Chapter 23

BLUE STEEL INSTALLATIONS

LIST OF CONTENTS

SERVICING

LIST OF TABLES

REMOVAL AND INSTALLATION

LIST OF ILLUSTRATIONS

Introduction

1. This chapter contains descriptive and servicing information for the electrical equipment and controls installed in the aircraft to permit the carriage of the Blue Steel store. The circuits introduced consist of:-

D.C. and A.C. distribution.
Fin-gap doors control.
Store hoisting controls.
Hydraulic power system.
Folding fin control.
Store control system, switching and monitoring.
Store alternator monitoring.
A.P.U. switching and monitoring.
Store propulsion system switching and monitoring.
Aircraft starting of E.P.C.U.
H.T.P. tanks, temperature warning.
Store fire detection system.
Store and store heating system temperature indication.
Store heating system.
Store refrigeration system.
Fuzing and arming.
Release system and indication.
Navigational system, aircraft portion.
Telemetry switching and monitoring.

2. The systems are described with regard to the aircraft, but where it is necessary to illustrate the operation of a circuit, sections of the store installation are included. Theoretical circuit diagrams of the more complex circuits are provided, which should be read in conjunction with the text. Illustrations of controls and equipment peculiar to particular systems are positioned close to the paragraphs concerned, equipment or controls grouped together which affect more than one system are illustrated near the beginning of the text. Routing charts are included at the end of the text.

3. Description is based on the assumption that the necessary operations for change of role detailed in Book 1 are complete. The main structural alteration affecting the electrical installations is the removal of the bomb doors and the substitution of hinged fairings shaped to accommodate the upper part of the store. These fairings carry the connections between the aircraft and the store, also a pair of small doors to accommodate the upper fin of the store.

4. Portions of the wiring used for the other bombing roles are used in the Blue Steel role, common wiring runs are described where used.

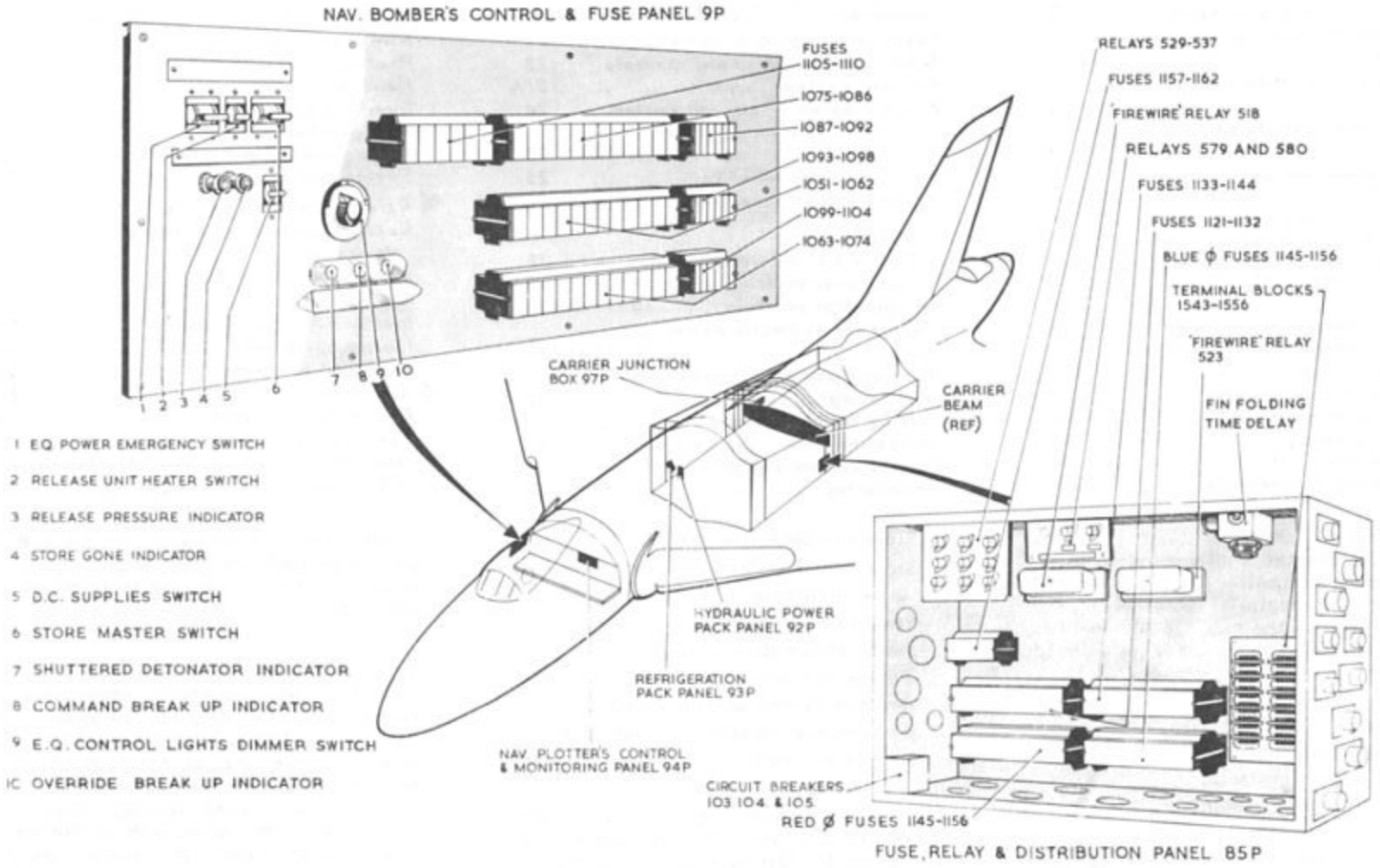

Fig.1 Panel location and release controls

(◀ Mods 1753 and 1492 ▶)

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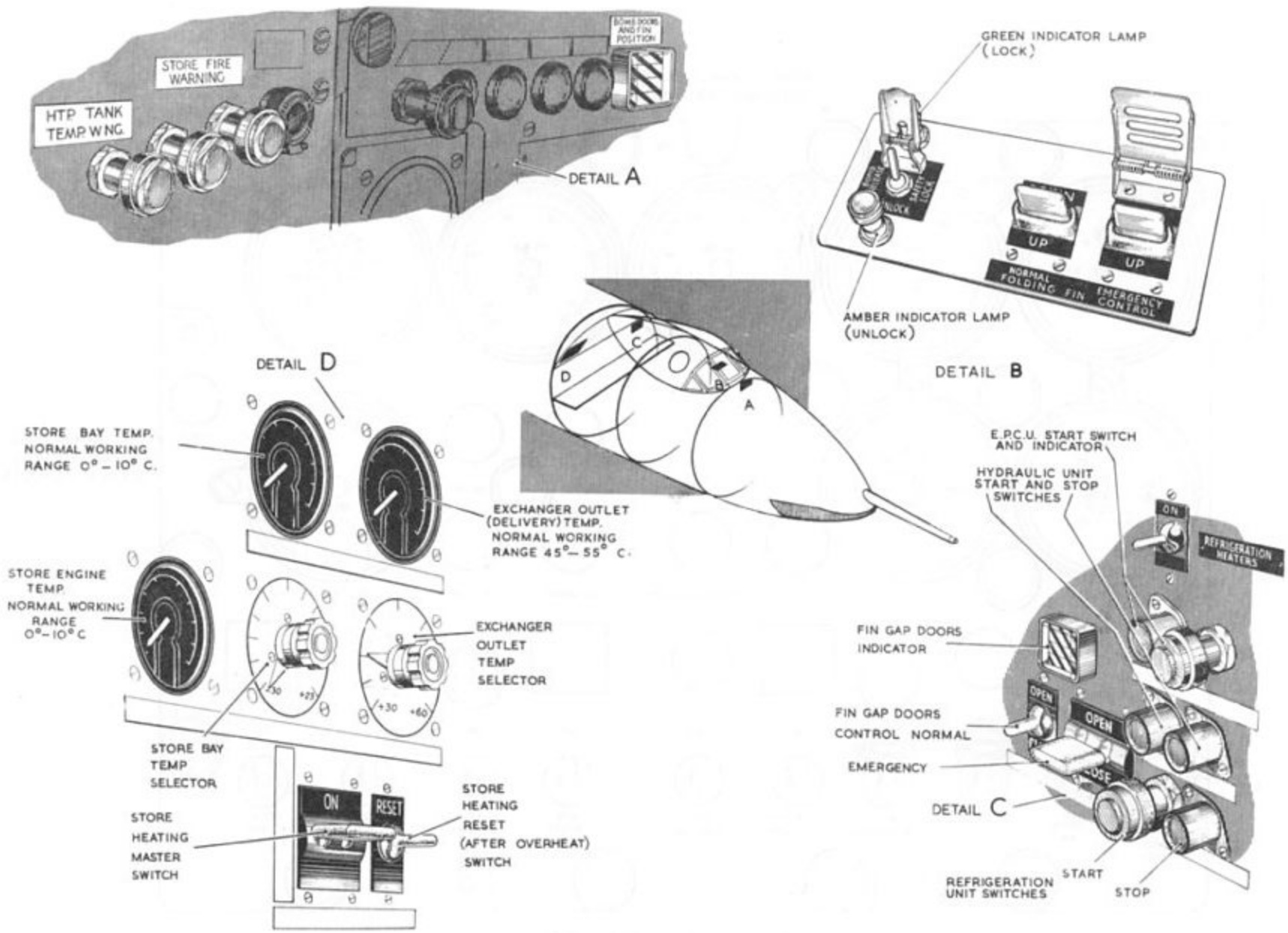

Fig. 2. Miscellaneous controls and indicators.

(◄Guard removed from switch►)

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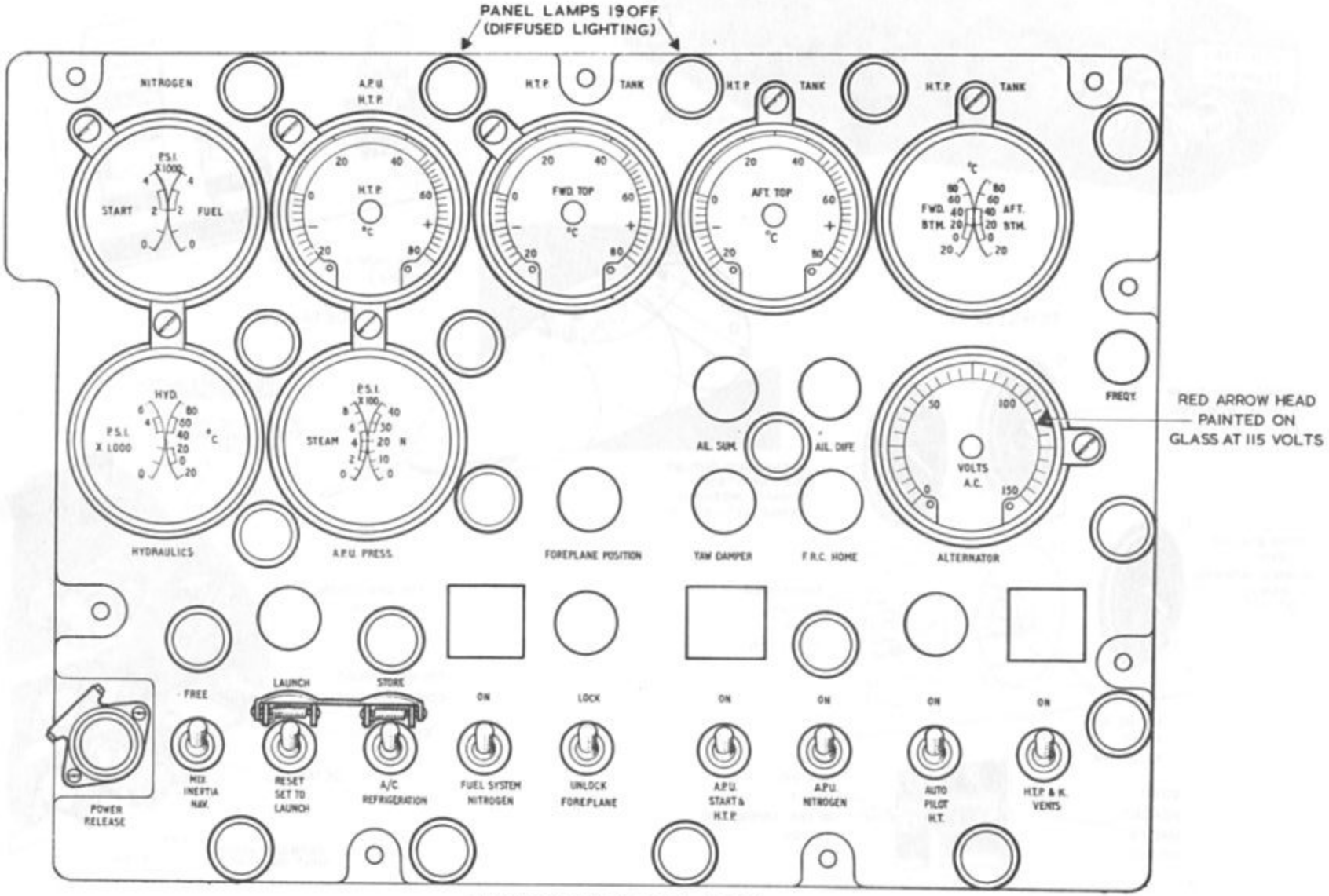

NAV/PLOTTER'S PANEL (94P)

Fig. 3 Store Controls and Monitoring

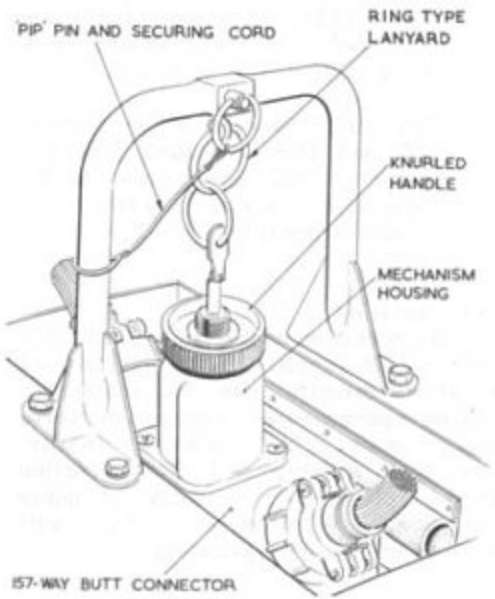

Fig.4. Butt connector locking and ejection
(Mod.1536 incorporated)

Abbreviations

5. To ease labelling of switches and indicators, the following abbreviations are used on the aircraft, in the text and on illustrations, diagrams and routing charts:-

A.P.U. - Auxiliary power unit
E.P.C.U. - Electrical power control unit
H.T. - High tension
H.T.P. - High test peroxide
K. - Kerosene

STORE CONNECTIONS

6. Electrical connections between the store and the aircraft are made by quick-release multi-pin Cannon type connectors. The mating halves are locked together by a mechanism contained in the aircraft half of the connector, unlocking and ejection taking place as the store is released, the mechanisms are tripped to unlock and eject by means of ring type lanyards.

7. To conform with armament terminology the connectors are defined as butt-connectors, although in fact they are plugs and sockets, the plug portion being fitted to the aircraft.

Mating of connectors

8. When disconnected from its corresponding half the aircraft connector pins are retracted behind a barrier, to give mechanical protection. Correct mating to the store or test equipment is achieved in the following manner (refer to fig.4 for externals of a typical connector):-

(1) Rotate fully anti-clockwise the knurled handle at the rear of the connector.

(2) Mate the two halves and apply slight pressure, when an audible "click" should signify the correct location of the locking mechanism.

(3) Rotate fully clockwise the knurled handle, to draw the two halves together.

TESTING

9. The complete Blue Steel installation is tested by use of the "test-set-aircraft missile installation" (T.S.A.M.I.), details of the connection and use of the test set are given in the appropriate publication.

D.C. AND A.C. DISTRIBUTION

General

10. The majority of the store-control and services circuits are supplied by fuses situated either at the Nav/bomber's bombing control panel 9P (replacement panel, item 1/V.9783) or in the bomb bay fuse, relay and distribution panel 85P, both these panels being introduced during the conversion to the Blue Steel role. Other store circuits are supplied by fuses in permanent panels.

11. A circuit diagram of the introduced supplies is provided in fig.5, the diagram including the supplies for the fuzing, arming and release circuits. The routing of the supplies for general circuits is given in fig.28, whilst the routing of fuzing, arming and release supplies will be found in fig.46.

12. As the aircraft is liable to conversion to and from the Blue Steel role, a complete index of fuses for the role is provided in tables 1, 2 and 3. Table 1 lists details of 28-volt d.c. fuses in permanent panels; where a fuse controls a circuit both inside and outside the role the "outside" circuit is noted in brackets; where the function of the circuit changes due to the role the prior title is again noted in brackets. Table 2 lists the 28-volt d.c. fuses introduced and table 3 the 115-volt 3-phase a.c. fuses introduced and permanent.

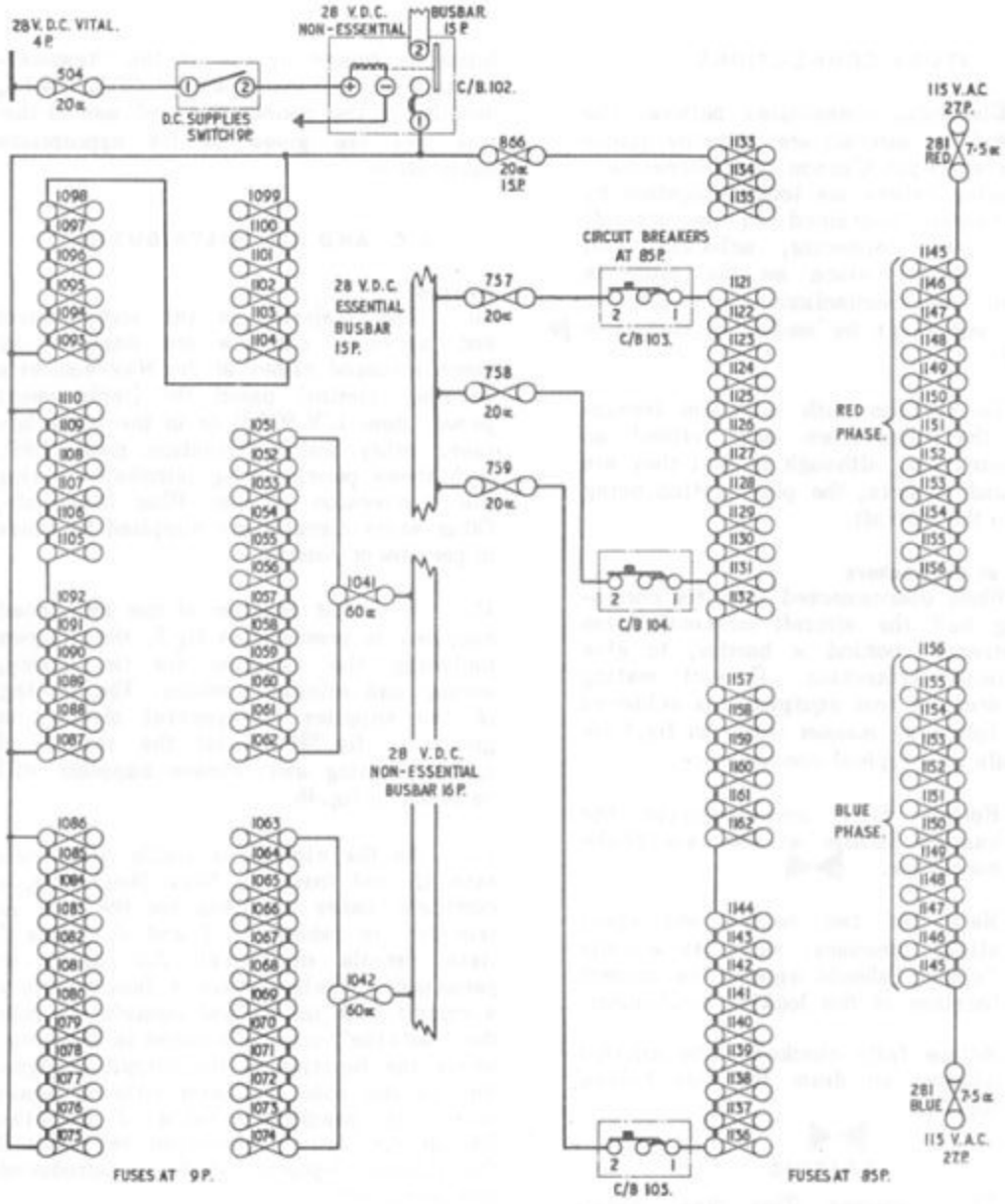

Fig.5 D.C. and a.c. distribution and control

Distribution

13. Reference to fig.5, will show the distribution scheme is simple, the following points should be noted:-

(1) Each bank of fuses at 9P is double-fed.

(2) All d.c. fuses at 85P (apart from fuses 1133, 1134 and 1135) are triple-fed, the three feeder lines being protected at each end.

(3) The wiring between 9P and panels 15P and 16P, including fuse 504 and C/B 102, is common to the integrated wiring system for special store roles.

Supply isolation

14. By operation of the D.C. SUPPLIES switch at 9P, supplies to the majority of the store circuits can be controlled. Supplies permanently connected serve fuzing, arming and release circuits, temperature warning and fire detection circuits, plus other circuits of minor importance. Reference to fig.5 will illustrate the switching circuit.

FIN-GAP DOORS CONTROL

General

15. The substitution of hinged fairings for the bomb doors, during the conversion, obviates the requirement for bomb doors operation. The fairings, however, carry a pair of small doors designed to accommodate the upper fin of the store, the controls which formerly operated the bomb door jacks now being used to operate the fin-gap door jacks.

16. Operation of the doors is effected by electrically-operated selector valves in the hydraulic system, which control the operation of the jacks. Together with the selector valves, the system uses the majority of the wiring installed

TABLE 1

28-VOLT D.C. SUPPLY

DISTRIBUTION FUSES EXISTING

Fuse No.	Rating (amp.)	Service	Location	Type	Category
502	5	Lighting E.Q. control unit	4P	S	V
504	20	D.C. supplies control, 9P fuses 1085 to 1110, 85P fuses 1133 to 1135	4P	S	V
602	2.5	Normal fin-gap doors selection	3P	S	E
616	7.5	Release safety lock	3P	S	E
620	5	H.T.P. tank temp. warning test. (Brake parachute control)	3P	S	E
627	5	Normal fin-folding control and A.S.I. warning. (A lighting gear actuation).	3P	S	E
638	5	Emergency fin-gap doors selection	3P	S	NE
639	5	Emergency hydraulic power pack, pilot's control switch	3P	S	NE
645	5	Emergency fin-folding control	3P	S	NE
749	7.5	Emergency hydraulic power pack, control for aircraft services	15P	S	NE
757	20	Supply to 85P, via C/B 103	15P	S	E
758	20	Supply to 85P, via C/B 104 Triple feeders	15P	S	E
759	20	Supply to 85P, via C/B 105	15P	S	E
852	7.5	Emergency hydraulic power pack, control for store hoisting	19P	S	V
866	20	Supply to 85P, fuses 1133 to 1135	15P	S	NE
937	2.5	Fire detector system test	3P	S	E
938	5	Autopilot H.T. switch, hydraulic pressure selection	3P	S	E
970	5	Bomb fuzing and release	3P	S	E
1041	60	Supply to 9P fuses 1051 to 1062	16P	H3	NE
1042	60	Supply to 9P, fuses 1063 to 1074	16P	H3	NE
1167	7.5	Release safety lock	4P	S	E

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TABLE 2

28-VOLT D.C. SUPPLY

DISTRIBUTION FUSES INTRODUCED

Fuse No.	Rating (amp.)	Service	Location	Type	Category
1051		Spare	9P	S	NE
1052	10	Type E.Q. control unit, No.1 supply	9P	S	NE
1053	5	E.P. power control, pitot pressure switch protection	9P	S	NE
1054		Spare	9P	S	NE
1055	5	Protective relay unit	9P	S	NE
1056	5	Bomb release switch supply	9P	S	NE
1057	5	Reset switch - store heating	9P	S	NE
1058		Spare	9P	S	NE
1059	10	Store release, pneumatic release valve	9P	S	NE
1060	5	Store release, powered release push switch (dual supply, with fuse 1070)	9P	S	NE
1061	5	Store release, master switch (dual supply with fuse 1071)	9P	S	NE
1062		Spare	9P	S	NE
1063	2·5	Bomb-gone and release-pressure indicators, lamp test	9P	S	NE
1064	5	E.P. power control, nose wheel doors up protection	9P	S	NE
1065	10	Store release, Mk.14 release unit adaptor box heaters	9P	S	NE
1066		Spare	9P	S	NE
1067		Spare	9P	S	NE
1068	10	Type E.Q. control unit, No.2 supply	9P	S	NE
1069	5	Protective relay unit	9P	S	NE
1070	5	Store release, powered release push switch (dual supply with fuse 1060)	9P	S	NE
1071	5	Store release, master switch (dual supply with fuse 1061)	9P	S	NE
1072		Spare	9P	S	NE
1073	10	Store release, pneumatic release valve	9P	S	NE
1074		Spare	9P	S	NE
1075		Spare	9P	S	NE
1076		Spare	9P	S	NE
1077		Spare	9P	S	NE
1078		Spare	9P	S	NE
1079		Spare	9P	S	NE
1080		Spare	9P	S	NE
1081	5	Fuel vent valves control and indication	9P	S	NE
1082	10	Inertia navigator and optical link control	9P	S	NE
1083	5	Fuel system nitrogen switch	9P	S	NE
1084	2·5	Fuel system, H.P. nitrogen pressure indicator	9P	S	NE

TABLE 2 (Continued)

28-VOLT D.C. SUPPLY

DISTRIBUTION FUSES INTRODUCED

Fuse No.	Rating (amp.)	Service	Location	Type	Category
1085	2·5	Starter system, H.P. nitrogen pressure indicator	9P	S	NE
1086	2·5	Fuel system H.T.P. temperature indicator, forward top	9P	S	NE
1087	2·5	Fuel system H.T.P. temperature indicator, aft top	9P	S	NE
1088	2·5	Fuel system H.T.P. temperature indicator, forward bottom	9P	S	NE
1089	2·5	Fuel system H.T.P. temperature indicator, aft bottom	9P	S	NE
1090	2·5	Auto pilot H.T. switch	9P	S	NE
1091	2·5	Fore-plane unlock switch	9P	S	NE
1092	5	A.P.U. start, H.T.P. and nitrogen controls, hyd. power stop	9P	S	NE
1093	2·5	A.P.U./H.T.P. tank temperature indicator	9P	S	NE
1094	2·5	A.P.U. steam and nitrogen pressure indication	9P	S	NE
1095	2·5	Safety circuits, indicator test	9P	S	NE
1096	5	Hydraulic power unit start and stop	9P	S	NE
1097	2·5	Hydraulic monitoring, pressure indicator	9P	S	NE
1098	5	Store heating, master switch	9P	S	NE
1099	2·5	Exchanger outlet temperature indication	9P	S	NE
1100	2·5	Engine bay temperature indication	9P	S	NE
1101	2·5	Store bay temperature indication	9P	S	NE
1102	5	Refrigeration system control A.E.O.	9P	S	NE
1103	5	Refrigeration system control Navigator	9P	S	NE
1104	2·5	A.P.U. steam and nitrogen pressure indication	9P	S	NE
1105	2·5	Telemetry monitoring, M.T.S. switch	9P	S	NE
1106	2·5	Telemetry monitoring, telemetry switch	9P	S	NE
1107	2·5	E.P.C.U. start control	9P	S	NE
1108	20	Telemetry monitoring, A.W.R.E. switch	9P	S	NE
1109	2·5	Hydraulic temperature indicator	9P	S	NE
1110	5	Refrigerant pack heaters	9P	S	NE
1121	2·5	H.T.P. tank forward, temperature warning indicator	85P	S	E
1122	2·5	H.T.P. tank aft, temperature warning indicator	85P	S	E
1123	2·5	A.P.U. - H.T.P. tank, temperature warning indicator	85P	S	E
1124	5	Safety circuits indication	85P	S	E
1125	2·5	Fire detection relay unit No.523	85P	S	E
1126		Spare	85P	S	E
1127	2·5	Release system - pressure switch	85P	S	E
1128	5	Store heating, overheat shut-off valve	85P	S	E

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TABLE 2 (Continued)

28-VOLT D.C. SUPPLY

DISTRIBUTION FUSES INTRODUCED

Fuse No.	Rating (amp.)	Service	Location	Type	Category
1129	2·5	Store heating, overheat control	85P	S	E
1130	2·5	Fin folding indicator	85P	S	E
1131	2·5	Pressure selector valve, hydraulic power	85P	S	E
1132	2·5	Bomb gone indicator	85P	S	E
1133	2·5	Fin gap doors indicator	85P	S	NE
1134	5	Refrigeration system, hot air shut-off valve	85P	S	NE
1135		Spare	85P	S	NE
1136		Spare	85P	S	E
1137		Spare	85P	S	E
1138		Spare	85P	S	E
1139	2·5	Fire detection relay unit No.518	85P	S	E
1140		Spare	85P	S	E
1141		Spare	85P	S	E
1142		Spare	85P	S	E
◀ 1143	5	Hydraulic power unit controls	85P	S	E
1144	7·5 ▶	Hydraulic power unit cooling valves	85P	S	E
1157	5	Telemetry monitoring, relay switching unit	85P	S	E
1158	5	Telemetry monitoring, relay switching unit	85P	S	E
1159	5	Telemetry monitoring, relay switching unit	85P	S	E
1160	5	Telemetry monitoring, relay switching unit	85P	S	E
1161		Spare	85P	S	E
1162		Spare	85P	S	E

TABLE 3

115-VOLT, 3 PHASE, 400 C/S SUPPLY

DISTRIBUTION FUSES

Fuse No.	Rating (amp.)	Service	Location	Type	Category
246		Spare S.T.I./Vulcan/302	24P	S	E
281	7·5	Supply to 85P fuses 1145 to 1156	27P	S	E
341	5	Inertia navigator and optical link supplies	11P	S	NE
1145	5	Store heating, No.1 mag, amplifier red phase, No.2 mag. amplifier blue phase	85P	S	E
1146	2·5	Fire detection, relay unit 523 red phase, relay unit 518 blue phase	85P	S	E
1147		Spare	85P	S	E
1148		Spare	85P	S	E
1149		Spare	85P	S	E
1150		Spare	85P	S	E
1151	5	Telemetry monitoring, relay switching unit	85P	S	E
1152		Spare	85P	S	E
1153		Spare	85P	S	E
1154		Spare	85P	S	E
1155		Spare	85P	S	E
1156		Spare	85P	S	E

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for bomb doors operation. Control of the circuit is transferred from the first pilot to the air electronics officer (A.E.O.).

17. In normal flight conditions, or when hydraulic pressure is available from a ground servicing trolley, control of the fin-gap doors is achieved by two selector valves in the main hydraulic system. For emergency flight conditions and occasional ground use, control is obtained by a third selector valve employed in a separate hydraulic system pressurised by the emergency hydraulic power pack. This power pack is described electrically in Chap.19 and is not to be confused with the hydraulic power unit described in succeeding paragraphs.

Indication

18. One 3-position magnetic indicator, Dowty type C5175Y Mk. 15, gives indication of doors closed and doors open and can indicate failure of the doors to reach either final position. The indicator is situated at the A.E.O. station (fig.2) and presents a black face with doors closed, a white face with doors open and a striped face during door travel. The indicator is controlled by four standard Type 1A micro switches operated by the action of the fin-gap doors, two switches being wired in series for both closed and open indications so that the indicator is not energised until both doors are fully operated.

Controls

19. The doors are controlled by switches installed adjacent to the indicator. The switches are:-

(1) Normal fin doors control switch. A single-pole change-over switch labelled OPEN - CLOSE.

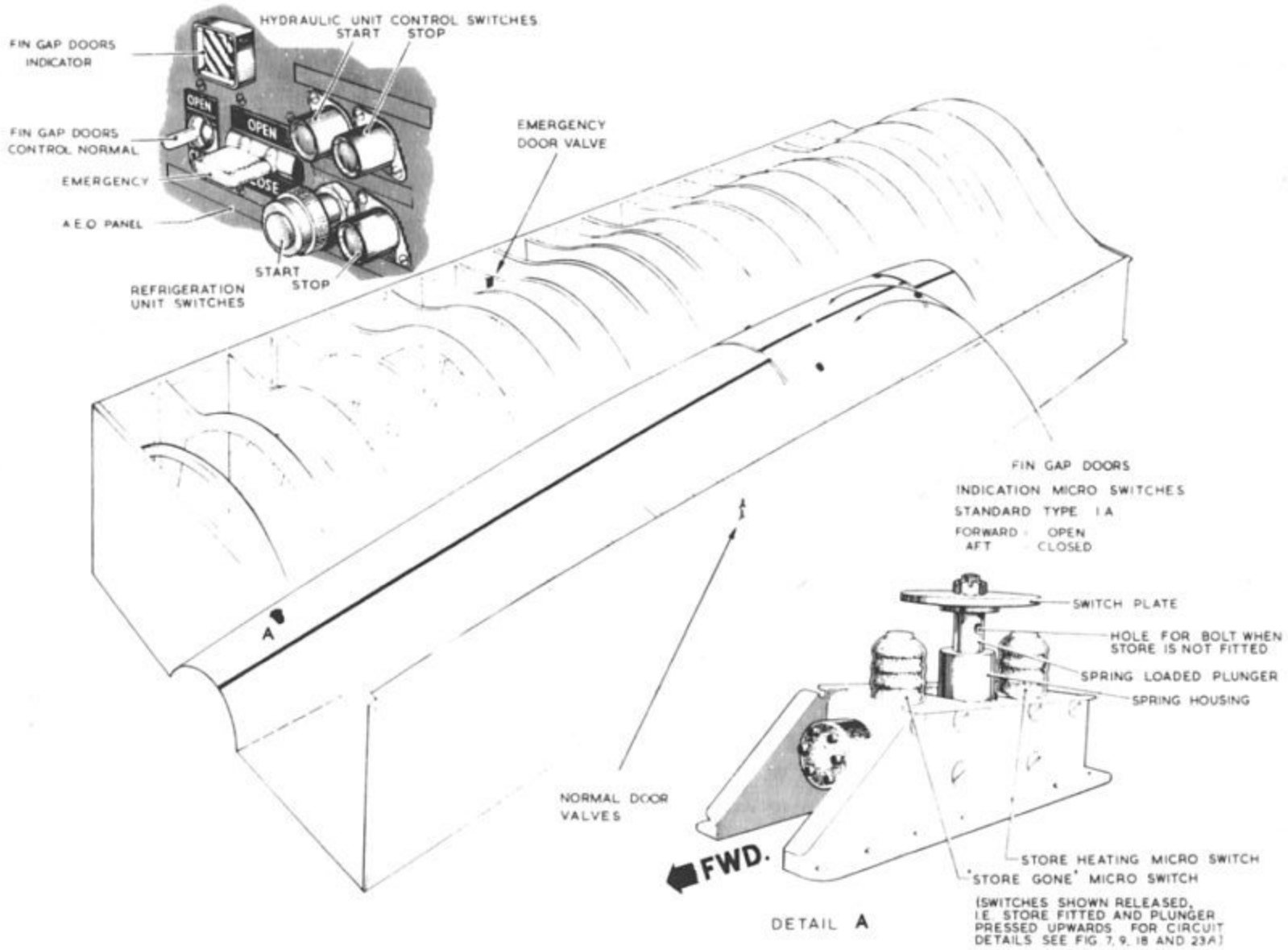

Fig 6. Fin-gap door controls and equipment

(2) Emergency fin doors control switch. A double-pole, 3-position change-over switch, labelled OPEN-CLOSE.

20. Connected in the circuit between the supply fuses and the foregoing control switches are two micro switches, Ref.No.5CW/4742, entitled STORE HEATING and STORE GONE respectively. The micro switches are normally held pressed (store not fitted) by a plate attached to a spring-loaded plunger. When the store is fitted, the plunger is pressed upwards to release the micro switches, which, besides their titled function (para.180 and 258) break the supply to the control switches, so preventing the fin-gap doors being operated against the upper fin of the store. A hole through the plunger near the top enables a 2BA bolt to be inserted to act as a stop against the plunger housing, thus protecting the micro switches from excessive override should the plunger be trodden on at any time while the store is not fitted. The plate must be pulled upwards to reveal the plunger hole in order to insert the bolt.

Circuit operation

21. The following sequence of operations should be read in conjunction with fig.7. For normal control it is assumed that the emergency fin doors control switch is in the centre (off) position. For both normal and emergency control it is assumed that the store is not fitted, in which case the micro switches will be pressed to connect the supply from fuses 602 and 638.

22. The circuit in fig.7 is duplicated in fig.9 for store hoisting control as parts of the circuit fulfil a dual role. This expedient will lessen the number of cross references and show the interconnection of the two systems.

Normal selection

23. The fin-gap doors circuit (fig.7) is shown with the fin-gap doors closed, and it will be seen that:-

(1) Terminal 1 of the fin-gap doors indicator is fed from fuse 1333 via contacts A-C of the doors closed micro switches connected in series. The indicator is thus energised to show a black face.

(2) The close solenoids of the normal door valves are energised from fuse 602 via contacts 5-6 of the store heating micro switch, contacts 2-3 of the normal fin-gap doors control switch and normally closed contacts 257/1. The solenoids are earthed via normally closed contacts 257/5.

24. When the normal fin-gap doors control switch is placed to OPEN, the open solenoids of the normal door valves will be energised from fuse 602 via contacts 5-6 of the store heating micro switch, contacts 2-1 of the control switch and normally closed contacts 257/4. The fin-gap doors will then begin to open.

25. As the doors begin to open, the fin-gap doors indicator will be de-energised by operation of the doors closed micro switches, and will show a striped face.

26. When the fin-gap doors are fully open, the doors open micro switches will be operated and a supply will be made from fuse 1133, via contacts A-C of the micro switches to terminal 2 of the indicator, which will be energised to show a white face.

Emergency selection

27. For emergency operation of the fin-gap doors, the emergency hydraulic power pack is used. This circuit incorporates a time delay unit, which operates in conjunction with a by-pass valve connected in the hydraulic circuit, and allows the power pack motor to attain running speed off load (para.31). Reference to fig.7 will show that the supply to energise the time delay unit (via pin L) is connected through normally open contacts B2-B1 of relay 760 and normally closed contacts 5CM-5NO of relay 14 (G.P.U.) and 13 (A.A.P.P.). This ensures that the hydraulic circuit will not function until either:-

(1) The pitot head is switched on (relay 760 energised) or,

(2) A 200-volt ground supply is connected (G.P.U. relay energised) or,

(3) The A.A.P.P. supply is connected (A.A.P.P. relay energised).

28. The power pack motor contactor (relay 259) is double-acting, the two sections being separately energised. For descriptive purposes only, the sections will be referred to as:-

(1) 259A where the relay obtains a 200-volt, 3-phase supply from the aircraft busbars.

(2) 259G where the relay obtains a similar supply via the bomb bay ground supply plug.

It should be noted that the bomb bay ground supply plug is used only for store hoisting and lowering, this system being described in subsequent paragraphs. A full description of the power pack and associated controls is given in Chap.19.

29. Referring to fig.7, when the emergency fin-gap doors control switch is placed to CLOSE, the following circuit action will result:-

(1) The close solenoid of the emergency doors valve will be energised by a supply from fuse 638 via contacts 2-3 of the store gone micro switch, contacts 5-4 of the control switch and normally closed contacts 254/4.

(2) Relay 257 will be energised from fuse 638 via the store gone micro

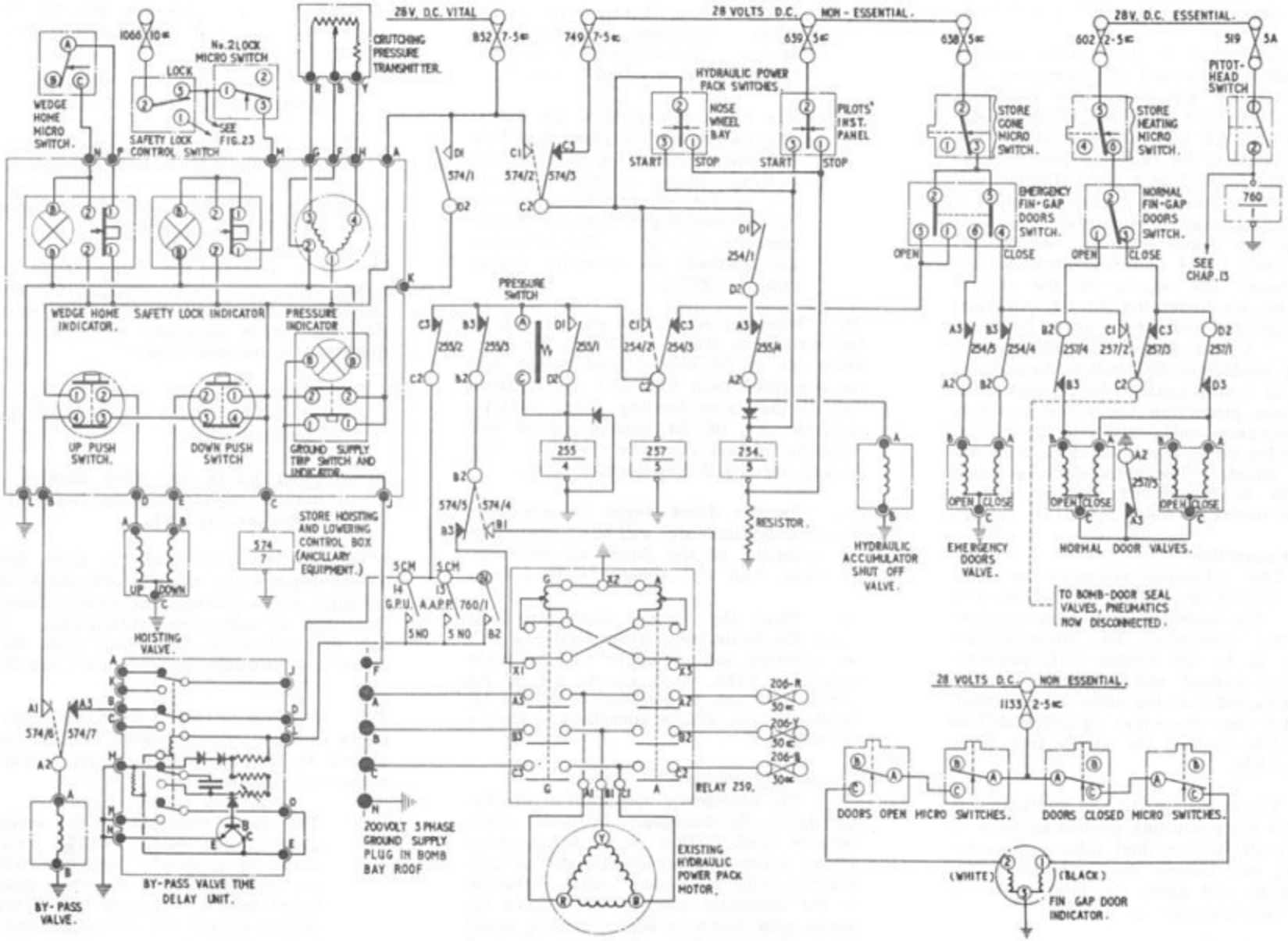

Fig 7 Fin-gap doors and associated controls

(◀ Mods. 1363 and 1552 ▶)

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switch, contacts 2-1 of the control switch and normally closed contacts 254/3.

(3) Relay 259A will be energised via contacts 254/3, 255/3, 574/5 and interlock contact X1.

(4) The by-pass valve will be energised via contacts 254/3, 255/2, the normally closed contacts of the time delay unit (pins D-B), and normally closed contacts 574/7.

(5) The time delay unit will be energised to start the timing sequence via contacts 254/3, 255/2, G.P.U. relay contacts (para.27, sub para.2) and pin L of the time delay unit. This operation is described in para.38.

30. Opening of relay contacts 257/1, 257/4 and 257/5 will completely isolate the normal door valves from the circuit and earth, thereby isolating any fault in the normal hydraulic system. Contacts 257/2 and 257/3 are used for bomb doors seal operation not required in this role, and are shown to continue the sequence of contact numbering only.

31. Closing of relay 259A contacts A2-B2-C2 will connect the 200-volt, 3-phase supply from fuses 206R, Y, B to the hydraulic power pack motor via relay terminals A1-B1-C1. Opening of the interlock contact X3 prevents inadvertent operation of relay 259G.

32. The by-pass valve, when energised, connects the hydraulic pressure and return lines, therefore pressure build-up on starting is low and the motor will quickly attain running speed. After 2 seconds, the delay unit's internal relay will be energised causing the supply to be removed from pin B, and thus de-energising the by-pass valve. Pressure will then be built up in the hydraulic system and the fin-gap doors will begin to close.

33. As the doors begin to close, the indicator will be de-energised by operation of the doors open micro switches, and will show a striped face. When the doors are fully closed, the doors closed micro switches will be operated and a supply from fuse 1133 will energise the indicator at terminal 1 via contacts A-C of the micro switches. The indicator will show a black face.

34. With the doors fully closed, the hydraulic pressure will increase, and on reaching a nominal 4,000 p.s.i. will cause the pressure switch to close and energise relay 255. The following action will result:-

(1) Contacts 255/1 will close to hold in relay 255.

(2) Contacts 255/2 will open to de-energise the time delay unit, which will be ready for subsequent operation on selection of doors open.

(3) Contacts 255/3 will open to de-energise relay 259A thereby breaking the supply to the power pack motor.

(4) Contacts 255/4 will open to isolate the wheel brakes accumulator shut-off valve (Chap.19)

35. The correct control action at this stage would be the selection of the control switch to the centre (off) position. This cancels the circuit operation described in the preceding paragraph, thus leaving the circuit prepared for starting the power pack from other sources.

36. Placing the emergency fin-gap doors control switch to OPEN causes similar circuit operation to that described for CLOSE selection, except that the open solenoid of the emergency doors valve is energised from fuse 638 via contacts 5-6 of the control switch and normally closed contacts 254/5. Operation of the fin-gap doors micro switches and indicator is as described in para.25-26.

Operation of time delay unit

37. Reference to fig.7 will show that pins H, M and N are at earth potential and that pins D and L are at 28 volts potential when the associated circuit is operated. The supply at pin D will be connected across the normally closed contacts of the internal relay to pin B. The supply at pin L is applied to the relay coil and at a lower potential to the capacitor through the fixed and variable resistors. Initially, little current will flow through the relay coil and transistor C-E to earth due to the low potential at transistor B.

38. As the capacitor becomes charged, the potential at transistor B will increase until, at a time dependent on the value of the variable resistor, sufficient current will flow to energise the relay coil. Operation of the relay contacts will:-

(1) Provide a full earth for the relay coil via pins E-O, the relay contacts and pin H, to lock in the relay.

(2) Short-circuit the capacitor, thus discharging and preparing it for subsequent operation.

(3) Open the path between pins D and B.

39. The resistor between pin M and the relay coil provides a parallel path for a portion of the coil energising current. The two diodes between pin M and the resistor bank serve to direct induced coil-collapse voltage away from the transistor.

STORE HOISTING SYSTEM

General

40. The carrier beam, installed

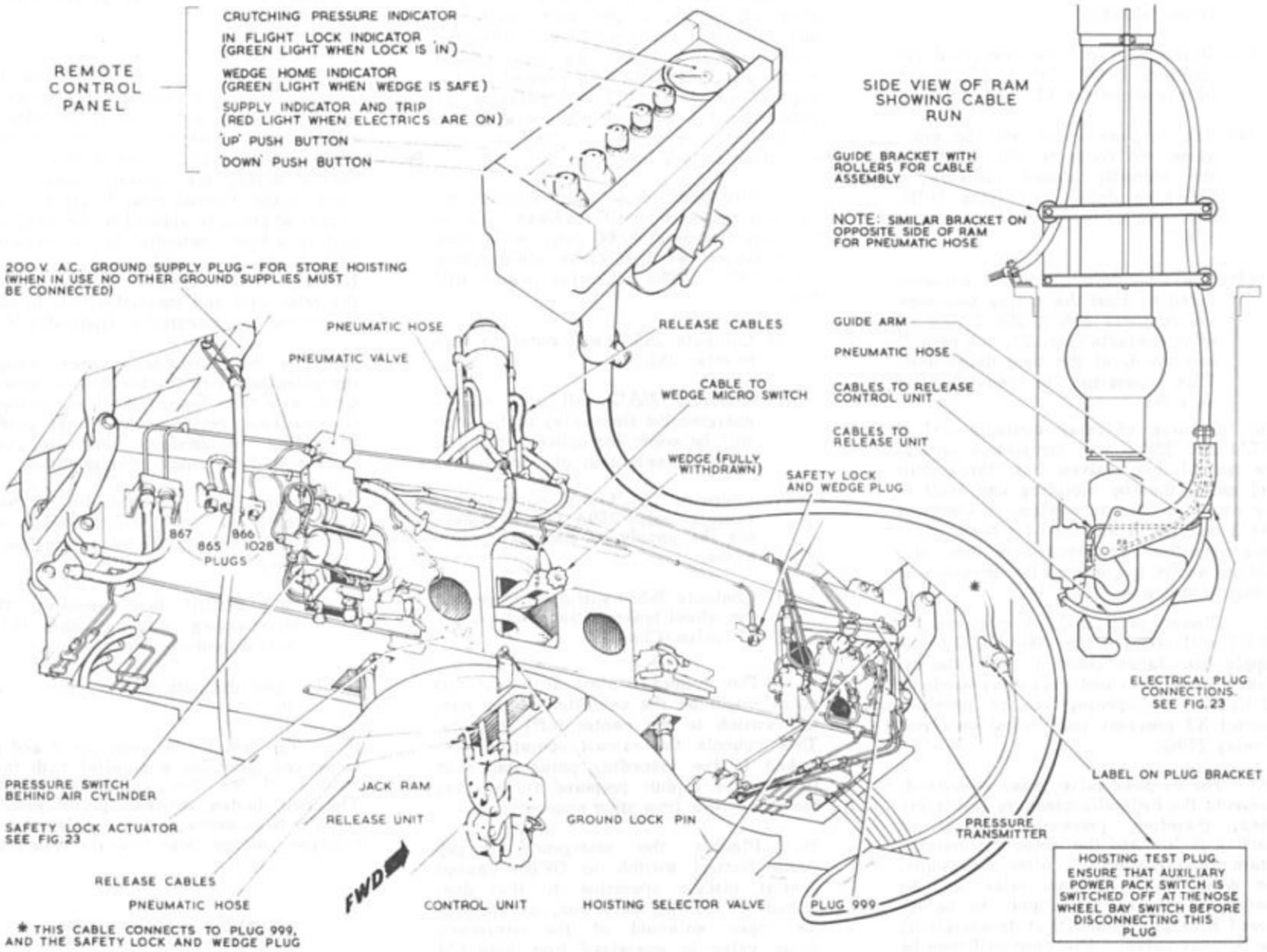

Fig. 8. Store hoisting equipment.

(◀ *Mods 1353 1561 and 1626* ▶)

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◀ in the bomb bay during change of role operations, carries the single suspension point for the store. The suspension point consists of a pneumatically operated release unit which, along with a release control unit, is attached to the ram of a hydraulic jack. This arrangement provides the means for loading or unloading the store, the jack being lowered for attachment of the store to the release unit, and then raised to hoist the store to the crutching position. Connections to the release unit and release control unit (para.268 - 269) are made by a pneumatic hose and two electrical cables. These must first be disconnected at the release control unit mounting before the jack is retracted. With the introduction of Mod.1626, however, the hose and cables are lengthened to follow the travel of the jack, their movement being guided by rollers on a guide bracket around the jack during extension and retraction operations (fig.8).

41. A wedge assembly fitted to the jack housing is inserted under a boss on the jack when the store is fully hoisted and crutched. The weight of the store is then removed from the jack to the wedge. Crutching operations are described in Book 1, Sect.5, Chap.5.

42. The release unit is fitted with a safety lock pin to prevent inadvertent release, movement of the lock pin to free the release unit for operation being controlled either electrically or manually (para.250-252). In addition, an overriding safety precaution is provided by a ground lock safety pin, which is inserted in the control mechanism of the release unit (fig.8).

Jacking controls

43. The hydraulic jack is operated by a two-way, blind-neutral, selector valve which is connected to the hydraulic system pressurised by the emergency hydraulic power pack. The selector valve is controlled from the ground by means of a hand-held ancillary control panel, which connects to a plug fitted to a bracket on the port side of the bomb bay (bomb arch 151.919A). When not in use, the control panel is carried in a special stowage provided on the upper face of the port bomb bay fairing door (near to bomb arch 201.367A).

44. As a safety precaution during hoisting and lowering operations, the emergency hydraulic power pack motor is driven by a separate 200-volt ground supply plug installed in the bomb bay roof starboard (between bomb arches 151.919A and 171.824A) no other supplies being connected to the aircraft, except the internal 28-volt battery feeding the vital busbar. The aircraft circuit is automatically prepared for the 200-volt ground supply upon connection of the ancillary control panel to the aircraft.

45. The ancillary control panel carries the following switches and indicators:-

(1) Ground supply trip switch and indicator. A combined push-switch and red warning lamp, giving indication of the readiness of the system for hoisting operations, and providing the means of tripping the ground supply input.

(2) Wedge home indicator. A green warning lamp with press-to-test facility, controlled by a micro switch operated by the hydraulic jack wedge.

(3) Safety lock indicator. A green warning lamp with press-to-test facility, controlled by No.2 lock micro switch within the release control unit.

(4) Crutching pressure indicator. A dial indicator, connected to a pressure transmitter on the carrier beam, which registers pressure in the jack for crutching purposes.

(5) Up and down push-switches which control the hydraulic jack.

46. When the store is correctly crutched and the wedge is inserted, the wedge home indicator will be lit by a supply from the vital busbar fuse 852 (para.58). The safety lock indicator, however, will not be lit until the 28-volt ground supply switch is switched on. A supply to the safety lock indicator will then be made from fuse 616 via the safety lock switch on the port console and the No.2 lock micro switch in the release control unit (para.268).

WARNING

Prior to any lowering or hoisting operation, the electrical and mechanical safety lock operating rods and the manual release operating rod must be fully retracted. Pre mod.1626, the two electrical sockets and the pneumatic hose at the release control unit must be disconnected and secured clear of the jacking system. Suitable blanks are to be fitted to the points disconnected, and examination for ingress of foreign matter should be made prior to reconnection. Post mod.1626 no disconnection is necessary.

Hydraulic power pack controls

47. The emergency hydraulic power pack is also used for systems other than store hoisting. The associated controls are as follows:- ▶

(1) Hydraulic power pack START-STOP switch adjacent to 16P on the starboard aft side of the nose wheel bay. This switch is used to start the power pack for store hoisting or for charging the wheel brake accumulators.

(2) Hydraulic power pack START-STOP switch on the first pilot's port console 6P. pre mod.1139.

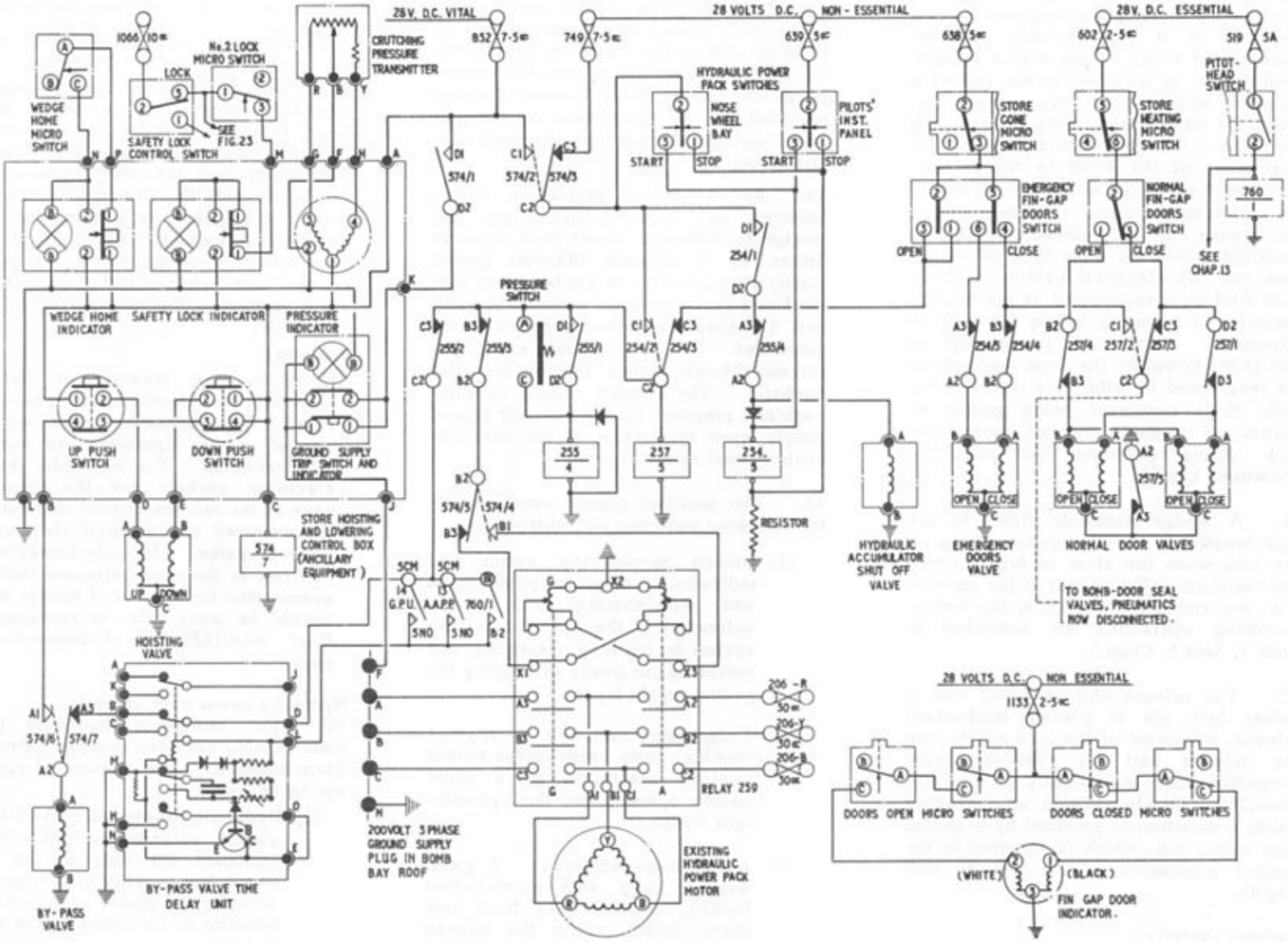

Fig. 9 Store hoisting and associated controls

(◀ Mods. 1363 and 1552 ▶)

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(on the pilots' centre instrument panel post MOD.1139). This switch is used only when charging the wheel brake accumulators.

(3) Emergency fin gap doors switch at the A.E.O. station. The function of this switch is described in the FIN-GAP DOORS CONTROL paragraphs.

48. The power pack motor is driven either from the aircraft 200-volt, 3-phase a.c. supply or a separate ground supply (referred to in para.44) via a double acting contactor (designated relay 259) mounted forward of the pack. The two sections of the contactor are separately energised. For descriptive purposes only, the sections will be referred to as:-

(1) 259G where the contactor obtains a 200-volt, 3-phase supply from the separate ground supply plug.

(2) 259A where the contactor obtains a similar supply from the aircraft busbars.

It should be noted that the aircraft supply is used only for fin-gap door operation and charging the wheel brake accumulators.

Circuit operation

49. The following sequence of operations should be read in conjunction with the theoretical circuit diagram, fig.9. The following assumptions are made:-

(1) The ground supply trolley referred to in para.44 is connected to the aircraft, and is running.

(2) The ancillary control panel is connected to the aircraft.

(3) No other supplies are connected to the aircraft.

The diagram is duplicated in the fin-gap door control paragraphs, as parts of the circuit fulfil a dual role. It is intended that this expedient will lessen the number of cross references and illustrate the tie-up between the two systems.

Automatic action

50. Referring to fig.9, it will be seen that connection of the ancillary control panel has energised relay 574, from fuse 852 via the control panel pins A-C (it should be noted that fuse 852 is supplied by the Vital busbar, which in turn is supplied direct from the aircraft battery). Operation of relay 574 causes the following:-

(1) Closing of contacts 574/1, which direct a supply from fuse 852 to pin F of the ground supply plug (see para.44) via the control panel pin K, normally closed contacts of the ground supply trip switch and pin J; the trip switch lamp is lit by this supply. The supplying of ground supply plug pin F allows the trolley circuit breaker to be engaged, giving a 200-volt, 3-phase 400c/s supply to the ground supply plug (pins A, B, C and N).

(2) Opening of contacts 574/3, which takes the power pack control circuit away from fuse 749. The non-essential busbar is 'dead', (sub. para.(3) of previous para.).

(3) Closing of contacts 574/2, which places the power pack control circuit under the control of fuse 852.

(4) Opening of contacts 574/5, which prevents the connection of the power pack motor to fuses 237.

(5) Closing of contacts 574/4, which prepares the circuit for the energising of relay 259G.

(6) Opening of contacts 574/7, which isolates the by-pass valve from the time delay unit.

(7) Closing of contacts 574/6, which energises the by-pass valve from fuse 852 via the control panel pin A, normally closed contacts 4-3 and 3-4 of the DOWN and UP push switches and pin B of the control panel. This action enables the power pack to run under light pressure as the by-pass valve, when energised, couples the hydraulic circuit pressure and return lines; under this condition the only restriction will be in components and the pressure build-up will be relatively low.

51. Fuse 852 also supplies the pressure indication system, the lock-pin indicator press-to-test facility, the wedge home indication and the normally open contacts of the UP and DOWN push switches.

Power pack starting

52. Holding the nosewheel bay hydraulic power START/STOP switch momentarily to START will energise relay 254 from fuse 852, via the now closed contacts 574/2 and contacts 2-3 of the switch. Operation of relay 254 will cause the following:-

(1) Closing of contacts 254/1, which forms a hold-in circuit for relay 254, fed from fuse 852 via the now closed contacts 574/2 and normally closed contacts 255/4. This supply also opens the hydraulic accumulator shut-off valve, which has no function in this application of the power pack.

(2) Closing of contacts 254/2, which energises relay 257, supplies contact 1 of the pressure switch and contacts 255/2 and 255/3. The supply is taken from fuse 852 via contacts 574/2.

(3) Normally closed contacts 255/2 direct the supply described in sub-para.(2) to the by-pass valve time delay unit, this supply has no effect on the valve (see sub.para. (6) of para.50).

(4) Normally closed contacts 255/3 direct the supply described in sub.para.(2) to energise relay 259G, via the now closed contacts 574/4 and relay 259 interlock contact X3.

(5) Opening of contacts 254/4 and 254/5, which isolate the emergency fin-gap door valve.

53. Operation of relay 257 causes the opening of contacts 257/1, 257/4 and 257/5, which isolate the normal fin-gap door valves.

54. Operation of relay 259G closes contacts A3, B3 and C3 which connect the ground supply to the power pack motor via terminals A1, B1 and C1. As there is relatively little pressure build-up due to the energising of the by-pass valve (sub.para.(7) of para.50) the motor will attain running speed almost instantaneously and continue to run under this low pressure condition.

55. The isolation of the normal and emergency fin-gap door valves ensures that all pressure is delivered to the hoisting system, and the doors remain in the position originally selected.

Hoisting

56. Referring to fig.9, it will be seen that an UP selection at the ancillary control panel will:-

(1) Energise the UP solenoid of the hoisting selector valve, via terminal 1-2 of the push switch and pin D of the control panel.

(2) Break the supply to the by-pass valve described in para.50, sub. para.(7), de-energising the valve.

57. The hydraulic system will now revert to pressure conditions giving pressure to the jack, and hoisting will commence. Release of the UP push switch during hoisting operations will:-

(1) De-energise the UP solenoid of the hoisting valve, the valve is self-centring and the jack will remain in the operated position.

(2) Energise the by-pass valve, allowing the system to run under low pressure conditions.

58. When the store is in the correctly crutched position, the pre-determined correct pressure will be indicated at the crutching pressure indicator. The wedge assembly should now be manually wound in, and when fully home will operate the wedge home micro switch, giving indication at the ancillary control panel.

Lowering

59. Prior to lowering from the crutched position an UP selection has to be made at the control panel to take the weight of the store off the wedge, which can then be removed.

60. A DOWN selection at the control panel will:-

(1) Energise the DOWN solenoid of the hoisting selector valve, via terminal 1-2 of the push-switch and pin E of the control panel.

(2) Break the supply to the by-pass valve described in para.50, sub. para.(7), de-energising the valve.

61. The hydraulic system will now revert to pressure conditions giving pressure to the jack, and lowering will commence. Release of the DOWN push-switch during lowering operations will:-

(1) De-energise the DOWN solenoid of the hoisting valve, the valve is self-centring and the jack will remain in the operated position.

(2) Energise the by-pass valve, allowing the system to run under light loading conditions.

62. Should a condition arise where the pressure at the power pack is sufficient to close the pressure switch (3,900 ±20 p.s.i.) relay 255 will be energised, (supply detailed in sub.para.(2) of para. 52) causing the following:-

(1) Closing of contacts 255/1, providing a hold-in circuit for relay 255, fed from fuse 852 via the now closed contacts 574/2 and 254/2.

(2) Opening of contacts 255/3, which de-energise relay 259G, and break the supply to the power pack motor.

(3) Opening of contacts 255/4, which break the hold-in circuit for relay 254.

63. The consequent closing of contacts 254/4 and 254/5 puts the emergency doors valve back in the circuit, whilst the opening of contacts 254/2 causes the de-energising of relay 257, putting the normal door valves back in the circuit. The opening of contacts 254/2 also breaks the hold-in supply for relay 255 (sub.para.(1) of previous paragraph); the system is now isolated.

64. The system is switched off by holding the nosewheel bay START/STOP switch momentarily to the STOP position. This action causes a positive supply to be applied to the 'earthy' side of the coil of relay 254 from fuse 852, the consequent de-energising of the relay coil will cause the following:-

(1) Opening of contacts 254/1, which break the hold-in supply for relay 254, ensuring that the relay remains de-energised on release of the switch.

(2) Closing of contacts 254/4, and 254/5, which put the emergency doors valve back in the circuit.

(3) Opening of contacts 254/2, which de-energise relays 259G and 257 stopping the hydraulic pack and putting the normal door valves back in the circuit.

65. The separate 200-volt a.c. ground supply is dispensed with by pressing the supply trip switch and indicator at the ancillary control panel, when the supply described in para.50, sub.para.(1) is interrupted causing the trolley circuit breaker to be opened.

66. Disconnection of the ancillary control panel will de-energise relay 574, causing a reversion of the events described in para.20, the power pack now being controlled from fuses 749 and 639 and supplied from the aircraft busbars should charging of the wheel brake accumulators or fin-gap door operation be required.

HYDRAULIC POWER SYSTEM

General

67. A self-contained hydraulic system is provided in the aircraft to supply the store with the necessary hydraulic pressure for various store systems. Prior to being launched the store provides its own pressure, and the system in the aircraft is shut down. The following paragraphs deal solely with the aircraft system.

Hydraulic power unit

68. Situated just aft of the front spar in the bomb bay starboard, the power unit consists of a high pressure pump driven by a continuously-rated 200-volt 3-phase motor, B.T.H. Type L.K.1818, and various control valves, three of which are electrically operated. The valves are an off-loading by-pass valve, a pressure selector valve and an isolating valve. All the foregoing are contained in one pack, together with other equipment described in Sect.5, Chap.5. The associated electrical control devices are fitted on a panel (92P) attached to the pack.

Motor protection

69. Motor circuit protection is provided by a motor overload protection unit, H.S.A. Part No. 32/V.11313, inserted between the motor and a main contactor. The contactor is tripped by the protection unit in the event of overload conditions. Additional protection is provided by high-rupturing-capacity fuses.

70. The motor is cooled by air from two sources. In flight by ram air, on ground by exhaust cooling air from the condenser of the refrigeration system described in the relevant chapter of Sect.5. The control of the changeover of air supply is described in the REFRIGERATION SYSTEM paragraphs.

Off-loading the system

71. The off-loading by-pass valve is provided in the hydraulic circuit for two functions; on starting, the valve is energised to de-restrict the hydraulic circuit until the motor has reached running speed; on stopping, the valve is again energised to relieve pressure which would otherwise be trapped in part of the circuit. The timing of the period for the starting function is achieved by means of a transistorised time delay unit, H.S.A. Part No.18/V.9303, giving 2 seconds delay.

Pressure selection

72. The pressure selector valve is provided to alter the pressure of the fluid being delivered to the store, according to the store system in use at the particular period. Low pressure is required during flight and in standby periods and high pressure in the following circumstances:-

(1) At the initial take-over from ground hydraulic supply.

(2) During fin folding operations.

(3) Upon selection of the store auto-pilot system.

73. The requirement described in sub.para.(1) of the preceding paragraph is of short duration. The timing of the requirement is achieved by a transistorised time delay unit, H.S.A. Part No.1/V10783 giving 8 seconds delay.

Fluid isolation

74. The isolating valve is provided for two functions: in the first instance to ensure that no hydraulic fluid is delivered to the store until pressure has built up; secondly, on the stopping of the unit, to isolate the delivery pressure line from the umbilical coupling and discharge the pressure from the coupling into the return line. The second function is required to assist the easy disengagement of the pull-off couplings as the store leaves the aircraft. The timing of the first function is achieved by the unit referred to in para.73.

Fluid warm up

75. Should the temperature of the hydraulic fluid be below 15°C. at take-over the power unit motor will be overloaded. The fluid is warmed by circulation at low pressure through the aircraft system only, the restriction due to components being sufficient to raise the temperature of the fluid. On starting, the ON push switch should be manually held in, this causes the isolating valve to remain closed and

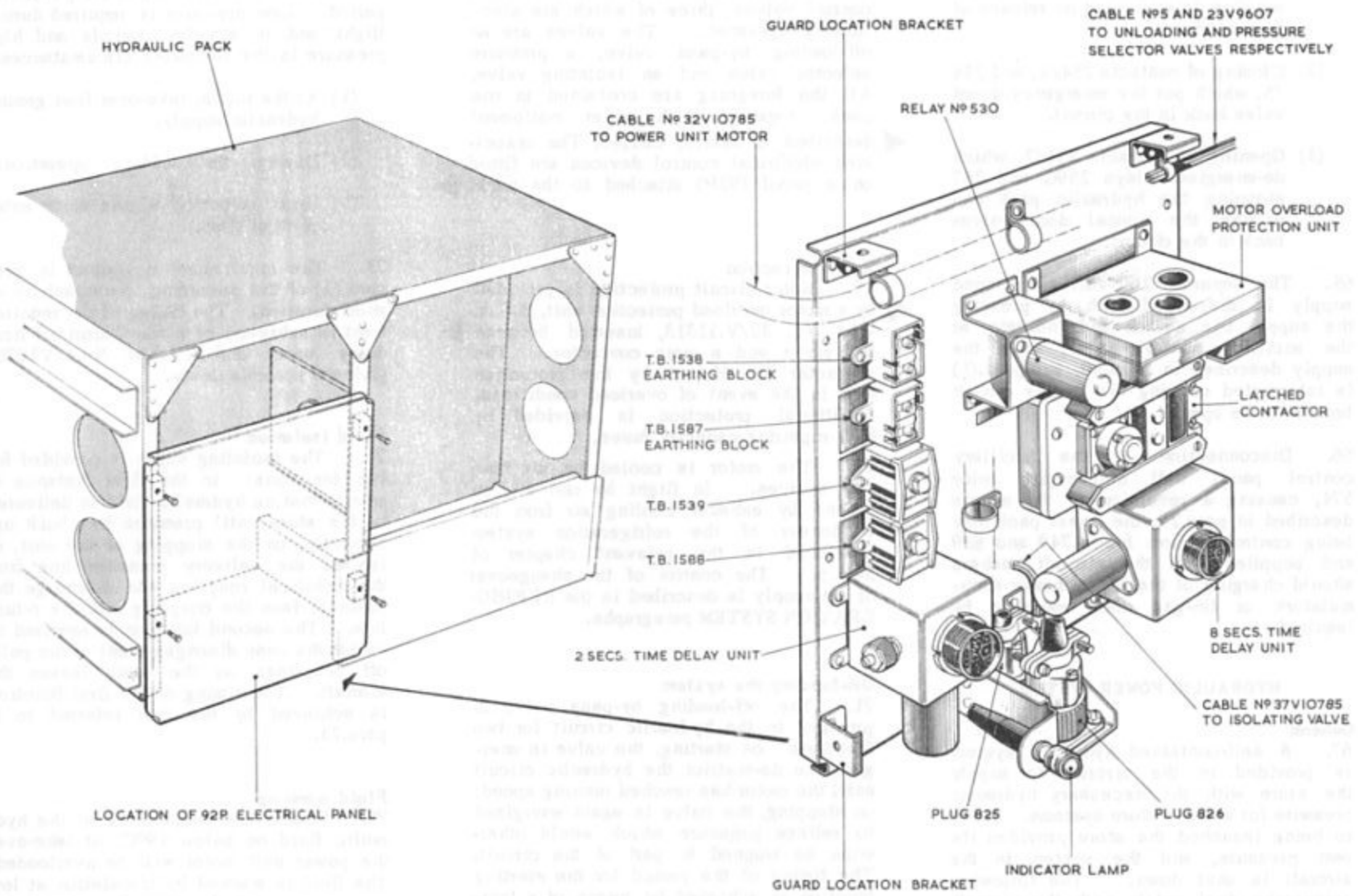

Fig.10 Hydraulic power unit control panel

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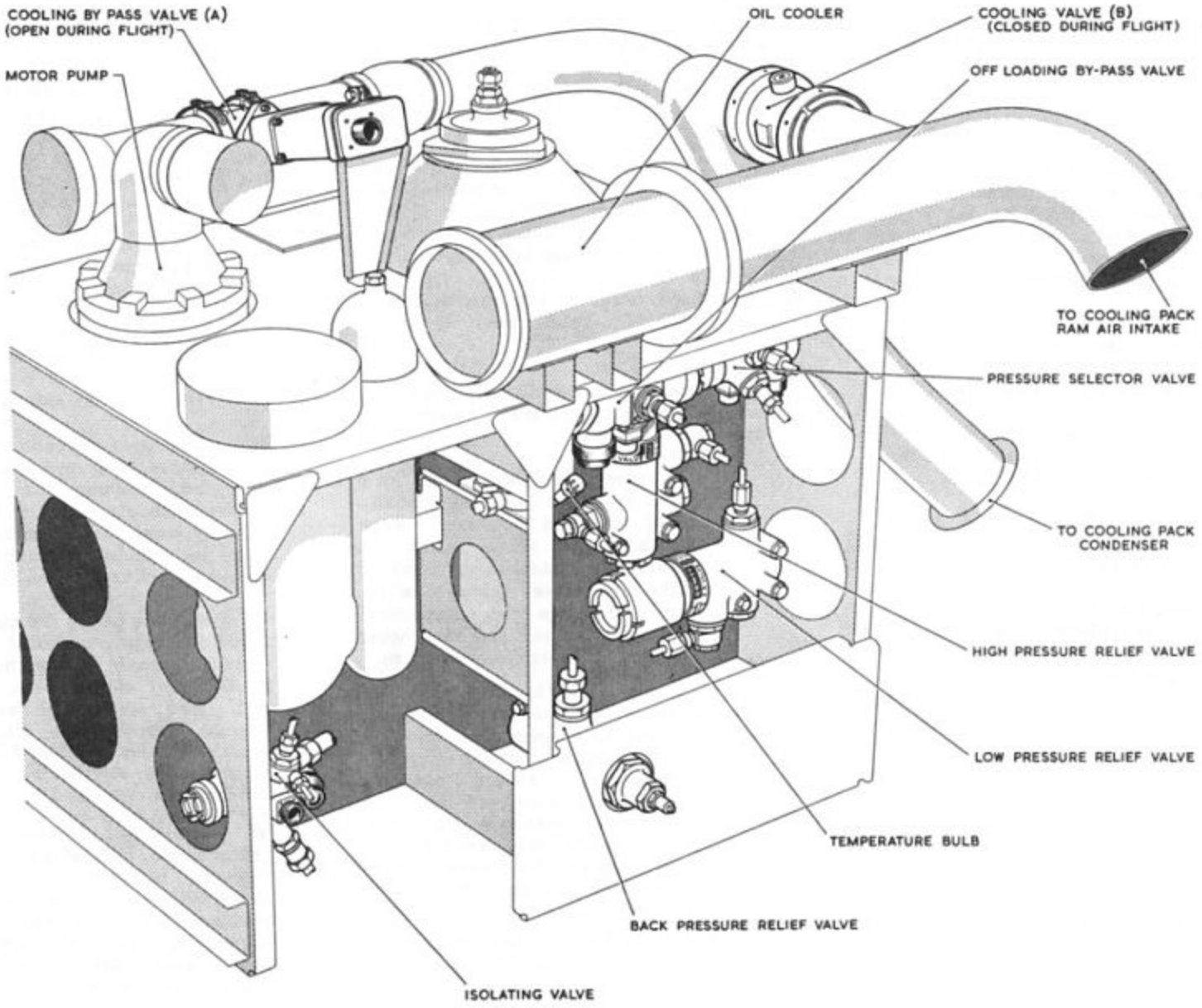

Fig.11 Hydraulic power unit components
(*Minor alterations*)

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low pressure to be selected. When the required temperature is attained, the ON push switch may be released and the system will operate at high pressure until take-over from ground hydraulic supply.

Controls

76. The power unit is started and stopped by means of suitably labelled push switches installed at the A.E.O. station. The unit is also stopped by the sequential operation of the following switches at the navigator plotter's panel 94P:-

(1) A.P.U. start and H.T.P. switch. A 2-position, double-pole, double-throw switch, labelled ON.

(2) Inertia navigator switch. A 2-position, double-pole, double-throw switch, labelled FREE/MIX.

77. Pressure delivery to the store is increased due to the operation of the following switches:-

(1) Autopilot H.T. switch, on the navigator plotter's panel 94P. A 2-position, double-pole switch, labelled ON.

(2) Fin control switch, on the first pilot's port console 5P.

(3) Alighting gear selector switch, on the pilots' centre instrument panel.

Indication

78. One blue warning light gives indication that the power unit is running, and is installed at 92P.

Monitoring

79. Indication of hydraulic pressure obtaining inside the store, and the temperature of the fluid in the system is given by a combined pressure and temperature gauge, Type S216/1/27, installed at the navigator plotter's panel 94P. The associated temperature sensitive bulb is fitted in the pressure line from the hydraulic pump, at the power unit.

Circuit operation

80. The following sequence of operations should be read in conjunction with the theoretical circuit diagram contained in fig.12. The time delay units referred to in para.71 and 73 are basically similar, therefore the full internal circuit is drawn once only. For further details see A.P.4343C, Vol.1, Book 2, Sect.3.

Starting

81. Reference to fig.12 will show that the following hydraulic valves are energised:-

(1) The pressure selector valve, by a supply from fuse 1131, via normally closed contacts 533/1. When energised the valve opens the pressure line to a relief valve which limits the delivery pressure at the store couplings to a nominal 1,650 p.s.i., this pressure being the normal running (low) pressure.

(2) The off-loading by-pass valve, by a supply from fuse 1143, via the 2-second time delay unit (pin J - normally closed contacts - pin A) and normally closed contacts 530/3. When energised the valve connects the pressure and return lines, thus the only restriction is in the lines and the pressure build-up on starting of the power unit is relatively low.

82. Pressing the ON push switch will direct a supply from fuse 1096 to terminal X2 of relay 512, via terminals 1-2 of the push switch. This supply closes the relay (which is mechanically latched in) causing the closing of the contacts, with the following effects:-

(1) The 200-volt a.c. 3-phase supply is directed from fuses 45 to the power unit motor, via the motor overload protection unit. The motor starts and quickly reaches running speed, due to the provision described in sub-para.(2) of the previous paragraph.

(2) A supply is directed from fuse 1143 to pin L of the 2-second time delay unit, via relay 512 terminals 2-1. This supply starts the timing sequence described in para.88.

(3) The start indicator is illuminated and a supply is directed to terminal 4 of the ON push switch, both from the source and path described in the preceding sub paragraph.

83. After two seconds the time delay unit internal relay operating coil will be energised, causing the supply to be removed from pin A. With the consequent de-energising of the unloading by-pass valve the hydraulic circuit will revert to pressure conditions (1,650 p.s.i.).

84. Release of the ON push switch will direct the supply obtained in para.82 (3) across terminals 4-3 of the push to pins L, D and J of the 8-second time delay unit, then across the normally closed internal contacts and out at pin B to energise the coil of relay 533. The timing sequence is started by the supply on pin L and is described in para.88.

85. Operation of relay 533 will open contacts 533/1, breaking the supply to the pressure selector valve. When de-energised, the selector valve closes the pressure line to the relief valve limiting the delivery pressure to 1,650 p.s.i., leaving another relief valve to control the delivery pressure at a nominal 2,200 p.s.i.

86. After eight seconds the time delay unit internal relay operating coil will be energised, causing the following:-

(1) Opening of the contacts referred in para.84 causing the de-energising of relay 533. The consequent closing of contacts 533/1 will energise the pressure selector valve.

(2) Closing of internal contacts, which direct the supply from pin J (see para.84) to pin K, to energise the isolating valve.

By these means the pressure selector valve reverts the system to deliver pressure at 1,650 p.s.i., and the isolating valve opens to commence delivery to the store.

87. The system though selected to 1,650 p.s.i., will now have sufficient latent power above this figure to cope with the transient high flow demand imposed at the instant of change-over to aircraft from ground supply.

Operation of time delay units

88. Reference to fig.12 will show that pins H, N and M are at earth potential, and that pins L and J (and D) are at 28 volts potential when the associated circuits are operated. The supply at pin J (and D) will pass across the normally closed contacts of the internal relay and out at pin A (or B). The 28 volt potential is applied via pin L to one end of the relay coil, and a certain lower potential to the capacitor through the fixed and variable resistors. Initially, little current will flow through the coil and transistor C-E to earth as this path of the transistor is non-conducting due to the small potential difference between transistor E and B. As the capacitor becomes charged this difference in potential will increase, causing the path C-E to become increasingly conductive until, at a time dependent on the value of the variable resistor, there is sufficient current flow to energise the relay coil. Operation of the relay contacts will:-

(1) Provide a full earth for the relay coil via pin H, relay contacts, pin O and pin E, therefore locking in the relay.

(2) Short out the capacitor, discharging it and preparing for a subsequent operation.

(3) Open the circuit between pins J and A (pins D and B).

(4) Close the circuit between pins J and K (pins D and C).

89. The resistor between pin M and the relay coil provides a parallel path for a portion of the coil energising current. This is a current limiting device to protect the transistor. The two diodes between pin M and the resistor bank serve to direct inverse coil - collapse voltages away from the transistor.

Fluid warm up

90. Holding in the ON push switch will delay the events described in para.84 to 87 until the fluid is sufficiently warm. See para.75.

Pressure selection

91. It will be seen, on reference to fig.12, that a supply from fuse 938 is available at the normally open contacts of a relay in the adaptor box monitoring (B.S.). (the adaptor box is described in the STORE CONTROL SYSTEM, SWITCHING AND MONITORING paragraphs). Selection of the autopilot H.T. switch to ON will energise the relay, causing the supply from fuse 938 to pass across the now closed contacts to energise the coil of relay 533 via a diode, which prevents unwanted feed-back from the store. The consequent circuit action and effect is described in para.85.

Stopping during launching preparations

92. Referring to fig.12, selection of the A.P.U. start and H.T.P. switch to ON will provide a supply from fuse 1092 at the FREE position of the inertia navigator switch, via pins 16 and 60 of No.2 butt connector and an internal link in the store. Selection of the inertia navigator switch to FREE will energise the coil of relay 530, operation of the relay will cause the following:-

(1) Closing of contacts 530/2, which direct a supply from fuse 1143 to energise the unloading by-pass valve (it should be noted that the supply across contacts 530/3 was removed in para.83). In the energised condition the valve connects the pressure and return lines, consequently relieving the pressure between the pump and a non-return valve in the pressure line.

(2) Closing of contacts 530/1, which direct a supply from fuse 1143 to terminal X3 of relay 512. This supply lifts the mechanical latch (see para.82), the relay opens, interrupting the 200-volt a.c. supply to the motor and the power unit stops. The opening of contacts 2-1 interrupts the supply to the start indicator, the coils of the 2-second and 8-second time delay units and the isolating valve.

93. The isolating valve, when de-energised, closes the pressure line to the store umbilical coupling and opens the umbilical line to the return line, to discharge the remaining pressure from the store coupling.

Manual stopping

94. Consider the power unit motor to be started and running as described in para. 82 to 87. Referring to fig.12, pressing the OFF push switch will direct a supply from fuse 1096,to terminal X3 of relay 512. This supply lifts the mechanical latch

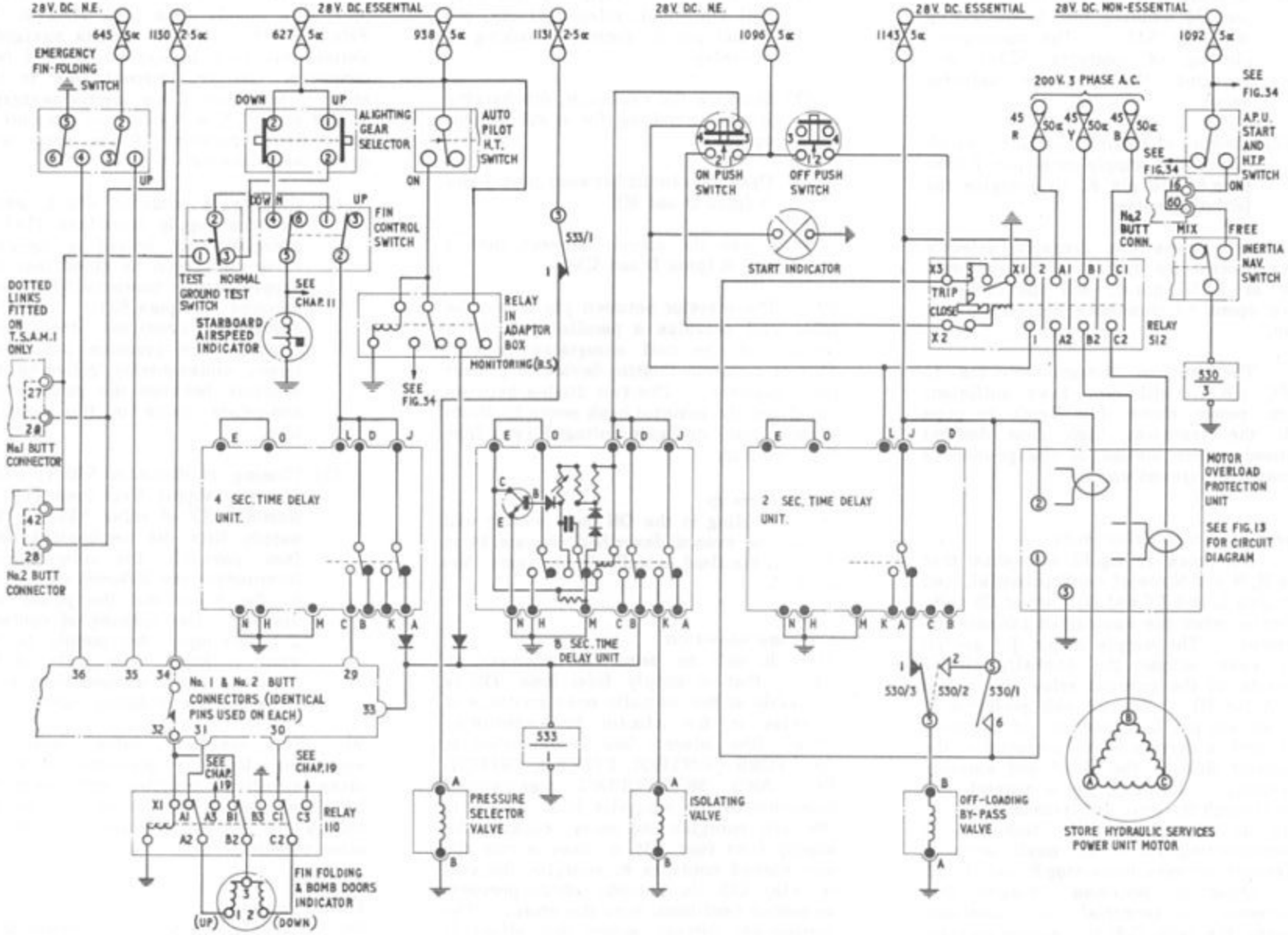

Fig. 12 Hydraulic power and folding fin controls

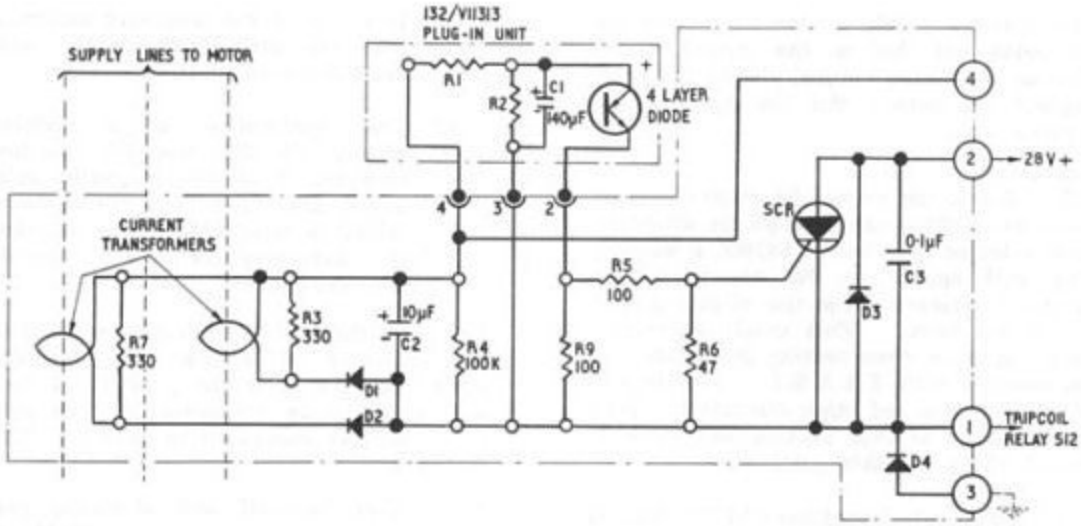

Fig.13. Motor overload protection
(Mod.2102 Incorporated)

(see para.82), the relay opens, interrupting the 200-volt a.c. supply to the motor and the power unit stops. The opening of contacts 2-1 interrupts the supply to the start indicator and the coils of the 2-second and 8-second time delay units.

95. The time delay units revert to the unoperated position, causing the following:-

(1) Energising of the unloading by-pass valve from fuse 1143, via the now closed contacts of the 2-second time delay unit and contacts 530/3.

(2) De-energising of the isolating valve.

By these means the power unit is put to the 'no-pressure' condition and isolated from the store coupling.

Motor overload protection

96. Should the motor be overloaded for any reason, the supply from fuse 1143 standing at terminal 2 of the protection unit will be directed to terminal 1 and thence to terminal X3 of relay 512. This supply has the same effect as described in para.94 and 95. The operation of the unit is described in the succeeding paragraphs in conjunction with fig.13.

97. Referring to fig.13. It will be seen that of the three motor supply lines, two are taken through current transformers and therefore form the primaries of the transformers. Current flowing in the lines will be sensed, transformed and appear as developed potentials across the two 330 ohm resistors R3 and R7.

98. These voltages are rectified, smoothed and applied to a fixed potentiometer formed by R1 and R2. The smoothing is sufficient to ensure that the voltage at the potentiometer will follow the higher of the two voltages induced at R3 and R7. This causes the capacitor C1 to charge at a voltage proportional to the higher of the two currents flowing in the a.c. lines being monitored.

99. The circuit is so arranged that the voltage at C1 will only exceed the breakdown voltage of the 4-layer diode when the motor current is becoming dangerously high.

100. When the 4-layer diode breaks down C1 discharges through it into the resistance network R5, R6 and R9 and triggers the silicon controlled rectifier SCR.

101. The triggering of the SCR completes a path from terminal 2 to terminal 1 and to terminal X3 of the contactor. This will energise the contactor trip coil and open circuit the supply lines to the motor.

102. The unit gives protection against overloads when the motor is running, and unbalance and overload conditions on starting.

FOLDING FIN CONTROL

General

103. The lower fin of the store is folded upwards at all times when the aircraft is on the ground and on approach to land, being extended after take-off and during flight. The mechanism for fin folding is contained within the store, the controls for which are contained in the aircraft.

Outline of system

104. The fin can be folded and extended using the hydraulic pressure supplied by the power unit described in the preceding paragraphs. This system is normally used and concerns this book more than the emergency system which can only be used to fold the fin and provides its own pressure. The complete fin folding system in the store is described in the relevant publication.

105. Considering the normal system; higher pressure than the normal running pressure of the hydraulic power unit is required for folding fin operations. The provision of this high pressure is automatic upon commencement of the particular movement selected and continues until the movement is complete. The duration of the high pressure condition is controlled from the store.

106. An additional short term selection of high pressure is made upon selection of fin down, prior to actual movement of the fin, enabling the power unit to build up sufficient pressure to cope with initial demand. The provision is timed by a transistorised time delay unit, AVRO Part No.25/V.9303, giving 4 seconds delay between fin down selection and fin movement.

Controls

107. Normal and emergency control of the fin is obtained by two switches installed on the first pilot's console 6P, the switches are:-

(1) Normal fin control switch. A 2-position double-pole on/off switch, labelled DOWN-UP.

(2) Emergency fin folding switch. A 2-position double-pole on/off switch, labelled UP.

108. To facilitate testing of the system in conjunction with T.S.A.M.I. a single-pole 2-position switch is mounted outboard of 6P in line with the folding fin control panel. This switch is set below the general level of the switches on 6P, to avoid inadvertent operation. The switch is titled GROUND TEST SWITCH, the positions being labelled TEST and and NORMAL with spring return to the NORMAL position.

109. Interposed in the circuit between the supply fuse and the ground test switch is the existing alighting gear selector. This forms a safety device to prevent the fin being unfolded on the ground, being also an overriding control should the pilot neglect to select the fin up prior to landing.

Indication

110. Should the normal fin control switch be in the DOWN position when the alighting gear selector is selected DOWN, a warning flag will appear at the second pilot's airspeed indicator when the alighting gear is locked down. This condition necessarily applies when testing the system in conjunction with T.S.A.M.I. For details of the indicator and other circuits involved see Chap.11 of this Section and Book 3, Sect.7, Chap.2 of this publication.

111. One Dowty 3-position C5175Y Mk.154 magnetic indicator gives indication of fin up and fin down, and can indicate a failure of the fin to reach either final position. The indicator is situated on the pilots' centre instrument panel 1P, and presents 'UP' with the fin up, 'DOWN' with the fin down and a striped face during fin travel.

112. This indicator occupies a position formerly used by a 2-position magnetic indicator for the bomb doors system. Mod. 748 (Blue Steel fixed fittings) changed the indicator to a Dowty 3-position, Type C5175Y Mk.15 and modified the circuit for either bomb door or fin folding indication. Mod.200 (change of role) introduced the present indicator for use with the fin folding systems only.

Circuit operation

113. The following sequence of operations should be read in conjunction with the theoretical circuit diagram contained in fig.12.

Normal selection

114. The circuit is shown with the aircraft on ground and fin folded and it will be seen that relay 110 is energised from fuse 1130 via pins 34-32 of No.1 and No.2 butting connectors (wired in parallel). Operation of relay 110 causes the following:-

(1) Isolation of the magnetic indicator from the wiring associated with bomb doors indication.

(2) The application of a positive supply to the normally earthed terminal 3 of the magnetic indicator, from fuse 1130 via contacts B1-B2 of relay 110. This prepares the indicator for 'earth' signals from the store.

115. As the fin is folded terminal 1 of the indicator is earthed, via contacts A2-A1 of relay 110 and pins 31 of No.1 and No.2 butting connectors. The indicator will be energised to give the 'UP' indication.

116. After take-off and alighting gear UP selection, a supply is available at terminal 1 of the normal fin control switch, from fuse 627 via terminals 1-2 of the alighting gear selector and terminals 3-2 of the ground test switch. On placing the control switch to the DOWN position this supply is directed to pins L, D and J of the 4-second time delay unit, then across the normally closed internal contacts and out at pin A to energise the coil of relay 533 via a diode, which prevents unwanted feed-back from the store (see para.121). The timing sequence of the delay unit will be started by the supply on pin L, and is described in para.88 and 89.

117. Operation of relay 533 will cause the opening of contacts 533/1, with consequent increase in pressure as described in para.85.

118. After four seconds the time delay unit internal relay operating coil will be energised, causing:-

(1) The supply to be removed from pin A, which temporarily de-energises relay 533.

(2) A supply to be directed from pin D to pin C and thence to pins 29 of No.1 and No.2 butting connectors.

119. The fin now commences to unfold, the earth is removed from pins 31 of the butting connectors and therefore terminal 1 of the magnetic indicator, which, now it is de-energised shows a striped face. A supply (fed from fuse 1130) appears at pins 33 of the butting connectors to energise relay 533, causing a regaining of the high pressure referred to in para.117. as described in para.85.

120. On the fin reaching the fully down position the store circuit causes terminal 2 of the magnetic indicator to be earthed, via contacts C2-C1 of relay 110 and pins 30 of the butting connectors, the indicator is now energised to give the 'DOWN' indication. At the same time the supply is removed from pins 33 of the butting connectors, causing the de-energising of relay 533 with the consequent reversion of the hydraulic power unit to the low pressure condition.

121. On placing the normal fin control switch to the UP position the supply is removed from the time delay unit and thus from pins 29 of the butting connectors. The supply from fuse 1130 re-appears at pins 33 of the butting connectors to energise relay 533 (giving high pressure selection). The fin now commences to fold causing the earth to be removed from terminal 2 of the indicator, which, now it is de-energised shows a striped face. The diode between relay 533 and the 4-second time delay unit pin A prevents the supply from pins 33 of the butting connectors passing across the now closed contacts of the delay unit to pin L of the unit. The time delay unit is therefore protected from unnecessary operation.

122. On reaching the fully folded position, the fin causes an indication as described in para.115.

Overriding selection

123. Assuming the normal fin control switch to be selected to the DOWN position. A DOWN selection of the alighting gear selector will cause the following:-

(1) A removal of the supply from pins 29 of the butting connectors, causing an action identical to that caused by selecting UP at the fin control switch (para.121), followed by indication as described in para.115.

(2) A supply to be directed to the warning flag of the second pilot's airspeed indicator, from fuse 627 via terminals 2-1 of the alighting gear selector and terminals 4-5 of the fin control switch.

124. The warning flag will continue to operate after the alighting gear is locked down and will alert the pilots to check the fin position as shown by the fin folding indicator. Cancellation of the A.S.I. warning is obtained by selecting the normal fin control switch to the UP position.

Emergency selection

125. Referring to fig.12, placing the emergency fin folding switch to the UP position will provide a supply and earth to pins 35 and 36 respectively of No.1 and No.2 butting connectors. As the fin folds due to this provision, (see para.104) indication will be as described in para.115.

Ground test with T.S.A.M.I.

126. As the alighting gear selector will be selected DOWN, no supply can pass via the selector to terminal 1 of the fin control switch. A supply is provided however when the ground test switch is held to TEST: the supply passes from fuse 938 to pins 28 of No.1 and No.2 butting connectors, via links on the T.S.A.M.I. connectors to pin 27 of No.1 and pin 42 of No.2 butting connector, then to terminal 1 of the test switch and across the switch contacts to terminal 1 of the fin control switch. The laid-down test with T.S.A.M.I. can now be carried out.

STORE CONTROL SYSTEM, SWITCHING AND MONITORING

General

127. The store is equipped with a complete flying control system, and the aircraft carries the means of engaging and monitoring the system.

Control and indication

128. Two switches are associated with the control system and are situated on the control and monitoring panel 94P, the switches are:-

(1) AUTOPILOT H.T. switch, a 2-position, double-pole, double-throw switch, labelled ON. Spring-loaded to the off position.

(2) FOREPLANE switch, a 2-position, double-pole, double-throw switch labelled LOCK/UNLOCK.

◀ Seven Dowty 2-position indicators monitor the system, six are Type C5165Y/P Mk.2 and are titled:- FOREPLANE POSITION, AIL.SUM, AIL.DIFF., F.R.C. HOME, YAW DAMPER and AUTOPILOT H.T. The remaining indicator, Type C5165Y/P Mk.1, is titled FOREPLANE LOCK. ▶

Circuit

129. Reference to fig.34 will show the pin numbers involved at No.2 butting connector. It will be seen that the lines from the store to the indicators, except for foreplane lock, pass through the Adapter Box Monitoring (See S.D.4766C, Vol.1, Part 2, Sect.3, Chap.4). The lines from the store for yaw damper, aileron sum, aileron difference and foreplane position carry signals of low amplitude only, amplifiers in the adapter box providing the necessary current to energise the indicators.

Autopilot switching

130. The operating sequence is initiated by the selection and holding of the autopilot H.T. switch to ON, which causes the following:-

(1) Energising of a relay in the adaptor box, which in turn energises relay 533 (see para.91 and 85) to give high pressure conditions at the hydraulic power unit in order to meet increased load conditions in the store.

(2) The provision of a supply to operate a 4-second time delay unit in the adaptor box, fed from fuse 1090.

A delay of four seconds will elapse before the store circuit is energised by the supply from fuse 1090 at pin 23 of No.2 butt connector. During this time the hydraulic system will have attained high pressure conditions.

131. When the store circuit has operated a supply is fed back via pin 97 of No.2 butt connector, to form a hold-in circuit for the relay in the adaptor box and energise the autopilot H.T. indicator. The autopilot H.T. switch should be released as the indicator face changes. The diode in the circuit prevents the indicator being energised before the supply appears at pin 97 of the butt connector.

Foreplane lock

132. If, prior to launching the store, the FOREPLANE POSITION indicator shows a white face, the FOREPLANE LOCK switch can be selected to UNLOCK until the indicator presents a black face (with the centralising of the foreplanes). The switch should then be selected to LOCK.

STORE ALTERNATOR MONITORING

General

133. The output of the store alternator is monitored for voltage and frequency error at the nav./plotter's panel 94P (fig.3). A 3-phase a.c. supply from the alternator is fed to 94P via the Adaptor Box Monitoring (fig.34), where frequency error is sensed.

Monitoring and indication

134. Indication of output voltage is provided by a dial indicator, type S149/2/242 (alternative item S149/2/137), which has an easily readable datum point in the form of a red arrow painted at 115 volts. An amber indicator lamp will light to show correct output frequency, i.e., 400 ± 24 c/s.

Circuit

135. Reference to fig.34 will illustrate the complete circuit, from the indicators to No.1 butting connector.

A.P.U. SWITCHING AND MONITORING

General

136. The A.P.U., which provides hydraulic power within the store and also drives the store alternator, is controlled and monitored from the nav./plotter's panel 94P. The associated circuit routing charts are contained in fig.35, 36 and 37.

Controls

137. Nitrogen to the A.P.U. is controlled by the A.P.U.-NITROGEN switch, a 2-position, double-pole, double-throw switch, labelled ON. The A.P.U. is started and H.T.P. supplied to it by operation of the A.P.U. START & H.T.P. switch, a 2-position, double-pole, double-throw switch, labelled ON.

Indication

138. The position of the A.P.U./H.T.P. cock is given by a 3-position, C.5175Y/P Mk.15, indicator mounted above the A.P.U. START & H.T.P. switch.

Monitoring

139. Indication of the A.P.U./H.T.P. tank temperature is provided by a dial indicator, type S149/1/136. Indication of nitrogen and steam pressure is provided by a two-channel dial indicator, type S216/1/23.

Circuit operation

140. Description is limited to the interlocking arrangements with the SET-TO-LAUNCH and FUEL SYSTEM NITROGEN switches described in the STORE PROPULSION SYSTEM, SWITCHING AND MONITORING paragraphs and reference should be made to fig.14 contained in those paragraphs. Refer to fig.35 for fuses and pins at butt connectors in the remainder of the circuit.

Interlocking

141. Referring to fig.14, it is presumed that a supply is available at the centre terminal of the SET-TO-LAUNCH switch. Placing the A.P.U. NITROGEN switch to ON will provide one path for the supply when the set-to-launch switch is selected to LAUNCH and part of the interlocking circuit in the store will be completed. This action ensures that the A.P.U. system is maintained by the store supply.

STORE PROPULSION SYSTEM, SWITCHING AND MONITORING

General

142. The propulsion motor fuel system is controlled and monitored from panel 94P. The circuits are mainly simple and only one small theoretical diagram is provided, fig.14.

Controls

143. The fuel system is controlled by two switches, a third switch (3) is associated with (2). The switches are:-

(1) H.T.P. and K. VENTS switch, a 2-position, double-pole, double-throw switch, labelled ON.

(2) FUEL SYSTEM NITROGEN switch a 2-position, double-pole, double-throw switch labelled ON.

(3) SET-TO-LAUNCH switch,a double-pole, double-throw, switch, with

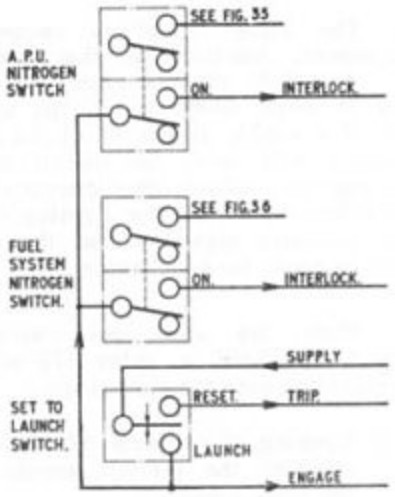

Fig.14 Set-to-launch interlock

spring return to the centre off position, labelled LAUNCH/RESET.

Indication

144. The positions of the valves associated with the switches described in (1) and (2) of the preceding paragraph are indicated by Dowty 3-position, C5175Y/P MK.15, magnetic indicators mounted immediately above the switches. Set to launch indication is given by a 2-position magnetic indicator C5165Y/P MK.2, which shows a BLACK face when energised and a WHITE face when de-energised.

Nitrogen monitoring

145. Indication of the value of high pressure nitrogen available for the propulsion system and starter system, is provided by a two-channel dial indicator, type S.216/1/20.

Oxidant monitoring

146. Indication of the temperature of the H.T.P. tanks is provided by three dial indicators which are:-

(1) A single-channel, type S149/1/133, indicator giving the temperature at the top of the forward tank.

(2) A single-channel, type S149/1/134, indicator giving the temperature at the top of the aft tank.

(3) A two-channel, type S.216/1/21, indicator giving the temperature at the bottom of the forward and aft tanks.

Circuit operation

147. The monitoring circuits in particular are completely "straight-line", the complete circuit can be readily understood by reference to fig.37. Description of part of the fuel system is contained in the following paragraphs, the portion not described can be readily understood by reference to fig.36.

Nitrogen valves indication

148. Nitrogen OFF is indicated by the presentation of a WHITE face by a 3-position magnetic indicator (para.144). Reference to fig.36 will show that the indicator is energised to present this face by a supply at terminal 2, obtained from pin 114 of No.1 butting connector. The energising of the indicator by means of terminal 1 to present a BLACK face for ON requires three supplies, thus:-

(1) A supply from pin 19 of No.1 butting connector to energise relay 531.

(2) A supply from pin 18 of No.1 butting connector to pass across the now closed contacts of relay 531 to energise relay 532.

(3) A supply from pin 115 of No.1 butting connector to pass across the now closed contacts of relay 532 to energise the indicator.

Interlocking

149. Referring to fig.14, it is presumed that a supply is available at the centre terminal of the set-to-launch switch. Placing the FUEL SYSTEM NITROGEN switch to ON will provide one path for this supply when the set-to-launch switch is selected to LAUNCH, and part of the interlocking circuit in the store will be completed. This action ensures that the store propulsion system is maintained by the store supply. Selection to RESET at the set-to-launch switch will put this system and A.P.U. system (see para.141) under the control of the aircraft supply.

AIRCRAFT STARTING OF E.P.C.U.

General

150. The E.P.C.U., which controls the store alternator output, is started from the A.E.O's station (fig.2). When the E.P.C.U. is started and functioning correctly, a maintaining circuit within the store is held isolated by a relay (580) energised from the aircraft supply.

Control and indication

151. One double-pole, spring loaded to off, push switch, Ref.No.5CW/5057, is wired as a single-pole push switch to start the E.P.C.U. Indication that the complete circuit is ready for operation is given by a warning lamp, Page Type C500/C/8, with press-to-test facility. On pressing the head of the lampholder, the lamp will light, if serviceable. The lamp is titled HOME INDICATOR and situated adjacent to the push switch.

Circuit operation

152. The following sequence of operations should be read in conjunction with the theoretical circuit diagram, fig.15, where all relay contacts are shown in the de-energised condition.

153. Referring to fig.15, it will be seen

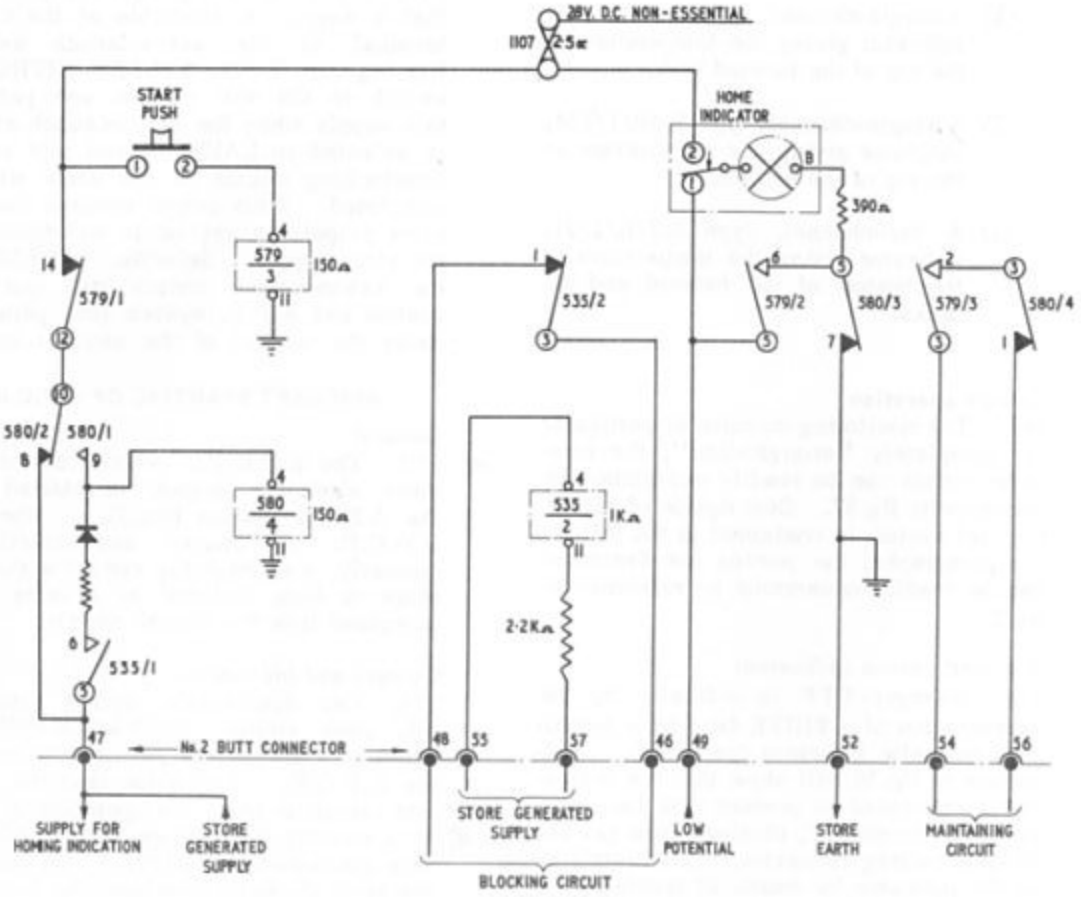

Fig. 15 E.P.C.U. starting

that fuse 1107 supplies the home indicator press-to-test circuit, the start push-switch, and pin 47 of No.2 butt connector via normally closed contacts 579/1 and 580/2. The supply at pin 47 passes through the store circuit to appear as a lower potential at pin 49 to light the home indicator, which is earthed via a 390 ohm resistor and normally closed contacts 580/3. The filament, Ref.No.5L/9959118, glows dimly with the circuit operating correctly. The resistor is incorporated to protect the filament against overvolt conditions, in which case the filament will give a full light.

154. The store circuit, a sequencing arrangement, functions so that irrespective of which position the sequence stops at when de-energised, the application of a supply at pin 47 of No.2 butt connector will drive the circuit to the home position without other circuit effect. At the home position the lighting of the home indicator signifies that the whole circuit is ready for sequencing.

155. When the start push-switch is pressed, and held in, relay 579 will be energised to cause the following:-

(1) Opening of contacts 579/1, which isolates the aircraft supply from the store supply.

(2) Closing of contacts 579/2, which shorts out the home indicator and earths pin 49 of No.2 butt connector via normally closed contacts 580/3.

(3) Closing of contacts 579/3, which completes a circuit across pins 54 and 56 of the butt connector, via normally closed contacts 580/4 to maintain the sequence.

156. After a short period a high potential store generated supply will appear at pins 55 and 57 of the butt connector to energise relay 535 and cause the following:-

(1) Opening of contacts 535/2, which removes a blocking circuit.

(2) Closing of contacts 535/1, which energises relay 580 via the 47 ohm resistor and diode from a store generated supply now at pin 47 of the butt connector.

157. The energising of relay 580 will cause the following:-

(1) Opening of contacts 580/2 to further isolate the aircraft supply, and closing of contacts 580/1 to connect the coil of relay 580 to contacts 579/1.

(2) Opening of contacts 580/3, which isolates the home indicator completely from earth.

(3) Opening of contacts 580/4, which completely isolates the maintaining circuit now not required. The starting sequence is now completed.

158. When the start push-switch is released, relay 579 will be de-energised and its contacts will revert to the positions shown. Relay 535 will remain energised from the store supply, and relay 580 will be held energised from the aircraft supply via contacts 579/1 and 580/1.

Starting drill

159. The correct operations should be:-

(1) Observe that the home indicator is lit.

(2) Ascertain that the hydraulic supply in the store is correct. (Monitored at the Nav/plotters panel).

(3) Press and hold the start push-switch for a minimum period of 2 seconds.

(4) Observe there is no indication at the home indicator on release of the start push-switch.

(5) Observe the store generated supply indicated at the Nav/plotters panel is correct (para.134).

WARNING . . .
In case of hydraulic failure or shut-down of the hydraulic power unit, the following operation must be carried out prior to re-establishing the hydraulic supply:-

Press and release the E.P.C.U. start button and check that the home indicator lights.

Hydraulic power can now be restored.

H.T.P. TANKS TEMPERATURE WARNING

General

160. The presence of high temperature conditions at the H.T.P. tanks in the store is indicated by a single, suitably labelled, red warning light installed on the first pilot's instrument panel 1P.

Circuit

161. The outputs of three store-contained warning systems, forward tank, aft tank and A.P.U. tank, converge to illuminate the warning light. The independent output of each system is also sufficient to illuminate the warning light. The fuses for the three systems are located in 85P.

162. The complete aircraft circuit will be readily understood by referring to fig.39. The warning light has press-to-test facility, where, on pressing the head of the lampholder the lamp will be lit, if serviceable, by a supply from fuse 620.

STORE FIRE DETECTION SYSTEM

General

163. Information of the presence of fire in the store is gathered by means of tubular temperature sensitive elements installed in the store, the information is translated by two relay control units and presented to the first pilot in the form of two red warning lights, see fig.2. The two systems are completely independent of each other, one being a duplicate of the other.

Sensitive elements

164. The Graviner 'firewire' system is used. The firewires consist of a stainless steel tube forming one conducting path, a centrally disposed co-axial conductor, and a filling medium separating the two. The filling medium has the property of high electrical resistance at low temperature and low resistance at high temperature.

Control units, Type 162D

165. A change in the impedance of the of the firewire elements due to fire or overheating causes the control units to operate and illuminate the fire warning indicators. The component circuits of the unit consist of a transformer, an SCR network and two relays. The units are installed in panel 85P, as illustrated in fig.1.

Warning lights

166. The lampholders have integral press-to-test facility, this is essentially a single pole switch, which, when the head of the lampholder is pressed directs a supply to operate one relay in the control unit. Should the complete circuit be correct, the warning light is illuminated by a supply from the control unit.

Circuit operation

167. The following sequence of operations should be read in conjunction with the theoretical circuit diagram, fig.16. As the two systems are essentially the same, apart from differing fuses, one complete circuit only is drawn and described.

Normal condition

168. Referring to fig.16, it will be seen that the transformer primary is energised from fuse 1146-B and earth. Normal conditions exist when the temperature of the fire zone is below that required for a warning signal and the impedance value of the sensing element is consequently high.

169. With the system at normal, negligible current will flow in the sensing and signal circuits and the SCR will be biased off, the bias potential at the gate being due

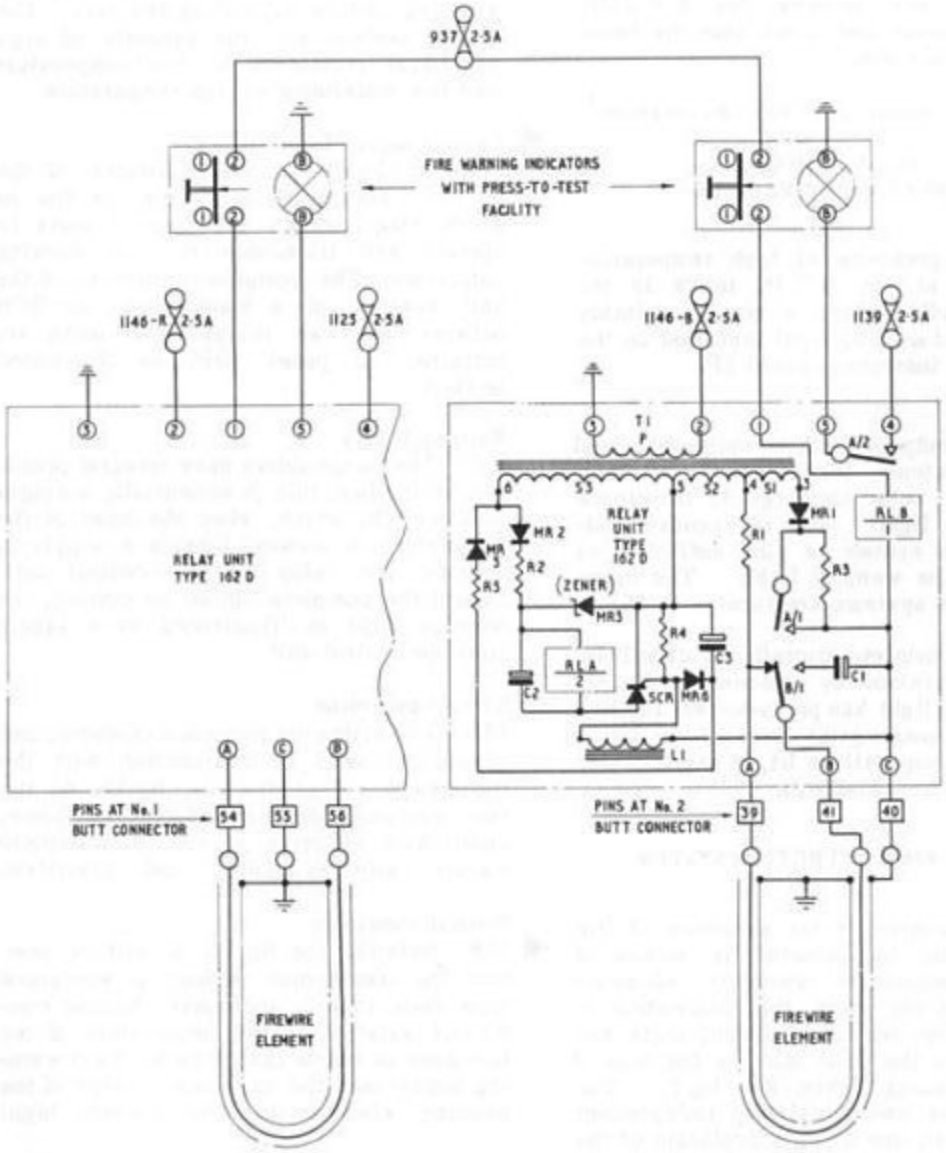

Fig.16. Fire detection system
(B.Comm. Mod. Vulcan/083B.C. incorporated)

to the potential drop across resistor R4.

170. The capacitor C3 maintains the potential drop across resistor R4 when it discharges, each second half of the cycle. As the SCR is maintained in a non-conductive state, relay RLA remains de-energised.

Operated condition

171. When the temperature in the fire zone increases, the impedance value of the sensing element will change. At a pre-determined level the SCR will conduct due to a rise in the potential at the gate, current will flow and relay RLA will be energised. The contacts of the relay close, RLA/1 to short circuit R3 thereby increasing the flow of current in the sense circuit, and RLA/2 to complete the circuit to the warning lamp, via fuse 1139.

Circuit test

172. Presuming the normal condition to apply. By pressing the head of the warning indicator a supply from fuse 937 will energise relay RLB, the earth return being via the sensing element capillary. Contacts RLB/1 close to connect the capacitor C1 in series with the central electrode of the sensing element. As the control unit is operative and monitoring the impedance of the sensing element, the capacitor will assist in raising the potential at the gate of the SCR, which will conduct, and relay RLA will be energised.

173. A warning indication will be given, as described in para.171. Releasing the warning indicator head will remove the supply to relay RLB and contacts RLB/1 will open the circuit to the capacitor C1. This will lower the potential at the gate of the SCR which will then return to the non-conductive state, relay RLA will be de-energised and the warning signal cancelled. It will be seen that the complete system including the firewire is tested.

STORE, AND STORE HEATING SYSTEM TEMPERATURE INDICATION

General

174. Two indicators, type S.63/4/1146, give indication of temperature conditions within the store. Another indicator, type S.63/4/1147, gives indication of the temperature of the air being delivered to the store. The temperatures are essentially connected with the store heating system described in the succeeding paragraphs. The three indicators are all calibrated from -20°C to +80°C, the only difference between them being a white band painted on the scale showing the operating temperature range.

175. The operating ranges of the indicators are as follows:-

(1) The Exchanger outlet (delivery) temperature range from 45° to 55°C.

(2) The Store bay temperature range from 0° to 10°C.

(3) The Store engine temperature range from 0° to 10°C.

176. The indicators are installed with the store heating controls (temperature selectors) at the navigator/bomber's station see fig.2. The temperature bulb (type S110G) for the heat exchanger outlet (delivery temperature) indicator is located between bomb arches 201.367A and 225.227A in the bomb bay roof. The temperature bulbs for store temperature are located within the store.

Circuit

177. No theoretical circuit diagram is included, the circuit can readily be understood by reference to fig.41. The operating principle of the indicators is described in A.P.1275A, Vol.1, Sect.17, Chap.11. Details of the temperature bulbs are given in Chap.18 of the same publication together with a theoretical presentation of the complete thermometer system.

STORE HEATING SYSTEM

General

178. The system is designed to maintain temperature within the store between selected limits. Existing components of the bomb bay heating system are utilised, together with the components introduced on change of role. The new components affecting this chapter are an air-to-air heat exchanger, a shut-off valve, ducting and pull-off connector to the store, and a follow up resistor at the existing cold air valve. Contained in the ducting between the heat exchanger and the store, are two ductstats (temperature sensitive elements) and the temperature bulb referred to in para.176.

Outline of system

179. Hot air is bled from the engine compressors and passed to the heat exchanger via the shut-off valve and the existing hot air control valve, where it is cooled by a flow of ram air from the intake in the fin via the existing cold air valve. After passing through the heat exchanger, the warm air is delivered directly to the store by the pull-off connector. Exhaust ram air from the heat exchanger passes to the existing bomb bay heating ducts, giving a secondary warming effect.

180. Once the system is initiated by the master switch, the temperature of the air supplied to the store is automatically controlled, subject to the mandatory requirements set by manual temperature selectors at the Nav./bomber's station. Should a condition occur where the air delivered to the store is too hot, the shut-off valve is brought into operation to close the hot air ducting upstream of the hot air control valve. As the store leaves the aircraft, the hot air supply is stopped due to the operation of the store heating micro switch, triggered by the parting of the store and the aircraft, which closes the hot air control valve.

Electrical controls

181. The hot and cold air flow to the heat exchanger is regulated by the actuators which operate the control valves already referred to. The actuators are in turn controlled by the action of temperature-sensitive bridge networks on magnetic amplifiers to increase or decrease the mass flow of hot or cold air as demanded by temperate conditions. Two separate networks are employed, one for the control of each air supply source.

Temperature sensitive networks

182. The networks, which decide the operation of the magnetic amplifiers, are distributed at the salient points in the system, and form a theoretical wheatstone bridge. One arm of the bridge is contained within the magnetic amplifier (and can be considered as a standard reference) whilst its opposite is composed of the temperature selector and the control actuator-operated follow-up resistor connected in series. The two other arms of the bridge consist of the ductstats, which are temperature-sensitive elements (nickel resistors).

Components

183. For control of hot air, the components are:-

Shut-off valve and actuator FKH/A/5063

Control valve and actuator FKH/A/5063, operating the follow-up resistor FLJ/A/4.

Ductstats (2), inside the store

Flamestat, inside the store

Magnetic amplifier, FLM/A/14

Temperature selector, FHK/A/45 labelled STORE BAY SELECTOR, range -30°C to +23°C

Locations for the majority of the above components are given in fig.2 and 17, the magnetic amplifier is mounted adjacent to 85P.

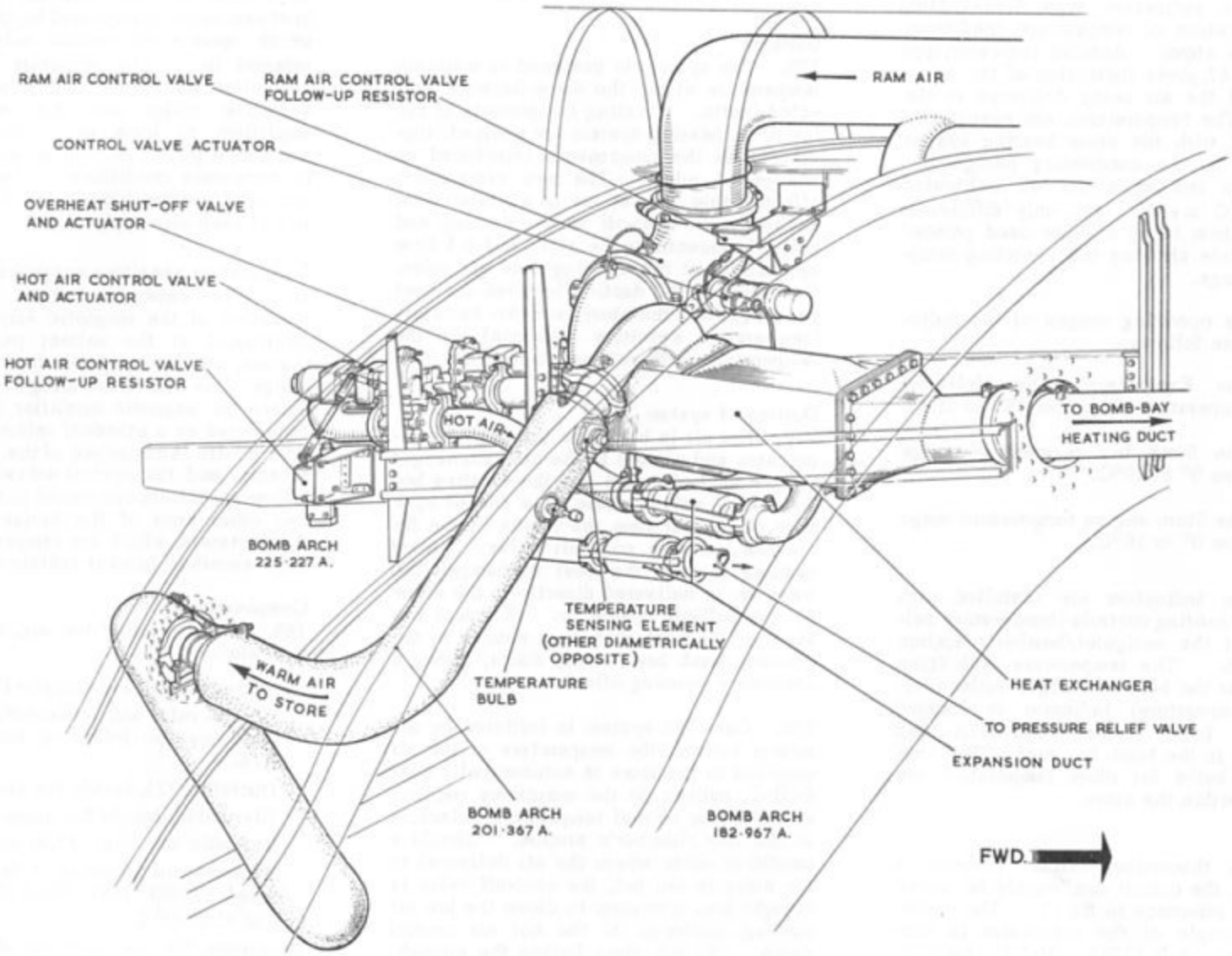

Fig.17 Store heating components

(◂ *Mods 1318 and 1319* ▸)

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184. For control of cold air the components are:-

Ram air control valve actuator C5520, also operating the follow-up resistor FLJ/A/12

Ductstats (2) FHG/A/35

Magnetic amplifier FLM/A/14

Temperature selector, FHK/A/46, labelled STORE EXCHANGE OUTLET range 30° to 60°C

Locations of the majority of the above components are given in fig.2 and 17, the magnetic amplifier is mounted adjacent to 85P

Manual controls

185. The two systems are switched on by means of the store heating control master switch at the Nav/bomber's station, a double-pole, two-position switch labelled ON. The hot air control system is brought back into operation after overheat conditions by means of a single-pole, normally "made" switch, labelled RESET. Installed above the two switches are the temperature selectors referred to in para. 183 and 184.

Circuit operation

186. The circuit is fed by four fuses:-

(1) Fuse 1057, supplying the reset switch

(2) Fuse 1098, supplying the master switch

(3) Fuse 1128, supplying the overheat shut-off valve

(4) Fuse 1129, supplying relay 538 via butt connector and flamestat

The following sequence of operations should be read in conjunction with the theoretical diagram fig.18, where the wheatstone bridges referred to in para.182, are presented in normal form, but with the component parts withdrawn for clarity.

Hot air control

187. Referring to fig.18, the circuit is shown with the master switch off, and it will be seen that:-

(1) Fuse 1128 maintains the overheat shut-off valve in a normally open position via normally closed contacts 538/2.

(2) A supply will pass from fuse 1098 across contacts 2-1 of the master switch to pin C of the hot air control valve, holding the valve in the closed position.

(3) Fuse 1057 supplies terminal 9 of relay 538, via the RESET switch, in readiness for overheat conditions.

The circuit is drawn with the valves operated and the internal limit switches in the actuator-operated position.

188. On placing the master switch to ON, contacts 2-1 are opened and the supply is removed from pin C of the control valve. At the same time contacts 5-6 close and a supply from fuse 1098 is directed to the following points:-

(1) Pin A of the 12-pin plug at the magnetic amplifier; supplying the wheatstone bridge (pins A and G are internally linked), the normally open contacts of the control relays, and the bias windings of the transductors, via normally closed contacts 529/2.

(2) Terminal 9 of relay 529 in readiness for shut down on release of the store.

(3) Contact 2 of the store heating micro switch, in readiness for shut down on release of the store.

At the same time, relay 534 is energised via contacts 2-3 of the master switch, closing contacts 534/1 and 534/2. This action connects the a.c. supply to the primary winding of the transformer in the magnetic amplifier. The output of the transformer is a nominal 14.5 volts.

Operation of amplifier

189. Referring to fig.18. The control windings of the two transductors are connected in series across the bridge output, and any changes in current flowing through them will amplify the value of the transductor circulating currents.

190. The circulating currents flow unidirectionally through the operating coils of relays R1 and R2 via the full-wave bridge-connected rectifiers, ensuring positive action. Inserted in the d.c. portion of the circuits is a resistor and the voltage appearing across this resistor energises the transductor feed-back winding which is so connected as to increase the gain and sensitivity. Series - connected bias windings, fed from the d.c. source, quench the circulating current when there is no current flow through the control windings.

191. When the temperature being controlled is at its selected level, the resistance values of the four segments of the control bridge are equal, therefore no current will flow through the control windings. The circulating currents will consequently be quenched, and relays R1 and R2 will be in the unoperated positions shown. Should the controlled temperature vary either up or down from the selected level, the resultant change in sensing element resistance will un-balance the control bridge, causing current to flow through the control windings. The control windings are so connected that the circulating current of one transductor will rise and the other be further quenched. When the circulating current of the selected transductor rises to a nominal 50 mA the associated relay will be operated.

192. Taking the operation of relay R1 (which is in answer to a demand for increase in temperature) the supply made available in sub-para 188 (1) now passes from pin A across the now closed contacts

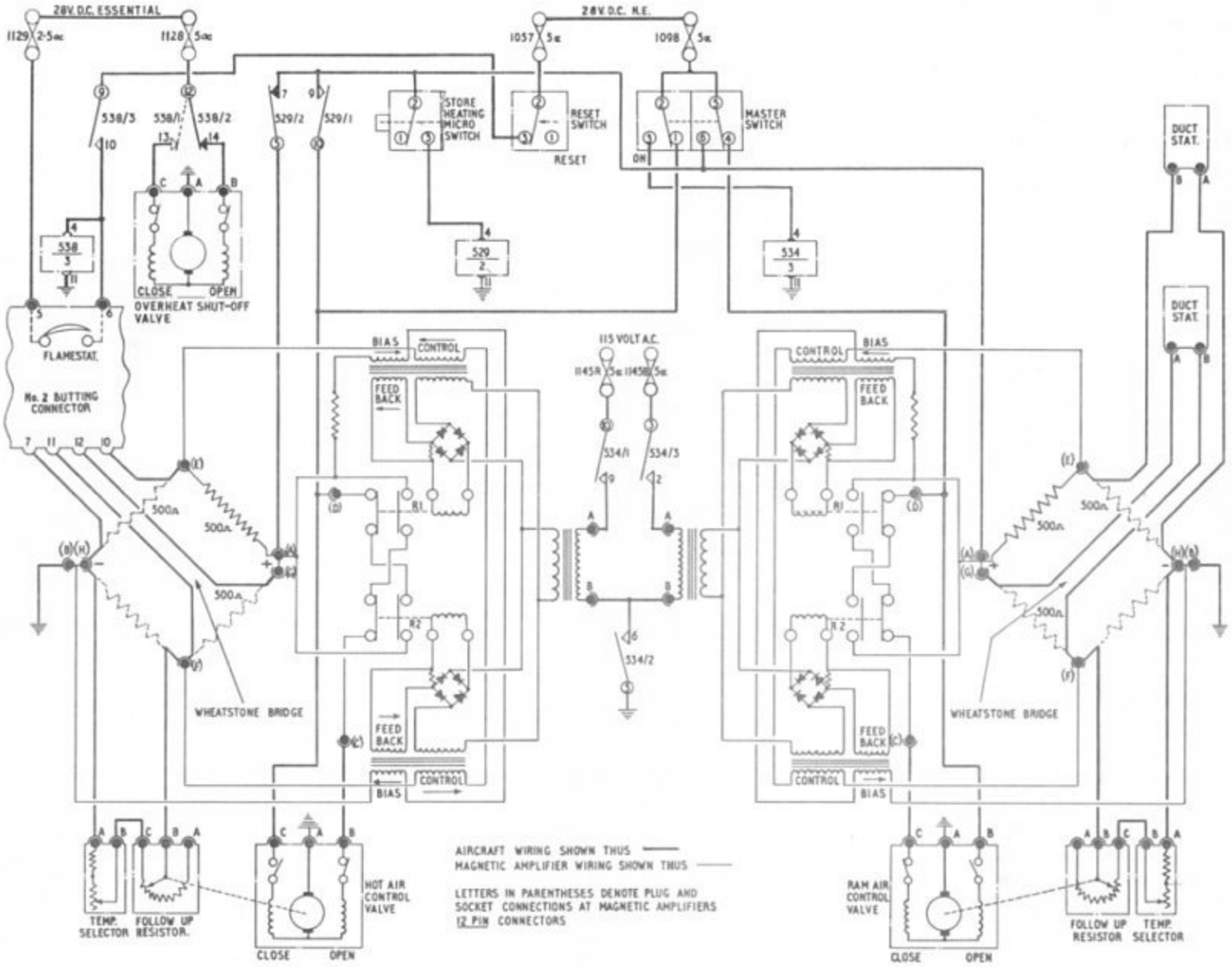

Fig. 18 Heating system control

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of relay R1 and across the normally closed contacts of relay R2 to appear at pin C. This supply operates the hot air control valve in the open direction by means of control valve pin B, causing the mass flow of hot air through the heat exchanger to increase. The consequent increase in temperature within the store alters the resistance of the sensing elements, and when the control bridge returns to a balanced state the amplifier will return to a quiescent condition, causing the control valve to halt.

193. In answer to a demand for decrease in temperature, relay R2, will be operated, the hot air control valve will be moved in the close direction and the hot air mass flow will decrease. The interconnection of the relay contacts prevents the possibility of the amplifier attempting to energise both the open and closed fields of the control valve at the same time, should a condition arise whereby both relays are energised simultaneously.

Temperature selection

194. The temperature selector consists of a fixed resistor making up the greater percentage of the full value, and a variable resistor swept by means of the control knob, which at its own maximum value makes up the full value. The follow-up resistor, operated by the control valve, is of the same maximum value as the variable portion of the temperature selector. The two components are connected in series into the wheatstone bridge as shown in fig.18.

195. Taking a hypothetical value of 5 for each variable, the total in series will be 10. Consider the wheatstone bridge to be balanced with both values at 5 and the selector then to be set to 3. The bridge will become unbalanced, the amplifier will sense the change and the control valve will be moved to a new position, altering the value of the follow-up resistor. As the follow-up resistor attains a value of 7 the bridge will again be balanced, control valve movement will stop, and temperature control will be on a different level.

Overheat control

196. Referring to fig.18, and presuming that the hot air control by the foregoing system has been lost, leaving the hot air control valve in the open position. In this condition the flamestat within the store will close, causing a supply from fuse 1129 to energise relay 538 via pin 6 of No.2 butting connector. The energising of relay 538 will cause:-

(1) The opening of contacts 538/2 isolating the OPEN field of the shut-off valve.

(2) The closing of contacts 538/1 energising the CLOSE field of the shut-off valve.

(3) The closing of contacts 538/3 to form a hold in circuit via the spring biased to on RESET switch, using the supply from fuse 1057.

197. The system will remain shut down until the RESET switch is placed momentarily to RESET, when, if the flamestat is open and the hot air system is again serviceable, the interruption of relay 538 hold in circuit will de-energise the relay and cause the contacts referred to in para.196 to revert to the original positions, opening the overheat shut-off valve and allowing the control valve to control the supply of hot air.

Shut down

198. On release of the store, a supply standing at contact 2 of the store heating micro switch (sub.para. (3) of para.188) passes across the now closed contacts 2-3 to energise relay 529 and causes the following:-

(1) Contacts 529/2 to open, isolating the temperature control portion of the hot air circuit.

(2) Contacts 529/1 to close, directing a supply to pin C of the hot air control valve and so close the valve.

Ram air control

199. Referring to fig.18, the circuit is shown with the master switch off, and it will be seen that a supply will pass from fuse 1098 across contacts 5-4 of the master switch to the pin B of the ram air control valve, this supply operates the valve to open. The circuit is drawn with the valve open and the internal limit switches in the actuator-open position.

200. The ram air valve is left open with the system closed down to provide initial cold air when the system is switched on, thus preventing a blast of hot air reaching the store.

201. By placing the master switch to ON, contacts 5-4 are opened and the supply is removed from pin B of the control valve. At the same time contacts 5-6 close and a supply is directed to pin A of the 12 pin plug at the magnetic amplifier, supplying the wheatstone bridge (pins A and G internally linked), the normally open contacts of the control relays, and the windings of the transductors. At the same time relay 534 is energised via contacts 2-3 of the master switch, causing the closing of contacts 534/2 and 534/3. This action connects the a.c. supply to the primary winding of the transformer in the magnetic amplifier, which functions in exactly the same manner as described in previous paragraphs.

202. Taking the operation of relay R1 (which is in answer to a demand for increase in temperature), the supply made available in para.201 now passes from pin A across the now closed contacts of relay R1 and across the normally closed

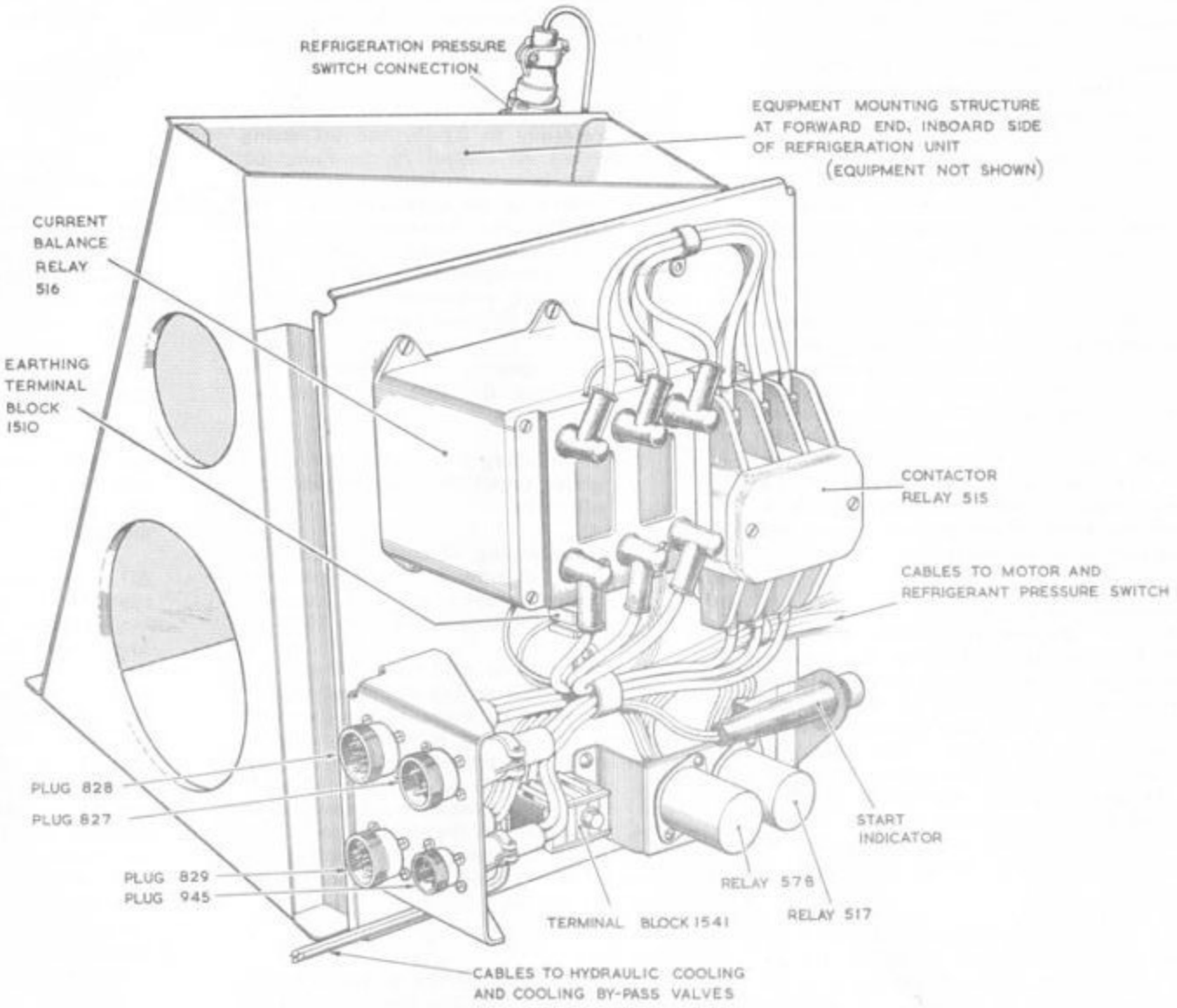

Fig. 19 Refrigeration system components

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contacts of relay R2 to pin C. This supply operates the ram air control valve to close, via pin C of the valve, causing the mass flow of cold air through the heat exchanger to decrease.

203. The consequent increase in the heat exchanger outlet duct temperature alters the resistance of the sensing elements, and when the control bridge returns to a balanced state, the amplifier will return to a quiescent condition. In response to a demand for decrease in temperature, relay R2 will be operated to open the ram air valve and increase the cold air mass flow.

REFRIGERATION SYSTEM

General

204. The refrigeration pack, installed at the starboard side of the bomb bay near the front spar, is provided for the cooling of components within the store while the store is attached to the aircraft. Prior to release, a valve in the store is opened to continue refrigeration after release. The action to open the valve also automatically closes the aircraft system down. Electrical controls for the pack are contained in a panel attached to the pack. The panel, 93P, is shown in fig.19.

Outline of the system

205. Refrigeration is achieved by a vapour cycle circuit operating in conjunction with a cooling air system. Heat is extracted from the refrigerant by means of compression and subsequent cooling of the compressed vapour. High pressure air, fed from the main engine compressors, is cooled by acceleration and ram air to absorb heat from the compressed vapour by its passage through a condenser.

Hydraulic power unit cooling

206. Cooling for the hydraulic power unit is controlled by the refrigeration circuit. During ground running of the refrigeration and hydraulic power systems, the high pressure air, after passing through the refrigerant condenser (para.205), is ducted via a cooling valve (B) to cool the power unit motor and oil cooler before exhausting into the bomb bay. The air pressure closes a non-return valve to prevent exhaustion into the refrigeration pack ram air intake. During flight, due to the opening of an airspeed switch, the cooling valve (B) is closed and a cooling by-pass valve (A) is opened. The high pressure air now exhausts direct into the bomb bay via the by-pass valve (A), and ram air, tapped from the refrigeration pack ram air intake, now passes via the non-return valve to cool the power unit motor and oil cooler. The two valves (A) and (B), electrically-actuated 2-position, Type FMP/A/122, are shown in fig.11.

Airspeed switch

207. The airspeed switch, Type TP5872, which controls the operation of the valves, is connected to the starboard pitot-static system in tandem with the bomb fuzing switch (para.233), and is located on the starboard side of the bomb bay. The switch opens on a rising speed of 150 knots; further details will be found in A.P.1275A, Vol.1, Sect.24.

Refrigerant compressor drive

208. The horizontally-opposed twin-cylinder reciprocating compressor is driven through a gear-box by a 200-volt, 3-phase motor, Type AE1134, developing approximately 2 H.P. The motor is cooled by ram air, assisted by an integral fan.

Motor protection

209. Apart from the normal fuse protection, the motor is protected by a current-balance relay (516) connected between the main contactor (relay 515) and the motor. Full details of the current-balance relay, Type F4909/1, will be found in A.P.4343C, Vol.1, Book 4.

Pressure switch

210. A pressure switch, Type FRJ/A/18, is fitted in the hot compressed vapour line between the compressor and condenser behind 93P (fig.19). The switch protects the system against high pressure, and operates at 240 p.s.i. Should the pressure reach this level, the switch will open, causing the supply to the motor to be cut off thus stopping the pack.

High pressure air valve

211. This valve is fitted in the engine charge air ducting in the bomb bay roof between bomb arches 151.919A and 172.942A. The valve is electrically operated by an actuator to open when the refrigeration pack is started, and to close when the pack is stopped.

Refrigeration pack heater muffs

212. Three 28-volt heater muffs, controlled by a switch on the navigator's panel at the A.E.O's station, ensure favourable local vapour conditions for the safe starting of the pack. Two of the muffs, H.S.A. Part No. 75c/Z9954 and 75b/Z9954, are fitted around the compressor. The remaining muff, H.S.A. Part No. 10/Z11162, is fitted around the liquid trap. The muffs are automatically cut off when the pack is started.

Controls and indication

213. The pack is controlled by two push-switches, labelled START and STOP respectively, at the A.E.O.'s station (fig.2). The start switch, Page Type C180/A/5, embodies an indicator lamp (amber) which is normally lit when the aircraft supplies are switched on, and remains out when the pack is started and running. A remote indicator lamp, installed on 93P for servicing purposes, is lit only when the pack is running, as opposed to the start switch indicator. The pack is also controlled from a refrigeration switch, which is double-pole, 3-position, spring-loaded to centre-off, labelled STORE - A/C (aircraft) on the nav/plotter's panel 94P.

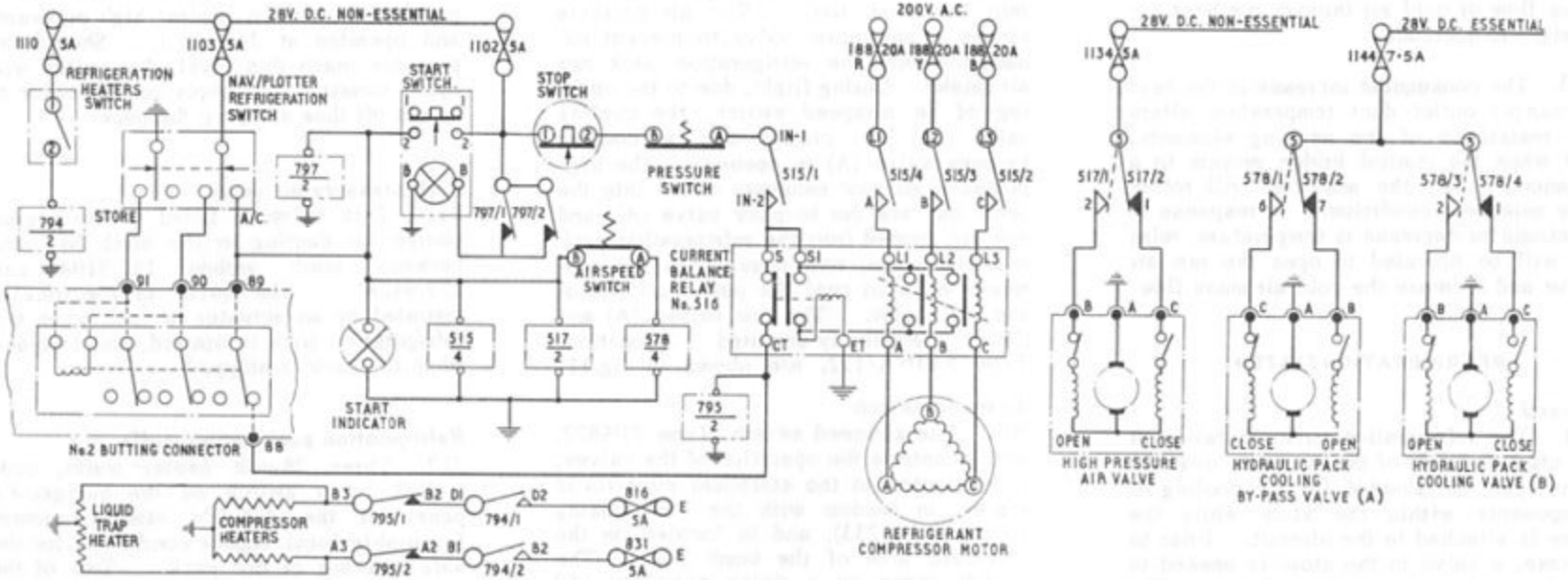

Fig.20. Refrigeration system

◀ *(Alteration at butting connector, Fuse 1144 now 7.5A)* ▶

Circuit operation

214. The following sequence of operations should be read in conjunction with fig.20, where the circuit is shown with the pack switched off.

Shut-down condition

215. Supplies are made as follows to operate the valves and their actuator limit switches:-

(1) From fuse 1134 via normally closed contacts 517/2 and pin C of the high pressure air valve actuator to close the valve.

(2) From fuse 1144 via normally closed contacts 578/4 and pin B of the hydraulic pack cooling by-pass valve (A) to open the valve.

(3) From fuse 1144 via normally closed contacts 578/2 and pin C of the hydraulic pack cooling valve (B) to close the valve.

216. Prior to starting the pack, the heater muffs around the compressor and liquid trap must be switched on for at least 6 minutes, in which case a supply from fuse 1110 will be made via the heaters switch to energise relay 794. Supplies to the heaters will then be made from fuses 816 and 831 via contacts 794/1 and 794/2, and normally closed contacts 795/1 and 795/2. Note that the start push-switch indicator will be lit by a supply from fuse 1102 via normally closed contacts 797/1 and 797/2.

Starting

217. When the start push-switch is pressed, relays 515, 517, 578, 795 and 797 will be energised from fuse 1102 (relay 578 via the airspeed switch contacts, and 795 via pins 89-88 of No.2 butt connector). The following action will then result:-

(1) Contacts 515/1 will close to hold in these relays via contacts S-CT of the current balance relay 516. (Relay 795 direct, and 517, 578, 797 via pins 88-89 of No.2 butt connector). Also the remote start indicator lamp will be lit.

(2) Contacts 517/2 will open, and contacts 517/1 will close to energise the open field of the high pressure air valve actuator from fuse 1134, thus opening the valve to admit high pressure air to the pack.

(3) Contacts 578/2 will open, and contacts 578/1 will close to connect a supply from fuse 1144 to open the cooling valve (B).

(4) Contacts 578/4 will open, and contacts 578/3 will close to connect a supply from fuse 1144 to close the cooling by-pass valve (A).

(5) Contacts 795/1 and 795/2 will open to cut off supplies to the three muff heaters.

(6) Contacts 797/1 and 797/2 will open to cut off the supply to the start push-switch indicator lamp.

(7) Contacts 515/2, 515/3 and 515/4 will close to connect a 200-volt a.c. supply from fuses 188R, Y, B to start and run the compressor motor.

218. Selection of the nav/plotter's refrigeration switch to A/C gives the same sequence of events as described in the previous paragraph, the initiating supply in this case being fed from fuse 1103.

Hydraulic cooling change-over
219. In flight the airspeed switch is open and relay 578 is de-energised. The cooling by-pass valve (A) is thus open and cooling valve (B) is closed as described in para.215, and the hydraulic unit is cooled by ram air, the exhaust from the refrigeration pack being directed into the bomb bay.

High pressure conditions
220. When the refrigerant pressure reaches 240 p.s.i., the pressure switch will open to interrupt the supply from fuse 1102, causing the motor to stop and the pack to shut down. The start push-switch indicator lamp will immediately be lit as a result, thus warning the A.E.O. of this condition.

Stopping during launching preparations
221. In flight, with the pack running, selection of the nav/plotter's refrigeration switch to STORE will open a refrigerant valve in the store and also energise a relay to interrupt the hold-in circuit for relays 515, 517 and 797. These relays will be de-energised to result in the following:-

(1) Contacts 517/1 will open, and contacts 517/2 will close, to close the high pressure air valve and cut off the high pressure air to the pack.

(2) Contacts 515/1 will open to de-energise relay 795 and reconnect the heater muffs, and also isolate the hold-in circuit for the relays as described.

(3) Contacts 797/1 and 797/2 will close to light the start push-switch indicator lamp.

(4) Contacts 515/2, 515/3 and 515/4 will open to stop the compressor motor.

Manual stopping
222. If the stop push-switch is pressed in flight while the pack is running, relays 515, 517, 795 and 797 will be de-energised with results as outlined in the previous paragraph. With the aircraft on the ground, however, relay 578 will also be de-energised (para.216).

Motor protection, current-balance
223. With the compressor motor running normally, the 3-phase supply lines will be balanced and the current-balance relay 516 will not be energised. Should an out-of-balance condition occur, however, e.g. an open circuit on one phase, the unequal current flow will cause the relay to be energised, thus breaking contacts S-CT. This will interrupt the supply from fuse 1102 to de-energise the associated control relays, shut down the system and light the start push-switch indicator lamp.

FUZING AND ARMING

General
224. Although the fuzing and arming system and the release system are complementary, the link-up is small and well defined. For convenience of description and operation the systems are treated separately, with cross references where necessary.

225. The fuzing and arming system uses a large part of the wiring already installed for No.2 special store, together with the airspeed pressure switch used in that system. For the purposes of description and operation in the following paragraphs it is assumed that the necessary operations for conversion to the Blue Steel role have been carried out.

Equipment
226. The carrier junction box, designated 97P, installed in the bomb bay starboard adjacent to the carrier beam, collects the signals from the various control units and distributes them to certain fuzing units (para.230), the separation switch and to the store. In the junction box are two series-coil-operated relays which are operated by

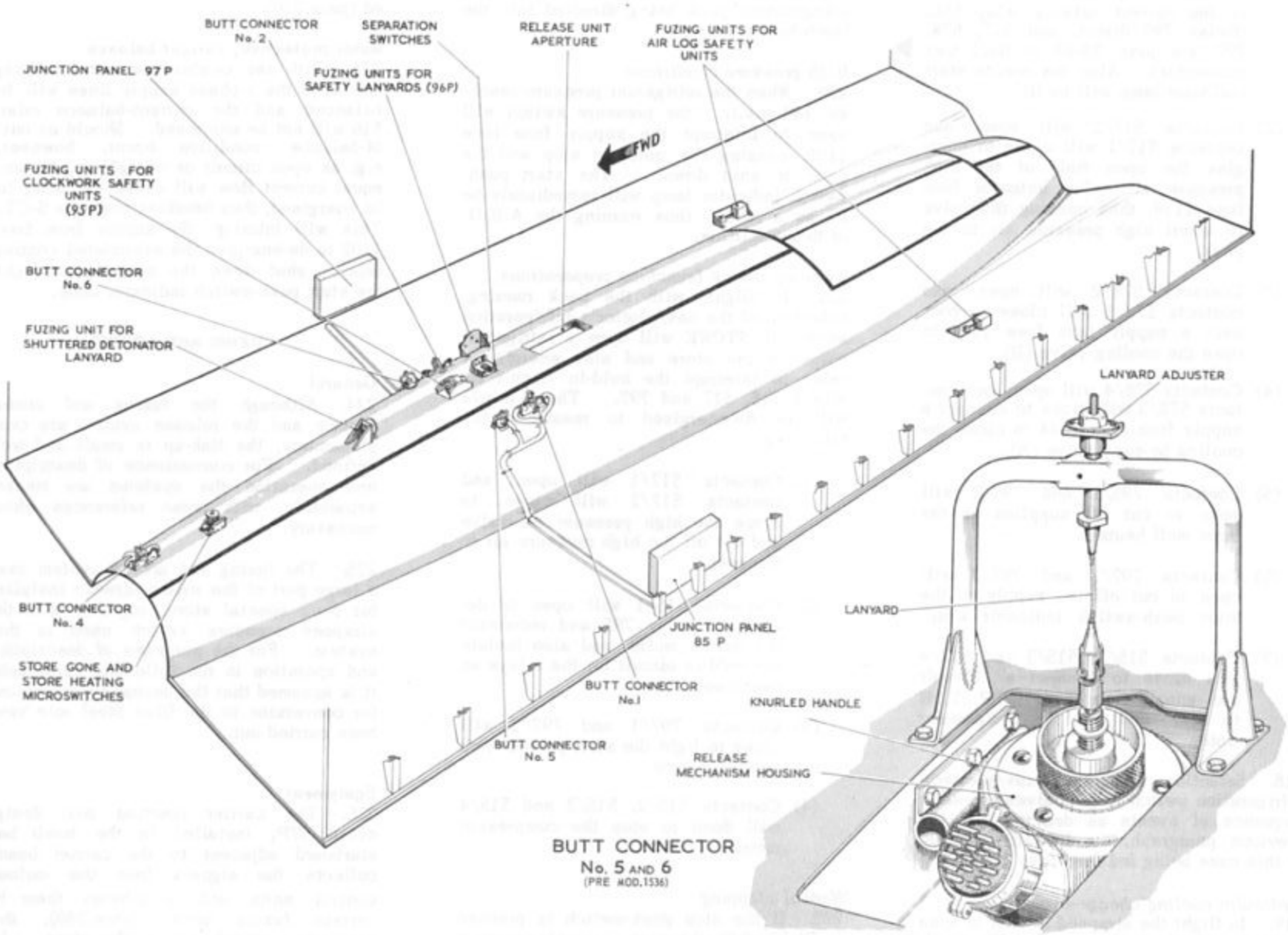

Fig.21. Fuzing, arming and release components
(Note added at Butt Connector No.5 and 6)

the release system to provide supplies to the separation switch.

227. Provision is made for the carriage of stores using either clockwork safety units (C.S.U.'s), which are no longer used, or air log safety units (A.L.S.U.'s). Originally when a store using C.S.U.'s was fitted, cable F3051 was connected to plug 993 at 97P. With the carriage of stores using only A.L.S.U.'s, cable F3196 must be connected to plug 993, the other cable (F3051) being connected to a stowage plug at the side of 97P.

Control units

228. Fuzing and arming controls for the installation consist of a control unit, Type E.Q., mounted on the lower forward section of the navigator bomber's panel 9P; a protective relay unit and a separation switch junction box. Both the latter items are mounted at the top of the front spar in the bomb bay, the protective relay unit being situated slightly to starboard of the aircraft centre-line, the separation switch junction box being fitted at the extreme starboard side.

Separation switch

229. The separation switch, mounted on the starboard fairing door on the aircraft centre-line at bomb arch datum 151.919A, controls the special fuzing circuits to the store, and contains two sets of change-over contacts which are operated by the scissors movement of two levers on the switch assembly. When the store is fitted to the aircraft the levers are moved automatically, and the contacts changed over to isolate the associated circuits. Two 6-pin connectors connect the separation switch with the carrier junction box 97P, two 6-pin snatch connectors connect the separation switch to the store.

Fuzing units

230. Four fuzing units, Ref.No.5D/1476, are still provided for the two different systems (para.227). The two fuzing units for the C.S.U.'s are grouped together to form 95P, mounted immediately forward of the separation switch. The two fuzing units used to trigger the A.L.S.U.'s are mounted at the aft outboard sides of the fairing doors, adjacent to the fin-gap doors. Three other fuzing units for the store are described under the release system (para.245 and 257).

Butt connectors

231. The 18-pin butt connectors, which convey the arming control circuits to the store, are mounted to port and starboard of the C.S.U. fuzing unit assembly (95P), equally spaced about the aircraft centre-line. The connectors are attached to the store after final positioning of the store and are self-locking; the locks are released and the connectors ejected by means of fixed lanyards which are tensioned by the falling of the store.

Test sockets

232. Two 6-pin test sockets, labelled respectively E.P. TEST and E.Q. TEST are mounted on the plug stowage bracket for the integrated wiring system (No.1 and 2 special stores). The bracket is installed at the rear face of bomb arch 123.015A starboard, and the test sockets are approximately in line with the butt connectors. The E.P. test socket is wired direct to the protective relay unit. The E.Q. test socket is wired into the output from the separation switch junction box, only pins A and B being used.

Power supply controls

233. The system is rendered safe whilst the aircraft is on the ground by two methods. Master supplies are taken to the protective relay unit through:-

(1) The port aft nosewheel doors-up micro switch.

(2) An airspeed pressure switch (referred to in para.225 and described in Chap.21 of this section).

By these means fuzing and arming is prevented until the aircraft is airborne and in full flight.

234. Should it become necessary, the above precautions can be by-passed by the operation of the E.Q. POWER SUPPLY EMERGENCY OVERRIDE switch, a double-pole on-off switch mounted at the Nav/bomber's panel 9P. This switch is equipped with an individual guard which is locked with 22 s.w.g copper wire to prevent inadvertent operation.

Circuit operation

235. A brief outline of the circuit follows, and should be read in conjunction with the theoretical circuit diagram, fig.22, which shows also the interconnections between the various equipment items. The circuit is drawn A.O.G.

Power supplies

236. Referring to fig.22, it will be seen that a supply is available at terminal A of the airspeed pressure switch and terminal 2 of the emergency override switch, fed from fuse 1053. As the pressure switch closes on rising airspeed the supply will be directed to the protective relay unit. Selection of the emergency override switch gives the same result.

237. A supply is also available at terminal 5 of the emergency override switch fed from fuse 1064. As the micro switch contacts close due to the closing of the nose wheel doors the supply will be directed to the protective relay unit. Selection of the emergency override switch gives the same result.

238. It will be seen that d.c. is supplied to the protective relay from fuses 1055 and 1069. The E.Q. control unit is supplied with d.c. from fuses 1052 and 1068, whilst the lighting supply for this particu- unit is taken from fuse 502 via a dimmer- switch.

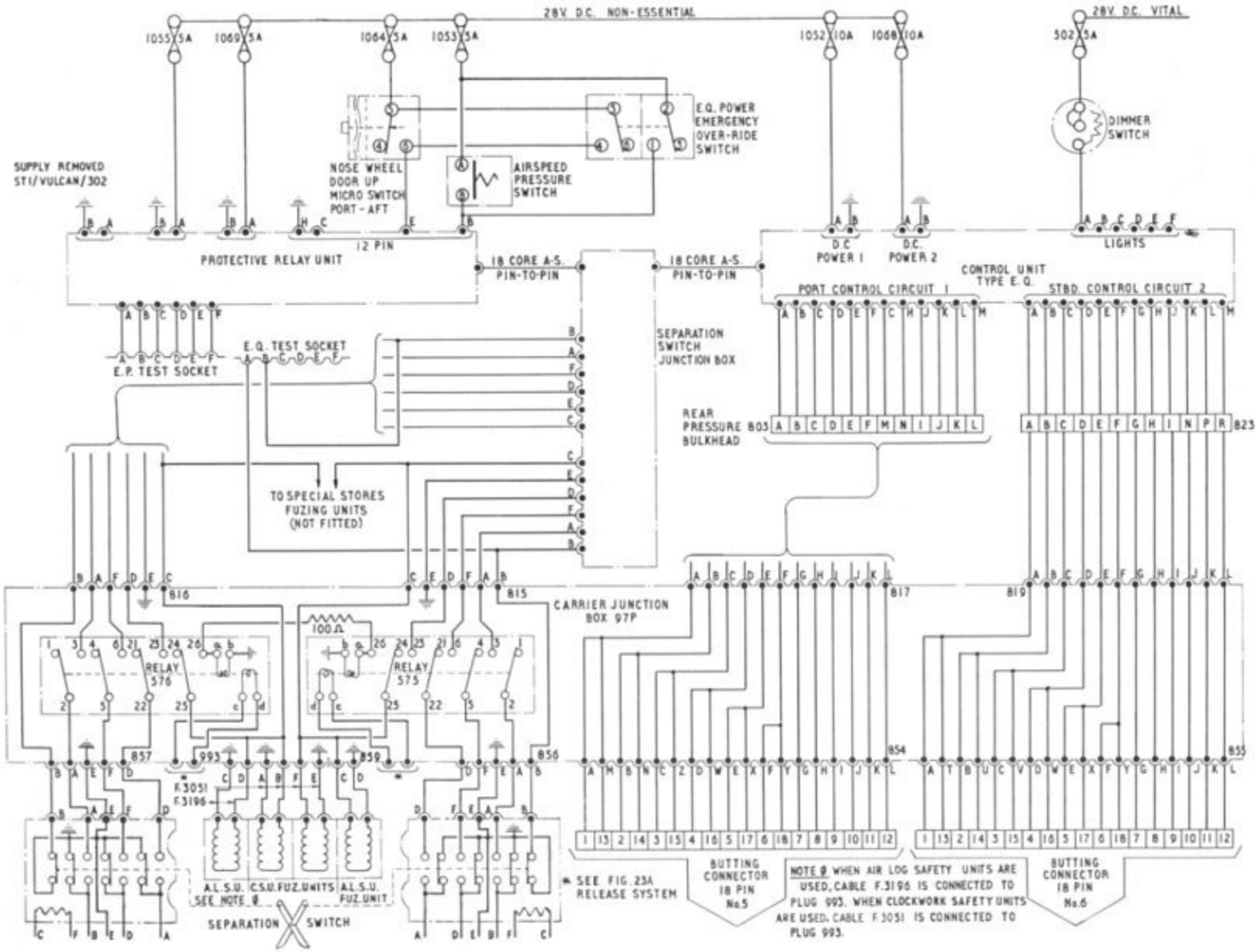

Fig.22 Fuzing and arming circuits

(S.T.I./Vulcan/302 satisfied)

Fuzing and arming

239. Referring to fig.22 and assuming a 28-volt supply to be appearing at pins C of plugs 815 and 816 of the carrier junction box, it will be seen that, due to this supply, either the C.S.U. or A.L.S.U. fuzing units can be energised (dependent upon which cable is connected to plug 993). As already stated (para.227) only stores fitted with A.L.S.U.'s are now carried, so that, with cable F3196 connected to plug 993, one A.L.S.U. fuzing unit will be energised via pin D of plug 993 and the other A.L.S.U. fuzing unit energised via pin C of plug 859.

240. The operating coils of relays 575 and 576 (terminals c-d) are wired in series with the dual wired release circuit and on release the relays will be energised momentarily, the circuit action due to this will be:-

(1) Closing of contacts 25-26, which provide hold-in circuits for the relays by energising the other coils (terminals a-b), picking up the supplies assumed in para.239.

(2) Closing of contacts 2-3, 5-6 and 22-23, which complete the circuits between the separation switch junction box and the separation switch.

241. Supposing a failure of one path of the release system in which case only one of relays 575 and 576 would be energised. In this circumstance the other relay would be energised by the a-b coil via the 100 ohm resistor and held in by its own supply (assumed in para.239). Should this supply not be available the relay would drop out due to the voltage drop across the 100 ohm resistor, which is a function of the resistor and the current drawn by the fuzing units.

Voltage detection tests

242. During the period between T.S.A.M.I. tests on the general system and loading of the store to the aircraft, a series of checks are to be carried out on No.5 and 6 butt connectors and snatch plugs. A Test-set, Voltage Detection, Ref.No.76T/514, is used for these tests, detailed operating instructions being provided with the test-set. The aircraft a.c. and d.c. busbars will need to be energised and 115-volt a.c. supply established by selection of No.1 transformer switch at the secondary supplies control panel 50P. The d.c. supplies switch at 9P is to be selected ON.

243. The necessary operations before and after the tests are detailed in the appropriate publication.

RELEASE SYSTEM AND INDICATION

General

244. The store can be released electrically in two ways, viz. powered, to reach the target by means of self-propulsion, or ballistically, when the target is reached without propulsion. With powered release, control is under the Nav/plotter; ballistic release however is controlled by the air bomber from either the navigational or bombsight position.

245. Powered release of the store requires the removal of certain safety measures, which is achieved by three fuzing units, Ref.No.5D/1746, mounted on the starboard fairing door. The units are not used in the ballistic release role.

246. Emergency manual release is also available in the event of failure of the normal controls. Two snatch handles, one for removing a safety lock and one for release, are fitted in the roof at the navigators' station. The handles are mechanically coupled to the release control unit, (para.249) which operates the main release unit by direct action.

247. The release system uses part of the wiring already installed for the No.1 special store (Chap.21). For the purpose of the description and operation outlined in the following paragraphs, it is assumed that the necessary operations for conversion of the aircraft to the Blue Steel role have been carried out.

Main release unit

248. The carrier beam, installed transversely in the bomb bay between bomb arches 151.919 and 182.967, carries the store hoisting hydraulic jack. At the lower end of the jack is attached the No.14, Mk.2 release unit together with a release control unit (fig.23). The release unit is normally fired by electrically controlled pneumatic pressure, and is fitted with a heater mat to maintain smooth operation of the mechanism in low temperature. No thermostat to prevent overheating is provided, as the surface area is large enough to dissipate the heat supplied. The release unit is cocked by pressing the safety lock lever of the release control unit and turning the cocking attachment at the side of the release unit, using the appropriate cocking tool. A spring-loaded lock pin at the top of the release unit prevents inadvertent release (para.250).

Release control unit

249. The release control unit is fitted at the forward end of the release unit, its function being to:-

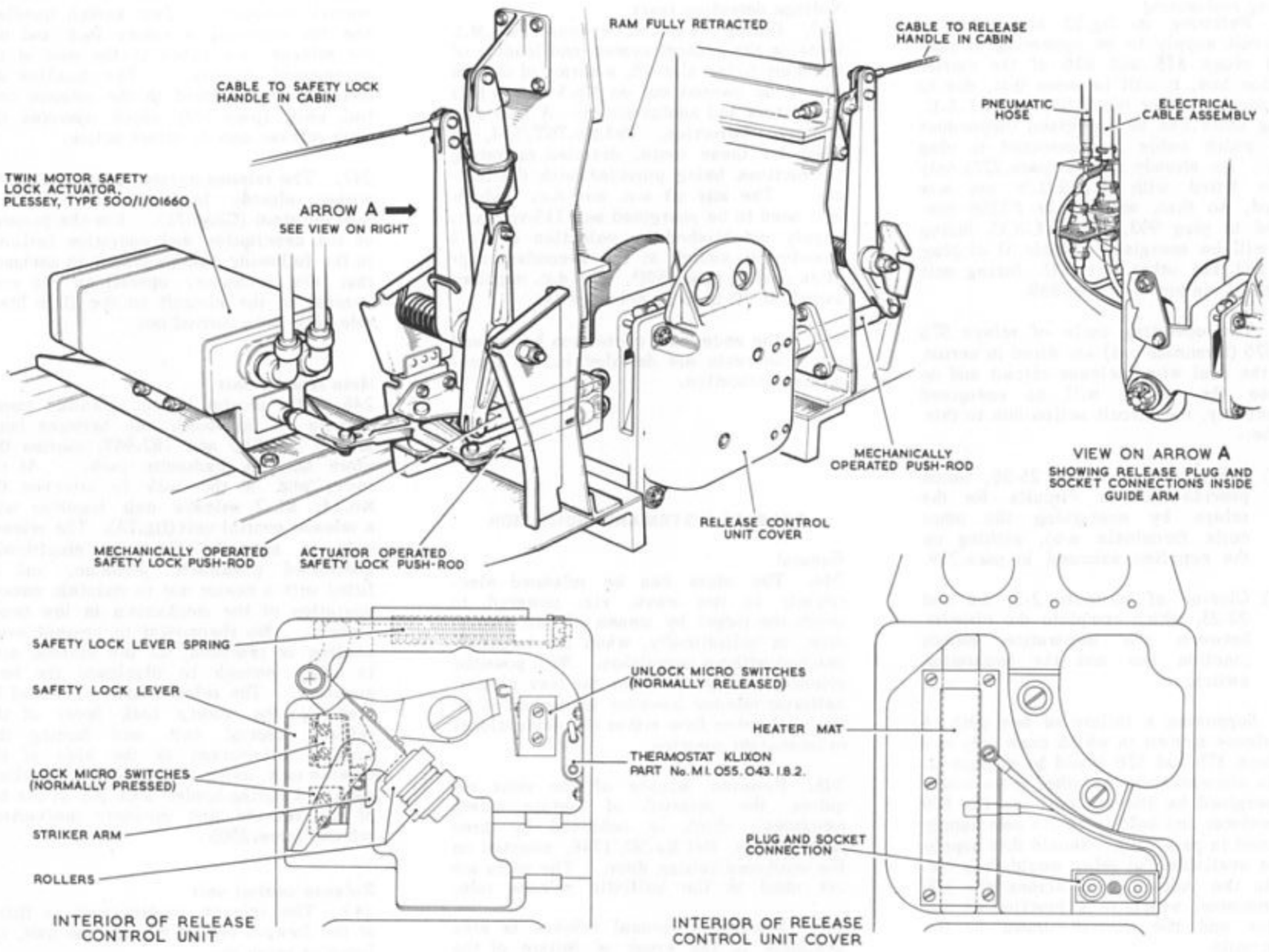

Fig.23 Safety lock actuator and controls

◀ *(Mod. 2166 incorporated)* ▶

(1) Provide a safety lock control to prevent inadvertent operation of the release unit.

(2) Adapt the release unit to be operated mechanically, i.e., by the two snatch handles in the crew's compartment.

A heater mat is fitted inside the unit together with a thermostat which closes between 1.6 and 10 deg.C. to switch on the mat, and opens between 7.2 and 18.3 deg.C to switch off the mat.

Safety lock

250. The spring-loaded lock pin at the top of the release unit ensures that the release unit cannot be operated until the lock pin is withdrawn against the spring. The forward end of the pin is connected to a yoke assembly which normally butts against two rollers on the end of a safety lock lever within the release control unit. Thus, when the lever is pressed, the rollers will move off the yoke to free the lock pin and allow the release unit to be fired either electro-pneumatically or mechanically.

251. The safety lock is normally operated by a twin-motor actuator, which, in the extended position, presses the safety lock lever to unlock the release unit, and in the retracted position, allows the lever to return and lock the release unit. Four micro switches inside the release control unit provide control for an indicating circuit and also the EXTEND fields of the actuator. The micro switches are operated alternately in pairs by the safety lock lever according to the position of the actuator. With the actuator retracted, one pair (designated 'lock') is held pressed, while the other pair (designated 'unlock') is released. With the actuator extended, the lock pair is released and the unlock pair pressed.

Mechanical release

252. The two snatch handles in the crew's compartment are connected to two push rods, one on either side of the release control unit. The safety lock handle moves the safety lock lever (in the same way as the actuator) and the release handle moves a bell crank lever which pulls the lock pin in the main release unit. Further details will be found in Sect.5, Chap.5.

Pneumatic release valve

253. A solenoid operated valve, Frazer Nash 2-way Mk.4, Ref.No.11A/5589, is mounted on the pneumatic panel on the carrier beam. This valve, with 0.03 sec. operating time, delivers compressed nitrogen to operate the main release unit, and has two independent control circuits and solenoids so that either one, or both simultaneously, can operate the valve. The release valve will operate over a wide range of supply pressure; after operation there is a delay of approximately five seconds before the valve automatically closes and resets, the nitrogen having been discharged into the atmosphere.

254. Any failure of the unit is to safe. The electrical circuits are broken less than 20 milliseconds before the main release unit is operated, and reset at the same time as the valve after operation of the release unit.

Pressure switch

255. To give indication of sufficient pressure available at the release valve inlet, a pressure switch, Type ACM 17730, is incorporated in the pneumatic circuit and located on the carrier beam pneumatic panel. The switch contacts close on a rising pressure of 625 ± 50 p.s.i. to light an indicator lamp on 9P, and open on a falling pressure of 575 ± 100 p.s.i. to switch off the lamp.

Butt connector release

256. In addition to the two butt connectors used in the fuzing and arming system, three others are connected to the store. These are each 157-way, and like the fuzing and arming connectors are attached to the store after final positioning, and are self locking. These are released from the store mechanically by a lanyard attached to a cradle on the connector housing; the pulling force being a function of the falling of the store.

Fuzing units

257. On powered release of the store, three fuzing units, Ref.No.5D/1476, are energised, one for the shuttered detonator lanyard, and the other two for the safety lanyards. The former unit is mounted on the fairing approx. 9 ft. from the front spar, and is only for use with certain stores released over a missile range. The latter two units are mounted on 96P, together with an additional unit which is not electrically connected, but which is used to facilitate the positioning of a fixed lanyard during the hoisting operation of the store. 96P is mounted forward and starboard of the store suspension aperture (fig.21).

Store gone and heating micro switches

258. The store, when fitted, presses a spring-loaded plunger which operates a 'Store gone micro switch', Ref.No.5CW/4742. When the store leaves the aircraft, the micro switch is released, the action of which causes an indicator lamp on panel 9P to light. A 'Store heating micro switch' is also mounted on the same assembly and operated by the same plunger. The micro switches are located approximately 42 in. from the front spar, and in addition to their titled function, also form part of the fin gap doors control.

Control switches

Store release

259. Store release is controlled from 9P by the bomb selector switch, a double-pole, 3-position on-off-on switch, labelled POWER-BALLISTIC. Powered release

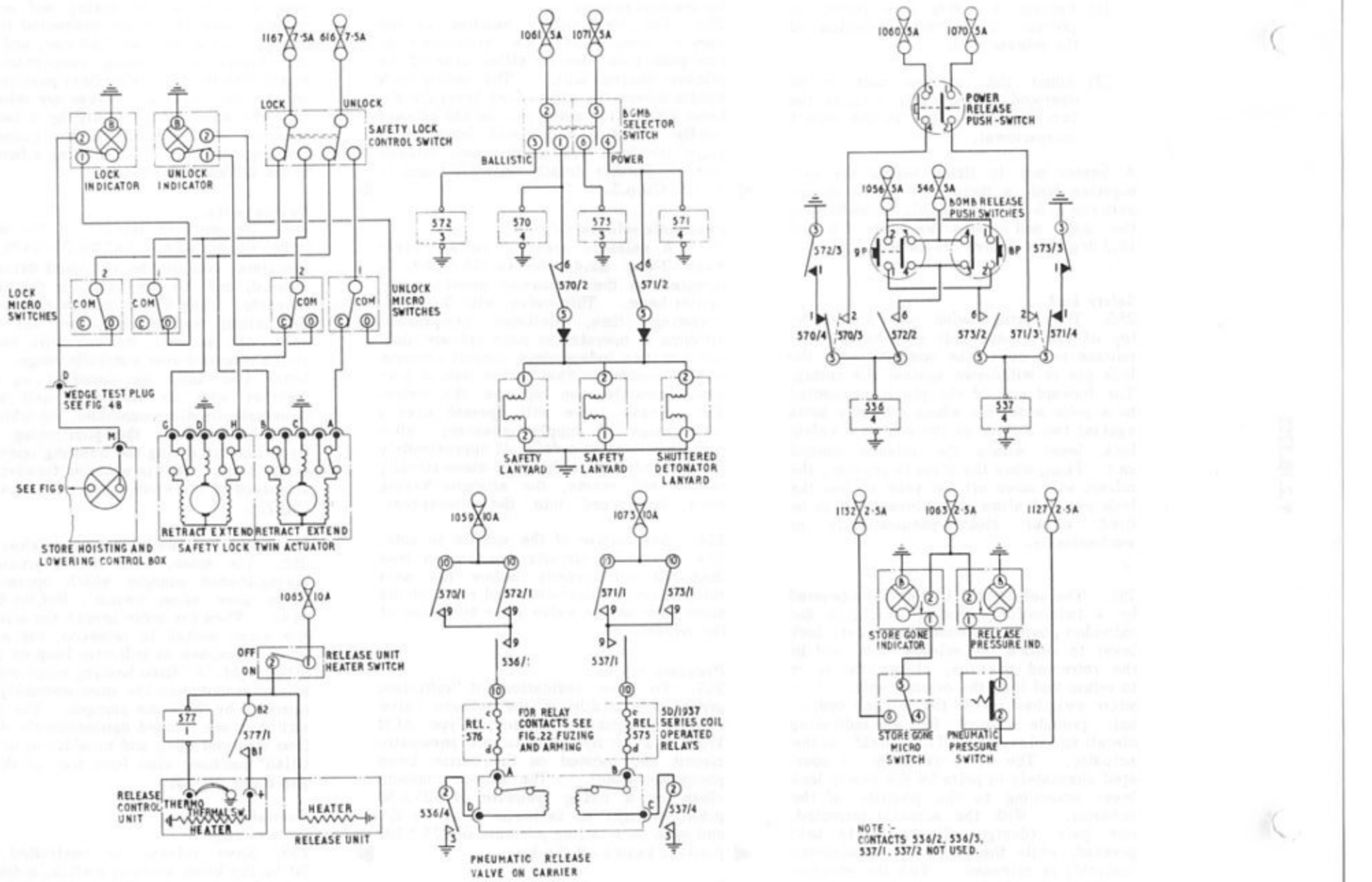

Fig. 23A Release system

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◀ is controlled by a red-guarded push-switch on the nav/plotter's panel 94P. Ballistic release is controlled by the existing bomb release push-switches on 8P and 9P. The bomb selector switch is fitted with a guard which is locked with 22 S.W.G. copper wire to prevent inadvertent operation during flight, the copper wire being broken by purposeful lift of the guard.

Release and control unit heaters

260. Both main release unit and release control unit heaters are controlled by a single-pole switch on 9P. The heater for the release unit is fed direct from the switch, while the heater for the control unit is fed via the contacts of relay 577.

Safety lock

261. Operation of the safety lock actuator is controlled by a selector switch, labelled LOCK-UNLOCK, on the port console. The switch is fitted with a guard, which is wirelocked similarly to the bomb selector switch on 9P.

Indication

262. Two amber warning lamps, one to give indication of sufficient pressure for release, and the other to give indication that the store has left the aircraft are located on 9P. Two further indicator lamps, one green and one amber, are positioned at the lock and unlock positions respectively of the safety lock switch on the port console, and are controlled by the micro switches in the release control unit. All lamps are equipped with dimming and press-to-test facilities.

Outline of circuit

263. To guard against possible failures, the release circuit is, for the most part, dual fed. Where the dual feeding becomes common at one destination, blocking rectifiers are introduced to prevent feedback into other parts of the circuit. The circuit is divided into sections by relay contacts, and the separate sections are rendered safe from inadvertent feeds by connection to earth through the normally made contacts of the associated relays.

Circuit operation

264. The following circuit operation should be read in conjunction with fig.23A, which is drawn on the assumption that the store is fitted, i.e. with the release unit cocked, the safety lock in and the release pressure correct.

Release and control unit heaters

265. Reference to fig.23A will show that the release unit and release control unit heaters are fed from fuse 1065 via the heater switch. When the switch is placed to ON, the supply to the release unit heater will be fed direct. At the same time the supply will be made to the coil of relay 577 and terminal B2 of normally open contacts 577/1. The earth return for the relay coil is taken through the contacts of the control unit internal thermostat, which, being closed, will cause relay 577 to be energised. Contacts 577/1 will then close to connect the supply to the control unit heater.

266. When the internal temperature of the control unit reaches the desired level, the internal thermostat will open to de-energise relay 577 and cut off the supply to the control unit heater. On cooling, the thermostat will close and the relay will again be energised to supply the heater, thus automatically maintaining the temperature of the control unit within the required range.

Release pressure indicator

267. Since the correct pneumatic pressure will be available for release of the store, the pressure switch will be closed and the release pressure indicator lamp will be lit by a supply from fuse 1127 via the pressure switch contacts.

Safety lock operation

268. With the safety lock switch selected to LOCK (fig.23A), supplies from fuses 616 and 1167 will be made through the respective contacts of the switch to the retract fields of the actuator. The actuator will thus be retracted and the respective internal limit switches open. At the same time, the supply from fuse 1167 will be made via contacts COM-O of No.1 lock micro switch to light the lock indicator lamp (green). Note that a supply will also be made from fuse 616 to pin M of the ground test and store hoisting plug via contacts COM-O of No.2 lock micro switch. This provides a safety lock indication on the ancillary control panel when used (para.46).

269. When the switch is selected to UNLOCK, it will be seen that the supplies are now connected via contacts COM-C of No.1 and 2 unlock micro switches to the extend fields of the actuator. As the actuator extends, No.1 and 2 lock micro switches will be released and the lock indicator will go out. When the actuator is fully extended, the respective internal limit switches will open, the lock pin in the release unit will be free to move and No.1 and 2 unlock micro switches will be pressed. The unlock indicator lamp (amber) will then be lit via contacts COM-O of No.2 unlock micro switch. In addition, it should be noted that:-

(1) The test circuit for the lock indicator via No.2 lock micro switch is broken.

(2) The test circuit for the unlock indicator is prepared, and supplies to the extend fields of the actuator are cut off via No.1 and 2 unlock micro switches.

Powered release

270. As the release unit is dual fed and dual operating, it is proposed, in order to avoid confusion, to deal with the operation of one half of the circuit only, by assuming that one master fuse is removed. ▶

The other half of the circuit is a duplication of the part described and can be followed in similar manner.

271. Assuming that fuse 1071 is removed (fig.23), selection of the bomb selector switch to POWER will energise relay 570 from fuse 1061 via contacts 2-1 of the switch. The following action will then take place:-

(1) Contacts 570/2 will close to supply the safety lanyard and shuttered detonator lanyard fuzing units, which will be energised to grip the lanyards.

(2) Contacts 570/4 will open to remove the safety earth from the coil of relay 536, and contacts 570/3 will close to prepare the energising circuit for relay 536 from the power release push-switch.

(3) Contacts 570/1 will close to prepare the energising circuit for the pneumatic release valve from fuse 1059.

272. When the power release push-switch is pressed, relay 536 will be energised from fuse 1060 via contacts 3-4 of the push-switch and the now closed contacts 570/3, to result in the following:-

(1) Contacts 536/1 and 536/4 will close to energise both relay 576 and the pneumatic release valve, which are in series. Operation of relay 576 will prepare the fuzing and arming circuits to the store (para.240), while operation of the release valve will allow the pneumatic pressure to open the release unit to release the store for powered flight.

Ballistic release

273. Ballistic release is described assuming that fuse 1071 is removed as for powered release (para.270/271).

274. Selection of the bomb selector switch to BALLISTIC will energise relay 572 from fuse 1061 via contacts 2-3 of the switch to result in the following:-

(1) Contacts 572/3 will open to isolate the coil of relay 536 from the safety earth.

(2) Contacts 572/2 will close to prepare the energising circuit for relay 536 from either the Nav/bomber's or prone bomber's release push-switch.

(3) Contacts 572/1 will close to prepare the energising circuit for the pneumatic release valve from fuse 1059.

275. When either the Nav/plotter's or prone bomber's push-switch is pressed, relay 536 will be energised and the store will be released as described in para.272. ◀In this case, however, the store control circuits are not initiated (para.276(2)).▶

276. It will be seen, in effect, that ballistic release differs from powered release in two respects only, viz:-

(1) Control is commanded by the Nav/bomber or prone bomber.

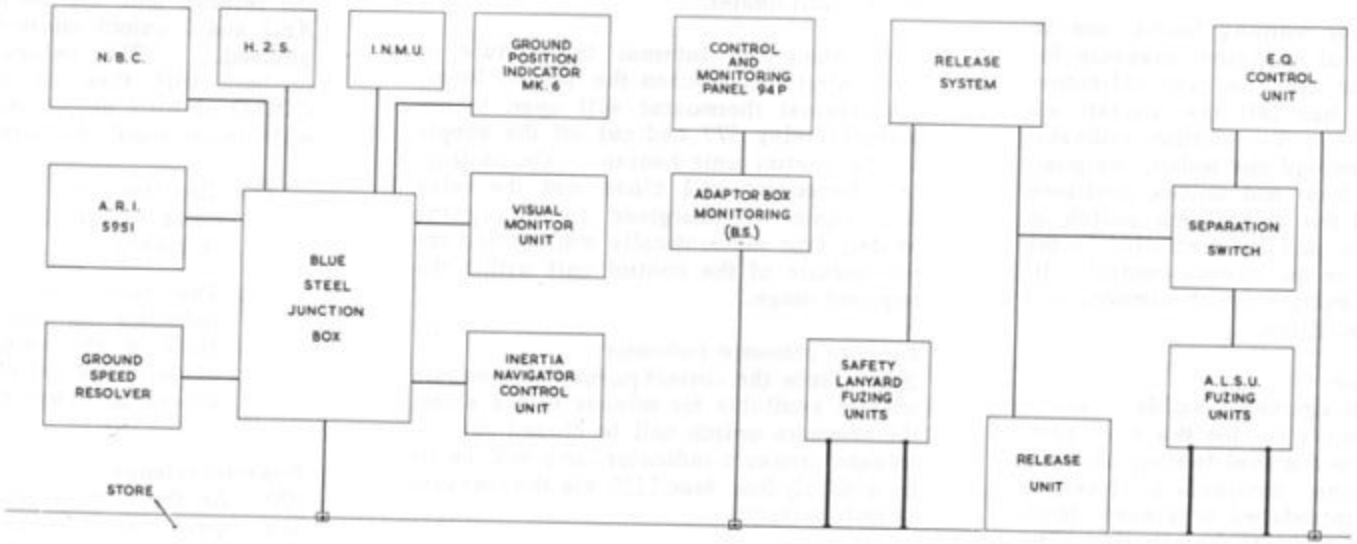

Fig.24 Block diagram of aircraft system (◀Mod.1777▶)

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(2) The safety lanyard and shuttered detonator lanyard fuzing units are not energised.

It is of course necessary for ballistic release to be under control of the air bomber, since operation of the associated controls to fire the propulsion motor in the store is not required.

SAFETY CIRCUIT INDICATORS

277. Three press-to-test indicators, Type C500/A/8, are provided on 9P for use when the store is released over a missile range (fig.50). The press-to-test circuit is fed from fuse 1095. The system is fully described in S.D.4766D, Vol.1, Sect.12.

NAVIGATION SYSTEM, AIRCRAFT PORTION

278. Guidance of the store after release is controlled by an inertia navigation system within the store. Prior to release, this system is linked to the aircraft navigation system, which feeds information and heading corrections up to the point of release.

279. With the store attached to the aircraft in flight, the inertia navigator (store) is monitored by the inertia navigator (aircraft) in conjunction with the aircraft navigation system (A.R.I.5951, N.B.S. and the G.P.I. Mk.6). The inertia navigator (aircraft) is connected to the aircraft system via the Blue Steel junction box (fig.52), and utilises the following equipment, which is shown located in fig.25:-

G.S.R. (Ground speed resolver)
Visual monitor unit
Inertia navigator control unit

Supplies

280. Reference to fig.51 will show that control of certain supplies to the system is initiated by the inertia supplies switch, labelled FREE-MIX on the nav./plotter's panel 94P.

281. Supplies to the G.P.I.6, 115-volt, 3-phase a.c., and 28-volt d.c., are controlled by the G.P.I. switch on 12P (Chap. 7) and fed via the Blue Steel junction box plugs 31A and 30A respectively. This switch also controls the supply to the G.S.R. and G.P.I.6 blowers. The a.c. supply is fed from the N.B.S. transformer, which is controlled by the N.B.S. transformer switch, also on 12P. Both switches, therefore, must be ON to render the supplies available.

282. The a.c. supply via the Blue Steel junction box also feeds the inertia navigator (store) gyro heaters and the Flight Data Recorder (fig.54). During standby periods, the gyro heaters only may be switched on by using the I.N. gyro pre-heat switch on 12P.

Circuit operation

283. When the N.B.S. transformer switch is placed to ON (fig.51), the transformer will be energised (Chap.7) and a 115-volt, a.c. supply will be available from fuses 341R and B.

284. With the G.P.I. switch now placed to ON, a d.c. supply from fuse 708 will be made across normally closed contacts C2-C3 of relay 316 and terminals 2-1 of the switch to energise relay 540, and also the G.P.I. via plug 30A, pin A of the Blue Steel junction box. The a.c. supply from fuses 341R and B will then be made to the G.P.I. and the inertia navigator (store) gyro heaters via the respective contacts in series of relays 540 and 316, and plug 31A, pins A, B, C of the Blue Steel junction box. This supply is also made available to the flight data recorder via the respective contacts of relay 540.

285. During standby periods when the I.N. gyro pre-heat switch is placed to ON, relay 316 will be energised from fuse 728 via terminals 2-1 of the switch. This supply will now be made across contacts D1-D2 of relay 316 to complete the energising circuit for the N.B.S. transformer, thus by-passing the N.B.S. transformer switch. The a.c. supply to the gyro heaters will then be made from fuses 341 R and B via the respective contacts of relay 316.

G.S.R. and G.P.I. Mk.6 cooling

286. Cooling for the G.S.R. and G.P.I.6 units is provided by two 200-volt, 3-phase blower motors. The blowers are connected to their associated units by flexible tubing, and are installed, one under the 2nd pilot's floor for the G.S.R., and one behind the navigator's panel for the G.P.I.6. The blowers are controlled by the G.P.I. switch (para.281), which when placed to ON, will energise relay 761 to complete a 200-volt supply to the motors from fuses 737 R, Y, B (fig.56). Further details of the installation are given in Book 1, Sect. 3, Chap.8.

FLIGHT DATA RECORDER

287. A flight data recorder (fig.54) is installed to record certain data prior to release of the store during test flights. The instrument comprises a recorder unit, Ref.No.9CA/154, and a recorder timing unit, Ref.No.9CA/155, both fitted on resilient mounting trays on the floor at the navigator's station. An on/off switch and an event marker push-switch is provided on a switch panel at the centre of the navigator's panel. The instrument is linked to the I.N. control unit, and 115-volt, 3-phase a.c. supplies are connected when the N.B.S. transformer switch and the G.P.I. switch on 12P are placed to ON (para.281-282). Further details will be found in A.P.4766C, Vol.1, Book 4.

TELEMETRY SWITCHING AND MONITORING

288. The telemetry switching and monitoring circuits are required when the aircraft is over a missile range. Control of the system is made from 99P at the navigator's station, which is connected to a telemetry relay switching unit in the bomb bay and also direct to the store (fig.55). The system is fully described in S.D.4766.

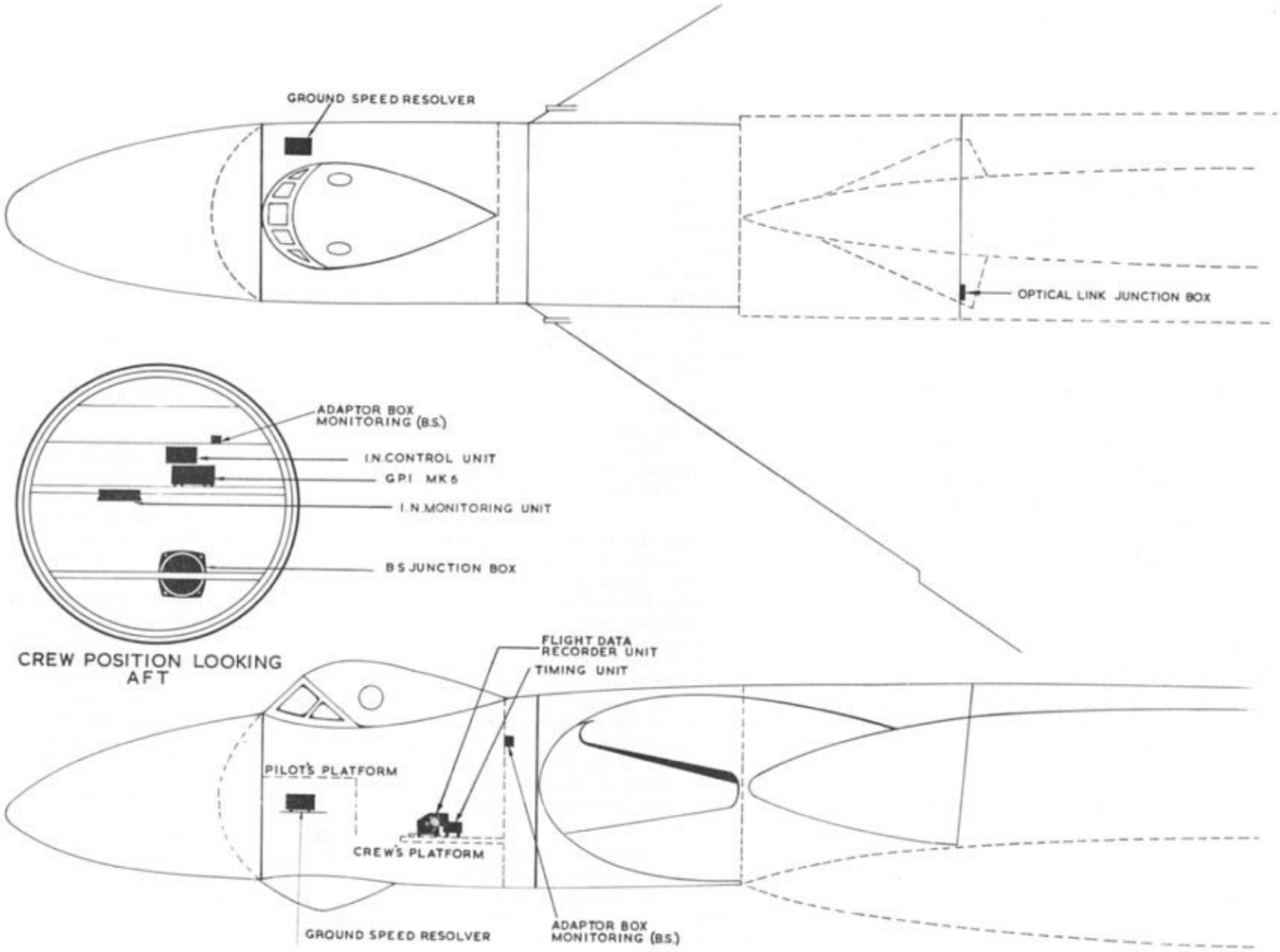

Fig.25 Navigation system, component location
(*Minor alterations*)

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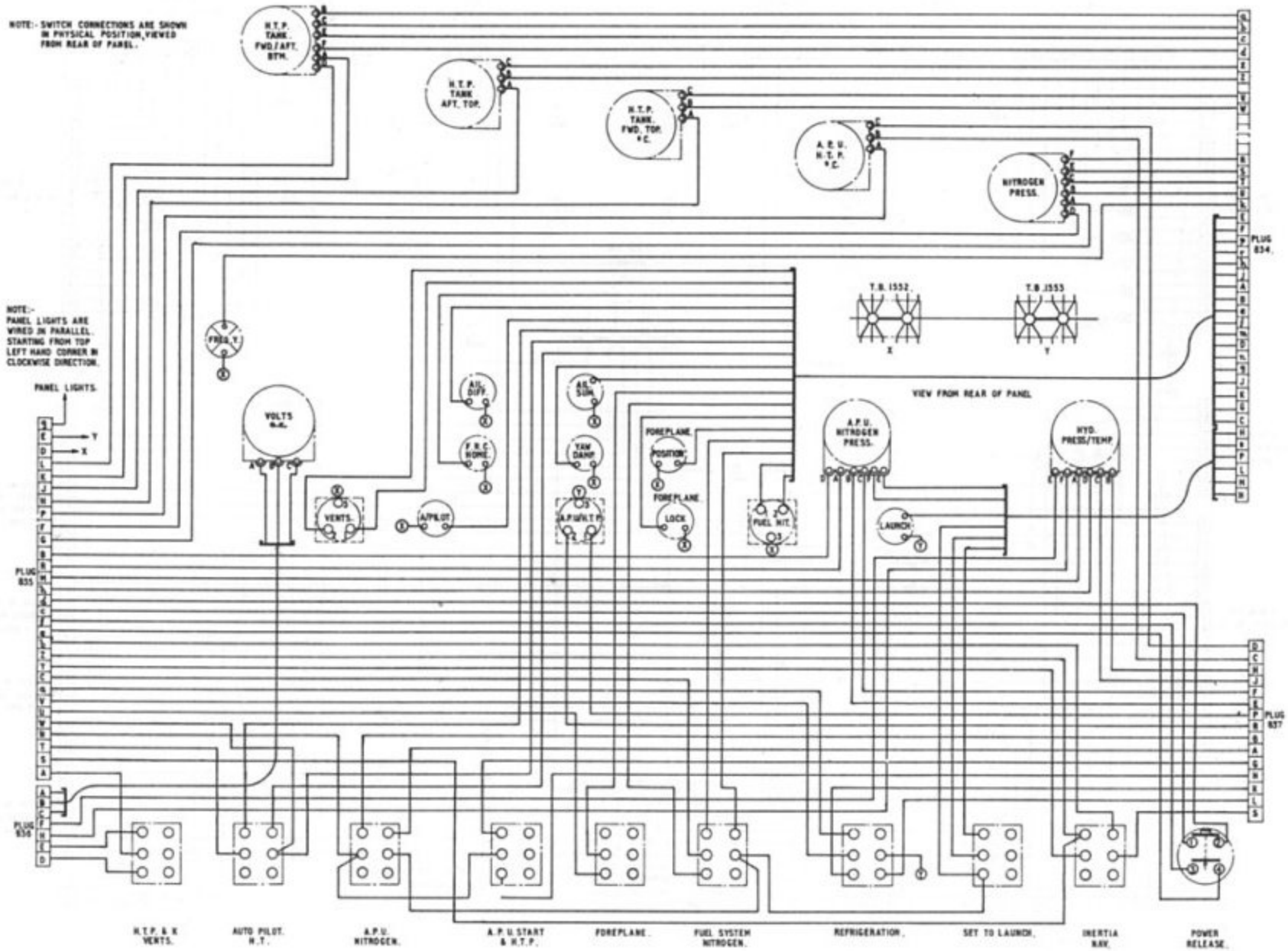

Fig.26 Wiring diagram panel 94P.

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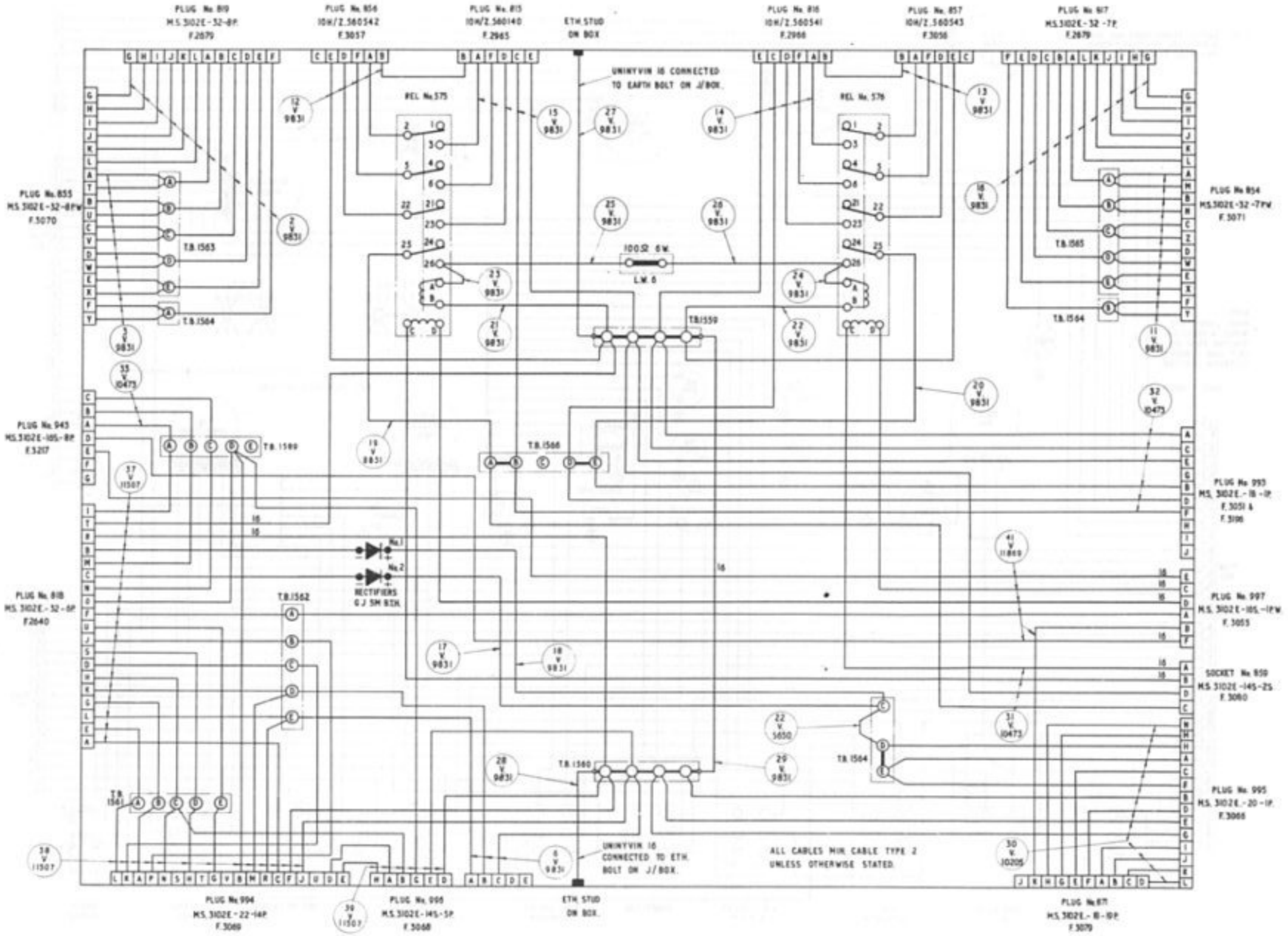

Fig 27 Wiring diagram panel 97 P.

(◄ Mod. 1233 ►)

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SERVICING

Precautions
289. Before any wiring and components are disconnected ensure that all switches and circuit breakers are in the OFF position and that all fuses, that are in any way connected with the system concerned, are withdrawn. Before applying 200-volt supplies to the aircraft, ensure that both the aircraft emergency power pack and the hydraulic power unit (Blue Steel) switches are in the OFF position, also that the switches for the bomb doors or fin gap doors are selected to the position taken up by the units concerned (Chap.19).

290. Before raising or lowering the store hoisting hydraulic jack it must be ascertained that the wedge, actuator rod and mechanical control unit operating rods are fully retracted. In view of the vulnerability of the wiring on the fairing doors, access to the bomb bay must be strictly limited to personnel engaged on the actual work in hand. The operators concerned should wear the appropriate footwear and the wiring should be suitably protected by mats or locally made guards.

◀ *NOTE . . .*
Mod.1712 introduces protective caps for fitment to umbilical connections to prevent ingress of dirt when aircraft is operating without the missile. ▶

General
291. Before proceeding with any servicing reference should be made to the early part of this chapter and to Chapters 12, 19, 20 and 21 of this publication and also to Sect.5, Chap.5. These references should give the operator a working knowledge of the basic and integrated systems requiring servicing. A periodic check of all wiring and components should be carried out in accordance with Vol.5. Continuity, insulation resistance checks and fault finding should be carried out with the aid of circuit diagrams contained in this and the other chapters already quoted. Paragraphs 293 - 299 pin point items, in the various systems, which are considered as worthy of attention.

Installation checks
292. Checking of the Blue Steel installation is carried out by using the Test Set Aircraft Missile Installation (T.S.A.M.I.). Full details of preparing the aircraft circuits and instructions for testing with T.S.A.M.I. are contained in Schedule C.S.D.E./S.1523/5/1/GW.

Hinged panels
293. All cables to the A.E.O's and Nav/air bombers hinged panels must be carefully examined for freedom from damage due to the frequent opening of these panels. The strainer wires supporting these panels must be kept in position and serviceable. All cables to and from the panels must be so positioned as to avoid strain when the panels are opened.

Fin gap doors
294. The bellows and grommets of the two Type C1813Y Mk.1 micro switches and the bellows and plastic covers of the four standard Type 1A micro switches should be examined for serviceability and freedom from foreign matter. Reference to Chapter 19 of this publication should suffice to cover servicing of the system, reading "fin gap doors" for "bomb doors".

Hydraulic power unit and refrigeration pack
295. Access to the interior of panels 92P and 93P, situated on the respective units, is obtained by the removal of four 'pip' pins on each panel. The components should be examined for cleanliness and security, any faulty or suspect components should be returned to bay servicing for replacement. No servicing is possible on the time delay units. Component testing of the electro-hydraulic valves is described in A.P.1803D.

Control system, switching and monitoring
296. Panel 94P should be sent to bay servicing for periodic calibration of instruments or if faulty. The face of the panel is transparent plastic covered with black paint, light from the panel lamps passes through the interior of the plastic to illuminate the instruments. It is therefore essential to maintain the black painted surface in good condition, to prevent extraneous light passing out of the panel into the crew's eyes. The adapter box monitoring (B.S.) contains "potted" items and should be replaced as a complete unit, if faulty.

Store fire detection
297. It is important that the system be tested regularly. Reference should be made to A.P.957C, Vol.1, Part 1, Sect.3, Chap.1 and A.P.4343, Vol.1, Sect.22, Chap.2. Details for the servicing of the control units will be found in A.P.4343, Vol.1, Sect.22, Chap.1 and A.P.4343E, Vol.1, Book 3, Sect.14, Chap.7.

Store heating and temperature indication
298. Reference should be made to Chapter 12 of this publication and to A.P.4343, Vol.1, Sect.12, Chap.5. No other servicing is possible, faulty components should be removed and replaced by serviceable items.

Store fuzing, arming and release systems
299. Before servicing, reference should

be made to Chapters 19, 20 and 21. The circuit used is basically that used for the 7,000 lb. Store, with the E.Y. control

General
300. Chapters 12, 15, 19, 20 and 21 cover many of the components dealt with in this chapter, to which reference should be made as required. Information on others is given below. Where no information is given about a component, no special difficulty has been visualised and further information is considered unnecessary. It is important to ensure that blanking caps are immediately fitted to all plugs and sockets disconnected. Panel covers, component lids etc. should be replaced as soon as possible. Before installation ensure that plugs, sockets and components are free from foreign matter.

Safety lock actuator
301. Removal of the actuator is achieved by disconnecting the connecting rod from the actuator arm and disconnecting the two electrical plugs. The four bolts holding the actuator to the mounting can then be removed.

302. The installation of the actuator can be accomplished by a reversal of the operations given in para.301. The setting of the actuator arm and connecting rod is given in Book 1, Sect.5, Chap.5 of this publication.

Release unit
303. Book 1, Sect.5, Chap.5 of this publication describes the work entailed in removing and replacing the release unit.

Fin-gap door controls
304. Access to the switch and indicator light connections is obtained by lowering the A.E.O's hinged panel. First position the angle-poise lamp so that no damage will occur when the panel is lowered, then undo the four countersunk screw-headed Dzus fasteners and lower the panel until its weight is supported by the strainer wire provided.

Store hoisting controls
305. Removal of the pressure indicator, switches and indicator lights from the ancillary control panel presents no great difficulty. The countersunk screws in the protective strips are removed and the face of the panel can then be eased up to obtain access to the connections, permitting the removal of individual items.

Hydraulic power unit (Blue Steel)
306. To remove panel 92P for bay servicing, carry out the following:-

(1) Remove plugs 825 and 826 carrying supplies and control services.

(2) Disconnect the cables from the pressure valves at the terminal blocks.

(3) Disconnect the 3-phase cables from the motor at the contactor terminals.

(4) Remove the three clips holding the above cables to the panel.

The four panel fixing bolts can now be removed and the panel is free.

Control system, switching and monitoring
307. Removal of the adapter box monitoring (B.S.) consists of unscrewing the four plugs on the port side of the box and removing the four bolts holding the base of the adapter box to the rear structure of the navigator's table.

308. Removal of panel 94P for bay servicing necessitates the removal of eight mushroom-headed screws and the supporting of the panel whilst plugs 834, 835, 836 and 837 are unscrewed from the plug break. The panel and its associated wiring is now free and special care must be taken to avoid scratching the black-painted, transparent plastic face of the panel.

Store heating system and temperature indication
309. Access to the connections of the temperature selectors and indicators for removal is gained by lowering the navigator bomber's sloping hinged panel. Before undoing the countersunk screw-headed Dzus fasteners to lower panel, ensure that the angle-poise lamps are so positioned as to avoid damage when the panel is lowered, and that the strainer wire holding the weight of the panel is secure.

310. Removal of the magnetic amplifiers (on the port wall of the bomb bay) for either bay servicing or replacement will be facilitated by first removing the mounting bracket. Co-operation with other trades is required if actuator valves have to be removed from the heater ducting.

thirty days whilst fitted to the aircraft, or after frequent or heavy landings, or before being fitted with a live store.

Refrigeration pack

311. To remove panel 93P for bay servicing, carry out the following:-

(1) Disconnect plugs 827, 828, 829 and 945, blank off and stow cables temporarily.

(2) Disconnect the three phase cables from the motor at the overload protection relay (No.516).

(3) Disconnect the cables from the pressure switch Type FRJ/A/18 at relay No.515 and T.B.1541-C.

(4) Disconnect the plug at the hydraulic cooling valve situated in the ducting adjacent to the hydraulic power unit on the front spar.

(5) Disconnect the cables to T.B. 1647-A-B-C, situated on the side of the hydraulic power unit crate.

(6) Remove the clips securing the above cables, now remove the four panel fixing bolts and the panel is free.

Store fuzing, arming and release systems

312. Before lowering the carrier beam hydraulic jack to remove release unit read the WARNING notice for store hoisting controls contained in Book 1, Sect.5, Chap.5. Apart from the release unit, components will only be removed if faulty or on a major inspection. The carrier beam will normally only be removed for a change of aircraft role as the components fitted to it are readily removable. The carrier beam is prepared for removal as follows:-

(1) Ensure that all switches including those of the aircraft emergency hydraulic power pack are OFF.

(2) Disconnect cables to plugs 865, 866 and 867 at the carrier beam plug break, blank off, secure and stow temporarily near 97P.

(3) Disconnect plug 999 from the pressure transmitter plug bracket on the hydraulic hoisting valve panel on the carrier beam, and the plug to the test plug bracket inboard of the panel. Unclip these cables and stow at stowage provided on the bomb arch.

(4) Disconnect plugs 869 and 870 at carrier beam to avoid damage during handling, blank off and secure to beam.

The carrier beam is now ready for mechanical disconnection and removal by other trades.

313. The separation switch box is removed by disconnecting two angle plugs from the box, pulling the quick release "pip" pin to free the stowed bracket, and then undoing the four bolts holding the switch box. The clockwork safety units have plug breaks in the wiring adjacent to the units for quick removal.

TABLE 4

NAVIGATIONAL SYSTEM CONNECTOR DETAILS

G.S.R. Conn. Ref.	Airframe Connector Reference	Routing End 'A'	Routing End 'B'	Min. Cable Type	Wiring	Screens End 'A'	Screens End 'B'	Shells End 'A'	Shells End 'B'	Routing Chart
1A	F2950	R.P.B.972	G.S.R 1A	18D	See table 5	Pin V	Shell	Ins.	Screen	Fig.52
	F2988	R.P.B.972	F.S.B 980	18D	Pin to Pin	Pin V	Pin V	Insulated		
2A	45/T4798	G.S.R.2A	J/B 1193	12C	Pin to Pin	Shells		Screen		Sect.7 Chap.5
	44/T4798	J/B.1195	B.S.J/B 2A	12C	Pin to Pin	Shells		Screen		
	43/T4798	J/B.1194	NAV.COMP. REPEAT 31C	RISTS 54/502	Pin to Pin	Shell	Ins.	Screen	Ins.	
3A	F2942	B.S.J/B 3A	G.S.R.3A	12C	Pin to Pin	Shells		Screen		Fig.52
4A	2/T4882	G.S.R.4A	R.P.B 176	12C	Pin to Pin	Ins.	Shell	Ins.	Screen	Fig.53
	3/T4882	R.P.B.176	Op.Link J/B 1008	12C	Pin to Pin	Shells		Screen		
5A	F2958	B.S.J/B 5A	R.P.B 974	18D	See table 5	Shell	Pin V	Screen	Ins.	
	F2996	R.P.B 974	F.S.B 982	18D	Pin to Pin	Pin V	Pin V	Insulated		
6A	F2956	B.S.J /B 6A	R.P.B 975	25C	See table 5	Shell	Pin d	Screen	Ins.	
	F2962	R.P.B 975	F.S.B 983	25C	Pin to Pin	Pin d	Pin d	Insulated		
7A	5/T5142	G.P.I 7A	R.P.B 973	25C	See table 5	Shell	Pin d	Screen	Ins.	Fig.52
	F2960	R.P.B 973	F.S.B 981	25C	Pin to Pin	Pin d	Pin d	Insulated		
8A	F2957	B.S.J/B 8A	R.P.B 976	25C	See table 5	Shell	Pin d	Screen	Ins.	
	F2972	R.P.B 976	F.S.B 984	25C	Pin to Pin	Pin d	Pin d	Insulated		
9A	14/T4882	Op.Link J/B 1009	Wing Joint 778	18C	Pin to Pin	Shells		Screen		Fig.53
	15/T4882	U/C.Bay 782	Wing Joint 778	18C	Pin to Pin	Shells		Screen		
	16/T4882	Track unit LV/A	U/C Bay 782	18C	See table 5	Shells		Screen		
10A	4/T4882	Op.Link J/B 1010	Op.Link Rec.10A	6C	Pin to Pin	Shells		Screen		
11A	F2986	B.S.J/B 11A	R.P.B.978	4C	Pin to Pin	Shell	Pin E	Screen	Ins.	
	F2998	R.P.B. 978	F.S.B.986	4C	Pin to Pin	Pin E	Pin E	Insulated		
12A	F2959	B.S.J/B 12A	R.P.B.1026	25D	See table 5	Shell Pin G	Pin J	Screen	Ins.	Fig.52
	F2997	R.P.B 1026	F.S.B.985	25D	See table 5	Pin J	Pin G	Insulated		
13A	7/T4882	G.S.R 13A	R.P.B.157	6C	Pin to Pin	Ins.	Shell	Ins.	Screen	Fig.53
	12/T4882	Wing joint 777	R.P.B.157	6C	Pin to Pin	Shells		Screen		
	11/T4882	U/C Bay 780	Wing joint 777	6C	Pin to Pin	Shells		Screen		
	13/T4882	U/C Bay 780	Track unit LD	6C	See table 5	Shells		Screen		
14A	F2941	I.N.C.H.14A	G.S.R.14A	12C	Pin to Pin	Shells		Screen		Fig.52

TABLE 4 (Cont'd.)

NAVIGATIONAL SYSTEM CONNECTOR DETAILS

G.S.R. Conn. Ref.	Airframe Connector Reference	Routing End 'A'	Routing End 'B'	Min. Cable Type	Wiring	Screens End 'A'	Screens End 'B'	Shells End 'A'	Shells End 'B'	Routing Chart
16A	9/T4798	G.S.R 16A	- T.C.U.3	6C	Pin to Pin	Shells		Screen		
17A	10/T4798	G.S.R 17A	- T.C.U.5	6C	Pin to Pin	Ins.	- Shell	Ins.	- Screen	Sect.7
N.B.S.139	34/T4798	G.S.R 139	- F.P.B.139-R	6D	Pin to Pin	Ins.	- Shell	Screen		Chap.5
19A	11/T4798	J/B 343/19	- G.S.R.19A	6C	Pin to Pin	Shell	- Ins.	Screen	- Ins.	
20A	3/T5142	B.S.J/B 20A	- G.P.I.20A	25C	Pin to Pin	Shells		Screen		
21A	8/T5142	B.S.J/B 21A	- G.P.I.21A	25X	Pin to Pin	Shells Pin G	- Pin G	Screen		
24A	2/T5142	B.S.J/B 24A	- G.P.I.24A	18J	Pin to Pin	Shells Pin J	- Pin J	Screen		
25A	4/T5142	B.S.J/B 25A	- G.P.I.25A	12C	Pin to Pin	Shells		Screen		
26A	F2944	B.S.J/B 26A	- I.N.Ctl.26A	25C	Pin to Pin	Shells		Screen		Fig.52
27A	F2943	B.S.J/B 27A	- I.N.Ctl.27A	12C	Pin to Pin	Shells		Screen		
28A	F2939	B.S.J/B 28A	- V.M.U 28A	25D	Pin to Pin	Shells Pin G	- Pin G	Screen		
29A	F2945	B.S.J/B 29A	- V.M.U.29A	25C	Pin to Pin	Shells		Screen		
33A	8/T4882	T.C.U 8	- R.P.B.100	6C	Pin to Pin	Shells		Screen		Fig.53
	9/T4882	R.P.B 100	- Op.Link J/B.1011	6C	Pin to Pin	Shells		Screen		
35A	2/T5246	B.S.J/B 35A	- R/Tim.Unit 35A	25D	Pin to Pin	Shell Pin G	- Ins. - Pin G	Screen	- Ins.	Fig.54
N.B.S.44	12/T4798	B.S.J/B 44	- Wind Mon.44	12C	Pin to Pin	Shells		Screen		Sect.7 Chap.5

V.2.1B.1257

TABLE 5

NAVIGATIONAL SYSTEM CONNECTOR WIRING

Installation connector reference	Airframe connector reference	End A	End B
1A	F.2950	T	O
remaining wires pin-pin		U	Q
5A	F.2958	O	T
remaining wires pin-pin		Q	U
6A	F.2956	O	a
remaining wires pin-pin		Q	b
7A	5/T.5142	O	a
remaining wires pin-pin		Q	b
8A	F.2957	O	R
remaining wires pin-pin		Q	S
		R	a
		S	b
9A	16/T.4882	1	A
		2	B
		3	C
		4	D
		5	E
		6	F
		7	G
		8	H
		9	J
		10	K
		11	L
		12	M
		13	N
		14	O
		15	P
		16	Q
		17	R
		18	S

Installation connector reference	Airframe connector reference	End A	End B
12A	F.2959	A	R
		B	P
		C	N
		D	M
		E	L
		F	K
		G	J
		H	H
		J	G
		K	F
		L	E
		M	D
		N	C
		O	T
		P	b
		Q	d
		R	A
		S	S
		T	a
		U	Z
		V	Y
		W	X
		X	W
		Y	V
		Z	u
12A	F.2997	R	A
		P	B
		N	C
		M	D
		L	E

(continued in third column)

Installation connector reference	Airframe connector reference	End A	End B
12A	F.2997	K	F
		J	G
		H	H
		G	J
		F	K
		E	L
		D	M
		C	N
		T	a
		b	b
		d	d
		A	R
		S	S
		a	T
		Z	U
		Y	V
		X	W
		W	X
		V	Y
		u	Z
13A	13/T.4882	A	1
		B	2
		C	3
		D	4
		E	5
		F	6

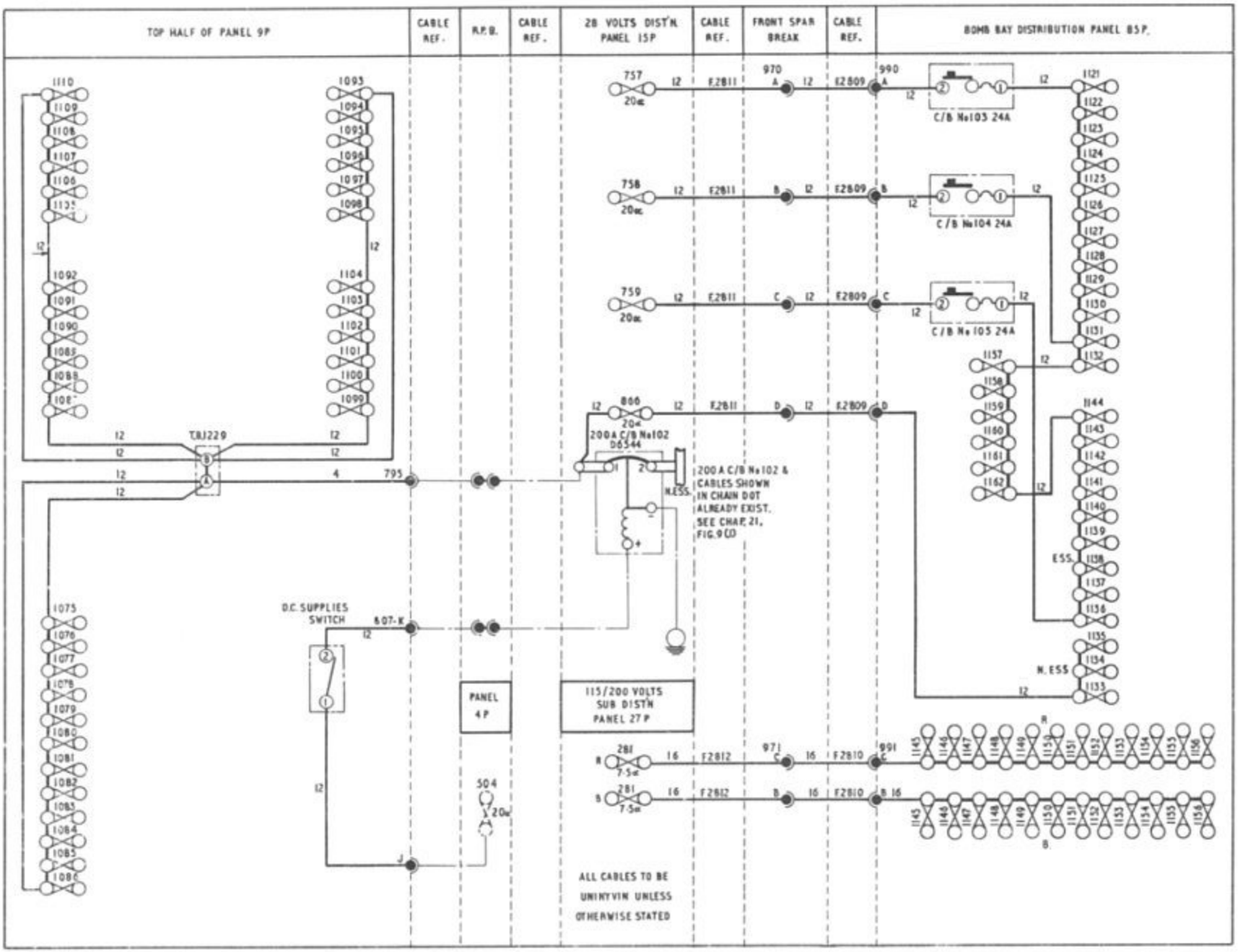

Fig. 28 D.C. and A.C. distribution

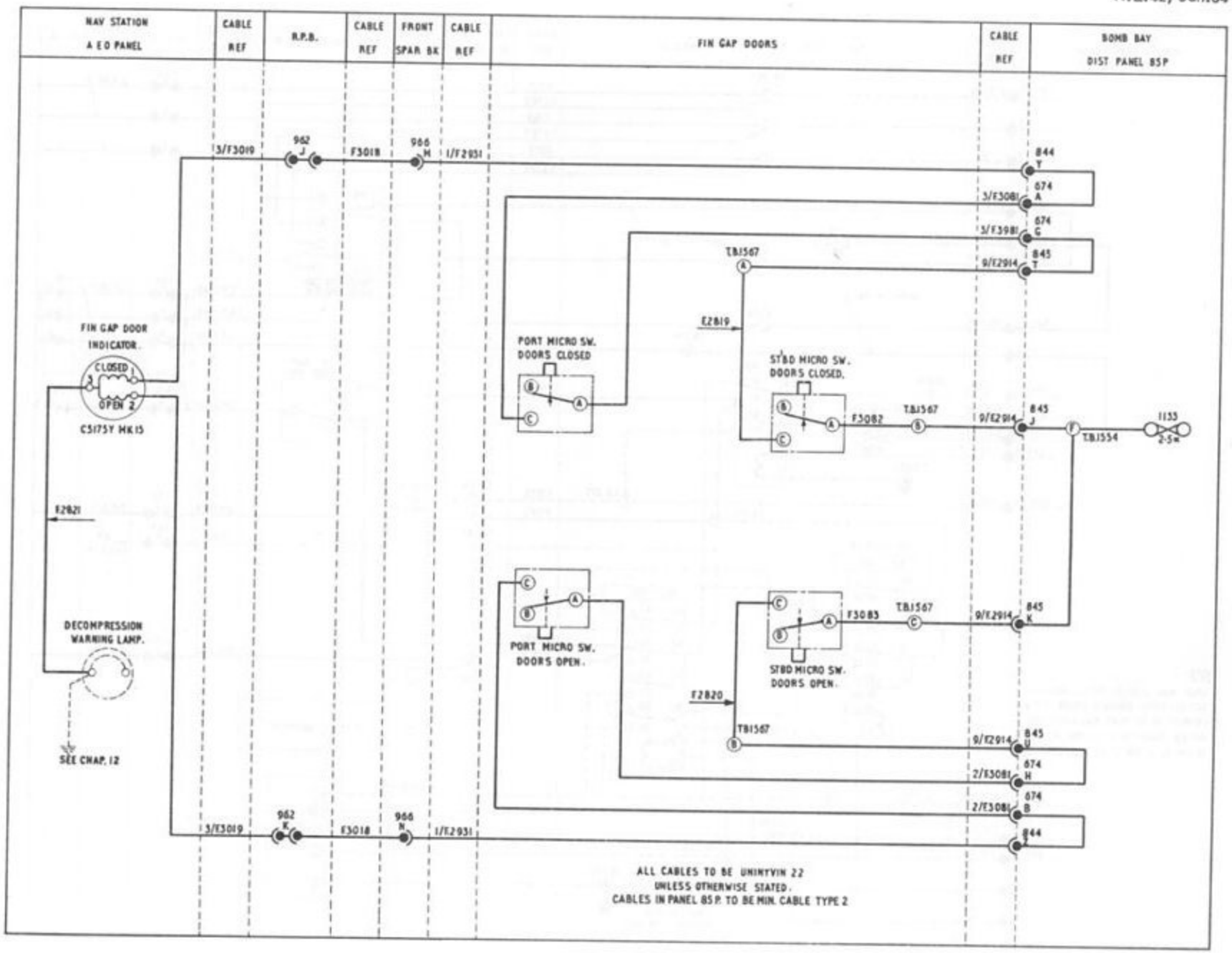

Fig.29 Fin-gap door indication

RESTRICTED

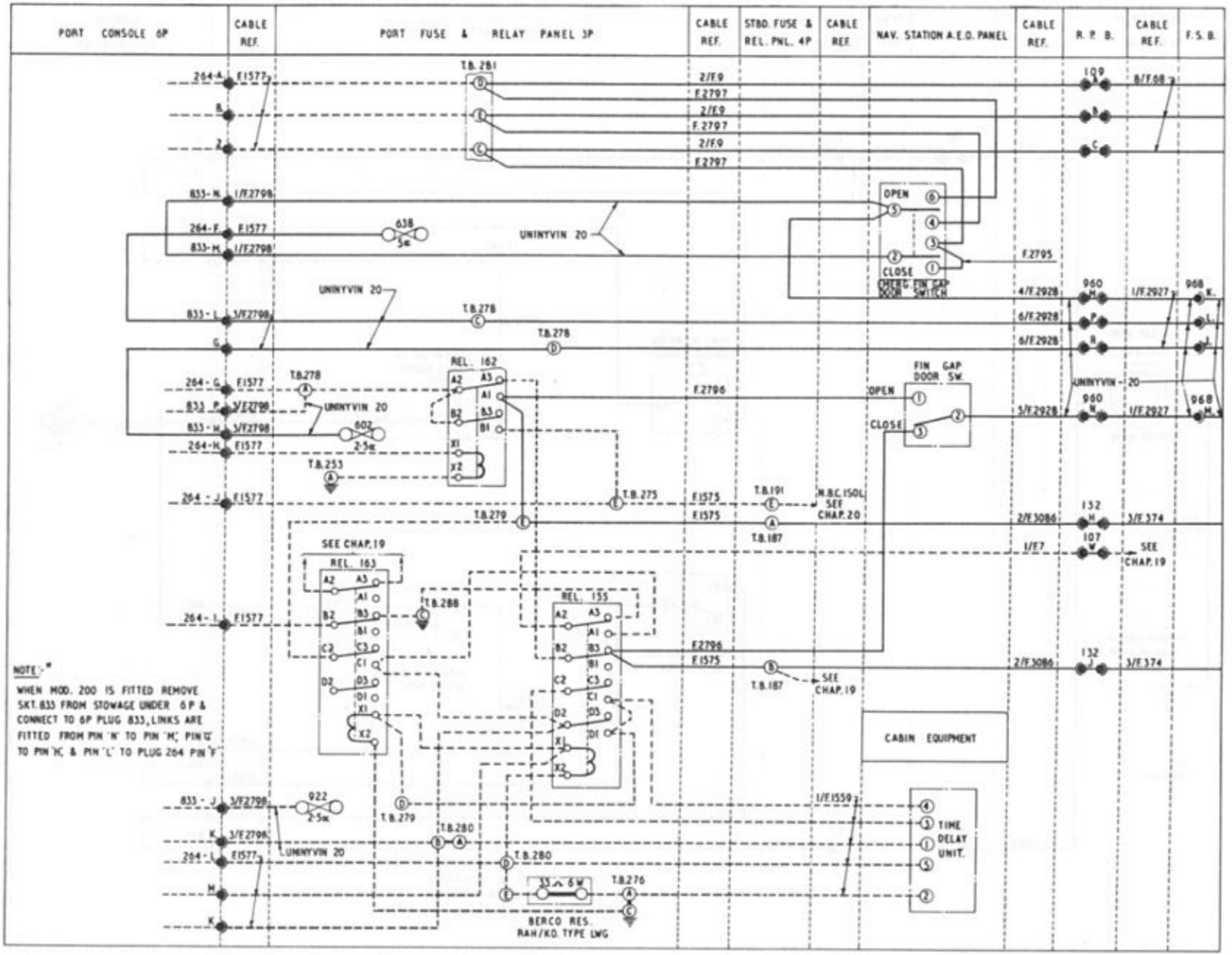

Fig. 30 (I) Fin-gap door controls

(◀ *Ref. from T.B. 187A deleted* ▶)

RESTRICTED

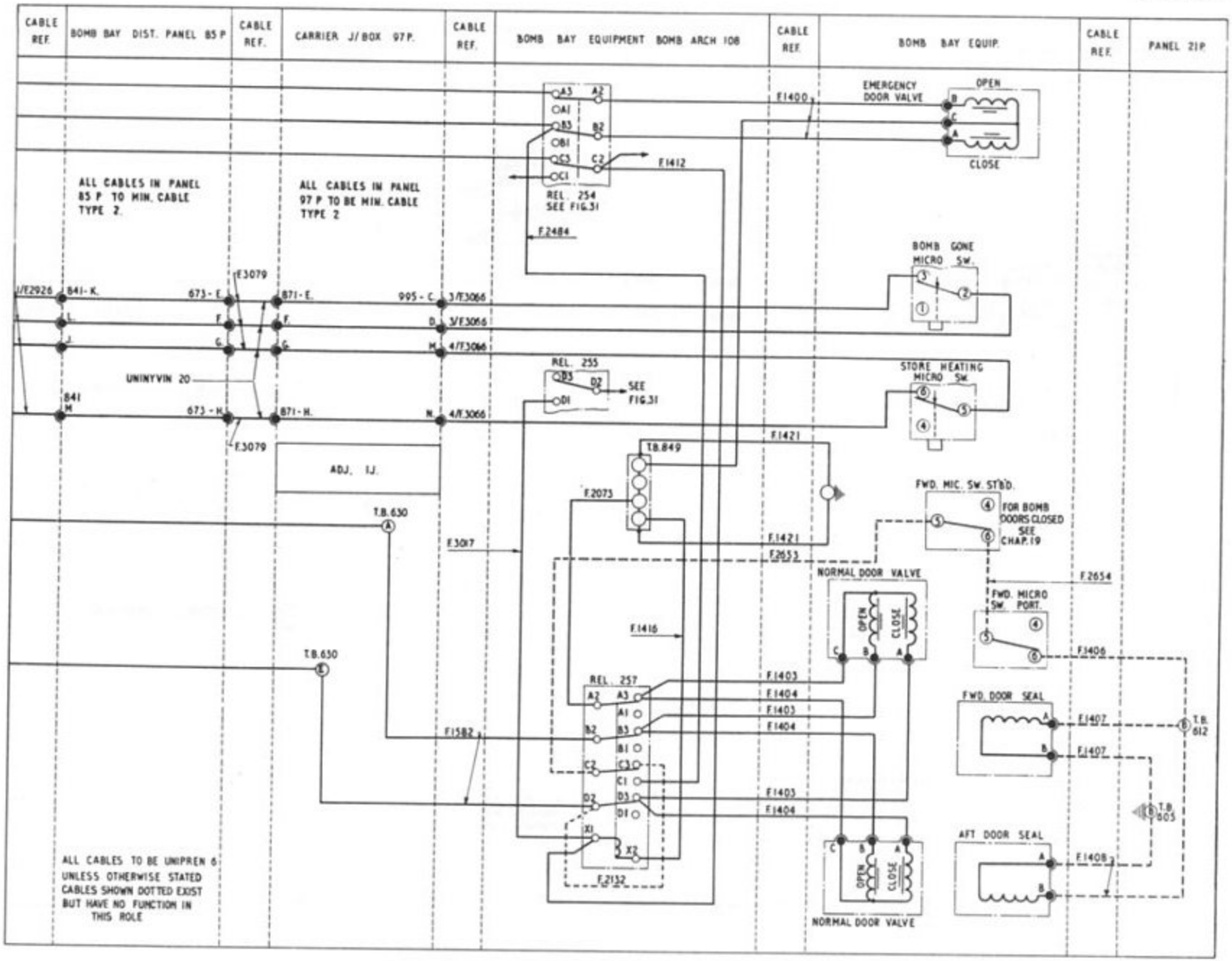

Fig. 30 (2) Fin-gap door controls
(◄T.B. 630 - B now E►)

RESTRICTED

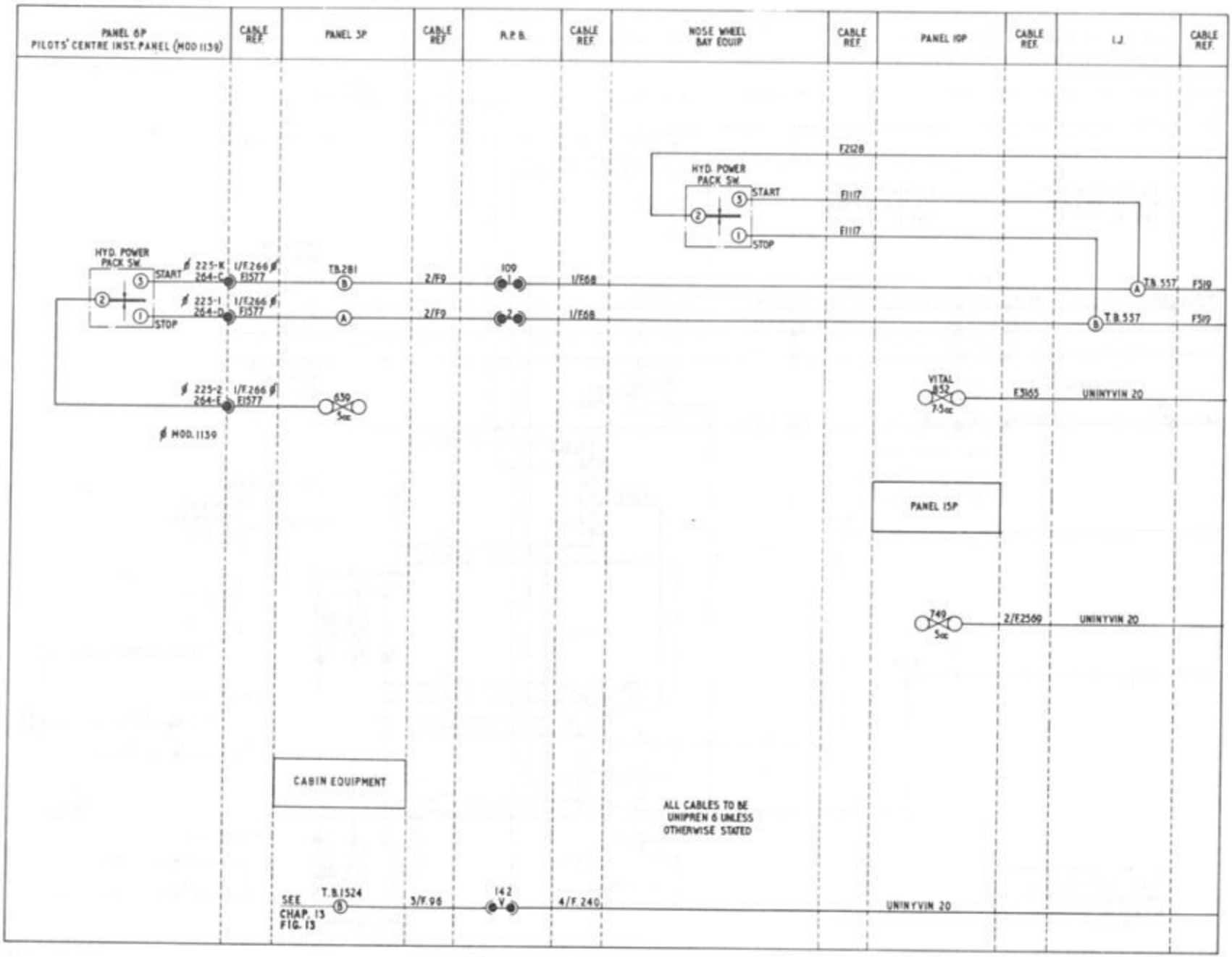

Fig. 31(1) Emergency hydraulic power pack

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V.2.1B.1258

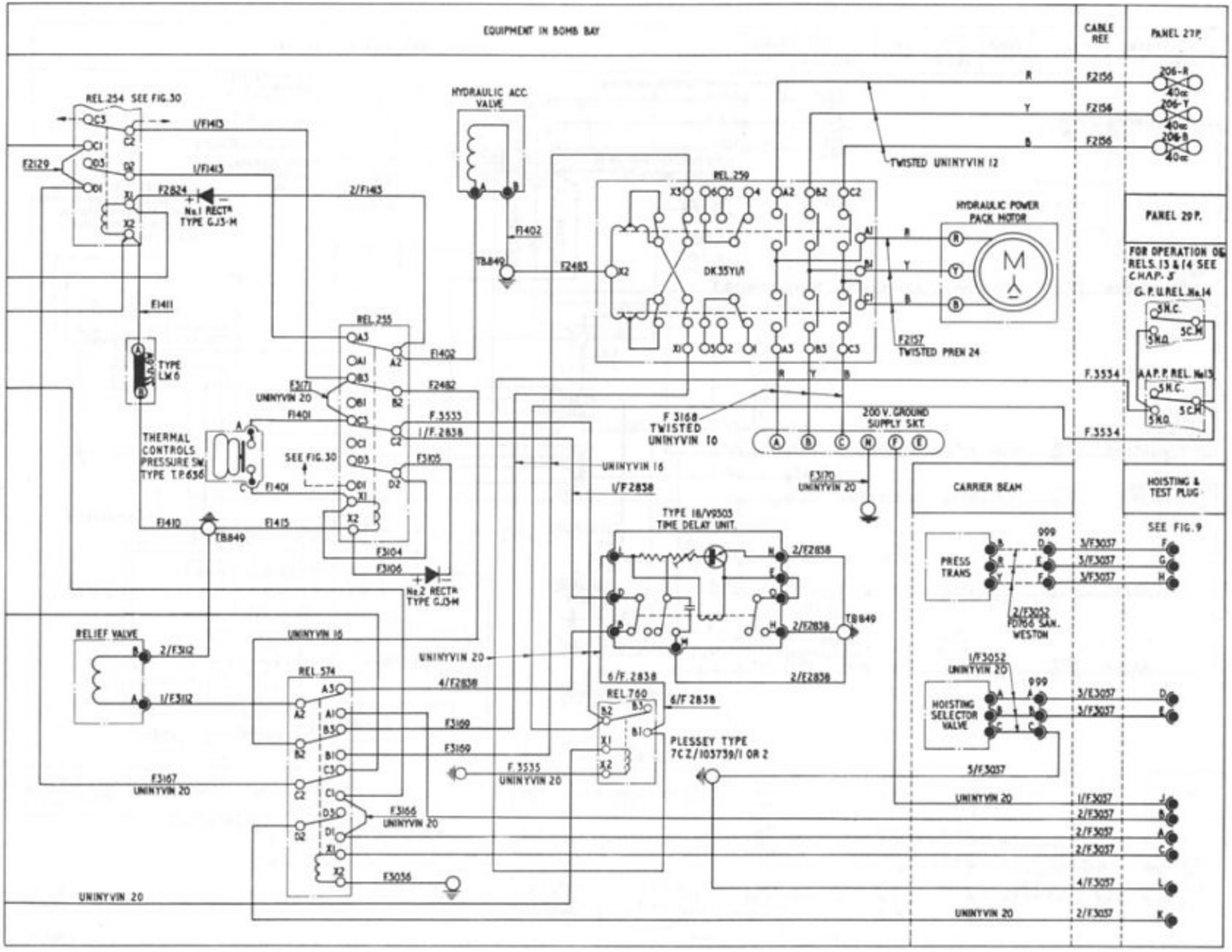

Fig. 31 (2) Emergency hydraulic power pack

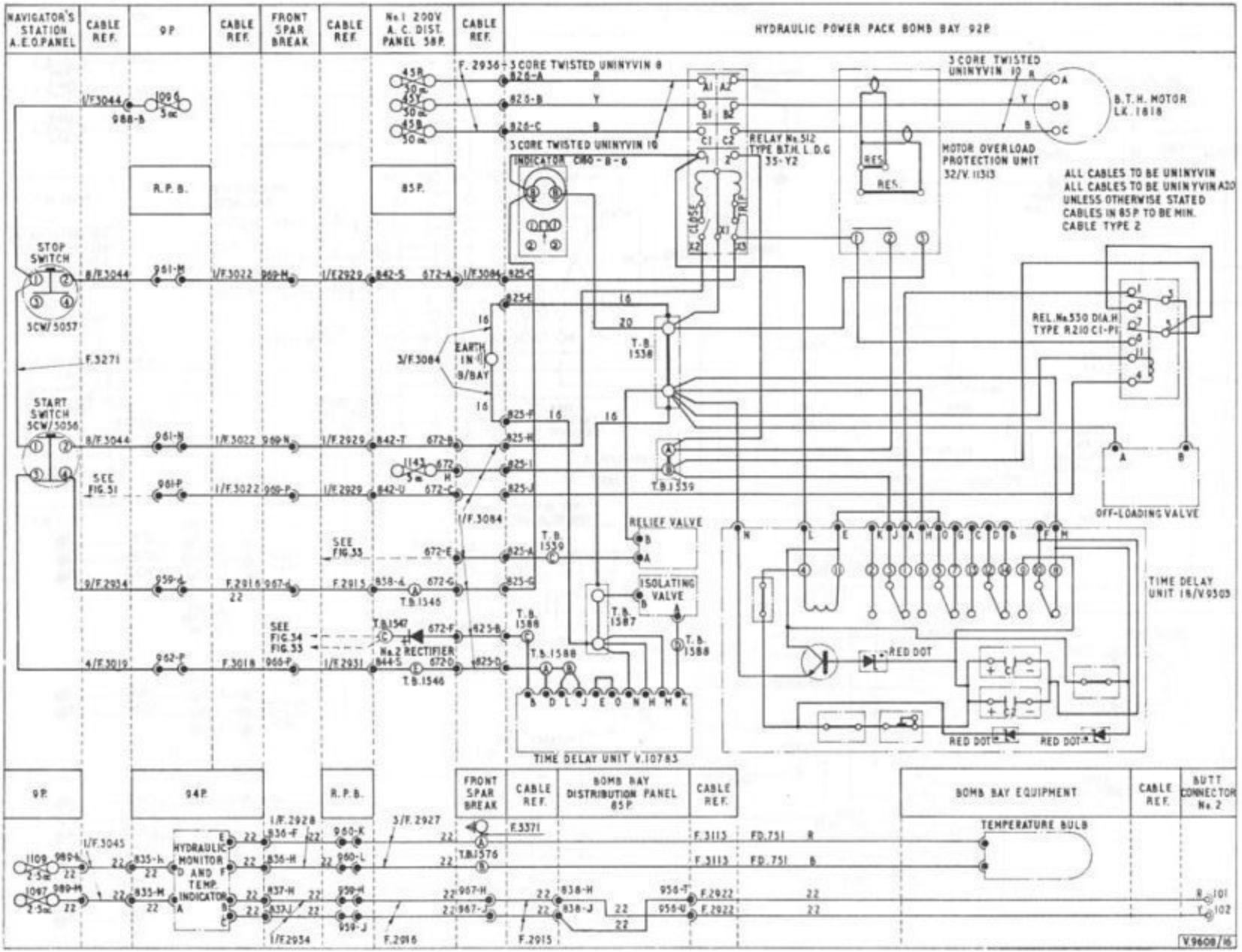

Fig.32. Hydraulic power unit and monitoring
(Mod.2102 incorporated)

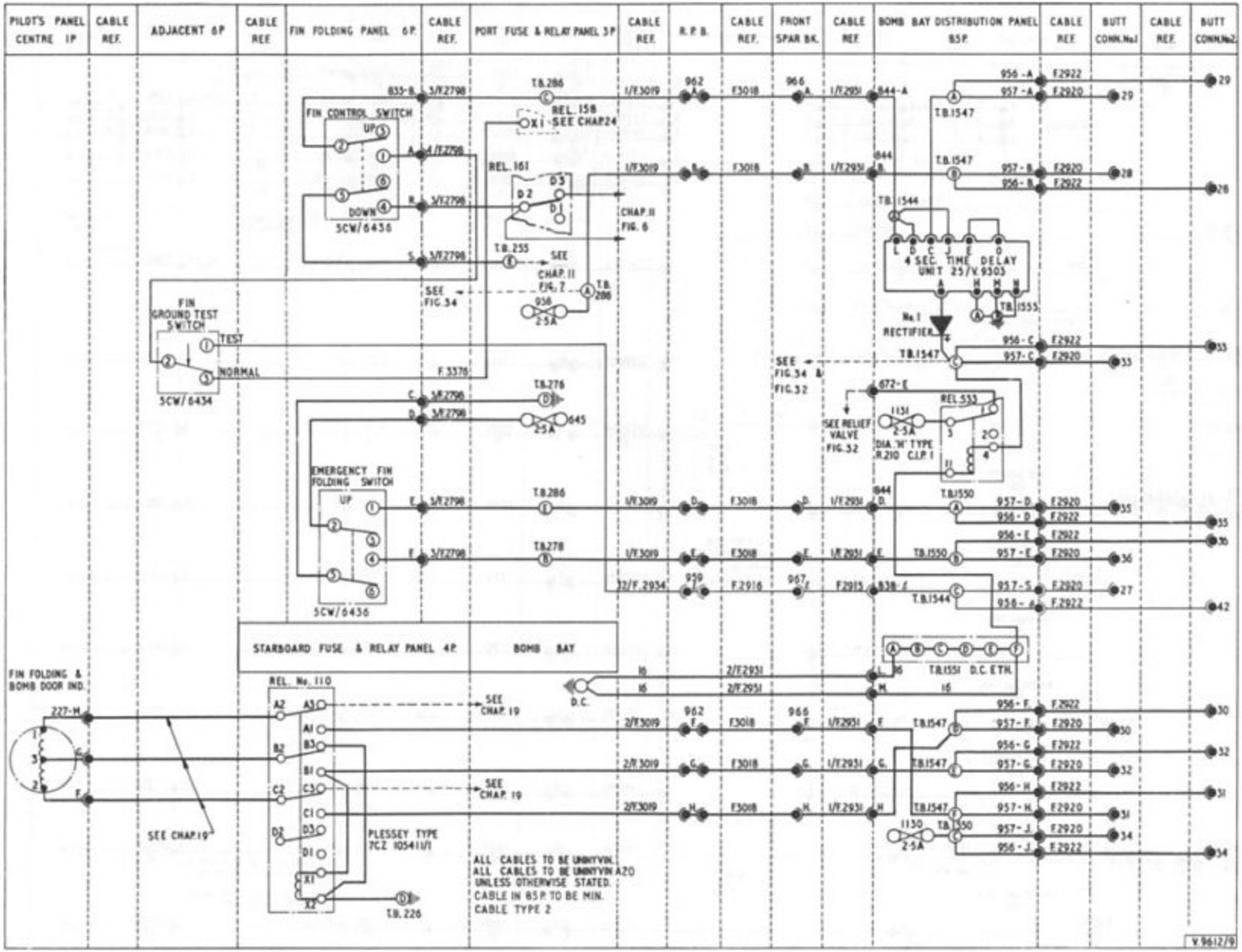

Fig.33. Folding fin control and indication
(alterations at relay 161)

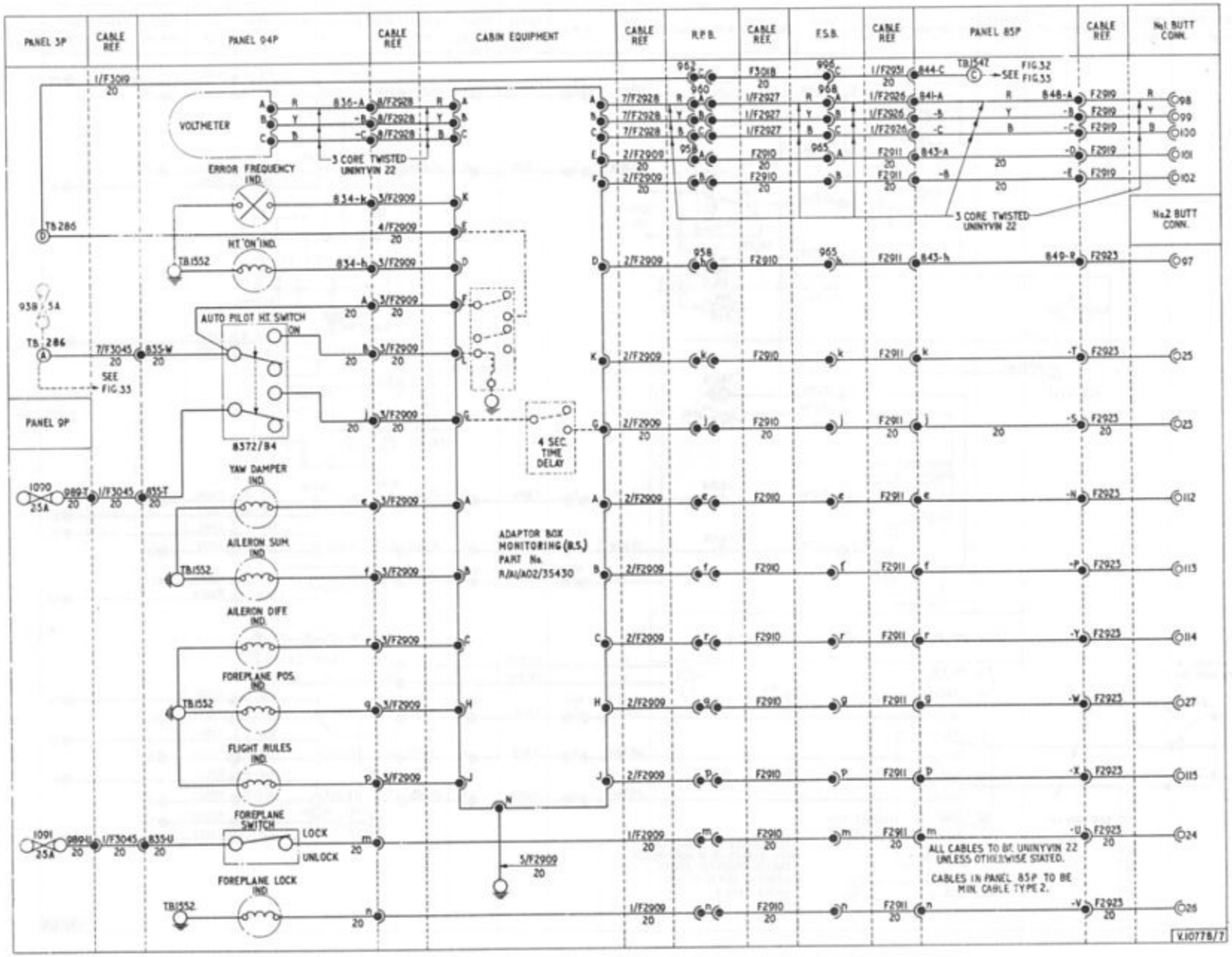

Fig.34. Control system switching and monitoring
◀ *(Mod.2056 incorporated)* ▶

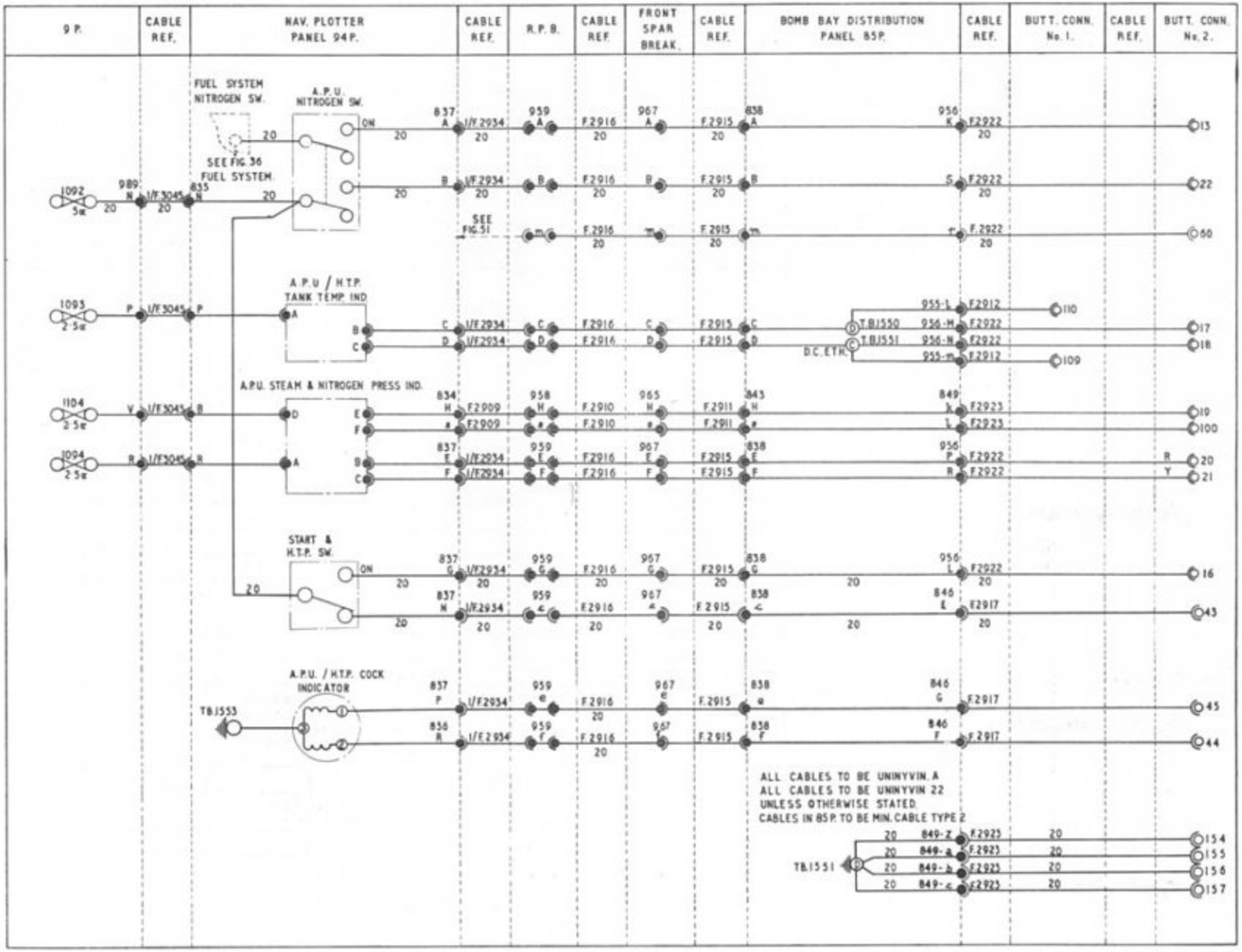

Fig. 35 A.P.U. start and monitoring

RESTRICTED

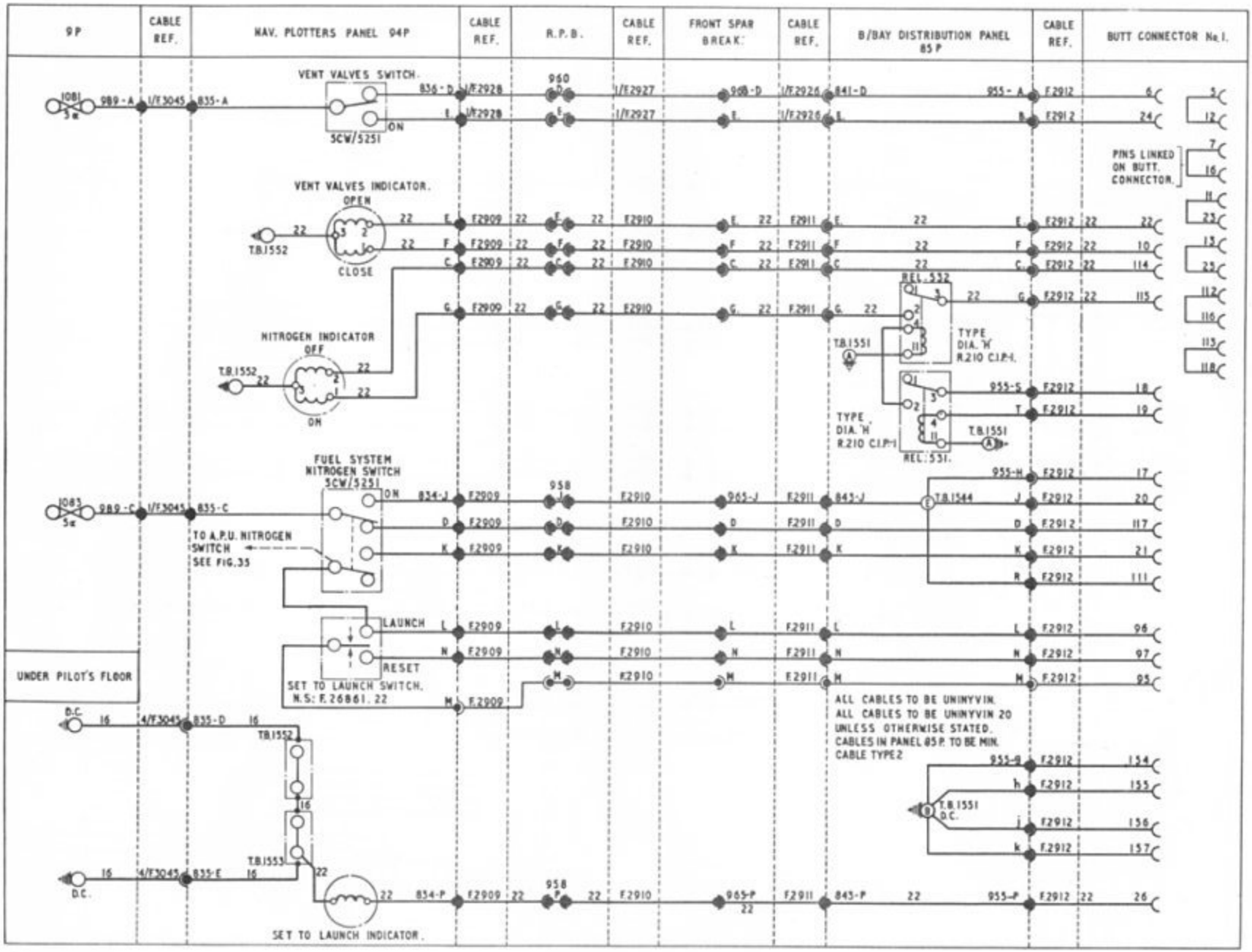

Fig. 36 Propulsion system control

RESTRICTED

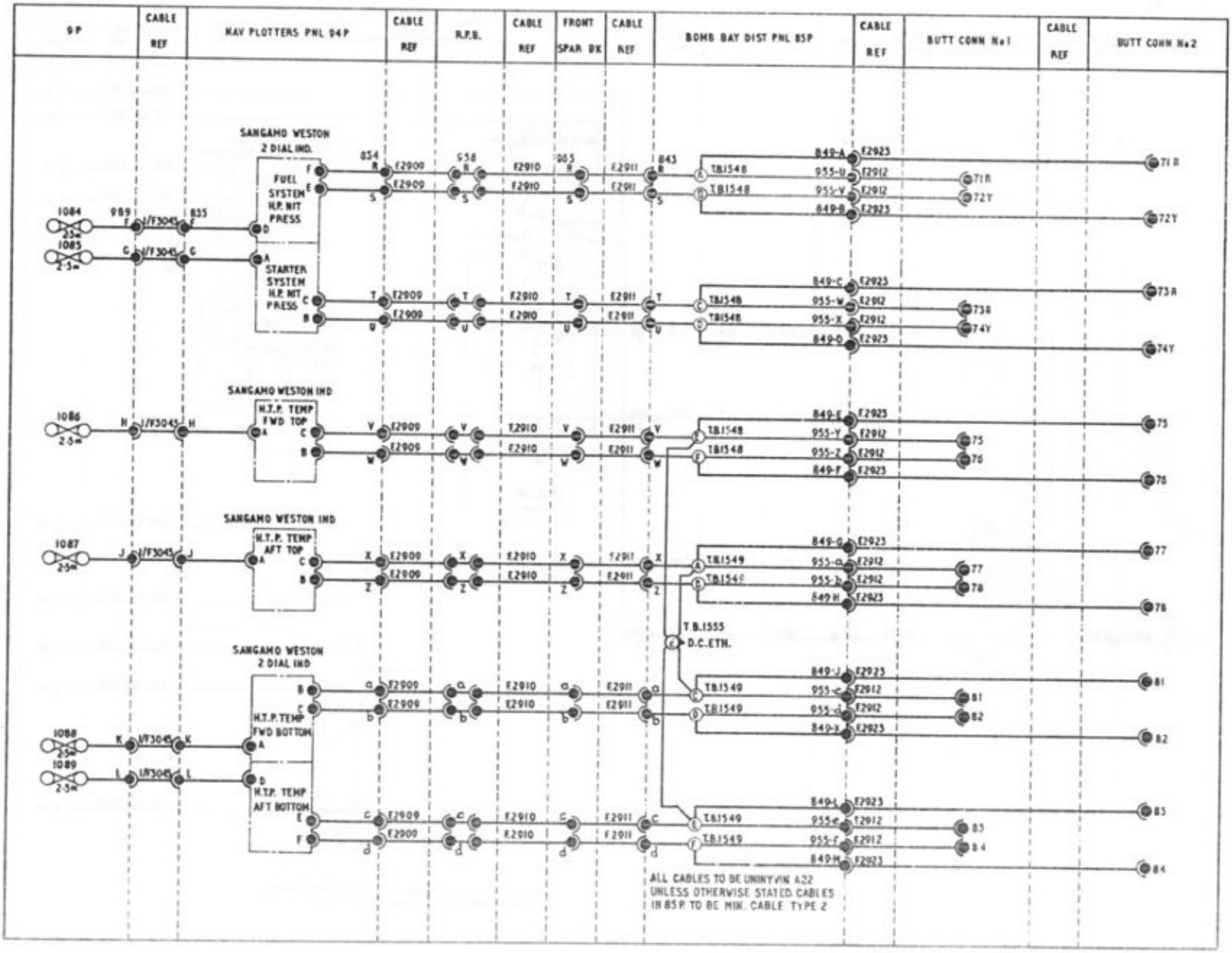

Fig. 37 Propulsion system monitoring

RESTRICTED

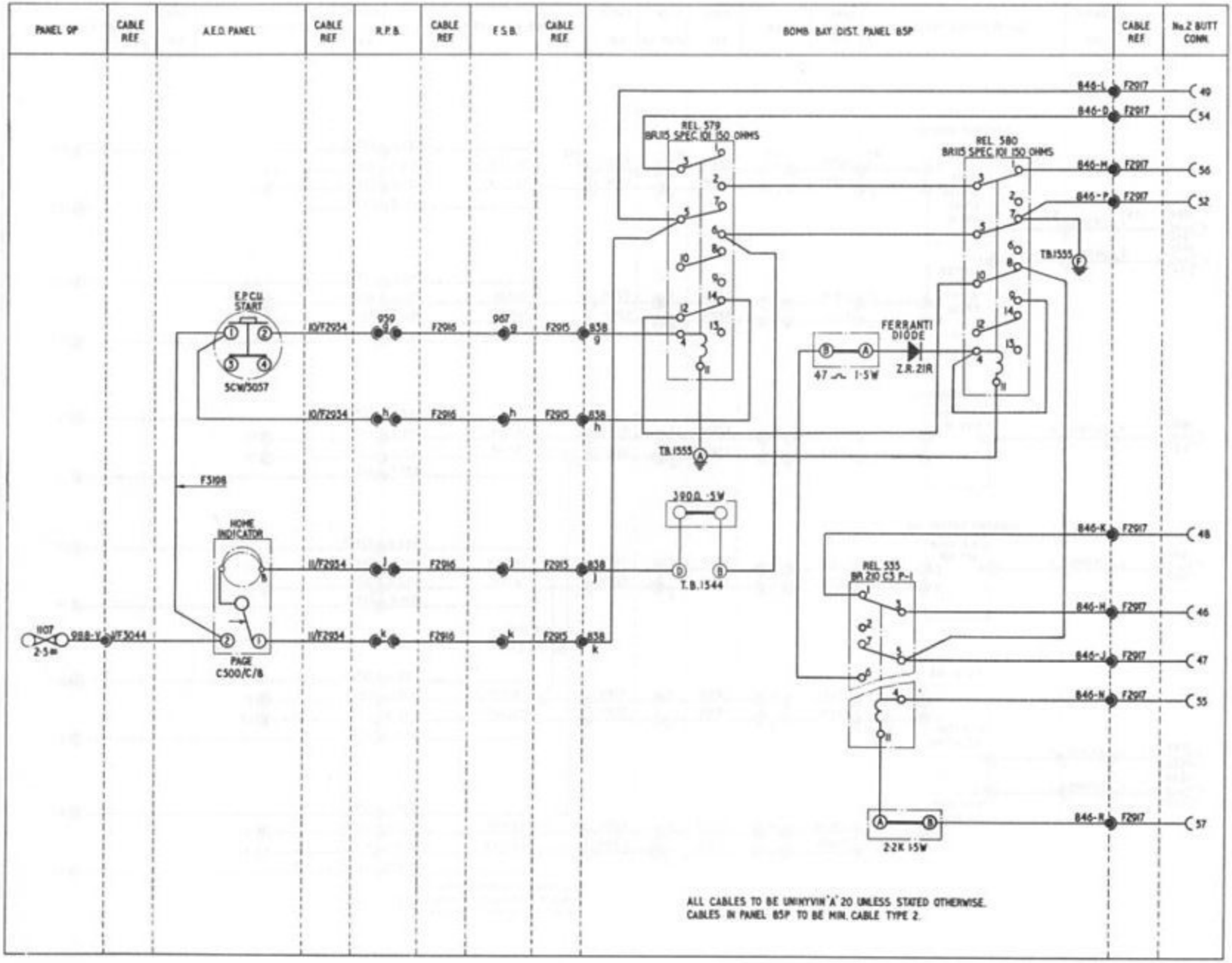

Fig. 38 Starting of E.P.C.U.

(Mod 1633)

RESTRICTED

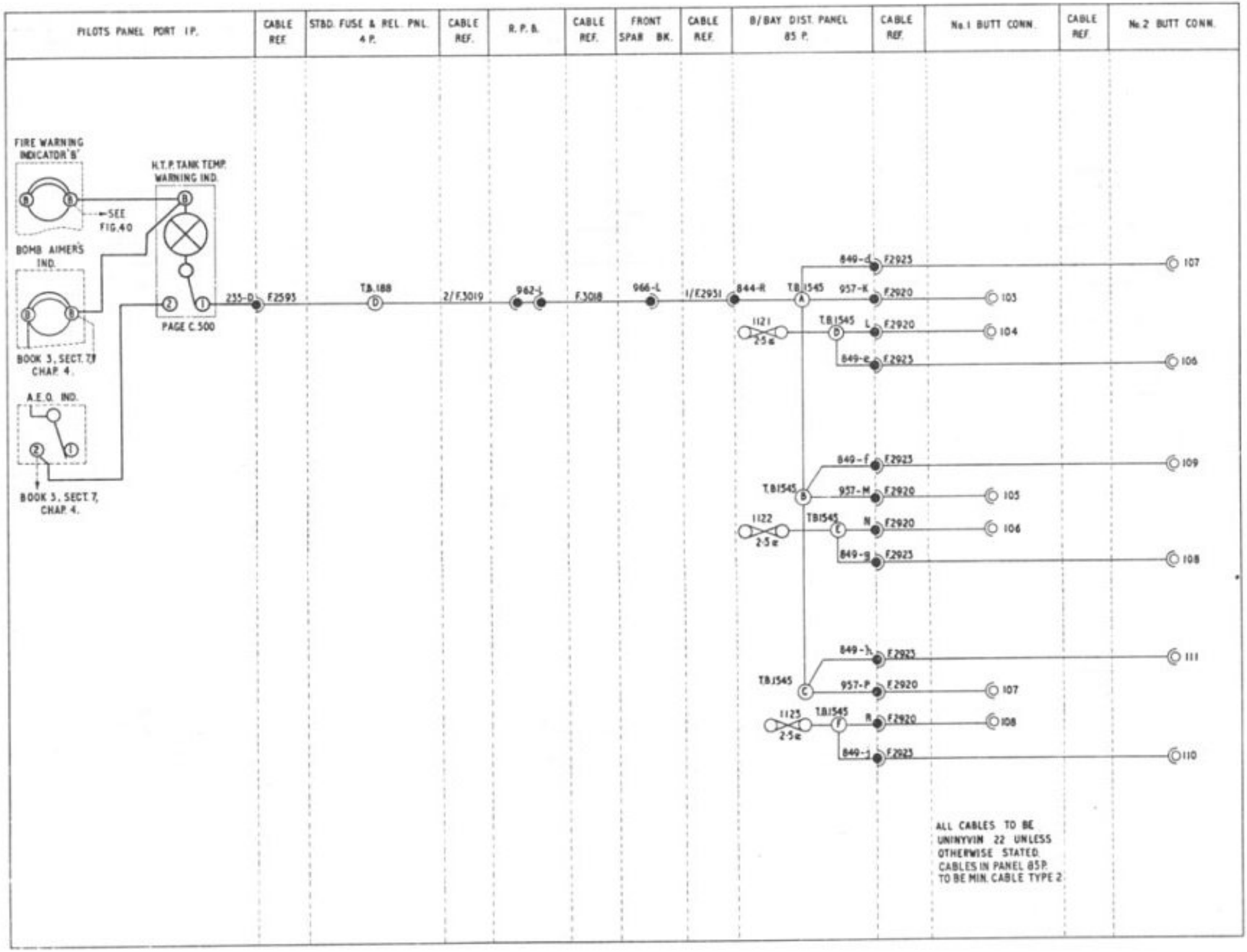

Fig. 39 H.T.P. tanks temperature warning
(◄ Mod. 1888 ►)

RESTRICTED

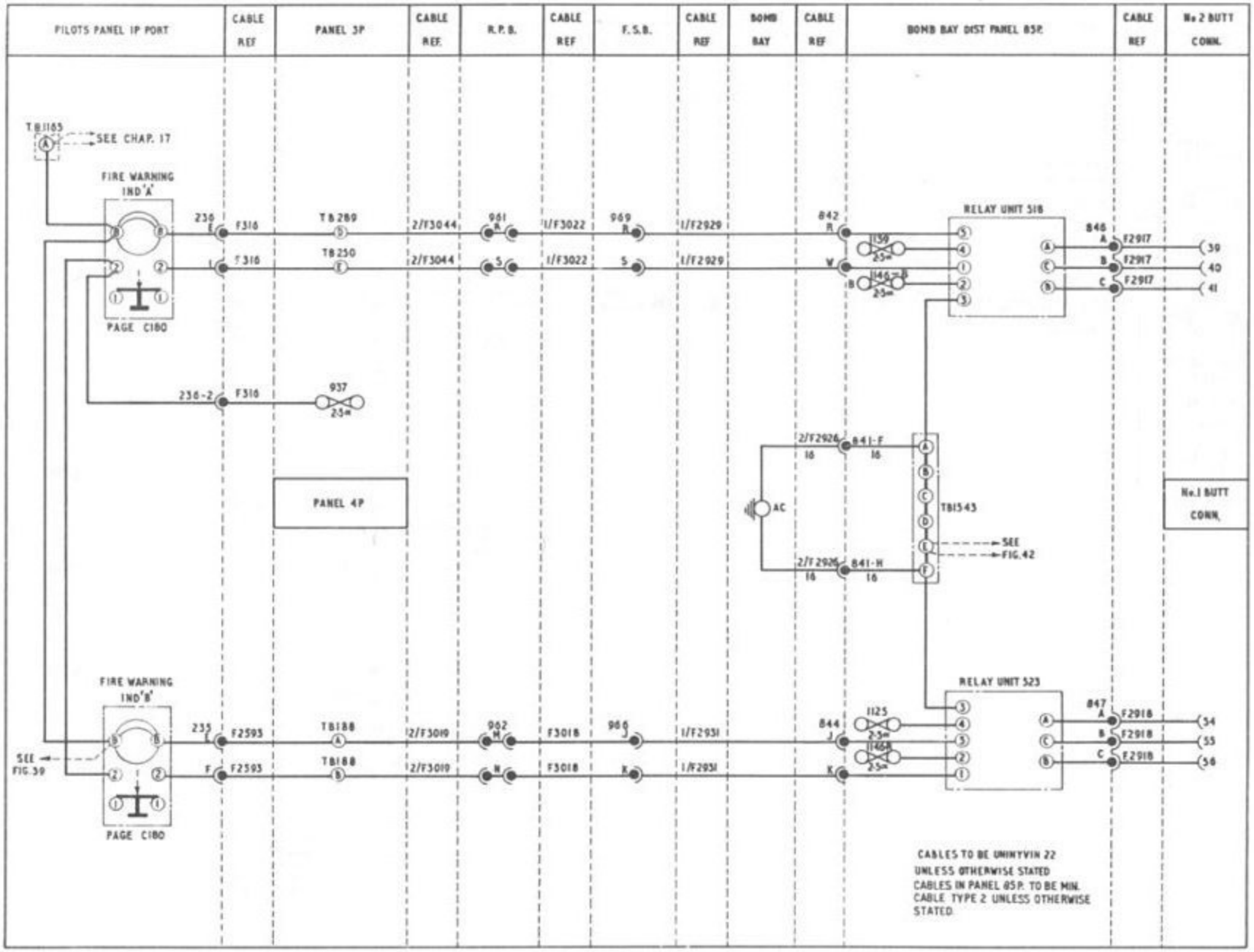

Fig. 40 Fire detection system

(◂ *T.B. 1165E now 1165A* ▸)

RESTRICTED

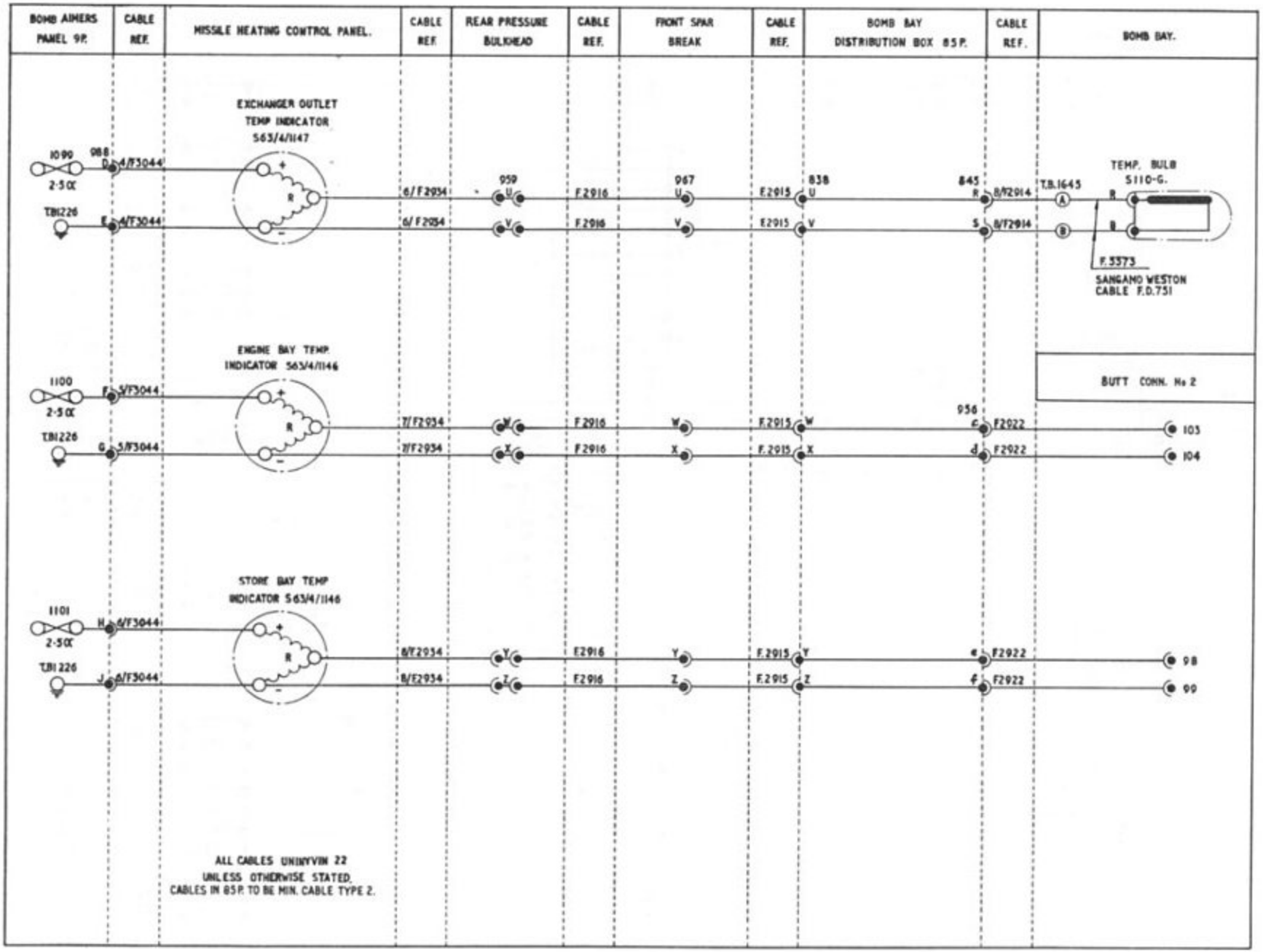

Fig. 41 Heating system indication

RESTRICTED

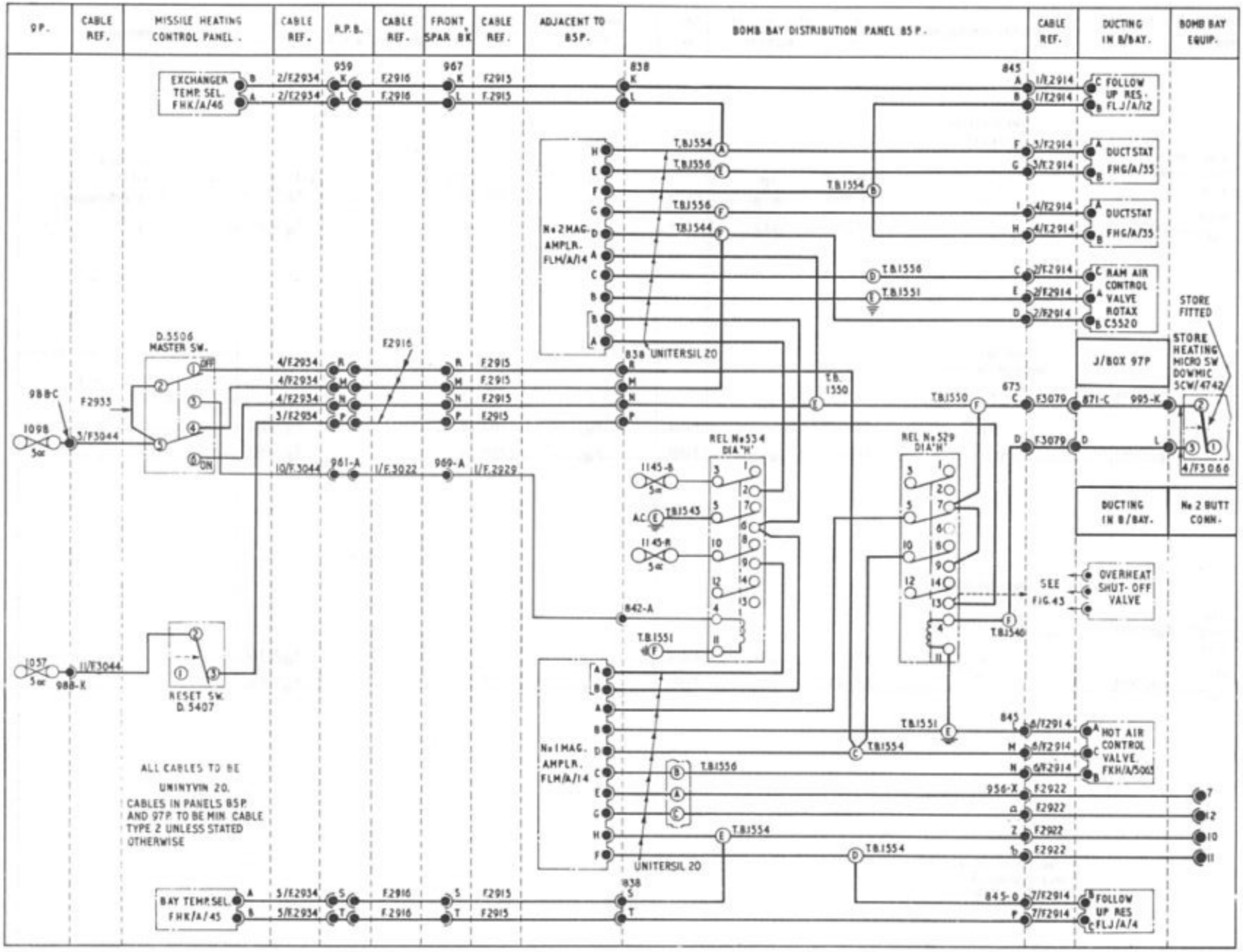

Fig. 42 Heating system

(◄ *Note added at micro switch* ►)

RESTRICTED

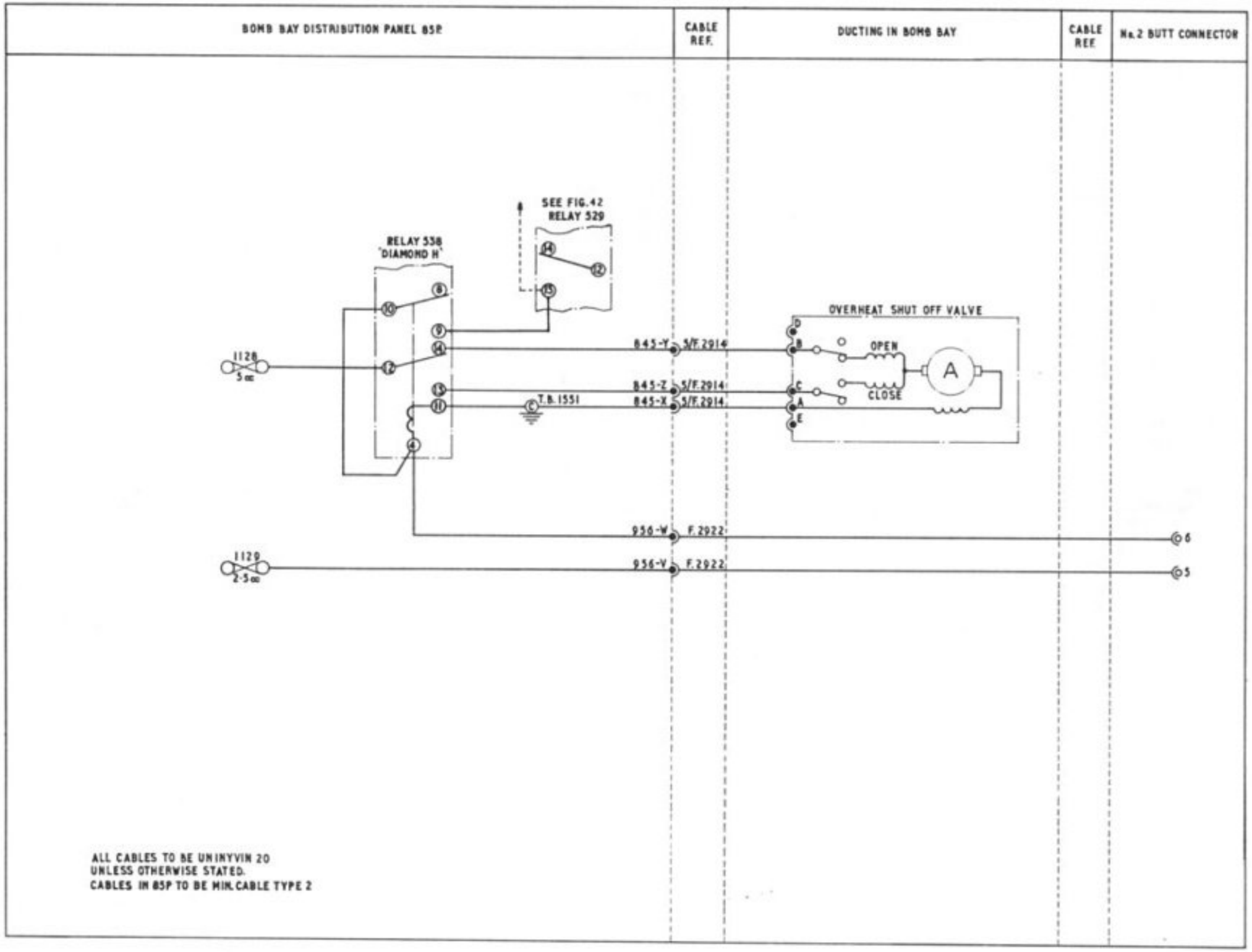

Fig.43. Overheat control

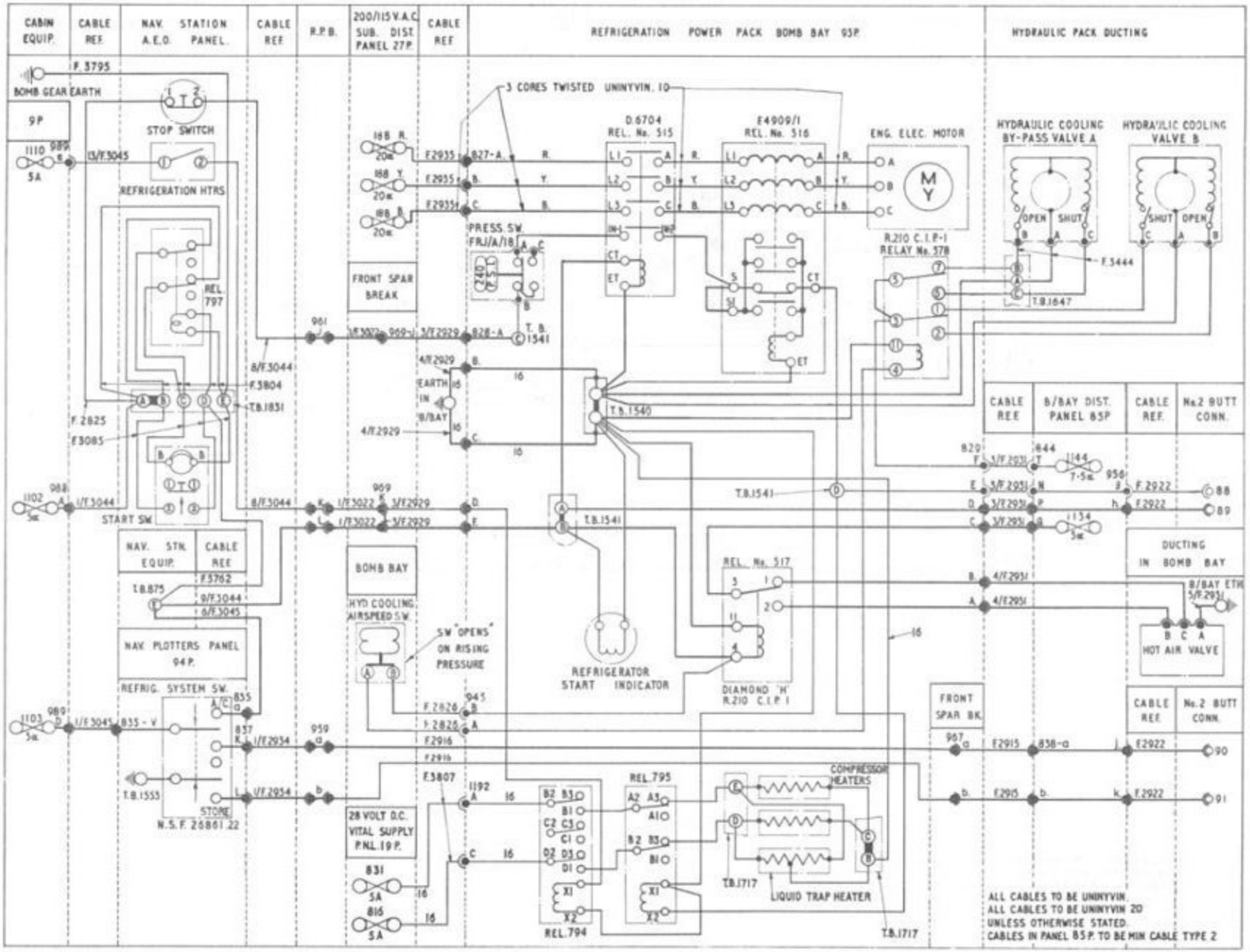

Fig. 44 Refrigeration system

(▲ Fuse 1144 rating increased ▼)

RESTRICTED

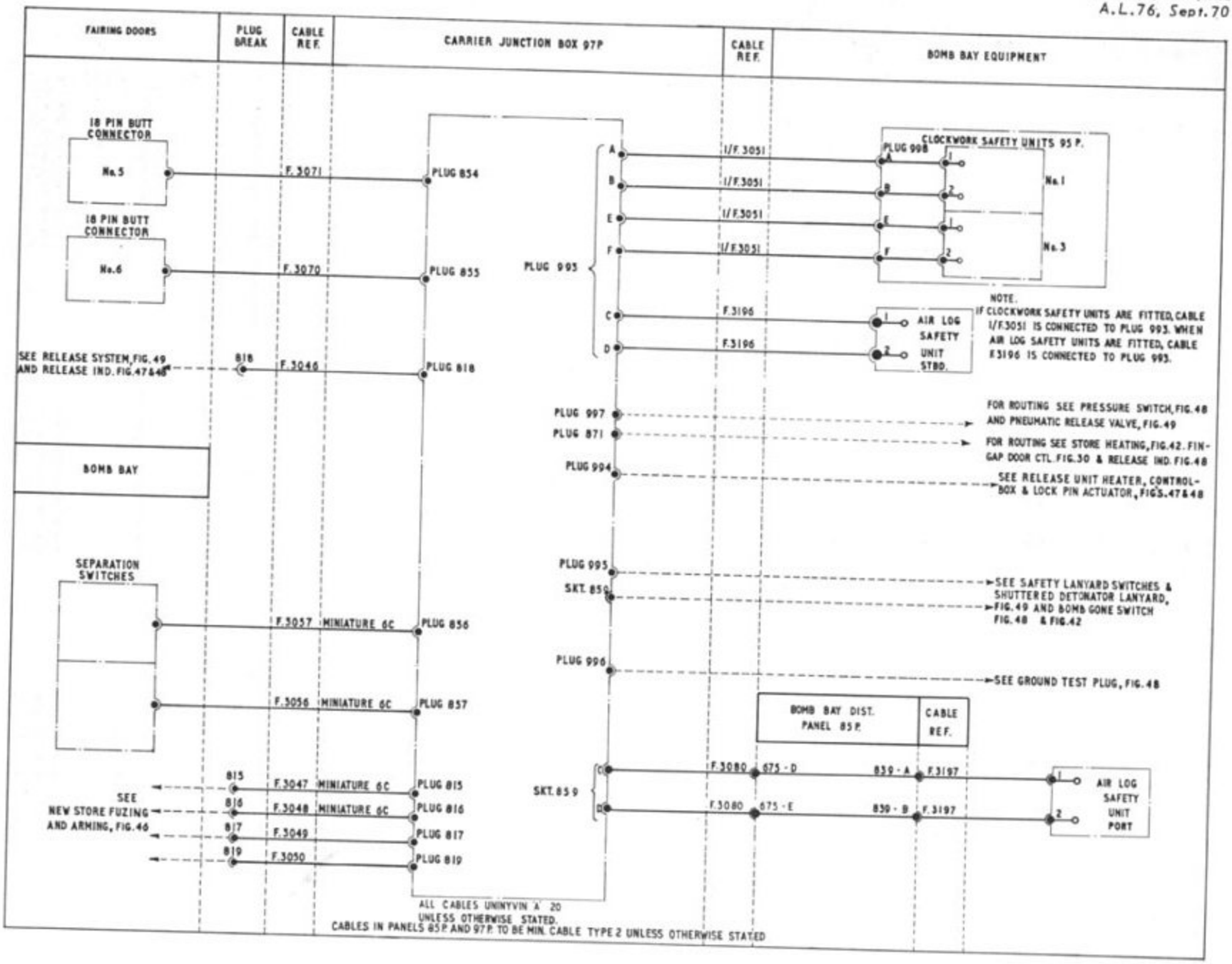

Fig.45 Fuzing, arming and release

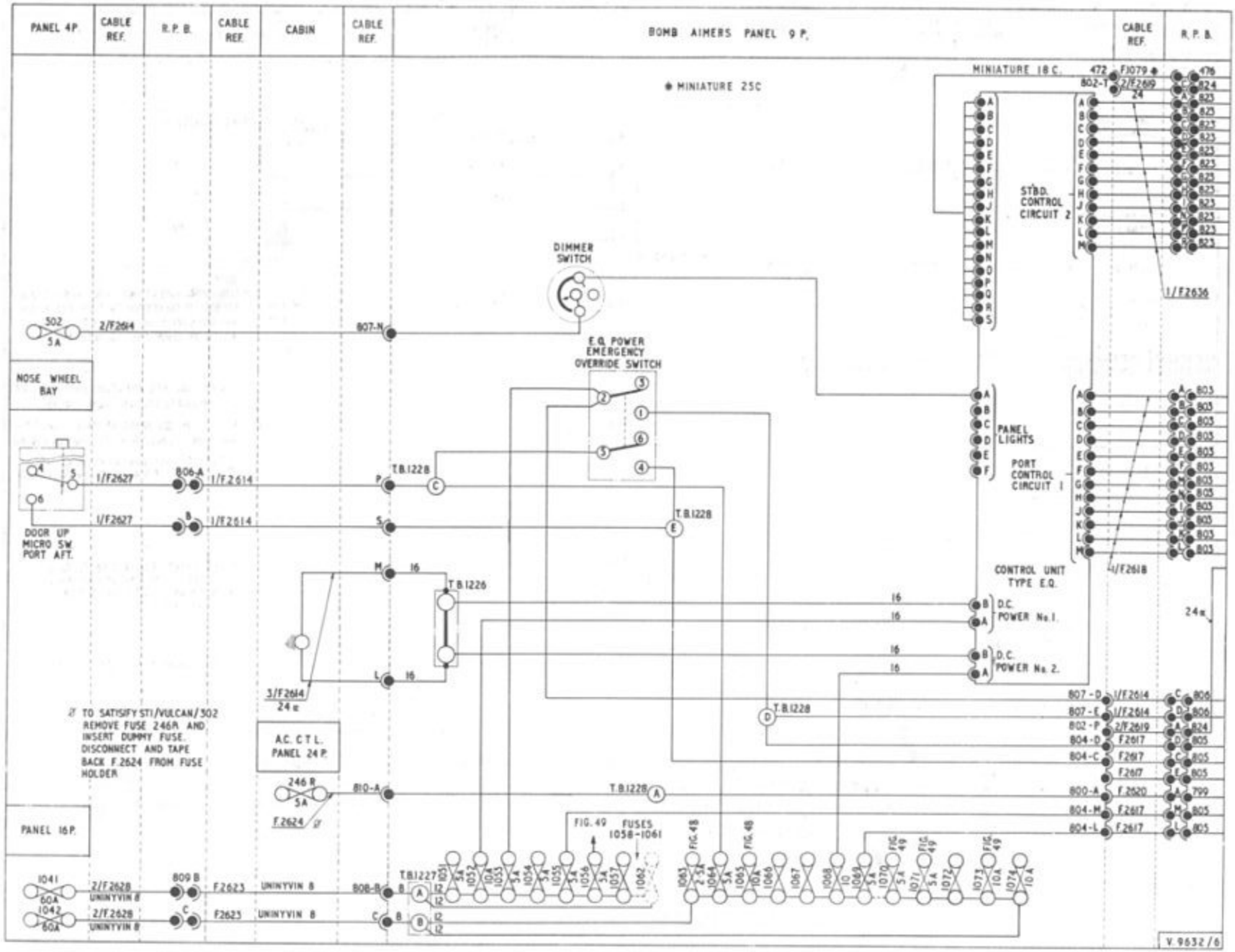

Fig.46(1) Fuzing and arming

(Note referring to S.T.I./Vulcan/302 added)

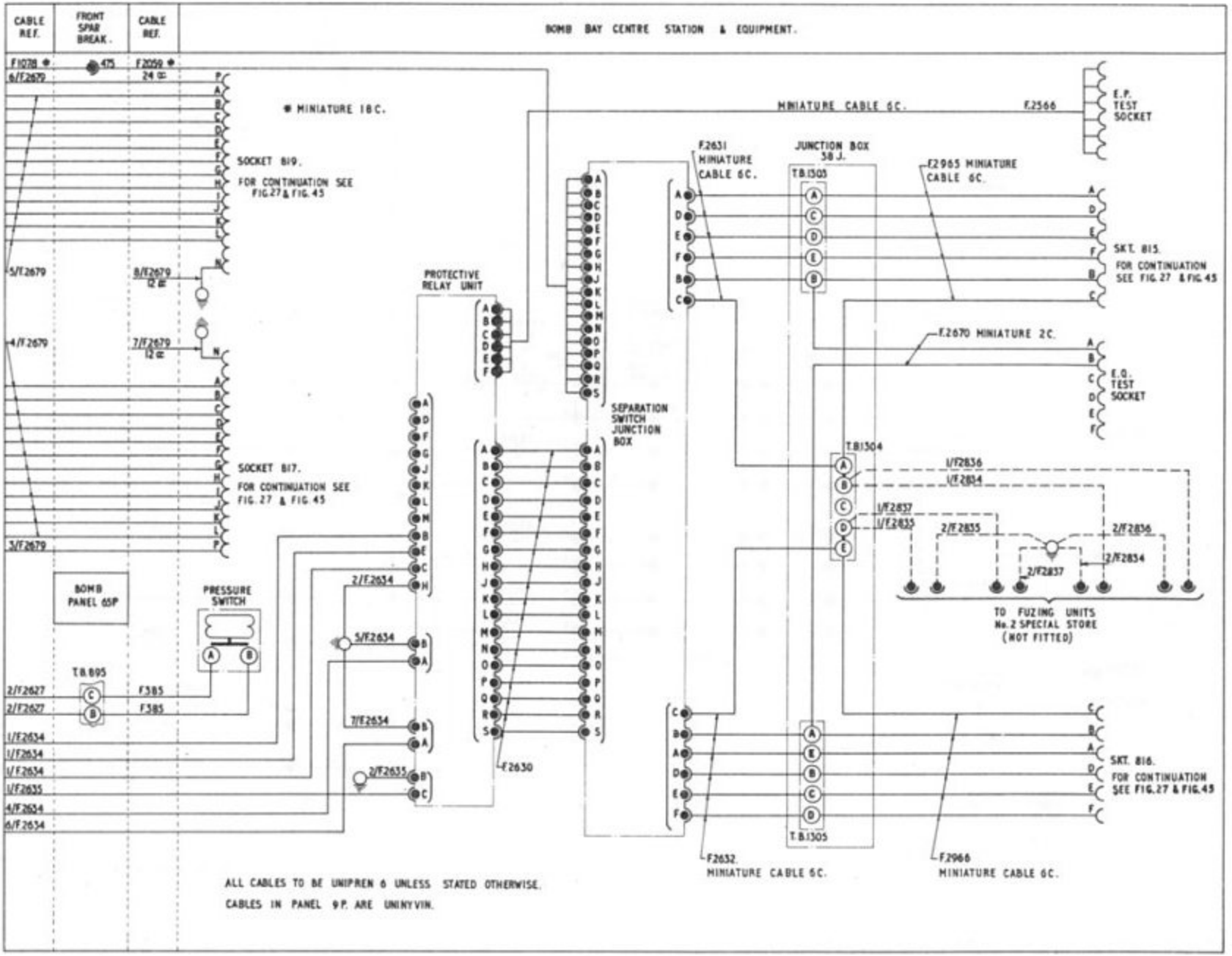

Fig.46(2) Fuzing and arming

RESTRICTED

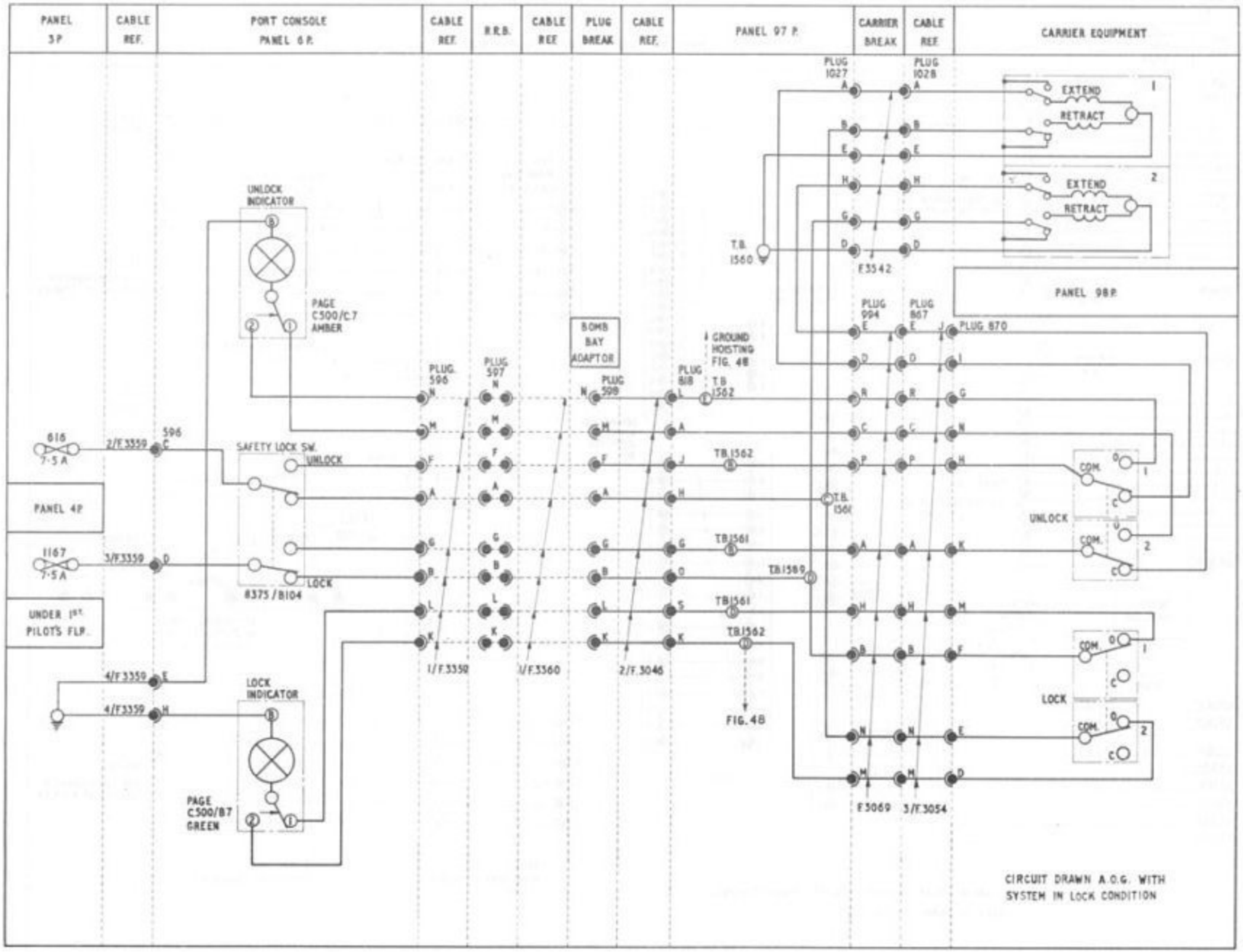

Fig. 47. Release unit safety lock.

(◄ Bomb bay column changed ►)

RESTRICTED

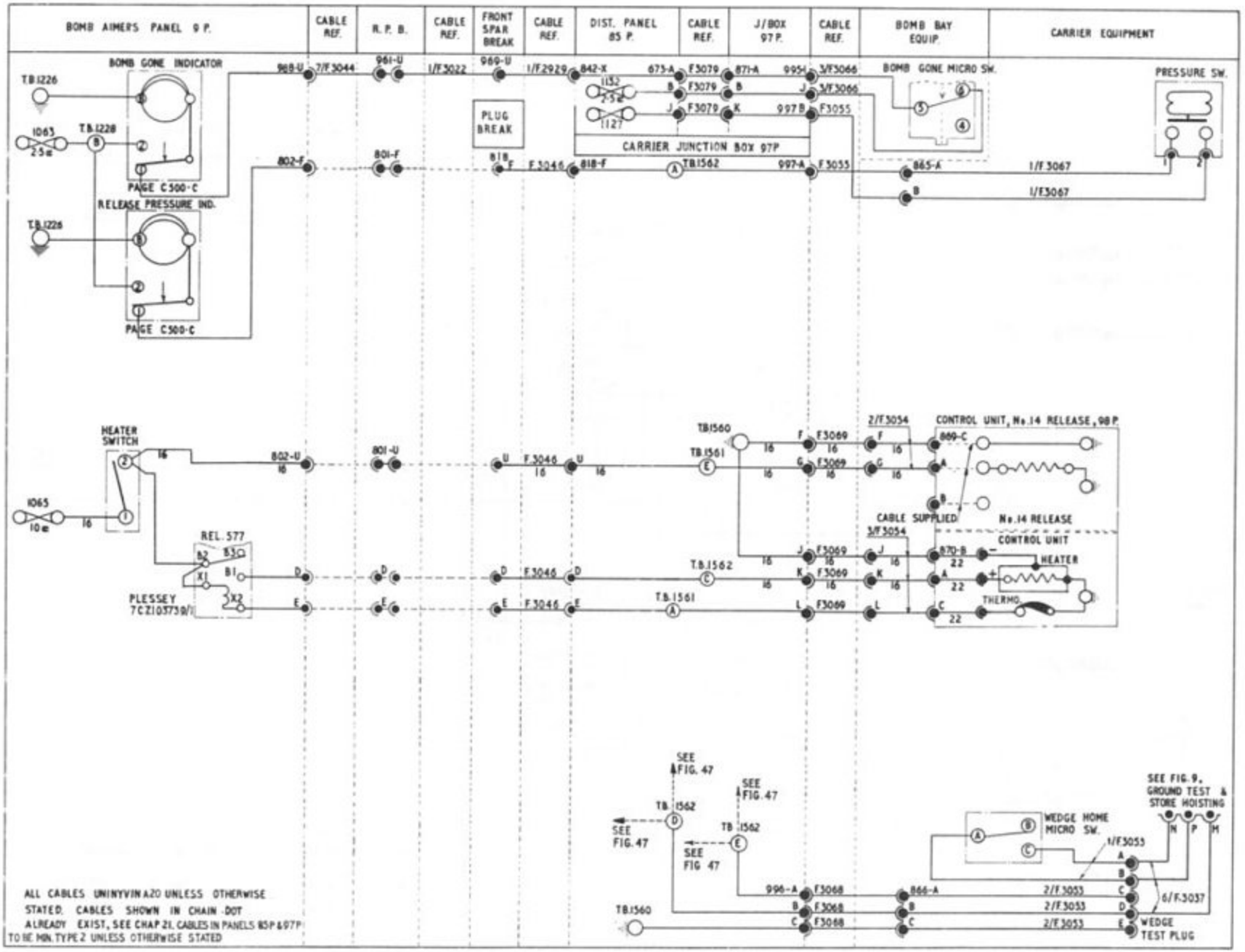

Fig. 48 Release system indication and slip heaters

(◀ *Mods 1350 and 1353* ▶)

RESTRICTED

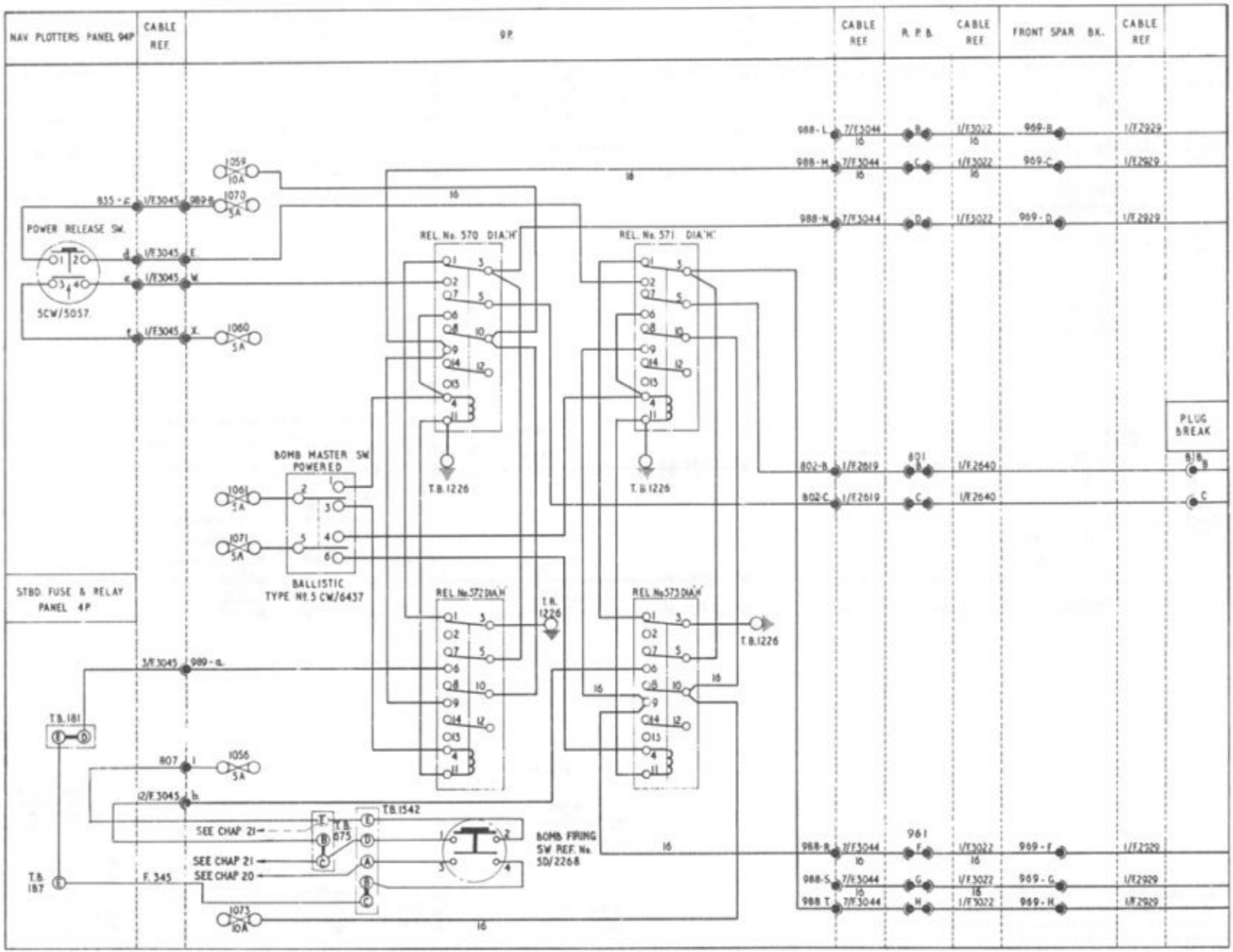

Fig. 49 (1) Release system

(◄Mod 2021►)

RESTRICTED

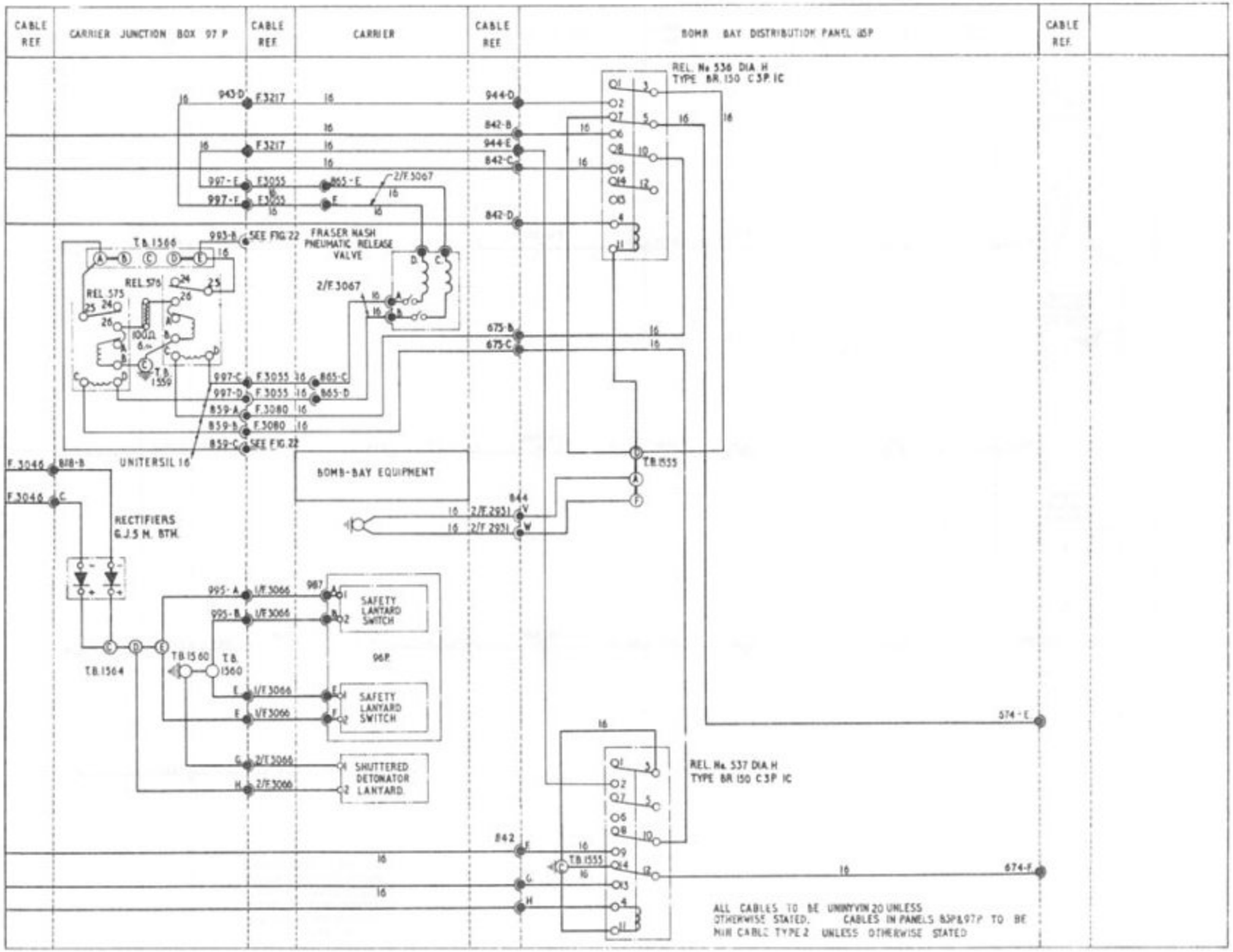

Fig. 49(2) Release system
(◂ Mods. 1429, 1492 and 1782 ▸)

RESTRICTED

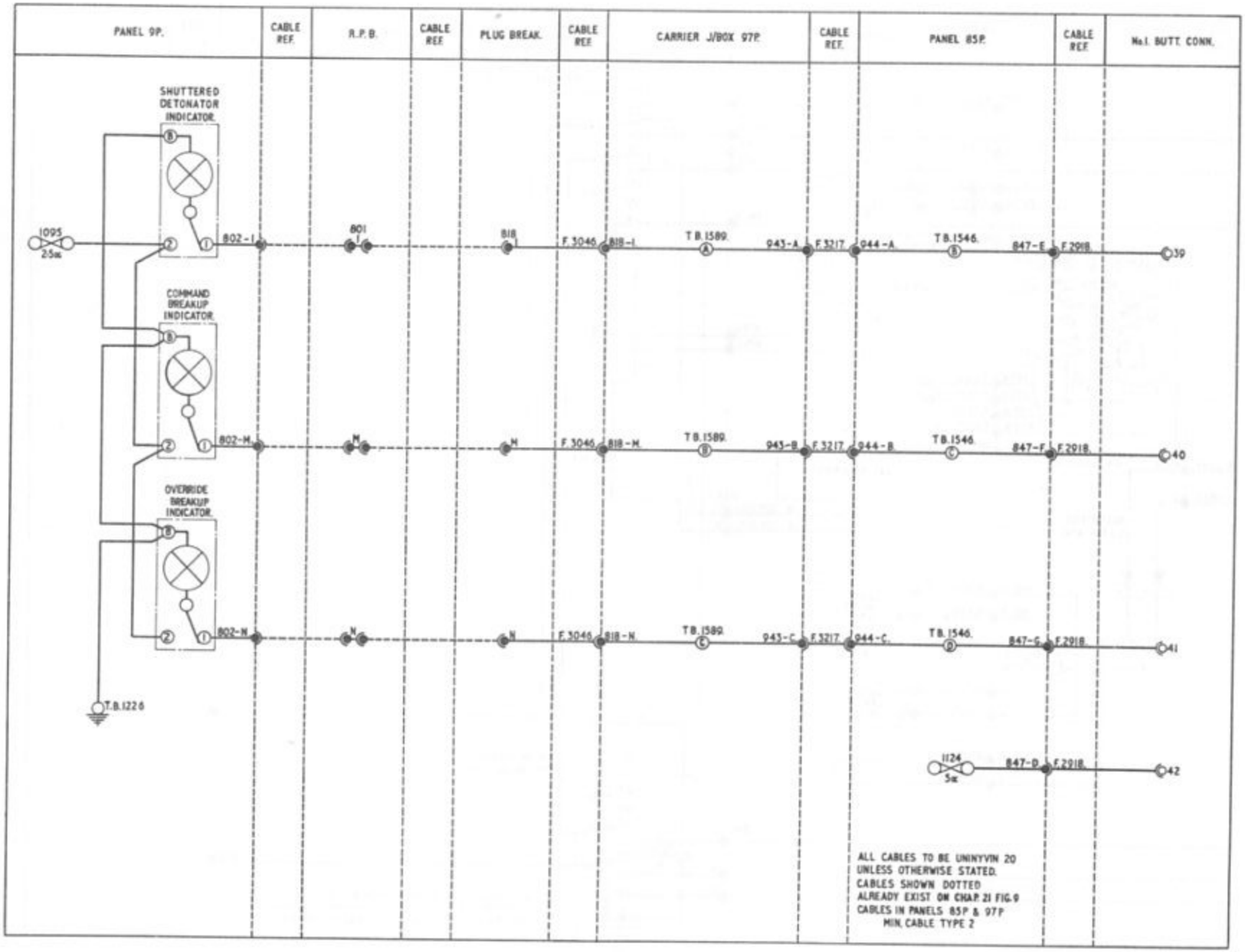

Fig. 50 Safety circuits
(◀ *Mods. 1350 and 1353* ▶)

RESTRICTED

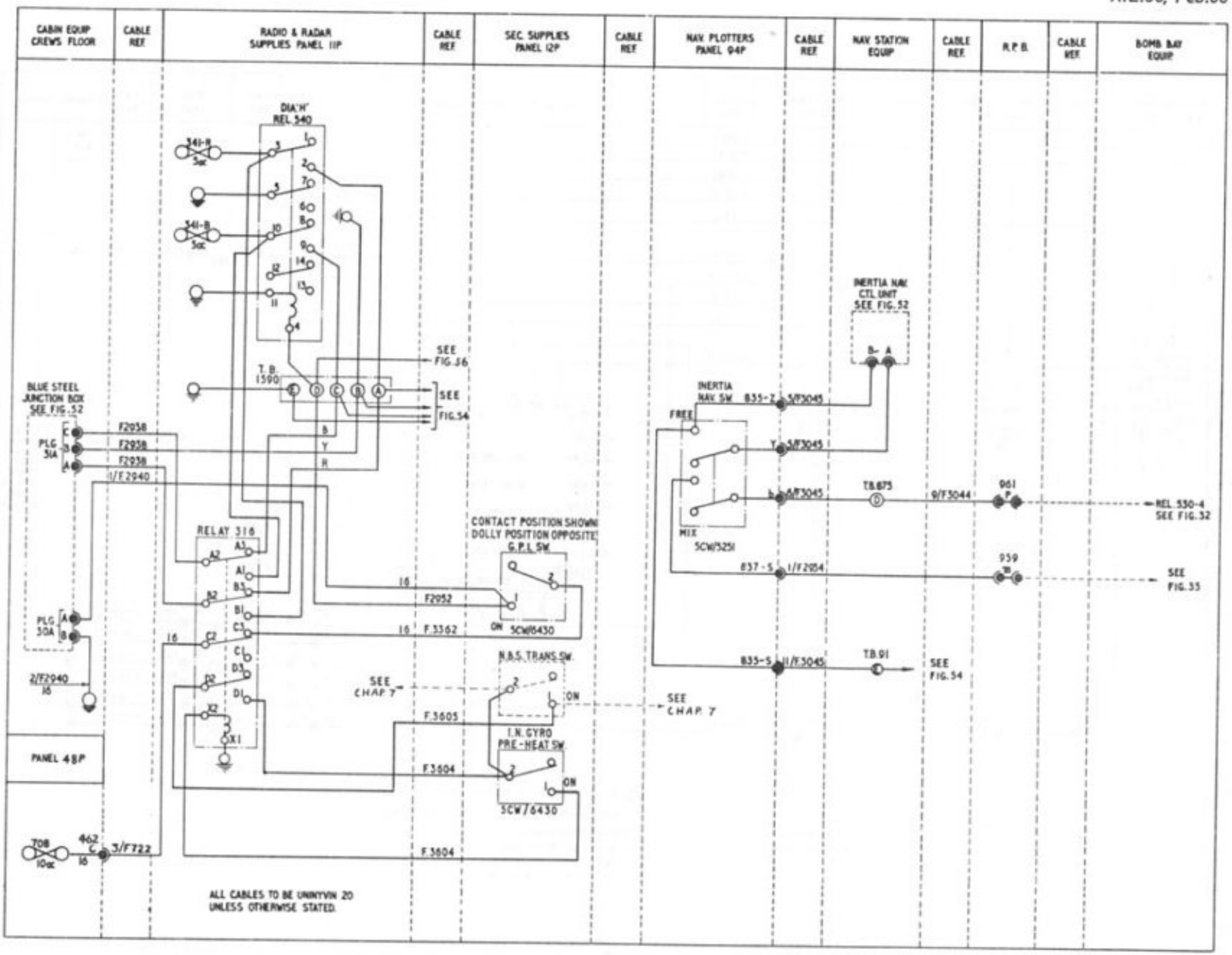

Fig.51 Inertia navigator supplies

(◂ Mods. 1698 and 1710 ▸)

RESTRICTED

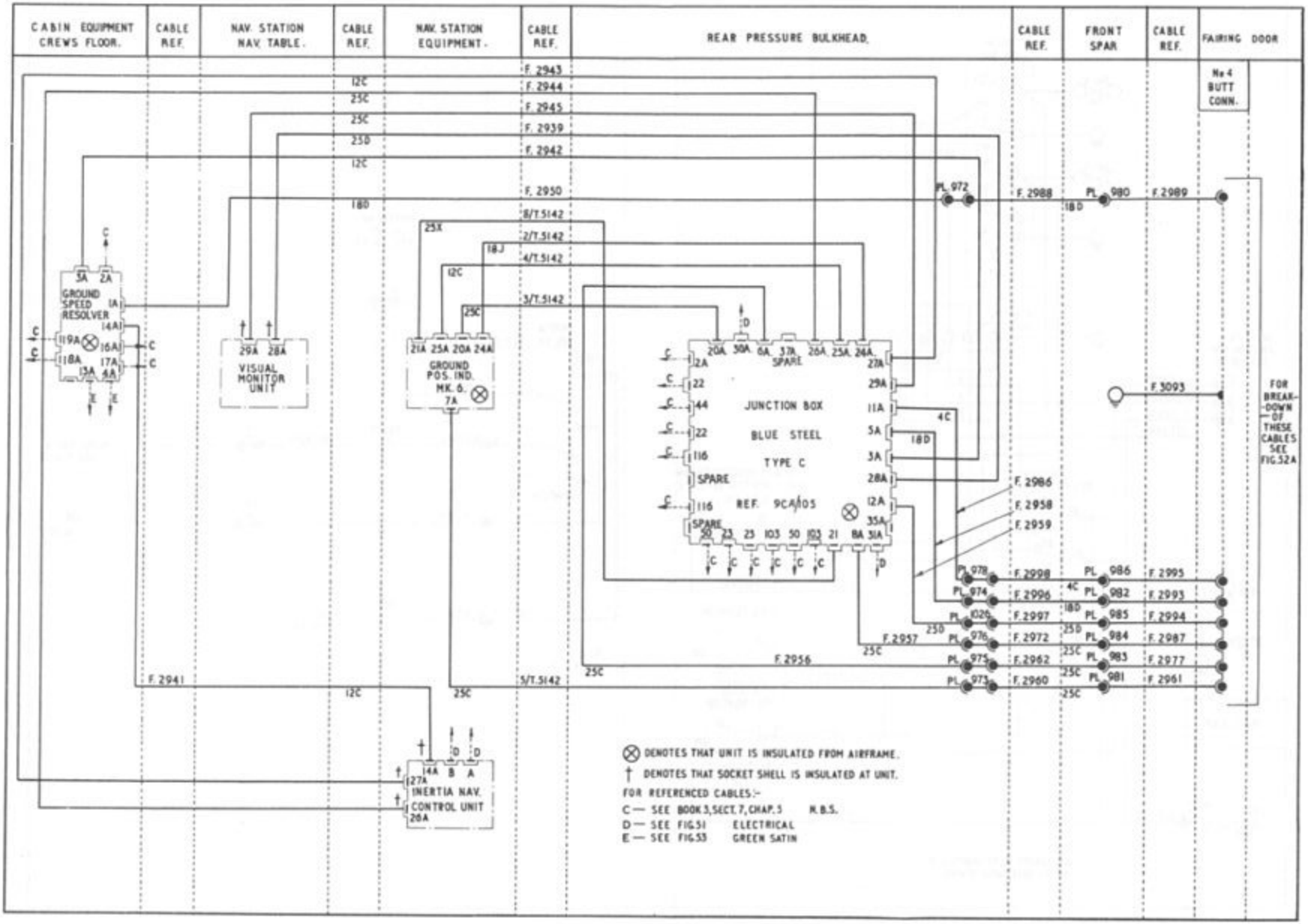

Fig. 52 Inertia navigator

(◄ Mod. 1852 ►)

RESTRICTED

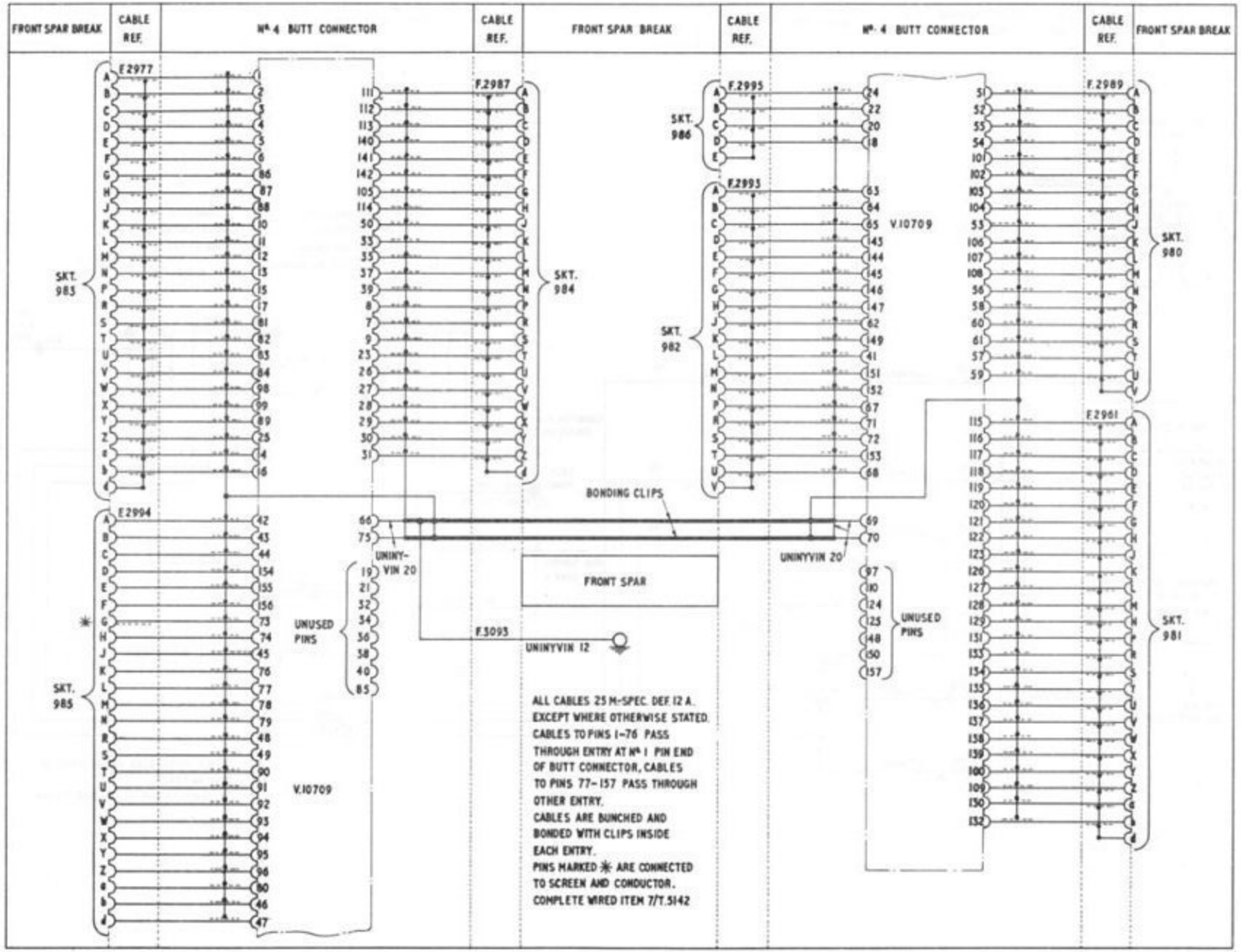

Fig. 52A No 4 Butt connector wiring.

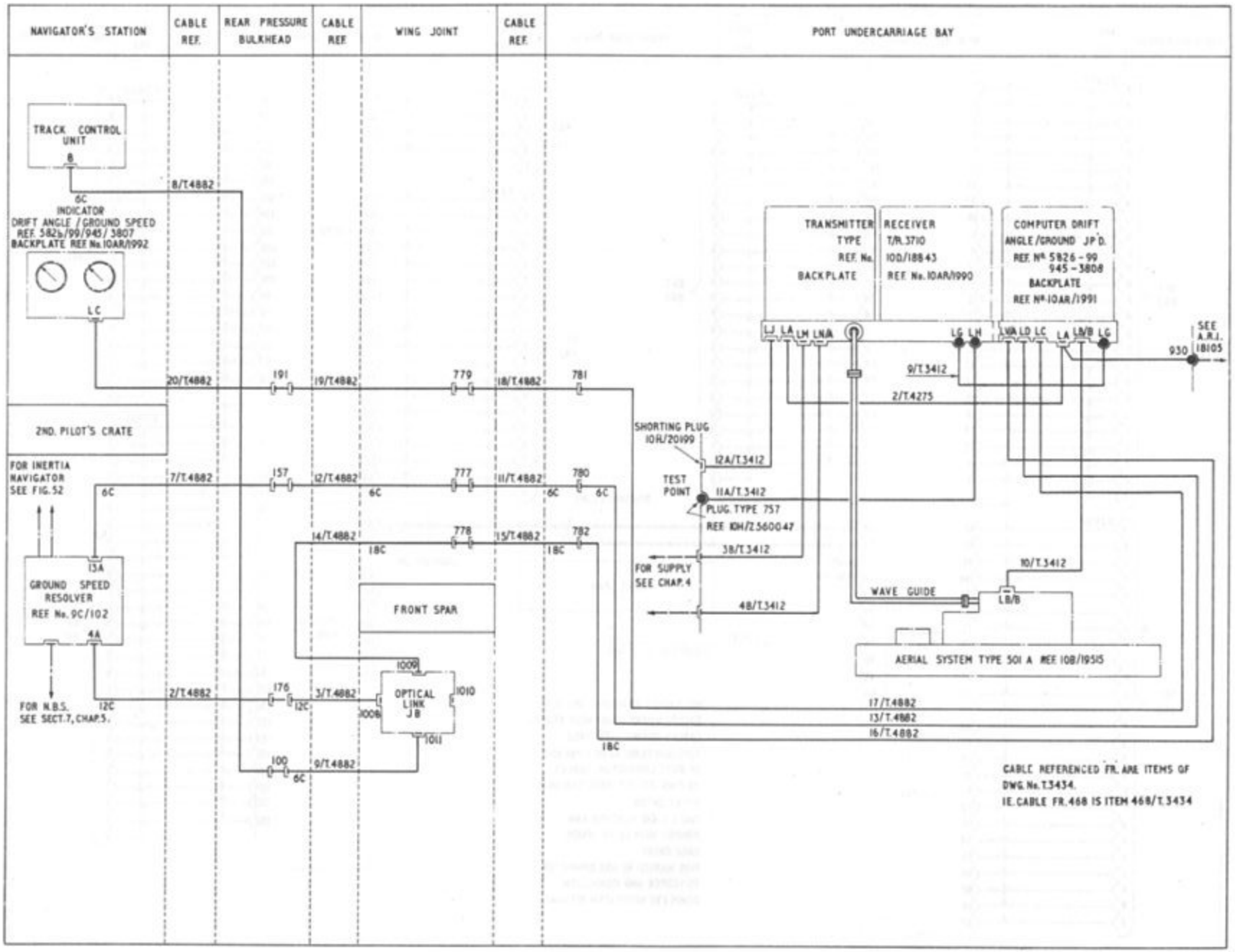

Fig. 53 A.R.I. 5951

(◄ Mod. 1777 ►)

RESTRICTED

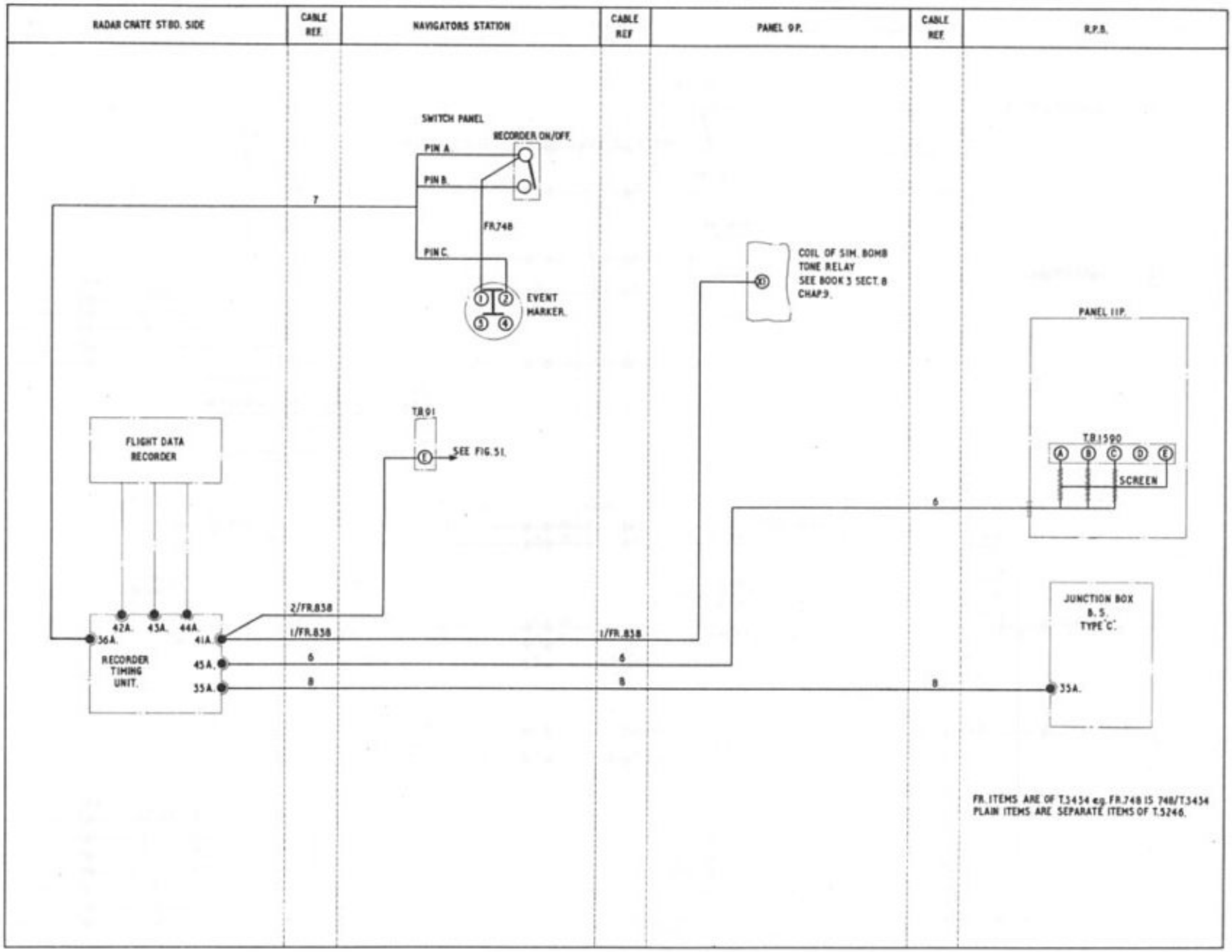

Fig. 54 Flight data recorder
(◄ Mod. 1696 part B ►)

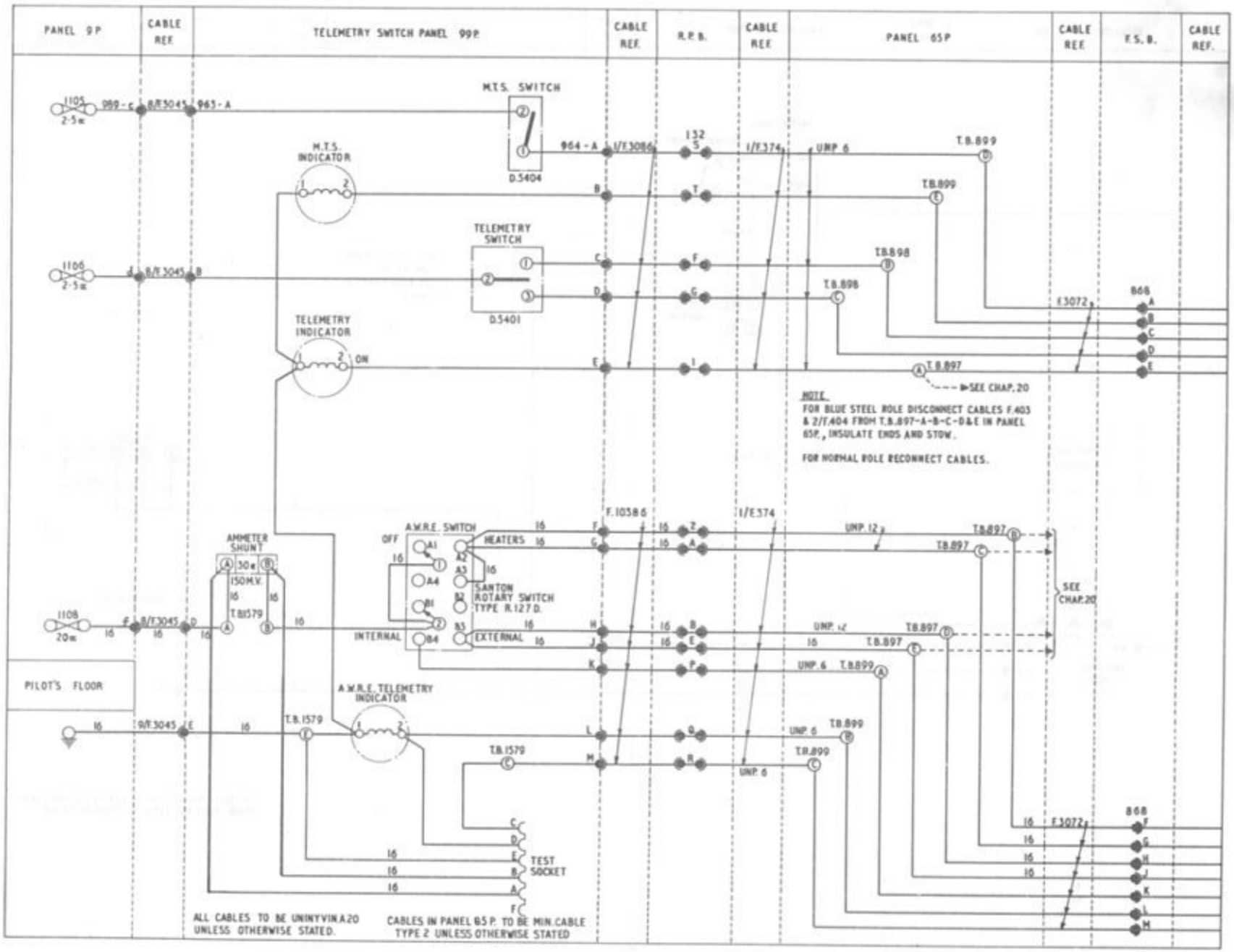

Fig.55 (1) Telemetry switching & monitoring

RESTRICTED

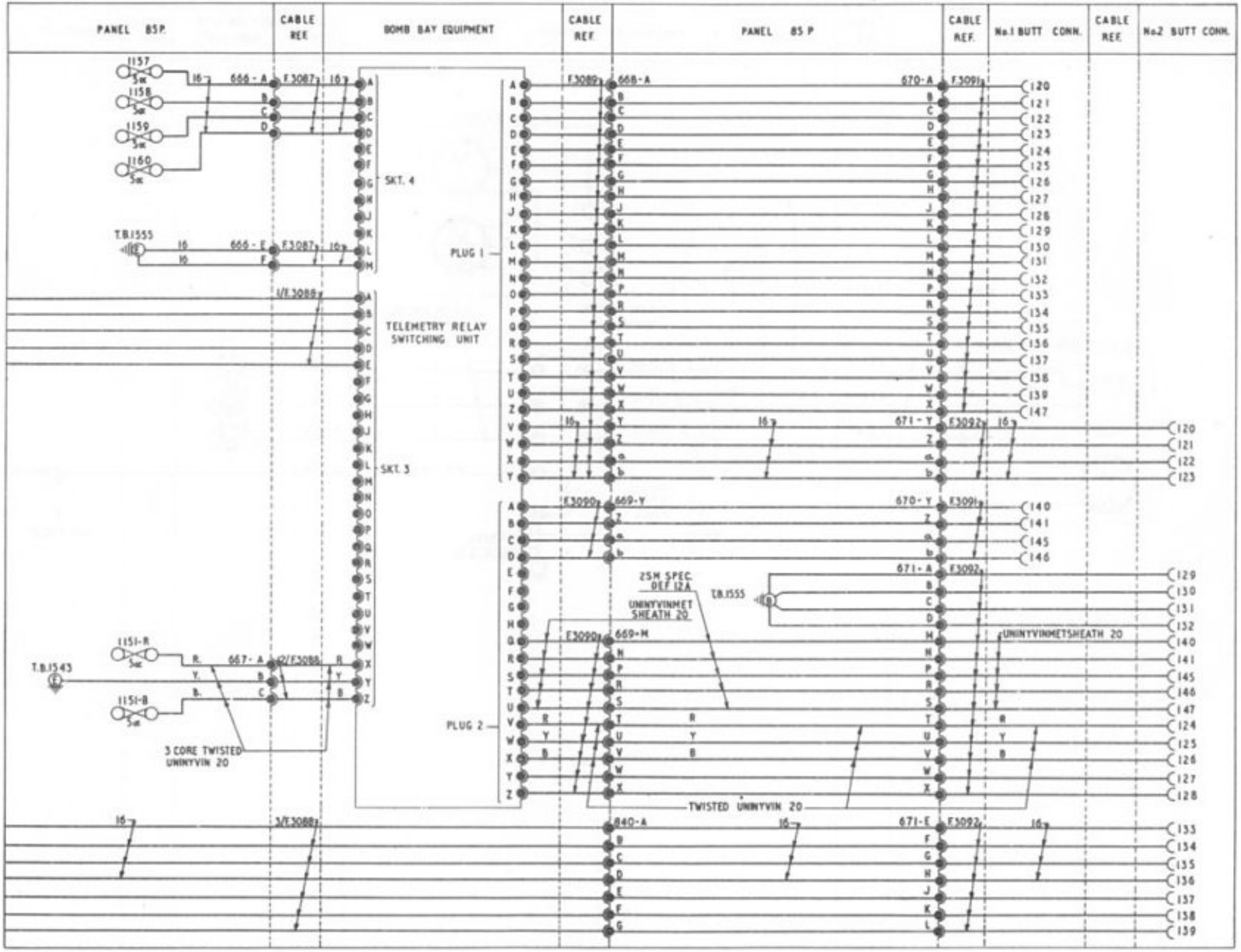

Fig. 55(2) Telemetry switching & monitoring

RESTRICTED

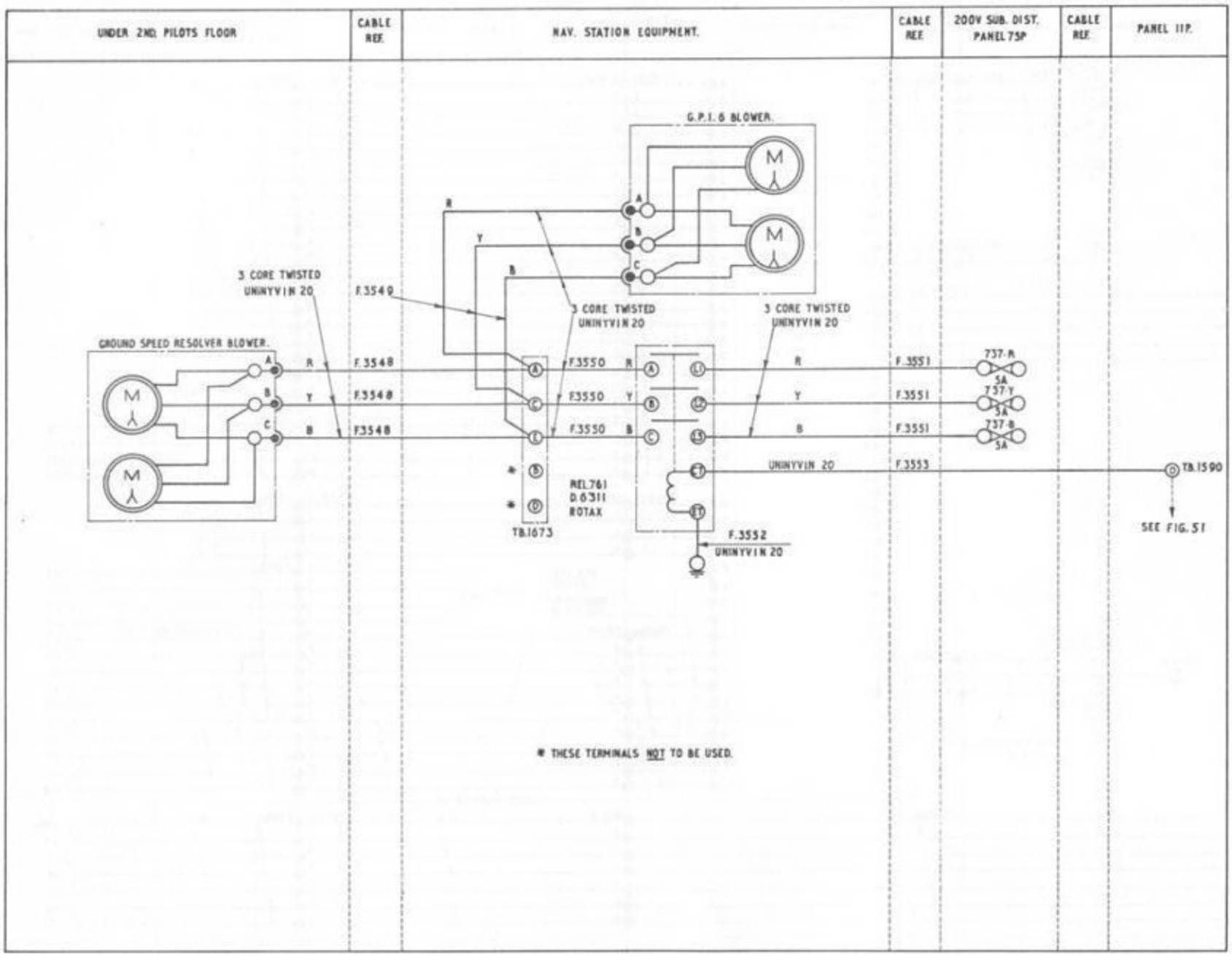

Fig 56 G.S.R. and G.P.I. Mk. 6 cooling