# Group 8 HEATING, VENTILATION AND DE-ICING CONTROLS

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**Introduction**

1. This group contains descriptive and servicing information for the electrical controls and circuits for the heating, ventilation and de-icing systems. These systems consist of:-

Air conditioning
Ration heaters
Sextant head heaters
Bomb bay heating
Battery heating and ventilation
Windscreen de-mister
Wing, fin, engine and inverter de-icing
Pilot and air bombers windscreen de-icing
Probe de-icing (post Mod.38)
H2S air valve

2. A general location illustration is provided in fig.1, other location illustrations will be found adjacent to the text for the system concerned. Table 1 gives titles, type numbers and location of all components. Theoretical circuits are provided where necessary. It should be noted that the main distribution fuse tables are included in Group 1 of this Chapter.

## DESCRIPTION AND OPERATION

### AIR CONDITIONING

**General**

3. A complete system of pressurization and cabin heating is fitted to the aircraft, and is operated by compressed air obtained from the four engines.

4. The engine air tapping on the port side of each engine has an actuator operated isolation valve and a non-return valve as part of the engine unit.

5. A suitable ducting connected to each pair of engine compressors runs forward. The mass flow control valve, Type FKH/A/49, mass flow modulator, Type FMY/A1, and the mass flow controller, Type FOA/A/7, are situated in each main ducting just forward of the front spar. Mod.299 introduces a mass flow modulator, Type FMY/A2 in lieu of Type FMY/A1.

6. The duct from each mass flow control valve turns inboard, at the rear end of the nose wheel bay, to the air conditioning crate. The outlet from the forward side of the crate passes into the cabin through a non-return valve.

7. All the air conditioning components are contained in the air conditioning crate on the port side of the nose-wheel bay and consists of:-

(1) Air-to-air cooler, Type 27UA/487.
(2) Temperature control valve, Type FKH/A/50.
(3) Brake turbine unit, Type BT.15 Mk.2A.
(4) Underheat temperature controller, Type FLW/A/6.
(5) By-pass control valve, Type FKH/A/40.
(6) Water separator, Type WE.60.
(7) Overheat switch, Type FHO/A/87.
(8) Follow up resistor, Type FLJ/A/8.

8. The air flow through the crate is variable according to the position of the temperature control valve as follows:-

(1) Hot – straight through.
(2) Intermediate – some air straight through, remainder through the air-to-air cooler.
(3) Warm – all air through the air-to-air cooler.
(4) Intermediate – all air through the cooler, some air through the turbine unit.
(5) Cold – all air through the cooler and turbine unit.

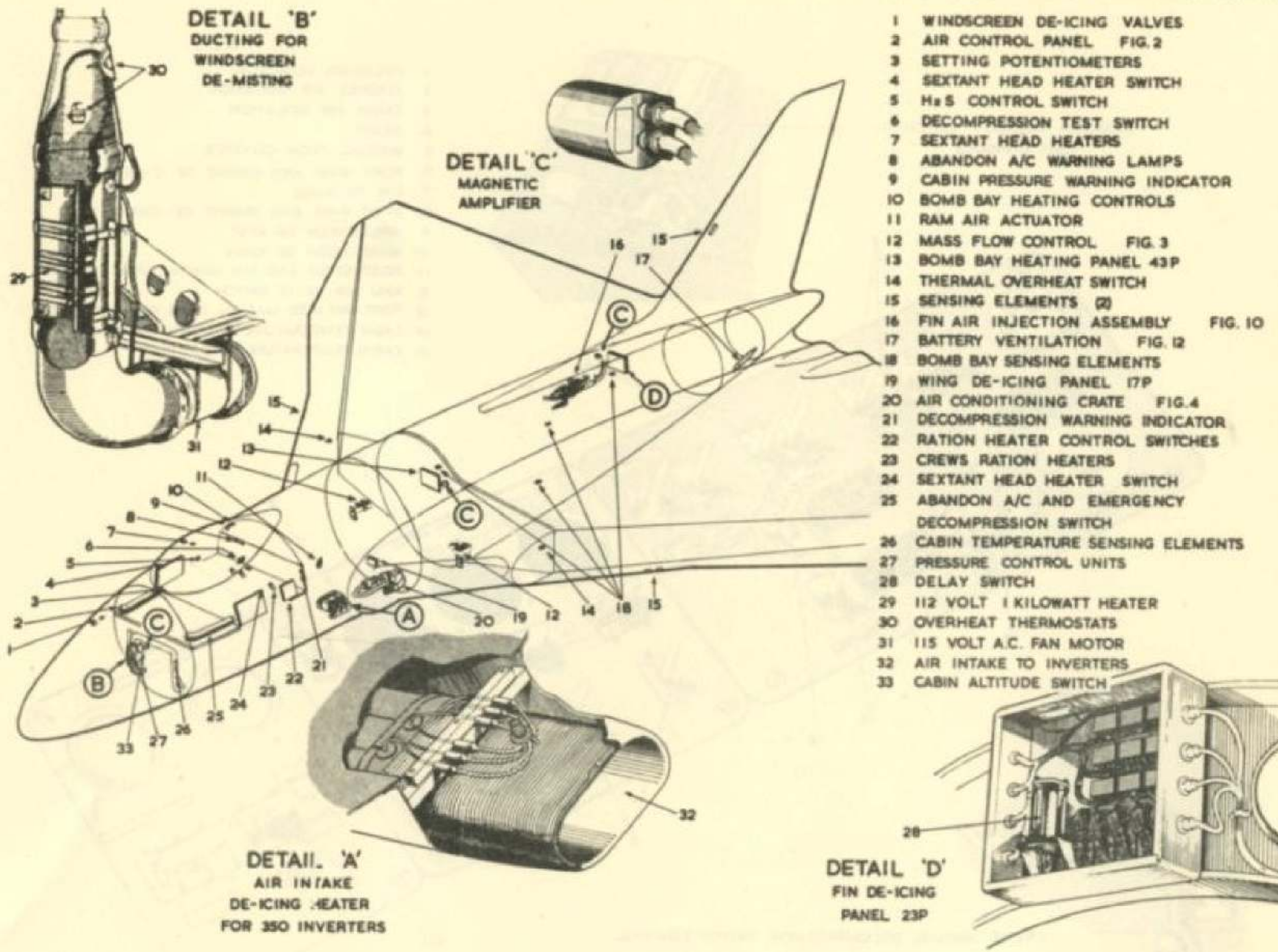


FIG. 1. LOCATION OF COMPONENTS

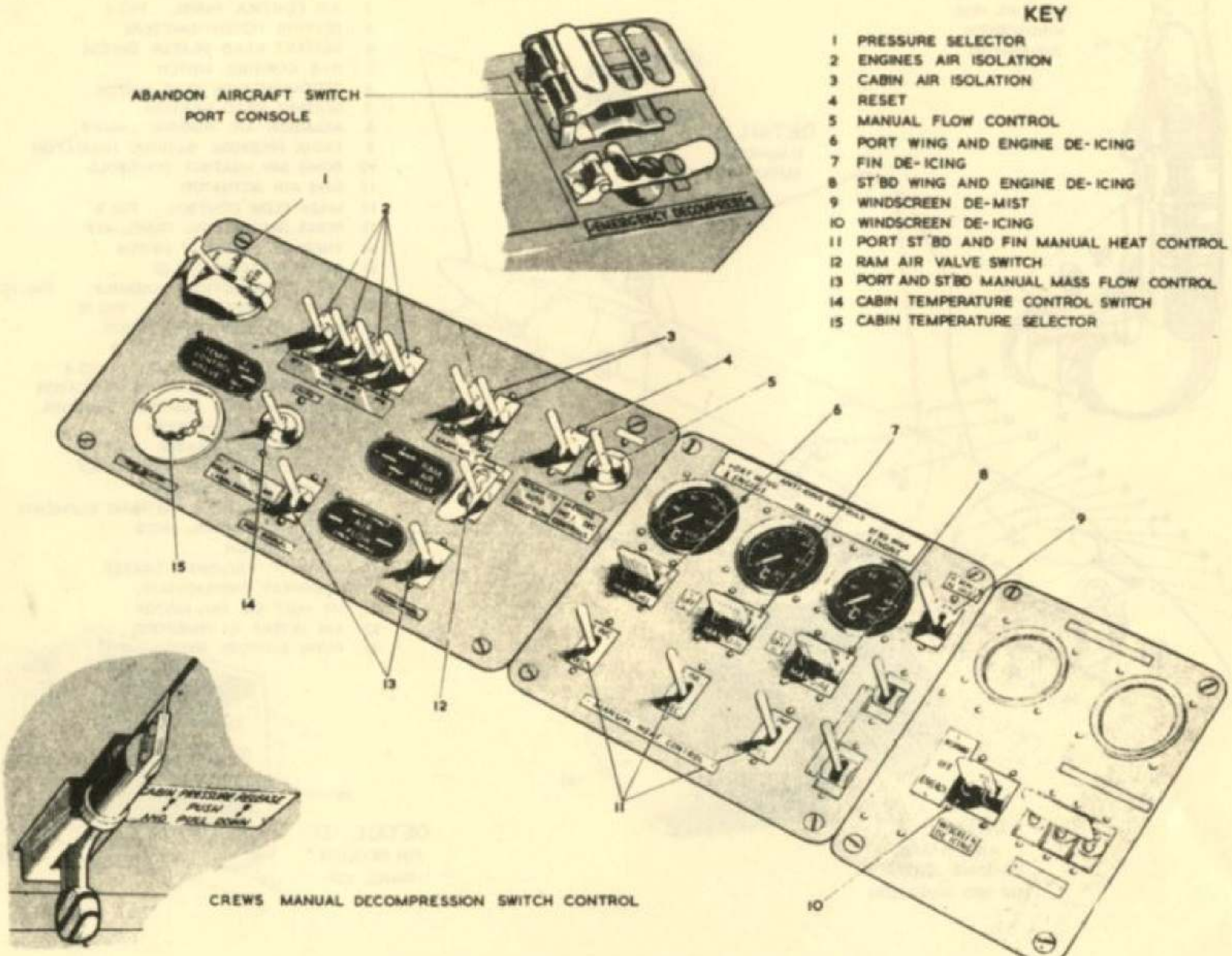


FIG.2. AIR CONTROL PANEL (PRE-MOD 38)

KEY

1 PRESSURE SELECTOR
2 ENGINES AIR ISOLATION
3 CABIN AIR ISOLATION
4 RESET
5 MANUAL FLOW CONTROLS
6 WINDSCREEN DE-MIST
7 WINDSCREEN DE-ICING
8 PORT WING AND ENGINE DE-ICING
9 FIN DE-ICING
10 ST'BD WING AND ENGINE DE-ICING
11 PORT ST'BD AND FIN MANUAL HEAT CONTROL
11A PORT AND ST'BD ENGINES DE-ICING SWITCHES (MOD 1091)
12 PROBE DE-ICING
13 RAM AIR VALVE SWITCH
14 PORT AND ST'BD MANUAL MASS FLOW CONTROL
15 CABIN TEMPERATURE CONTROL SWITCH
16 CABIN TEMPERATURE SELECTOR

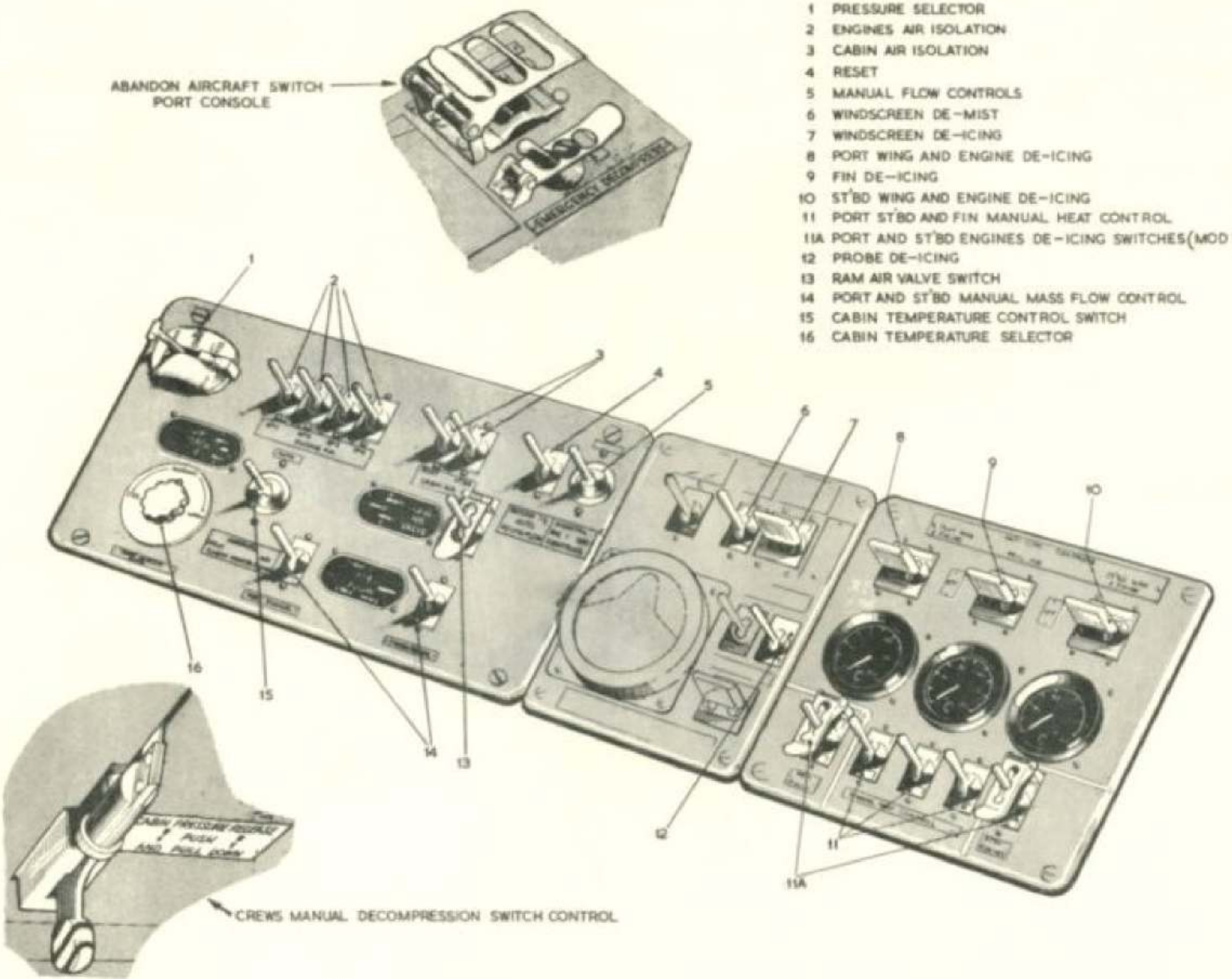


Fig. 2A Air control panel (post. Mod. 38)

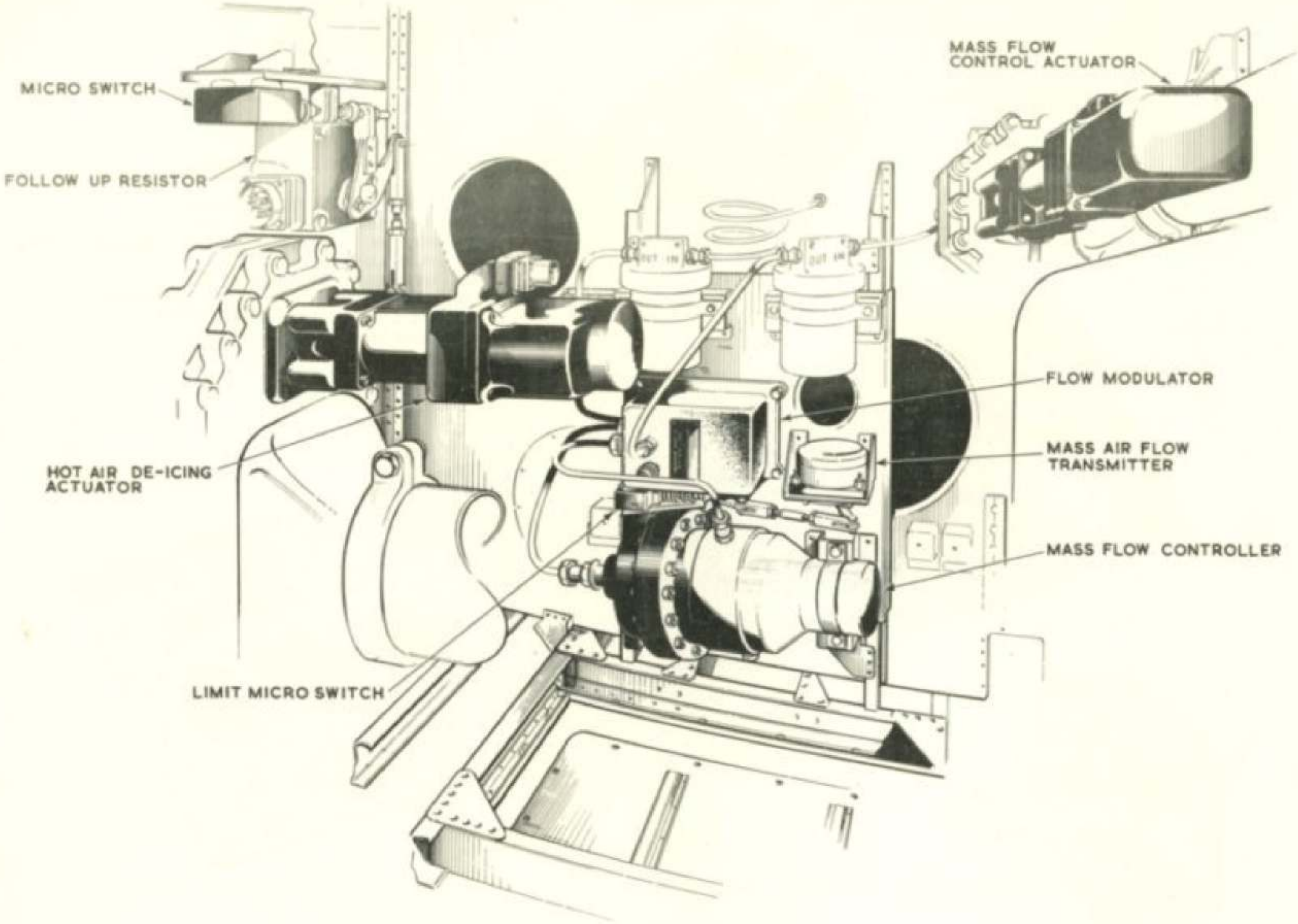


Fig. 3 Mass flow control

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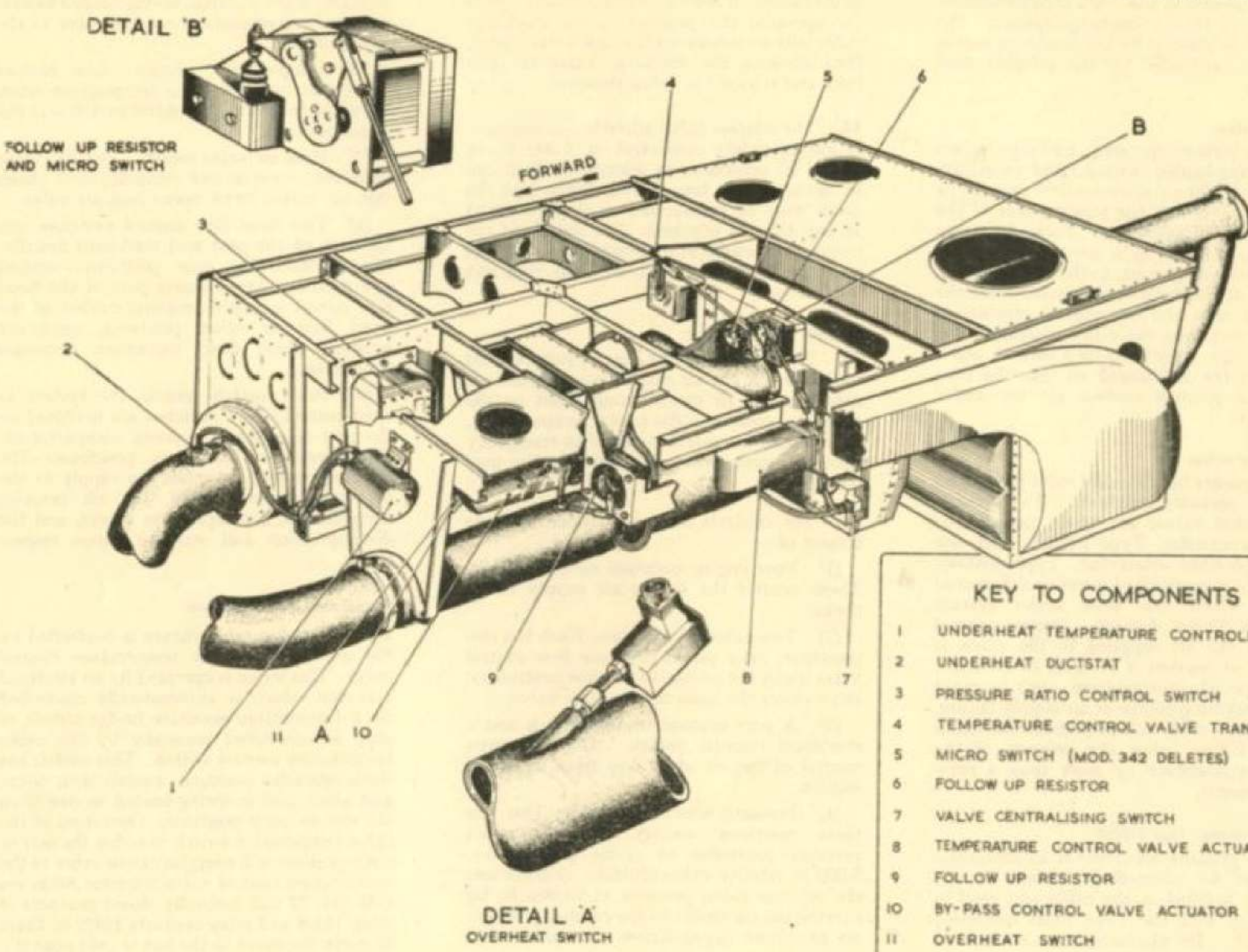


### KEY TO COMPONENTS

1 UNDERHEAT TEMPERATURE CONTROLLER
2 UNDERHEAT DUCTSTAT
3 PRESSURE RATIO CONTROL SWITCH
4 TEMPERATURE CONTROL VALVE TRANSMITTER
5 MICRO SWITCH (MOD. 342 DELETES)
6 FOLLOW UP RESISTOR
7 VALVE CENTRALISING SWITCH }
8 TEMPERATURE CONTROL VALVE ACTUATOR }
9 FOLLOW UP RESISTOR
10 BY-PASS CONTROL VALVE ACTUATOR
11 OVERHEAT SWITCH

**Fig. 4. Air conditioning crate**

#### *Pressure control*

**9.** The pressure in the cabin is controlled by restriction in the air discharge system. The restriction is effected by the discharge valves which are controlled by the pressure controllers.

#### *Discharge valves*

**10.** Two bellows-operated discharge valves and a spring-loaded inward relief valve, are contained in the combined valve unit, Type Normalair 20/65, on the forward face of the front pressure bulkhead. Each discharge valve is controlled by a pressure controller which applies air pressure to the valve bellows. The area of the bellows is greater than the valve seat area and the control pressure is slightly lower than the cabin pressure. The discharge unit is enclosed by a shroud, and a duct feeds the discharged air into the nose section to provide cooling for the radar equipment.

#### *Inward relief valves*

**11.** A separate inward relief valve is fitted on the front pressure bulkhead. Two further inward relief valves are fitted, one to the pressure controller, Type 510350, and one to the pressure controller, Type 510340, to limit the magnitude of negative differential pressure which can arise under certain conditions during descent. During normal operation the air supplied to the cabin is sufficient to prevent a reversal of pressure, but, in special circumstances, such as rapid descent following engine or air supply failure, these inward relief valves prevent the cabin pressure falling below the pressure of the ambient atmosphere by more than a prescribed amount.

#### *Pressure controller, Type 510350*

**12.** This pressure controller is an automatic instrument for controlling pressure in the cabin. It is fitted in the cabin and used in conjunction with the Type 20/65 combined valve unit. Its characteristics are set to meet particular requirements.

#### *Decompression valves*

**13.** A decompression valve is connected to each control line to the discharge valve. Both valves are controlled either electrically or manually. When the decompression valves are operated the pressure in the discharge valve bellows is released through a static vent, thus allowing the discharge valve to open fully and release the cabin pressure.

**14.** The relative cabin altitude, i.e. pressure, is automatically controlled at 5,000 ft. or 25,000 ft. according to selection, which can be made at any time during flight, and the cabin may be pressurized or de-pressurized at any time as required. For details of the complete mechanical system reference should be made to Book 1, Sect. 3, Chap. 8 of this publication.

#### **Controls and indicators**

**15.** The majority of the control switches and indicators for the air conditioning system are fitted to the air conditioning panel on the starboard console in the pilots' compartment. An abandon aircraft switch and an emergency decompression switch are fitted to the port console.

**16.** The controls on the starboard console consist of:—

(1) Four engine isolation cocks switches. These control the engine air supply on-off cocks.

(2) Two cabin air switches. Each has two positions; OPEN places the mass flow control valve under the control of the flow controllers; SHUT closes the mass flow control valve.

(3) A port manual control switch and a starboard manual switch. Each provides control of the air mass flow from a pair of engines.

(4) Pressure selector switch. This has three positions:—CRUISE sets the cabin pressure controller to cruise position i.e. 5,000 ft. relative cabin altitude. COMBAT sets the relative cabin pressure at 25,000 ft. by moving the controller to the combat position. NO PRESSURE depressurizes the cabin.

(5) Cabin temperature control switch. This has four positions:—central OFF position, AUTO position which puts the temperature control valve under automatic control; MANUAL HOT, spring-loaded to OFF, moves the temperature control valve to the hot position; MANUAL COLD, spring-loaded to OFF, moves the temperature control valve to the cold position.

(6) Temperature selector auto control selects the required cabin temperature when the cabin temperature control switch is in the AUTO position.

(7) Ram air valve switch. This has three positions:—central OFF position; SHUT closes ram air valve; OPEN opens ram air valve.

(8) Two flood flow control switches, one for each of the port and starboard installations. Each has four positions:—central OFF position; RESET resets part of the flood flow circuit to enable manual control of the flood flow in other positions; INCREASE increases flood flow; DECREASE decreases flood flow.

(9) Reset switch returns the system to auto control. Two switches are mounted on the port console in the pilots' compartment. These switches have two positions:—The forward position switches the supply to the pressure selector switch, the aft position energizes the decompression valves, and the decompression and warning lamps respectively.

#### **Temperature and mass flow**

**17.** The cabin temperature is controlled by the movement of the temperature control valve. This valve is operated by an electrical actuator, which is automatically controlled by a temperature sensitive bridge circuit or may be controlled manually by the cabin temperature control switch. This switch has three operative positions, namely HOT, COLD, and AUTO, and is spring-loaded to OFF from the HOT or COLD positions. Operation of the cabin temperature switch to either the HOT or COLD position will energize one or other of the temperature control valve actuator fields via C.B. No. 77 and normally closed contacts of relay 114/8 and relay contacts 124/2 or 124/1 to move the valve to the hot or cold position. When the cabin temperature control switch is moved to the AUTO position, a supply from C.B. No. 77 will energize relay No. 119. A 115-volt a.c. supply is then connected, via fuse No. 266 and relay contacts 119/4, to

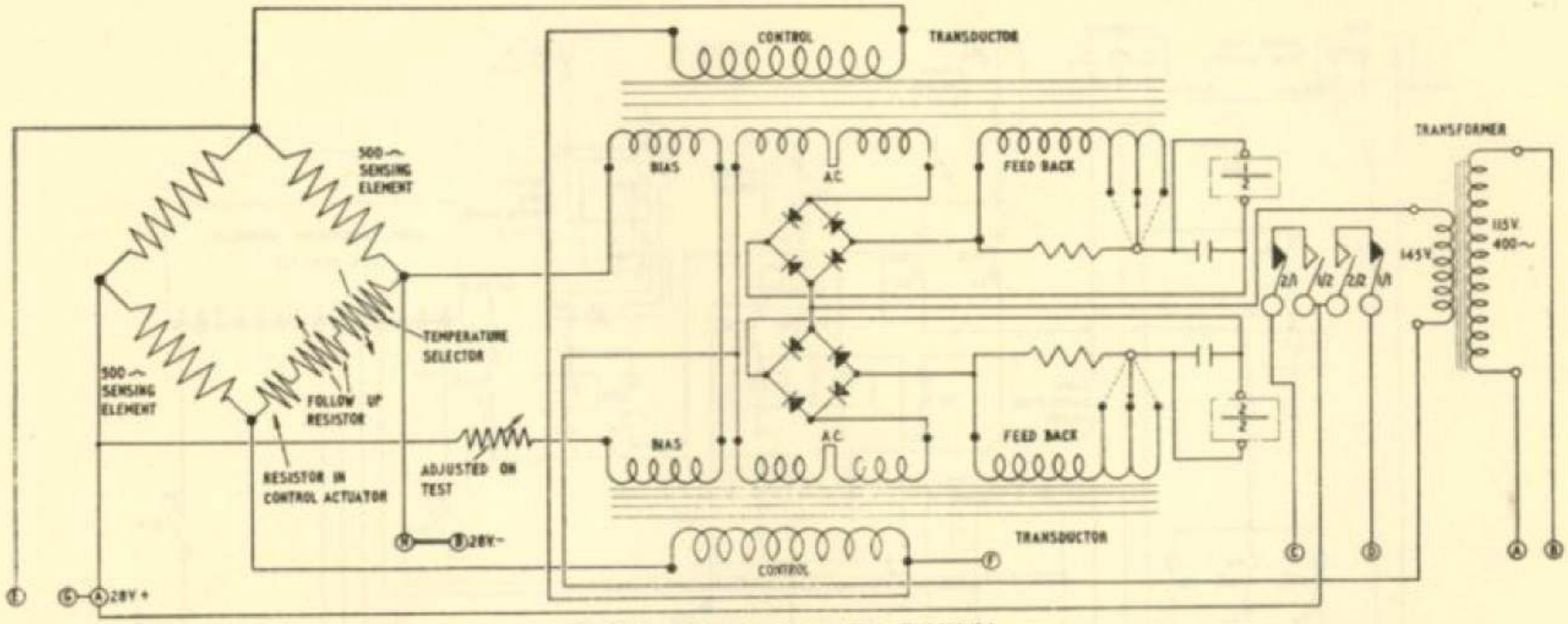


**Fig. 5. Balanced magnetic amplifier FLM/A/14**

terminals A and B of the cabin temperature control amplifier. A 28-volt d.c. supply is connected to the temperature control amplifier via the cabin temperature control switch.

**18.** The temperature control amplifier, Type FLM/A/14, embodies a balanced resistance bridge network and a transductor. A change in temperature of the sensing units unbalances the bridge to pass a current through the control winding of the transductor. This triggers off the transductor, the output of which is applied to one of two relays, one controlling a supply to the increase field of the hot air valve actuator and the other to the decrease field. The actuator moves to open or close the valve, and, at the same time, to adjust the follow up resistor until balanced conditions are again obtained in the resistance network.

**19.** Details of the operation and servicing of the temperature controller will be found in A.P.1275A, Vol. 1, Sect. 20. A circuit diagram is shown (*fig.* 5) for reference only.

*Circuit operation (pre Mod. 265)*

**20.** Reference to fig. 6 will show that, when the temperature control valve has reached the fully cold position under manual control and the temperature selector is adjusted for a further reduction in temperature, the temperature control valve micro switch will be operated to make contacts A and C. A supply is now fed via normally closed contacts of relays 114/8, 115/5 and 119/2 to terminals 2 of the mass flow manual switches. Operation of these switches to INC. will now feed this supply to the increase field of the mass flow modulators. The mass flow modulator resets the datum of the mass flow controller which now controls at a higher mass flow. As soon as the mass flow modulator moves off from the minimum flow position external limit switches are operated and their contacts energize relay 124. Contacts 124/1 and 124/2 will open to isolate the temperature control valve from the temperature control switch. This action prevents movement of the temperature control valve until the mass flow is reduced to normal.

**21.** When heating is required, the mass flow manual switches must be placed to DEC. until the modulator has reached the normal flow position and the limit switches have reverted to normal position to de-energize relay 124. Contacts 124/1 and 124/2 are again closed and the temperature control valve actuator is reconnected to the temperature control switch. Operation of the temperature control switch to the HOT position will now move the temperature control valve to the warm position. As soon as the temperature control valve moves away from the fully cold position, its external micro switch contacts open and the supply to the mass flow manual switch is cut off.

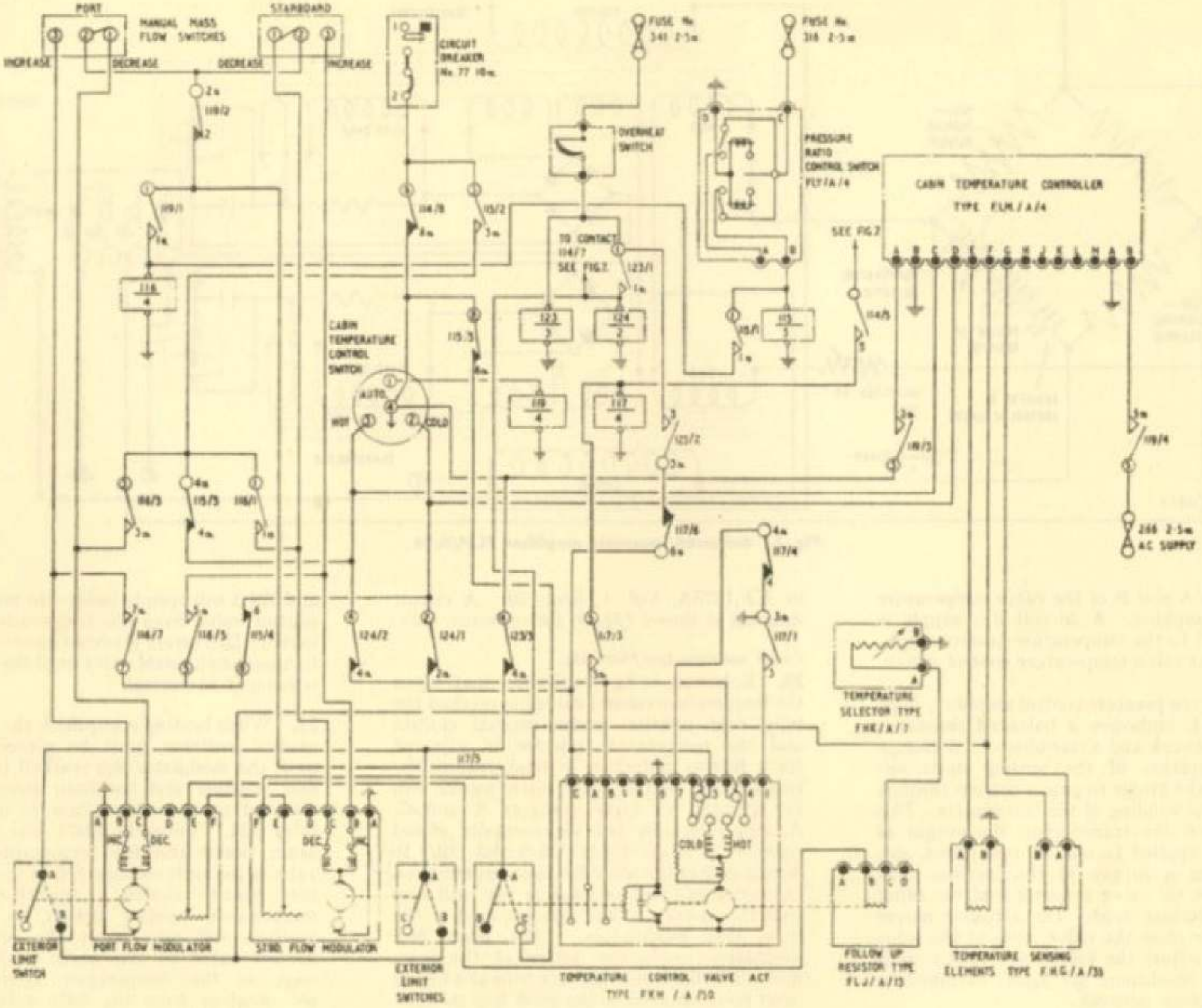


Fig. 6. Temperature and mass flow (H) (pre Mod. 265 and 342)

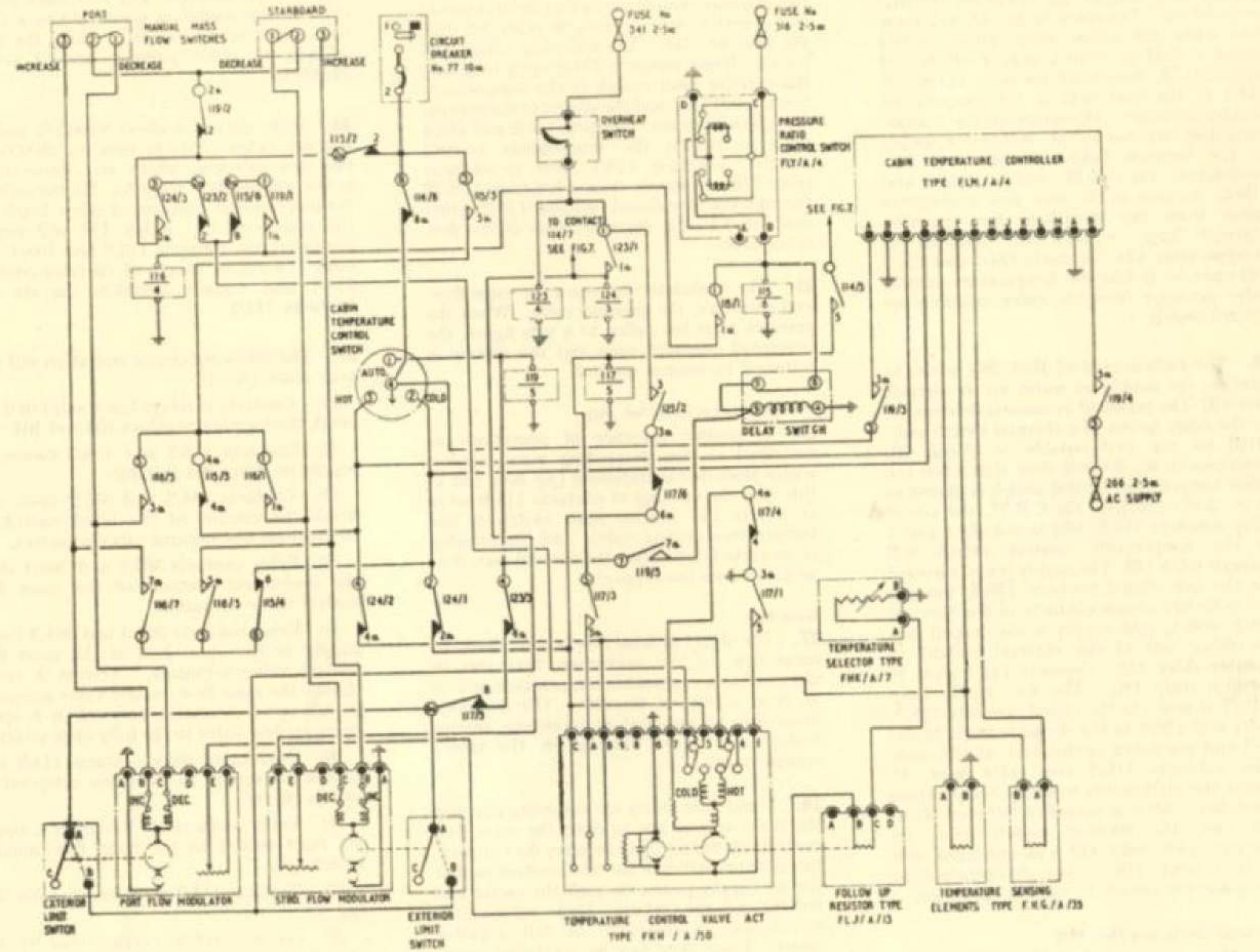


Fig. 6A. Temperature and mass flow (post Mod. 342)

*Circuit operation (post Mod. 265 and 342)*

**22.** Mod. 342 deletes the external limit switch from the temperature control valve actuator and utilises the actuators internal limit switch. Reference to fig. 6A will show that when the cabin temperature control switch is held to COLD a supply will be fed from C.B.77, the closed contacts 114/8 and 124/1 to the cold field of the temperature control actuator. Operation of the manual mass flow switches to INC. will feed a supply to the increase fields of the mass flow modulators, via C.B.77, contacts 115/2 and 119/2. As soon as the mass flow modulators move from the minimum flow position external limit switches are operated to energize relay 124. Contacts 124/1 and 124/2 will open to isolate the temperature control valve actuator from the cabin temperature control switch.

**23.** The embodiment of Mod. 265 serves to increase the supply of warm air at aircraft take-off. The period of increase is determined by the delay action of a thermal switch unit, fitted on top and outside of panel 4P. Reference to fig. 6A will show that when the cabin temperature control switch is placed to AUTO, a d.c. supply, via C.B.77, the closed relay contacts 114/8, and terminals 4 and 1 of the temperature control switch will energize relay 119. The supply is now directed via the now closed contacts 119/5, through the normally closed contacts of the thermal delay switch, (the supply is also looped into the delay coil of the thermal switch) to energize relay 115. Contacts 115/1 close to energize relay 116. The d.c. supply from C.B.77 is now via the closed contacts 115/3, 116/1 and 116/3 to the decrease fields of the port and starboard modulators, at the same time, contacts 115/3 and 115/4 open, to isolate the modulators from the temperature controller. After a period of between 60 to 120 secs. the thermal switch trips, its contacts open, relay 115 is de-energized, and in turn relay 116 is also de-energized so returning the circuit to normal operation.

*Overspeed control (pre Mod. 342)*

**24.** The speed of the turbine unit is proportional to the pressure ratio across it. The pressure ratio is applied across a pressure ratio switch which is set to a ratio equivalent to the maximum speed of the turbine. When this pressure ratio is reached a pair of contacts in the switch close to energize relay No. 115, via fuse No. 316. The following action will occur:—Relay contacts 115/5 open to isolate the exterior limit switch of the temperature control actuator, and the supply to the manual mass flow switches. Contacts 115/3 and 115/4 open to isolate the temperature control switch. Contacts 115/1 close to energize relay 116. A supply is now fed from C.B.77 through the new closed contacts 115/2, 116/1 and 116/3 to the decrease fields of the flow modulators.

**25.** The modulator decreases the mass flow, and therefore, the pressure ratio. When the pressure ratio has fallen to a safe figure, the overspeed contacts open and the system is returned to normal control.

*Overspeed control (post Mod. 342)*

**26.** A similar sequence of operations as described in the preceeding para. applies where Mod. 342 is embodied (*fig.* 6A), but in this case the opening of contacts 115/6 serve to isolate the interior limit switch of the temperature control valve, and the opening of contacts 115/2 isolate the manual mass flow switches from the supply.

**Flood flow**

**27.** The object of flood flow is to increase the mass flow to the maximum that can be obtained at a reasonable temperature and in as short a time as possible. The increased mass flow is required to overcome serious leakage or combat damage in the crew's compartment.

**28.** Flood flow starts up automatically and the main actions are to open the mass flow control valves fully, and to move the temperature control valves to the mid position so that the air supply passes through the cooler and not through the turbine. These valve movements are accomplished at full actuator speed. Flood flow can be controlled under manual operation and the system can be reset to normal operation at any time.

*Circuit operation*

**29.** Flood flow is brought into operation by two altitude switches and two main relays. One altitude switch is connected to a static vent and is set to 30,000 ft. whilst the other is open to cabin pressure and is set at 29,000 ft.

**30.** If the aircraft is above 30,000 ft. and the relative cabin altitude rises to 29,000 ft., the two switches, which are connected in series, will energize relay No. 118 through the normally closed contacts of relay 114/2 and the reset switch. Relay 118 will remain energized, via contacts 118/5 and 105/1, and relay 114 will be energized via relay contacts 118/1 and remain locked-in via its own contacts 114/1.

**31.** The following circuit operation will now take place (*fig.* 7).

(1) Contacts of relays 118/4 and 118/6 will break the supplies to relays 103 and 104.

(2) Contacts 118/2 and 118/3 connect a supply to relays 364 and 365.

(3) Contacts 364/2 and 365/2 open, and break the circuits of the bleed resistances to the mass flow control valve actuators.

(4) Relay contacts 364/1 and 365/1 short the centrifugal contacts of the mass flow control valve actuators.

(5) Relay contacts 364/3 and 365/3 feed a supply to the open field of the mass flow control valve actuators. Actions 3 and 4 change the mass flow control valve actuators to full speed operation and action 5 opens the mass flow valve to the fully open position.

(6) Opening of relay contacts 114/8 also breaks the supply to the cabin temperature switch (*fig.* 6).

(7) Relay contacts 114/3 connect a supply via reset switch to the flood flow manual switch (*fig.* 7).

(8) Contacts 114/7 energize relay No. 124 (*fig.* 6).

(9) Contacts 114/5 energize relay No. 117 (*fig.* 7), contacts of relay 117/4 will open and break the supply to the bleed resistance of the temperature control valve actuator.

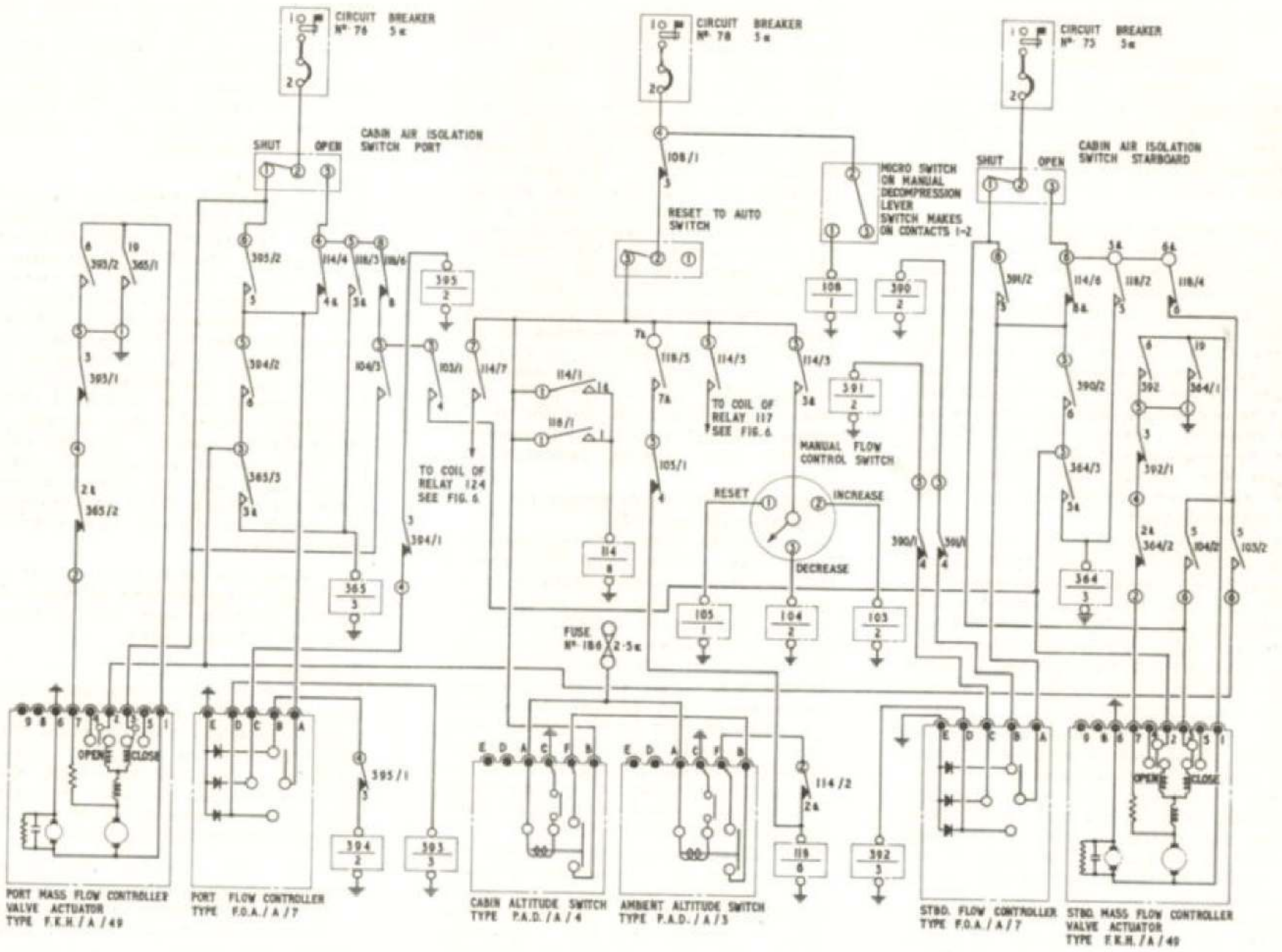


Fig. 7 Flood flow controls

(10) A supply is fed to the centralising switch of the temperature control valve actuator via relay 117/3.

(11) Contacts 117/1 short the centrifugal contacts of the temperature control valve actuator.

Action 9 changes the actuator to full speed operation and prevents any interference from the temperature control valve. Action 10 energizes the hot or cold field to move the temperature control valve actuator to the central position.

*Manual control of flood flow*

32. After flood flow has started it can be controlled manually by the use of the flood flow manual switch. The switch must first be held to the RESET position. This will energize relay No.105, and contacts 105/1 will open, thus breaking the locked-in circuit of relay No.118. Contacts 118/5 will open and relay 118 will not be re-energized when the reset switch is released. Relays 364 and 365 will be de-energized and the supply to the mass flow control valve actuator will be broken, the actuator will now revert to regulated speed.

33. A supply is connected via normally closed contacts 118/4 and 118/6 to contacts 5 and 3 respectively of relays 103 and 104, movement of the manual control switch to INC. or DEC. as required will energize relay 103 or 104 respectively and a supply will be connected to either the open or close fields of the mass flow control valve actuators.

34. When flood flow is no longer required, the system is returned to normal by operating the reset switch. If, however, conditions are such that both altitude switches are still closed, flood flow will restart as soon as the reset switch is released. The supply is connected to the flood flow system via the contacts of relay 108, whose coil is connected in parallel with the release valve units, so that the flood flow circuit will be isolated when DECOMPRESSION is selected.

**Pressure control and decompression (pre Mods. 209 and 623)**

35. Three pressure control switches, two on the port and one on the starboard console, control pressure in the cabin. When the abandon aircraft switch on the port console is ON, the release valve units will be energized. At the same time the abandon aircraft warning lamps on the navigator's panel will be lit and relay 108 will be energized to disconnect the flood flow circuit. The same circuit operation will also take place when the emergency decompression switch is ON. The 2nd pilot's pressure control switch has three positions:- NO PRESSURE, which energizes the release valve units, and CRUISE and COMBAT, which operate the pressure controller to set the cabin pressure to the required cabin altitude 5,000 ft. and 25,000 ft. respectively. Note that operation of the emergency decompression switch (1st pilot) overrides any selection of the 2nd pilot's pressure control switch. For operation of the door warning indicators see Group 9.

**Pressure control and decompression (post Mods.209 and 623)**

36. Mod.209 deletes the entrance door lever micro switch, and introduces a double-pole micro switch operated by the manual decompression lever at the crew's station, and also a double-pole control switch in the nose wheel bay to enable the cabin to be decompressed externally. Reference to fig.8A will show that each double-pole switch controls the positive and earth supplies to the release valve units. Note that Mod.209 is embodied currently with Mod.208, which introduces a magnetic indicator in the nose wheel bay to enable ground personnel to check that the entrance door is closed.

37. Mod.623 enables the entrance door to be opened in an emergency by means of a pneumatic ram controlled by an electrically operated unimatic valve (Book 1, Sect.3, Chap.11). Operation of the valve is controlled by a double-pole switch on the navigator's panel.

**Cabin pressure warning**

38. Should serious loss of cabin pressure occur, a switch within the pressure controller will close and a supply from fuse 190 will light the decompression warning lamps on the navigator's panel. At the same time relay 109 will be energized and contacts 109/1 will close to operate the warning horn. The warning horn may be switched off by operating the horn isolation switch.

**Overheat circuit**

39. A flamestat temperature switch is situated in the outlet of the air conditioning crate and is set to make contact at 175 deg.C. Should the temperature of the air rise to this figure the contacts close. Reference to fig.6 will show that when the temperature switch operates, a supply via fuse No.341 energizes relay 123. Relay 124 is now energized via contacts 123/1, and contacts 123/2 connect a supply to the cold field of the temperature control valve actuator to reduce the temperature. Contacts 124/1 and 124/2 open to isolate the temperature control valve from the temperature controller and contacts 123/3 open to isolate the supply to the air flow modulator micro switches.

40. When the temperature of the air has fallen by approximately 25 deg.C, the overheat contacts reopen and the system will revert to normal control.

**Underheat**

41. If the outlet temperature of the turbine is allowed to fall below freezing point, the moisture in the air would freeze and block the water separator. This is prevented by the underheat valve which bleeds some warm air from the turbine inlet to the turbine outlet to keep the temperature above freezing point.

42. A d.c. bridge with sensing elements at the turbine outlet and with a moving coil relay connected across it, controls the by-pass valve actuator through two relays. A follow up resistor connected to the by-pass valve

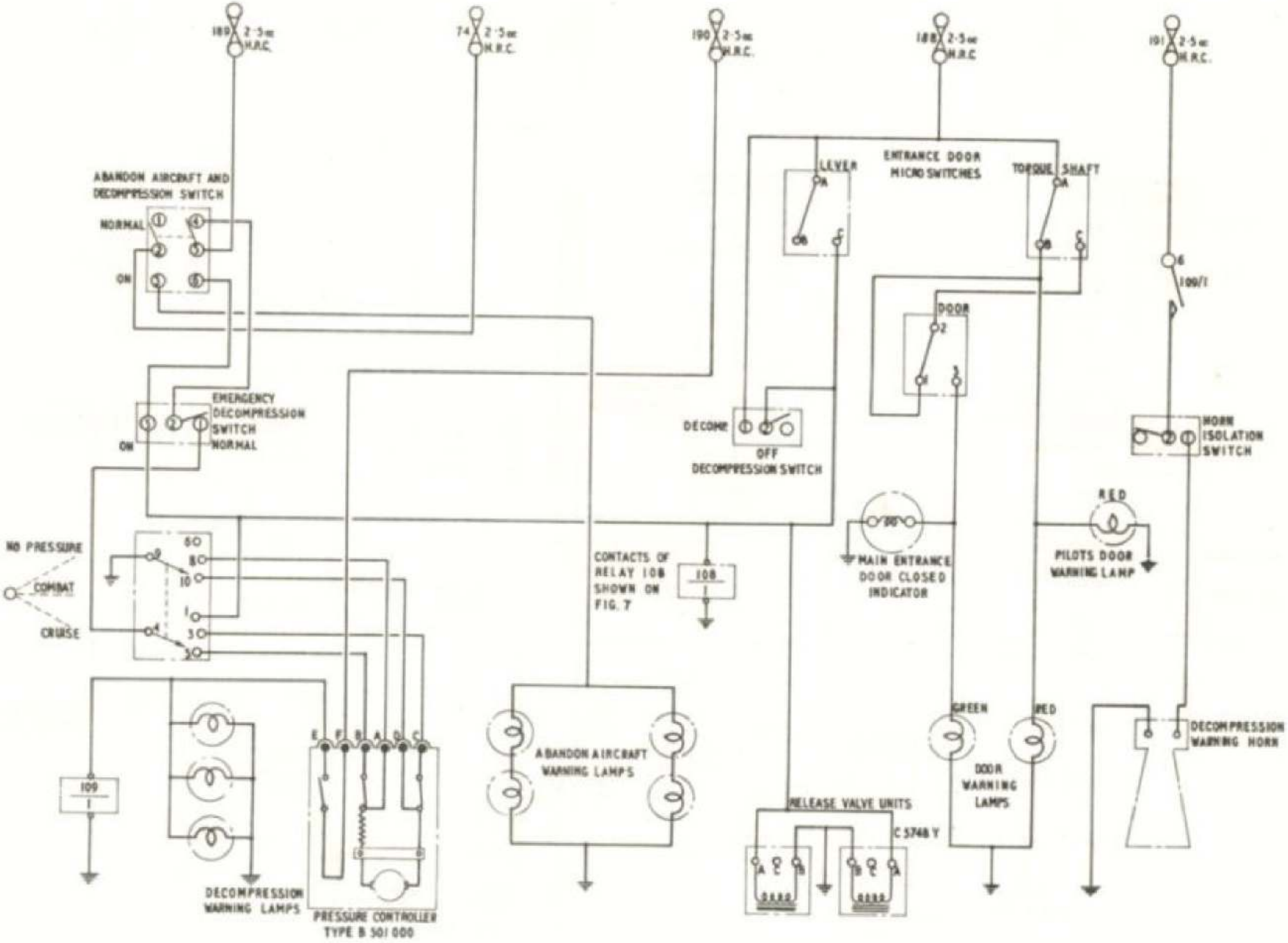


Fig. 8. Decompression and warning. (pre Mods. 209 and 623.)

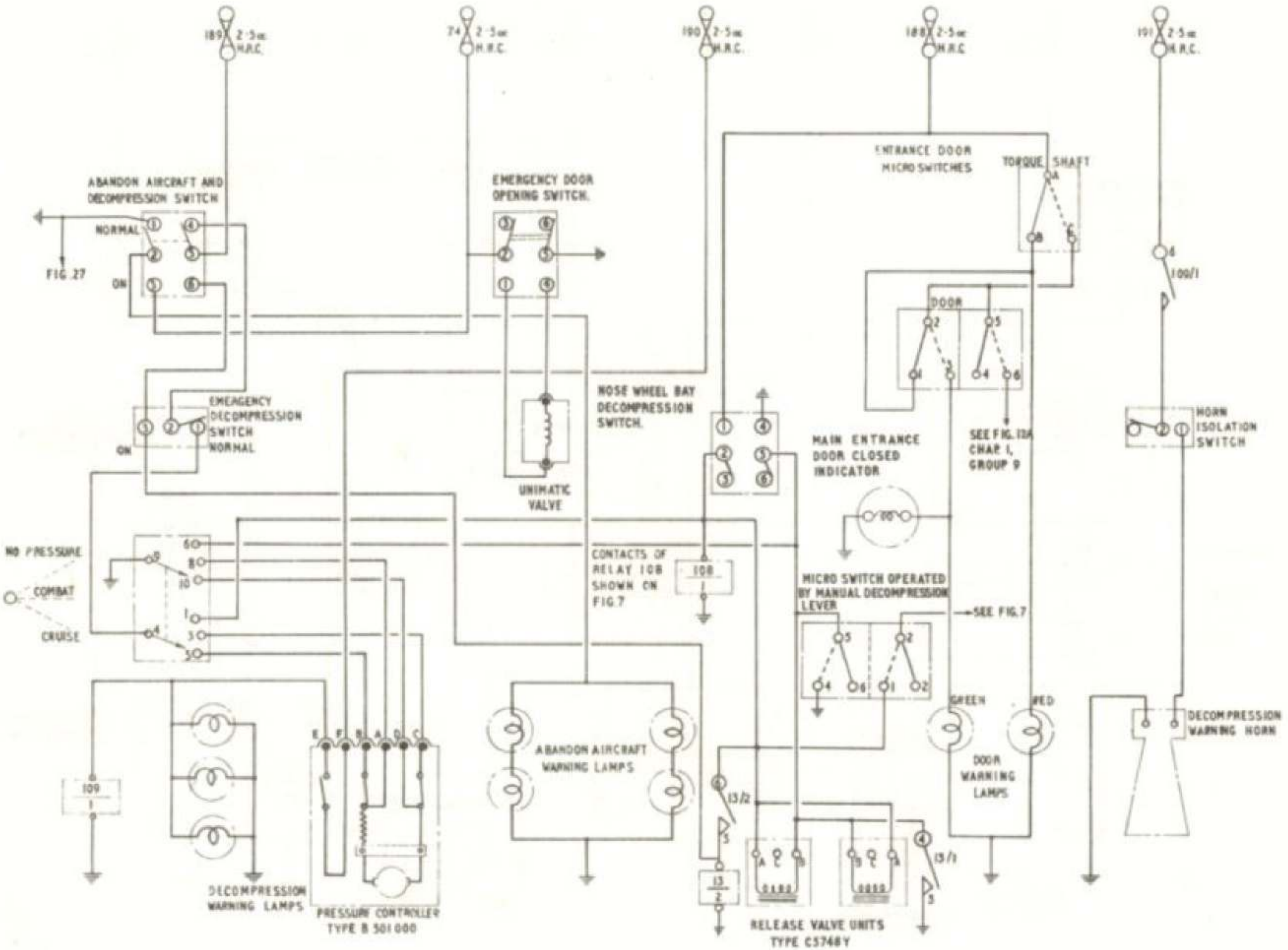


Fig. 8A. Decompression and warning (post Mods. 209 and 623)

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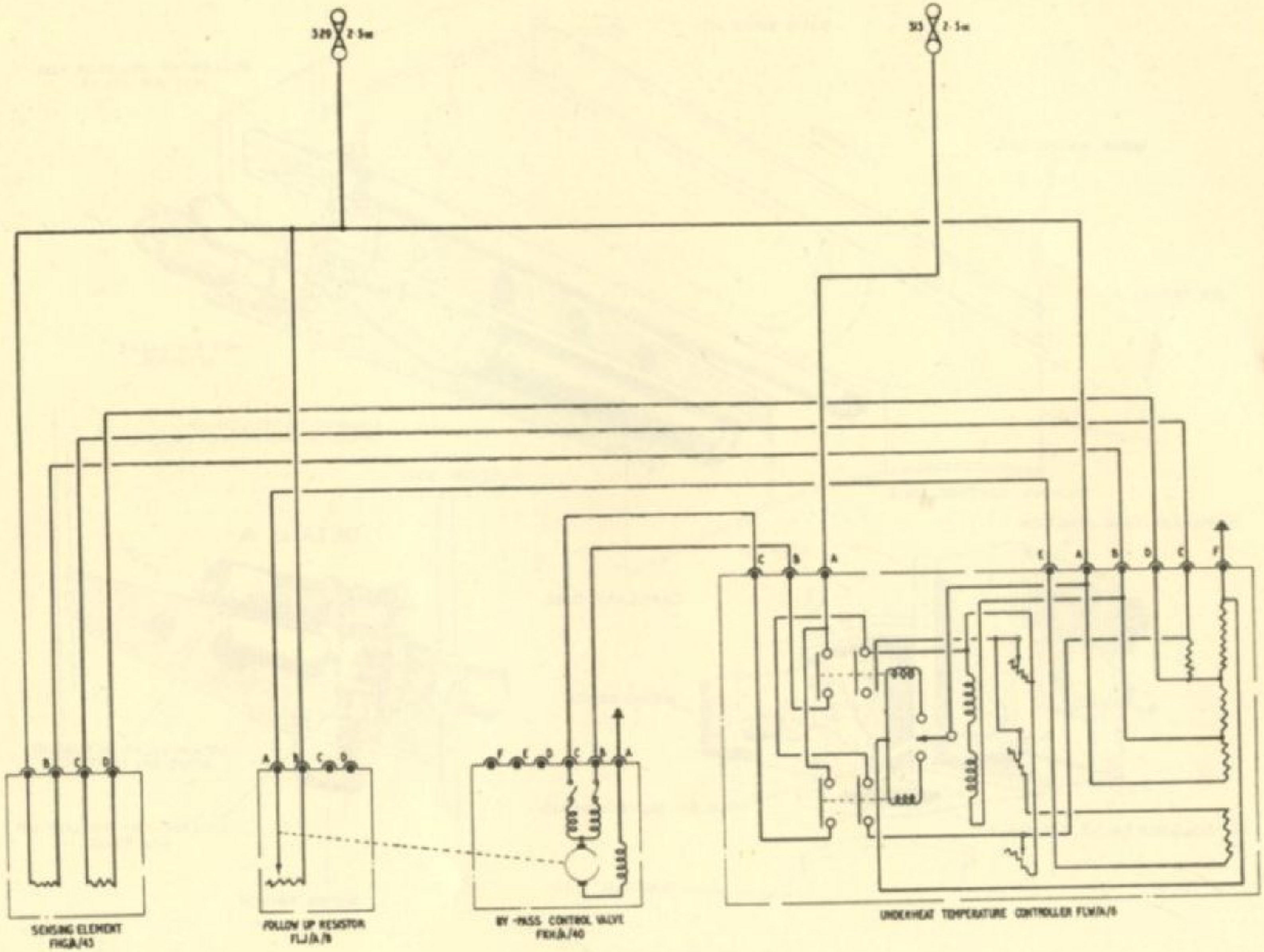


Fig. 9. Underheat controls

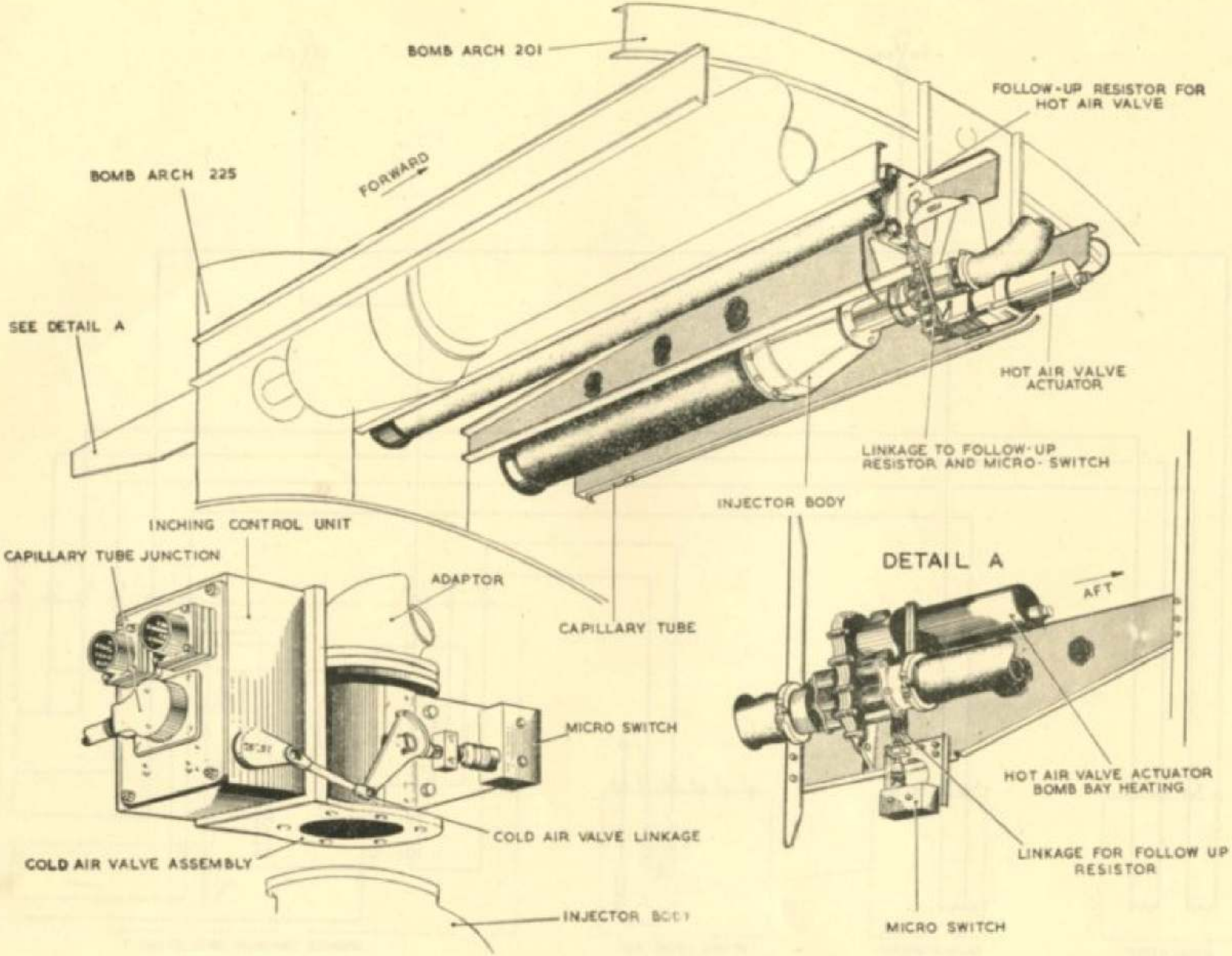


Fig. 10. Fin air injection assembly

re-balances the bridge after limited valve movement, so that there is a valve position for a particular temperature.

43. The system is entirely automatic in operation, no manual override being provided. A circuit diagram is contained in fig.9 and operation and servicing details for the under-heat temperature controller FLW/A/6 will be found in A.P. 1275A, Vol.1.

**Engine isolation cocks**

44. The engine air tapping on the port side of each engine has an actuator operated isolation valve and a non-return valve, and is under the control of the air isolation switches fitted on the starboard console. Operation of any one of the isolation switches to either the OPEN or SHUT position will move the actuator to open or shut position. Thus the air supply from any one engine can be isolated from the system.

*Circuit operation*

45. Four 2-position switches are mounted on the starboard console, each controlling an actuator fitted to one engine. For the purpose of this description the operation of No.1 engine actuator is described, the other three being similar (fig.18).

46. Movement of the engine air switch to SHUT will connect a supply, via C.B. No.20, to terminal 1 of the engine air switch and thence to the close field of the actuator valve to shut off the flow of air from No.1 engine.

47. Movement of the engine air switch to OPEN will connect the supply, via C.B. No.20 to terminal 3 of the engine air switch. The supply will thus be fed to the open field of the actuator valve, the valve will move to the open position and a supply of air will again be available.

**Ram air valve actuator**

48. When the aircraft is flying unpressurised ventilating air for the cabin is supplied from a forward facing air intake. Control of ram air is by means of a valve fitted on the aft face of the rear pressure bulkhead. This valve, which is operated by a split series actuator, may be opened or closed by selection, a switch fitted on the starboard console and labelled OPEN and SHUT being provided for this function.

49. Coupled to the actuator is a Desynn transmitter which, operating in conjunction with an indicator fitted on the starboard console, serves to give visual indication of valve position.

50. A routing chart combining ram air control and position indicator is shown in fig.19.

## RATION HEATERS

**General**

51. Five ration heaters are installed in the aircraft and located as follows:-

One adjacent to port console.

One adjacent to starboard console.

One each for the A.E.O. navigator and air bomber situated adjacent to their crew position.

52. The heaters which are designed for heating tinned rations during flight operate on a voltage of 28 volts and the heating element is rated at 75 watts. Full details of operation and servicing will be found in A.P. 4343E, Vol.1.

**Circuit operation**

53. Reference to fig.20 will show that the first pilot's and A.E.O.'s ration heaters are controlled by a switch fitted to panel 10P, the second pilot's and air bomber's ration heaters are controlled also by a switch fitted to panel 10P. The navigator's ration heater has its own control switch.

## SEXTANT HEAD HEATERS

**General**

54. Provision has been made for heating the sextant heads fitted in the aircraft on each side of the cabin. A switch fitted in the distribution panel 3P controls the heater supply to the port sextant head, and a similar switch on the distribution panel 4P controls the heater supply to the starboard sextant head. The supply is 28-volt d.c. A routing chart is contained in fig.21.

## BOMB BAY HEATING

**General**

55. The bomb bay is heated to maintain the bomb gear and other equipment at a temperature of a few degrees above freezing point. The system is situated entirely within the bomb bay and is similar to the de-icing systems, except that it operates continuously when switched on.

56. A branch of the engine hot air feed to the fin de-icing system passes through a hot air valve to the nozzle of an injector, and a branch of the cold air feed to the fin de-icing system passes through the cold air valve to the body of the injector. All these items are situated adjacent to the fin de-icing injector in the bomb bay arch (fig.10).

57. The outlet from the injector system is connected to two distribution ducts running forward and aft in the bomb bay, with branch pipes to distribute the heating air at regular positions throughout the bomb bay. An outlet louvre in the port bomb bay door provides an exhaust vent for the heated air. Full details of the hot air system will be found in Book 1, Sect.3, Chap.9 of this publication.

**Controls and indicators**

58. Two control switches and a temperature indicator are positioned on the starboard side of the navigator's panel. These are as follows:-

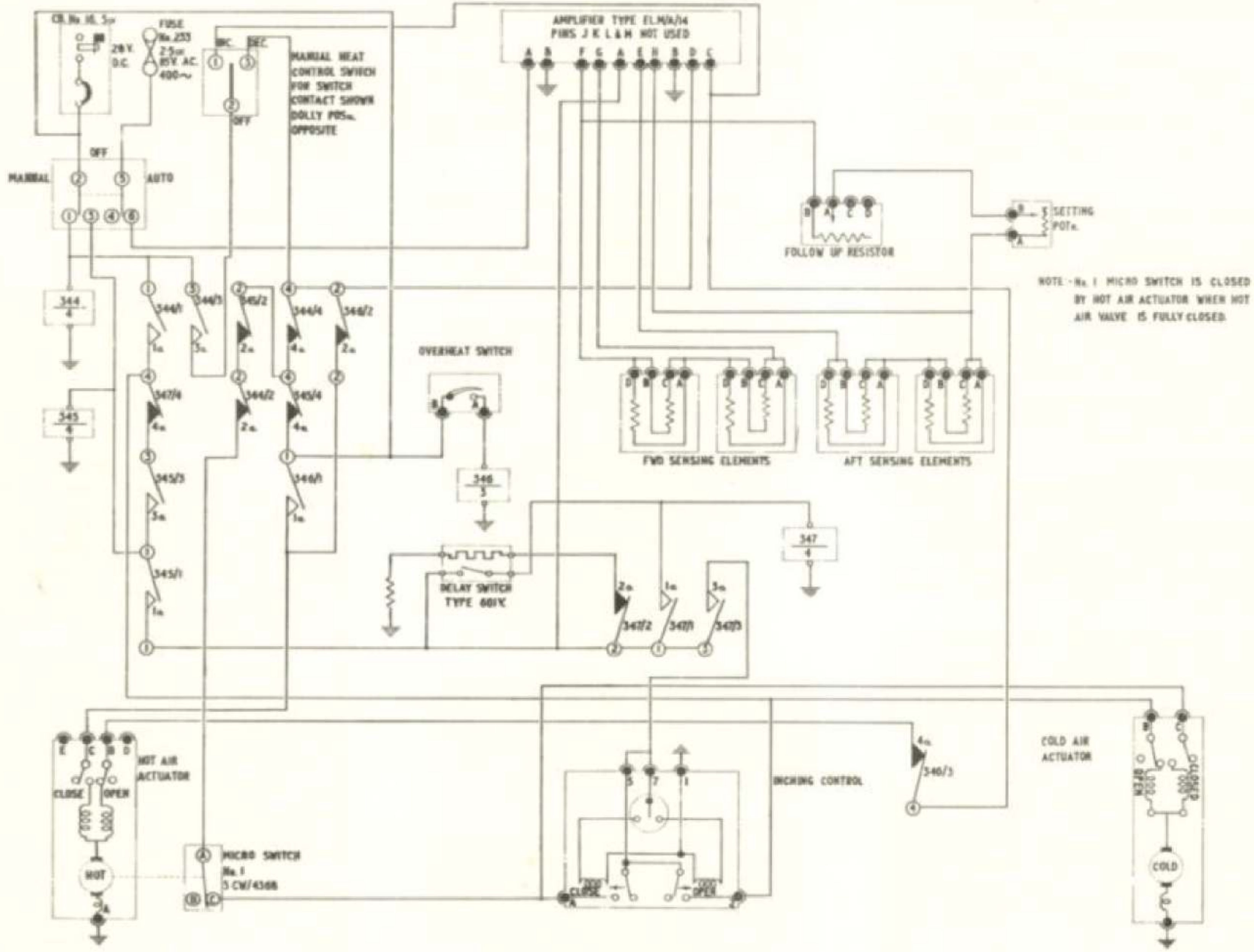


Fig. 11 Bomb bay heating

**RESTRICTED**

(1) Main control switch, labelled AUTO-OFF-MANUAL.

(2) Bomb bay heating switch, labelled INC.-OFF-DEC., spring-loaded to OFF.

(3) Bomb bay temperature selector.

(4) Bomb bay temperature indicator (Book 3, Sect.5, Chap.2, Group 5).

59. In addition, the following equipment is fitted for automatic control of the heating system:- Amplifier unit, Type FLM/A/14, Hot air valve actuator, Type FJC/A/14, Cold air valve actuator, Type C5520, Inching control, Type FDF/A/3010, Follow-up resistor, Type FLJ/A/4, Sensing elements (4), Type FHJ/A/2. The location of these items are shown in fig.1.

60. Before the bomb bay heating system can function, the engine air switches must be placed to ON. It is also assumed for the purpose of the following circuit operation that the appropriate a.c. and d.c. supplies are switched on.

**Circuit operation**

61. Reference to fig.11 will show that when the auto-manual switch is placed to AUTO, a 28-volt d.c. supply from C.B.16 will be fed via terminals 2-3 of the switch to energise relay 345. At the same time a 115-volt, 400 c/s a.c. supply from fuse 233 will be fed via terminals 5-6 of the switch to the amplifier input. Contacts 345/1 will close to connect the d.c. supply via contacts 347/2 to energise the delay switch, and contacts 345/3 will close to connect the same supply via contacts 347/4 to the open field of the cold air valve actuator. The close field of the actuator is isolated by the opening of contacts 345/2 and 345/4.

62. The cold air valve actuator will move to the fully open position, the open field of the hot air actuator being already under automatic control via the normally closed contacts 346/3.

63. Meanwhile after a delay of ten seconds, the delay switch will operate and relay 347 will be energised. Contacts 347/1 will close to provide a hold-in supply for relay 347, and contacts 347/3 will close to complete the supply to the inching control. At the same time contacts 347/2 and 347/4 will open to isolate the delay switch and the open field of the cold air valve actuator respectively.

64. At this stage the control of the hot air valve actuator will be taken over by the amplifier unit in conjunction with the bomb bay sensing elements and the setting of the temperature selector on the navigator's panel. The cold air valve will be under control of the inching controller.

65. The system functions in similar manner to the wing and fin de-icing systems. Note therefore that the action of the hot air valve micro switch ensures that the cold air valve will not be closed until the hot air valve is fully closed.

*Manual control*

66. When manual control of the bomb bay heating system is required, the auto-manual switch is selected to MANUAL. The following sequence of operations will then take place.

67. A 28-volt supply from C.B.16, via terminals 2-1 of the auto-manual switch will energise relay 344 (Supplies to the amplifier unit and the inching controller will be disconnected and automatic control will cease). Contacts 344/1 will close to connect the supply to the open field of the cold air valve actuator, and contacts 344/3 will close to connect the supply to terminal 2 of the manual heat control switch. At the same time contacts 344/2 will open to isolate the close field of the cold air valve actuator, and contacts 344/4 will open to isolate the close field of the hot air valve actuator.

68. The cold air valve will open. Operation of the hot air valve will be controlled by the auto-manual switch, so that selection of the switch to INCREASE will energise the open field of the valve via contacts 346/3 and selection of the switch to DECREASE will energise the close field of the valve via contacts 346/2.

NOTE...

*Routing chart fig.32A shows the re-orientation of cables due to the introduction of Mod.260. Circuit operation remains unchanged.*

**Overheat switch**

69. Should the temperature of the heated air exceed 130 deg.C., a thermal overheat switch in the bomb bay air ducting will close, which will result in the closing of the hot air valve. When the temperature of the air drops to 120 deg.C., the overheat switch will open and the circuit will return to normal.

70. Should the switch close due to the specified rise in temperature, a supply from C.B.16, via the switch contacts, will energise relay 346. Contacts 346/3 will then open to isolate the open field of the hot air valve actuator, and contacts 346/1 will close to energise the close field of the actuator direct from C.B.16. Opening of the switch will de-energise relay 346 and allow the hot air valve to open.

## BATTERY HEATING AND VENTILATION

**General**

71. A system of battery heating and ventilation is provided in the aircraft power compartment. To prevent damage to the aircraft batteries due to freezing conditions in flight, a thermostatically controlled heater is installed in a large round duct on the port side of the power compartment. Branch pipelines from the duct are taken to the battery boxes to provide circulating hot air; inlet and outlet air ducts are located under the floor of the compartment. The heater is automatically switched on as a

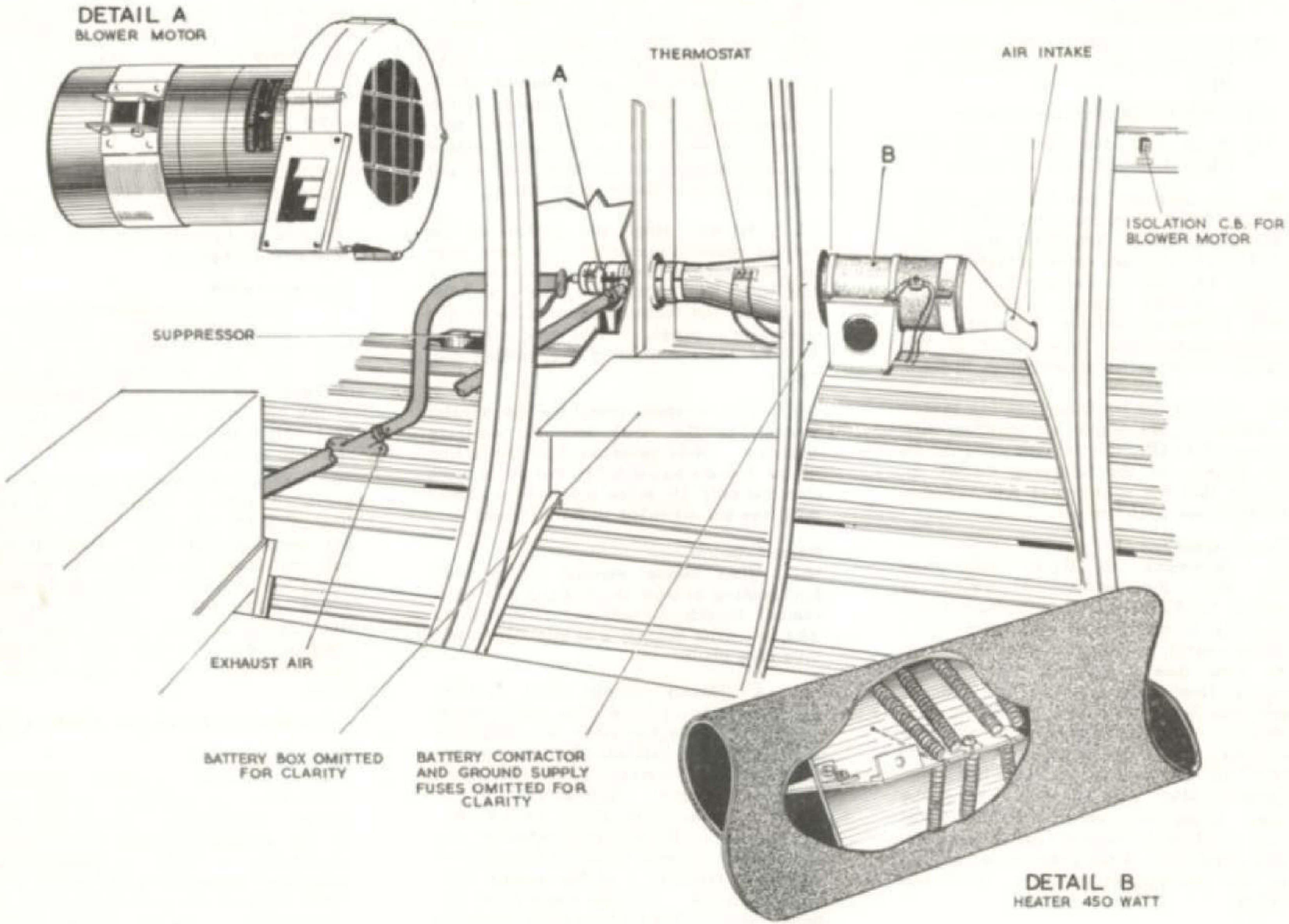


Fig.12 Battery ventilation

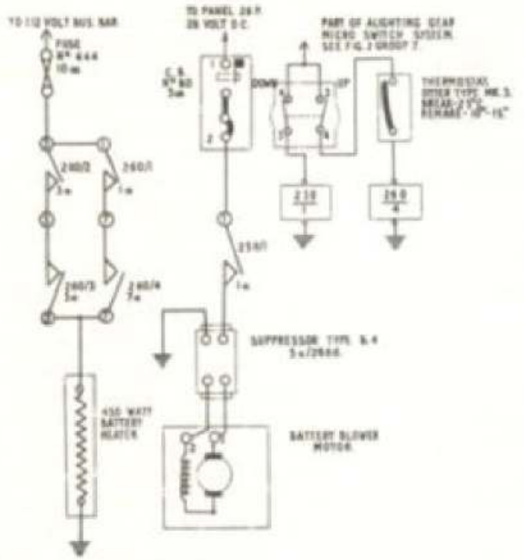

Fig.13 Battery heating and ventilation

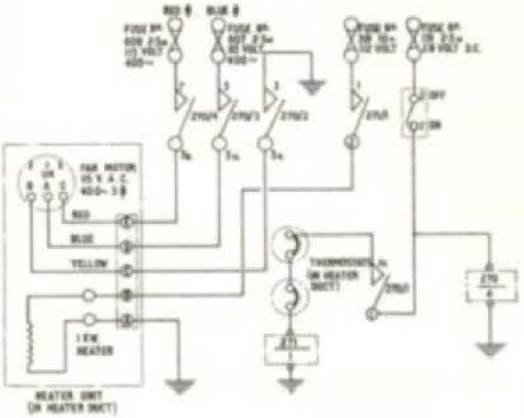

Fig.14 Windscreen de-mister

function of alighting gear up selection and automatically switched off as a function of alighting gear down selection.

72. Whilst the aircraft is on the ground, accumulation of gases in the power compartment is prevented by the provision of a blower motor in the hot air duct. This motor is switched on as a function of alighting gear down selection, thus ensuring that circulation of air within the compartment will be maintained when the supply due to the slip stream has been cut off. The motor is switched off as a function of alighting gear up selection. A circuit breaker fitted in the power compartment also enables the motor to be switched off, if desired, whilst the aircraft is on the ground.

**Circuit operation**

73. Reference to fig.13 and to fig.2, Group 7, of this chapter, will show that a supply for the two relays in the battery heating and ventilation system is governed by the selection of either UP or DOWN on the alighting gear selection switch.

74. When UP is selected, a supply will be fed to the coil of relay No.260, relay 260 will be energized and contacts 260/1, 2, 3 and 4 will be made to feed a supply from the 112-volt bus-bar to the 450-watt battery heater.

NOTE...

*In view of the large current consumption of the heater, relay 260 has its contacts connected in series parallel.*

75. When DOWN is selected a supply will be fed to relay No.259. Relay 259 will be energized, contacts 259/1 will close and a supply via C.B. No.80 will operate the blower motor. Radio interference is minimized by the fitting of a suppressor across the supplies to the blower motor.

## WINDSCREEN DE-MISTER

**General**

76. A thermal system of de-misting the pilots' windscreen is used on the aircraft. A ducting, with branch pipes connected to the pilots' windscreen, is located under the starboard side of the pilots' floor.

77. The ducting houses a 115-volt, 3-phase a.c. fan motor, a 1-kilowatt, 112-volt heater and two thermostats. For details of the ducting system reference should be made to Book 1, Sect.3, Chap.8 of this publication.

#### Circuit operation

78. Reference to fig.14 will show that when the windscreen de-mister switch fitted on the starboard console 7P (fig.2, pre Mod.38 and fig.2A, post Mod.38) is moved to the ON position, a 28-volt d.c. supply via fuse No.131 will energize relay No.270, to close contacts 270/1, 2, 3 and 4.

79. Contacts 270/2, 3 and 4 serve to feed the a.c. supply via fuses No.606, 607 and earth to operate the fan motor.

80. Contacts 270/1 feed the d.c. supply via fuse No.131 and the series connected thermostats to energize relay No.271. Contacts 271/1 close to connect the d.c. supply via fuse No.391 to the heater unit.

### WING, FIN, ENGINE AND INVERTER DE-ICING

#### Wing and fin de-icing

81. The aircraft employs a thermal de-icing system by means of which the leading edges of the main planes and the leading edge of the fin may be heated to prevent formation of ice. Hot air tapped from the engine compressors is mixed with cold air to give a regulated temperature and is then ducted round the inside of the leading edges, giving up heat to the skin. Three separate systems are used i.e., port mainplane de-icing, starboard mainplane de-icing, and fin de-icing. Each system can be selected to operate automatically, either individually or collectively, as a function of ice formation detection or to operate individually under manual control.

#### Normal conditions

82. Under normal conditions automatic control will be employed, but manual control can be used in an emergency on failure of the automatic control circuits. Selection of automatic control can be made by three selector switches labelled AUTO-MANUAL fitted on the de-icing panel forming part of the starboard console panel 7P (fig.2). Immediately above these switches are three ratiometer type indicators which indicate the temperature of the air in the leading edge ducts. Below each selector switch is a manual heat control switch labelled INCREASE-DECREASE. Two further switches, labelled PORT ENGINES and STARBOARD ENGINES respectively, provide separate control for the engine de-icing circuits for the purpose of ground engine runs. Mod.38 calls for repositioning of the de-icing panel. This re-arrangement is shown in fig.2A.

83. Equipment in the automatic control circuits includes three amplifier control units, Type FLM/A/14 and three inching control units, Type FDF/A/3113.

#### Amplifier control

84. Each amplifier control unit consists of a 3-stage amplifier, a network of resistances operating on the wheatstone bridge principle and two relays, one controlling supplies to the increase field of the split-series hot air valve actuator, and the other controlling supplies to the decrease field of that actuator. For a circuit diagram of the amplifier see fig.5. Temperature sensing elements are installed in the leading edges, these form the variable section of the bridge circuit which determines the action of the hot air valve actuator control circuits.

85. Operation of the cold air valve actuators is controlled by bellows-operated switches in each inching control unit. The action of the inching control is determined by the reaction of a temperature sensitive phial in each leading edge warm air duct. The phial is connected to the bellows by a capillary tube.

#### Setting potentiometers

◀ 86. Three setting potentiometers, Type FHK/A/20, are mounted adjacent to panel 4P. These form part of the amplifier control resistance networks and are selected to position 10 for normal operation of the system. A 115-volt, single-phase, 400 c/s a.c. supply is fed to each amplifier from the No.3, Type 350, inverter. The a.c. supplies and distribution are fully described in Group 3A. ▶

87. D.C. supplies to the hot and cold air valve actuators and the extractor flap actuator are obtained from the 28-volt bus-bar via circuit breakers No.15 (fin) and 32 and 33 (wings).

#### Automatic control

88. Under automatic control, the operation of each circuit will be initiated by the closing of a switch in the ice detection unit. Operation of the hot air valve actuator will then be controlled automatically by the action of relays in the amplifier control unit. These relays will act as inching controls for the hot air valve actuator in accordance with the changes of temperature during flight. The extractor flaps will be operated to the fully open position and remain so during the period the ice detector switch is closed. Having been fully opened on operation of the ice detector switch, the cold air valve, after a delay to allow the slower hot air valve to open, will be switched back to the required position by the action of its associated inching control unit.

89. The distribution of excessively hot air through the ducting is avoided by the inclusion of a micro switch in each circuit. This micro switch controls the closing of the cold air valve in such a manner that the cold air valve will not be closed until the hot air valve is fully closed. Further protection is afforded by a thermal overheat switch fitted in the leading edges. If the temperature in either leading edge duct exceeds 160 deg.C, the associated overheat switch will close, and the hot air valve will be closed.

#### Automatic control, circuit operation

90. The following paragraphs describe the sequence of operation following the selection of AUTO on the auto-manual selector switch as applied to the port wing de-icing installation.

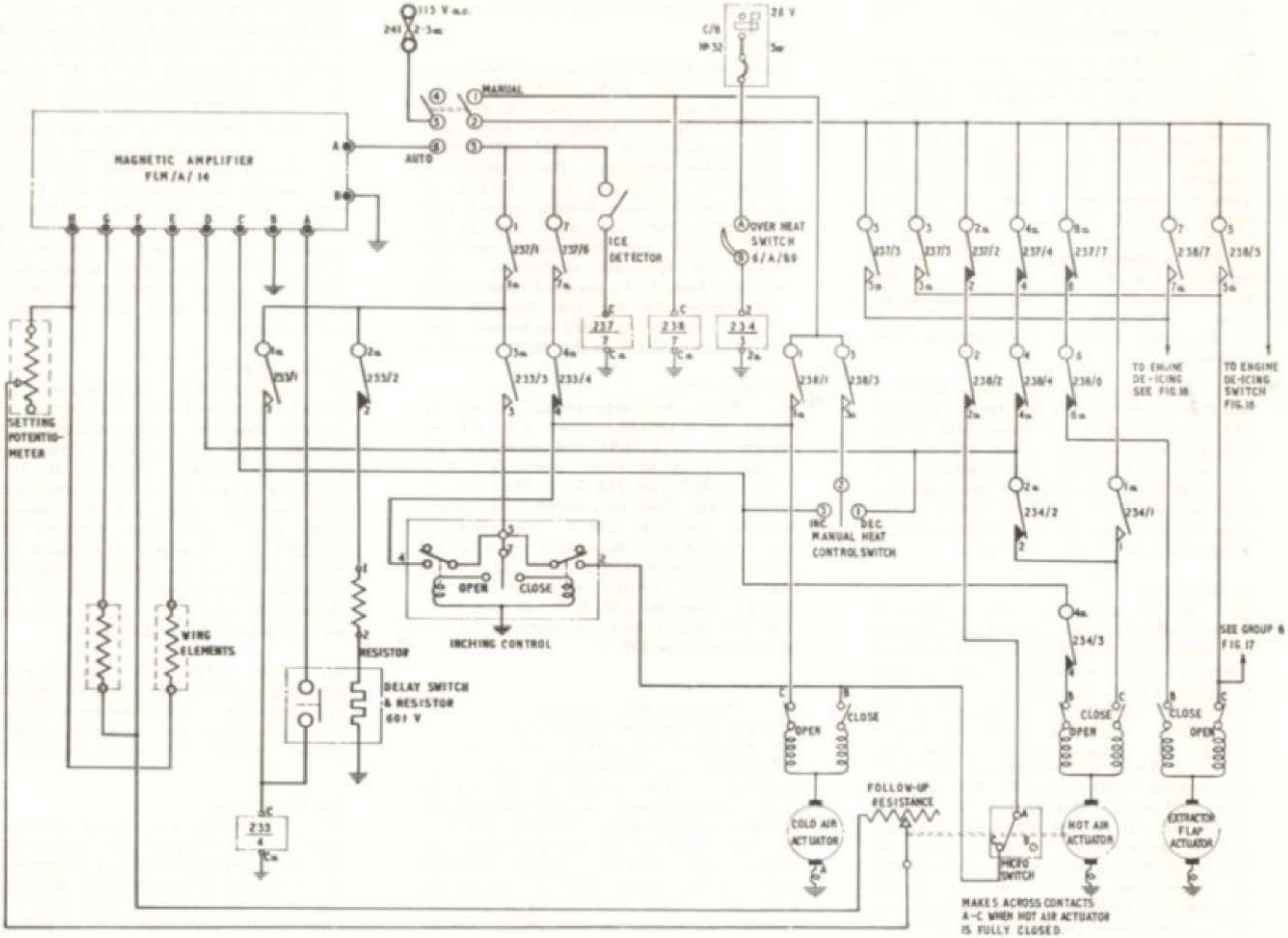


Fig. 15 Port wing de-icing control

The sequence is similar for the starboard wing and for fin installations. It is assumed that the appropriate a.c. and d.c. supplies are available.

91. Reference to fig.15 will show that when the ice detection switch operates, relay 237 will be energized via C.B. No.32 to close contacts 237/1, and 237/6, which are linked to the d.c. supply via terminal 3 of the auto-manual switch, and contacts 237/3 and 237/5 which are directly connected to the 28-volt d.c. supply at C.B. No.32. From contacts 237/1 the supply is fed to terminal A of the magnetic amplifier and through normally closed contacts 233/2 to the heater resistance of the thermal delay relay. Contacts 237/3 feed the supply to the open field of the extractor flap actuator.

92. The supply from contacts 237/6 is fed through the normally closed contacts 233/4 to energise the open field of the cold air valve actuator, which will operate the valve to the fully open position. At the same time a supply from the amplifier will be made via contacts 234/3 to the open field of the hot air valve actuator, which will open the hot air valve.

*Delay switch*

93. In the meantime, after a delay of ten seconds, the delay switch will operate and relay 233 will be energized to close contacts 233/1 and 233/3 and to open contacts 233/2 and 233/4. Contacts 233/1 will then form a hold-in circuit for relay 233. Contacts 233/3 will feed a 28-volt d.c. supply to the centre contacts of the bellows-operated switch in the inching control unit for the cold air valve actuator. The opening of contacts 233/4 will cut off the supply to the open field of the actuator. At this stage the control of the hot and cold air valves will be taken over by the amplifier control unit and the inching control respectively. The actuators will be operated to positions determined by the reaction of the sensing elements and the temperature of the sensitive phial. Details of operation and servicing of the amplifier FLM/A/14 will be found in A.P.1275A, Vol.1.

NOTE...

*Where an aircraft has been handed over to the Service with no ice detectors fitted, it should be noted that the two cables to the ice detector will have been short circuited, the terminal ends having been bolted together. The sequence of operations following the selection of AUTO on the auto manual switch will be exactly the same as if the ice detector switch had been fitted and had closed due to icing conditions. The bolt will have to be removed when fitting and connecting the ice detector, the system then being fully automatic with the selector switch in the AUTO position.*

*Manual control*

94. When the auto-manual switch is placed to MANUAL, relay 238 will be energised via C.B.32 and terminals 1-2 of the switch to close contacts 238/1, 238/3, 238/5 and 238/7. The cold air actuator will then be opened by a supply through contacts 238/1, the extractor flap actuator will be opened by a supply through contacts 238/5, and the manual heat control switch will be supplied through contacts 238/3. At the same time the engine de-icing circuits will be fed via contacts 238/7.

95. Opening and closing of the hot air valve will now be controlled by placing the manual heat control switch to the INCREASE or DECREASE position as required. The circuit to the hot air valve actuator will be fed through the normally closed relay contacts 234/3 to the open field of the hot air valve actuator, and normally closed contacts 234/2 to the close field of the hot air actuator. The cold air valve and extractor flap actuators will remain at the fully open position during the period that the auto-manual switch is at MANUAL.

*Switching off*

96. When the auto-manual switch is placed to OFF, the supply to relay 238 will be broken and it will be de-energized. A supply from C.B. No.32 will be connected via contacts 237/7 and 238/6 to the close field of the extractor flap, and via contacts 237/4, 238/4 and 234/2 to the close field of the hot air actuator. As soon as the hot air valve is closed, its mechanically operated micro switch will operate at contacts A and C and a supply will be connected to the close field of the cold air actuator, via relay contacts 237/2 and contacts 238/2. With all valves closed the system is shut off. A similar sequence of operations will take place when the ice detection switch opens.

*Overheat switch*

97. Should the temperature of the heated air exceed 165 ± 5 deg. C., the thermal overheat switch situated in the leading edge (fig.1) will close and a 28-volt d.c. supply via C.B. No.32 and terminals A and B of the thermal switch will energize relay 234 to close contacts 234/1 and open contacts 234/2 and 234/3. Opening of contacts 234/2 will isolate the open field of the hot air actuator and a supply will be fed to the close field of the hot air valve actuator, via contacts 234/1 and C.B.32.

98. This valve will close to cut off the supply of hot air, and the temperature will decrease. The overheat switch will then revert to the open position and normal control will again be possible.

**Engine de-icing**

99. A thermal system of de-icing is used for the engine air intake bullet. Hot air is bled from the low pressure side of the engine by means of an electrically operated valve actuator, Type FKH/A5006 fitted on the starboard side of the stator case. The hot air is piped to the engine annulus, which surrounds the rear portion

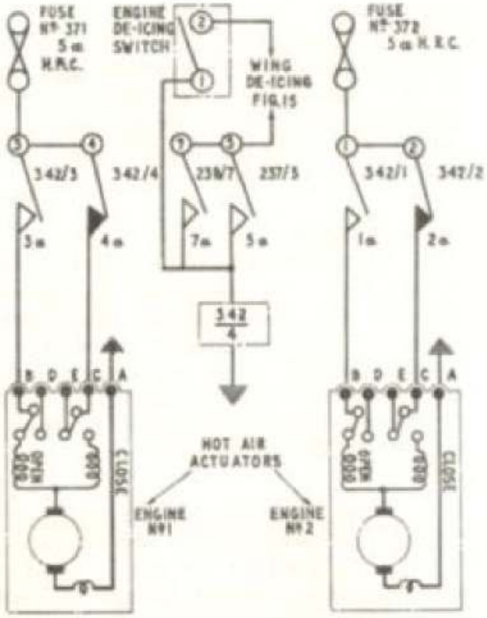


**Fig.16 Engine de-icing**

of the engine air intake bullet. Hot air is then directed by means of the annulus casting struts, to the interior of the air intake bullet and is then exhausted to atmosphere.

*Control*

100. The electrically-operated valve actuators are operated as a function of the aircraft's wing de-icing system. No.1 and No.2 engine valve actuators by the port wing de-icing controls, and No.3 and No.4 engine valve actuators by the starboard wing de-icing controls.

**Circuit operation**

101. The circuit operation for No.1 and 2 engines only is described, the operation for No.3 and 4 engines being similar. The associated theoretical circuit diagram is shown in fig.16 which should be read in conjunction with fig.15.

*Auto-control*

102. With the port wing auto-manual switch at AUTO, relay 237 will be energized from C.B.32 via contacts 2-3 of the switch. Contacts 237/5 will then close to energise relay 342. As a result, contacts 342/3 and 342/1 will close to energise the open fields of No.1 and 2 engine actuators from fuses 371 and 372 respectively.

103. When the auto-manual switch is moved to OFF, relays 237 and 342 will be de-energised, and contacts 342/4 and 342/2 will revert to their normally closed position to connect the supply to the close fields of the actuators.

*Manual control*

104. When the auto-manual switch is placed to MANUAL, relay 238 will be energised by a supply from C.B.32 via contacts 2-1 of the switch. Contacts 238/7 will then close to energise relay 342 and the open fields of No.1 and 2 engine actuators will be energised.

105. When the auto-manual switch is moved to OFF, relays 238 and 342 will be de-energised to revert the supply to the close fields of the actuators.

*Independent control*

106. When independent control of the engine de-icing system is required, e.g., during ground engine runs, the two associated control switches on the starboard console will be placed to ON. In the case of the port engines, relay 342 will be energised direct from C.B.32 and the open fields of the actuators will be energised.

**Inverter de-icing**

107. To prevent formation of ice in the Type 350 inverter cooler intake situated in the nose-wheel bay, port side, an electrical heater unit is fitted (fig.17). When icing conditions are met the sequence of operations will be as follows. The port auto-manual switch fitted on the de-icing panel will already have been moved to AUTO or MANUAL. If on AUTO, relay 237 will already be energized (para.102). A supply will then be connected, via C.B. No.32 and contacts 237/3, to a micro switch on the nose leg oleo; contacts 5 and 6 of this micro switch are made when the oleo leg is extended i.e., when the aircraft leaves the ground. The supply is then fed to relay 447, located in the bomb bay on the forward face of the front spar. Relay 447 will now be energized and a 112-volt d.c. supply will be fed via contacts 447/1 to terminal A of the heating element.

108. If the auto-manual switch has been placed to MANUAL relay 238 will be energized and a supply will be connected via contacts 238/5 to the nose oleo leg micro switch. The same sequence of operations will now take place.

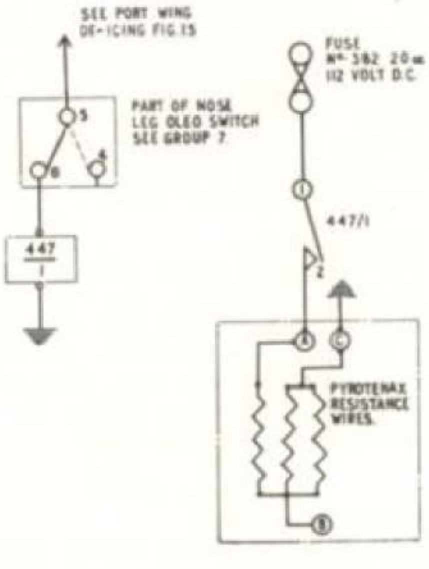


**Fig.17 Inverter intake de-icing**

109. When the aircraft is on the ground the supply to the heater will be inoperative due to the fact that the nose leg oleo switch disconnects the supply to relay 447.

## PILOTS' AND AIR BOMBER'S WINDSCREEN DE-ICING

### General

110. In addition to the thermal windscreen demisting systems described in para.76 to 80 of this Group, a fluid system of de-icing the pilots' and air bomber's windscreens is used on the aircraft.

◀ 111. With this system, de-icing fluid is sprayed on to the windscreens, the flow of fluid being controlled by the action of two dual solenoid operated valves, Type AC11392 and Type AC11348, for the pilot's and air bomber's windscreens respectively. The valves are fitted together at the starboard side of the de-icing fluid tank.

### Pilots' windscreen control

112. The pilots' control switch is fitted on the starboard console (pre Mod.38 on the nitrogen panel, post Mod.38 on the flight refuelling panel). The switch, Ref.No. 5CW/6436, is 3-positioned and labelled NORMAL-OFF-EMERGENCY. Operation of the switch will energise the respective windscreen valve.

*Normal operation*

113. When the pilots' control switch is placed to NORMAL, the low pressure solenoid of the valve will be energised to partially open the valve and allow a restricted flow of de-icing fluid to spray on to the windscreen through the spray pipes on the windscreen frame.

*Emergency operation*

114. When the pilots' control switch is placed to EMERGENCY, both solenoids of the valve will be energised to fully open the valve and thus increase the flow of de-icing fluid to spray on to the windscreen.

### Air bomber's control

115. The air bomber's control switch and labelling is similar to that of the pilots, with similar circuit operation. However, the de-icing fluid is sprayed on to the air bomber's windscreen at a reduced rate of flow.

116. A routing chart of the circuit is given in fig.22 (pre Mod.38) and fig.22A (post Mod.38). The mechanical aspect of the system is described Book 1, Sect.3, Chap.9 of this publication. ▶

## PROBE DE-ICING (Post Mod.38)

### General

117. Vulcan Mod.38 introduces the fixed fittings to enable the aircraft to be refuelled in flight, and this modification includes facilities for de-icing the refuelling probe. It should be noted that the removable flight refuelling fittings are introduced by Mod.39.

118. De-icing fluid is piped under pressure to the refuelling valve situated at the end of the probe. An ON-OFF valve is controlled by an actuator, this in turn being fed from the aircraft's 28-volt, d.c. supply via fuse No.195 in panel 4P and a single-pole switch situated on the starboard console 7P.

### Mk.1A aircraft

119. On Mk.1A aircraft no requirement exists for probe de-icing and the system is removed by Mod.869.

## H2S AIR VALVE

### General

120. A pressurized dry air supply is provided for the H2S scanner unit fitted in the nose of the aircraft. Air is supplied from ground air equipment to a single high pressure cylinder fitted in the port side of the nose.

### Pressure relief

121. A pressure relief valve, set to 2,250 p.s.i. is embodied in the line between the cylinder and the charging valve. This charging valve and the pressure relief valve are located behind the removable panel which gives access to the emergency equipment on the port side of the aircraft's nose.

122. From the cylinder the air is piped through a reducing valve and the pressure is now reduced to 30 p.s.i. At this pressure the air passes through an electromatic tap, Type AC.11312, to a pressure regulator.

### Pressure regulator

123. There are two outlets from the pressure regulator; one supplies a regulated flow of air at 15 p.s.i. to the H2S scanner unit, this outlet being also connected to a pressure gauge in the crew's compartment; the second outlet is piped to the cabin for pressure relief.

### Operation

124. A switch labelled ON-OFF, mounted on a bracket fitted on the starboard side of the crew's panel 12P, controls the 28-volt d.c. supply via fuse No.61 to the electromatic tap.

### Installation

125. Details of the installation and operation of the system are contained in Book 1, Sect.3, Chap.7 of this publication. A routing chart of the electrical controls is contained in fig.23.

## TABLE 1 LIST OF COMPONENTS

| Component | Type | Location |
|---|---|---|
| **AIR CONDITIONING COMPONENTS** | | |
| Ambient altitude switch | PAD/A/3 | Under pilots' floor starboard side |
| Cabin altitude switch | PAD/A/4 | |
| Pressure controller | B510,740 | |
| Release valve units (2) | C5478Y | |
| Decompression warning horn | 5C/1961 | |
| Horn isolation switch | D5404 | |
| Temperature control amplifier | FLM/A/14 | |
| Manual flow control switch | 5C/1979 | Starboard console |
| Reset switch | D5407 | |
| Port and starboard cabin air isolation switches | 5C/4179 | |
| Temperature control valve indicator | FL423 | |
| Cabin temperature control switch | 5C/1979 | |
| Cabin temperature selector | FHK/A7 | |
| Port and starboard manual mass flow switches | 5C/4178 | |
| Pressure selector switch second pilot's | C5148Y | |
| Ram air valve indicator | 231FL | |
| Ram air valve switch | D5403 | |
| Isolation cock switches | D5406 | |
| Emergency decompression switch | D5406 | Port console |
| Abandon aircraft and decompression switch | D5506 | |
| Indicator lamp,red,door warning | 5C/1064 | |
| Port and starboard flow modulators | FMY/A/1 (FMY/A/2,post Mod 299) | Under engine air intakes |
| Port and starboard flow controllers | FOA/A/7 | |
| Port and starboard mass flow control valve actuators | FKH/A/49 | |
| Pressure ratio control switch | FLY/A/4 | |
| Micro limit switches (4) (3,post Mod.342) | 5C/4638 | |
| Pressure ratio control switch | FLY/A/4 | Fitted in air conditioning crate,nose wheel bay |
| Temperature control valve actuator | FKH/A/50 | |
| Follow up resistor | FLJ/A/13 | |
| Overheat switch | FHD/A/87 | |
| Underheat temperature controller | FLW/A/6 | |
| Underheat follow up resistor | FLJ/A/8 | |
| By pass control valve | FKH/A/40 | |
| Follow-up resistor | FLJ/A/13 | |
| Underheat sensing element | FHG/A/43 | |
| Temperature control transmitter | C6A/2134 | |

**TABLE 1** - *continued*

| Component | Type | Location |
|---|---|---|
| Temperature sensing elements | FHG/A/35 | Mounted inside ducts port and starboard of cabin |
| Underheat sensing element | FHG/A/43 | Under adapter duct |
| Ram air valve | 303,400 | Aft face of rear pressure bulkhead |
| Ram air transmitter | 135FL | |
| Manual decompression switch | 5C/4098 | Under second pilot's floor |
| Torque shaft micro switch | 5C/4098 | At main entrance door |
| Entrance door micro switches | C1831Y | |
| Door warning lamps Red | 5C/1069 | |
| Door warning lamps Green | 5C/1552 | |
| Abandon aircraft warning lamps | 26DC/9391 | Navigator's panel (12P) |
| Decompression warning lamps | 5C/1556 | |
| Engine isolation cock actuators | FKH/A/5061 | Fitted to engines |
| Main entrance door magnetic indicator | 5CZ/5073 | Nose wheel bay |
| Decompression switch | 5C/4225 | |
| **DE-ICING COMPONENTS** | | |
| Setting potentiometers (3) | FHK/A/20 | Fitted adjacent to panel 4P |
| Port, starboard and fin manual-auto switches | D5501 | Starboard console 7P |
| Port, starboard and fin manual heat control switches | D5403 | |
| Pilots' windscreen de-icing switch | D5501 | |
| Wing hot air actuators (2) | FJC/A/19 | 1 of each under port and starboard air intakes and 1 of each under the dorsal fin in the bomb bay |
| Fin hot air actuator | FJC/A/14 | |
| Micro switches (3) | 5CW/4638 | |
| Cold air actuators (3) | A0220 | |
| Inching controls (3) | FDF/A/3113 | |
| Follow up resistances (3) | FLJ/A/4 | |
| Port and starboard extractor flap actuators | A0217 | Under air intakes |
| Overheat switches (3) | FHO/A/63 | Fitted in hot air duct in leading edges |
| Wing elements (6) | FKA/A/2 | |
| Ice detectors | | Not finalised |
| Inverter de-icing heater (pyrotenax) | Avro Pt.No. 20/Z8929 | Fitted inside inverter air intake |
| Engine de-icing hot air actuators | FKH/A/5006 | One fitted to each engine |

TABLE 1 - *continued*

| Component | Type | Location |
| --- | --- | --- |
| Pilots' windscreen de-icing valve | ◀ AC11392 | Starboard side of de-icing fluid tank |
| Air bomber's window de-icing valve | AC11348 ▶ | Aft of the de-icing fluid tank |
| Air bomber's window de-icing switch | D5501 | Air bomber's panel 8P |
| Delay switch (2) | 601V | Panel 17P |
| Delay switch (1) | 601V | Panel 23P |
| **BATTERY HEATING AND VENTILATION** | | |
| Blower motor suppressor | 5U/3310<br>134.5C/2866 | Fitted to the ventilation duct port side of power compartment |
| Thermostat<br>Heater | Otter A, Mk.III | Fitted inside ventilation duct port side of power compartment |
| **WINDSCREEN DE-MISTER** | | |
| Fan motor | 115 volt a.c.<br>400 c/s. 3-phase | Fitted inside heater duct in cabin |
| Heater<br>Thermostats (2) | 26DC/2554<br>AW/45541 | |
| Control switch | D5404 | Starboard console 7P |
| **RATION HEATERS AND CONTROLS** | | |
| First pilot's ration heater | 5V70 | Adjacent to port console 6P |
| Second pilot's ration heater | 5V70 | Adjacent to starboard console 7P |
| Ration heaters, signaller, navigator, air bomber | 5V70 | Crew's position |
| Ration heater control switches (3) | D5404 | Fitted to generator panel 10P |

TABLE 1 - *continued*

| Component | Type | Location |
|---|---|---|
| **SEXTANT HEAD HEATERS** | | |
| Control switch port | D5404 | Fitted to panel 3P |
| Control switch starboard | D5404 | Fitted to panel 4P |
| Heaters combined with sextant mountings (2) | Mk.1B 6B2587 | Cabin equipment port and starboard |
| **BOMB BAY HEATING COMPONENTS** | | |
| Manual and auto control switch<br>Manual and heat control switch<br>Temperature selector | 5C/4199<br>5C/4178<br>FKH/A/17 | Navigator's position 12P |
| Time delay switch | 601V | Panel 43P |
| Hot air actuator<br>Micro switch No.1<br>Cold air actuator<br>Inching control<br>Follow up resistor | ◀ FJC/A/14 ▶<br>5CW/4638<br>C5520<br>FDF/A/3010<br>FLJ/A/4 | Adjacent to dorsal fin de-icing equipment fitted in the bomb bay arch |
| Sensing elements 4 | FHJ/A/2 | 2 port side of bomb bay aft<br>2 starboard side of bomb bay fwd. |
| Amplifier | FLM/A/14 | Adjacent to 43P front spar |

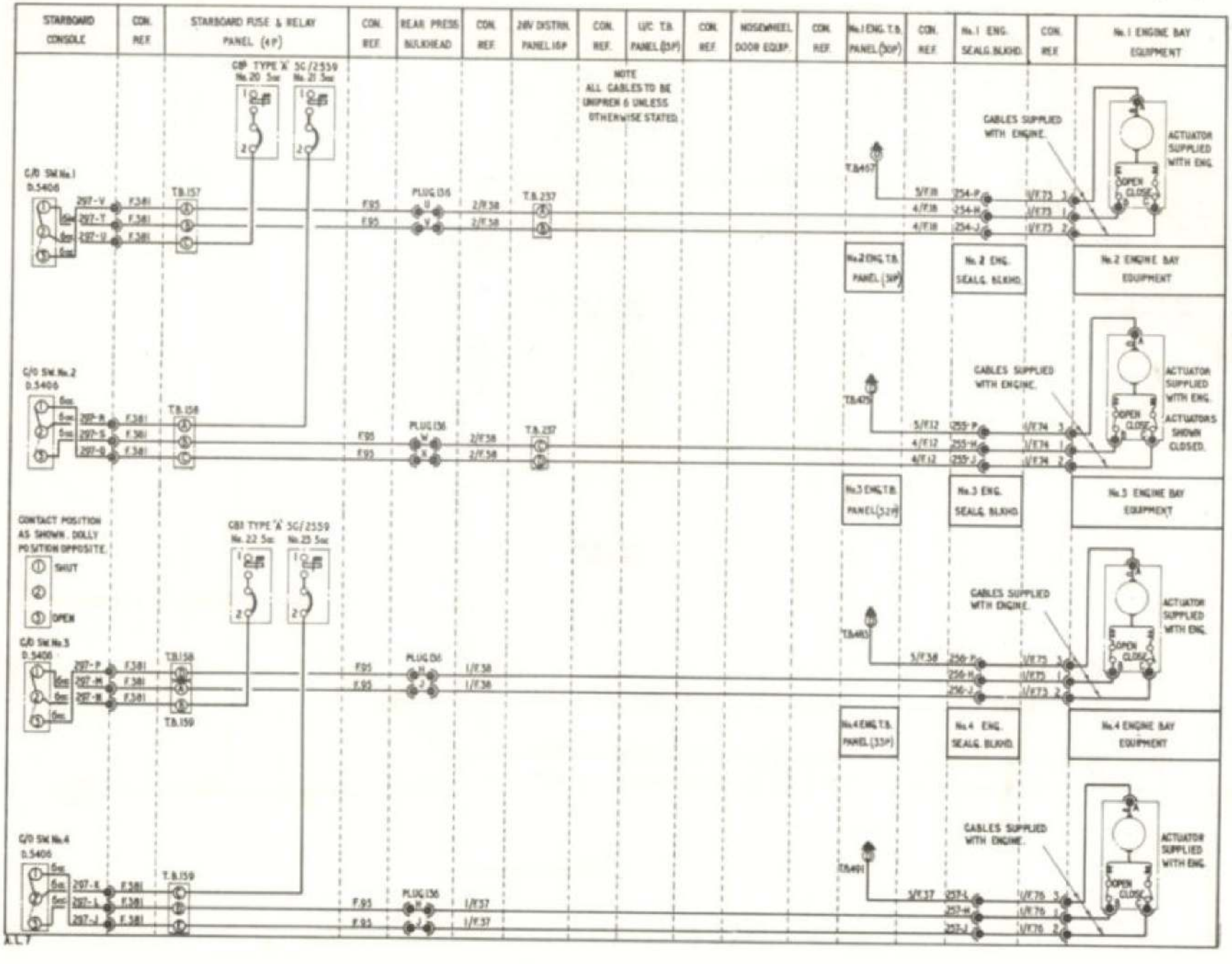


Fig. 18 Engine isolation cocks.

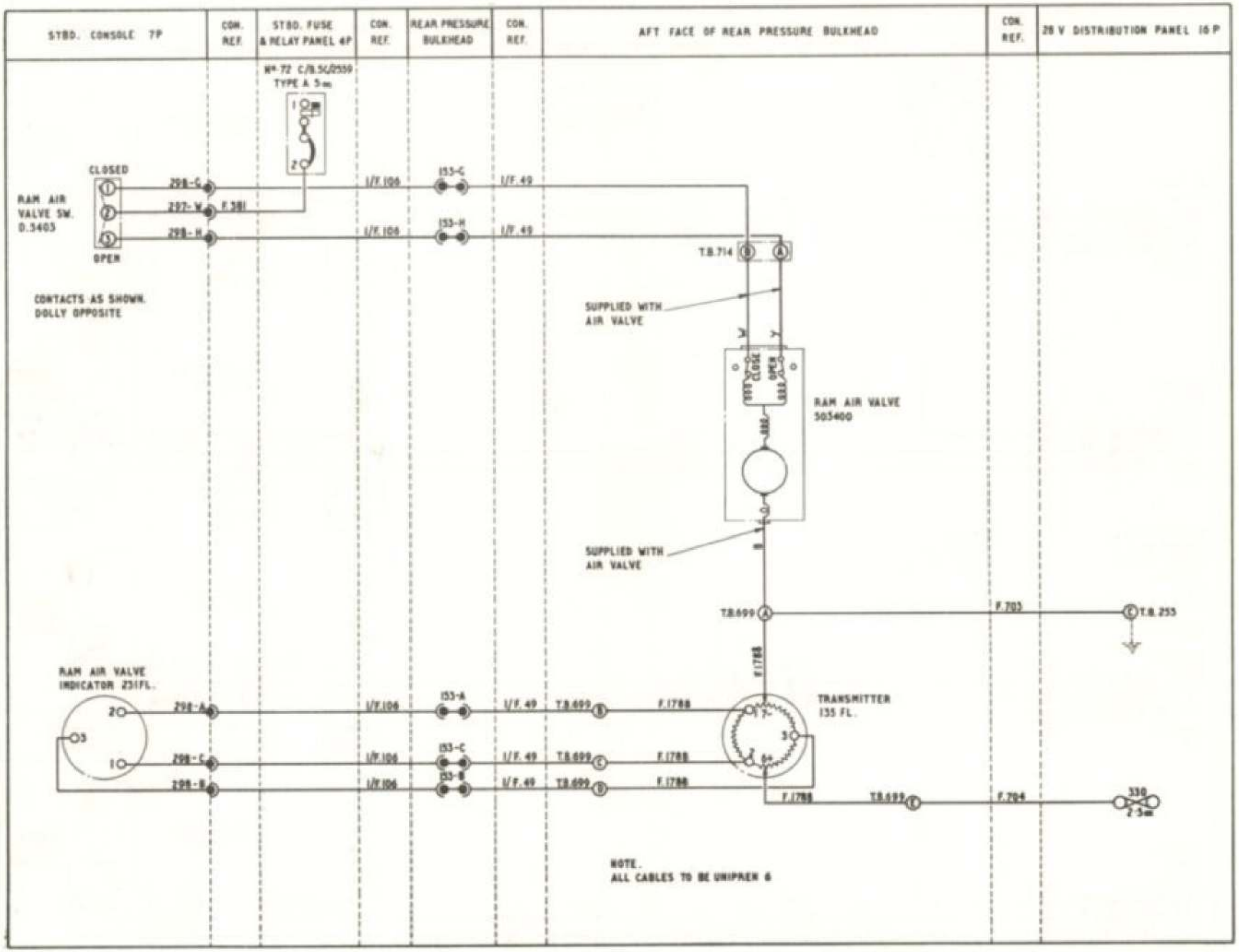


Fig.19 Ram air valve

(◄ *Correction to valve cable colours* ►)

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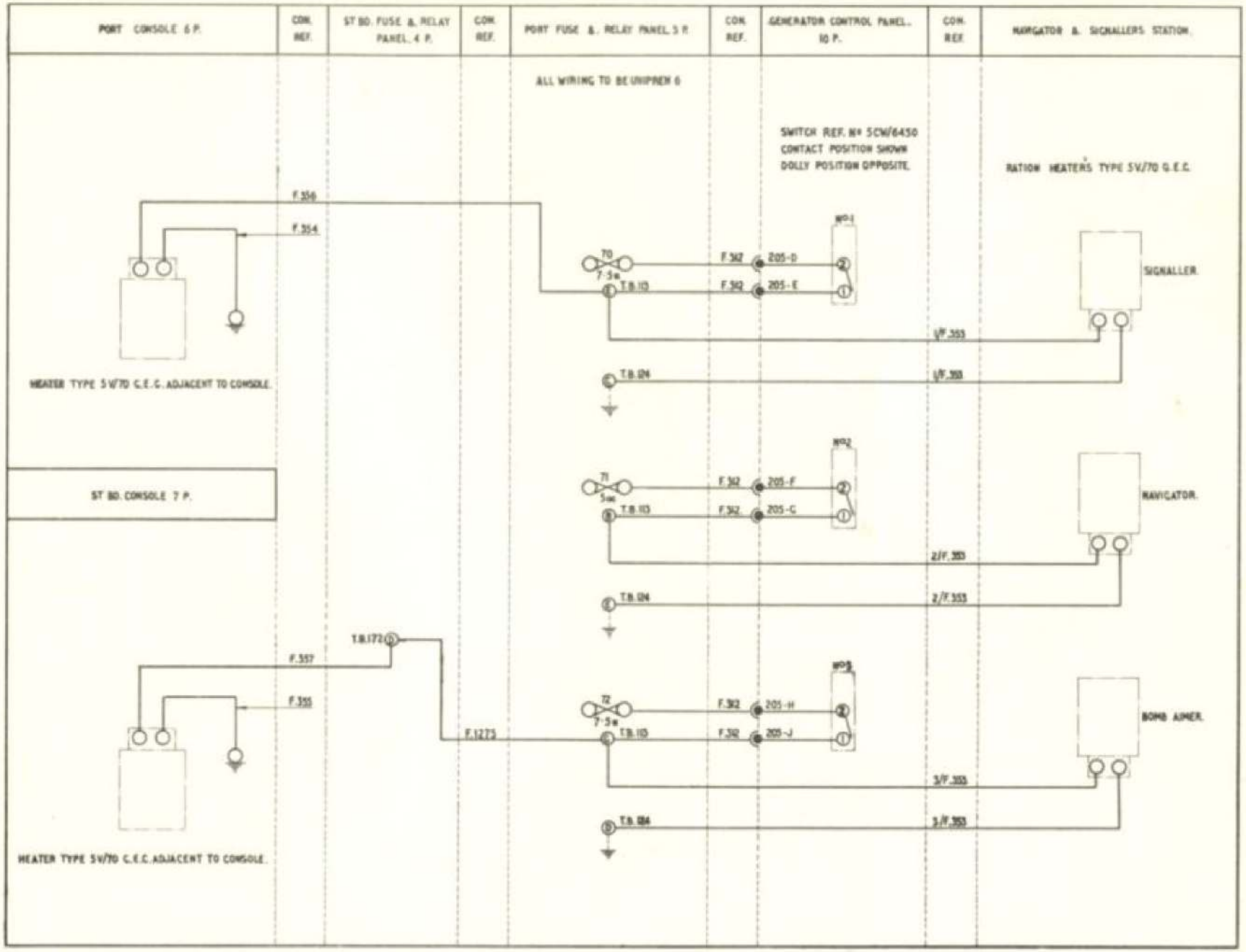


Fig. 20 Crews ration heaters

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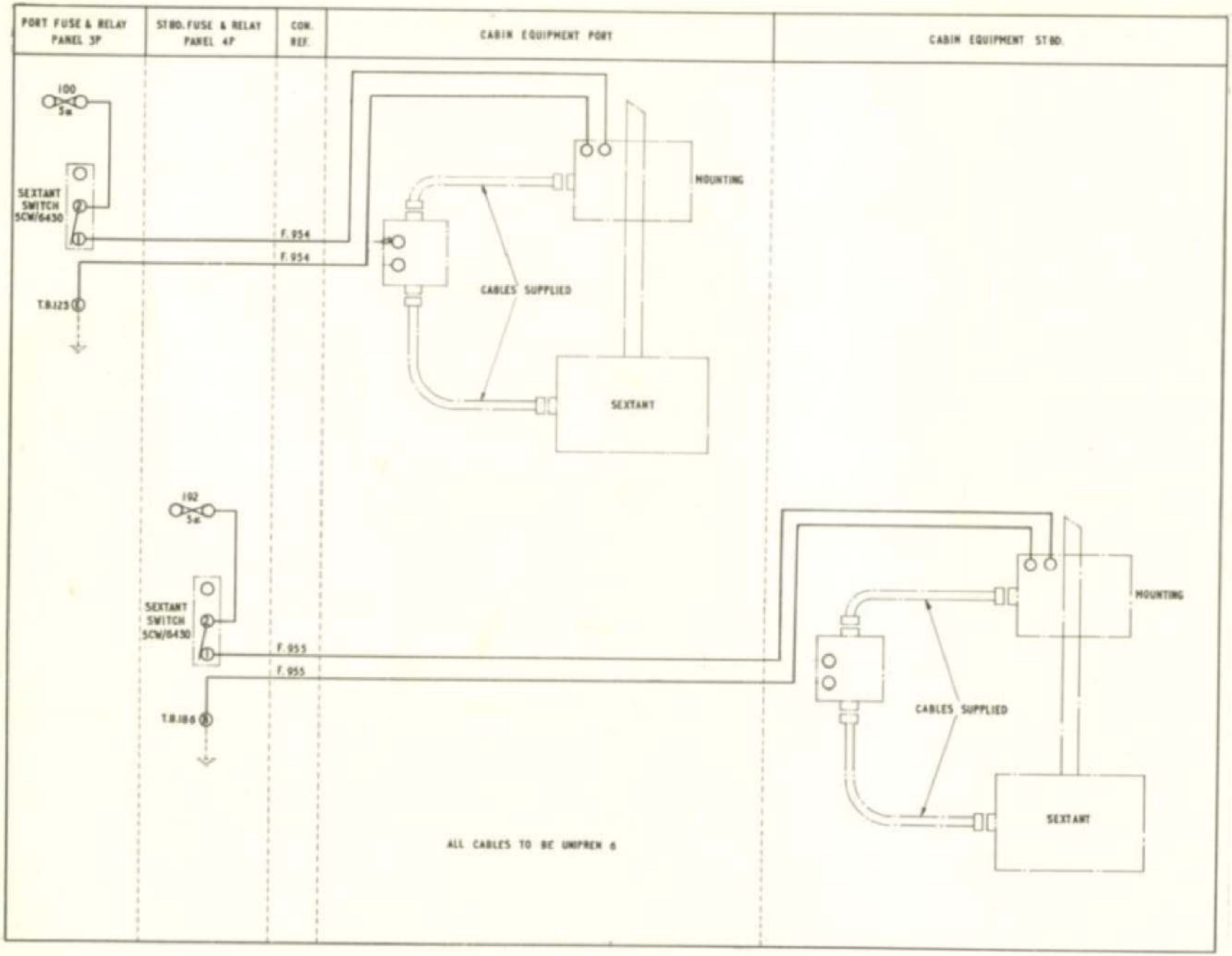


Fig. 21 Sextant head heater

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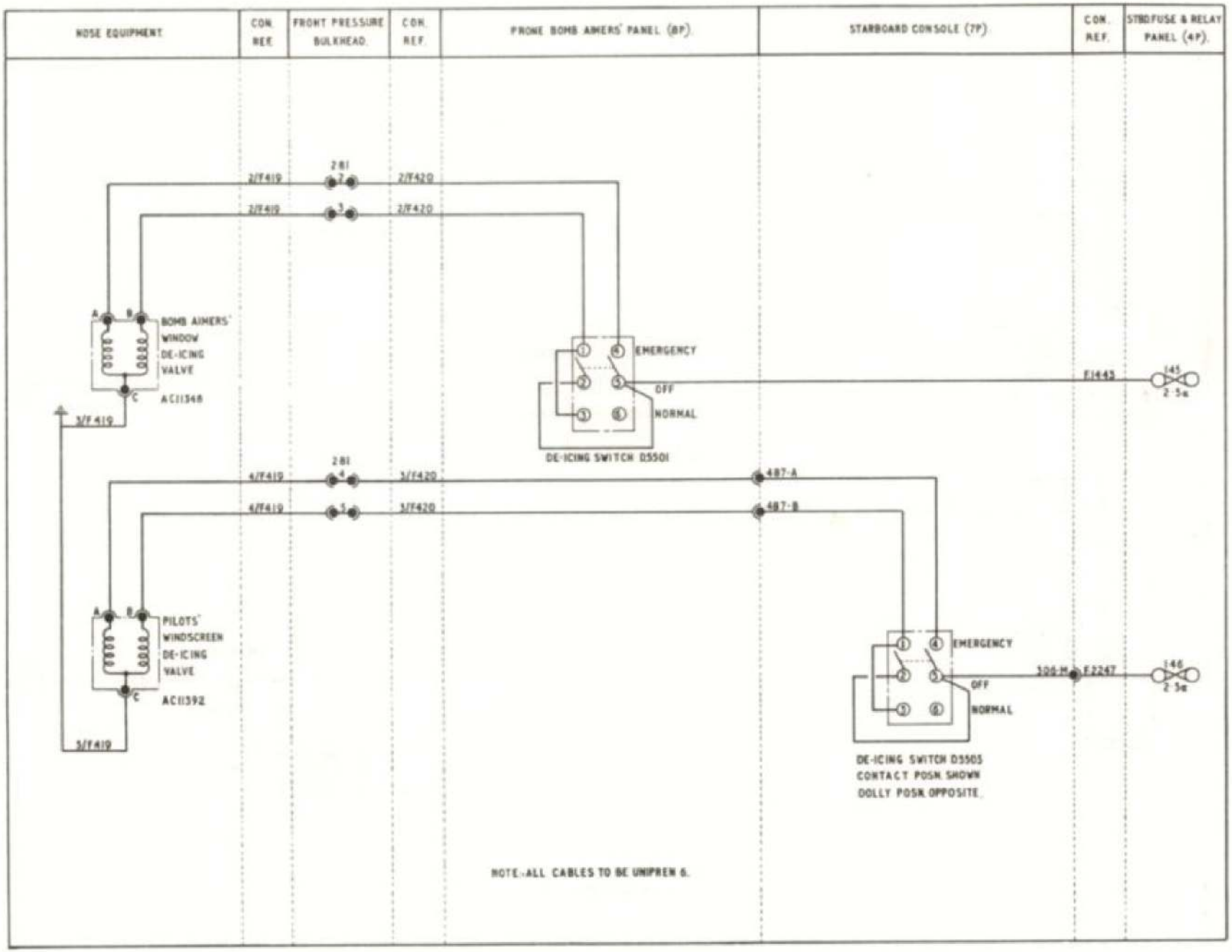


Fig. 22 Pilots' and air bomber's windscreen de-icing (pre Mod. 38)
(◄Mod 549►)

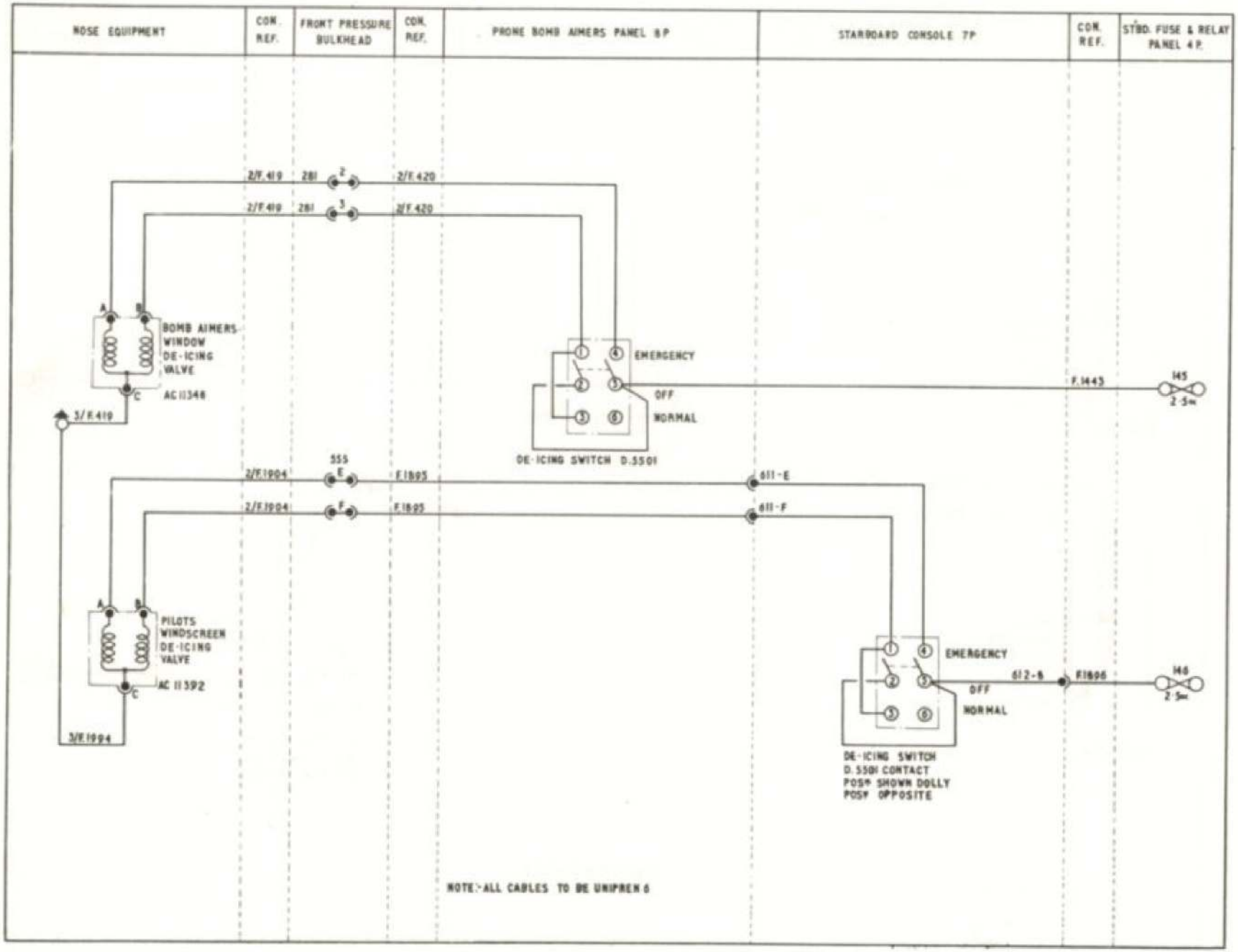


Fig. 22A Pilots' and air bomber's windscreen de-icing (post Mod. 38)

(◄Mod 549►)

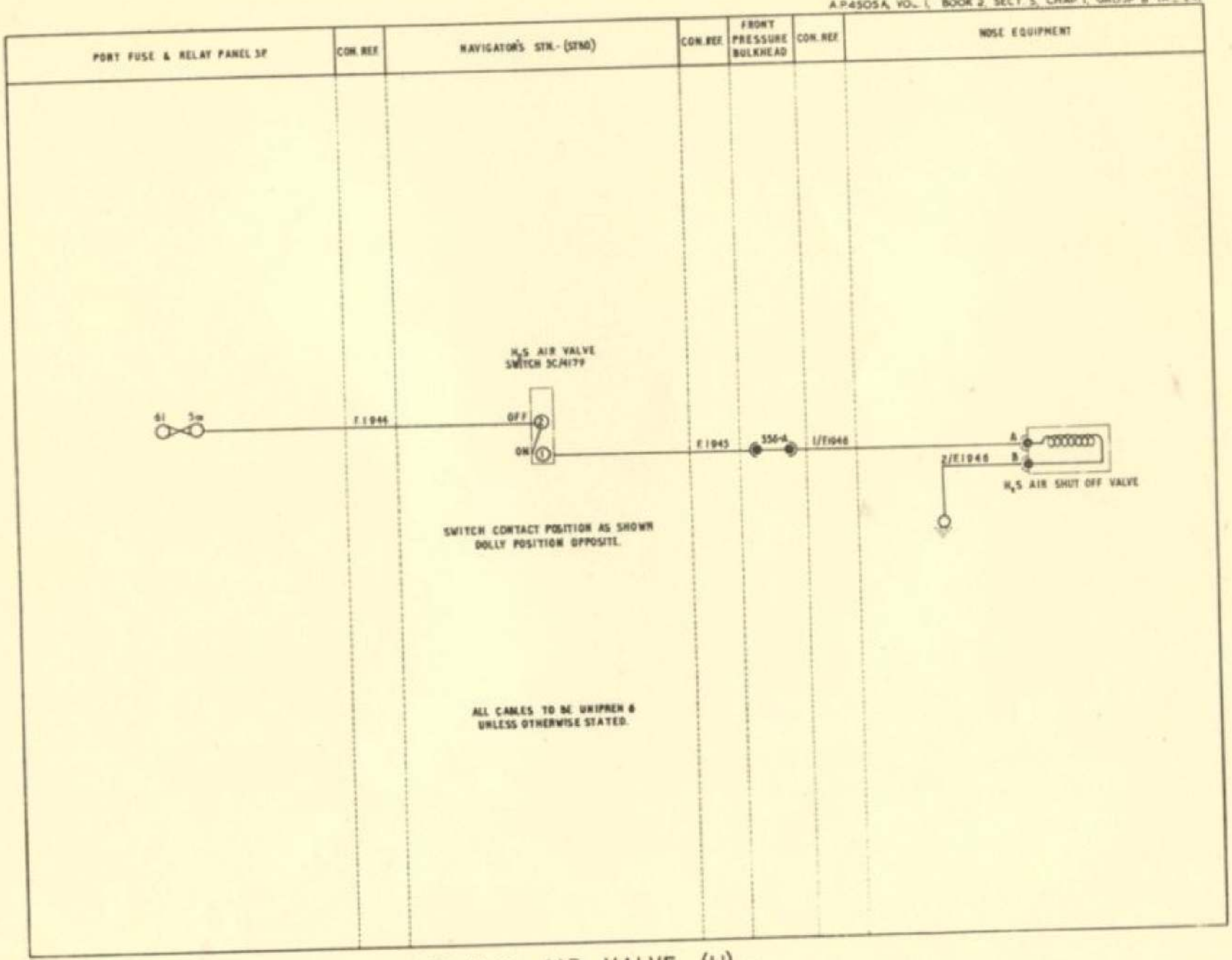


FIG. 23 $H_2S$ AIR VALVE (H)

(A.L.24, Mar 58)

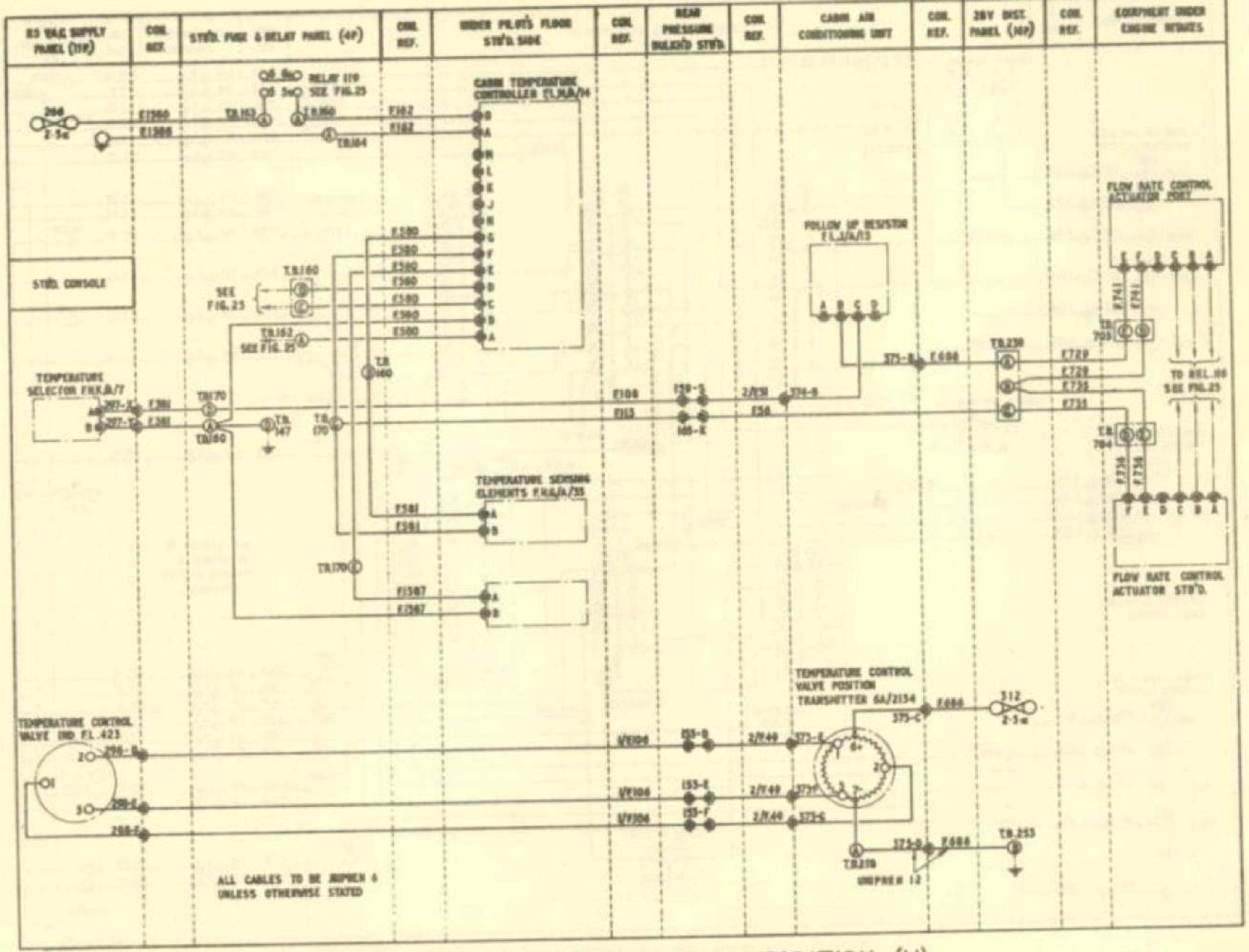


FIG. 24 CABIN TEMPERATURE & INDICATION (H)

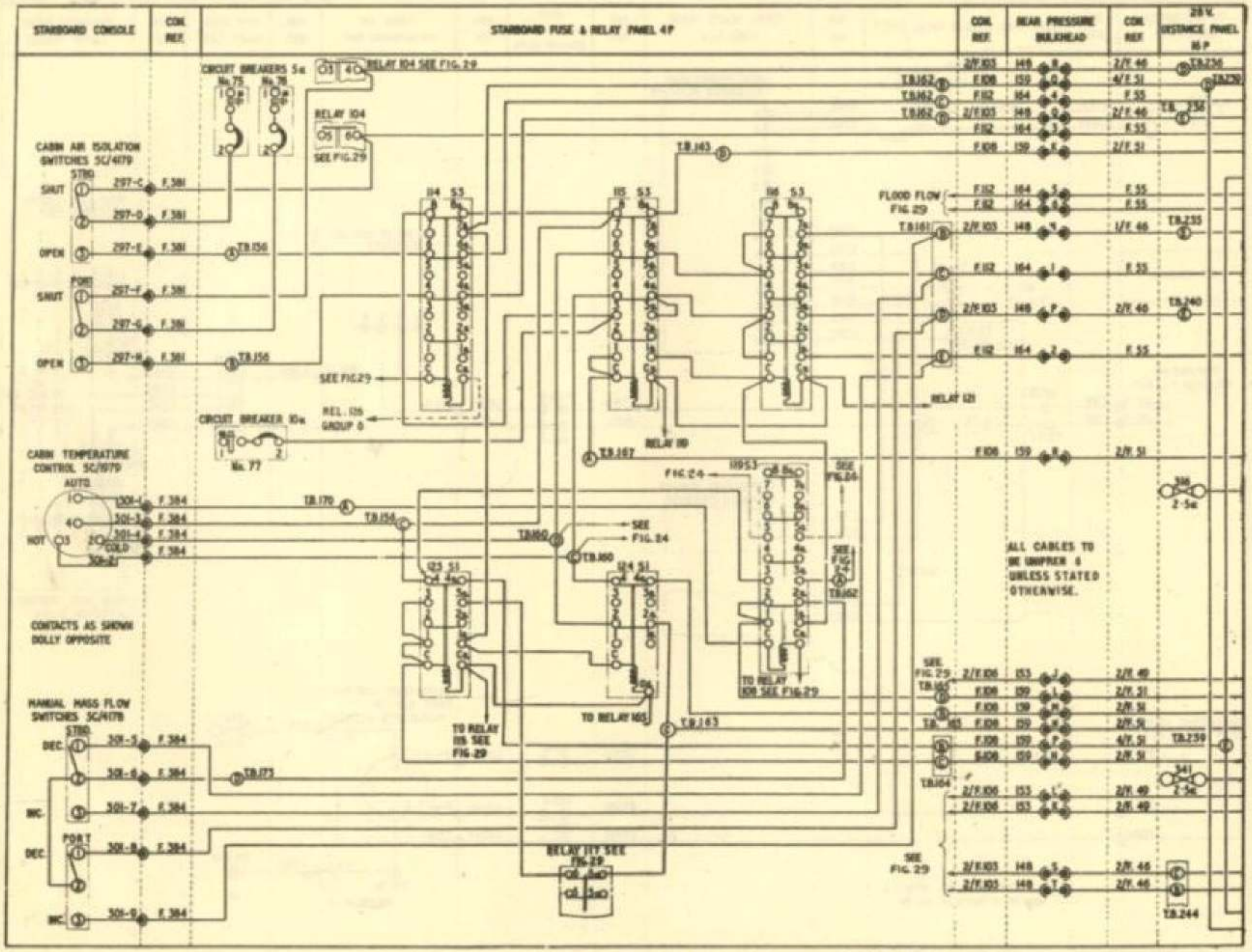


FIG. 25(1). TEMPERATURE & MASS FLOW-PRE. MOD. 265 / PRE. MOD. 342 (H)

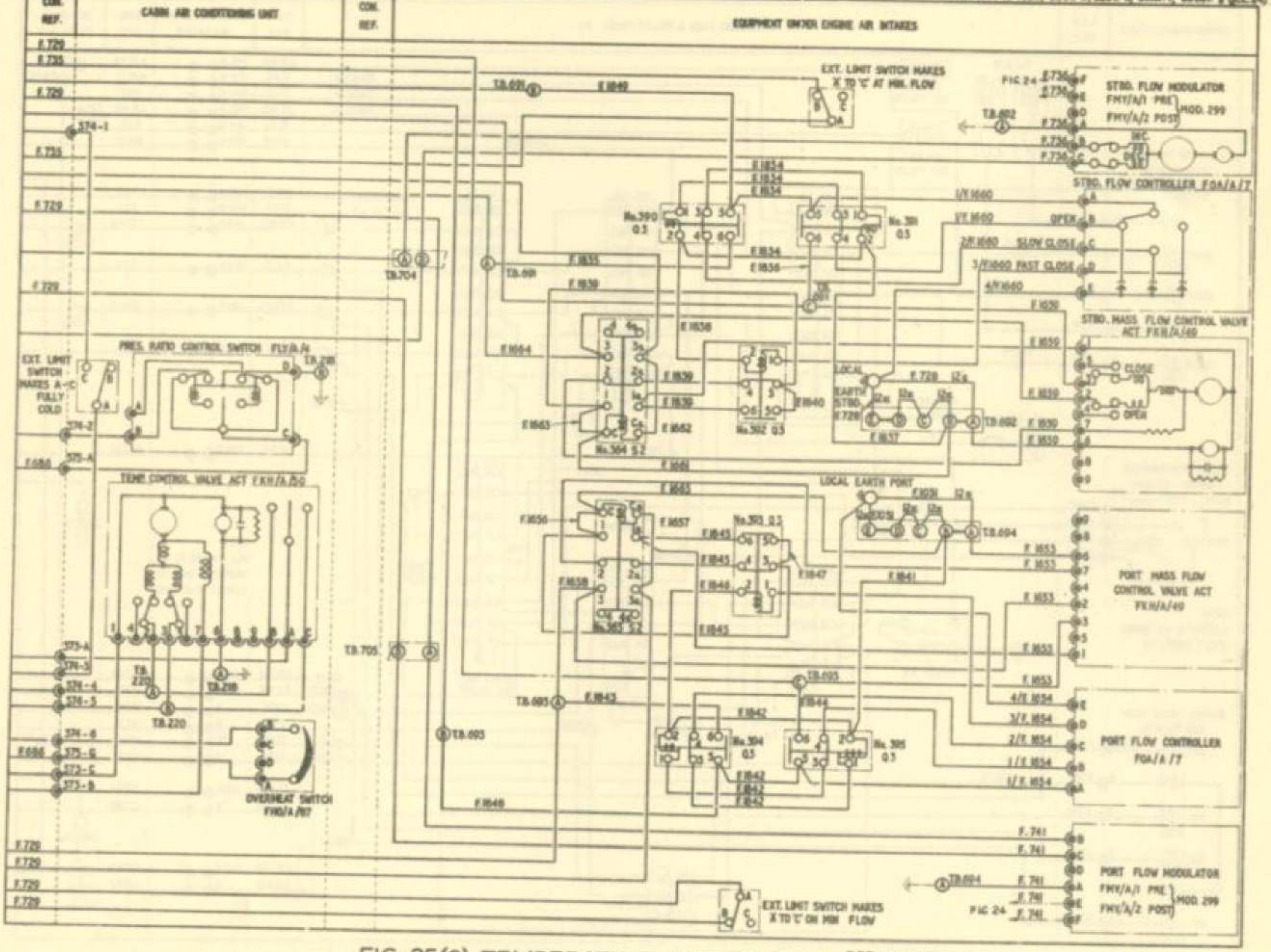


FIG. 25(2). TEMPERATURE & MASS FLOW - PRE MOD. 265 PRE. MOD. 342 (H)

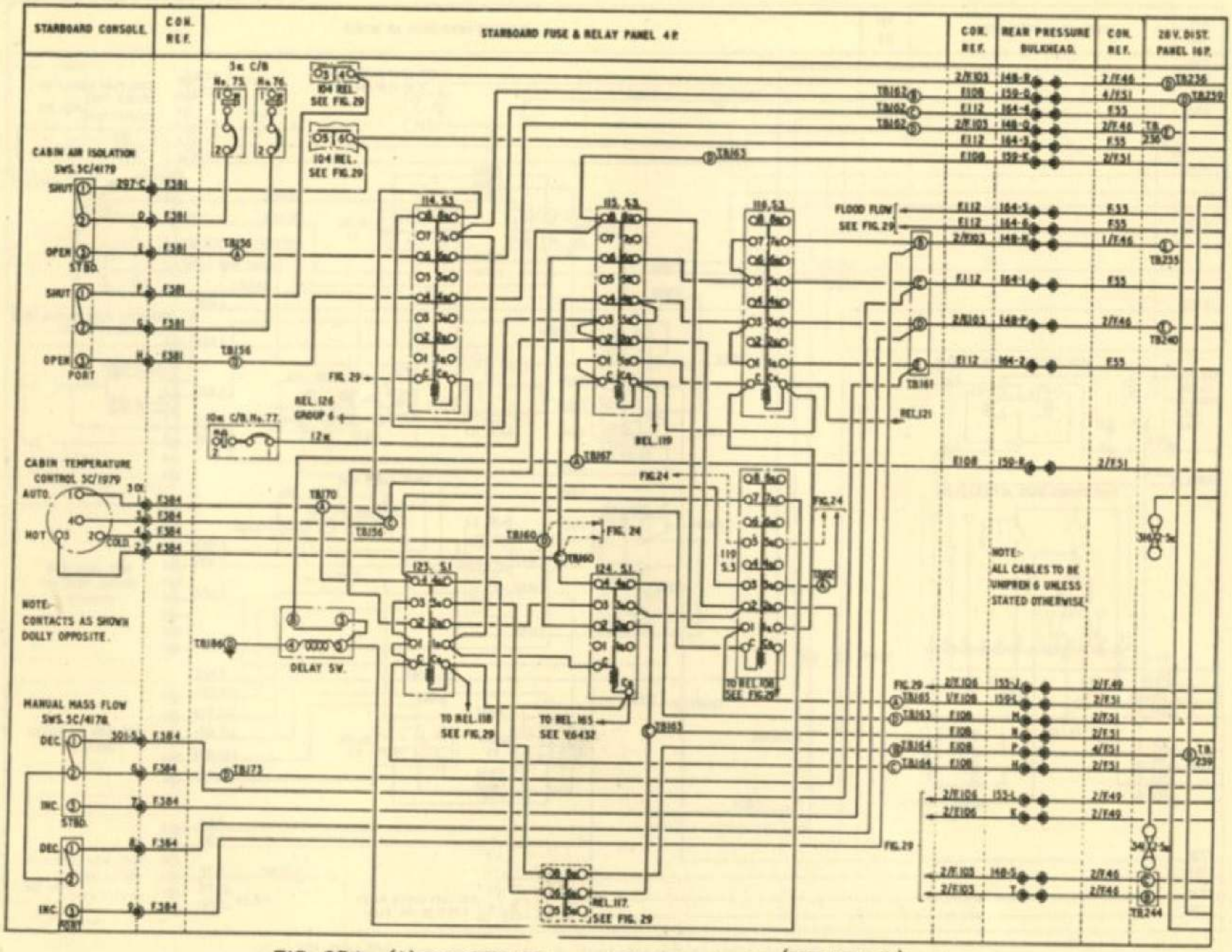

FIG. 25A. (I) TEMPERATURE AND MASS FLOW (POST MOD. 265) (POST MOD. 342) (H)

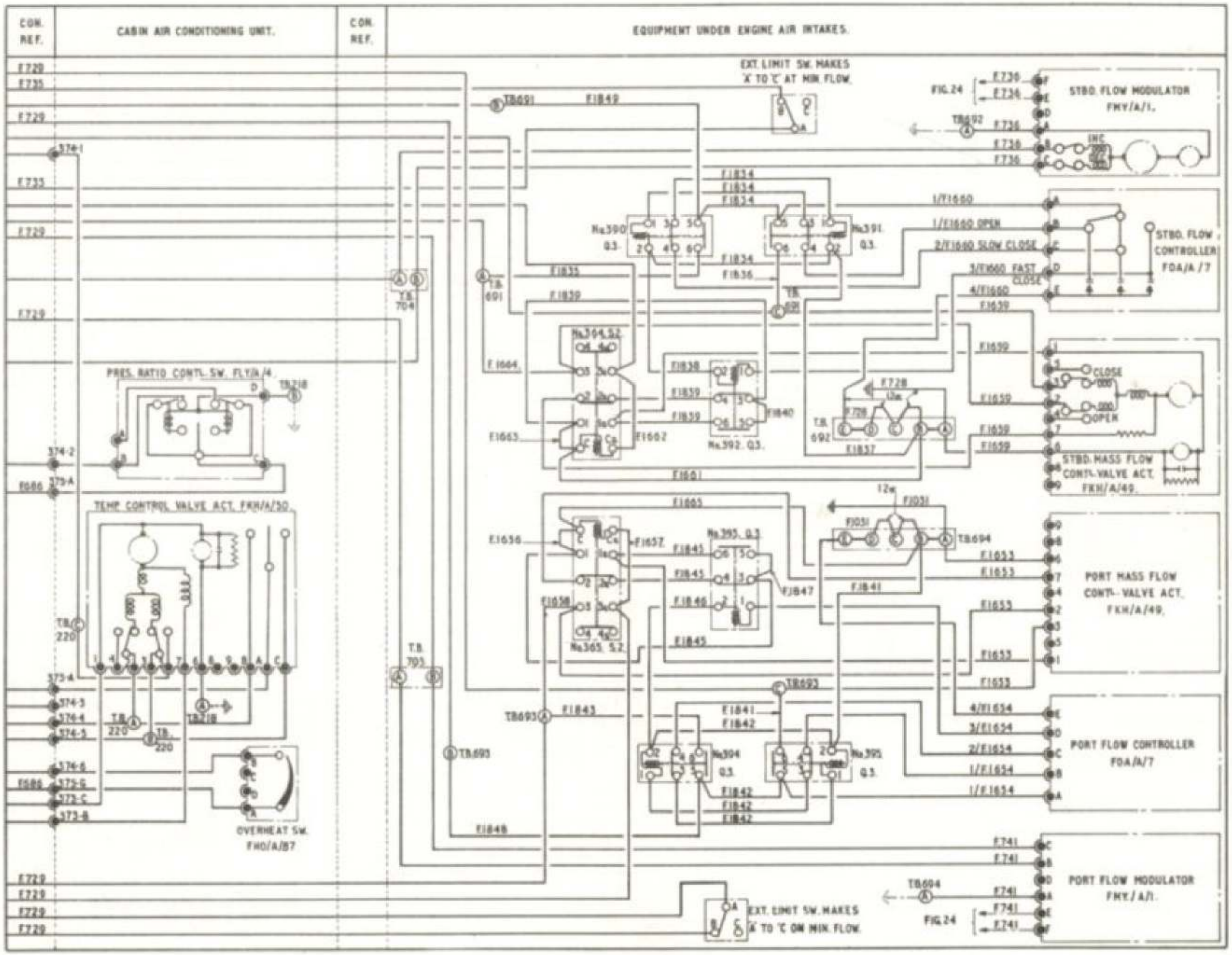


Fig. 25A (2) Temperature and mass flow (post Mod. 265 and 342)
(◄Correction to ratio switch►)

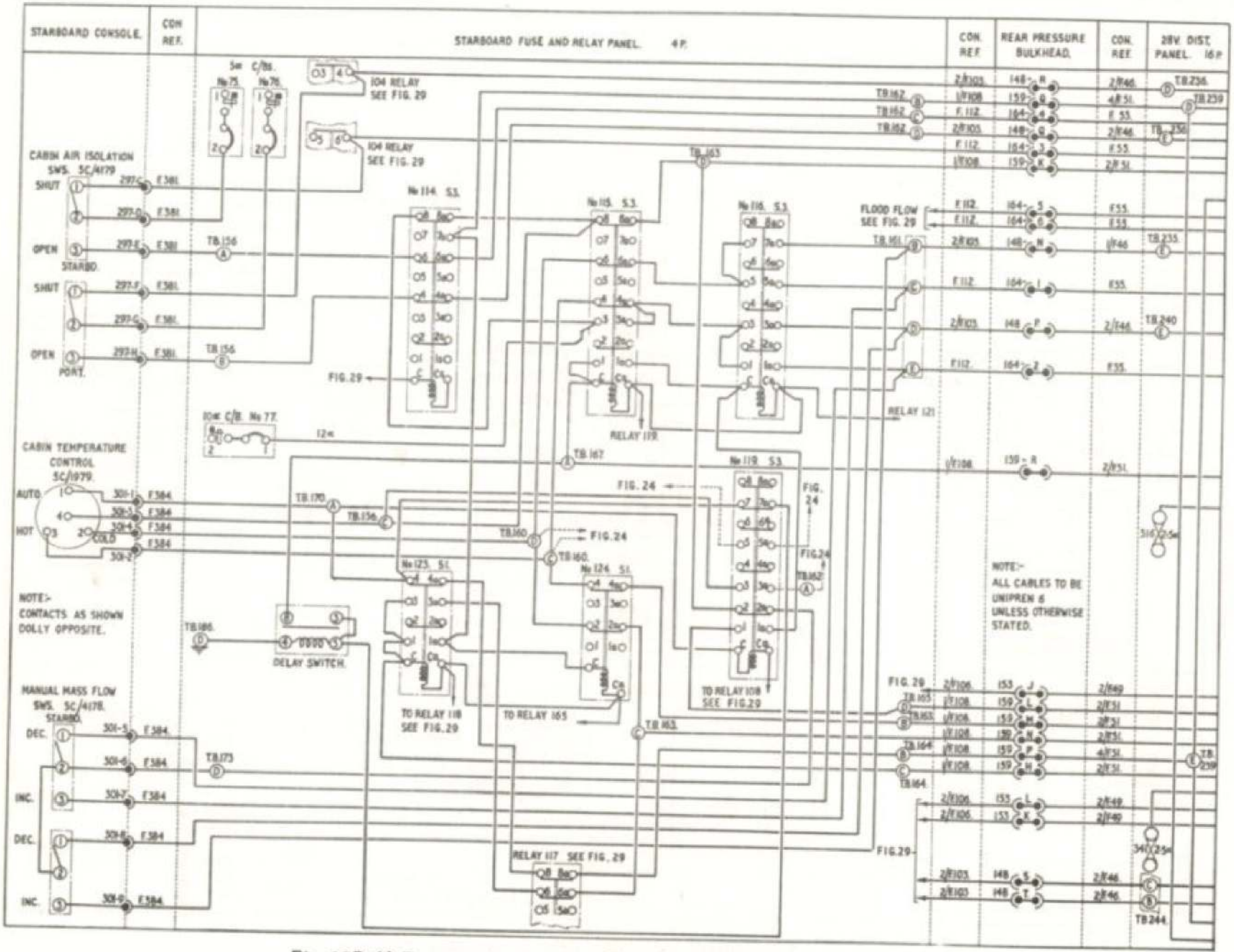


Fig. 25B (I) Temperature and mass flow (post Mod. 265, pre Mod. 342)

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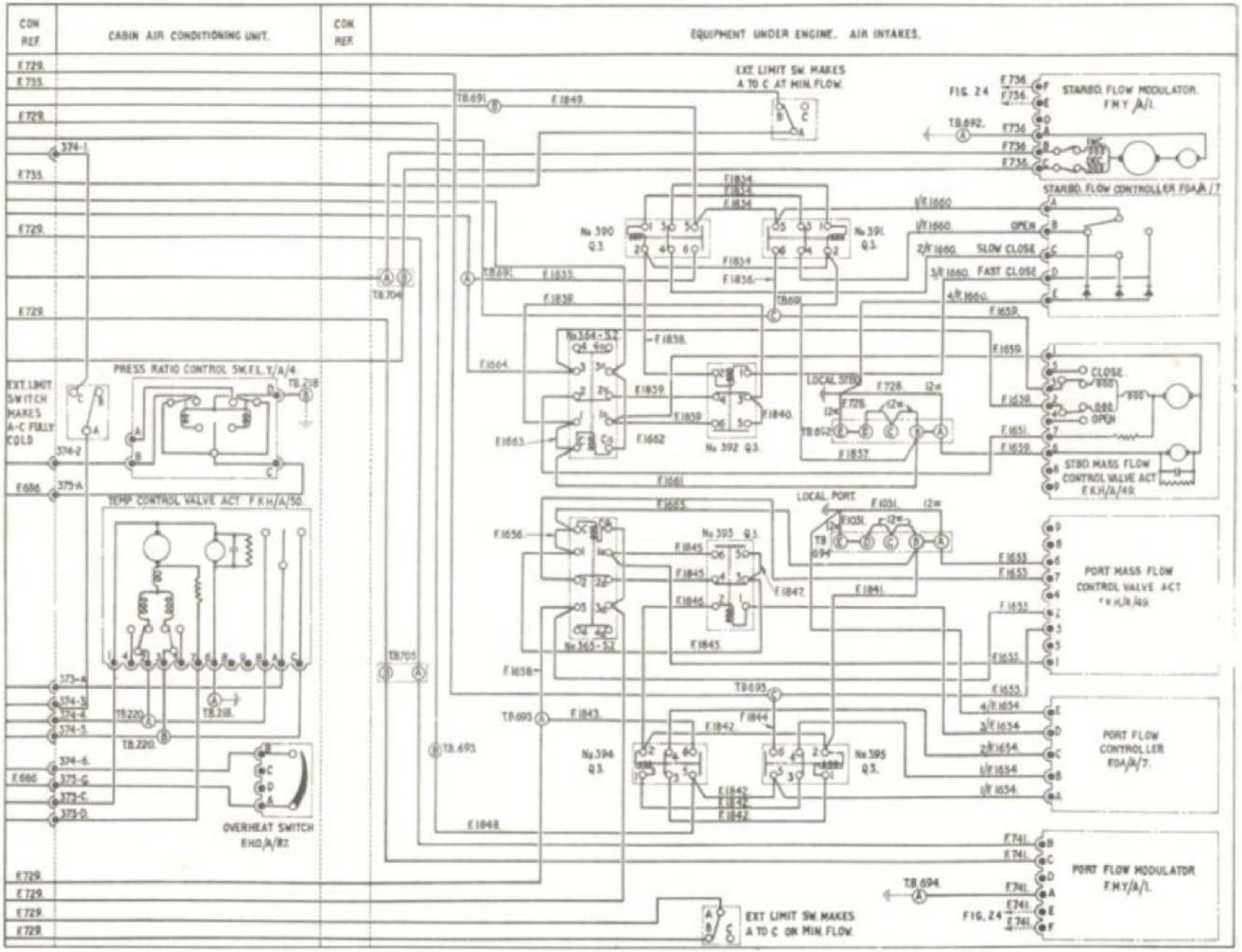


Fig. 25B (2) Temperature and mass flow (post Mod 265, pre Mod 342)
(◄Correction to ratio switch►)

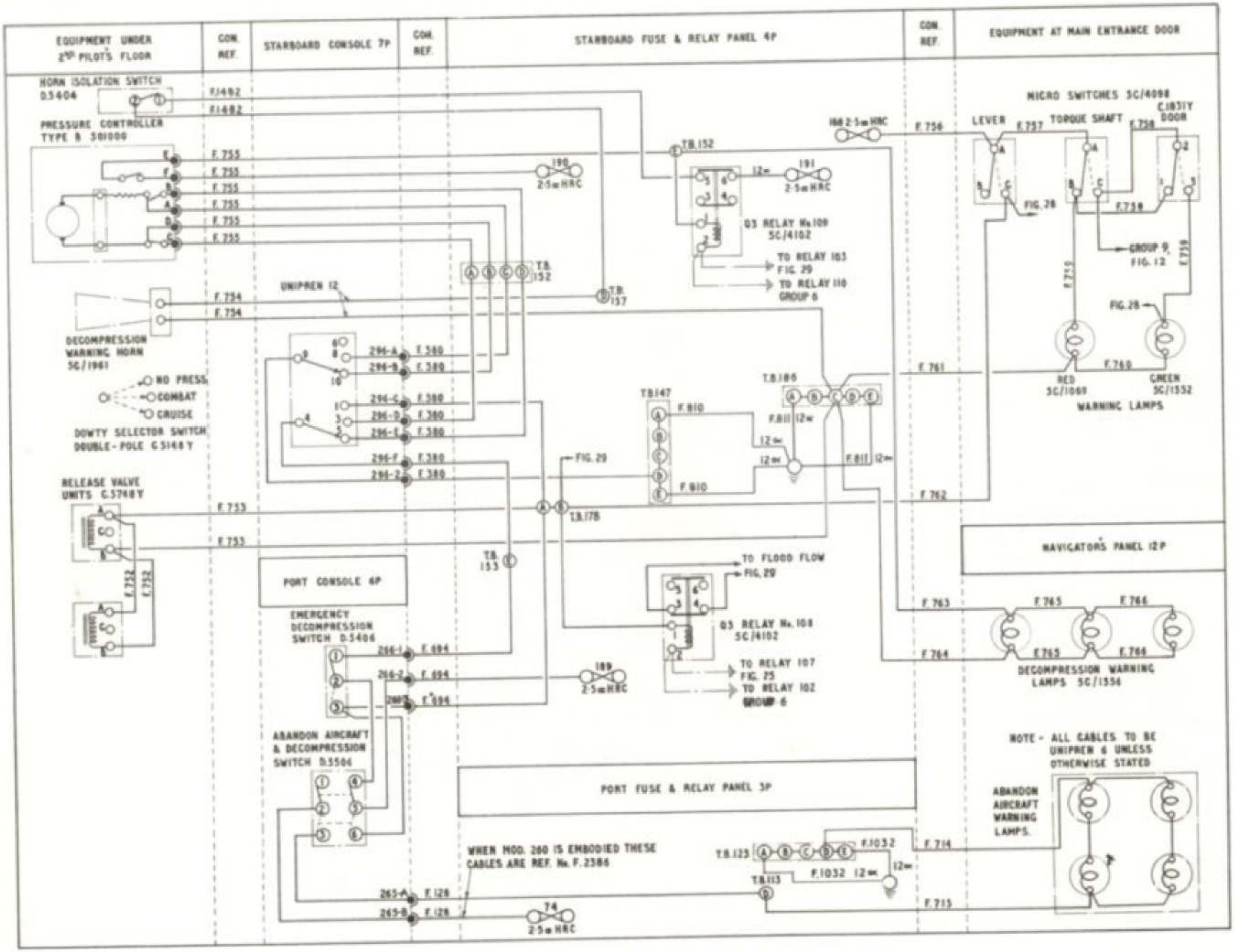


Fig. 26. Decompression and warning. (pre Mods 209 and 623.)

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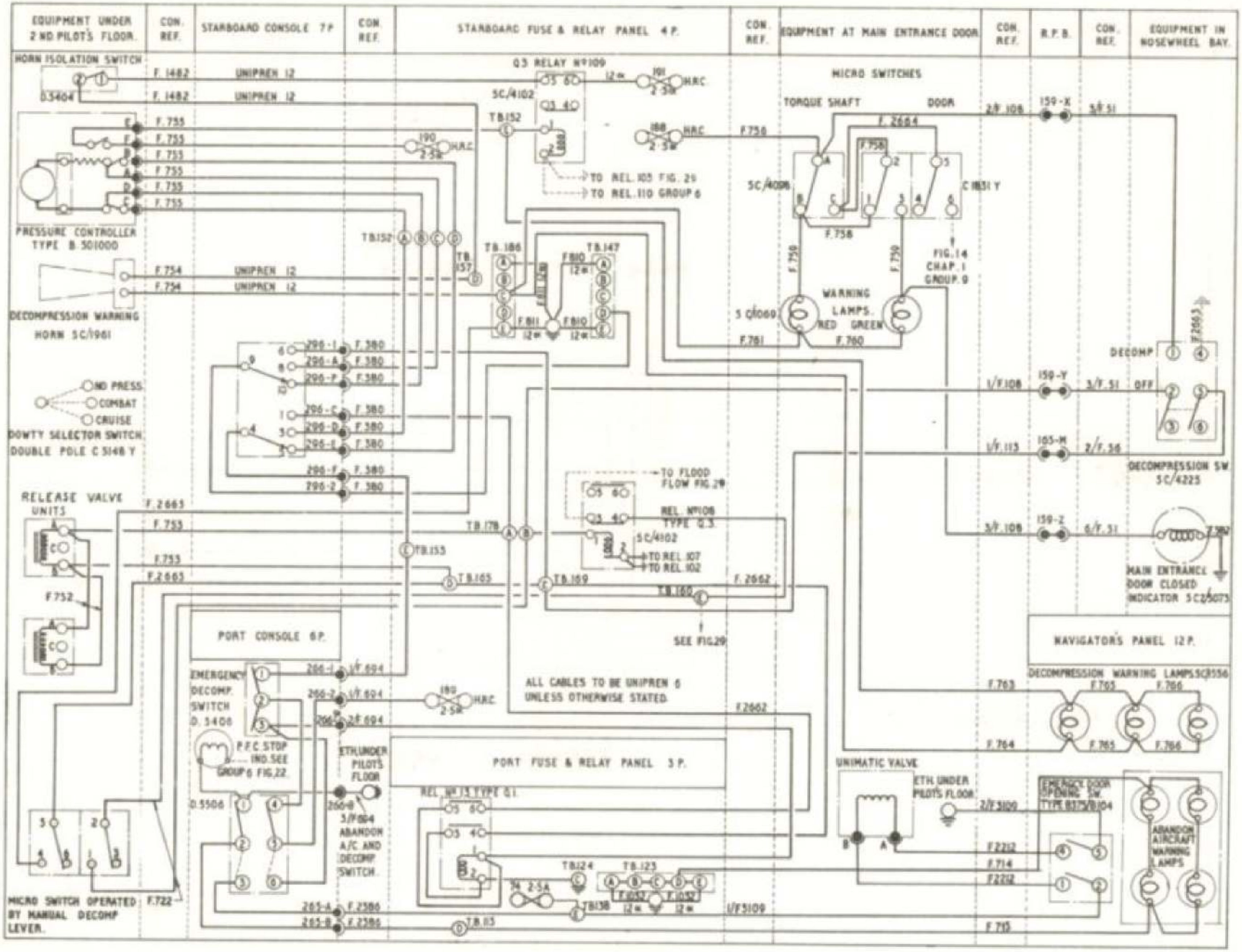

Fig. 27. Decompression and warning (post Mods. 209 and 623)

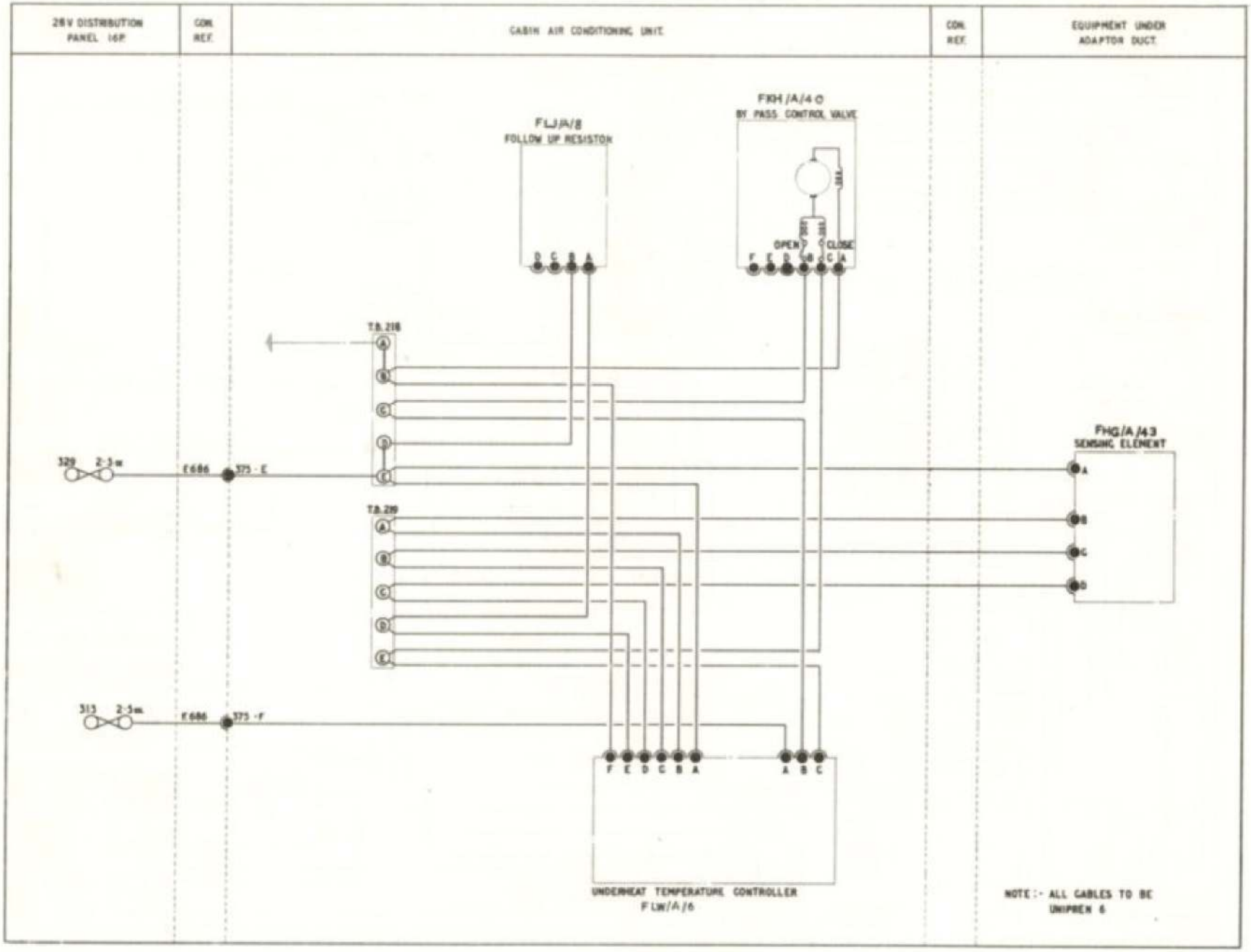


Fig. 28. Underheat controls.

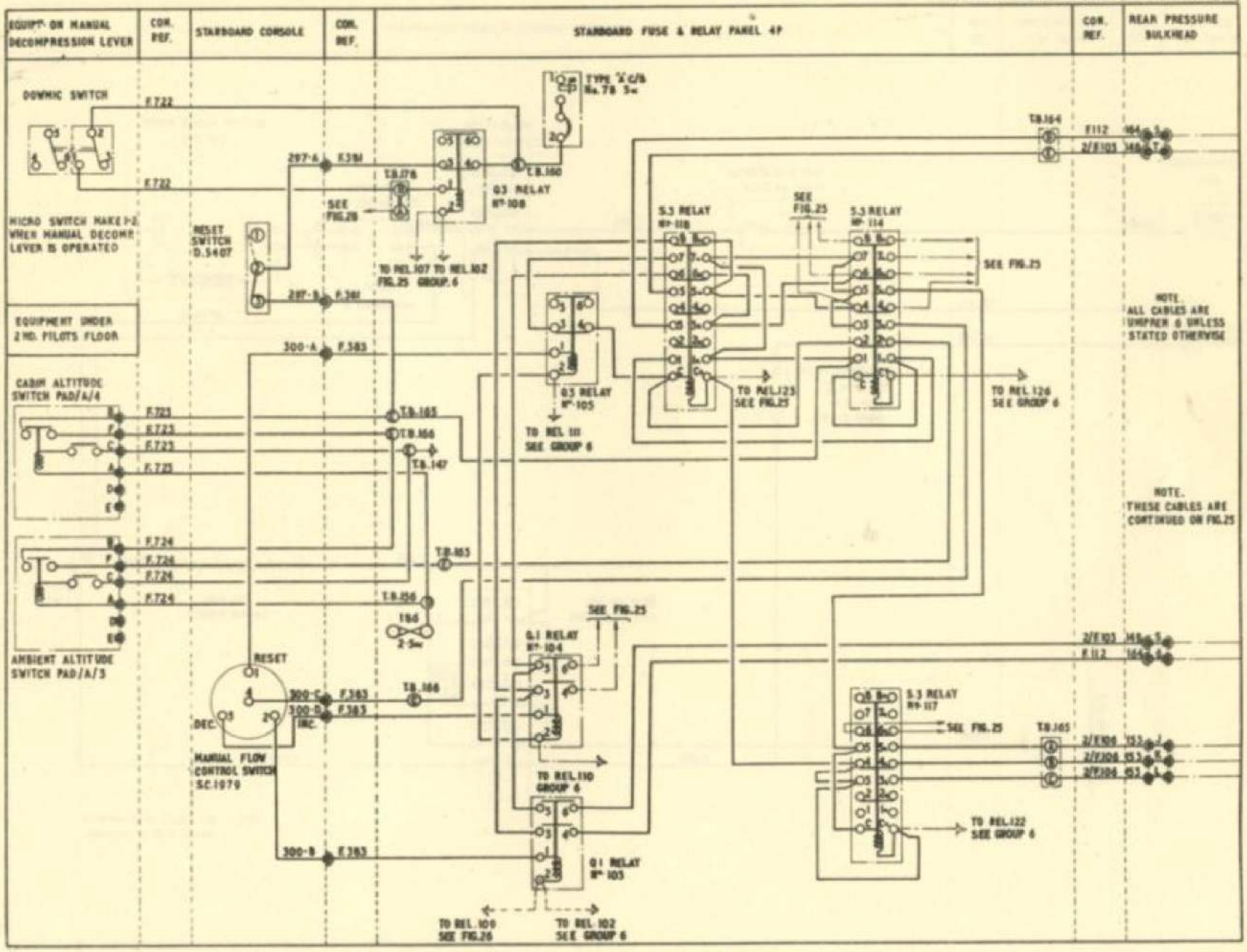


FIG. 29 FLOOD FLOW (H)

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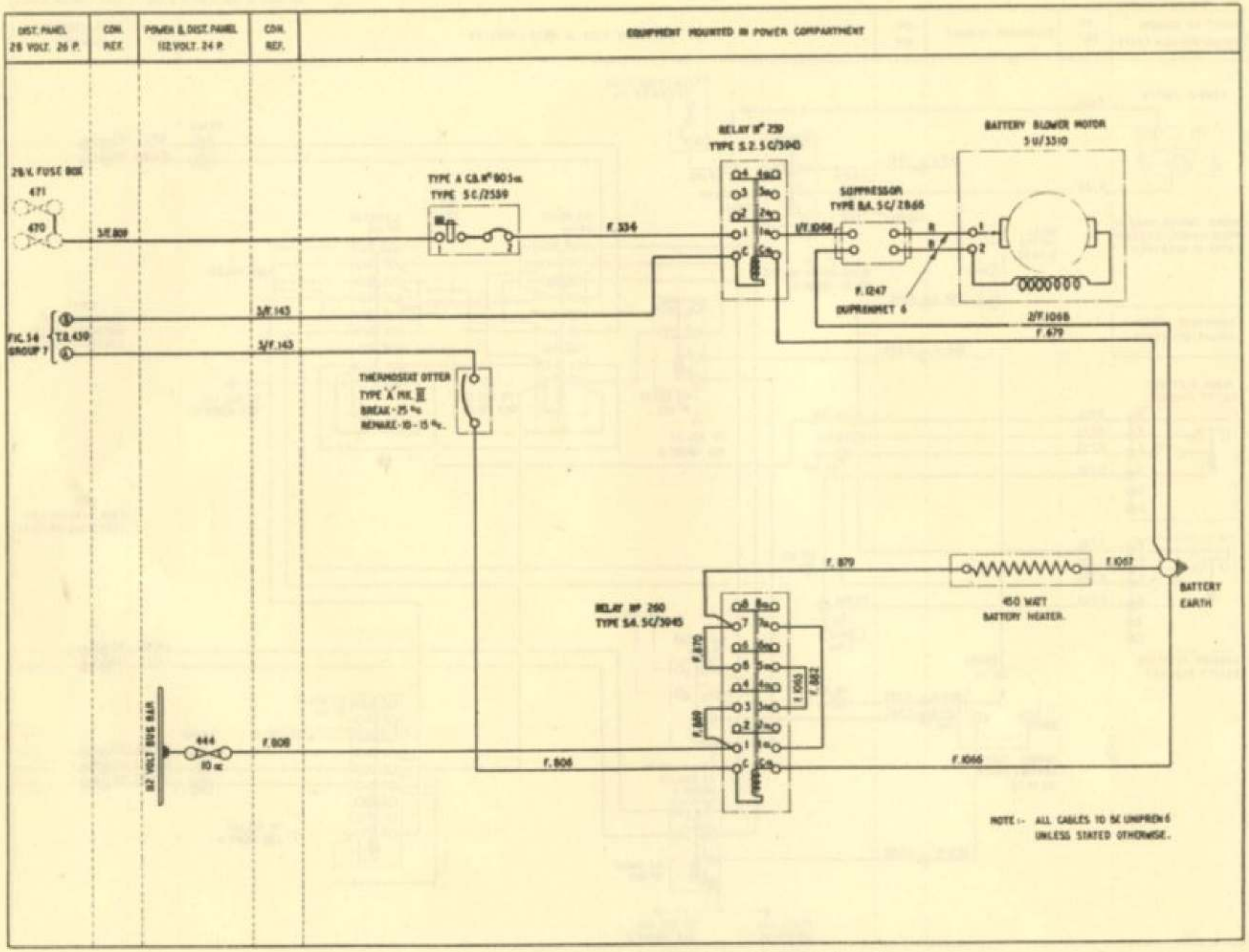


FIG 30 BATTERY HEATING AND VENTILATION (H)

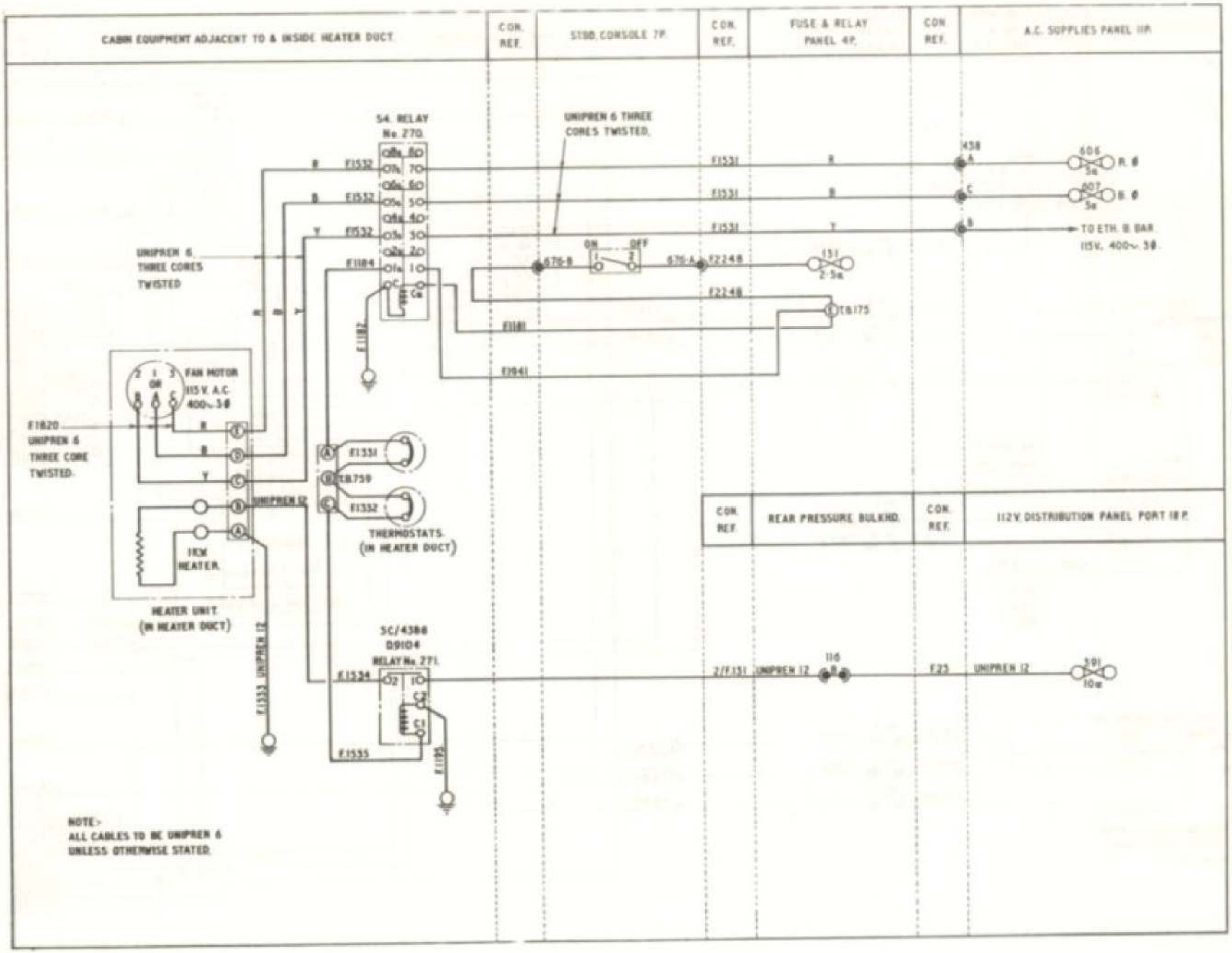


Fig. 31 Windscreen de-mister

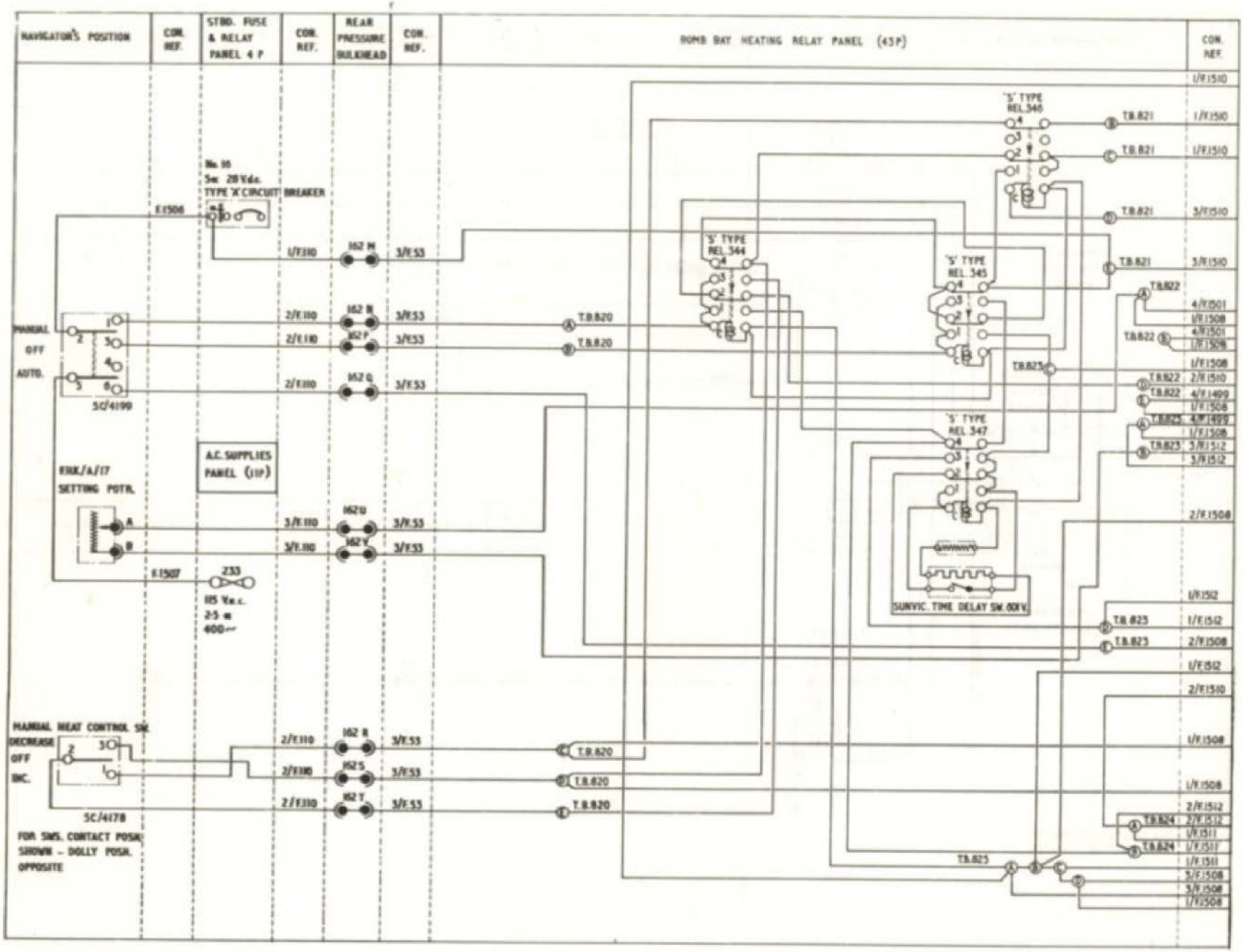


Fig.32(1) Bomb bay heating (pre Mod. 260)

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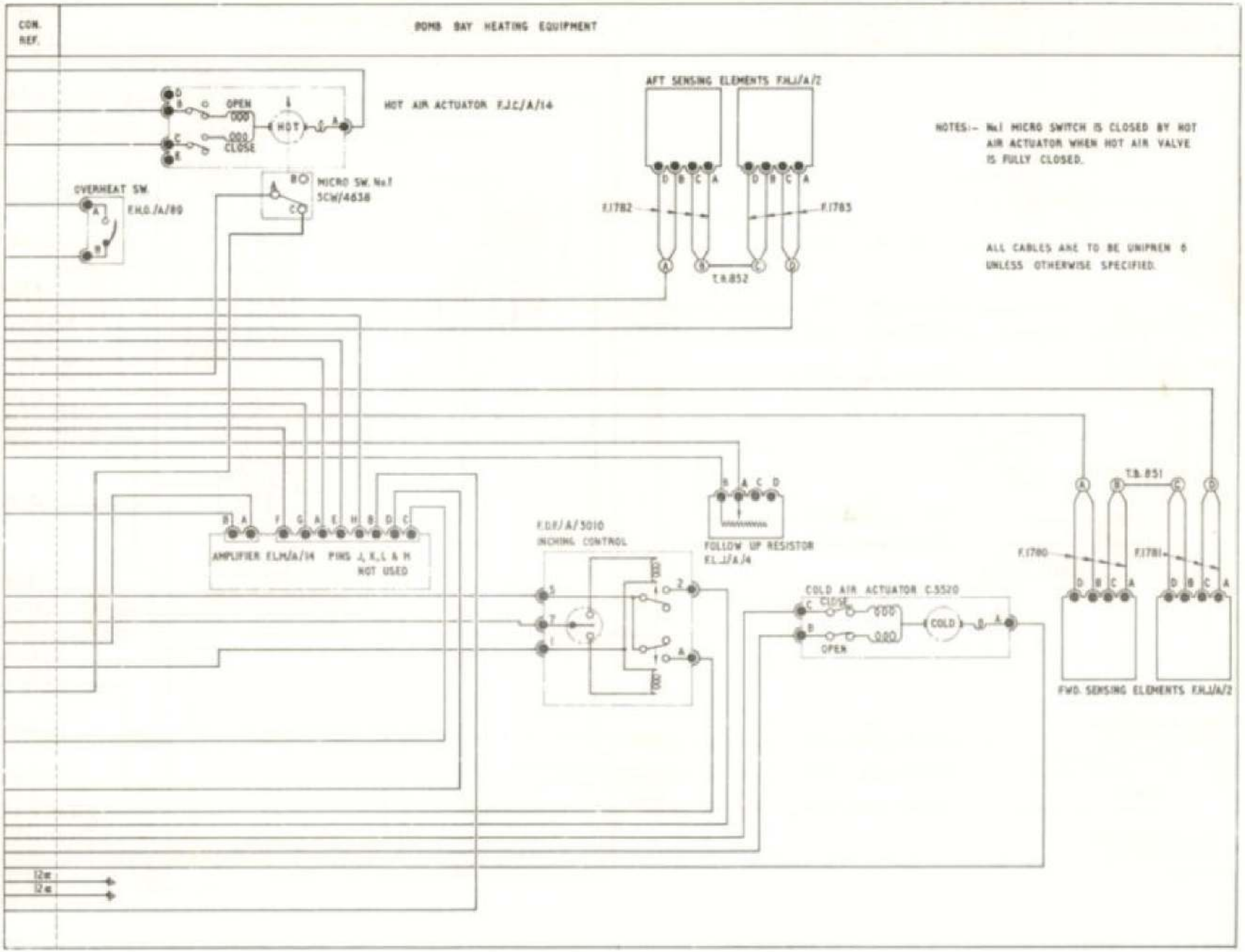


Fig. 32 (2) Bomb bay heating (pre Mod. 260)

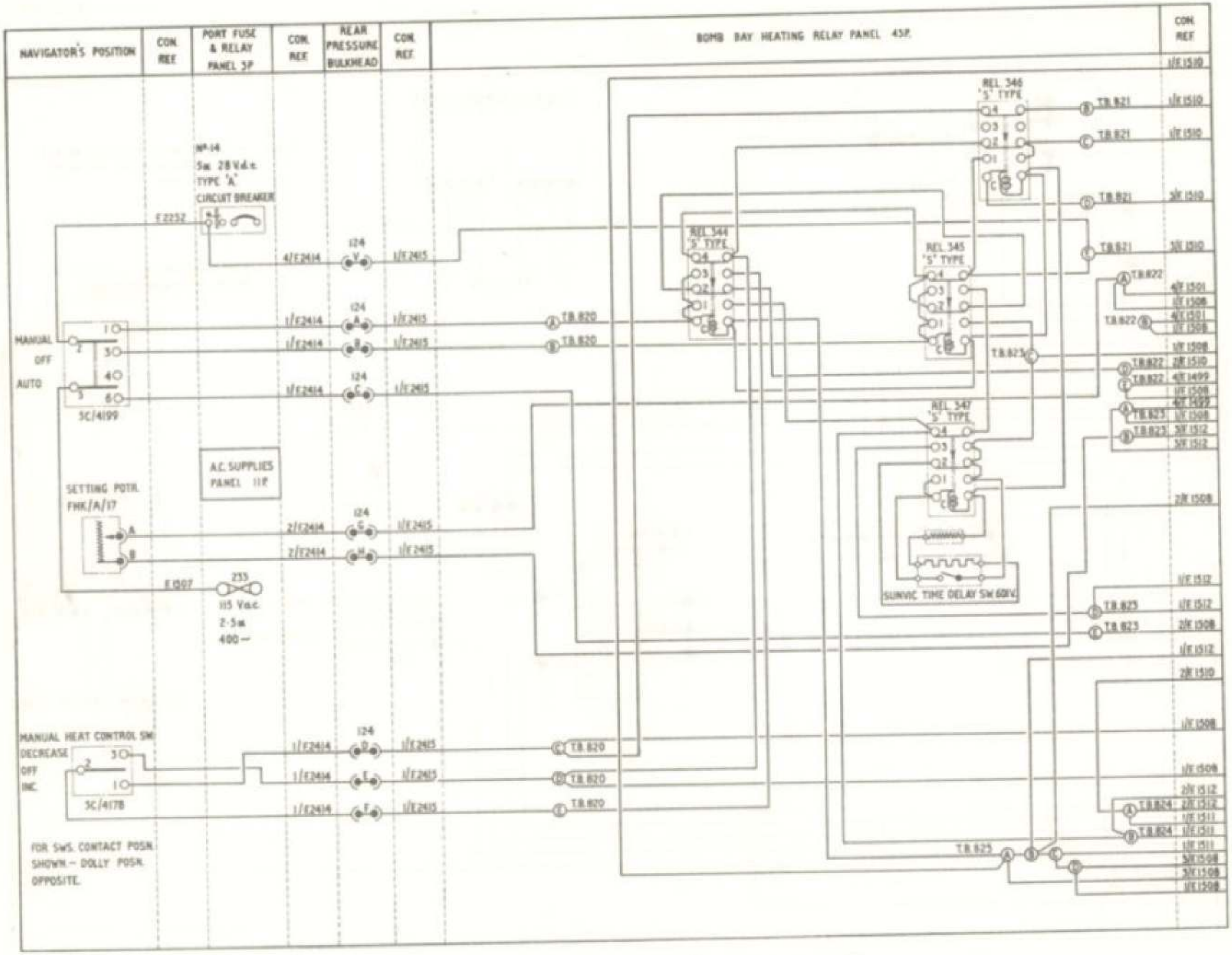

Fig. 32A (1) Bomb bay heating (post Mod. 260)

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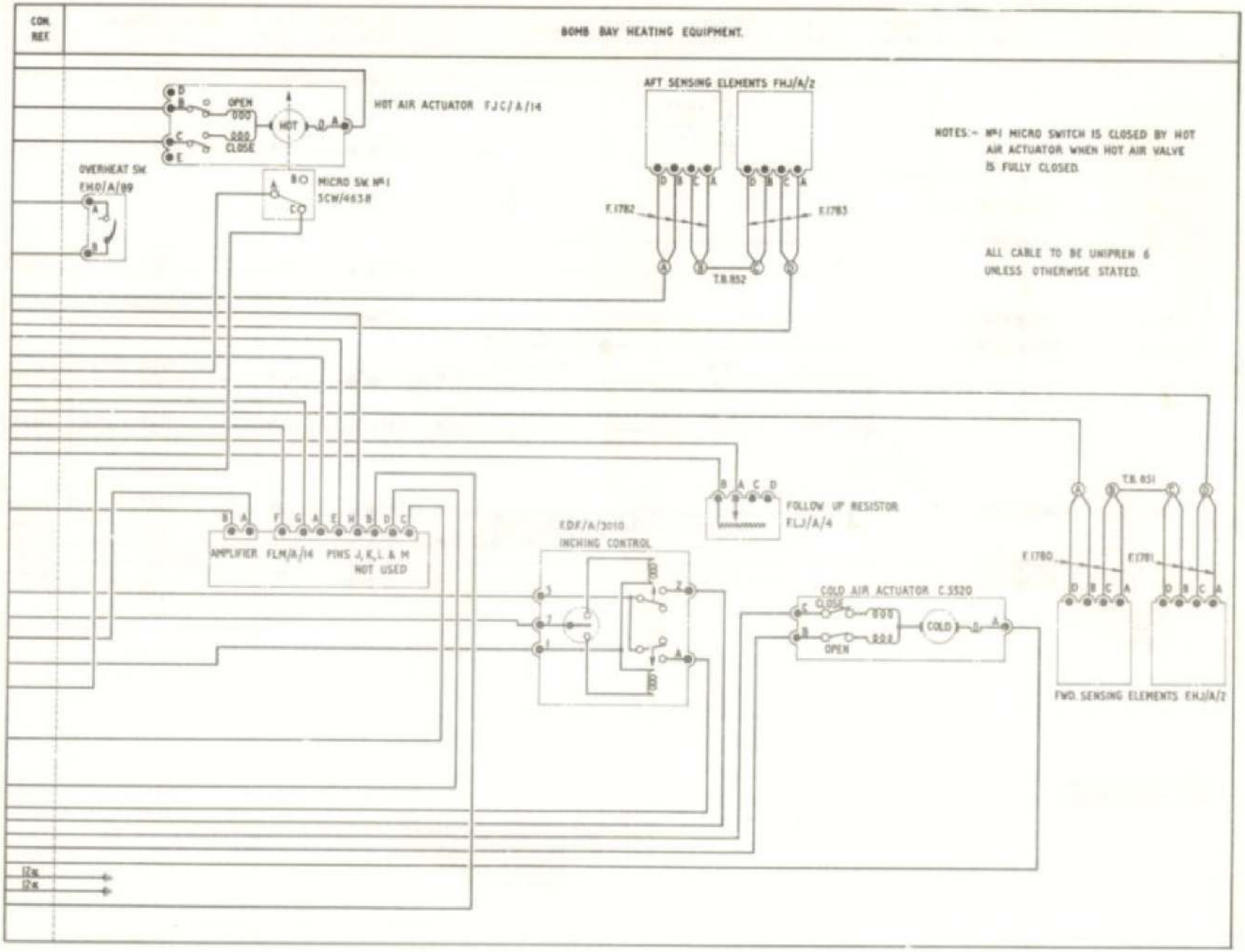


Fig.32A (2) Bomb bay heating (post Mod. 260)

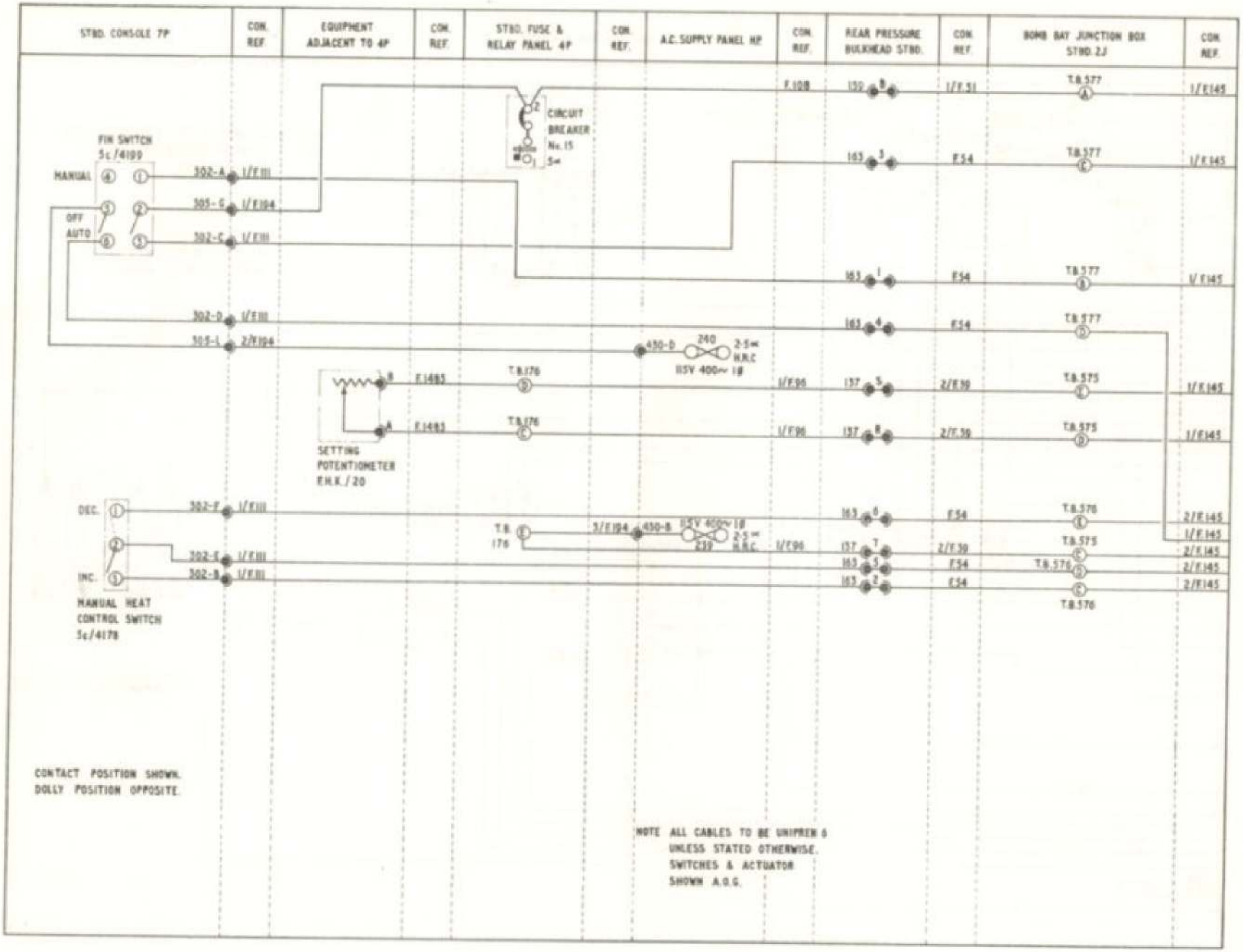


Fig. 33(1) Fin de-icing (pre Mod. 260)

**RESTRICTED**

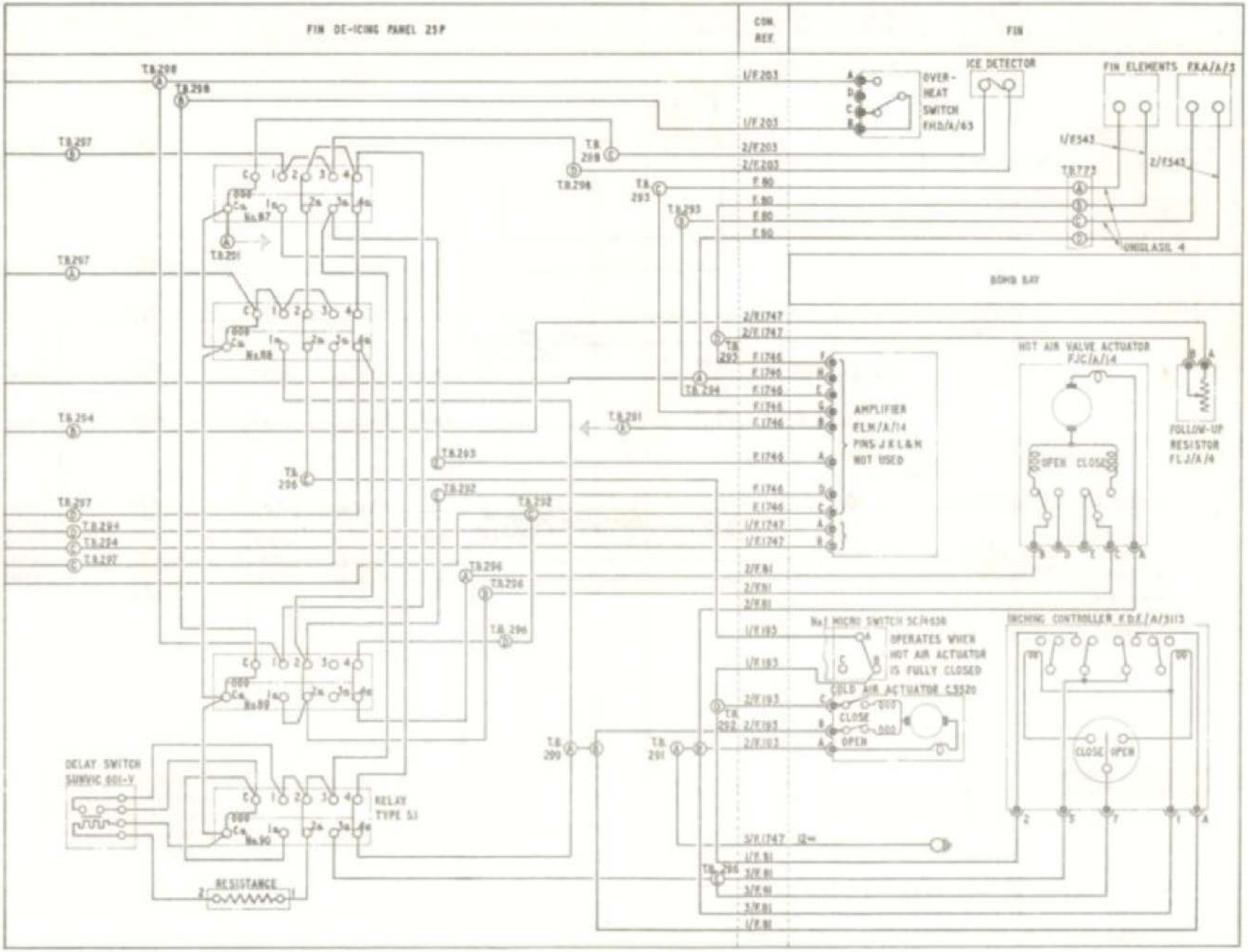


Fig. 33 (2) Fin de-icing (pre. Mod. 260)

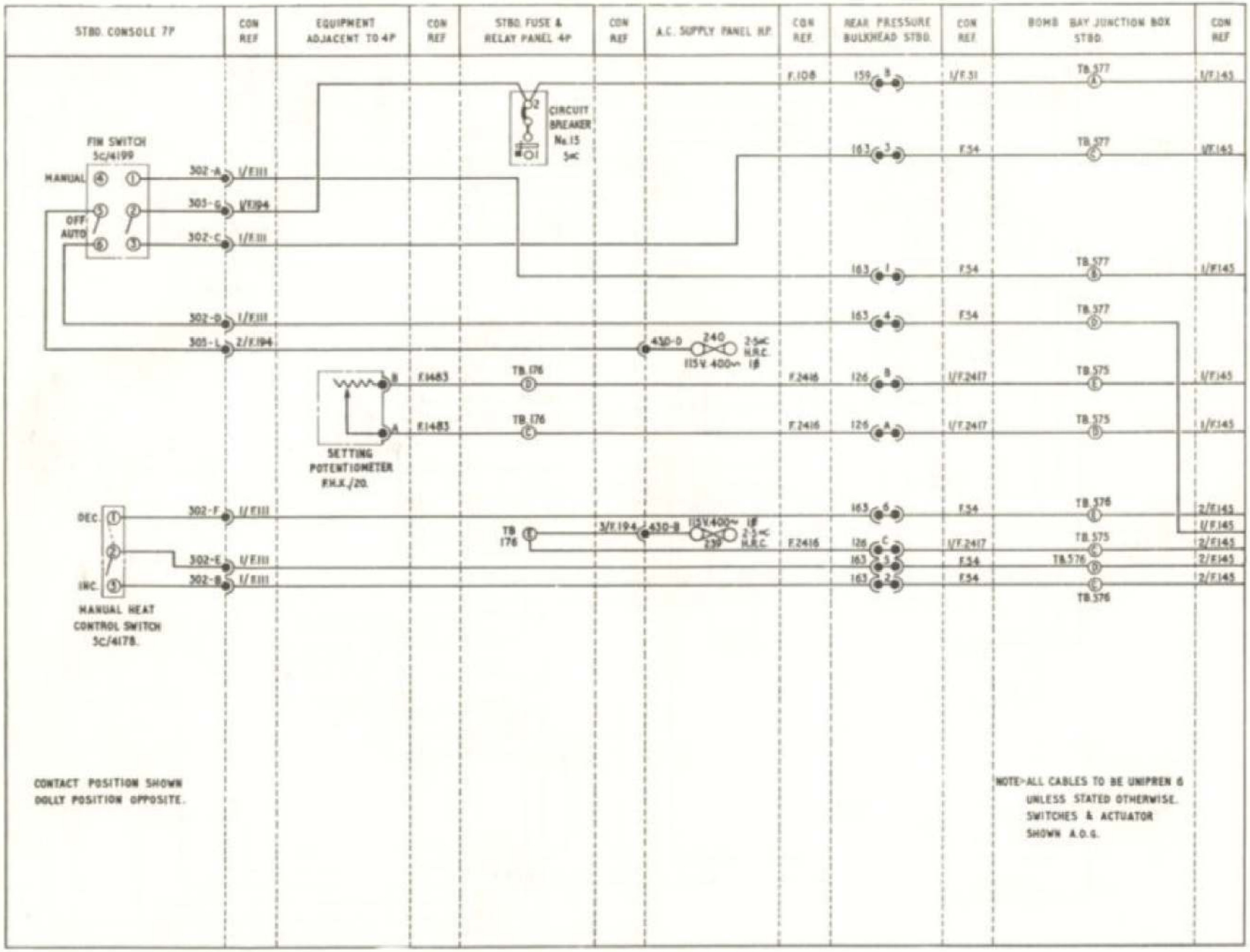


Fig. 33A (1) Fin de-icing (post. Mod. 260)

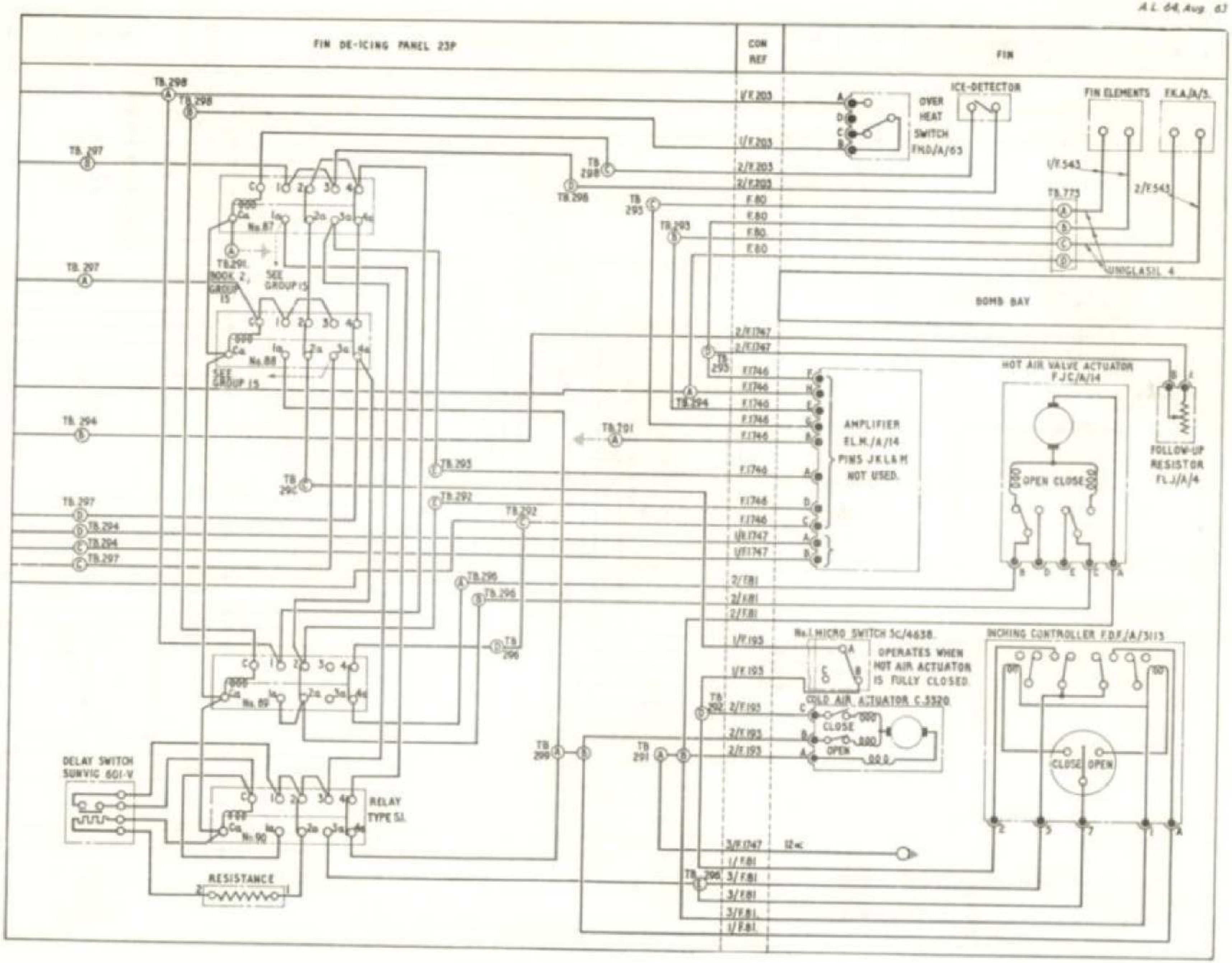


Fig. 33A (2) Fin de-icing ( post. Mod. 260 )

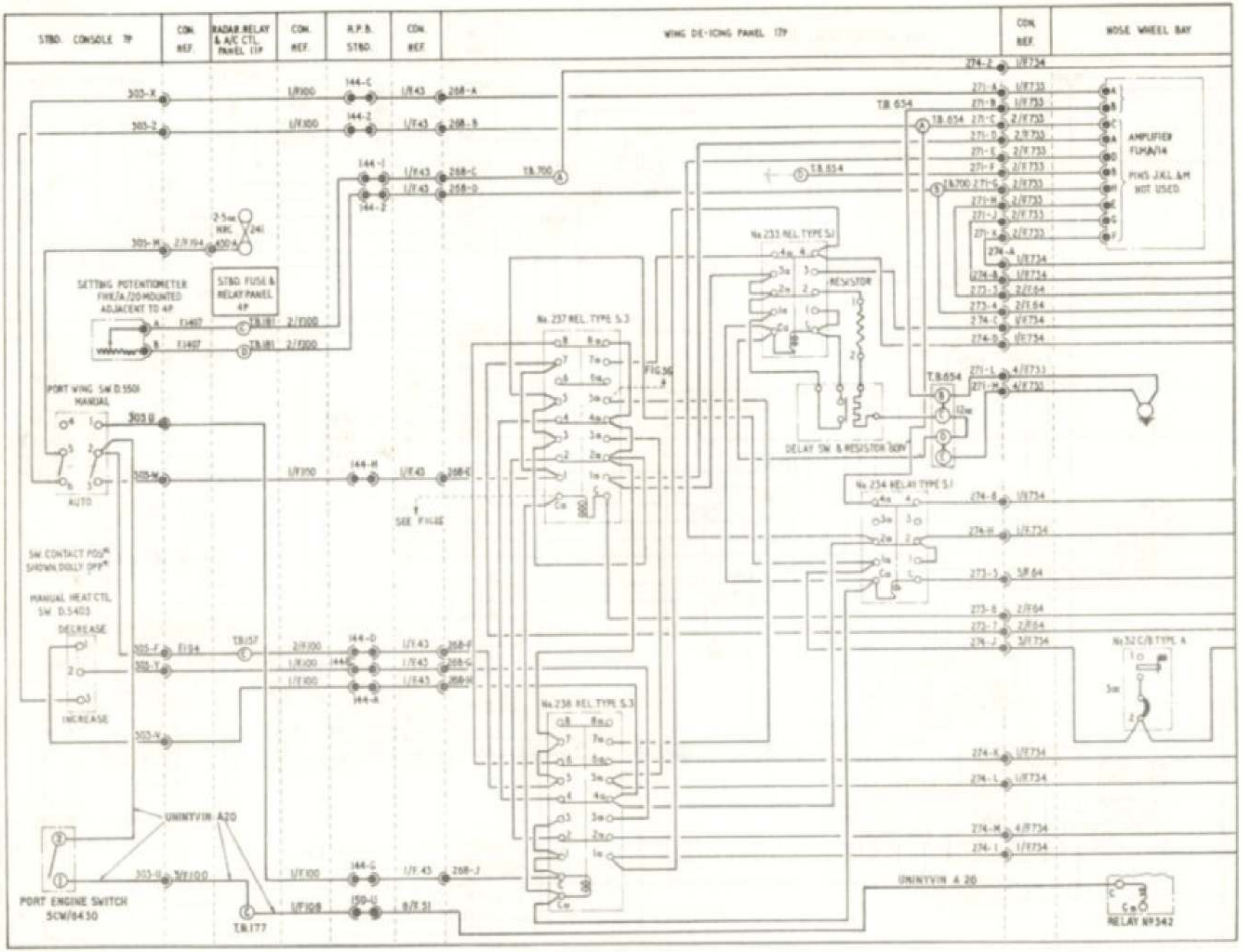

Fig. 34 (1) Port wing de icing.

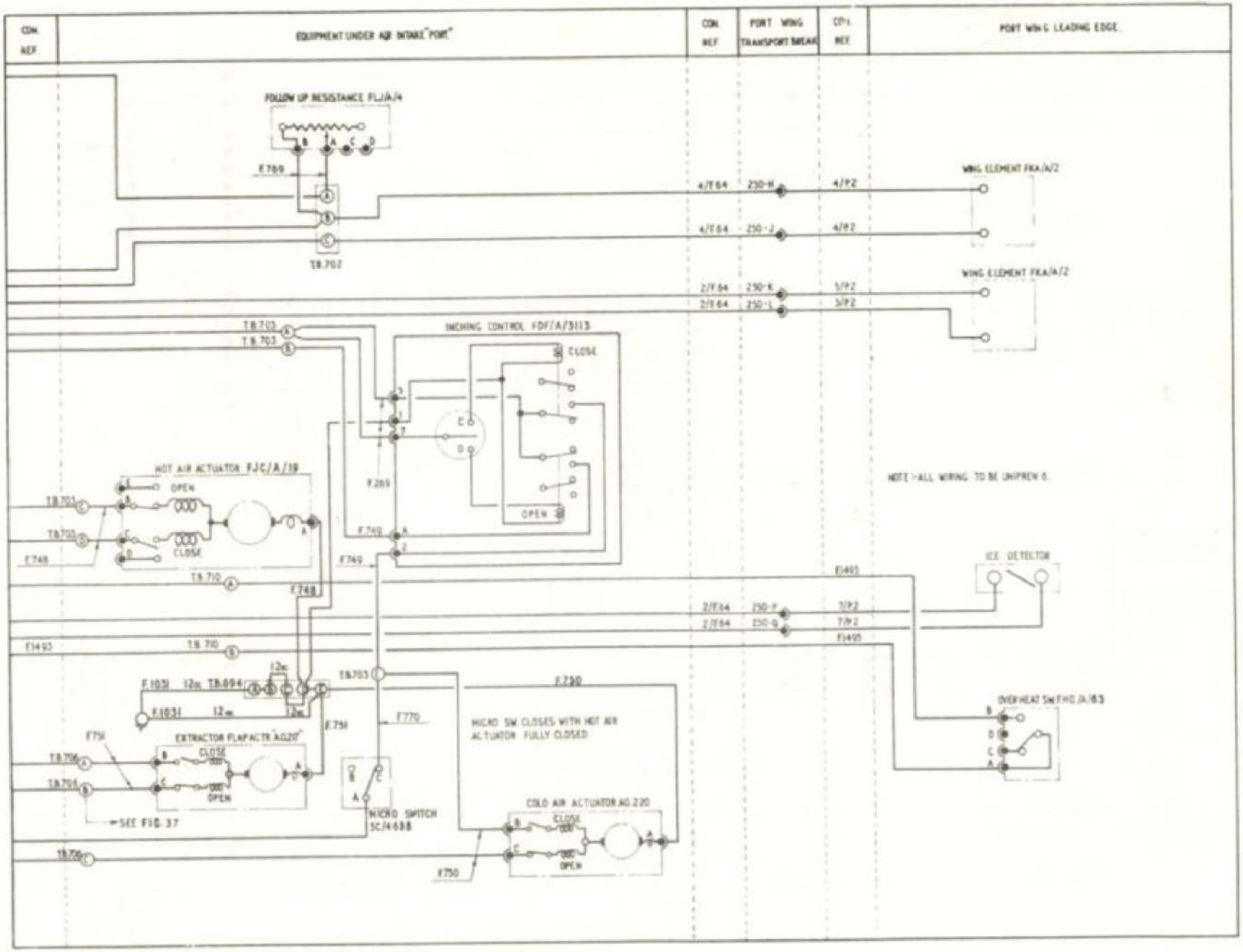


Fig. 34 (2) Port wing de icing.

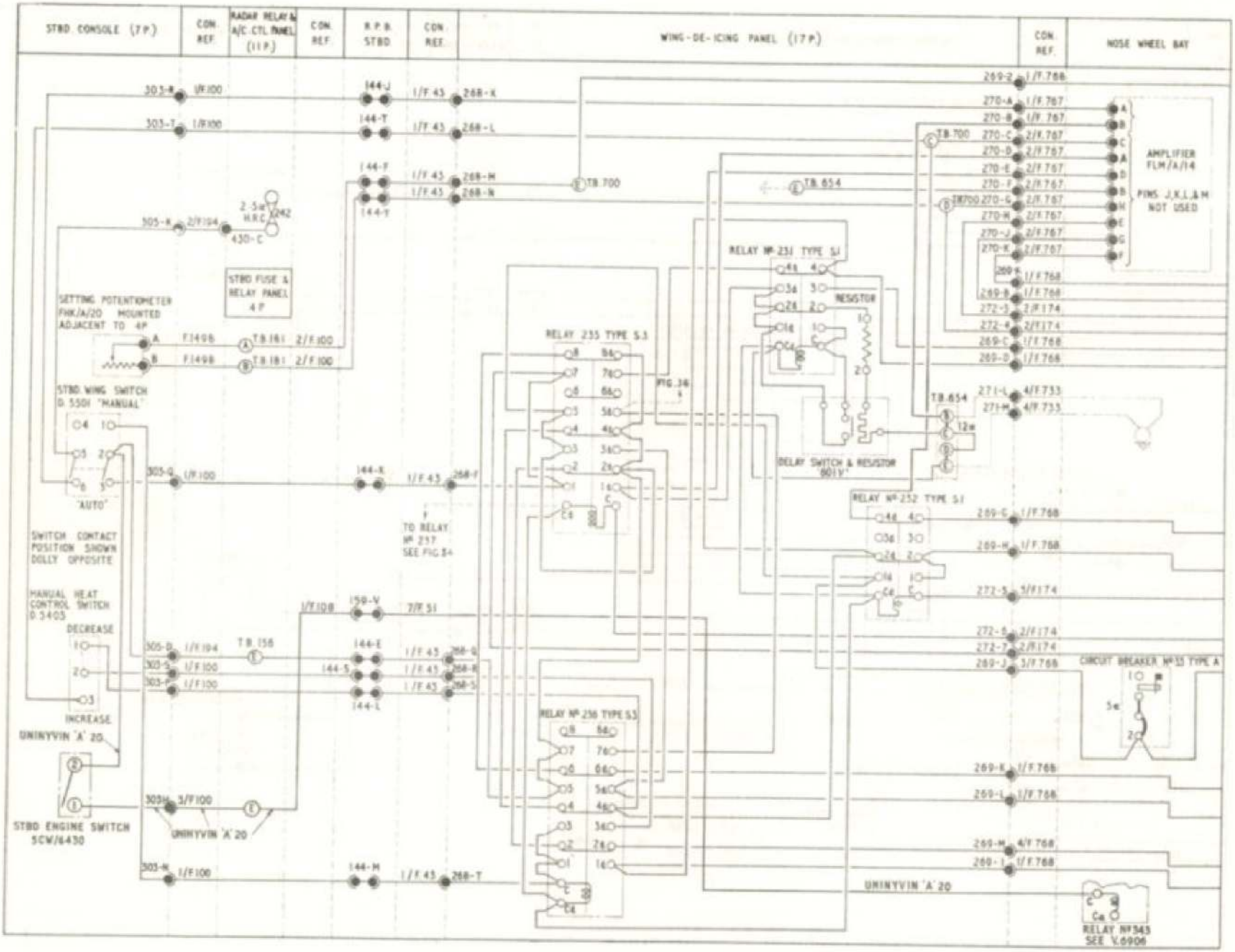


Fig. 35 (1) St'bd wing de-icing

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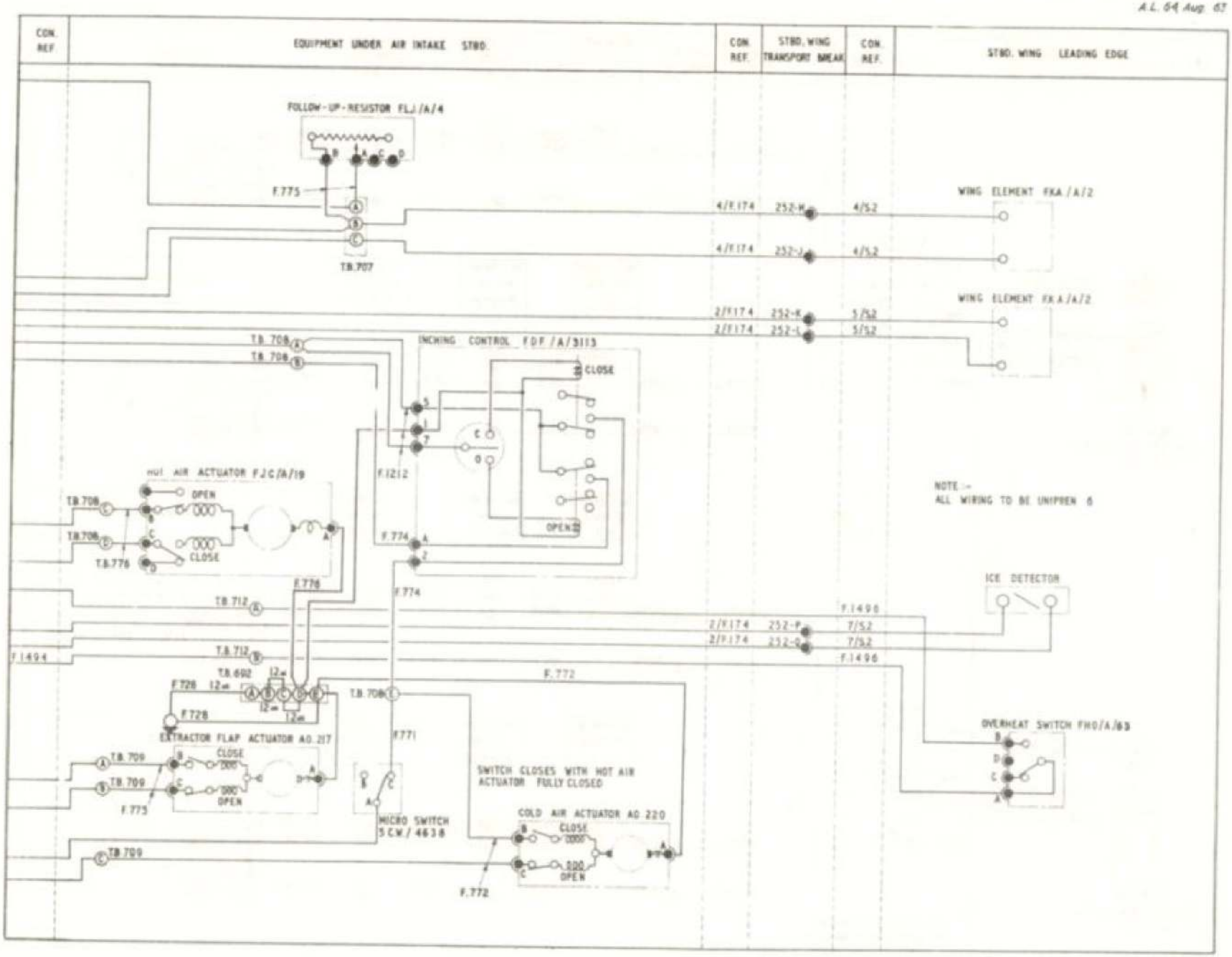


Fig.35 (2) St'bd wing de-icing

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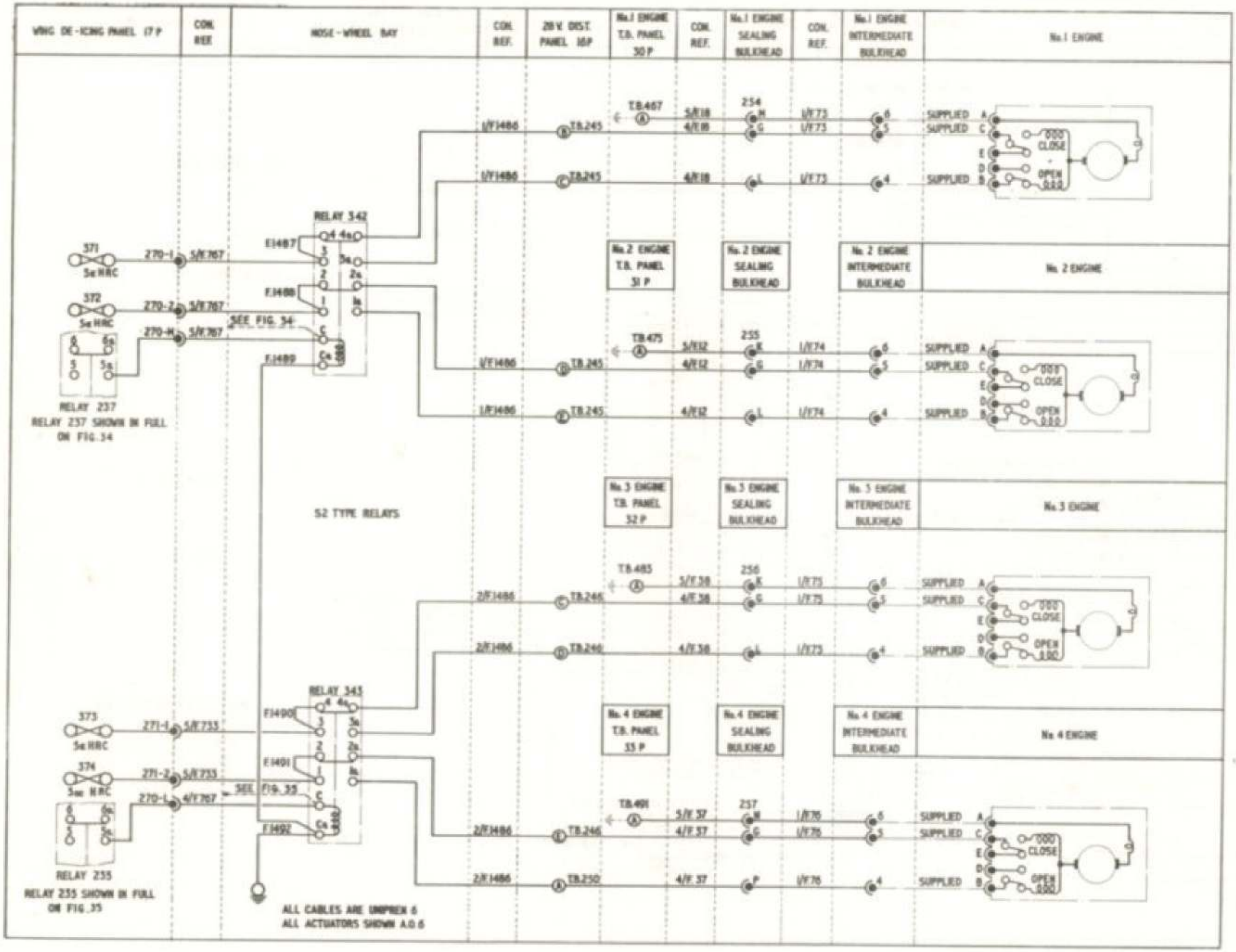


Fig. 36 Engine de-icing

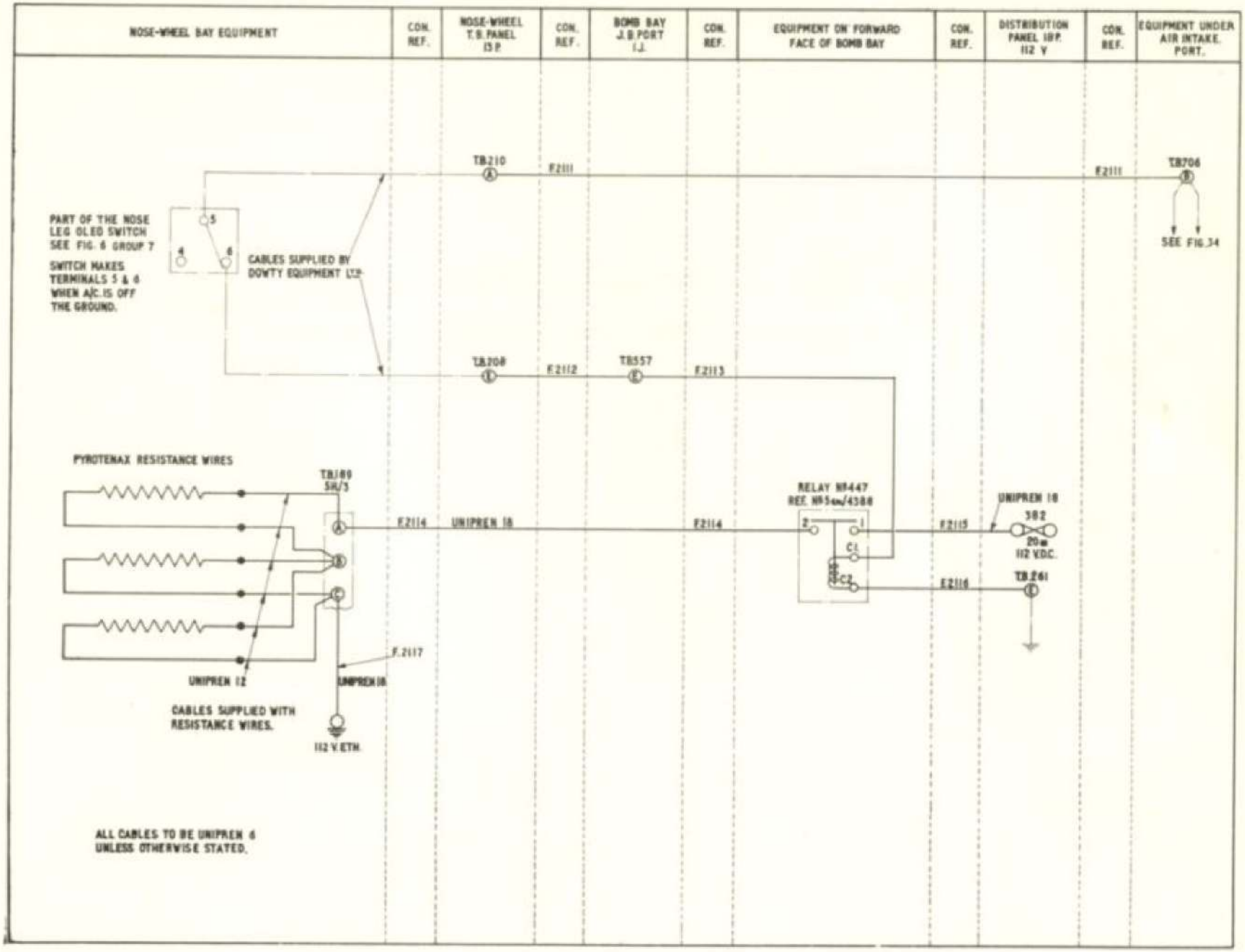


Fig. 37 Inverter de-icing

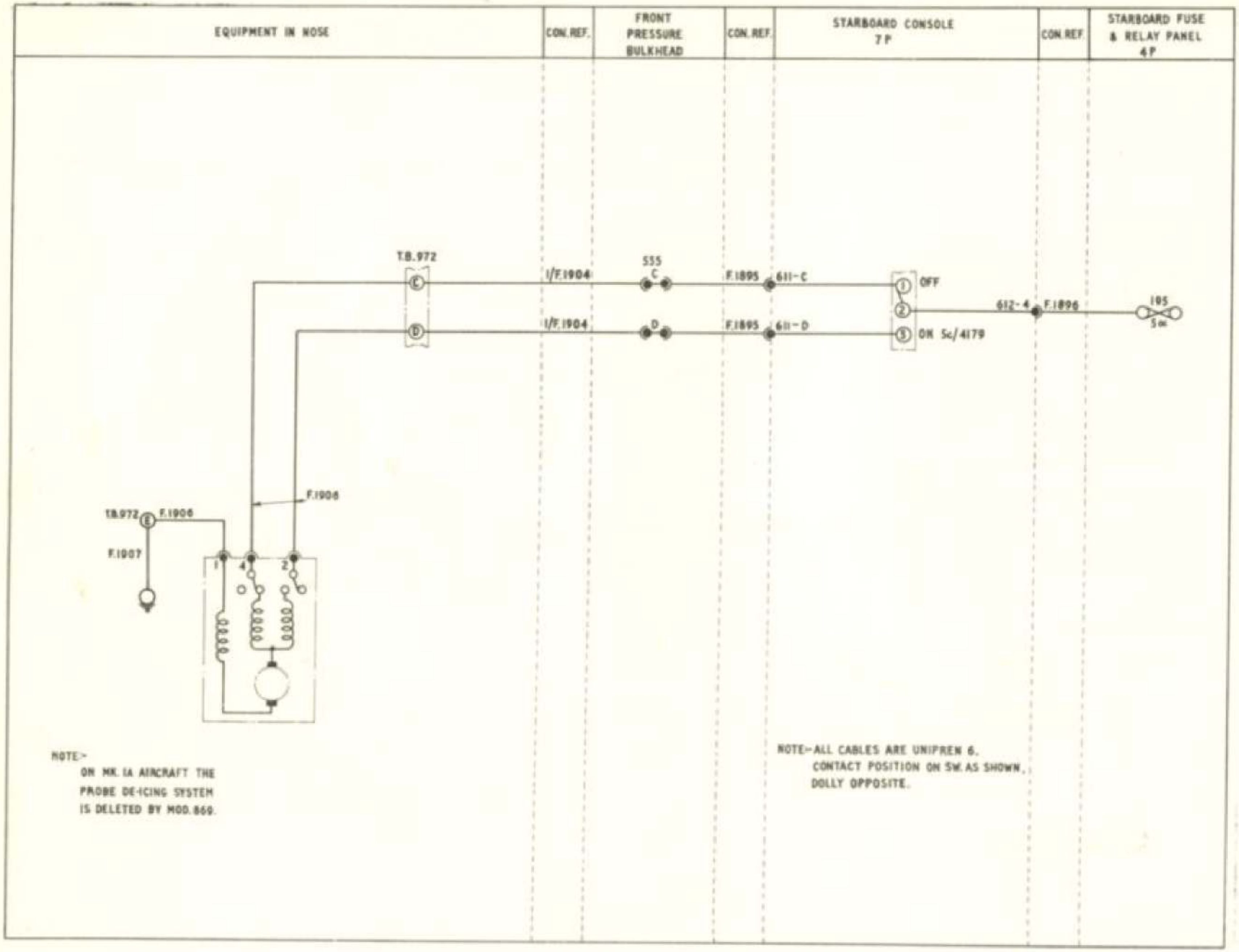


Fig. 38 Probe de-icing (post Mod. 38)