Group 2A

D.C. POWER AND DISTRIBUTION

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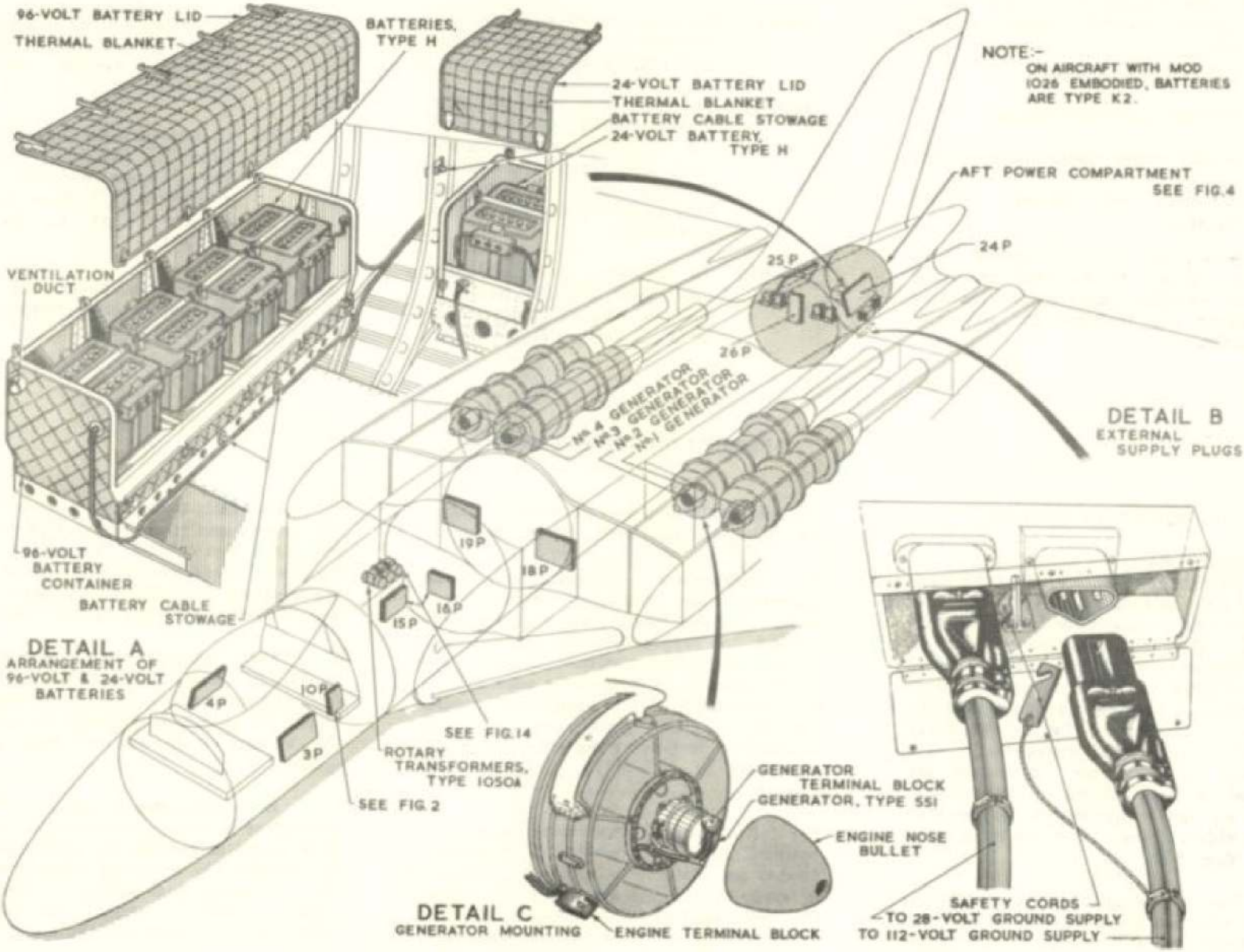

Fig.1 Location of components

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Introduction

1. This Group contains descriptive and servicing information for the electrical controls and circuits of the d.c. power services on the aircraft. These services consist of:-

(1) 112-volt power controls

(2) 112-volt power distribution

(3) 28-volt rotary transformers control

(4) 112-volt and 28-volt battery isolation

2. Theoretical circuit diagrams are provided adjacent to the text describing the more complex circuits, and location illustrations are included for all major components.

3. The following modifications to the d.c. power supply and distribution circuits are all included in this Group:-

Mod.613 To make provision for E.C.M. installation including A.R.I. 5919 (Mk.1A aircraft).

Mod.697 To re-arrange the 112-volt busbar system so that No.3 and 4 generators each supply loads from their own separate busbars which are isolated from each other and from the port busbar.

Mod.874 To introduce voltage regulators, Type 120, Ref.No.5UC/6882, in lieu of voltage regulators, Type 91, Ref.No. 5UC/5522, and introduce control amplifiers Ref.No. 5UC/6883.

Mod.988 To replace the aluminium cables which connect to the generator thermal unit, by copper cables.

Mod.1026 To introduce battery alkaline, Type K2 Ref.No.5J/3483, in lieu of battery lead acid, Type H, Ref.No.5J/3303, or battery alkaline Type K, Ref.No. 5J/3364.

Mod.1044 Re-position panel 67P from fin post in power compartment to the bomb bay.

DESCRIPTION AND OPERATION

112-VOLT POWER CONTROL

112-volt generators

4. Four 112-volt, 22·5 kW compound-wound d.c. generators, Type 551, are installed, one in the nose bullet of each engine. The generators are designed to give satisfactory performance with a speed range of 2,860 to 10,000 r.p.m. Cooling is effected by blast air produced from the engine air intakes. On aircraft where Mod.664 is embodied concurrently with Olympus Mod.448, the generators are changed to Type 551A. The terminal block on these generators is mounted on the side instead of the end housing as in the Type 551.

5. Each generator is a compound-wound six-pole machine with interpoles. In addition, series de-compounding windings wound on the alternate main poles, and working in conjunction with the voltage regulators, provide further control for parallel operation when required.

6. **Condensers,** integral with each generator, and connected between both sides of the armature and earth, are installed to suppress radio interference. In addition to the positive, negative and field terminals, a terminal is provided for the connection of the equalising circuit. Details of the generators, including descriptive and servicing information are contained in A.P.4343A, Vol.1, Sect.4, Chap.1.

7. No.1 and 2 generators operate in parallel and are connected to a common busbar on 24P. No.3 and 4 generators normally operate individually, each supplying their own separate busbars on 25P. Arrangements are made for automatic load transfer in the event of failure of the No.3 or 4 generators. Should No.1 and 2 generators fail, their loads may be manually transferred to No.3 and 4 generators, which are then operated in parallel. Full details of these functions are given under the headings 'Transfer of generator loads' and 'Transfer of loads circuit operation.'

8. Each generator output is controlled by its own carbon pile regulator. Voltage trimming resistances, Type 5, are provided in the aft power compartment for trimming the voltage regulators off load on the ground.

9. Each generator is connected to its respective busbar by the action of a heavy duty magnetic switch, the action of which is controlled by a manual selector switch, and an engage push-switch. These two manual switches control the magnetic switch via interlock and isolation relays.

10. Generator protection is afforded by

the inclusion of a field switch, which is controlled by:-

(1) A main thermal unit

(2) A crash switch

(3) A field relay

Neon indicators are fitted in each of the 112-volt distribution panels (18, 19, 24 and 25P), as a warning of live busbar conditions. Each generator is equipped with a red power failure warning lamp, and a total generator failure warning lamp is provided at the pilots' station. Load ammeters are provided, one for each generator, at the navigation station.

11. A voltmeter, connected to the battery busbar, serves to indicate supply voltage, and push-button selector switches are provided alongside the voltmeter on 10P for checking the output of individual generators.

Generator control equipment

12. The bulk of the equipment for controlling and protecting the generating systems is fitted to the generator control panels (24P port and 25P starboard) in the aft power compartment. The remainder of the components are fitted to the structure in the power compartment. The aft power compartment is illustrated in fig.3 and 4.

Panel 24P

13. This panel, on the port side of the power compartment, carries the controlling equipment for the No.1 and 2 generator circuits, as follows:-

◀ (1) Main magnetic switches, 5CW/4600 ▶ These units form the main contactors between the generators and their associated busbars, and are controlled by manual selector switches in the cabin (10P).

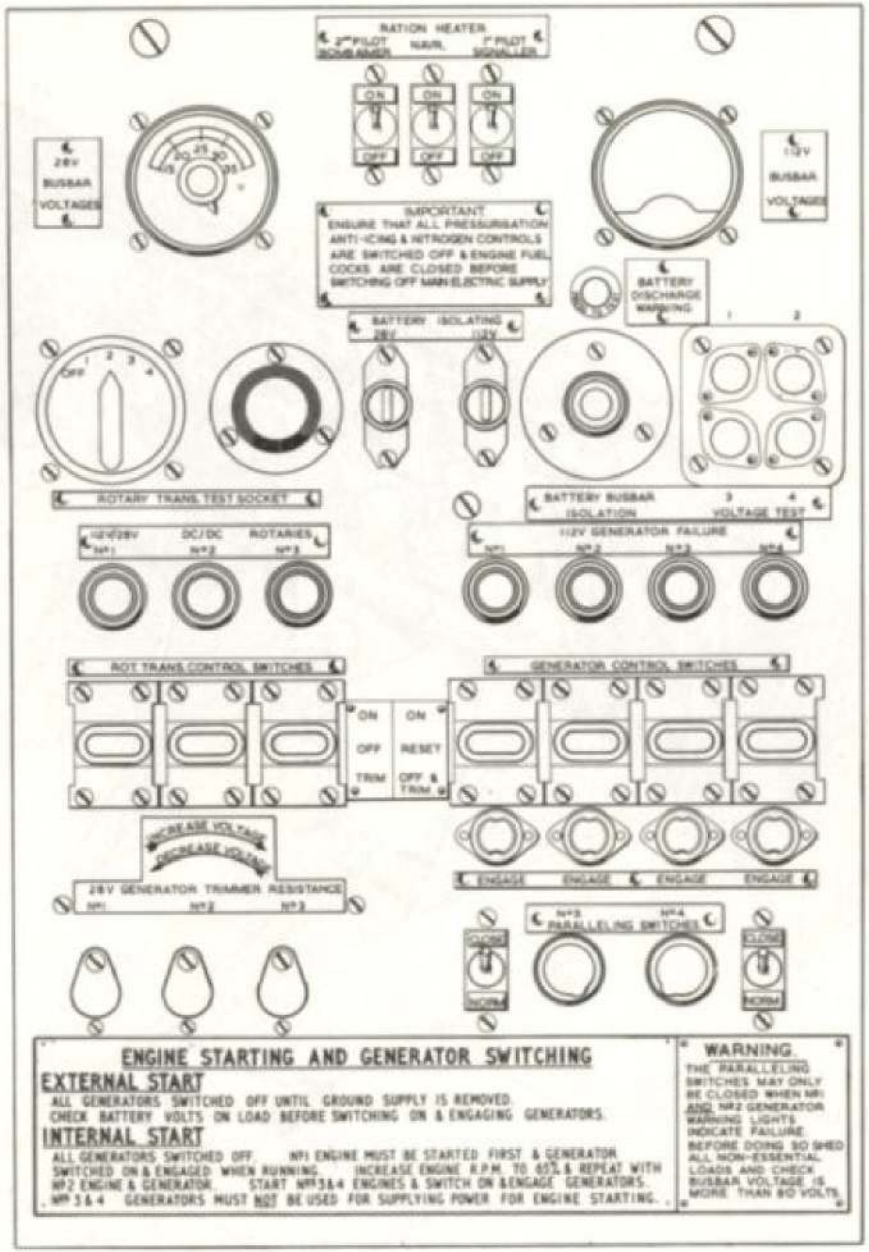

Fig.2 Generator control panel 10P

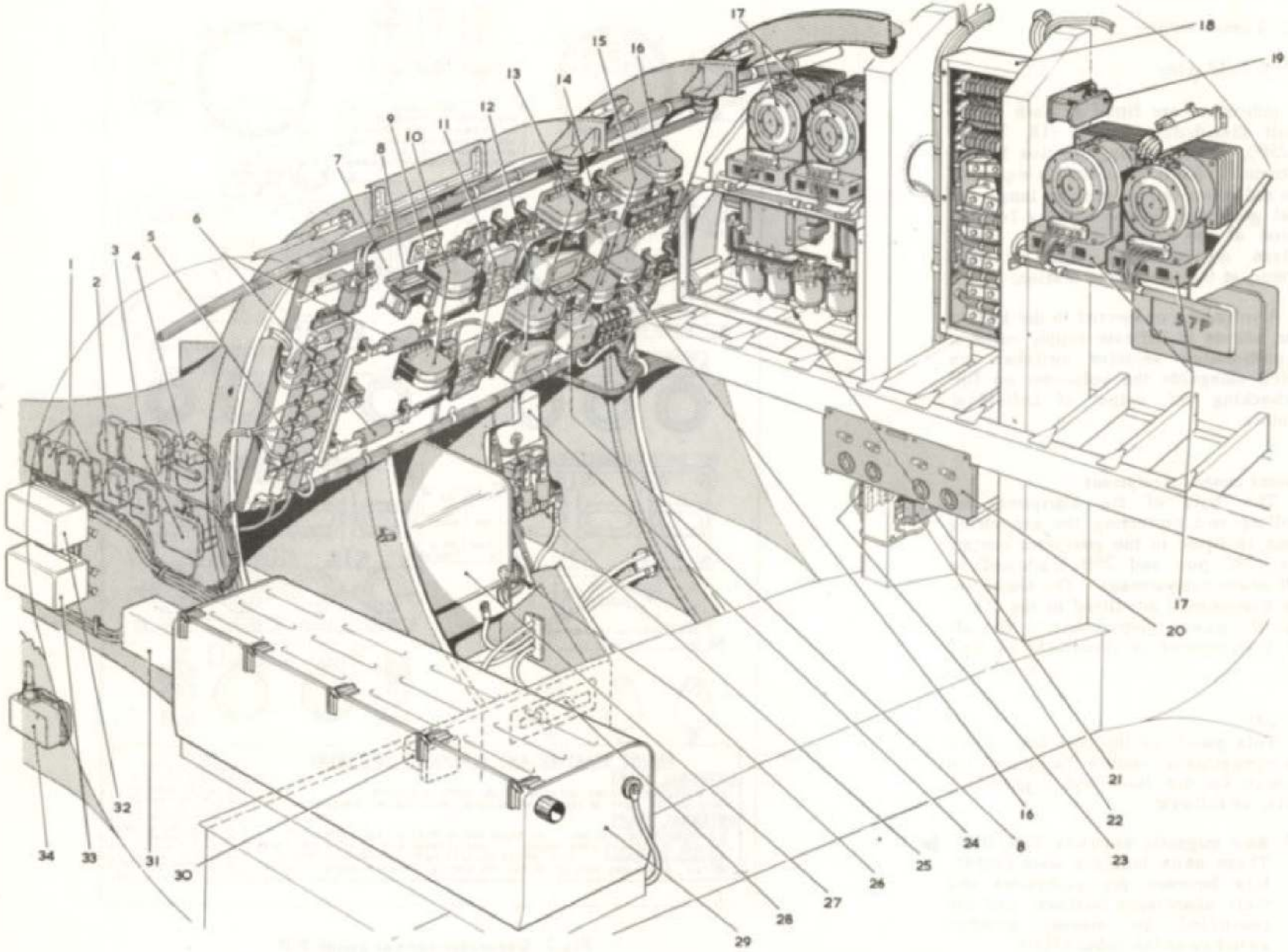

Fig.3 Power equipment in aft power compartment – pre Mods. 874 and 1044

KEY TO FIG.3

Power equipment in aft power compartment - pre Mods.874 and 1044

1 RELAYS NO.154, 155, 156 AND 157
2 RELAYS NO.678, 681 AND 158
3 RELAYS NO.674 AND 675
4 ENGINE STARTING CONTACTOR NO.677
5 BATTERY BUSBAR DIST. FUSES
6 NO.1 AND 2 GEN. MAIN FUSES
7 PANEL 24P - GEN. CONTROL PANEL
8 INDICATOR RELAYS NO.534 AND 535
9 LIVE BUSBAR IND. AND FUSE
10 NO.1 AND 2 GEN. INTERLOCK RELAYS NO.133 AND 138
11 NO.1 AND 2 GEN. MAGNETIC SWITCHES NO.379 AND 384
12 NO.1 AND 2 GEN. DIFFERENTIAL CUT-OUTS NO.135 AND 140
13 NO.1 AND 2 GEN. VOLTAGE PICK-UP RELAYS NO.132 AND 137
14 NO.1 AND 2 GEN. MAIN THERMAL UNITS NO.378 AND 383
15 NO.1 AND 2 GEN. FIELD SWITCH UNITS NO.377 AND 382
16 NO.1 AND 2 GEN. FIELD RELAYS NO.376 AND 381
17 VOLTAGE REGULATOR UNITS
18 PANEL 26P - 28-VOLT DIST.
19 RELAY NO.261
20 REMOTE TRIMMERS AND VOLTAGE SOCKET PANEL
21 STARTER PANEL
22 PANEL 67P - LOAD AMMETER RELAY PANEL (RELAY NO.648)
23 96 AND 24-VOLT BATTERY LOAD AMMETER SHUNTS
24 24-VOLT BATTERY ISOLATION CONTACTOR
25 GROUND SUPPLY FUSES
26 RELAYS NO.259 AND 260
27 24-VOLT BATTERY
28 ENGINE STARTING MAIN FUSE
29 96-VOLT BATTERY
30 RELAY NO.685 - BATTERY DISCHARGE WARNING
31 CONTACTOR NO.676 - GROUND ISOLATION CONTACTOR
32 96-VOLT BATTERY ISOLATION CONTACTOR
33 CONTACTOR NO.673 - BATTERY BUSBAR ISOLATION CONTACTOR
34 P.F.C. TIME DELAY SWITCH (PORT AND STARBOARD)

NOTE...
The controlling equipment for No.3 and 4 generators is fitted to panel 25P (facing 24P in the power compartment). Contactors No.670, 672, and relays No.669 and 671 are located on the structure below 25P.

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(2) Field relays, Type 3A, No.3 (5CW/5695). These relays are calibrated to pull in at 70 - 75 volts. An economy resistance is fitted and connected in series with the operating coil when the relay is energised. The purpose and operation of the relay is described under the heading 'Generator circuit operation'.

(3) Interlock relays (pre-Mod.874), Type 3A, No.3 (5CW/5695). The operation of this relay, is the same as that of the field relay of the same type.

(4) Interlock relays (post-Mod.874), F7401, Ref.No.5CW/6844. These relays have a built-in resistor, and are specially suited to operate in conjunction with the voltage reference unit.

(5) Indicator relays, Plessey Type 7C2/105411/1. These relays are of the standard changeover pattern, and are employed to control the total generator failure indicator on the pilots' panel. Operation of the indicator relays is given under the heading 'Generator circuit operation'.

(6) Differential cut-outs, Type 1A, No.1 (5CY/4413). These units are used in conjunction with the magnetic switches (5CW/4600) to connect the generators to the busbar. A reverse current of 15 to 30 amp. will open the cut-outs, but where the shunt coil is connected between the generator busbar and earth (Mod.874), up to 60 amp. reverse current will be required.

(7) Field switches, Type 2A, No.2 (5CW/5694). Further protection to the generators is provided by these field switches, which are connected one in each generator field circuit. With the field switch open, the field current is reduced to a minimum and therefore the generator output falls to a safe level.

(8) Main thermal units, Type 1A, No.2 (5CW/4407). Thermal effects of any overload currents in the generator main outputs will cause the thermal units to operate, and in turn operate the field switch, to reduce the output of the overloaded generator. Further details of the protection circuits are discussed under the heading 'Generator protection system.'

Panel 25P

14. Panel 25P is installed on the starboard side of the aft power compartment, and houses the necessary control gear for the No.3 and 4 generators. These

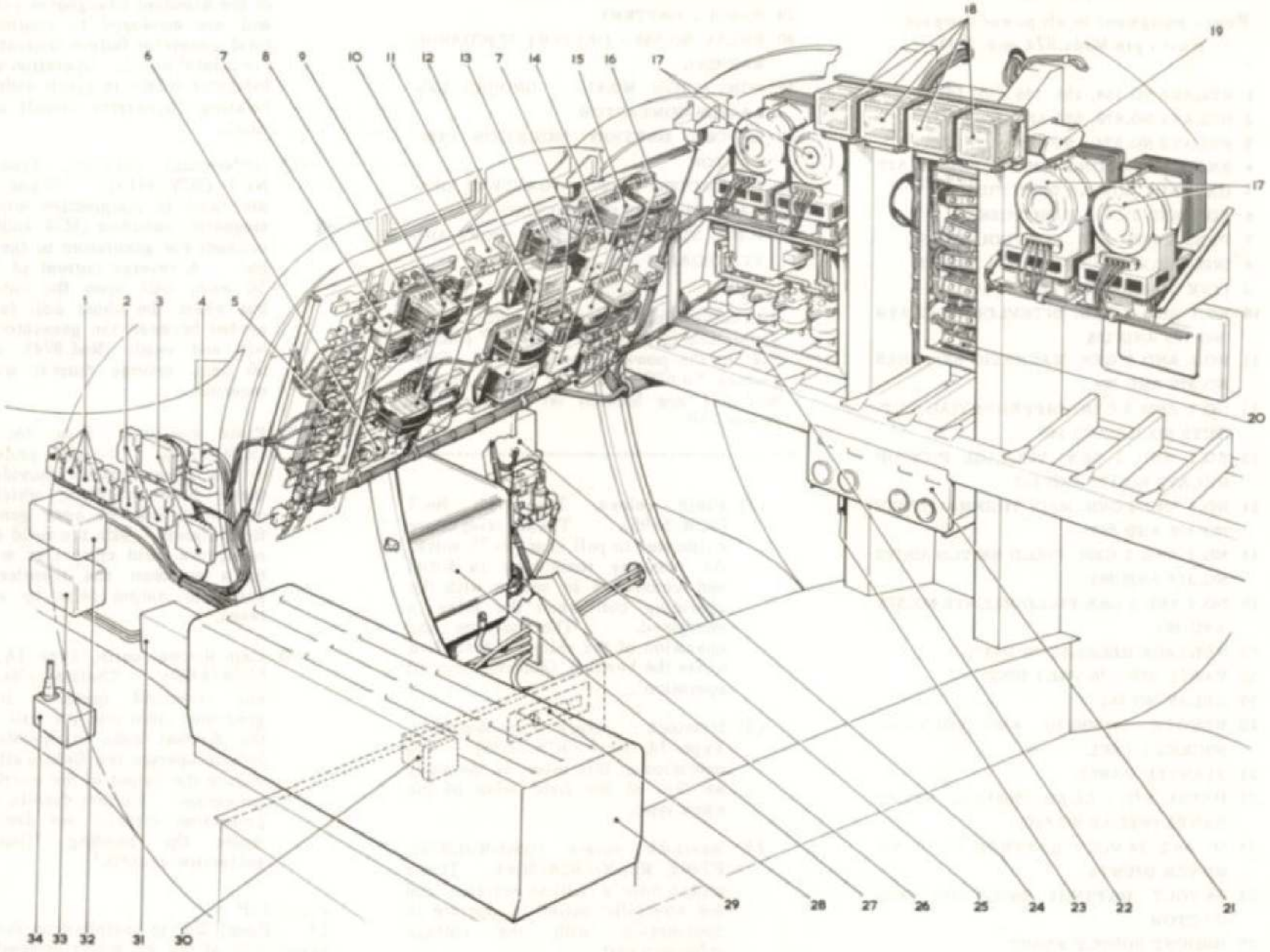

Fig. 4 Power equipment in aft power compartment – post Mods. 874 and 1044

KEY TO FIG.4

Power equipment in aft power compartment - post Mods.874 and 1044

1 RELAYS NO.154, 155, 156 AND 157
2 RELAYS NO.678, 681 AND 158
3 RELAYS NO.674 AND 675
4 ENGINE STARTING CONTACTOR NO.677
5 BATTERY BUSBAR DIST. FUSES
6 NO.1 AND 2 GEN. MAIN FUSES
7 IND. RELAYS NO.534 AND 535
8 LIVE BUSBAR IND. AND FUSE
9 NO.1 AND 2 GEN. INTERLOCK RELAYS NO.133 AND 138
10 NO.1 AND 2 GEN. MAGNETIC SWITCHES NO.379 AND 384
11 PANEL 24P - GEN. CONTROL PANEL
12 NO.1 AND 2 GEN. DIFFERENTIAL CUT-OUTS 135 AND 140
13 NO.1 AND 2 GEN. 100-VOLT REF. UNITS NO.132 AND 137
14 NO.1 AND 2 GEN. MAIN THERMAL UNITS NO.378 AND 383
15 NO.1 AND 2 GEN. FIELD SWITCH RELAYS NO.377 AND 382
16 NO.1 AND 2 GEN. FIELD RELAYS NO.376 AND 381
17 VOLTAGE REGULATOR UNITS
18 REGULATOR AMPLIFIER UNITS
19 RELAY NO.261
20 PANEL 26P - 28-VOLT DIST.
21 REMOTE TRIMMERS AND VOLTAGE SOCKET PANEL
22 STARTING PANEL
23 96 AND 24-VOLT BATTERY LOAD AMMETER SHUNTS
24 24-VOLT BATTERY ISOLATION CONTACTOR
25 GROUND SUPPLY FUSES
26 RELAYS NO.259 AND 260
27 24-VOLT BATTERY
28 ENGINE STARTING MAIN FUSE
29 96-VOLT BATTERY
30 RELAY NO.685 - BATTERY DISCHARGE WARNING
31 CONTACTOR NO.676 - GROUND ISOLATION CONTACTOR
32 96-VOLT BATTERY ISOLATION CONTACTOR
33 CONTACTOR NO.673 - BATTERY BUSBAR ISOLATION CONTACTOR
34 P.F.C. TIME DELAY SWITCH (PORT AND STARBOARD)

NOTE...
The controlling equipment for No.3 and 4 generators is fitted to panel 25P (facing 24P in the power compartment). Contactors No.670, 672, and relays No.669 and 671 are located on the structure below 25P.

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control units are all similar to those on the port panel.

15. Descriptive and servicing information for all types of magnetic switches, and the main thermal units will be found in A.P.4343C, Vol.1, Book 2, Sect.3 and 4; the differential cut-outs are described in A.P.4343B, Vol.1, Sect.11, Chap.1.

Voltage control

16. On aircraft prior to Mod.874, the generator voltage is controlled by a voltage regulator, Type 91. The generator voltage on aircraft with Mod.874 embodied, is controlled by a voltage regulator, Type 120, operating with a regulator amplifier, Ref.No.5UC/6883.

(1) Voltage regulator, Type 91. These units are connected, one in each generator circuit, and take the form of a series of carbon discs, the degree of compression of which, is varied to meet varying speed and load conditions. Since the resistance of the carbon pile varies with the amount of compression, the generator field current is adjusted to meet the varying conditions imposed on the generator. A voltage coil reacts on the carbon pile, to give the necessary changes in compression. To enable the generators to be run in parallel, an equalising coil is included in each regulator.

(2) Voltage regulator, Type 120. This component is similar in operation to the voltage regulator, Type 91. The important difference, is that the equalising, shunt, and series stabilising coils, are replaced by one auxiliary coil, which is energised from the regulator amplifier.

(3) Regulator amplifier Ref.No.5UC/6883. The purpose of the regulator amplifier, is to reduce any error in the generated voltage. To achieve this purpose, the ampere-turns of an auxiliary coil (situated in the voltage regulator, Type 120), are adjusted; this will influence the voltage coil of the voltage regulator, and hence the resistance of the carbon pile.

Further information on the voltage regulators and regulator amplifiers will be found in A.P.4343B, Vol.1.

Panel 10P

17. The manual control switches for the generator system are fitted to the forward half of panel 10P, installed on the port side of the crew's cabin at the signaller's station as illustrated in fig.2. These controls consists of:-

(1) Generator control switches - these are of the double-pole 3-way type, labelled ON-RESET-OFF & TRIM and serve as main control switches for the generators.

(2) Generator engage switches - these

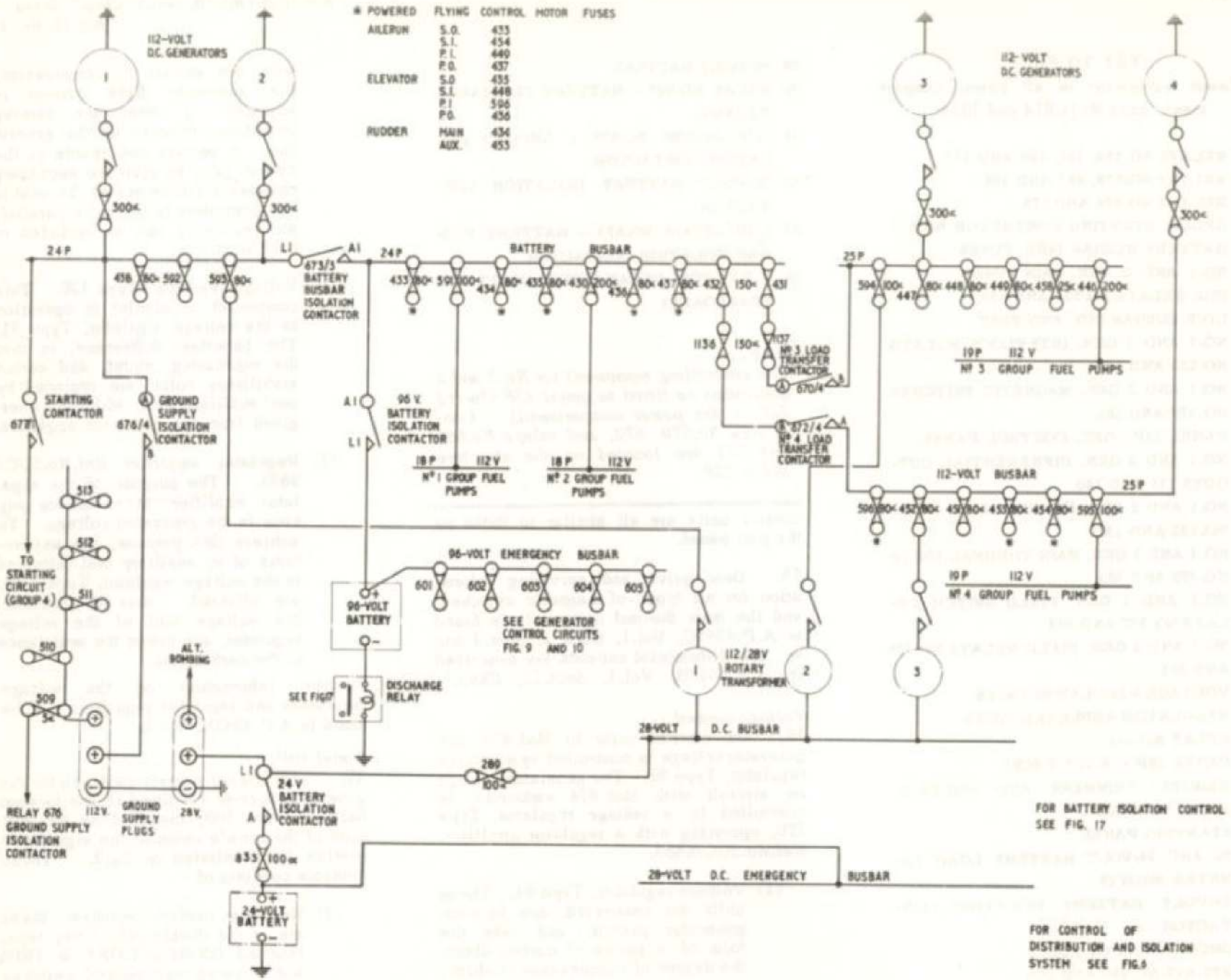

Fig. 5 D.C. main distribution and busbar isolation

Fuse 509 value corrected

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are single-pole push-switches, labelled ENGAGE, and are employed to connect the generators to their respective busbars.

(3) Generator paralleling switches - these are single-pole switches labelled No.3 and 4 PARALLELING SWITCHES, CLOSE - NORMAL, and are used to connect No.3 and 4 generators to the main battery busbar under certain fault conditions.

18. Also fitted to panel 10P are the four generator failure warning red indicator lamps, the No.3 and 4 generator paralleling amber indicator lamps, a battery busbar isolation push-switch and indicator, a 96-volt battery discharge, red, warning indicator, voltmeter and associated test push switches, and the 96-volt and 24-volt battery isolation switches. The a.c./d.c. rotary transformer controls occupy the aft portion of 10P.

Load ammeters

19. The four generator load ammeters, (Ref.No.5Q/25645) are installed on the upper portion of the port panel of the navigation station. These ammeters are of the vertical scale pattern, and are fitted together in one case as shown in fig.12. The ammeter shunts, which are connected in the generator main negative leads, are fitted one in each engine bay.

20. It should be noted that the ammeter shunts are connected as follows:-

No.1 shunt to No.4 meter
No.2 shunt to No.3 meter
No.3 shunt to No.2 meter
No.4 shunt to No.1 meter

The numbering used for the meters is that of the manufacturer's stamped on the instrument cases. This arrangement permits the frontal labelling of the instruments to be in conformity with the aft-facing crew position. In the case of the No.1 and 2 generators, two sets of relay contacts, 684/4 - 684/3 and 684/2 - 684/1, respectively, are connected in parallel across the ammeter circuits. The ammeter isolation relay No.684 is fitted on panel 70P. This relay is energised to close its contacts thus placing the ammeter out of circuit during engine starting operations. See Fig.13.

21. Fitted adjacent to the generator load ammeters are the rotary transformer-load ammeters, and the 96-volt and 24-volt battery ammeters. These instruments are dealt with in the text covering their respective circuit operations.

Transfer of generator loads

22. A d.c. main distribution diagram is provided in fig.5, and this illustration gives the general layout of the main 112-volt busbars and a basic pattern of the d.c. distribution. Referring to fig.5, it will be seen that under normal conditions, the No.1 and 2 generators, operating in parallel are connected to a portion of the main busbar on 24P. This busbar is designated 'No.1 and 2 generator busbar'.

No.1 and 2 generator busbar

23. From the No.1 and 2 generator busbar, only the following 112-volt loads are connected:-

No.1 D.C./D.C. Type 1050 rotary transformer
No.1 D.C./A.C. Type 350 inverter
24P live busbar indication

The engine starting system is connected to the No.1 and 2 generator busbar via a heavy duty starting relay No.677, and the 112-volt external supply plug is connected to the same busbar via a heavy duty ground supply contactor No.676.

Battery busbar

24. The other portion of the 24P busbar, designated the 'battery busbar' is connected, via the 96-volt battery isolation contactor, to the aircraft battery. The battery busbar supplies the following 112-volt loads:-

No.1 group fuel pumps
No.2 group fuel pumps
S.O. aileron P.F.C. motor
P.O. aileron P.F.C. motor
S.O. elevator P.F.C. motor
P.O. elevator P.F.C. motor
Main rudder P.F.C. motor
Port air brakes actuator

and other miscellaneous loads.

25. The battery busbar is normally connected to the No.1 and 2 generator busbar via the contacts of a heavy duty contactor No.673, designated 'Battery busbar isolation contactor'. When this contactor is energised, No.1 and 2 generators will supply all the loads listed in para.23 and 24.

No.3 generator busbar

26. The No.3 generator normally supplies a portion of 25P busbar, designated the 'No.3 generator busbar', which supplies the following 112-volt loads:-

No.2 D.C./D.C. Type 1050 rotary transformer
No.2 D.C./A.C. Type 350 inverter
No.3 Group fuel pumps
S.I. elevator P.F.C. motor
P.I. aileron P.F.C. motor
Starboard air brakes actuator

and other miscellaneous loads.

No.4 generator busbar

27. The remaining portion of the 25P

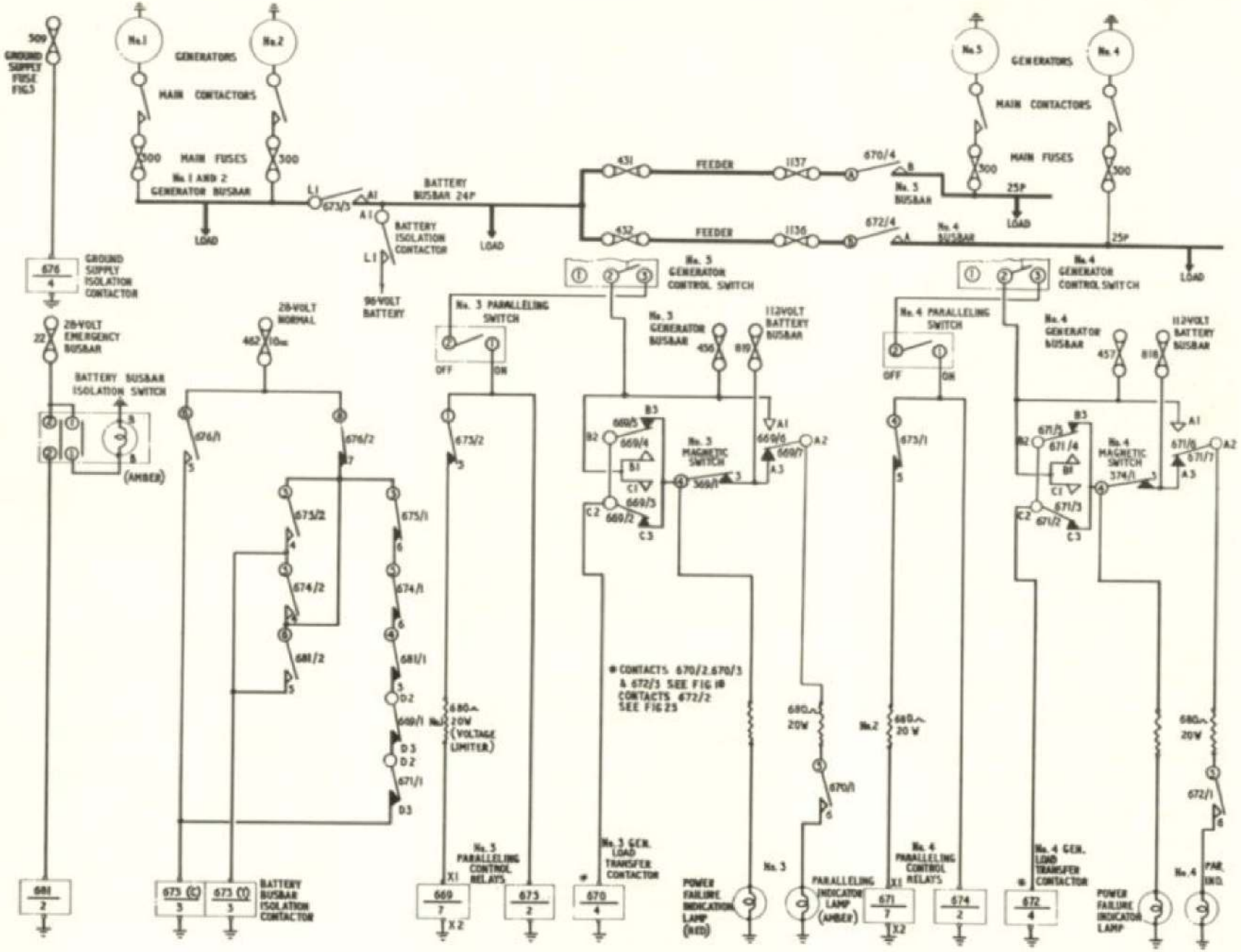

Fig. 6 Main distribution busbar control

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busbar, designated 'No.4 generator busbar', is fed by the No.4 generator, and supplies the following 112-volt loads:-

No.3 D.C./D.C. Type 1050 rotary transformer
No.3 D.C./A.C. Type 350 inverter
No.4 group fuel pumps

and the remainder of the P.F.C. motors.

28. Further reference to fig.5 will show that the No.3 and 4 generator busbars are each connected via their respective transfer contactors (No.670 and 672) to the battery busbar, via fused feeder links.

29. From the foregoing, it will be seen that under certain circumstances, the No.1 and 2 generators will supply the No.3 and 4 generator loads, and the No.3 and 4 generators will supply the battery busbar loads. Further general details of these arrangements are discussed in the following paragraphs.

Load transfer

30. Should the output of No.1 generator fail, the No.1 and 2 generator and the battery busbar loads will be borne by the No.2 generator. Similarly, should the No.2 generator fail, the loads will be borne by the No.1 generator. In the event of a failure of both the No.1 and the No.2 generators, operation of the No.3 and 4 generator paralleling switches on 10P to CLOSE, will energise both load transfer contactors No.670 and 672. This action will cause the No.3 and 4 generators to operate in parallel, and the battery busbar loads will be supplied by these two generators. Note that in this case the No.1 and 2 generator busbar will be isolated, and those loads on the busbar will not be supplied.

31. In the event of a failure of the No.3 generator, the No.3 generator busbar loads will automatically be transferred to the battery busbar (operation of load transfer contactor 670). Similarly, should the output of No.4 generator fail, the No.4 generator busbar loads will be automatically transferred to the battery busbar. In both of these cases of failure the No.1 and 2 generators will supply the failed generator loads.

32. Should both the No.3 and No.4 generators fail, then a similar automatic load transfer will take place, and both busbars will be fed from the No.1 and 2 generators.

33. From the foregoing general load transfer arrangements, it can be seen that the system caters for all cases of generator failure with the maximum safety precautions. Load shedding in the case of a multiple generator failure is carried out by the operator, and essential loads are not disturbed. The generator and battery ammeters will give the operator a clear indication of the state of the system, and the battery discharge indicator will assist in protecting the main 96-volt battery. The complete circuit operation for the load transfer arrangements is given under the heading 'Transfer of loads circuit operation'.

Generator circuit operation

34. The generator circuit operation outlined in the ensuing paragraphs should be read in conjunction with the theoretical circuit diagrams contained in fig. 6,7,8,9 and 10. Reference is made to the particular circuit diagram where necessary.

35. Circuit operation is described from a normal external ground supply engine start to the final engage of the No.4 generator, and the necessary precautions, and laid down handling drill, are quoted where necessary.

Initial checks

36. Prior to starting the engines, the battery busbar isolation switch/indicator, should be depressed, and a check made to see that the amber indicator is lit. This action will ensure that the battery busbar isolation contactor No.673 is de-energised See fig.6. On pulling the push-switch, the amber warning lamp should be extinguished.

37. The next step is to connect the ground supply truck to the 112-volt external supply plug, then place both the 96-volt and 28-volt battery isolation switches on 10P to the ON position. Next place all four generator control switches to the OFF position, switch on No.1 rotary transformer, and No.1 and 3 inverters.

38. The engines may now be started, No.1 first, and the engines run at ground idling speed. After all engines are running satisfactorily, remove the 112-volt ground supply plug, then check that the 96-volt battery volts are above 88 volts after the battery has been suitably loaded (as in para.37) for 30 seconds. Next check that each generator output is 108-116 volts, then switch ON and ENGAGE each generator in the order 1, 2, 3 and 4.

Ground supply - circuit operation

39. Referring to fig.5, 6 and 17, it will be seen that prior to engine starting operations when the 112-volt ground supply is connected to the aircraft ground supply plug, a supply from the third pin of the plug will be connected to the bank of ground supply fuses 509-513. A supply via fuse 509 will then be fed to energise the ground supply isolation contactor 676, and the following action will result:-

(1) Closing of the heavy duty contacts 676/4 will connect the 112-volt ground supply to the No.1 and 2 generator busbar (fig.5 and 17).

(2) Opening of contacts 676/3 will

isolate the No.1 generator interlock circuit, and prevent the generator being connected to the No.1 and 2 generator busbar (fig.7).

(3) Contacts 676/2 will open to isolate fuse 462 (28-volt) from the trip coil of contactor 673 (fig.6).

(4) Contacts 676/1 will close to energise the close coil of the battery busbar isolation contactor 673 (fig.6).

40. Operation of the battery busbar isolation contactor No.673 to close, will cause the following circuit action to take place:-

(1) Closing of contacts 673/3 will connect the battery busbar to the external supply via the No.1 and 2 generator busbar.

(2) Opening of contacts 673/1 and 673/2 will isolate the No.3 and 4 generator paralleling control relays (669 and 671, fig.6).

41. Meanwhile, a supply from fuse 819 fed from the battery busbar, will energise the coil of the No.3 generator load transfer contactor, via contacts 369/1 (No.3 generator magnetic switch), and the paralleled contacts 669/2 and 669/5. See fig.6. This action will cause contacts 670/4 to close, and the No.3 generator busbar will be connected to the battery busbar. Also, closing of contacts 670/1 will connect the same supply via normally closed contacts 669/7 to light the No.3 paralleling amber indicator lamp on 10P, thus indicating that the No.3 generator busbar loads are being fed from the battery busbar. Note, at this stage, that the closing of contacts 670/3, which are interposed in the No.3 and 4 generator equalising circuit (fig.8), will be dealt with in the appropriate text for paralleling operation. The normally closed relay contacts 670/2 in parallel with contacts of the differential cut-out provide an alternative connection for the 'hold-in' supply to the coil of the magnetic switch. This serves to reduce the effect of line drop during airbrake manipulation. Opening and closing of these contacts will take place in accordance with the energising and de-energising respectively of the load transfer contactor No.670. When No.3 and 4 generators are functioning in parallel these contacts will be open and normal differential cut-out control will be effective.

42. A similar circuit operation to that outlined in para.41 will also take place for the No.4 generator load transfer contactor 672, using a supply from fuse 818 (circuit shown on fig.6).

43. The external 112-volt ground supply will now feed all the busbars, and the necessary loads, (fuel pumps etc.), may be switched on in preparation for engine starting.

Removing the ground supply

44. Assuming that all four engines have been successfully started using the external supply. With the generator control switches in the ON position, the following paragraphs cover the circuit operation on removal of the ground supply.

45. With the engines running at ground idling speed, remove the external supply. At this point, the ground supply isolation contactor will be de-energised, and the following circuit action will occur:-

(1) Operation of contacts 676/4 to open will isolate the 112-volt ground supply plug from the No.1 and 2 generator busbar.

(2) Operation of contacts 676/1 to open will isolate the supply line to the close coil of contactor 673 (battery busbar isolation).

(3) Closing of contacts 676/2 will connect fuse 462 to prepare the trip coil circuit of contactor 673. Note at this stage that the trip coil circuit is incomplete, and the battery busbar isolation contactor will remain latched 'in'.

(4) Finally, contacts 676/3 will close, thus enabling the interlock circuit of No.1 generator to be completed.

46. At this stage, all the busbars will be fed from the aircraft internal 96-volt battery, and the battery voltage must be checked before No.1 generator is engaged on the busbar (para.39 refers).

Connecting No.1 generator to the busbar - pre Mod.874

47. Referring to fig.7, it will be seen that the No.1 generator output is connected to the busbar via the main contacts of the heavy duty magnetic switch No.379. The coil of the magnetic switch is supplied from the generator output via contacts 4-3 of the interlock relay, contacts 4-3 of the voltage pick-up relay, the control and engage switches, and contacts 6-7 of the differential cut-out. Note that the coil of the interlock relay obtains its supply from the generator output, via the field relay, contacts 676/3 (para.45(4)), and the generator control switch.

48. The voltage pull-in coil of the differential cut-out, requires a voltage in excess of busbar voltage for its operation. Since the generator output is normally controlled at operative busbar potential, then a measure of de-control must be applied to allow the generator voltage to rise above the busbar voltage as a function of switching on. This is achieved by isolation of the remote trimmer resistance from the voltage regulator until the magnetic switch comes into operation.

49. The normally open contacts 5-6 of the magnetic switch are connected in parallel with the normally closed contacts 5-6 of the interlock relay. The latter, with the generator control switch in either the RESET or OFF/TRIM positions, completes the remote trimmer resistance circuits. With the generator control switch in the ON position, the interlock relay will be energised via contacts 676/3 of the ground isolation contactor, and contacts 5-6 of the field relay. Note also that the No.1 generator ENGAGE push-switch is interposed between the control switch ON contact No.3, and the differential cut-out contacts 6-7 (via contacts 3-4 of the voltage pick-up and interlock relays). Until the magnetic switch closes, there will be a period of de-control during which the trimmer resistance is isolated, thus the generator voltage will rise to above the normal controlled value.

50. When the generator output reaches 75 volts, the interlock relay 133 will be energised with a supply from the generator, via fuse 440, terminals 2-3 of the control switch, contacts 676/3 of the isolation contactor, and contacts 6-5 of the field relay, and the following circuit action will take place:-

(1) Operation of contacts 5-6 to open will isolate the trimmer resistance.

(2) Closing of contacts 3-4 will prepare a portion of the engage circuit

51. At the same time, the voltage pick-up relay No.132, will be energised from the generator output, and closing of contacts 1-7 will connect the generator supply to one end of the pull-in coil of the differential cut-out. The other end of the cut-out coil is connected to terminal A of the magnetic switch. With a voltage differential of 3·5 to 4 volts, i.e., with a generator output of 114 volts, the differential cut-out contacts 6-7 will close, thus preparing the engage switch circuit to the close coil of the magnetic switch. Note also that closing of the pick-up relay contacts 3-4 will have prepared a further portion of the engage circuit.

52. Operation of the No.1 generator engage switch will now close the magnetic switch and connect the generator to the No.1 and 2 generator busbar in the following manner:-

(1) A supply from fuse 440 will be directed via the generator control switch terminals 2-3, the ENGAGE switch contacts, contacts 4-3 of the voltage pick-up relay, contacts 4-3 of the interlock relay, and finally contacts 6-7 of the differential cut-out to the close coil of the main magnetic switch.

53. On operation of the magnetic switch, the following circuit action will take place:-

(1) The generator will be connected to the busbar via contacts B-A.

(2) The period of de-control will be terminated by completion of the remote trimmer resistance circuit, via contacts 5-6.

(3) The equalising circuit to No.2 generator will be completed via contacts 1-2.

(4) The power failure red warning indicator will be de-energised by the opening of contacts 3-4.

54. It will be seen that the indicator relay No.535 will be energised at the same time as the magnetic relay, and:-

(1) Operation of the paralleled C2-C1 and D2-D1 contacts to close will form a 'hold-on' circuit for the coil of the magnetic switch.

(2) Opening of the paralleled A2-A3 and B2-B3 contacts will interrupt the series contact circuit to the pilots' generator failure warning lamp, causing the lamp to be extinguished.

No.1 generator will now be 'on line', and take over the loads being supplied by the battery.

Connecting No.2 generator to the busbar - pre Mod.874

55. The foregoing circuit operation for connecting the No.1 generator to the busbar will take place for the No.2 generator. When the No.2 ENGAGE push-switch is depressed, both generators will operate in parallel supplying all loads until the No.3 then the No.4 generators are connected to the busbar.

Connecting No.1 generator to the busbar - post Mod.874

56. Basically the circuit operation for connecting the No.1 generator to its busbar, post Mod.874, is very similar to that outlined for the No.1 and 2 generators, pre Mod.874; with the following exceptions:-

(1) The normal interlock relay is replaced by an interlock relay of a special pattern, in that it has a built-in resistor and,

(2) A 100-volt reference unit is used in place of the voltage pick-up relay.

57. The interlock relay, No.133, is of the Rotax F.7401 series, and is specially suited to operate in conjunction with the voltage reference unit. The interlock relay resistance is employed to replace the resistance offered by the battery which would normally provide the differential voltage for the magnetic switch operation.

58. Referring to fig.9, it will be seen that the No.1 generator output is connected to the busbar, via the main contacts of the

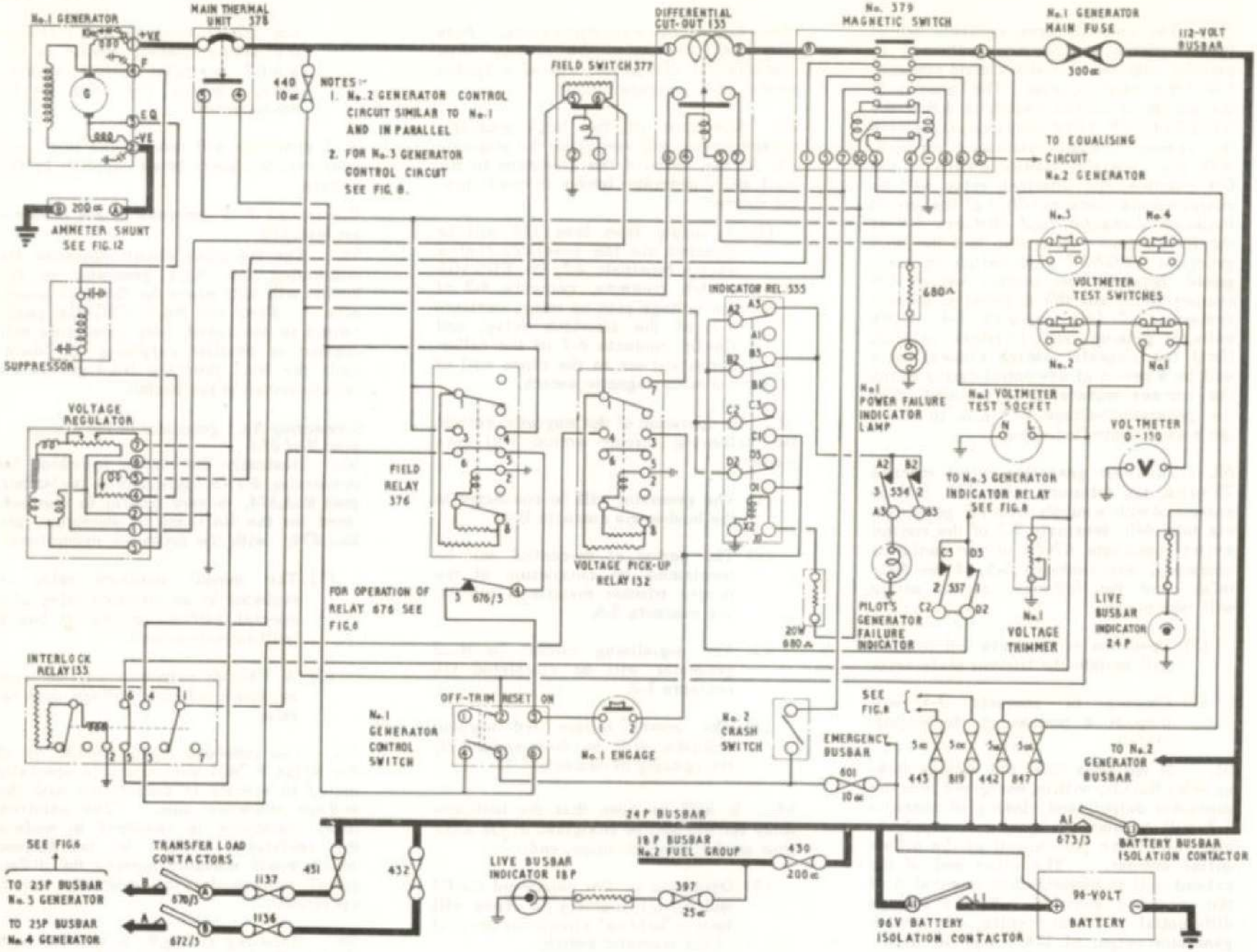


Fig. 7 No.1 generator control circuit - pre Mod. 874

(Indicator resistance value corrected)

RESTRICTED

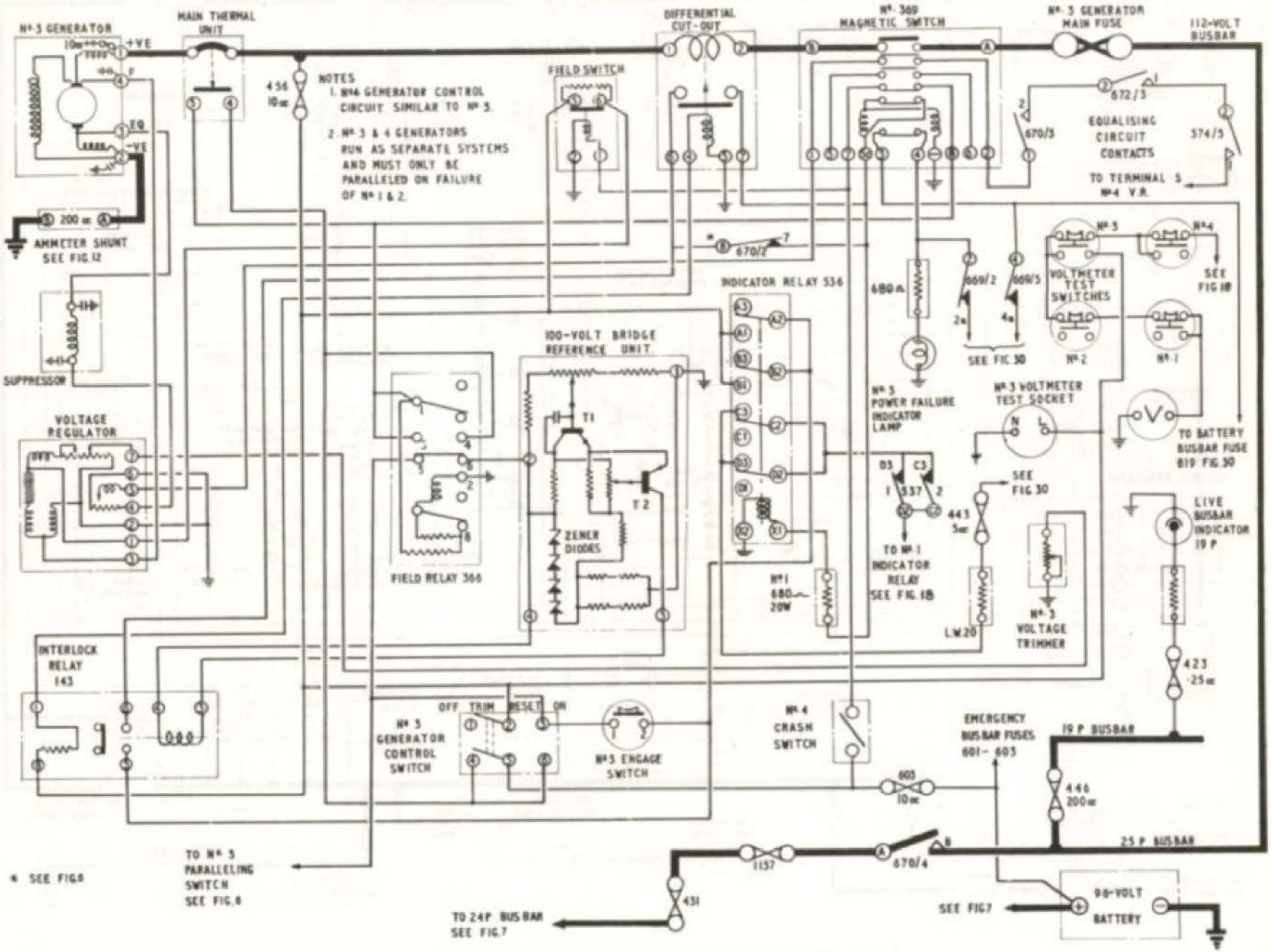


Fig. 8 No. 3 generator control circuit – pre Mod. 874
(indicator resistance value corrected)

RESTRICTED

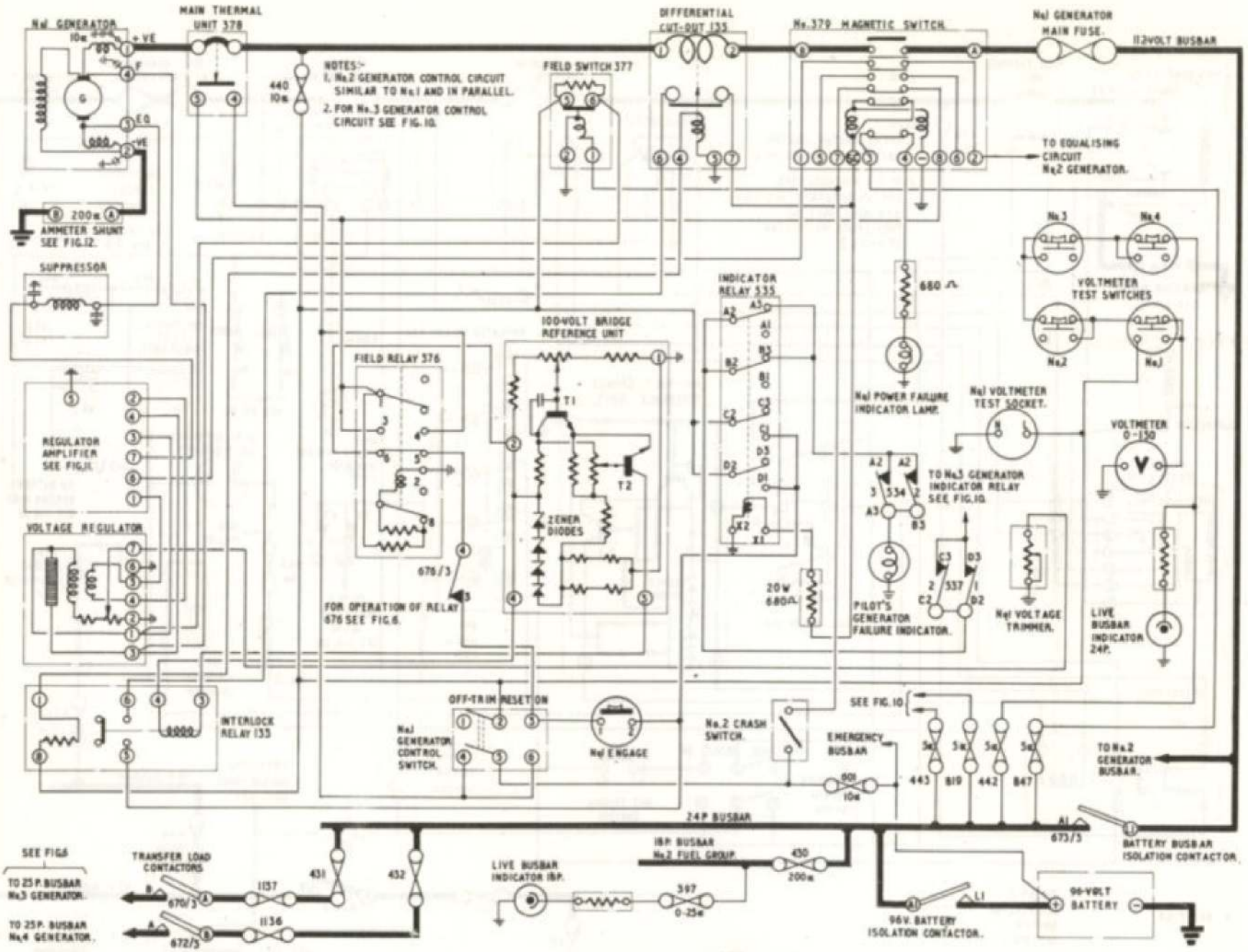


Fig.9 No.1 generator control circuit – post Mod. 874

(Indicator resistance value corrected)

RESTRICTED

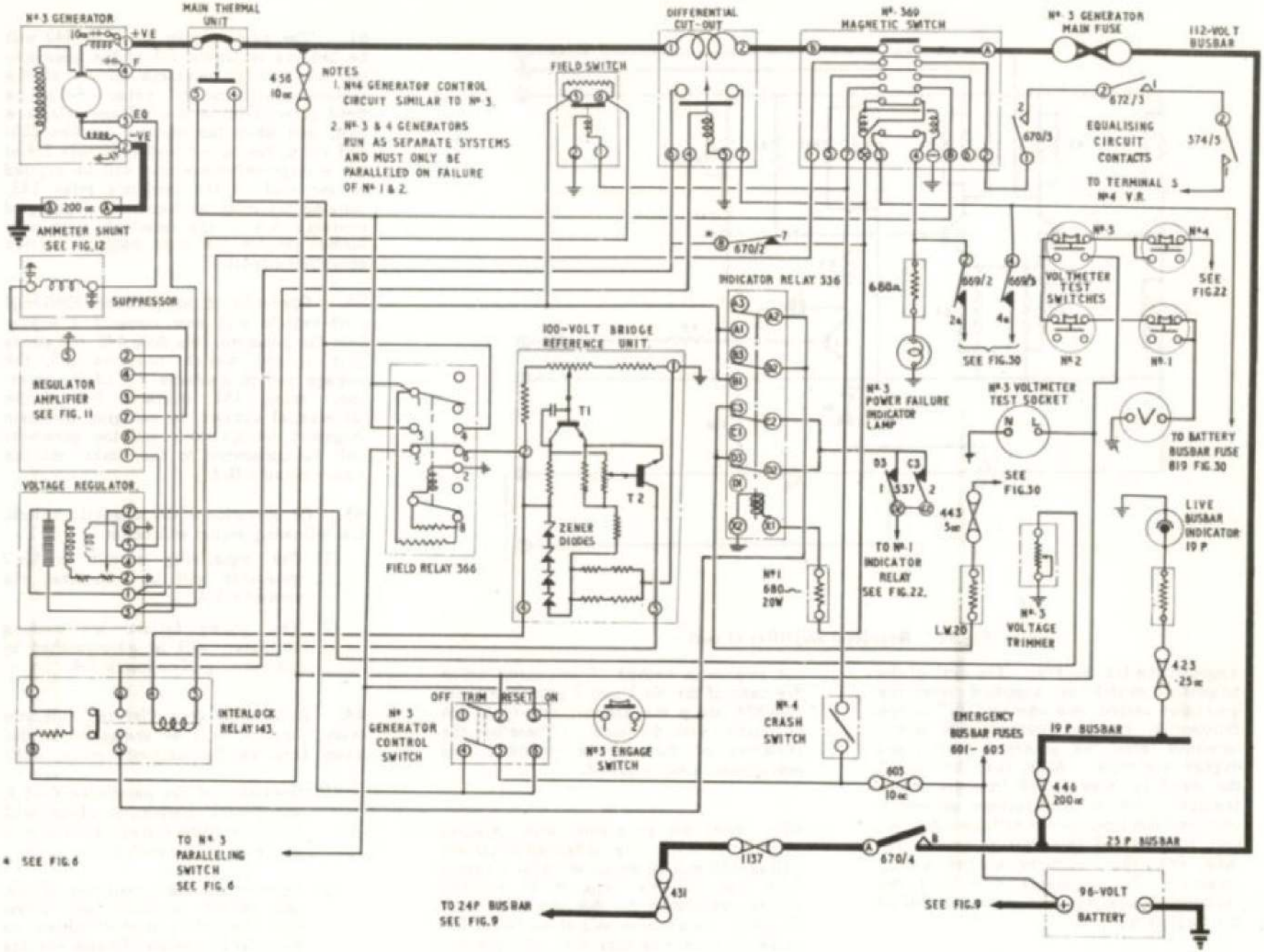


Fig. 10 No. 3 generator control circuit – post Mod. 874

4 Indicator resistance value corrected

RESTRICTED

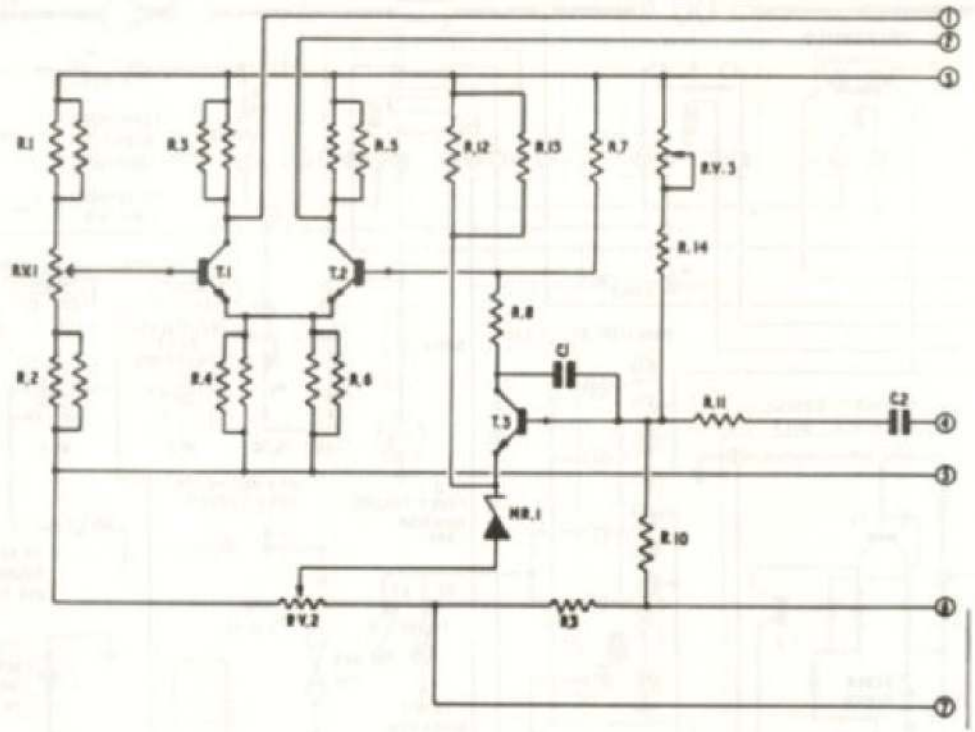


Fig.11 Regulator amplifier circuit

magnetic switch No.379. The coil of the magnetic switch is supplied from the generator output, via contacts 6-7 of the differential cut-out, contacts 5-6 of the interlock relay, the generator control and engage switches. Note, that the coil of the interlock relay is fed from the output terminals 3-4 of the voltage reference unit, and the input to the voltage reference unit is obtained from the generator, via fuse 440, the generator control switch terminals 2-3, contacts 676/3 of the isolation contactor, and contacts 5-6 of the field relay.

59. The operation of the pull-in coil of the differential cut-out will in this case not require a method of de-control as in the case of the No.1 and 2 generators, pre Mod.874, since the aircraft battery is not in circuit with the coil. Therefore the isolation of the voltage regulator trim resistance is not required.

60. When the generator output reaches approx. 50 volts, the differential cut-out pull-in coil will be energised with a supply from fuse 440, via contacts 8-1 and the series resistance of the interlock relay No.133. This action will close the differential cut-out contacts 6-7, and prepare the operation of the close coil circuit of the magnetic switch No.379.

61. The same supply via fuse 440 will be fed via terminals 2-3 of the generator control switch, contacts 676/3 of the isolation contactor, and contacts 5-6 of the field relay 376, to the voltage reference unit, and when the voltage reaches 100-105 volts, the output from terminals 3-4 of the voltage reference unit will be applied to the coil of the interlock relay 133, causing the relay to operate. Closing of contacts 5-6 of the interlock relay will further prepare the main magnetic switch operation circuit.

62. Operation of the generator ENGAGE push-switch will now connect a supply from the generator, via fuse 440, the generator control switch contacts 2-3, the engage switch contacts 5-6 of the interlock relay 133, contacts 6-7 of the differential cut-out, to energise the main magnetic switch coil, and the generator will be connected to the busbar via the main contacts B-A.

63. On operation of the magnetic switch, the following action will occur:-

(1) The equalising circuit to No.2 generator will be completed via contacts 1-2.

(2) The power failure red warning indicator, will be extinguished by the opening of contacts 3-4.

64. It will be seen that the indicator relay, No.535, will be energised at the same time as the magnetic relay, and:-

(1) Operation of the paralleled C2-C1, and D2-D1 contacts to close, will form a hold-on circuit for the coil of the magnetic switch.

(2) Opening of the paralleled A2-A3, and B2-B3 contacts, will interrupt the series contact circuit to the pilots' generator failure warning lamp, causing the lamp to be extinguished.

No.1 generator will now be on-line, and will take over the loads being supplied by the battery.

Connecting No.2 generator to the busbar - post Mod.874

65. The circuit operation, for connecting the No.2 generator, post Mod.874, to the busbar, is the same as that described for the No.1 generator, post Mod.874. When the No.2 engage push-switch is depressed, No.1 and 2 generators will operate in parallel, and supply all loads until the No.3, and then the No.4 generators, are connected to their respective busbars.

Connecting No.3 generator to the busbar - pre and post Mod.874

66. The No.3 generator circuit, incorporates the interlock relay with the built-in resistor, and the 100-volt reference unit. The circuit operation for the No.3 generator, is the same as that for the No.1 generator (post Mod.874), until operation of the magnetic switch. See fig.8 and 10.

67. On operation of the magnetic switch the following circuit action will occur:-

(1) Closing of contacts 1-2, will prepare a portion of the No.3 and 4 generators equalising circuit.

(2) Opening of contacts 3-4 will extinguish the No.3 power failure warning red indicator.

68. At the same time the operation of contacts 3-4 to open, will interrupt the supply to the load transfer contactor No.670, and the coil of the contactor will be de-energised (fig.6), the following circuit action will then occur:-

(1) Opening of contacts 670/4 will disconnect the No.3 generator busbar from the battery busbar.

(2) Operation of contacts 670/1 will cause the No.3 amber paralleling indicator to be extinguished.

(3) Opening of contacts 670/3 will isolate the No.3 and 4 generators equalising circuit.

The No.3 generator will now be connected to No.3 generator busbar, ready to supply any loads that are switched on.

69. It will be seen that the indicator relay No.536, will be energised at the same time as the magnetic relay (fig.8), and:-

(1) Operation of the paralleled A2-A1, and B2-B1 contacts to close, will form a hold-on circuit for the coil of the magnetic switch.

(2) Opening of the paralleled D2-D3, and C2-C3 contacts, will further interrupt the supply line to the pilot's generator failure indicator.

Connecting No.4 generator to the busbar - pre and post Mod.874

70. The foregoing circuit operation for connecting the No.3 generator to the busbar will take place for the No.4 generator, except that the relay numbers bear a different reference. When No.4 generator is 'on line', it will supply its own busbar load, and the system will operate as outlined in para. 22-29.

Trimming the generator voltages

71. For checking and making adjustments to the generator outputs, a portable testmeter, Type S, should be plugged into the appropriate 3-pin socket, in the aft power compartment. The appropriate generator control should then be placed to the OFF/TRIM position. In the case of the No.1 and 2 generators, pre Mod.874, this action will isolate the supply to the interlock relay coil, and the operation of the relay contacts will place the trimmer resistance in circuit, and trip the magnetic switch. In the case of the No.1 and 2 generators, post Mod.874, and No.3 and 4 generators, pre and post Mod.874, the supply to the voltage reference unit will be interrupted, thus the interlock relay will be de-energised, and the generator will be disconnected from the busbar.

72. The testmeter will indicate the controlled voltage under no load conditions, and this may be adjusted to its correct value (110 volts with Type H batteries, or 112 volts with Type K2 batteries) by means of the remote trimmer. After the voltage has been set to its correct value, the trimmed generator is reconnected to its busbar by placing the generator control switch to the ON position, then depressing the ENGAGE push-switch. Note that the laid down procedure for checking and trimming the generators is contained in para.182, and assumes that Type K2 batteries are fitted (Mod.1026).

Generator protection system

73. Protection for the generators and associated circuits under excessive load conditions is provided by the main thermal unit in each case. Similar protection also exists during crash landing by operation of the respective crash switches. The following paragraphs deal with the operation of the protection circuits.

No.1 generator protection circuit - pre Mod.874

Overload conditions

74. In the event of No.1 generator becoming overloaded (fig.7), the main thermal unit will close and the following action will result. A supply from the 96-volt battery emergency busbar will be made via fuse 601, contacts 5-6 of the generator control switch and contacts 4-5 of the main thermal unit, to energise the field relay 376. A hold-in circuit is completed across the now closed contacts 3-4 of the field relay, and contacts 5-6

will be opened to break the supply to the coil of the interlock relay 133. This relay will then be de-energised and its contacts 3-4 will open to break the hold-in circuit to the magnetic switch 379 and the indicator relay 535. In consequence, the magnetic switch will be de-energised to (a) bring the generator off the busbar, (b) break the equalising circuit and (c) light the No.1 power failure indicator lamp from fuse 847. Note also that part of the circuit to the pilot's generator failure indicator lamp will be completed across the indicator relay closed paralleled contacts A2-A3 and B2-B3, and the relay open contacts C2-C3 and D2-D3 will provide a further break in the magnetic switch hold-in circuit.

75. In addition, the supply from fuse 601 will be made across contacts 8-7 of the magnetic switch to energise the field switch and open its contact 5-6. This action will insert the resistance, connected across the field switch contacts, in series with the generator field. The generator output voltage will then be appreciably reduced and the circuit will be rendered inoperative. At the same time, the closed contacts 3-4 of the field relay keep the relay energised, and also provide an alternative path for keeping the field switch energised.

76. When the thermal unit reopens, the generator control switch must be moved to RESET to break the supply from fuse 601 and de-energise the field relay and field switch. The generator may then be brought back on line by returning the control switch to ON and pressing the ENGAGE push-switch.

Crash switch operation

77. In the event of crash switch operation (in this case No.2 crash switch) the supply from the 96-volt battery emergency busbar via fuse 601 will be made across the crash switch contacts to energise the field switch. The field switch resistance will then be immediately inserted in the generator field circuit and, as already described in the foregoing paragraphs, the generator will be removed from the line by the resultant fall in output and the circuit will become inoperative.

No.2 generator protection circuit - pre Mod.874

78. The sequence of events for the No.2 generator protection, is similar to that which has been described for the No.1 generator protection, in the preceding paragraphs. Note that for crash switch operation, No.2 generator will function on operation of crash switch No.3.

No.1 generator protection circuit - post Mod.874

Overload conditions

79. The operation of the protection system for the No.1 generator, post Mod. 874, is similar to that already described for the No.1 generator, pre Mod.874. In the event of No.1 generator, post Mod.874 (fig.9), becoming overloaded, causing operation of the main thermal unit, a supply from the 96-volt battery emergency busbar will be made via fuse 601, contacts 5-6 of the No.1 generator control switch, and contacts 4-5 of the main thermal unit, to energise the field relay 376. A hold-in circuit is then completed, across the now closed contacts 3-4 of the field relay, and contacts 5-6 will be opened, to break the supply to the coil of the interlock relay 133. This relay will then be de-energised, and its contacts 5-6 will open to break the hold-in circuit to the magnetic switch 379, and the indicator relay 535. As a result of this action, the magnetic switch will be de-energised to (a) bring the generator off the busbar, (b) break the equalising circuit and (c) light the No.1 power failure warning lamp, from fuse 847. Note that part of the circuit, to the pilot's generator failure indicator lamp, will be completed, across the indicator relay closed paralleled contacts A2-A3 and B2-B3, and the relay open contacts C2-C3 and D2-D3 will provide a further break in the magnetic switch hold-in circuit.

80. In addition, the supply from fuse 601 will be made across contacts 8-7 of the magnetic switch, to energise the field switch. The resistance in the field switch will then be inserted in the generator field circuit, the generator voltage will fall, and the circuit will be rendered inoperative. At the same time, the closed contacts 3-4 of the field relay keep the relay energised, and also provide an alternative path for keeping the field switch energised.

81. When the thermal unit re-opens, the generator control switch must be moved to RESET, to break the supply from fuse 601, and de-energise the field relay and field switch. The generator may then be brought back on-line by returning the control switch to ON, and pressing the ENGAGE push-switch.

Crash switch operation

82. In the event of crash switch operation (in this case No.2 crash switch), the supply from the 96-volt battery emergency busbar, via fuse 601, will be made via the crash switch, to energise the field switch. The resistance in the field switch will then be inserted in the generator field circuit and the generator circuit will be rendered inoperative due to the resultant fall in voltage.

No.2 generator protection circuit - post Mod.874

83. Operation of No.2 generator (post Mod.874) protection circuit, is similar to that which has been described for the No.1 generator (post Mod.874). Note that the operative crash switch for the No.2 generator, is crash switch No.3.

No.3 generator protection circuit - pre and post Mod.874

Overload conditions

84. With the exception of one or two features, the operation of the protection system for the No.3 generator is similar to that already described for No.1 generator, post Mod.874. In the event of No.3 generator becoming overloaded (fig.8 and 10), a supply from the 96-volt battery emergency busbar will be made via fuse 603, contacts 5-6 of the No.3 generator control switch and contacts 4-5 of the main thermal unit, to energise the field relay 366. A hold-in circuit is completed across the now closed contacts 3-4 of the field relay, and contacts 5-6 will be opened to break the supply to the coil of the interlock relay 143. This relay will then be de-energised and its contacts 5-6 will open to break the hold-in circuit to the magnetic switch 369 and the indicator relay 536. As a result of this action, the magnetic switch will be de-energised to (a) bring the generator off the busbar, (b) provide a further break in the open-circuited equalising circuit, and (c) light the No.3 power failure warning lamp from fuse 819. Note that part of the circuit to the pilot's generator failure indicator lamp will be completed across the indicator relay closed contacts D2-D3 and C2-C3 and the relay open contacts A2-A3 and B2-B3 will provide a further break in the magnetic switch hold-in circuit.

85. Reference to fig.6 will show that the supply from fuse 819 across contacts 3-4 of the magnetic switch, will also be fed through the normally closed paralleled contacts 669/2 and 669/5 to energise the load transfer contactor 670. As in the case of generator failure, contacts 670/1 will close to light the No.3 paralleling indicator, 670/3 will close to partly complete the equalising circuit and 670/4 will close to transfer the load to No.1 and 2 generators.

86. In addition, the supply from fuse 603 will be made across contacts 8-7 of the magnetic switch to energise the field switch. The resistance in the field switch will then be inserted in the generator field, the generator voltage will fall, and the circuit will be rendered inoperative. At the same time, the closed contacts 3-4 of the field relay keep the relay energised, and also provide an alternative path for keeping the field switch energised.

87. When the thermal unit reopens, the generator control switch must be moved to RESET to break the supply from fuse 603 and de-energise the field relay and field switch. The generator may then be brought back on line by returning the control switch to ON and pressing the ENGAGE push-switch, then the transfer load contactor will be opened and normal load sharing conditions will be resumed.

Crash switch operation

88. In the event of crash switch operation (in this case No.4 crash switch) the supply from the 96-volt battery emergency busbar via fuse 603 will be made via the crash switch to energise the field switch. The resistance in the field switch will then be inserted in the generator field circuit and the generator circuit will be rendered inoperative due to the resultant fall in voltage.

No.4 generator protection circuit - pre and post Mod.874

89. The sequence of events for the No.4 generator protection, is similar to that which has been described for the No.3 generator. Note that the operative crash switch for the No.4 generator, is crash switch No.5.

Transfer of loads circuit operation

90. In the event of failure of any one generator, the subsequent loss in output will cause the associated controlling relays and magnetic switch to be de-energised, and the failed generator will be automatically isolated from the busbar. The ensuing paragraphs describe the circuit operation following any such loss of power from one or more generators, and the action necessary to initiate the transfer of generator loads as outlined in para. 30 to 33. A quick reference chart giving the appropriate handling procedure against possible generator failures is set out in Table 1.

No.1 or 2 generator failure pre Mod.874

91. Since the No.1 and 2 generators run in parallel and their load, which is connected from the No.1 and 2 generator busbar and the battery busbar 24P, is equally shared, the loss of either generator will result in the full load being borne automatically by the serviceable machine. At the same time, the associated power failure indicator lamp (red warning) will be lit from fuse 847 or 848 as the case may be, across contacts 3-4 of the de-energised magnetic switch (fig.7).

92. Assuming that No.1 generator has gone off line, the No.1 control switch should be immediately placed to OFF. This action will isolate the control circuit by the opening of the switch contacts 2-3, and maintain the supply from fuse 601 across contacts 5-4 for the protection circuit. By pressing the No.1 voltmeter test switch and checking the voltmeter, it can be established whether or not generator volts are available. If normal voltage reading 108-116 is obtained (via fuse 440), the control switch should be returned to ON and the engage push-switch pressed, in an attempt to bring the generator back on line.

93. If no generator voltage is obtained, an overload may have occurred with the resultant closing of the main thermal unit to bring the protection circuit into operation. The engine speed should then be

reduced to flight idling and an elapse of one minute should be allowed before taking further action. The control switch should then be placed from OFF to RESET to de-energise the field relay 376 (see PROTECTION, para.76), then back to OFF. The generator voltage should again be checked, and if normal, the generator should be brought back on line as described in the previous paragraph. If no generator voltage is indicated, it must be assumed that no output is available, and the control switch must be left in the off position.

94. If No.1 generator is brought off line due to overvolting by No.2, the increased voltage on the busbar will cause an increase in the output of No.1 rotary transformer. This will bring the output side of No.2 and 3 rotary transformers off line, and the associated No.2 and 3 red warning lamps will be lit in addition to the No.1 generator warning lamp. Excessive battery charging current will also be evident. The busbar voltage should then be checked and if above 120 volts, the overvolting generator (in this case No.2) should be switched off. The No.1 generator should then be checked for voltage at 108-116 volts, and re-engaged in the normal manner. This action will bring the three rotary transformers back to normal operating conditions and the associated No.1 and 2 red warning lamps will go out.

95. Similar fault conditions and remedial action as described, apply to No.2 generator.

No.1 or 2 generator failure -post Mod.874

96. Action, in the event of failure of No.1 or 2 generator, post Mod.874, is similar to that outlined for No.1 generator pre Mod.874.

No.3 or 4 generator failure - pre and post Mod.874

97. With the failure of No.3 generator (fig.8 and 10), the No.3 transfer load contactor 670 will be energised by a supply from fuse 819, through contacts 3-4 of the magnetic switch and relay contacts 669/2 and 669/5 in parallel (fig.6). Thus contacts 670/1 will close to light the No.3 paralleling indicator lamp, 670/3 will close to partly complete the equalising circuit with No.4 generator and 670/4 will close to transfer the No.3 generator load, which is connected from 25P, to the battery busbar 24P. At the same time the supply across the magnetic switch contacts 3-4 will light the power failure warning indicator.

98. Appropriate action to bring the generator back on line should be taken in a similar manner to that already described for No.1 generator. If it is possible to re-engage the generator, the generator voltage should be checked on load by pressing the No.3 voltage test switch. However, if the voltage is not within normal operating limits (108-116 volts) the generator should be switched off.

99. In the case of failure of No.4 generator the sequence of events will be similar to No.3, in that the transfer load contactor 672 will be energised by a supply from fuse 818, to light the No.4 amber paralleling lamp, to partly complete the equalising circuit with No.3 generator and to transfer the No.4 generator load on 25P to the battery busbar. The No.4 red power failure warning lamp will also be lit from fuse 818. The necessary action to bring the generator back on line is similar to that indicated for No.3 generator.

100. In the event of No.3 generator overvolting, failure of the output of No.1 and 3 rotary transformers will result, and the associated red warning lamps will be lit. Similarly, with No.4 generator overvolting, warning on No.1 and 2 rotary transformers will be given. In either case the generator voltage should be checked, and if above 120 volts, the generator should be switched off. The three rotary transformers will then be brought back to normal operating conditions and the associated red warning lamps will go out.

No.1 and 2 generator failure - pre Mod.874

101. The load shared by No.1 and 2 generators will be immediately borne by the battery should both generators fail. This condition will be indicated by No.1 and 2 red warning lamps as described in para.91. The battery busbar isolation switch (fig.6) should then be closed, and a supply from fuse 22, through the switch, will light the switch amber warning lamp and energise relay 681/2. This action will open contacts 681/1 to break the supply from fuse 462 to the close coil of the battery busbar isolation contactor, and close contacts 681/2 to trip the contactor. Contacts 673/1 will now close to prepare for energising relay 671, contacts 673/2 will close to prepare for energising relay 669, and contacts 673/3 will open to isolate the No.1 and 2 generator busbar from the battery busbar.

102. A check should then be made on the voltmeter to ensure that the battery voltage is above 80 volts. The No.3 paralleling switch should then be closed. This will complete the supply from fuse 456 (fig.6) across contacts 2-3 of No.3 generator control switch, and through the paralleling switch to energise relay 675/2. Contacts 675/1 will open to further isolate the close coil of contactor 673/3, and contacts 675/2 will close to complete an alternative supply path to the contactor trip coil. The supply through the paralleling switch will also energise relay 669 via the closed contacts 673/2.

103. Since relay 669 is energised, the operation will be as follows:-

(1) Contacts 669/3 and 669/4 will close to energise relay 670 from fuse 456.

(2) Contacts 669/2 and 669/5 will open.

(3) Contacts 669/6 will close to light No.3 paralleling lamp via the now closed contacts 670/1.

(4) Contacts 669/1 will open to further isolate the close coil of contactor 673/3.

(5) Contacts 670/3 will close to partly complete the equalising circuit with No.4 generator.

(6) Contacts 670/4 will close to connect No.3 generator to the battery busbar 24P.

104. The battery busbar voltage should now rise to 108-116 volts. When this has been checked, the No.4 paralleling switch should be closed (see fig.6). Relay 674/2 will then close to perform the same function as relay 675/2 i.e., to further open-circuit the close coil of contactor 673/3 and put an alternative supply on the trip coil. Relay 671 will also be energised via the No.4 paralleling switch and contacts 673/1 to result in the following:-

(1) Contacts 671/3 and 671/4 will close to energise relay 672 from fuse 457.

(2) Contacts 671/2 and 671/5 will open.

(3) Contacts 671/6 will close to light No.4 paralleling lamp via the now closed contacts 672/1.

(4) Contacts 671/1 will open to further isolate the close coil of contactor 673/3.

(5) Contacts 672/3 will close to complete the equalising circuit with No.3 generator.

(6) Contacts 672/4 will close to connect No.4 generator to the battery busbar to operate in parallel with No.3 generator.

105. A further check should be made of the battery busbar voltage which should remain within the accepted limits. It can now be seen that the load on the battery busbar will be transferred to No.3 and 4 generators, which will be running in parallel. The load on the No.1 and 2 generator busbar, however (i.e. the No.1 inverter, Type 350, and the No.1 rotary transformer, Type 1050A) will be cut off from any source of supply.

106. An attempt should then be made to revert to normal conditions by bringing the No.1 and 2 generators back on line. This is done by placing both control switches to OFF, then engaging either generator as described in para.93. Providing this action is successful, the system should be brought back to normal by pulling out the battery busbar isolation switch, and opening the No.3 and 4 paralleling switches. The battery busbar should then be checked on load at 108-116 volts, and an attempt made to bring the remaining generator back on line. Note that the No.1 and 2 generators should not be paralleled on no load.

No.1 and 2 generator failure - post Mod.874

107. The operation and procedure in the event of No.1 and 2 generators (post Mod. 874) failing, is the same as that outlined for failure of No.1 and 2 generators, pre Mod.874.

No.3 and 4 generator failure - pre and post Mod.874

108. With the failure of No.3 and 4 generators their loads will be automatically transferred to No.1 and 2 generators. The failed generators should then be re-engaged in turn as described in para. 98-99. If they cannot be brought back on line, the total load on No.1 and 2 generators should then be reduced to 300 amp.

Paralleling indicator lamps

109. It should be noted that the paralleling lamps, when lit, serve to indicate one of two conditions:-

(1) That the loads on No.3 and 4 generators have been transferred to No.1 and 2 generators, or

(2) That, by selection of both paralleling switches, the No.3 and 4 generators have been paralleled and are supplying the battery busbar load.

Other possible failures

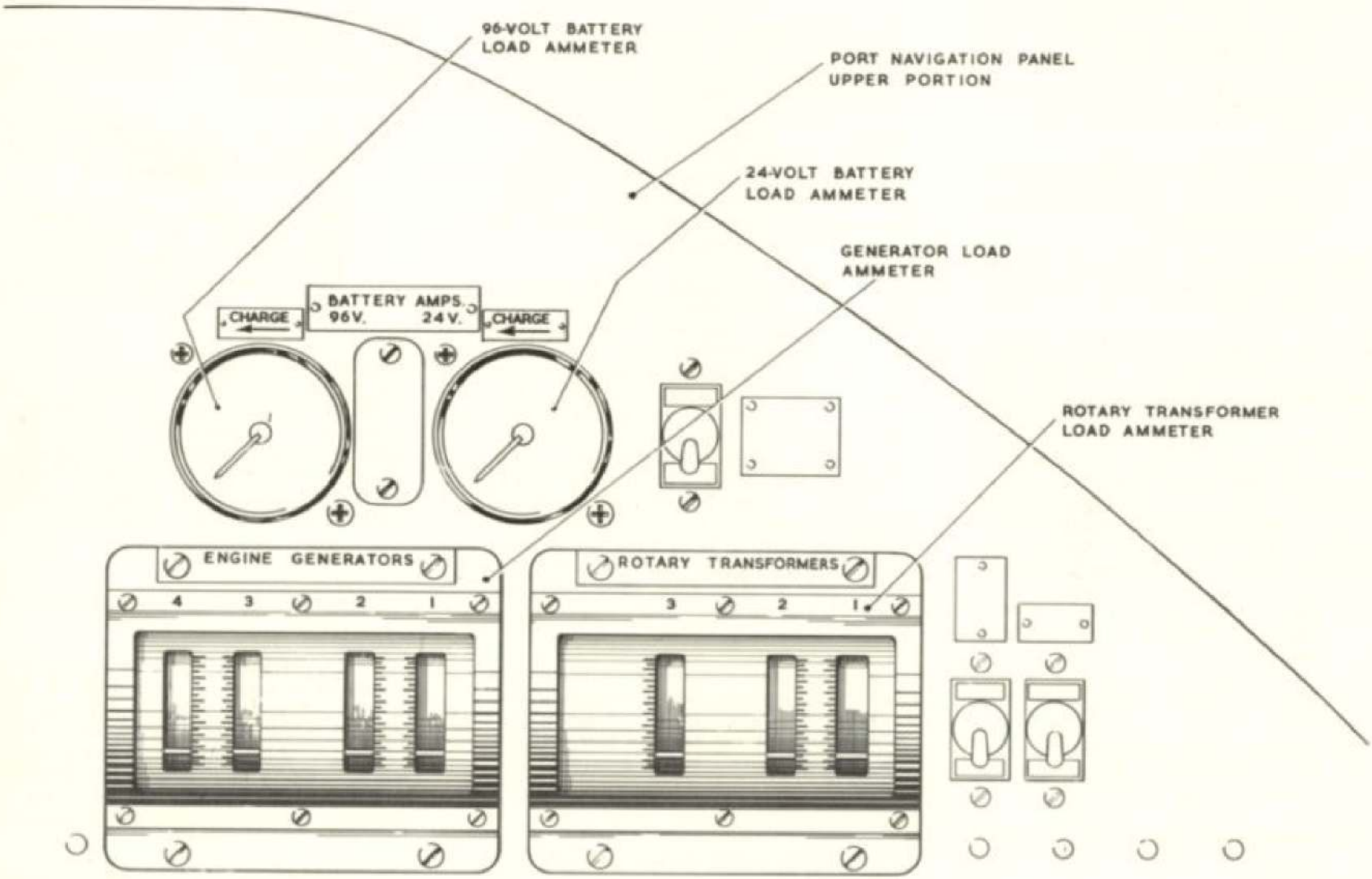
110. Other possible combinations of generator failures and the subsequent action for the transfer of loads as provided in Table 1, will be readily appreciated by reference to the outline of circuit operation given in the foregoing paragraphs in conjunction with fig.6,7,8,9 and 10.

112-VOLT POWER DISTRIBUTION

General

111. As previously stated in para.7, the outputs of the four generators are each fed to their respective busbars on panels 24 and 25P in the aft power compartment via 300-amp. H.R.C. horizontal busbar type fuses. Heavy duty fused cable feeders are connected between the No.3 and 4 generator busbars and the battery busbar.

112. Referring to fig.5, it will be seen that the feeder links from the main busbars on 24P and 25P are suitably fused, and connected to the appropriate sub-distribution busbars in panels 18P and 19P in the bomb bay. The 112-volt fuses are listed in Group 1, Table 3.



VIEW LOOKING AFT ON UPPER FACE OF
PORT PANEL AT NAVIGATION STATION

Fig. 12 Load ammeter panel

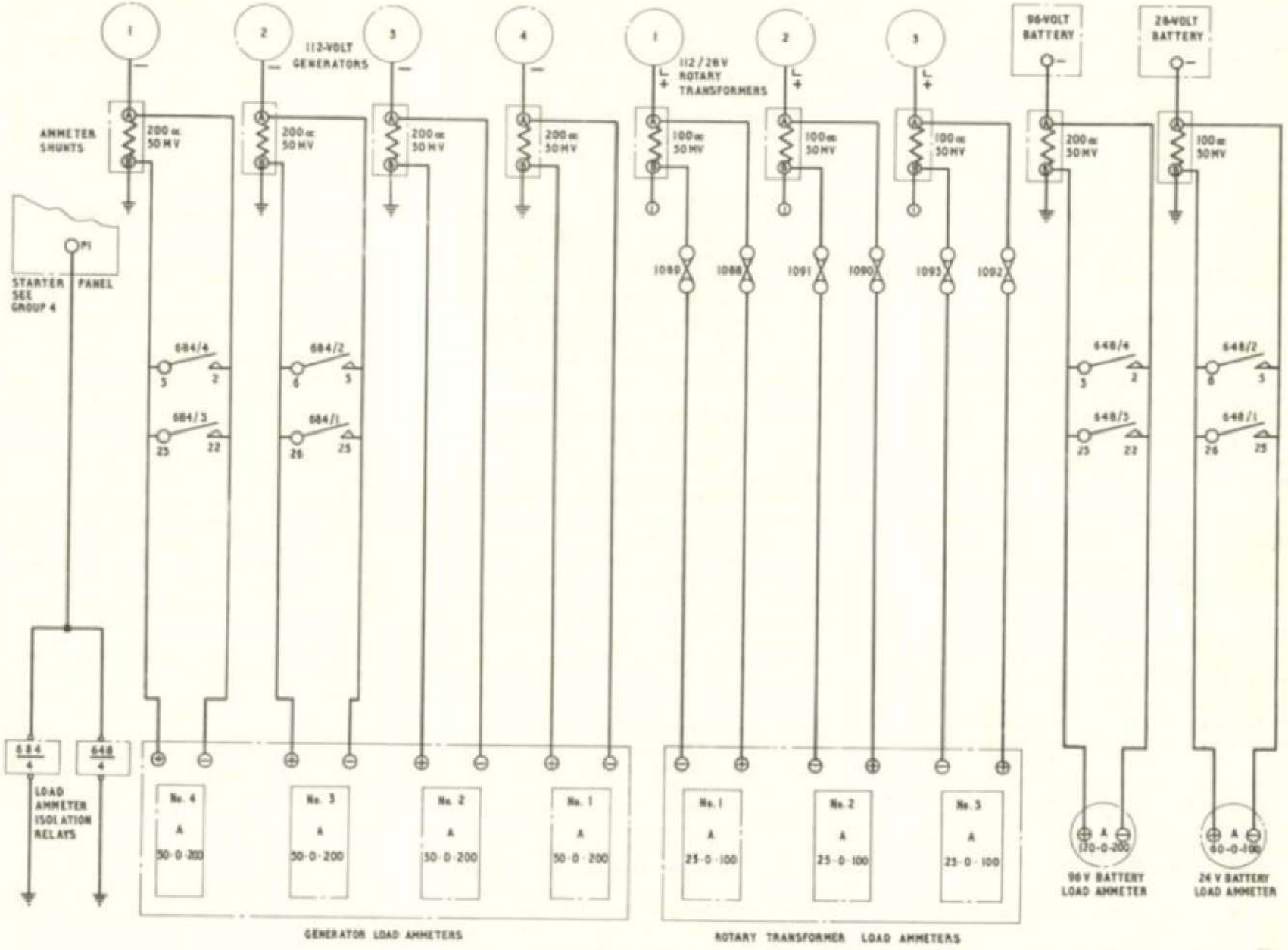


Fig.13 Load ammeters circuit

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96-volt batteries

113. Four batteries (Type H or K, pre Mod.1026, Type K2 post Mod.1026) connected in series, provide the main battery for the 112-volt section of the electrical system. They have a total nominal voltage of 96 volts, and a capacity of 40 ampere-hours. The batteries are installed on the floor of the aft power compartment, housed in a thermal blanket container. Provision is made for heating and ventilating the battery container; the circuit for this is fully described in Group 8, under the heading 'Battery heating and ventilation'.

114. During flight the batteries are charged from the 112-volt battery busbar to which they are connected through contacts A and L1 of the 96-volt battery isolation contactor. The contactor is controlled normally by the 96-volt battery isolation switch on 10P. Circuit description for battery isolation is given in para.161.

115. The negative terminal of the 96-volt battery is connected to earth via the coil of a battery discharge relay, and the 96-volt battery ammeter shunt.

Battery discharge relay

116. This unit, Type F.1723 (Ref.No. 5CW/6791), No.685, is installed near the 96-volt battery in the power compartment, and the coil of the relay is connected in series with the 96-volt battery negative lead. The contacts of the battery discharge relay are employed to illuminate a red warning indicator lamp unit, Type C.180/A.8, labelled BATTERY DISCHARGE WARNING. The indicator unit is fitted to panel 10P in the cabin.

117. When the battery discharge current is 150-180 amps., the coil of the relay will close its contacts, and the red filament of the indicator will be illuminated with a 28-volt supply from fuse 461, thus warning the crew that the 96-volt battery discharge current is excessive. See fig.17. The necessary drill for this indication will be found in Table 1. Note that the filament within the indicator may be checked by pressing the lamp, which will connect a supply from fuse 22 via the internal contacts of the indicator to illuminate the lamp.

96-volt battery load ammeter

118. The 96-volt ammeter, Type S149/2/112, is fitted on the navigation station panel alongside the generator load ammeters, as shown in fig.12. This instrument is scaled 120-0-200, and serves to show the charge current delivered to the 96-volt battery. The ammeter shunt (200 amp, 50 mV), is installed in the aft power compartment as shown in fig.3 and 4.

119. A battery load ammeter isolation relay No.648, is installed on panel 67P. On aircraft prior to Mod.1044, 67P is situated in the power compartment (Fig.3), but on aircraft with Mod.1044 embodied, it is situated in the bomb bay. Contacts 3 and 4 of relay No.648 are connected across the ammeter circuit. During engine starting operations, relay 648 is energised, thus isolating the battery ammeter (fig.13), so preventing damage to the instrument. Circuit details for the discharge relay and load ammeters are shown on fig.17.

112-volt ground supply plug

120. A 3-pin international pattern ground supply plug is fitted to a small compartment on the port side of the aircraft, accessible from the outside of the aircraft. The plug has two heavy duty pins, and a third pin carries a light duty connection to a bank of fuses mounted on a small panel within the power compartment. The positive heavy duty pin is connected to the No.1 and 2 generator busbar via the contacts of a ground supply isolation contactor. The negative heavy duty pin is connected to the aircraft metal structure.

121. When the external supply truck is connected to the aircraft plug, 112 volts is first fed to the group of fuses previously mentioned. One of these fuses, No.509, will energise the ground supply isolation contactor coil, (676) and by closing of its main contacts, the ground supply will be connected to the busbar. Full circuit details will be found under the heading 'Ground supply - circuit operation.'

ROTARY TRANSFORMER CONTROLS

General

122. Three rotary transformers, Type 1050A, and their associated control gear are installed in suitable rack compartments on the starboard side of the nose wheel bay. These transformers provide a 28-volt d.c. supply during flight. A location illustration for the rotary transformers is contained in fig.14.

123. They are driven from the 112-volt busbars in 24P and 25P, and their combined output is fed to a busbar in the 28-volt power panel 15P in the nose wheel bay. The rated output of each rotary transformer is 3 kW at full load, and equalising circuits are employed to balance the load between individual units.

124. Whilst the aircraft is on the ground, the rotary transformers are cooled by built-in fans, but in the air, blast cooling from the intake assists the fans, the exhaust air being vented to atmosphere. Descriptive and servicing details for the rotary transformers, Type 1050A, are contained in A.P.4343B, Vol.1, Book 3, Sect. 15.

Control gear

125. The location of the controlling gear for the rotary transformers is as follows:-

Contactor No.2 Thermal unit No.3	} Panel 19P on aft face of front spar

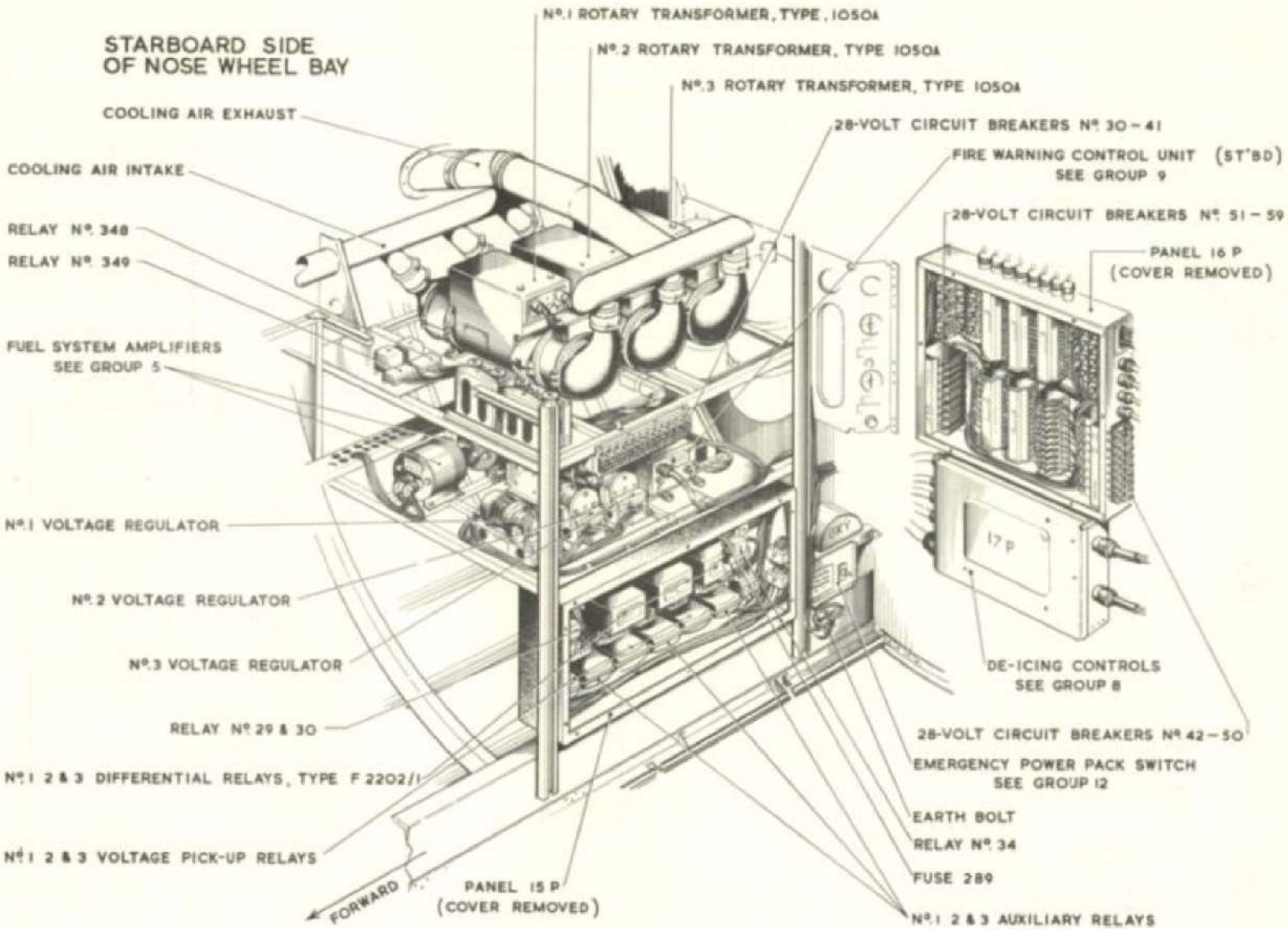

Fig. 14 Rotary transformers (P)

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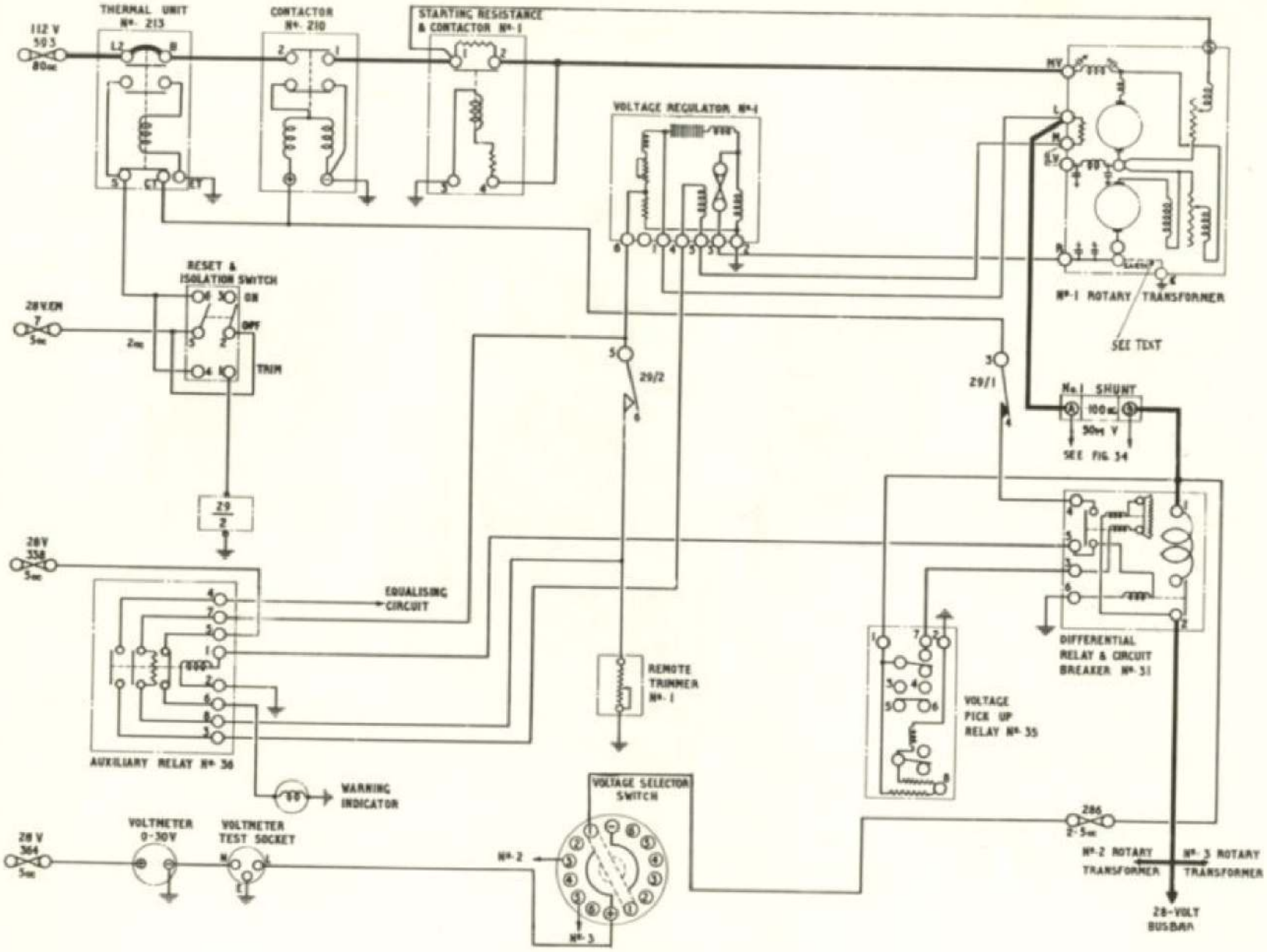

Fig. 15 Rotary transformer controls

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112-volt

Contactors No.1 and 2 } Panel 18P on aft face of front spar
Thermal units No.1 and 2.

Starting contactors No. 1, 2 and 3. } On aft face of front spar.

28-volt

Differential relay and circuit breaker units
Auxiliary relays
Interlock relays } On panel 15P at starboard side of nose wheel bay.

Voltage regulators - at starboard side of nose wheel bay.

Control panel (10P)

126. The 112/28-volt rotary transformer control switches, test socket, power failure warning indicators, etc., occupy positions on 10P similar to their equivalents in the 112-volt system; these controls are located as follows:-

(1) Busbar voltmeter 0-30 volts - top of panel.

(2) Test socket and voltmeter switch - immediately below voltmeter.

(3) Power failure warning indicators - immediately below voltmeter switch and test socket.

(4) Control switches - below warning indicators.

(5) Remote trimmer resistance - bottom of panel.

Voltage regulators

127. The three voltage regulators, Type 66, are fitted in the nose wheel bay, and are basically similar to the 112-volt regulators employed in the main generator circuits, but are designed to work on 28 volts. Descriptive and servicing details for the voltage regulators, Type 66, are contained in A.P.4343B, Vol.1, Sect.1.

Differential relay and circuit breaker

128. Three of these combined units, Type 2B, are employed, one in each rotary transformer circuit, to connect each rotary transformer to the busbar. The differential relay operates to supply the coil of the circuit breaker, and requires an output voltage 0·3 to 0·6 volts in excess of busbar voltage for its operation. The unit will cut out with a reverse current of 15-30 amp. from busbar to rotary transformer. The main contacts close with a potential difference of 18 volts across the operating coil. Descriptive and servicing details for the differential relay and circuit breaker, Type 1B, will be found in A.P.4343B, Vol.1, Sect.10.

Auxiliary relay, Type 3B, No.2

129. This unit incorporates a time delay and slugged coil. Operation of the delay relay is such that a delay between 55 and 75 milli-seconds is introduced into the coil circuit between the application of the supply voltage and the coil being energised. The time delay coil circuit is broken when the main coil pulls in. Descriptive and servicing information on this unit will be found in A.P.4343C, Vol. 1, Sect.3.

Voltage pick-up relays

130. These relays incorporate two paralleled 33 ohm resistors connected in series with the coil, and they act as swamping resistances. Two further resistances in parallel, each of 100 ohms, are inserted in the coil circuit when the relay has pulled in. Descriptive and servicing details for the voltage pick-up relays, Type 1B, are contained in A.P. 4343C, Vol.1, Sect.3.

Starting resistance and contactor

131. These units, Type 1A No.1, are fitted on the front spar in the bomb bay; they are designed to limit the supply to the rotary transformers during the initial starting period. Descriptive and servicing information for these units is contained in A.P.4343C, Vol.1, Sect.8.

Circuit operation

General

132. The circuit operation contained in the following paragraphs should be read in conjunction with the theoretical circuit diagram contained in fig.15. Note that the circuit description given is for the No.1 machine; No.2 and 3 machines are similar in operation, apart from component numbering.

133. Since the rotary transformer output is normally controlled at the operative busbar voltage and a potential difference between the transformer output and the busbar voltage is a necessary function of switching on, a degree of de-control is required to satisfy the differential requirement. The method employed is to nullify the effect of the remote trimmer, and therefore allow the transformer output to rise above the normal controlled value until the switching sequence is complete. The de-control is then cancelled, and the transformer output lowered as the remote trimmer is reconnected in the circuit.

Starting the rotary transformers

134. When the control switch is placed to the ON, a 28-volt supply from fuse 7 will be connected to the coil of the contactor No.210, via the normally closed contacts S and C of the thermal unit No.213. The 112-volt supply will be connected from fuse 593, the thermal unit No.213, contacts 2-1, and the starting resistance of contactor No.1 to the input of the rotary transformer. Note that the shunt field of the rotary transformer is fed direct from terminal 1 of the starting contactor.

135. As the speed of the rotary transformer increases, the input current through the starting resistance will fall until the

voltage applied to the coil of the contactor rises to a level at which the coil will be sufficiently energised to close contacts 1 and 2. This action will short-circuit the starting resistance and put the rotary transformer on full input voltage.

136. Meanwhile, on the output side of the rotary transformer, the sequence of operations will be as follows:-

(1) Initially, de-control is imposed on the regulator due to the resistance across terminals 7 and 8 of the auxiliary relay in series with the remote trimmer resistance. When the output from the generator portion of the rotary transformer reaches a value of 16 to 18 volts, the coil of the pick-up relay will be sufficiently energised to close its contacts 1-7 and the generator voltage will be applied to one side of the differential relay coil, the other side already being connected to the busbar (terminals 3-2 of the differential relay). The de-controlled generator is allowed to build up in excess of the busbar voltage, and the differential action of the coil results in the closing of contacts 4-5.

(2) A supply from the positive terminal of the main contactor will now be directed via the normally closed contacts 29/1 of the interlock relay, and contacts 4-5 of the differential relay to energise the coil of the circuit breaker. Closing of contacts 1-2 of the circuit breaker will connect the output of the rotary transformer to the 28-volt busbar.

(3) Simultaneously, a parallel path from terminal 5 of the differential relay will provide a supply to the coil of the auxiliary relay via its terminals 1-2. Operation of contacts 7-8 will short-circuit the limiting resistance, and thus end the period of de-control. The closing of contacts 3-4 will complete the equalising circuit, and the opening of contacts 5-6 will de-energise the power failure warning indicator.

Trimming the rotary transformers

137. For checking and making adjustments to the rotary transformer output, a portable testmeter, Type S, should be plugged into the test voltmeter socket, and, in the case of the No.1 rotary transformer, the voltage selector switch placed to the No.1 position.

138. On placing the No.1 reset/isolation switch to the TRIM position, the interlock relay No.29 will be energised from fuse No.7 via the switch contacts 5-2-1. Opening of contacts 29/1 will isolate the circuit breaker, and closing of contacts 29/2 will short-circuit the resistance across the terminals 7 and 8 of the auxiliary relay. There will be no period of de-control therefore, during the trimming operation.

139. After the No.1 unit has been trimmed to the correct voltage, it is connected to the busbar by placing the control switch back to the ON position.

Switching off the rotary transformers

140. When the control switch is placed to the OFF position, the control circuit will be interrupted. The main contactor coil will be de-energised, allowing contacts 1-2 to open, thus isolating the motor section of the rotary transformer from the 112-volt supply. The circuit breaker coil will also be de-energised, causing opening of the main contacts, and the generator section of the rotary transformer will be isolated from the busbar.

141. The coil of the auxiliary relay will also be de-energised and the following circuit action will take place:-

(1) Opening of contacts 3-4 will isolate the equaliser circuit.

(2) Opening of contacts 7-8 will insert the limiting resistance in series with the trimmer resistance.

(3) Closing of contacts 5-6 will illuminate the power failure warning indicator.

Protection devices

142. The safety devices incorporated in the rotary transformer system are as follows:-

(1) Thermal units in the 112-volt supply line.

(2) Reverse current circuit breaker in the 28-volt output line.

(3) Fuse in the generator field circuit (integral with the voltage regulator).

Thermal unit

143. This unit, Type 2A No.2, is described in A.P.4343C, Vol.1, Book 2, Sect.4, Chap.41. It is preset to operate at 100 per cent overload, and expansion of the thermal strip will cause the protective coil to be energised due to the closing of the auxiliary contacts. The effect of the coil will be to close the secondary contacts, so that the effect of the overload conditions will be maintained independent of thermal effects, until the coil circuit has been interrupted by the operation of the control switch to the OFF position.

144. In addition to closing the 28-volt 'hold-in' circuit, the coil will also open contacts S-CT, and the following circuit action will also take place:-

(1) The main contactor coil circuit will be interrupted, contacts 1-2 will

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VULCAN B MK. 1 AND B MK. 1A AIRCRAFT

ADVANCE INFORMATION LEAFLET NO. 1/61

Insert this leaflet in A. P. 4505 A & C, Vol. 1, Book 2,
Sect. 5, Chap. 1, Group 2A, to face para. 170.

Mod. 874 - To introduce voltage regulators, Type 120, Ref. 5UC/6882, in lieu of voltage regulators, Type 91, Ref. 5UC/5522, and to introduce control amplifiers, Ref. 5UC/6883.

1. Where Mod. 874 is embodied, the voltage regulators and control amplifiers are sealed units and no adjustment of these items is permissible. Voltage trimming of the generators is to be carried out by adjustment of the remote trimmer resistances only as outlined in para. 170.

Notes:-

(1) The information contained in this leaflet will be incorporated by normal amendment list action in due course.

(2) If, after receipt of this leaflet, an amendment list with a prior date and conflicting information is received, the information in this leaflet is to take precedence.

ENGINEER

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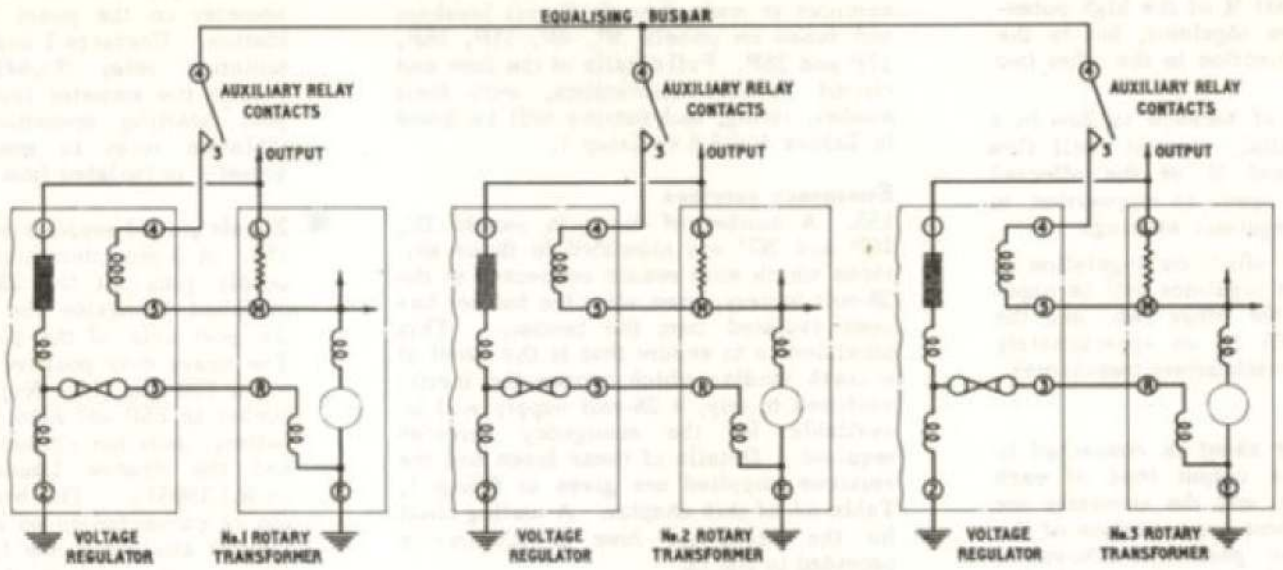


Fig.16 Rotary transformer equalising circuit

open, and the rotary transformer will be isolated from the busbar.

(2) The circuit breaker coil will be de-energised, and opening of its contacts 1-2 will isolate the generator section of the rotary transformer from the busbar.

(3) The auxiliary relay coil will be de-energised to:-

(a) Isolate the equaliser circuit.

(b) De-control the regulator circuit, and

(c) Complete the power failure warning circuit.

145. When the control switch is placed to the OFF position, the thermal unit coil 'hold' circuit will be interrupted and the rotary transformer may be started in the normal manner, provided that a time delay is allowed to permit the thermal strip to contract.

Reverse current circuit breaker

146. In the event of the rotary transformer output falling below busbar voltage, a reversal of current through the series winding will act in opposition to the differential relay, causing a rapid break action of the relay to interrupt current flow in the circuit breaker coil and auxiliary relay coil. The generator section of the rotary transformer is thus effectively protected against reverse current from the busbar.

Field fuse

147. Excessive field current would cause this fuse to blow, a collapse of field current would then occur, causing a decrease in generator output. This would cause reverse current action as described in the preceding paragraph.

Load equaliser circuit

148. Each of the three voltage regulators incorporates a compensating winding, these windings being interconnected during normal operation of the transformers, by the action of contacts 3-4 of the auxiliary relays.

149. The compensating or equalising coils are connected across terminals 4 and 5 of each voltage regulator, see fig.16, the No.4 terminals being connected externally via terminals 3-4 of the auxiliary relays to a common point. Ideally the potentials at terminals M of the three rotary transformers should be of equal value for all load conditions, when no current would flow around the equalising circuit. If for any reason there should be a difference of potential between terminal M of one rotary transformer and that of the other two, thus:-

(1) If the out of balance is due to a

high potential, current will flow from terminal M of the high potential voltage regulator, but in the opposite direction in the other two regulators.

(2) If the out of balance is due to a low potential, current will flow into terminal M of the affected regulator, again in opposition to the other regulator windings.

In each case the effect on regulation in the out of balance regulator will be opposite to that of the other two, and the overall result will be an approximately equal output from each rotary transformer.

Load ammeters

150. An ammeter shunt is connected in the main positive output lead of each rotary transformer, and the ammeters are installed on the port upper portion of the navigation station panel as shown in fig.12. A theoretical circuit for the ammeters is contained in fig.13.

151. Each ammeter lead is separately fused, ensuring that the instruments are protected from excessive currents. The fuses and ammeter shunts are installed in the nose-wheel bay, and fitted to a suitable panel behind 15P.

152. The load ammeters, Ref. No. 5Q/25644, are enclosed in one case, and are of the vertical scale type. Each ammeter will show the load current of its rotary transformer, thus enabling the operator to see at a glance if the system is load-sharing and operating correctly.

28-volt power distribution

153. Power supply from the 28-volt output side of the three rotary transformers is fed to a busbar in power panel 15P, and thence to the 28-volt distribution panel 16P on the bulkhead at the aft end of the nose-wheel bay. The circuit breakers on 15 and 16P form the feeders for the distribution fuses on the remainder of the 28-volt distribution panels.

154. The remaining distribution of 28-volt services is made through circuit breakers and fuses on panels 3P, 4P, 11P, 16P, 17P and 26P. Full details of the fuse and circuit breaker allocations, with their number, rating, and service will be found in Tables 4 and 5 in Group 1.

Emergency services

155. A number of fuses in panels 3P, 16P and 26P are allocated to those services which must remain connected to the 28-volt battery, even after the battery has been isolated from the busbar. This provision is to ensure that in the event of a crash landing which causes the inertia switches to trip, a 28-volt supply will be available for the emergency services required. Details of these fuses and the services supplied are given in Group 1, Table 6A of this chapter. A routing chart for the emergency fuse distribution is provided in fig.33.

24-volt battery

156. The battery, Type H or K pre Mod. 1026, Type K2 post Mod.1026, situated in the aft power compartment is provided for the 28-volt section of the electrical system. It has a capacity of 40 ampere-hours, and is permanently connected to the emergency busbar supply fuses at the port side of the power compartment. During flight this battery is charged from the rotary transformers via the 28-volt normal busbar to which it is connected through contacts L1-A of the 24-volt battery isolation contactor. The isolation contactor is controlled through its associated control relays by the 24-volt battery isolation switch on 10P, or by the conditions outlined under 'Battery isolation'.

Load ammeters

157. Referring to fig.17, it will be seen that the negative side of the 24-volt battery is connected to earth via an ammeter shunt (100 amp.50 mV). The 24-volt battery load ammeter, Type S149/2/113, is calibrated in 60-0-100 amp., and is located adjacent to the 96-volt battery ammeter on the panel at the navigation station. Contacts 1 and 2 of the ammeter isolation relay No.648 are connected across the ammeter leads. During engine starting operations, the ammeter isolation relay is energised, thus the ammeter is isolated from its shunt.

28-volt ground supply plug

158. A 3-pin international pattern ground supply plug for the 28-volt services is installed alongside the 112-volt plug on the port side of the power compartment. The heavy duty positive pin is connected via a 100 amp. fuse No.289 to the 28-volt busbar in 15P and also to one side of the battery isolation contactor main contacts and the Window Launching installation (A.R.I.18051). The heavy duty negative pin is connected to an earth point on the aircraft structure; the light duty positive pin is connected to the ground service lighting circuit (Group 10) and to the 10,000 lb. store circuit (Group 13).

159. When an external 28-volt supply is connected via the ground plug to the aircraft busbar, it is important that the rotary transformer control switches are in the OFF position. This will ensure that no damage is caused to either the rotary transformers or the ground supply truck.

160. The 24-volt aircraft battery can be charged from the ground supply, provided it is connected to the busbar by placing the 24-volt battery isolation switch to the ON position.

BATTERY ISOLATION CONTROLS

General

161. The battery isolation circuit provides a control partly automatic and partly manual. In addition to connecting the 96-volt and 24-volt batteries to their respective busbars, the circuit provides a means of starting the engine in an

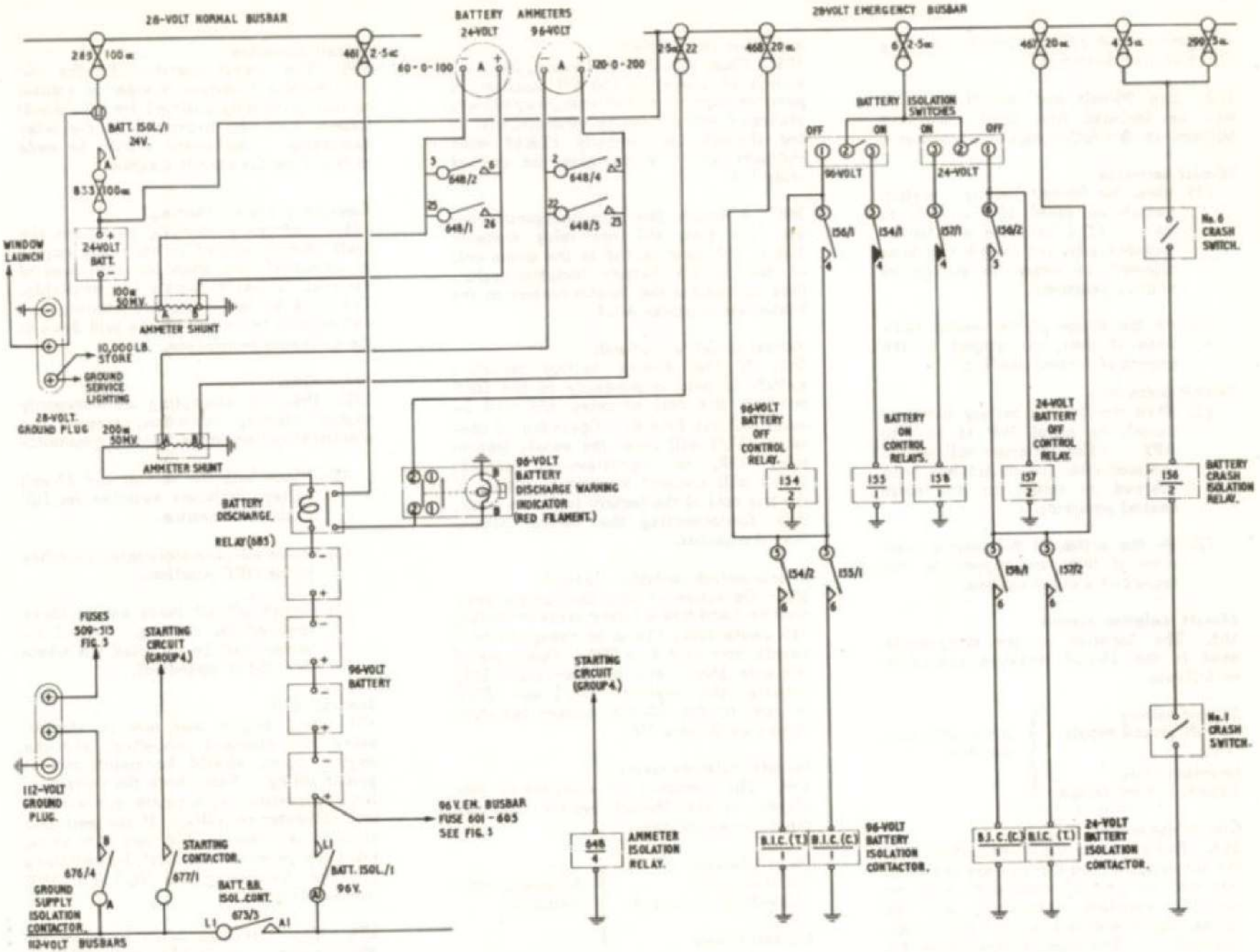


Fig.17 Battery isolation control circuit

Refs. added to 28-volt ground plug

emergency, and permits in-situ charging of the aircraft batteries.

162. The 96-volt and 24-volt batteries will be isolated from their respective busbars in the following circumstances:-

96-volt batteries

(1) When the 96-volt battery isolation switch on panel 10P is held to OFF. (The batteries will remain isolated after the switch has been allowed to return to its centre neutral position).

(2) By the action of the inertia switches if they are tripped by the impact of a crash landing.

24-volt batteries

(1) When the 24-volt battery isolation switch on panel 10P is held to OFF. (The batteries will remain isolated after the switch has been allowed to return to its centre neutral position).

(2) By the action of the inertia switches if they are tripped by the impact of a crash landing.

24-volt isolation circuit

163. The location of the components used in the 24-volt isolation circuit is as follows:-

24-volt battery 28-volt ground supply plug Isolation relay Type Q control relays	Aft power compartment

Circuit operation

164. Reference to fig.17 will show that the battery isolation circuits are shown in 'aircraft on ground' condition, with no external supplies connected, and the battery isolation switches in the NEUTRAL position. The circuit operations for connecting the batteries to their busbars, are outlined in the following paragraphs

Switching on - 24-volt

165. When the 24-volt battery isolation switch is placed to the ON position, a positive supply from the emergency busbar, via fuse 6 and the switch contacts, will be fed through the normally closed relay contacts 157/1 to energise the coil of relay 158.

166. A supply from the emergency busbar, via fuse 467 and relay contacts 158/1, will now be fed to the close coil of the 24-volt battery isolation relay, thus connecting the 24-volt battery to the busbar via contacts A-L1.

Manual isolation - 24-volt

167. If the 24-volt battery isolation switch is held momentarily to the OFF position the coil of relay 157 will be energised via fuse 6. Operation of contacts 157/1 will break the supply line to relay 158, and operation of contacts 157/2 will connect a positive supply to the trip coil of the battery isolation relay, thus disconnecting the 24-volt battery from the busbar.

Inertia switch isolation - 24-volt

168. Operation of both the inertia switches No.1 and 6 by a heavy or crash landing will cause relay 156 to be energised by a supply from fuse 4 or 299. Operation of contacts 156/2 will energise relay 157, causing relay contacts 157/1 and 157/2 to operate the 24-volt battery isolation circuit as in para.166.

96-volt isolation circuit

169. The location of components employed in the 96-volt battery isolation circuit is as follows:-

96-volt battery Isolation relay 112-volt ground supply plug. Control relays	Aft power compartment.

96-volt battery isolation switch - 10P in crew's compartment.

Circuit operation

170. The circuit operation for the 96-volt battery isolation system is similar to that previously outlined for the 24-volt battery with the exception of the relay numbering. Reference should be made to fig.17 for the circuit diagram.

Emergency engine starting

171. Emergency starting, using the aircraft 96-volt battery to start one engine is permitted only when no other form of external 112-volt supply is available. The drill for the emergency starting procedure must be carried out as laid down in the following paragraphs.

Preparation

172. Prior to attempting an emergency engine starting operation, prepare the electrical system in the following manner:-

(1) Place both the 96-volt and 24-volt battery isolation switches on 10P to the ON position.

(2) Place all generator control switches to the OFF position.

(3) Switch off all loads except those required for starting. (No.1 inverter must be switched ON where Mod.294 is embodied).

Starting drill

173. No.1 engine may now be started, using the standard procedure, and the engine r.p.m. should be maintained at ground idling. Next check the voltage of No.1 generator (appropriate push-switch and voltmeter on 10P). If the generator voltage is between 108 and 116 volts, bring the generator 'on line', by switching ON and depressing the No.1 ENGAGE push-switch.

174. The next step is to increase the No.1 engine r.p.m. to 65%, and switch on No.3 Type 350 inverter (for jet pipe temperature indication).

175. No.2 engine may now be started, run at idling speed, check generator voltage, and if this is between 108 and 116-volts, bring No.2 generator 'on line' by switching ON and depressing the ENGAGE push-switch. Then increase No.2 engine r.p.m. to 65%.

176. Repeat the same procedure for No.3 and 4 engines, and bring both No.3 and 4 generators on line. Switch on No.1 rotary transformer, Type 1050A, and then reduce No.1 and 2 engine r.p.m. to ground idling.

Checks after emergency starting

177. After all four engines have been successfully started, and all four generators are 'on line', carry out the following generator control system checks:-

(1) Switch OFF No.3 generator, and check that the No.3 generator amber paralleling indicator and power failure warning indicator lamps are both lit.

(2) Switch ON No.3 generator and depress the ENGAGE push-switch. Check that both the amber paralleling and red power failure warning indicator lamps are now extinguished.

(3) Repeat sub-para. (1) and (2) for No.4 generator.

(4) Operate the No.3 generator paralleling switch to the CLOSE position, and check that the associated paralleling amber indicator is lit.

(5) Operate No.3 generator paralleling switch to the NORMAL position, and check that the indicator is extinguished.

(6) Repeat sub-para. (4) and (5) for the No.4 generator.

(7) Finally, check the filament of the battery discharge warning indicator by depressing the lampholder.

NOTE...

The No.3 and 4 generators must not be used for supplying power for engine starting.

GROUND EARTH POINT

177A. An earth bolt is provided in the starboard forward side of the nose wheel bay in order to ground earth the aircraft for ground refuelling, bombing up and servicing operations.

SERVICING

General

178. Servicing of the generator and rotary transformer systems whilst the various units are installed in the aircraft is restricted to voltage trimming, and examination of the components for general security, cleanliness and correct functiontioning. Servicing details including matching, aligning and special tests for all components will be found in the relevant publication of the 4343 series of Air Publications.

179. Particular attention should be paid to all components having contact assemblies, i.e. circuit breakers, contactors, etc., for signs of worn or burnt contacts, and suspect units should be replaced by serviceable items of the correct type.

180. All heavy duty cables should be examined periodically for signs of chafing, loose connections, and general security; in particular, the 112-volt heavy duty fuses should be examined for signs of overheating, and security of bus-bar connections. Careful checking of the system wiring, and components will reduce fault conditions to a minimum.

Servicing platform

181. A servicing platform, split into two sections to facilitate fitment, is provided for protection of the lower structure of the aft power compartment. These two platform sections, (Ref.No.26DC/95153 and 26DC/95152) must be fitted into position whenever the equipment in the aft power compartment is being serviced, or during battery replacement periods.

Checking and trimming the generators

182. Voltage trimming and checking of the generator outputs are to be carried out during engine running periods when the generator voltages are suspect, and at the intervals laid down in A.P.4505A, Vol.4, or when components in the generator control circuit have been changed. The batteries should be given a voltage check prior to each flight. The following procedure must be adopted:-

Battery check

(1) Switch both the 96-volt and 24-volt battery isolation switches to their ON positions, and arrange for a 40 amp. (approx.) discharge on each battery. This can be obtained by starting four P.F.C. motors and switching on both V.H.F. sets (other loads may be required to make-up). Allow the loads to run for one minute, and check that the battery volts do not fall below 88 and 22 volts respectively. At the conclusion of the check, switch OFF the loads on the 24-volt battery.

(2) Increase the loads on the 96-volt battery to approx. 180 amp., and check that the battery discharge

red warning indicator lamp comes on. Switch OFF all the 96-volt battery loads, and check that the red warning indicator lamp is extinguished as the current decreases. Operate both battery isolation switches to OFF.

Generator checks

(3) With an external 112-volt ground supply connected to the aircraft, start the No.1 rotary transformer, and check that the battery busbar isolation contactor (No.673) has closed by starting No.3 inverter.

(4) Switch on both battery isolation switches, No.1 inverter, and No.2 and 3 rotary transformers. Start all engines and run at 65% r.p.m. Allow the voltage regulators to stabilise - about 30 minutes on no load or 20 minutes on load. The generator outputs are then trimmed off load, i.e. with the control switches placed to the OFF/TRIM positions. Trim each generator output in turn by the remote trimmer to 112 volts (Post Mod.874, the voltage regulator auxiliary coil must first be disconnected, see sub para.5). A check should be made during engine starting operations to ensure that the load ammeters of the 96-volt and 28-volt batteries are correctly shorted out.

(5) On aircraft embodying Mod.874, the auxiliary coil of each voltage regulator (Type 120) must be disconnected before any adjustment is made on the remote trimmer. This can be done by disconnecting the wiring at either terminal 4 or 5 on each voltage regulator and temporarily stowing the leads. When the generator voltage has been trimmed to 112 volts the regulator must be reconnected in each case. Note that should there be any variance in generator voltage after the regulator has been reconnected a final trimming adjustment to give the correct voltage must be made at R.V.3 in the regulator amplifier.

(6) Remove the 112-volt ground supply and switch ON and ENGAGE No.1 generator. Check that the No.1 generator power failure indicator and the pilot's power failure indicator red warning lamps are both extinguished. Note that the battery check (1) may be carried out at this stage if convenient, before switching on the generator.

(7) Switch ON and ENGAGE No.2 generator, and switch on as many loads as possible, including the 96-volt battery and the No.3 and 4 generator loads. Check that the No.2 generator power failure warning lamp is extinguished, and that both the No.3 and 4 generator paralleling indicator lamps are lit. Note that the loads will include P.F.C. motors, fuel pumps, rotary transformers, inverters etc., but the total load must not exceed 300 amp.

(8) Using the load ammeters, check at engine r.p.m. 33½%, 73% and maximum continuous (97% for E.C.U. 101 and 104 and 90% for E.C.U. 102) that the two generators load share so that they are within 40 amp. of each other.

(9) Switch ON and ENGAGE Nos.3 and 4 generators. Check that their generator failure warning lamps are extinguished, their paralleling warning lamps should also be extinguished indicating that the busbars on Nos.3 and 4 generators are isolated from the port side and from each other. Remove the covers from each of Nos.3 and 4 differential relays in turn and carefully push the polarised arm over to simulate reverse current operation. Check that the generator remains on line due to the contacts in the associated paralleling contactor shorting out the differential relay to keep the main contactor closed. Replace the relay covers after checking that the polarised arm when released has returned to the generating position.

(10) Place the No.3 and 4 generator paralleling switches to CLOSE. The amber indicators should now indicate to show that the battery busbar is isolated from the No.1 and 2 generator busbar and that the No.3 and 4 generators are sharing the battery busbar and their own loads.

(11) Repeat test (7) on Nos. 3 and 4 generators. The equalising circuit is completed when both generators through their interlink feeder cables are paralleled on the battery busbar. By reducing the engine r.p.m. reduce the voltage of the Nos. 3 and 4 generators in turn so that a reverse current from the generator at full voltage trips the other generator off line. Check that the differential relay is giving normal operation to trip the generator off line and that the shorting circuit through the paralleling contactor is now open-circuited. Increase voltage back to normal and re-engage the generators.

(12) Place the No.3 and 4 paralleling switches to NORMAL so that each generator is feeding its own loads.

(13) Depress the battery busbar isolation switch, check that its amber filament is indicating. Check that the battery busbar is now isolated from the No.1 and No.2 generator busbar, and that the main loads are fed from the battery. Pull out the battery busbar isolation switch. Check

that the battery busbar isolation amber warning lamp is extinguished and that the busbar voltage rises to generator voltage.

(14) Reduce the engine r.p.m. for No.3 generator until the generator comes 'off line'. Check that the load is transferred to the No.1 and 2 generators by observation of the load ammeters, and that the generator failure and paralleling warning lamps are illuminated. Increase the engine r.p.m. for No.3 generator until the main contactor closes, holding the ENGAGE button depressed. Check that the closing voltage is 100-105 volts, and that the load is transferred from the No.1 and 2 generators, also that the warning lamps are extinguished.

NOTE...
The testmeter, Type D, must be connected in parallel with the aircraft voltmeter, and the voltmeter push-switch must be depressed for readings. The voltmeter and ENGAGE push-switches must be depressed during the increasing r.p.m. period. Changes in engine r.p.m. must be made slowly to enable accurate voltage readings to be taken.

(15) Repeat (14) for No.4 generator.

Rotary transformer checks

(16) (a) With all three rotary transformers on line, trim the voltage as follows, using a Test meter, Type D:-

Select TRIM on each rotary transformer control switch in turn, and check that its voltage is 27·5 ± 1 volt (28 ± 1 volt for aircraft with Type K batteries).

(b) With as much 28-volt d.c. load switched on as possible:-

Adjust the trimmers until each rotary transformer load is within ± 10 amp. of the mean load, and the busbar voltage remains as in (a).

(17) At the conclusion of the checks outlined in (16) switch OFF all loads and check by observing the generator load ammeters that each 112-volt load is connected to the correct busbar.

(18) Switch OFF No.4, 3 and 2 generators, and check that each generator failure warning lamp is illuminated when its associated generator is switched OFF, and that the paralleling warning indicators are illuminated when the No.3 and 4 generators are switched OFF. Finally, switch OFF No.1 generator, and check that its power failure warning indicator and the pilot's power failure warning indicator are both illuminated. Check that the aircraft voltmeter is now showing battery voltage.

(19) Connect the 112-volt ground supply, and check that the aircraft voltmeter now reads the ground supply voltage. Remove the 112-volt ground supply.

(20) Place both 96-volt and 24-volt battery isolation switches to OFF. Finally stop all engines.

Trimming the rotary transformers

183. Until further notice, the rotary transformer output voltages must be trimmed as outlined in the preceding paragraph. Note that the trimmer resistance must not be tampered with during flight.

Ground running rotary transformers

184. It should be borne in mind that excessive running of the rotary transformers during ground servicing periods will reduce service life by causing unnecessary brush wear. It is essential therefore, that when 28-volt supplies are needed on the aircraft, an external 28-volt supply must be used at all times. When a ground supply is connected to the aircraft 28-volt external supplies plug the rotary transformer control switches must be in the OFF position.

Batteries

185. All the connections for the 96-volt and 24-volt batteries, must be kept clean and secure. When the batteries are Type H, the electrolyte should be checked daily for the correct S.G., but when Type K batteries are fitted, this check is not required. Note that the load check for the 96-volt battery (para.182), must be carried out prior to each flight. Descriptive and servicing details for the batteries are contained in 4343A, Vol.1, Sect.11 and 12 for Type H and K respectively.

REMOVAL AND INSTALLATION

General

186. For the most part, the removal of the various components used in the power supply services presents no serious difficulties. Points to be borne in mind are:-

(1) Before removing any item of electrical equipment, ensure that the circuit is electrically 'safe'.

(2) Always stow and insulate all disconnected cables.

(3) Before reconnecting cables, check with the appropriate routing chart for correct terminal and cable numbers.

187. Where it is necessary to remove major items of equipment from the aircraft, it is essential that use should be made of the proper ground equipment available for these tasks, if damage to the equipment is to be avoided. Where more than one man is necessary for the removal or assembly of a particular piece of equipment, no attempt should be made to carry out the task single-handed.

Removal of 112-volt generators

188. To prevent possible damage to these units during removal and assembly operations, the closest co-operation should be maintained between the electrical and engine trades. Full details for the removal and replacement of the generators are contained in the Olympus engine book, A.P. 4501B, Vol.1, to which reference should be made before this task is attempted.

Removal of rotary transformers

189. This is a task that can be carried out single-handed and no special equipment is necessary apart from a 'Safety-Raiser' or any other suitable adjustable form of trestle. The method of removal of the transformers is as follows:-

(1) Position the 'Safety-Raiser' or adjustable trestle beneath the nose-wheel bay, with the platform raised as high as the aircraft structure will allow.

(2) Disconnect the cooling duct inlet and exhaust manifold nose clips on all three transformers.

(3) Disconnect the electrical connections to the rotary transformers (a hand mirror may be required at this stage to enable the terminal connections to be tooled).

(4) Release the four bolts securing each transformer to the racks.

(5) Slide each rotary transformer inboard and clear of racks to the platform floor.

NOTE...

Before installing a rotary transformer in the aircraft it is essential to check that terminals E and Earth are connected together by means of the link provided in the terminal box. Also check that the output voltage is 27·5 volts. Failure to do this may result in extensive damage to components in the 28-volt system.

Removal of 96-volt and 24-volt batteries

190. Before any attempt is made to remove the batteries from the aft power compartment, the servicing platform (para. 181) should be positioned on the compartment floor.

191. Removing the batteries is a two man task, and a 'Safety-Raiser' or other suitable adjustable platform will be necessary. The 'Safety-Raiser' should be positioned below the aft power compartment and the platform raised as high as possible to the power compartment access hatch. The No.1 man remains on the 'Safety-Raiser' platform, No.2 man enters the power compartment and proceeds to remove the batteries as follows:-

(1) Release the fasteners on the 96-volt battery container, and remove the container cover.

(2) Disconnect the leads from the 96-volt batteries and stow the disconnected leads on the blocks provided.

(3) Undo the nuts holding the batteries to the container base, remove each battery in turn and pass to No.1 man on the platform.

(4) Remove the cover from the 24-volt battery, disconnect and stow the leads.

(5) Undo the nuts securing the battery to the tray.

(6) Remove the battery from the tray, by lifting the battery upwards and inboard to clear the edge of the tray.

(7) Lower the 24-volt battery to the No.1 man on the platform.

(8) The 'Safety-Raiser' platform may now be adjusted to its lowest position, and the batteries transferred to a suitable transport trolley.

192. Replacement of serviceable batteries is carried out in reverse order of the foregoing procedure, ensuring that all connections are correctly and securely replaced on the batteries.

TABLE 1

HANDLING PROCEDURE UNDER GENERATOR FAILURE CONDITIONS

INDICATION	FAILURE	ACTION
Case 1. No.1 or 2 generator red light on.	No.1 generator or No.2 generator	(1) Check busbar voltage for signs of under or over-volting generator. (2) If busbar voltage is normal check the failed generator voltage. (3) If voltage is normal switch the generator to OFF-TRIM, and re-check voltage. (4) If voltage is between 108-116 volts, select generator switch ON and press ENGAGE button. Check busbar voltage and load ammeters. (5) If generator remains off line or is not within 108-116 volts, switch generator to OFF-TRIM. Load shed prior to use of airbrakes; No.1 inverter (transfer load to No.2) No.1 rotary transformer. (6) If after action (2) the generator voltage is zero, leave the generator ON. Only attempt reset action if further generator failures occur, after reducing appropriate engine speed to below 40% r.p.m.
Case 2. No.3 or 4 generator red, and one amber light on.	No.3 generator or No.4 generator	(1) Check loads transferred to port busbar. (2) Check the failed generator voltage. (3) If voltage is between 108-116 volts, press appropriate ENGAGE button. Check amber light goes out and ammeter is showing load. (4) If generator remains off line, set generator switch to OFF-TRIM (No load shedding required). (5) If after action (2) the generator voltage is zero, proceed as for (6) case 1.
Case 3. No.1 and 2 generator red lights on. Battery volts on busbar. Battery discharge red warning light probably on.	No.1 generator and No.2 generator	(1) Check busbar voltage is above 80 volts and battery discharge is not above 150 amp. (2) Press No.1 generator ENGAGE button. If generator fails to come on line, press No.2 generator ENGAGE button.

TABLE 1 (cont'd.)

INDICATION	FAILURE	ACTION
Case 3 (cont'd.)		(3) If one generator is successfully brought on line, check busbar voltage is between 108-116 volts and generator ammeter is showing load. (4) Attempt to re-engage remaining generator as per case 1. (5) If No.1 or No.2 generator cannot be brought on line, press in BATTERY BUSBAR ISOLATION button (Amber light on) No.1 rotary transformer and No.1 inverter off line. (6) Load shed:- (i) No.1 rotary transformer. (ii) Window dispensers. (iii) I.F.F. (iv) Ration heaters. (v) Auto-pilot. (vi) I.L.S. (vii) U.H.F or V.H.F. as required. (viii) All fuel pumps except one per group. (ix) Windscreen de-misting. (x) Nos.4 and 5 inverters. (xi) Radio and radar altimeters. (xii) Radio compass. (xiii) Port sextant heater. (xiv) Scanner rotation and stabilisation. (xv) N.B.S. and H2S. (xvi) Starboard sextant heater. (7) (i) Check that 112-volt busbar voltage reads over 80 volts, and that the battery discharge is not more than 150 amps.

TABLE 1 (cont'd.)

INDICATION	FAILURE	ACTION
Case 3 (cont'd.)		(ii) Select the No.3 PARALLELING SWITCH TO CLOSE (amber light on) and re-check the busbar voltage. If 108-116 volts, select the No.4 PARALLELING SWITCH TO CLOSE (Amber light on) and re-check voltage. (iii) If the battery discharge indication at (i) above is more than 150 amps. see under port busbar failure case 8. (8) Check the voltage of the failed generators and attempt to reset/re-engage one generator as per case 1. (9) If one generator is successfully re-engaged, pull out the BATTERY BUSBAR ISOLATION switch (amber light out) and return the No.3 and No.4 PARALLELING SWITCHES to NORMAL (amber lights out). (10) Check that the 112-volt busbar voltage is between 108-116 volts and generator ammeter showing normal load. (11) Attempt to reset/re-engage the remaining generator as per case 1 and re-check busbar voltage and load ammeters. Do not attempt to reset both generators with the busbar isolation switch in (i.e. under no load conditions).
Case 4. No.3 and 4 generator red, and two amber lights on.	No.3 and 4 generator	Note: Loads will be transferred automatically to the port busbar. (1) Load shed as for case 3. (2) Check the failed generator voltages. (3) Attempt re-engage/reset as per case 2. (4) If one generator can be brought back on line no loads need remain shed.
Case 5. No.1 or 2 generator red light on plus No.3 or No. 4 red and amber lights on.	No.1 or 2 generator plus No. 3 or No.4 generator.	(1) Load shed as for case 3 (2) Check failed generator voltages. (3) Attempt to re-engage/reset, generators per cases 1 and 2 as appropriate.

TABLE 1 (cont'd.)

INDICATION	FAILURE	ACTION
Case 6. Three generator red lights. Battery discharge red light, plus 1 or 2 amber paralleling lights.	Any three generators.	(1) Check airbrake operation with pilot. (2) Load shed:- (i) Nos.1 and 2 rotary transformers. (ii) H.F. unless beyond UHF/VHF range. (iii) All E.C.M. equipment. (iv) Ration heaters. (v) Stand-by rudder P.F.C. motor. (vi) Inboard aileron P.F.C. motors. (vii) Auto -pilot. (viii) I.L.S. (ix) V.H.F. or U.H.F. as required. (x) All fuel pumps except one per group. (xi) De-icing. (xii) Windscreen de-misting. (xiii) Nos.1, 3, 4 and 5 inverters. (xiv) Radio and radar altimeter. (xv) Radio compass. (xvi) Port sextant heater. (xvii) Scanner rotation and stabilisation. (xviii) N.B.S. and H2S. (xix) A.M.U. (xx) Starboard sextant heater. (3) Press the generator ENGAGE buttons in order 4 to 1.

TABLE 1 (cont'd.)

INDICATION	FAILURE	ACTION
Case 6 (cont'd.)		(4) If unable to re-engage No.1 or No.2 generators, check the busbar voltage is above 80 volts, battery discharge not above 150 amps, load shedding complete, and then parallel generator(s). (5) Minimise all services. (6) Attempt reset as required for the appropriate generator.
Case 7. All warning lights on. 1st Pilot's warning light on.	All four generators.	(1) Check airbrake operation with pilot. (2) Oxygen mask toggle down, check 100% oxygen set. (3) Load shed:- (i) All rotary transformers. (ii) H.F. unless beyond UHF/VHF range. (iii) All E.C.M. equipment. (iv) Ration heaters. (v) Minimise all services. (vi) Stand-by rudder P.F.C. motor. (vii) Inboard aileron P.F.C. motors. (viii) Auto-pilot. (ix) I.L.S. (x) V.H.F. or U.H.F. as required. (xi) All fuel pumps except one per group. (xii) De-icing. (xiii) Windscreen de-misting. (xiv) Nos.1, 3, 4 and 5 inverters. (xv) Radio and radar altimeters.

TABLE 1 (cont'd.)

INDICATION	FAILURE	ACTION
Case 7 (cont'd.)		(xvi) Radio compass. (xvii) Port sextant heater. (xviii) Scanner rotation and stabilisation. (xix) N.B.S. and H2S. (xx) A.M.U. (xxi) Bomb bay heating. (xxii) Starboard sextant heater. (4) Press generators ENGAGE buttons in order 4, 3, 2, 1. (5) If generators remain off line, try resetting if time permits. (6) When busbar voltage has dropped to 80 volts, warn the captain and prepare to abandon aircraft.
Case 8. Battery discharge warning, red light on.	Port busbar failure.	(1) Warn pilot of possible loss of outer P.F.C. motors and the main rudder P.F.C. motor. (2) Press in the BATTERY BUSBAR ISOLATION button (amber light on). (3) If the battery discharge is under 150 amps. the fault is on the generator portion of the busbar. If Nos.1 and 2 generators are off line, leave the generator switches ON. If the generators are still on line switch to OFF-TRIM. (4) Parallel Nos.3 and 4 generators as in case 3. (5) If the battery discharge is still more than 150 amps. switch off the the 96-volt battery isolating switch. (i) If the battery discharge warning light goes out the fault is on the battery busbar. (ii) If the light remains on, the fault is on the 96-volt battery or its connections. Inform pilot to switch off outer P.F.C.'s and main rudder P.F.C.

TABLE 1 (cont'd.)

INDICATION	FAILURE	ACTION
Case 8 (cont'd.)		(6) If battery busbar fault:- (i) Do not parallel Nos.3 or 4 generators. (ii) Leave 96-volt battery switch OFF. (iii) Leave battery busbar isolation button in. (iv) Carry out the reset action for No.1 or No.2 generator as in case 1, for supplying No.1 inverter and No.1 rotary transformer if required. (7) If 96-volt battery fault:- (i) Leave battery isolating switch OFF. (ii) Confirm outer P.F.C.'s and main rudder motors tripped. (iii) Carry out the reset action as for case 1 for Nos.1 and 2 generators. If one or both generators are successfully brought back on to main busbar, pull out the busbar isolation switch, and restart the switched - off P.F.C. motors. (iv) If Nos.1 or 2 generators cannot be brought on line carry out paralleling action for Nos.3 and 4 generators before restarting the P.F.C. motors.
Case 9. Over-volting or under-volting generators.		
No.2 generator red light on. Nos. 2 and 3 rotary transformers red lights on. Busbar voltage high.	No.1 generator over-volting	In all cases switch the over-volting generator to OFF-TRIM and re-engage the failed generator. Check that the rotary transformers come back on line.
No.1 generator red light on. Nos. 2 and 3 rotary transformers red lights on. Busbar voltage high.	No.2 generator over-volting.	

TABLE 1 (cont'd.)

INDICATION	FAILURE	ACTION
Case 9 (cont'd.)		
Nos.1 and 3 rotary transformers red lights on. No.3 generator voltage high.	No.3 generator over-volting.	In all cases switch the over-volting generator to OFF-TRIM and re-engage the failed generator. Check that the rotary transformers come back on line.
Nos.1 and 2 rotary transformers red lights on. No.4 generator voltage high.	No.4 generator over-volting.	
No warning lights. Busbar voltage 100 volts or less. No.1 or No.2 load ammeter showing zero, the other approximately twice the normal load.	Open circuit on No.1 or No.2 generator.	(1) Identify failed generator (load ammeter will read zero). (2) Switch failed generator to OFF-TRIM. Check generator warning light now on. (3) Busbar voltage should be normal. (4) Proceed as in case 1 for failed generator. Note 1: This fault can bring the sound generator off line. This can be identified by its warning light being on. Positively identify the faulty generator and switch to OFF-TRIM before attempting to engage sound generator. Note 2: Similar faults could occur with Nos.3 and 4 generators in parallel working only.

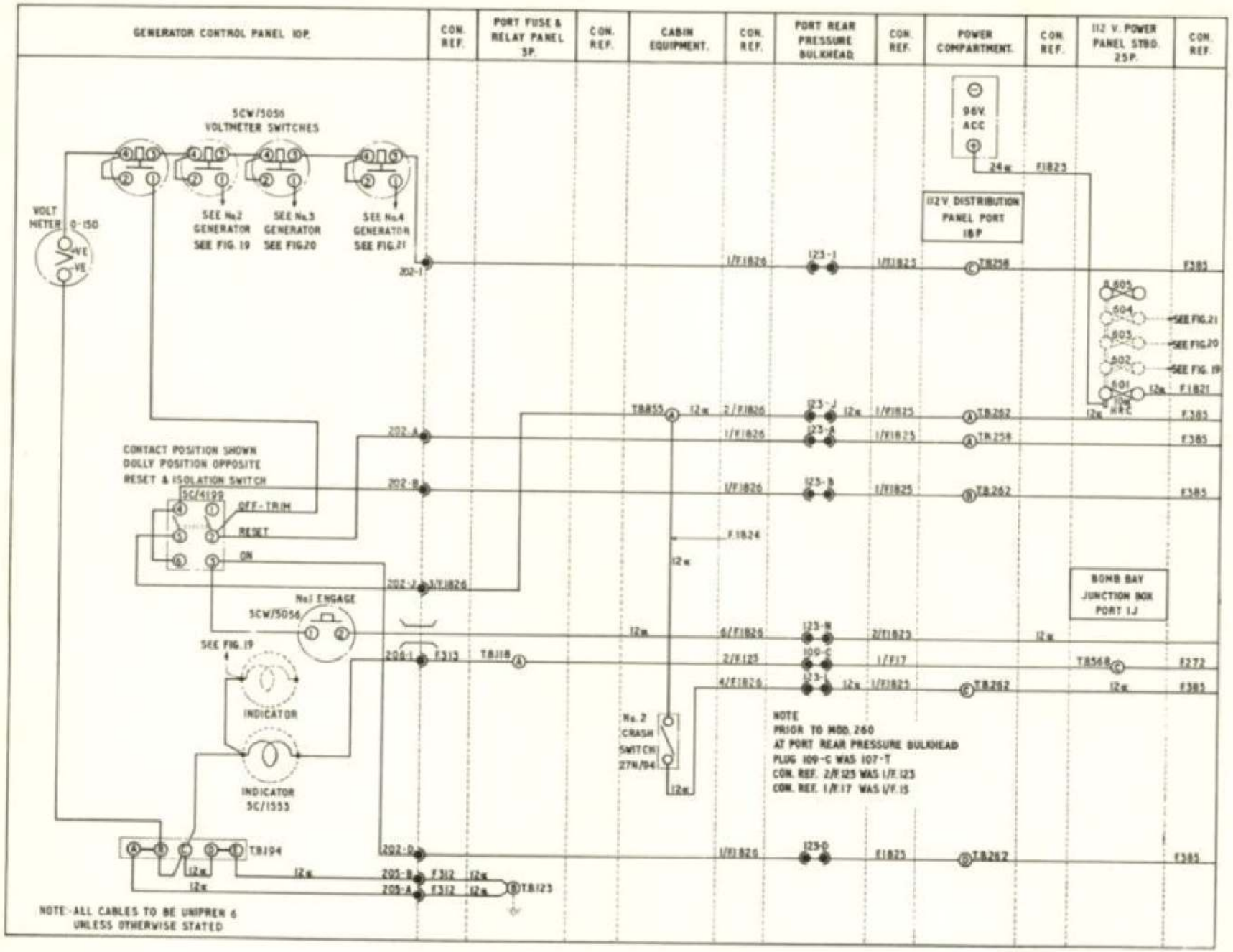


Fig. 18 (1) Nº 1 generator controls – pre Mods. 874 and 988

RESTRICTED

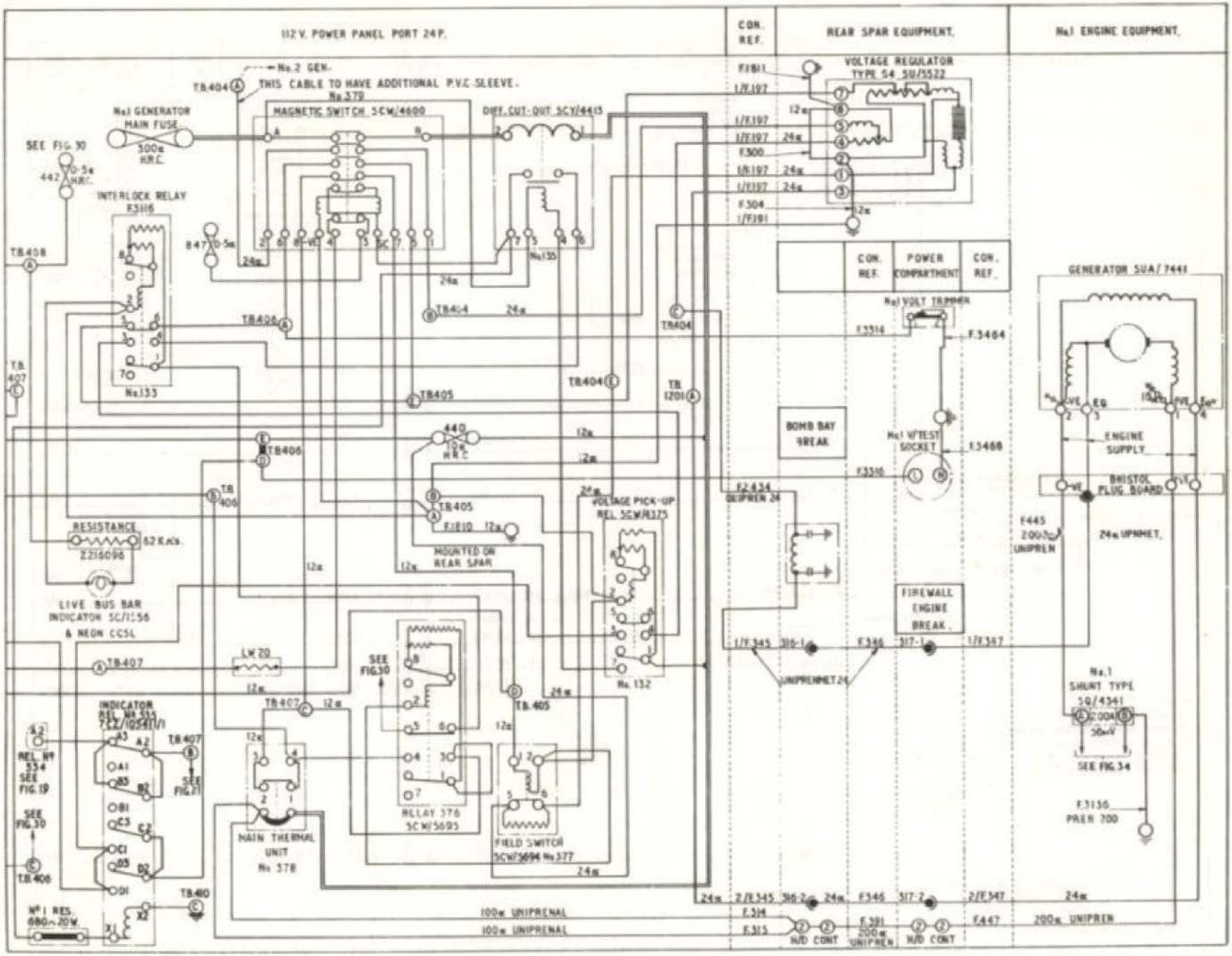


Fig. 18 (2) No 1 generator controls – pre Mods. 874 and 988

Magnetic switch Ref. No. changed

RESTRICTED

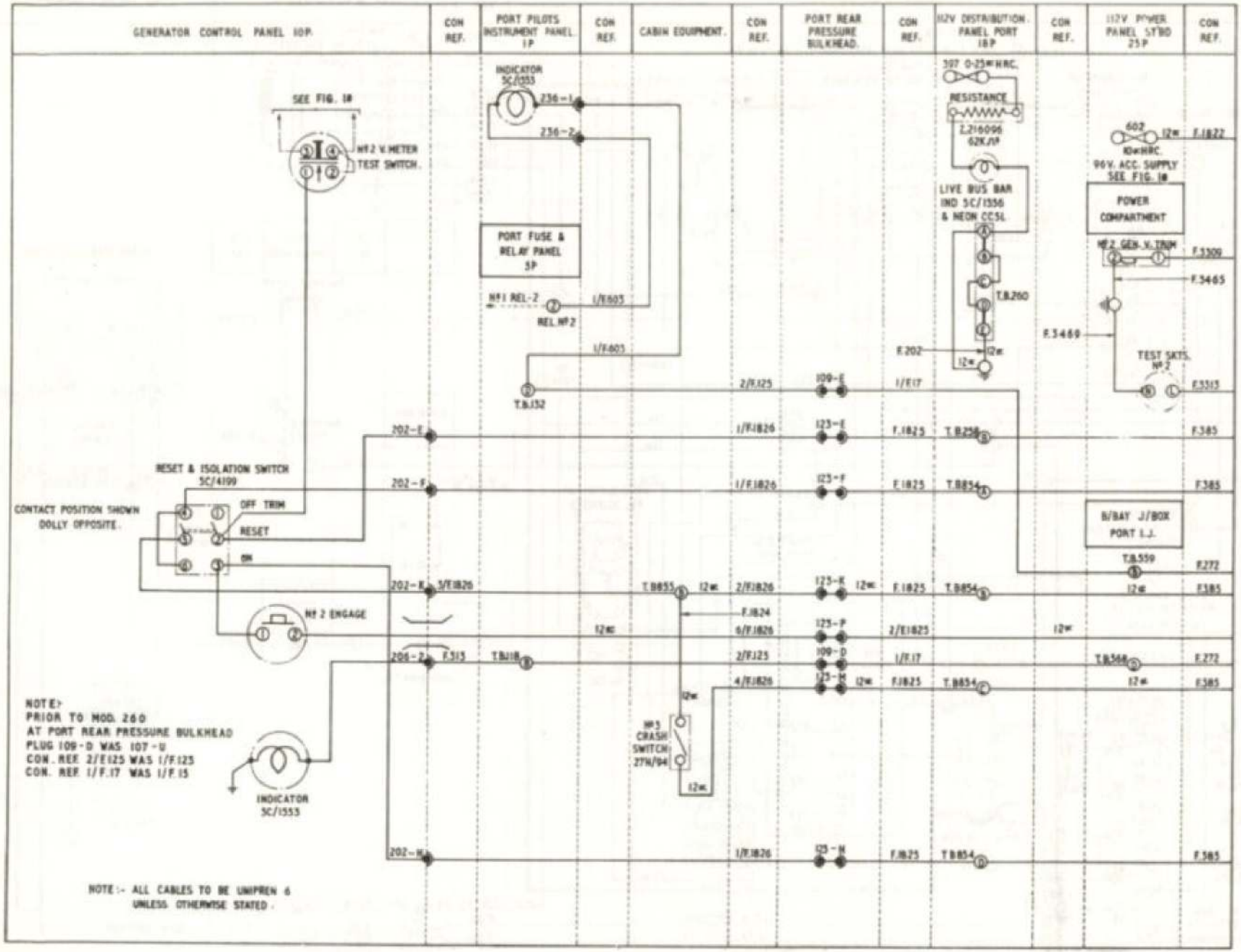


Fig. 19 (1) No 2 generator controls – pre Mods. 874 and 988

RESTRICTED

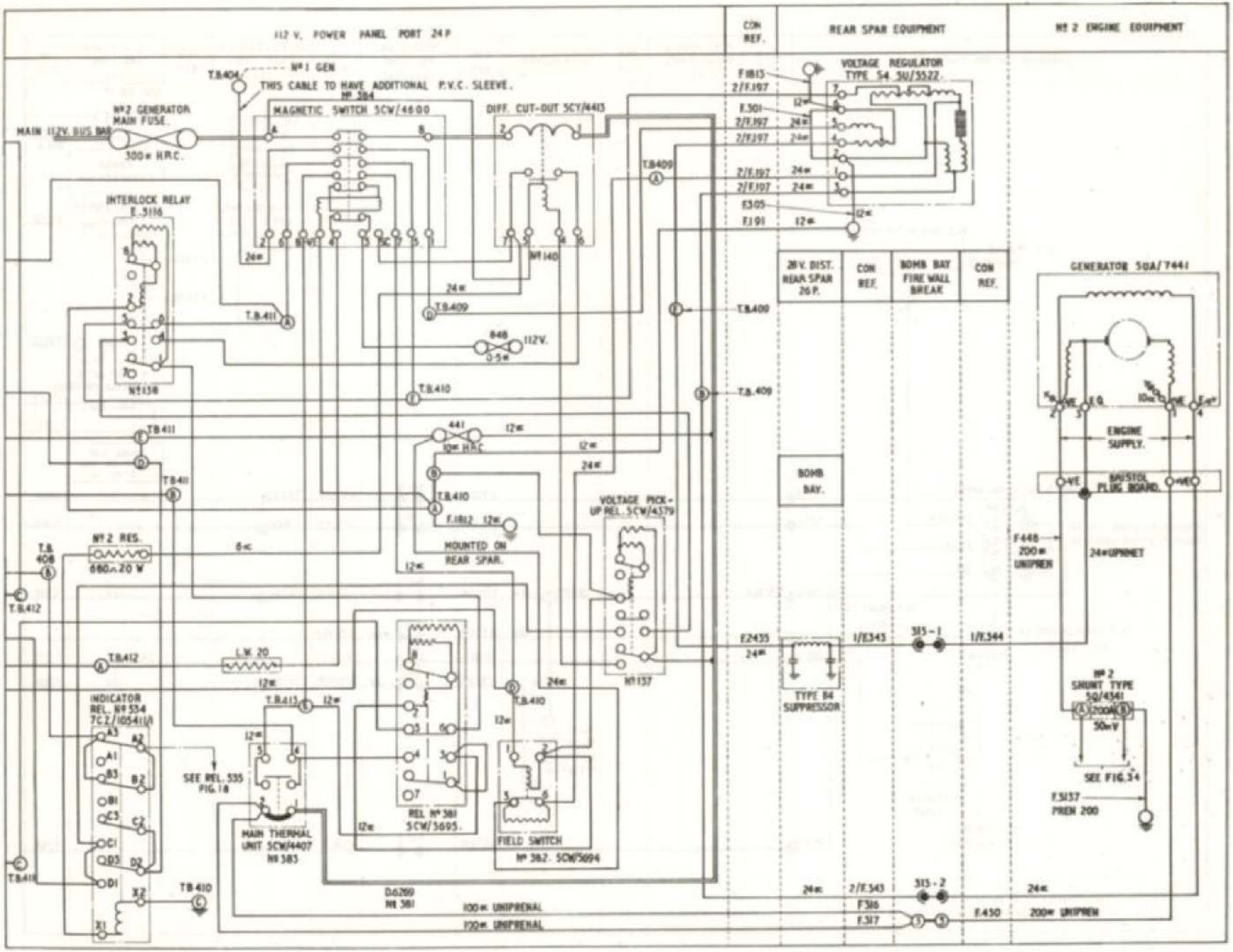


Fig. 19 (2) No 2 generator controls – pre Mods. 874 and 988

Magnetic switch Ref. No. changed

RESTRICTED

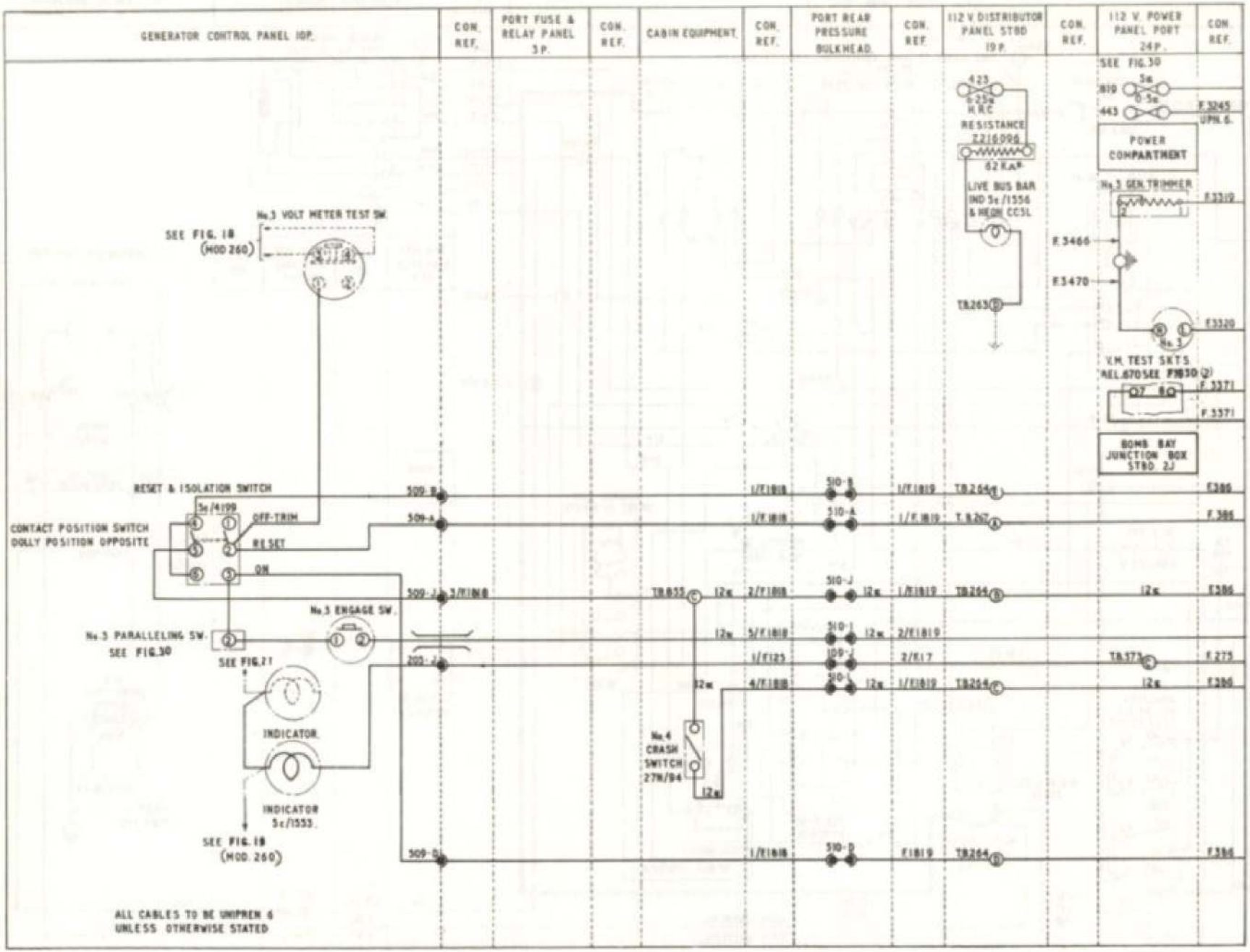


Fig. 20 (I) Nº 3 generator controls — pre Mods. 874 and 988

RESTRICTED

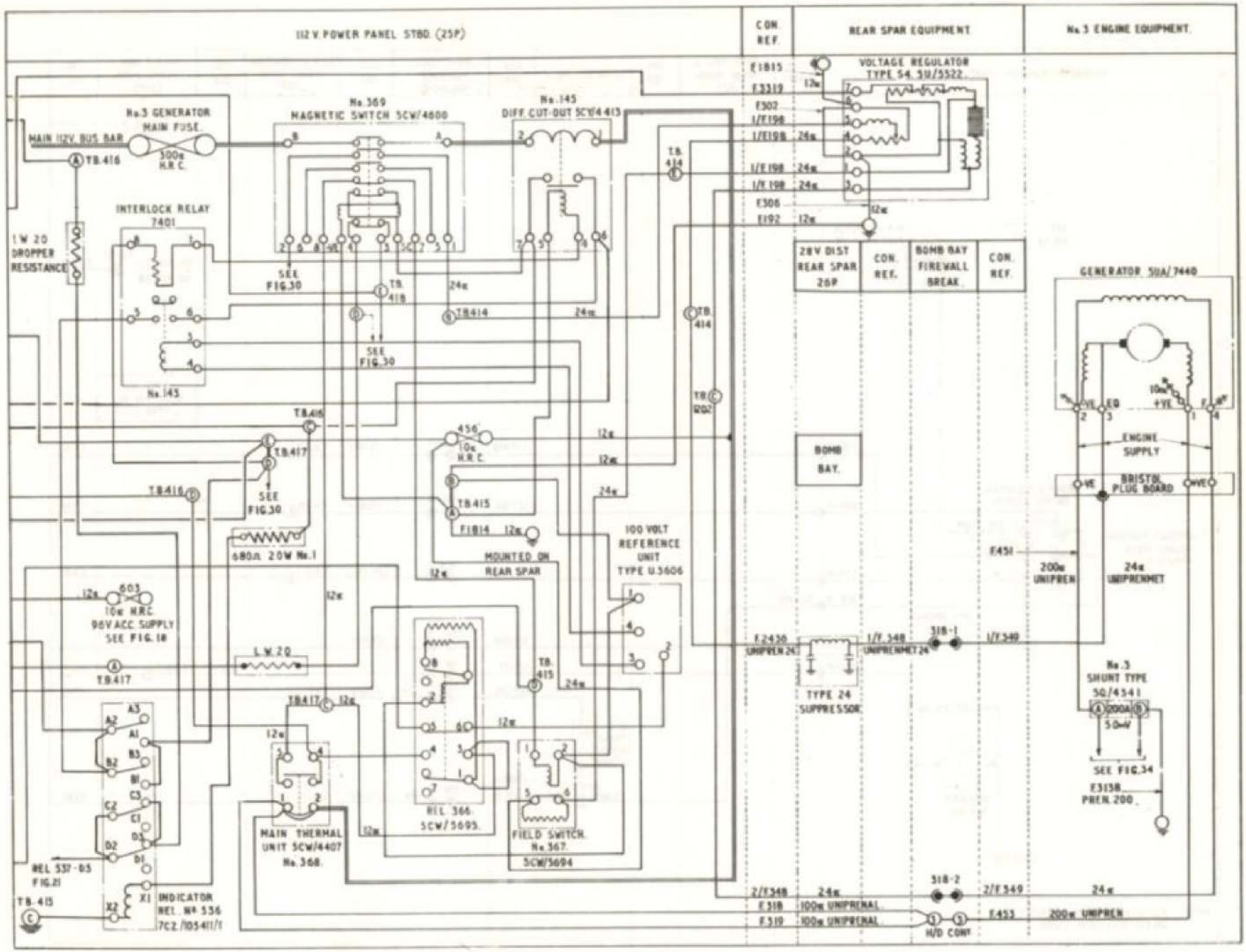
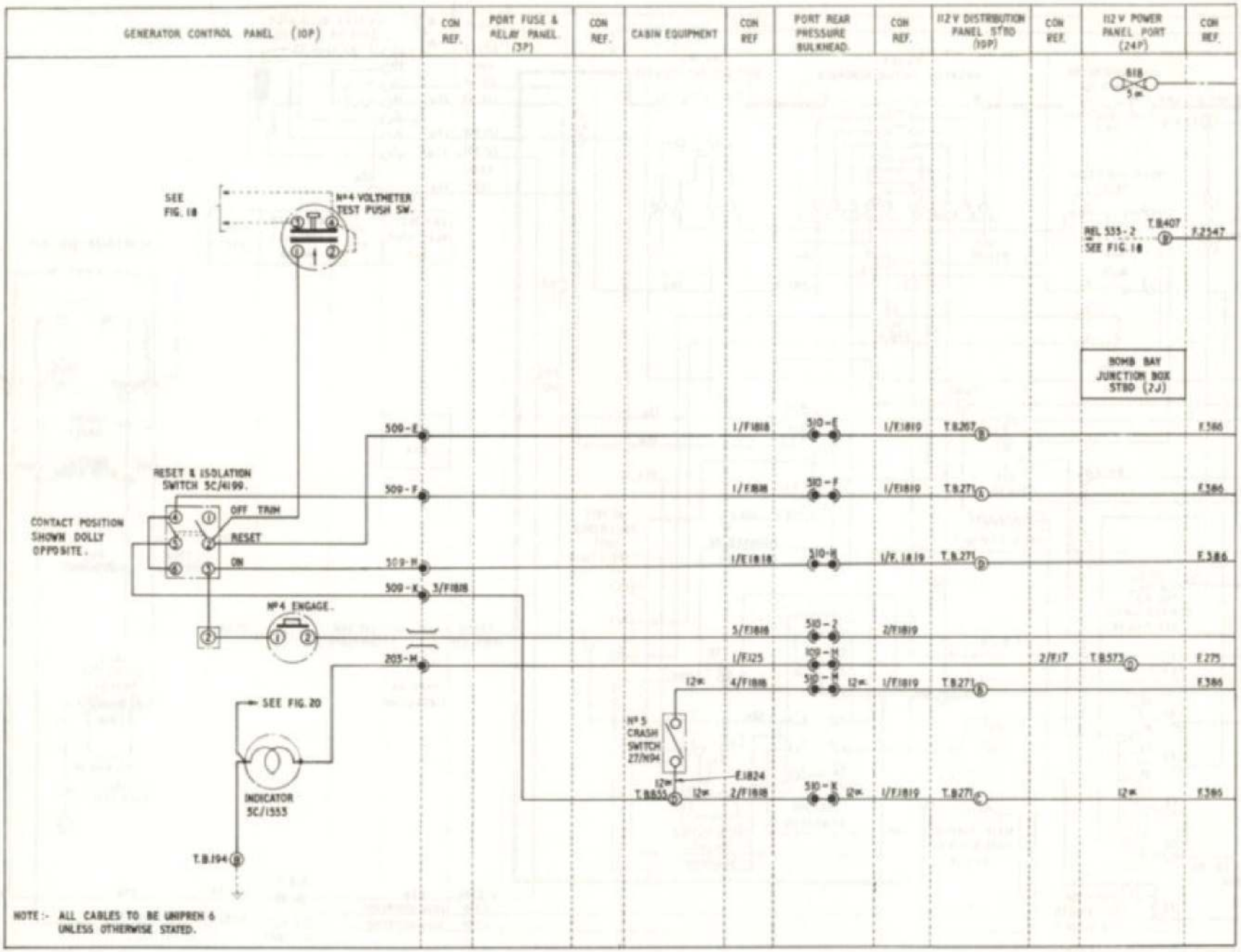


Fig 20 (2) Nº 3 generator controls – pre Mods. 874 and 988

Magnetic switch Ref No changed

RESTRICTED



NOTE:- ALL CABLES TO BE UNIPREN 6 UNLESS OTHERWISE STATED.

Fig. 21 (1) Nº 4 generator controls — pre Mods. 874 and 988

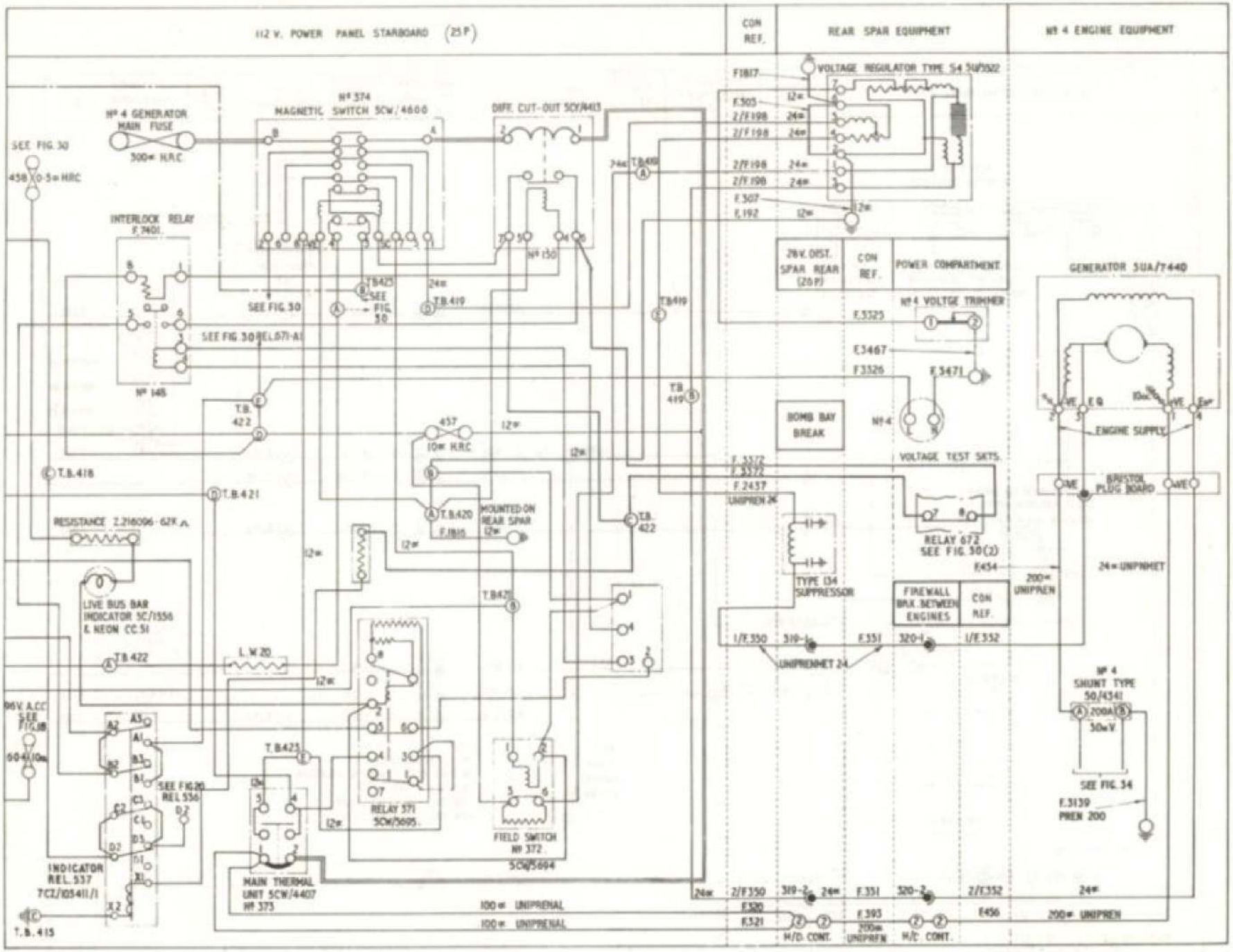


Fig. 21 (2) Nº 4 generator controls — pre Mods. 874 and 988

Magnetic switch Ref. No. changed

RESTRICTED

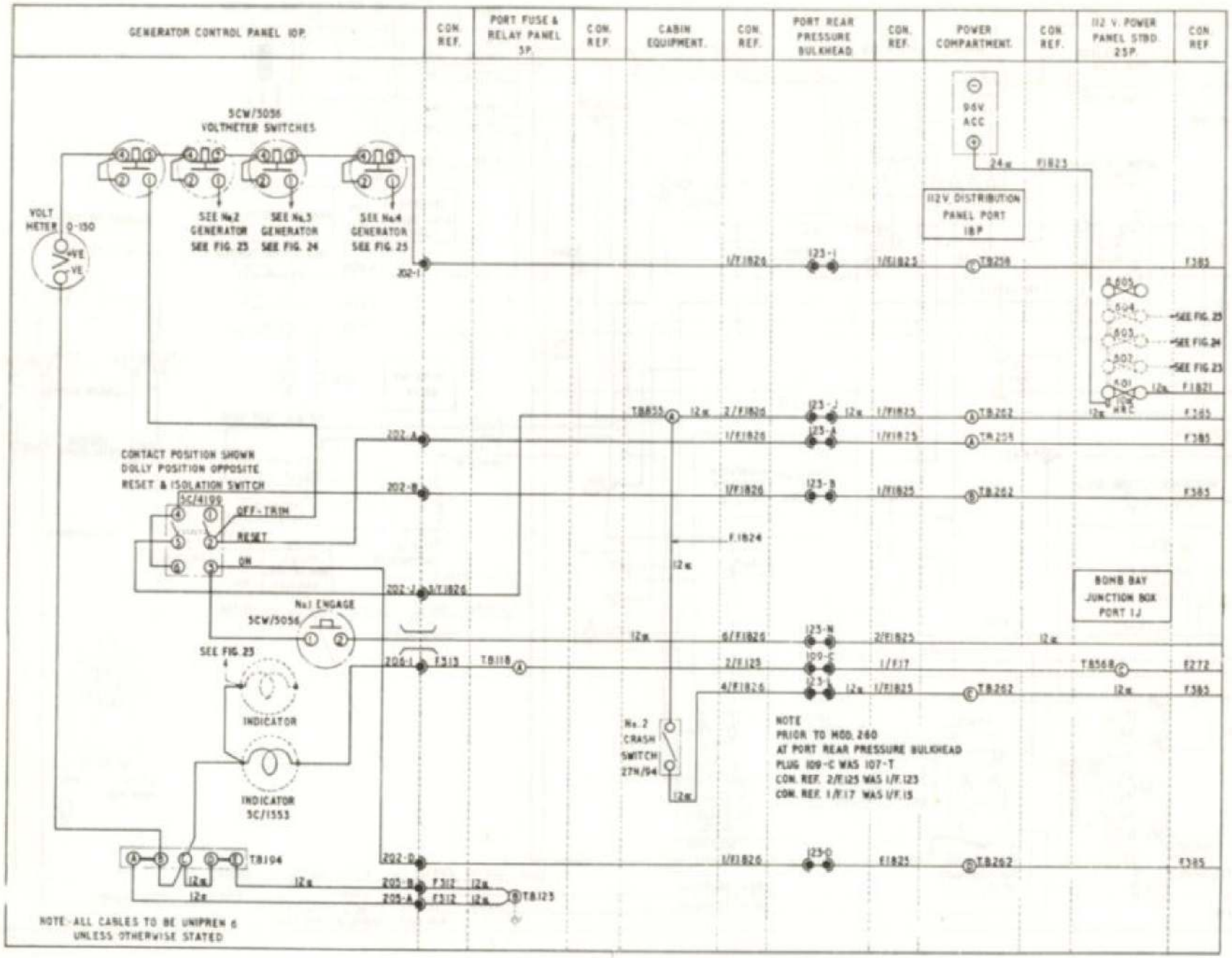


Fig. 22 (1) Nº 1 generator controls – post Mods. 874 and 988

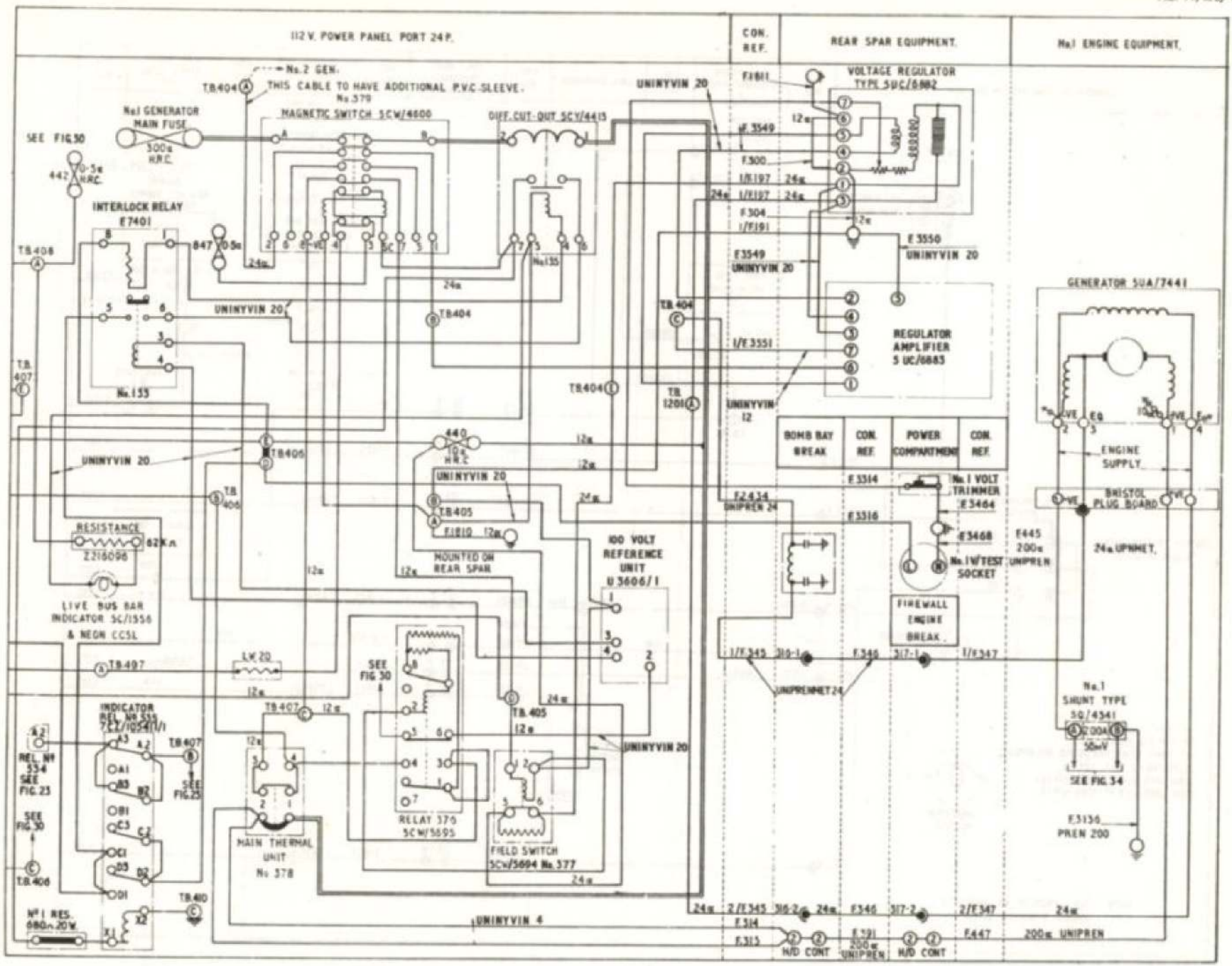


Fig. 22 (2) Nº 1 generator controls - post Mods. 874 and 988

Magnetic switch Ref. No. changed

RESTRICTED

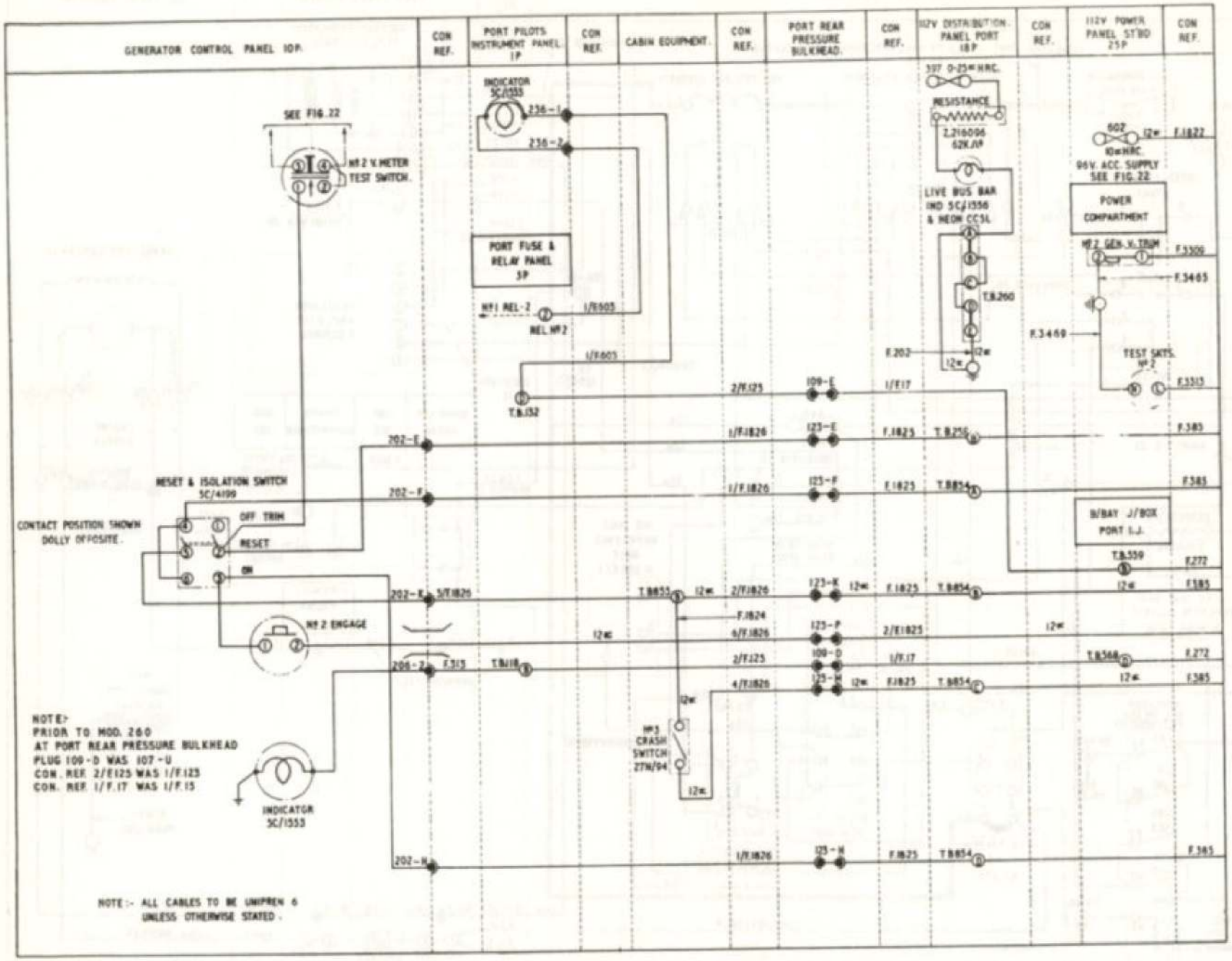


Fig. 23 (1) Nº 2 generator controls – post Mods. 874 and 988

RESTRICTED

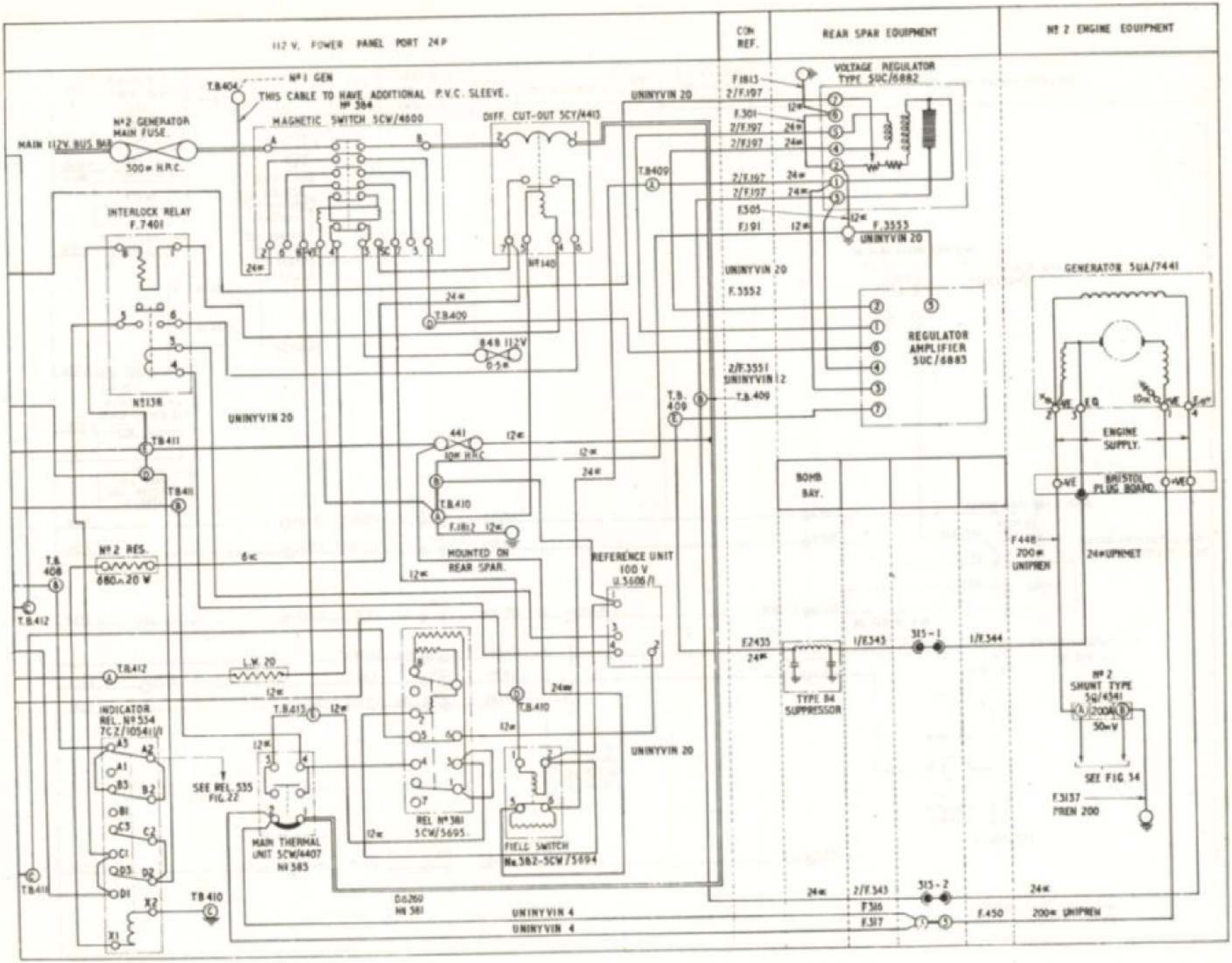


Fig. 23 (2) No 2 generator controls – post Mods. 874 and 988

Magnetic switch Ref. No. changed

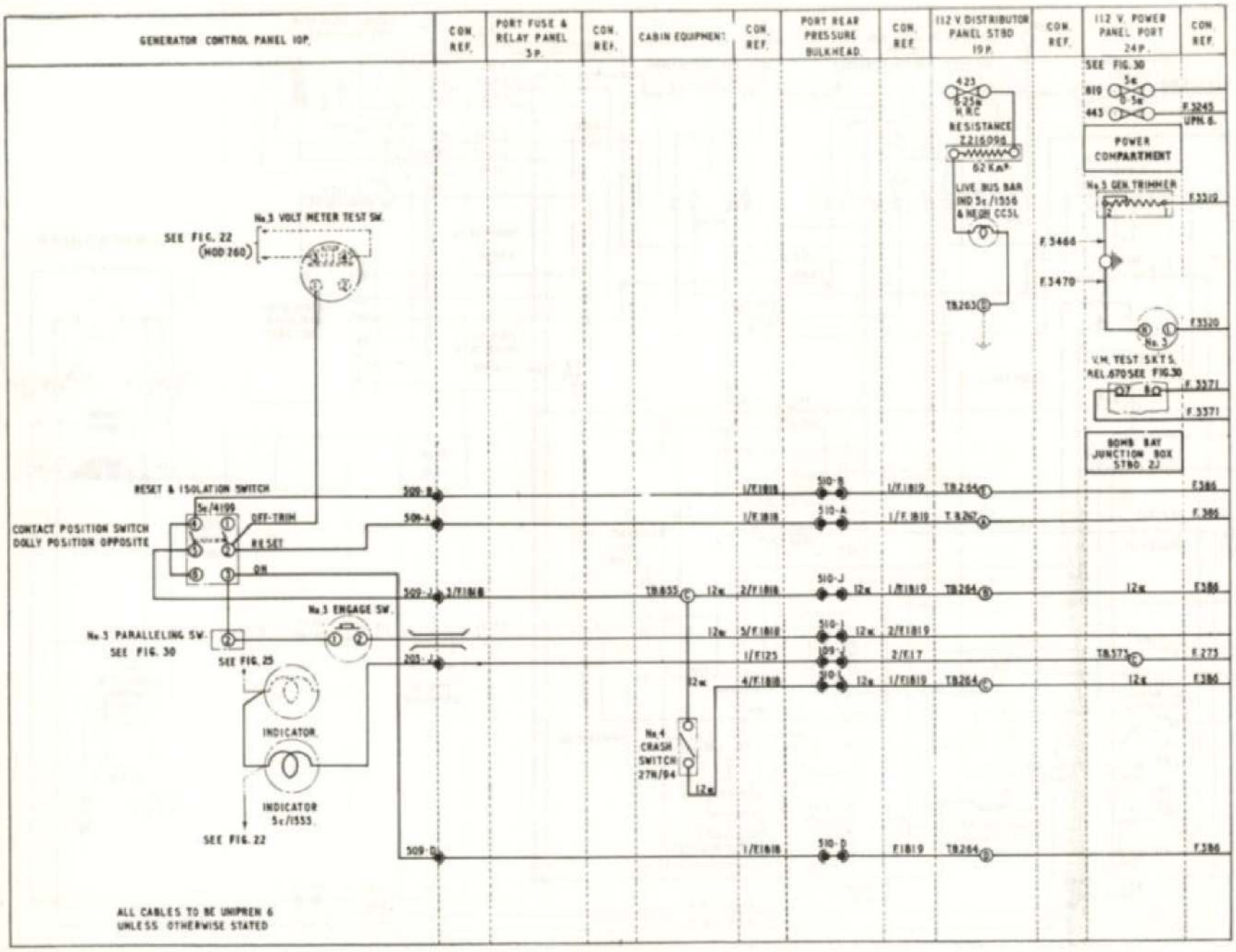


Fig. 24 (1) Nº 3 generator controls - post Mods. 874 and 988

RESTRICTED

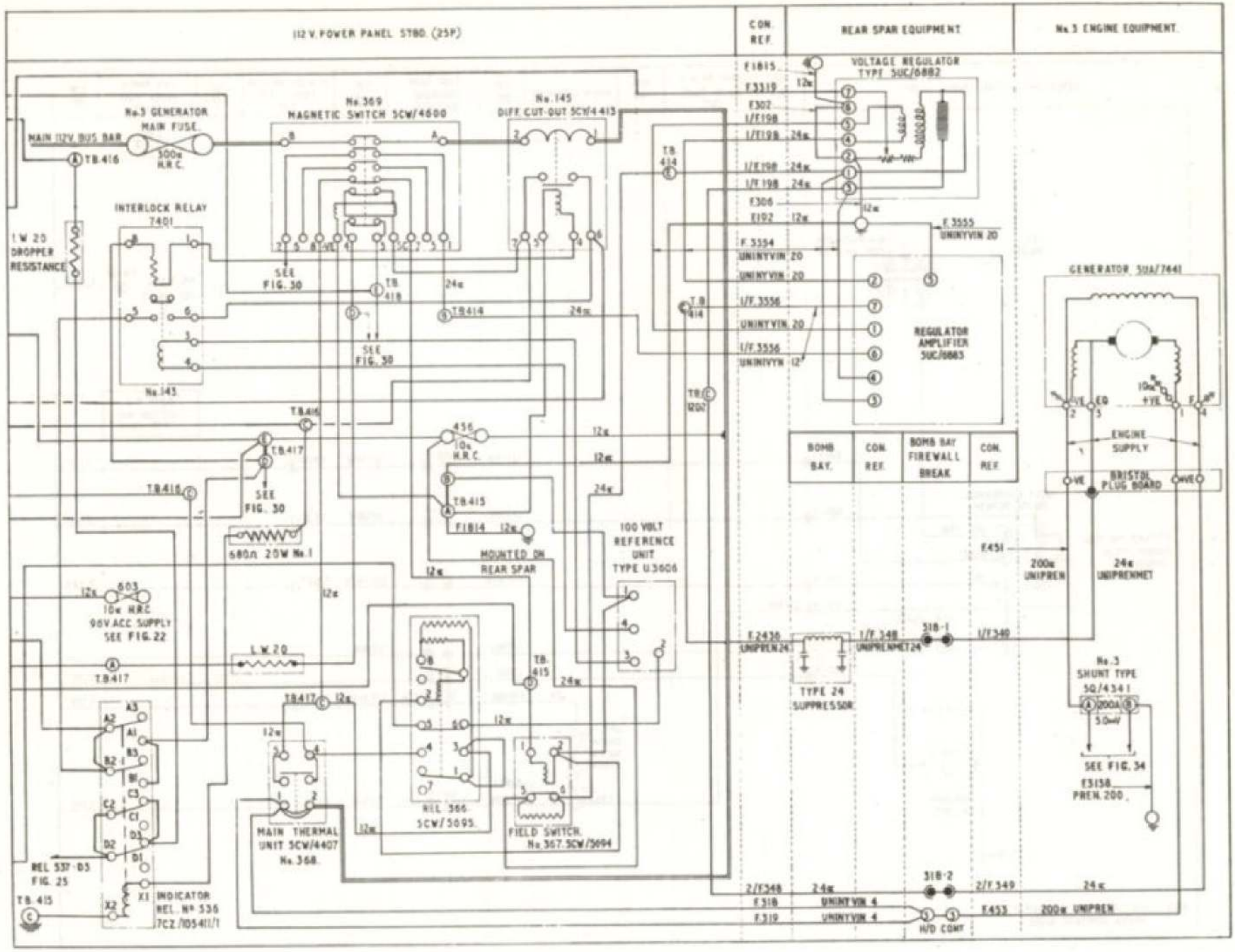


Fig. 24 (2) No 3 generator controls - post Mods. 874 and 988

Magnetic switch Ref. No. changed

RESTRICTED

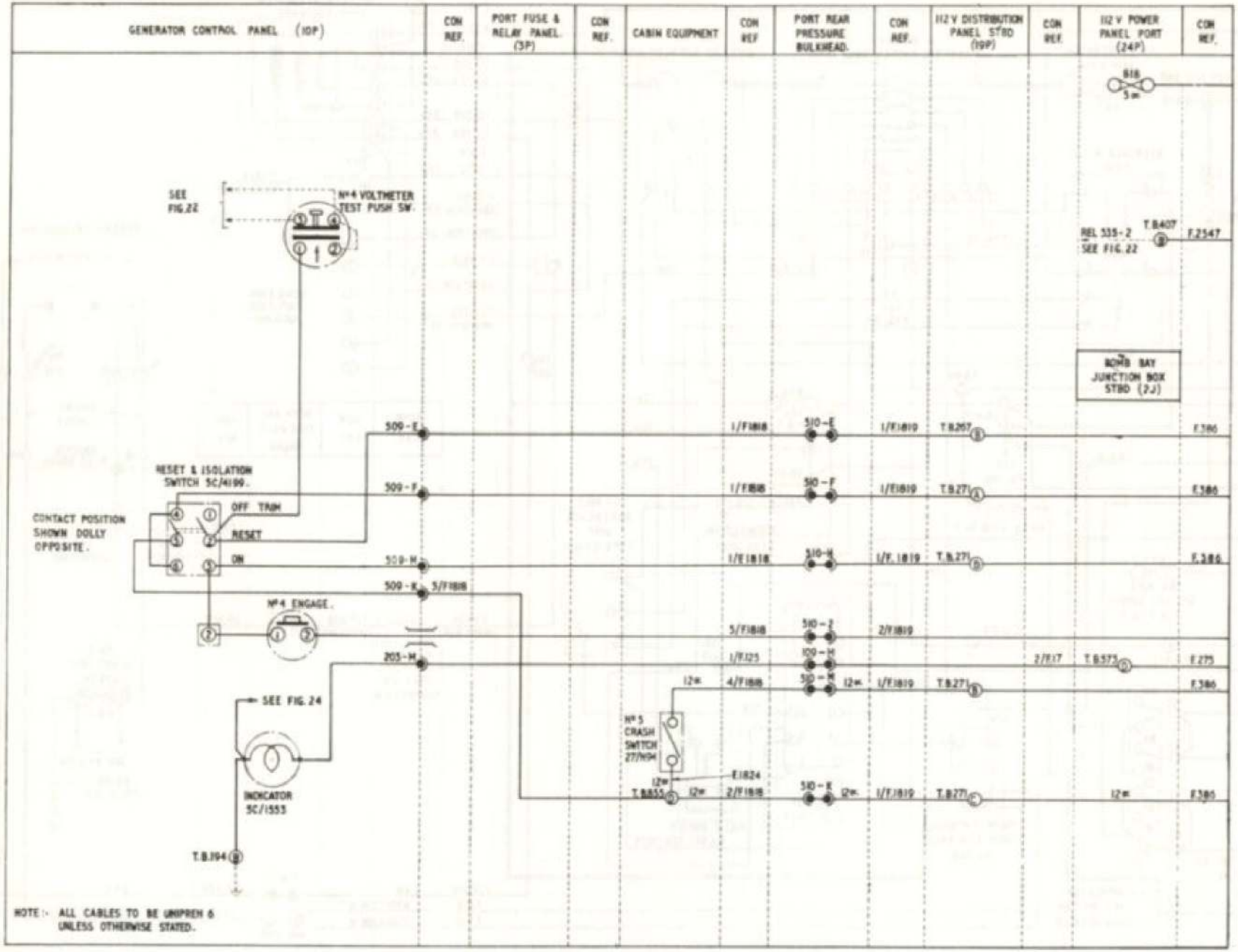


Fig 25 (1) Nº 4 generator controls – post Mods. 874 and 988

RESTRICTED

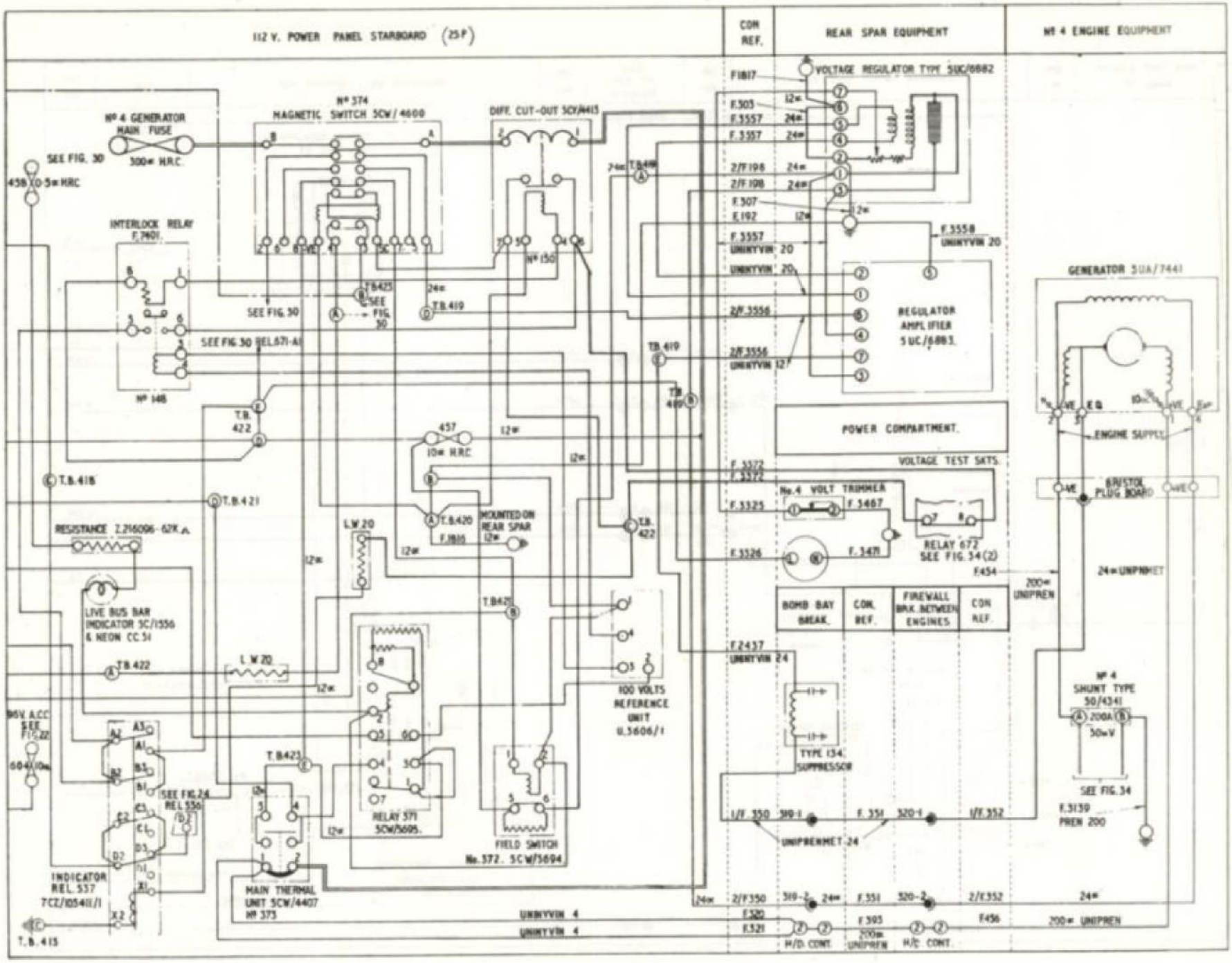


Fig 25 (2) No 4 generator controls – post Mods. 874 and 988

Magnetic switch Ref. No. changed

RESTRICTED

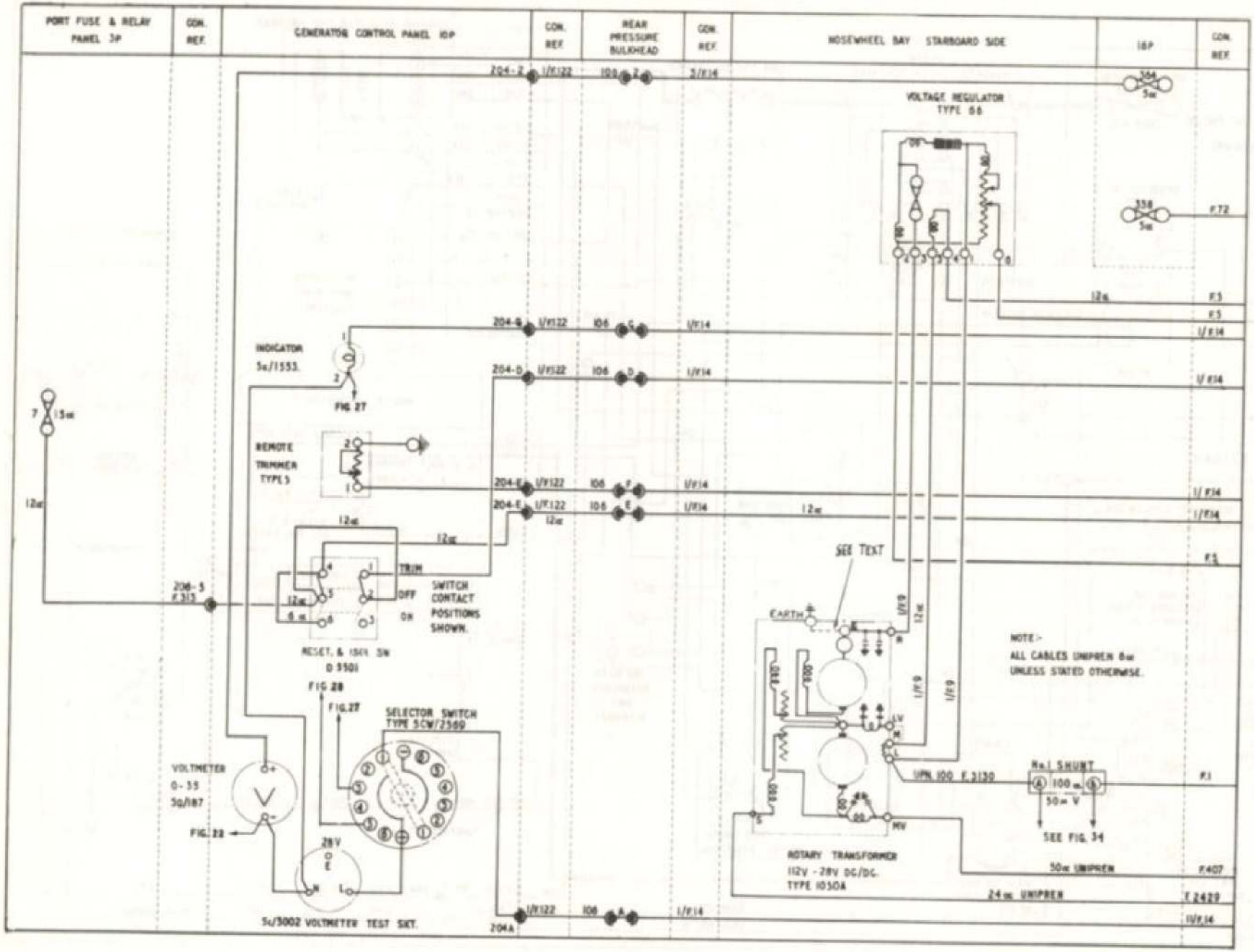


Fig.26 (1) Nº 1. rotary transformer controls

RESTRICTED

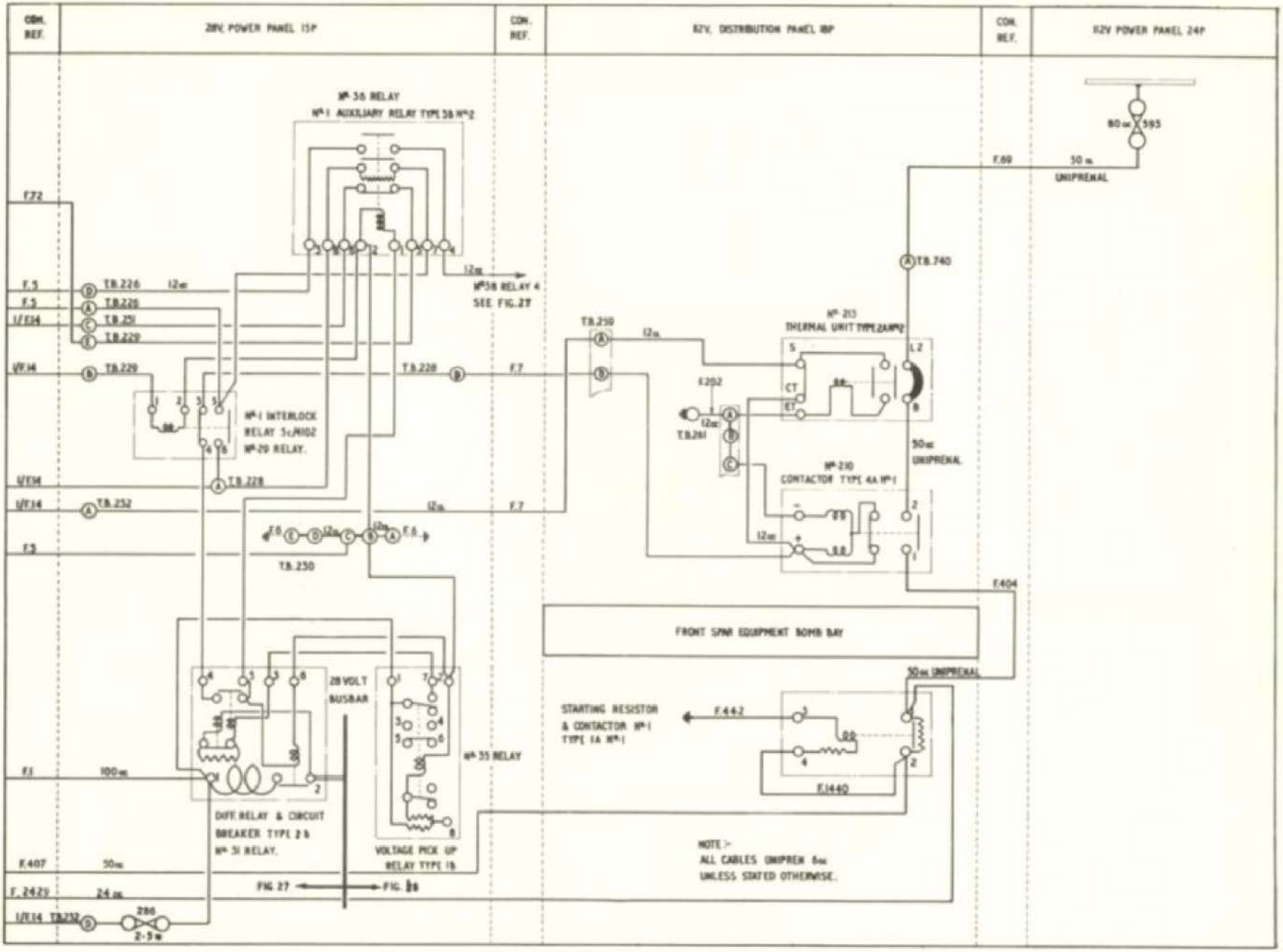


Fig.26 (2) No 1 rotary transformer controls

RESTRICTED

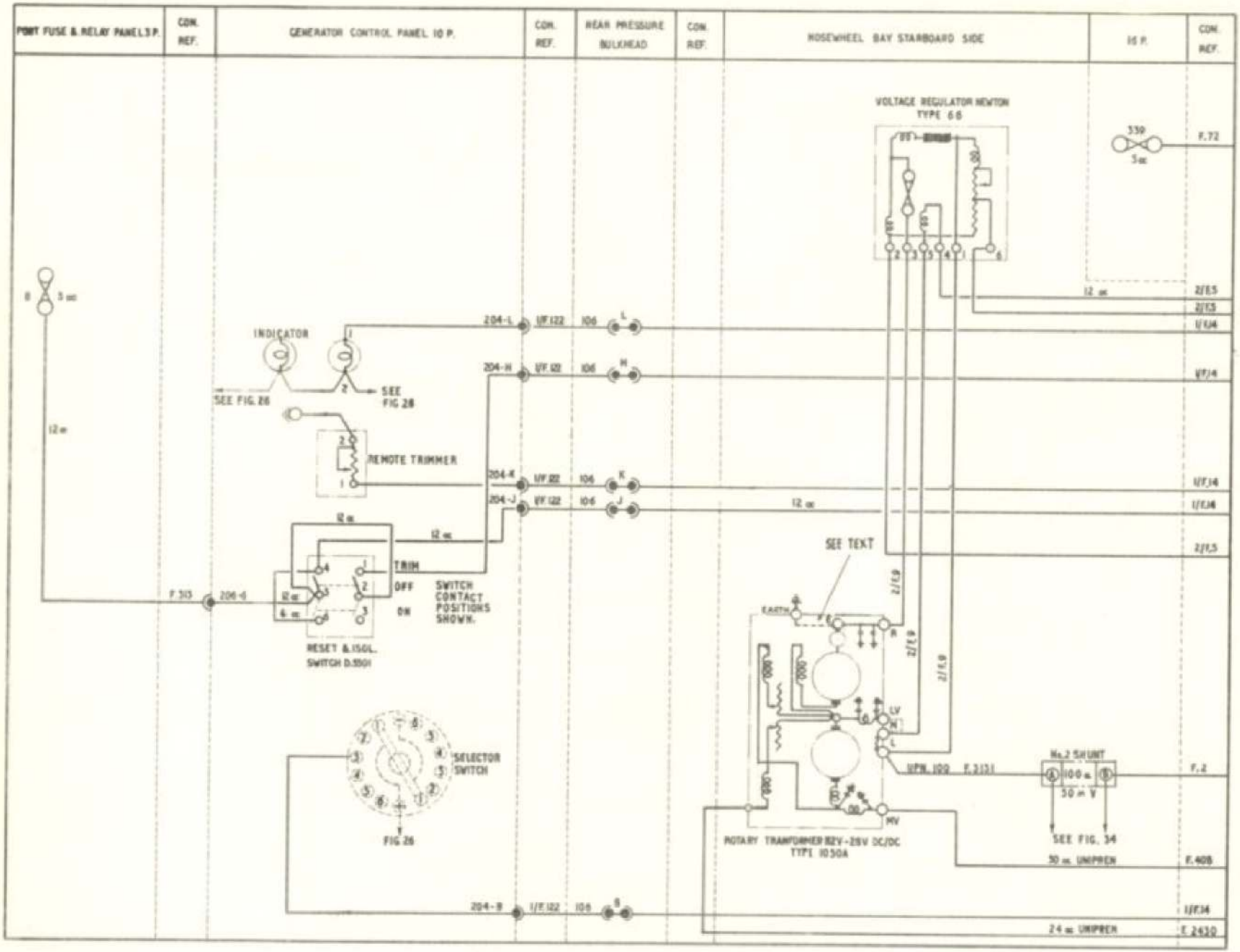


Fig. 27(1) No 2 rotary transformer controls

RESTRICTED

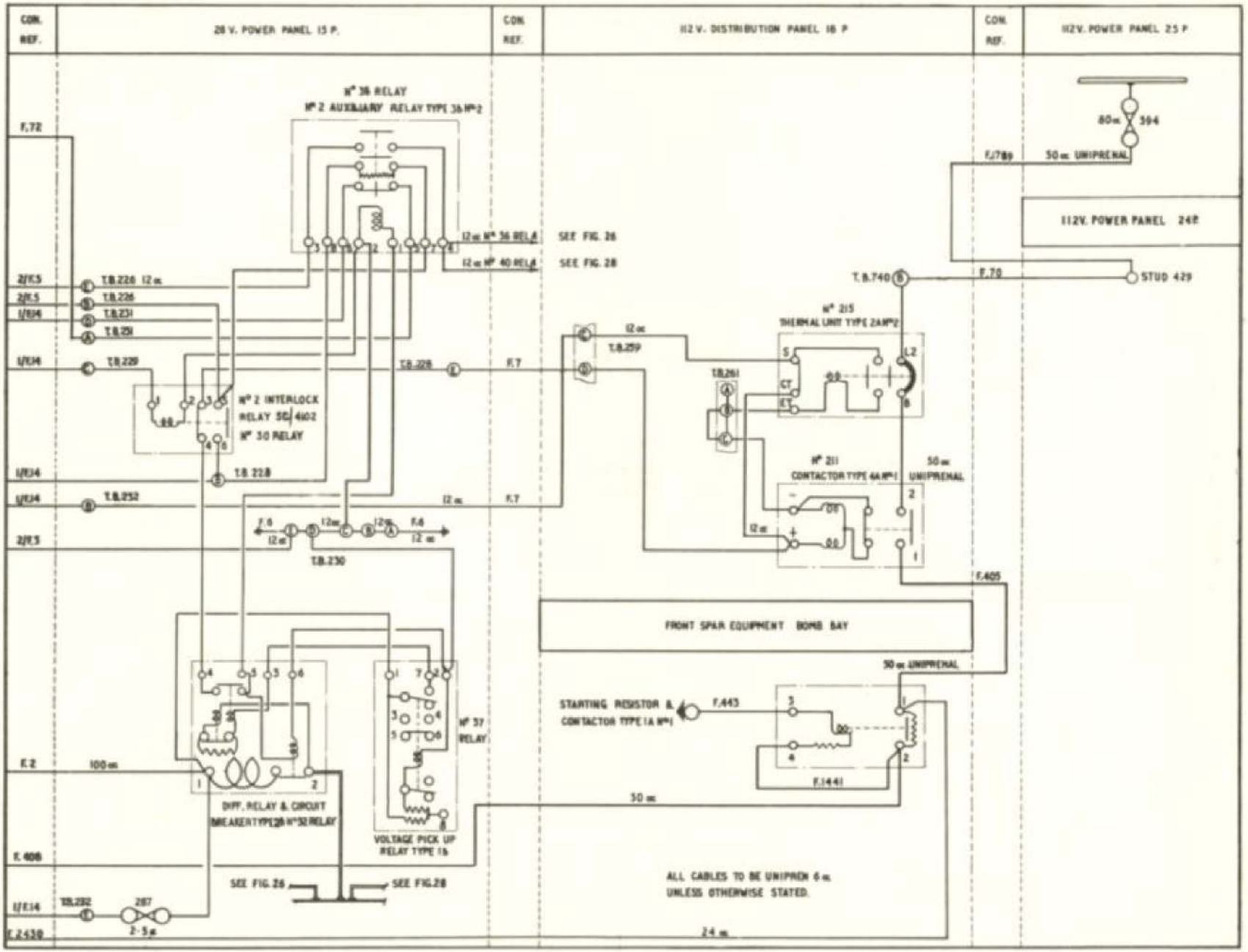


Fig. 27 (2) N°2 rotary transformer controls

RESTRICTED

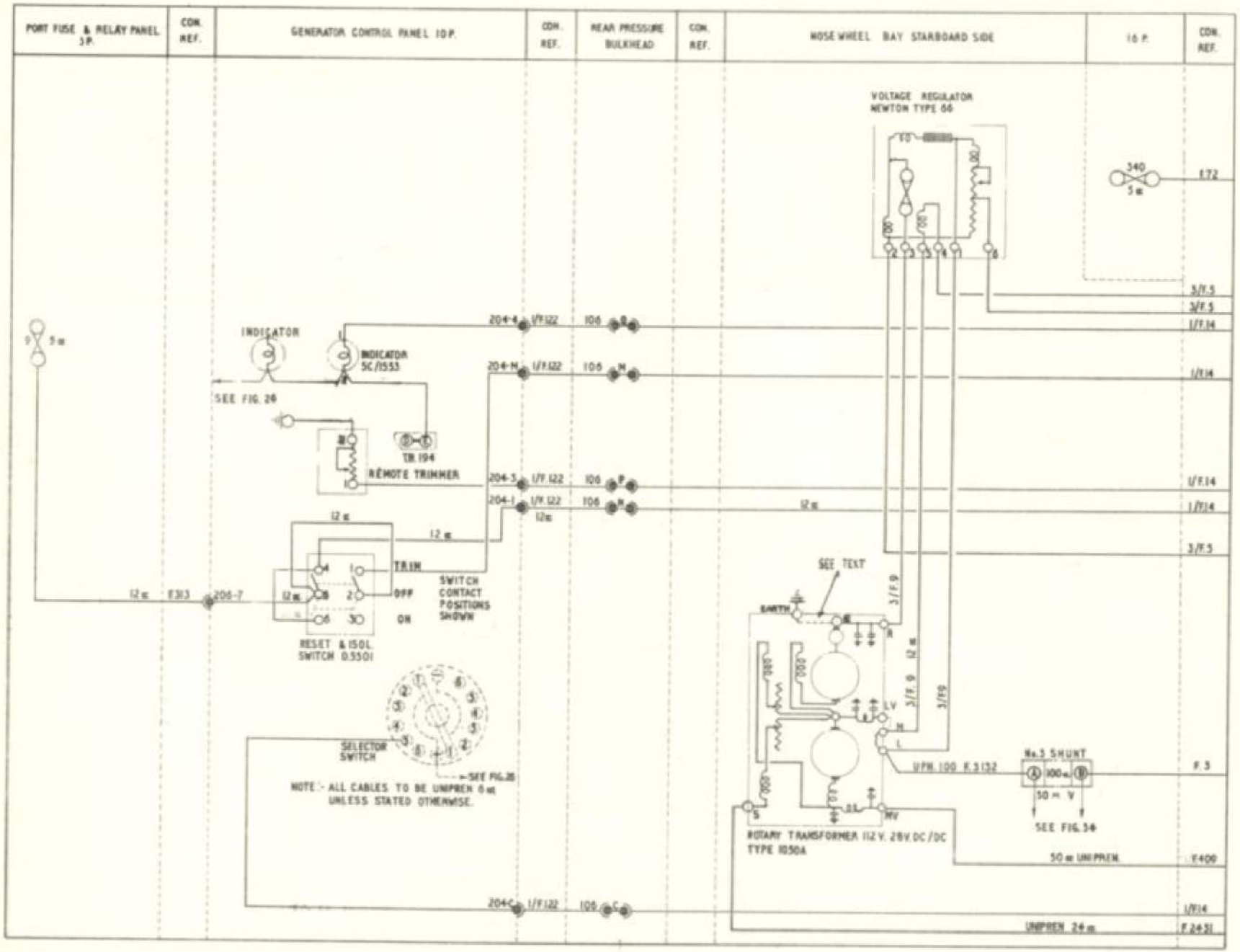


Fig.28(1)Nº3 rotary transformer controls

RESTRICTED

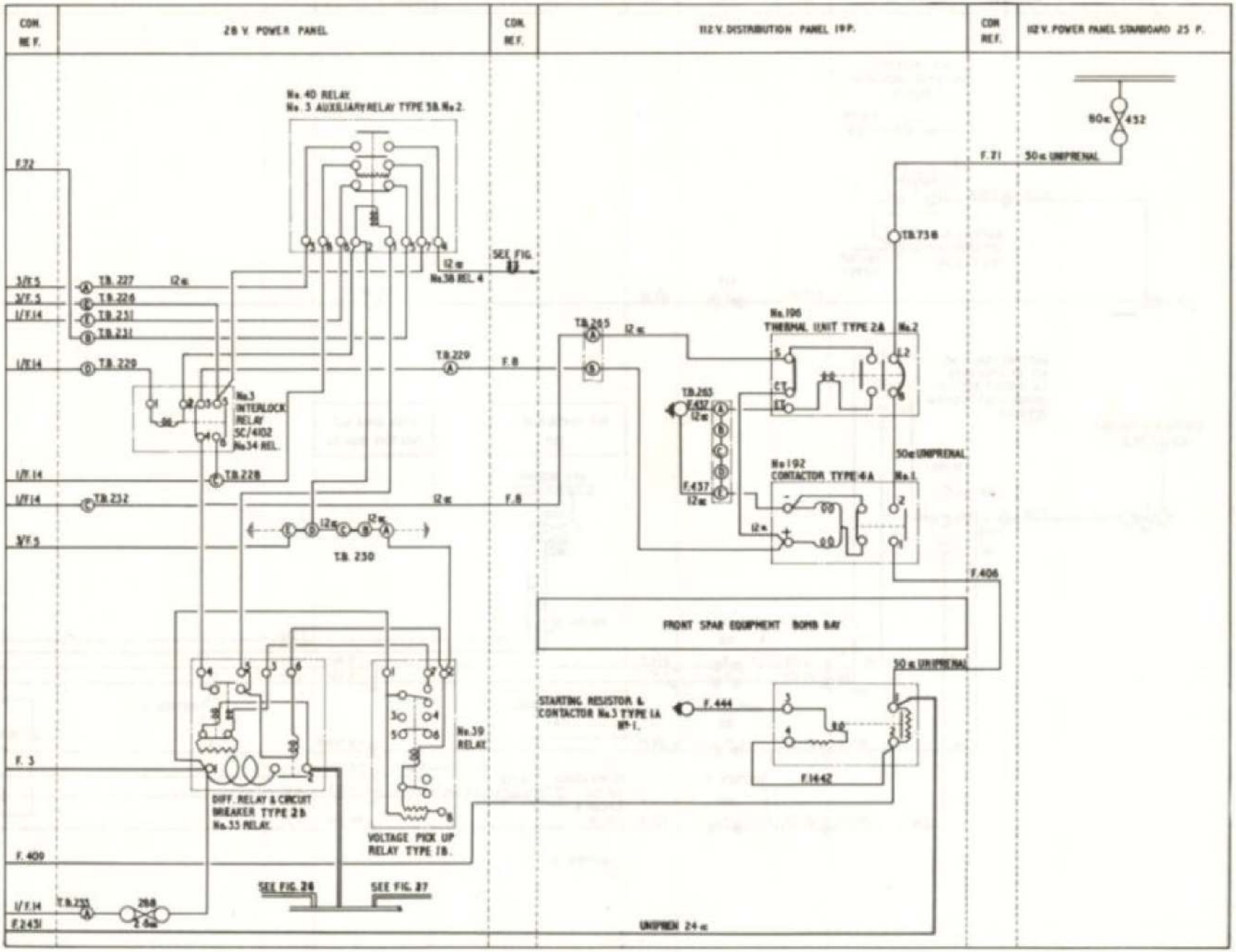


Fig. 28(2) Nº 3 rotary transformer controls

RESTRICTED

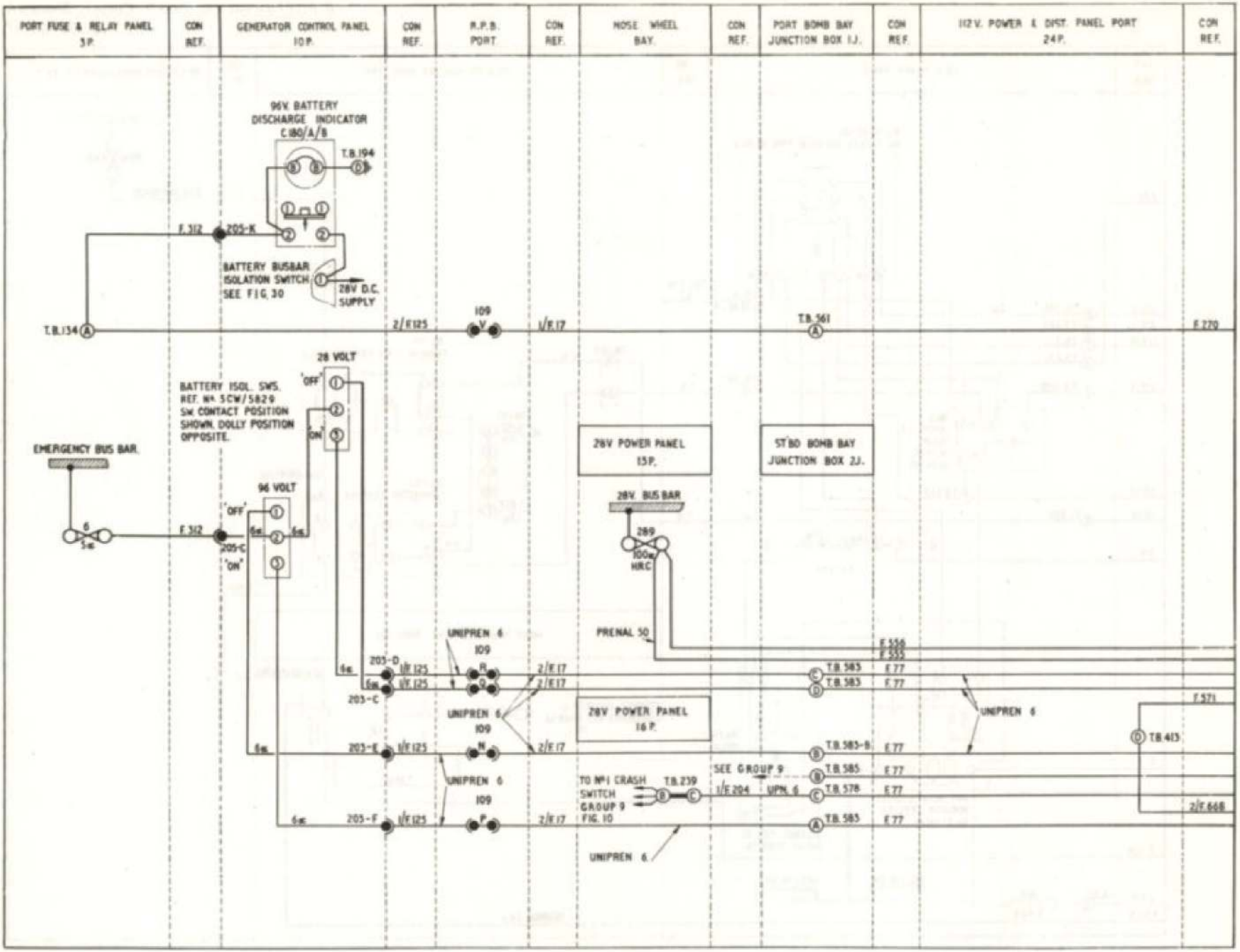


Fig 29 (1) Battery isolation controls

◂ Correction to T.B. 585 ▸

RESTRICTED

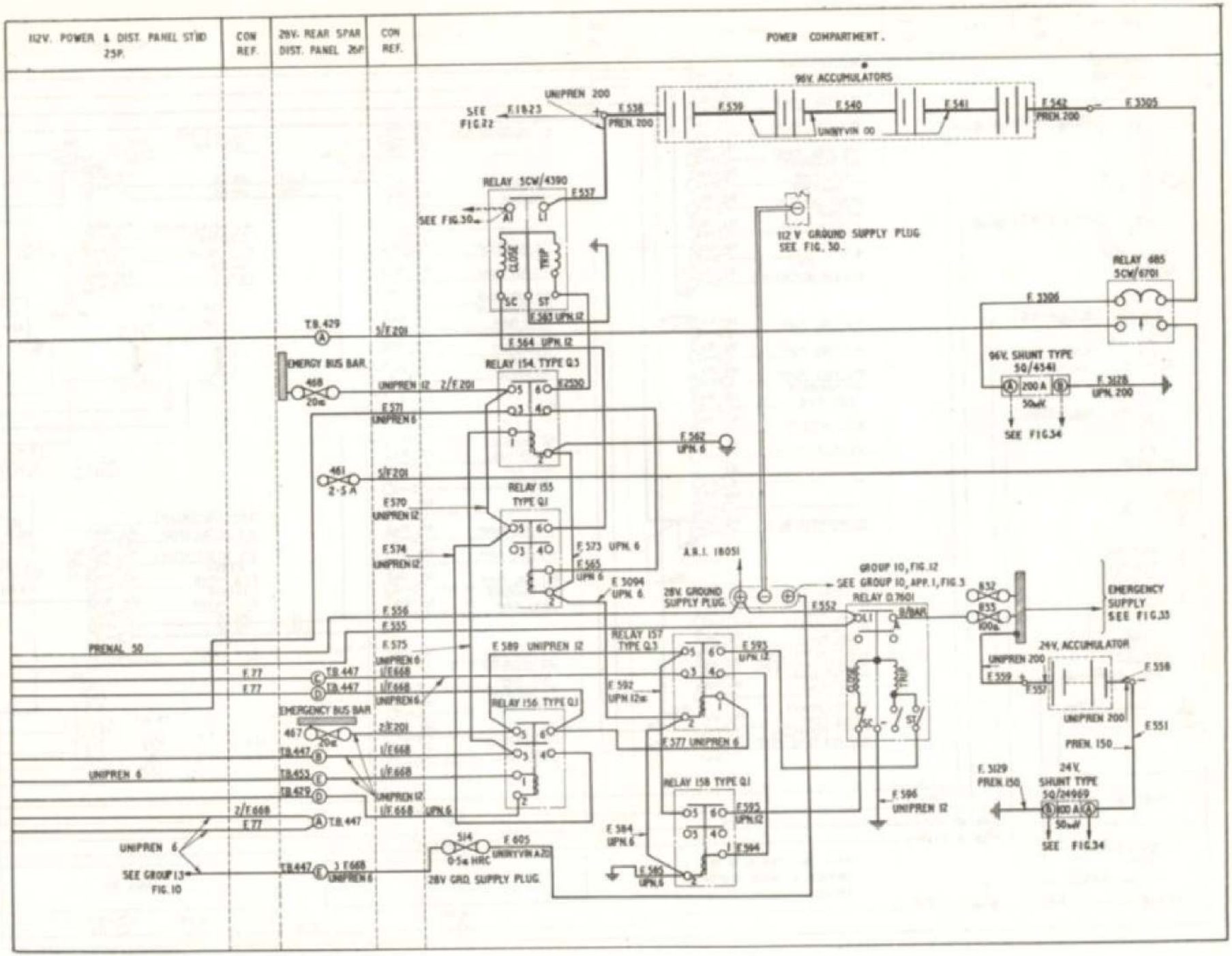


Fig. 29 (2) Battery isolation controls

◀ Parts added ▶

RESTRICTED

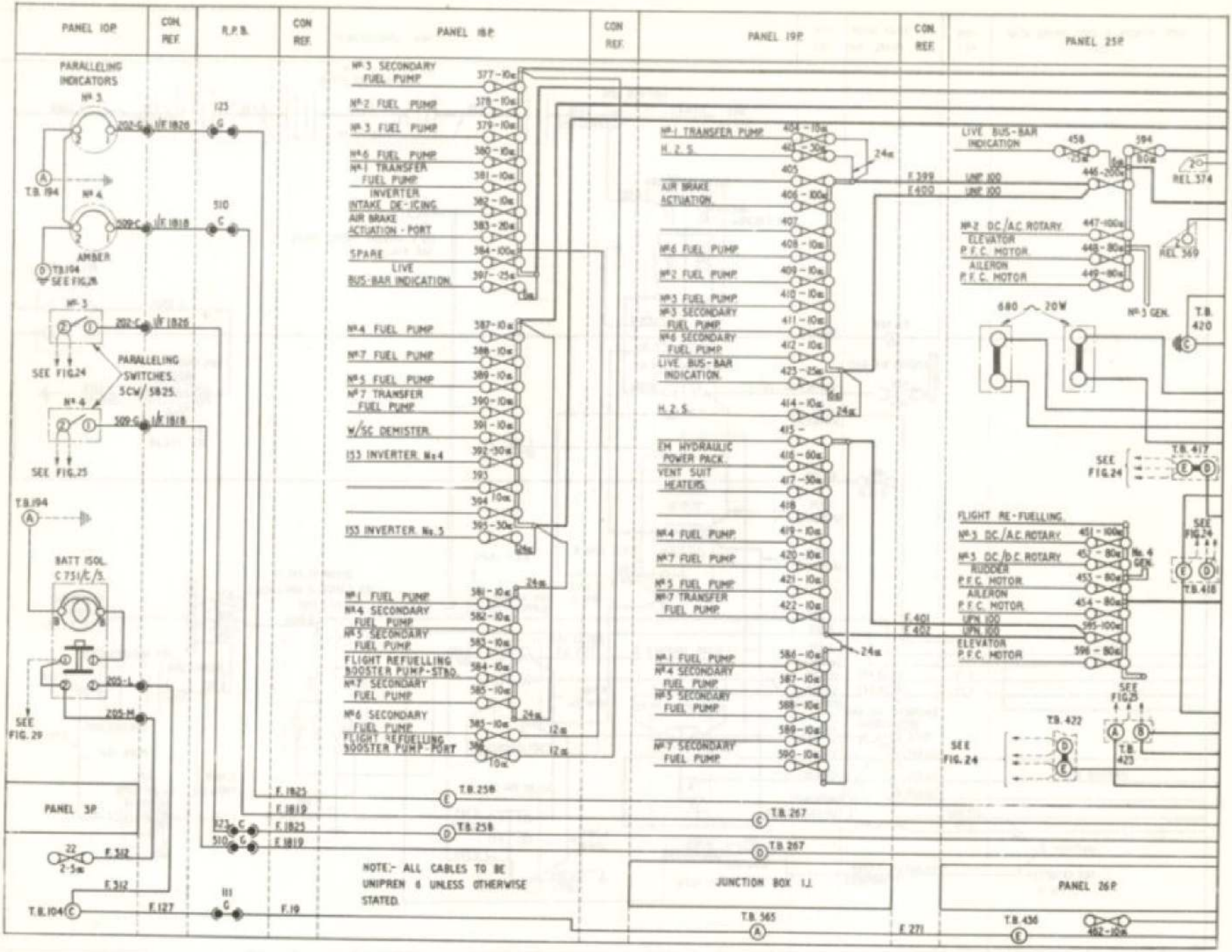


Fig. 30(1) 112-volt distribution

Minor corrections

RESTRICTED

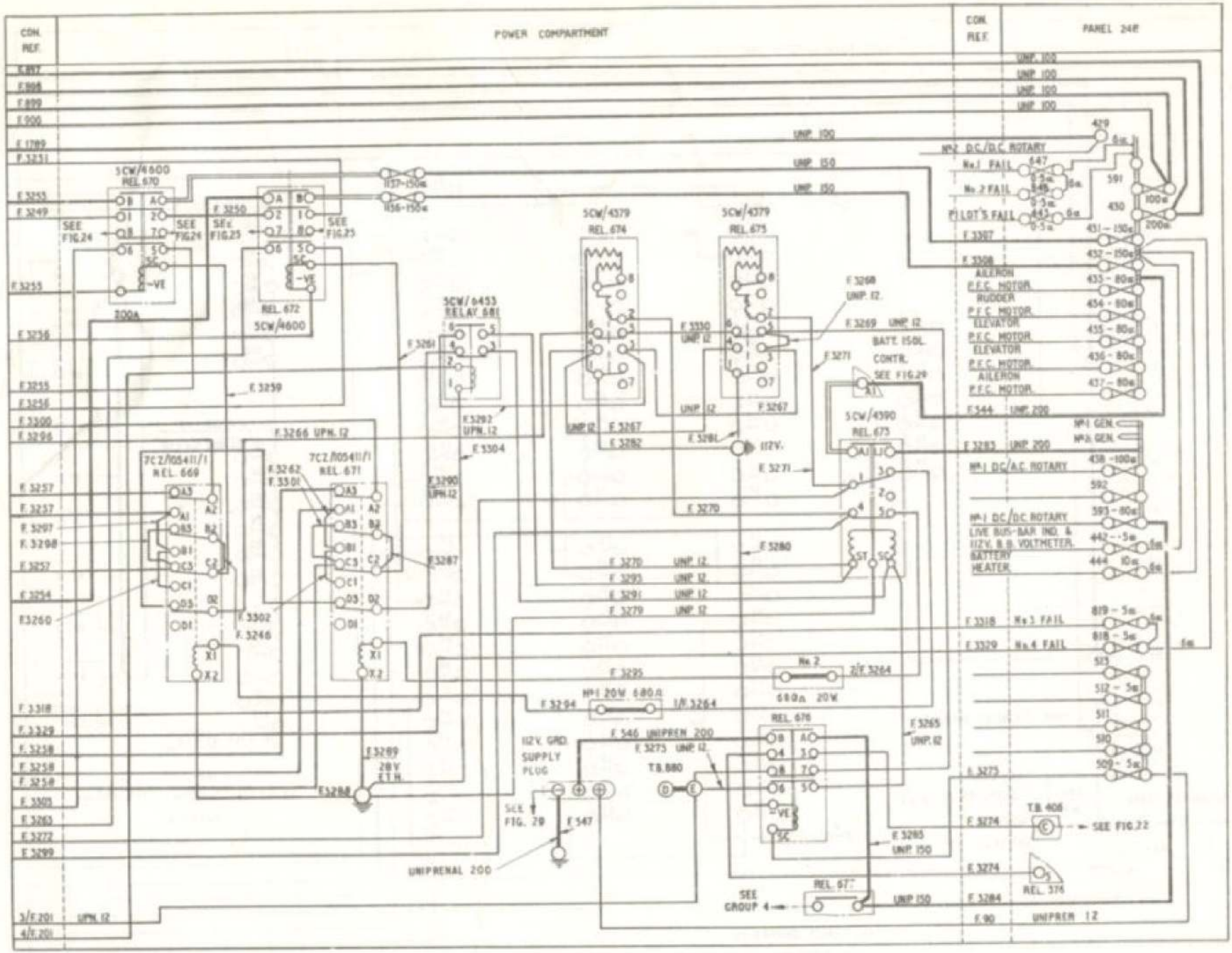


Fig. 30 (2) 112-volt distribution

Minor corrections

RESTRICTED

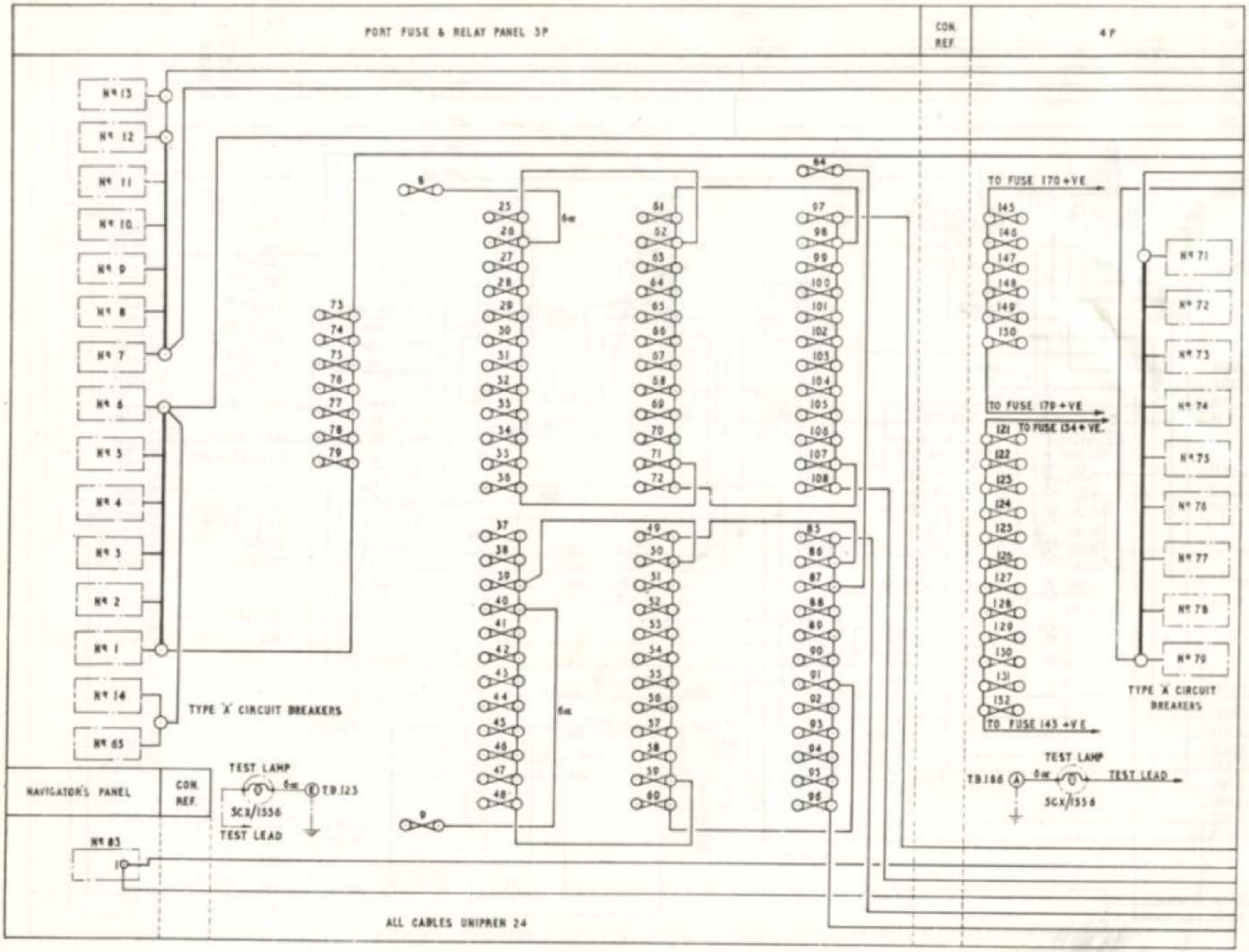


Fig. 31(1) 28-volt distribution forward of R.P.B.

◂ Mod. 1707 ▸

462716 500 5,67 H.S.A.1354

RESTRICTED

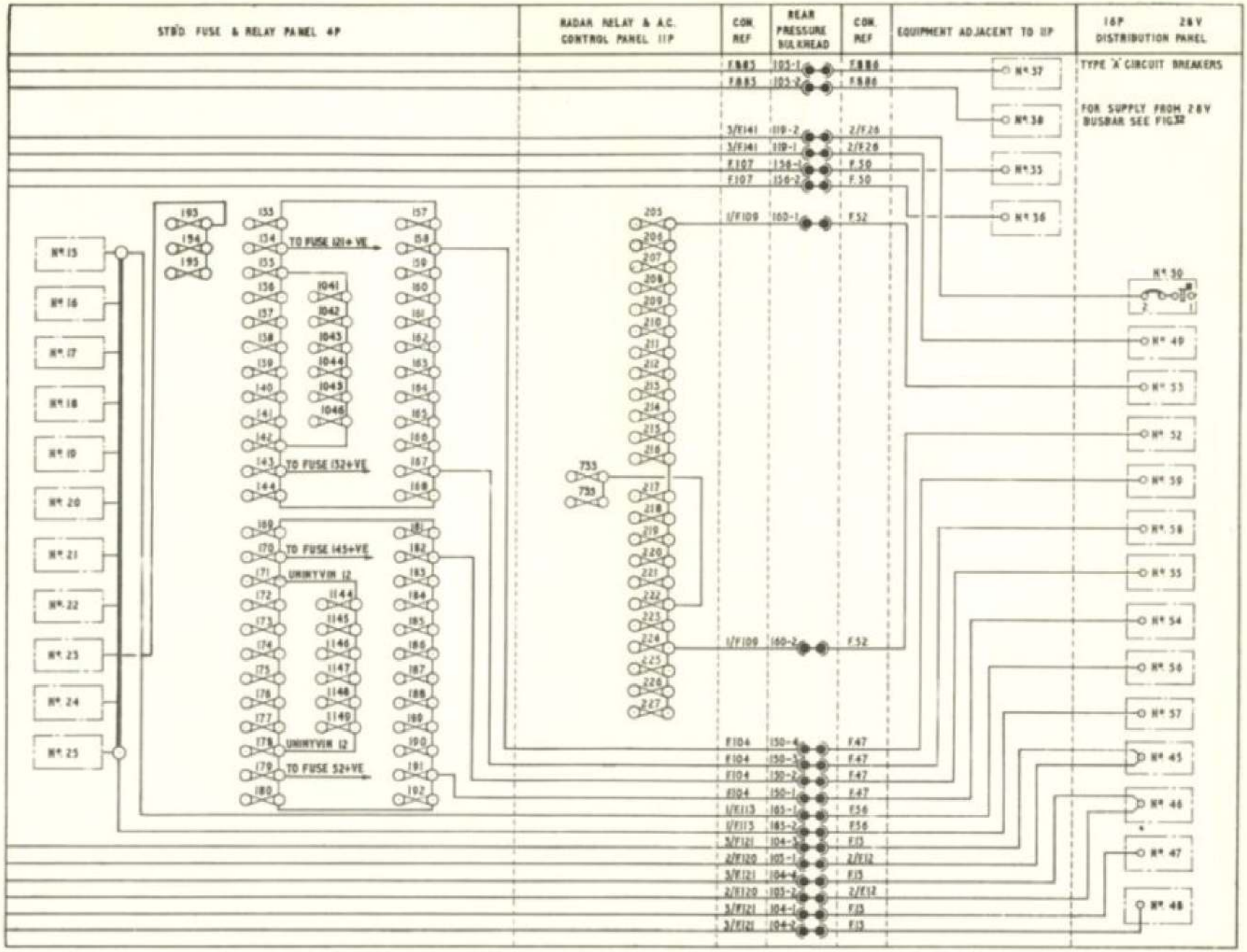


Fig. 31 (2) 28-volt distribution forward of R.P.B.

RESTRICTED

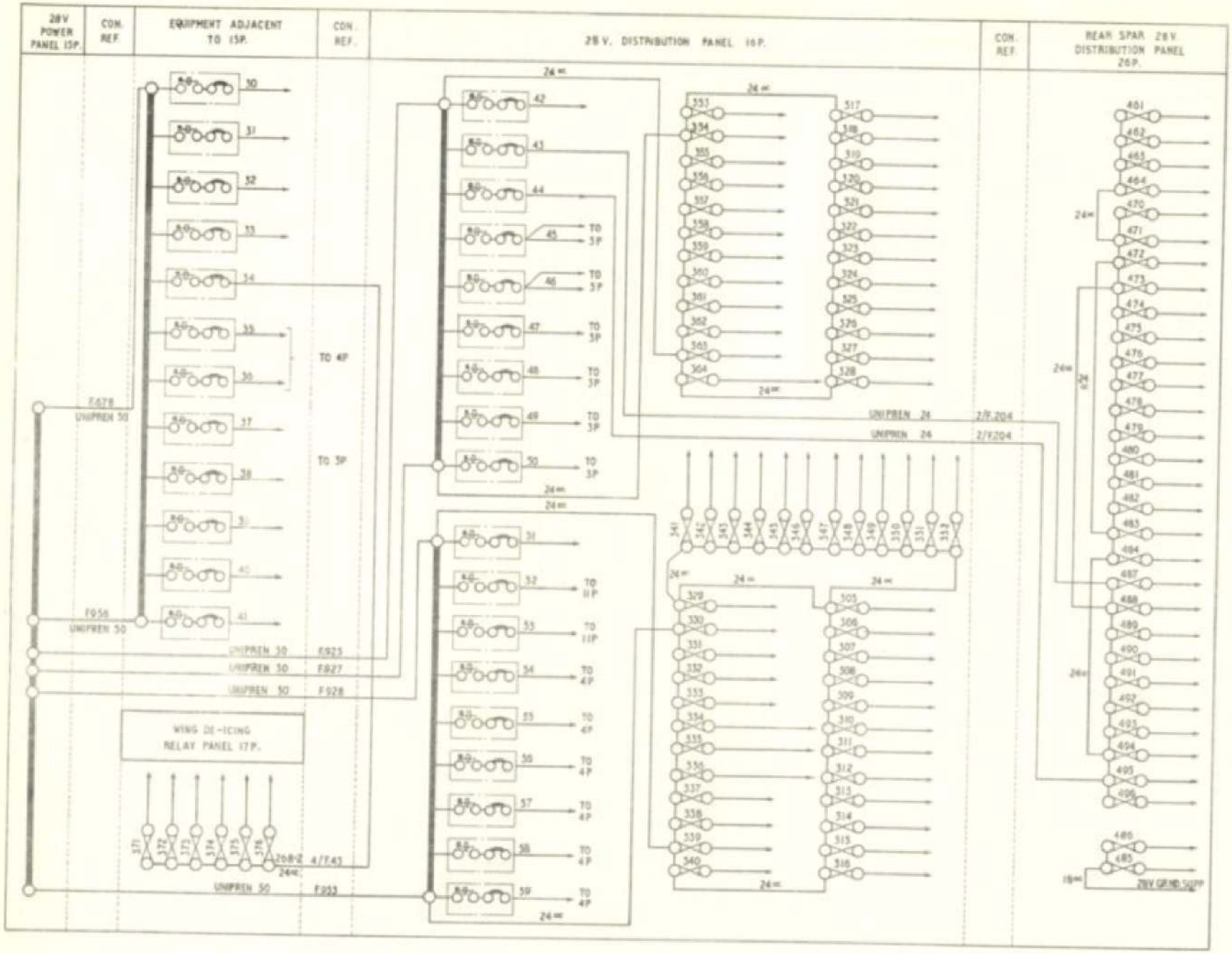


Fig. 32 28-volt distribution aft of R.P.B.- pre Mod. 613

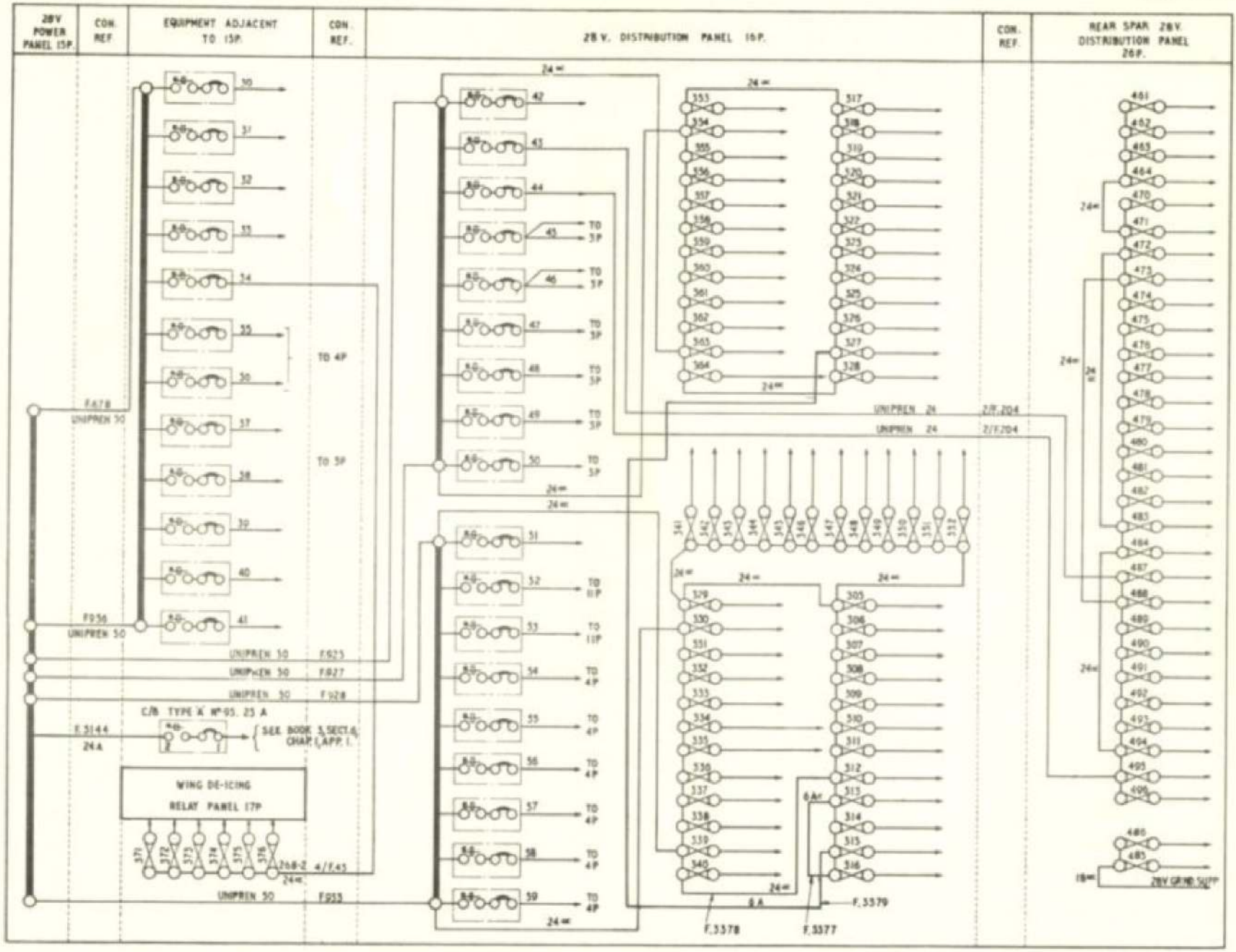


Fig. 32A 28-volt distribution aft of R.P.B. – post Mod. 613

RESTRICTED

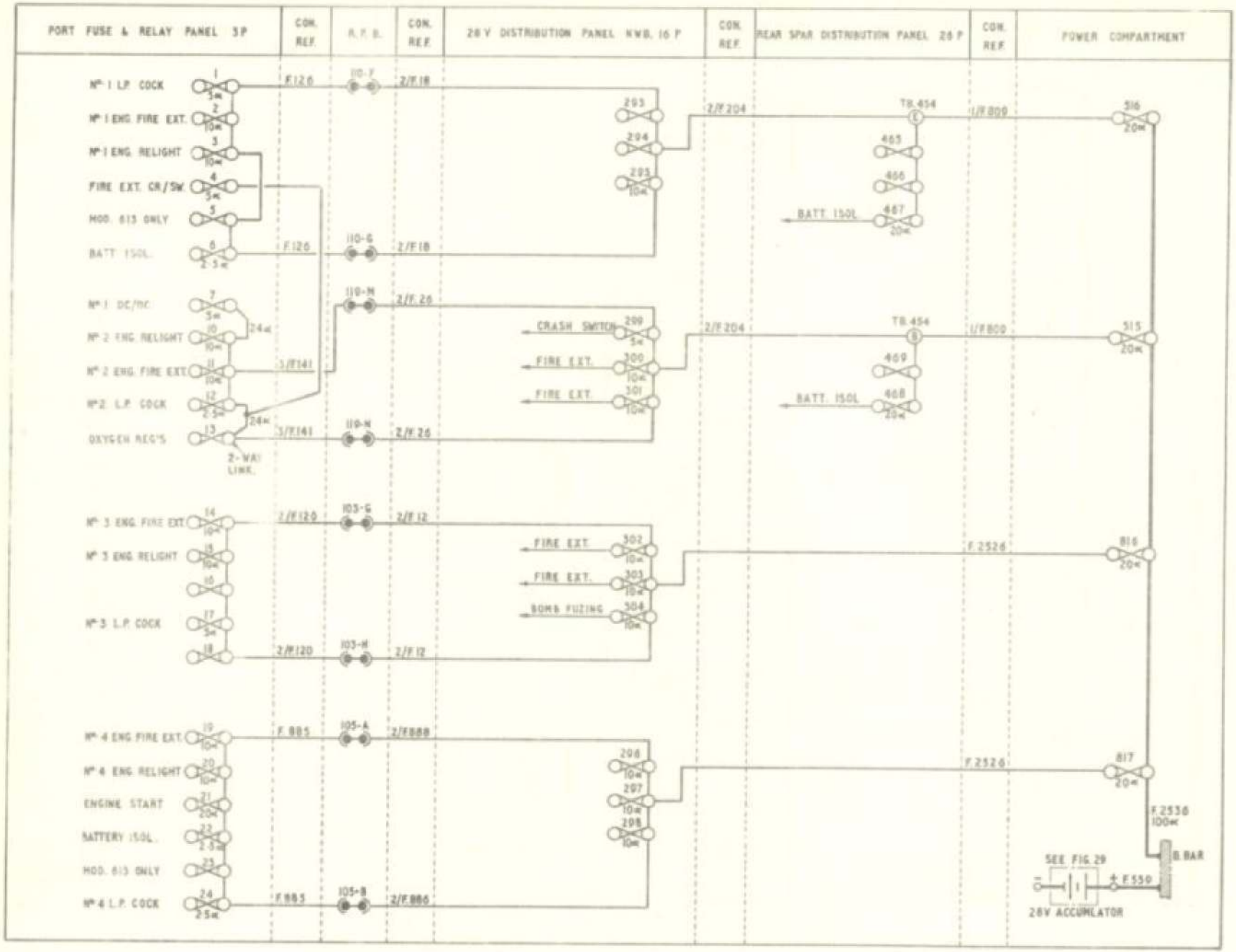


Fig. 33 28-volt emergency supplies

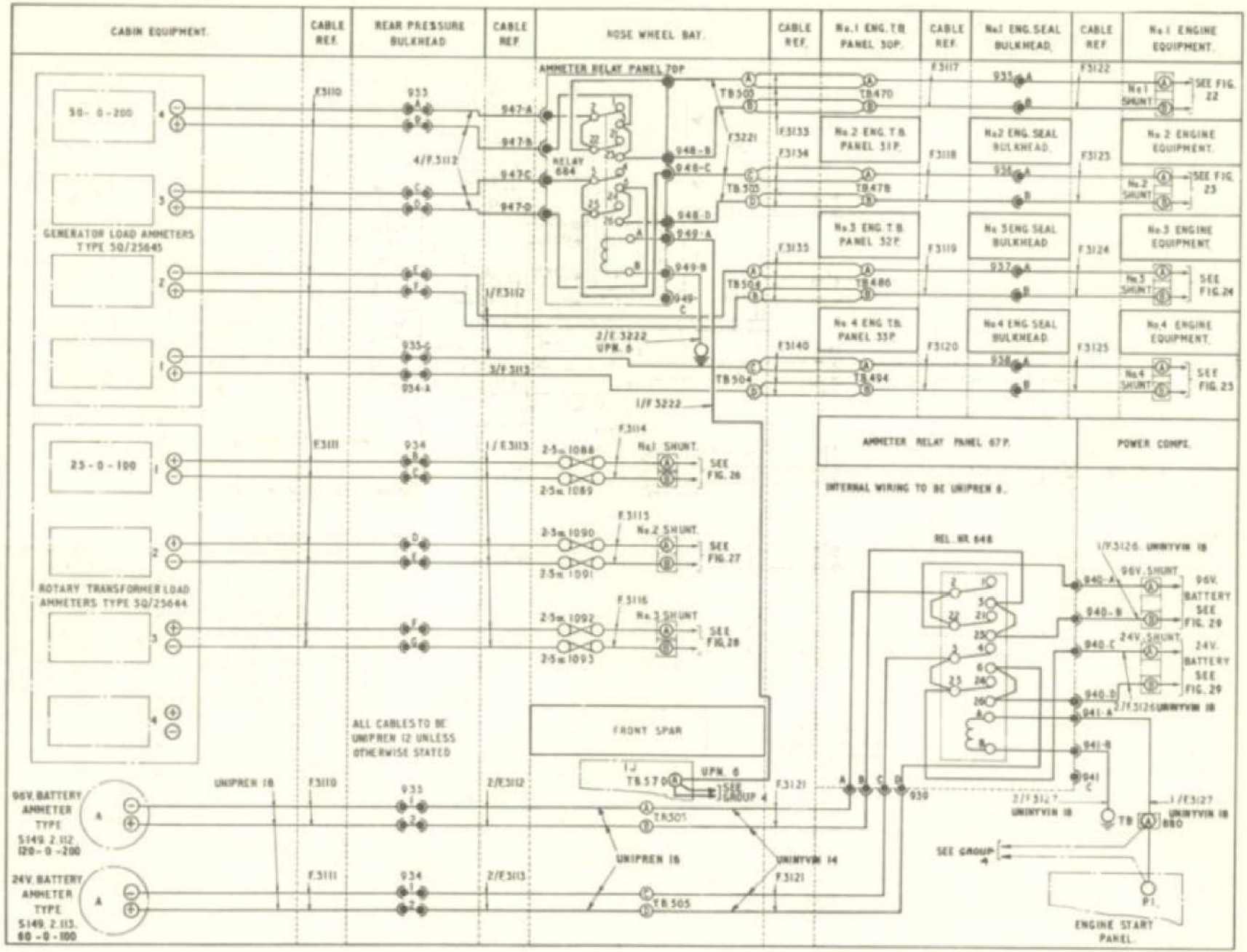


Fig. 34 Load ammeter controls – pre Mod. 1044

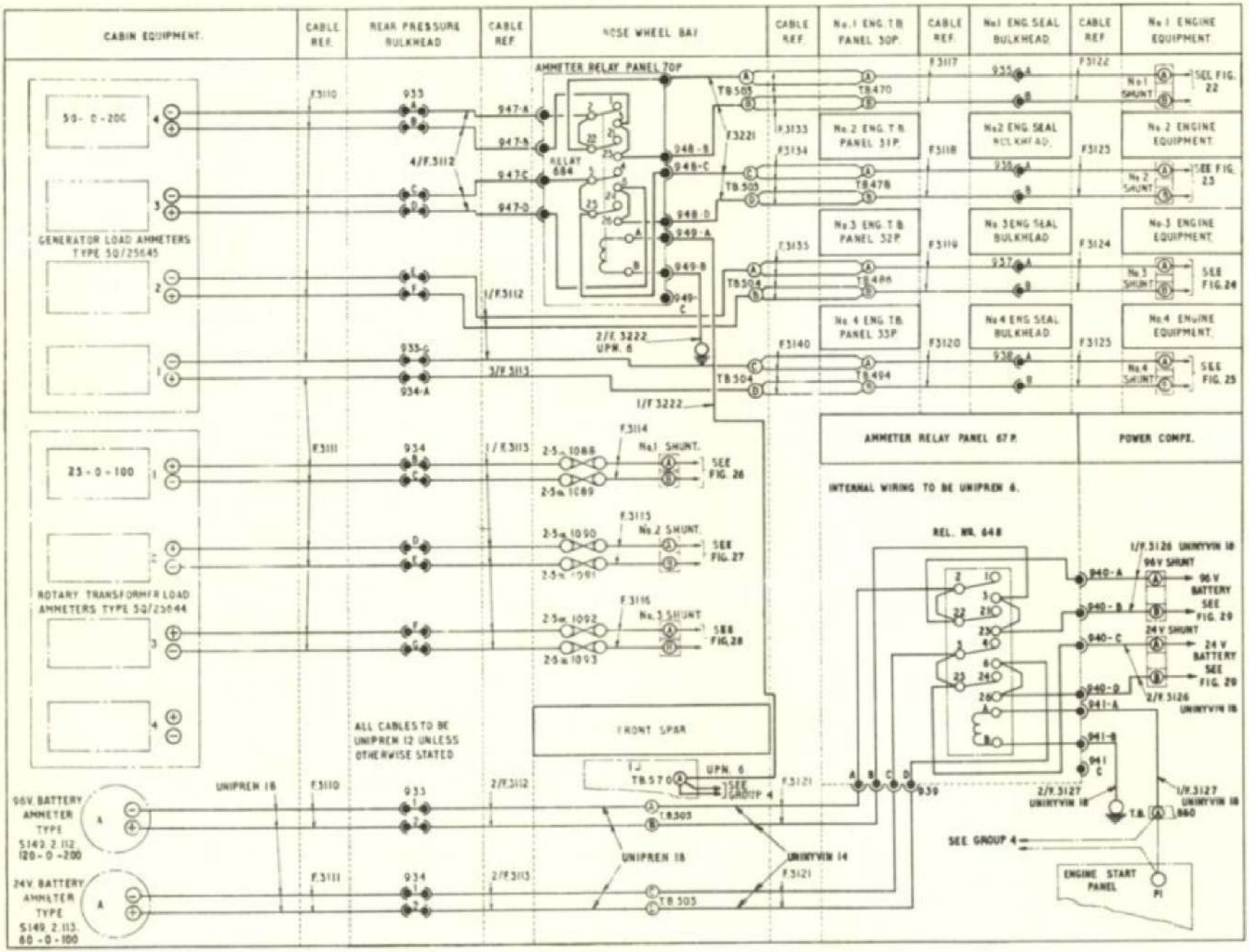


Fig. 34A Load ammeter controls – post Mod. 1044