve by rotating the square end of the valve stem anti-clockwise.

Remove the cap from the suction gauge port and connect a pressure gauge to the port union.

Open the valve and check the pressure recorded. If the gauge shows a pressure above zero, close the suction service valve and start the engine to operate the compressor until suction pressure is reduced to 2 lb. sq. in. (0·1406 kg./cm.F).

Stop the engine and close the discharge service valve.

Unscrew the large hexagon gland nuts and remove the service valves from the compressor unit.

Release the jockey pulley pivot bolt, swing the pulley bracket down and remove the drive belt.

Withdraw the two bolts securing the carrier bracket to the exhaust manifold and the cylinder block. Withdraw the carrier bracket lower pivot bolt. Disconnect the clutch cable and remove the unit. Detach the carrier bracket from the compressor.

**Note:** The left hand valve cover on the engine cannot be removed with the compressor in position. To give the necessary clearance to enable the cover to be removed proceed as follows:—
Release the jockey pulley pivot bolt, swing the pulley bracket down and remove the compressor

drive belt.

Withdraw two bolts securing the carrier bracket to the exhaust manifold and the cylinder block. Release the lower bracket pivot bolt and swing the unit away from the engine.

**DO NOT DISCONNECT THE COMPRESSOR HOSE CONNECTIONS FROM THE COMPRESSOR.**

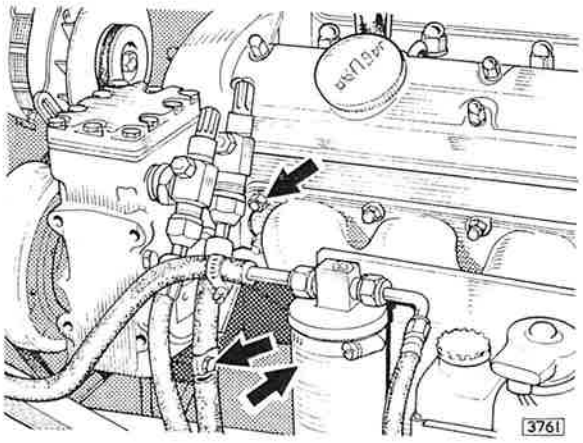


Fig. 3. *The compressor tie bracket and lower pivot mounting point.*

**Refitting**

Refitting is the reverse of the removal procedure.

Ensure that the pulleys are in line, check with a straight edge before finally tightening the securing bolts.

Re-charge the system as detailed on pages RY.S.00P RY.S.00.

When refitting the service valves, check that the mounting surfaces on the valves and the compressor are clean and that the "O" ring valve mounting gaskets are in good condition. If deformed, broken or split, replace with new gaskets.

Align the valves correctly to the cylinder head and tighten to a torque of 65–70 ft. lb. (8·983–9·674 kg./m.).

Special care should be taken to ensure that no dirt or foreign matter enters the compressor during installation.

A new replacement compressor should not be lef unsealed to the atmosphere longer than is absolutel necessary for actual preparation and installation. I no case should the compressor be open to the atmo sphere for longer than five minutes.

Check the oil level as detailed on page RY.s.2. .

When replacing parts and re-inserting bolts anc setscrews, the specified torque requirements shoulc not be exceeded (see table below).

Bolts should always be run in so that the bol heads make contact and then be rightened evenly tc the correct torque figures.

| Location | Torque |
|---|---|
| Cylinder head | 20–24 ft. lb. (2·764–3·316 kg./m.) |
| Crankshaft end | 15–20 ft. lb. (2·073–2·764 kg./m.) |
| Seal plate | 6–10 ft. lb. (0·829–1·382 kg./m.) |
| Mounting | 14–17 ft. lb. (1·934–2·349 kg./m.) |
| Front bearing lock nuts | 6 ft. lb. (0·829 kg./m.) |
| Connecting rods | 7 ft. lb. (0·967 kg./m.) |
| Oil filler plug | 18–20 ft. lb. (2·487–3·040 kg./m.) |
| Service valve locknut | 65–70 ft. lb. (8·983–9·674 kg./m.) |

**Shaft Seal Assembly (Replacement)**

Remove the compressor unit as detailed previously in this section.

Remove the clutch assembly as detailed on page RY.s.7.

Place the compressor on the work bench with shaft uppermost.

Wash or clean the seal plate and adjoining surfaces to remove all dirt.

Remove seal plate assembly after withdrawing six bolts. Gently pry plate loose, being careful not to scratch or nick the crankcase mating surfaces or edges.

Remove the carbon nose and spring assembly by prying behind the drive ring. When removing the seal assembly from the shaft, care must be taken that the crankshaft is not scratched. If the rubber seal around the shaft does not come out with the carbon nose and spring assembly, remove the seal with long nosed pliers pulling on the edge of the grommet.

Remove all dirt and foreign material from crankshaft mating surfaces to seal plate, exposed crankshaft and adjacent surfaces.

Remove the new carbon shaft seal washer from the bellows seal assembly. (Parts are contained in the shaft seal assembly kit). Coat the exposed surface of the crankshaft with clean refrigerant oil. Dip the new bellows of the seal assembly and shaft seal washer in refrigerant oil. Place the bellows seal assembly over the shaft with the end for holding the shaft seal washer facing the shaft end.

Push the bellows seal assembly, by hand, on the shaft to a position beyond the taper of the shaft.

Assemble the shaft seal washer in the bellows seal assembly, checking that the assembly and the shaft are free from dirt. Assemble the seal washer so that the raised rim is away from the bellows seal and that the notches in the washer line up with the nibs in the bellows assembly. Cover exposed surfaces of the shaft seal washer with clean refrigerant oil.

Install new rectangular section "O" ring in the crankshaft mating surfaces for seal plate.

Place the new front seal plate over the shaft and line up the holes. Push the seal plate evenly against the crankcase and retain in this position while inserting and tightening two diametrically opposed bolts. Insert the remaining four bolts and tighten evenly to the correct torque figure.

Rotate the shaft by hand 15–20 revolutions to seat the seal.

**Cylinder Head and Valve Plate Assembly**

For the best results, the compressor should be removed from the engine as detailed previously in this section. Clean off all road dirt and dismantle on a clean bench.

Remove ten bolts from the cylinder head assembly and detach the valve plate and head assembly, by lightly tapping upwards with a soft-nosed mallet. Note the location of the valve plate in relation to the cylinder head for reference when refitting.

Remove the valve plate from the cylinder head by holding the plate and tapping sideways against the head with a soft mallet.

Remove all particles of gasket from the surface of the cylinder head and the cylinder, taking care not to scratch the mating surfaces or edges.

Fit the new valve plate gasket, contained in Valve Plate Kit. Keep the gasket dry.

Place the new valve plate assembly over the gasket so that the letter "S" stamped on the plate is visible, and on the same side as the word "Suction" cast on the front of the crankcase.

Locate the new cylinder head gasket on the valve plate as noted on removal. Fit the cylinder head. Check that the word "Suction" on the head is on the same side as the word "Suction" on the crankcase. Insert the bolts through the cylinder head, valve plate and gaskets. Tighten all bolts evenly in a diagonal sequence to the correct torque figure. Refit the magnetic clutch.

Refit the compressor unit to the engine and recharge the system

Leak test all joints on completion.

After a period of two hours from time of assembly re-torque the cylinder head bolts.

## SERVICE REPLACEMENT UNITS

**Replacement compressors are not available on an exchange basis and must be replaced with new units obtainable from JAGUAR DISTRIBUTORS or DEALERS.**

## THE COMPRESSOR SERVICE VALVES

**DESCRIPTION**

Two service valves, Suction and Discharge, are located on the crankcaseand secured by locknuts.

Each of these valves has three ports or openings, one to which the refrigerant line is connected, one opening to the compressor and one known as the "service port", for connecting to the pressure gauge by means of a flexible hose.

The valve setting is accomplished by rotating the stem, normally covered by an aluminium cap, either clockwise or counter-clockwise.

With the discharge valve in the back-seated position —fully counter-clockwise—the refrigerant flow is

from the compressor to the refrigerant line. In the suction valve this is in the opposite direction.

With the valve in the forward seated position (clockwise), the valve is blocking the seat to the refrigerant line and the flow is from the compressor through the service port.

The two valves are identical with the exception that the discharge valve has a $\frac{1}{2}$" refrigerant fitting connection and the suction valve has a $\frac{5}{8}$" fitting connection.

If the valves are positioned anywhere between the fully back seated and fully forward seated positions, all three ports would be opened and, therefore, there would be a passage to the compressor and also the service ports.

This would be the position in which the system could be operating and, at the same time, recording pressure reading.

No service is possible on the valves and, if fault should be replaced.

**Removal**

Remove all refrigerant from the system by "Pum ing Down",

Disconnect all pipe lines, unscrew the locknu and remove the valves.

**Refitting**

Ensure that the cylinder and valve mating fac are clean.

Apply a light film of refrigerant oil to both face fit the valve and tighten the locknut to the corre torque as detailed on page RY.s.5.

Position the valves at an angle of 45° to clear th bonnet when the pipe lines have been connected.

## THE MAGNETIC CLUTCH

### GENERAL DESCRIPTION

The magnetic clutch consists of two major parts- the holding coil and the rotor-pulley assembly. When an electrical circuit is completed through the holding or field coil to ground, the clutch coil is electrically energised, creating a magnetic field. This couples the plates against the tension of the spring which is connected to the pulley, forming an integral part with respect to motion. Inasmuch as the belt is driving the pulley and all parts are coupled, the compressor is driven at its tapered shaft through the key.

Upon breaking the coil electrical circuit, the magnetic field is broken and the pulley revolves freely around the compressor shaft and bearing. Shims are provided at the hub of the plate for adjusting the plate clearance. Too small a clearance can cause a scraping of the plates. Too great a clearance will cause short-circuiting of the magnetic clutch which will weaken the field.

The approximate current consumption of th magnetic clutch is three amps at 12 volts.

Very little maintenance is required on this assembly Any clutch slipping should be traced to either in correct clearance or low voltage to the clutch. I these are checked and found correct and the clutch is still inoperative, it should be replaced.

**Removal**

Disconnect the cable at the snap connector Remove the compressor setscrew and flat washer and withdraw the clutch unit. If the rotor and pulley assembly will not release from the compressor shaft insert a $\frac{5}{8}$" U.N.C. setscrew and tighten. The rotor assembly should then release.

**Refitting**

Refitting is the reverse of the removal procedure.

## THE EXPANSION VALVE

### GENERAL DESCRIPTION

The expansion valve is an automatic thermal valve located in the evaporator assembly case (see Fig. 1).

The valve is the dividing point between the high and low pressure sides of the system and automatically meters the high pressure, high temperature, liquid refrigerant through a small orifice controlled by a ball valve, into the low pressure, cold temperature side of the evaporator coil.

The low pressure is created by the pull of the suction side of the compressor.

The expansion valve used in the Jaguar air conditioning equipment consists of a thermal bulb and capillary tube charged with vapour refrigerant; a diaphragm power element; balancing spring; external equalising pressure tube; valve seat actuating pin; ball seat; inlet port and screen and outlet port.

Liquid refrigerant, under high pressure, enters through the inlet port screen and tends to open the ball valve against the return spring tension.

The thermal bulb, which is clipped to the outlet line of the evaporator, is sensitive to the temperature of the vapour leaving the coil.

The last portion of the evaporator coil is absorbing additional heat from the air passing over, due to the action of the fans. The vapour of the coil becomes super-heated and the temperature rises.

The thermal bulb receives this temperature rise and the pressure of the vapour within the bulb correspondingly increases.

This pressure increase operating against the diaphragm and actuating needle, opens the valve against the spring pressure and allows a flow of liquid to the coil.

As the liquid in the coil progresses towards the outlet, the coil super-heat is reduced, the pressure on the diaphragm and the actuating needle is relieved and the spring again forces the ball seat to close the flow of liquid. In this way, the valve senses the demands of the system and meters the correct amount of liquid refrigerant and also prevents a liquid slug from entering the compressor.

In order to balance the liquid pressure on the ball seat plus the diaphragm and spring forces, an equal force is necessary, operating on the underside of the diaphragm. The external equaliser is used for this purpose.

This taps pressure from the outlet of the evaporator to the chamber behind the diaphragm of the valve.

By utilising the external equaliser an account is made of the small amount of pressure drop that occurs in the coil and the resultant drop in temperature. This relays the actual condition of the coil outlet to the expansion valve power element, more accurately provides metering of the fluid and more positively prevents liquid slugs from leaving the evaporator coil.

If the capillary tube should lose some of its vapour charge the power element will weaken so that the valve will close too frequently and, therefore, starve the coil, and the efficiency of the refrigeration system would be impaired. A low suction pressure of the compressor would result.

If the expansion valve screen were to become clogged with some foreign substance, flow of the liquid would be reduced and the coil would starve, the efficiency of the system would be impaired and a low suction pressure would result.

The effects of moisture or water in a refrigerant system will be covered more thoroughly under section "Receiver/Dryer" Assembly, however, one of its effects can be pointed out here. One of the characteristics of Refrigerant 12 is that it can carry in suspension minute droplets of water. These droplets remain as liquid water in the high pressure side because of the high pressure side's temperature. It now reasons that the discharge pressure of the compressor is maintained clear to the ball seat of the expansion valve. This point is the dividing point of the refrigeration system. Everything from it to the suction inlet of the compressor is maintained at the low pressure figure of the suction of the compressor. The small orifice at the ball valve seat is minute compared to the lines going to and passing from it, thereby producing this dividing point. At this point, of course, the suction pressure drops abruptly and the temperature of the liquid refrigerant correspondly drops. The small droplets of water that have been maintained as water in liquid form on the high side, are suddenly subjected to the extreme cold temperature of the low side. They become icy or an icy sludge and can either completely block the orifice at the ball seat of the valve or form an erratic sludge at that point that will go away and come back at frequent intervals. A solid plug of ice will render the system inoperative, and the suction pressure reading at the compressor will drop into a deep vacuum as the compressor will cause removal of everything from the ice block to the compressor. The sludge will reduce the effectiveness of the system and the suction pressure reading will be erratic.

An excellent way to determine whether an expansion valve difficulty is ice or something else, this, of course, after having observed a suction reading that is in vacuum, would be to heat the body of the valve in the vicinity of the ball seat, taking care not to overheat the diaphragm and observe the suction reading. If ice is there, the heating will immediately melt it, liquid will charge into the evaporator, the suction pressure will increase sharply.

If the loss of the thermal bulb charge is suspect, it can be subjected to unusual heat by wrapping it with a person's hand. This unusual heat will cause the expansion valve to flood the coil if the thermal bulb charge is normal and an abnormally high suction reading will result. If the suction pressure does not rise, it can be assumed that the power element is weak.

The air conditioning valve is pre-set by the manufacturer of the valve for the correct opening and operating super heat and, therefore, spring tension field adjustments are not to be made. If the valve meters too much liquid, which would constantly maintain an excessive suction presure reading, this would be a result of a defective spring tension or adjustment and the valve should be replaced.

Erratic conditions sometimes occur at the expansion valve when the system is first started. These conditions result in erratic suction pressure readings that are unusually high. While a system lies dormant, through the night for example, the vapour in the evaporator coil can condense and when the refrigeration system is begun, a slug of liquid can make its way towards the compressor. At least the condition of the entering substance to the compressor is wet or dense. This, of course, results in unusually high suction pressure readings. As soon as the slug of liquid passes the thermal bulb point on the coil outlet, the expansion valve, as described, will close. These erratic conditions which are observed as pressure readings will cease whenever this stabilises and a constant production of liquid is produced to the expansion valve and they are quite normal.

**Removal**

Remove the Radio/Heater control panel as detailed in Section N.

The air-conditioning thermostat will remain in position after detaching the control knob.

Remove the gearbox console cover as detailed in Section N.

Remove all refrigerant from the system by pumping down.

Remove the clip securing the thermal bulb to the outlet pipe.

Disconnect the pipe unions and withdraw the valve.

**Refitting**

Refitting is the reverse of the removal procedure.

Re-charge the system on completion.

## THE RECEIVER DRIER-SIGHTGLASS ASSEMBLY

### GENERAL DESCRIPTION

The functions of the receiver drier assembly and sight-glass are to filter the liquid refrigerant, to absorb any water that may be prevalent in the system and to provide a storage tank of liquid refrigerant in which a pick-up tube submerged in the liquid will ensure that a solid column is available to supply the expansion valve.

A sight-glass is provided in the outlet line of the assembly to enable a visual check of the fluid flow to be made.

If the sight-glass is clear, this indicates that a solid column of pure colourless refrigerant is passing through; conversely if bubbles or foam are visible this indicates that the pick-up tube is not submerged in liquid refrigerant and is receiving a mixture of liquid and vapour and the vapour is, therefore, causing bubbles in the liquid, giving the appearance of foam.

This indicates that the liquid charge in the receiver is insufficient, and the system needs more refrigerant.

The cotton bobbin preparation used as a filter in the system, filters out all impurities and foreign matter. It is possible for refrigerant, under high temperature, to re-act with refrigerant oil in the compressor and form a precipitation which, if not effectively filtered out, will eventually clog the expansion screen.

The silica-gel molecular sieve desiccant absorbs and prevents passage of any moisture which may be present in the refrigerant.

Refrigerant "12" is a hydrocarbon containing the chlorine and fluorine halogens which is formed with methane.

The hydrogen found in water, can under certain temperature conditions, hydrolize with the chlorine and fluorine to form hydrochloric and hydrofluorine acids.

The hydrochloric acid will attack copper, of which all condenser and evaporator coil tubes are made, and carry the copper to steel portions of the system such as rod and valve plates.

If the resultant copper plating becomes too thick it may seriously affect the efficiency of the compressor unit.

The hydrofluoric acid formed is an etching acid and can seriously attach and pit the finely polished surface of the compressor valve plate.

It is, therefore, of the utmost importance that the water is not allowed in the system and that small amounts be absorbed in a good drier.

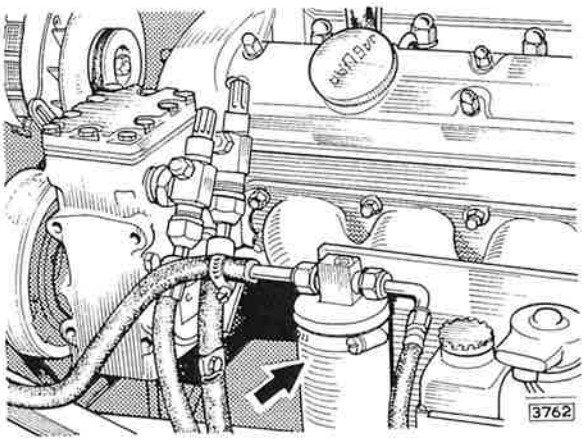


Fig. 4. *The receiver/drier mounting.*

A. Thermostat switch (radiator fan).
B. Radiator strut.
C. Condenser top mounting.
D. Condenser bottom mounting.

### SERVICING

If the drying agent in the receiver/drier unit becomes completely absorbed with water, the unit must be removed and returned for reclaiming.

The receiver/drier unit can only be completely serviced with the use of special equipment.

If the system is allowed to remain open for a long period of time, or for a shorter period in very humid conditions, the drier unit must always be changed before putting the care back in service.

DO NOT REMOVE the protective sealing caps from a new unit until it has been fitted and is ready for coupling to the pipe unions.

**Removal**

"Pump Down" the system.

Disconnect the pipe lines and blank off the unions and pipe lines.

Release the clip and withdraw the receiver unit.

**Refitting**

Refitting is the reverse of the removal procedure.

Recharge the system.

## THE CONDENSER

### GENERAL DESCRIPTION

The condenser is a single unit mounted in front of the radiator matrix.

The function of the condenser is to cause removal of the vapour super heat and to effect a change of state from vapour to liquid by passing the high latent heat off to the surrounding heat mediums.

Refrigerant "12" vapour at 120 lb. per sq. in. (8·43 kg./cm.$^2$) occupies approximately 23 cubic feet (·65 m.$^3$) per 1 lb. (0·454 kg.) of weight. The liquid refrigerant "12" occupies approximatley 1·3 cubic feet (·036 m.$^3$) per 1 lb. (0·454 kg.) of weight or the liquid takes approximately 1/18th as much space. Consequently, the quicker the condenser manufactures liquid the sooner there will be more space in which the compressor can unload its charge of vapour, and the compressor head pressure will be lower for a given heat load condition.

It is essential that the condenser is cooled efficiently by the passage of the car through the air.

Any obstruction such as dirt, mud, or any foreign matter, will prevent the lowering of the refrigerant temperature resulting in increased head pressure.

Normally the condenser will be of a lower temperature than the car radiator. Any lowering of the efficiency will increase the temperature of the condenser to a point where it may be higher than the car radiator and allow the engine to overheat.

No routine maintenance is necessary.

**Removal**

Remove the bonnet as detailed in Section N. "Body and Exhaust".

Remove all refrigerant from the system by "Pumping Down". Withdraw all securing screws and detach

the condenser unit after disconnecting the hoses.

**Refitting**

Refitting is the reverse of the removal procedure. Recharge the system on completion.

**Testing for Leaks**

When removed from the car, the condenser unit can be leak tested if required as follows:—

Seal off the outlet pipe union with a suitable cap nut and sealing disc.

Connect a refrigerant container, one of the small capacity canisters is preferable, by a suitable length of flexible hose to the condenser inlet union.

Open the container valve and allow a quantity of refrigerant "12" to enter the condenser.

To test, pass the leak detector hose around all the condenser tubes, paying particular attention to the "U" bends at the ends of the tubes.

If any leaks are detected, it is advisable to replace the faulty unit as effective repairs are difficult to carry out without special equipment.

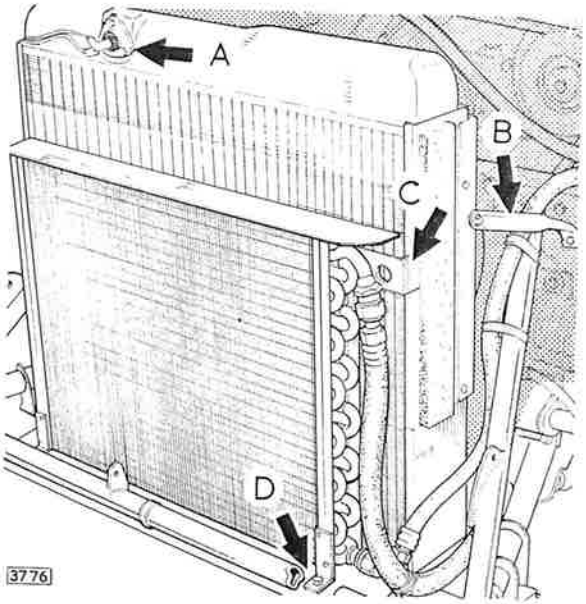


Fig. 5. *The condenser mounting.*

A Fan thermostat switch.
B Radiator mounting strap.
C Condenser upper monting.
D Condenser lower monting.

## THE EVAPORATOR

### GENERAL DESCRIPTION

The evaporator, of fin and tube construction contained in a case which also houses the blower fan, is mounted below the instrument panel.

A metered supply of low pressure, cold refrigerant is drawn through the evaporator coils by the suction side of the compressor.

Heat laden air from the car interior is pulled over the coil by the centrifugal fan, and the temperature difference between the hot air and cold refrigerant causes a heat transfer from the warm air to the cold liquid.

As the liquid is absorbing the heat from the air the refrigerant is caused to vaporise or "boil".

Refrigerant "12" boils at −20°F (−29°C) at atmospheric pressure.

The vapour has more coil to pass through before its exit, and as the warm air is still imparting heat to the refrigerant vapour and as the vapour is in a saturated state, any further heat absorbed by it creates a superheat and its temperature begins to rise.

Condensation of the moisture in the air occurs simultaneously with the reduction of the air temperature. This water condensate is drained out of the evaporator assembly and discharged through drain pipes.

Frequently the condensate will drain from the evaporator case very soon after the car comes to rest and the blower is switched off and this will create a condensate puddle underneath the car.

This is a natural condition and no investigation as to cause is necessary.

No routine maintenance is required, and any repairs can only be carried out if the evaporator is removed from the car.

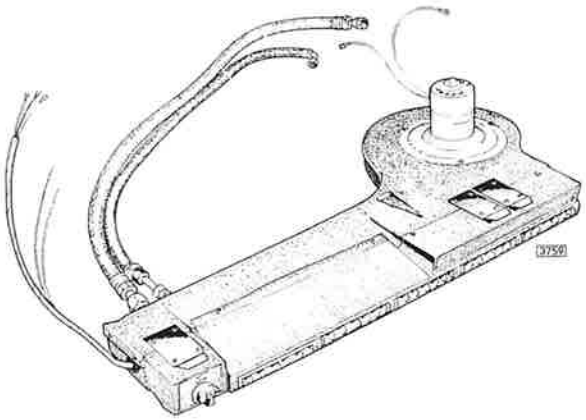


Fig. 6. *The evaporator unit.*

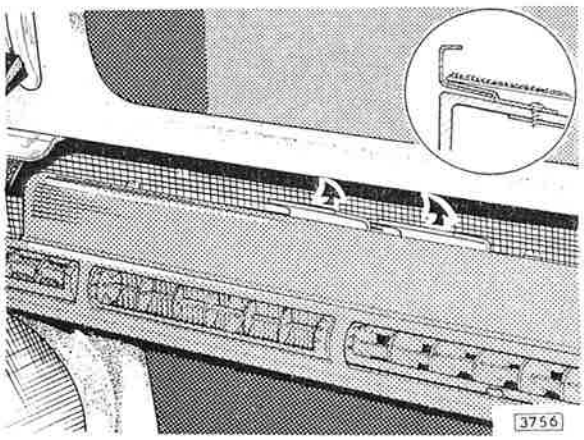


Fig. 7. *The evaporator facia mounting.*

**Removal**

Slide the seats back to the full extent of the slides.

Remove all refrigerant from the system by "Pumping Down"

Disconnect all pipe unions and blank off the ends to prevent the ingress of dirt or moisture.

Withdraw the drive screws securing the side fixing bracket to the body panel.

Carefully ease the unit forward until the top fixing clips are clear of the bottom edge of the facia panel and lower the unit to the floor of the car.

Extract the drive screws and remove the cover from the front of the case.

Lift the thermostat capillary tube away from the evaporator coils and withdraw the evaporator assembly away from the case.

**Note:** Care must be taken when the assembly has been removed, that the drain pipes and unions underneath are not damaged by contact with the floor or work-bench. Support the assembly on blocks to keep the pipes clear.

**Refitting**

Refitting is the reverse of the removal procedure.

Recharge the system on completion.

**Testing for Leaks**

When removed from the car the evaporator can be leak tested, if required, as follows:—

Seal off the outlet union with a suitable cap nut and sealing disc.

Connect a refrigerant container, one of the small capacity canisters obtainable is preferred, by a suitable length of flexible hose to the evaporator inlet union.

Open the container valve and allow a quantity of refrigerant "12" to enter the evaporator coil.

To test, pass the leak detector hose around all tubes, paying particular attention to the "U" bends at the ends of the tubes.

If any leaks are detected, it is advisable to replace the faulty unit, as effective repairs are difficult to carry out without special equipment.

# THE ELECTRICAL SYSTEM

## GENERAL DESCRIPTION

The electrical system consists of a combined rotary "ON/OFF" fan blower variable speed switch and thermostat control, a fan blower motor, one external resistor, an in-line fuse and a magnetic clutch unit with the necessary wiring.

A second relay is included in the radiator fan circuit when air-conditioning equipment is fitted, the purpose being to over-ride the "OTTER" thermostat switch located in the header tank when the system is switched on and so ensuring that the radiator cooling fan motors are operating.

This relay is additional to the one included in the radiator fan circuit fitted to all cars.

The rotary switch (outer control ring) controlling the blower motor speeds, is wired in series with the resistor unit to give "OFF", "L" (Low) "M" (Medium) and "H" (High) positions. See circuit diagram Fig. 5.

In the "L", "M", or "H" positions, the circuit is completed from the ignition switch via the fuse and relay, through the thermostatic switch (central control knob) to the compressor drive clutch.

Progressive rotation of the thermostat control in the direction of the arrow will result in the switch contacts remaining closed until the capillary tube from the switch, inserted into and in between the fins of the evaporator coils, senses a temperature that is below the manual setting.

When this temperature is reached, the contacts will open, and the circuit to the magnetic clutch will be broken.

The clutch will disengage and cease to drive the compressor.

As the temperature in the evaporator rises, the thermostat will again close and the clutch re-engage.

The manual setting is progressive in the direction of the arrow towards "COOLER".

Maximum clockwise rotation will give the coldest coil temperature without opening the clutch circuit.

Minimum rotation will open the clutch circuit most frequently as its sensing temperature is the highest, and will keep the evaporator coil at a warmer temperature.

The normal setting would be approximately three quarters of full rotation.

Icing of the evaporator coil, which restricts and can ultimately block the air flow into the car, occurs more during days of moderate temperature and relative high humidity.

Position the thermostat to a HIGHER TEMPERATURE setting to correct this condition.

HIGHER TEMPERATURE thermostat settings may have to be employed in moderate temperatures, cloudy days or night time driving.

These conditions are also conducive to icing as the relative humidity increases when the sun is obscured.

The extreme left thermostat setting, that is with the white indicator mark vertical, is **OFF** and the clutch circuit will always remain open.

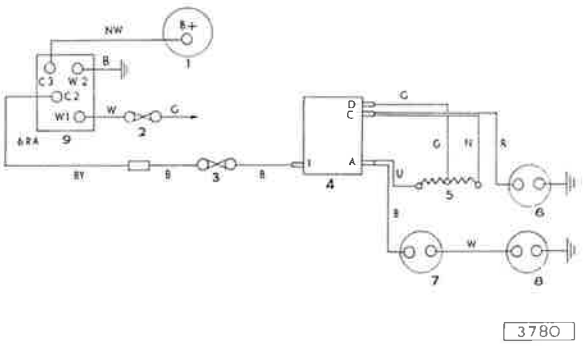


Fig. 8. *The evaporator circuit diagram.*

1. Alternator.
2. Fuse No. 6.
3. In-line fuse.
4. Control switch.
5. Resister.
6. Motor.
7. Thermostat switch.
8. Clutch.
9. Relay.

## THE EVAPORATOR FAN MOTOR

### Checking

Switch on the fan motor. Check at the low, medium and high positions to ensure that the resistor is working correctly.

### Removal

Remove two cap nuts and detach the radio/ashtray console.

Lower the evaporator unit as detailed on page RY.s.12.

Disconnect the feed and earth cables, withdraw the four retaining screws and remove the fan and motor assembly.

Check the fan for damage and renew if necessary.

The fan is a balanced assembly, and care must be taken to ensure that any balance pieces fitted are not displaced

### Refitting

Refitting is the reverse of the removal procedure.

Renew the cork gasket if damaged, and ensure that the earth connection is clear and tight when re-assembling.

## THE THERMOSTAT

If the thermostat is not automatically switching "OFF" the compressor drive clutch unit at the pre-set temperature, check that the capillary tube is positioned between the fins of the evaporator coil.

The thermostat and capillary tube assembly is a sealed unit and must be changed if faulty.

### Removal

Lower the evaporator unit as detailed on page RY.s.12.

Withdraw the retaining screws and detach the top panel from the case.

Carefully remove the capillary tube from the evaporator coils.

With a small screwdriver used as a lever, remove the two control knobs.

Withdraw two screws and detach the unit from the mounting panel.

Remove two screws and detach the thermostat unit from the fan switch.

### Refitting

Refitting is the reverse of the removal procedure.

## "OTTER" THERMOSTAT (OVER-RIDING) RELAY

### Checking

The relay is the top one of the two mounted on the carrier bracket attached to the sub-frame cross-member between the radiator fans.

Disconnect and remove the relay. Note the cable connections for reference when refitting.

Connect a 12 volt supply to terminals W1 and W2.

Connect a test lamp wired in series with a 12 volt battery to terminals C1 and C2.

If the relay contacts are closing the bulb will become illuminated.

Replace if faulty.

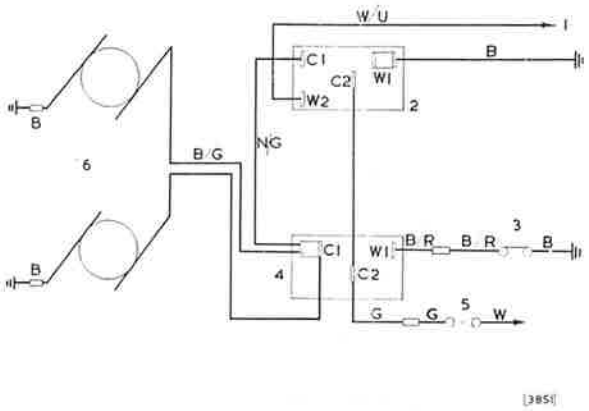


Fig. 9. *The radiator cooling fan circuit diagram with over-riding relay incorporated.*

1. Control switch feed.
2. Over-riding relay.
3. "Otter" thermostat switch.
4. Fan relay.
5. Fuse No. 6.
6. Radiator fan motors.