NOTE ON CARS WHICH ARE TO BE USED OVERSEAS.

Changing over Dipping Reflectors to meet the Right-Hand rule of the road.

In countries where the rule of the road is right-hand (instead of left-hand, as in the United Kingdom), the dipping reflector can be arranged to dip vertically or to the right.

Reflectors which are located to the body by a screw at the top of the rim have an alternative screw hole, for use when the reflector is required to dip vertically.

With the type of reflector located on three supports, fitting the reflector so that the slot marked "R" engages with the top support causes it to dip to the right.

INSTRUCTIONS FOR

LUCAS

ELECTRIC LIGHTING AND STARTING EQUIPMENT & ACCESSORIES

DESIGNED AND MANUFACTURED BY

JOSEPH LUCAS LTD.,

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TELEPHONE: NORTHERN 5201 (12 LINES)
CODES USED: A.B.C. (5TH AND 6TH EDITIONS), BENTLEYS & 2ND BENTLEYS.

TL/102/L *Instruction Booklet No. 219.*

INDEX.

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 Service. A list of Lucas Service Depots is given on page 37.

LUCAS 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 the majority of 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 14, are carried out, this arrangement ensures that the battery is kept in good condition without the possibility of excessive overcharging.

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.

The ignition switch usually takes the form of a key which can be withdrawn when the ignition is switched off, thus ensuring the safety of the car in the absence of the owner.

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 14.

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.

LUCAS-STARTIX AUTOMATIC STARTING.

Lucas-Startix equipment starts the engine automatically immediately the ignition switch is turned on. It restarts the engine whenever it stalls: in traffic, on a hill, free wheeling, when manœuvring; in fact, whenever and as long as the switch remains on. Immediately the engine fires, the starter is automatically switched off. When the engine is stalled, it automatically waits for one second before reclosing the main switch, and so delays restarting until the engine has actually come to rest. In cold weather the delay action automatically frees a sticking starter pinion.

A hand control is provided as an alternative to the automatic control for special and emergency use.

HOW LUCAS-STARTIX EQUIPMENT FUNCTIONS.

The Lucas-Startix switchbox houses two solenoids or electro-magnets with moving plungers. The one solenoid operates the main starter switch, while the other is a trip switch for switching off the starter.

The main starter switch solenoid "A" (Fig. 2) has one winding which is connected to the battery via the control switch. The trip switch coil "B" has two windings, the outer one being energised from the battery through the starter switch, and the inner one being connected to the dynamo terminal.

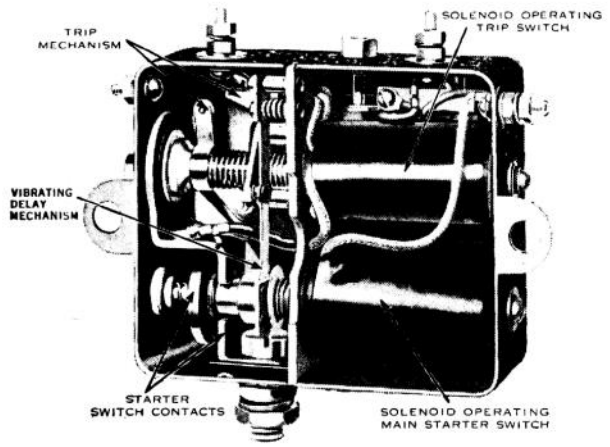


Fig. 1. Interior of Lucas-Startix Switchbox.

When the key in the instrument panel switch is turned to the "auto" position, current from the battery passes through the tungsten contacts "H" to the main switch solenoid. The current passing through the coil pulls its plunger in, which closes the main switch contacts at "C."

This allows current to pass from the battery through the main switch, a single-turn series coil "D," and to the starting motor, and it also energises the outer windings of the trip switch coil. When the engine starts, its increase of speed automatically disengages the starter pinion from the flywheel. The starter motor is now idling and takes a much lower current. Thus the pull due to the series coil "D" is overbalanced by that due to the outer winding of the trip coil, and the trip switch plunger is pulled in. The inward travel of this plunger pulls lever "E" over until it deflects the arm "F," opening the tungsten contacts, breaking the circuit through the solenoid "A," and so switching off the starter.

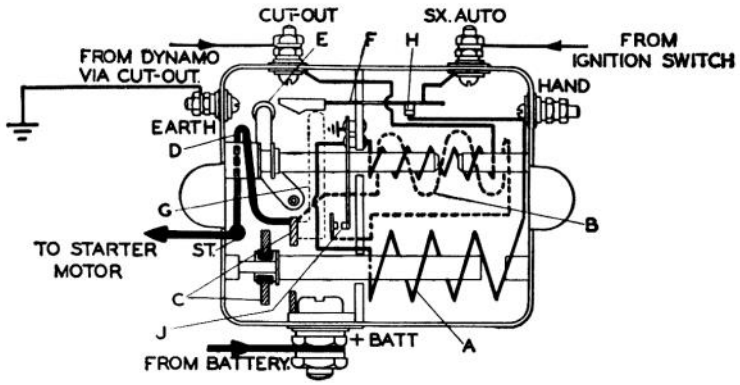


Fig. 2. Internal Connections of Lucas-Startix Switchbox.

The outer winding of the trip coil is now de-energised, but the plunger is held in by the inner winding, which is energised by the dynamo and it remains in this position so long as the engine is running. At speeds below the "cutting-in" speed of the dynamo the winding is connected to the dynamo, via an additional pair of contacts fitted to the cut-out. When the engine speed increases

and the main cut-out contacts close, the auxiliary contacts open and insert a resistance in series with the winding, which limits the "hold-on" current to a fraction of an ampere.

When the engine stops, the dynamo stops generating, and the trip plunger is released. The release of the trip plunger does not, however, immediately reclose the trip contacts "H," for, in the act of moving, the lever "E" flicks the arm "F," causing it to vibrate for one second. Until this vibration has died down the contacts will not pass their normal current. There is thus a period of one second interposed between the instant of release of the plunger and the re-engagement of the starter. Thi enables the engine to come to rest before being restarted.

A similar vibrating delay device is incorporated in the outer trip coil winding circuit. It consists of two contacts "J" one of which is on a spring blade which is set in vibration by a movement of the flange on the solenoid switch plunger immediately this is operated. It delays for an instant the energising of the trip coil winding and so ensures that the trip mechanism does not operate before the starter pinion has time to engage with the flywheel and turn the engine.

Another feature of the **Lucas-Startix** is a thermostatic device which operates if for any reason the engine will not turn with the switch in the "auto" position, *e.g.*, when left in gear with the brakes on. In these circumstances, heating occurs which causes the thermo strip "G" to open the trip contacts periodically. This results in the repeated switching on and off of the starter and the consequent clicking of the switch gives an indication that there is something wrong, thus warning the driver to switch off.

For instructions on operation of Lucas-Startix Equipment, see page 20.

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.

INSTRUMENT PANEL.

The instrument panel houses the control switches, ammeter and ignition warning lamp already described along with other instruments. The instrument faces are illuminated by indirect lighting from concealed lamps. In the majority of panels, sockets are provided to take a Lucas Inspection lamp plug.

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 near-side 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 lamps 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 pivotted 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.

Lucas-Graves Bulb Anti-Dazzle System.

The Lucas-Graves bulb is a special double filament type, either filament of which can be used at will, to give a normal driving beam or an anti-dazzle light as required. The main filament is located at the focus of the reflector in which the bulb is fitted, and is the source of the normal driving beam. The secondary filament is slightly in advance of the main filament, and is provided on its underside with a shield which cuts off all the rays which ordinarily would be reflected upward to cause dazzle. The combination of this forwardly placed filament and the shield, results in a downward projection of a flood of light which is completely non-dazzling, and provides a driving light for an ample distance ahead.

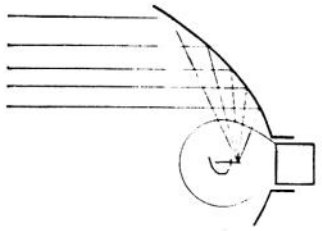


Fig. 3. Main Filament "On" giving Normal Driving Beam.

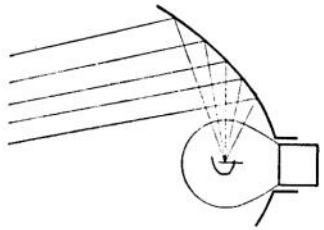


Fig. 4. Secondary Filament "On" giving Anti-dazzle Beam.

The glass front fitted to lamps in which these bulbs are fitted is of special design, consisting of a series of vertical lenses of correct optical curvature, which spread the beam sideways so as to illuminate the full width of the road, and it also diffuses the beam, giving an even field of illumination in the normal or dipped positions.

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 ⅜in. above the top of the plates.
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 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 above the top of the plates, but well short of the bottom of the vent plugs. If acid solution has been spilled, it must be replaced by a diluted sulphuric acid solution of the strength indicated on either the side or the cover of the battery. 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 corrosion. 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 37. 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.

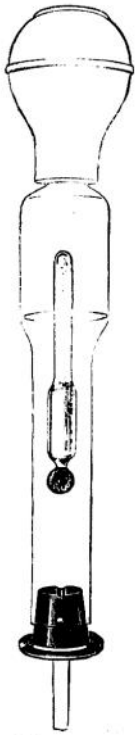


Fig. 5.
Lucas Hydrometer.

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 Lucas 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.

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, leave the charging switch, if possible, in the full charge position for longer periods of running (see page 15). 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 Lucas 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.

In summer, when the lamps are very little used, keep the switch in the "half charge" position and in winter, when the lighting and starting load is heavier, keep the switch in the "full charge" position. For cars running under average conditions, this will ensure that the battery is kept in a fully charged state.

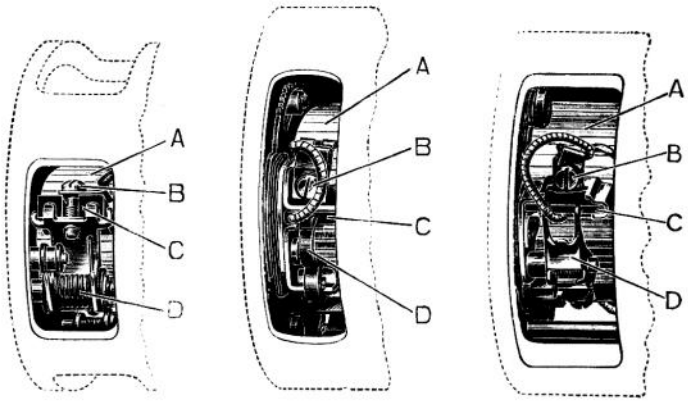
However, in exceptional cases it may be advisable to use the switches out of season. For instance, if, in winter, the car is run regularly during the day with practically no night running, and the hydrometer readings are always found to be about 1.225 or 1.285 (according to the type of battery), and 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.

DYNAMOS AND DYNAMOTORS.

The dynamo (or dynamotor) requires very little attention to ensure satisfactory running. Very occasionally—about every season—examine the brushes and commutator. These are protected by a short metal band cover secured by a screw and nut. When withdrawing the fixing screw, take care not to lose the nut, as the cover is liable to fly open when the screw is released.

Brushgear.

The design of the brushgear on different types of machines varies slightly in design and various types are illustrated in Fig. 6.



(i.) (ii.) (iii.)

Fig. 6. Dynamos with End Covers removed to show Brushgear and Commutator.

A—Commutator.
B—Screw.
C—Brush.
D—Brush spring or spring lever.

Inspect the three brushes and see that they press firmly on to the commutator. With some machines, Fig. 6 (i), the brushes are secured to spring arms; the arms should move freely on their pivots. With other types of machines, Fig. 6 (ii and iii), the brushes are held in holders by spring levers.

With the types as shown in Fig. 6 (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 Lucas 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 Lucas 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 precaution 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 con-

siderable mileage, the dynamo should be dismantled for cleaning, adjustment and repacking the bearings with grease. This should be done preferably by the nearest Lucas Service Depot.

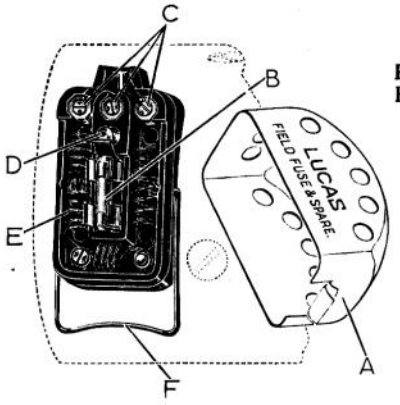


Fig. 7. Dynamo Terminal, Fuse and Resistance Unit, with cover removed.

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. 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 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. If it has blown, 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 Lucas standard fuse as originally fitted. The size of the fuse is marked on a coloured paper slip which can be seen inside the fuse.

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 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.

Most 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 8). If it is a tight fit, lever it off with a screwdriver.

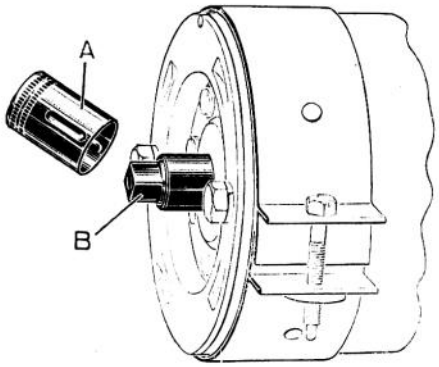


Fig. 8. Squared End of Starter Shaft with Cover removed.
A—Metal cover. B—Squared end of shaft.

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.

OPERATION OF LUCAS-STARTIX AUTOMATIC STARTING EQUIPMENT.

Make sure the gear lever is in neutral, and adjust the throttle, choke and ignition timing controls to the normal starting positions.

Auto Position.

Turn the switch key to the "auto" position for automatic starting. Use this position for normal running.

Hand Position.

For non-automatic starting, turn the key to the hand position. This switches on the ignition only. Then press the button firmly; this controls the starter motor, and should be released as soon as the engine fires.

Use this position in the following circumstances :—

(1) To read petrol gauge (electrically operated types), etc., when you do not want to start the engine.

(2) When the engine is left running unattended, e.g., when the engine is warming up first thing in the morning. Otherwise variations in carburetter conditions, which would be corrected by the driver when present, may result in the engine ceasing to fire, the starter cranking continuously, and, in the end, a discharged battery.

(3) If the battery is so nearly run down that it is necessary to start by hand cranking. Under these conditions the car cannot be started automatically.

(4) If the dynamo will not charge. **Lucas-Startix** is designed so that the dynamo keeps the starter out of action. If the dynamo fails to charge, for any reason, the starter tries intermittently to re-engage with the flywheel, and so immediately advises the driver that the dynamo needs attention. No damage will be done to the flywheel under these conditions. In abnormal circumstances, of which the above is one example, turn the switch into the "hand" position.

It should be remembered that whenever the engine stops, **Lucas-Startix** automatically cranks the engine. It is important, therefore, when the engine stalls in gear, to declutch so as to obtain normal starting conditions.

If, when the switch is in the "auto" position, the starter operates repeatedly, this may be due to incorrect throttle opening. In this case the throttle opening should be re-set. Should this not be effective, the reason should be investigated.

The Lucas-Startix Automatic Switch is adjusted to the correct setting at the works, and, as it requires no further attention, it is sealed. In the unlikely event of trouble occurring in the unit, the seal should not be broken, but the complete unit should be returned to the nearest Service Depot for examination.

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 letters and the cable ends by coloured sleevings. 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.

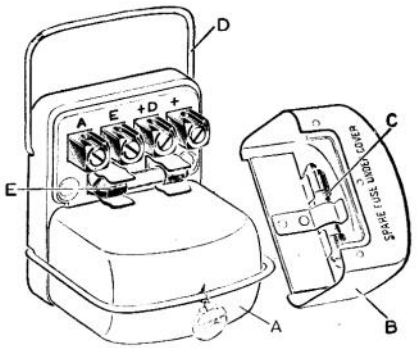


Fig. 9. Cut-out and Fuse Type CF3.

A.—Cut-out cover.
B.—Fuse cover.
C.—Spare fuse.
D.—Clip for securing fuse cover.
E.—Fuse in auxiliary accessories circuits.

Replacement of Fuses.

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 Lucas Service Depot.

Type CF3 Unit (Fig. 9). The fuse in this unit is in the accessories circuits and the indication that it has blown will be the failing of the horn or any other electrical accessory connected to the "+" and "E" terminals. Remove the fuse from its holder, and see whether there

is a break in the fuse wire. If it has blown, replace with the spare fuse "C."

Type CJF Unit (Fig. 10). There are three fuses, of the cartridge type in this unit, which protect the equipment in the event of short circuits. One, marked "H," protects the head lamps; another, marked "S & T," the side and tail lamps; and the third, marked "AUX," the circuits of the auxiliary accessories, which include the horn, electric windscreen wiper, etc.

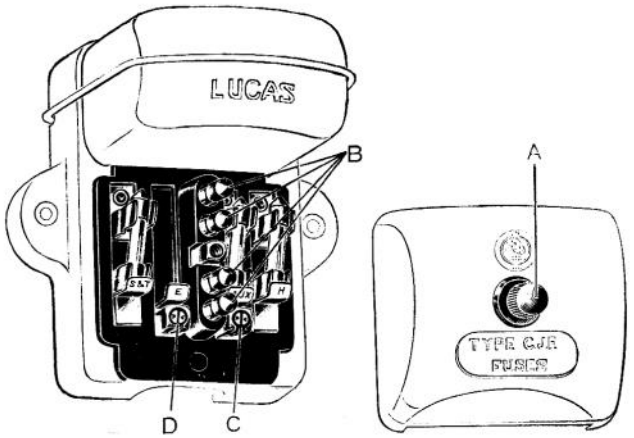


Fig. 10. Combined Cut-out and Junction Box Type CJF.

A.—Cover fixing screw.
B.—Spare fuses.
C.—Terminal for connecting horn, windscreen wiper and other extra accessories.
D.—Earthing terminal.

If the head lamps, or the side and tail lamps, or all the units connected to the auxiliary accessory terminal fail to function, examine the particular fuse protecting them. Replace with one of the spare fuses provided.

Wiring Extra Accessories.

When fitting extra accessories to the car they should be wired to the combined junction box, cut-out and fuse unit, usually mounted on the engine side of the dash.

With the CJF unit (Fig. 10), the accessories should be wired to the terminals marked "AUX" & "E."

With the CF3 unit, (Fig. 9), the terminals marked "+" and "E" are utilized.

When wiring up accessories to these units, the fuse should be removed while wiring is being carried out.

With equipments that do not include one of the above junction box units, accessories must be connected to the terminals at the back of the switchbox or instrument panel. The supply terminal is usually marked "A" and the earthing terminal is marked "E." If an earthing terminal is not provided, the negative lead must be secured in good electrical contact with a metal part of the chassis.

With insulated return sets, the negative terminal is marked "—B."

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

> Bare about ⅜in. of the cable, twist the wire strands together and turn back about ¼in. 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.

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 Lucas 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.—The fronts of most types of head lamps are secured by means of a screw "B" (Fig. 11). 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. With some lamps, the reflector is fixed to the lamp front and the bulb holder is secured to the reflector by means of a spring fixing. To remove the bulb holder, press down the ends of the securing spring and withdraw them from the slots in which they locate.

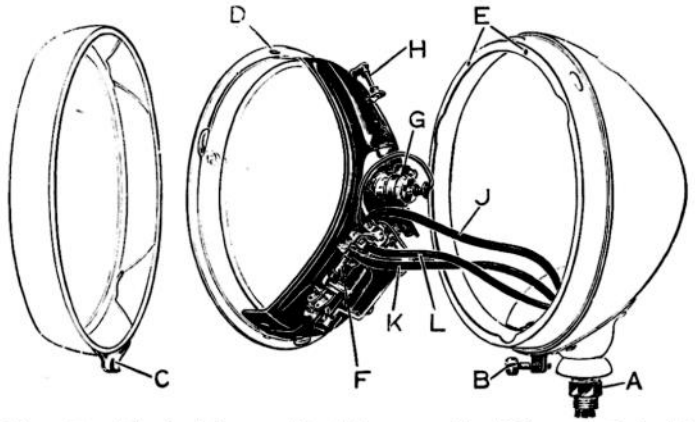


Fig. 11.—Typical Lucas Head Lamp with "Dip and Switch" Reflector, Dismantled.

A—Locking nut for adjustable mounting.
B—Front fixing screw.
C—Slot.
D—Reflector fixing screw.
E—Alternative locations for reflector fixing screw.
F—Fuse.
G—Clamping clip for focussing adjustment.
H—Spare fuse.
J—Cable to distribution box or switch box.
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 hinged brackets. To replace a bulb, the bracket can be moved upwards, leaving the bulb 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 (Fig. 12) while with other

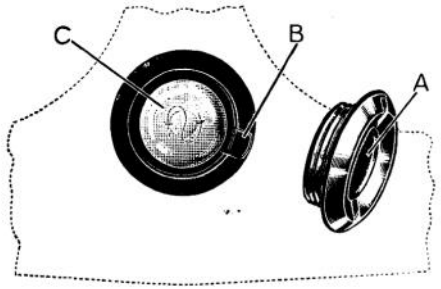


Fig. 12.—Ignition Warning Lamp with Screw-on Front.
A—Warning lamp front.
B—Tab to facilitate bulb removal.
C—Bulb.

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. 11) 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 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.

It should be noted that head lamps fitted with Lucas-Graves double filament bulbs do not require focussing. These bulbs are specially standardised, so that when a replacement bulb is fitted, the filament will be at the focus of the reflector. It is, however, of the utmost importance that the lamps be aligned so that the normal driving beams are projected straight ahead, *i.e.*, parallel to the road and to each other.

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 mechanism. 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 Lucas 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 Lucas 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 Lucas Service Depot for examination.

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, 20 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 18).
	Commutator greasy or dirty.	Clean with soft rag moistened in petrol. (See page 17).
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 16).
	Brushes worn, not fitted correctly, or wrong type.	Replace worn brushes. See that brushes "bed" correctly. (See page 16).
Ammeter gives high charge reading.	Dynamo giving high output due to:—	
	Loose connections 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 12).
	Brushes not fitted correctly.	See that brushes "bed" correctly. (See page 16).
	Control brush position altered.	Have control brush adjustment re-set at nearest Lucas Service Depot.

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

HOW TO LOCATE AND REMEDY STARTER MOTOR TROUBLE.

CONDITION.	PROBABLE FAULT.	REMEDY.
	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.
Motor sluggish or fails to move engine.	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 18).
	Brushes worn, not fitted correctly or wrong type.	Replace worn brushes. See that brushes "bed" correctly. (See page 18).
	Starter pinion jammed in mesh with flywheel.	Rotate squared end of starter shaft with spanner. (See page 19).
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 19).
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 19).

HOW TO LOCATE AND REMEDY TROUBLE IN LUCAS-STARTIX AUTOMATIC STARTING EQUIPMENT.

SYMPTOMS.	PROBABLE FAULT.	REMEDY.
Starter will not turn engine or operates intermittently.	Battery discharged.	Crank engine by hand.
	Faulty battery connections.	Examine connections. Tighten if necessary.
	Stiff engine.	If possible, crank engine by hand. Locate and remedy cause of engine stiffness.
	Faulty earthing of Lucas-Startix switchbox unit.	See that case of unit is secured to metal part of chassis or connection taken from case to chassis. On some models, an earthing terminal is provided.
Starter operates when engine is running and switch is in "Auto" position.	Idling speed set lower than cranking speed. (Happens particularly when engine is hot and battery is fully charged).	Set throttle for higher idling speed.
	Dynamo not charging or output low, due to: (1) Loose or broken connections in dynamo charging circuit. (2) Field fuse blown. (3) Dynamo brushes and commutator greasy or dirty.	Check charging circuit wiring, particularly battery connections. Tighten connection or fit new lead. Fit replacement fuse. Clean commutator and brushes. See that brushes are free in holders. (See page 16).
	Faulty connection between dynamo and Lucas – Startix switchbox unit.	Examine connection from cut-out unit to "Cut-out" terminal on Lucas-Startix switchbox unit.
	Starter brushes sticking, or commutator dirty.	Clean commutator, brushes and inside holders. See that brushes are free in holders. (See page 16).
	Faulty earthing of Lucas-Startix switchbox unit.	See that case of unit is secured to metal part of chassis or connection taken from case to chassis. On some models, an earthing terminal is provided.

NOTE.—If fault cannot be located and remedied, use "HAND" position and visit nearest Lucas Service Depot, so that the equipment can be examined and re-adjusted, if necessary.

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 27).
	Bulbs discoloured through use, or reflectors dirty.	Fit new bulbs (see page 24) or clean reflectors. (See page 29).
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 23).
	Battery discharged.	As above.
	Loose or broken connection.	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 or workmanship under which any repair or replacement is carried out entirely free of charge.

Battery Exchange 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 affected 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.

LUCAS
SERVICE DEPOTS

In the event of any difficulty with any part of the equipment, no matter how trivial, we shall be only too pleased to give every assistance possible. The best course to adopt is to call at the nearest Lucas Service Depot, the addresses of which are given below, when the equipment can be examined as a whole. The depots are not only at your disposal for repairs, overhauls and adjustments, but to give free advice. If it is necessary, however, to communicate, or when ordering spare parts, always give the type and number of the unit in question, the make and, if possible, the date of the car on which it is fitted.

BELFAST ... ... **3/5, Calvin Street, Mount Pottinger**
Telephone: BELFAST 7017 Telegrams: "SERVDEP, BELFAST"

BIRMINGHAM, 18 ... ... **Great Hampton Street**
Telephone: CENTRAL 8401 (10 lines) Telegrams: "LUCAS, BIRMINGHAM"

BRIGHTON ... ... **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 & 3841 Telegrams: "LUCAS, COVENTRY"

DUBLIN ... **Portland Road 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 ... ... **450/456, Edge Lane**
Telephone: OLD SWAN 1408 (4 lines) Telegrams: "LUSERV, LIVERPOOL"

LONDON ... ... **Dordrecht Road, Acton Vale, W.3**
Telephone: SHEPHERD'S BUSH 3160 (10 lines)
Telegrams "DYNOMAGNA, ACT, LONDON"

LONDON ... ... **759, High Road, Leyton, E.10**
Telephone: LEYTONSTONE 3361 (3 lines)
Telegrams: "LUSERDEP, WALT, LONDON"

LONDON ... **155, Merton Road, Wandsworth, S.W.18**
Telephone: PUTNEY 5131 (6 lines) and 5501
Telegrams: "LUSERV, WANDS, LONDON"

MANCHESTER ... ... **Talbot Road, Stretford**
Telephone: LONGFORD 1101 (5 lines) Telegrams: "LUCAS, STRETFORD"

NEWCASTLE-ON-TYNE, 2 ... ...**64/66, St. Mary's Place**
Telephone: CENTRAL 25571 (3 lines)
Telegrams: "MOTOLITE, NEWCASTLE-ON-TYNE"

IN ADDITION THERE ARE LUCAS-C.A.V.-ROTAX OFFICIAL BATTERY SERVICE AGENTS IN IMPORTANT CENTRES THROUGHOUT THE COUNTRY. LIST ON APPLICATION.