

Chapter 4

STANDARD CENTRALIZED WARNING SYSTEMS

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Introduction

1. In a centralised warning system, provision is made in the cockpit for immediate indication of failure of any one or more of a number of important circuits in the aircraft. Due to variations in particular installations, this system of warnings varies widely from aircraft to aircraft; this chapter describes

the general principles of this manner of indication and also gives details of certain typical systems, but for details relevant to any one aircraft, reference must be made to the appropriate Aircraft Handbook, and to the volumes in the A.P.4343 series or elsewhere which describe the components used.

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DESCRIPTION

2. Warnings of failure of essential services, which could cause an emergency prejudicial to the safety of the aircraft, are given both visually, by the flashing of attention getter lights, and audibly, and the appropriate lights on a central panel are lit to indicate the particular service concerned. Thus the attention of the pilot is directed to the state of emergency, so that remedial action can be taken. In addition to these primary warnings, additional secondary or auxiliary warnings may be given; these may or may not be accompanied by the flashing of attention getter lights and the audible warning; primary and secondary warnings may be presented on separate panels, or in separate sections of a common indicator unit, in which case the primary emergency warnings will be indicated by red lights, and the secondary or auxiliary warnings by amber lights.

3. The following paragraphs give examples of certain specific types of centralised warning system, which illustrate the principles involved. There may be considerable variations in actual aircraft systems, both in the particular indications given, which depend on the relative importance of the aircraft services as determined by its role, and in the component switches, relays, lamps, etc., embodied in the units.

Standard warning system, Mk. 1

4. This system, a circuit diagram of which is given in fig. 1, was the original design, which depends on a choke and lamp surge current for triggering the system; it has been superseded by later designs, but will still be encountered on older type installations. The system incorporates a flasher and excitation unit, an indicator unit, an audio warning unit, and red attention lights. The main components of these units are listed in Table 1, which indicates the A.P. references.

Flasher and excitation unit

5. The flasher and excitation unit incorporates in one casing two high-speed relays, with a choke and a rectifier, and a mechanism for flashing the attention lights. The high-speed relays, Type SM8 (Ref. No. Z530037) have each one set of change-over contacts, and two coils; that across terminals a-b is the operating coil, and across terminals c-d

the holding coil, which is connected in series with a 150-ohm resistor to limit the holding current in the coil.

6. The flashing mechanism consists of two relays, Type SM4A-N5 (Ref. No. Z530458) each in a circuit with a resistor and a capacitor. The time constants of the individual relay circuits are such that when initiated by the excitation unit, the relays will alternately operate and drop out, thus flashing the attention lights and the cancel switch light. A further relay, Type SM4A-N5, is the ground/flight relay, which automatically cuts out all warnings except fire and wing fold when the aircraft is connected to the ground supply.

Indicator unit

7. Each indicator unit groups together the various emergency lights, which are duplicated for each service in case of lamp failure. Also fitted on or near the indicator unit are the appropriate fire warning push-switches (marked F) for initiating the extinguisher equipment, a cancel switch (marked C) for cutting out the audible and visible warnings except the appropriate lights on the indicator panel, a master switch (marked M) for removing all warnings except those for fire and wing fold when the aircraft is on the ground with the bus-bar live, and a test switch (marked T) for checking the system for correct operation.

Audio warning unit

8. The audio warning unit is a transistorized unit which, when energized, injects the sound of a slowly operated fire bell into the crew's headphones.

Push-switches and attention lights

9. The push-switches used as required are versions of C180, C181, C182, and C183. C180 and C181 have illuminated heads, and are respectively single-pole, change-over, spring-return (for cancel switch and fire warning switches), and single-pole, change-over, push-pull (for master switch); C182 and C183 have plain heads, and are respectively a 12-way and 24-way test push-switch. The attention lights are the red cockpit floodlight, Type D; they are dimmed automatically by connection of series resistors when the cockpit lighting master switch is on.

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TABLE 1
List of main components

Description	A.P. reference
Flasher and excitation unit	A.P.4343C, Vol. 1, Book 2, Sect. 3
Incorporating—	
Relay, Type SM8	A.P.4343C, Vol. 1, Book 2, Sect. 3
Relay, Type SM4A-N5	A.P.4343C, Vol. 1, Book 2, Sect. 3
Indicator unit	A.P.4343E, Vol. 1, Book 4, Sect. 18
Audio warning unit	A.P.4343E, Vol. 1, Book 4, Sect. 18
Push-switches	A.P.4343C, Vol. 1, Book 1, Sect. 1
Cockpit floodlight, Type D	A.P.4343E, Vol. 1, Book 1, Sect. 7

Operation

10. The main emergencies of which warning is given are shown in fig. 1, though in certain instances other warnings may be included. Table 2 lists a number of aircraft services, which may be classified as of primary or secondary importance according to the aircraft role, and indicates the component responsible for communicating the warning, together with A.P. references. Detailed information for a particular aircraft will be found in the relevant Aircraft Handbook.

11. When any one or more of the emergencies which are provided for arises, the appropriate pair of lamps on the indicator unit is lit. At the same time the surge current through the choke in the excitation unit produces a voltage which energizes the operating coil (a-b) of each high-speed relay through a resistor/capacitor network. The contacts operate to complete a hold-in circuit through the other coil (c-d), and the normally-closed contacts of the cancel switch. After initial impulse, current ceases to flow through the operating coil a-b.

12. The closing of the contacts in the high-speed relays gives a positive supply to the audio warning unit, and also to the flasher unit, which controls the two attention lights and the light in the cancel switch; in the case of a fire warning, the light in the appropriate fire extinguisher switch will also be lit.

Cancel switch

13. The above indications will continue as long as the emergency continues; depressing the cancel switch will de-energize the high-speed relays, thus cutting off the supply to the audio warning unit and the flasher unit; the audio warning will cease, and the attention lights and the light in the cancel switch will go out. The appropriate indication will, however, remain until the emergency has been rectified; if the emergency was a fire warning, the light in the appropriate fire extinguisher switch will also remain illuminated for the duration of the emergency.

Test switch

14. Operation of the test switch provides a check of the whole system. When the switch is depressed, the high-speed relays are energized, the audio warning is injected into the crew's headphones, the attention lights and the cancel switch light flash, all the emergency lights on the indicator panel, including the fire extinguisher switch lights, are illuminated, also the light in the master switch. On releasing the test switch, all these indications will cease with the exception of the flashing lights and the audio warning; these will persist until the cancel switch is depressed.

Master switch

15. When the aircraft is on the ground with the bus-bar live, certain emergency indications

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TABLE 2
List of certain essential services

Emergency	Warning transmitted by	A.P. reference
Fire	Fire detector	A.P.4343E, Vol. 1, Book 3, Sect. 14
Generator failure	Differential relay	A.P.4343B, Vol. 1, Book 2, Sect. 10 or A.P.4343C, Vol. 1, Book 2, Sect. 3
Hydraulic failure	Flow indicator valve	A.P.1803B, Vol. 1, Sect. 10
Cabin pressure failure	Pressure controller	A.P.1275A, Vol. 1, Sect. 20
Oxygen failure	Monitor unit	A.P.4343C, Vol. 1, Book 2, Sect. 3
Oil pressure failure	Pressure switch	A.P.1275A, Vol. 1, Sect. 24
Fuel pressure failure	Pressure switch	A.P.1275A, Vol. 1, Sect. 24
Wing fold	Micro switch	A.P.4343C, Vol. 1, Book 1, Sect. 1
Icing conditions	Ice detector	A.P.1275A, Vol. 1, Sect. 27
Canopy lock	Micro switch	A.P.4343C, Vol. 1, Book 1, Sect. 1

will inevitably appear, since the appropriate emergency switches will be closed. Such indications with the exception of fire and wing fold warnings, can be removed by pulling out the master switch; the switch will then become illuminated to show that the system is dead. Fire and wing fold will, however, continue to operate the system.

Ground/flight relay

16. When the aircraft is on the ground and the bus-bar is energized from an external source, the ground/flight relay will be energized from the third pin of the ground supply socket. This automatically removes all warnings from the panel, with the exception of fire and wing fold, thus preventing overheating of the panel and prolonging lamp life.

Standard warning system, Mk. 2

17. This system differs from the Mk. 1 system in that it is triggered by the surge current through a capacitor. There are also

certain mechanical differences in the design and panel arrangement, in the rating of the filament lamps on the indicator unit, and in the provision for rendering certain lamp indications ineffective while the aircraft is on the ground.

18. A typical circuit diagram is given in fig. 2. Each emergency has its own capacitor and rectifier in series with the operating coil of the high-speed relay, to give excitation for the audio warning unit and the flasher unit; in place of the ground/flight relay are two relays, Type SM5A-N25, these being the mute relay and the mute over-ride relay respectively. On the indicator unit, a mute switch (marked M) removes all warnings except those for fire and wing fold when the aircraft is on the ground with the bus-bar live, and a ground test switch (marked GT) restores the warnings temporarily when the aircraft is on the ground and connected to an external supply. The other features of the system are similar to those already described for the Mk. 1 system.

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Operation

19. When any one or more of the relevant emergencies arises, the appropriate pair of lamps on the indicator unit is lit. At the same time the surge current through the associated capacitor and rectifier in the excitation unit energizes the operating coil (a-b) of each high-speed relay. The contacts operate to complete a hold-in circuit through the other coil (c-d), and the normally-closed contacts of the cancel switch. The capacitor becomes fully charged, and thus current ceases to flow through the operating coil a-b.

20. The closing of the contacts in the high-speed relays gives a positive supply to the audio warning unit, and also to the flasher unit, which controls the two attention lights and the light in the cancel switch; in the case of a fire warning, the light in the appropriate fire extinguisher switch will also be lit.

Cancel switch

21. The above indications will continue as long as the emergency continues; depressing the cancel switch will de-energize the high-speed relays, thus cutting off the supply to the audio warning unit and the flasher unit; the audio warning will cease, and the attention lights and the light in the cancel switch will go out. The appropriate indication will, however, remain until the emergency has been rectified; if the emergency was a fire warning, the light in the appropriate fire extinguisher switch will also remain illuminated for the duration of the emergency.

Test switch

22. Operation of the test switch provides a check of the whole system. When the switch is depressed, the high-speed relays are energized, the audio warning is injected into the crew's headphones, the attention lights and the cancel switch light flash, all the emergency lights on the indicator panel, including the fire extinguisher switch lights, are illuminated, also the light in the mute switch. On releasing the test switch, all these indications will cease with the exception of the flashing lights and the audio warning; these will persist until the cancel switch is depressed.

Mute switch

23. When the aircraft is on the ground with the bus-bar live, certain emergency indica-

tions will inevitably appear, since the appropriate emergency switches will be closed. Such indications, with the exception of fire and wing fold warnings, can be removed by pulling out the mute switch to energize the mute relay; the switch will then become illuminated to show that the system is dead. Fire and wing fold will, however, continue to operate the system.

Mute relay

24. When the aircraft is on the ground and the bus-bar is energized from an external source, the mute relay will be energized from the third pin of the ground supply socket. This automatically removes all warnings from the panel, with the exception of fire and wing fold, thus preventing overheating of the panel and prolonging lamp life. Resistors are connected in series with the wing fold and mute switch lamps, since these lamps maybe lit for long periods. Rectifiers in series with the mute relay coil prevent coupling of the bus-bar to the ground supply.

Ground test switch

25. Depressing the mute over-ride push-switch, engraved GT, will restore the warnings momentarily by breaking the supply from the ground supply socket to the mute relay coil.

Mute over-ride relay

26. Prior to engine starting, the correct indications can be shown on the panel by energizing the mute over-ride relay; this may be achieved from the operation of the fuel pump master switch, or some similar means.

Transistorized system

27. In some flasher and excitation units, the flashing is achieved by a transistorized section, as shown in the typical circuit diagram in fig. 3. It comprises an astable multi-vibrator, using two low power transistors (GET.111) driving two medium power transistors (GET.110). Two 5-ohm limiting resistors are incorporated to limit the lamp surge current. In other units, a bi-stable transistorized switching unit replaces the high-speed relays. Such transistorized components are sometimes referred to as forming part of a Mk. 3 standard warning system; in general, the operation of the remainder of the system is as described above for the Mk. 2 system.

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SERVICING

28. A functional check of the system can be made by depressing the test switch, with the master switch (or mute switch) in the flight position, i.e., pushed in. When this is done, the following indications should appear simultaneously:—

- (1) The attention lights flash.
- (2) The audio warning is injected into the crew's headphones.
- (3) All the emergency lights on the indicator unit are illuminated.
- (4) The cancel switch light flashes.
- (5) The fire extinguisher switch lights are illuminated.
- (6) The master (or mute) switch light is illuminated.

29. When the test switch is released, the following events should occur:—

- (1) The attention lights flash.
- (2) The audio warning operates.

(3) All warning lights on the indicator panel are extinguished.

(4) The cancel switch light flashes.

(5) The fire extinguisher switch lights are extinguished.

(6) The master (or mute) switch light is extinguished.

30. Depressing the cancel switch should cause the attention lights and the cancel switch light to be extinguished, and the audio warning to cease.

31. These tests will reveal the serviceability of the filament lamps; faulty lamps should be renewed.

32. It is important to note that all the capacitors in the system are tantalum capacitors suitable for 70V working; they should not, therefore, be subjected to 250-volt insulation resistance testing, nor to reversed polarity.

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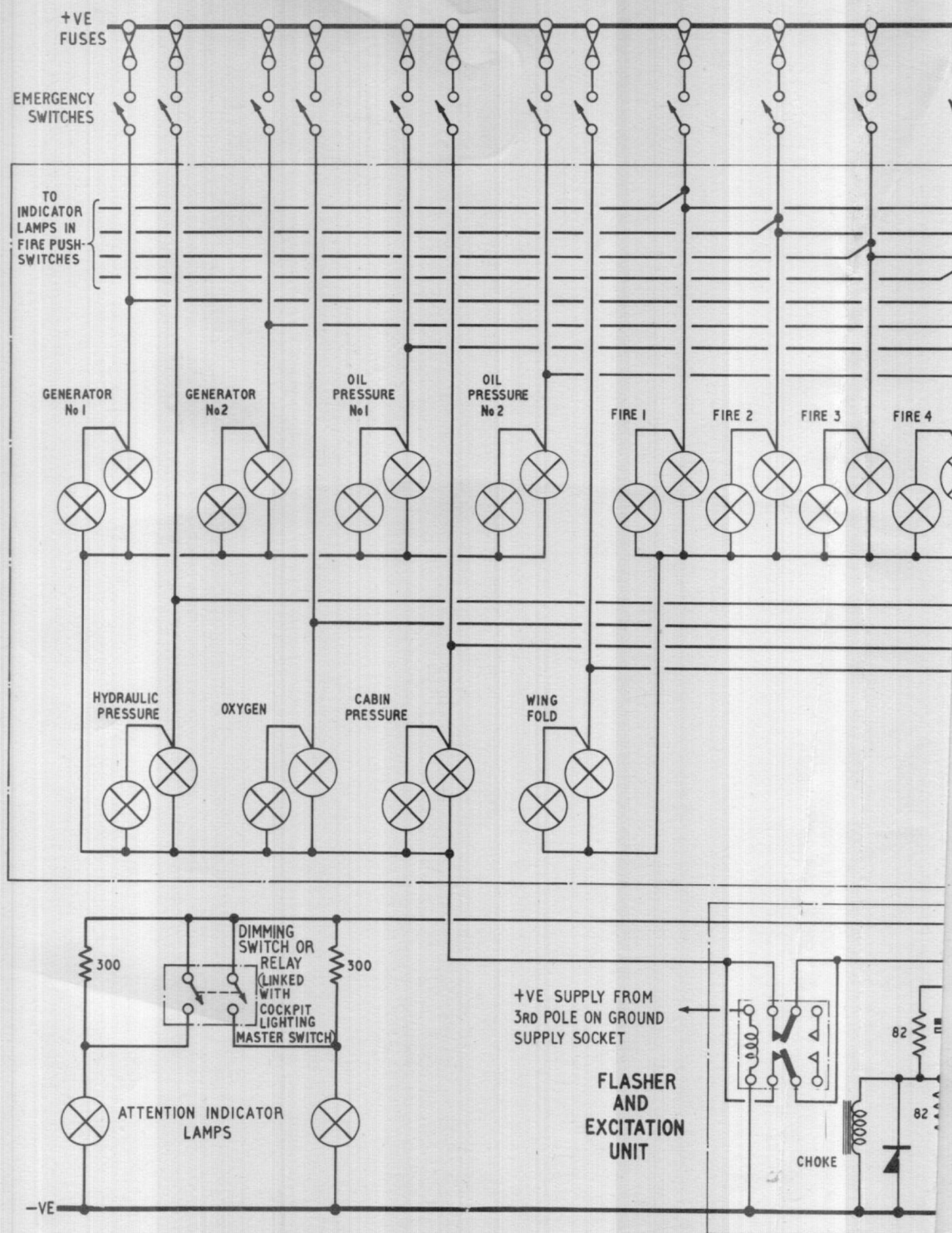
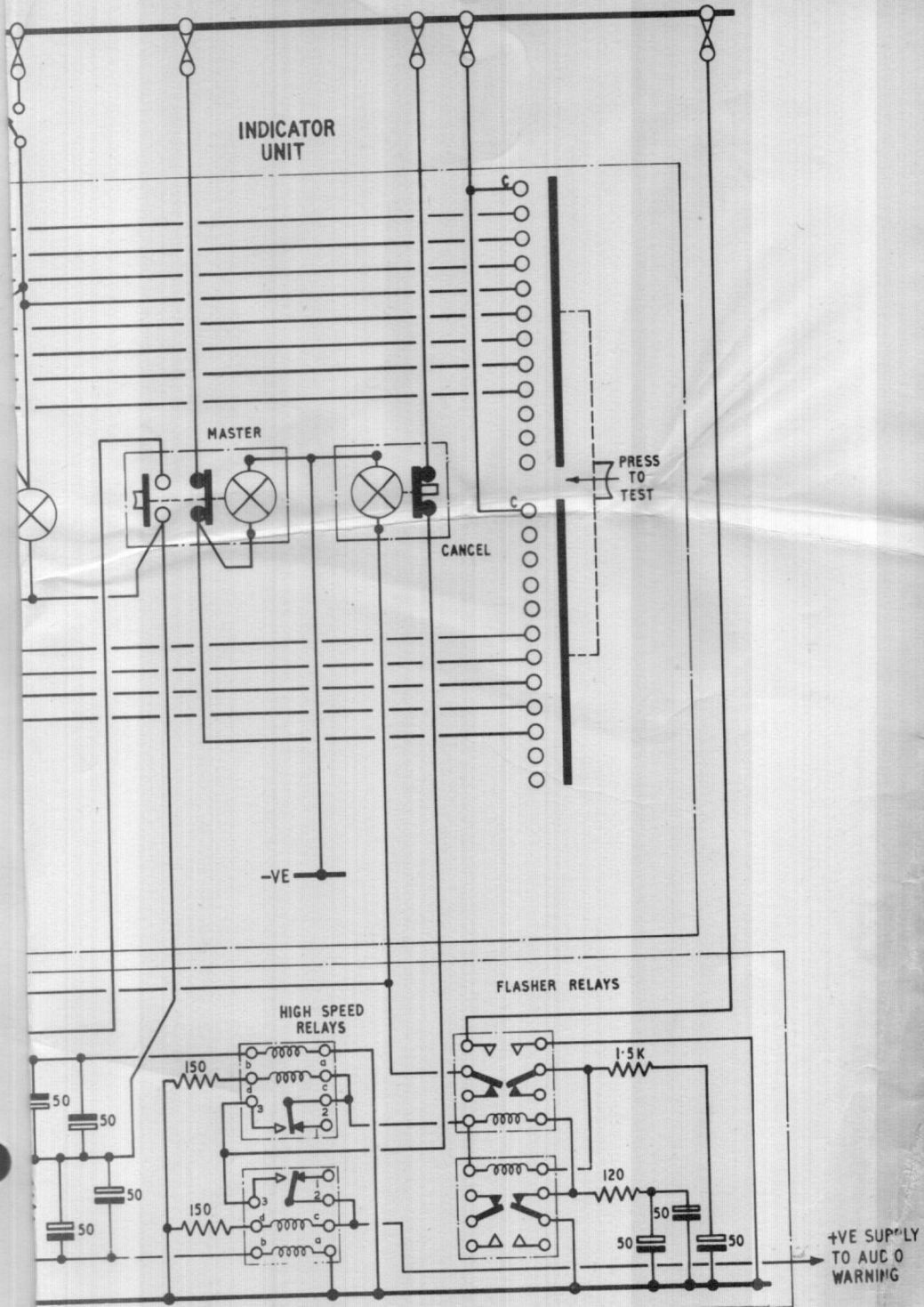


Fig.1

D.1399. 370272. 10/63. S.W.Ltd.

Typical circuit diagram - standard
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Warning system, Mk. I.

Fig. 1

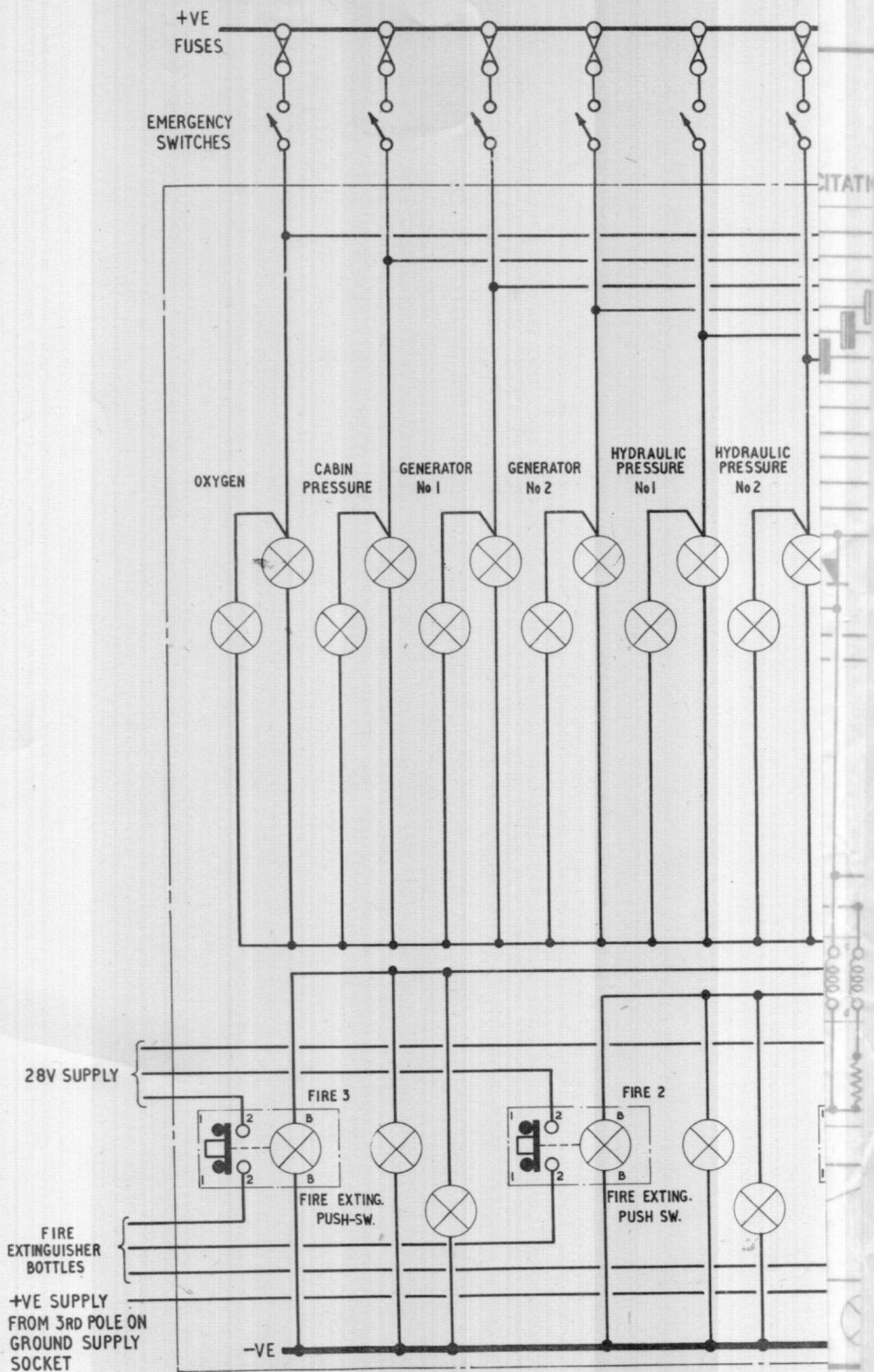
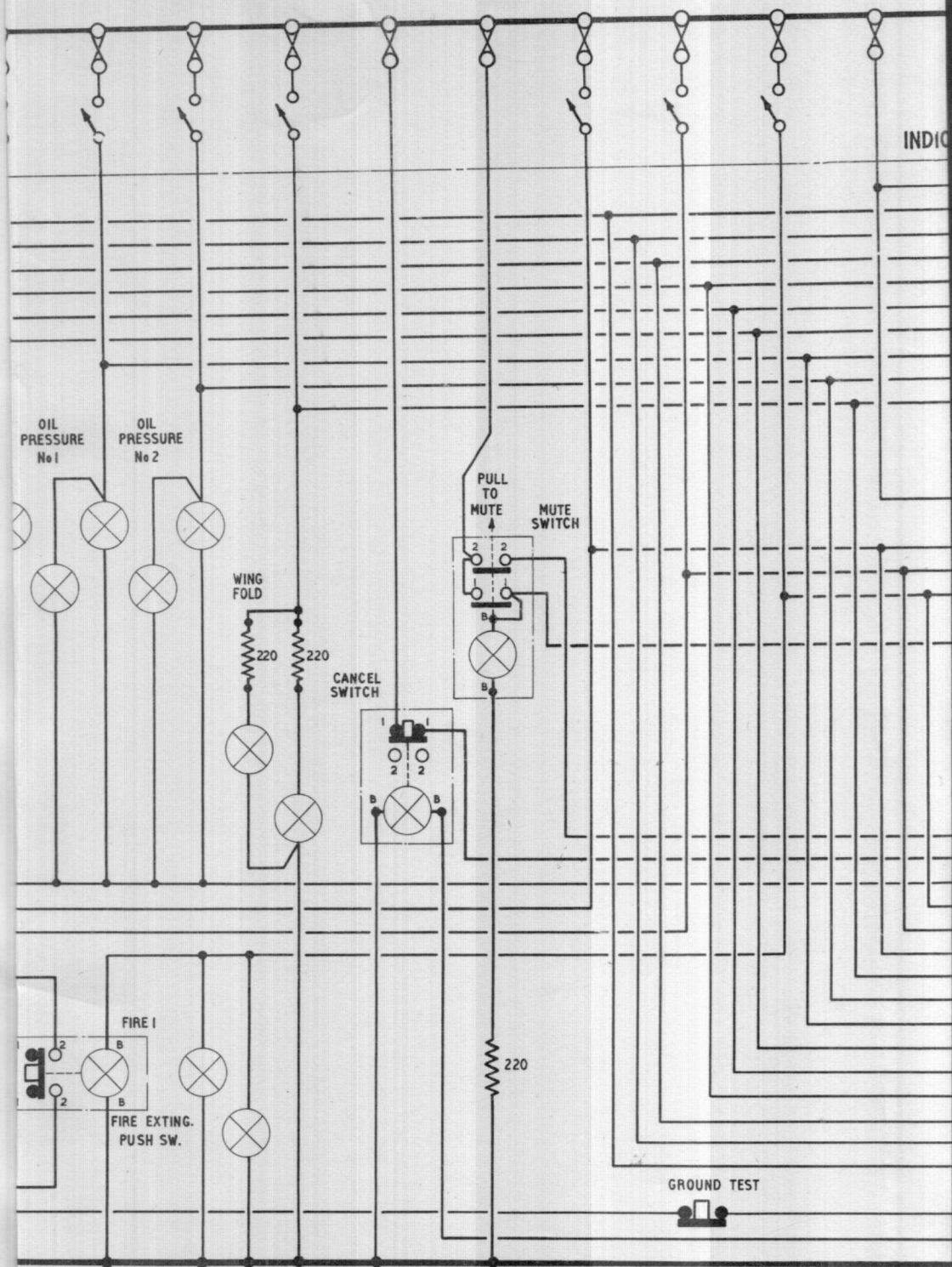


Fig. 2



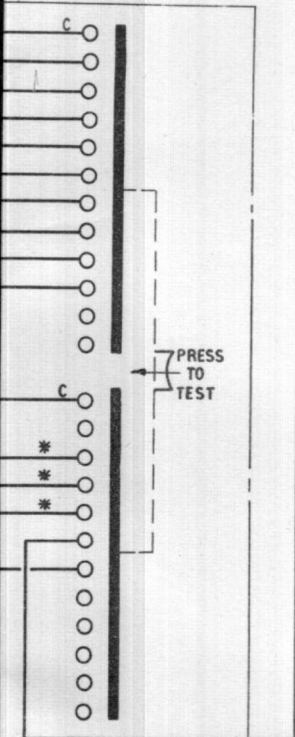
Typical circuit diagram - standard

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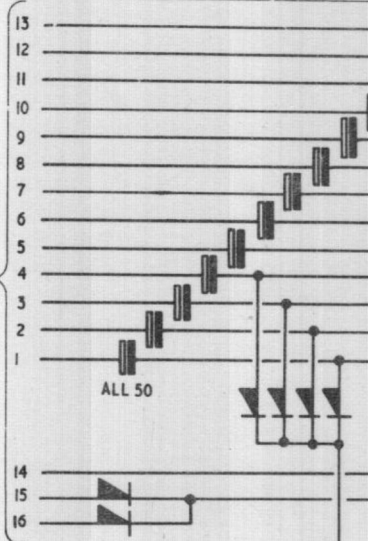
+VE SUPPLY TO TEST POINT
IN RESETTNG FIRE DETECTORS

WHEN THIS SUPPLY
IS USED WIRES
MARKED * ARE NOT
CONNECTED TO THE
TEST PUSH-SWITCH

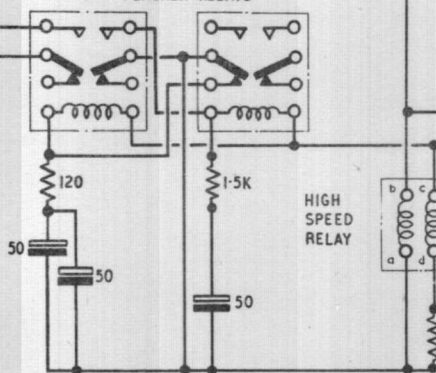
ATOR UNIT



FLASHER AND EXCITATION



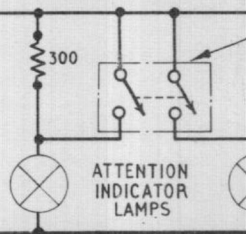
FLASHER RELAYS



HIGH SPEED RELAY



THESE NUMBERS
ARE FOR REFERENCE
ONLY AND WILL NOT
NECESSARILY AGREE
WITH ANY NUMBERS
FOUND ON THE
EQUIPMENT



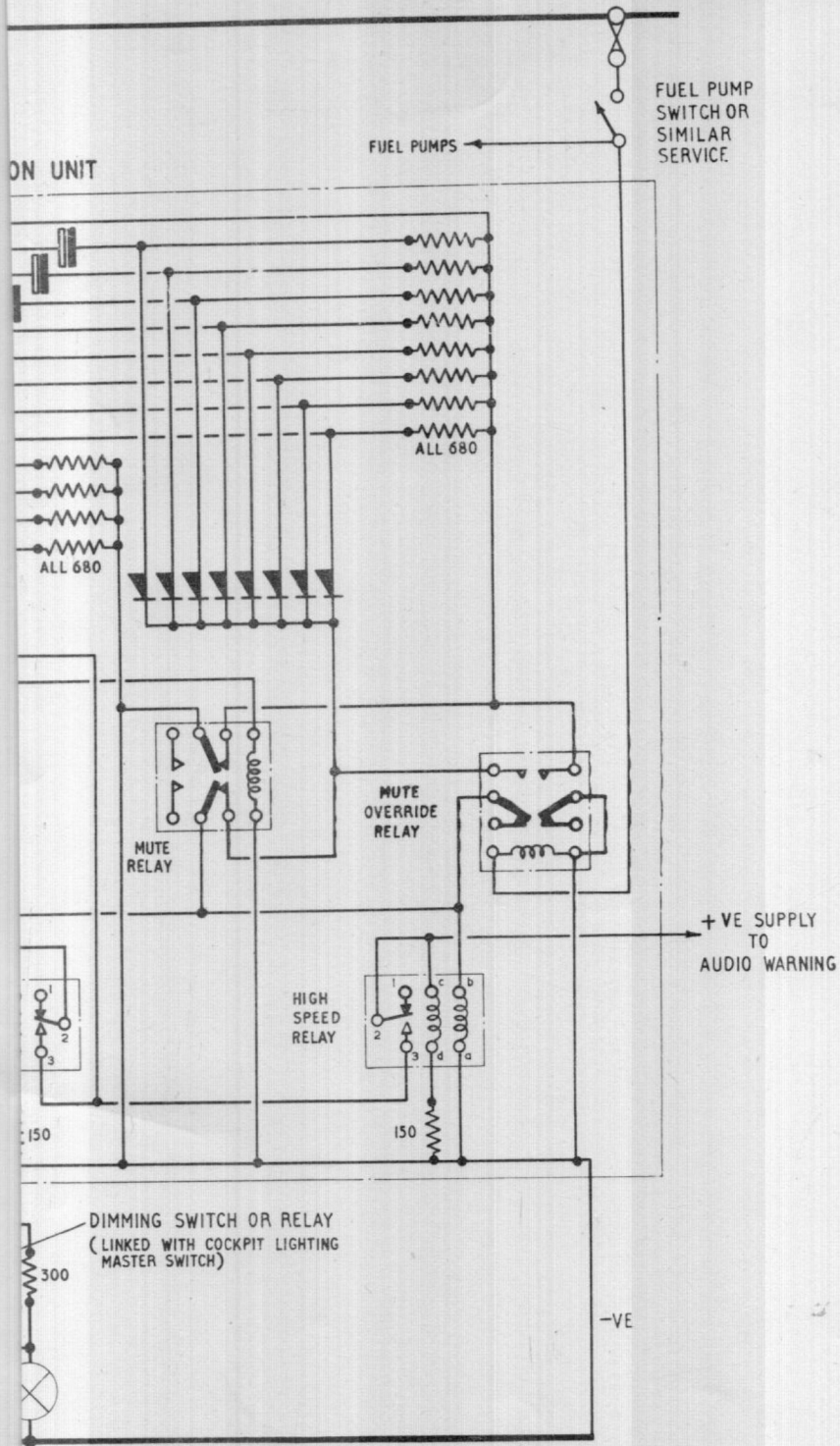


Fig. 2

PART OF UK-AN
37 POLE PLUG

OXYGEN 2
OXYGEN PRESSURE I
CABIN PRESSURE
HYDRAULIC PRESSURE

D.C. GENERATOR

REHEAT 1
REHEAT 2
FIRE 1
FIRE 2

MASTER SWITCH
28V D.C. POSITIVE

D.C. NEG & EARTH

ATTENTION LIGHT I

CANCEL LAMP
(ATTENTION LIGHT 2
IF REQUIRED.)
AUDIO WARNING

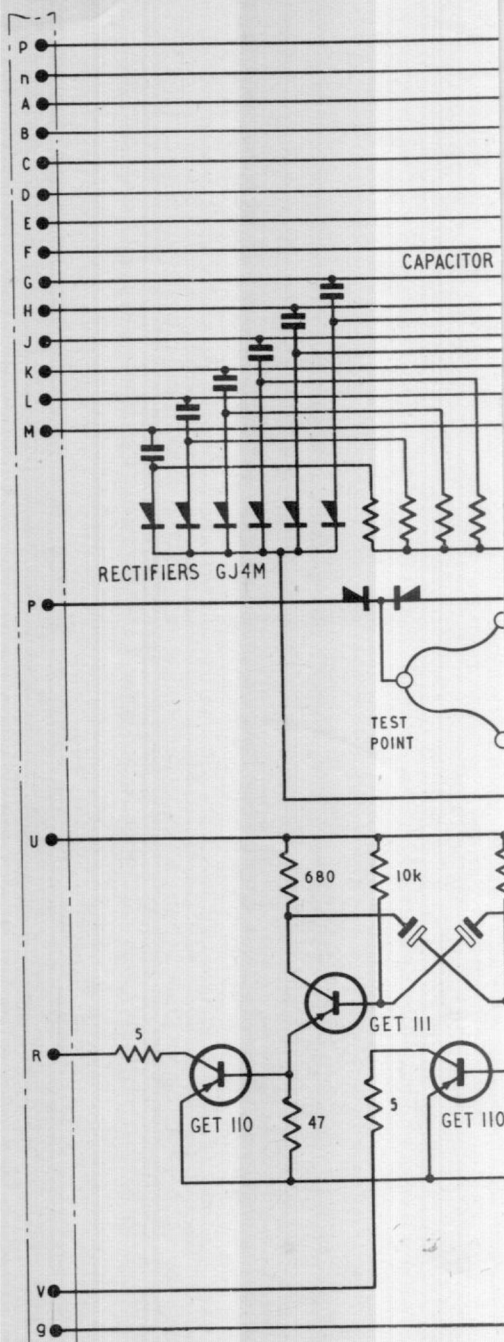


Fig. 3

Typical circuit diagram

R E

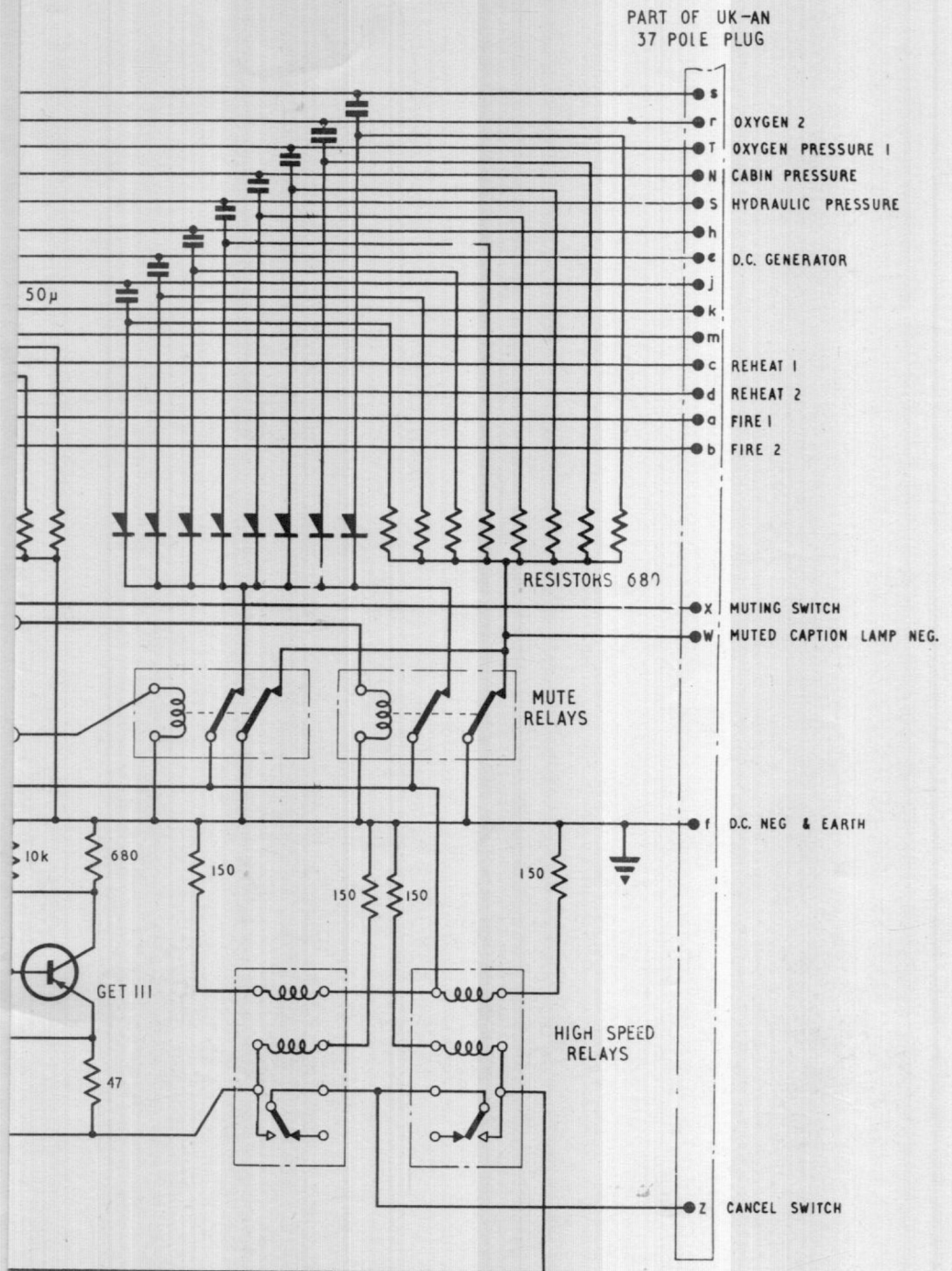


Diagram - transistorized flasher unit
S T R I C T E D

Fig.3