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INSTRUCTIONS FOR

ROTAX

ELECTRIC LIGHTING

AND

STARTING EQUIPMENT

& ACCESSORIES

**ROTAX LTD.,
WILLESDEN JUNCTION,
LONDON, N.W.10.**

TELEGRAMS: "RODYNALITE, PHONE, LONDON."

TELEPHONE: WILLESDEN 2480 (PVTE. BCH. EXCHANGE).

CODES USED: A.B.C. (5TH & 6TH EDITIONS) AND MARCONI INTERNATIONAL.

Instruction Booklet No. 222 B

P/34/L Printed in England



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INTRODUCTION.

To ensure the best service from the electrical equipment the amount of attention needed is very small, but some attention is essential, for example, "topping-up" of the battery, which is just as important as refilling the radiator or pumping up the tyres. We therefore advise owners to make a periodical inspection and to carry out the instructions given in the following pages.

As this booklet covers equipment fitted to various cars, it may be found that an equipment differs slightly in detail from the description given, but no difficulty should be experienced as the essential information on maintenance remains unaltered.

The booklet is divided into three sections. Section I gives a brief description of the equipment and how it functions, Section II deals with operation and maintenance, while Section III is devoted to the location and remedy of possible faults.

If you are in any difficulty or require further information and advice, no matter how trivial, do not hesitate to take advantage of the wide facilities of LUCAS-C.A.V.-ROTAX Service. A list of Service Depots is given on page 32.

ROTAX ELECTRICAL EQUIPMENT.

SECTION I.

DESCRIPTION OF THE EQUIPMENT AND HOW IT FUNCTIONS.

The electrical equipment on a car is a self-contained system and is, in effect, a miniature electrical power-plant. The dynamo, which is driven by the engine, is the source of supply of current for the ignition coil (when coil ignition is fitted), the lamps, starter motor and accessories. The battery acts as a "reservoir" of energy to supply the current for the starter motor and the lamps when the car is stationary.

The dynamo output is controlled by what is known as the third-brush method. The object of this third-brush system is to regulate the output of the dynamo at high speeds and keep it steady, independent of the speed at which the dynamo is running, as it must be remembered that the dynamo speed varies as the engine speed. On some cars, the dynamo is arranged to give alternative outputs. For daytime running, there is a half charge and a full charge position of the charging switch, and with the majority of cars, there is, in addition, a third and higher charging rate which only comes into operation when the lamps are switched on. The arrangement allows the driver to choose the appropriate charging rate during daytime running to suit the conditions under which the car is being run. Provided the instructions on the use of the charging switch, given on page 10, are carried out, this arrangement ensures that the battery is kept in good condition without the possibility of excessive over-charging.

Connected between the dynamo and the battery is the cut-out. It is, in effect, an automatic switch, which acts as a "valve" in the dynamo charging circuit, allowing the flow of current from the dynamo to the battery only. It completes the charging circuit when the dynamo is running fast enough to generate a voltage sufficiently high to charge the battery, and disconnects it again when the speed is low. The function of the cut-out is very often misunderstood—it does not prevent overcharging of the battery. It fulfills no other object than that of preventing current from flowing from the battery through the dynamo windings when the car is stationary or when it is running very slowly.

The starting motor is constructed with a shaft fitted with a pinion, which, on rotation, runs into engagement with the geared rim of the flywheel. Immediately the engine begins to fire, the pinion is automatically thrown out of mesh.

Now let us observe what happens in the various circuits when the equipment is in use. First, the starting switch is closed, thereby allowing a current to flow from the battery to operate the starter motor, to start the engine. When the engine is running it is driving the dynamo, but the latter will not charge the battery until the cut-out operates. When the speed of the engine is increased, the needle of the ammeter will be seen to flicker over to the "charge" side. This means that the cut-out has closed and is allowing a small current to pass to the battery. As the car speed increases, the current will increase also until it reaches a maximum. It will then remain nearly constant irrespective of the car speed owing to the third-brush regulating system.

At night, the lighting switch will be closed by the driver, allowing the current to pass from the battery to the lamps. If the lamps are switched on when the car is stationary (the dynamo not running), all the current for lighting has to come from the battery, and the amount

will be shown on the discharge side of the ammeter. If the engine is running, the ammeter will register the difference of the amount of current being discharged by the battery and the current passing into the battery from the dynamo.

SWITCHES CONTROLLING THE EQUIPMENT.

Various forms of ignition switch are used and may be pull and push, barrel, or key type. In some instances ignition control is combined with the lighting and charging switch.

The combined lighting and charging switch is mounted in the instrument panel, or, with some equipments, it is fitted to the bottom of the steering column, and is controlled by a lever in the centre of the steering wheel. For full instructions on the use of the charging switch, see page 10.

The starter switch is arranged either for hand or foot operation. With some equipments a solenoid operated switch is fitted. This is controlled by a press button switch incorporated in the instrument panel.

IGNITION WARNING LAMP.

This lamp is incorporated in the instrument panel when coil ignition is fitted. It automatically gives a red light whenever the ignition is on and the engine is stationary, and so reminds the driver to switch off. This reduces the possibility of the battery being discharged by current flowing through the coil windings.

It will be noticed that the warning lamp also lights when the engine is running very slowly. This is because the lamp is connected across the cut-out points and will light up at speeds below the cutting-in speed of the dynamo.

OIL WARNING LAMP.

On some panels an oil gauge is dispensed with and a light on the panel glows when the oil pressure is insufficient.

INSTRUMENT PANEL.

The instrument panel houses the control switches, ammeter and ignition warning lamp already described, along with other instruments. The instrument faces are usually illuminated by indirect lighting from concealed lamps. In the majority of panels, sockets are provided to take an inspection lamp plug. On some panels a fuse is provided for the dynamo field.

HEAD LAMPS.

The majority of head lamps are fitted with an anti-dazzle device arranged for operation by a switch which is usually mounted on the steering column.

“Dip and Switch” Reflectors (Electrically Operated).

With this anti-dazzle scheme, the nearside head lamp beam is dipped and turned to the near-side of the road and the off-side lamp is simultaneously switched off. With some equipments, both head lamp beams are arranged to dip and turn to the left.

The dipping of the head lamp beam is effected by a movement of the reflector. This is made in two parts; the centre portion is pivoted on ball bearings in a fixed rim which is, in turn, secured to the head lamp body. The movement of the reflector is controlled by means of a solenoid.

SECTION II.

RUNNING INSTRUCTIONS & MAINTENANCE.

THE BATTERY.

It is of the utmost importance that the battery should receive regular attention, as upon its good condition depends the satisfactory running of the starting motor, the illumination of the lamps, and, when coil ignition is fitted, the running of the car.

The following are the most important maintenance hints :—

1. Keep the acid level with the top of the separators.
2. Add only distilled water, never tap water.
3. Test the condition of the battery by taking readings of the specific gravity of the acid in each cell with a hydrometer.
4. Never leave the battery in a discharged condition.
5. Keep the terminals spanner tight, and smeared with vaseline. Also, with earth return sets, see that the nut securing the lead from the negative battery terminal to the chassis is tight.

Topping Up.

At least once a month, remove the vent plugs in the top of the battery and examine the level of the acid solution. If necessary, add distilled water, which can be obtained at all chemists, and most garages, to bring the level of the acid solution up to the top of the separators. If acid solution has been spilled, it must be replaced by a diluted sulphuric acid solution of the same specific gravity as the electrolyte in the cell to which it is to be added. When examining the cells, naked lights must not be held near the vents, on account of the possible danger of igniting the gas coming from the plates.

Greasing Terminals.

Examine the battery terminals and see that they are quite tight. Keep them smeared with vaseline to prevent cor-

rosion. Keep the top of the battery clean and dry; take care not to spill water on it when adjusting the level of the electrolyte or taking specific gravity readings.

Testing the Condition of the Battery.

It is advisable to complete the inspection by measuring the specific gravity of the acid, as this gives a very good indication of the state of charge of the battery.

An instrument known as a hydrometer is employed for this purpose, and should be of the type illustrated. These can be bought at any of our Service Depots, the addresses of which are given on page 32. Voltmeter readings of each cell do not provide a reliable indication of the condition of the battery unless special precautions are taken which make such a test unsuitable for the average owner, and on that account we do not recommend this test.

How to Use the Hydrometer.

Before measuring the specific gravity of the acid solution by means of the hydrometer, see that the acid is at its correct level. Readings should be taken for each of the cells in turn after a run on the car, when the electrolyte is thoroughly mixed. The readings should be approximately the same. If one cell gives a reading very different from the rest it may be that the acid has been spilled or has leaked from this particular cell, or there may be a short between the plates. In this case we advise the owner to have his battery examined at a Service Depot to trace the cause and prevent the trouble from developing.

With batteries for which the strength of the acid recommended is 1.225, the specific gravity of the solution when the battery is fully charged will be 1.225-1.250. When half discharged, it will be about 1.200, and when fully discharged about 1.150.

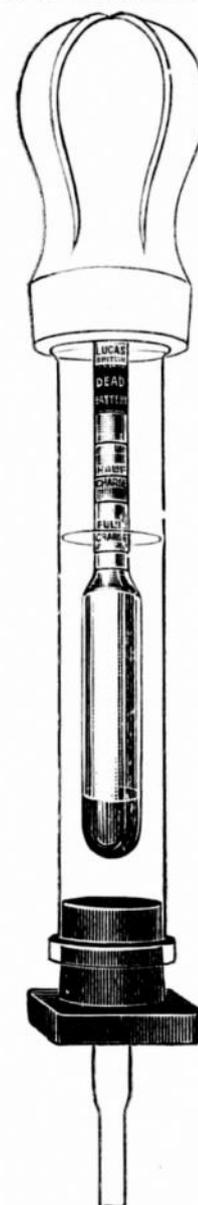


Fig. 1.
Syphon
Hydrometer.

For other types of batteries for which the strength of acid recommended is 1.285 or 1.320, the specific gravity figures are:—1.285-1.300 when fully charged, about 1.210 when half discharged, and about 1.150 when fully discharged. These figures are given assuming the temperature of the solution is about 60°F. For fuller particulars regarding temperature corrections see our “First Charge” instructions, a copy of which can be obtained on application.

If the battery is found to be in a half discharged or lower state of charge, the charging switch should, if possible, be left in the full charge position for longer periods of running (see page 11). It should be remembered that the battery will be helped to regain its normal condition if its load is temporarily lessened, as for instance, by using the side instead of the head lamps. If the gravity does not rise in a reasonable time, it is advisable to have the battery inspected at a Service Depot. On the other hand, if the battery is always found to be in a fully charged condition and the acid level gets unusually low, then decrease the charging time.

The battery must never be left in a fully discharged condition, and unless some long runs are to be taken, it is advisable to have the battery charged up from an independent electrical supply.

Storage of a Battery.

If the equipment is not used for several months, the battery must be given a small charge from a separate source of electrical energy about once a fortnight, in order to obviate any permanent sulphation of the plates. In no circumstances must the electrolyte be removed from the battery and the plates allowed to dry, as certain changes take place which result in loss of capacity.

USE OF THE BATTERY CHARGING SWITCH.

The battery is the “reservoir” for the energy generated by the dynamo and once it is “full,” there is no object in delivering further current to it. While it is always

better to keep a battery overcharged rather than undercharged, it should be remembered that excessive overcharging will quickly reduce the acid level and tend to shorten the life of the battery.

Therefore, to ensure that the battery is kept in good condition without the possibility of excessive overcharging, the dynamo or dynamotor on the majority of cars, is arranged to give alternative outputs. In summer when the lamps are very little used, the dynamo gives about half its full output during daytime running. During the winter, when the lighting and starting load is heavier, it is intended that the charging switch should be kept in the "full charge" position.

The charging switch should be kept in the appropriate position according to the season. For cars running under average conditions this will ensure that the battery is kept in a fully charged state.

However, in exceptional cases it may be advisable to use the switches out of season. For instance, if, in winter, the car is run regularly during the day with practically no night running, and the hydrometer readings are always found to be about 1.225 or 1.285 (according to the type of battery), and if the acid level gets unusually low, then it is probable that the battery is being overcharged. In these circumstances, move the charging switch to the half charge position. On the other hand, if exceptional use is made of the lamps and starter in the summer, causing the battery to be in a low state of charge (hydrometer readings of 1.200 or under), then run with the charging switch in the full charge position.

The majority of sets are arranged so that when the lamps are switched on, the dynamo automatically gives its full charge. This can easily be ascertained by noting that there is no change of ammeter reading on moving the charging switch, when the lamps are on and the car is running. If there is a change of reading, it follows that the dynamo is not arranged to give its full output when

the lamps are switched on, and, consequently, it is important to switch to this position whenever the lamps are in use.

In equipments where the dynamo is not arranged to give a reduced output, the battery should be charged for 1 to 2 hours during the daytime running in the summer, for slightly longer than this in the winter, and whenever the lamps are in use.

While these times will serve as a rough guide for cars running under average conditions, the charging period should obviously be varied if the hydrometer readings indicate that the battery is being under or overcharged.

On a new car during the running-in period, it is advisable to keep the switch in the full charge position all the time, in order to compensate for the heavy starter motor load due to the initial stiffness of the engine.

DYNAMOS AND DYNAMOTORS.

The dynamo (or dynamotor) requires very little attention to ensure satisfactory running. Very occasionally—about

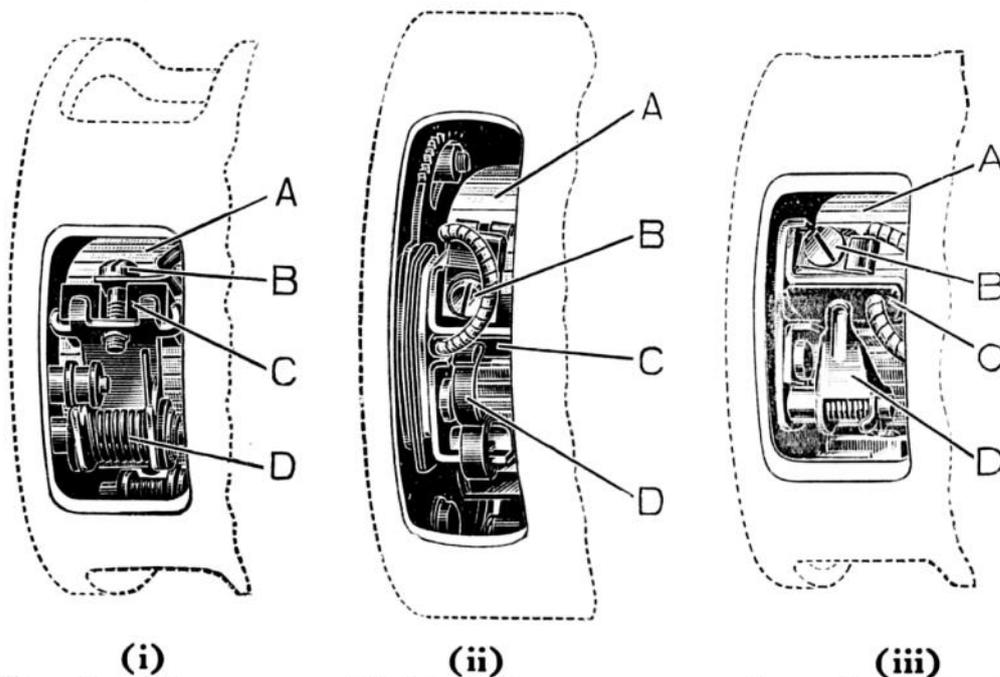


Fig. 2. Dynamos with End Covers removed to show Brushgear and Commutator.

A—Commutator.
B—Screw.

C—Brush.
D—Brush spring or spring lever.

every season—examine the brushes and commutator. These are protected by a sheet metal band cover secured by a screw and nut.

Brushgear.

The design of the brushgear on different types of machines varies slightly in design and various types are illustrated in Fig. 2.

Inspect the three brushes and see that they press firmly on to the commutator. With some machines, Fig. 2 (i), the brushes are secured to spring arms; the arms should move freely on their pivots. With other types of machines, Fig. 2 (ii and iii), the brushes are held in holders by spring levers.

With the types as shown in Fig. 2 (ii and iii), see that the three brushes slide freely in their holders and that they are “bedding” evenly on the commutator. This is checked by examining the faces of the brushes in contact with the commutator; they should present a uniformly polished appearance. Dirty brushes may be cleaned with a cloth moistened with petrol.

After cleaning, or removal for any purpose, care must be taken to replace brushes in their original positions, otherwise they will not “bed” properly on the commutator. After long service, when the brushes have become worn so that they will not bear properly on the commutator, they should be replaced. It is recommended that none but genuine replacement brushes are fitted, as these are specially made and will give the best results and the longest life. We advise owners to have the brushes fitted at a Service Depot so that they can be properly “bedded” to the commutator.

When ordering brush replacements, state whether they are main or control brushes, and for what type of machine they are required.

Cleaning Commutator.

The surface of the commutator should be kept clean and free from oil and brush dust, etc.; neglect of this pre-

caution will result in the commutator becoming blackened, causing sparking to occur at the brushes, and consequently shortening the life of the machine. The best way to clean the commutator is to insert a fine duster, held by means of a suitably-shaped piece of wood against the commutator surface, slowly rotating the armature at the same time.

Lubrication.

As the bearings are packed with grease before leaving the works, very little attention is needed. A few drops of oil, however, may be added through the lubricators, when provided, say every 1,000 miles. The reader is cautioned that far more trouble has been caused by excessive oiling than by too little. When a greaser is provided, this should be given one turn about every 1,000 miles and when empty, should be refilled with a good quality high melting point grease. On some machines, there is a flap marked "GREASE" at the commutator end. Periodically, say when the engine is being decarbonised, move aside the flap and add a very small quantity of high melting point grease. After a considerable mileage, the dynamo should be dismantled for cleaning, adjustment and repacking the bearings with grease. This should be done preferably by the nearest Service Depot.

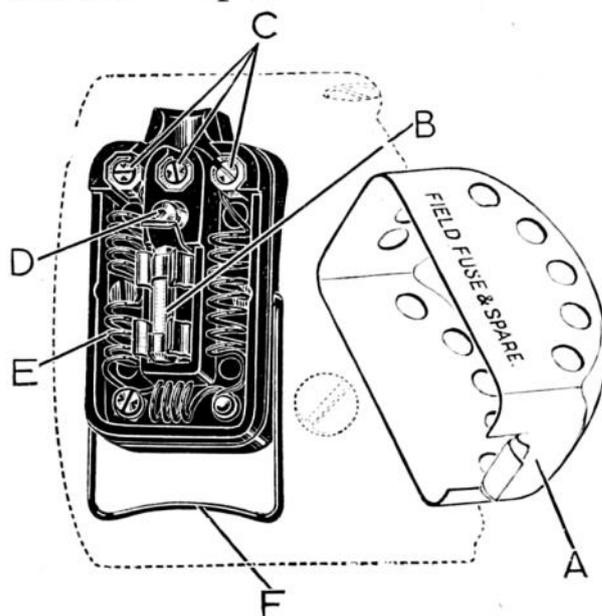


Fig. 3. Dynamo Terminal, Fuse and Resistance Unit, with cover removed.

- A—Cover.
- B—Fuse.
- C—Terminals.
- D—Spare fuse
- E—Resistance wire.
- F—Cover retaining wire.

Dynamo Field Fuse.

With some machines, a fuse is provided in the dynamo field circuit to protect the machine in the event of anything being wrong in the charging circuit, e.g., a loose or broken battery connection. If the dynamo fails to charge the battery at any time (indicated by no charge reading being given on the ammeter during daytime running), check the wiring and then inspect the fuse.

On some cars, the fuse is fitted in the instrument panel; the holder can be withdrawn for renewal by means of a projecting knob. Spare fuse wire is carried on the holder. On other cars the fuse is of the cartridge type and is housed along with the half charge resistance in a small rectangular unit fixed on the dynamo yoke. If the fuse blows, replace it with the spare fuse provided. If the new fuse blows after starting up, the cause of the trouble must be found, and we advise that the equipment is examined by one of our Service Depots. Never fit any fuse other than the standard fuse as originally fitted.

STARTER MOTORS.

Give the starter brushgear and commutator similar attention to that described for dynamos. If, for any reason, the pinion wheel on the motor does not engage

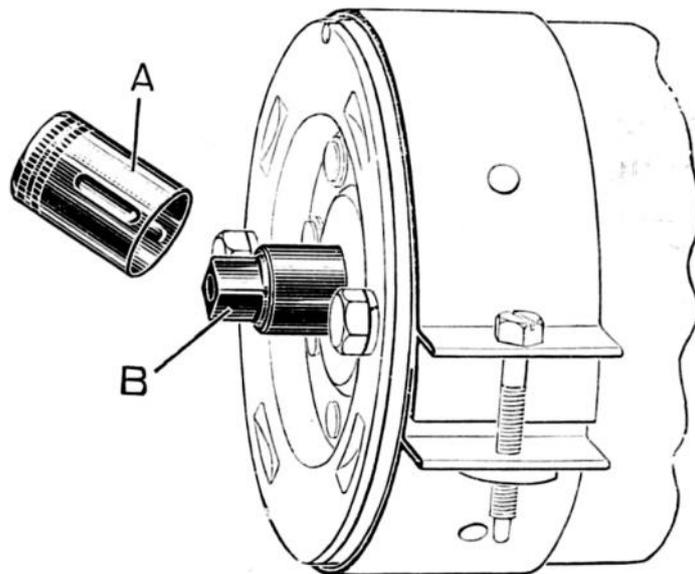


Fig. 4. Squared End of Starter Shaft with Cover removed.
A—Metal cover. B—Squared end of shaft.

with the flywheel teeth, examine the screwed sleeve on the armature spindle to see that it is free from dirt; if necessary, wash over with paraffin. Occasionally, give it a few drops of machine oil.

Some starters are provided with extended shafts with square ends, which can be rotated by means of a spanner in the remote possibility of the pinion becoming jammed in mesh with the flywheel for any reason. Access is obtained to the squared end by pulling off the metal cap "A" (Fig. 4). If it is a tight fit, lever it off with a screwdriver.

When Starting.

Observe the following points when starting the engine :—

- (i.) Always retard the ignition. This minimises the possibility of back-firing.
- (ii.) Operate the starter switch firmly without hesitation.
- (iii.) Never operate the starter when the engine is running. If the engine does not fire at once, allow it to come to rest before pressing the switch again.

In order to facilitate starting in cold weather, it is advisable to make use of the mixture control or air strangler, etc., and before using the electric starter, crank the engine over slowly by the starting handle for two or three revolutions, as this will considerably diminish the load for starting.

CUT-OUT AND FUSE UNITS.

With most equipments, the cut-out is mounted together with one or more fuses as one unit, which usually also forms a junction box. This unit is generally mounted on the engine side of the dash. The terminals are identified by either numbers or letters and the cable ends by coloured sleeveings. With some equipments, the cut-out is mounted as a separate unit on the dynamo yoke.

The function of the cut-out is described on page 5.

As the mechanism is accurately set before leaving the Works and does not require adjustment, the cover protecting it is sealed.

Replacement of Lighting and Accessories Fuses.

With the majority of equipments, fuses are provided to protect the lamps and accessory circuits. Before replacing a blown fuse, inspect, for faulty wiring, the equipment the fuse protects, and see that all connections and terminals are tight. If the fuse blows repeatedly, and the cause cannot be traced, have the equipment examined at the nearest Service Depot.

Types with Strip Fuse.

To fit a new fuse with these units, withdraw the fuse holder and remove any remaining traces of fuse strip. Take a length of spare fuse strip which is carried on the fuse holder and secure it under the spring clips on the holder, which should then be re-inserted in its fixing

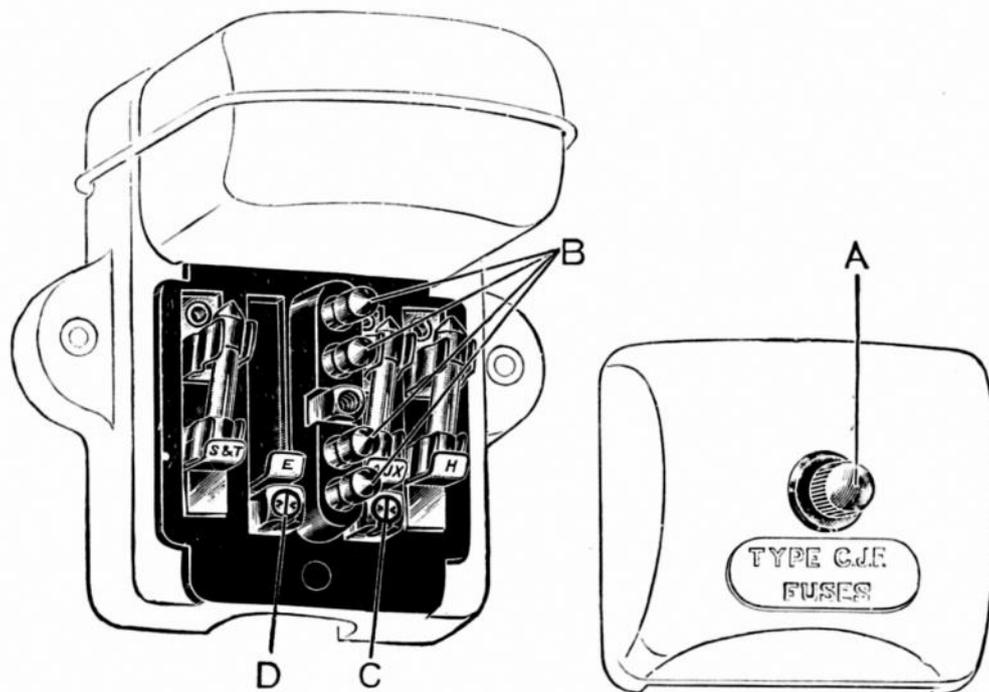


Fig. 5. Combined Cut-out and Junction Box Type C.J.F.

A—Cover fixing screw.
C—Terminal for connecting horn, windscreen wiper and other extra accessories.

B—Spare fuses.
D—Earthing terminal.

Terminals in switchboxes, junction boxes, etc., are of a standard grub screw type. To make efficient connections to terminals, proceed as follows:—

Bare about $\frac{3}{8}$ in. of the cable, twist the wire strands together and turn back about $\frac{1}{8}$ in. so as to form a small ball. Remove the grub screw from the appropriate terminal and insert the wire so that the ball fits in the terminal post. Now replace and tighten the grub screw; this will compress the ball to make a good electrical connection.

For particulars of other units, types RIF, RF, CJR and CFR, see separate leaflets.

LAMPS.

Replacement of Bulbs.

When the replacement of any bulb is necessary, it is important that the same size bulb is fitted. The B.A.S. number will be found stamped on the cap of the burnt out bulb. We strongly recommend that bulbs supplied by us are used, as these are arranged to be in focus and give the best results with our reflectors. For particulars of Blue Star High Efficiency Bulbs, see separate leaflet. The methods of removing the fronts of the lamps for bulb replacement are given below.

Head Lamps. Head lamp fronts are secured either by a screw on top of the rim, a screw on the underside of the rim or by a headed stud at the side.

To remove the first type of fixing, take out the top screw and twist the rim about $1\frac{1}{2}$ in. in an anti-clockwise direction and then pull forward. Reverse this process when re-assembling. To remove fronts with the second type of fixing it is only necessary to slack off the screw underneath the rim and disengage it from the slotted lug. The front can then be lifted off.

Fronts having the snap-on type of fixing—having the side screw—can be removed by turning this screw about $\frac{1}{4}$ of a turn. This movement presses a cam against the body and pushes the front off. To replace, turn back the screw head and locate the cam between two lugs on the body, then push the front into place.

The fronts of other types of head lamps are secured by means of a screw "B" (Fig. 7). To remove the front, slacken the screw and swing it aside from the slot "C." The front can then be removed. When replacing the front, locate the top first, then press on the rim at the bottom of the lamp.

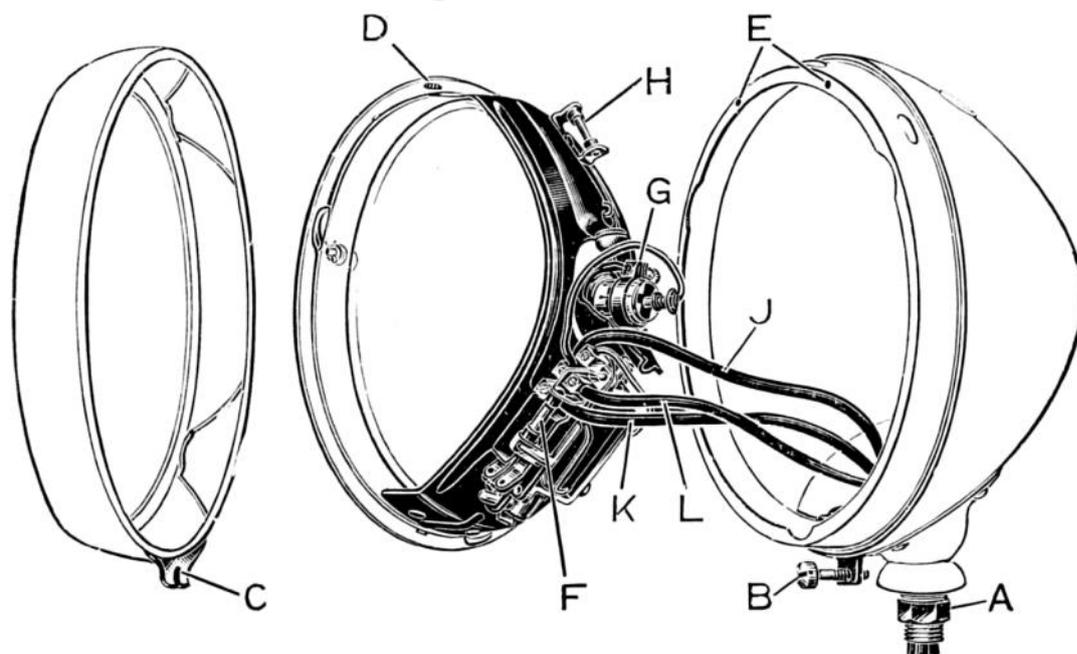


Fig. 7. Head Lamp with "Dip and Switch" Reflector, Dismantled.

- | | |
|---|--|
| A—Locking nut for adjustable mounting. | F—Fuse. |
| B—Front fixing screw. | G—Clamping clip for focussing adjustment. |
| C—Slot. | H—Spare fuse. |
| D—Reflector fixing screw. | J—Cable to distribution box or switch box. |
| E—Alternative locations for reflector fixing screw. | K—Cable to offside lamp. |
| | L—Cable to dipper switch. |

Side Lamps. The method of removing the side lamp fronts is similar to that for the head lamps.

The fronts of some lamps are secured by means of a screw at the top of the lamp.

With other types of lamps it is necessary to remove the body from its base in order to carry out a bulb replacement. This is achieved by slackening a securing screw or with some models by unscrewing the body itself.

Rear Lamps. The front of the "Stop" Tail Lamp is secured by means of a screw which is withdrawn to remove the front for bulb replacement.

To remove the front of the "Stop" Tail and Reversing Lamp, withdraw the four fixing screws.

With some types of tail lamps, remove the front portion of the lamp by turning it to the left and withdraw it from the base. When replacing, see that the studs locate with the slots in the lamp front, then push it home to lock it in position.

With other types of tail lamps, the front can be removed by unscrewing it to the left.

Panel Lamps and Dash Lamps. Panel lamps incorporated in instrument panels are usually accessible from the back of the panel.

With some types, the bulb holders can be released from the back of the panel for bulb replacements by turning them to the left (as viewed from back of panel). With other types, the bulb holders are mounted on brackets which are either hinged, or can be withdrawn when the two knurled nuts are removed, thus rendering the bulbs accessible.

On some cars, a dash lamp is fitted. The cover can easily be withdrawn from the lamp body for a bulb replacement.

Ignition Warning Lamp. The warning lamp bulb is usually rendered accessible for replacement by removal of the front carrying the red glass. With some panels, this is removed by unscrewing, while with other units it is secured by two screws. When the front is not detachable, the bulb holder can be released from the back of the panel by turning it to the left.

Aligning and Focussing.

To obtain the best results from the lamps, it is essential that they are in good alignment and that the bulbs are focussed correctly.

For the best projection of light, the bulb filament must be as near as possible to the focus of the reflector. As the position of the bulb filament relative to the cap varies slightly with different bulbs, provision is made for adjusting the position of the bulb relative to the reflector.

With some types of lamps, the bulb holder is arranged so that it can be moved backwards or forwards, when the clamping clip "G" (Fig. 7) at back of the reflector is slackened. Care must be taken to tighten the clip after the adjustment. The reflector may easily be removed when focussing. With some types, it is secured on three supports. Reflectors that have a cork washer in the rim are secured by a screw. Turn back the two ends of the washer at the top of the rim, the screw can then be removed and the reflector withdrawn by turning it to the left. With other types, the reflector can be removed, when the fixing screws are withdrawn, by turning it to the left.

With other types of lamps, alternative positions are provided for the bulb in its holder. Each position should be tried for the best result.

The alignment of the lamps is very easily carried out, as they are usually fixed on a universal mounting, which is locked by a single nut.

The simplest method of adjusting and focussing the lamps is to take the car on to a straight, level road at night, and then to align them so that the beams are parallel with the road and with each other. Then focus the driving light bulbs as follows:—

Cover over the one lamp and adjust the position of the bulb in the other lamp so as to obtain the most intense beam. Finally, focus the other lamp bulb in the same way.

Dipping Reflectors (Electrically Operated).

The mechanism calls for no attention whatever. There is nothing to adjust and no lubrication is required.

If the reflector fails to function, examine the fuse which is carried in spring clips alongside the dipping mechan-

ism. If there is a break in the fuse wire, replace the fuse. A spare fuse is clipped near the dipper unit. Before trying the lamp, see that the moving portion of the reflector rocks freely.

If the fuse should blow repeatedly, and the cause of the trouble cannot be found, have the reflector examined at the nearest Service Depot.

Cleaning Lamps.

The reflectors are protected by a transparent and colourless covering, which enables any accidental finger marks to be removed with chamois leather or a soft cloth without affecting the surface of the reflector. Do not use metal polishes on reflectors. Ebony black lamps can be cleaned with a good car polish. Chromium plated lamps will not tarnish and only need wiping over with a damp cloth to remove dust or dirt.

ELECTRIC WINDSCREEN WIPERS.

MT and CW Types.

The wiper motor requires absolutely no attention; all moving parts are packed with grease during assembly, and no lubrication is necessary.

With dual-arm types, however, occasionally give the two pivots on the coupling bar a drop of oil. Do not add more, otherwise oil may get on to the blades. About once a year, the second arm should be removed from its shaft, the spindle withdrawn and smeared with grease. If the rubber squeegee becomes worn or perished, it can be easily replaced at a very small cost.

ELECTRIC HORNS.

High-Frequency Types (Alto and Altette). These horns, before being passed out of the Works, are adjusted to give their best performance and will give a long period of service without any attention; **no subsequent adjustment is required.**

If the horn becomes uncertain in its action, giving only a choking sound, or does not vibrate, it does not follow that the horn has broken down. First ascertain that the

trouble is not due to some outside source, *e.g.*, a discharged battery, a loose connection or short circuit in the wiring of the horn, or in some cases, a blown fuse. It is also possible that the performance of a horn may be upset by the horn becoming loose on its mounting.

In the case of horns mounted on cross bars in front of the radiator, the note may be impaired by the bar itself vibrating, or by any rattling or drumming of mudwings or head lamps which may be attached to the cross bar. This can be ascertained by removing the horn from its mounting, holding it in the hand and pressing the push. If the note is still unsatisfactory, **do not attempt to dismantle the horn**, but return it to a Service Depot for examination.

“TRAFFICATORS” (*Regd. Trade Mark*).

The “Trafficators” require no adjustment in service, beyond very occasional lubrication. About every 2-3 months or if the arms become stiff at any time, raise the “Trafficator” arm and apply a smear of thin oil, such as sewing machine oil, by means of a feather or similar article to the moving parts of the hinge on which the arm operates.

Replacement of Bulbs.

If at any time the arm fails to light up when in operation, examine the bulb. To remove the bulb, switch the “Trafficator” on, and then, supporting the arm in a horizontal position, move the switch to the off position. Now withdraw the bulb holder, which is clipped to the underside of the arm, by means of the metal tongue provided. Do not attempt to remove the bulb holder while the “Trafficator” is switched on, as it may cause a short circuit and so damage it.

With flush fitting type “Trafficators,” the arm is of different design. The bulb can readily be removed from its holder when the cover is released by moving the small trigger on the underside of the arm.

Bulbs Fitted:—

12-volt Set—No. T126F 6-watt Festoon type.

6-volt Set—No. T66F 6-watt Festoon type.

SECTION III.

LOCATION AND REMEDY OF TROUBLES.

Although every precaution is taken to eliminate all possible causes of trouble, failure may occasionally develop through lack of attention to the equipment or damage to the wiring. The most probable faults are tabulated, according to the symptoms which are displayed, in the fault-finding tables at the end of the booklet.

We give a few hints on the best way to make use of these tables, as the sources of many troubles are by no means obvious. In some cases, a considerable amount of deduction from the symptoms is needed before the cause of the trouble is disclosed. For instance, the engine might not respond to the starter switch; a hasty inference would be that the starter motor is at fault. However, as the motor is dependent on the battery, it may be that the battery is exhausted. This, in turn, may be due to the dynamo failing to charge, and the final cause of the trouble may be perhaps a loose terminal nut either at the battery or elsewhere in the charging circuit.

Much evidence can be gained from the ammeter. If, for instance, no charge reading is indicated when the car is running at, say 25 miles per hour, with the charging switch in the full charge position and the lights "off," the dynamo is failing to charge. To ensure that the ammeter is not at fault, the lights should be switched on while the car is stationary, when a reading on the discharge side of the scale should be observed. Again, if the maximum ammeter reading is much below normal when the dynamo is charging, or if the needle fluctuates when the car is running steadily, a low or intermittent dynamo output can be suspected. The dynamo may have been neglected, and the trouble could be caused by, say, worn brushes or a dirty commutator.

Should the intensity of the lights vary, or should they fail entirely, it is probably due to the battery terminals being allowed to corrode and the consequent breaking of a connection. If the cause of the trouble is not located

at the battery, the switchbase or the junction box should next be examined : particularly see that all the terminals are quite tight, if one particular lamp does not light, look for a broken filament or a loose connection at the lamp. When the car is stationary and the lamps light when switched on, but gradually go out, the battery is probably exhausted due to excessive use of the starter motor and lights, or to the dynamo failing to charge.

HOW TO LOCATE AND REMEDY DYNAMO TROUBLE.

SYMPTOMS.	PROBABLE FAULT.	REMEDY.
Ammeter fails to indicate charge when running with no lights in use, or gives heavy discharge with lights on.	Dynamo not charging due to: Broken or loose connection in charging circuit causing field fuse to blow. (When fitted).	Examine charging circuit wiring. Tighten loose connection or replace broken lead. Particularly examine battery connections. Fit replacement fuse. (See page 15).
	Commutator greasy or dirty.	Clean with soft rag moistened in petrol. (See page 13).
Ammeter gives low or intermittent charge reading.	Dynamo giving low or intermittent output, due to:—	
	Loose or broken connections in dynamo circuit.	Examine charging circuit wiring. Tighten loose connections or replace broken lead. Particularly examine battery connections.
	Commutator or brushes greasy.	Clean. (See page 13).
Ammeter gives high charge reading.	Brushes worn, not fitted correctly or wrong type.	Replace worn brushes. See that brushes "bed" correctly. (See page 13).
	Dynamo giving high output due to:—	
	Loose connection in dynamo charging circuit.	Examine charging circuit wiring. Particularly battery connections. Tighten loose connections.
	Battery acid level low.	"Top up" cells with distilled water. (See page 8).
	Brushes not fitted correctly.	See that brushes "bed" correctly. (See page 13).
	Control brush position altered.	Have control brush adjustment re-set at nearest Service Depot.

Note.—This table also can be used for the dynamotor.

HOW TO LOCATE AND REMEDY STARTER MOTOR TROUBLE.

CONDITION.	PROBABLE FAULT.	REMEDY.
Motor sluggish or fails to move engine.	If engine cannot be turned by hand, then fault is due to a stiff engine.	Locate and remedy cause of stiffness.
	If engine can be turned by hand, then trouble may be due to:—	
	Battery discharged.	Start by hand. Charge battery either by a long period of daytime running or from independent electrical supply.
	Broken or loose connection in starter circuit.	See that connections to battery, starter and starter switch are tight, and that cables connecting these units are in order.
	Starter commutator or brushes dirty.	Clean. (See page 15).
	Brushes worn, not fitted correctly, or wrong type.	Replace worn brushes. See that brushes "bed" correctly. (See page 15).
	Starter pinion jammed in mesh with flywheel.	Rotate squared end of starter shaft with spanner. (See page 16). When a squared end is not provided on the starter shaft, the pinion can usually be released by putting the car in gear and rocking it backward and forward. If this method fails, remove starter from car and test its alignment. Remount starter and tighten fixing bolts.
Starter operates but does not crank engine.	Pinion of starter drive does not engage with flywheel, due to dirt on screwed sleeve.	Clean sleeve with paraffin and add a few drops of machine oil. (See page 15).
Starter pinion will not disengage from flywheel when engine is running.	Starter pinion jammed in mesh with flywheel.	Rotate squared end of starter shaft with spanner. (See page 16).

HOW TO LOCATE AND REMEDY LIGHTING TROUBLE.

SYMPTOMS.	PROBABLE FAULT.	REMEDY.
Lamps give insufficient illumination.	Battery discharged.	Charge battery either by a long period of daytime running or from independent electrical supply.
	Lamps out of alignment, or bulbs out of focus.	Align lamps and focus bulbs. (See page 21).
	Bulbs discoloured through use, or reflectors dirty.	Fit new bulbs (see page 19) or clean reflectors. (See page 23).
Lamps light when switched on, but gradually fade out.	Battery discharged.	As above.
Brilliance varies with speed of car.	Battery discharged.	As above.
	Battery connection loose or broken.	Tighten connections, or replace faulty cables.
Lights flicker.	Loose connection.	Locate loose connection and tighten.
Failure of lights.	Fuse blown.	Examine wiring for faulty cables and remedy. Fit replacement fuse. (See page 17).
	Battery discharged.	As above.
	Loose or broken connections.	Locate and tighten loose connection, or re-make broken connection.

LUCAS-C.A.V.-ROTAX

RAPID BATTERY SERVICE

The Quickest and Most Generous Scheme —how you can benefit by this Service.

This original scheme of Battery Service is of vital interest to all owners of cars equipped with a LUCAS, C.A.V. or ROTAX Battery, and is available at all LUCAS—C.A.V.—ROTAX Service Depots (see opposite page) and Official Battery Service Agents (list of the latter forwarded on application). It is simple and straightforward, and has been introduced with the express purpose of providing motorists throughout the country with facilities for rapid Battery Service which will give complete satisfaction to the owner with a minimum loss of time, trouble and expense. Also, it is an addition to the existing 90 days' free Service covering defective materials of workmanship under which any repair or replacement is carried out entirely free of charge.

Battery Exchanged for Brand New One during the First Two Years.

At any time during the first two years' life of a LUCAS, C.A.V. or ROTAX Battery (providing there has been no obvious misuse or accidental damage) you can be supplied with a brand new Battery in exchange for your present one, you paying the proportionate charge of one twenty-fourth of the list price of the new Battery for each month since the Battery to be replaced was first put into service (assuming you are the first and only user). This exchange can be effected in Twenty Minutes as it is not necessary to make an internal examination of your present Battery and this can be immediately replaced with a fully charged one from stock. It will be necessary, of course, to produce some evidence of the date on which your present Battery was first put into Service. It will be understood that the benefit of this arrangement cannot be extended where the Battery has been damaged by accident or obviously misused.

90 Days' Free Battery Service.

Everyone who owns or buys a LUCAS, C.A.V. or ROTAX Battery is entitled—without fee or charge whatever—to the protection and advantages afforded by REGISTERING with any Combined Battery Service Agent.

The Service is organised to relieve you of the trouble of battery care and attention at the most important period of the battery's life, namely, whilst it is new, when the least injurious condition may impair its efficiency and effectively shorten its period of useful life.

During the period of three months following registration, your battery will receive free of charge the specialised technical services of battery engineers trained in our various works in the most up-to-date battery practice. Immediately after the purchase of your car (or within one week of delivery), call at any one of our Battery Service Agents and present the Registration Card which is usually to be found amongst the various literature handed over with the car. Should, by any chance, this card be missing, a copy of this, together with a complete list of our Agents' addresses may be obtained from us. Our Depot or Battery Service Agent will gladly make you a Registered Owner and at once examine and test your Battery, noting and attending in particular to these points :—

- (1) Correcting acid level in all cells.
- (2) Testing and correcting acid gravity.
- (3) Seeing that the terminals are tight and clean.
- (4) Ascertaining whether the dynamo output is correct for its type.

He will also hand you an Inspection Card which will entitle you to two further inspections to be made during the first three months of the Battery's life.

These further inspections need not necessarily be made by the same Battery Service Agent, but if more convenient to you, will be carried out by any Official Battery Service Agent appearing in our list and situated in any part of the country, providing you produce the Inspection Card at the time of your call.

All owners of a new Lucas, C.A.V. or Rotax Battery, whether purchased with new cars or at a later date, are entitled to register and secure the full benefit of this free service.

LUCAS-C.A.V.-ROTAX

SERVICE DEPOTS

All owners are urged to take advantage of the facilities offered by LUCAS-C.A.V.-ROTAX Service.

For the benefit of the users of our equipment we have established Service Depots in all large towns, which are not only at your disposal for repairs, overhauls, and adjustments, but to give free advice. If you experience any difficulty with any part of the equipment, do not hesitate to consult us, we shall be only too pleased to be of assistance. The best course to adopt is to call at our nearest Service Depot, the addresses of which are given below, when the equipment can be examined as a whole.

If it is necessary to replace any part, order Genuine LUCAS-C.A.V.-ROTAX Spares. It is obvious that only the designers and manufacturers of the equipment are in a position to make replacement parts which will give satisfactory and lasting service.

When corresponding with Depots, or when ordering spare parts, give the name, model and year of the car; the unit of equipment; and particular part in question. Units of equipment are identified by letters and numbers stamped or moulded on some part of the article. It is essential to quote this marking to ensure that correct replacements are sent.

Illustrated spare parts lists are available on application. State year, make and model of engine.

BELFAST	3/5, Calvin Street, Mountpottinger
Telephone: BELFAST 7017	Telegrams: "SERVDEP, BELFAST"
BIRMINGHAM, 18 ... ..	... .. Great Hampton Street
Telephone: CENTRAL 8401 (10 lines)	Telegrams: "LUCAS, BIRMINGHAM"
BRIGHTON	85, Old Shoreham Road, Hove
Telephone: PRESTON 3001 (4 lines)	Telegrams: "LUSERV, BRIGHTON"
BRISTOL ... ..	... .. 345, Bath Road
Telephone: BRISTOL 76001 (4 lines)	Telegrams: "KINGLY, BRISTOL"
CARDIFF ... ..	... .. 54a, Penarth Road
Telephone: CARDIFF 4603 (4 lines)	Telegrams: "LUCAS, CARDIFF"
COVENTRY ... ..	... .. Priory Street
Telephone: COVENTRY 3068	Telegrams: "LUCAS, COVENTRY"
DUBLIN	Portland St. North, North Circular Road
Telephone: DRUMCONDRA 434 (6 lines)	Telegrams: "LUSERV, DUBLIN"
EDINBURGH, 11 ... ..	... .. 32, Stevenson Road, Gorgie
Telephone: EDINBURGH 62921 (4 lines)	Telegrams: "LUSERV, EDINBURGH"
GLASGOW ... ..	... .. 227-229, St. George's Road
Telephone: DOUGLAS 3075 (5 lines)	Telegrams: "LUCAS, GLASGOW"
LEEDS ... ..	... .. 64, Roseville Road
Telephone: LEEDS 28591 (5 lines)	Telegrams: "LUSERDEP, LEEDS"
LIVERPOOL, 13 ... ..	... .. 450/456, Edge Lane
Telephone: OLD SWAN 1408 (4 lines)	Telegrams: "LUSERV, LIVERPOOL"
LONDON	Dordrecht Road, Acton Vale, W.3
'Phone: SHEPHERDS BUSH 3160 (10 lines)	'Grams: "DYNOMAGNA, EALUX, LONDON"
LONDON	757-759, High Road, Leyton, E.10
Telephone: LEYTONSTONE 3361 (4 lines)	'Grams: "LUSERDEP, WALT, LONDON"
LONDON	155, Merton Rd., Wandsworth, S.W.18
Telephone: PUTNEY 5131 (6 lines) & 5501	'Grams: "LUSERV, PUT, LONDON"
MANCHESTER ... ..	... .. Talbot Road, Stretford
Telephone: LONGFORD 1101 (5 lines)	Telegrams: "LUCAS, STRETTFORD"
NEWCASTLE-ON-TYNE, 2 ... ..	... .. 64/66, St. Mary's Place
Telephone: CENTRAL 25571 (3 lines)	'Grams: "MOTOLITE, NEWCASTLE-ON-TYNE"

IN ADDITION THERE ARE LUCAS—C.A.V.—ROTAX OFFICIAL BATTERY SERVICE AGENTS, OFFICIAL SPARES STOCKISTS AND DEALERS IN IMPORTANT CENTRES THROUGHOUT THE COUNTRY.

