Group E.1

A.C. SUPPLIES (CODE CH)

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A list of Appendices is given at the end of this chapter.

Introduction

1. This group contains the description and operation of the a.c. supplies circuits with information on the servicing required to maintain the equipment in an efficient condition. Routeing and theoretical diagrams are included, figs.1 and 2 showing the supply circuitry and flying instruments supplied pre and post Mods. 1015 and 1183; figs.3 and 4 showing the circuitry and instruments supplied post Mod.1375. Detailed information on the standard items of equipment fitted in these supply circuits will be found in the Air Publications listed in Table 1.

◀ **Note . . .**

On aircraft post Mod.1420 radar ranging (A.R.I.5820) is rendered inoperative by isolating the system from aircraft power supplies. ▶

DESCRIPTION

A.C. supplies

2. This circuit controls the supply to the alternating current operated flight instruments and the engine temperature control circuit described in Section 5, Chapter 2 of this volume and to the A.R.I.5820 described in Section 6, Chapter 2 also of this volume. The supply is 115 volts, 3-phase, 400 cycles per second, which is obtained from two inverters mounted on the cabin floor on the starboard side behind the seat. The flight instruments and engine temperature control are normally operated by No. 1 inverter, while No. 2 inverter supplies the A.R.I.5820, but should No. 1 inverter fail, No. 2 inverter will automatically off-load the A.R.I.5820 installation and act as a stand-by supply to maintain operation of the flight instruments and engine temperature control circuit. The No. 2 inverter does, however, supply the flight instruments while the aircraft is on the ground until the engine is started and the generators come on line. Located on the top of the a.c. junction box are two circuit breakers, one of which protects each inverter. A magnetic indicator to give indication of inverter change-over is provided on the centre instrument panel shows BLACK when No. 1 inverter is operating and WHITE when No. 2 is operating. A switch marked TEST-NORMAL is situated on the generator control panel. An inverter selector switch marked NORMAL-STANDBY is located on the rear portion of the cabin port shelf and the d.c. input to each inverter is controlled by relays. Suppressors are provided between the d.c. and a.c. sections of the circuit to minimize interference with the radio equipment. The a.c. output of the inverters and the off-loading of the A.R.I.5820 is controlled by two torque switches and a relay, while the supply to the oil pressure gauge is taken through an auto-transformer and another suppressor. The torque switches, auto-transformer, control relays and suppressors are all located within the A.C. junction box, situated on the starboard side of the cabin. The circuit is coupled to the engine starter master switch and to the generators and batteries circuit. It can also be operated from a ground supply for test purposes.

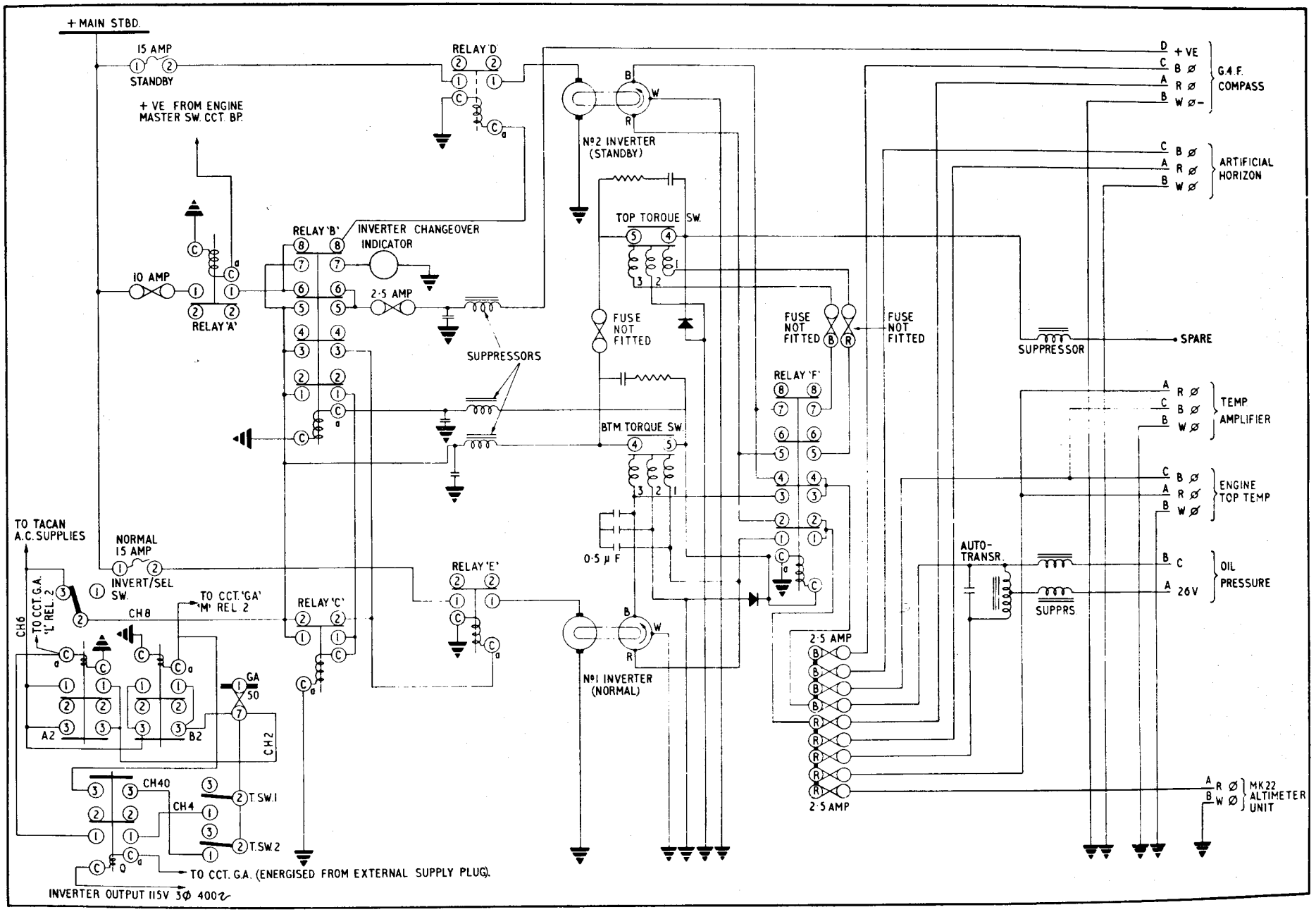

Fig. 1 A.C. supplies circuit — pre Mod. 1375 (theoretical)

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Operation

3. With 28V d.c. supply available at the bus bars, when the engine master switch is selected ON a supply from the engine starter circuit breaker will energize the coil of relay A. With this relay energized, supply is passed via the 10 amp fuse and contacts 1a-1 of relay A, contacts 8-8a of de-energized relay B and contacts 3-2 of the radar ranging switch to energize relay D and supply No.2 inverter via the STANDBY (No.2) circuit breaker and contacts 1-1a of relay D. This inverter will now supply a.c. to the flight instrument via contacts 4-4a, 2-2a of de-energized relay F and the phase bus bars as shown in figs.1 and 3. An additional supply via contacts 1a-1 of relay A, contacts 6-6a of relay B, a 2.5 amp fuse and suppressor is taken as d.c. bias for the Type G4F compass. Post Mod.1375 (fig.3) a supply is taken via a 5 amp fuse and contacts 3a-3 of relay A to supply the d.c. input to the Type 375 static inverter which operates the Mk.30B height encoding altimeter.

4. When the engine is started and the generators have come on line, the main circuit breakers close and relays A.2 and B.2 are energized. A supply is then fed via the contacts of relay A.2 or B.2, the test switch, the inverter selector switch and contacts of relay C, which are made while this relay is de-energized, to energize relay E. With relay E energized, a supply is made via the NORMAL circuit breaker to No. 1 inverter, which commences operation to feed the bottom torque switch and contacts 1 and 3 of relay F. When the output reaches 100 volts, the torque switch operates, its contacts 4–5 complete a circuit to energize relays B and F. A supply is also fed to contacts 5–4 of the top torque switch, via a fuse, in preparation for supplying the A.R.I.5820 junction box and its inverter when the top torque switch is energized. When relay F operates, the output of No. 1 inverter is connected to the a.c. bus-bars to supply the a.c. loads. When relay B operates, relay D is de-energized, thus isolating No. 2 inverter, which ceases operation. At the same time a supply is passed via contacts 7–7 of relay B to feed the inverter change-over indicator to show BLACK i.e. normal operation; contacts 5–5 continue the supply via the fuse and suppressor to the G.4F compass; contacts 3–3 pass a hold-on supply to relay E; while contacts 1–1 supply relay C. Relay C, which receives a hold-on supply through its own contacts, operates, thereby isolating the main circuit breaker supply (*Group B.I*) from the coil of relay E. This ensures that, in the event of failure of No. 1 inverter and consequent de-energization of relay B, relay E will not be re-energized by the main circuit breaker supply.

5. When the A.R.I.5820 is switched ON, a supply is conducted from the 10 amp. fuse to the contacts of relay A, which are closed while this relay is energized and through the radar ranging control switch to the coil of relay D. With relay D energized, the supply from No. 2 circuit breaker to No. 2 inverter is completed and the inverter commences operation to feed the top torque switch and the phase bus-bars in the A.R.I.5820 junction box, via the contacts of relay F, which are made while this relay is energized. When the output of No. 2 inverter reaches 100 volts, the top torque switch will make contact to supply d.c. to the A.R.I.5820 junction box and Type 206 inverter (*para. 4*) and the A.R.I.5820 commences operation.

6. If No. 1 inverter fails, the bottom torque switch will be de-energized, thus breaking contact and de-energizing relays B and F. The de-energizing of relay B breaks the supply to the inverter change-over indicator and de-energizes relay E to isolate the supply to No. 1 inverter. The de-energizing of relay F causes the top torque switch to de-energize and break the supply to the A.R.I.5820, thus off-loading this equipment and rendering that installation inoperative. At the same time, No. 1 inverter is isolated from the phase bus-bars and the output of No. 2 inverter is connected to the bus-bars, thus maintaining the flight instruments in operation. This whole operation takes place automatically and the inverter change-over indicator provides warning that failure has occurred. A similar process takes place if the supply fails due to a fuse failure or an open circuit.

7. Placing the inverter selector switch in the STANDBY position will break the hold-on circuit of relay C and de-energize this relay. Returning the selector switch to the NORMAL

TABLE 1

Equipment type and Air Publication reference

Equipment Type	Air Publication
Inverters, Type 100A	A.P.113D–0104–16
Auto-transformers, Smiths 213 M.V.	A.P.113D–0400 series
Torque switches, Type B.2, E.A.P.2340	A.P.113D–1384–1
Circuit breakers, Type A.3	A.P.113D–0900 series
Suppressors, Type F. No. 2	A.P.113D–1902–1
Magnetic indicator, Dowty, Type C.5165Y, Mk. 1	A.P.113F–0615–1
Relays, Type S.1 and S.3	A.P.113D–1309–1
Test switch, C.W.C. Type XD.782 No. 4 Inverter selector switch C.W.C. XD.778 No. 4	A.P.113D–1100 series

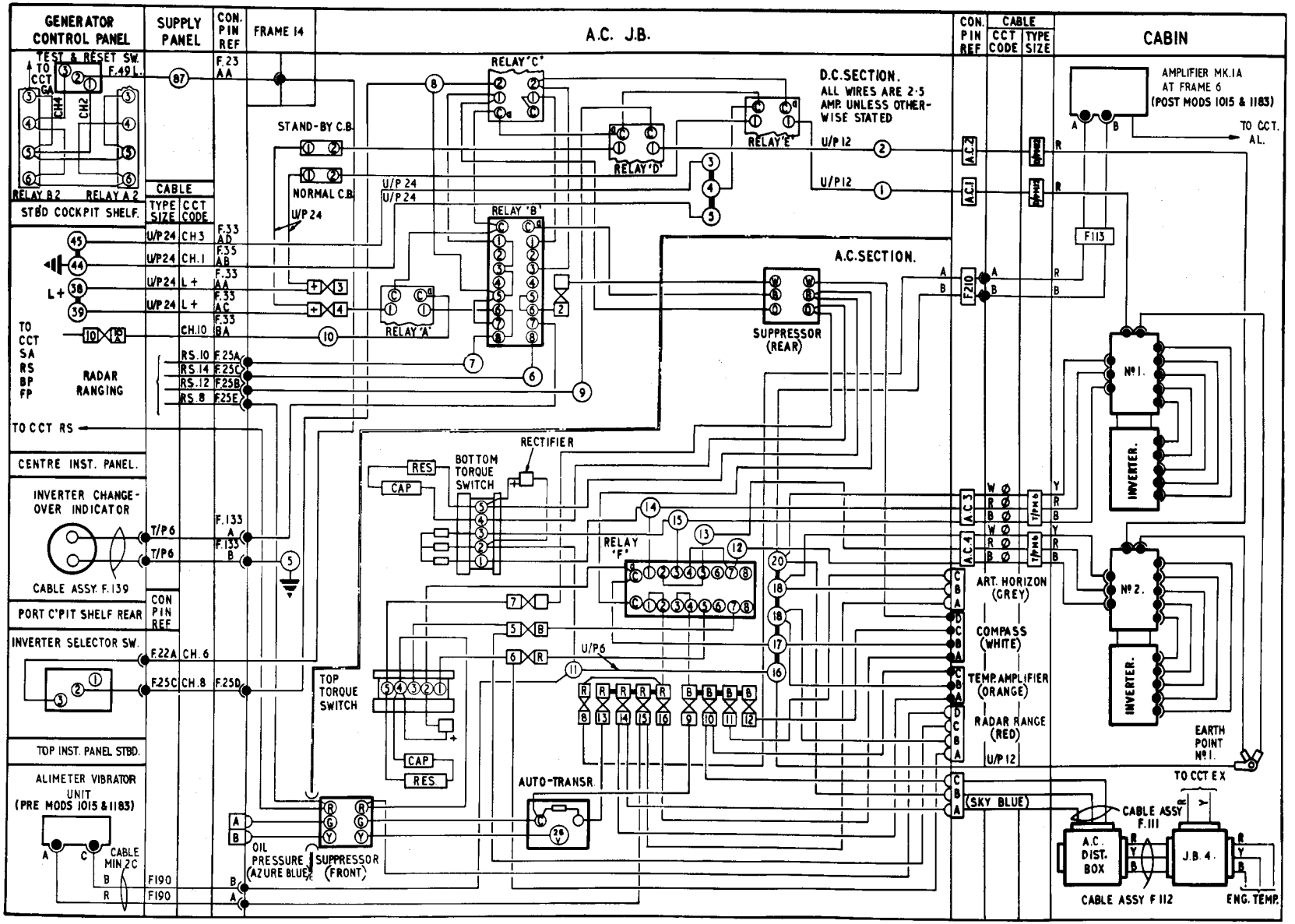

Fig. 2 A.C. supplies circuit — pre Mod.1375 (routeing)

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position will now energize relay E and complete the supply to No. 1 inverter which will recommence operation as described in para. 4. This facility is used to allow No. 1 inverter to come back on line if its failure is of a temporary nature.

SERVICING

General

8. For general servicing of the electrical system as a whole, reference should be made to Group A.1 of this chapter. Apart from keeping all the components clean and carrying out the standard routine tests of security and serviceability as described in the appropriate Air Publications quoted in para. 1, the only other servicing is the testing of the standby circuit as described in para. 9 of this group.

Ground testing stand-by circuit

9. During daily servicing and before each flight, the operation of the main and standby inverters, together with the automatic change-over circuit should be tested for correct functioning. The method to be adopted is as follows :—

(1) Ensure that the battery master switch is in the ON position or that an external supply is connected to the aircraft's external supply plug (*Group A.1*).

(2) Switch on the engine master switch and check that No. 2 inverter runs up and supplies the G.4.F compass, the artificial horizon, and the oil pressure gauge. Check that this applies :—

(*a*) With the inverter selector switch in both NORMAL and STANDBY positions.

(*b*) With the radar ranging in both ON and OFF positions.

Then return the inverter selector switch to NORMAL and the radar ranging switch to the OFF positions.

(3) Operate and hold ON the test switch on the generator control panel (thus simulating "engine-running" conditions). Check that No. 2 inverter ceases operation and No. 1 inverter runs up, the instruments originally supplied by No. 2 inverter now being supplied by No. 1. The change-over indicator should now show BLACK i.e. normal operation. Then check that :—

(*a*) Selecting STANDBY with the inverter selector switch causes No. 2 inverter to take over from No. 1 inverter.

(*b*) Returning the inverter selector switch to NORMAL brings No. 1 inverter into operation again and shuts down No. 2 inverter.

(4) With the inverter switch at NORMAL, switch the radar ranging switch ON. Check that No. 2 inverter runs up and the radar indicator shows WHITE i.e. normal operation. Then leaving the radar on check that :—

(*a*) Selecting STANDBY with the inverter selector switch causes No. 1 inverter to shut down so that the instruments are supplied by No. 2 and the radar becomes inoperative. The change-over indicator will show WHITE and the radar indicator BLACK.

(*b*) Returning the inverter selector switch to NORMAL brings in No. 1 inverter again and No. 2 reverts back to supply the radar.

(5) Leaving the radar switch ON, trip the circuit breaker for No. 1 inverter (*this simulates a failure*) and observe that this inverter ceases operation, also that the radar ceases to function. Check that the instruments continue to operate, however, as these are supplied by No. 2 inverter, the radar having been off-loaded. The change-over indicator will now show WHITE and the radar indicator BLACK.

(6) Re-set No. 1 inverter circuit breaker and note that there is no resulting change in the operation of the inverters i.e. No. 2 inverter is still supplying the instruments and No. 1 not functioning. Momentarily switch the inverter selector switch to STANDBY and back to NORMAL again. Check that No. 1 inverter recommences operation and supplies the instruments while No. 2 reverts back to supplying the radar.

(7) Trip No. 2 inverters circuit breaker and observe that No. 2 inverter and the radar stop functioning. Re-set the circuit breaker and check that the inverter and radar recommence operation.

(8) Release the test switch on the generator control panel and allow it to come to the NORMAL position (*this simulates engine or generator failure*). Check that No. 1 inverter and the radar cease operating and that the instruments are supplied from No. 2 inverter. This completes the tests on the inverter change-over circuit.

(9) Return all switches to OFF or NORMAL positions and disconnect the external supply if used.

Setting up inverters

10. The procedure for setting up the inverters on the bench, is given in the Air Publications quoted in Table 1.

REMOVAL AND ASSEMBLY

General

11. The recommended procedures for the removal of the inverters and the a.c. junction box are described in Group A.2. For removing the remainder of the components no special instructions are necessary. The locations of and means of access to the components are given in Group A.3.

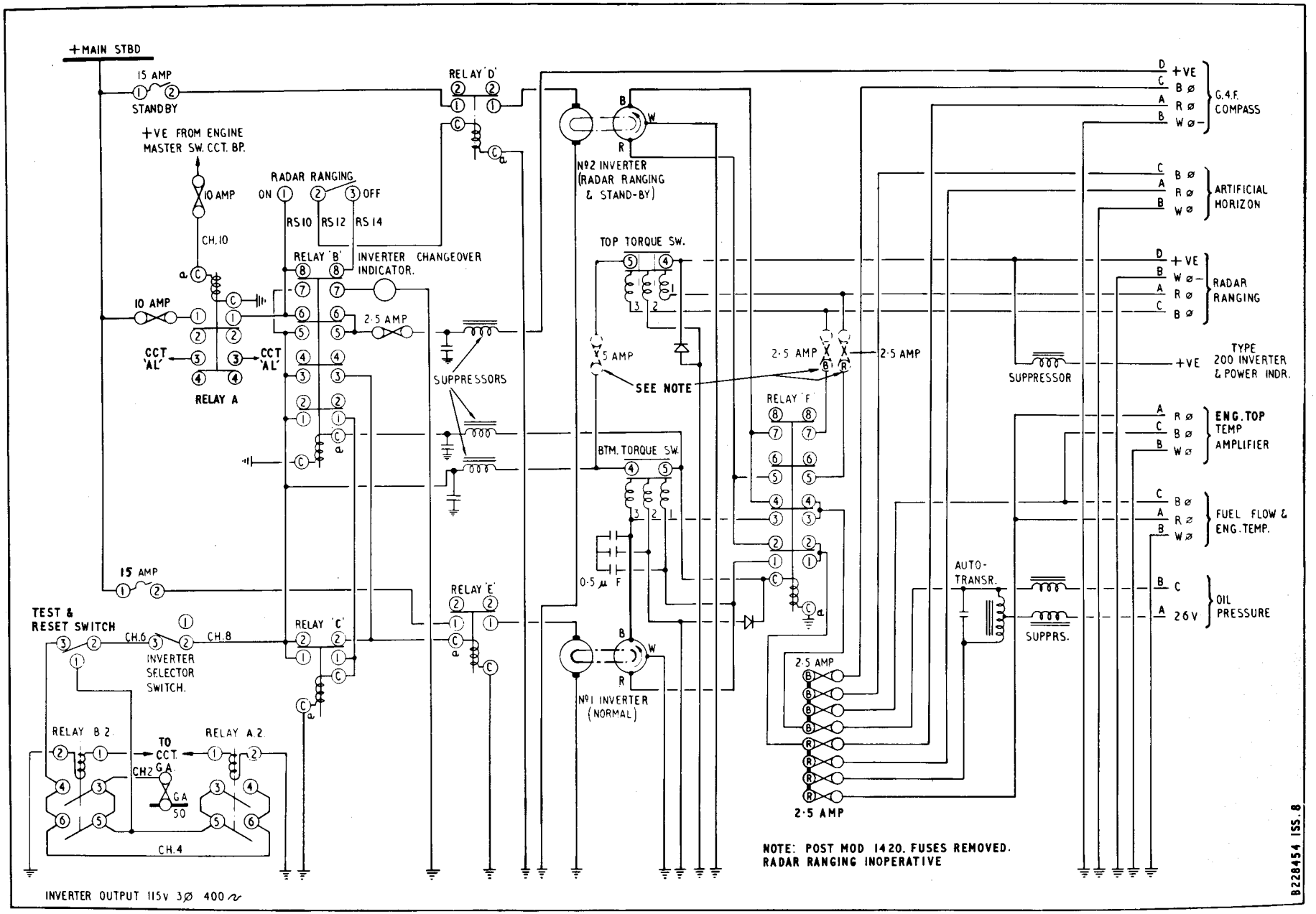

Fig. 3 A.C. supplies circuit — post Mod. 1375 (theoretical)

◀ (minor amendment. Mod.1420 added) ▶

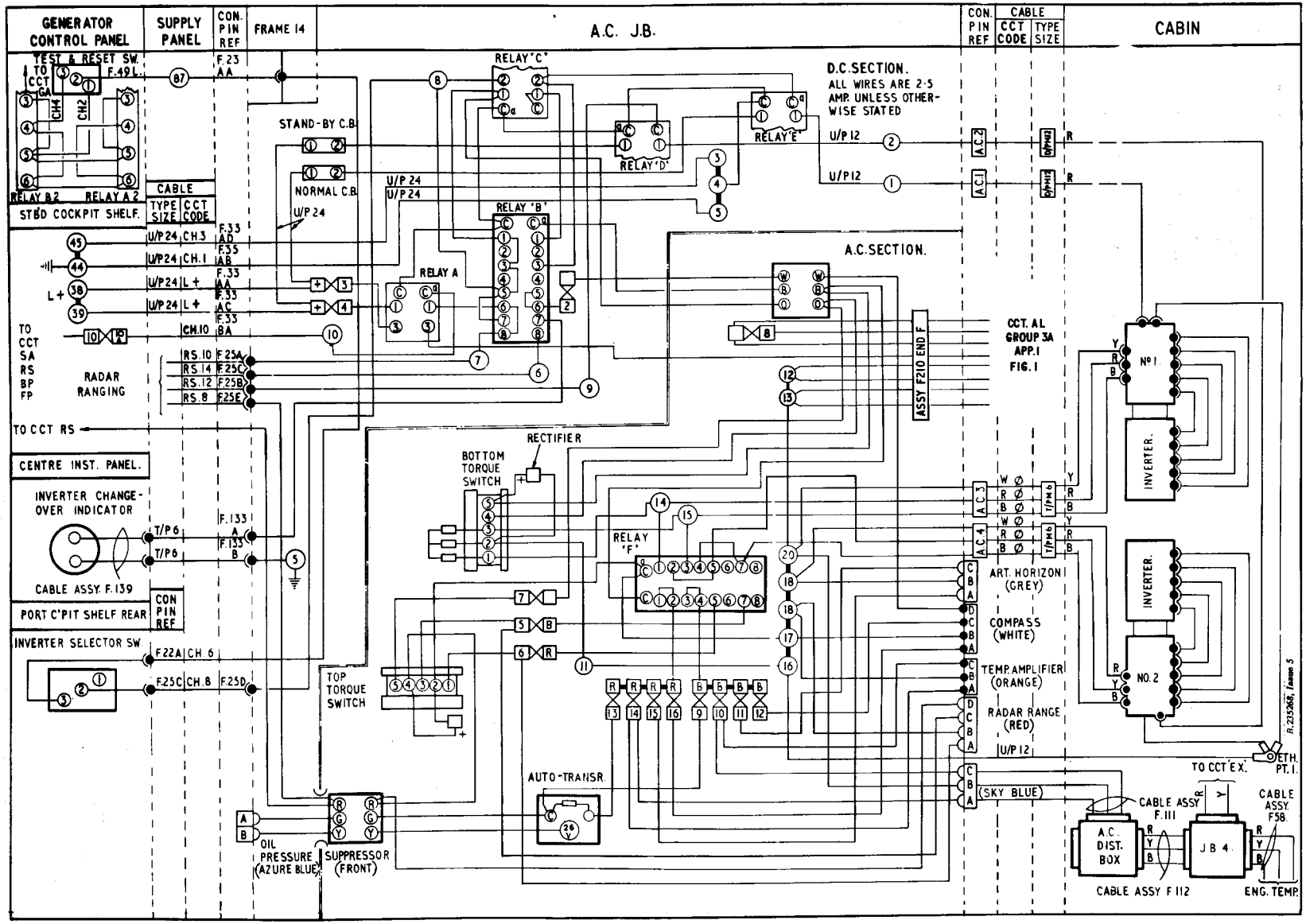

Fig. 4 A.C. supplies circuit – post Mod.1375 (routeing)

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Appendix 1 - MODIFICATION 1320 (S.O.O.)

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Introduction

1. This Appendix describes the revised a.c. supplies circuit introduced by Mod.1320 (*Tacan*) into certain Mk. 6 aircraft. Circuit changes are contained in the wiring diagrams at figs. 1 and 2 of this Appendix. Circuit operation for the A.R.I.18107 (*Tacan*) equipment a.c. supplies is described in Sect. 5, Chap. 1, Group H.1, Appendix 2.

DESCRIPTION

General

2. Generator control relays A.2 and B.2 are replaced by new type relays A.2 and B.2 (*Group B.1*). The duplicated wiring through the relays provides supplies to No. 1 inverter and to the Tacan equipment, so that if either relay A.2 or B.2 is de-energized supplies will be maintained to both equipments. An additional inverter test switch is introduced and is mounted on the generator control panel. The revised circuit wiring to the switches provides for the ground testing of the inverters and the automatic change-over circuit, when an external supply is connected to the aircraft.

Operation

3. When the engine is started and the generators are on line (*Group B.1*) relays A.2 and B.2 are energized and a duplicated supply is routed through the relay contacts to the Tacan equipment (*Group H.1*) and through the inverter selector switch, relays C and E to No. 1 inverter.

Generator failure

4. In the event of failure of either generator, either relay A.2 or B.2 is de-energized but the supply to the Tacan equipment and No. 1 inverter is maintained by the duplicate supply fed through the other relay. If either of the generators fail while No. 2 inverter is supplying the loads normally supplied by No. 1 inverter, the d.c. supply to No. 2 inverter is not interrupted. The supply to the Tacan equipment is unaffected by failure of either No. 1 or No. 2 inverter, but in the event of failure of the Tacan equipment inverter, alternative supplies are not available and the equipment should be switched off.

External supply

5. With the external supply connected to the aircraft, hold-off relay Q is energized and a supply is then available from a fuse, via the inverter test switches to the coils of relays A.2 and B.2. The operation of the test switches will cause relays A.2 and B.2 to be energized allowing the supply through the relay contacts to the Tacan start switch and also to No. 1 inverter.

Note . . .

With the battery master switch ON *and the external supply plug removed from the aircraft, the circuit to the Tacan equipment and No. 1 inverter is broken by the open contacts of de-energized relays A.2 and B.2. No.2 inverter will however, operate, providing the engine start master switch is placed to the* ON *position.*

Ground testing

6. Ground testing the a.c. supplies and control circuit is carried out with the engine stopped, the battery master switch OFF, and an external supply connected to the aircraft (*Group B.1*). When an external supply is connected, the hold-off relay Q is energized and contacts 1–1 and 3–3 feed a supply from the inverter test switches, which, when operated energize relays A.2 and B.2. By use of the inverter change-over selector switch and the inverter test switches, airborne running conditions can be simulated. The inverters can be tested separately, or with the engine master switch on, the automatic change-over sequence of both inverters can be tested. The tests should be made during daily servicing and before each flight using the following procedure :—

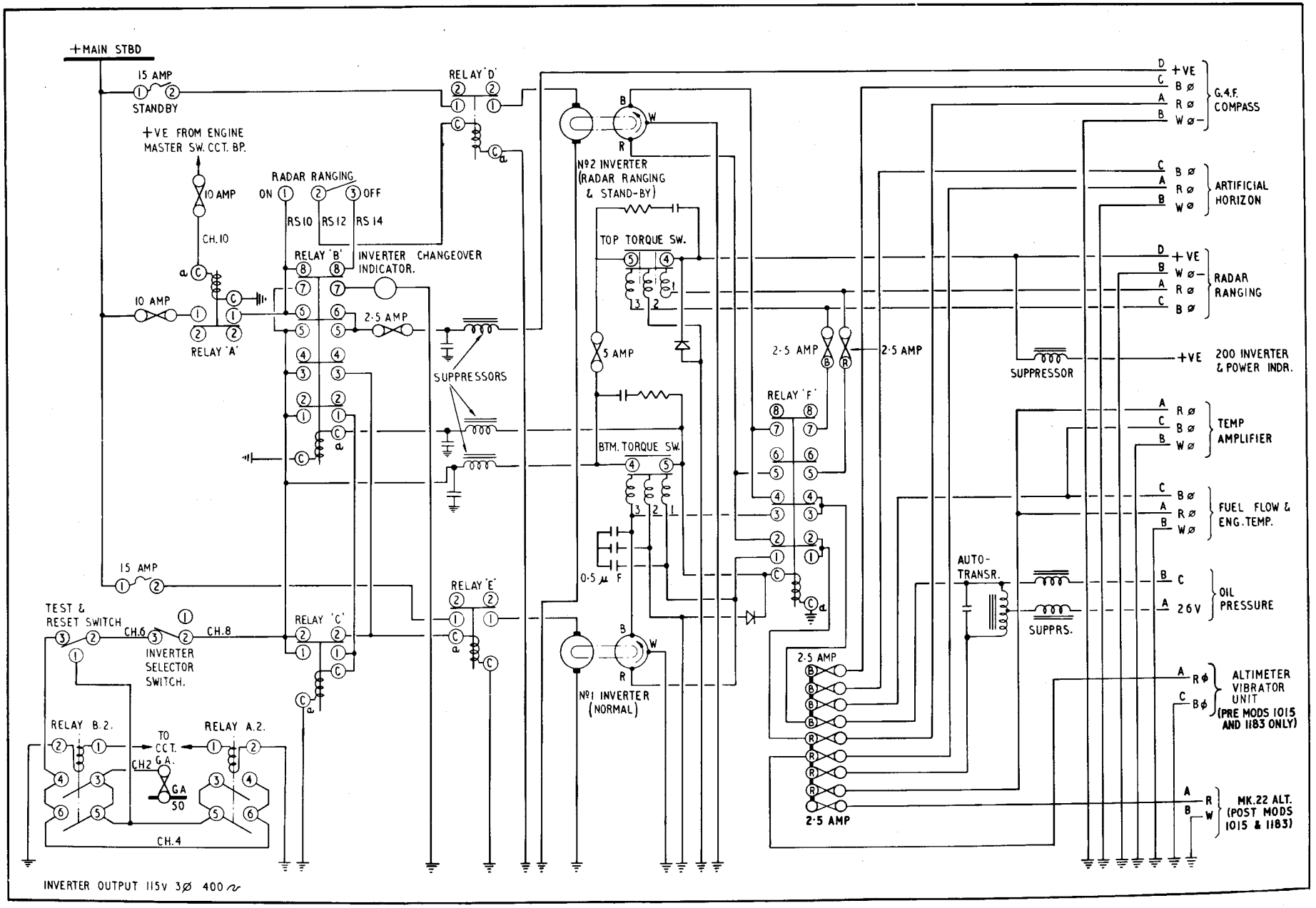

Fig. 1 A.C. supplies circuit (theoretical)

◀ (minor amendment) ▶

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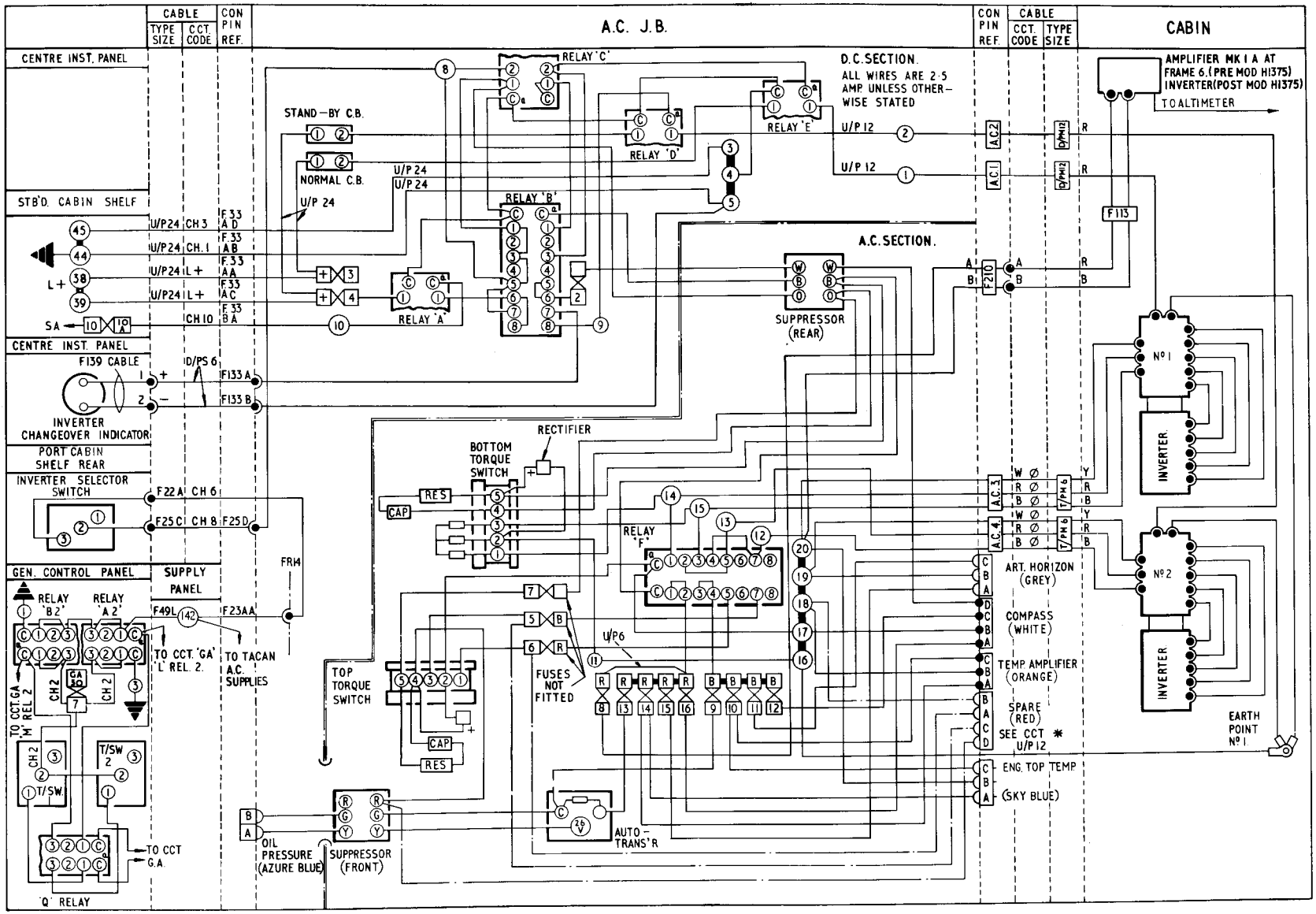

Fig. 2 A.C. supplies circuit (routeing)

◀ (minor amendment) ▶

(1) Ensure that the battery master switch is OFF, and that an external supply is connected to the ground supply plug. Check that the inverter selector switch is set to NORMAL.

(2) Put the engine master switch to ON. Check that No. 2 inverter runs and supplies the a.c. loads, and that the indicator shows WHITE.

(3) Hold No. 1 test switch on the generator control panel to the TEST position. Check that No. 1 inverter operates, supplying the a.c. loads and that No. 2 inverter is switched OFF. Check that the indicator shows BLACK.

(4) Release No. 1 test switch (*simulating failure of No. 1 inverter*) and check that No. 2 inverter operates and supplies the a.c. loads.

(5) Repeat tests (*3*) and (*4*) using No. 2 test switch.

(6) Return the engine master switch to OFF and disconnect the external supply plug.