Chapter 2

WINDSCREEN DE-ICING CONTROLLERS, PLESSEY, TYPE 4, Mk. 1, 3 and 4

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Controller, Plessey, Type 4, Mk. 1

Part No. 7CZ/106800/9	*Ref. No.*
Contacts (control and overheat)	*Single change-over*
Contact rating	*24V d.c., 3 amp* / *150V a.c., 3 amp* non-inductive
Supply	*115V ± 5 per cent* / *400 c/s ± 5 per cent*
Temperature differential	*1°C for control* / *15°C for overheat*
Control temperature	*40°C ± 1°C* / *55°C ± 5°C*
Correct functioning limits	*up to 10 per cent on voltage and frequency*
Operating ambient temperature range	*−40°C to +85°C*
Overall dimensions (including fixing brackets and terminal block)	*3·5 in. × 2·12 in. × 3·75 in.*
Weight	*1¼ lb.*
Fixing centres (back or base mounting)	*3·1 in. × 1·5 in.*

Controller, Plessey, Type 4, Mk. 4

Part No. 7CZ/106803/10	*Ref. No. 5CZ/6027*
Part No. 7CZ/106803/11	*Ref. No. 5CZ/6022*
Part No. 7CZ/106803/13	*Ref. No. 5CZ/6254*
Supply	*200V, 400 c/s*
Control temperature	
Controller (Ref. No. 5CZ/6027)	*45°C ± 1°C; 60°C ± 5°C*
Controller (Ref. No. 5CZ/6022)	*50°C ± 1°C; 65°C ± 5°C*
Controller (Ref. No. 5CZ/6254)	*60°C ± 1°C; 75°C ± 5°C*

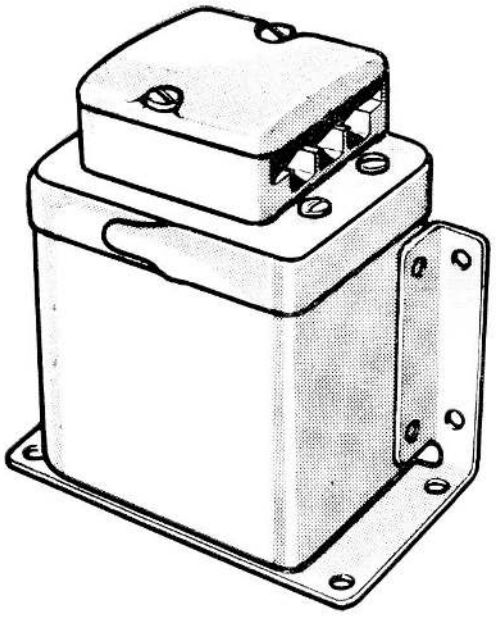

Fig. 1. External view of de-icing controller, Type 4, Mk. 1

KEY TO FIG. 3

1 COVER ASSEMBLY
2 6 B.A. SCREW AND WASHER
3 SEALING BAND
4 CONTAINER
5 INSULATOR (GLASSBOARD LINER)
6 6 B.A. STEEL SCREW
7 SPRING WASHER
8 PLAIN WASHER
9 PILLAR AND SUPPORT ASSEMBLY (SPRING BASEPLATE)
10 6 B.A. STEEL SCREW
11 SPRING WASHER
12 PLAIN WASHER
13 CIRCUIT BOARD A EYELET ASSEMBLY
14 CIRCUIT BOARD C EYELET ASSEMBLY
15 BOBBIN ASSEMBLY (CONTROL)
16 BOBBIN ASSEMBLY (OVERHEAT)
17 6 B.A. SCREW AND WASHER
18 6 B.A. SPECIAL SCREW
19 NUT
20 TERMINAL BLOCK
21 TERMINAL PLATE
22 RESISTOR
23 CIRCUIT BOARD B EYELET ASSEMBLY
24 RECTIFIER
25 CABLEFORM
26 CAPACITOR
27 TRANSDUCTOR
28 RELAY
29 SPACER
30 TRANSFORMER

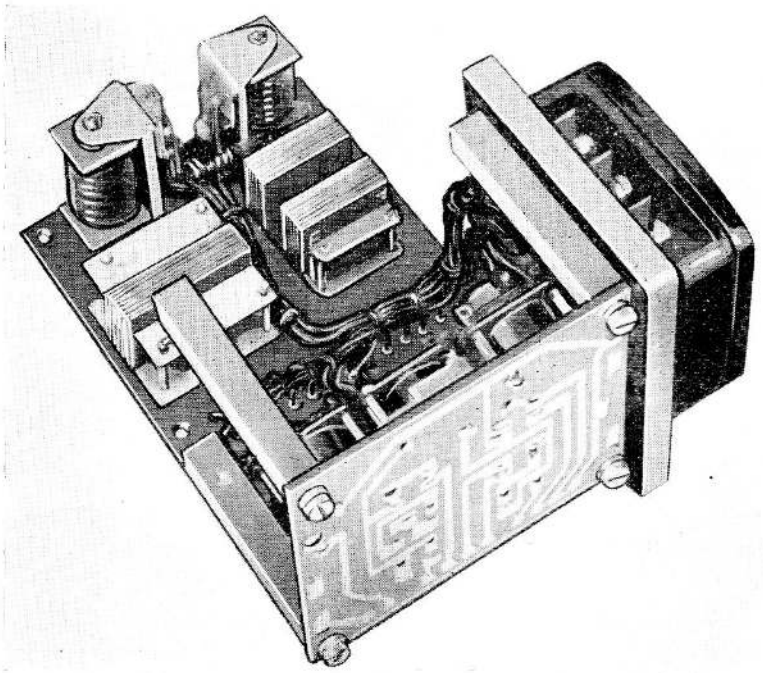

Fig. 2. Controller with case removed showing printed circuitry and folding construction

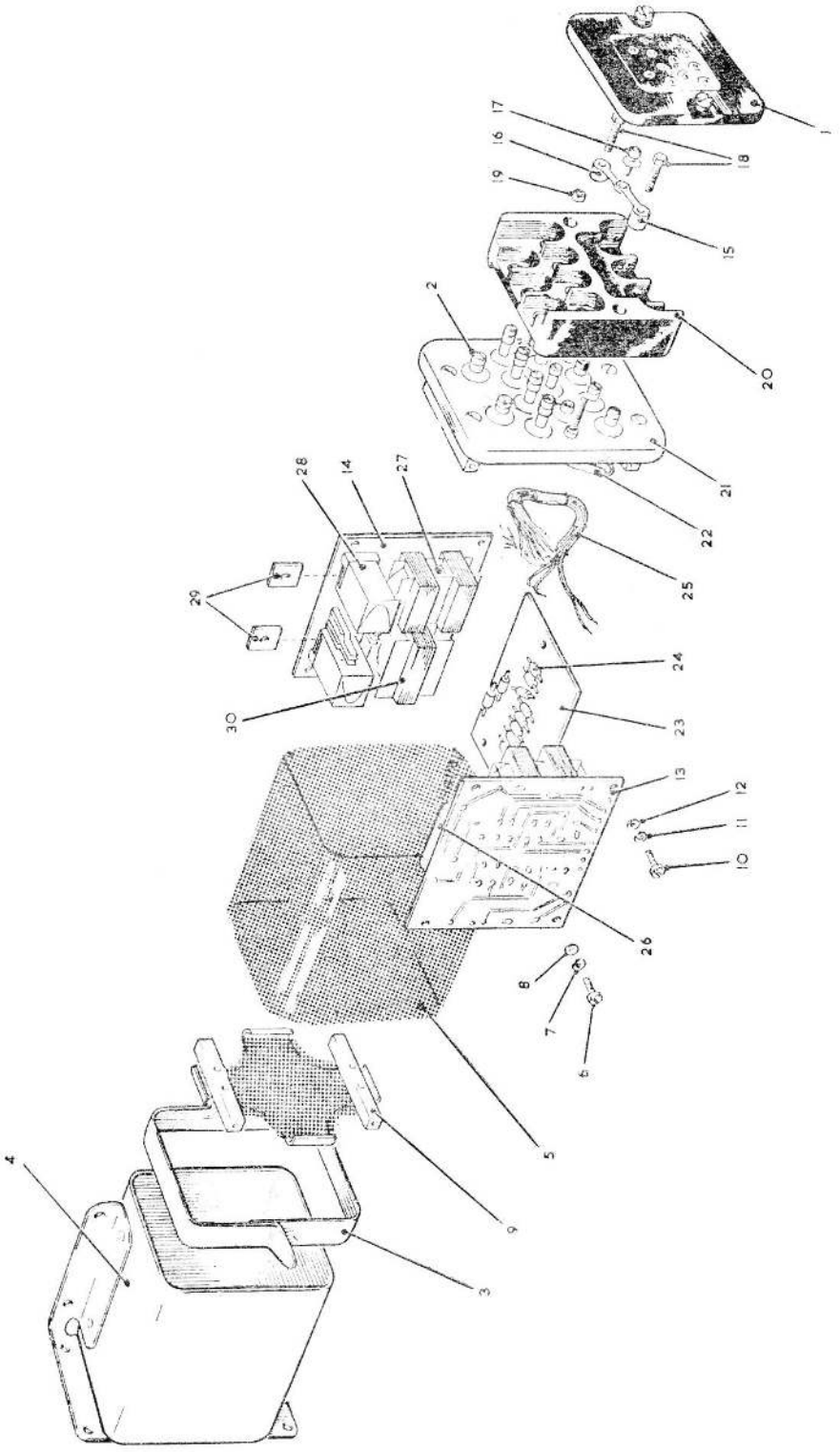

Fig. 3. Exploded view of de-icing controller, Type 4, Mk. 1

Introduction

1. The Plessey windscreen de-icing controllers, Type 4, Mk. 1 and Mk. 4, are used on aircraft to control the electrical supply to film heaters in the windscreen. This control is achieved by energizing or de-energizing the coil of a contactor which is inserted in the supply lines to the heaters.

2. Transductors provide the necessary output current to operate the relay which energizes the coil of the contactor, the operation of the transductors being dependent upon the resistance of the temperature sensing elements inserted in the laminations of the windscreen itself. Since the resistance of these elements is dependent upon the temperature of the windscreen, complete control is obtainable.

DESCRIPTION

Controller, Type 4, Mk. 1

3. The controller is shown in Fig. 1. The controller components are mounted on three printed circuit boards A, B and C and wired internally by flexible leads. An exploded view of the controller is shown in Fig. 3. When assembled, all the controller components are accommodated in a container which is then sealed. The printed circuit boards form three sides of a cube and fold out flat for servicing purposes. Inside the container the circuit boards are protected by a glassboard insulator. A spring base plate holds the assembly firmly in the container. External connections to the controller are made by means of the glass sealed terminals which are shrouded by a moulded terminal block and cover.

4. The controller consists of three main parts: (1) The supply transformer which transforms the supply from 115V, 400c/s. The secondary winding of this transformer feeds transductors and sensing elements of the circuit; (2) The control circuit which consists of three transductors, control slave relay, and control sensing elements; (3) The overheat circuit, overheat slave relay, and overheat sensing element.

Controller, Type 4, Mk. 3

5. See Note to para. 23.

Controller, Type 4, Mk. 4

6. This controller is identical to the Mk. 1, the essential differences being as shown in the Leading Particulars. In addition the Mk. 4 controller is designed to work with a 300 ohm sensing element, whilst the Mk. 1 works with a 100 ohm element. Operation of the Mk. 4 controller is identical to that of the Mk. 1 described in the subsequent paragraphs.

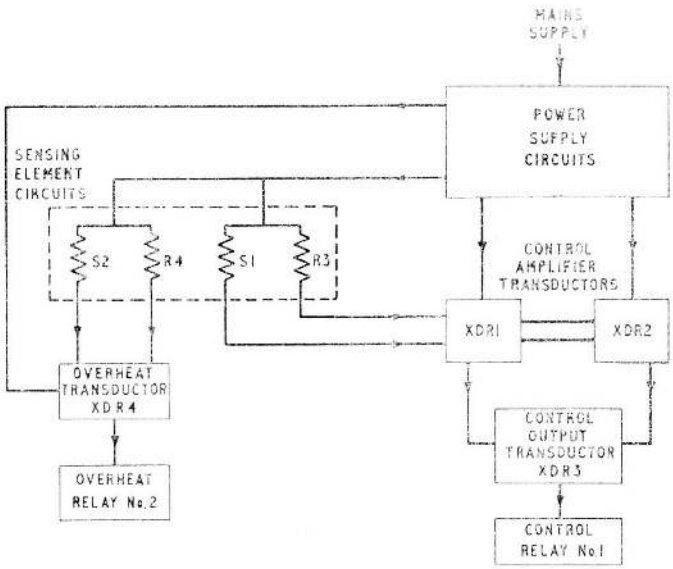

Fig. 4. Block schematic diagram

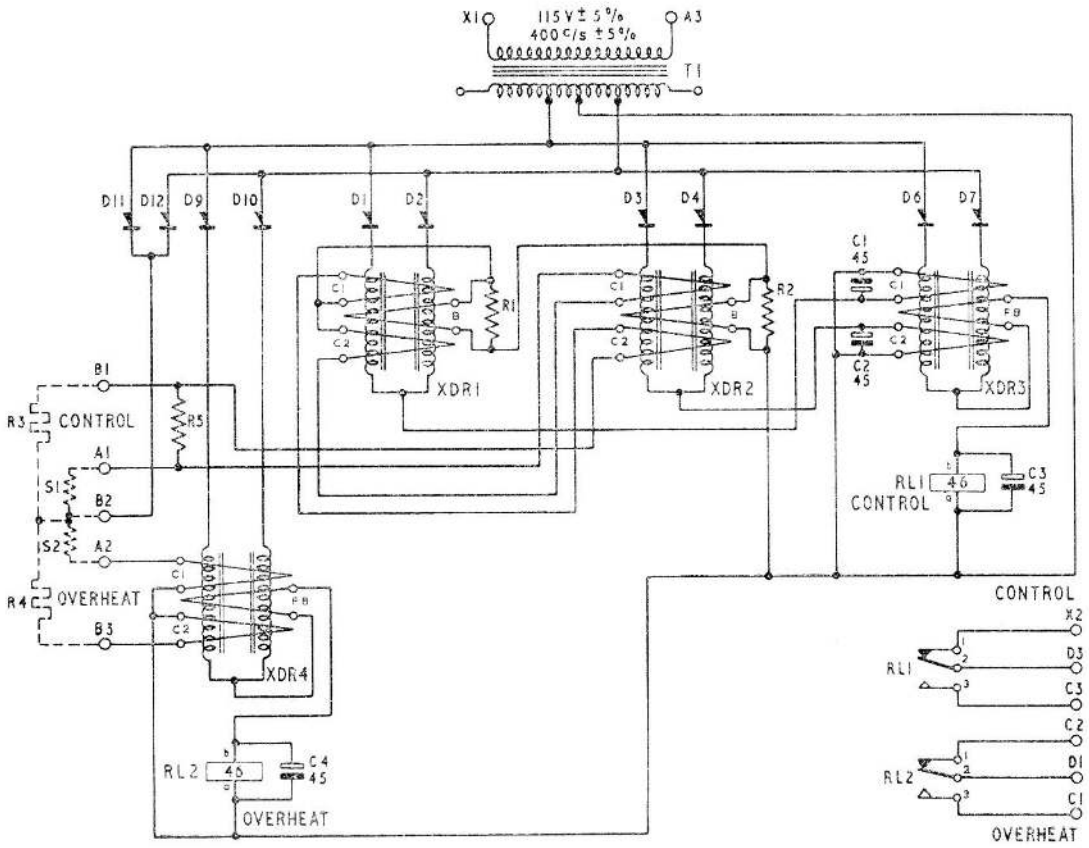

Fig. 5. Circuit diagram for Type 4, Mk. 1 and 4 controllers

OPERATION

Control circuit

7. The control circuit (*fig.* 5) consists of sensing element S1, fixed resistors R3, R5, R1 and R2, transductors XDR1, XDR2 and XDR3, capacitors C1, C2 and C3, and relay RL1.

8. The control relay RL1 is provided with single change-over contacts brought out to terminals C3, D3 and X2. The contacts are isolated from all other circuitry. Normally the " make " contact between C3 and D4 is used to energize the power contactor coil. Thus relay RL1 energized represents power " on " to the screen. The relay coil current is controlled by transductor XDR3, and together with by-pass capacitor C3 represents the load on this transductor.

9. The transductor XDR3 and all other transductors in the controller are auto-excited, parallel-connected units fed from a centre-tapped secondary of the transformer T1 providing a full-wave rectified output into the load.

10. The d.c. excitation is provided by rectifiers D6 and D7; each of these rectifiers feeding an a.c. winding. Positive operation is ensured by the bi-stable characteristic of the transductor, and the action is quite independent of the rate of change of the input signal to the transductor.

11. The signal to transductor XDR3 is provided by transductors XDR1 and XDR2 connected in push-pull. The loads on the push-pull stage are windings C1 and C2, and capacitors C1 and C2. When this stage is balanced, the effective input to XDR3 is

zero. Under these conditions, XDR3 will operate RL1. Transductors XDR1 and XDR2 function as linear amplifiers and the input signal is derived as follows.

12. A full-wave rectified current, derived from rectifiers D11 and D12, is passed through sensing element S1, through winding C1 on XDR2 and winding C2 on XDR1. The effect of resulting ampere-turns acting on these two transductors is backed off by the current passing through R3 and winding C2 on XDR2, and winding C1 on XDR1. Thus the current passing through the sensing element S1 is compared with a fixed current, and any change in sensing element resistance will cause a difference in ampere-turns acting on the transductors.

Overheat circuit

13. The overheat circuit (*fig.* 5) consists of a sensing element S2, a fixed resistor R4, transductor XDR4, capacitor C4, rectifiers D9 and D10, and relay RL2. The overheat relay is provided with single change-over contacts brought out to terminals C1, C2 and D1. The contacts are isolated from all other circuitry. Normally the " make " contacts C2 and D1 are in series with the power contactor coil; thus when the control relay is energized and the overheat relay is de-energized, power is applied to the windscreen. Relay RL2 is identical to RL1 in all respects and is controlled by transductor XDR4, which has bi-stable operation as in XDR3.

14. The signal to XDR4 is derived in a similar manner to that of the control channel. The current through S2 and C1 is backed off by the current through R4 and C2. Thus a change in resistance (from the normal) of S2 will cause an unbalance of ampere-turns acting on XDR4 such that if S2 increases, the transductor will be driven up thus energizing RL2 and discontinuing power to the windscreen.

SERVICING

15. Since the controller is a sealed unit, very little servicing can be done other than external inspection for damage, security of attachment and the condition of connecting wiring.

16. If the operation of controller is suspect, the following external tests may be carried out.

Tests (controller, Type 4, Mk. 1)

17. A supply of 115V at 400c/s is required for the test. Two decade resistance boxes calibrated from 100 to 150 ohms should be connected to terminals A1, B2 (control) and A2, B2 (overheat). These simulate the control and overheat sensing elements. The control resistance box should be a slide-wire type capable of reading increments of 1 ohm.

18. Connect four 3 watt lamps to terminals X2, D3; D3, C3; C2, D1; and D1, C1. These indicate the closing of the contacts of the two relays and are referred to subsequently as:—

X2, D3—" Control " relay de-energized (power off)	...	L1
D3, C3—" Control " relay energized (power on)	... ...	L2
C2, D1—" Overheat " relay de-energized (power on)	...	L3
D1, C1—" Overheat " relay energized (power off)	... ...	L4

Control functioning

19. Proceed as follows:—

(1) Set both decade resistances to 107 ohms. Switch on the supply. Lamps L2 and L3 should light.

(2) Increase the value of the control resistance until L1 lights (L2 extinguished). This must occur between 110·2 ohms and 111·2 ohms.

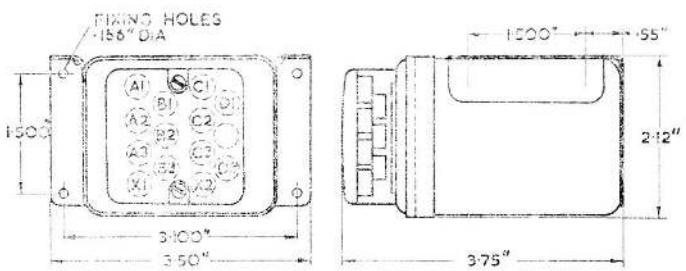

Fig. 6. Installation diagram

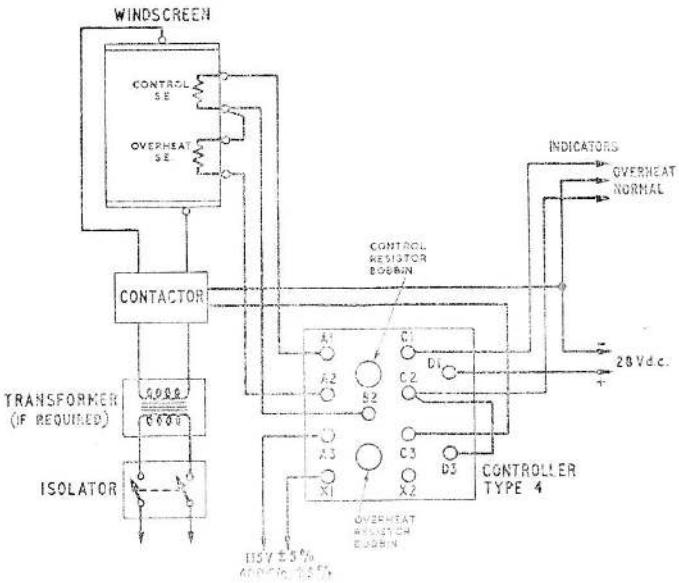

Fig. 7. Wiring diagram

(3) Reduce the control resistance until L2 lights again. The difference in readings of the control resistance for L2 " on " and L1 " on " should not exceed 0·5 ohms. If these requirements are not met, the control amplifier working point requires adjustment and the unit should be sent for repair.

Overheat functioning

20. Proceed as follows:—

(1) Set both decade resistances to 107 ohms. Switch on the supply. Lamps L2 and L3 should light.

(2) Increase the value of the overheat resistance until L4 lights (L3 extinguished). This should occur between 116·1 ohms and 121·4 ohms.

(3) Reduce the overheat resistance until L3 lights again. The difference in readings of the overheat resistance for L4 " on " and L3 " on " should not exceed 8 ohms.

Insulation resistance

21. Apply 115V±5 per cent, 400c/s to terminals A3, X1, and connect the decade resistance boxes to terminals A1, B2 (control) and A2, B2 (overheat). Adjust the boxes to 107 ohms each. Check insulation resistance with 500 volt insulation resistance tester between terminals:—

X2 and D3	C2 and C3
D1 and C1	C1 and C3
C1 and X2	X2 and C2

The minimum permissible value is 20 megohms.

22. Adjust the boxes to 123 ohms each. Check the insulation resistance at 500 volts between terminals:—

C2 and D1
C3 and D3

The minimum permissible value is 20 megohms.

Tests (controller, Type 4, Mk. 4)

23. A supply of 200V at 400c/s is required for the test. Two decade resistance boxes calibrated from 50 to 500 ohms should be connected to terminals A1, B2 (control) and A2, B2 (overheat). These simulate the control and overheat sensing elements. The control resistance box should be slide-wire type capable of reading increments of 1 ohm.

Note . . .

An earlier version of these controllers, the Type 4, Mk. 3 (Part No. 7CZ/106802/11), which operated on 115V supply and worked in conjunction with a 300 ohm sensing element, has been superseded by Type 4, Mk. 4 controller (Ref. No. 5CZ/6027). Tests on the Type 4, Mk. 3 controller are the same as for Type 4, Mk. 4 controller (Ref. No. 5CZ/6022), except for the supply voltage, this controller having the same control temperature range.

24. Connect four 3 watt lamps to terminals X2, D3; D3, C3; C2, D1; and D1, C1. These indicate the closing of the contacts of the two relays and are referred to subsequently as:—

X2, D3—" Control " relay de-energized (power off) ...	L1
D3, C3—" Control " relay energized (power on)	L2
C2, D1—" Overheat " relay de-energized (power off) ...	L3
D1, C1—" Overheat " relay energized (power on)	L4

Control functioning

25. Proceed as follows:—

(1) Set both decade resistances to 323 ohms (for controller, Ref. No. 5CZ/6027), 331 ohms (for controller, Ref. No. 5CZ/6022), or 347 ohms (for controller, Ref. No. 5CZ/6254). Switch on the supply. Lamps L2 and L3 should light.

(2) Increase the value of the control resistance until L1 lights (L2 extinguished). This must occur between 336·9 ohms and 340·1 ohms (for controller, Ref. No. 5CZ/6027), 344·9 ohms and 348·1 ohms (for controller, Ref. No. 5CZ/6022), and 360 ohms and 364·0 ohms (for controller, Ref. No. 5CZ/6254).

(3) Reduce the control resistance until L2 lights again. The difference in readings of the control resistance for L2 " on " and L1 " on " should not exceed 4 ohms. If these requirements are not met, the control amplifier working point requires adjustment and the unit should be sent for repair.

Overheat functioning

26. Proceed as follows:—

(1) Set both decade resistances to 323 ohms (for controller, Ref. No. 5CZ/6027), 331 ohms (for controller, Ref. No. 5CZ/6022), or 347 ohms (for controller, Ref. No. 5CZ/6254). Switch on the supply. Lamps L2 and L3 should light.

(2) Increase the value of the overheat resistance until L4 lights (L3 extinguished). This should occur between 345·5 ohms and 370·4 ohms (for controller, Ref. No. 5CZ/6027), 362·4 ohms and 378·4 ohms (for controller, Ref. No. 5CZ/6022), 378·4 ohms and 394·5 ohms (for controller, Ref. No. 5CZ/6254).

(3) Reduce the overheat resistance until L3 lights again. The difference in readings of the overheat resistance for L4 " on " and L3 " on " should not exceed 24 ohms.

Insulation resistance

27. Apply 200V±5 per cent, 400c/s to terminals A3, X1, and connect decade resistance boxes to terminals A1, B2 (Control) and A2, B2 (overheat). Adjust the boxes each to 323 ohms (for controller, Ref. No. 5CZ/6027), 331 ohms (for controller, Ref. No. 5CZ/6022), or 347 ohms (for controller, Ref. No. 5CZ/6254). Check insulation resistance with a 500V insulation resistance tester between terminals:—

X2 and D3	C2 and C3
D1 and C1	C1 and C3
C1 and X2	X2 and C2

The minimum permissible value is 20 megohms.

28. Adjust the boxes each to 372 ohms (for controller, Ref. No. 5CZ/6027), 380 ohms (for controller, Ref. No. 5CZ/6022), or 396 ohms (for controller, Ref. No. 5CZ/6254). Check the insulation resistance at 500V between terminals:—

C2 and D1
C3 and D3

The minimum permissible value is 20 megohms.

(81346) Gp. 375/1. D.4536/Wt. 59828/460033/L.P.S. 2750/1/60.