6 Take out the two steady springs passing through the backplate by depressing them and twisting.
7 Pull on the toe of the leading shoe to disengage it from the wheel cylinder. Take off the ratchet wheel and the cam assembly from the shoe.
8 Pull the heel of the shoe out of its slot in the fixed mounting. Tension on the spring will now be released and the other shoe will fall away.
9 Disconnect the hydraulic pipe from the wheel cylinder and remove the rubber boot from the handbrake lever and the wheel cylinder.
10 Remove the wheel cylinder outer piston (Fig. 9.12), and now slide the cylinder casting forward and at the same time pivot it about its forward end and withdraw the rear end from the slot in the backplate. Rearward movement of the cylinder will now bring its forward end clear of the backplate.
11 Thoroughly clean all dust from the shoes, the backplate and the drum using a stiff wire brush. Do not use compressed air.
12 Clean the backplate and the cylinder bearing surfaces and make sure that the cylinder moves freely on the backplate.
13 Check that each piston is free in its cylinder, the rubber covers are not perished or damaged and that there are no hydraulic fluid leaks.
14 Refitting the brake assembly is generally the reverse of the above procedure.
15 Place the lever through the slot in the backplate and, with the piston pointing in the forward rotation of the wheel, engage the forward end of the cylinder in the slot and slide it well forward. Engage the rear end in the slot and slide the cylinder back to hold it in position.
16 Fit the rubber boot to the lever and the wheel cylinder body.
17 Replace the outer piston.
18 Examine the brake shoes and it will be seen that the linings are shorter in length than the platforms to which they are rivetted. The end at which the greater portion of platform is exposed is known as the "toe" and the opposite end is known as the "heel", of the shoe.
19 When installed on the backplate, the toe of the leading shoe is to be adjacent to the wheel cylinder piston, whilst the toe of the trailing shoe engages a slot in the fixed housing. This condition is clearly shown in Fig. 9.2.
20 Hook the larger pull-off spring into the appropriate holes in the shoes so that it will lie on the upper surface when assembled.
21 Offer up the shoes to the backplate with the pull-off soring on the outside. Engage one shoe in its slots and then engage one end of the other shoe in a slot and then pull its other end into position.
22 Pull back the toe of the leading shoe slightly to allow assembly of the ratchet wheel and cam in the slots in the shoe. The ratchet wheel is to be on the outside so that it will engage the spring pawl and also the commencement of the cam form is to be adjacent to the wheel cylinder piston.
23 Pass the stems of the steady springs through the holes in the shoes and engage with the backplate by depressing and twisting them.
24 Place the adjustment lever on the pin in the trailing shoe so that it points outwards, assemble the washer and circlip to secure it in position.
25 Hook the adjustment lever spring into the appropriate hole in the leading shoe and into the hole in the adjustment lever and now rotate the lever into position so that it correctly engages the teeth on the ratchet wheel.
26 Pull on the heel of the trailing shoe and check that the spring pawl prevents the ratchet wheel from rotating. Allow the lever pawl to click into position in a fresh tooth and ensure that when the brake shoe is released the ratchet wheel is rotated. After this check, pull on the toe of the leading shoe to back-off the adjustment and bring the ratchet wheel back to its original position.
27 Refit the brake drum. If difficulty is experienced in getting it over the brake shoes, suspect that adjustment, as per paragraph 26, has not been backed-off sufficiently.
28 Refit the hydraulic fluid pipe to the wheel cylinder. Note that, if the bleed screw has been removed and not refitted at this stage, the pipe assembles in the connection nearest to the lever.
29 Connect the handbrake cable to the lever and use a new split pin to secure the clevis pin.
30 Refit the roadwheel.
31 Bleed the system as described in Section 2.
32 Pump the brake pedal a few times to take up all adjustment.

## 5 Front drum brake wheel cylinder - dismantling, overhaul and reassembly

1 Thoroughly clean the exterior of the cylinder to remove all trace of road dirt. Maintain absolute cleanliness when stripping the cylinder and to this end it is advisable to cover the top of the bench on which you are working with clean cloth or paper. Under no circumstances allow oil or grease to come into contact with any of the rubber components.
2 Refer to Fig. 9.11 which gives an exploded view of the cylinder.
3 Disengage the larger rubber boot from the piston end (2) and from the groove in the cylinder body.
3 Take out the piston end followed by the spring and the piston pin (4).
4 Disengage the rubber boot from the smaller piston (10) and from its groove in the cylinder body.
5 Using your fingers, push the piston from the smaller end through the bore to extract the larger piston (6), the cup (7), the cup filler (8) and the taper spring followed by the small piston.
6 Remove the taper seal (11) from the small piston by easing it out of its groove.
7 Clean all items in fresh brake fluid.
8 Examine the cylinder bore and the pistons for scores or abrasions as these may cause leaks. If in doubt as to their condition it is advisable to obtain a new cylinder assembly.
9 Any rubber component showing signs of wear, perishing or swelling should be renewed but it is as well to obtain a repair kit and replace these items as a matter of course.
10 Commence reassembly by fitting the larger end of the taper spring into the cup filler and enter them into the body with the spring leading.
11 Smear the rubber cup with hydraulic fluid and push it into the body with the lip leading. Be very careful not to turn back the lip or to buckle it.
12 Now insert the piston with its flat face leading and then pass the stem of the piston pin through it and the cup and cup filler.
13 Locate the spring on the piston pin followed by the piston end.
14 Stretch the large rubber boot onto the piston end and then work it into its groove in the body.
15 Smear the tapered rubber seal with brake fluid and then work it into its groove in the small piston, note that the seal is assembled larger end first, that is to say with the small end at the slotted end of the piston.
16 Fit the small piston to the body with its slotted end outwards taking care to ease the seal evenly past the edge of the bore.
17 Stretch the small rubber boot onto the piston and make sure that it seats properly in its groove in the body.

## 6 Rear drum brake wheel cylinder - dismantling, overhaul and reassembly

1 Thoroughly clean the exterior of the cylinder to remove all trace of road dirt. Maintain absolute cleanliness when stripping the cylinder and to this end it is advisable to cover the top of the bench on which you are working with clean cloth or paper. Under no circumstances allow oil or grease to come into contact with any of the rubber components.
2 Refer to Fig. 9.12 which gives an exploded view of the cylinder.
3 Lift off the rubber boot.
4 Withdraw the outer piston (7). Tap out the lever axis pin and remove the lever (1).

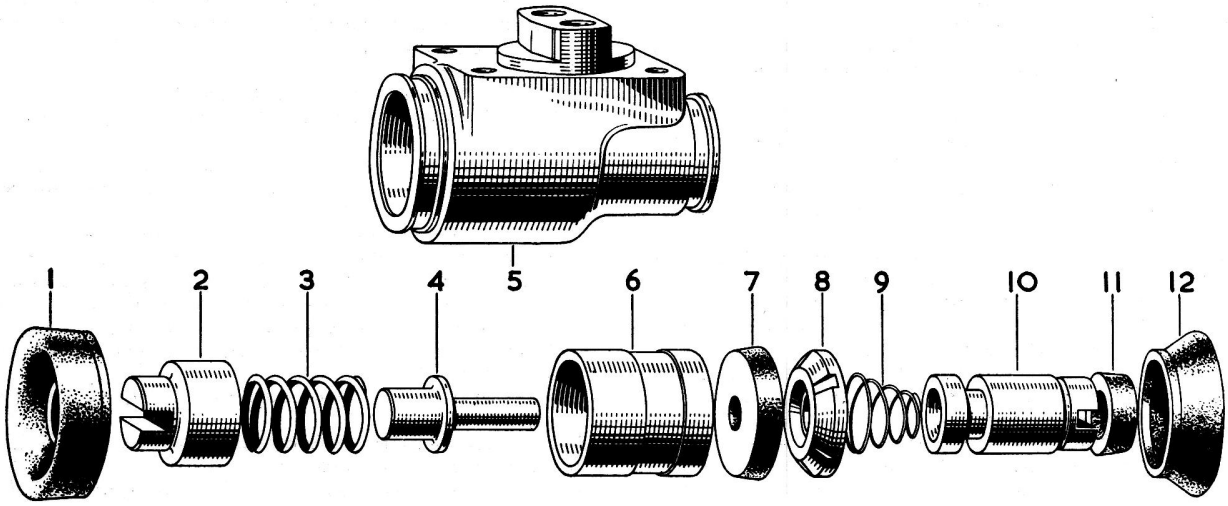



**FIG.9.11. EXPLODED VIEW OF THE FRONT WHEEL CYLINDER**

*1 Rubber boot*
*2 Piston end*
*3 Spring*
*4 Piston pin*
*5 Body*
*6 Piston*
*7 Rubber cup*
*8 Cup filler*
*9 Taper spring*
*10 Piston*
*11 Rubber seal*
*12 Rubber boot*

5 Try to shake out the inner piston (5). If this will not shift it, apply a low air pressure (foot pump) to the hydraulic pipe connection but be careful to catch the piston as it is expelled because if it falls onto a hard floor it will be damaged beyond repair.
6 Ease the rubber seal out of its groove in the outer piston (7) and the inner piston (5).
7 Clean all parts in fresh hydraulic fluid.
8 Examine the bore in the body and the pistons for wear, scores or abrasions as may cause leaks. If you are in any doubt about their condition it is advisable to renew the assembly.
9 Examine the rubber components for signs of wear, perishing or swelling and renew as necessary. We feel that it is as well to obtain a repair kit and replace these items as a matter of course.
10 Commence reassembly by easing the rubber seal (6) into the groove in the outer piston.
11 Fit the rubber seal (4) into its groove in the inner piston making sure that the larger end is facing away from the slotted end of the piston.
12 Enter the inner piston in the body with the end fitted with the seal leading and so that the widest part of the slot is adjacent to the slot in the body. Take care not to damage the seal when easing it past the edge of the bore.
13 Place the lever in position and fit the pin.
14 Insert the outer piston turning the seal onto its side so that the edge which tends to protrude enters the bore last.
15 Place the rubber dust cover in position.

## 7 Disc brake friction pads - removal and refitting

1 The minimum permissible thickness of friction pads including backing plate is ¼ inch (7 mm) after which the pads complete with backing plates should be renewed.
2 Jack up the car, remove the road wheel and support the car on a firmly based axle stand.
3 The friction pad assembly is illustrated in Fig. 9.13.
4 Remove the nut, washer and bolt securing the keep plate and remove the plate.
5 Due to the self adjusting feature of the brakes the pad will be within approximately 0.005 inch of the disc; it is possible that the disc will have worn slightly throwing up a ridge on the periphery which will be accentuated by road dirt and rust and which will, because of the small clearance, possibly obstruct removal of the pad, so make sure that any ridge as may be

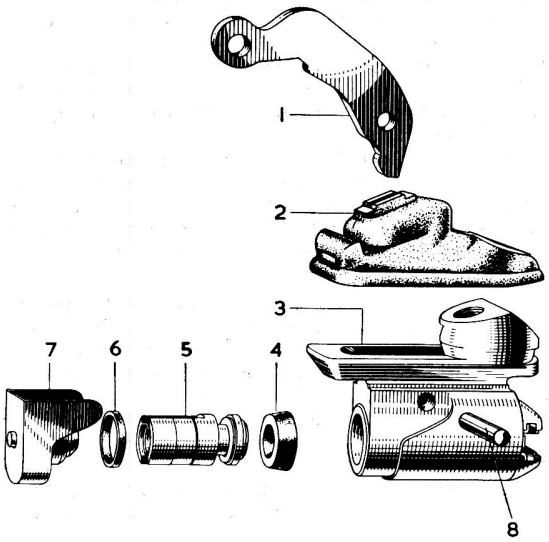



**FIG.9.12. EXPLODED VIEW OF REAR DRUM BRAKE WHEEL CYLINDER**

*1 Handbrake operating lever*
*2 Rubber boot*
*3 Body*
*4 Rubber seal*
*5 Inner piston*
*6 Rubber seal*
*7 Outer piston*
*8 Lever axis pin*

present is cleaned off.
6 Engage a hooked implement in the hole in the lug of the pad securing plate and withdraw the pad assembly.
7 Repeat the foregoing for the other pad at that particular wheel.
8 Thoroughly clean the backing plate and the surrounding area of the pad.
9 If new pads are being fitted always use those manufactured to the recommended specifications given at the beginning of this Chapter.
10 In order to fit new pads, which will be of increased thickness to those removed, it will first be necessary to reset the pistons to their outermost position. Before doing this, partially empty the brake supply tank to accommodate the fluid displaced by the pistons.
11 A special tool is available for resetting the pistons but this work can be done using a stout screwdriver to lever on the end of the piston. The main point to watch is keeping the piston square in the bore, if the piston becomes tilted and is levered in that condition, it, or the cylinder bore, will be damaged.
12 Having moved the piston out of the way, insert the friction pad, replace the keep plate and secure with the nut and bolt.

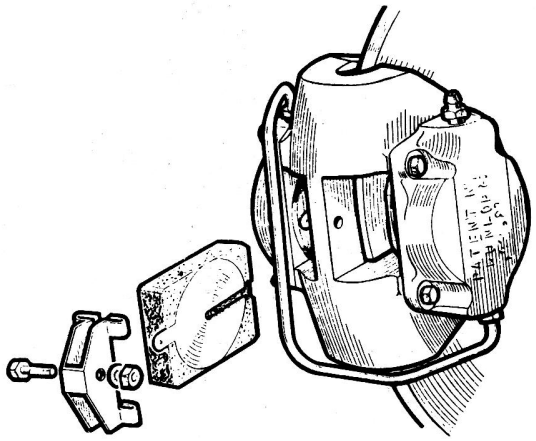


Fig.9.13. Removing a friction pad

## 8 Front disc brake caliper - removal and refitting

1 Jack up the car and remove the road wheel. Support the car on a firmly based axle stand.
2 Disconnect the flexible hydraulic pipe at the caliper mounting bracket and plug the unions to prevent the ingress of dirt.
3 Break the locking wire to the two mounting bolts. Remove the bolts and carefully withdraw the caliper assembly to note the position and number of shims fitted between the assembly and the mounting bracket.
4 Reassembly is the reverse of the above procedure but fit the original shims and secure with the two bolts.
5 Check the gap between each side of the caliper and the disc both at the bottom and at the top. The difference should not exceed 0.010 inch (0.25 mm), remove or add shims as necessary to centralise the caliper body (see Fig. 9.14).
6 Lockwire the two mounting bolts using soft iron locking wire or alternatively annealed copper wire (to anneal the wire, heat to red heat and allow to cool or quench in water).
7 If you removed the bridge pipe, connecting the two cylinder assemblies, remember that it must be fitted with the hairpin bend in the inboard cylinder block.
8 Refit the flexible hydraulic pipe making sure that you do not twist it whilst tightening down.
9 Bleed the brake system as described in Section 2 and check for leaks.
10 Refit the road wheel.

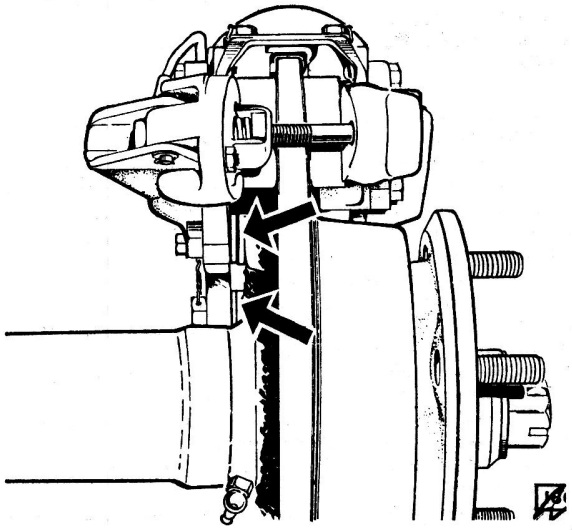


Fig.9.14. Location of caliper adjustment shims

## 9 Rear disc brake caliper - removal and refitting

1 Jack up the car and remove the road wheel. Support the car on a firmly based axle stand.
2 Withdraw the split pin and take out the clevis pin attaching the handbrake cable to the operating lever.
3 Disconnect the main hydraulic fluid pipe at the caliper and plug the unions to prevent the ingress of dirt.
4 Break the locking wire to the two mounting bolts, remove the bolts and carefully lift off the caliper assembly, complete with the handbrake calipers, noting the number and position of shims between the caliper assembly and the mounting bracket.
5 Refitting is the reverse of the above. The caliper assembly must be centralised as described in Section 8 for the front caliper assembly.
6 Reconnect the handbrake to the operating lever using a new split pin to secure the clevis pin.
7 Bleed the system as described in Section 2 and check for leaks.
8 Refit the road wheel.

## 10 Front and rear discs - removal and refitting

1 Jack up the car to remove the appropriate road wheel. Support the car on a firmly based axle stand.
2 Refer to Sections 8 and 9 and remove the brake caliper assembly.
3 Refer to Chapter 8 or to Chapter 11 and follow the instructions for removing the rear or front hubs as the case may be.
4 Remove the five nuts and bolts with spring washers securing the disc to the hub and remove the disc.
5 To reassemble, first secure the disc to the hub with the five nuts and bolts.
6 Refit the hub to the car and now check the end float of the wheel hub bearings and adjust as necessary in the manner described in Chapters 8 or 11, as applicable, so that the end float does not exceed 0.005 inch (0.13 mm) otherwise the brakes may tend to drag and not function properly.
7 Check the disc for true rotation by clamping a Dial Test Indicator in a convenient position so that the button of the indicator bears on the disc. Rotate the disc and check it for truth, the "run-out" should not exceed 0.006 inch (0.15 mm): If this amount is exceeded, check the components for damage especially the mating surfaces of the disc and the hub. If there is no visible cause for the trouble, suspect that the disc is distorted and verify by checking against another item.

8 Refit the caliper assembly and check for centralisation as set out in Section 8 or 9.
9 Bleed the brake system and check for leaks.
10 Refit the road wheel.

## 11 Disc brakes - renewing the brake piston seals

Leakage past the brake piston seals will be denoted visually by an accumulation of oil in the area of the brake caliper and by a fall in level of fluid in the reservoir. In bad cases a spongy pedal action may be noticed. You are advised also to fit a new dust seal when renewing the piston seal.
1 Remove the friction pads as described in Section 7.
2 Disconnect and blank off the main hydraulic pipe. Remove and blank off the bridge pipe between the calipers.
3 Remove the four bolts securing the cylinder blocks to the calipers and remove them.
4 Thoroughly clean all dirt from the exterior of the cylinder blocks before you start to dismantle them.
5 Take off the dust seal from its groove around the face of the cylinder block.
6 Connect the cylinder block to a low pressure air source to eject the piston assembly.
7 For older models (Fig. 9.15 and Fig. 9.4), remove the screws securing the plate to the piston. Lift off the plate and the piston seal and withdraw the retractor bush from within the piston bore. Support the backing plate and press out the piston. Discard the dust seal.
8 On later type cars carefully push out and remove the piston seal and dust seal using a blunt screwdriver.
9 Check that the piston and cylinder bore are clean and show no sign of damage.
10 For older models, engage the collar of a new dust seal with the lip on the backing plate but be careful not to stretch the seal too much. Locate the backing plate on the piston spigot and with the piston suitably supported, press the backing plate fully home. Insert the retractor bush into the bore of the piston. Lightly smear the new piston seal with brake fluid and fit it to the piston face. Attach the plate to the piston with the two screws and then peen some of the metal of the plate into the screw slots to lock them.
11 Smear the piston and seals of later models with brake fluid and then work the seal onto the piston using the fingers only.

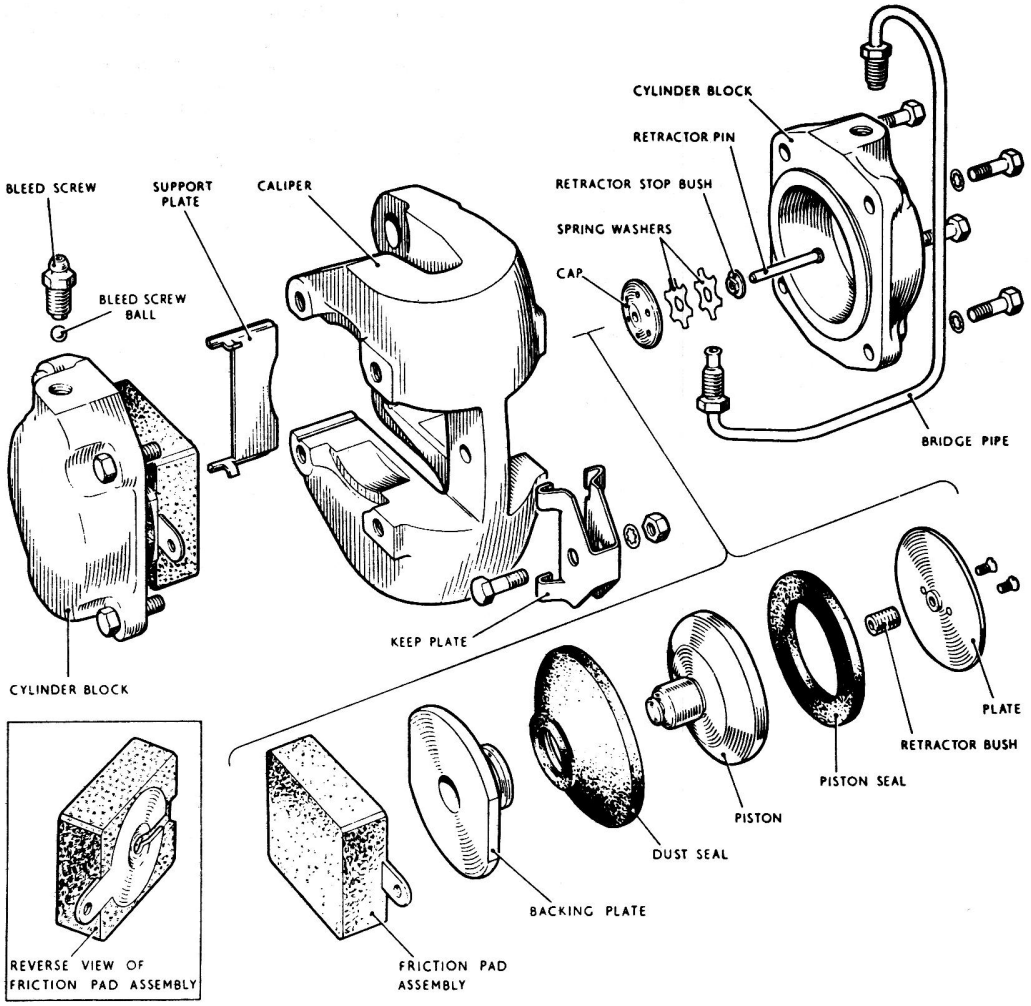



**Fig.9.15. Front brake caliper assembly (earlier type cylinder assembly illustrated)**

Locate the retractor pin in the retractor bush in the piston and then insert the washer, spring and spring housing, in that order, in the bore of the cylinder.
12 For both types, press the piston assembly into the cylinder bore and during this operation ensure that the piston is square to the bore and that the piston seal does not become twisted or trapped as it enters.
13 Engage the outer rim of the dust seal in the groove around the cylinder block face and make sure that the two support plates are in position.
14 Refit the cylinder blocks to the calipers and secure with the four bolts.
15 Refit the friction pads and secure in position with the keep plate and the nut and bolt.
16 Refit the bridge pipe between the calipers and make sure that the "hair pin" bend portion is connected to the inboard cylinder block, that is the block furthest from the road wheel. The bridge may have an identification sleeve marked "Inner Top".
17 Reconnect the main hydraulic pipe.
18 Bleed the brake system as described in Section 2 and check for leaks.
19 Refit the road wheel.

## 12 Handbrake - adjustment

1 The automatic adjustment feature of the rear drum brakes will normally keep the handbrake in correct adjustment and no attention should be necessary.
2 If an excessive amount of handbrake lever travel is obtained, the cable can be adjusted, on those cars fitted with a yoke type compensator, by means of the hexagonal nut at the front end of the handbrake cable. Fully release the handbrake and turn the nut clockwise until all slack is taken out of the cable but be sure that the cable is not under tension. Jack up each rear wheel in turn and rotate the wheel with the handbrake off to be sure that the brake is not binding.
3 For those cars fitted with a scissors type compensator, first release the handbrake. Remove the clevis pin securing the fork end to the operating link and now slacken the locknut and turn the fork end in the required direction so that when the clevis pin is refitted there is no slack in any of the three cables, ensuring, of course that they are not under tension. Jack up each rear wheel in turn, make sure that the handbrake is fully released, and rotate the wheel to check that the brake is not binding.
4 Cars equipped with disc brakes have a handbrake system entirely independant of the foot brake. The position of the friction pads in relation to the disc had to be hand adjusted in early models, but this type was superseded by self adjusting calipers; both types are illustrated in Figs. 9.16 and 9.17 respectively. Provision on both types is made for adjustment of the main cable in cases where excessive brake lever travel is experienced.
5 To adjust the calipers on the early type, jack up each rear wheel in turn and remove the wheel. A slotted adjustment bolt will be seen at the top of the caliper and clockwise rotation of this bolt will bring the friction pads closer to the disc. (photo)
6 Refit the road wheel and, with the handbrake fully released, check that the brake is not binding.
7 Adjustment of the main handbrake cable is provided at the fork end connecting to the compensator lever (Fig. 9.19). Make sure that the hand brake is fully released, remove the split pin and the clevis pin securing the fork end of the cable to the compensator lever, undo the locknut and adjust the fork end so that, when it is refitted to the compensator lever, there is no slack in any of the cables but they must not be under tension. Jack up each rear wheel in turn and check that the brake is not binding. Tighten up the locknut at the fork end and fit a new split pin in the clevis pin.

## 13 Handbrake friction pads - removal and replacement

1 Securely chock the front wheels, release the handbrake and select neutral gear.
2 Jack up the rear of the car and remove the road wheels. Place a firmly based axle stand in position to support the car.
3 Slacken off the handbrake adjuster bolt (first remove the split pin locking the bolt on the self adjusting type) until its end is flush with the nut on the inner handbrake pad carrier.
4 Slacken the nut in the side face of the pad carrier. (photo)
5 Pull out the friction pad using, if necessary, a hooked tool in the hole in the securing plate. (photo)
6 Fit the new friction pads into the carriers with the short face pointing upwards and ensure that the pad securing plate locates correctly over the head of the retaining bolt which protrudes through the inside face of the pad carrier. Tighten down on the nut to secure the friction pads.
7 Reset the forked shaped retraction plates by slackening, after knocking back the locking tabs, the two pad carrier pivot bolts and retightening. Lock the bolt heads by knocking up the second pair of tabs on the locking plate.
8 Adjust the position of the friction pads in the manner described in Section 12 for the non self adjusting type.
9 For the self adjusting type, screw up on the adjuster screw until there is a distance of 7/16 inch (11.1 mm) between the friction pads (this will give 1/32 inch clearance of each pad from the disc). Replace the split pin to lock the adjuster bolt. Rotate the disc to make sure the brake is not binding.
10 Refit the road wheels.

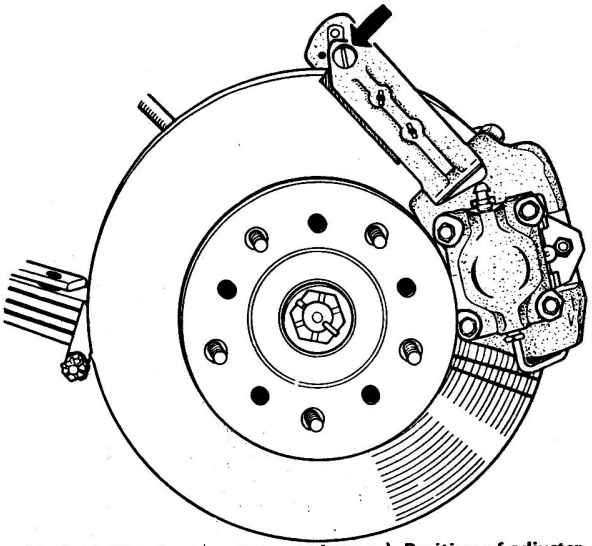


Fig.9.16. Handbrake caliper (early type). Position of adjuster bolt arrowed

12.5. Adjusting the handbrake caliper

## 14 Handbrake friction pad carriers - removal and refitting

1 Firmly chock the front wheels and release the handbrake.
2 Jack up the rear of the car and remove the road wheels. Support the car on firmly based axle stands.

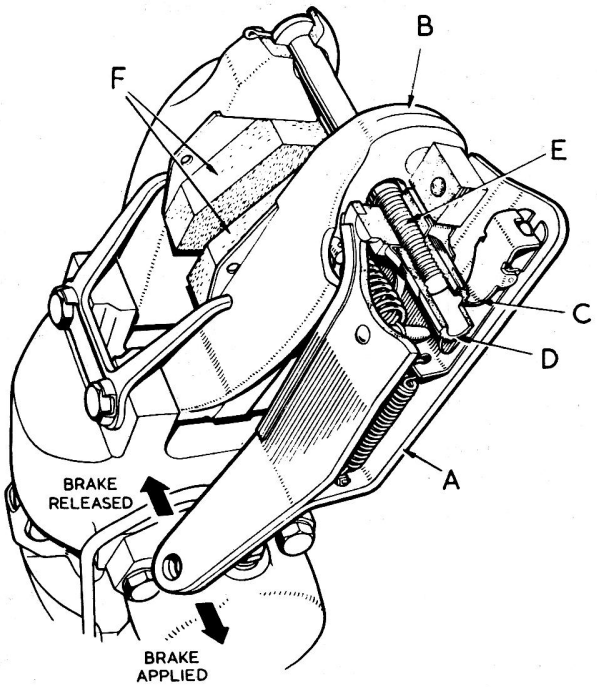



**FIG.9.17. SELF ADJUSTING HANDBRAKE ASSEMBLY**

*A Operating lever*
*B Friction pad carrier*
*C Pawl*
*D Ratchet nut*
*E Adjuster bolt*
*F Friction pads*

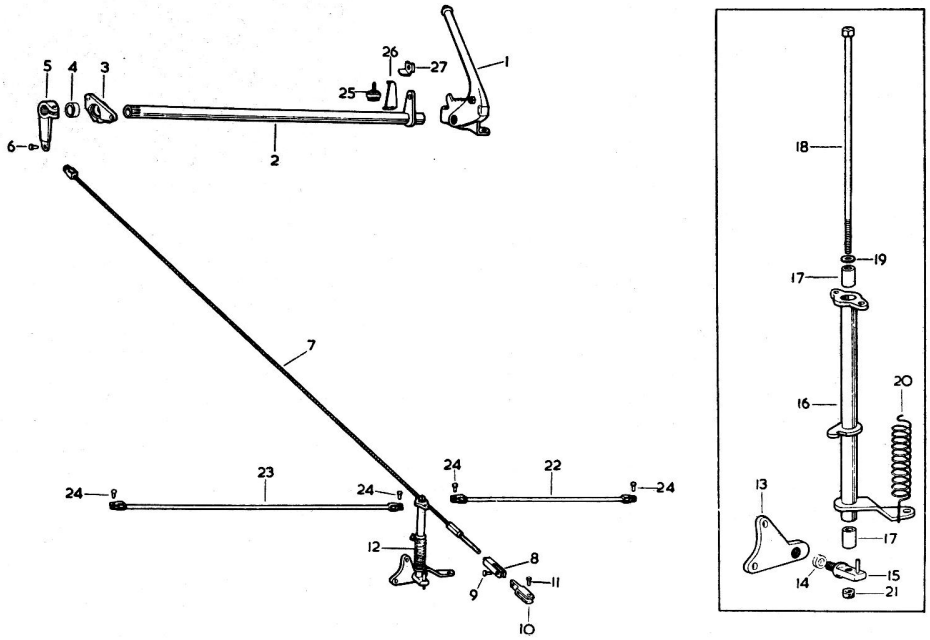


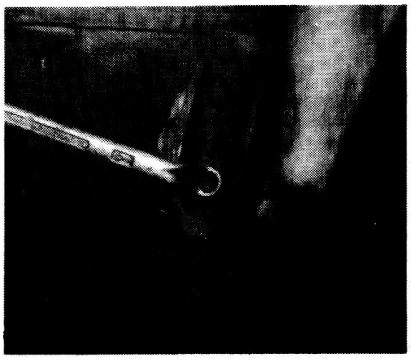

**FIG.9.18. THE HANDBRAKE ACTUATING MECHANISM (LATER TYPE)**

1 *Handbrake lever assembly*
2 *Cross shaft assembly*
3 *Shaft housing*
4 *Rubber seal*
5 *Handbrake lever to cable*
6 *Clevis pin*
7 *Primary cable*
8 *Rear fork end*
9 *Clevis pin*
10 *Universal jaw*
11 *Clevis pin*
12 *Compensator lever assembly*
13 *Rear axle bracket*
14 *Felt seal*
15 *Fulcrum pin assembly*
16 *Balance lever assembly*
17 *Bush bearing*
18 *Spindle assembly*
19 *Washer*
20 *Return spring*
21 *Nut*
22 *R.H. cable assembly*
23 *L.H. cable assembly*
24 *Clevis pin*
25 *Interrupter switch*
26 *Switch bracket*
27 *Switch operating bracket*

3 Remove the split pin and withdraw the clevis pin attaching the handbrake cable to the brake operating lever.
4 Knock back the tabs of the locking plate and unscrew the two pivot bolts. (photo) It will be seen that these bolts are screwed under the head and some difficulty, due to rust etc., can be anticipated in getting them out after the thread is clear. You may have to resort to holding the head of the bolt with a mole wrench and then work the bolt backwards and forwards and at the same time pulling in an upward direction.
5 Lift off the friction pad carrier assembly.
6 Refitting is the reverse of the above procedures but it must be noted that the retraction plates are "handed" on late model cars and it is essential that these plates are fitted in the correct position.
7 To check for correct hand, lay the plates on a flat surface with the prongs and locating extensions pointing upwards. It will be seen that one of the plates has a square cut face uppermost. This plate must always be fitted to the left hand caliper.
8 When fitting these plates, place the prongs in the holes in the pad carriers. Position the lower locating extension between the upper and lower bridge clamps and secure the clamps to the caliper with the two pivot bolts. Check that the retraction plate location extension is free to move between the bridge clamps when secured and that the handbrake mechanism is operating correctly.

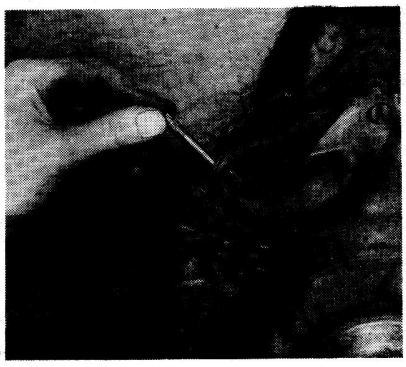
## 15 Handbrake friction pad carriers - dismantling and reassembly

1 Remove the friction pad carriers from the car as described in Section 14.
2 For the non self adjusting type, separate the friction pad carriers by unscrewing the adjuster bolt (photo), but take care to control the run of the self-locking nut in the forked end of the operating lever.
3 Detach the pivot seat from the forked end of the operating lever by taking out the split pin and withdrawing the clevis pin. Do not attempt to remove the spring or the squared nut unless these are damaged.
4 Remove the friction pads in the manner described in Section 13.
5 The self adjusting type is dismantled by first removing the cover securing bolt and withdrawing the pivot clevis pin.
6 Remove the dust cover and take out the split pin locking the adjuster bolt. Unscrew the adjuster bolt from the ratchet nut and withdraw the nut and the bolt.
7 Detach the pawl return spring and withdraw the pawl over the locating dowel.
8 Disengage the operating lever return spring and remove the operating lever and the lower cover plate.
9 Remove the friction pads in the manner described in Section 13.
10 Reassembly is the reverse of the above procedures.

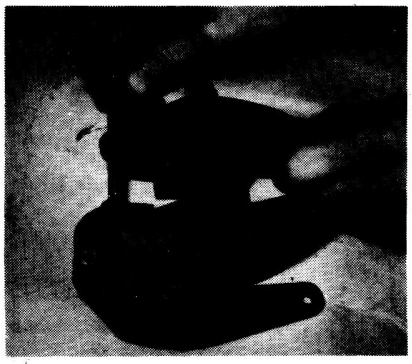


13.4. Friction pad securing nut

13.5. Removing the friction pad



14.4. Handbrake caliper pivot bolt



15.2. Separating the friction pad carriers

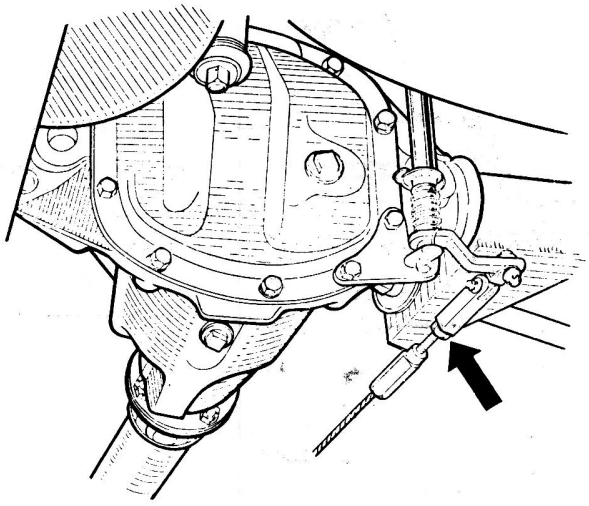


**Fig.9.19. Adjustment of main handbrake cable**

## 16 Brake pedal assembly - removal and refitting

The brake pedal is removed complete with its common mounting block with the clutch pedal in the manner described in Chapter 5.

## 17 Master cylinder - removal and refitting

1 Remove the split pin and take out the clevis pin securing the push rod to the brake pedal. To do this, push the front seat back to its full extent in order to give better access.
2 Have a clean container ready, disconnect the two hydraulic pipe unions and collect the fluid draining from the reservoir. Blank off the pipe and the master cylinder unions to prevent the ingress of dirt.
3 Remove the nuts and the spring washers from the mounting flange and lift off the cylinder.
4 Refitting is the reverse of the above procedures.

## 18 Master cylinder - dismantling and reassembly

Depending on the age of your car, one of three types of master cylinder will be fitted. The first, fitted to early cars, is identical with the clutch master cylinder described in Chapter 5 with the exception of differences, for identification purposes, in the hydraulic union nut as illustrated in that Chapter. This type of cylinder was superseded by a Dunlop unit and this was later replaced by a Girling unit. Both latter types have a separate hydraulic fluid reservoir. The method of operation of the Dunlop and Girling units is very similar but there are differences in the dismantling and reassembly procedures. These master cylinders are illustrated in Figs. 9.20 and 9.21 respectively.
1 Paragraphs 2 - 14 inclusive deal with the dismantling and reassembly of the Dunlop unit. Maintain absolute cleanliness throughout the whole of this operation.
2 Ease the dust excluder clear of the head of the master cylinder.
3 Using a pair of suitable pliers, remove the circlip to release the push rod complete with the dished washer.
4 Withdraw the piston complete with the return spring and the spring support and the valve assembly.
5 Remove both seals from the piston and remove the seal from the end of the valve.
6 Examine the bore of the cylinder for scores or abrasions as may cause leakage and if either of these are present, the unit should be replaced.
7 We strongly recommend that you replace all seals as a matter of course irrespective of their visual condition.
8 Lubricate the valve seal with the hydraulic fluid and assemble it to the end of the valve making sure that the lip registers in the groove.
9 Lubricate the piston seals with hydraulic fluid and fit them in their grooves around the piston.
10 Insert the piston into the spring support and assemble the return spring and the valve. Lubricate the piston with Girling Rubber Grease.
11 Smear the cylinder bore with hydraulic fluid and slide the piston/valve assembly into the bore taking care not to damage or twist the seals.
12 Enter the push rod against the head of the piston and depress the piston sufficiently to allow the dished washer to seat on the shoulder at the head of the cylinder.
13 Fit the circlip and check that it is fully engaged with the groove.
14 Fill the dust excluder with Girling Rubber Grease and refit it round the head of the cylinder.
15 The following paragraphs deal with the dismantling and reassembly of the Girling master cylinder.
16 Release the crimping and take off the metal end cap.
17 Using a suitable pair of pliers, take out the circlip from the groove in the top of the cylinder bore.
18 Withdraw the push rod complete with the dished washer and dust seal.
19 The return spring will now push the piston and the non-return valve out of the bore.
20 Lift the prong of the spring seat out of the piston recess and remove the plunger and spring retainer.
21 Remove the non-return valve seal and the piston seal.
22 Examine the bore for scores or abrasions as may cause leakage, if either of these are present, the unit should be replaced.
23 We strongly recommend that you replace all seals as a matter of course irrespective of their visual condition.
24 Lubricate the piston and the non-return valve seals with hydraulic fluid and assemble them in their respective positions.
25 Lubricate the bore of the cylinder with hydraulic fluid and carry on to reassemble the unit in the reverse order to the above taking great care not to damage or twist the seals when inserting them into the bore.

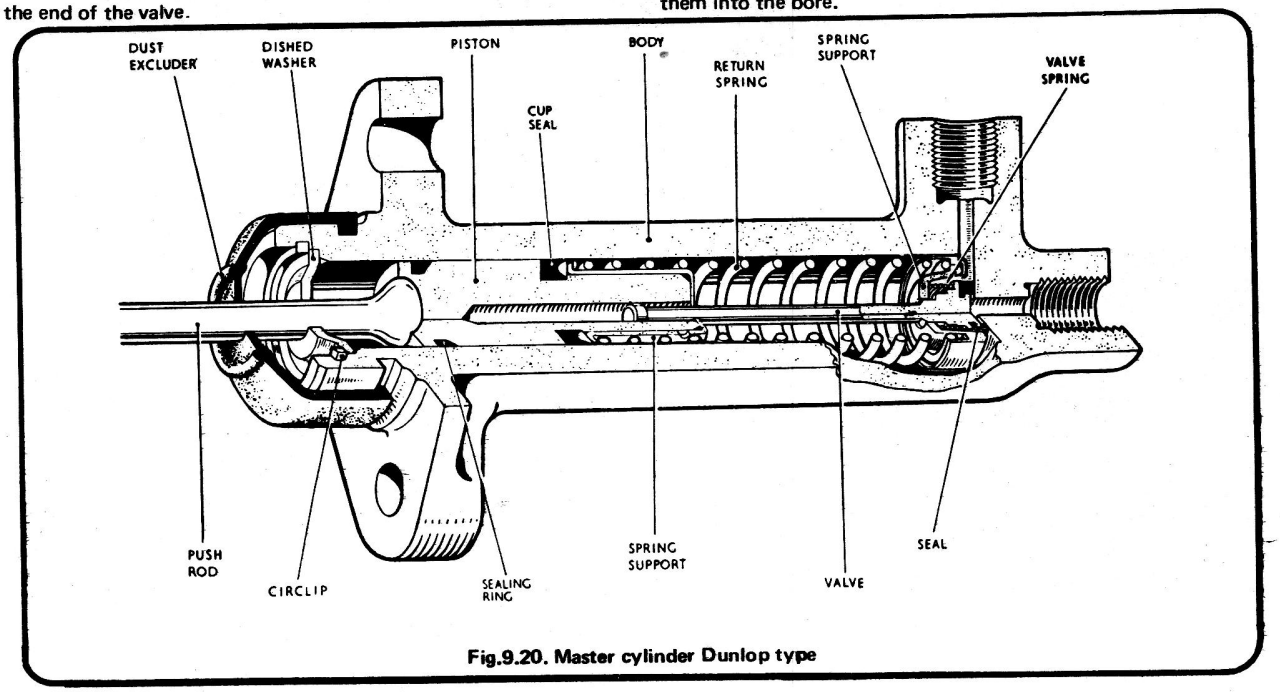



Fig.9.20. Master cylinder Dunlop type

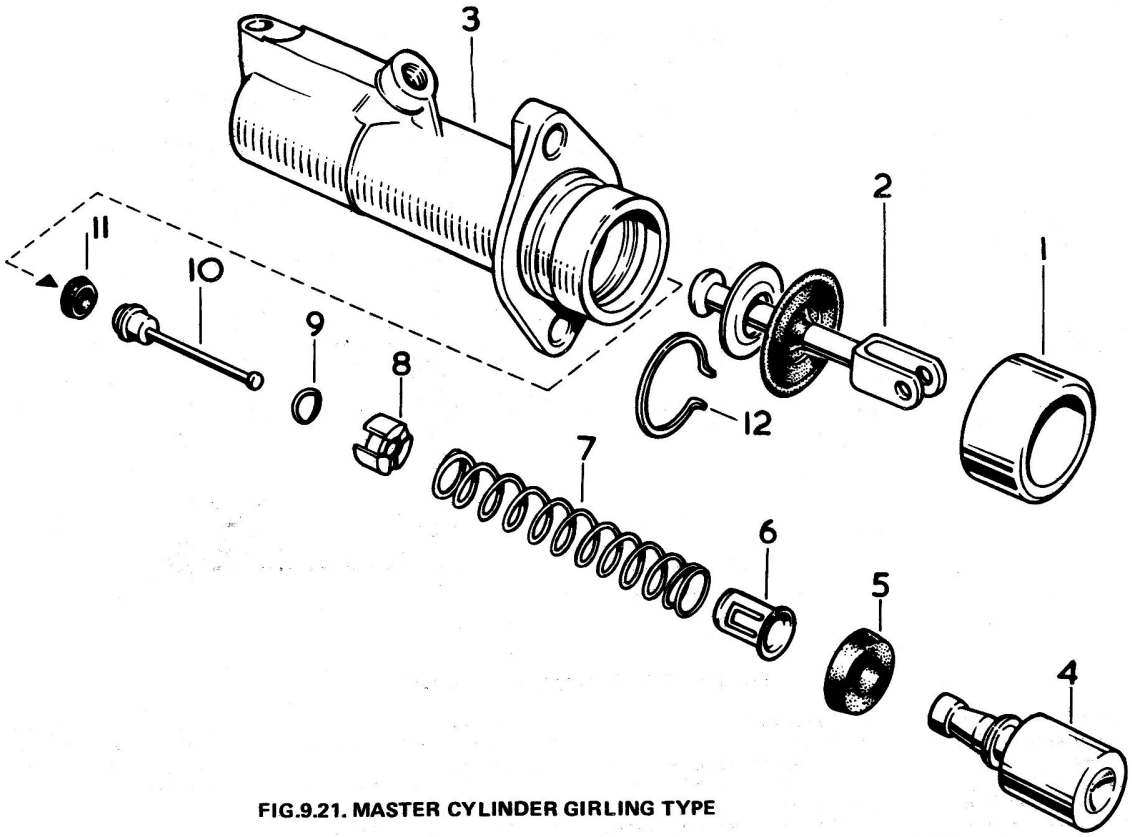



**FIG.9.21. MASTER CYLINDER GIRLING TYPE**

*1 End cap*
*2 Push rod assembly*
*3 Body*
*4 Piston*
*5 Piston seal*
*6 Spring seat*
*7 Return spring*
*8 Plunger*
*9 Waved washer*
*10 Valve piston*
*11 Valve seal*
*12 Circlip*

## 19 Brake servo unit - description

A vacuum servo unit is fitted into the brake hydraulic circuit in series with the master cylinder, to provide power assistance to the driver when the brake pedal is depressed. Early 2.4 and 3.4 litre cars equipped with drum type brakes are fitted with a 5½ inch unit but a 6.7/8 inch type is provided on all other models in conjunction with a brake pedal of different ratio. The unit operates by vacuum obtained from the inlet manifold and consists basically of a servo piston, a hydraulic slave cylinder, an air control valve and a vacuum reservoir.

When the servo unit is in the released position, the servo piston is held off by means of a spring and the degree of vacuum existing in the vacuum reservoir is also present on each side of the booster piston. When the brake pedal is depressed, the hydraulic pressure from the brake master cylinder causes the air control valve in the servo to admit atmospheric pressure and this acts upon the outer face of the servo piston to drive it inward. A rod attached to the centre of the piston operates the slave cylinder and thus boosts the hydraulic pressure at the brakes without any increase of foot pressure at the brake pedal.

Under normal operating conditions the vacuum servo unit is very reliable and does not require overhaul except possibly after very high mileage. In the event of a fault arising in the unit, we feel that it is far better to obtain a service exchange unit rather than try to repair the original.

## 20 Brake servo unit - removal and refitting

1 Remove the windscreen washer bottle to improve access from above.
2 Disconnect the clip securing the air intake pipe to the air cleaner.
3 Jack up the car and remove the offside road wheel. Support the car on a firmly based axle stand.
4 Disconnect the primary hydraulic pipe at the brake union and drain the hydraulic system into a clean container. Blank off the union and the pipe after draining to prevent the ingress of dirt.
5 Undo the banjo bolt and detach the vacuum reservoir hose from the large slave cylinder connection.
6 Disconnect the unions securing the rigid hydraulic pipes at the top and at the end of the slave cylinder. Pull the pipes out of contact with the slave cylinder and blank them off.
7 Undo the two nuts and bolts securing the servo unit clamp and support block to the right hand wing valance inside the engine compartment.
8 Working from inside the right hand front wheel arch, take out the eight bolts securing the servo unit and the supporting cowl.
9 Lift out the servo unit and the supporting cowl.
10 Separate the servo unit and the supporting cowl by undoing the three securing nuts.
11 Refitting is the reverse of the above procedure but make sure that the rubber grommets with their spacers inside, are fitted to the three mounting studs of the servo unit and the slave cylinder support block.
12 The brake servo air cleaner should be serviced before refitting by washing it in methylated spirits and after thorough drying, relubricate the wire mesh with brake fluid.
13 Finally, top up the hydraulic system and bleed as described in Section 2.

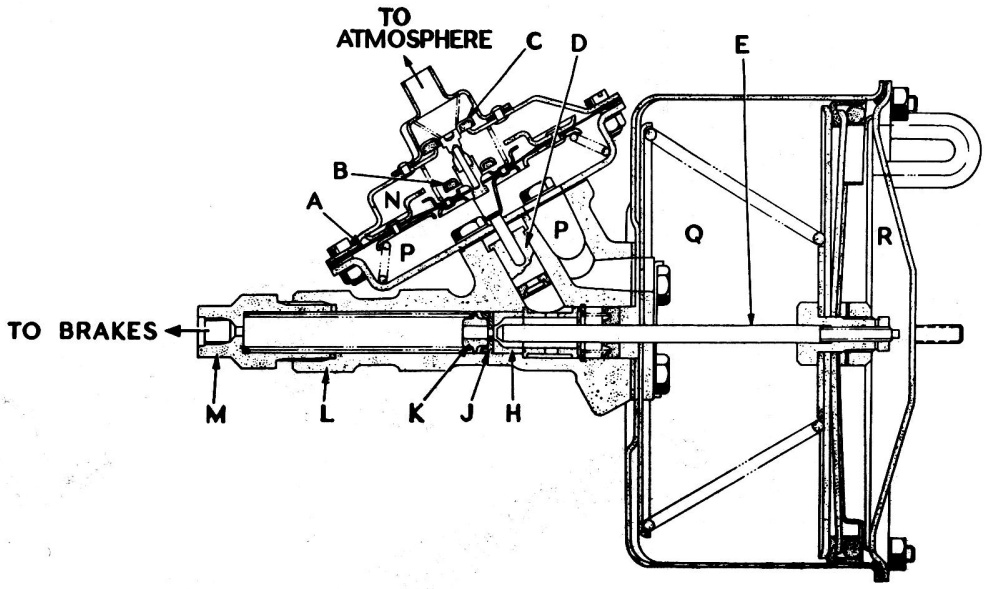



**FIG.9.23. THE 6.7/8 INCH SERVO UNIT**

*A Diaphragm assembly*
*B Vacuum valve*
*C Air valve*
*D Air valve piston*
*E Servo piston pushrod*
*H Slave cylinder piston*
*J Rubber cup*
*K Spring guide*
*L Vacuum passage between chambers P and Q*
*M Adaptor*
*N Chamber, above diaphragm assembly*
*P Chamber, below diaphragm assembly*
*Q Chamber, inner (vaccum) side of servo piston*
*R Chamber, outer side of servo piston; vacuum when brakes are off, atmospheric pressure when brakes are being applied*

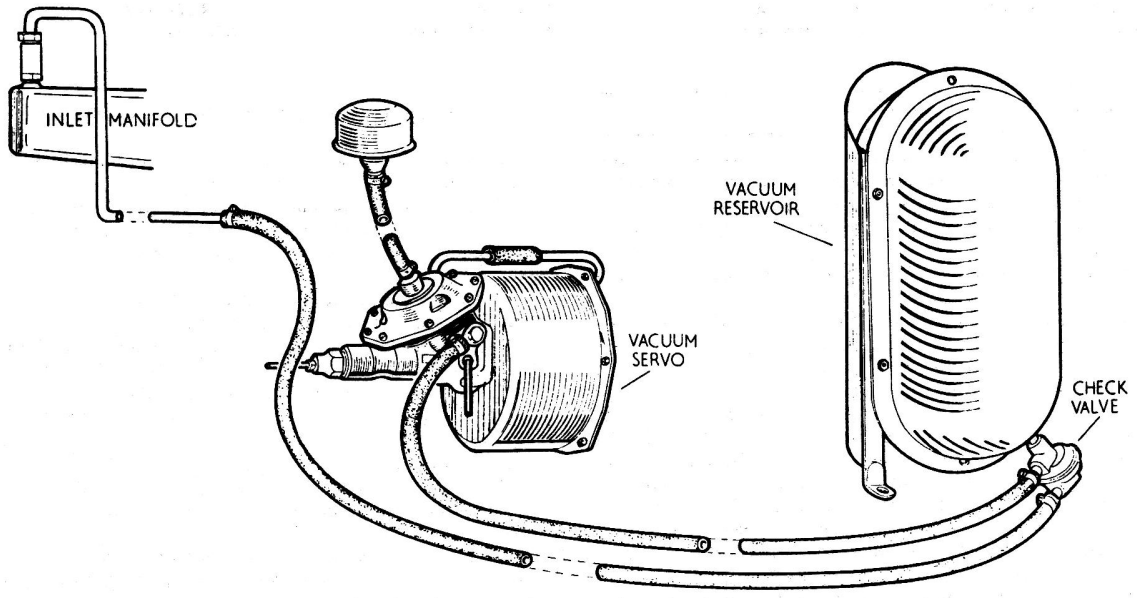



**Fig.9.22. Layout of the servo mechanism**

## 21 Vacuum reservoir and check valve description

The vacuum reservoir and check valve, which is inserted in the vacuum line between the inlet manifold and the servo unit, is located, together with a stone guard, in the front section of the right hand front road wheel arch. It provides a reserve of vacuum for assistance in braking if the engine stalls. The check valve is fitted in the bottom of the front face of the reservoir and its lower connection goes to the inlet manifold whilst the upper connection goes to the vacuum port of the servo unit.

Incorporated in the inlet port of the check valve is a rubber spring loaded valve which is drawn away from its seat when there is a depression in the inlet manifold thus exhausting the reservoir. When the depression in the reservoir equals that of the inlet manifold, the valve spring returns the valve to its seat and thus maintains vacuum in the reservoir.

## 22 Vacuum reservoir and check valve - removal and refitting

1 Jack up the front of the car and remove the right hand front road wheel. Support the car on a firmly based axle stand.

2 Scrape all road dirt away from the reservoir.

3 Remove the three nuts and bolts and detach the reservoir and the stone guard from the wheel arch.

4 Undo one hose clip, remove the hose and clearly identify it.

5 Undo the other hose clip, remove the hose and identify this one.

6 Undo the four nuts and bolts securing the stone guard to the reservoir and remove it.

7 If necessary, unscrew the check valve from the bottom of the reservoir.

8 Refitting is the reverse of the removal procedure but make sure that the rubber hoses are fitted to the correct unions on the check valve, ie the hose from the servo unit connects to the check valve connector nearest to the screwed connection, this connector has two grooves in its body. The inlet manifold pipe goes to the bottom check valve union which has two annular ribs in its body.

**23 Fault diagnosis**

| Symptom | Reason/s | Remedy |
|---|---|---|
| Brake travel excessive | Fluid level too low | Top up master cylinder reservoir and check for leaks |
| | Wheel cylinder or caliper leaking | Dismantle wheel cylinder or caliper, clean, fit new rubbers and bleed brakes. |
| | Master cylinder leaking | Dismantle master cylinder, clean, fit new rubbers and bleed brakes. |
| | Brake flexible hose leaking | Examine and fit new hose. Bleed brakes. |
| | Brake line fractured | Replace with new pipe. Bleed brakes. |
| | Brake system unions loose | Check, tighten unions as necessary. Bleed brakes. |
| | Normal wear of linings | Fit replacement shoes or friction pads. |
| Brake pedal feels springy | New linings not yet bedded in | Use brakes gently until springy feeling ceases. |
| | Brake drums or discs badly worn, weak or cracked | Fit new brake drums or discs. |
| | Master cylinder securing nuts loose | Tighten nuts and make sure that spring washers are fitted. |
| Brake pedal feels spongy and soggy | Wheel cylinder or caliper leaking | Dismantle wheel cylinder or caliper, clean, fit new rubbers and bleed brakes. |
| | Master cylinder leaking | Dismantle master cylinder, clean, fit new rubbers and bleed brakes. |
| | Brake pipe line or flexible hose leaking | Fit new pipe line or hose. Bleed brakes. |
| | Unions in brake system loose | Examine for leaks and tighten. Bleed brakes. |
| Brakes uneven and pulling to one side | Linings, drums or discs contaminated with oil or grease | Ascertain and rectify source. Clean drums and discs and fit new linings if necessary. |
| | Tyre pressures incorrect | Check and rectify. |
| | Brake backplate or disc loose | Check and tighten as necessary. |
| | Brake shoes or pads fitted incorrectly | Remove and fit correct way round. |
| | Different types of lining fitted at each wheel | Fit linings of correct specification all round. |
| | Anchorages for front or rear suspension loose | Check and tighten as necessary. Ensure rubbers are not perished. |
| | Brake drums or discs badly worn crakced or distorted | Fit new brake drums or discs. |
| Brakes tend to bind, drag or lock-on | Incorrect adjustment of brake shoes or pads | Check and rectify shoe/pad adjustment mechanism |
| | Handbrake cable over-tightened | Adjust correctly. |
| | Master cylinder by-pass port choked | Dismantle and clean master cylinder. Bleed brakes. |
| | Wheel cylinder piston seized | Dismantle and rectify wheel cylinder. Bleed brakes. |
| | Blockage of port through which air enters servo valve assembly | Remove and clean servo unit. Bleed brakes. |
| | Drum brake shoe pull-off springs weak, broken or loose | Examine springs and replace as necessary. |
| Brakes fail to release | Handbrake over-adjusted | Check and adjust correctly |
| | Master cylinder by-pass port choked | Dismantle master cylinder, clean and bleed brakes. |
| | Excessive friction between wheel cylinder seals and cylinder body | Dismantle wheel cylinder and rectify. Bleed brakes. |

# Chapter 10 Electrical system and instruments

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**Specifications**

**12 volt positive earth type**

| | |
|---|---|
| **Battery** | |
| Type | |
| Mk 1 models and 2.4 litre Mk 2 | GT9A or GTZ9A for all models plus GTW9A for Mk 1 models and GTW9A/3 for 2.4 litre Mk 2 |
| Voltage | 12 |
| Number of plates per cell | 9 |
| Capacity (20 hour rate) | 58 ampere hour |
| Mk 2, 3.4 litre, 3.8 litre and 340 | |
| Type | BV.11A |
| Voltage | 12 |
| Number of plates per cell | 11 |
| Capacity (20 hour rate) | 67 ampere hour |
| 240, also 2.4 litre Mk 2 (see above) | |
| Type | S.9 |
| Voltage | 12 |
| Number of plates per cell | |
| Capacity (20 hour rate) | 60 ampere hour |

**Starter motor**

| | |
|---|---|
| 2.4 litre all models and 240 | Lucas M.418.G. |
| Lock torque | 17 lb.f.ft. with 440–460 amps at 7.4–7 volts |
| Torque at 1000 rpm | 8 lb.f.ft. with 250–270 amps at 9.4–9 volts |
| Light running current | 45 amps at 7400–8500 rpm |
| 3.4 litre all models, 3.8 litre and 340 | Lucas M.45.G |
| Lock torque | 22 lb.f.ft. with 430–450 amps at 7.8–7.4 volts |
| Torque at 1000 rpm | 8.3 lb.f.ft. with 200–220 amps at 10.2–9.8 volts |
| Light running current | 45 amps at 5800–6800 rpm |

**Dynamo**

| | |
|---|---|
| 2.4 litre Mk 1 | C.45 PV.5 |
| 3.4 litre Mk 1 | C.45 PVS.5 |
| Performance data of the above:- | |
| Cutting in speed | 1100–1250 rpm at 13.0 generator volts |
| Max: output | 22 amp. at 1700–1900 rpm at 13.5 generator volts and a resistance load of 0.61 ohms |
| Field resistance | 6.0 ohms |
| 2.4 litre Mk 2 and 240 | C.45 PV.6, C.40L and C.42 (special order only) |
| Performance data:- | |
| Cutting in speed | 1300 (max) rpm at 13 generator volts |
| Max: output | 25 amps at 2050 rpm for type C.45 PV.6<br>25 amps at 2400 rpm for type C.40L<br>30 amps at 2200 rpm for type C.42<br>all at 13.5 generator volts and a resistance load of 0.54 ohms |
| Field resistance | 6.0 ohms |
| 3.4 and 3.8 litre Mk 2 and 340 | C.45 PVS6, C.42 and C.48 (special order only - high output) |
| Performance data:- | Data for C.45 PV.6 given above also applies to the C.45 PVS6 generator.<br>Data for C.42 generator given above. |
| Type C.48 | |
| Cutting in speed | 850 (max) rpm at 13 generator volts |
| Max: output | 35 amps at 1650 (max) rpm at 13.5 generator volts and a resistance load of 0.385 ohms |
| Field resistance | 6.0 ohms |

**Windscreen wiper motor**

| | |
|---|---|
| Type | Lucas DR.3 two speed |
| Wiping speed: | |
| Normal | 45–50 cycles per minute |
| High | 60–70 cycles per minute |
| Light running current: | |
| Normal speed | 2.7–3.4 amps |
| High speed | 2.6 (or less) amps |
| Stall current | 10–11 amps |
| Control switch | 79.SA |
| Pressure of blades against windscreen:- | |
| Arms with leaf type springs | 4.5–7.5 ounces |
| Arms with coil type springs | 5.5–7.5 ounces |
| Maximum permissible force to move cable rack in protective tubing with motor, arms and blades disconnected | 6.0 lbs |

**Replacement bulbs** (all 12 volt)

| Lamp | Watts | Lucas No: | Remarks |
|---|---|---|---|
| Headlight | Sealed beam units for UK (240 and 340), USA, Canada and RH drive export | | |
| | 60/36 | 404 | Large globe |
| Side light<br>Map light<br>Pillar interior light<br>Number plate<br>Luggage boot light | 6 | 989 | No.222 can be used |

| | | | |
|---|---|---|---|
| Front and rear Flashing indicators Reversing light | 21 | 382 | |
| Rear/brake light | 21/6 | 380 | |
| Fog lights | 48 | 323 | |
| Rear interior light | 6 | 254 | |
| Instrument illumination Headlamp warning light Ignition warning light Fuel warning light Handbrake/brake fluid warning light | 2.2 | 987 | |
| Switch indicator strip Flashing indicator warning light Overdrive indicator light Auto-trans: indicator light | 1.6 | 281 | sub-miniature |

## 1 General description

All models have 12 volt electrical systems in which the positive battery terminal is earthed.

The major components of the system are a 12 volt battery located at the top right hand side of the engine bulkhead, a dynamo mounted on the engine at the front left hand side, a starter motor at the rear right hand side of the engine and a current and voltage regulator on the left hand valance in the engine compartment.

The battery supplies a steady amount of current for the ignition, lighting and other electrical circuits, and provides a reserve of electricity when the current consumed by the electrical equipment exceeds that being produced by the dynamo.

The battery is charged by one of the various types of dynamo enumerated under Specifications at the beginning of this Chapter. The main external difference in the various types of dynamo is that whereas the connections to the earlier types were secured by nuts, the later types use Lucar connectors.

Although full instructions for the periodic overhaul and minor servicing of the various electrical components are given in this Chapter it must be appreciated that rectification of major faults will require specialised knowledge and equipment and so, where such faults arise, the defective item should be removed and replaced with a serviceable item which can be obtained on an exchange basis.

Wiring diagrams covering the various models are given at Figs 10.50, 10.51, 10.52 and 10.53.

## 2 Battery - removal and replacement

1 Mark the position of the bonnet hinges relative to the bonnet. With the help of an assistant to support the bonnet, remove the four bolts securing it to the hinges and then lift the bonnet forward off the car and store it where it will not be damaged.

2 Remove the battery cover by springing back the two clips.

3 Remove the securing screw attaching each terminal to its lug on the battery or, if applicable, undo each terminal clamping nut and bolt.

4 Remove the two bolts (one each side of the battery) which hold the battery retaining band and remove the band and the rubber packing.

5 Lift out the battery from the tray.

6 However, it is possible to remove the battery without taking off the bonnet provided you are strong enough to lift the heavy battery clear of the car. Proceed as outlined in paragraphs 2-4 above, use a stubby screwdriver to undo the terminal screws. Now tilt the battery forward but do not tilt so far as may cause spillage of the electrolyte; put your left hand underneath the lip on the top of the battery and your right hand under the battery. Lift the battery upwards and outwards, you will find that this is made awkward by restriction of access due to the bonnet. Make sure that you do not drop the battery as soon as it is clear of the tray as damage to the clutch and brake master cylinders and pipes will result.

7 Replacement is the reverse of the removal procedure in each case but before refitting the terminals clean them and then coat them with vaseline to prevent corrosion; DO NOT use an ordinary grease.

## 3 Battery - maintenance and inspection

**Note:** Never use a naked light when examining a battery as an explosive mixture of oxygen and hydrogen is given off when it is on charge or when standing idle.

1 Normal weekly battery maintenance consists of checking the level of the electrolyte in the cells to ensure that the separators are covered by about ¼" of electrolyte. If the level has fallen, top up with distilled water only. Do not overfill the battery. If the battery is overfilled or any electrolyte is spilled, clean it away immediately as the electrolyte is extremely corrosive.

2 Keep the terminals clean and covered with petroleum jelly.

3 Clean the top of the battery regularly. Maintaining it in a clean and dry condition will help to prevent corrosion and will also ensure that the battery does not become partially discharged by leakage through dampness and dirt.

4 Inspect the battery securing nuts, the clamp plate, the tray and leads for corrosion which will show up as white fluffy deposits brittle to the touch. If corrision is found, clean it off with ammonia and then paint over the clean metal with an anti-rust, anti-acid paint.

5 Inspect the battery case for cracks. If a crack is found, clean and plug it with one of the proprietry compounds now on the market. If leakage through the crack has been excessive it will be necessary to refill the cell concerned with fresh electrolyte. Cracks are commonly caused at the top of the battery case by pouring in distilled water in the middle of winter AFTER instead of BEFORE a run. This gives the water no chabce To mix with the electrolyte and so it freezes and splits the battery case.

6 If very frequent topping up is necessary and it has been established that the case is not cracked, the fault is due to over-charging of the battery and indicates a need to check and reset the voltage regulator. (Refer to Sections 17, 18 or 19 as applicable).

7 If the battery persists in a low state of charge, first consider the conditions under which the battery is used. If it is subjected to long periods of discharge without suitable opportunities for recharging, a low state of charge must be expected. If, on the other hand, the battery remains in a low state of charge when the car is in regular use with reasonably long running peoiods each day then it may be that the dynamo or the voltage regulator are at fault. A heavy discharge tester can be used to determine whether or not the fault lies in the battery. Your local

garage can easily carry out the test for you but the battery will have to be removed for the test because the car bonnet will prevent access for the tester to the battery terminals. The contact prongs of the tester are pressed against the exposed positive and negative terminals of each cell. A good cell will maintain a reading of 1.2-1.5 volts for at least six seconds. If, however, the reading falls off rapidly that particular cell is probably faulty and will especially if other cells are also at fault, account for the low state of charge of the battery.

8 The specific gravity of the electrolyte in each cell should be checked periodically using a hydrometer but to avoid misleading readings do not take hydrometer readings immediately after Topping up with distilled water. The readings given by each cell should be approximately the same and if one cell differs appreciably from the others, an internal fault in that cell is indicated.

9 The appearance of the electrolyte drawn into the hydrometer will give an 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 poor condition.

10 The specific gravity of the electrolyte varies with its temperature and so, for convenience in comparing specific gravities, this is always corrected to 60° F. The method of correction is as follows:-

For every 5°F below 60°F **deduct** 0.002 from the hydrometer reading to obtain the correct specific gravity at 60°F.

For every 5°F above 60°F **add** 0.002 to the hydrometer reading.

11 The specific gravity of electrolyte corrected to 60°F is given in the following table:-

| State of charge | U.K. and climates ordinarily below 90°F (32.2°C). Specific gravity corrected to 60°F | Climates frequently over 90°F (32.2°C) Specific gravity corrected to 60°F |
|---|---|---|
| Fully charged | 1.270 – 1.290 | 1.210 – 1.230 |
| About half charged | 1.190 – 1.210 | 1.120 – 1.150 |
| Completely discharged | 1.110 – 1.130 | 1.050 – 1.070 |

## 4 Battery - electrolyte replenishment

1 If the battery is in a fully charged state and one of the cells maintains a specific gravity reading lower than the others and a check of each cell has been made with a discharge tester with satisfactory results, then it is likely that at some time electrolyte has been lost from the cell.

2 Top up the cell with a solution of 1 part sulphuric acid to 2.5 parts water. If the cell is already fully topped up, draw some electrolyte out of it with a pipette.

3 When mixing sulphuric acid and water NEVER ADD WATER TO THE ACID. Always pour the acid slowly onto the water in a glass container. IF WATER IS ADDED TO THE SULPHURIC ACID IT WILL EXPLODE.

4 Recharge the battery after topping up with the electrolyte and recheck hydrometer readings.

## 5 Battery charging

1 In winter time when a heavy demand is placed on the battery it is a good idea to have the battery charged occasionally from an external source at a rate of 5 amps. Alternatively, a trickle charger, charging at the rate of 1.5 amps can be safely used overnight. Special rapid boost charges which are claimed to restore the power of the battery in 1 to 2 hours are most dangerous unless they are thermostatically controlled as they can cause damage to the battery plates through overheating.

## 6 Dynamo - removal and refitting

1 For cars fitted with power steering, first disconnect the pipes to the pump at the rear of the dynamo and then drain the hydraulic system as described in Chapter 11. Proceed as follows to remove the dynamo and pump as one system.

2 Disconnect the cables from the Lucar connectors, or by undoing he securing nuts as appropriate, at the rear of the dynamo, noting that the terminals are of different sizes.

3 Remove the nut and bolt securing the adjusting link to the dynamo.

4 Remove the two nuts and bolts, one at the front and one at the rear, which secure the dynamo to the mounting bracket.

5 Tilt the dynamo to assist in removing the fan belt from the pulley and then lift the dynamo out of the car.

6 Refitting is the reverse of the removal procedure. Before final tightening of the securing bolts, position the dynamo so that it is possible to depress the belt about ½" (12 mm) at a point midway between the fan and dynamo pulleys.

7 On cars fitted with power steering, refer to Chapter 11 for procedures for refitment of the hydraulic pipes, refilling and bleeding the hydraulic system.

## 7 Dynamo - dismantling

1 The main difference between both types of dynamo is that the porous bronze bearing ring bush of the early type is replaced by a ball race. In addition the yoke of the later type is provided with 'windows' to enable examination of the brush gear without dismantling the dynamo. The 'windows' are covered with a steel band secured by a nut and bolt.

2 Remove the nut securing the driving pulley. Take off the pulley and collect the Woodruff key from the shaft.

3 Unscrew and remove the two through bolts.

4 Take off the commutator end bracket from the yoke.

5 Remove the driving end bracket complete with the armature.

6 Lift the brush springs to one side and draw the brushes out of the brush holders, note their position for refitment if they are not being renewed. Undo the screws and lock washers holding the brush leads to the commutator end bracket and remove the brushes.

7 The bearings need not be removed, or the armature shaft separated from the driving end bracket unless the bearings or the armature are to be renewed. If the items are to be separated, support the driving end bracket and press out the shaft by means of a hand press.

## 8 Dynamo - examination

1 Fit the brushes to their respective holders and check them for freedom of movement. If movement is sluggish, remove them and ease the sides by lightly polishing with a smooth file.

2 Measure the length of the brushes, the minimum permissible length is 11/16" and brushes not meeting this must be renewed and bedded to the commutator.

3 Fit the commutator end bracket over the commutator, fit the brushes in their holders and, using a spring balance, test the brush spring tension. The tension of a new spring and new brush is 28 ozs and the minimum permissible tension for correct operation is 20 ozs. Renew any brush spring when the tension falls below that value. It should be noted that it is possible to examine the brushes and to check the spring tension without dismantling the later type of dynamo as this work can be done through the 'window' (see Fig10.3).

4 Clean the commutator with a petrol moistened cloth. A commutator in good condition will be smooth and free from pits or burned spots. Minor blemishes can be removed by polishing the commutator with fine glass paper whilst rotating the armature. It may be possible to rectify a badly worn commutator by mounting the armature in a lathe and taking a light cut with a very sharp tool at a high speed. But do not remove

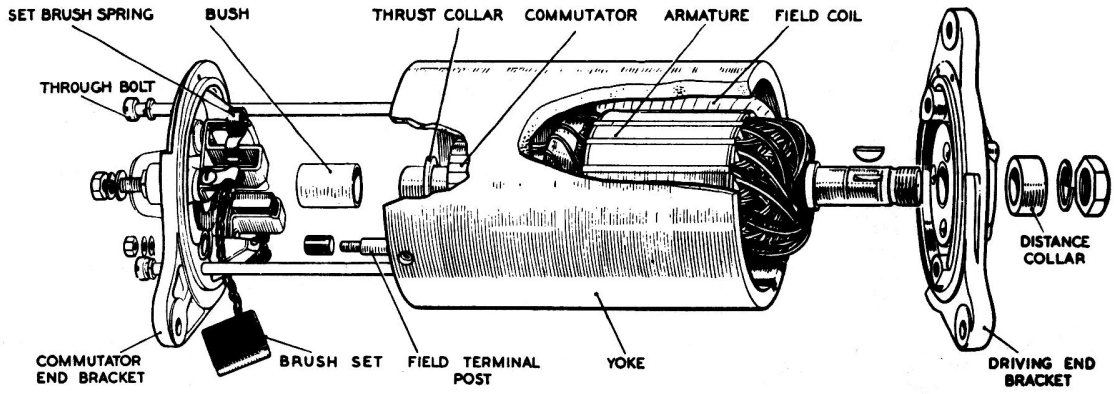



**Fig.10.1. The dynamo (early type)**

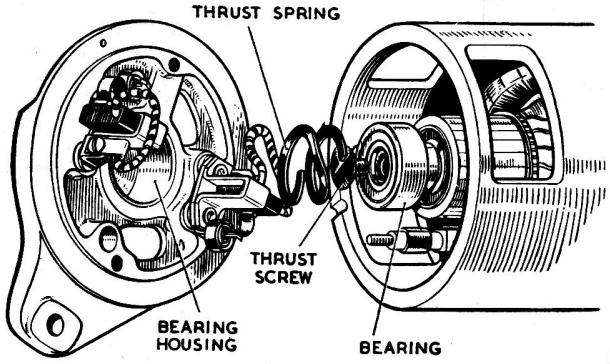



**Fig.10.2. Dynamo (later type) commutator end bracket removed**

more metal than absolutely necessary.

After working in the lathe, polish the commutator with fine glass paper. Now undercut the insulators between the segments to a depth of 1/32" as illustrated in Figs10.4. A hacksaw blade ground to the thickness of the insulator is a handy tool for undercutting but make sure that the insulator is cut away squarely and cleanly as shown in Fig.10.5.

5 Burnt commutator segments are indicative of an open circuited armature winding. If you have no armature testing facilities the only way it can be checked is by substitution.

6 The old armature is removed from the driving end bracket in the manner described in Section 7.

7 It is essential, when fitting the new armature, that the inner journal of the ball race is supported by a piece of mild steel tube of suitable diameter.

8 The resistance of the field coils can be checked without removing them from the yoke by using an ohmmeter connected between the field terminal and the yoke. The field resistance is 6.0 ohms. If a meter is not available, the field coils can be checked by connecting a 12 volt battery between the field terminal and the yoke with an ammeter in series.

9 The ammeter reading should be about 2 amperes, if a zero reading or 'infinity' on the ohmmeter is recorded, an open circuit in the field winding is indicated. If the current reading is above 2 amps or the meter reading is lower than 6 ohms it means that the insulation of one of the coils has broken down.

10 Replacement of the field coils involves the use of equipment not normally available to most home mechanics so our recommendation is that in the event of field coil failure, you obtain a replacement exchange dynamo.

11 Check the condition of the bearings. They must be changed when wear has reached the point of allowing visible side movement of the armature shaft. A bush bearing is fitted to the commutator end bracket and a ball bearing at the drive end bracket of the earlier type of dynamo, whilst later types have a ball race at each end.

12 To change a bearing bush, first obtain a replacement and then allow it to soak for 24 hours immersed in thin engine oil so that the pores of the brush are filled with lubricant.

13 Remove the old bearing bush from the commutator end bracket using an extractor or by screwing an 11/16" tap into the bush for a few turns and then using the tap as an extractor but make sure that the tap is screwed in squarely to avoid damage to the bracket and that side loads are not applied when pulling out the bush.

14 Examine the felt ring in the bearing housing and if it is in good condition it can be re-used.

15 Replace the felt ring and then press the new bearing bush into the housing using a shouldered and highly polished mandrel of the same diameter as the armature shaft. Press in the bush until the end is flush with the inner face of the bracket.

16 To replace the ball race at the driving end, refer to Fig.10.7 and drill out the rivets which secure the retaining plate to the end bracket and then remove the plate.

17 Press the bearing out of the end bracket and collect the corrugated washer, the felt washer and the oil retaining washer.

18 Pack the new bearing with high melting point grease.

19 Refit the oil retaining washer, the felt washer and the corrugated washer to the bearing housing in that order and then locate the bearing in the housing and press it home.

20 Assemble the bearing retaining plate and insert new rivets from the inside of the end bracket and then open them out with a punch to secure the plate.

21 The ball race fitted at the commutator end of the armature shaft as illustrated in Fig.10.2 is secured to the shaft by a thrust screw. The bearing can be removed with an extractor after the thrust screw has been removed. When fitting a new bearing, first pack it with high melting point grease and then press it home against the shoulder on the shaft and finally secure it with the thrust screw.

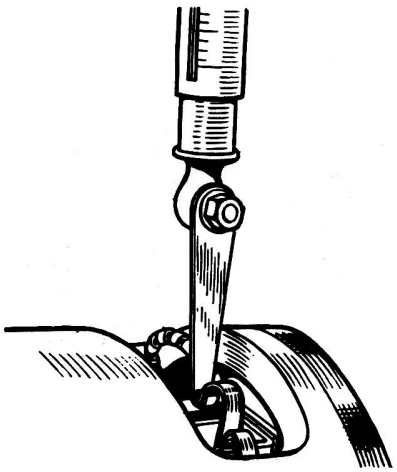


Fig.10.3. Checking the tension of the brush spring

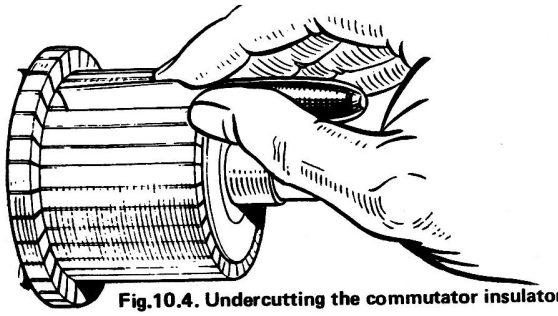


Fig.10.4. Undercutting the commutator insulators

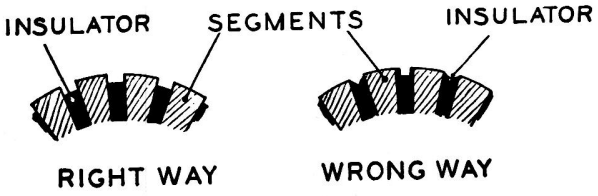



Fig.10.5. Correctly and incorrectly cut insulators

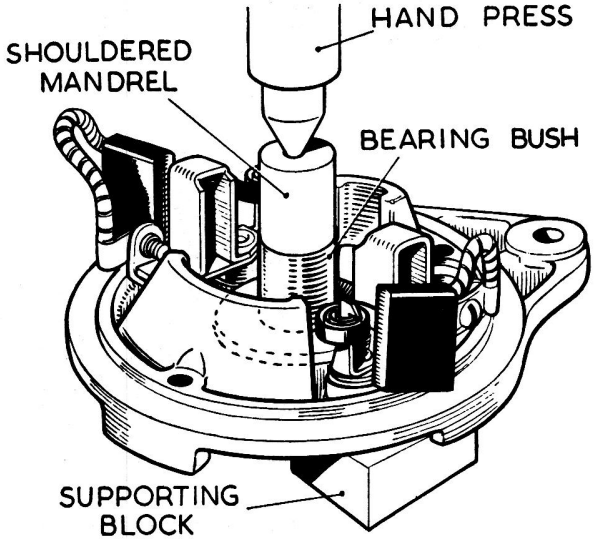



Fig.10.6. Fitting a bearing bush

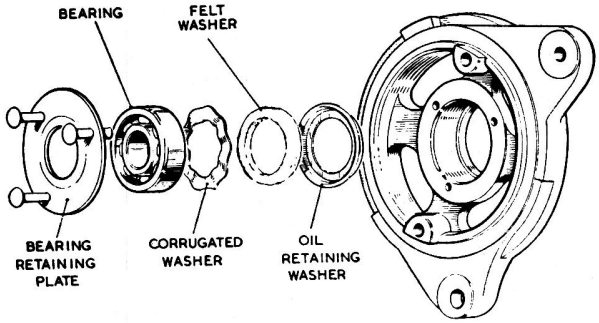



Fig.10.7. The drive end bracket bearing assembly

## 9 Dynamo - reassembly

1 Fit the drive end bracket to the armature shaft and during this operation the inner journal of the race in the bracket must be supported. A piece of tube 4" in length and 1/8" thick and 11/16" internal diameter will be found suitable for this. The drive end bracket itself must not be used as a support.
2 Place the yoke over the armature to mate with the drive end bracket.
3 Assemble the brushes to the same brush holders from which they were removed (unless new brushes are being fitted) and secure their leads to the terminals with the screw and shakeproof washer. Lift up the brush springs and place them to one side so that they are not bearing on the brushes.
4 Make sure the brushes are clear of the commutator end of the holders and then fit the commutator end bracket to the armature shaft until the brush holders are partly over the commutator. Release the brush springs and then slide the commutator end bracket home against the yoke so that the projection on the bracket locates in the yoke.
5 After making sure that the mounting holes in the commutator end and the driving end brackets are correctly aligned, refit the two through bolts and tighten down.
6 Lubricate the commutator end bearing (bush type) by injecting a few drops of medium engine oil into the hole marked "oil" at the end of the bearing housing (Fig.10.8).

## 10 Dynamo - testing in position

1 If it is noted, from ammeter readings during normal running, that there is no charge or low or intermittent charge, proceed as follows to determine the cause of the fault.
2 Check the fan belt and adjust as necessary.
3 If the dynamo or control box connections have been upset, check that they are connected correctly. The large and the small dynamo terminals should be connected to control box terminais "D" and "F" respectively.
4 Next switch off all lights and accessories (do not forget the

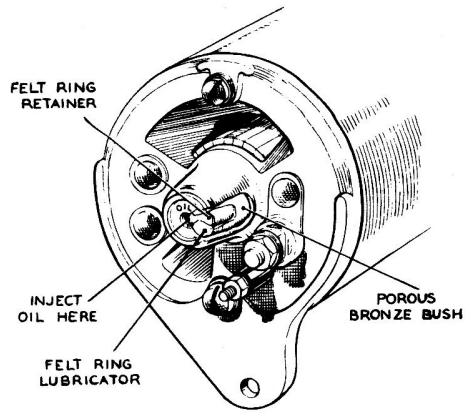



**Fig.10.8. Lubricating the bush bearing**

rear window heater if this is fitted and is connected to operate when the ignition is switched "ON"), disconnect the cables from the dynamo terminals and connect the two terminals with a short length of wire.

5 Start the engine and allow it to run at normal idling speed. Now attach the negative lead of a 0.20 volt moving coil voltmeter to one dynamo terminal and the positive lead to a good earth on the yoke.

6 Gradually increase engine speed and note the reading of the voltmeter which should rise rapidly and without fluctuation. Do not allow the reading to reach 20 volts and do not race the engine in an attempt to increase the voltage. A generator speed of about 1000 rpm is all that is required.

7 If the voltage does not rise rapidly and without fluctuation, an internal fault is indicated and the dynamo will have to be removed for detailed examination and test as indicated in Section 8 but before doing this, if a radio suppressor is fitted between the output terminal of the dynamo and earth, disconnect it and re-test the dynamo. If readings are now satisfactory, the capacitor is the cause of the fault.

## 11 Starter motor - description

The starter motor uses a series wound, four pole and four brush system which has an extended shaft carrying the starter drive. It is of similar construction to the dynamo except that heavier gauge copper wire is used in the windings of the armature and field coils.

## 12 Starter motor - removal and refitting

1 Disconnect the battery.

2 Place the car over a pit or raise the front to give access to the terminal connection. Make sure that the car is well supported before doing any work underneath it.

3 Disconnect the cable from the terminal at the end of the motor.

4 Working from inside the car, move both seats to the rear as far as they will go and then remove the seat cushions. Slacken the gear lever knob locknut and remove the gear lever knob.

5 Unscrew the chrome knob securing panel assembly between the two seats, lift the rear of the panel upwards and rearwards to remove it.

6 Undo the two thumb screws and remove the trim panel from the right hand side of the gearbox cover.

7 Detach the right hand heater hose from the distributor box and you will see a circular plate in the floor, remove the plate to gain access to the nut of the top bolt securing the starter motor. Remove the nut but leave the bolt in position.

8 Working from underneath the car, remove the nut from the bottom bolt.

9 Support the starter motor and withdraw both bolts (they are connected by a curved metal rod). Now withdraw the starter motor.

10 Refitting is the reverse of the removal procedure.

## 13 Starter motor - testing in position

1 Switch on the lights and the ignition, ensure that the gear selector lever on automatic transmission models is in "N" or "P"

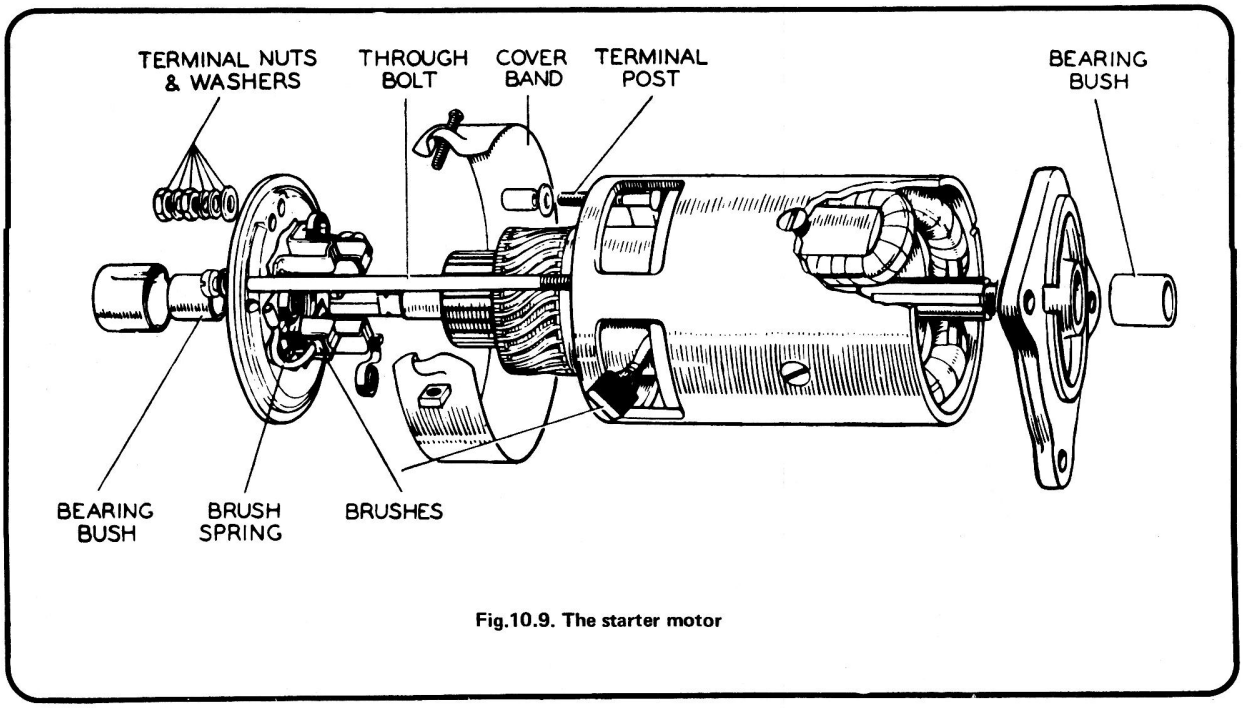



**Fig.10.9. The starter motor**

2 Operate the starter control, if the lights go dim but the motor is not heard to operate, it shows that current is flowing through the motor windings but that, for some reason, the armature is not rotating. It may be that the pinion has not disengaged from the starter ring on the flywheel in which case the motor will have to be removed from the car for examination.
3 If, when the starter is operated, the lamps retain their full brilliance and the motor does not operate, check the circuit for continuity starting with the battery connections (especially the earth connection), then look carefully at the engine earth connection followed by the connectios to the motor and the starter switch. If it is established that voltage is getting to the motor when the switch is operated, an internal fault in the motor is indicated.
4 Sluggish or a slow action of the motor is usually caused by a loose connection resulting in high resistance in the circuit, check as described in paragraph 3.
5 If the motor is heard to operate but it does not turn the engine, a fault in the drive is indicated which will involve removal of the motor for rectification.

## 14 Starter motor - dismantling and reassembly

1 Before completely dismantling the motor to check for a fault, first make sure that the brushes are not the cause of the trouble. This can be done by slackening the nut and bolt securing the "window" cover band, slide the band clear of the 'windows' and the brushes can now be lifted out for examination. It is also possible to check the weight of the brush spring (correct tension 30-40 ozs) using a spring balance through the window.
2 Leave the brushes out of their holders if they are satisfactory and further dismantling is necessary.
3 Remove the nuts from the terminal post at the commutator end bracket.
4 Unscrew the two through bolts, and making sure that the brushes do not foul the yoke, remove the commutator end bracket from the yoke.
5 Relate the brushes, if they are serviceable, to their respective holders and then undo the lead securing screws and remove the brushes.
6 Withdraw the driving end bracket, complete with the armature and drive, from the yoke.
7 Now refer to Fig.10.11 for dismantling of the drive.
8 Take out the split pin from the shaft nut (B), hold the squared end of the shaft with a spanner and then unscrew the nut.
9 Take off the main spring (C) followed by the remainder of the components.
10 Reassembly of the starter motor and drive is a reversal of the above procedure.

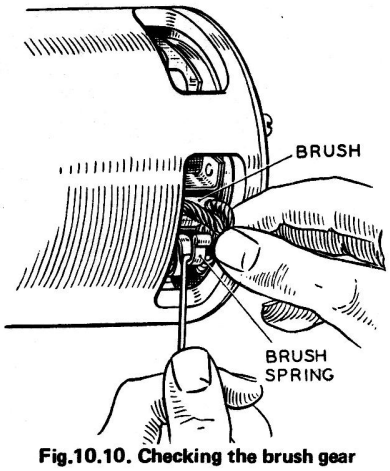


Fig.10.10. Checking the brush gear

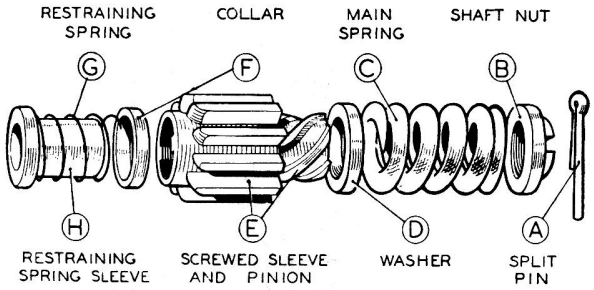


Fig.10.11. The starter drive

## 15 Starter motor - examination, test and rectification

1 Except for the following points, follow the instructions given for the dynamo in Section 8:-
a) The minimum permissible length of the brushes is 5/16".
b) The acceptable tension of the brush springs is 30-40 ozs.
c) The insulators between the commutator segments MUST NOT BE UNDERCUT.
d) No attempt should be made to machine the armature core or to true a distorted armature shaft.
e) If either the screwed sleeve or the pinion of the drive are worn or damaged, they must be replaced as a pair , not separately.

## 16 Voltage and current regulator - general

Early Mk.1, 2.4 litre cars are fitted with an RB 106/1 or RB 106/2 unit having a voltage regulator and cut-out. The RB 310 voltage and current regulator is fitted to later 2.4 litre and all 3.4 litre Mk 1 cars and early Mk 2 models. All later models use the RB 340 control box. RB 310 and RB 340 control boxes readily identifiable by their covers which, in the case of the former is an aluminium pressing and a moulded black plastic for the latter.

Only a good quality MOVING COIL VOLTMETER (0-20 volts) must be used when carrying out any of the continuity checks enumerated in the following Sections.

## 17 Voltage regulator RB 106/1 and 106/2 - cleaning, checking and adjustment

1 If it is found necessary to clean the regulator contacts, this can be done with a fine carborundum stone or fine emery cloth. The cut-out contacts should be cleaned with fine glass paper. All traces of metal dust or foreign matter must be removed after cleaning by use of a clean cloth and methylated spirits.
2 To check continuity between the battery and the control box first disconnect the cable from the control box terminal 'A" and connect the cable to the negative terminal of the voltmeter. Connect the positive terminal of the voltmeter to a good earth on the chassis and a reading of 12 volts (battery voltage) should be obtained. If there is no reading, a fault in the wiring is indicated and this should be checked for defects or loose connections. Reconnect the cable to terminal "A" of the control box on completion of the check.
3 The regulator is carefully set during manufacture and normally no adjustment is necessary in service but if the battery does not keep in a charged condition or if the dynamo output does not fall when the battery is fully charged, the setting must be checked and adjusted. However, first make sure that the trouble is not due to causes such as a slipping fan belt or a defective battery.
4 Disconnect the cables at terminals "A" and "A1" at the control box and connect these cables together. Now connect the

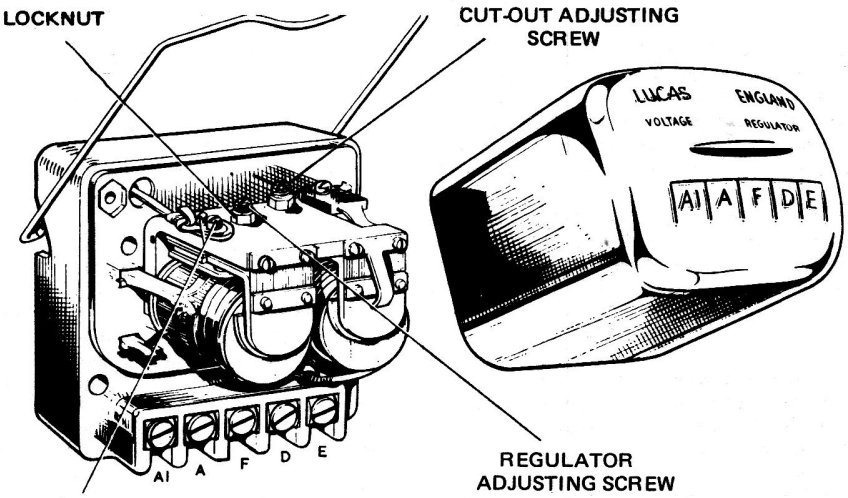



**Fig.10.12. The RB.106/1 control box**

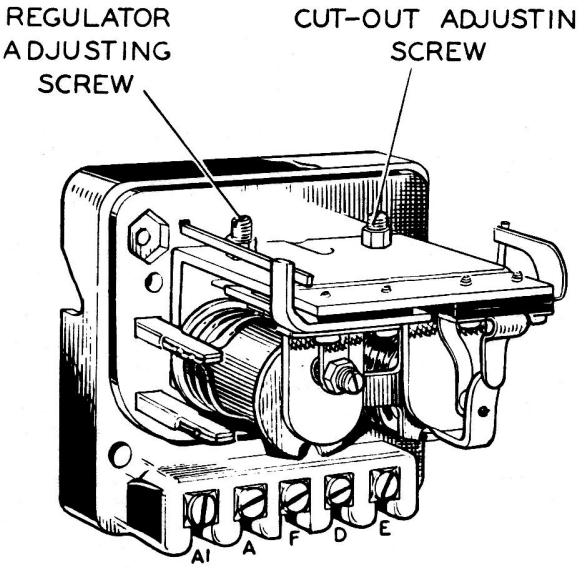



**Fig.10.13. The RB.106/2 control box**

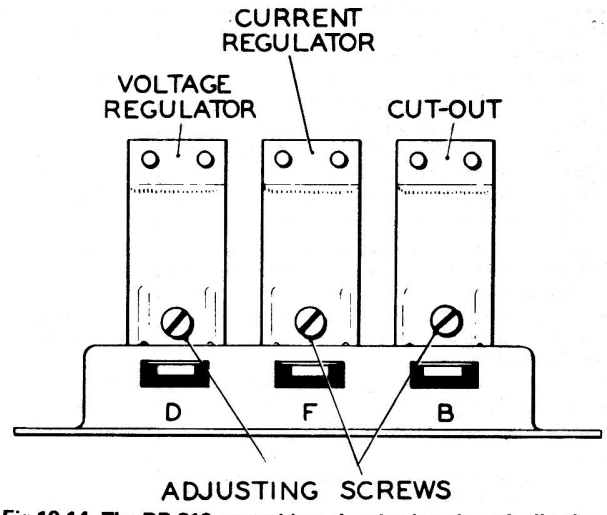



**Fig.10.14. The RB.310 control box showing location of adjusting screws**

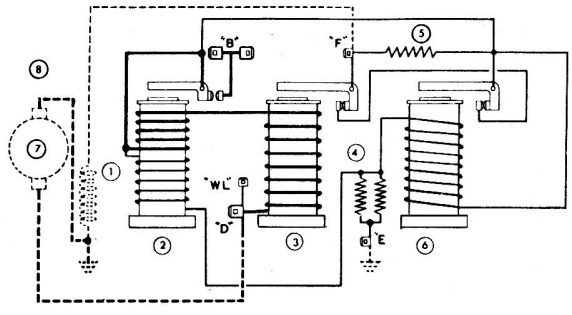



**FIG.10.15. CIRCUIT DIAGRAM OF RB.340 CONTROL BOX**

*1 Field*
*2 Cut-out relay*
*3 Current regulator*
*4 Swamp resistor*
*5 Field resistor*
*6 Voltage regulator*
*7 Armature*
*8 Generator*

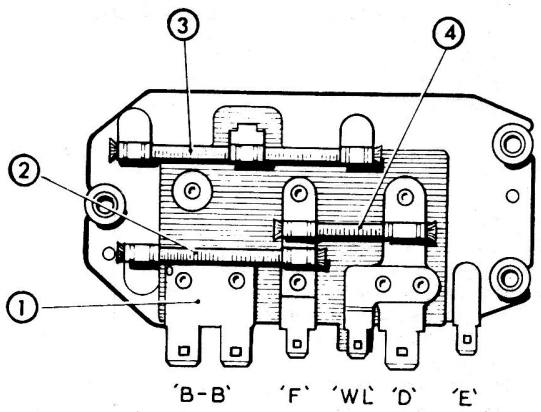



**FIG.10.16. THE UNDERSIDE OF THE RB.340 CONTROL BOX**

*1 Battery main terminal*
*2 Swamp resistor*
*3 Ballast resistors*
*4 Field resistors*

voltmeter to terminals "D" and "E" of the control box.
5 In order to obtain accurate readings, the air temperature in the vicinity of the control box should be known as indicated in the table given below. Any adjustment found necessary should be completed within 30 seconds because heating of the shunt coil by the energising current may cause false settings to be made.
6 Start the engine and run up to 2100 rpm when the open circuit voltage reading should be within the following limits:-

| Regulator Temperature | Voltage Setting |
|---|---|
| 50°F (10°C) | 16.1 – 16.7 |
| 68°F (20°C) | 16.0 – 16.6 |
| 86°F (30°C) | 15.9 – 16.5 |
| 104°F (40°C) | 15.8 – 16.4 |

7 If the voltmeter reading is outside the limits quoted above, slacken the locknut of the voltage adjusting screw and turn the screw clockwise to raise the setting and anti-clockwise to lower it until the correct setting is obtained.
8 Retighten the locknut.
9 If, despite the fact that the regulator is correctly set and the contacts are clean, the battery is still not being charged in may be that the cut-out requires adjustment.
10 Connect the voltmeter between terminals "D" and "E" of the control box. Start the engine and slowly increase its speed until the cut-out contacts are seen to close; note the voltage recorded at this point. The cut-out contacts should have closed at between 12.7 and 13.3 volts and if this is not achieved, slacken the locknut securing the cut-out adjusting screw and turn the screw clockwise to increase the voltage and anti-clockwise to reduce it. Turn the screw only a fraction of a turn at a time and then tighten the locknut. Recheck, after each adjustment, on the voltage at which the cut-out contacts close. These checks, as with adjustment of the regulator, must be done as quickly as possible to avoid errors due to rises in temperature.

## 18 Voltage and current regulator RB 310 - cleaning, checking and adjustment

1 Clean the regulator and cut-out contacts in the manner described in Section 17.
2 Check continuity between the battery and the control box in the manner described in Section 17 except that in this case the negative terminal of the voltmeter is connected to control box terminal "B".
3 To adjust the voltage regulator, disconnect the cable from control box terminal "B" and connect the voltmeter to control box terminal "D" and a good earthing point. Now carry on as set out in paragraphs 5 and 6 of Section 17, the open circuit voltage for this model regulator should lie within the following limits:-

| Regulator Temperature | Voltage Setting |
|---|---|
| 50°F (10°C) | 15.1 – 15.7 |
| 68°F (20°C) | 14.9 – 15.5 |
| 86°F (30°C) | 14.7 – 15.3 |
| 104°F (40°C) | 14.5 – 15.1 |

4 If the reading is outside the above limits, refer to Fig.10.14 and rotate the adjusting screw, which is adjacent to the "D" terminal, clockwise to increase and anti-clockwise to decrease the setting.
5 To adjust the current regulator it is necessary that the dynamo develops its full rated output and so the voltage regulator must be made imoperative, this is done by short circuiting the regulator contacts with a crocodile clip placed between the insulated fixed contact bracket and the voltage regulator frame.
6 Now disconnect the cable from terminal "B" and connect a first grade 0-14 amp moving coil ammeter between this cable and terminal "B".
7 Start the engine and run it at about 2700 rpm; the ammeter reading should be 24-26 amps. If this reading is not obtained, adjust on the centre adjusting screw depicted in Fig.10.14, screw clockwise to increase and anti-clockwise to decrease the setting.
8 Carry out a final check by stopping the engine, restarting and again running at 2700 rpm to make any further adjustment as may be necessary.
9 Remove the ammeter and restore the original connections.
10 The cut-out is adjusted in exactly the same manner as described in paragraph 10 of Section 17. It must be noted that the cut-out adjustment screw is that shown on the extreme right in Fig.10.14 adjacent to terminal "B".

## 19 Voltage and current regulator RB 340 - cleaning, checking and adjustment

1 The regulator and the cut-out relay contacts are cleaned in the same manner as the other types of regulator.
2 First check what pattern dynamo is fitted as the test methods are not the same for all types. You will find the type and serial number of the dynamo stamped on the upper part of the yoke.
3 Open circuit settings for the various types of dynamo normally used in conjunction with the RB 340 regulator are given below.

| Regulator Temperature | Voltage | |
|---|---|---|
| | C.40–C42 dynamo | C.48 dynamo |
| 10°C ( 50°F) | 14.9–15.5 | 15.0–15.6 |
| 20°C ( 68°F) | 14.7–15.3 | 14.8–15.4 |
| 30°C ( 86°F) | 14.5–15.1 | 14.6–15.2 |
| 40°C (104°F) | 14.3–14.9 | 14.4–15.0 |

4 To check the open circuit voltage (do the work as quickly as possible to avoid errors due to heating of the coil) first take off the cable from terminal "B" at the control box.
5 Connect a voltmeter between terminal "D" of the box and a good earth. It may be more convenient to take off the ignition warning light feed from terminal "WL" and to use the blade of that terminal which is electrically common with terminal "D" (see Fig.10.17).
6 Start the engine and run it at 1800 rpm for C.40L and C.48 dynamos and at 2700 rpm for C.42. Check the voltmeter which should be steady and lie between the limits quoted in paragraph 3. An insteady reading may be due to dirty contacts which should be checked and cleaned. If the reading is steady but outside limits, the regulator, all other factors being satisfactory, will have to be adjusted.
7 Remove the cover of the control box if you have not already done so and, with the engine running at the speeds quoted in paragraph 6, turn the voltage adjustments cam (Fig.10.18) until the correct setting is obtained. Clockwise rotation of the screw will increase and anti-clockwise rotation will decrease the voltage. A special tool, which engages in the serrations of the adjustment cams, is used for turning the cams and this you may be able to borrow from your local garage.
8 Check your settings by stopping the engine, re-start it and carry out a check at the speed required for your dynamo. If readings are now satisfactory, remake the original connections and refit the cover.
9 The "on load" setting for the regulator is equal to the maximum rated output of the dynamo which for the C.42 is 30 amps, for the C.48 35 amps and for the C.40L 25 amps. So, to check the "on load" setting, the dynamo must be made to develop its maximum rated output and this is done by shorting out the voltage regulator, Fig.10.19 shows a bulldog clip being used for this purpose.
10 Now withdraw the cable from terminal "B" and connect the cable to the load side of a first grade 0-40a moving coil ammeter and then connect the other side of the ammeter to one of the control box terminal blades "B". Make sure that terminal "B" carries only this one connection, all other load connections must be made to the battery side of the ammeter.
11 Switch on all lights, this will ensure that the generator does indeed develop its full output.
12 Start the engine and run it at 2700 rpm for the C.42 dynamo and at 1800 rpm for the C.40L and C.48 dynamos. Watch the

ammeter needle which should be steady and should indicate a current equal to the maximum rated output of the dynamo quoted in paragraph 9. Fluctuations of the needle in excess of ± 1 amp indicates dirty contacts which should be rectified.

13 *If readings are too high or too low, adjust on the cam until* the correct settings are obtained. Clockwise rotation of the cam will increase and anti-clockwise rotation will decrease the setting.

14 When the reading is satisfactory, switch off the engine and remake the original connections.

15 The electrical settings of the cut-out relay are:-

| | |
|---|---|
| Cut-in voltage | 12.6 – 13.4 |
| Drop-off voltage | 9.3 – 11.2 |

16 To check the above settings, connect a voltmeter between the control box terminal "D" and a good earthing point but, as in the case when adjusting the open circuit settings, terminal "WL" (Fig.10.20) may be used if desired (see paragraph 5).

17 Start the engine, switch on the headlamps and slowly increase engine speed at the same time watching the voltmeter. The voltage should rise steadily and then drop slightly at the moment the contacts close. The cut-in voltage is that which is recorded immediately before the drop back and should be within the limits given in paragraph 15. If the cut-in voltage is outside the limits quoted, adjustment is necessary.

18 Reduce the speed of the engine (dynamo) to below cut-in value, take off the cover of the control box and turn the cut-out relay adjustment cam a small amount in a clockwise direction to increase the setting and in an anti-clockwise to reduce it. Carry on adjusting and checking as instructed in paragraph 17 until the correct setting is obtained.

19 Remake the connections and replace the cover.

20 To check drop-off settings, disconnect the cable from terminal "B" at the box and connect a voltmeter between terminal "B" and earth.

20 Start the engine and run up to about 1800 rpm, slowly decelerate and observe the point at which the voltmeter suddenly records a zero reading which indicates the opening of the contacts. An adjustment must be made if the reading is outside the limits given in paragraph 15.

21 Stop the engine and remove the cover of the control box. Now very carefully bend the fixed contact bracket, reducing the gap will increase the drop-off voltage and increasing the gap will lower it.

22 Repeat the test and readjust until the correct setting is obtained. The resulting blade deflection should be in the region of 0.010 - 0.035 " (0.25 - 0.80 mm).

23 Remake the original connections and replace the cover of the box.

24 The air gap settings are accurately adjusted during manufacture and should require no further attention during the life of the control box. However, if the original settings have been disturbed they must be reset as follows.

25 To set the core gaps of the voltage and current regulators, refer to Fig.10.21 and, using a suitable tool, turn the adjustment cam (A) fully anti-clockwise and now slacken the adjustable contact locking nut and screw back the adjustment contact.

26 Taking care not to turn up or damage the copper shim, insert a 0.052 - 0.056" (1.3 - 1.4 mm) feeler gauge between the armature and the copper separation on the core face. The gauge should be inserted as far back as the two rivet heads on the underside of the armature.

27 Hold the feeler gauge in position and press down squarely on the armature, now screw in the adjustable contact until it just touches the armature contact. Retighten the locking nut and then take out the gauge.

28 Carry out the electrical setting procedure as previously described.

29 To adjust the contact "follow through" and armature-to-bobbin core gap of the cut-out relay, refer to Fig.10.22.

30 Press the armature down squarely against the copper separation on the core face.

31 Adjust the fixed contact bracket to give a "follow through" (or blade deflection) of the moving contact of 0.010 - 0.035" (0.25 - 0.89 mm). Release the armature.

32 Adjust the armature back stop to give a core gap of 0.035 - 0.045" (0.89 - 1.14 mm).

33 Now check the cut-in and drop-off voltage settings as described in paragraphs 15-23.

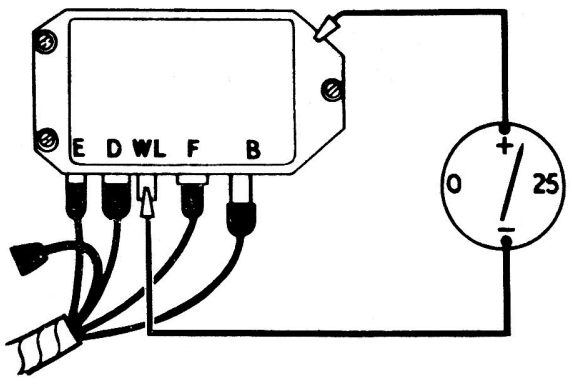



Fig.10.17. RB.340 control box. Checking open circuit setting

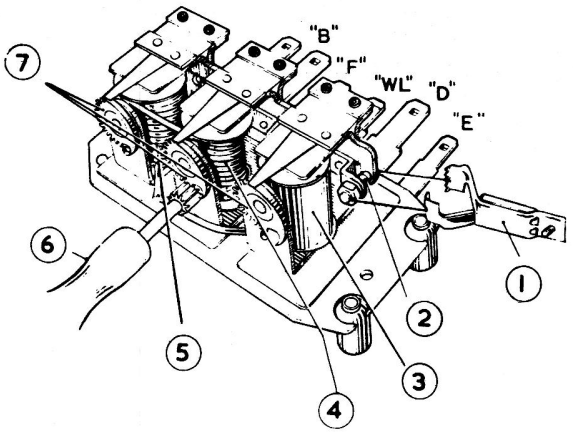



FIG.10.18. RB.340 CONTROL BOX ADJUSTING THE CAMS

1 *Bulldog clip*
2 *V.R. contacts*
3 *Voltage regulator*
4 *Current regulator*
5 *Cut-out relay*
6 *Setting tool*
7 *Adjustment cams*

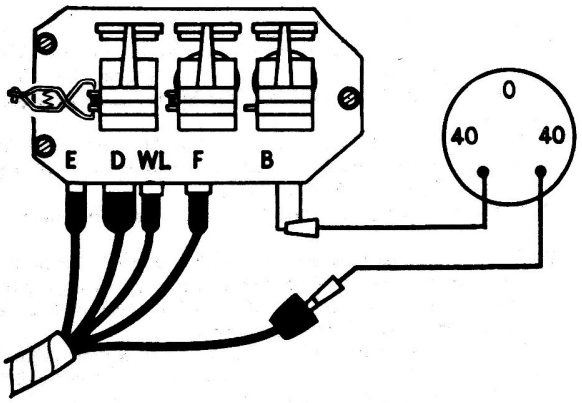



Fig.10.19. RB.340 control box. Checking the 'on-load' setting

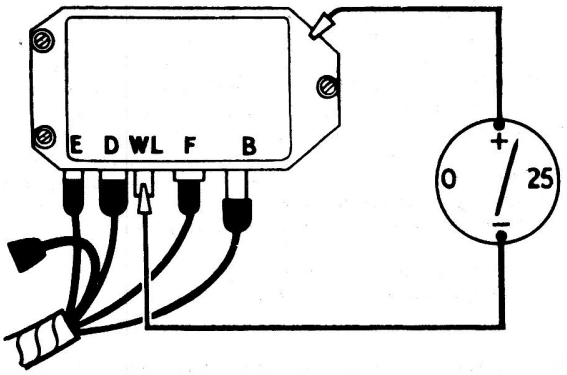



Fig.10.20. RB.340 control box. Checking the cut-in voltage

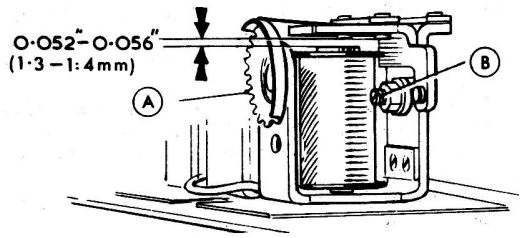



FIG.10.21. RB.340 CONTROL BOX. VOLTAGE REGULATOR GAP SETTING

*A Turn cam fully anti-clockwise* *B Slacken contact screw*

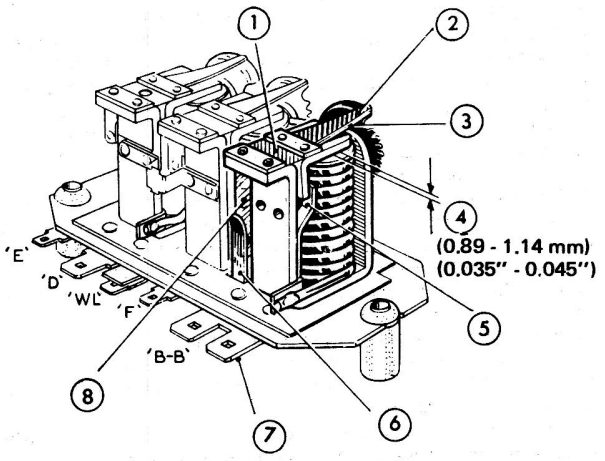



FIG.10.22. RB.340 CONTROL BOX CUT-OUT AIR GAP SETTING

*1 Hinge spring*
*2 Armature*
*3 Bi-metal backing spring*
*4 Armature to bobbin core gap*
*5 Armature back stop*
*6 Fixed contact bracket*
*7 'B-B' terminal plate*
*8 Moving contact blade*

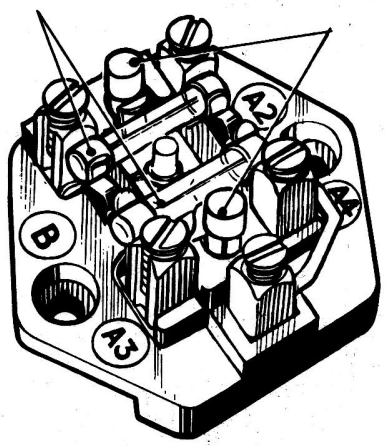



Fig.10.23. SF.6 Fuse unit

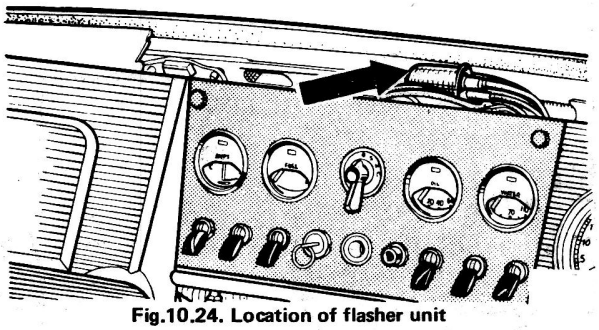


Fig.10.24. Location of flasher unit

## 20 Fuses - general

Two live glass cartridge type fuses of 35 and 50 amp capacity, and two spare fuses are carried in a Model SF6 fuse unit as illustrated in Fig 10.23.

The 35 amp fuse (B-A2) is in circuit with the interior lights, cigar lighter and headlamp flasher.

The 50 amp fuse (A3-A4) protects the circuits of the heater fan, direction indicators, braking lights, petrol gauge, overdrive solenoid, reversing light, windscreen wipers, overdrive or automatic transmission warning light, oil pressure gauge, water temperature, windscreen washer and the horns.

If either of the fuses blow due to a short circuit or similar trouble, trace and rectify the cause before fitting a new fuse. Do NOT fit a fuse of a higher capacity than that intended for the circuit it protects.

## 21 Flasher unit - general

The flasher unit is housed in a small cylindrical container and is mounted, as shown in Fig.10.24, underneath the wooden screen rail capping below the windscreen. The capping is removed by undoing the nut hidden away underneath at each end and then lifting off the assembly (see Chapter 12).

Inside the flasher unit is a switch which is operated automatically by the alternate heating and cooling of a wire. There is also a small relay to flash the switch warning light and failure of this light to flash will indicate a fault in the system.

## 22 Flasher unit - fault tracing and rectification

1 Check the bulbs for broken filaments.
2 Refer to the wiring diagram at Fig.10.25 and check all circuit connections.
3 Remove the screen rail capping by undoing the nut which will be found underneath at each end and then lift off the capping.
4 Switch on the ignition and check with a voltmeter that terminal "B" on the flasher unit is at 12 volts with respect to earth.
5 Connect terminals "B" and "L" of the flasher unit together and now operate the direction-indicator switch, if the unit operates it is defective and must be replaced.
6 If the foregoing tests prove satisfactory, it must be the switch which is at fault and this is best tested by substitution.

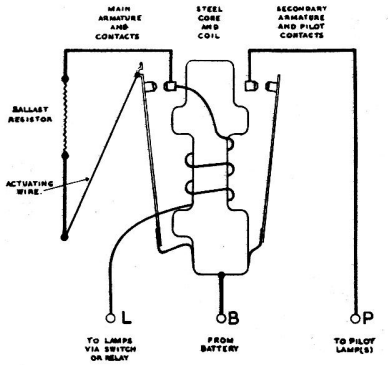



**Fig.10.25. Flasher unit wiring diagram**

## 23 Windscreen wiper mechanism - fault diagnosis and rectification

The windscreen wiper is a two speed, thermostatically protected, self parking, cable rack unit is controlled by a switch giving Park, Normal and High Speed operation. If the motor is overloaded, the resultant overheating of the windings will cause a thermostat to trip and isolate the motor from the supply. Adjustment to the self parking mechanism can be made by turning the knurled nut near the cable rack outlet (Fig.10.26). Turn only one or two serrations at a time and check. Poor operation of the wiper mechanism can be either electrical or mechanical in origin. Unless the cause of the fault is apparent proceed as follows to determine the cause of the failure.
1 Refer to Fig.10.27. Check the voltage between the supply terminal of the motor (green cable connection) and earth using a first grade moving coil voltmeter. The voltage, with the wiper working normally, should be 11.5 volts and if the supply is found to be low, check the battery, the switch (by substitution), the cabling and the connections.
2 If the voltage is correct, disconnect the cable rack at the wiper gearbox and measure the light running current with a first grade moving coil ammeter connected in the supply cable. The light running current must not exceed 3.4 amps at Normal speed and if this exceeded, fit a new motor.
3 If the electrical tests prove satisfactory check the cable rack and tubing. The maximum permissible force to move the cable rack in the tube is 16 lbs with the wiper arms, blades and motor disconnected. You can take this measurement by hooking a spring balance in the hole in the cross-head and withdrawing the rack with the balance.
4 Binding of the rack can be due to kinked or flattened tubing or, if just replaced, due to faulty installation. Badly kinked or flattened tubing must be replaced and any bends of less than 9" radius reformed.
5 Check the wheel boxes for misalignment or looseness and rectify as necessary.

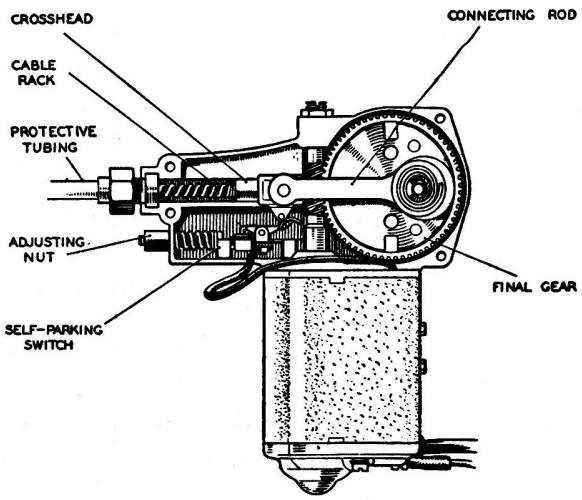



**Fig.10.26. Type DR3 windscreen wiper motor (cover plate removed)**

## 24 Windscreen wiper mechanism - removal and refitting of wiper motor and cable

1 Disconnect the battery.
2 Withdraw the wiper arms from the spindles by pressing down on the catch and pulling outwards.
3 Unscrew the large nut connecting the cable guide to the wiper motor.
4 Remove the setscrew securing the earth wire to the motor.
5 Note the position of the cable connections and then disconnect the cables at the motor.
6 Turn the road wheels to full left lock to give better access to the three nuts in the right wing valance which secure the motor to the body. Remove the nuts.
7 The wiper motor and cable can now be removed as an assembly by drawing the cable through the guide tube.
8 Refitting is the reverse of the removal procedure.

## 25 Windscreen wiper mechanism - removal and refitting of wheelbox

1 An exploded view of a wheel box is given in Fig.10.28. The wheelboxes (one per wiper) are located behind the right and left hand facia panels.
2 Disconnect the battery.
3 Unscrew the two nuts and then lift the screen rail capping off the brackets. Take care not to scratch the windscreen.
4 To remove the right hand panel, remove the dash casing from beneath the steering column by withdrawing the four screws and the two bezels of the flexible odometer and clock setting drives.
5 Detach the angle tie plate from the bottom hidden face of the facia board by removing the two nuts.
6 Take out the ignition key and the cigar lighter. Undo the two thumbscrews and fold the instrument panel downwards.
7 On cars with automatic transmission, remove the short control rod from the ball pin on the lever at the right hand side of the steering column.
8 Separate the upper and lower switch covers from the steering column.
9 Identify the snap connectors of the trafficator warning light harness, separate them and withdraw the harness.
10 Detach the steering column assembly from the body bracket by removing the two nuts and allow the rim of the steering wheel to lie on the driver's seat cushion.
11 Detach the side facia panel by removing the securing screws and nuts.

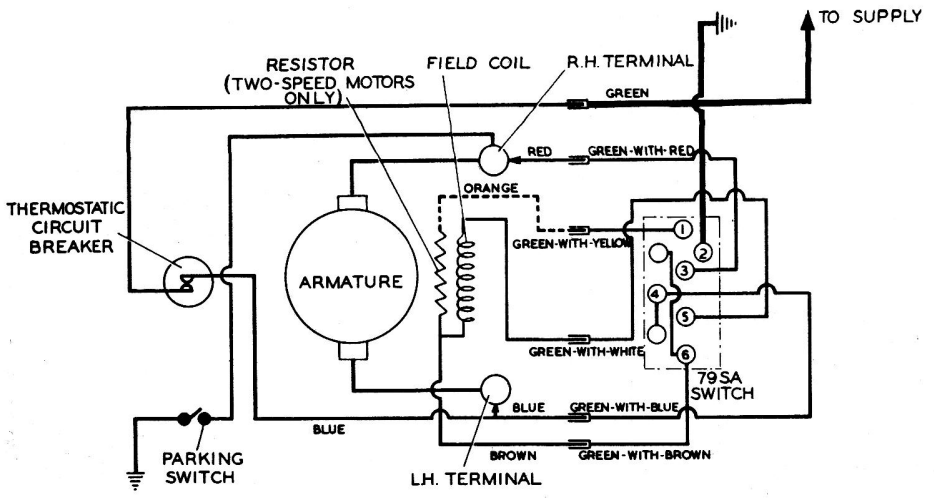



**Fig.10.27. Wiring connections - switch to wiper motor**

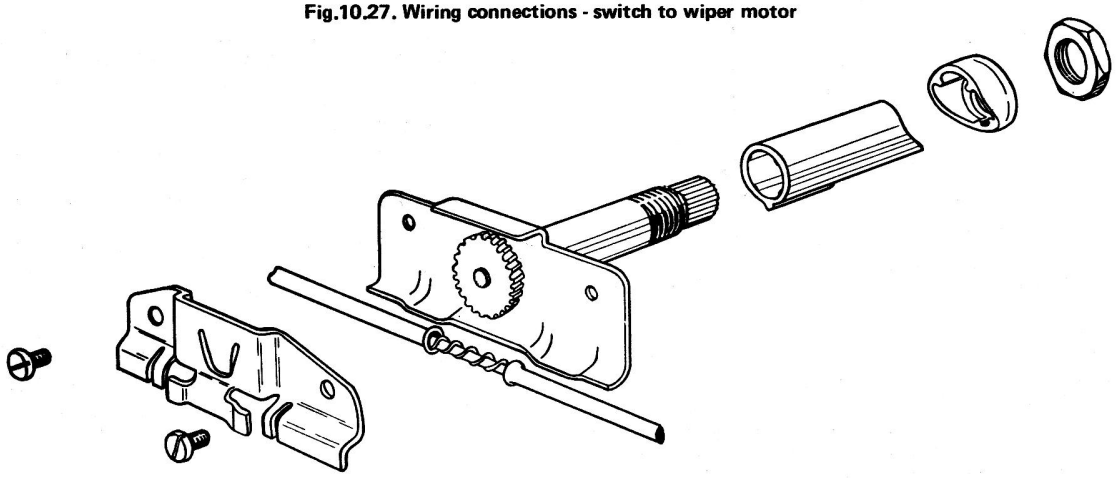


**Fig.10.28. A wheelbox**

12 Detach the speedometer drive, all warning lights and leads from the instruments and detach the flexible control cable from the carburettor mixture lever quadrant by slackening the trunnion screw.
13 The right hand side facia panel can now be lifted out.
14 To remove the left hand facia panel, remove the four screws holding the dash casing beneath the glove box.
15 Remove the two screws and serrated washers securing the glove box panel to the instrument panel.
16 Remove the detachable side panel of the glovebox adjacent to the light switch. The panel is retained in position by adhesive.
17 Remove the two nuts and washers at the rear of the glovebox which secure the steady bracket to the body.
18 Remove the two nuts securing the wooden strip along the front of the tray.
19 Disconnect the two cables from the glovebox illumination light at their snap connectors.
20 Withdraw the left hand facia panel.
21 Withdraw both wiper arms from the spindles.
22 From outside the car, remove the large nuts securing the wheelboxes to the scuttle and take off the chrome distance pieces and the rubber seals.
23 Remove the backplates from the wheelboxes by undoing the two screws.
24 Pull away the cable from the worm wheels and slide off the conduit tubing.
25 Withdraw the wheelboxes and conduits.
26 Refitting is the reverse of the above procedure but make sure that the flared end of the first wheelbox registers with the outer narrow slot in the cover plate.

## 26 Lighting equipment - removal, adjustment and refitting of components

1 To guard against accidental blowing of a fuse, it is always a wise precaution to disconnect the battery before breaking any connections which may leave you with bare cable ends.
2 Refitting of components is the reverse of the removal sequences given below.
3 To remove **non-sealed beam headlamps,** (Fig.10.29) take out the rim securing screw which will be found at the bottom of the rim and then pull out on the rim at the bottom to release it from the lipped catch at the top.
4 Press the light unit inwards against the three spring loaded adjustment screws and turn it anti-clockwise to disengage the unit from the keyhole slots.
5 Press in on the bayonet adaptor at the rear of the unit and turn anti-clockwise to remove the bulb. Note that a notch in the flange of the bulb is arranged to locate with a ridge in the bulb

holder. The light unit can now be removed.
6 Disconnect the bulb holder from the adaptor.
7 The **sealed beam headlamps**(Fig.10.30) are removed by first taking off the rim as described above and then removing the three cross headed screws to take off the headlamp retaining rim.
8 Withdraw the headlamp and unplug the adaptor at the rear of the unit.
9 Sealed beam headlamps are interchangeable with the non-sealed beam type provided they are fitted in pairs.
10 The headlamps should be set so that when the car is carrying its normal load, the driving beams are parallel with each other and with the road. However, although the headlamps can be set approximately at home, this is a job which, to get the best results, should be left to a garage having the necessary equipment for accurate alignment.
11 Vertical trimming of both types of headlamps is effected by adjustment of the top spring loaded screw whilst the two side screws are used for horizontal trimming. None of these screws should be touched when the headlamp is removed or alignment will be upset.
12 To remove the **sidelamp** (Fig 10.31), take out the screw in the top of the lamp nacelle, turn the rim clockwise and then pull forward to withdraw the lamp and bulb holder, you may find it necessary to ease the cable through the grommet under the wing in order to get enough movement on the unit to clear the nacelle. Press inwards on the bulb and turn anti-clockwise to remove it. Press the cables out of the connectors at the rear of the unit and remove it from the car.
13 The **front flasher unit** assembly (Fig.10.32) is held to the front wing by three screws and to get at these the rim of the unit must first be removed by taking out the screw at the bottom and then lifting off the rim and glass. The bulb can now be taken out. Now remove the holding screws and remove the unit from the car. Slide back the body rubber and disconnect the cables.
14 To remove the **Stop/Tail/Flasher** lamp, Figs.10.33 and 10.34, first take out the screw at the bottom of the lamp glass, lift the glass outwards and upwards from the bottom to release it. The bulbs can now be taken out.
15 A screw will be seen just above the reflector unit, remove it and then take out the screws securing the hardboard trim in the luggage compartment and remove the trim. Remove the plinth securing nut and the plinth and rubber seating gasket can now be removed, Disconnect the cables.
16 The light unit of the **fog lamp** (Figs.10.35 and 10.36) is removed by taking out the screw at the bottom of the lamp, now disengage the rim at the top and withdraw the light unit from the back shell. Ease back the earth contact and withdraw the bulb.

17 When replacing the bulb, align the groove in the bulb plate with its register in the reflector.
18 When refitting the later type fog lamp unit, be careful to ensure that the contact blade coupled to the red/yellow cable registers with the centre contact on the bulb.
19 The beam of the fog lamp is adjusted by slackening the nut of the attachment bolt, which on the later type is accessible from beneath the car, and then moving the lamp to the desired position. But, as with the headlamps, to get the full benefit from the lights it is best to have the lamps correctly aligned at a garage with the necessary equipment for the work.

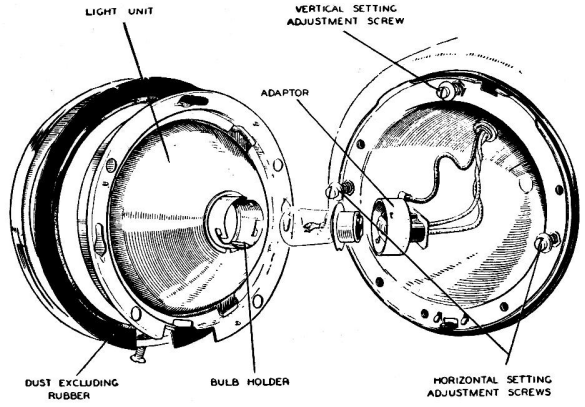



Fig.10.29. Headlamp removal (non-sealed beam)

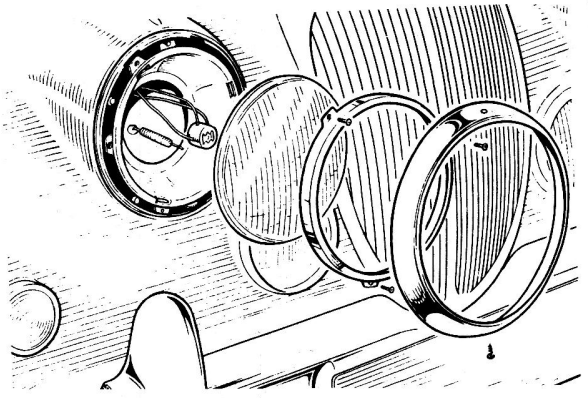


Fig.10.30. Removal of sealed beam units

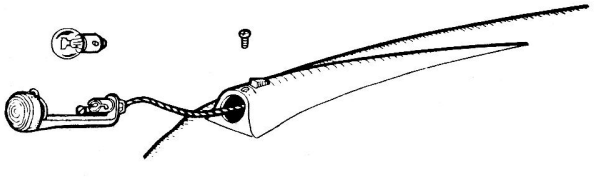


Fig.10.31. Removing a sidelamp

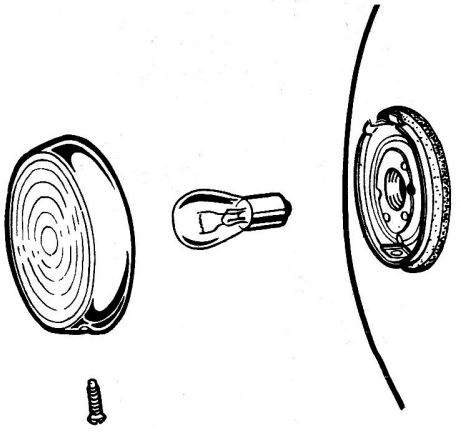


Fig.10.32. The front flasher unit

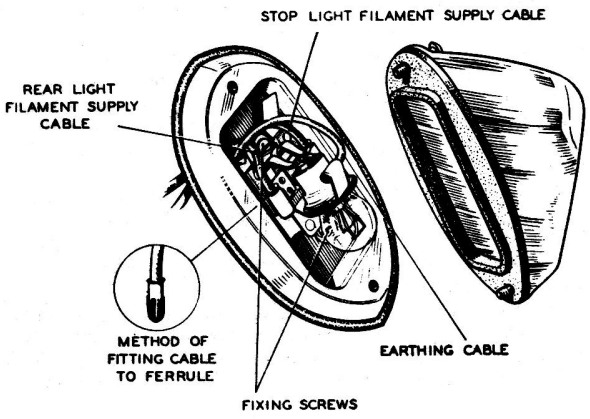



Fig.10.33. Rear/Stop/Flasher lamp unit (early models)

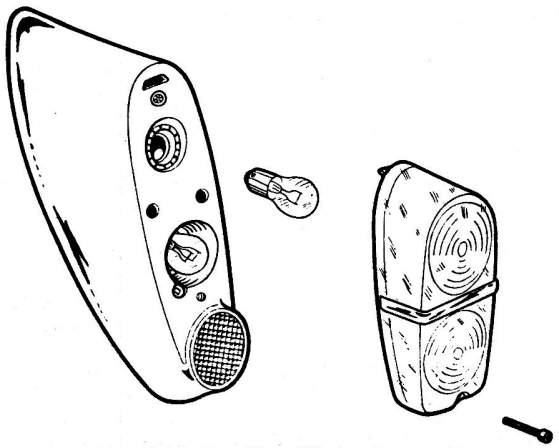


Fig.10.34. Rear/Stop/Flasher lamp unit (later models)

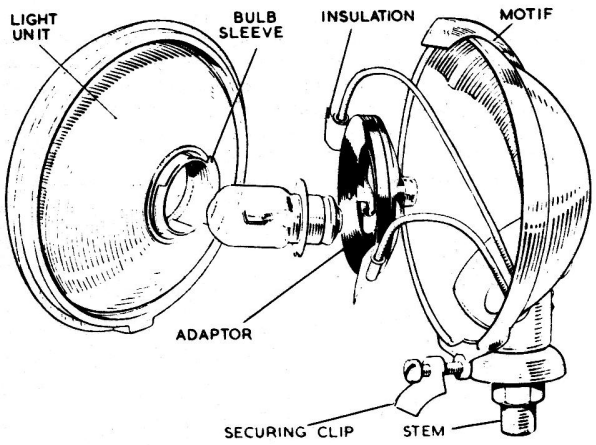



Fig.10.35. Fog lamp (early type)

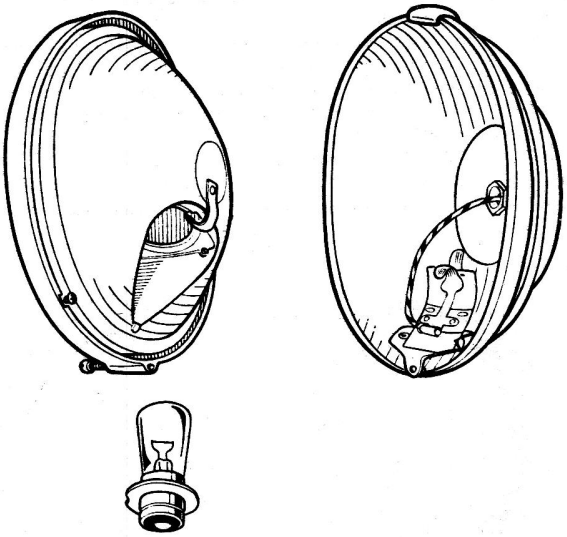


Fig.10.36. Fog lamp (later type)

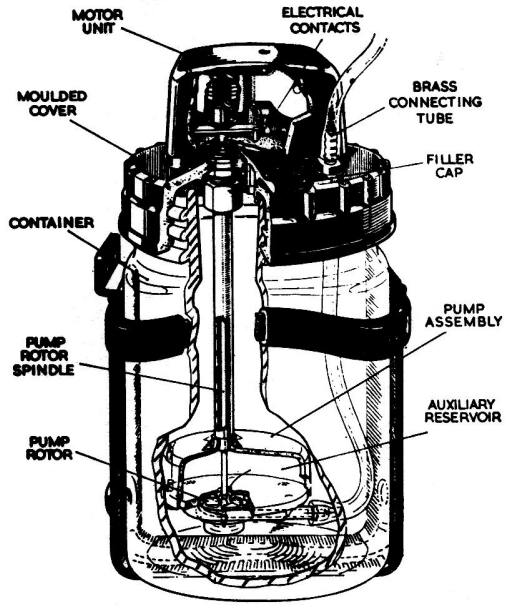



Fig.10.37. Type 5SJ windscreen washer unit

## 27 Windscreen washer (electrical) - testing in position

Early cars were fitted with a windscreen washer operating by vacuum but later models are equipped with an electrically operated Lucas 5SJ unit as illustrated in Fig.10.37. In the event of faults arising in this equipment proceed as follows.

1 Check the polarity as indicated on the moulding housing and then connect a direct current voltmeter to the motor terminals.

2 Switch on the ignition and then operate the washer switch at the same time observing the voltmeter. If a low or zero voltage is indicated, check the fuse, the switch and external connections and rectify as necessary.

3 If the voltmeter gives a reverse reading, transpose the connections to the motor.

4 If supply voltage is indicated at the terminals but the unit fails to operate, an open circuit winding or a fault in the brush gear can be suspected and the motor should be dismantled and tested as outlined in Section 28.

5 If the motor can be heard to operate but does not move freely, connect a suitable DC ammeter in series with the motor and operate the switch. If the current reading exceeds 2 amps, remove the motor and check that the pump impeller shaft rotates freely. If the shaft is difficult to turn, the water pump unit will have to be replaced. If the shaft turns freely, the fault is in the motor which will have to be dismantled for inspection.

### 28 Windscreen washer (electrical) - dismantling, testing and reassembling

1 Disconnect the external tube and the electrical connections and remove the cover from the bottle.
2 Remove the self tapping screw securing the motor to the cover and lift off the motor unit but be careful not to lose the coupling which connects the armature coupling to the pump spindle coupling. In some models it will be found that this coupling is a piece of split tube and cases have been experienced where this slips, and although the motor operates, the pump spindle is not turned. If this occurs, squeeze the tube with a pair of pliers to tighten it on the pump and armature spindles.
3 Remove the armature coupling from the armature shaft by holding the shaft with a pair of pointed pliers and, using a second pair of pliers, draw off the armature coupling.
4 Remove the screws from the bearing plate and take off the plate and the rubber gasket.
5 Take out the two screws holding the terminals and the terminal nuts and brushes can now be removed and the armature withdrawn, but take care not to lose the bearing washer which is loosely fitted to the armature shaft.
6 It is advised that you do not disturb the pole assembly unless this is absolutely necessary. If it has to be removed, take careful note of its position in relation to the motor housing. The narrower pole piece is adjacent to the terminal locations. Also take note of the position of the pole clamping member which, when fitted correctly, locates on both poles, if it is not fitted correctly pressure will be applied to one pole piece only.
7 If the motor has been overheated or if any part of the housing is damaged, there is no alternative to replacement.
8 Examine the armature, if it is damaged or if the windings are loose or badly discoloured, fit a new armature.
9 Clean the commutator with a non-fluffy cloth moistened in petrol and if it is badly discoloured, polish it with very fine glass paper.
10 Check the resistance of the armature winding using an ohmmeter. The resistance should be 2.8 - 3.1 ohms.
11 Examine the brushes, if they are less than 1/16" (1.59 mm) in length they should be replaced.
12 Reassembly of the unit is the reverse of the dismantling procedure but watch the following points:-
a) Fill the bearing recess in the motor with Rocal Molypad molybdenised grease and be sure to remove any excess from the face of the bearing boss.
b) See that the pole piece assemblies are secure and that they are firmly located on the circular spigot and are the right way round.
c) Make sure that the brushes bear firmly against the commutator.
d) Before replacing the motor on the cover, be sure that the armature coupling is pushed fully home and that the intermediate coupling is in place.

### 29 Heater fan motor and fan switch - testing, removal and refitting

1 In the event of malfunctioning of the heater fan motor, first check that current is reaching the motor by connecting a voltmeter to the input terminal and to earth. Switch on the ignition and the heater fan switch and observe the reading on the voltmeter. If there is no reading check through the connections and test the switch by substitution.
2 If current is reaching the motor and all connections are clean and in good order, the motor will have to be replaced with a new item.
3 The heater unit must be removed in order to take off the motor and full instructions for this work will be found in Chapter 12.
4 Having removed the heater unit, unscrew the nut holding the fan on the motor spindle and withdraw the fan.
5 Remove the three setscrews and plain washers holding the fan motor to the case assembly and then take off the rubber washers which will be found under the plain washers.
6 Lift off the motor and collect the three rubber washers which were over the setscrews and between the motor flange and the case assembly. Remove the earth wire fitted under one of the securing setscrews and then take off the felt washer from the motor spindle.
7 Refitment of the motor is the reverse of the removal sequence.
8 If the fault lies in the switch, first disconnect the battery.
9 Remove the two thumb screws which secure the instrument panel and fold the panel downwards after removing the cigar lighter and the ignition key.
10 Note the location of the cable connections to the three Lucar tags at the back of the switch and then pull off the cables.
11 Unscrew the chrome bezel which holds the switch to the instrument panel taking care, of course, not to scratch the panel.
12 Remove the switch from the rear of the panel.
13 Refitting the fan switch is the reverse of the above removal procedure.

### 30 Horns and horn relay - fault tracing and rectification

Mk 1 and early Mk 2 cars are fitted with one high and one low note model HF 1748 horns, later Mk 2 cars have model WT 618 U and the latest are equipped with model 9H. The horns are mounted at the front end of the car on either side of the engine compartment immediately below the radiator. The model 9H horn circuit operates through a Lucas 6RA relay which is mounted on the left hand wing valance adjacent to the fuse block. Model HF 1748 and WT 618 U horns can be adjusted whilst installed on the car but model 9H horns will have to be removed for adjustment.
1 In the event of a horn failing to sound or its performance becoming unsatisfactory, make sure that the fault is not due to external causes before making any adjustments. The most common faults likely to be experienced are :-
a) Battery condition
b) Loose or broken connections in the horn circuit. This can be checked by using a voltmeter or test lamp.
c) Loose fixing bolts on horn mounting bracket.
d) Faulty relay. First check that current is available at the terminal carrying the brown/blue cable and atthe terminal to which the green cable is connected.
e) Make sure that the fuses have not blown.
f) We have has experience of the horn slip ring on the inner steering column (see Chapter 11) being worn through due to a broken spring contact. This was an extreme case but is quoted as an illustration of thenecessity for thorough checking before suspecting faults in the horn itself.
2 A **Model HF 1748** horn in correct adjustment will pass 3.5 to 4 amps. Adjustment must be effected with the ignition switched "ON" and the horn push (ring) depressed and using a 0-10 amp moving coil ammeter. Turn the horn adjustment screw (Fig.10.38) clockwise to increase the current and anti-clockwise to decrease it. Adjustment does not alter the note of the horn but takes up wear in the moving parts which, if not corrected, will result in loss of power and roughness in tone.
3 To adjust the **Model WT 618 U** horn (Fig.10.39) first remove the domed cover by taking out the centre screw. Connect a 0-20 amp first grade ammeter in series with the horn and then slacken the locknut to the contact. Now switch on the ignition and operate the horn push (ring) and adjust the contact to give 13.5 to 15.5 amps at 12 volts. Retighten the locknut and refit the dome.
4 The **Model 9H** horn must be removed from the car for adjustment. A small serrated adjustment screw, "A" in Fig.10.40, is provided to take up wear only, alteration of its position will not affect the pitch of the note. The screw "B", the centre slotted core must on no account be disturbed.
5 Connect a 0-25 moving coil ammeter in series with the horn supply feed and protect the ammeter from overload by connecting an ON-OFF switch in parallel with its terminals, keep the

switch "ON" whilst taking readings.
6 Turn the adjustment screw "A" anti-clockwise until the horn just fails to sound and then slowly turn it clockwise until the horn operates within the limits of 6.5 - 7.0 amperes.
7 Model 9H horns can be fitted as replacements for the other types provided that the cable connections are changed for Lucar tags. When fitting replacement horns, make sure that the lock-washers are correctly positioned one each side of the mounting bracket and ensure that the 5/16" centre fixing bolt is secure but not overtight; overtightening of this bolt will damage the horn. If you use a centre fixing bolt or other than the correct type, the bolt must nonot be screwed into the horn to a depth greater than 11/16" (17.5 mm).
8 If the **horn relay** is not heard to operate when the horn push or ring is operated with the ignition switched "ON" it can be suspected of being faulty but first make sure that the fuses have not blown.
9 Check with a test lamp that current is present, with the ignition switched "ON", at the terminal carrying the green cable. Check also that the terminal carrying the brown/purple cable is live.
10 Remove the purple/black cable and earth the terminal to a clean part of the frame. The relay coil should now operate and the contacts should be heard to close. Reconnect the cable.
11 Failure of the above tests means that the relay is faulty and must be replaced.

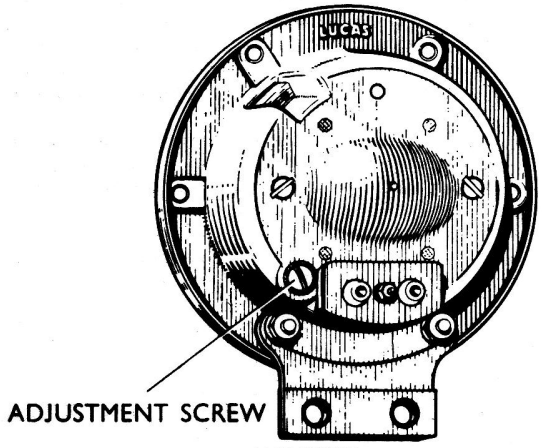



**Fig.10.38. Model HF.1748 horn**

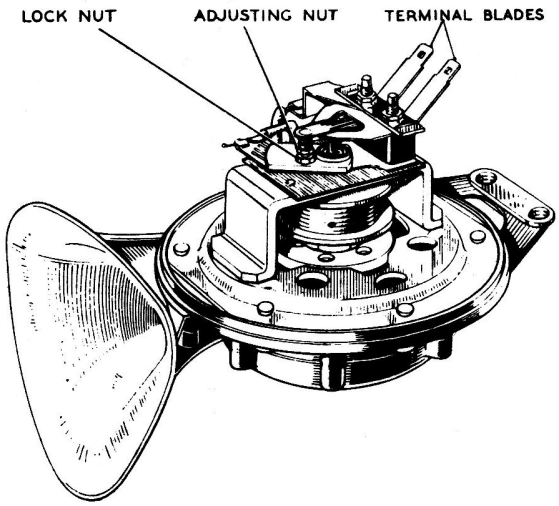



**Fig.10.39. Model WT.618.U horn (domed cover removed)**

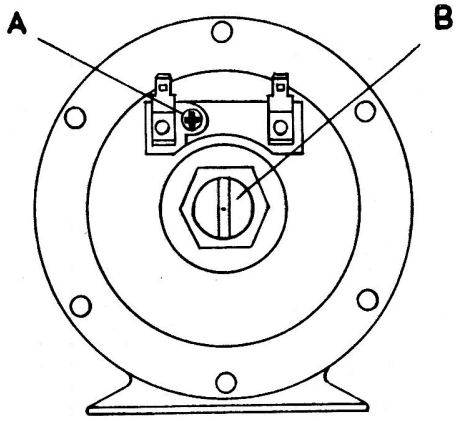



**Fig.10.40. Model 9H horn**

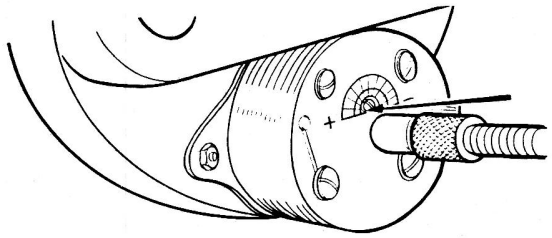


**Fig.10.41. Clock adjusting screw**

## 31 Electric clock - removal and adjustment

1 Both the speedometer and the revolution counter must first be removed and instructions for this are given in Sections 36 and 37.
2 Detach the clock from the hidden face of the revolution counter by taking off the two nuts. Take the flexible setting drive off the clock by undoing the knurled sleeve.
3 If the clock needs adjustment refer to Fig.10.41 and turn the small screw towards the minus sign if the clock is gaining and towards the plus sign if losing. The action of setting the hands automatically starts the clock.

## 32 Miscellaneous interior equipment and indicator lights - replacement of bulbs

1 The **brake fluid and handbrake warning** light bulb is replaced by unscrewing the bezel of the lamp taking care to control the run of the spring loaded bulb. Take out the bulb and feed the replacement into the spring loaded bulb holder, make sure that the red transparent window is retained in the bezel by a small circlip, position the designation plate on the bulb holder and then screw on the bezel. The bulb holder itself can be removed after taking out the bulb and removing the side facia panel.
2 To replace the **carburettor mixture control warning light** (if fitted), take out the four screws followed by the two bezels of the odometer and clock setting drives and remove the dash casing beneath the steering column. Pull off the bulb holder from the rear of the light unit above the lever quadrant. Replace the bulb and the other components in the reverse sequence to the foregoing. The lamp unit itself can be removed after removal of the bulb by unscrewing the body of the unit and withdrawing the red transparent window from the front face of the facia board.
3 To adjust the **carburettor mixture control warning light switch,** remove the dash casing from underneath the steering column as described above. Set the mixture control lever ¼" (6.350 mm) from the bottom limit of its travel, adjust on the nuts on the threaded shank of the switch until the light goes out

when the ignition is switched "ON". Tighten the nuts and actuate the lever a few times to make any final adjustment as may be necessary. Refit items in the reverse order to that in which they were removed.

4 The **overdrive and intermediate speed hold switches** are removed by first taking off the dash casing beneath the steering column in the manner described in paragraph 2. Disconnect the battery. Remove the switches from the hidden face of the instrument facia by rotating the screwed ring anti-clockwise. Collect the escutcheon plate. Refit the switches in the reverse order.

5 The **flashing indicator control** is removed by first disconnecting the battery as a precautionary measure. Remove the screws and take off the upper and lower switch covers from around the steering column. Take off the dash casing from underneath the steering column as described in paragraph 2. Disconnect the seven cable harness at the snap connectors on the left hand side of the steering column after making sure that you are conversant with the location of cables for refitment. Take out the two horizontally positioned screws at the right hand side of the control lever and then lift off the lever. Refitting is the reverse of the foregoing.

6 To replace the **flashing indicator warning light** bulbs, remove the screws securing the upper cover around the steering column. Withdraw one, or both, bulb holders from the sockets in the upper cover and remove the bulb from the holder by pressing inwards and rotating 90° in either direction. The bulb is replaced by inserting the cap into the bulb holder and then rotating it 90° until the notches inside the bulb holder are located. Replace all items in the reverse order to the foregoing.

7 The **map light** bulb which is located in the centre forward part of the screen capping, is removed by pressing inwards and then rotating in either direction until the bayonet cap becomes free and is replaced in the reverse manner. If the map lamp unit is to be removed it will be necessary to take off the screen capping by undoing the two hidden nuts at each end (see Chapter 12) and then lifting it off the brackets, watch that you do not mark the windscreen. The lamp unit is attached to the capping by two screws, identify the leads to the unit and then take out the two screws and remove it. The lamp unit is refitted in the reverse order to that in which it was removed.

## 33 Revolution counter AC generator, if fitted - testing

1 In the event of malfunctioning of the revolution counter, first check the leads and connections from the generator, which is located at the rear of the right hand camshaft, to the hidden face of the instrument in the car.

2 If the leads and connections appear to be satisfactory, detach the leads from the terminals at the generator and then connect an AC voltmeter across the terminals.

3 Start the engine and observe the voltmeter, as a rough guide the output of the generator is about one volt per 100 rpm. If the output is satisfactory, it is the instrument which is at fault and this will have to be removed and replaced as described in Section 37.

4 If there is no output from the generator or if the output is low or fluctuating, the generator will have to be replaced. Instructions for the removal and refitment of the AC generator are given in Chapter 1.

## 34 The instrument panel - removal and refitting

1 Disconnect the battery.

2 Paragraphs 3-15 (inclusive) cover the work for Mk 1 models.

3 For Mk 1 cars, first remove the dash casing by removing the scuttle vent lever knob and then taking out all the screws from the casing which can now be drawn downwards.

4 Refer to Fig.10.42 and take off the facia panel by removing the thumb screws (A) and the cigar lighter (B). Now depress the plunger in the side of the light switch (C) and withdraw the lever and repeat this for the wiper switch knob (D). Take out the ashtray (E) and working from underneath, remove the two screws (H). The panel can now be removed by sliding it over the remaining switches.

5 Partially drain the radiator and then unscrew the water temperature gauge bulb from the inlet manifold water jacket by holding the flats on the bulb and unscrewing the union nut.

6 Remove the grommet at the rear of the engine compartment through which the oil gauge pipe and the water temperature capillary tube pass.

7 Release the capillary tube from its clips taking care not to bend the tube.

8 Now refer to Fig.10.43 which shows the instrument panel with the centre facia removed.

9 Remove the two screws which secure the clock adjuster cable on the cowl adjacent to the left hand heater door.

10 Mark the position of the three instrument panel securing bolts and then remove them.

11 Ease the panel forward taking care not to strain the water temperature gauge capillary tube, and then unscrew the flexible cable unions to the revolution counter and the speedometer.

12 Working from above, unscrew the pipe connection to the oil pressure gauge.

13 Identify the electric leads to the various services and disconnect them.

14 Ease the panel forward into the car at the same time having an assistant to watch that the capillary tube does not foul any projection and is not kinked whilst being withdrawn through the bulkhead.

15 Having removed the panel it is advisable to immediately remove the water temperature/oil pressure gauge to prevent damage to the capillary tube. The gauge is removed by undoing the two securing screws and withdrawing the gauge forward out of the panel.

16 The following paragraphs cover the removal of the instrument panel from the Mk 2 and later model cars.

17 Remove the ignition key and the cigar lighter.

18 Undo the thumb screws at the top of the panel and then hinge the panel downwards (Fig.10.44).

19 Examine the electrical connections closely and, after identification, disconnect them from the various services.

20 Remove the electrical harness and clips from the panel posts by withdrawing one screw from each and now remove the harness clip and screw from each hinge inside the panel aperture.

21 Working from beneath the panel and above the "newspaper" tray, take out the two bolts from the extended portion of each hinge.

22 The panel can now be lifted out.

23 Refitting is the reverse of the above removal sequences but extreme care must be taken when installing the panel on Mk 1 models to ensure that the capillary tube is not damaged in any way; to this end we suggest that the water temperature/oil pressure gauge is refitted to the panel after the panel has been installed. In each case be sure, by reference to the wiring diagram, that electric leads are refitted in accordance with the colour coding.

## 35 The instrument panel components - removal and refitting

The following work can be done without removing the instrument panel from the car but first disconnect the battery and then, for Mk 1 cars, remove the centre facia and the panel securing bolts in the manner described in paragraphs 3 - 11 of Section 34 so that the panel can be eased forward. For Mk 2 and later models, remove the ignition key and take out the cigar lighter and then remove the two thumb screws at the top of the instrument panel and hinge the panel downwards.

Refitment of each item is generally the reverse of the order in which it was removed but be certain, by reference to the appropriate wiring diagram, that leads are replaced correctly according to their colour coding.

1 The **ignition switch** on Mk 1 cars is removed by undoing the locking ring securing it to the panel and then pushing the switch

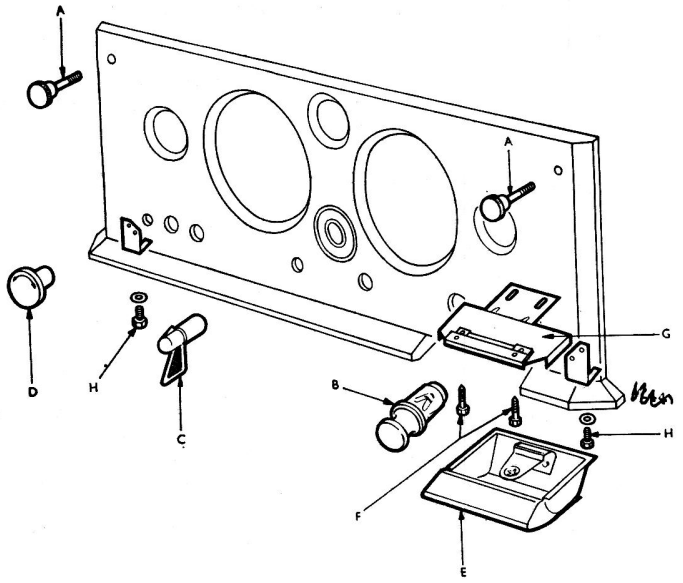



Fig.10.42. Removal of the centre facia panel (Mk.1 models)

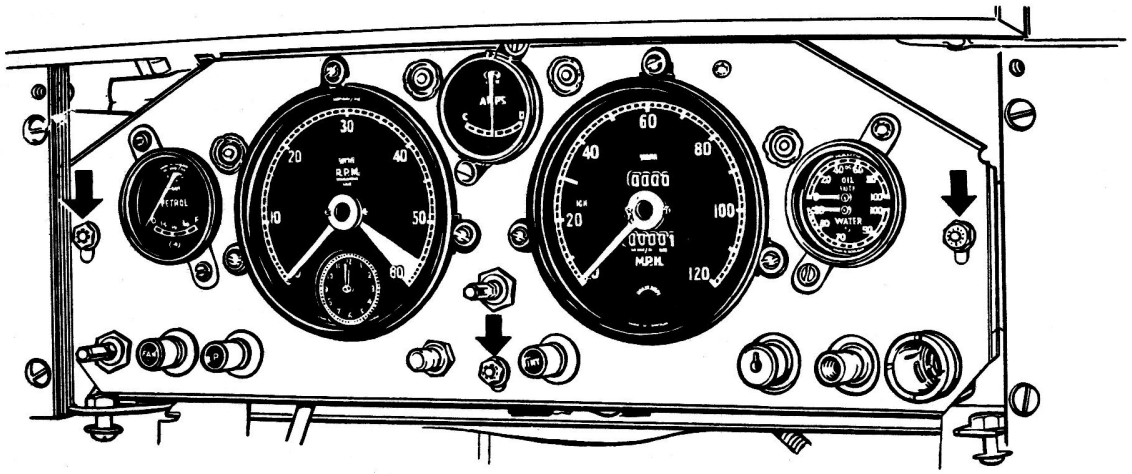



Fig.10.43. Instrument panel Mk.1 models (centre facia panel removed)

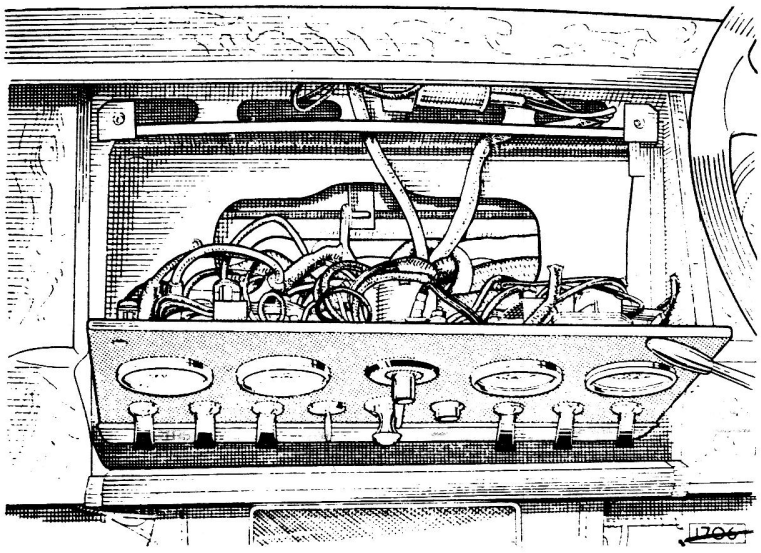


Fig.10.44. Instrument panel, later type, hinged down

out to the rear of the panel. The leads can now be identified and then disconnected.

2 The ignition switch of Mk 2 models is removed by first identifying and then removing the leads. Now unscrew the chrome ring and take out the switch by inserting a piece of wire through the hole in its body.

3 Faults in the **cigar lighter** will most probably be due to failure of the element and to change this, hold the unit in the palm of the hand, knob first, and pull the sleeve down against the pressure of the spring. Unscrew the lighter element and fit the replacement. The lighter unit is removed from the panel by detaching the leads and taking off the nut and "U" piece from the centre terminal post after which the unit can be withdrawn from the front face of the panel. When refitting, make sure that the terminal post is firm and tight and that the insulating washer in the "U" piece is also tight and is in good condition. A poorly fitting washer or a washer in poor condition can cause a direct short.

4 To remove the **starter push switch** from Mk 1 models, take off the nut at the front of the panel, push the switch out through the back of the panel and take off the leads. For Mk 2 and later model cars, first remove the leads from the switch, remove the nut from the hidden face and withdraw the switch from the front of the panel.

5 The **head, side and fog light switch** is removed by first depressing the small plunger at the right hand side of the switch operating lever and then pulling the lever off the spindle, this work has already been done in the case of Mk 1 cars when the centre facia panel was removed. Now, for Mk 1 cars, remove the nut at the front of the panel and push the switch to the rear, disconnect the leads and remove the switch. For Mk 2 cars, disconnect the leads, remove the nuts from the posts holding the switch and withdraw the switch from the front of the panel. The designation plate is attached to the centre facia panel on Mk 1 cars but for Mk 2 models it is attached to the instrument panel by a nut. When refitting the control lever in each case make sure that it is pressed far enough on to the spindle for the plunger to engage the drilling in the side of the lever, a smear of vaseline on the spindle may help.

6 The **tumbler type switches** of Mk 2 cars are removed by first detaching the leads and then, holding the switch lever in the horizontal position, unscrew the chrome ring at the front of the panel and withdraw the switch. The switches on Mk 1 cars are removed by undoing the nut or locking ring securing the switch to the panel and then push the switch out to the rear of the panel and detach the leads.

7 The **ammeter and fuel gauges** fitted to Mk 1 cars are removed by undoing the two securing screws and then pulling the gauge forward into the car so that the leads can be detached. These gauges fitted to Mk 2 cars are attached to the panel by means of knurled finger nuts passing through a "U" piece. Detach the leads from the back of the gauges, undo the finger nuts and press the gauge out from the back of the panel. When refitting the gauges to Mk 2 models, make sure that the "U" piece does not foul any terminal or bulb holder.

8 To remove the **oil pressure and water temperature gauges** from Mk 2 cars, in which they are separate items, proceed in the manner described in paragraph 7 for the ammeter and fuel gauge. The oil pressure and water temperature indication is given by a combined gauge in Mk 1 cars and to remove it first partially drain the radiator and then remove the temperature gauge bulb from the inlet manifold water jacket by holding the flats on the bulb and unscrewing the union nut. Now remove the grommet on the bulkhead at the rear of the engine compartment through which the water temperature capillary tube and the oil gauge pipe pass. Remove the capillary tube from the various securing clips taking care not to bend it. Unscrew the union nut holding the oil pressure pipe to the rear of the gauge. Remove the two screws securing the gauge to the panel and now withdraw the gauge from the front of the panel taking care not to bend the capillary tube and at the same time have an assistant to watch that the tube does not become caught up and to help guide it through the bulkhead.

9 The **voltage regulator** for the fuel and water temperature gauges, fitted to Mk 2 and later model cars only, is situated at the top right hand side of the panel and is removed by detaching the leads and by taking off the one securing nut. Make certain that a good earth is made between the regulator and the panel when you are refitting it.

10 The **instrument illumination bulbs** are housed in holders at the back of each instrument. Pull off the holder and then remove the bulb by turning it anti-clockwise.

11 Removal of the **speedometer** and the **revolution counter** from the instrument panel of Mk 1 cars is covered in Sections 36 and 37.

## 36 Speedometer and speedometer drive cable - removal and refitting

1 Disconnect the battery.

2 The following paragraphs 3-9 (inclusive) cover the removal of the instrument from Mk 1 cars.

3 Remove the dash casing, the centre facia panel and the instrument panel, to the extent of being able to pull it forward for access, in the manner described in Section 34 paragraphs 3 11 inclusive.

4 Unscrew the pipe connection from the rear of the oil pressure gauge.

5 Unscrew the union nut attaching the flexible drive to the rear of the instrument.

6 Withdraw the two warning light bulb holders from the rear of the instrument.

7 Remove the three screws securing the speedometer to the panel and remove the instrument from the front of the panel.

8 Unscrew the speedometer cable drive connection at the gearbox or overdrive, as applicable, and detach the cable from the retaining clips.

9 Remove the grommet from the bulkhead at the rear of the engine compartment through which the cable passes and then withdraw the cable.

10 The following paragraphs refer to removal of the speedometer from Mk 2 and later model cars.

11 Remove the dash casing from beneath the side facia panel by taking out the four screws and the two bezels from the odometer and clock setting drives.

12 Working from underneath, remove the knurled sleeve securing the flexible drive to the instrument.

13 Detach the electrical leads from the back of the speedometer after identifying their location for correct refitment.

14 Remove the two knurled securing nuts and then withdraw the instrument from the front of the facia board.

15 Remove the flexible drive cable in the manner described in paragraphs 8 and 9 above.

16 The inner flex of the drive cable can be removed, after removing the instrument, with the outer casing in situ. However, if the inner flex is broken, it will be necessary to disconnect the outer casing at the gearbox and to then withdraw the inner flex from both ends.

17 Refitting of the speedometer is the reverse of the removal operations in both cases but as the correct performance of the instrument depends to a very great extent on the serviceability of the drive cable and its connections, parhicular attention should be paid to the following points:—

a) The run of the flexible drive must be smooth with a minimum bend radius of 6" and with no bend within 2" of any securing point. Change the position of clips to meet that requirement if it is necessary.

b) Clip the drive at suitable points, do not allow it to flap freely.

c) Avoid crushing the outer casing by overtightening on a clip.

d) The outer flex connections should be finger tight only.

e) The flexible drive should be lubricated periodically (10,000 miles servicing).

f) The inner flex must protrude 3/8" beyond the outer case as shown in Fig.10.45.

**Note** Speedometer needle waver, a common fault, can be caused

by lack of lubrication of the inner cable, kinked cable, crushed outer case, connections overtightened, severe bends in the cable, insufficient engagement of the inner cable (Fig.10.45) etc.

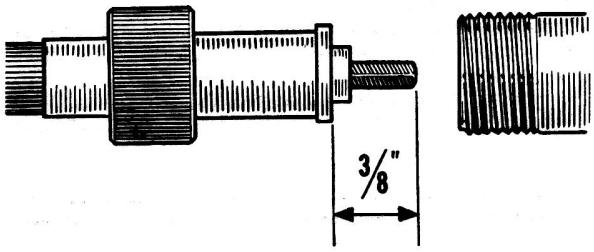



Fig.10.45. Engagement of inner flex of speedometer drive cable

## 37 The revolution counter - removal and refitting

1 Disconnect the battery.
2 The following paragraphs 3-8 (inclusive) cover the removal of the instrument from Mk 1 cars.
3 Remove the dash casing, the centre facia panel and the instrument panel, to the extent of being able to pull it forward for access, in the manner described in Section 34 paragraphs 3-11 inclusive.
4 Unscrew the pipe connection from the rear of the oil pressure gauge.
5 Unscrew the flexible cable (if fitted) from the rear of the instrument.
6 Disconnect the cables from the electric clock and, if applicable, from the instrument.
7 Remove the three screws securing the revolution counter to the panel and withdraw it from the front of the panel.
8 Disconnect the flexible drive (if fitted) by undoing the union at the camshaft drive, remove the grommet from the engine bulkhead and withdraw the drive.
9 The following paragraphs refer to the removal of the revolution counter from Mk 2 and later cars.
10 To improve access, remove the speedometer as described in the previous Section.
11 Remove the illumination lamps from the back face of the instrument and from the clock.
12 Detach the two centre leads and the earth lead.
13 Take off the two knurled nuts and then withdraw the instrument from the front of the facia.
14 Remove the clock as described in Section 31.
15 Refitting in both cases is the reverse of the removal procedure but the attention of owners, of those cars fitted with a flexible drive to the counter, is drawn to paragraph 17 of Section 36.

## 38 The bi-metal resistance instrumentation - fault finding

The engine temperature, engine oil pressure and petrol tank contents gauges fitted to later model cars are operated by transmitters mounted on the engine or in the fuel tank. The gauge units operate on the thermal principle having a heater winding wound on a bi-metal strip. The transmitter units of the engine temperature and petrol tank contents gauge are of the resistance type whilst the oil pressure transmitter is of the thermal pressure principle also with a heater winding wound on a bi-metal strip but having a contact at one end with a second contact mounted on a diaphragm sensitive to the pressure of the oil. Wiring diagrams for these systems are given in Figs.10.46, 10.47, 10.48 and 10.49.

The possible cause of faults, as indicated by gauge readings, is given in the following charts.

## 39 Wiring diagrams - colour coding

Wiring diagrams for the various models are given in Figs.10.50, 10.51, 10.52 and 10.53. The cable colour code used in these diagrams is given below.

Note: When a cable is shown as having two colour code letters, the first letter denotes the main colour and the second denotes the tracer colour.

| | | |
|---|---|---|
| B Black | P Purple | Y Yellow |
| U Blue | G Green | D Dark |
| N Brown | S Slate | L Light |
| R Red | W White | M Medium |
| K Pink | | |

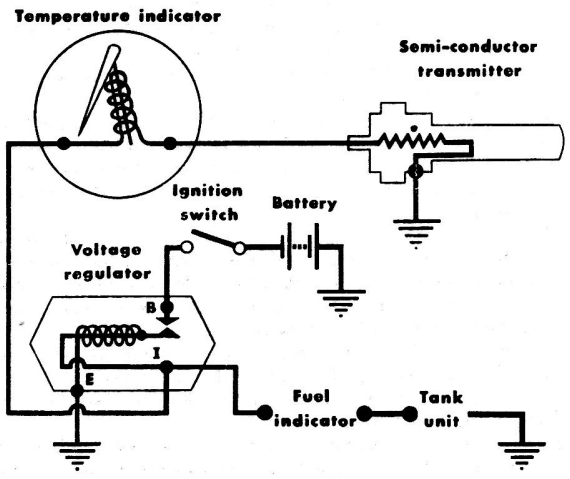



Fig.10.46. Wiring diagram of the fuel tank contents and water temperature gauges with the voltage regulator

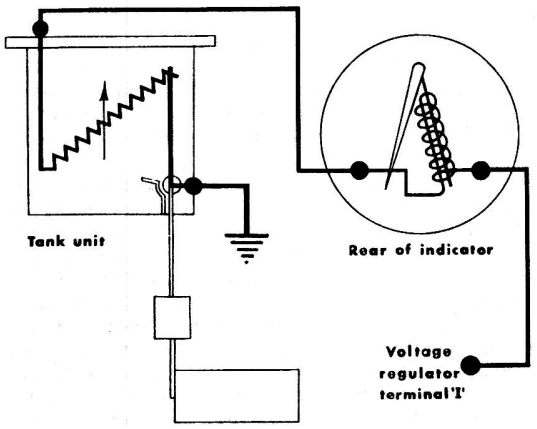



Fig.10.47. The fuel tank contents gauge circuit

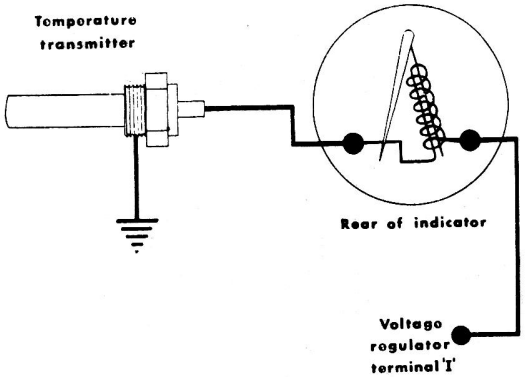



Fig.10.48. The water temperature gauge circuit

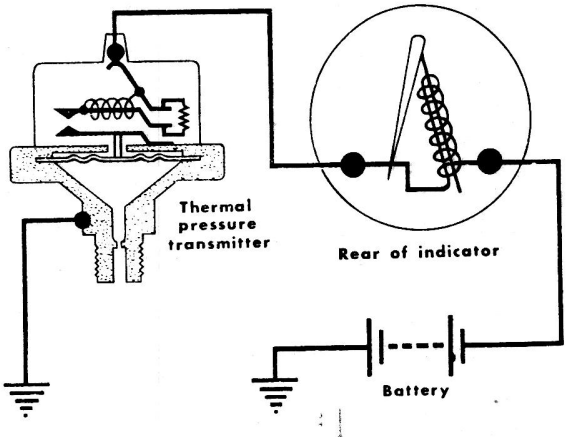
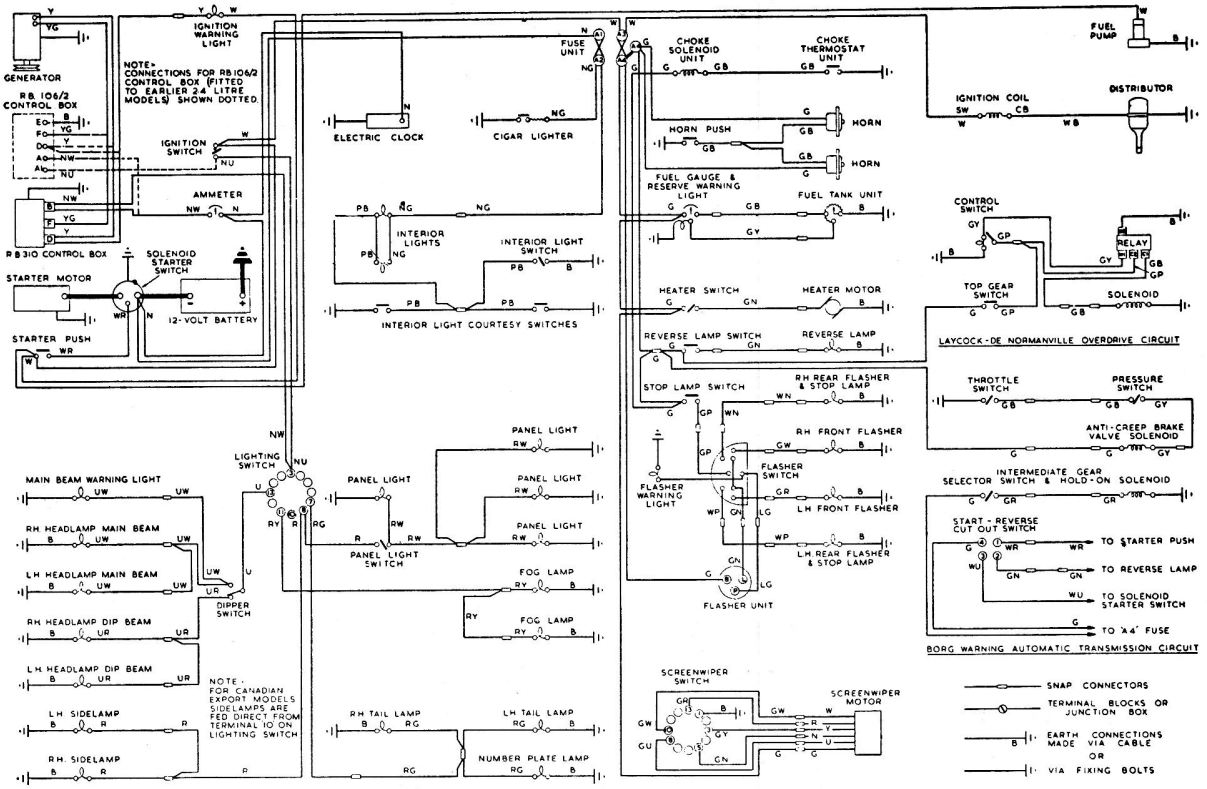



Fig.10.49. The engine oil pressure gauge circuit




**CABLE COLOUR CODE**

| | | | | | |
|---|---|---|---|---|---|
| B | BLACK | P | PURPLE | Y | YELLOW |
| U | BLUE | G | GREEN | D | DARK |
| N | BROWN | S | SLATE | L | LIGHT |
| R | RED | W | WHITE | M | MEDIUM |

When a cable has two colour code letters, the first denotes the main colour and the second denotes the tracer colour.

Fig.10.50. Wiring diagram for 2.4 and 3.4 litre Mk.1 models

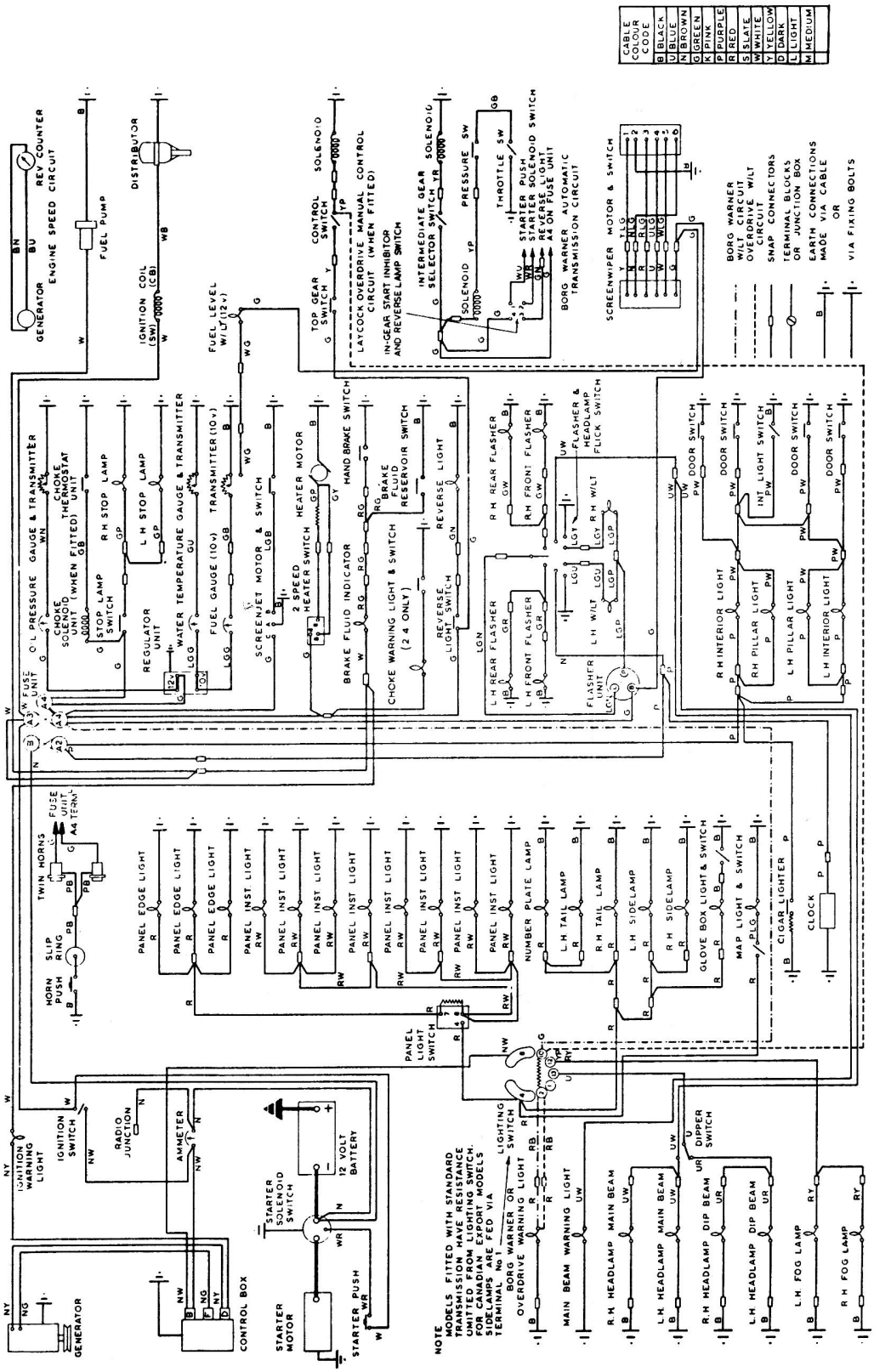



**Fig.10.51. Wiring diagram for the 2.4, 3.4 and 3.8 litre Mk.2 right hand drive models**

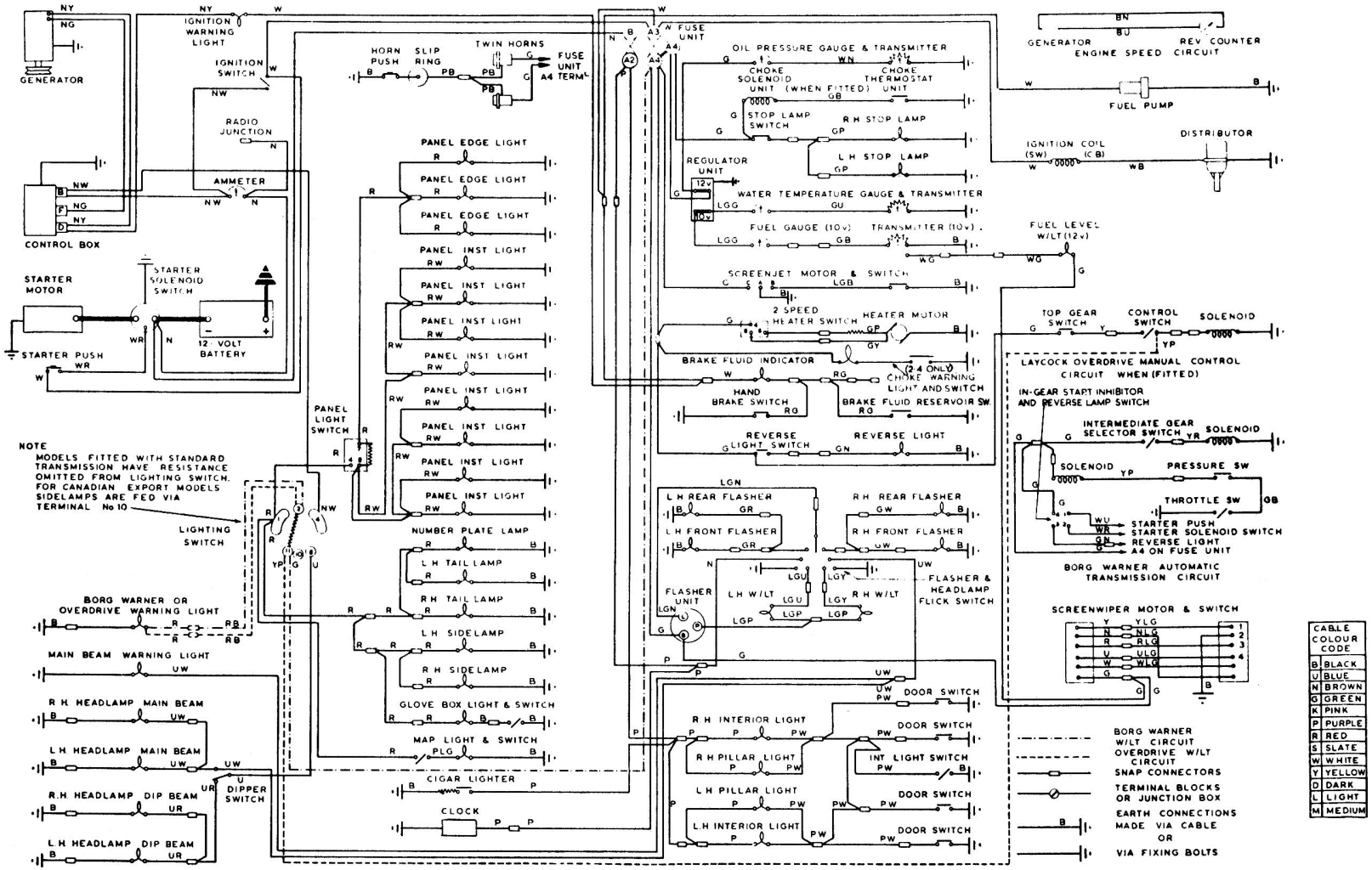



**Fig.10.52. Wiring diagram for the 2.4, 3.4 and 3.8 litre Mk.2 left hand drive models**

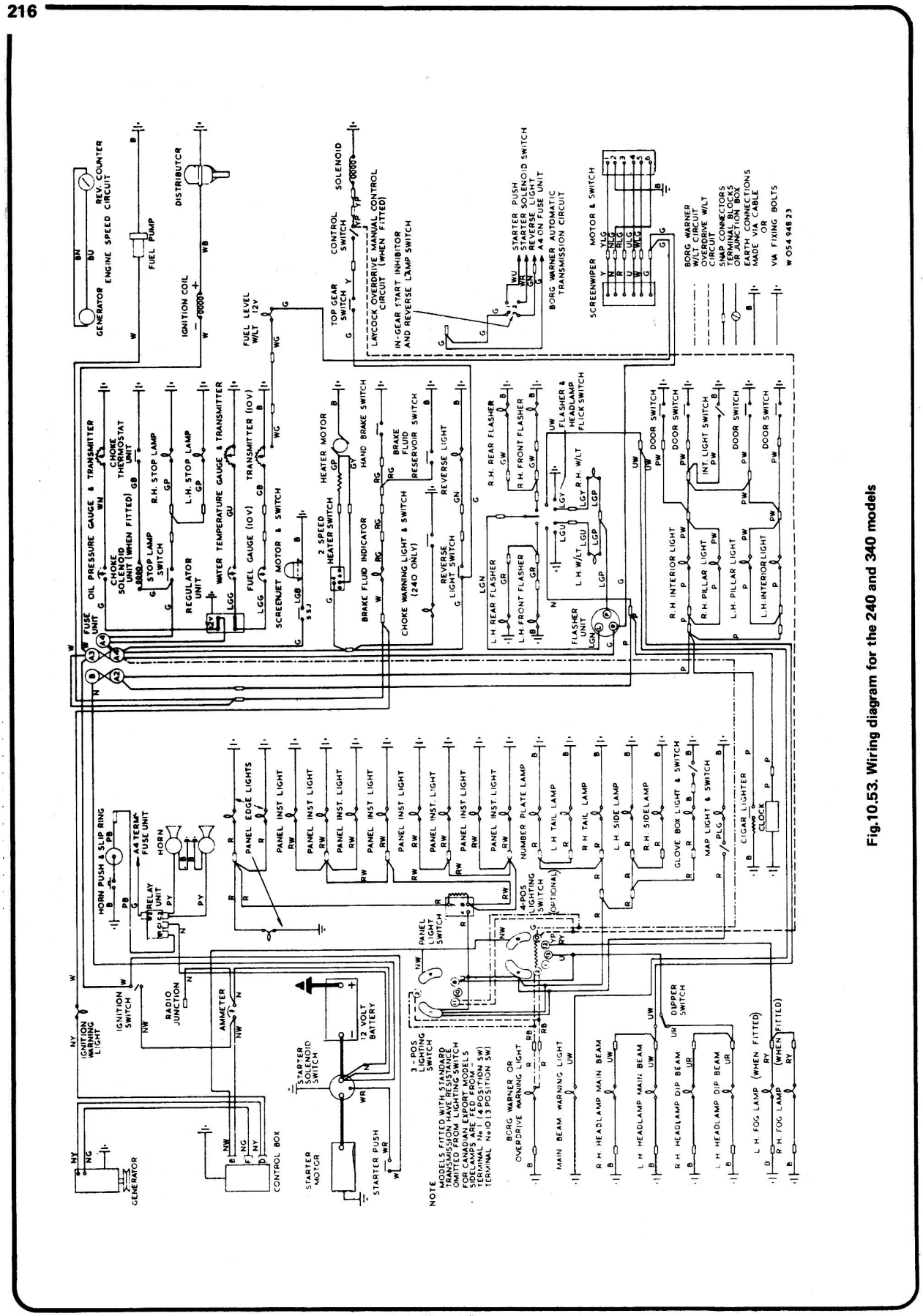



**Fig.10.53. Wiring diagram for the 240 and 340 models**

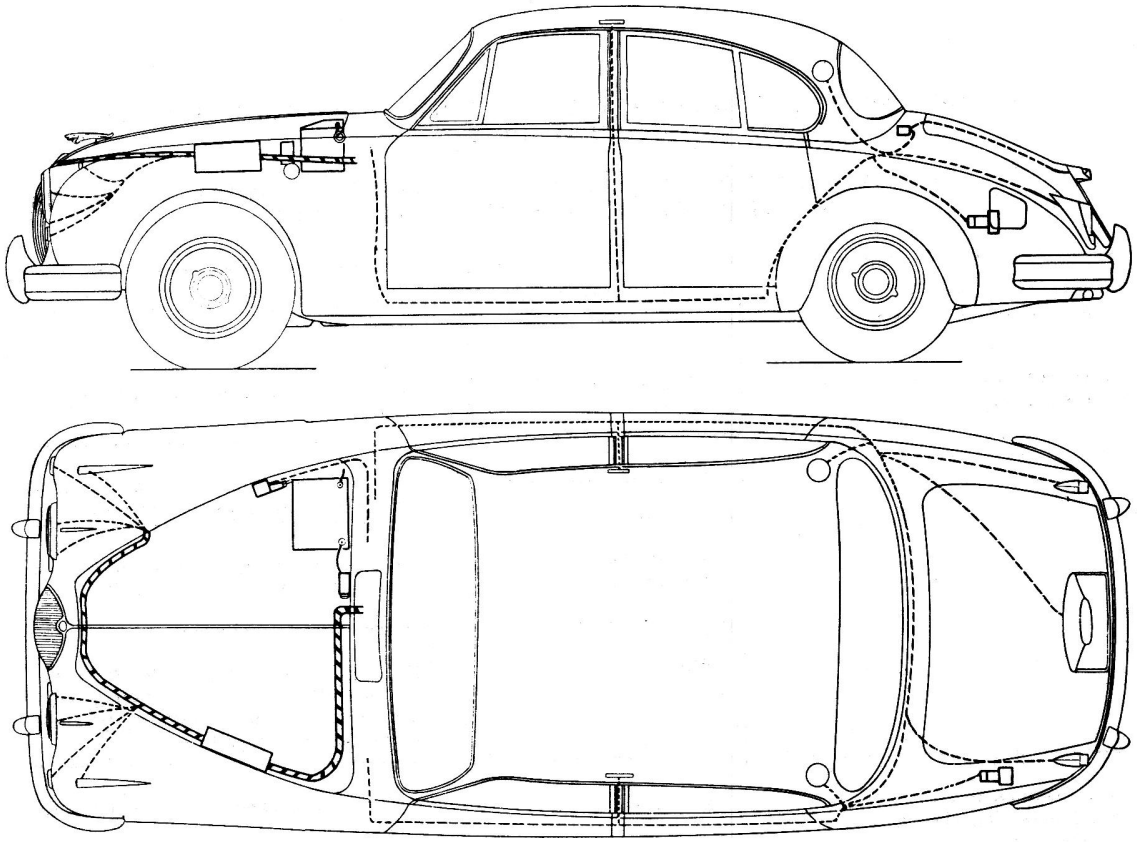


Fig.10.54. Layout of the wiring harness

## FIG. 10.55. ANALYSIS OF ENGINE OIL PRESSURE GAUGE FAULTS

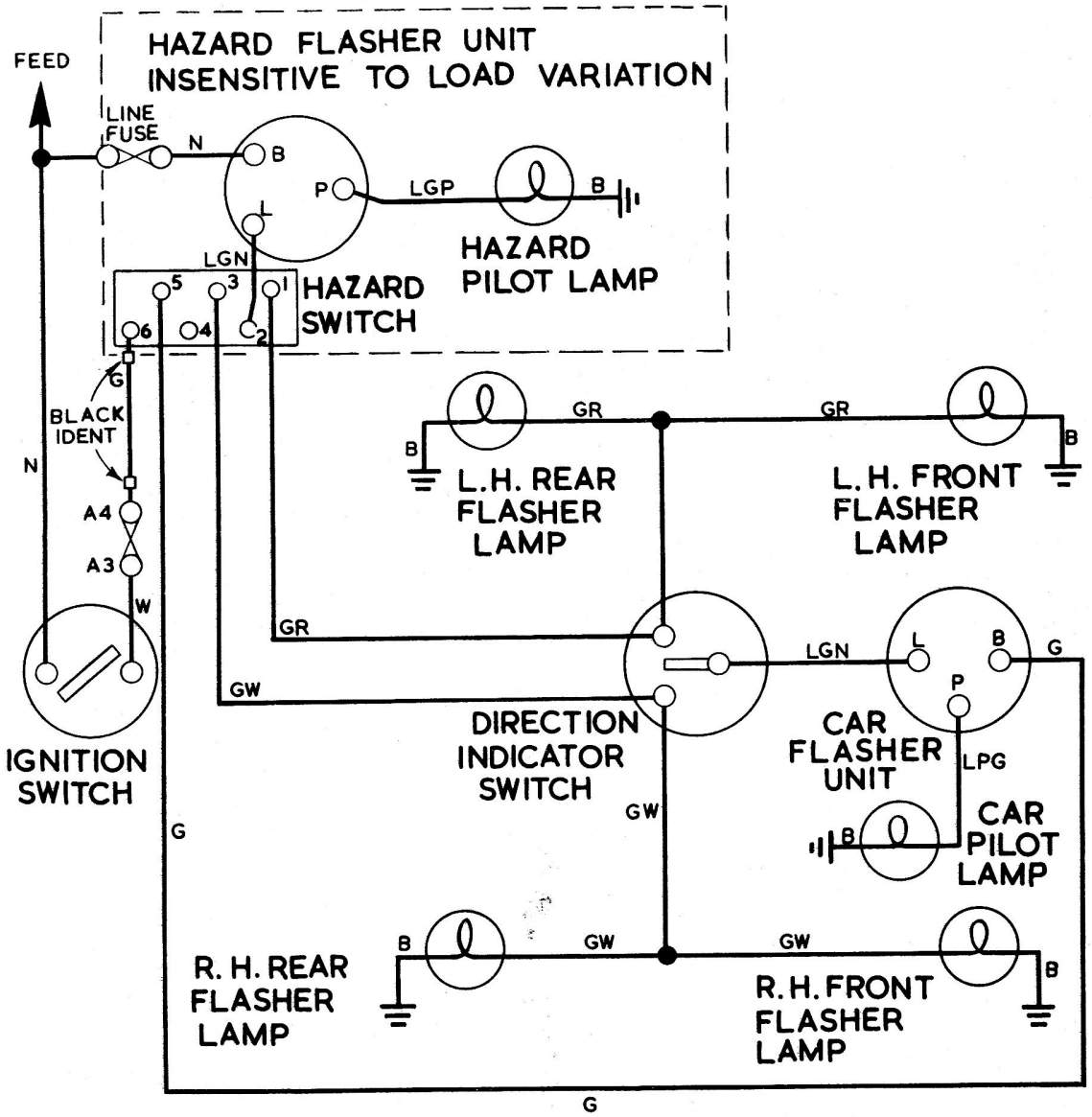
**NOTE: THE INSTRUMENT PANEL GAUGE MUST NEVER BE CHECKED BY SHORT CIRCUITING THE TRANSMITTER UNIT TO EARTH**

| Symptom | Unit Possibly at Fault | Action |
|---|---|---|
| Instrument panel gauge showing a "zero" reading | Wiring | Check for continuity between the gauge and the transmitter unit and that the latter is earthed. |
| | Instrument panel gauge | Check for continuity between the gauge terminals with leads disconnected. If satisfactory replace the transmitter unit. |
| Instrument panel gauge showing a reading with ignition switched but engine not running | Transmitter unit on oil filter head | Check by substituting another transmitter unit. |
| Instrument panel gauge showing a high reading and overheating | Transmitter unit on oil filter head | Check by substituting another transmitter unit. |
| Instrument panel gauge showing a below "zero" reading with ignition switched off | Instrument panel gauge | Check by substituting another instrument panel gauge. |

## FIG. 10.56. ANALYSIS OF ENGINE TEMPERATURE AND PETROL TANK CONTENTS GAUGES FAULTS

**NOTE: THE INSTRUMENT PANEL GAUGES MUST NEVER BE CHECKED BY SHORT CIRCUITING THE TRANSMITTER UNITS TO EARTH**

| Symptom | Unit Possibly at Fault | Action |
|---|---|---|
| Instrument panel gauge showing a "zero" reading | Voltage regulator | Check output voltage at terminal 1 (eye) is 10 volts. |
| | Instrument panel gauge | Check for continuity between the gauge terminals with the leads disconnected. |
| | Transmitter unit in petrol tank or engine unit | Check for continuity between the terminal and the case with lead disconnected. |
| | Wiring | Check for continuity between the gauge, the transmitter unit and the voltage regulator. Also that the transmitter unit and voltage regulator are earthed. |
| Instrument panel gauge showing a high low reading when ignition is switched on | Voltage regulator | Check output voltage at terminal 1 (eye) is 10 volts. |
| | Instrument panel gauge | Check by substituting another instrument panel gauge. |
| | Transmitter unit in petrol tank or engine unit | Check by substituting another transmitter unit in petrol tank or engine unit. |
| | Wiring | Check for leak to earth. |
| Instrument panel gauge showing a high reading and overheating | Voltage regulator | Check output voltage at terminal 1 (eye) is 10 volts |
| | Wiring | Check for short circuits on wiring to each transmitter unit. |
| Instrument panel gauge showing an intermittent reading | Voltage regulator | Check by substituting another voltage regulator. |
| | Instrument panel gauge | Check by substituting another instrument panel gauge. |
| | Transmitter unit in petrol tank or engine unit | Check by substituting another transmitter unit in petrol tank or engine unit. |
| | Wiring | Check terminals for security, earthing and wiring continuity. |




| | | | |
|---|---|---|---|
| B | BLACK | LGN | LIGHT GREEN \ BROWN |
| G | GREEN | LGP | LIGHT GREEN \ PURPLE |
| GR | GREEN \ RED | N | BROWN |
| GW | GREEN \ WHITE | W | WHITE |

**Fig. 10.57. Wiring diagram for traffic hazard warning system**