Chapter 12 WARNING AND EMERGENCY SERVICES

LIST OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

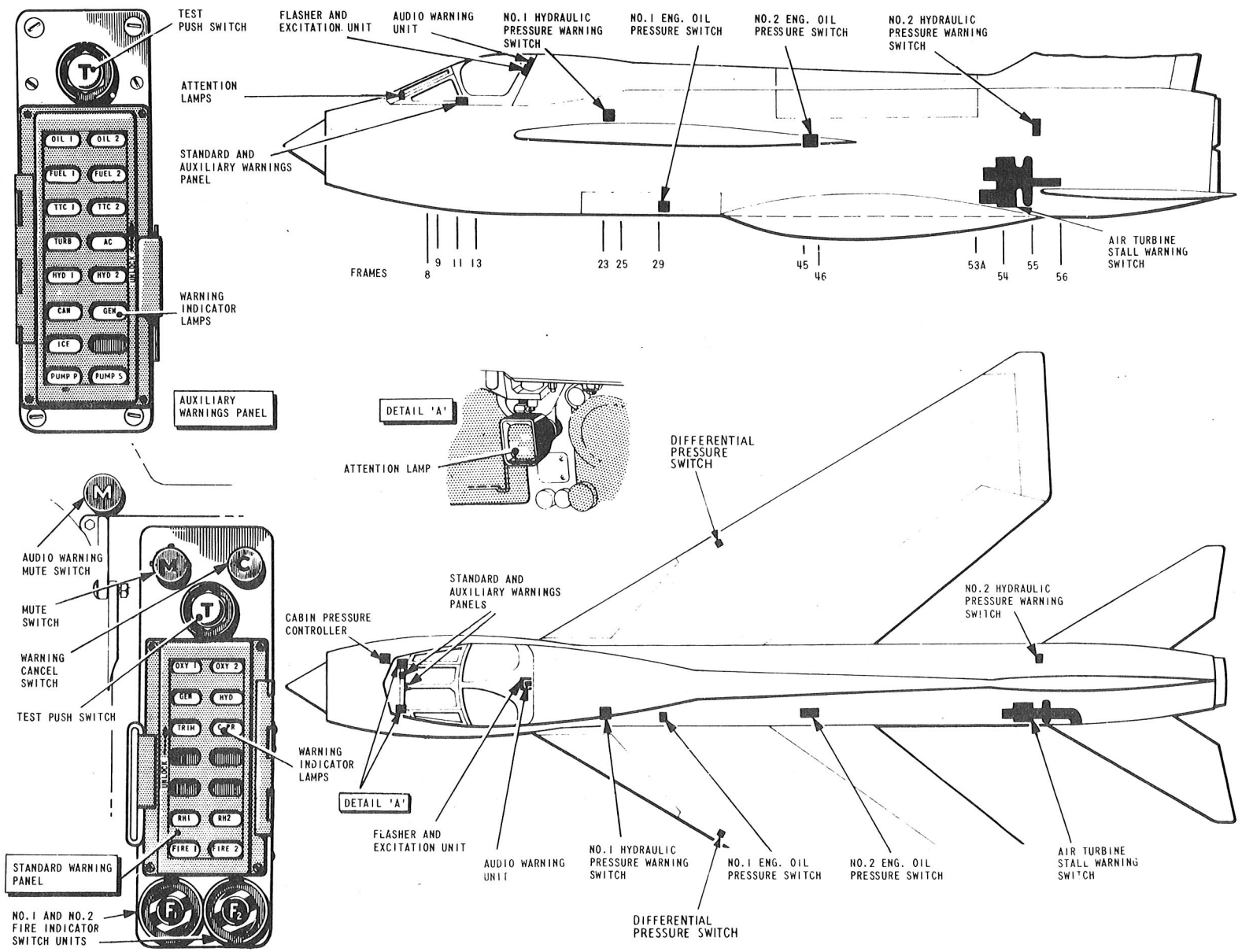


FIG.1. WARNING AND EMERGENCY SERVICES DETAILS

Mod 4167, 4022 embodied

DESCRIPTION

General

1. The warning and emergency circuits are designed to give, in the cabin, indications of a failure in any of the important circuits. These warnings, except those classified as additional warnings, are classified by their functional importance, into two groups - the standard warning system and the auxiliary warnings system.

2. The circuits included in the standard warning system indicate the more dangerous occurrences, whilst failures associated with the auxiliary warnings system are of a less serious nature. In each case, warning failure indications are given by a number of panel-mounted lamps. The emergency circuits are those associated with the fire extinguishers serving the engine bays, and an inertia switch system which automatically initiates protective operations in the event of a crash landing.

STANDARD WARNING SYSTEM

General

3. Fitted to centre panel A4, the standard warning display panel carries indicators that give warning of a failure in any one of the more important circuits. These are No.1 and No.2 engine bay fire areas, No.1 and No.2 reheat fire areas, the stand-by generator, hydraulic, cabin pressure, oxygen and auto trim circuits. The unit operates in conjunction with a flasher and excitation unit and two attention lamps. Provision is also made for an audio warning to be heard through the pilots' headphones. A description of the standard warning system will be found in A.P.4343, Vol.1.

TABLE 1
Standard warning panel - indicator lamps

Caption	Interpretation	Rating
OXY 1	Oxygen pressure warning (pupil)	All lamps rated at 28-volt 0.04A, Ref.No.5L/9959118
OXY 2	Oxygen pressure warning (instructor)	
GEN	Generator failure warning	
HYD	Hydraulic failure of both systems	
TRIM	Auto trim circuit failure	
CPR	Cabin pressure failure warning	
RHT 1	No.1 jet pipe reheat area fire	
RHT 2	No.2 jet pipe reheat area fire	
FIRE 1	No.1 engine bay fire area	
FIRE 2	No.2 engine bay fire area	
	4 spare ways	

Standard warning display panel

4. The Type C5830 warning panel groups on one indicator unit, all those lamps associated with the circuits mentioned in para.3. It also incorporates a TEST switch, a CANCEL switch with an integral lamp and a MUTE switch, also with an integral lamp. Two indicator switch units associated with the fire extinguishing apparatus are also fitted. The indicators on top of the panel assembly are covered by a transparent caption plate which can be adjusted for NIGHT or DAY use. The caption plate is labelled according to the functional purpose of the lamps underneath; the labelling interpretations, and lamp ratings are given in Table 1. A description of the panel will be found in A.P.4343E, Vol.1, Book 4.

(1) *Warning indications*

Failure of any one circuit associated with the warning panel will cause the relevant lamps to light, the attention lights to flash, and a fire-bell type clanging note to be heard in the pilot's headphones.

(2) *Cancel switch*

Operation of the cancel switch will cause the attention lights to go out and the audio warning to cease but the circuit warning will remain on.

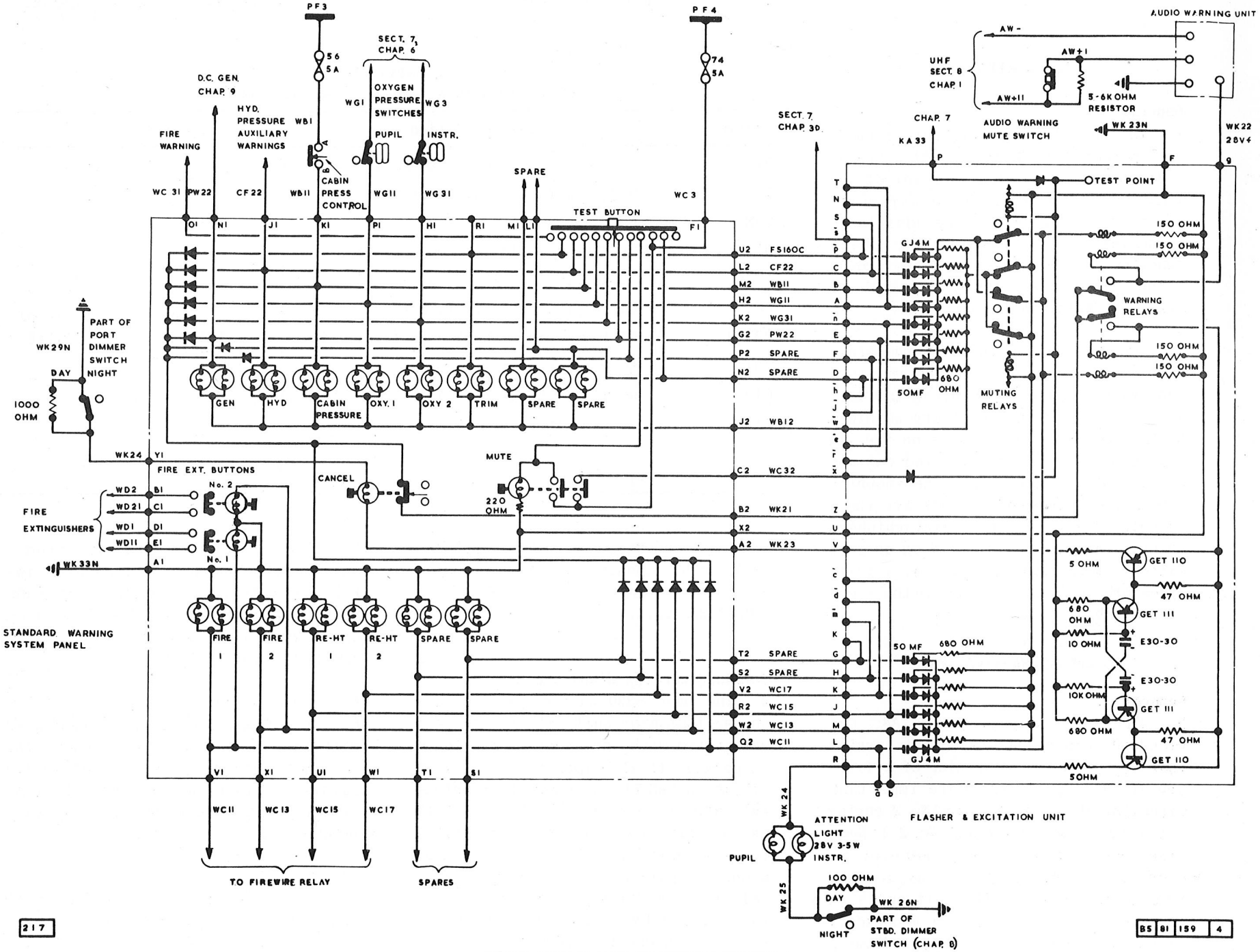


FIG.2. STANDARD WARNING SYSTEM

(3) *Mute switch*
During servicing or ground checking, with the engine master switch ON, the indicators labelled OXY 1, OXY 2, CPR, HYD, GEN, TRIM, and two of the spare circuit lamps, will light. These can be muted for the servicing period by operation of the MUTE switch on the panel.

(4) *Audio warning mute facility*
The volume of the audio warning in the pilot's headphones can be considerably reduced by operation of the AUDIO WARN. PULL – MUTE switch, located on panel A1.

(5) *Test switch*
All lamp filaments in the standard warning panel can be tested for continuity by operation of the switch labelled TEST.

(6) *Dimming facility*
The indicator lamps in the standard warning panel can be dimmed during use by the manual operation of a sliding screen above the caption plate. The attention lights are automatically reduced in brilliance by operation of the starboard dimmer switch *(Chap.8)*. The port dimmer switch is arranged to control the dimming of the cancel indication on the warning panel.

Standard warning circuits
5.
(1) *Fire warnings*
Operation of the Firewire relay unit, which is controlled by the sensing element in either of the engine bays or the reheat fire areas, will cause the appropriate warning indicator on the panel to light. An engine bay fire will be indicated by FIRE 1 or FIRE 2 warnings coming on and at the same time the associated integral lamps in F1 or F2 indicator switch units will light. Pressing of the appropriate switch unit will discharge the contents of the extinguishers into the affected fire area. Fire in the reheat areas will be indicated by RHT 1 and RHT 2 on the display panel. This is dealt with by shutting down the reheat system. The various ways of accomplishing this are described in Chap.7 of this section.

(2) *Generator failure warnings*
Generator system failures are indicated by warnings on the standard and auxiliary warnings panels. If the main generator fails, its differential relay and contactor unit becomes de-energized and its auxiliary contacts 7 and 8 close, completing circuit PW1 – PW11 to bring on the GEN warning on the auxiliary warnings panel. At the same time, the main generator's current-sensing unit is de-energized and its contacts close to complete the circuit PW2 – PW21 – PW22 via the stand-by current-sensing unit, thus bringing on the GEN indication on the standard warning panel. Should the stand-by generator be started up, its current-sensing unit will open and the GEN indication on the standard warning panel will go out, but the GEN indication on the auxiliary warnings panel will stay on.

(3) *Hydraulic failure warning*
In the event of a failure of both No. 1 and No. 2 hydraulic systems, the HYD 1 and HYD 2 warnings will appear on the auxiliary warnings panel and at the same time a relay operates in the circuit to light the warning labelled HYD on the standard warning panel.

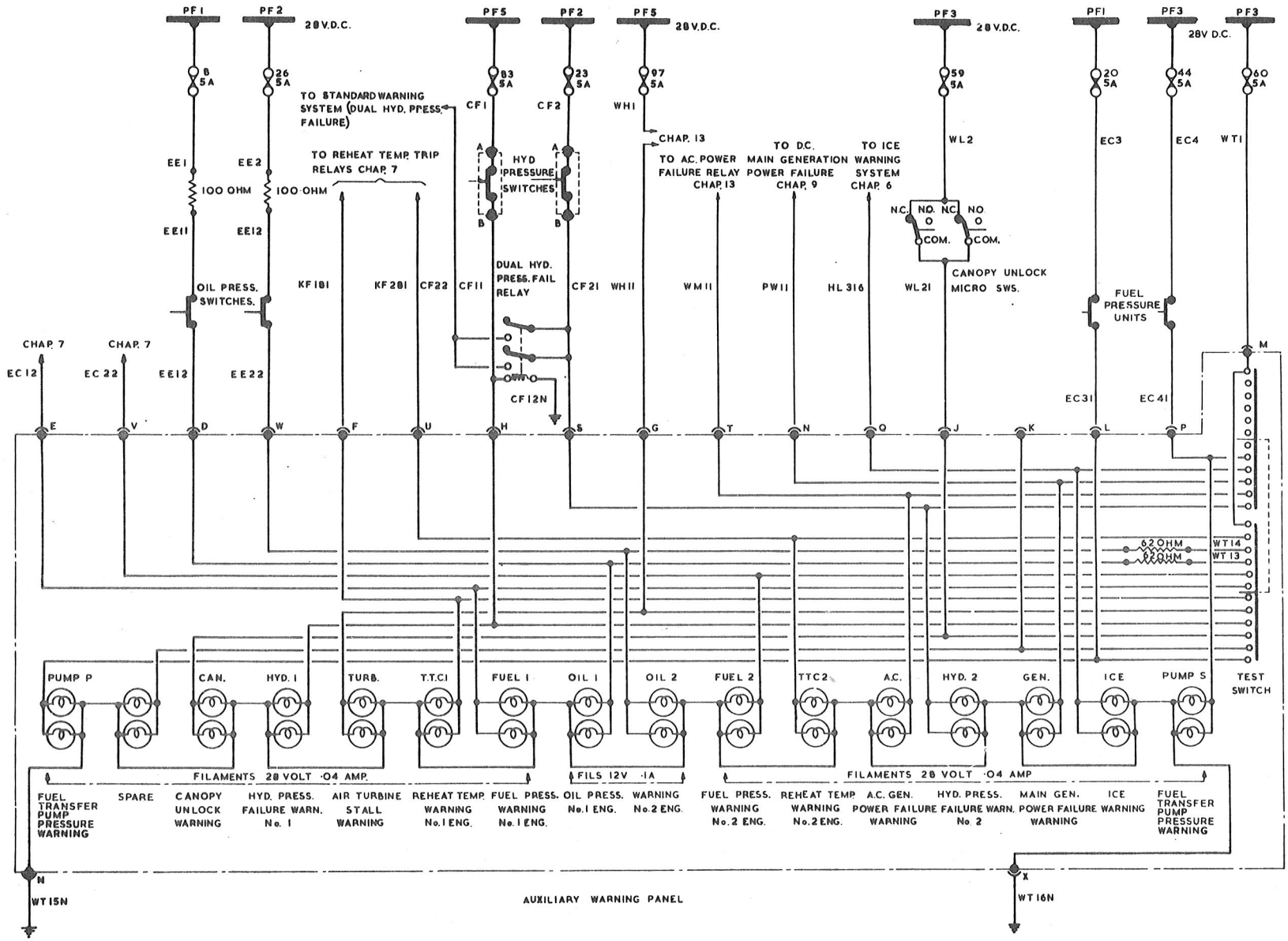
(4) *Oxygen pressure failure warning*
Warning of individual failure in the oxygen supply to the pupil's or the instructor's positions, is given by indicators labelled OXY 1, OXY 2 on the display panel. Both sets of warnings are controlled by pressure switches incorporated in the oxygen pipelines to each seat.

(5) *Cabin pressure failure warning*
Warning of a drop in cabin pressure is controlled by a switch incorporated in the Type C pressure controller, located at the right-hand aft end of the forward equipment compartment. When the switch contacts are made, due to loss of pressure, the circuit is made to the warning indicator CPR on the display panel.

(6) *Trim failure warning*
This circuit is not at present operative.

(7) *Spare circuits*
The four spare circuits are equipped with lamp filaments which, should the necessity arise, can be used as replacements for any unserviceable ones in the other circuits.

Flasher and excitation unit
◀ 6. The Type C1950/1 transistorized ▶ flasher and excitation unit is mounted on the aft pressure bulkhead. It controls



49

FIG.3. AUXILIARY WARNINGS SYSTEM

B5 | B1 | 10479 | 1

Mod. 4167 embodied

the attention lights and audio warning circuits. A description of the unit will be found in A.P.4343C, Vol.1, Book 2, Sect.3.

Attention lamps

7. The attention lights, located above and to each side of the flight instrument display unit, are controlled by the excitation and flasher unit. Should a failure occur in any one of the important circuits associated with the standard warning panel, the relevant warning indicator will light, the audio warning be heard, and the attention lights will start to flash, thereby calling the pilot's attention more quickly to the important failure. The flashing and audio warning can be stopped by operation of the CANCEL switch.

Audio warning unit

8. The Type A1205, audio warning unit is located on the aft pressure bulkhead and operates in conjunction with the attention lights and the standard warning system. The unit generates a signal which is fed into the pilot's headphones, via the audio section of the U.H.F., to produce a sound similar to the clanging of a fire-bell. A muting switch labelled AUDIO WARN. PULL-MUTE, located on panel A1 attenuates the warning by switching an extra resistor into the volume control network *(Sect. 8, Chap.1)*.

AUXILIARY WARNINGS SYSTEM

General

9. Warning of a failure in any of the circuits classified as of secondary importance, will be shown by indicators on the auxiliary warnings display panel in the cabin. The circuits associated with the panel are: canopy unlock, ice warning, main generator, fuel and oil pressures, a.c. generator, turbine, hydraulic, and the J.P.T. system. Provision is made on the panel for testing the lamp filament continuity and also to vary the indicator display to suit night or day requirements.

Auxiliary warnings display panel

10. Located on panel A1, this unit contains a number of indicators which become illuminated according to the circuit at fault. Each pair of circuit indicator lamps lie in their own pocket behind a suitably marked caption plate. A screen fitted in front of the latter can be manually operated for day or night requirements. Incorporated in the unit are two 62 ohm resistors associated with the oil pressure warning circuit. All lamp filaments may be checked for continuity by operation of the TEST push switch on the panel. Table 2 gives the captions, their interpretation, and lamp filament ratings of the auxiliary warnings panel.

TABLE 2
Auxiliary warnings panel - indicator lamps

Caption	Interpretation	Rating
CAN	Canopy unlock warning	28-volt 0.04A Ref.No.5LX/9959118
ICE	Ice warning	
GEN	Main d.c. generator failure warning	
FUEL 1	Fuel pressure warning No.1 engine	
FUEL 2	Fuel pressure warning No.2 engine	
OIL 1	Oil pressure warning No.1 engine	12-volt 0.1A Ref.No.5LX/9959120
OIL 2	Oil pressure warning No.2 engine	
A.C.	A.C. generator power failure warning	28-volt 0.04A Ref.No.5LX/9959118
TURB	Air turbine stall warning	
HYD 1	Hydraulic pressure failure warning No.1 system	
HYD 2	Hydraulic pressure failure warning No.2 system	
TTC 1	Reheat temperature warning No.1 jet pipe area	
TTC 2	Reheat temperature warning No.2 jet pipe area	
PUMP P	Fuel transfer pump pressure warning (port)	
PUMP S	Fuel transfer pump pressure warning (stbd.)	
	1 spare circuit	

Auxiliary warnings circuits

11.

(1) *Fuel pressure warning*

Pressure switches fitted in the fuel pipelines of both No.1 and No.2 engines sense a fall in pressure and signal a warning to the appropriate indicators FUEL 1 and FUEL 2 on the display panel. The operation of the switches is described in Sect.4, Chap.2.

(2) *Oil pressure warning*

Each engine is equipped with a pressure-operated switch controlling the relevant oil pressure warning circuit. A drop in oil pressure below a pre-determined value results in the necessary OIL 1 or OIL 2 warning being given on the display panel.

(3) *A.C. generator power failure warning*

A description of the a.c. generator power failure warning (A.C.) circuit is included in Chap.13 of this section.

(4) *Air turbine stall warning*

This circuit is controlled by the stall warning switch on the air turbine unit, the switch being mechanically actuated by movement of the turbine blades. Any fall in turbine speed from the governed setting will cause the switch to close and the indicators labelled TURB on the display panel to light. As an additional safety feature another switch, the turbine underspeed switch, is paralleled with the stall warning circuit and will operate at 10 per cent underspeed or below.

(5) *Top temperature trip warning*

Lighting of the indicators TTC 1 or TTC 2 on the display panel is an indication that reheat for the associated engine has been cancelled. Tripping of the reheat system under a varying set of conditions is explained in Chap.7 of this section.

(6) *Hydraulic pressure warnings*

Two Type TP.298 pressure switches located at frame 23 port and frame 55 starboard are associated with No.1 and No.2 hydraulic controls systems respectively. Should pressure in either system fall below 1750 lb/in² the relevant switch will close and light the indicators HYD 1 or HYD 2 on the display panel. In the event of a failure of both hydraulic systems, a warning is also indicated on the standard warning panel *(para.4)*. This is effected by a Type F relay, receiving an energizing supply from No.1 circuit and connecting a supply from No.2 circuit to the indicator labelled HYD on the standard warning panel.

(7) *Main generator failure warning*

Warning of a main d.c. generator failure is given by an indicator on the display panel labelled GEN. Further information on this circuit is included in the standard warning system.

(8) *Ice warning*

Ice conditions prevailing in the duct assembly will be sensed by the ice warning components, resulting in the lighting of the indicator labelled ICE on the display panel. A description of the ice warning system is given in Chap.6 of this section.

(9) *Canopy unlock warning*

Should the canopy not be securely locked, a visual warning will be given by the indicator on the display panel labelled CAN. The operation of this circuit is given in Chap.14 of this section.

(10) *Fuel transfer pump warning*

A differential pressure switch, Type TP.30099, situated between the transfer pump and the shuttle valve in each wing detects any change in the fuel pressure from the pump and controls the circuit to the warning lamps on the auxiliary warnings panel. A drop in fuel pressure will result in the lamps, labelled PUMP P or PUMP S, being illuminated to indicate that the associated pump has either failed or is running dry.

(11) *Spare circuits*

The spare circuits included in the panel assembly are fitted with lamps rated as shown on Table 2. These lamps may be used for replacement purposes as required.

Test switch

12. The continuity of the panel wiring and also of all lamp filaments, may be checked by operating the TEST switch. The test switch, when pressed, connects a supply to each lamp circuit. In the oil pressure circuits, which employ 12-volt lamps, the connection is made via a 62-ohm resistor fitted in the panel assembly.

ADDITIONAL WARNING CIRCUITS

Canopy control warning

13. Selection of the external or internal canopy control handles to the OPEN or CLOSED position will, as well as their normal function *(Chap.14)*, result in a circuit being made to a warning buzzer located on the aft pressure bulkhead.

Oxygen flow warning

14. Indication of oxygen flow to both the pupil's and the instructor's positions, is given by two magnetic indicators, port and starboard on the A1 panel. Each indicator is controlled by a switch incorporated in the oxygen regulator. With oxygen flowing the switch makes and breaks causing the indicators to blink.

Inverter change-over warning

15. Should the normal instrument supplies

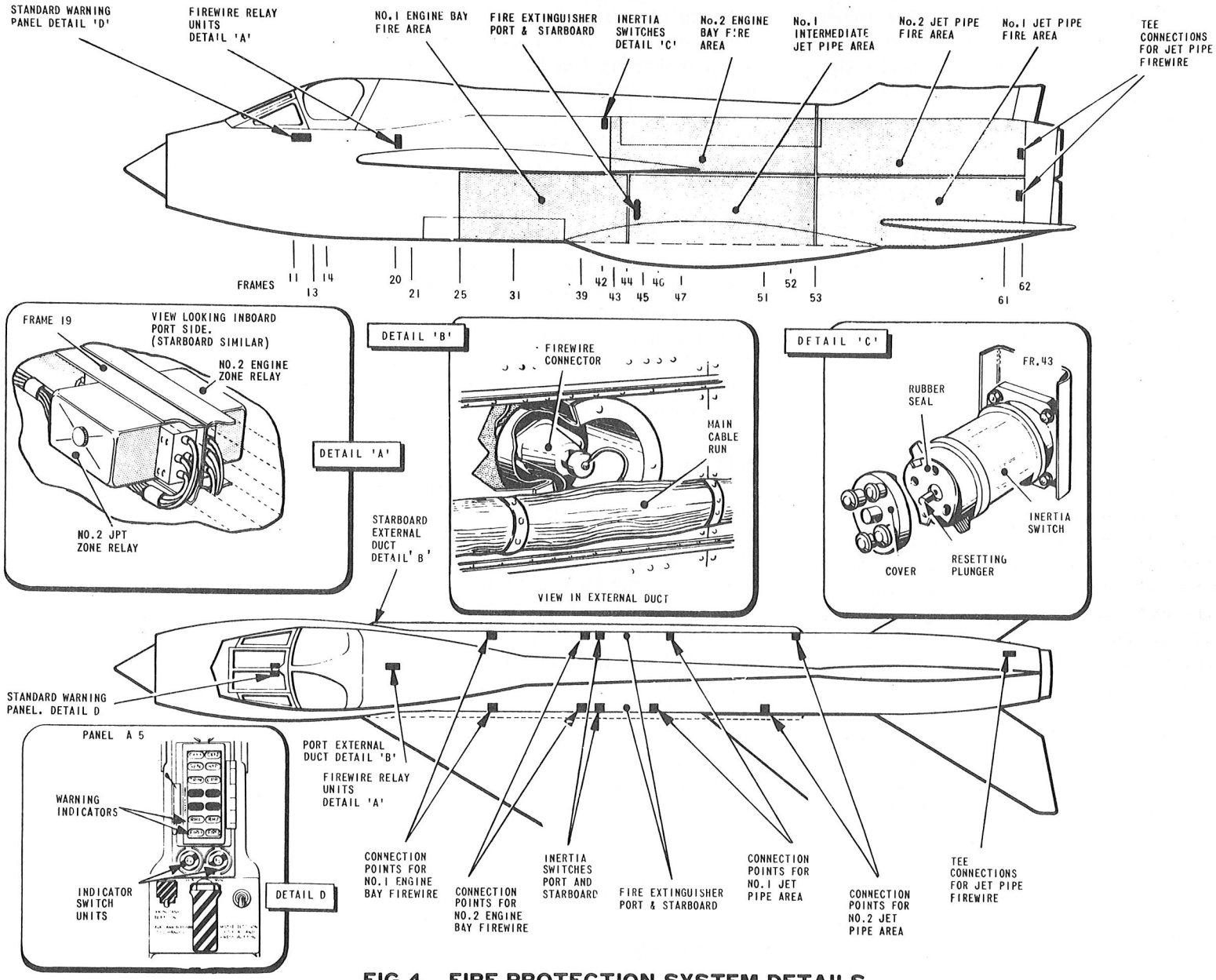


FIG.4. FIRE PROTECTION SYSTEM DETAILS

5-9162-1

fail, warning that automatic change-over to a stand-by supply *(Chap.4)* has taken place, is given by a magnetic indicator located on the A1 panel. Normally the indicator shows black; on change-over it displays the word ON in black on a white background.

Armament warnings

16. A number of warnings, mainly associated with the armament services, are grouped together and mounted on the A1 panel. Their purpose and function in the armament circuits is described in Chap.2 of this section.

FIRE PROTECTION SYSTEM

General

17. Fire protection equipment provides for constant monitoring of all fire areas surrounding the engines and the jet pipes, and automatically warns the pilot if an outbreak of fire should occur. The engine bays are protected by fire extinguishing apparatus, whilst fire in the jet pipe areas is dealt with by cutting off engine reheat. Information relating to fire detection and extinguishing systems in general is given in A.P.957C, Vol.1, A.P.4343E, Vol.1, Book 3, and the A.P.107E series. Additional information on the fire protection system is included in Sect.4, Chap.5 of this publication.

Fire detection

18. Fire detection in any one of the fire areas is by means of a continuous medium temperature sensing element loop which is arranged around the area. This is controlled by a relay unit, which is in turn connected to the associated warning circuit. Each sensing element loop consists of a number of element units of varying lengths, joined together by special end fittings and couplings, details of which will be found in Table 3. Each Firewire circuit is connected to special type connectors attached to the inner surfaces of the external ducts. From these connectors the circuits are extended to the relay units in the main equipment compartment. A loop of Firewire cable is included as part of the jet pipe and is located around the reheat portion; it connects into the main jet pipe zone loop at fr. 61 by a short length of Unifirewire cable and a special 3-way coupling.

Relay units

19. Four Type 162D relay units are located on a ledge in the main equipment compartment. Each unit consists of a detection relay and associated circuitry, and a base. The base unit is permanently attached to the aircraft structure, the relay unit being secured to the base by a knurled-headed bolt which runs through the centre of the unit to engage with a captive locknut in the base unit. Electrical connection between the two units is effected by spring-loaded butt connectors. This arrangement enables the relay unit to be removed from the aircraft without disturbing the aircraft wiring, by simply releasing the knurled-headed securing bolt.

Warning indication

20. Warning of a fire in the engine bay areas is given by the indicators labelled FIRE 1, FIRE 2, on the standard warning panel, and also by the integral lamps of the indicator switch units F1 and F2 fitted on the panel assembly. When abnormal conditions prevail in the jet pipe areas, the indicators labelled RHT 1 and RHT 2 will light. The warning circuits and their operation in conjunction with the attention lights and audio warning circuits, are described in the standard warning system *(para.4)*.

Extinguisher circuits

21. Two dual-headed extinguishers, Type 141A (post Mod.4023) (Type 101A pre Mod. 4023) are respectively installed in the port and starboard sides of the rear fuselage between frames 44 and 45. The one on the port side serves the port side of both No.1 and No.2 engine bays, the starboard extinguisher performing a similar function on the starboard side. The detonator circuits for the extinguisher heads are so arranged that on receipt of a fire warning in the cabin, pressing the appropriate indicator switch will blow the associated heads, thus discharging the total contents of both extinguishers into the relevant area. In the event of a crash landing and the subsequent automatic operation of the inertia switches, both heads on each bottle will be blown and the contents discharged to No.1 and No.2 engine bays. The fire extinguisher circuits are supplied from the battery busbar PE via the d.c. feeder fuse panel.

Fire indicator fuze units

22. Two Type A384 fuze units, each of which carries a Type 984 fire indicator fuze are mounted on the refuelling lights panel, between frames 47 and 48

(61P). They are connected to the port and starboard extinguisher circuits. If the extinguisher bottles are discharged, either manually or automatically, at least one of the indicators will become energized and fuzing of its element will occur. This results in the formation of a reddish-brown deposit on the interior surface of the bulb indicator, thus providing a visual indication that an extinguisher has been discharged and requires replacement. Two non-electric indicating discs are also fitted to the airframe and operate via a vent pipe from the extinguishers to show discharge conditions. Their location and operation is described in Sect.4, Chap.5.

Inertia switches

23. Two Mk.2 inertia switches, mounted on the forward face of frame 43, port and starboard, are connected in series with the solenoid of a crash relay, installed in the D2 relay box. This relay is associated with several protective circuits. If, due to a crash landing, both inertia switches operate, the relay becomes energized by a supply from the service battery via the d.c. feeder fuse panel. Closure of the relay contacts initiates the following automatic operations:-

(1) Isolation of the general service battery from the d.c. distribution system.

(2) Interruption of the field circuits of the main and stand-by generators *(Chap.9)* and the a.c. generator *(Chap. 13)*.

TABLE 3

Details of Firewire units and fittings

Note... *All sensing elements are Mk.2 medium temperature range*

Equipment	Type	No. Off
No.1 engine bay		
Sensing Firewire	D2370/120	5
Sensing Firewire	D2370/60	3
Sensing Firewire	D2370/30	3
Sensing Firewire	D2370/20	1
◀ Harness flexible connector	D2605/21	1
Harness flexible connector	D2605/18	1
Coupling unit	D2291/D2475	7
Coupling unit	D3131	2
Coupling unit	D2243	2
Coupling unit	D2447	2
Termination unit	D3171	2
No.1 jet pipe area		
Sensing Firewire	D2370/20	1
Sensing Firewire	D2370/120	7
Sensing Firewire	D2370/60	1
Sensing Firewire	D4615	1
Harness interconnector	D2210	1
Coupling unit	D2291/D2475	7
Coupling 3-way	D2460/12	1
Termination unit	D3171	2
No.2 engine bay		
Sensing Firewire	D2370/89	1
Sensing Firewire	D2370/120	
Sensing Firewire	D2370/60	2
Sensing Firewire	D2370/30	1
Sensing Firewire	D2370/20	3
Non-Sensing Firewire	D2370/36	2
Harness flexible connector	D2605/18	2
Coupling unit	D2291/D2475	6
Coupling unit	D828/D3131	4
Coupling unit	D2243	2
Coupling unit	D2447	2
Termination unit	D3800	2
No.2 jet pipe area		
Sensing Firewire	D2370/120	3
Sensing Firewire	D2370/60	3
Sensing Firewire	D2370/20	2
Sensing Firewire	D4615	1
Non-Sensing Firewire	D3370/60	1
Non-Sensing Firewire	D3370/84	1
Coupling unit	D2291/D2475	6
Coupling unit	D828/3131	2
Coupling 3-way	D2460/12	1
~~ Harness interconnector	D2211	1
Termination unit	D3800	2 ▶

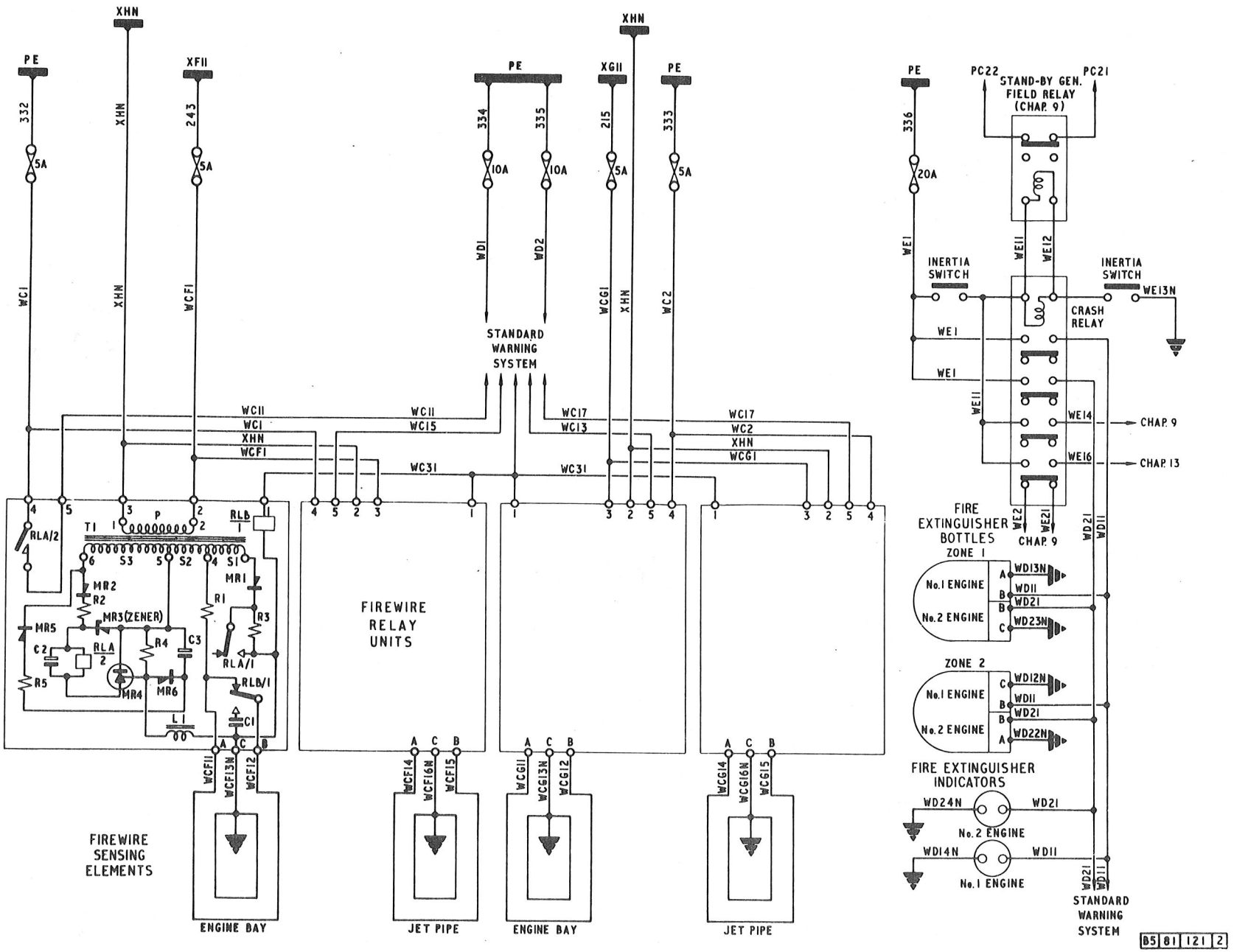


FIG. 5 FIRE PROTECTION SYSTEM

Mod. 2511 embodied