Chapter 5 FIRE PROTECTION SYSTEM

CONTENTS

ILLUSTRATIONS

Introduction

1. The fire protection system is operated in two ways as follows:-

(1) Manually by push-button control from the cabin.

(2) Automatically by inertia switches which operate the spray units in the event of a crash landing.

The manual control in the cabin incorporates a fire warning lamp which is actuated by flame detector switches on Pre-mod.960 aircraft or by a Graviner continuous fire-wire system on Post-mod.960 aircraft. The type and reference numbers of the major components used in the systems will be found in the Leading Particulars and details of the electrical circuits in Sect. 5, Chap.1, Group C2. For a description of fire protection generally, reference should ◀ be made to A.P.107E – series. ▶

Extinguisher bottles *(fig.2)*

2. Two methyl bromide fire extinguisher bottles are provided, mounted in cradles, one on the aft face of the main spar frame and the other on the forward face of frame 26. The bottles are secured in their cradles by metal straps which incorporate toggle

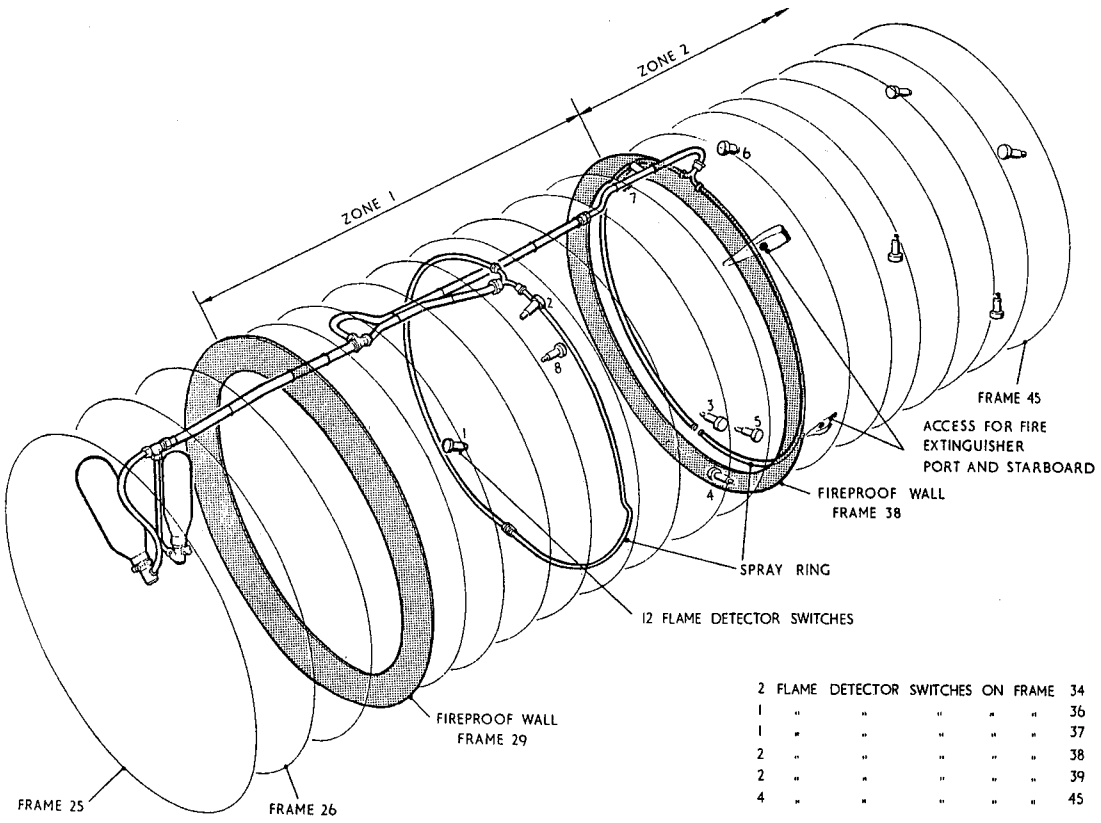

Fig.1 Fire protection system (Pre-Mod.960)

fasteners. Each bottle has a single discharge head which is piped into a tee-piece from which a common pipe conveys the extinguisher fluid to a second tee-piece in the region of frame 31. From this tee-piece, separate pipes branch off to feed the two-spray rings in the engine bay. The discharge heads are fired electrically, either by means of the pilot's push-button control, or automatically on operation of the inertia switches *(para.4)*. The capacity of the forward bottle is 12 lb. and that of the rear bottle 6 lb. Each bottle is provided with an indicator pin which lies flush with the surface of the operating head when the bottle is fully charged. When the bottle is discharged, the pin protrudes 3/8 in. approx.

Spray units

3. For fire protection purposes, the engine bay is divided into two zones by a fireproof bulkhead at frame 38. A similar firewall at frames 29 and 30 isolates the forward fire zone from components forward of the engine bay. A spray ring is fitted in each fire zone, the forward ring encircling the engine compressor outlet casing and the rear ring encircling the turbine nozzle box. The two spray rings are separately fed from the tee-piece in the main supply line from the extinguishers (para.2). The forward ring is drilled with two rows of holes which are alternately staggered to direct the spray on to the engine both fore and aft. The holes in the rear ring are similarly drilled and staggered but are so positioned that they direct the spray both inwards and aft from the firewall.

Inertia switches *(fig.3)*

4. The inertia switches operate in the event of a crash landing. The forward switch is mounted at the bottom of frame 12 in the gun bay and the rear switch is in the radio bay where it is mounted below the battery mounting platform.

Flame detector switches - Pre-mod.960 *(fig.4)*

5. On aircraft pre-mod.960 twelve unit resetting flame detector switches are mounted at vital points in the engine bay and in the region of the jet pipe joint. The switches operate when subjected to temperatures in excess of that for which they are pre-set, thus completing the circuit to illuminate the fire warning lamp incorporated in the pilot's push-button control *(para.7). They do NOT operate the fire extinguishing system.* The location of the switches is shown in fig.1.

Note . . .

In certain circumstances during an engine ground run, when the engine bay

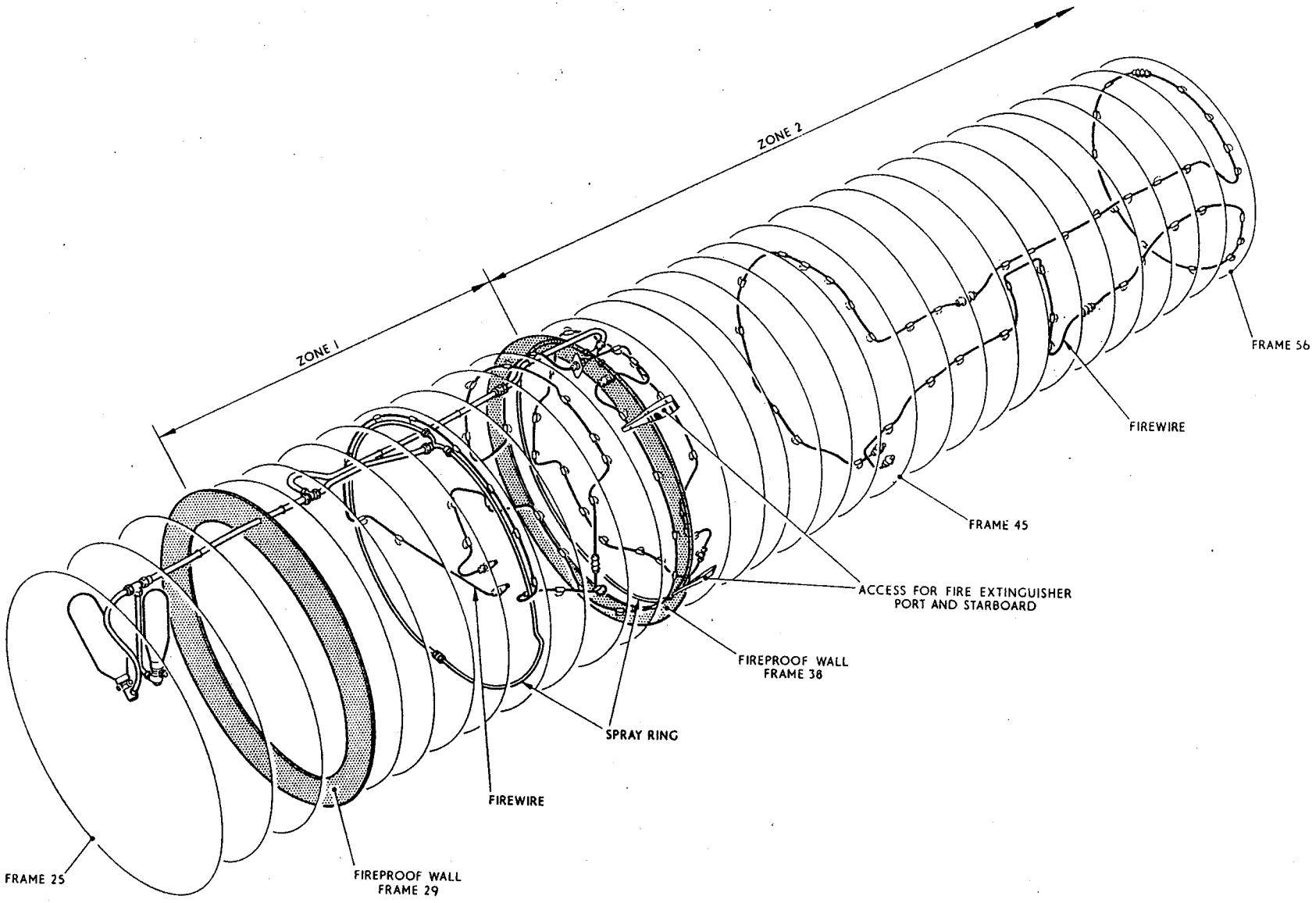

Fig. 1A Fire protection system (Post mod. 960)

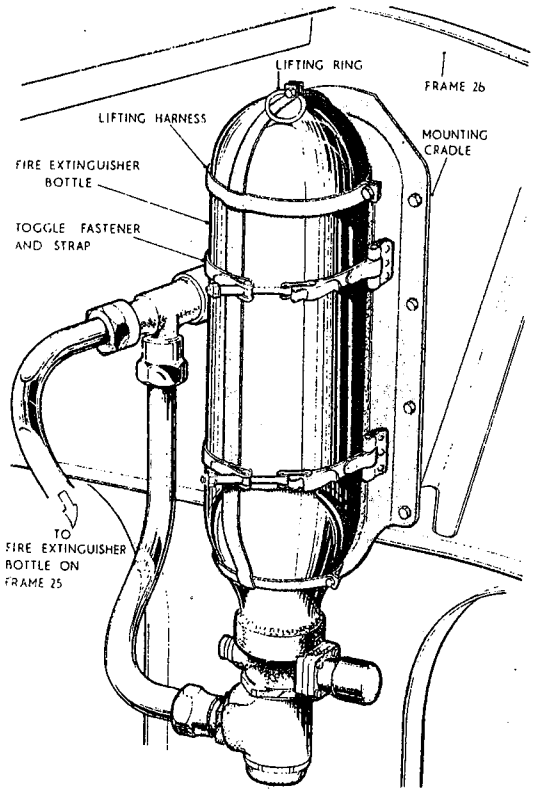

Fig.2 Fire extinguisher bottle

may become temporarily overheated, the fire warning lamp may flicker on and off although there is no fire. In such circumstances emergency action is not necessary unless the lamp remains steadily illuminated.

Graviner firewire installation - Post-mod. 960 *(fig.1A)*

6. On aircraft embodying mod.960 a Graviner firewire installation is fitted, which comprises two detector loops fitted around and along the engine bay. The loop, mainly in zone 1, disposed between frames 34 and 39, comprises four 10 ft. elements and one 5 ft. element connected by coupling units forms a continuous loop from Graviner termination fittings on frame 36. In zone 2, between frames 45 and 57, four 10 ft. elements coupled together form a continuous loop from termination fittings on frame 45. Each detector loop is connected from its termination fittings to the Graviner firewire D.C. control unit, which is mounted on a bracket on the starboard side of the front fuselage between frames 14 and 15. The elements are semi-flexible stainless steel capillary tubes having a central electrode separated from the wall of the tube by a special filling material. The electrical resistance of this material decreases as its temperature rises. A small current is flowing from the central electrode to the wall of the tube, when the temperature rises above a pre-determined level the decreased resistance results in an increased flow of current from the electrode to the wall of the tube, which energizes a relay switch to complete the circuit to illuminate the fire warning lamp incorporated in the pilot's push button control *(para.7). The firewire installation does not operate the fire extinguishing system.* The location of the elements is shown in fig.1A.

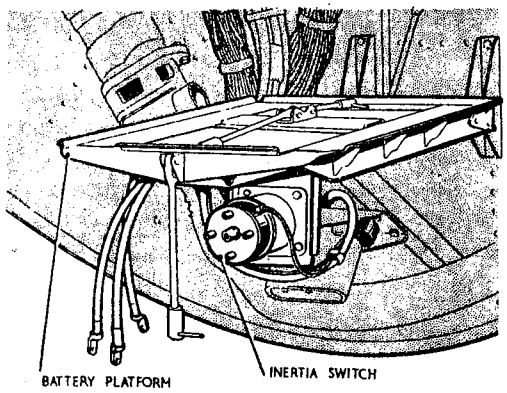

Fig.3 Typical inertia switch

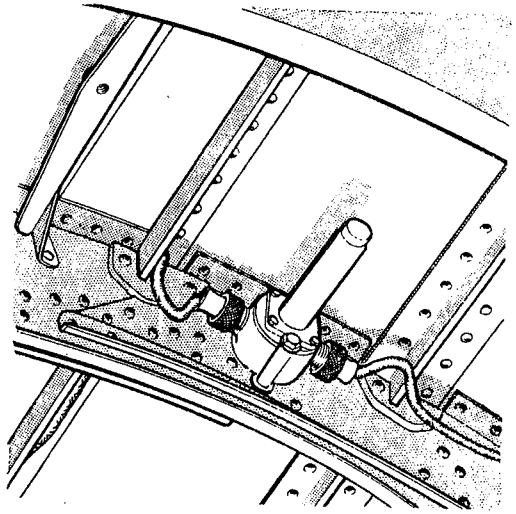

Fig.4 Typical flame detector switch assembly

Fire extinguisher manual control

7. The manual control consists of a push-button switch which is mounted on the starboard arch panel in the cabin. The action of pressing the push-button energizes the fuse in the discharge head of each extinguisher bottle, which being piped to the engine system, feed extinguisher fluid to the spray rings. The manual control switch incorporates the ENGINE FIRE warning lamp which is actuated by the flame detector switches *(para.5)* on Pre-mod.960 aircraft or by the firewire detector loops on

Post-mod.960 aircraft. The lamp and firewire circuit *(Post-mod.960)* are checked for serviceability by operating a test switch located on the cabin starboard shelf.

Access for fire appliance nozzle *(fig.5)*

8. Access is provided to allow the nozzle of a fire extinguisher appliance to be inserted at four points, two on either side of the fuselage in zone 2, aft of frame 38. These access points comprise small spring loaded doors set in the channel of the zone cooling ducts *(fig.5)* and are identified on the external finish of the aircraft by the words 'Fire door'.

SERVICING

General

9. Before attempting to service any part of the fire protection system, the aircraft must be made electrically safe, and, since the battery isolating switch in the cabin does NOT isolate the fire protection circuit, the following procedure MUST be adopted prior to servicing or removal of any component:-

(1) Place the battery isolating switch in the cabin to the GROUND position.

(2) Ensure that the ground service trolley battery is disconnected from the aircraft.

(3) Either (a) remove the aircraft battery leads from their terminals on the batteries and place them where they will not short against the aircraft structure, or (b) remove the fuses protecting the fire protection circuit (Sect.5, Chap.1, Group C.2) to complete the isolation.

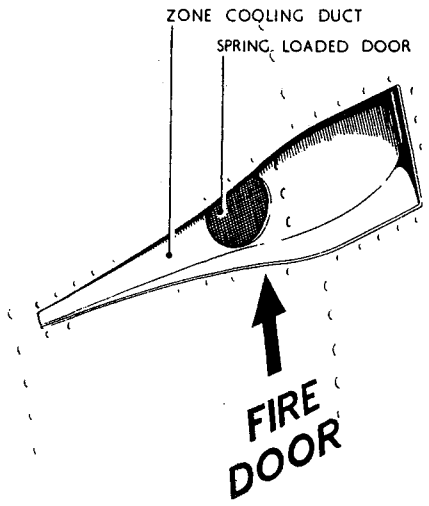

Fig.5 Access for fire appliance nozzle

Flame detector switches and Graviner firewire installation.

10. Apart from the routine checks for continuity and insulation which are described in A.P.113 – series, and a functioning check which is described in Sect.5, Chap.1, Group C2 of this volume, no servicing of the flame detector switches or Graviner firewire installation is possible.

Inertia switches

11. The procedure for re-setting the inertia switches is described in Sect.5, Chap.1, Group C.2 of this volume. No other servicing apart from ensuring security of attachment, is possible.

Extinguisher bottles

12. The fire extinguisher bottles must be weighed to determine whether they have been leaking or discharged. The weight of each bottle when fully charged and complete with cartridge assembly is as follows:-

Forward bottle ... ... 18 lb. 4½ oz. ± 4 oz.
Rear bottle ... ... 10 lb. 1 oz. ± 4 oz.

Should either bottle weigh less than its full weight given above, or the weight stamped on the bottle which must always be taken as the overriding authority, it should be replaced by a fully-charged bottle. Checks for determining the serviceability of the discharge heads of the bottles and other electrical tests are given in Sect. 5, Chap.1, Group C.2 of this volume.

MB and BCF fire extinguishant

12A. Bromochlorodifluoromethane (BCF) fire extinguishers are being issued for use with aircraft and are also being introduced into aircraft extinguisher systems by modification.

12B. BCF is an effective fire control agent. However, like most other fire suppressants, effective cleaning procedures must be implemented to any hardware which has been subject to the extinguishant and its by-products. To prevent corrosion when ground extinguishers are used the minimum quantity for effective control of the fire should be used.

12C. A.P.1464C, Vol.2, Pt.1, details the action for treating aero-engines after contamination by fire extinguishant methyl bromide (MB) but does not refer to BCF extinguishant. In due course this leaflet will be replaced by an A.P.100 series leaflet which will cover the use of BCF as well as MB extinguishant.

◀ **12D.** Pending the issue of this A.P.100 series leaflet, the following procedure should be used as a guide to the action to be taken following the use of either BCF or MB fire extinguishers on an engine; this procedure supersedes the action detailed in A.P.1464C, Vol.2, Pt.1, Leaflet 14.

Recommended procedures following the use of MB or BCF

12E. *In-flight fires using aircraft-carried extinguishers* – Following a fire incident or an accidental discharge of the extinguisher system, the normal ventilation flow will disperse the extinguishant and its by-products and no further cleaning procedures are required.

12F. *Ground fires* –

(1) *Using aircraft-carried extinguishers* – Following a fire incident or an accidental discharge of the extinguisher system, the following action should be taken:–

(a) If the engine is operational carry out a ground run within 30 min. of the discharge.

(b) If the engine is not operational the access doors should be opened, access panels removed and the ECU area dried out thoroughly with a warm air blower. If a blower is not readily available, or in inclement weather conditions, where possible the aircraft should be removed to the hanger and the ECU dried accordingly.

(2) *Using ground services extinguisher* – In the event of ground fire extinguishing equipment being used it is expected that the minimum quantity of agent should be used to provide effective control of the incident. If the agent has been applied to the accessory bays etc. carry out cleaning procedures. If the agent has been applied to the intake or exhaust system and the engine is operational a ground run should be carried out within 30 min. of the incident. If the engine is not operational, the engine should be dried out by the application of a warm air blower via the intake or the nozzle, dependant on where the extinguishant has been applied.

12G. *Engine rejection* –

(1) If as a result of a fire incident the engine is to be rejected for mechanical reasons, if the engine can be motored over copious injection of PX-24 is recommended before despatch to the overhaul base.

(2) If for any reason excessive quantities of MB or BCF have been used to control the fire incident, although this will almost certainly involve engine rejection for the cause of the incident, the engine should be rejected for cleaning purposes irrespective of service condition.

(3) When returning an engine which has been subject to MB or BCF, silica-gel should be placed in the container and the exterior marked that the engine has been subject to fire extinguishing agent.

12H. *Ground running* – When a ground run is to be carried out to dry out the engine installation, the running time will be dependant on the size of the unit and whether the extinguishant has been applied internally or externally. As a general guide, a minimum of 5 min. for an internal and 15 min. for an external application should be used.

12J. *Heater application* – If a heater is to be used to dry out the engine internally, application time will vary with the size of the engine; a minimum of 4 hours is recommended.

12K. *Water* – Under no circumstances is water to be used.

12L. *Lubrication* – MB and BCF are effective degreasing agents and oil and grease films should be restored. Lubricate all controls and components in accordance with the relevant chapters. ▶

Spray rings and pipe-lines

13. Examine the pipes and spray rings for security of attachment and ensure that no chafing of pipes has occurred. Ensure that the holes in the spray rings are clear and are unobstructed.

REMOVAL AND ASSEMBLY

General

14. Before attempting to remove any component of the fire protection service, the aircraft MUST be rendered electrically safe as described in Para.9. Bared ends of electrical leads removed must be taped immediately after disconnection to eliminate the possibility of fire due to shorts. *This is essential as there is always a possibility of the batteries being reconnected before all the leads are replaced.*

Extinguisher bottles

15. With one man releasing the extinguisher bottles through the fuel vent connection access panel at the top of the fuselage and another assisting through the engine starter bay below, the removal of the bottle is effected as follows:-

(1) Render the aircraft electrically safe *(para.9)*.

(2) Gain access via the fuel vent connection access door and the engine starter bay door (Sect.2, Chap.4, fig.1).

(3) Remove the electrical connections at the operating heads of the bottles.

(4) Disconnect the supply pipes from their unions on the bottles.

(5) Remove the tank relief valve in way of bottle removal (Sect.4, Chap.2).

(6) Operate the toggle fasteners securing the metal straps that secure the bottles in their cradles, open out the straps and remove the bottles.

Flame detector switches

16. Once access has been obtained, the removal of the flame detector switches presents no unusual difficulties. Removal is effected as follows:-

(1) Render the aircraft electrically safe *(para.9)*.

(2) Gain access to the flame detector switch concerned and remove the electrical connections at the switch.

(3) Remove the nuts and bolts securing the switch to the structure and remove the switch.

Graviner firewire installation

17. Once access has been obtained, after first rendering the aircraft electrically safe, the removal of the D.C. control unit presents no unusual difficulty. To remove the detector elements, however, it will be necessary to remove the engine. During reassembly care must be taken to:-

(1) Prevent the ingress of moisture, sealing caps must be left on until the units or elements are installed.

(2) the element must be set clear of all structure to avoid the possibility of chafing due to vibration; the radius of any bend must not be less than 1.0 in. and no bend in the element is to commence within ½ in. of a supporting clip.

(3) no grease of any description is to be applied to the end connections.

(4) all coupling units, termination and bulkhead fittings must be tightened up to a torque loading of 80-100 lb.in. using special spanner "ACRATORK" 'A' or 'JUNIOR' with adaptor, Pt.No. J.69263 or "BRITOOL" model A.V.T. 100.

(5) all threaded couplings are to be locked with 22 s.w.g. stainless steel locking wire to specification D.T.D.189 or 161.

(6) New copper 'S' washers must be fitted whenever any connection is disturbed.

(7) Mounting bushes are to be assembled with the slit adjacent to the clip opening and the clip fastener is to be turned until the cam screw pegs engage in the wells in the clip cam.

Inertia switches

18. To remove the inertia switches proceed as follows:-

(1) Render the aircraft electrically safe *(para.9)*.

(2) Gain access to the forward inertia switch through the gun bay and the rear switch through the radio bay.

(3) Remove the electrical connections at the switch.

(4) Remove the securing nut and bolts and remove the switch.

Assembly

19. The assembly of the components of the fire protection service is, in general, a reversal of the removal procedure. For details of the electrical tests and the resetting of the inertia switches, prior to reconnection, refer to Sect.5, Chap.1, Group C.2.