

Chapter 25

FIRE DETECTOR SYSTEM, WALTER KIDDE, TYPE WK892561

LIST OF CONTENTS

	Para.		Para.
<i>Introduction</i>	1	Installation	
Description		<i>Control unit</i>	13
<i>General</i>	2	<i>Detector element</i>	14
<i>Circuit</i>	3	Servicing	15
Operation		<i>In-situ testing</i>	16
<i>General</i>	6	<i>Short circuit test of the detector element</i>	17
<i>Short circuit discriminator</i>	8	<i>Continuity test of the detector element</i>	18
<i>D.C. operation</i>	11	<i>Bench testing of the control unit</i> ...	19
<i>Test of system, in-situ</i>	12		

LIST OF ILLUSTRATIONS

	Fig.		Fig.
<i>General view of the control unit</i> ...	1	<i>Detector element temp./resistance graphs</i>	4
<i>View of the detector element</i>	2	<i>Insulation resistance/ambient temperature graph</i>	5
<i>Circuit diagram</i>	3		

LIST OF APPENDICES

	App.
<i>Standard serviceability test for control unit,</i> <i>Walter Kidde, type WK 892561</i> ...	A

LEADING PARTICULARS

<i>Control unit, Walter Kidde, type WK 892561</i>	... Ref. No. 5CZ/7776
<i>Detector element, Walter Kidde, type WK885318</i>	... Ref. No. 5CZ/7777
Input voltage	
<i>Normal supply</i>	115V, 400c/s
<i>Standby supply</i>	28V, d.c.
<i>Test relay and warning circuit supply</i>	28V, d.c.
Input current (excluding test relay and warning circuit)	
<i>Normal supply</i>	30mA
<i>Standby supply</i>	177mA
<i>Receptacle, Thorn-Bendix, Part No. PT1H-12-10P</i>	Ref. No.

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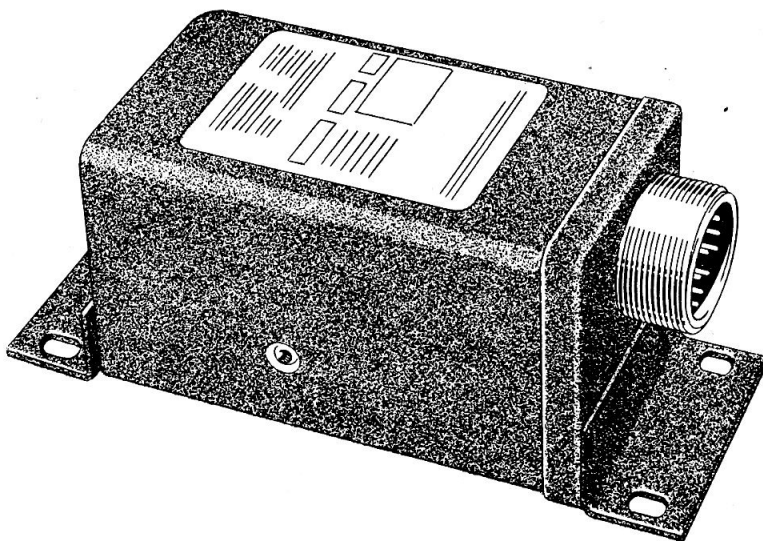


Fig. 1. General view of the control unit

Introduction

1. The control unit is illustrated at fig. 1, and in conjunction with a detector element provides a continuous warning of fire or over-heat conditions in the monitored zone. The detecting system comprises a thermistor-type continuous element located in the monitored zone which is connected to the control unit. The control unit monitors the resistance of the detector element, and will energize the fire warning system when a temperature rise causes the detector element resistance to fall to 450 ohms. The control unit will also discriminate between true and false warnings.

DESCRIPTION

General

2. The control unit is a sealed item, a threaded hole is provided in the case to test for leaks. A ten pole Bendix plug is mounted at one end to provide electrical connection to the unit, pins are labelled from A to K inclusive omitting I. The unit is supplied with 115V 400c/s and 28V d.c., the unit under normal circumstances will function on 115V a.c. with the 28V d.c. supply being used for the fire warning signal circuit only. Should the a.c. supply be interrupted or fail the unit will continue to operate on 28V d.c. supply, the changeover being effected automatically within the unit by a relay (RL1). The unit is secured by four screws through the feet integral with the case.

Circuit

3. The circuit is illustrated at fig. 3, and comprises a transformer (T1) and rectifier circuit to provide a supply to transistors and sensing circuit when a.c. supply is being utilised. The d.c. supply is fed to the transistors via a dropper resistor. The transistors are connected to form two Schmitt triggers, VT1 and VT2 forming the warning trigger, VT3 and VT4 forming the short circuit discriminator trigger. One end of the detector element is connected to pins C and E whilst the other end is connected to pins D and F, pins C and D are commoned via contacts of the test relay as also are pins E and F. The effect of increasing temperature in the monitored zone will decrease the resistance between points (X) and (Y).

4. The detector element comprises a metal capillary through which pass two detector wires. The detector wires are separated by a filler material which also serves to keep the detector wires from contact with the capillary. The filler material has a positive temperature co-efficient. A view of the detector element is shown at fig. 2.

5. The system has a built in test circuit which will check the operation of the control unit and the continuity of detector element. The control unit has a built in facility to discriminate between true and false warnings. The system will remain operative should the detector element fracture provided the detector wires are not shorted. The possibility of a

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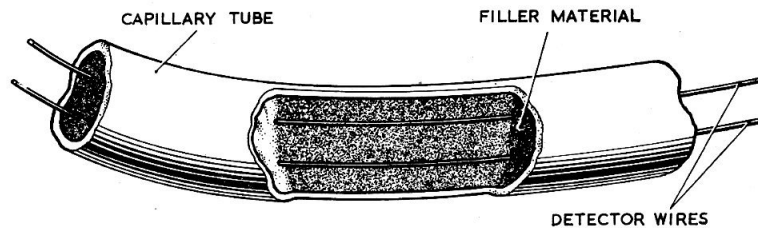


Fig. 2. View of the detector element

short occurring between the detector wires, or between a detector wire and the capillary, on element fracture, is extremely unlikely.

OPERATION

General

6. The Walter Kidde, isolated circuit fire detector system utilises the resistance of the detecting element system to monitor the temperature in the potential fire zones. When the resistance between the detector wires falls to 450 ohms VT1 will be cut-off and VT2 will conduct. VT1 and VT2 in the configuration used in this control unit form a 'Schmitt Trigger', this is sometimes given the name 'emitter-coupled binary'. The value of resistance across (X) and (Y) at which VT1 will cut-off is dependent upon the value of R1, this is arranged such that when the detector resistance is 450 ohms or less VT1 will be 'switched' off and VT2 will be 'switched' on, i.e. R1 and the detector element form a potential divider.

7. The resistance values are chosen such that when zero signal is applied to the input of VT1 it is 'switched' OFF and VT2 is 'switched' ON. If a voltage V_1 ('upper trip voltage') is applied to VT1, VT1 is switched ON and VT2 is very quickly switched OFF, this is the stand by condition. As long as the input is held above V_1 , VT1 will remain ON and VT2 will remain OFF. If the input to VT1 is allowed to fall to V_2 ('lower trip voltage') VT1 will switch OFF and VT2 will switch ON. Therefore VT2 will be on or off depending upon the level of input voltage at VT1. The circuit belongs to the bistable multivibrator family, one collector is cross coupled to the opposite base via R4, the other cross coupling is by means of the common-emitter resistor R5, hence the alternative name for this circuit is an 'emitter-coupled bistable'.

Short circuit discrimination

8. Should the detector element develop a

fault which produces a short circuit between element wires, this condition will not give a fire warning. The condition is determined a short circuit when the resistance across (X) and (Y) falls to 170 ohms or below. The short circuit is also a 'Schmitt Trigger', the input potential divider being R2 and the detector element, set to operate at 170 ohms detector element resistance. When a short circuit condition exists VT3 is switched off and VT4 is switched on so preventing VT1 switching off and hence VT2 being switched on.

9. If warning conditions exist in the monitored zone, and subsequent to this a short circuit condition arose; the fire warning signal would not be interrupted. This is arranged by contacts RL2/2 of the warning relay (RL2) which, when the relay is energized, disconnects VT4 collector from VT1 collector and so prevents the short circuit discriminator output affecting the warning circuit.

10. When VT2 is switched on the warning relay RL2 will be energized: one set of contacts complete the 28V d.c. positive supply to give a warning signal; the remaining set of contacts disconnect the short circuit discriminator circuit.

D.C. operation

11. Should the a.c. supply fail, the supply change over relay, RL1, will de-energize. One set of contacts will connect 28V d.c. positive line, from pin G of Bendix 10 pole receptacle, to the 'top rail' of the transistor circuitry via a dropper resistor R6. The other set of contacts connect the 'bottom rail' to earth, which is common with d.c. negative. The detector element will now be connected to ground on one side, hence it is no longer an isolated system, and the resistance measured by the element, will be between one of the detector wires (pin C) and the earth (pin E).

Test of system, in-situ

12. The control unit has a test relay (RL3)

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and a test resistor built in for in-situ testing of the control unit and the detector element. The test relay is energized by the test switch, which completes a 28V d.c. positive supply to the relay coil. The test relay contacts when energized connect the test resistance between pins F and D, simulating the element alarm resistance. Providing that the control unit is functioning correctly and that the detector element has continuity the warning circuit will be energized.

INSTALLATION

Control unit

13. The control unit may be mounted in any attitude using the four holes provided in the mounting feet. MS-4 (silicone grease) may be used on the threads of the plug and socket making electrical connection to the control unit but this grease is not to be used on any other part of the system.

Detector element

14. The torque loading for connections is between 30 and 35 lb. in. The minimum radius permitted for bends of the element is 1 in. but the preferred value is 3 in. The detector element must be kept straight between an element connector and the first element clamp.

SERVICING

15. The control unit should be examined visually to ensure it is mechanically undamaged, particular attention being paid to the electrical connection receptacle. The sealing of the unit may be checked, using the threaded hole provided together with an adapter, to hold a pressure of 2 in. mercury for 5 minutes.

In-situ testing

16. Testing of the control unit when fitted to the aircraft is described in para. 12. Should the warning circuit fail to be energized when the test switch is operated one or more of the following points should be considered:—

- (1) Check that power supplies are available at the control unit.
- (2) Ensure warning system is not defective.

(3) Check that the detector has continuity and freedom from short circuits as described in paras. 17 and 18.

(4) Check that the control unit is functioning correctly by bench test described in para. 19.

Short circuit test of the detector element

17. Using a Bridge-Megger tester, type B (Ref. No. 5G/1708) measure the insulation resistance between the detector wires, and earth, the capillary tube is earthed. The minimum reading obtained, in Megohms, is calculated as follows:—

(1) Using the graph at Fig. 5, determine the value for 'MINIMUM MEG-FEET'.

(2) Divide this value by the length of the detector element in feet.

(3) The figure so obtained is the minimum resistance allowed, in Megohms.
E.g. Let the ambient temperature be 80°F. and the element length be 10 feet. Then minimum allowable reading will be $\frac{5.5}{10} = 0.55$ Megohms.

Continuity test of the detector element

18. Using a Bridge-Megger tester type B (Ref. No. 5G/1708) measure the resistance of the detector loop. The reading obtained must not exceed 1 ohm per foot length of the detector element. A low reading indicates a short between the detector wires, a high reading indicates a high resistance contact or a discontinuity within the detector loop.

Bench testing of the control unit

19. The control unit may be functionally tested using the Standard Serviceability Tests, at Appendix A to this chapter. Additionally these tests may be performed at the maximum and minimum supply voltages: for a.c. supply at 97 volts, 388c/s and at 128 volts, 412c/s; for d.c. supply at 18 volts and at 30 volts. The input current at these voltages shall be as indicated in Appendix A.

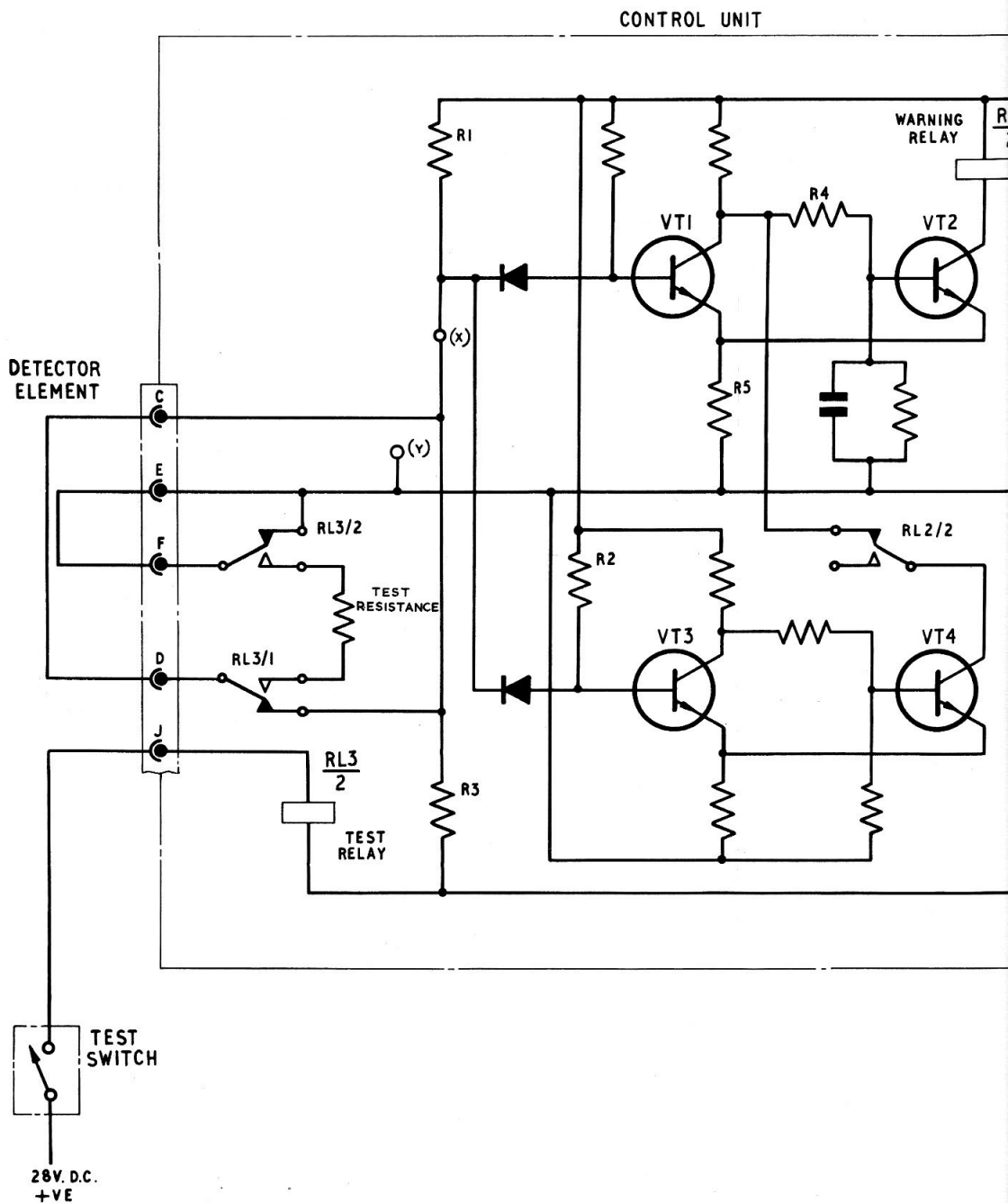
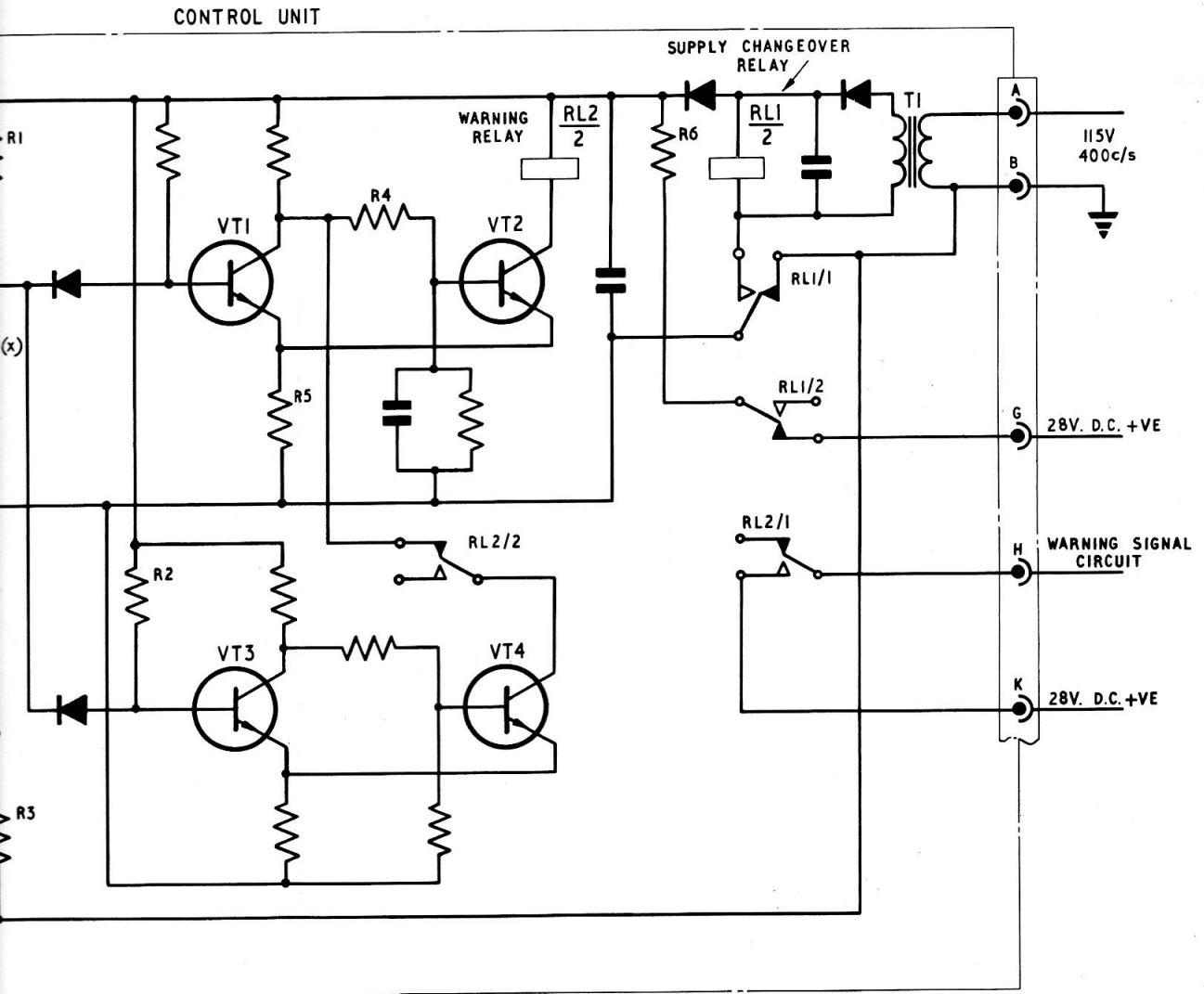


Fig. 3

Dd. 90445, 570528, 7/65, J.L.Ltd.

Circuit diagram
R E S T R I C T E D



Circuit diagram

Fig.3

R E S T R I C T E D

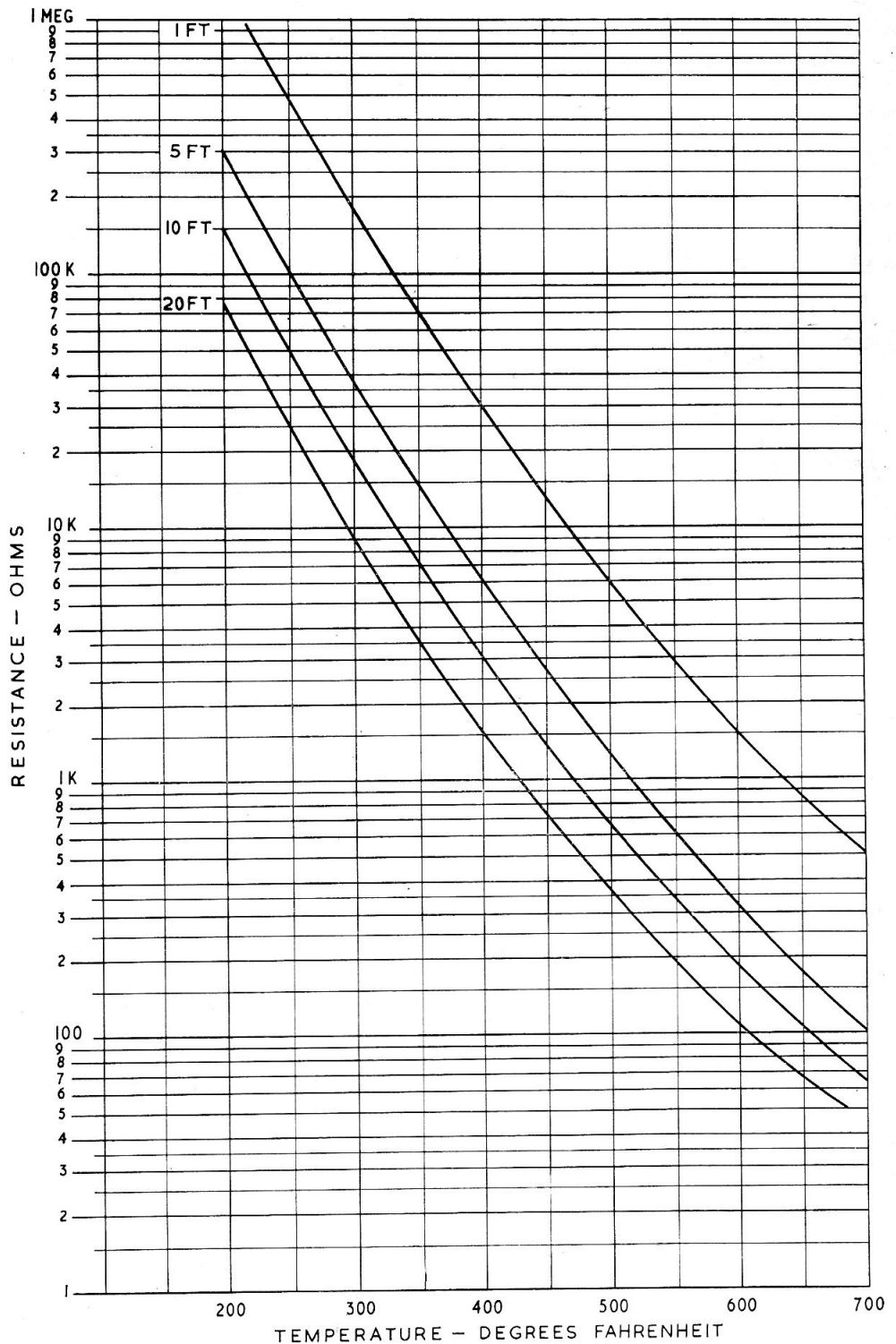


Fig. 4. Detector element temp./resistance graphs

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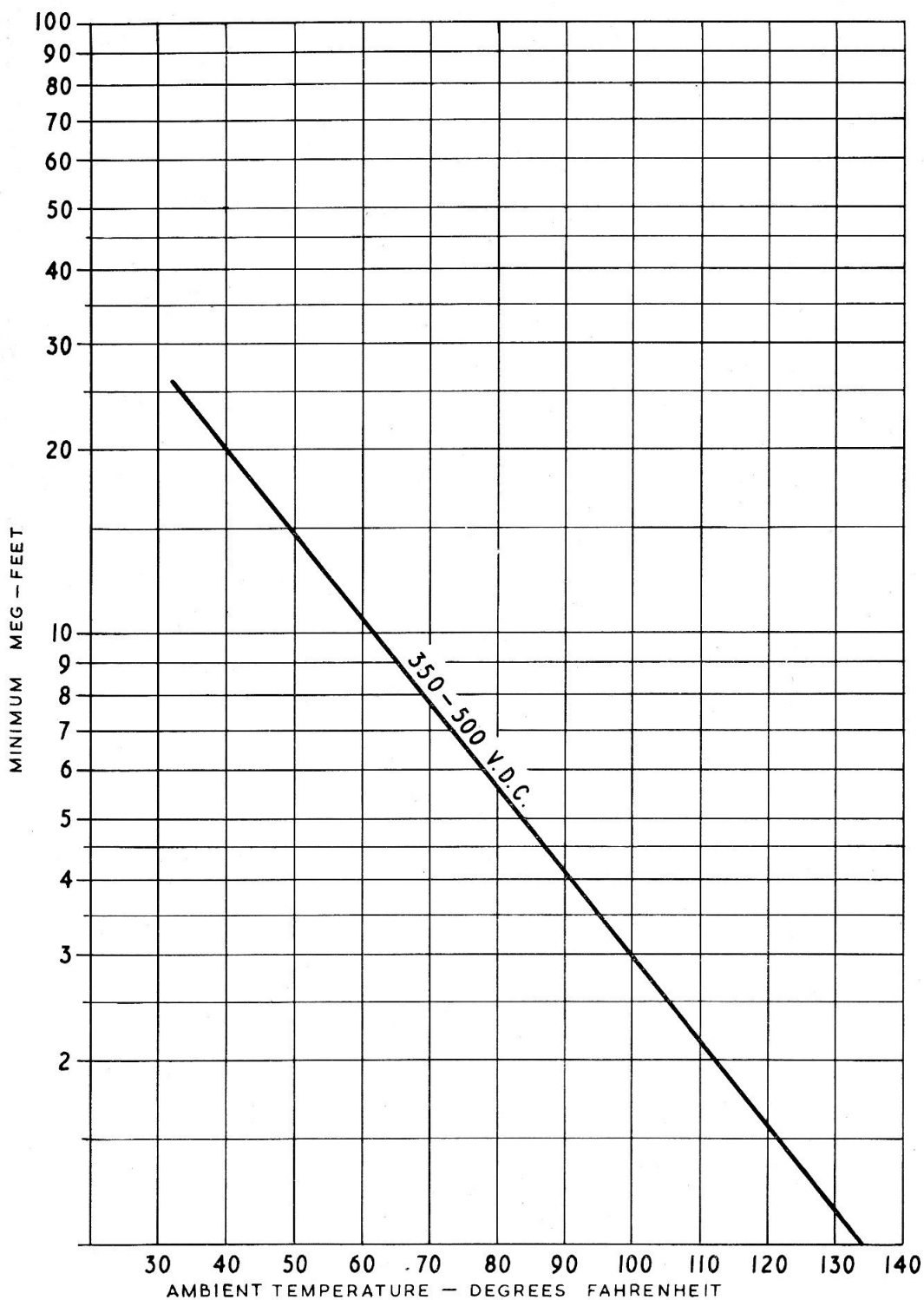


Fig. 5. Insulation resistance/ambient temperature graph

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Appendix A

STANDARD SERVICEABILITY TEST FOR CONTROL UNIT, WALTER KIDDE, TYPE WK892561

Introduction

1. The following tests may be applied to a control unit prior to installation or whenever serviceability is suspect.

TEST EQUIPMENT

2. The following test equipment, or equivalents, will be necessary to perform these tests.

- (1) A 28 volt d.c. supply.
- (2) A 115 volt 400c/s a.c. supply.
- (3) A Cannon free plug, Part No. KPT06E-12-10S, (Ref. No.) with suitable tails (identified) attached to connect supplies, etc., to the control unit.
- (4) A decade resistance box, 0-11, 110 ohms (Ref. No. 5G/3728).
- (5) A 28 volt, 2-8 watt warning lamp.
- (6) A Multimeter, Type 12889 (Ref. No. 5QP/17447).

TEST PROCEDURE

3. Connect the control unit as follows:—

- (1) The 28 volt lamp between pins H and B, test warning lamp.
- (2) The decade resistance box between pins C and E, the resistance valve set to approximately 1000 ohms, and place a single pole switch (refer to as Switch A) in series with one line. Also common pin C to pin D and pin E to pin F.
- (3) The a.c. supply to pins A and B, line connection to pin A.
- (4) The 28V d.c.: positive to pins G, K and to pin J via a single pole switch (Refer to as switch B); negative, and earth, to pin B.

A.C. operation

4. With switch A in the closed position, steadily reduce the value of the decade resistor until the test warning lamp is illuminated, this should occur at 450 ohms ± 22.5 .

5. With switch A in the open position set the decade resistor to a value of 140 ohms. On closing switch A the warning lamp should remain extinguished. This test proves the functioning of the short circuit discriminator.

Note . . .

The decade resistor should not be steadily reduced in value for this test as operation of the warning relay, contact RL2/2, disconnects the output of the short circuit discriminator.

6. With switch A in the open position close switch B, putting a positive supply to pin J and hence energizing the test relay. The warning lamp should now illuminate.

D.C. operation

7. Repeat the tests detailed in para. 4 to 6 with the a.c. supply to pins A and B switched off.

Input current tests

8. The maximum power taken by the unit, whether it is in the standby or the warning condition, is 3-0VA. For a.c. working a milliammeter inserted in the line to pin A should read 30mA maximum value. For d.c. working a milliammeter inserted in the line to pin G should read 177mA, maximum value.

Operation of the supply changeover relay

9. With the a.c. and d.c. supplies switched on and the decade resistor set to 600 ohms, close switch A and steadily reduce the value of the decade resistor to zero, the test warning lamp should now be illuminated. Switch the a.c. supply off, pause, then switch the a.c. supply on again; during this switching the test warning lamp should remain illuminated and not flicker.

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Insulation resistance test

10. Connect all the receptacle pins together and measure the insulation resistance, using a 500V insulation resistance tester Type A (Ref. No. 5G/1621), between the commoned pins and the receptacle shell. The reading obtained should be not less than 5 Megohms.

Note . . .

Ensure that a good connection is made to all pins as a bad connection to one pin may result in damage to the transistors.

11. Units which fail any of the above tests should be returned for repair in accordance with the current authorized procedure.

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