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EQUIPMENT

WORKSHOP INSTRUCTIONS

CONTROL BOX

MODEL RB340

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CONTROL BOX

MODEL RB340

1. GENERAL

Control box model RB340, like model RB310 which it supersedes, is an electro-magnetically operated three-bobbin unit. It has been designed for use with the present range of shunt wound direct current generators having either 4½ or 6-ohm field windings. The new unit operates on the current-voltage system of generator output regulation, enabling a more efficient utilisation of larger generator capacities to be achieved than is possible with the compensated voltage control system hitherto used in association with generators of lower output.

Model RB340 comprises two separate vibrating armature type single contact regulators and a cut-out relay on a rubber-mounted zinc plated steel base plate under a black phenolic moulded cover. One regulator is responsive to changes in current and the other to voltage.

Since the unit is designed primarily for use with installations employing the 'Lucar' connector system, provision has been made for the generator side of the ignition (or 'No Charge') warning light to be connected at the control box—the terminal layout being 'B-B', 'F', 'D-WL' and 'E'.

(a) SIMPLICITY OF ELECTRICAL AND MECHANICAL SETTINGS

The chief service feature of model RB340 is the simplicity in making electrical and mechanical settings. Except for adjustment of the cut-out relay drop-off voltage, which is effected by bending the fixed contact bracket, electrical settings are made by turning toothed adjustment cams carried on the front limb of each magnet frame. A special tool, Part No. 543 817 42, is available for this purpose. Partial rotation of an adjustment cam varies the spring tension acting on the associated armature. The torque required to turn these cams should be 2 to 4 lb.-in. (0.023—0.046 kg.-m.).

As the three armatures are riveted to the rear limb of U-shaped magnet frames, the back air gaps are fixed and non-adjustable and the only mechanical settings that may be required comprise simple adjustments to the armature-to-bobbin core air gaps.

(b) RECOMMENDED MOUNTING AND CHECKING POSITIONS

The control box mounting position adopted in production for all electrical settings and measurements, and that recommended to vehicle manufacturers, is

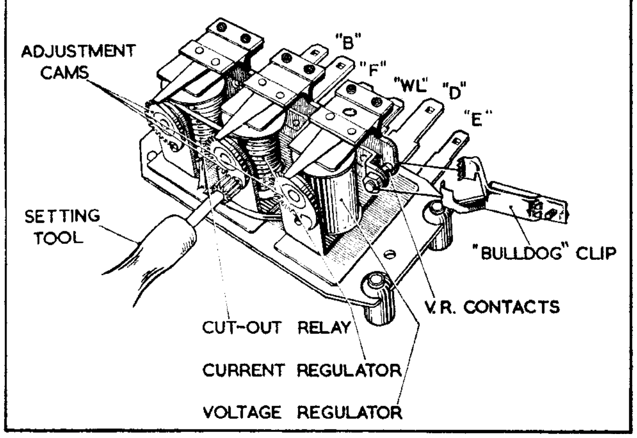

Fig. 1
Control Box with cover removed

the one which normally allows the easiest access to the adjustment cams, namely, cams uppermost and terminals pointing vertically downwards. However, since settings can be affected by change of position (due to the influence of gravity acting on the armatures), any bench settings in service should be made with the control box mounted as on the vehicle. Such settings should be made using a generator of the same model as that normally associated with the unit on the vehicle.

(c) TEMPERATURE COMPENSATION

The shunt coils of the voltage regulator and cut-out relay consist of many turns of fine copper wire. Consequently, the ohmic resistance of these coils rises and falls appreciably as the temperature rises and falls—such variations in temperature being due in part to ambient working conditions and in part to the passage through the coils of the operating current. In turn, these fluctuations cause the operating current and, therefore, the electro-magnetic attraction of the armatures to the bobbin cores, to vary inversely with changes in temperature. The effect of these magnetic changes would be to cause the system voltage to rise and fall with temperature.

To counter this effect and, in addition, to allow for seasonal variations in battery voltage—a higher operating voltage being provided in cold weather—the spring forces acting on the armatures of the voltage regulator and cut-out relay are arranged to vary automatically to meet changing conditions. This is effected by the use of bi-metal strip, a material which bends proportionately with changes in ambient temperature. In the voltage regulator, bi-metal strip is used to fabricate the armature hinge spring while, in the cut-out relay, it is used to supplement the armature control spring.

In addition to the use of bi-metal strip, the effect of temperature fluctuation on control box settings is further minimised in model RB340 by the use of a double swamp resistor connected in series with the two shunt coils. This enables coils of lower resistance to be used, while the resistor itself is wound with an alloy wire whose electrical resistance is only slightly affected by changes in temperature.

The current regulator is not compensated, since the resistance of its operating coil is too low to vary significantly with temperature changes.

(d) REPOLARISATION

When necessary, a control box originally intended for use with a positive-earth generator can be repolarised for use with a negative-earth generator (or vice versa) by applying a saturating direct current supply of appropriate voltage between terminals 'D' and 'E' for five seconds—the connection to terminal 'E' being of the required earth polarity.

Repolarising voltages are 10, 20 or 40 volts for 6, 12 and 24-volt units, respectively.

Before repolarising units having a diode in the field discharge circuit, the diode must be substituted for one of opposite polarity. See also SECTION F-1, PART B, Page 3, Para. 2(f).

(e) 'HOT-SETTING'

During manufacture control boxes are heat-soaked at 70°C. (158°F.) before electrical settings of the voltage regulators are made. Then, while at this temperature, the voltage regulators are set to operate at a comparatively low voltage (14.1±0.3 volts, for 12-volt units). This method, known as 'hot-setting', ensures that accurate and stable settings obtain at normal working temperatures.

On cooling to 20°C. (68°F.) the temperature compensation device causes units to regulate at higher voltages and between slightly wider limits (15.0±0.6 volts, for 12-volt units). Before units are despatched, 'cold' checks are carried out at this lower temperature to see that open circuit voltage performances fall between these wider limits. It follows, therefore, that these wider, 'cold checking', limits are the correct figures to use when **checking** factory-set units in service. Figures for service **setting,** however, must be to closer limits to ensure that adjustments carried out at lower temperatures shall result in correct regulation at higher temperatures.

Figures for Service Checking and Service Setting of open circuit voltages are specified in paragraph 2 (a) (ii) and illustrated graphically in Fig. 3.

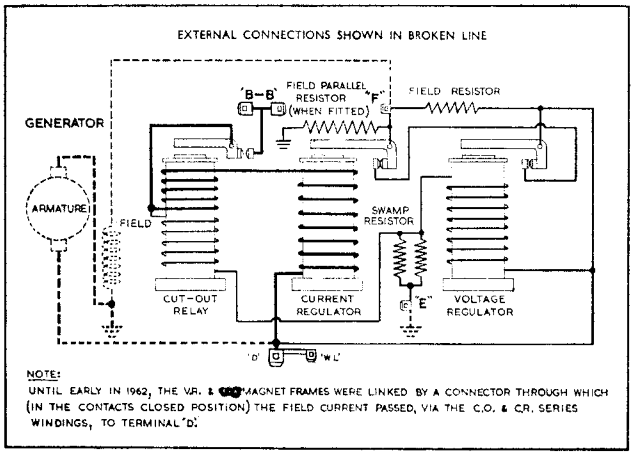

Fig. 2
Control Box and generator, internal connections

2. DESIGN DATA

When making electrical and mechanical adjustments, always aim for the nominal setting

(a) ELECTRICAL SETTINGS OF VOLTAGE REGULATOR

(i) The figures following apply to units having standard 12-volt settings. Figures for equivalent 6 and 24-volt units will be given in SECTION F-1 PART B as they become available (there being no such units at present in production), while any special settings will be given in SECTION F-1 PART A.

(ii)

Ambient Temperature	*Open Circuit Voltage* **Checking** *of 'Hot-set' Units*	*Open Circuit Voltage* **Setting**
10°C. (50°F.)	14.5—15.8	14.9—15.5
20°C. (68°F.)	14.4—15.6	14.7—15.3
30°C. (86°F.)	14.3—15.3	14.5—15.1
40°C. (104°F.)	14.2—15.1	14.3—14.9

(b) ELECTRICAL SETTING OF CURRENT REGULATOR

(i) The current regulator must be set to operate at a current value equal to the maximum rated

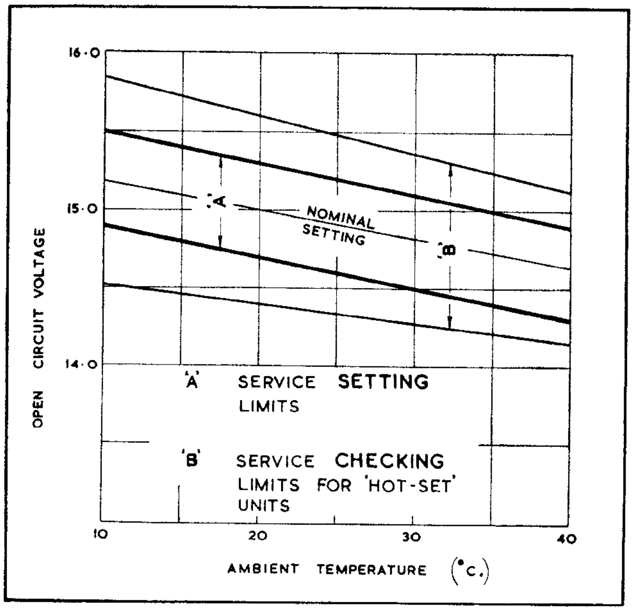

Fig. 3
Voltage regulator setting limits shown graphically, including checking limits of units set at 70°C. (158°F.)

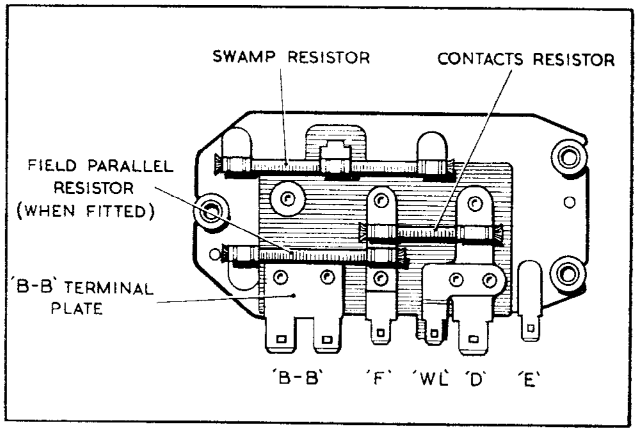

Fig. 4
Underside view of Control Box showing positions of resistors

output of the associated generator. The permissible setting tolerance is $\pm 1\frac{1}{2}$ amperes for all generators except model C48, when the tolerance is $\pm{}^{0}_{2}$ amperes.

(ii) The nominal setting is rubber-stamped in production either on the underside of the 'B-B' terminal plate or on the cover.

(iii) The maximum rated output of generators is given in SECTION A of this Manual but, for convenience, this information for some later generators is repeated here, as follows: C40A, 11 amp: C40-1, 22 amp: C40L, 25 amp: C42, 30 amp: C42 (uprated) and C48, 35 amp.

(c) ELECTRICAL SETTINGS OF CUT-OUT RELAY

	12-volt units
(i) Cut-in voltage:	12.6—13.4
(ii) Drop-off voltage:	9.3—11.2

(d) RESISTOR VALUES

(i) *Contacts Resistor*	*Resistance in ohms*	*Identification colour*
As fitted in units controlling 12-volt generators having $4\frac{1}{2}$ ohm field windings:	37—43	Yellow
As fitted in units controlling 12-volt generators having 6-ohm field windings:	55—65	Red

Note: The coloured paints used for indicating the ohmic values of these resistors are applied to one end of the fibre glass cores.

(ii) *Swamp Resistor* (*12-volt units*)	*Resistance in ohms*
Measured on unit between centre tag and base:	13.25—14.25
Replacement resistor measured between end tags before fitting to unit:	53—57
(iii) *Field Parallel Resistor*	
As fitted in units controlling model C48 generators:	37—43

(e) RESISTANCE OF SHUNT WINDINGS AT 20°C. (68°F.)

	Resistance in ohms
(i) Voltage regulator (12-volt units):	10.8—12.0
(ii) Cut-out relay (12-volt units):	8.8— 9.6

(f) ADJUSTMENT CAMS

Torque to turn cams:	2—4 lb.-in. (0.023—0.046 kg.-m.)

(g) AIR GAP SETTINGS

	Length
(i) Armature back gaps (non-adjustable):	0.030″—0.035″ (0.76—0.9 mm.)
(ii) Armature-to-bobbin core, VR and CR:	0.045″—0.049″ (1.04—1.24 mm.)
(iii) Armature - to - bobbin core, cut-out relay:	0.035″—0.045″ (0.9—1.04 mm.)
(iv) 'Follow-through' or blade deflection of cut-out relay moving contact:	0.010″—0.020″ (0.25—0.51 mm.)

3. SERVICING

(a) FAULT DIAGNOSIS

Symptom	*Possible Causes*
(i) No output from generator:	Generator driving belt broken. Loose connection or broken cable in charging circuit. Defective generator, control box or ammeter.
(ii) Intermittent or low output:	Generator driving belt slipping. Loose connection or broken cable in charging circuit. Defective generator, control box or ammeter. **Note:** In a 12-volt installation, the circuit resistance between the control box and battery should be of the order of 0.02-ohm. Equivalent values for 6-volt and 24-volt installations are 0.012-ohm, and 0.02—0.03-ohm, respectively.
(iii) Normal output but battery undercharged:	Low mileage. Defective battery.
(iv) High initial output, quickly falling to a low value:	Loose or corroded battery earth connection. Defective battery. Electrical or mechanical settings of control box incorrect.
(v) High output and battery overcharged:	Electrical or mechanical settings of control box incorrect. Loose or corroded control box earth connection.

(b) CONTROL BOX STABILITY TEST

(i) Connect a voltmeter as described in Para. 3 (d) (ii) and an ammeter as in Para. 3 (e) (iii–v).

(ii) Run the generator at 4,500 r.p.m. (or 4,000 r.p.m. model C48).

(iii) Switch on and off a lamp load equivalent to 75% of the maximum output of the generator.

(iv) Assuming the generator and external circuits to be in good order, instability [i.e., violent fluctuations of the voltage and current reactions to the conditions imposed in Para. 3 (b) (iii)] could be due to:

Air gap settings too narrow.

Foreign matter in air gaps.

Faulty internal connections causing intermittent open circuit.

(c) CHECKING CHARGING CIRCUIT

Before disturbing any adjustments (electrical or mechanical), examine as described below to ensure that the fault does not lie outside the control box:

(i) Check the battery by substitution or with an hydrometer and a heavy discharge tester, using a 150—160-ampere element for car battery cells and a 300-ampere element for commercial vehicle battery cells.

(ii) Inspect the generator driving belt. This should be just taut enough to drive without slipping.

(iii) Check the generator by substitution or by withdrawing the cables from the generator terminals and, using a suitable 'jumper lead', linking large generator terminal 'D' to small terminal 'F' and connecting a first-grade moving coil voltmeter between this link and earth and then running the generator up to about 1,000 r.p.m., when a rising voltage should be shown.

Note: A 0—10-volt instrument should be used when checking 6-volt units, 0—20 for 12-volt units and 0—40 for 24-volt units.

(iv) Inspect the wiring of the charging circuit and carry out continuity tests between the generator, control box and, when fitted, the ammeter.

(v) Check earth connections, particularly that of the control box.

(vi) In the event of reported undercharging, ascertain that this is not due to low mileage.

(d) VOLTAGE REGULATOR OPEN CIRCUIT SETTING

Checking and adjusting should be completed as rapidly as possible to avoid errors due to heating of the operating coil.

(i) Withdraw the cables from control box terminal blades 'B-B'.

Note: If the ignition switch is fed from terminal 'B-B', it will be necessary to join the ignition and battery feeds together with a suitable 'jumper lead', to enable the engine to be started.

(ii) Connect a first-grade moving-coil voltmeter between control box terminal 'D' and a good earthing point.

Note: A convenient method of making this connection is to withdraw the ignition warning light feed from control box terminal 'WL' and to clip the voltmeter lead of appropriate polarity to the small terminal blade thus exposed—this terminal being electrically common with terminal 'D'.

(iii) Start the engine and run the generator at 1,500 or 3,000 or 4,500 r.p.m., depending on whether it is model C48, or has a 6-ohm field winding, or a $4\frac{1}{2}$-ohm field winding, respectively.

(iv) Observe the voltmeter pointer.

The voltmeter reading should be steady and lie between the appropriate limits given in Para. 2 (a) (ii), according to the temperature.

Note: Service **checking** limits are applicable only if the previous open circuit setting was made at 70°C. When in doubt, use the service **setting** limits for both checking and setting.

An unsteady reading (i.e., one fluctuating more than $\pm$0.3-volt) may be due to unclean contacts. If the reading is steady but occurs outside the appropriate limits, an adjustment must be made. In this event, continue as follows:

(v) Stop the engine and remove the control box cover.

(vi) Re-start the engine and run the generator at 1,500/3,000/4,500 r.p.m., according to model.

(vii) Using a suitable tool, turn the voltage adjustment cam until the correct setting is obtained—turning the tool clockwise to raise the setting or anti-clockwise to lower it.

(viii) Check the setting by stopping the engine and then again raising the generator speed to 1,500/3,000/4,500 r.p.m., according to model.

(ix) Restore the original connections and refit the cover.

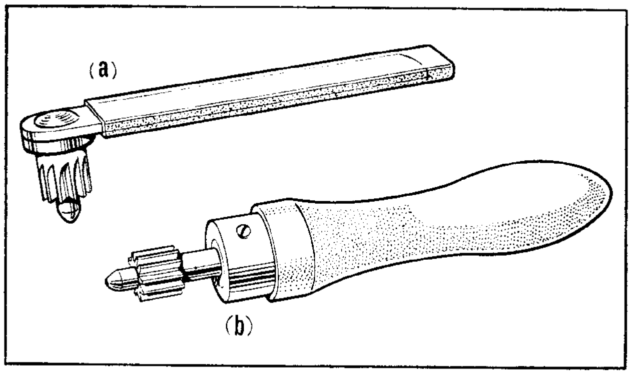

Fig. 5
Setting tools, (a) as used in service (b) as used in production

(e) CURRENT REGULATOR ON-LOAD SETTING

The generator must be made to develop its maximum rated output, whatever the state of charge of the battery might be at the time of setting. The voltage regulator must therefore be rendered inoperative, and this is the function of the bulldog clip used in 3 (e) (ii) in keeping the voltage regulator contacts together.

(i) Remove the control box cover.

(ii) Using a bulldog clip, short out the contacts of the voltage regulator.

(iii) Withdraw the cables from control box terminal blades 'B-B'.

(iv) Using a suitable 'jumper lead', connect the cables removed in (iii) to the load side of a first-grade 0—40-ampere moving-coil ammeter.

(v) Connect the other side of the ammeter to one of the control box terminal blades 'B-B'.

Note: It is important to ensure that terminal 'B-B' carries only this one connection. All other load connections (including the ignition coil feed) must be made to the battery side of the ammeter.

(vi) Switch on all lights, to ensure that the generator develops its full rated output.

(vii) Start the engine and run the generator at 4,500 r.p.m. (or 4,000 r.p.m., model C48).

(viii) Observe the ammeter pointer.

The ammeter pointer should be steady and indicate a current equal to the maximum rated output of the generator. Refer to Para. 2 (b) (iii) for information on this point.

An unsteady reading (i.e., one fluctuating more than $\pm$1 ampere) may be due to unclean contacts. If the reading is too high or too low, an adjustment must be made. In this event continue as follows:

(ix) Using a suitable tool, turn the current adjustment cam until the correct setting is obtained—turning the tool clockwise to raise the setting or anti-clockwise to lower it.

(x) Switch off the engine and restore the original connections.

(xi) Refit the control box cover.

(f) CUT-OUT RELAY ELECTRICAL SETTINGS

(i) *Checking and Adjusting Cut-in Voltage*

Checking and adjusting should be completed as rapidly as possible to avoid errors due to heating of the operating coil.

Connect a first-grade moving-coil voltmeter between control box terminal 'D' and a good earthing point, referring to the Note in Para. 3 (d) (ii).

Switch on an electrical load, such as the headlamps.

Start the engine and slowly increase its speed. Observe the voltmeter pointer.

The voltage should rise steadily and then drop slightly at the instant of contact closure. The cut-in voltage is that which is indicated immediately before the pointer drops back. It should occur between the limits given in Para. 2 (c) (i).

Note: Should the control box be checked on the bench, the cut-in voltage will be clearly indicated if a resistor to pass approximately 6 amperes is connected between terminal blades 'B-B' and 'E'.

If the cut-in occurs outside the correct limits, an adjustment must be made. In this event, reduce the engine speed to below the cut-in value and continue as follows:

Remove the control box cover.

Using a suitable tool, turn the cut-out relay adjustment cam a small amount in the appropriate direction—turning the tool clockwise to raise the setting or anti-clockwise to lower it.

Repeat the above checking procedure until the correct setting is obtained.

Switch off the engine, restore the original connections and refit the cover.

(ii) *Checking and Adjusting Drop-off Voltage*

Withdraw the cables from control box terminal blades 'B-B', referring to the Note in Para. 3 (d) (i).

Connect a first-grade moving-coil voltmeter between control box terminal blades 'B-B' and earth.

Start the engine and run up to approximately 3,000 r.p.m.

Slowly decelerate and observe the voltmeter pointer.

Opening of the contacts, indicated by the voltmeter pointer dropping to zero, should occur between the limits given in Para. 2 (c) (ii). If the drop-off occurs outside these limits, an adjustment must be made. In this event, continue as follows:

Stop the engine and remove the control box cover.

Adjust the drop-off voltage by carefully bending the fixed contact bracket. Reducing the contact gap will raise the drop-off voltage; increasing the gap will lower the drop-off voltage.

Retest and, if necessary, re-adjust until the correct drop-off setting is obtained.

Note: This should result in a contact 'follow through' or blade deflection of 0.010"—0.020" (0.25—0.51 mm.).

Restore the original connections and refit the cover.

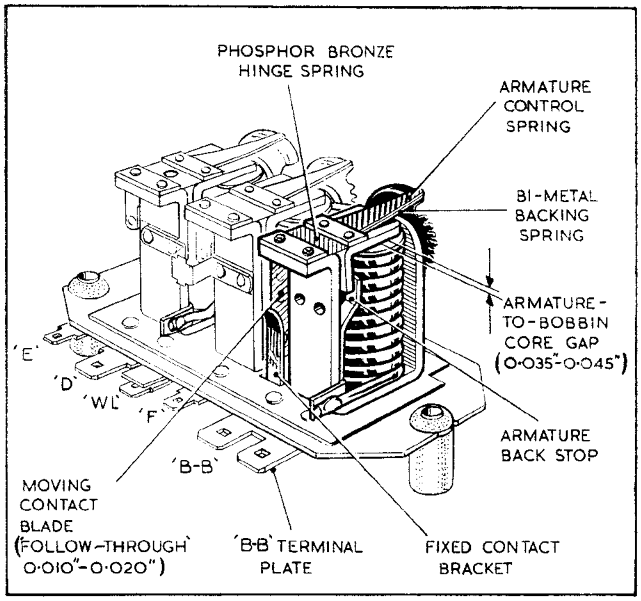

Fig. 6
Mechanical or air gap settings of cut-out relay

(g) ADJUSTMENT OF AIR GAP SETTINGS

Air gap settings are accurately adjusted during production of the control box and should require no further attention. If the original adjustments have been disturbed, it will be necessary to reset as described below.

(i) *Armature-to-Bobbin Core Gaps of Voltage and Current Regulators*

Using a suitable tool, turn the adjustment cam to the point giving minimum lift to the armature tensioning spring, i.e., by turning the tool to the fullest extent anti-clockwise.

Slacken the adjustable contact locking nut and screw back the adjustable contact.

Insert a flat steel feeler gauge of 0.045" (1.04 mm.) thickness between the armature and the copper separation on the core face, taking care not to turn up or damage the copper shim. The gauge should be inserted as far back as the two rivet heads on the underside of the armature.

Retaining the gauge in position and pressing squarely down on the armature, screw in the adjustable contact until it just touches the armature contact.

Retighten the locking nut and withdraw the gauge.

Carry out the electrical setting procedure.

(ii) *Contact 'Follow-through' and Armature-to-Bobbin Core Gap of Cut-out Relay*

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

Adjust the fixed contact bracket to give a 'follow-through' or blade deflection of the moving contact of 0.010″—0.020″ (0.25—0.51 mm.).

Release the armature.

Adjust the armature back stop to give a core gap of 0.035″—0.045″ (0.9—1.04 mm.).

Check the cut-in and drop-off voltage settings.

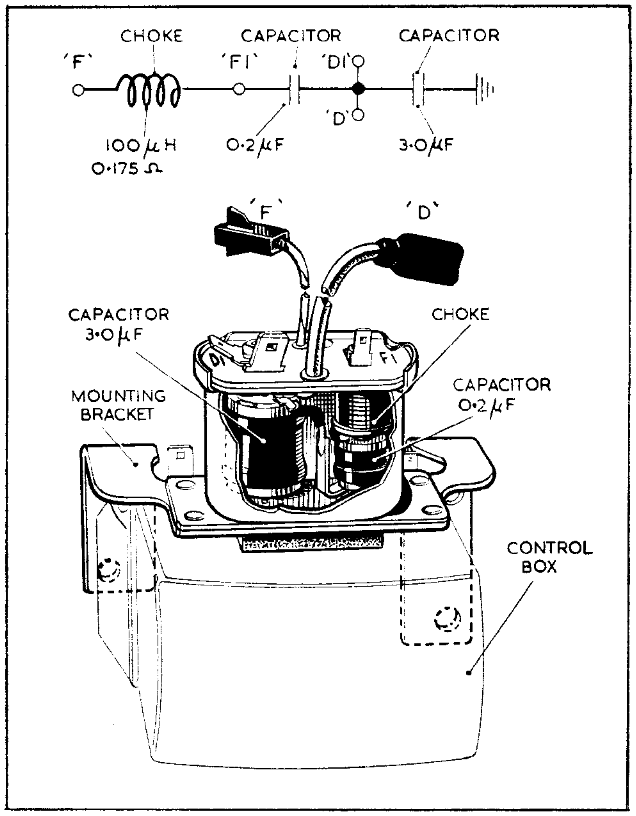

Fig. 7
Radio interference suppression, Filter Unit model WS18

(h) CLEANING CONTACTS

(i) *Regulator Contacts*

To clean the voltage or current regulator contacts, use fine carborundum stone or silicon carbide paper followed by methylated spirits (denatured alcohol).

(ii) *Cut-out Relay Contacts*

To clean the cut-out relay contacts, use a strip of fine glass paper—never carborundum stone or emery cloth.

4. RADIO INTERFERENCE SUPPRESSION

Interference with car radio emanating from the control box can be recognised by periods of continuous crackle and is caused by normal regulator action. This interference can be reduced or eliminated only through electrical filtering—no attempt should ever be made to remedy it by the indiscriminate fitting of capacitors or by tampering with the regulator contacts. The correct method of rectifying any radio interference set up by model RB340 control boxes is to fit Filter Unit Model WS18 Part No. 78147. This unit is similar to Part No. 78136 (designed for 'Lucar' terminalled model RB310 control boxes and illustrated in Publication No. 2015), containing two capacitors and a choke mounted on an insulating terminal base and enclosed by a metal screening cover, to which is riveted a fixing bracket.

Model WS18 Filter Unit is suitable for fitting closely adjacent to the control box in car-radio equipped civilian vehicles (Long, Medium and Short Wave reception) and in military vehicles not equipped with communication equipment.

5. CONTACT REPLACEMENT SETS

(a) RESTRICTED SERVICE

Owing to the riveted construction employed in the flow line assembly of model RB340 control boxes, dismantling in service cannot be encouraged. Accordingly, contact replacement sets are supplied solely for use overseas, where special service problems are encountered. The fitting of these sets involves the replacement of existing rivets with screws.

The Part Numbers of the sets are 543 820 77—8 & 9 for the Cut-out Relay, Voltage and Current Regulators, respectively. Each set comprises an Armature Assembly, Clamp Plate, Fixed Contact Screw and Nut (or, for cut-out relays, a 'B-B' Terminal Plate Assembly), and two 5BA screws with associated spring washers and lock nuts (two extra screws, spring washers and lock nuts being provided for the cut-out relay to secure the above terminal plate assembly).

(b) IDENTIFICATION OF ARMATURE ASSEMBLIES

(i) *Cut-out relay armature:*	Moving contact carried on phosphor bronze blade.

	Phosphor bronze hinge spring, unpierced.
	Blued steel control spring backed with bi-metal spring (high expansion side lowermost).
(ii) *Voltage regulator armature:*	Bi-metal hinge spring pierced with central 0.150″ (3.8 mm.) hole. (High expansion side of bi-metal uppermost).
(iii) *Current regulator armature:*	Blued steel hinge spring, unpierced.

(c) FITTING ARMATURE ASSEMBLIES

(i) Carefully remove existing rivets, using a file, centre-punch, twist drill ($\frac{3}{32}$″ dia.; 2.38 mm.), and a parallel-sided punch ($\frac{5}{64}$″ dia.; 1.98 mm.), in that order.

(ii) Discard original armature, clamp plate, and fixed contact screw and nut, or, when replacing a cut-out relay armature, the 'B-B' terminal plate.

(iii) Loosely assemble replacement parts to magnet frame, noting that the armature hinge spring has open-ended slotted fixing holes to facilitate fitting under the clamp plate.
Do not insert the fixed contact screw of the VR or CR more than 1$\frac{1}{2}$ to 2 turns at this stage.

(iv) When applicable, fit and tighten replacement 'B-B' terminal plate, inserting the securing screws from the upper side of the control box base plate.

(v) Insert a 0.032″ (0.81 mm.) feeler gauge approximately half-way up the back air gap.

(vi) Insert a 0.045″ (1.04 mm.) feeler gauge in the armature-to-bobbin core gap as far back as the two tension spring rivets.

(vii) Press the armature squarely down towards the bobbin core and back towards the magnet frame, firmly trapping both gauges.

(viii) Tighten the armature assembly securing screws.

(ix) Withdraw gauges and carry out mechanical and electrical adjustments. See Para. 5 (d), below.

(d) ADJUSTMENT SEQUENCE

After fitting a replacement contact set (or sets), the regulator or cut-out relay concerned must be adjusted both mechanically and electrically as described previously under 'SERVICING'—the order of electrical settings (when all three armatures have been replaced) being, first, the voltage regulator, secondly the cut-out relay and, thirdly, the current regulator.