

**SECTION L-3 Part A**  
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and Section L-1, Part B, Page 1*

# LUCAS

*Quality*

# EQUIPMENT

VOLUME 2

# WORKSHOP INSTRUCTIONS

## MOTOR CYCLE CONTROL BOX

### MODEL MCR2



JOSEPH LUCAS LTD · BIRMINGHAM 19 · ENGLAND

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# LUCAS WORKSHOP INSTRUCTIONS

## CONTROL BOX

MODEL MCR2

INCORPORATING C.V.C. REGULATOR TYPE LRT9

### 1. GENERAL

The control box houses the generator voltage regulator unit and the cut-out.

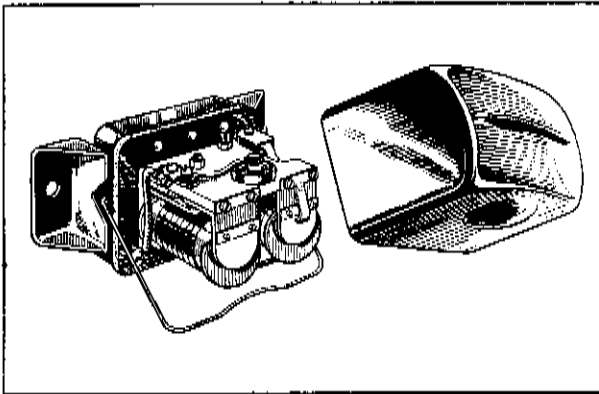


Fig. 1.

Control box with cover removed

Although combined structurally, the regulator and cut-out are electrically separate. Both are accurately adjusted during manufacture, and the cover protecting them should not be removed unnecessarily.

Terminal connections to the control box are made with plug-in cable ferrules which, to avoid incorrect or loose connections, are clamped in position by a non-reversible plate.

Tightness of terminal connections and good electrical contact are important points to ensure satisfactory operation of the control box. A defective earth connection can cause overheating and damage to the generator. It is important therefore that both ends of the earthing cable from control box terminal (E) are kept tightly secured.

#### THE REGULATOR

The regulator unit is arranged to work in conjunction with the shunt-wound generators described in SECTION L-2. The regulator is set to maintain a predetermined generator voltage at all speeds above the regulating point, the field strength being controlled by the automatic insertion of a resistance in the generator field circuit. When the generator voltage reaches a predetermined value, the magnetic flux in the regulator core due to the shunt or voltage winding becomes sufficiently strong to attract the armature to the core. This causes a pair of contacts to open and insert a resistor in the field circuit.

The consequent reduction in field current lowers the generator voltage and this, in turn, weakens the

magnetic flux in the regulator core. The armature therefore returns to its original position, thus closing the contacts, so that the voltage returns to the predetermined maximum. The cycle is then repeated, and an oscillation of the armature is maintained.

As the speed of the generator rises above that at which the regulator comes into operation, the amplitude of vibration increases and the periods of contact separation increase in length, with the result that the mean value of the generator output undergoes practically no increase once this regulating speed has been attained.

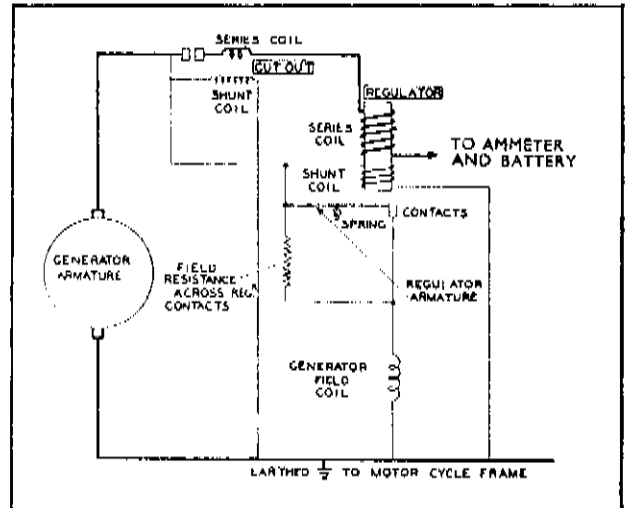


Fig. 2.

Schematic diagram of C.V.C. charging circuit

The series or current winding provides a compensation on this system of control, for if the control were arranged entirely on the basis of voltage there would be a risk of very seriously overloading the generator when the battery was in a low state of charge, particularly if the lamps were simultaneously in use. Under these conditions of reduced battery voltage, the output to the battery rises and, but for the series winding, would exceed the normal rating of the generator. The magnetism due to the series winding assists the voltage winding, so that when the generator is delivering a heavy current into a discharged battery the regulator comes into operation at a somewhat reduced voltage, thus limiting the output accordingly. By means of a temperature compensation device, the voltage characteristic of the generator is caused to conform more closely to that of the battery under



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all climatic conditions. In cold weather the voltage required to charge the battery increases, whilst in warm weather the voltage of the battery is lower. The method of compensation takes the form of a bimetallic spring located behind the tensioning spring of the regulator armature. The bimetallic spring causes the operating voltage of the regulator to be increased in cold weather and reduced in hot weather, and thereby to compensate for the variations in charging current which would otherwise occur due to the changing characteristics of the battery. The bi-metallic spring also compensates for effects due to increases in resistance of the copper windings from cold to working temperatures.

## THE CUT-OUT

The cut-out is an automatic switch connected between generator and battery. It consists of a pair of contacts held open by a spring and closed magnetically when the engine is running fast enough to cause the generator voltage to exceed that of the battery. The battery will then be charged by the generator. On the other hand, when the speed is low or the engine is stationary the contacts open, thus disconnecting the generator from the battery and preventing a reverse current flowing from the battery through the generator windings. Like the regulator, operation of the cut-out is temperature-controlled by means of a bi-metallic tensioning spring.

## 2. SETTING DATA

### (a) CUT-OUT

Cut-in voltage:	6.3—6.7 volts
Drop-off voltage:	4.5—5.0 volts
Reverse current:	3.0—5.0 amps.

### (b) REGULATOR—Setting on open circuit.

10°C. (50°F.):	7.7—8.1 volts
20°C. (68°F.):	7.6—8.0 volts
30°C. (86°F.):	7.5—7.9 volts
40°C. (104°F.):	7.4—7.8 volts

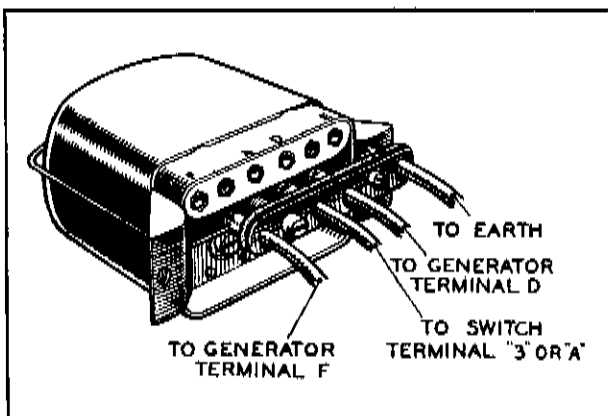


Fig. 3.  
External connections to control box

## 3. SERVICING

### (a) TESTING IN POSITION TO LOCATE FAULT IN CHARGING CIRCUIT

If the procedure given in SECTION L-2 shows the generator to be in order, proceed to check further as follows:

(i) First ensure that the wiring between battery and regulator is in order. To do this, disconnect the wire from the A terminal of the control box and connect the end of the wire removed to the negative terminal of a voltmeter. If necessary, remove the Control Box from the motor cycle.

NOTE These instructions are written for motor cycles fitted with positive-earth batteries. They will apply also to negative-earth machines if the stated polarity of any voltmeter connection is reversed.

Connect the positive voltmeter terminal to an earthing point on the motor cycle frame. If a voltmeter reading is given, the wiring is in order and the regulator must be examined.

(ii) If there is no reading, examine the wiring between battery and control box for defective cables or loose connections.

(iii) Re-connect the wire to terminal A.

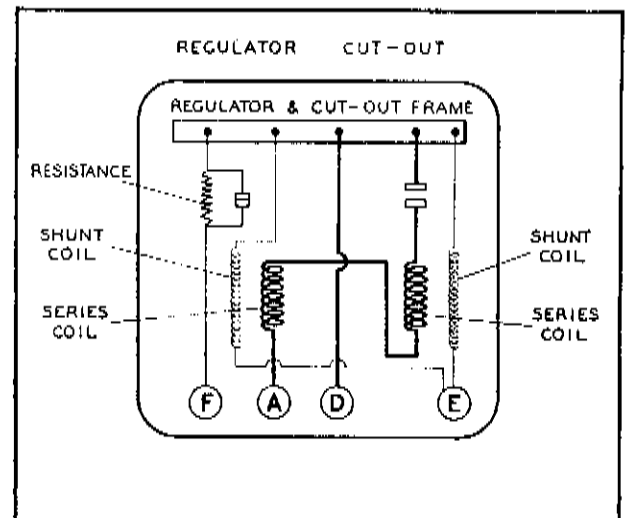


Fig. 4.  
Internal connections of control box

### (b) REGULATOR ADJUSTMENT

The regulator is carefully set during manufacture to suit the normal requirements of standard equipment and, in general, it should not be necessary to make further adjustments. However, if the battery does not keep in a charged condition, or if the generator output does not fall when the battery is fully charged it may be advisable to check the setting and re-adjust if necessary.



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It is important before altering the regulator setting on account of the battery being in a low state of charge, to check that its condition is not due to a battery defect or to a slipping generator drive.

## (i) ELECTRICAL SETTING

It is important that a good quality MOVING COIL VOLTMETER (0-10 volts) be available before attempting to adjust the regulator.

Disconnect the battery or, with coil ignition machines, disconnect control box terminal (A) Fig. 4; alternatively, place a piece of paper between the cut-out contacts, making sure that no paper fibres are left behind after removal.

Connect the negative lead of the moving coil voltmeter to the D terminal on the regulator (or generator), and connect the other lead from the meter to a convenient earth, e.g. control box terminal E.

Slowly increase the speed of the engine until the voltmeter needle "flicks" and then steadies; this should occur at a voltmeter reading between the limits given in Para. 2(b) on Page 2 for the appropriate temperature of the regulator.

If the voltage at which the reading becomes steady occurs outside these limits, the regulator must be adjusted.

Shut off the engine and remove the control box cover.

Refer to Fig. 5 and release locknut (A) holding adjusting screw (B) and turn the screw in a clockwise direction to raise the setting or in an anti-clockwise direction to lower the setting. Turn the screw a fraction of a turn only at a time and then tighten the

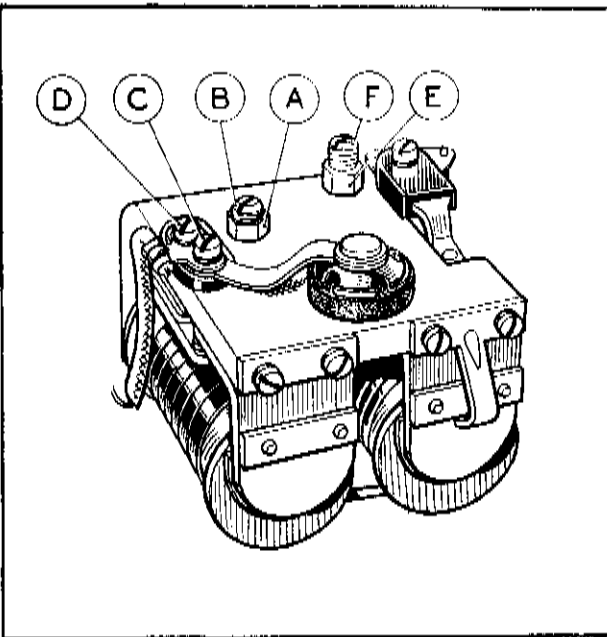


Fig. 5.  
Regulator and cut-out assembly

locknut. Repeat the open-circuit voltage test above until the correct setting is obtained.

Remake the original connections.

When the generator is run at a high speed on open circuit, it builds up a high voltage. Therefore, when adjusting the regulator, do not run the engine up to more than half throttle or a false voltmeter reading will be obtained. The adjustment should be completed within 30 seconds, otherwise heating of the shunt winding will cause an inaccurate setting to be made.

## (ii) MECHANICAL SETTING

The mechanical or air-gap settings of the regulator are accurately adjusted before leaving the works and provided that the armature carrying the moving con-

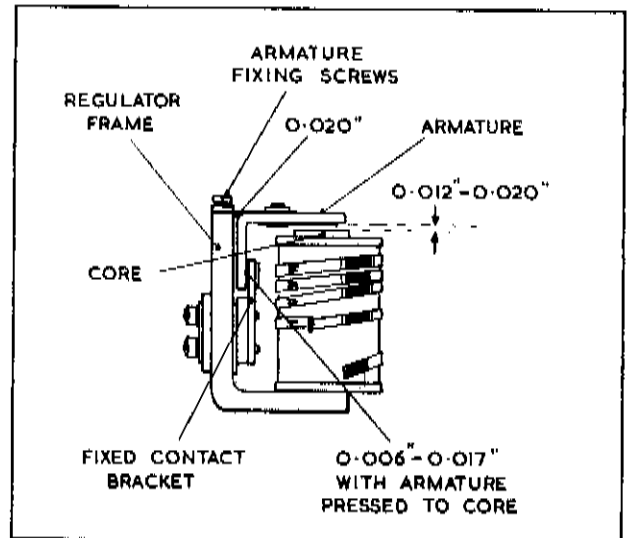


Fig. 6.  
Mechanical settings of regulator

tact is not removed, the regulator will not require further adjustment. If, however, the armature has been removed from the regulator, proceed as follows:—

Slacken the two armature fixing screws and also adjusting screw B. Insert a 0.020" feeler gauge between the back of the armature and the regulator frame. It is permissible for this gap to taper, either upwards or downwards, between the limits of 0.018" to 0.022".

With gauge in position, press back the armature against the regulator frame and tighten the two armature fixing screws. Remove the gauge and check the gap between the shim on the underside of the armature and the top of the core. This gap should be .012"—.020". If the gap is outside these limits correct by carefully bending the fixed contact bracket.

Remove the gauge and press the armature down, when the gap between the contacts should be .006"—.017".



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## (iii) CLEANING CONTACTS

After long periods of service it may be found necessary to clean the regulator contacts. These are made accessible by slackening the screws securing the plate carrying the fixed contact. It will be necessary to slacken the upper screw (C) a little more than the lower (D) so that the contact plate can be swung outwards (see Fig. 5). Clean the contacts with fine carborundum stone or fine emery cloth.

Carefully wipe away all traces of dust or other foreign matter with methylated spirits (de-natured alcohol). Re-position the contact plate and tighten the securing screws.

## (c) CUT-OUT ADJUSTMENT

### (i) ELECTRICAL SETTING

If the regulator setting is within the correct limits, but the battery is still not receiving current from the generator, the cut-out may be out of adjustment.

To check the voltage at which the cut-out operates, remove the control box cover and connect the voltmeter between terminals D and E. Start the engine and slowly increase its speed until the cut-out contacts are seen to close, noting the voltage at which this occurs. This should be between 6.3 and 6.7 volts at a fairly low engine speed.

If operation of the cut-out takes place outside these limits, it will be necessary to adjust. To do this, slacken the locknut (E) on the cut-out adjusting screw (F) and turn the screw in a clockwise direction to raise the voltage setting or in an anti-clockwise direction to reduce the setting. Turn the screw only a fraction of a turn at a time and tighten the locknut. Test after each adjustment by increasing the engine speed and noting the voltmeter reading at the instant of contact closure. Electrical settings must be made as quickly as possible to obviate temperature-rise effects.

If the cut-out fails to operate, there may be an open circuit in the wiring of the unit, in which case it should be removed for examination or replacement.

### (ii) MECHANICAL SETTING

If for any reason the armature has to be removed from the cut-out frame, care must be taken to obtain the correct air-gap settings on reassembly. These can be obtained as follows:

Slacken the two armature fixing screws, adjusting screw F and the screw securing the fixed contact.

Insert a 0.014" gauge between the back of the armature and the cut-out frame. (The air gap between the core face and the armature shim should now measure 0.011" - 0.015". If it does not, fit a new armature assembly.) Press the armature back against the gauge and tighten the armature fixing screws. With the gauge still in position, set the gap between the armature and the stop plate arm to 0.030" - 0.034" by carefully bending the stop plate arm. Remove the gauge and tighten the screw securing the fixed contact.

Insert a 0.025" gauge between the core face and the armature. Press the armature down on to the gauge. The gap between the contacts should now measure 0.002" to 0.006" and the drop-off voltage should be between the limits given in para. 2(a). If necessary, adjust the gap by carefully bending the fixed contact bracket.

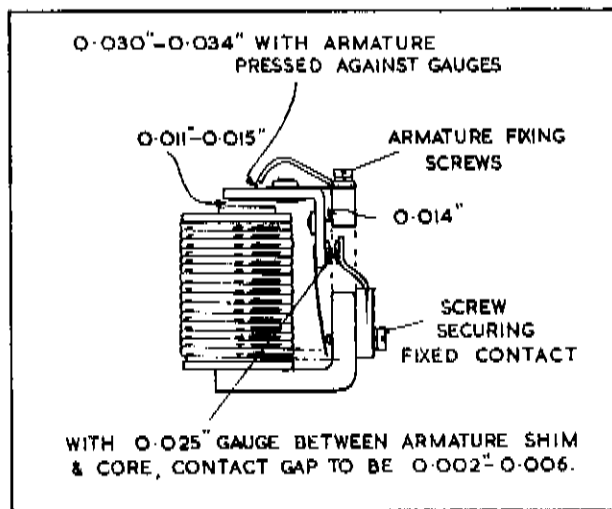


Fig. 7.  
Mechanical settings of cut-out

## (iii) CLEANING CONTACTS

If the cut-out contacts appear burnt or rough, place a strip of fine glass paper between the contacts then, with the contacts closed by hand, draw the paper through. This should be done two or three times with the rough side towards each contact. Wipe away all dust or other foreign matter, using a clean fluffless cloth moistened with methylated spirits (de-natured alcohol). Do not use emery cloth or a carborundum stone for cleaning cut-out contacts.



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## EQUIPMENT

VOLUME 2

### WORKSHOP INSTRUCTIONS

#### MOTOR CYCLE CONTROL BOX

MODEL RB107



JOSEPH LUCAS LTD · BIRMINGHAM 19 · ENGLAND

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# LUCAS WORKSHOP INSTRUCTIONS

## CONTROL BOX

### MODEL RB107

#### 1. GENERAL

In model RB107 control box, the regulator and cut-out contacts are positioned, for ease of access, above their respective armatures. It will be noticed that some of the internal electrical joints are resistance brazed.

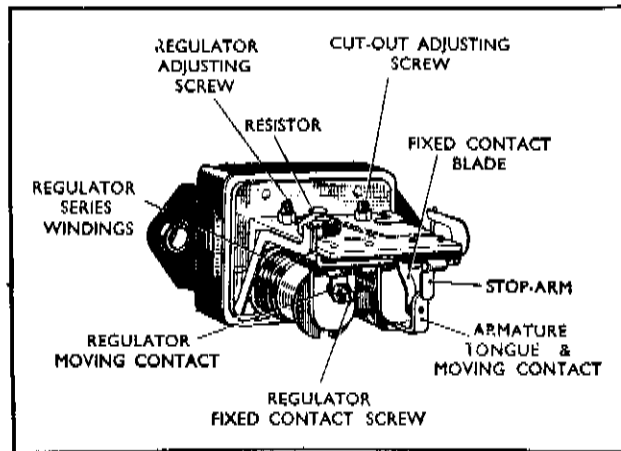


Fig. 1  
Control box with cover removed

#### 2. SETTING DATA

##### (a) CUT-OUT

Cut-in voltage ... ..	6.3—6.7 volts
Drop-off voltage ... ..	4.8—5.3 volts
Reverse Current ... ..	3.0—5.0 amp.

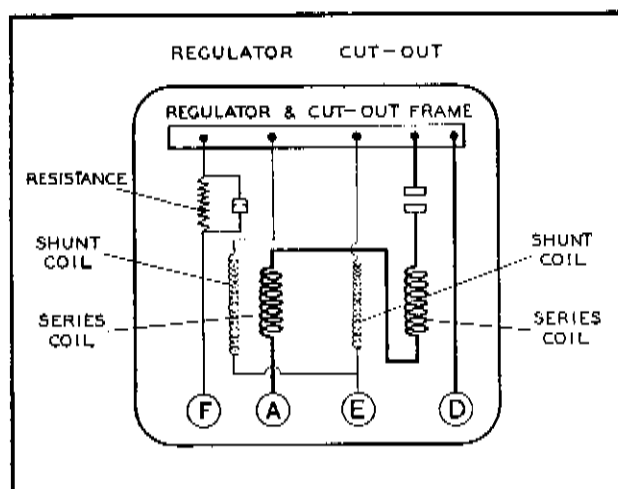


Fig. 2  
Internal connections of control box

##### (b) REGULATOR

Setting on open circuit relative to ambient temperature:

10°C. (50°F.) ... ..	7.7—8.1 volts
20°C. (68°F.) ... ..	7.6—8.0 volts
30°C. (86°F.) ... ..	7.5—7.9 volts
40°C. (104°F.) ... ..	7.4—7.8 volts

#### 3. SERVICING

Before making any adjustment to the regulator, ensure that the dynamo, dynamo drive and battery are in order. When a sound battery does not keep in a charged condition, or if the dynamo output does not fall when the battery is fully charged, the following procedure should be adopted:

##### (a) CHECKING THE WIRING BETWEEN BATTERY AND CONTROL BOX.

Remove the control box from its mountings and withdraw the cable from terminal 'A' and connect it to the negative terminal of a voltmeter.

Connect the positive terminal of the voltmeter to an earthing point on the machine. If a voltmeter reading is given, the circuit from the battery to terminal 'A' is in order.

If there is no voltmeter reading, examine the wiring between the battery and the control box for defective cables or loose connections. Re-connect the cable to terminal 'A'.

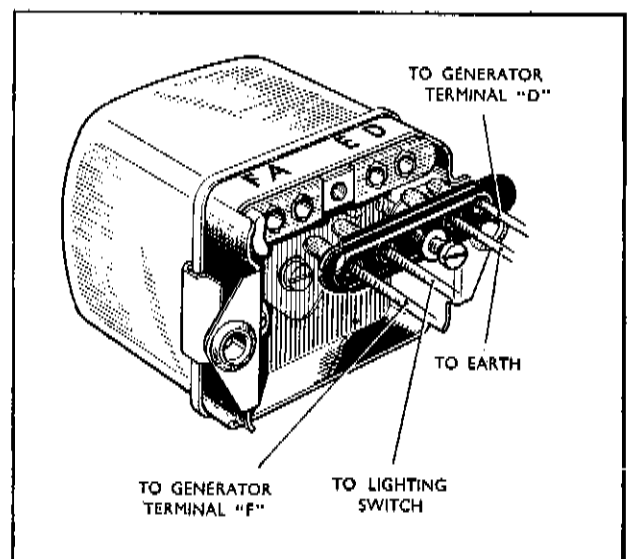


Fig. 3  
External connections to control box



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Check that the dynamo terminal 'D' is connected to control box terminal 'D' and that the cable is in good condition. Similarly, check the cable between terminals 'F' at the dynamo and control box.

## (b) REGULATOR ADJUSTMENT

### (i) Checking the electrical setting.

The regulator is carefully set during manufacture and, in general, it should not be necessary to make further adjustment. If, however, the charging system is suspected it is important that only a good quality MOVING COIL VOLTMETER (0—20 volts) is used to check the system. The electrical setting of the regulator can be checked without removing the cover from the control box.

Withdraw the plug-in connectors a small distance so that a voltmeter connection can be made to terminals 'D' and 'E'.

Connect the negative lead of the voltmeter to control box terminal 'D' and the positive lead to terminal 'E'. Remove the negative terminal from the battery. If coil ignition is fitted, run a temporary connection from the negative terminal of the battery to the 'SW' terminal of the coil.

With the ignition switch in the 'OFF' position start the engine. Slowly increase the speed of the engine until the voltmeter needle 'flicks' and then steadies. Note the reading and stop the engine. If the voltage lies outside the limits given in para. 2 (b), the regulator setting must be adjusted.

If the voltage is within the limits, examine the cut-out as described in para. 3 (c).

### (ii) Adjusting the electrical setting.

Adjustment of the regulator requires removal of the control box cover. This is facilitated by removing the control box from the machine and providing temporary connections. Loosen the control box cover securing clips by slackening the securing screws set in the base of the control box and lift off the cover.

It is important that regulator adjustments are carried out with the control box supported in a similar position to that on the machine.

Restart the engine.

Slacken the locknut of the regulator adjusting screw (see Fig. 1) and turn the screw in a clockwise direction to raise the setting or an anti-clockwise direction to lower the setting. Turn the screw only a fraction of a turn at a time and then tighten the locknut. Repeat as above until the correct setting is obtained.

Adjustment of regulator open-circuit voltage should be completed within 30 seconds, otherwise heating of the shunt winding will cause false settings to be made. Stop the engine.

Remake the original connections and replace the cover. Ensure that the cover seats correctly on the sealing washer.

**Note:** A dynamo run at high speed on open circuit will build up a high voltage. Therefore, when adjusting the regulator, do not run the engine up to more than half throttle or a false setting will be made.

### (iii) Adjusting the mechanical setting.

The mechanical or air-gap settings of the regulator, shown in Fig. 4, are accurately adjusted before leaving the works and, provided that the armature carrying the moving contact is not removed, these settings should not be tampered with. If, however, the armature has been removed, the regulator will have to be reset. To do this proceed as follows:

Slacken the fixed contact locking nut and unscrew the contact screw until it is well clear of the armature moving contact.

Slacken the locking nut on the voltage adjusting screw and unscrew the adjuster until it is well clear of the armature tension spring.

Slacken the two armature assembly securing screws.

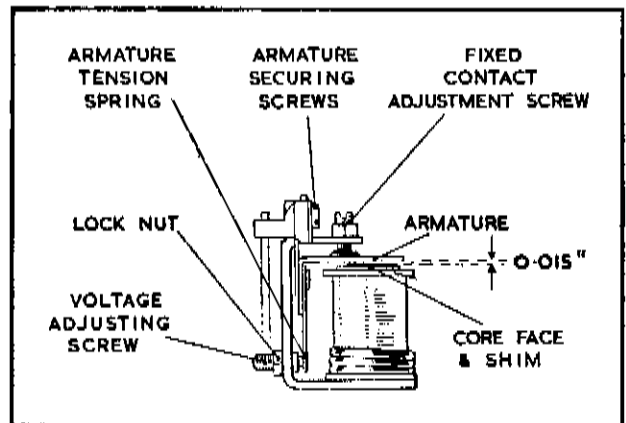


Fig. 4  
Mechanical settings of regulator

Using a 0.015" thick feeler gauge, wide enough to cover completely the core face, insert the gauge between the armature and core shim, taking care not to turn up or damage the edge of the shim.

Press the armature **squarely** down against the gauge and re-tighten the two armature assembly securing screws.

With the gauge still in position, screw the adjustable contact down until it just touches the armature contact. Re-tighten the locking nut.

Re-set the voltage adjusting screw as described under para. 3 (b) (ii).





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## (iv) Cleaning contacts.

After long periods of service it may be found necessary to clean the regulator contacts. Clean the contacts using fine carborundum stone or fine emery cloth.

Carefully wipe away all traces of dust or other foreign matter with methylated spirits (de-natured alcohol).

## (c) CUT-OUT ADJUSTMENT

### (i) Checking the electrical setting.

If the regulator is correctly set but the battery is still not being charged, the cut-out may be out of adjustment.

Replace the control box in the testing position, remake the temporary connections and remove the control box cover. Connect a voltmeter between terminals 'D' and 'E'.

Start the engine and slowly increase the speed until the cut-out contacts close. Note the voltage at which this occurs and stop the engine.

This should be 6.3—6.7 volts. If the operation of the cut-out takes place outside these limits, it will be necessary to adjust.

### (ii) Adjusting the electrical setting.

Restart the engine.

Slacken the locknut securing the cut-out adjusting screw and turn the adjusting screw in a clockwise direction to raise the voltage setting or in an anti-clockwise direction to reduce the setting.

Turn the screw only a fraction of a turn at a time and then tighten the locknut. Test after each adjustment by increasing the engine speed and noting the voltmeter reading at the instant of contact closure.

Stop the engine.

Electrical setting of the cut-out like the regulator, must be made as quickly as possible because of temperature-rise effects.

**Note:** If the cut-out does not operate, there may be an open circuit in the wiring of the cut-out and regulator unit, in which case the unit should be removed for examination or replacement.

### (iii) Adjusting the mechanical setting.

If for any reason the cut-out armature has to be removed from the frame, care must be taken to obtain the correct air-gap settings on re-assembly. These can be obtained as follows:

Slacken the adjusting screw locking nut and unscrew the cut-out adjusting screw until it is well clear of the tension spring.

Slacken the two armature securing screws.

Press the armature **squarely** down against the copper-sprayed core face and re-tighten the armature securing screws.

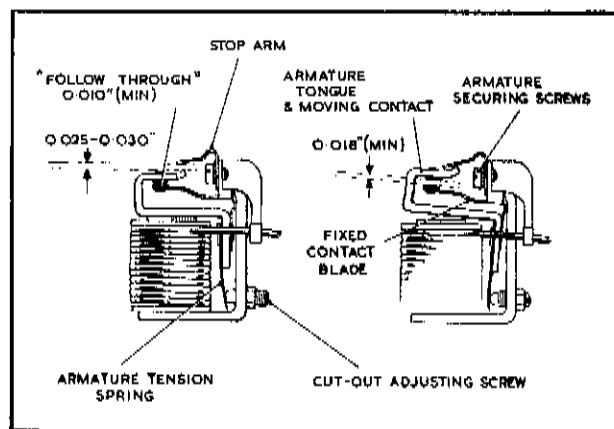


Fig. 5  
Mechanical settings of cut-out

Using a pair of suitable pliers, adjust the gap between the armature stop arm and the armature tongue by bending the stop-arm. The gap must be 0.025"—0.030" when the armature is pressed squarely down against the core face. Similarly, the fixed contact blade must be bent so that when the armature is pressed **squarely** down against the core face there is a **minimum** 'follow-through', or blade deflection, of 0.010".

The contact gap, when the armature is in the free position, must be 0.018" minimum.

Re-set the cut-out adjusting screw as described under para. 3 (c) (ii).

### (iv) Cleaning contacts.

If the cut-out contacts appear rough or burnt, place a strip of fine glass paper between the contacts—then, with the contacts closed by hand, draw the paper through. This should be done two or three times with the rough side towards each contact. Wipe away all dust or other foreign matter, using a clean fluffless cloth moistened with methylated spirits (de-natured alcohol).

Do not use emery cloth or a carborundum stone for cleaning cut-out contacts.

