Group C.2

FIRE WARNING AND EXTINGUISHER

(CODE FW AND FE)

CONTENTS

	Para.
Introduction	1
Description	
Fire warning and extinguisher	2
Operation	
Fire warning - Pre Mod.960	4
Fire warning - Post Mod.960	5
Fire extinction	7
Circuit test	9
Servicing	
General	10
Testing fire warning circuit	11
Continuity resistance test (Post Mod. 960)	12
Cleaning sensing element system (Post Mod. 960)	13
Examination of sensing elements (Post Mod. 960)	15
Replacement of copper washer (Post Mod. 960)	16
Torque loading gland nuts (Post Mod. 960)	17
Insulation resistance test (Post Mod. 960)	19
Testing of sensing elements (Post Mod. 960)	20
Testing fire extinguishers	21
Testing flame switches (Pre Mod. 960)	22
Re-setting inertia switches	23
Removal and assembly	
General	24

ILLUSTRATIONS

	Fig.
Fire warning and extinguishers Pre Mod.960 (routeing and theoretical)	1
Fire warning and extinguishers Post Mod.960 (routeing and theoretical)	2
Details of Firewire sensing elements installation (Post Mod.960)	3

TABLE

	Table.
Equipment type and Publication reference	1

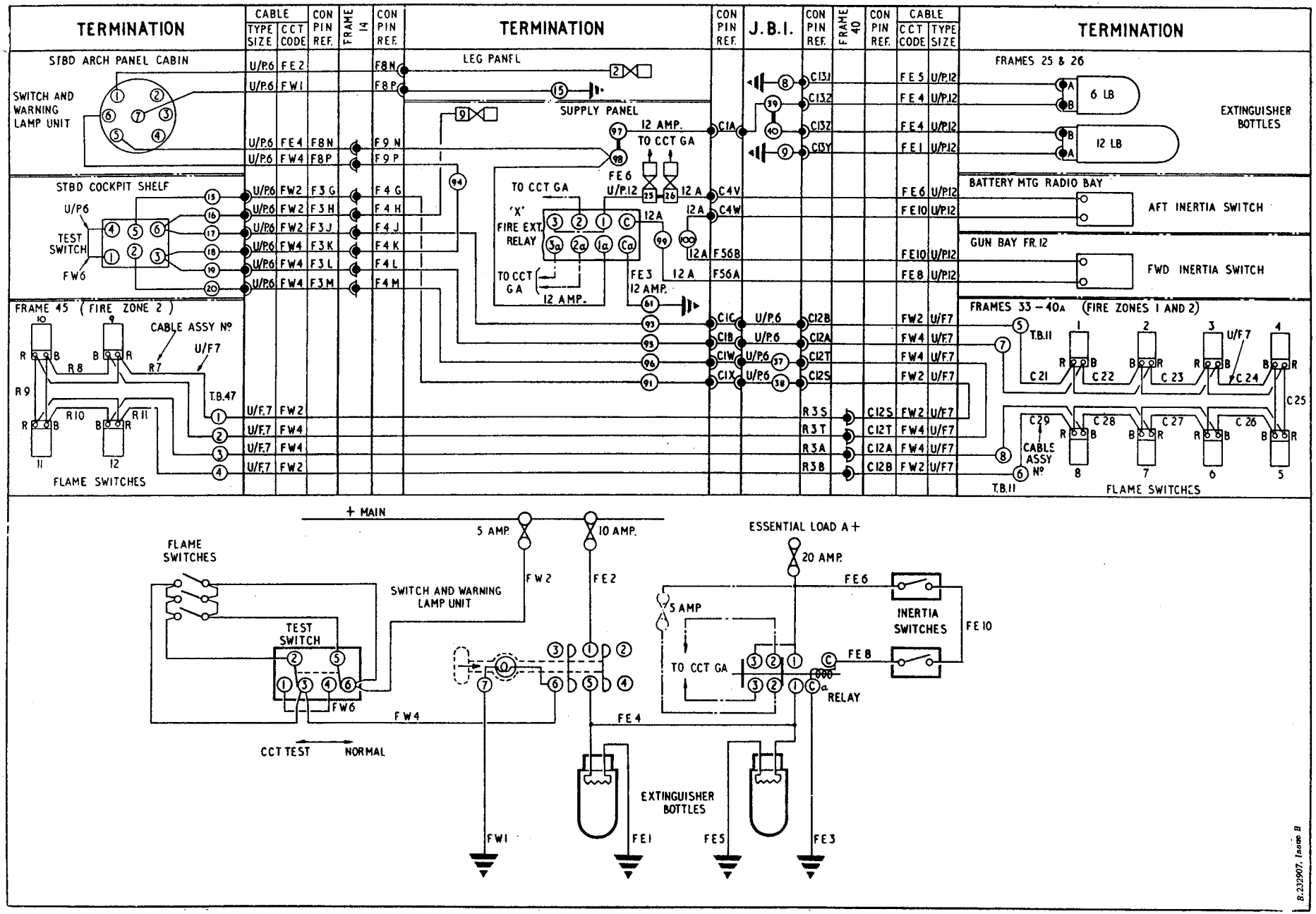

Fig.1 Fire warning and extinguisher – Pre Mod.960 (routeing and theoretical)

T.P.(E) 24392

Introduction

1. This group contains a description of the installation and method of operation of the fire warning and extinguisher circuits and information on the servicing required to maintain the equipment in an efficient condition. Routeing and theoretical circuit diagrams are also included. Detailed information on the standard items of equipment used in the circuit will be found in the air publications listed in Table 1.

DESCRIPTION

Fire warning and extinguisher

2. A lamp to give warning of fire in the engine bay or rear fuselage is contained in a combined warning lamp and extinguisher switch unit mounted on the starboard arch panel. On aircraft Pre Mod.960 this lamp is controlled by a number of re-setting flame switches which are situated around the engine bay between the rear spar frame and rear transport joint and at frame 45 in the rear fuselage. On aircraft Post Mod.960 the lamp is controlled by a number of Graviner "Firewire" temperature sensing elements fitted at frames 34, 38 and 39 in the engine bay and frames 45 and 56 in the rear fuselage. The elements are connected by coupling units and bulkhead fittings to a control unit fitted between frames 14 and 15 on the starboard side of the aircraft, and to the fire warning lamp unit and the system test switch on the cabin starboard shelf. The control units' supply is taken from the aircraft's d.c. system via a fuse on the supply panel.

3. The two fire extinguishers are carried in cradles mounted in the centre fuselage one on the aft face of the main spar frame and the other on the forward face of frame 26. The extinguishers are connected by a system of pipelines to two spray rings which encircle the engine bay at frames 34 and 38. The extinguishers are discharged electrically, either by manual pressing of the button of the combined fire warning and extinguisher switch unit, or automatically in the event of a crash landing etc. by operation of relay X, situated on the supply panel. This relay is energized by the operation of two inertia switches mounted, one underneath the battery platform in the radio bay and the other on frame 12 in the gun bay. When energized this relay also isolates the batteries from all but the essential load line and open-circuits the generator fields to off load the generators *(Group B.1)*. For a full description of the fire protection system, reference should be made to Sect.4, Chap.5.

TABLE 1

Equipment type and Air Publication reference

Equipment Type	Air Publication
Control unit, Type D.3000(2) or 165D(2) *(Post Mod.960)*	A.P.107E-0100 series
Firewire element - 10ft. D2370/120 Firewire element - 5ft. D2370/60 Bulkhead fitting D3131 Termination fitting D3170 Coupling unit D2475 *(Post Mod.960)*	A.P.107E-0102-1
Fire warning test switch Rotax D.5507 or C.W.C. Type XD.788 No.4 Fire warning lamp and extinguisher switch *(Pre and Post Mod.960)*	A.P.113D-1108-1
Fire extinguishers Mk.12A and 13A *(Pre and Post Mod.960)*	A.P.107E-0400-1A
Flame switches, Mk.4, No.HS/RS300 *(Pre Mod.960)*	A.P.107E-0100 series
Inertia switches, Mk.1 Type 8.C Fire Extinguisher relay Type S.No.3 *(Pre and Post Mod.960)*	A.P.113D-1309-1

Operation

Fire warning - Pre Mod.960

4. The flame switches are all connected in parallel, so that operation on any one switch will complete the circuit from the fuse to the warning lamp, via the contacts

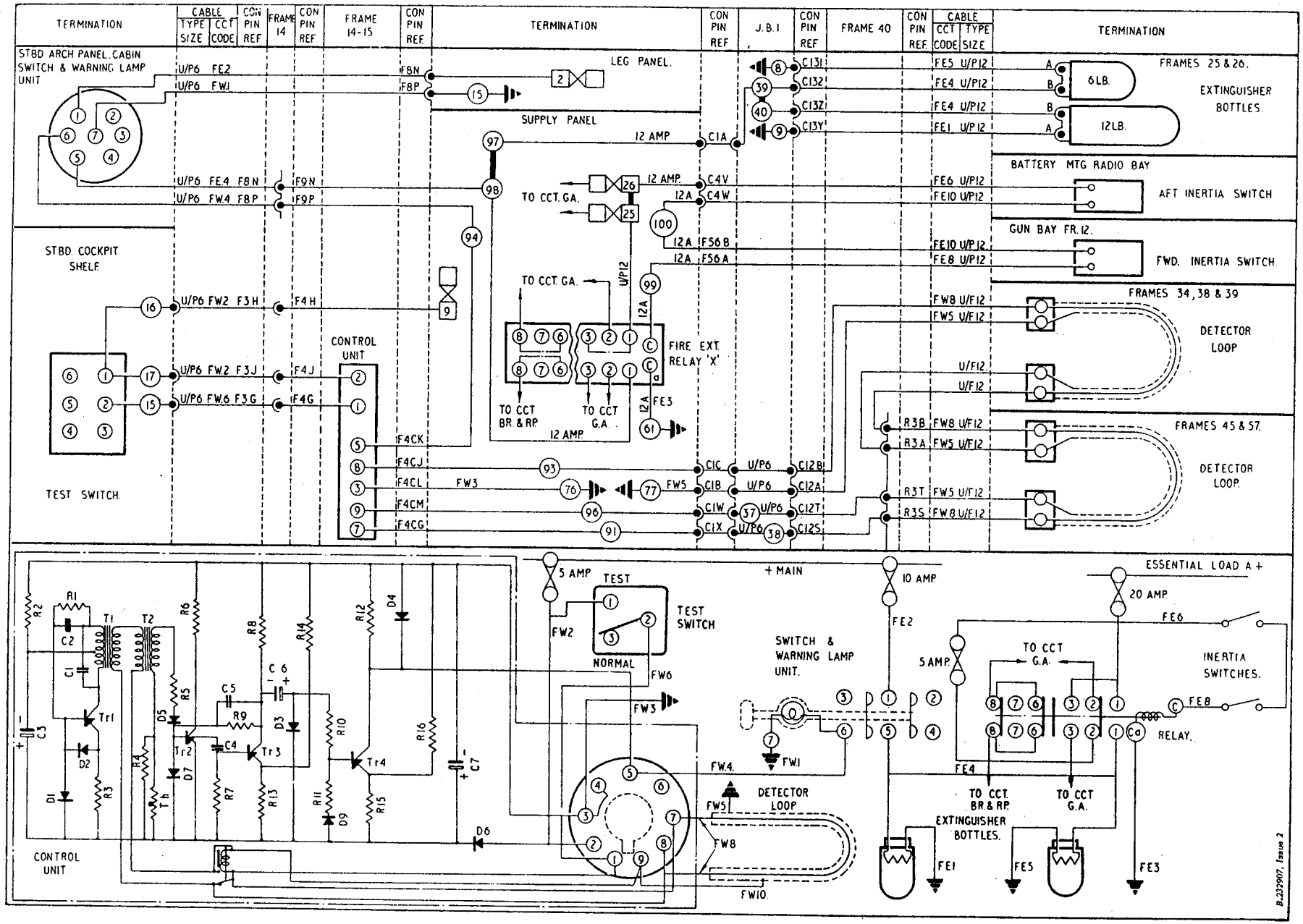

Fig. 2 Fire warning and extinguishers, Post Mod.960 (routeing and theoretical)

of the combined warning lamp and extinguisher switch unit. The flame switch contacts close at 300+30 – 0 deg.C. and the lamp may light intermittently on the ground or in the air, due to heat surges in the engine bay.

Fire warning – Post Mod.960

5. The sensing elements consist of a stainless steel capillary through the centre of which runs an electrode insulated from the capillary by a filling material which has a negative temperature co-efficient. As the ambient temperature rises the decreasing electrical resistance between the electrode and capillary is used to control the current in the control unit and hence the fire warning lamp.

6. The sensing elements used in the system have a combined length of 85 ft. resulting in a mean ambient operating temperature of 140 deg.C.

Fire extinction

7. It must be noted that operation of the flame switches *(Pre Mod.960)* or the fire-wire system *(Post Mod.960)* will not discharge the fire extinguishers, which, if the lamp remains alight steadily for a period of 5 to 10 seconds, must be discharged by pressing the fire extinguisher push button. When pressed this push-switch completes the circuit to blow the fuse in each extinguisher discharge head and both extinguishers are simultaneously discharged.

8. In the event of a crash landing etc., the inertia switches, which are connected in series with the coil of relay X, will operate and complete the circuit from the essential load line to energize the relay. When relay X is energized, contacts within the relay will close to complete the circuit from the essential load line to the fuze in each extinguisher discharge head and also feed the generator crash relays. The extinguishers are thus discharged and the generator crash relays energized to open circuit the generator fields *(Group B.1)*. Further contacts in relay X, which feed the battery relay, via the battery master switch when relay X is de-energized are opened when relay X is energized, so de-energizing the battery relay to isolate the batteries from all but the essential load line. The essential load line also feeds the tele-briefing control relays via a pair of contacts in relay X and this feed is also broken when relay X is energized, to prevent a possible fire hazard.

Circuit test

9. To test the continuity of the fire warning circuit wiring and the warning lamp filament for correct functioning, the fire warning test switch is moved to the CCT TEST position, thus placing the circuit wiring in series with the lamp. The lamp should light to indicate that the wiring is complete and that the filament is serviceable.

SERVICING

General

10. For general servicing of the electrical system, reference should be made to the information given in Group A.1. All the components should be kept clean and inspected periodically for signs of damage and to ensure that they are securely mounted. Apart from the servicing described in the following paragraphs and the standard bench testing of the components described in the appropriate Air Publications listed in Table 1, no further servicing should be necessary.

CAUTION

As operation of the battery master switch will not isolate the fire extinguisher circuit completely, the system must be rendered safe, by removing the circuit fuses, before commencing any servicing operations found necessary after carrying out the following tests.

Testing fire warning circuit

11. The fire warning lamp and the continuity of the wiring must be tested, before each flight, by the operation of the fire warning test switch. When the switch is placed in the CCT TEST position, the lamp should illuminate to indicate that the bulb filament is serviceable and the wiring is complete. The test should also be made on aircraft Post Mod. 960 whenever a disconnected firewire is reconnected.

Continuity resistance test (Post Mod. 960)

12. On aircraft Post Mod. 960 a further continuity test may be made by use of a suitable test meter. Maximum resistance for the complete circuit is 276 ohms. Resistance of individual elements is between 2 and 3 ohms per foot.

Cleaning sensing element system
(Post Mod. 960)

13. To prevent spurious fire warning, connector and element end fittings should be kept moisture free at all times. Care should be taken to ensure dryness in the working area when the system is being serviced or rectified. Gland nuts are to be free from grease.

14. Should element end fittings or connections require cleaning the following procedure should be applied:-

Note . . .

(1) Throughout the cleaning procedure it is essential that both ends of a connector are removed and that the amount of solvent used be kept to a minimum to lessen the risk of trapped solvent forming a moisture hazard.

(2) When couplings or connections are broken, the appropriate protective caps should be fitted immediately to prevent ingress of moisture.

◀ (1) If the contaminating particles appear to be loose and dry and show no sign of oily deposits, they are to be removed with a soft dry brush ensuring no brush hairs remain in the fittings or connectors.

(2) If oily deposits are present, brush out the affected parts with ARDROX 551 and allow to dry for at least 10 minutes. If available, apply moisture free compressed air or nitrogen for a minimum period of 30 seconds.

(3) Items showing signs of corrosion are to be replaced.

(4) After cleaning, complete an insulation resistance test. ▶

Examination of sensing elements *(Post Mod.960)*

15. Elements must be securely clipped to prevent chafing on the aircraft structure or other components. Disconnect coupling and fittings are to be protected against dirt and moisture by fitting the appropriate protective caps. The elements are to be examined frequently for acute bending and damage. The limits of acceptable damage are clearly defined in the relevant equipment servicing A.P. and these limits must be strictly observed.

◀ **Replacement of copper washer** *(Post Mod. 960)*

16. When a firewire is disconnected or replaced a new copper S washer is to be fitted.

Torque loading gland nuts *(Post Mod. 960)*

17. Gland nuts are to be tightened using a Richmont LTC-0 torque wrench set to 90 ± 10 lbf in. (10.17 ± 1.13 NM) with the appropriate adapter. Grease is not to be used on gland nuts.

18. The Richmont torque wrench requires the use of special adapters. Once the wrench has been set to a required torque value it will remain correct for any subsequent adapter which may be fitted. The following adapters including one with a square drive to fit a torque setting rig, will meet all firewire system requirements, (refer to AP119G-0128-1 for general information):-

(1) 5/8 in. AF (Part No. SFN 5/8)
(2) 3/8 in. BSF (15 mm) Crowfoot
(3) 17 mm Crowfoot
(4) 3/8 in. square drive.

Insulation resistance test *(Post Mod. 960)*

19. Whenever a disconnected firewire is reconnected or after the cleaning of element end fittings and connectors, an insulation resistance test at 250 volts should be completed. The insulation resistance of individual components is to be a minimum of 20 megohms. Resistance for the complete and installed system is to be a minimum of 1 megohm.

Note . . .

To prevent polarization of firewire elements, application of the resistance tester is to be limited to a maximum of 5 seconds. ▶

Testing of sensing elements *(Post Mod.960)*

20. Figure 3 gives the details and location of the sensing elements, coupling units and termination fittings, and is provided to assist when using Graviner Test Set T1580-02.

Testing fire extinguishers

21. To test the continuity of the fuzes in the fire extinguisher discharge heads, disconnect the electrical sockets from the plug on each discharge head and remove the heads from the extinguishers. Connect a suitable safety ohmmeter to each discharge head plug, in turn, and, if the reading obtained does not lie between 5 and 6 ohms (Type A716 head), or 7 to 11 ohms (Type A216 head), replace the unit with a fully serviceable component. It must be noted that the actuating fuzes are very sensitive and the electrical checks must be made with care. The safe test current is 10 mA. As an additional safeguard, it is recommended that the discharge heads are mounted on a suitable fixture with the charge end shielded but unrestricted in case of accidental firing. To measure the insulation resistance, take a reading between each plug pin and the discharge head body. The reading obtained should be at least 20 megohms. After replacing the discharge head and reconnecting the electrical connection, ensure that the extinguisher circuit wiring is undamaged by checking the resistance between terminal 97 on the supply panel and earth, using the safety ohmmeter with a 5 ohms resistor in parallel. The reading obtained should be between 1.6 and 2.1 ohms.

Testing flame switches *(Pre Mod. 960)*

22. On aircraft Pre Mod. 960 the re-setting flame switches, which operate the fire warning lamp, may be tested in situ, by using a 24 volt, 6 amp. battery-operated tong tester. After allowing 6 minutes for the tester to warm up, it should be fitted over the barrel of each switch in turn, when the warning lamp should illuminate to indicate satisfactory operation. The temperature setting adjusters of the flame switches are locked and sealed during manufacture and in no circumstances must any attempt be made to interfere with their setting. An inspection should, however, be made to ensure that the expansion barrel of each flame switch is not damaged.

Re-setting inertia switches

23. To re-set each inertia switch, proceed as follows:-

(1) Disconnect the aircraft main battery

and ensure that an external supply is not connected to the aircraft.

(2) Gain access to the switch *(Group A.3)* and remove the terminal cover.

(3) Re-set the switch, by pressing the re-setting plunger situated between the terminals of the switch.

(4) Replace the terminal cover.

(5) Reconnect the aircraft battery and replace any panels removed to gain access.

REMOVAL AND ASSEMBLY

General

24. Once access has been obtained, the removal and assembly of the electrical equipment forming the fire warning and extinguisher circuit should present no unusual difficulties. The location of, and access to all the components is indicated in Group A.3 and removal of the fire extinguishers is described in Sect.4, Chap.5.

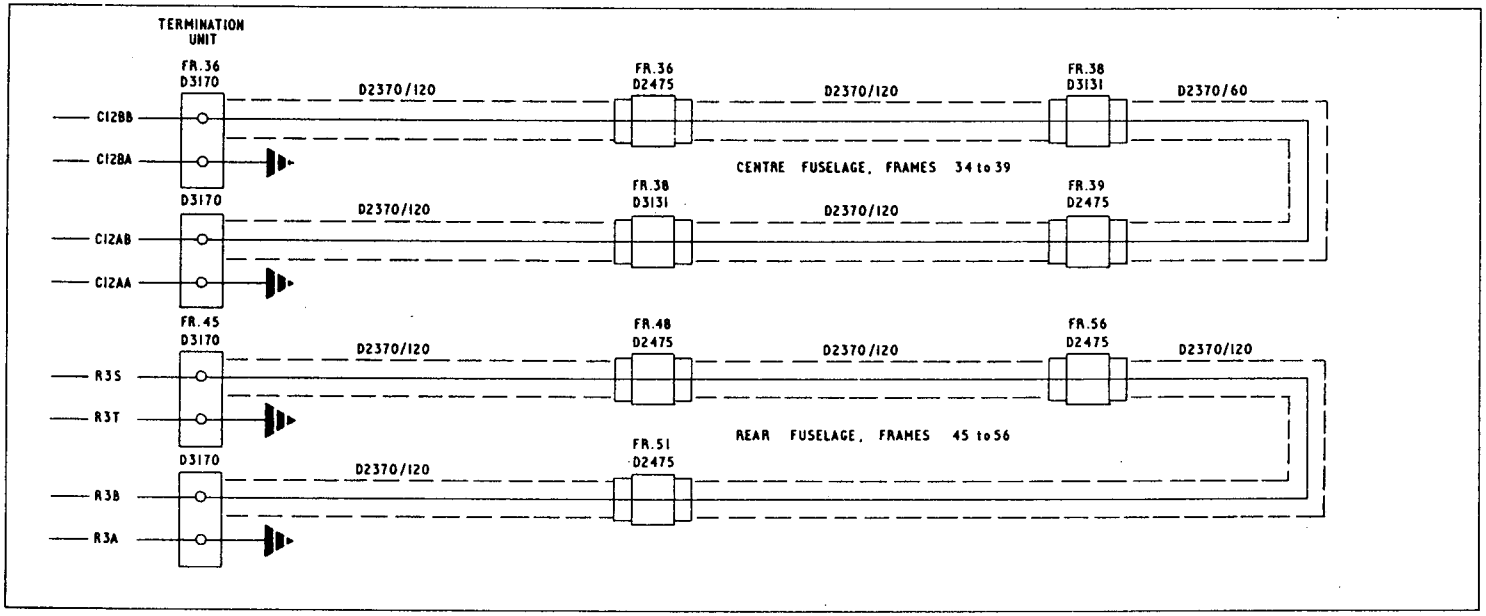

Fig. 3 Details of Firewire sensing elements installation (Post Mod.960)