Group 1 ENGINE STARTING

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

◀LIST OF APPENDICES

A List of Appendices appears at the end of the Group ▶

WARNING . . .

Voltages in excess of 100 volts either a.c. or d.c. can be dangerous under certain circumstances. Personnel should therefore ensure that the electrical system is electrically safe before any servicing is attempted. Where it is essential that tests or adjustments be made with the electrical power switched on, the greatest care must be exercised.

DESCRIPTION AND OPERATION

Introduction

1. The General Information Group contained in this Book immediately after Section 5 marker card, describes the layout and gives the interpretation of the schematic diagrams. Information on all the general modifications applicable to all aircraft can be found in the General Information Group.

General

2. Engine starting is achieved normally with power supplied at 112 volts and 28 volts, through the aircraft external supply plugs, from a starter trolley. The engines are started in turn, the time switch and start system controlling each starter motor as it is selected by the engine start selector switch. It is not necessary, however, to use external 28 volts, as the control circuits operated from the 28-volt bus-bar can be energized by placing the 24-volt battery switch to ON. This connects the battery to the bus-bar. If external power is not available, power for starting is obtained internally from the 96-volt and 24-volt batteries connected in series by the internal start switch. The starting master switch is provided with a position which allows the engines to be run up with the ignitors isolated. This is for 'blowing-out' the engines. If an engine is running under these conditions, or the aircraft is in flight with an engine off, but rotating due to the aircraft's speed, relight is obtained by depressing the relight push-switch in the throttle handle.

External start (*fig* 1)

3. Before starting, the 24-volt battery switch must be placed to ON, to connect the battery or the external 28-volt supply to the 28-volt main bus-bar. Although external starting may be achieved without an external 28-volt supply, in the following description it is assumed that both 112-volt and 28-volt external supplies are, in fact, connected. Also before starting, the instrument supplies contactor must be reset by selecting the instrument master switch to ON momentarily; unless this is done there will be no supply to the start switch or engine instruments.

4. When the 112-volt external supply is connected, it energizes the coils, of the two generator hold-off relays R17 and R18, through voltage dropping resistances, and the 96-volt flash-back relay coil R16. The generator hold-off relays, the contacts of which are in parallel, break the supply to No. 4 generator circuit breaker interlock relay, which, in turn, breaks the line to No. 4 generator circuit breaker, thus the generator cannot be put 'on line' whilst the external supply is connected. Generators Nos. 1, 2 and 3 must be at OFF before starting the engines (*Chap.* 1). The 96-volt flash-back relay (R16/1) operates to connect the external supply, through a fuse in the battery bay, to the engine starter motor circuit and to the 112-volt bus-bar.

5. When the 28-volt external supply is connected, it energizes the rotary transformer hold-off relay R13 and the 28-volt flash back relay R14. The 28-volt rotary transformer hold-off relay breaks the lines to the rotary transformer 112-volt end contactor and the 28-volt end circuit breaker thus No. 3 rotary transformer cannot be operated or put 'on line'. Nos. 1 and 2 rotary transformers must be switched OFF before starting the engines (*Chap.* 1).

6. The two-pole START MASTER switch, on the port console, has three positions, labelled SAFE, ISOLATE and START. One of its poles is supplied from either the essential services bus-bar, for internal start, or the main bus-bar via a fuse on panel D for external start. Both supplies are taken through contacts R5/1 and R5/2 of the 24-volt change-over relay, R5, on the 24-volt battery control panel.

7. With the master switch placed to START, the supply is connected to one pole of the INTERNAL START switch which will be in the NORMAL position for external start. The supply will also be connected to the start push-switch on the port console. From the push-switch the supply is taken to the other pole of the master switch, which, being in the START position, feeds the ignition or relight selector switch on the port console. This switch is operated by the same knob as the engine start selector switch and is interlocked with the start push-switch. This ensures that both switches select the same engine, and that another engine cannot be selected until the push-switch is released at the end of the start cycle for the engine being started. The relight selector switch feeds the ignition circuits (*para.* 20). The supply from the start push-switch also feeds the indicator lamp, the engine start selector switch, both on the port console, and, through the starter panel time switch normally closed engaging relay contact 2 (R10/5), the engaging relay coil R11.

8. From the engine start selector switch the supply is fed to the selected engine starter motor relay, R12, mounted in the compartment above the nosewheel bay. When the start push-switch is pressed, the engaging relay R11 and the selected starter motor relay R12 are energized, thus connecting (R11/1, R12/1) the selected engine starter motor to the external 112-volt supply through the engaging resistance and the overspeed relay coil R15. As soon as the starter motor is connected, the armature circuit current rises; when it reaches 180-220 amp. the overspeed relay operates (R15/1) to connect the supply from the start push-switch to the push-switch hold-in coil R7 and through the time switch contacts A (R10/3), and B (R10/2), to the time switch winding coil R10.

9. As soon as the time switch winding coil R10 is energized, it pulls in its armature and at the same time, opens its contacts R10/3. As soon as R10/3 opens, the time switch armature drops out again and closes R10/3. This is repeated to wind up the time switch spring by ratchet action. After 6 vibrations have taken place, the cams will have rotated so as to close contact (R10/4) and open contact (R10/2). This connects the supply from the push-switch directly to the winding coil instead of via the overspeed relay contact R15/1. At the end of the winding period, 3 seconds, the cams will open contact (R10/4), thus de-energizing the winding coil R10. The spring will now drive the main cams to operate the main contacts (R10/5) and (R10/1).

10. After 8 $\pm$1 seconds from the time of starting the time switch, the time switch engaging relay contact (R10/5) opens. At 6 $\pm$0·5 seconds the time switch second stage relay contact (R10/1) closes. Thus, the second stage relay R9 is operated to connect (R9/1) the starter motor on to full voltage, and the engaging relay R11 is de-energized. After 22 to 24 seconds from the time switch starting, the time switch second stage relay contact (R10/1) opens to de-energize the second stage relay R9 to disconnect (R9/1) the starter motor from its supply.

11. As soon as the starter motor is disconnected from its supply, the overspeed relay R15 is de-energized. Contacts R15/1 operate, breaking the circuit to the start push switch hold-in coil R7 allowing the push switch to return to normal and the start cycle indicator lamp to be extinguished. The time switch under the influence of its spring continues to unwind until 36 seconds after the winding coil was energized.

12. If the engine has run up to speed before the time switch second stage contact (R10/1) opens (22 to 24 seconds), the motor current will have fallen below 85 $\pm$5 amp. This is below the hold-in value for the overspeed

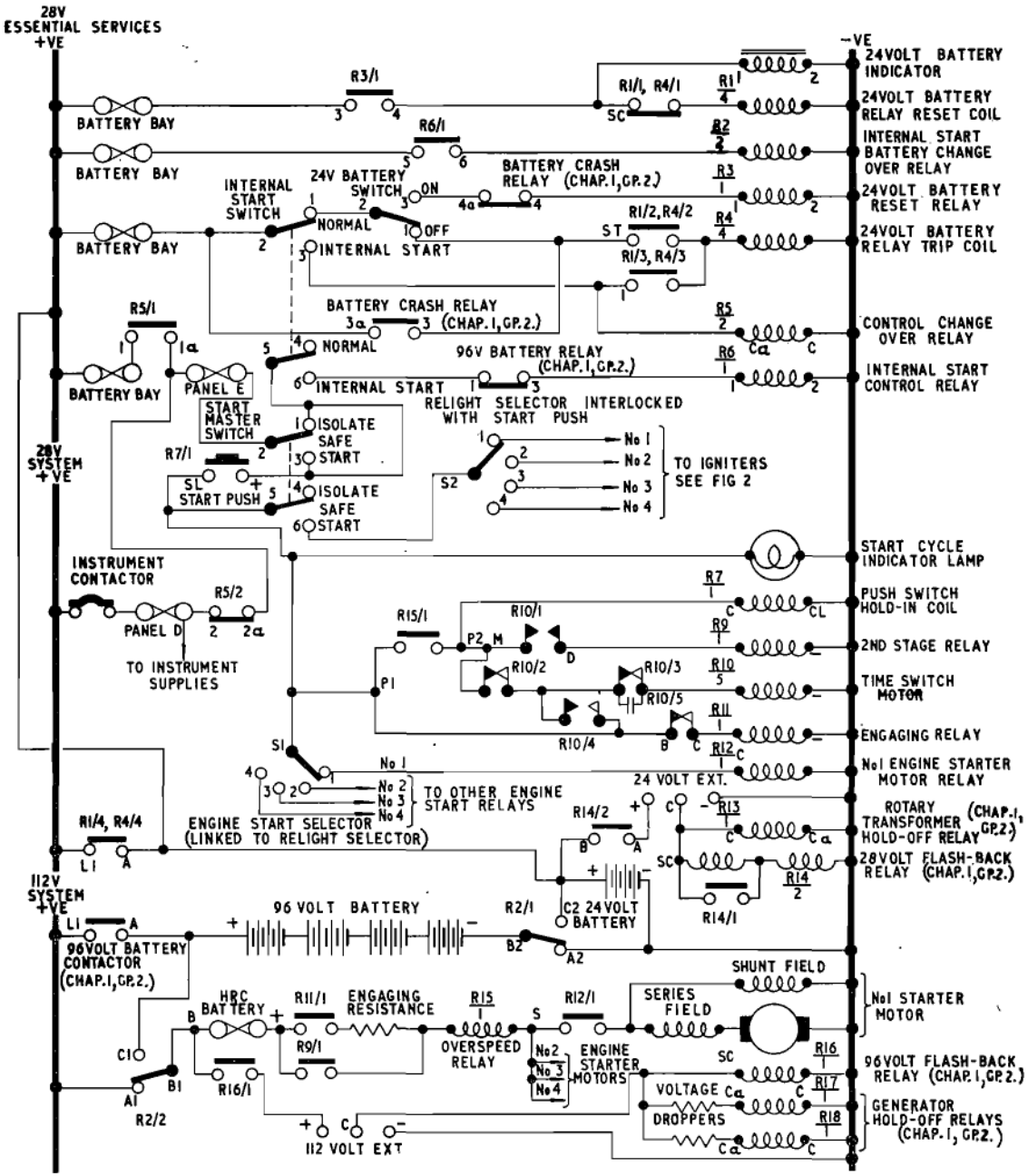

Fig. 1. Engine starter control

relay R15, which consequently becomes de-energized. Contacts R15/1 operate to disconnect the start push-switch hold-in coil R7 allowing the push switch to return to normal and the start cycle indicating lamp to be extinguished, as before.

13. It is not possible to start more than one engine during one complete cycle of the time switch (36 seconds). 8 ±1 seconds after the time switch has begun to operate contacts R10/5 open and disconnect the supply to the engaging relay coil R11 (*para.* 10). When the engine has run up to speed the overspeed relay coil R15 is de-energized and operates (R15/1) to disconnect the supply to the second stage relay coil R9 (*para.* 10). Thus the supply to the starter motor is disconnected (R11/1 and R9/1). If the engine start selector switch is selected to another engine and the start push switch pressed, during the cycle of operation of the time switch, the selected engine will not start, as the supply to the engaging relay coil R11 is disconnected by contacts R10/5, which opened 8 ±1 seconds after the time switch began to operate. Contacts R10/5 close, during the last two seconds of the time switch cycle, in the supply line to the engaging relay coil R11 and make ready the circuit for another engine start.

Note . . .

The above sequence of events applies to all engines, the engines being started in turn as selected by the start selector switch. After all engines have been started, the master switch should be returned to SAFE to isolate the complete starting system.

Internal start (*fig.* 1)

14. Before starting, the 2-pole INTERNAL START switch, mounted on the port console, must be placed to INTERNAL START. In this position, one pole of the switch connects a supply from the essential services bus-bar, through the closed (when reset) contacts, R4/3, of the 24-volt battery relay, to its trip coil R4 and also to the start control change-over relay R5. The 24-volt battery is thus disconnected (R4/4) from the main bus-bar and the start control circuits are connected (R5/1) to the essential services bus-bar. At the same time, the second pole of the internal start switch connects the circuit from the start master switch to the internal start control relay R6, through contacts of the 96-volt battery relay, closed if the 96-volt battery is on line.

15. As soon as the START MASTER switch is placed to START, the internal start control relay operates (R6/1) to connect a supply from the essential services bus-bar to the 96-volt internal start change-over relay R2, and to open the line from the 96-volt battery contactor reset relay contacts to the 96-volt battery contactor reset coil (*Chap.* 1). The 96-volt internal start change-over relay operates (R2/1), to connect the negative side of the 96-volt battery to the positive of the 24-volt battery (instead of to the negative line) and (R2/2) the positive side of the 96-volt battery to the112-volt starting circuit. Thus the two batteries are in series to give the required voltage.

16. The starting system operates as described for external start when the start push is depressed. As soon as the first engine started has attained sufficient speed, its generator is automatically connected to the 112-volt bus-bar by its undervolt and differential relays (provided that the GENERATOR CONTROL switch is in the ON position). Pre-Mod. 2260, the undervolt relay operates to connect a supply from the essential services bus-bar to the 96-volt battery contactor reset relay (*Chap.* 1). This operates to connect a further supply from the essential services bus-bar to contacts on the internal start control relay R6, so that, when the INTERNAL START switch is placed to NORMAL and the internal start control relay R6 is thus de-energized, the supply is connected to the 96-volt contactor reset coil, and the 96-volt battery connections are restored to normal, i.e. between the 112-volt bus-bar and the negative line. Post Mod. 2260, the 96-volt battery is controlled by the 96-volt battery switch. The series connection of the 96-volt and 24-volt batteries for internal starting will be broken, and the battery connections reverted to normal when the internal start battery change-over relay R2 is de-energized by the opening of the contact R6/1 of the internal start control relay when the INTERNAL START switch is returned to NORMAL.

17. The normal procedure to start the remaining engines, is with the INTERNAL START switch returned to NORMAL, the power for starting being provided by the generator of the first engine started, aided by the 96-volt battery. In order that this generator and its drive are not overloaded when the subsequent engines are being started, it is necessary to run the first engine above idling speed for this period. This engine may be run up to 6 to 7,000 r.p.m., the higher the better, the limitations being that the maximum permissible r.p.m. of 7,850 must not be maintained for more than 5 minutes, under these conditions the maximum permissible jet pipe temperature is 630 deg. C. If the INTERNAL START switch is not returned to NORMAL, the remaining engines can be started from the batteries.

18. The remaining engines are started as described for external start and allowed to run at idling speed. Once all the engines are started the first should be throttled back to idling speed and the start master switch returned to SAFE.

Blow out (*fig.* 1)

19. The engine START MASTER switch has a positioned labelled ISOLATE. When the switch is in this position, the ignition circuits are isolated, so that the engines may be run up, on internal or external power, with the ignition switched off. The starting system is otherwise as described in the foregoing paragraphs.

Ignition and relight (*fig.* 2)

20. Engine ignition during normal internal or external starting is accomplished automatically through the contacts of the engine relight selector switch, which is coupled to the engine start selector switch. When the

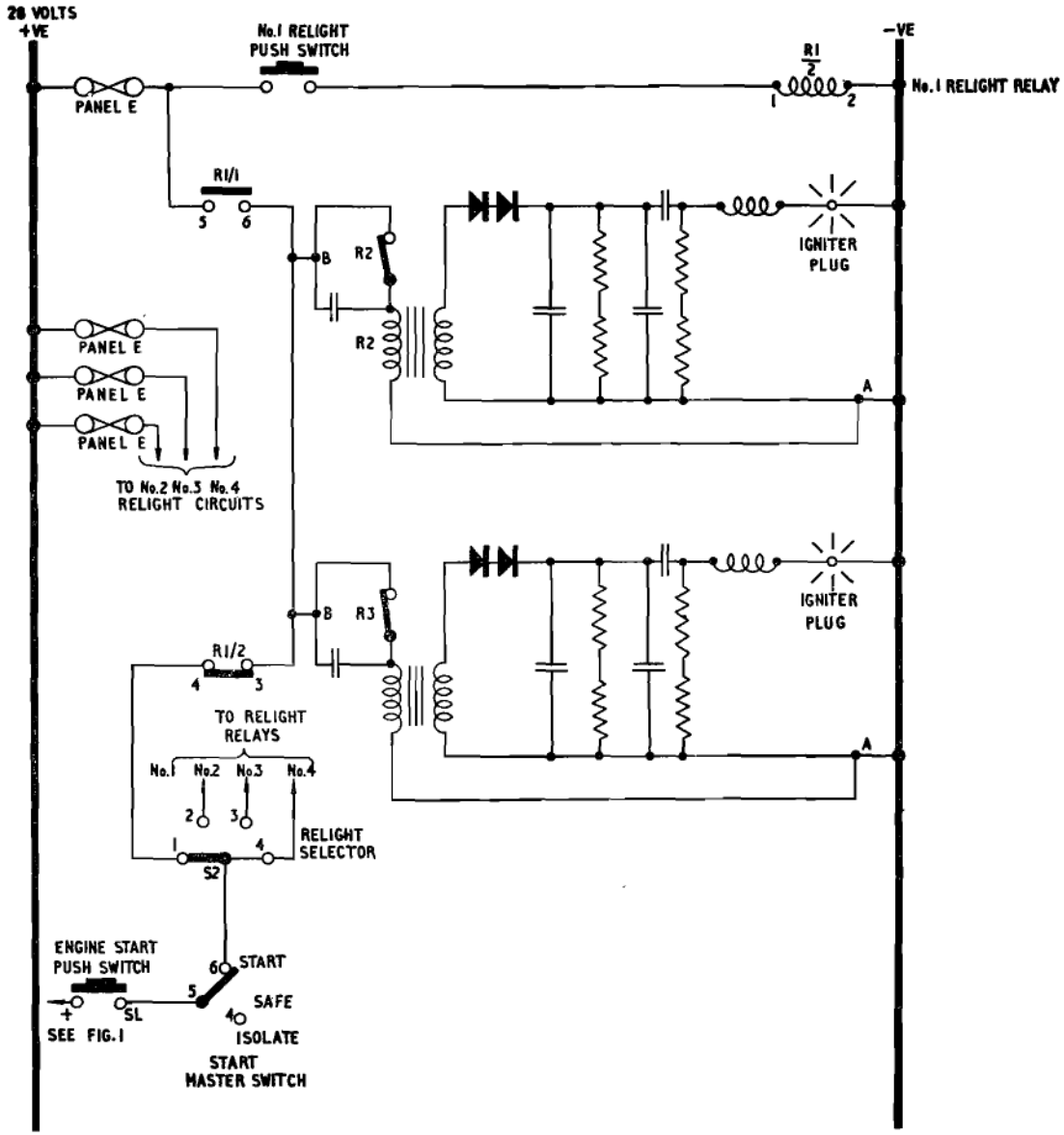

Fig. 2. Ignition and relight

start push-switch is depressed, a supply, from the start master switch, is connected through the normally closed contacts of the selected engine relight relay (R1/2) to the engine ignitor boxes, two per engine. The ignitor boxes contain booster coils to provide high voltage impulses to the ignitor plug electrodes.

21. For relighting on the ground, when the engines are running under blow out conditions, or in the air, when the engines are being rotated by air pressure due to the forward speed of the aircraft, a push-switch is provided in the top of each throttle lever. When any of these switches is depressed, a supply, from the port fuse panel E, is connected to the operating coil of the associated engine relight relay, R1 (Type Q3), mounted in the port console. This relay operates (R1/2) to disconnect the normal line to the ignitors. At the same time contacts R1/2 operate and connect an alternative supply from panel E to the ignitors. The relight circuits are separately fused. There should be a fifteen minute draining period between attempts to relight an engine.

Starting procedure

Note . . .

It is recommended that No. 4 engine is always the first to be started.

Using voltage regulated ground truck:—

22. (1) Ensure external 112-volt supply switched OFF, 28-volt supply need not be connected.

(2) Check No. 1, 2 and 3 generators OFF and No. 4 ON.

(3) Switch 24-volt battery ON.

(4) Select INSTRUMENT MASTER switch ON.

(5) Switch 96-volt battery ON if Mod. 2260 is incorporated or check 96-volt battery switch NORMAL pre-Mod. 2260.

(6) Switch ON external 112-volt supply.

(7) Check bus-bar voltages on trimmer panel voltmeters.

(8) Switch Nos. 1, 2 and 3 rotary transformers ON unless external 28-volt supply is connected in which case switch ON No. 3 only.

(9) Check 28-volt bus-bar has risen to 28 volts by reading trimmer panel voltmeter.

(10) Check:—

Throttle/H.P. cocks	....	Fully closed.
L.P. master cocks	....	ON.
Fuel pumps	....	Two ON per side. Fuel pressure warning lamps out.
ENGINE STARTER SELECTOR SWITCH....	....	No. 4.
ENGINE STARTER MASTER SWITCH	....	START.

(11) Open the H.P. cock, bring the throttle back to the gate, then without delay depress the starter push-switch for four to five seconds and release it. The next engine cannot be started until the time switch has run down. The engine should light up in 4 to 8 seconds after operating the starter push-switch.

(12) Select and start the remaining engines.

(13) When all engines have been started, disconnect 112-volt external supply; No. 4 generator will then come on line.

(14) Switch on the remaining three generators.

(15) Disconnect external 28-volt supply (if connected); No. 3 rotary transformer should come on-line then switch ON Nos. 1 and 2 rotary transformers.

Using external batteries

23. (1) Ensure that the external battery voltage is at least 120 volts and that it has a capacity of at least 25 amp. hrs.

(2) Switch 96-volt battery OFF or NORMAL (pre-Mod. 2260), 24-volt battery ON.

(3) Check Nos. 1, 2 and 3 generators OFF and No. 4 ON.

(4) Select the INSTRUMENT MASTER switch to ON.

(5) Check all rotary transformers OFF.

(6) Connect and switch on external supply.

(7) Start engines (items 10, 11 and 12 in (a) above).

(8) Switch ON the 96-volt battery (post Mod. 2260) or leave at NORMAL (pre-Mod. 2260) and without delay disconnect the external supply.

(9) Check No. 4 generator comes on-line and switch ON remaining generators.

(10) Switch ON all three rotary transformers.

Using internal batteries

24. Note . . .

(1) *If the battery bay temperature (as measured on the bomb bay temperature gauge) is 10 deg. C. OR ABOVE, internal starting should be carried out using the 96-volt battery alone, i.e. 96-volt and 24-volt battery switches ON.* INTERNAL START *switch to NORMAL. Proceed as for normal external starting.*

(2) *If the battery bay temperature (as measured on the bomb bay temperature gauge) is BELOW 10 deg. C. internal starting should be carried out using the 96-volt and 24-volt batteries together. Proceed as below.*

(1) Switch 96-volt and 24-volt batteries to ON (96-volt battery switch to EMERGENCY pre-Mod. 2260). Check voltages on voltmeters.

(2) Select INSTRUMENT MASTER switch ON.

(3) All generators and transformers OFF.

(4) Select L.P. master cocks ON, open H.P. cocks for all engines.

(5) Switch fuselage starboard fuel pumps ON, low pressure warning lamp out.

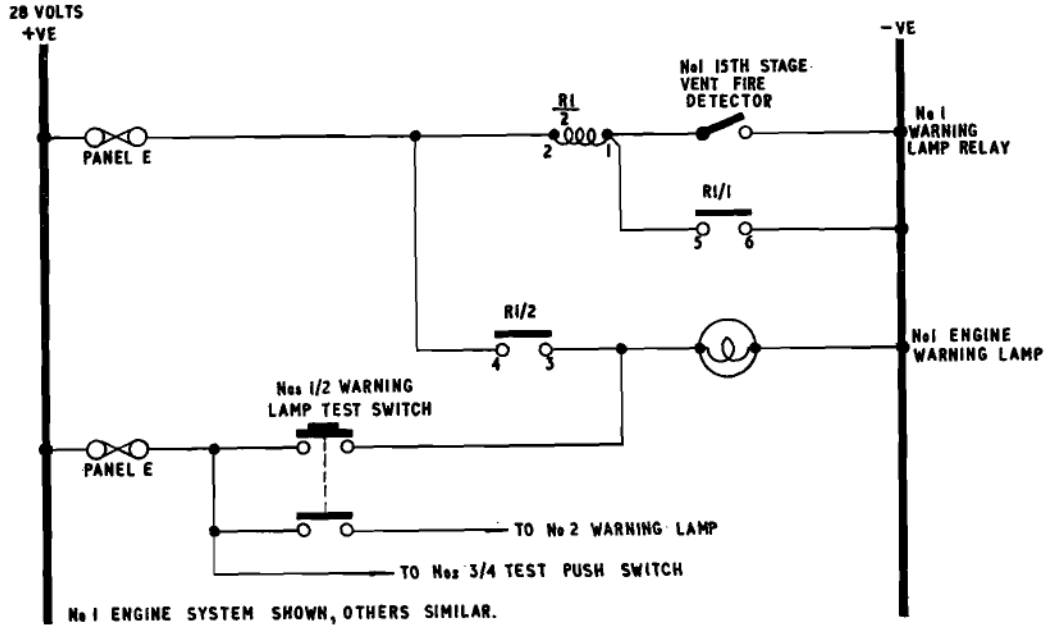

Fig. 3. Engine failure warning

(6) Switch 96-volt battery switch OFF (NORMAL pre-Mod. 2260) select INTERNAL START switch to INTERNAL START.

(7) Select engine starter selector to No. 4.

(8) Select START switch to START.

(9) Depress starter push-switch for four to five seconds.

(10) When engine has started, select INTERNAL START switch to NORMAL, 96-volt battery switch ON (post Mod. 2260) only.

(11) Switch No. 4 generator ON; No. 3 rotary transformer ON.

(12) Switch port fuselage fuel pumps ON, L.P. warning lamp out.

(13) Run No. 4 engine at a minimum of 6,500 R.P.M. whilst starting remaining engines.

(14) As each engine reaches idling speed, switch on its generator. No. 1 and 2 rotary transformers can be switched on after two engines have been started.

Failure to start

25. After a failure to start, if the H.P. cock is closed without delay, there should be no need to " blow through " the engine. If in doubt, excess fuel may be removed by motoring over the engine in the same way as for starting but with the H.P. cock closed and the STARTER MASTER switch at ISOLATE.

Engine failure warning (fig. 3)

WARNING . . .

When an engine failure warning lamp comes on, the engine concerned must be shut-down immediately.

Note . . .

This circuit is fitted until Mod. 2457 is introduced. This modification deletes the requirement for the circuit and the equipment will then be removed from the aircraft.

26. Mod. 1771 supercedes Mod. 1665, if incorporated, and introduces an engine failure warning system whereby, if the compressor 15th stage vent temperature rises (excessively and rapidly in cases of engine failure), a fire detector will give indication on the relative warning lamp on a panel above the instrument top panel.

27. When the temperature rises sufficiently above the normal level, the fire detector will close its contacts in the negative return circuit of a relay, Type Q1, mounted in the starboard console. The relay, supplied from panel E, will thus be energized to close its contacts R1/1 and R1/2. Contact R1/1 is in parallel with the fire detector and will hold the relay in if the fire detector should melt. Contactor R1/2 closes to connect the relay coil supply to the red warning lamp, Ref. No. 5CX/1553.

28. The relay coil supply is fused at 20 amp. to give time for the relay to operate before the fire detector is damaged by the heat, possibly causing a lower rated fuse to blow.

29. Two double pole push-switches are mounted adjacent to the warning lamps. Each switch tests two warning lamps. When a switch is pressed it connects a supply from panel E to the two associated warning lamps, for Nos. 1 and 2 engines or Nos. 3 and 4 engines. A single fuse is provided for all four lamps.

30. This Mod. is fitted to aircraft WP.218, WP.223 and subsequent aircraft, before delivery. If other aircraft are modified by retrospective action, cables need not be broken at panel C.

SERVICING

Introduction

31. A detailed description of all the general tests to be applied to all the aircraft circuits can be obtained from the General Information Group contained in this Book immediately after Section 5 marker page.

External start

Note . . .

(1) *If an external start is to be carried out using batteries in lieu of a voltage regulated ground truck it should be ascertained that these batteries have a voltage of at least* 120 *volts and that their total capacity is at least* 25 *amp. hours.*

(2) *The START push-switch must not be operated unless the selected engine is stationary.*

(3) *The starter motor must not be run continuously for more than* 30 *seconds approx. if the control circuit relays stick in, the START MASTER switch should be selected to SAFE immediately.*

(4) *Check that the engine air intake and jet pipe covers have been removed and that the area is clear of personnel.*

32. The following tests should be applied to each engine in turn, connect up both 28-volt and 112-volt d.c. external supplies and proceed as follows:—

(1) Check the circuit fuses.

(2) Check that airframe de-icing switches are at OFF.

(3) Check that all fuel cocks are closed.

(4) Check the start cycle current flow indicator lamp filament.

(5) Move the ENGINE SELECTOR switch to No. 1.

(6) Move the START MASTER switch to ISOLATE.

(7) Select the 24-VOLT BATTERY switch ON, check that the 96-VOLT BATTERY switch is OFF.

(8) Press the START push-switch. The engine should 'motor' for 22 to 24 seconds during which time the start push-

switch should hold-in and the start cycle indicator lamp should glow.

(9) Wait until 36 seconds have elapsed from the time of depressing the start switch. Allow the time switch to complete its full cycle before checking the next engine.

(10) When all engines have been tested, return the START MASTER switch to SAFE.

Internal start

33. It is not proposed, in this check, to actually start the engines thus avoiding a heavy drain on the batteries. The starter circuits have already been checked in the foregoing check.

(1) Check that external supplies are disconnected.

(2) Check that 24-volt battery switch is ON, 96-volt battery switch OFF.

(3) Select INTERNAL START switch to INTERNAL START, check that 24-volt battery goes off-line.

(4) Measure that the voltage at the starter panel in the servicing bay above the nosewheel (terminal +) is 120 volts approx.

(5) Return the internal start switch to NORMAL.

Ignition

34. (1) Check that the START MASTER switch is at SAFE.

(2) Check that an external 28-volt supply is connected.

(3) Operate each air relight push-switch in turn (in the end of each throttle lever) and check that the associated engine igniters operate satisfactorily. The ignitors of the selected engine can be heard operating, the average rate of sparking being between 60 and 120 sparks per minute.

WARNING . . .

After operation, these units may hold a lethal charge. Before working on the high energy ignition units, it is essential to make them safe. If the circuit has already been operated, as in the case of an attempted start, wait at least three minutes. Disconnect the L.T. supply plug, then remove the H.T. plug at the igniter unit TAKING CARE TO AVOID CONTACT WITH ANY CONDUCTING SURFACE. Finally with an instrument having an insulated handle, capable of withstanding 3 kV, short-circuit the H.T. connection of the igniter box to ground—TWICE. The circuit should now be safe.

Engine failure warning

35. (1) Check the circuit fuses and connect a 28-volt d.c. supply to the external connection.

(2) Depress No. 1 and No. 2 PRESS-TO-TEST switch on the panel above the instrument top panel and check that both No. 1 and No. 2 ENGINE FAILURE WARNING lamps come on. This checks the filaments.

(3) Repeat item 1 for Nos. 3 and 4 engines.

(4) Short-circuit the terminals of the fire detector in the 15th stage compressor vent of No. 1 engine and check that No. 1 ENGINE FAILURE WARNING lamp comes on and stays on.

(5) Repeat item 3 for Nos. 2, 3 and 4 engines.

(6) Switch off all aircraft electrical supplies (internal and external) and check that all the lamps go out.

(7) Remove the shorting links from the fire detectors.

(8) Select the 24-VOLT BATTERY switch to ON and check that the lamps do not come on.

(9) Select the 24-VOLT BATTERY switch to OFF.

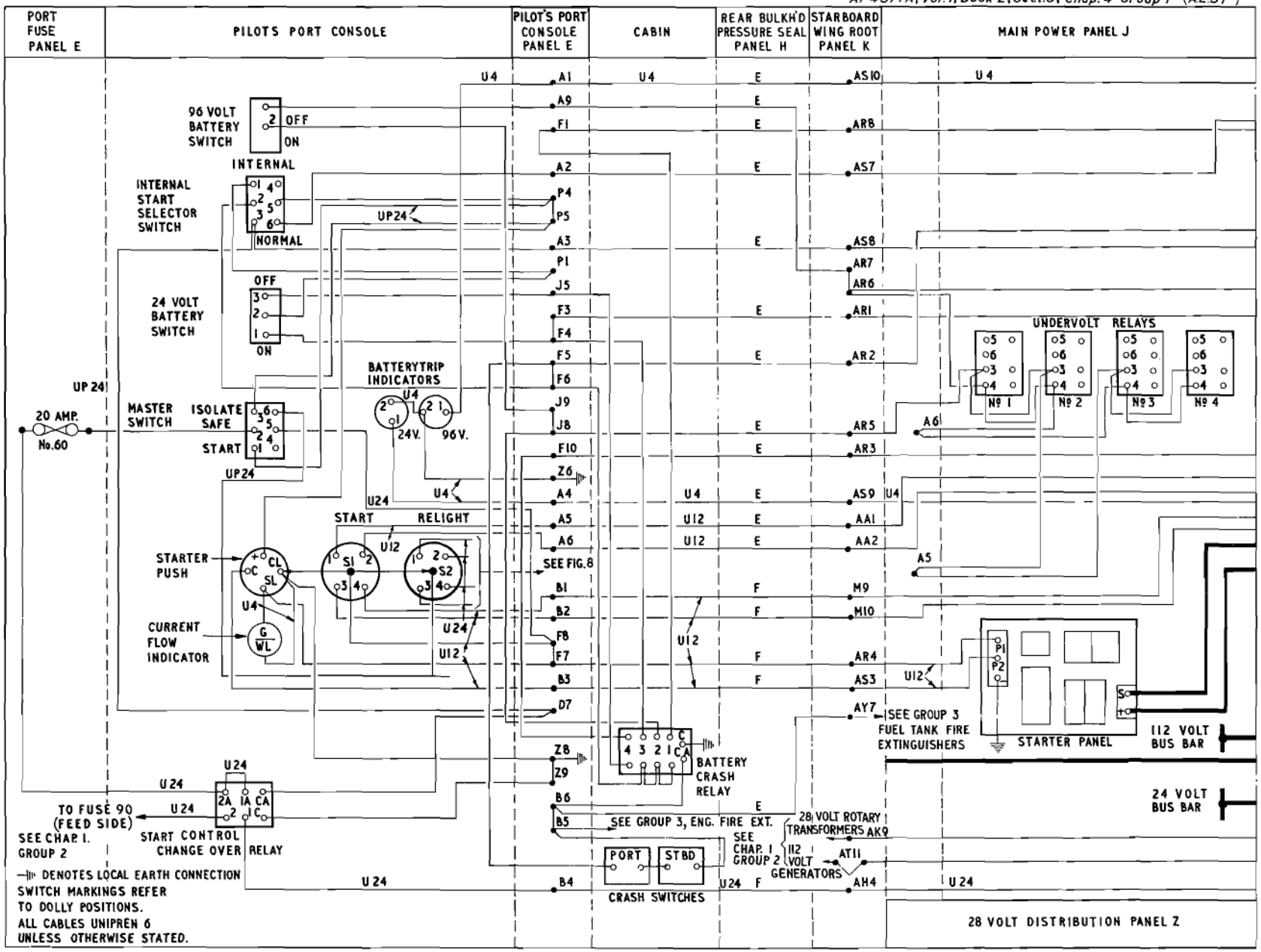

Fig 4 (1) Engine starting control (post Mod 2240)

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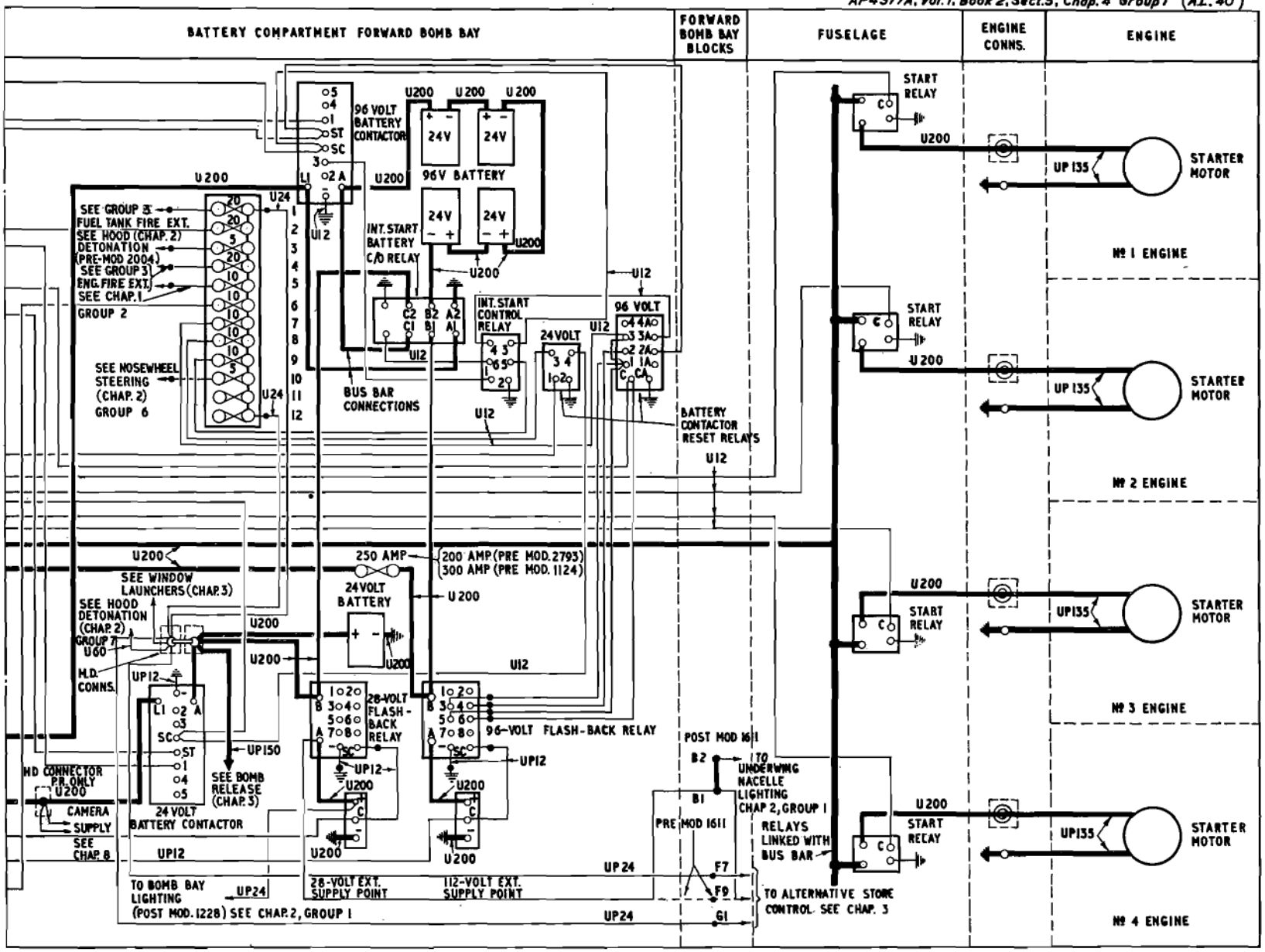

Fig. 4 (2) Engine starting control (post Mod 2240)

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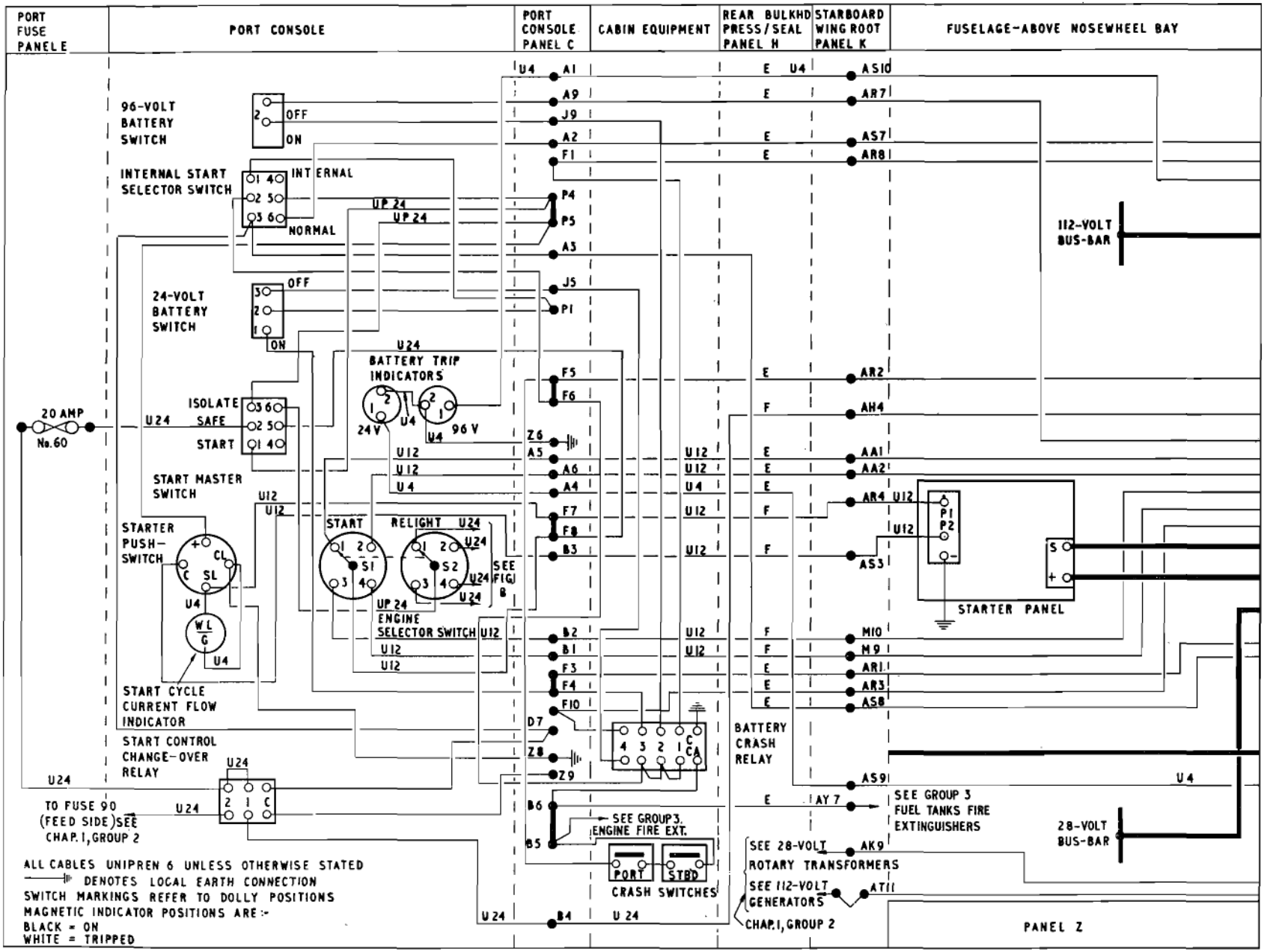

Fig 5 (1) Engine starting control (post Mods 2240 & 2260)

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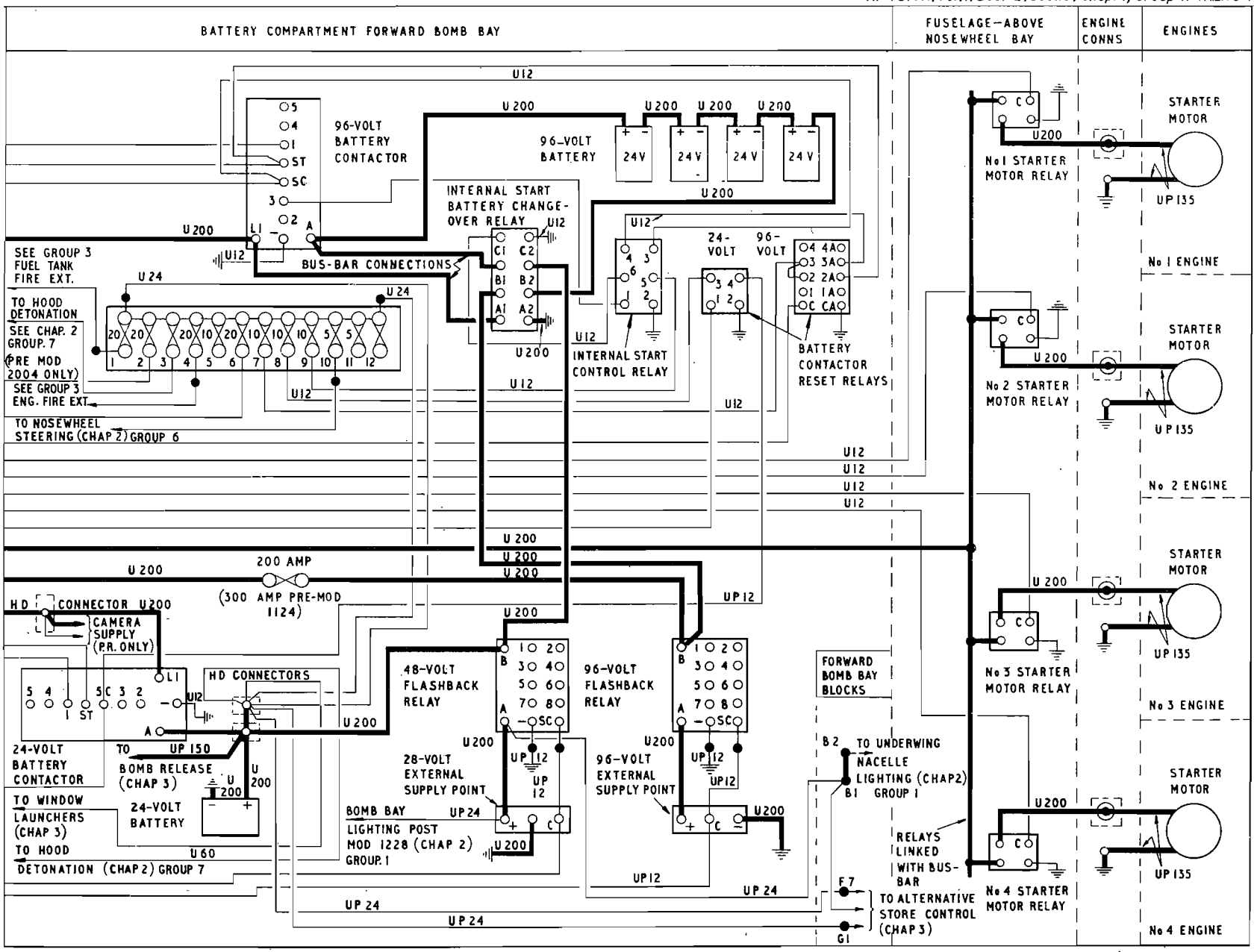

Fig 5 (2) Engine starting control (post Mods 2240 & 2260)

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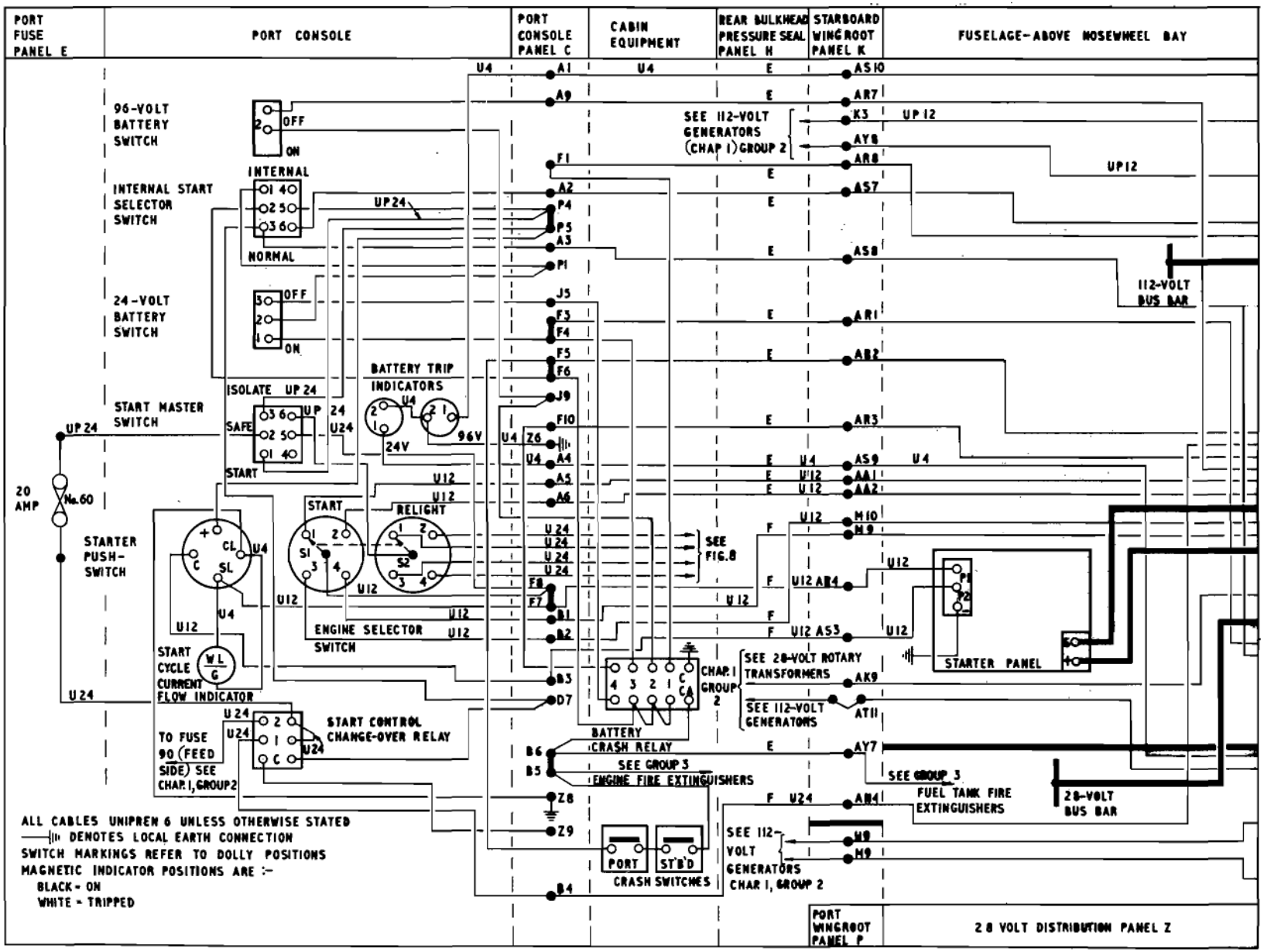

Fig 6 (1) Engine starting control (post Mods 2240, 2260 & 2259)

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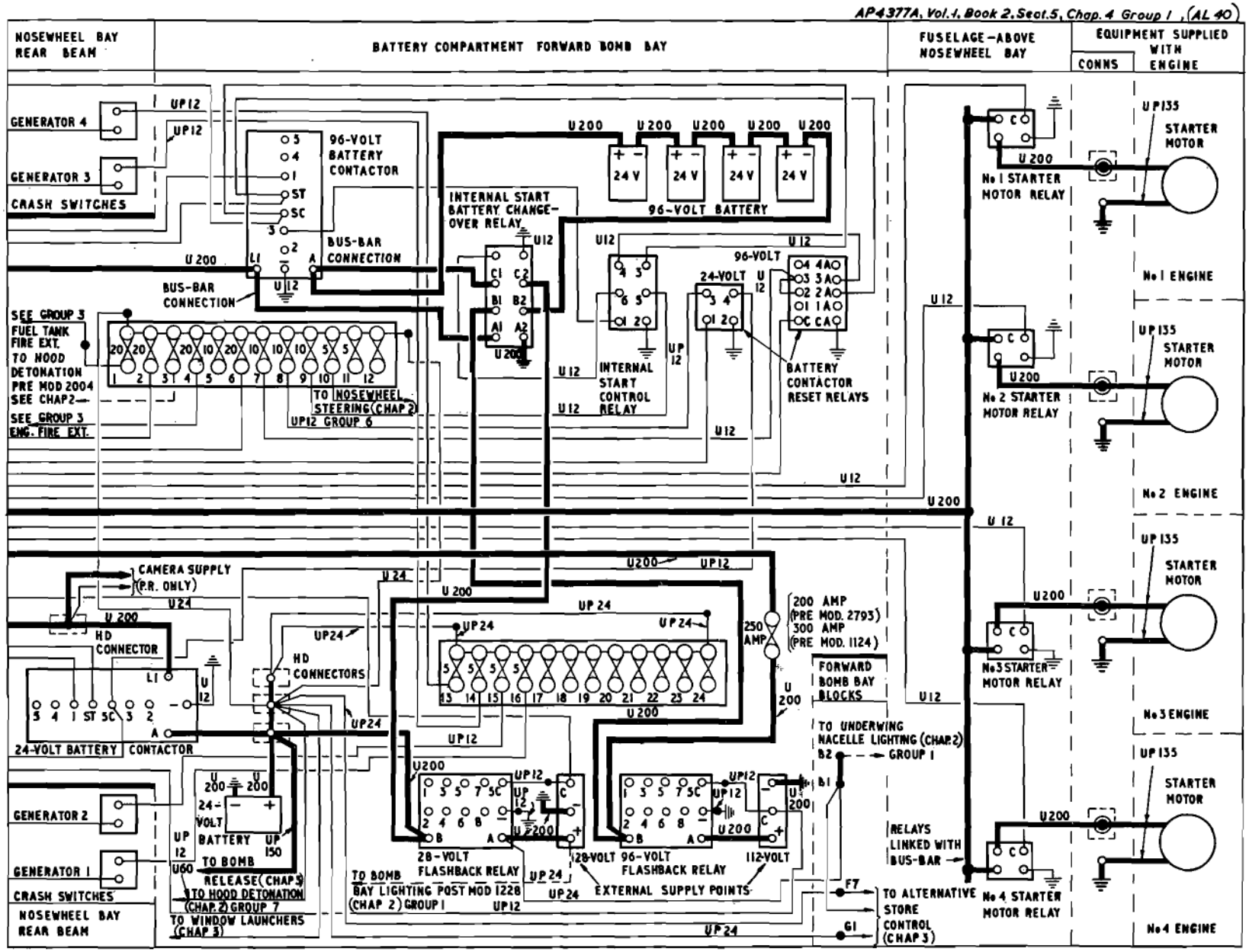

Fig 6 (2) Engine starting control (post Mods 2240, 2260 & 2259)

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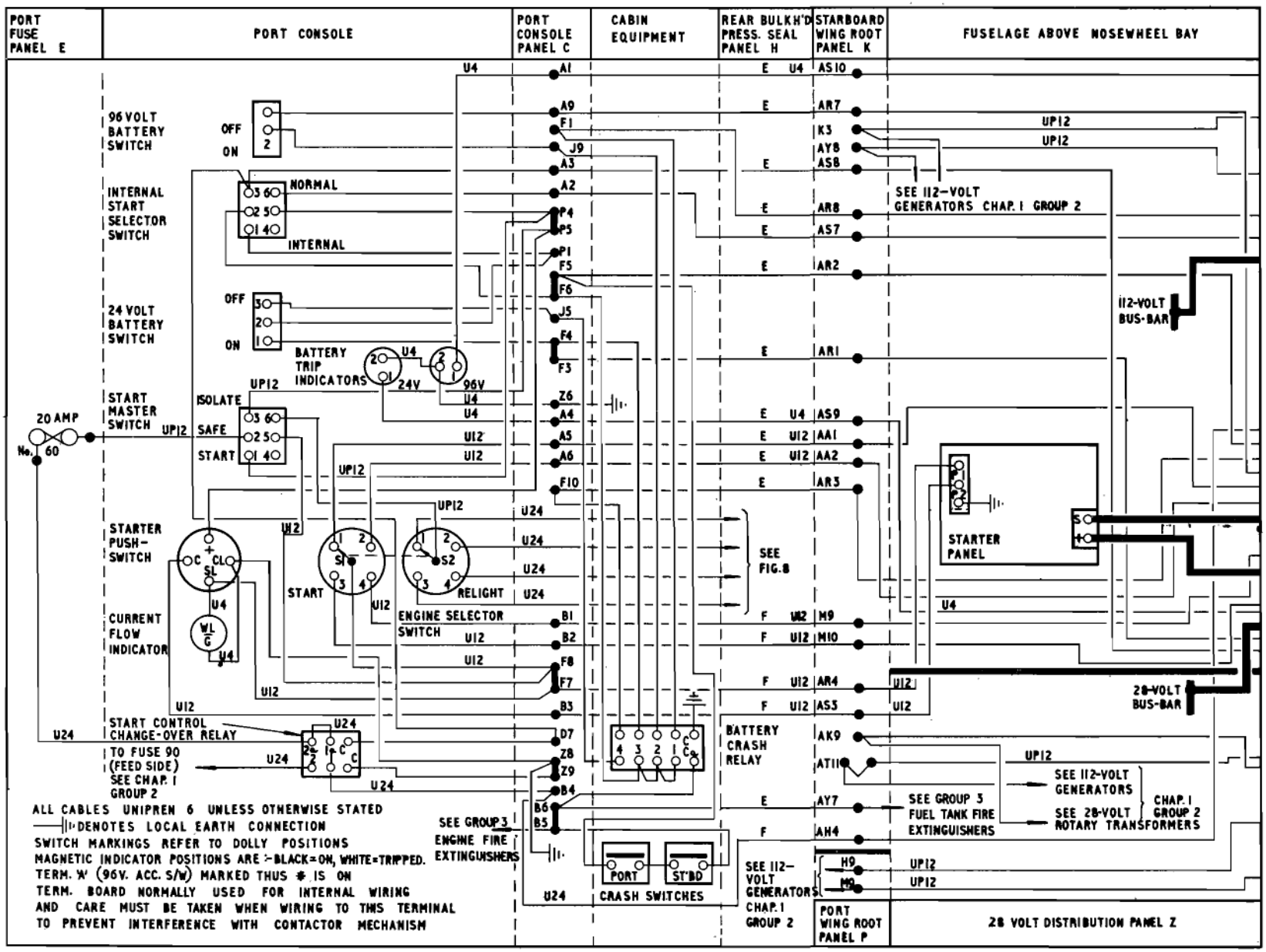

Fig 7 (1) Engine starting control (post Mods 2240, 2259, 2260 & 2376)

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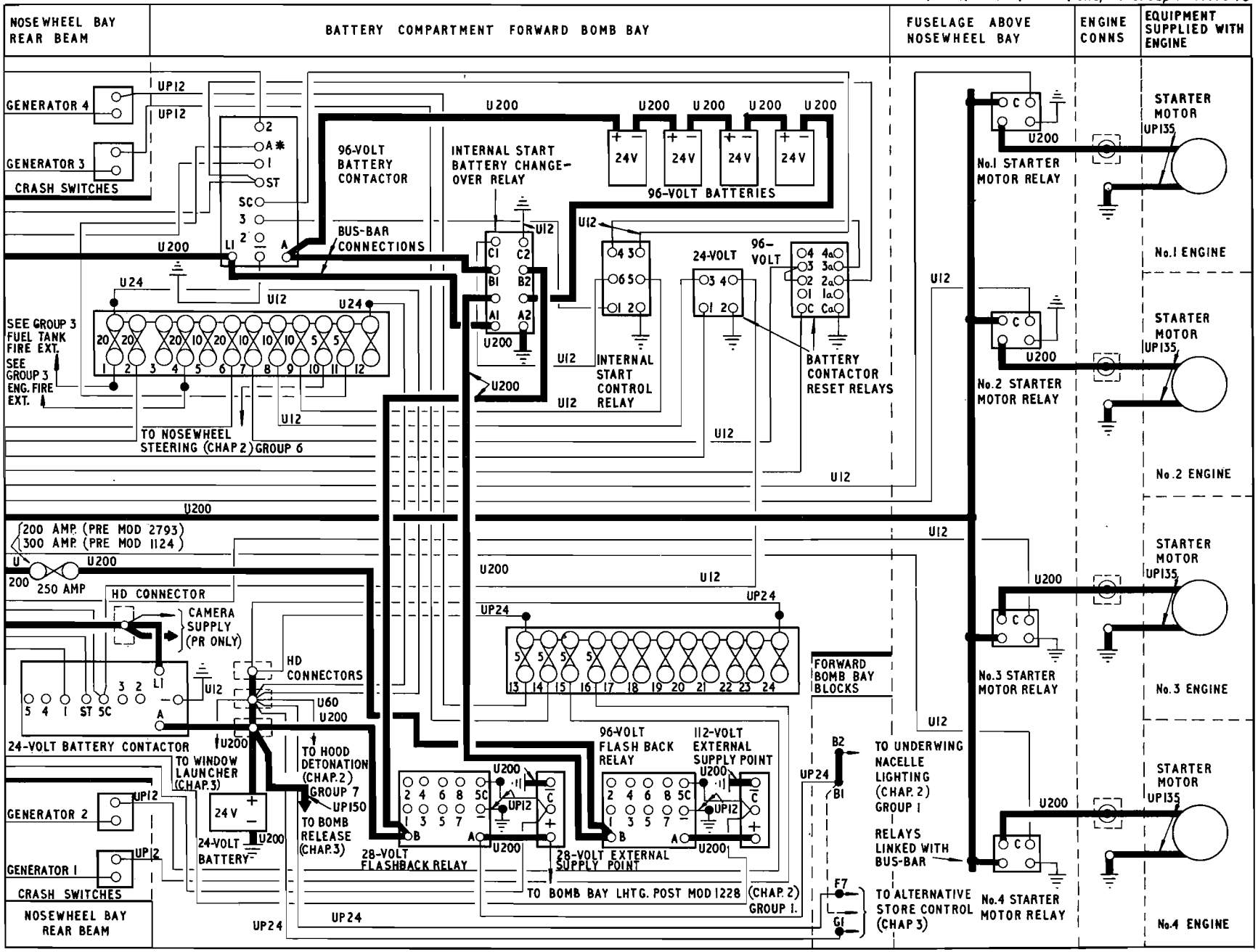

Fig 7 (2) Engine starting control (post Mods 2240, 2259, 2260 & 2376)

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75836 SHT 125-T

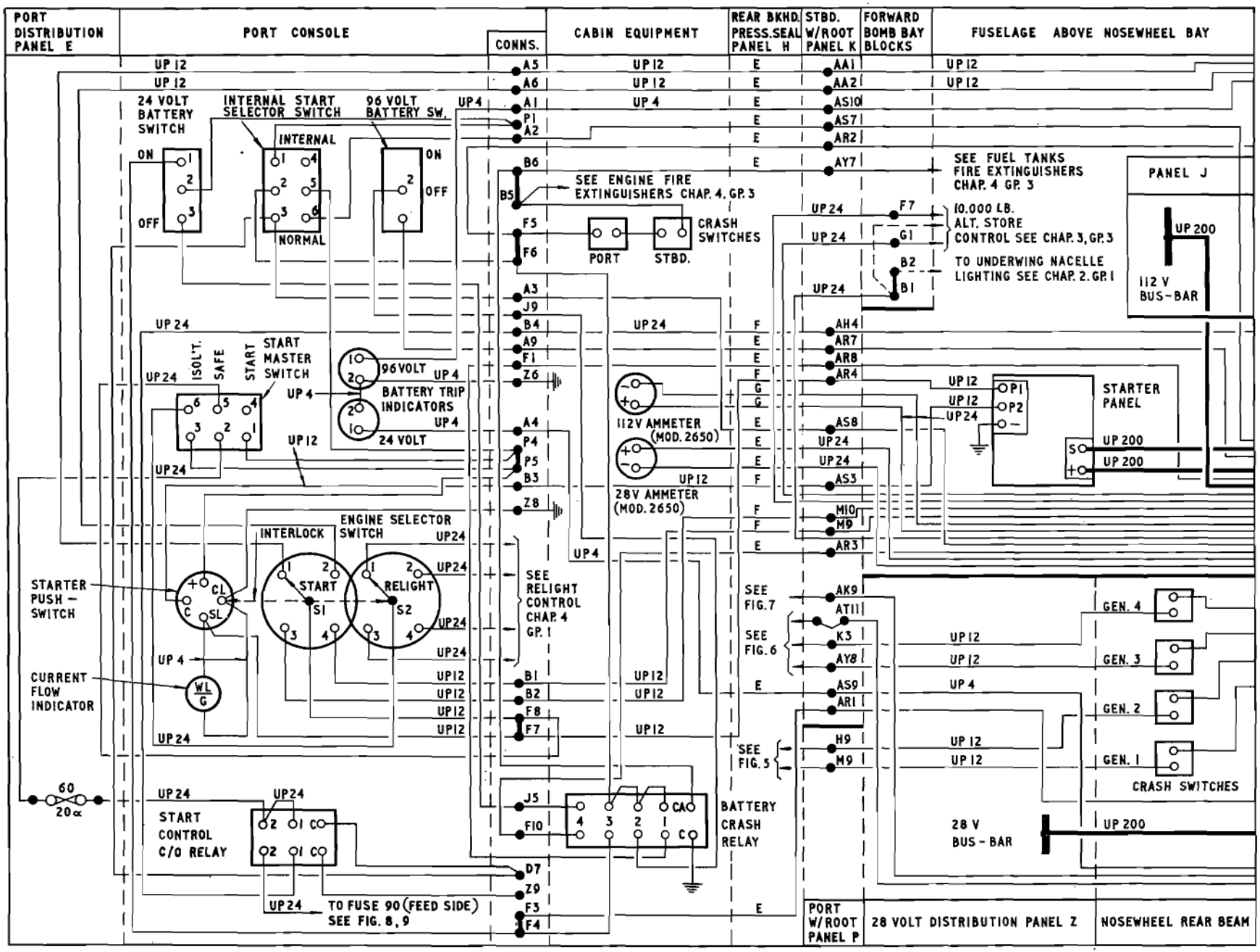

Fig. 7A(1) Engine starting control (post Mods. 2650, 2833 and 2945)

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75836 SHT. 125-Z
71036 SHT. 125-AA
70636 SHT. 125-AA

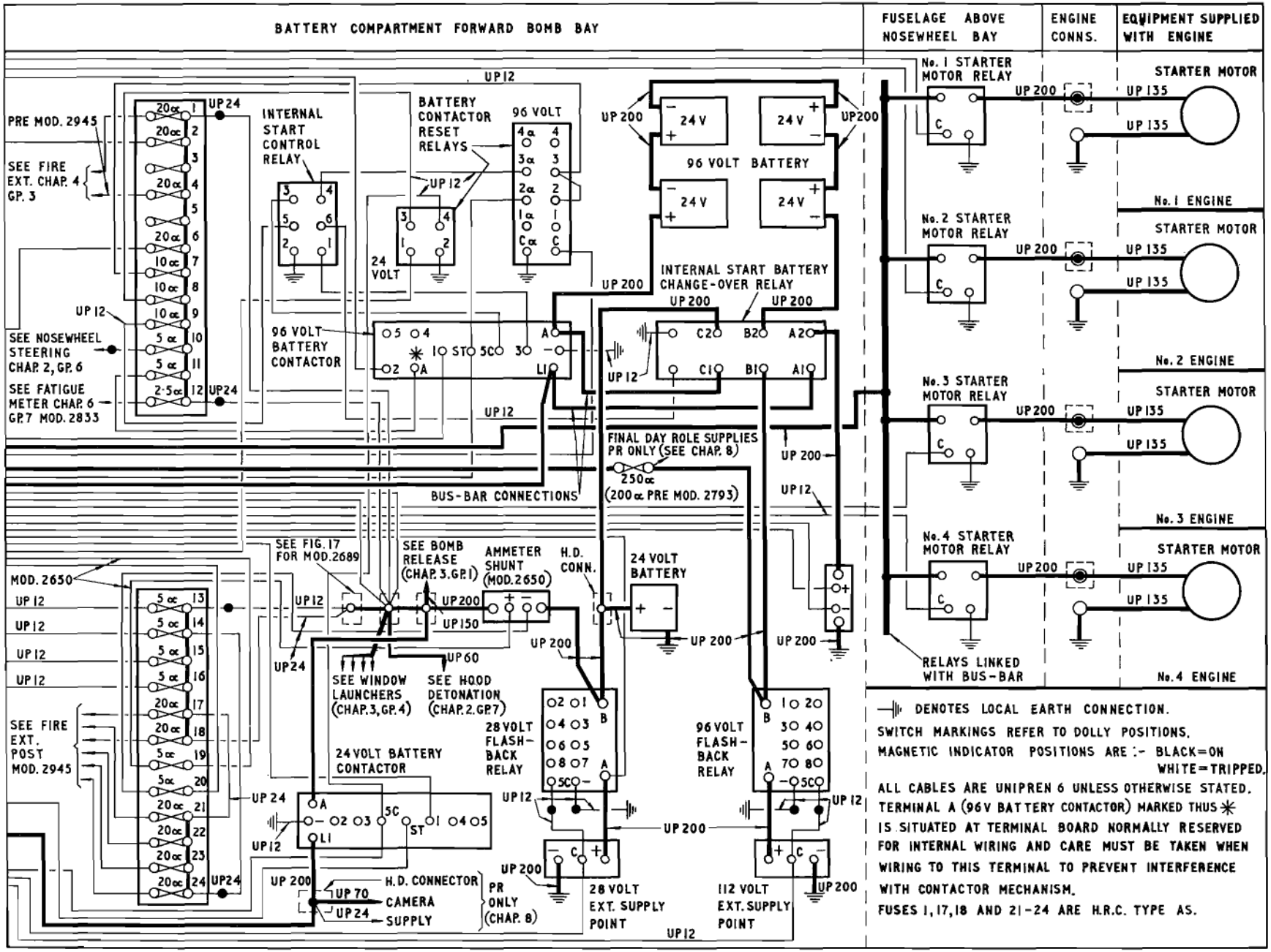

Fig. 7A(2) Engine starting control (post Mods. 2650, 2833 and 2945)

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75836 SHT. 125-Z
71036 SHT. 125-AA
70636 SHT. 125-AA

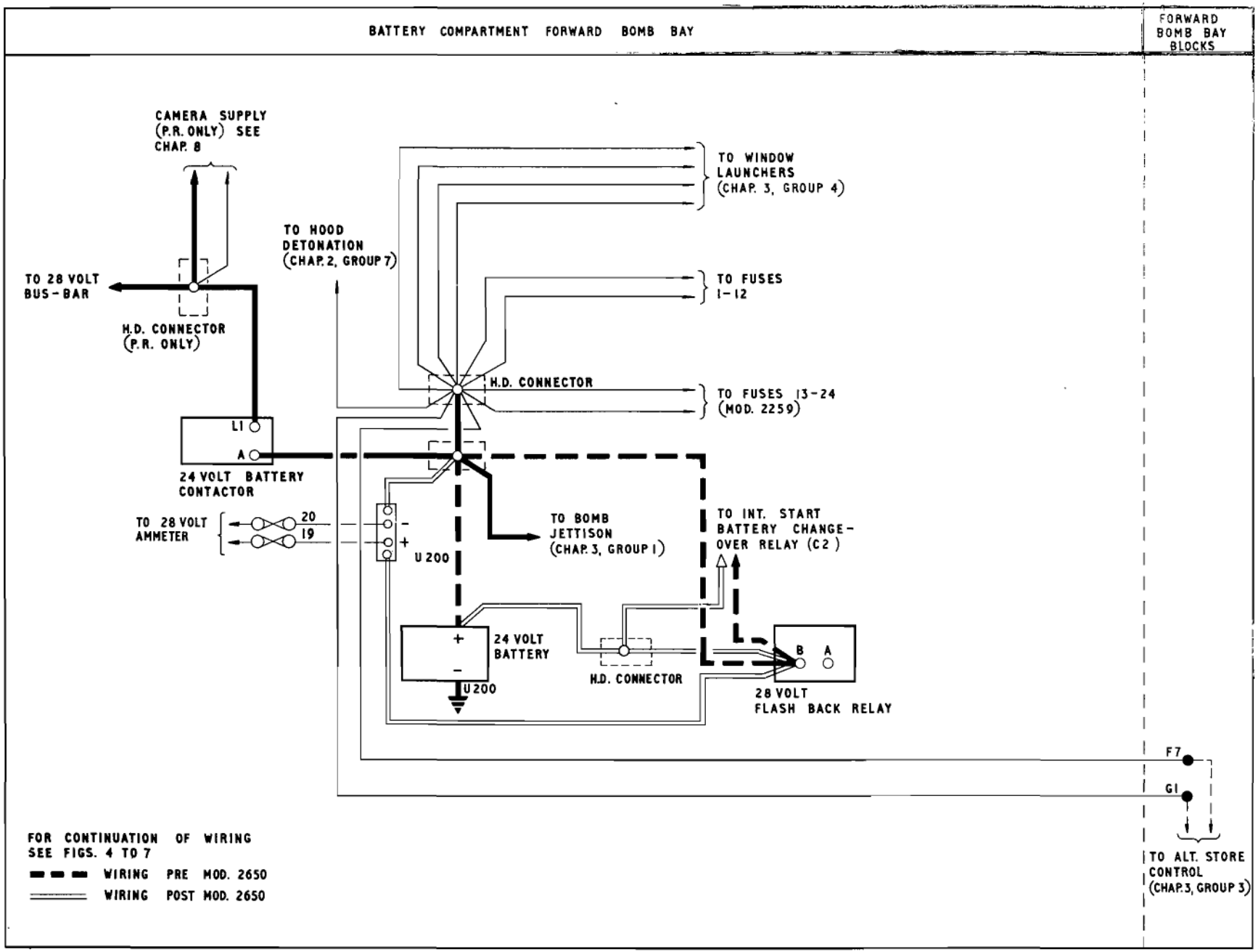

Fig. 7B Arrangement of H.D. blocks on battery bulkhead (post Mod. 2689)

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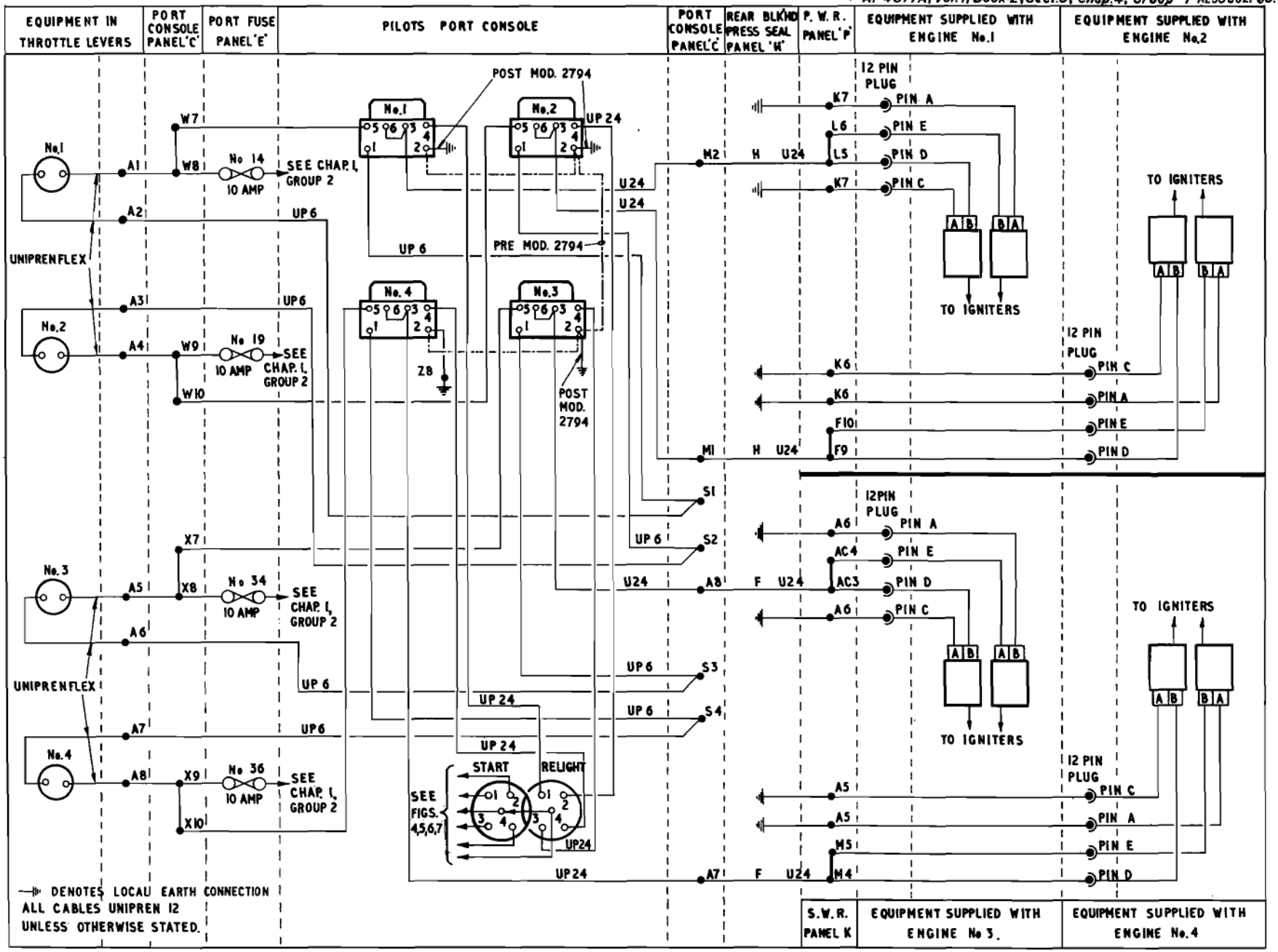

Fig. 8 Ignition and relight.

RESTRICTED

75836 SHT.192-D, 67436 SHT.192-G

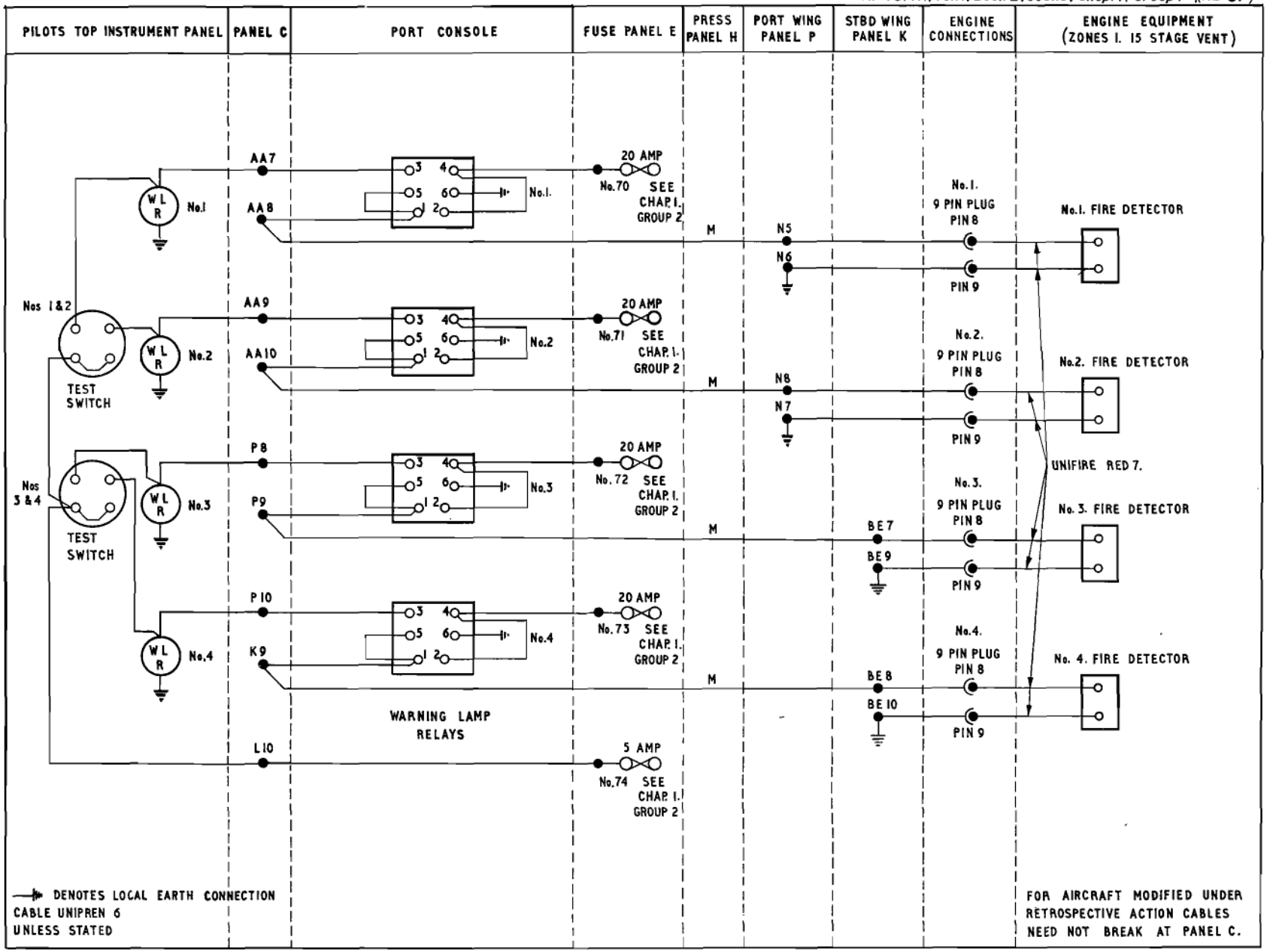

Fig. 9 Engine failure warning system (Mod.1771)

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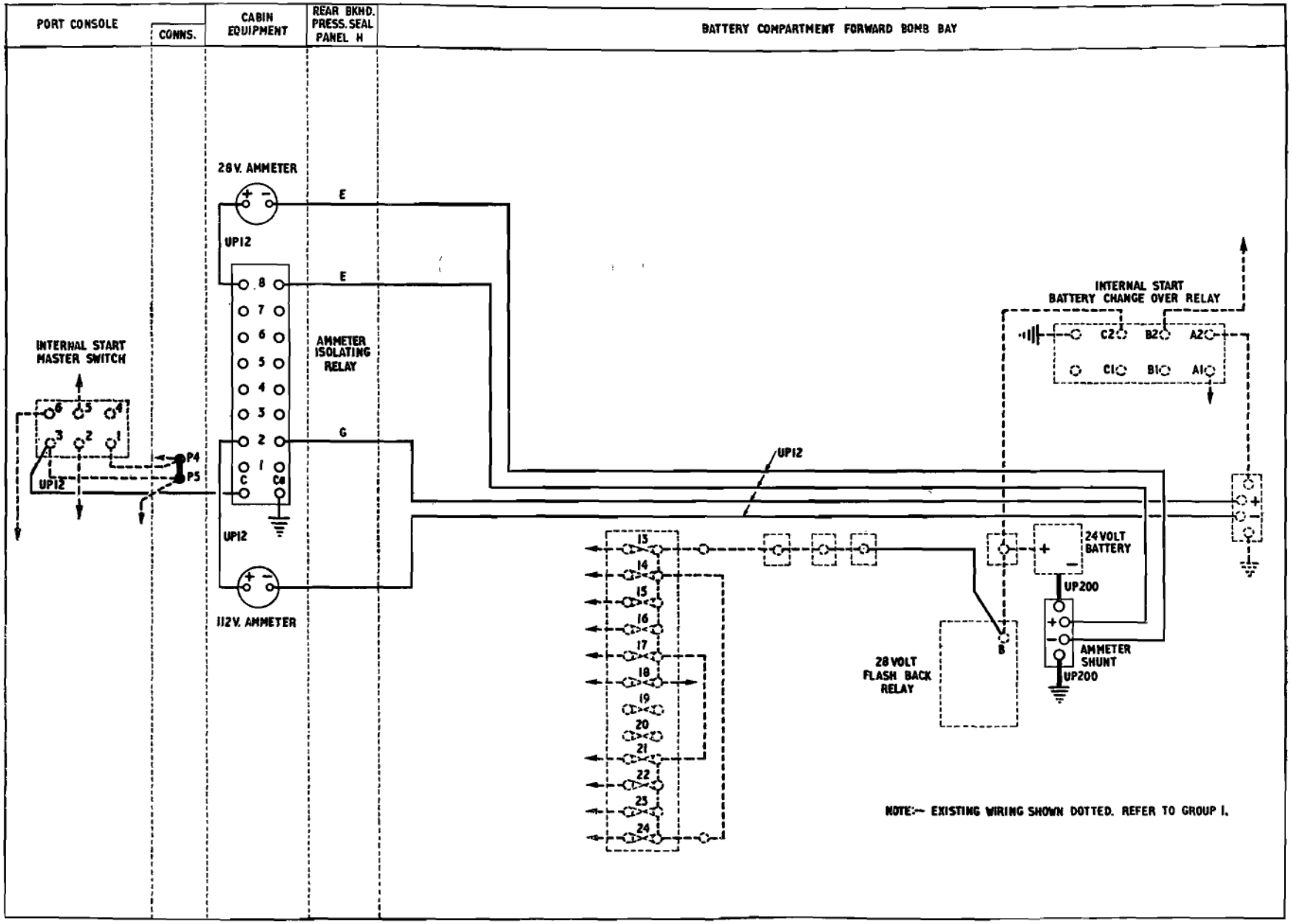
LIST OF APPENDICES

Appendix 1

ENGINE STARTING (post Mod. 2650)

General

1. Fig. 7A in Group 1 is amended to suit the latest issue of Mod. 2650 as shown in Fig. 1. The Mod., which is described in Chap. 1, Group 2, App. 4, has no effect upon the engine start circuit operation.



67436 SHT. 125-BJ
71036 SHT. 125-AD
75836 SHT. 125-AC

Fig. 1. Alterations to Fig. 7A in Group 1 (post Mod. 2650)

Appendix 2

ENGINE REAR BEARING WARNING SYSTEM (Mod. 3094)

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. This appendix describes the rear bearing temperature warning system introduced by Mod. 3094. Schematic and routeing diagrams are included in the appendix and the disposition of equipment is shown in the Group 4 location diagrams.

DESCRIPTION AND OPERATION

General

2. Red lamps are used to warn the pilots of dangerously high temperatures at the engine rear bearings.

3. Four lamps, one for each engine, are mounted on a panel above the engine fire warning lamps. Each lamp is controlled via a Type 9B relay by two fire detectors. The detectors are wired in parallel and fitted in the rear bearing air outlet ducts at zone 2 and the relays are located in panel E. Two filament test switches, located adjacent to the warning lamps, each serve two lamps.

No. 1 engine (*fig.* 1)

4. 28-volts from a fuse at panel E is permanently connected to the coil of relay R1. Operation of the fire detector completes the relay coil circuit to earth to energize the relay. Contacts R1/1 close to complete a hold-in circuit for the relay and contacts R1/2 close to connect the panel E supply to the warning lamp.

No. 2, 3 and 4 engines (*fig.* 1)

5. The No. 2, 3 and 4 engine circuits operate in a manner similar to that of No. 1 engine (*para.* 4).

Test switches (*fig.* 1)

6. With the test switches depressed, a panel E supply is connected to the warning lamp filaments.

SERVICING

Introduction

7. A detailed description of the general tests to be applied to all the aircraft electrical circuits can be obtained from the General Information Group. Reference should be made to the relevant Air Publication for information on the servicing of equipment used in the installation.

Function tests

8. (1) Connect a 28-volt d.c. supply at the external power supply plug.

(2) Select the 28-volt BATTERY MASTER switch to ON.

(3) Check the circuit fuses for serviceability and correct rating.

(4) Depress each test switch in turn and check that the associated lamps are serviceable.

(5) Using a suitable length of insulated cable, short circuit No. 1 and No. 2 detectors at Panel P and No. 3 and No. 4 detectors at Panel K in turn.

(6) Check that the associated warning lamps operate satisfactorily.

(7) Remove the link and restore disturbed wiring.

(8) Select the 28-volt BATTERY MASTER switch to OFF and remove the external supply.

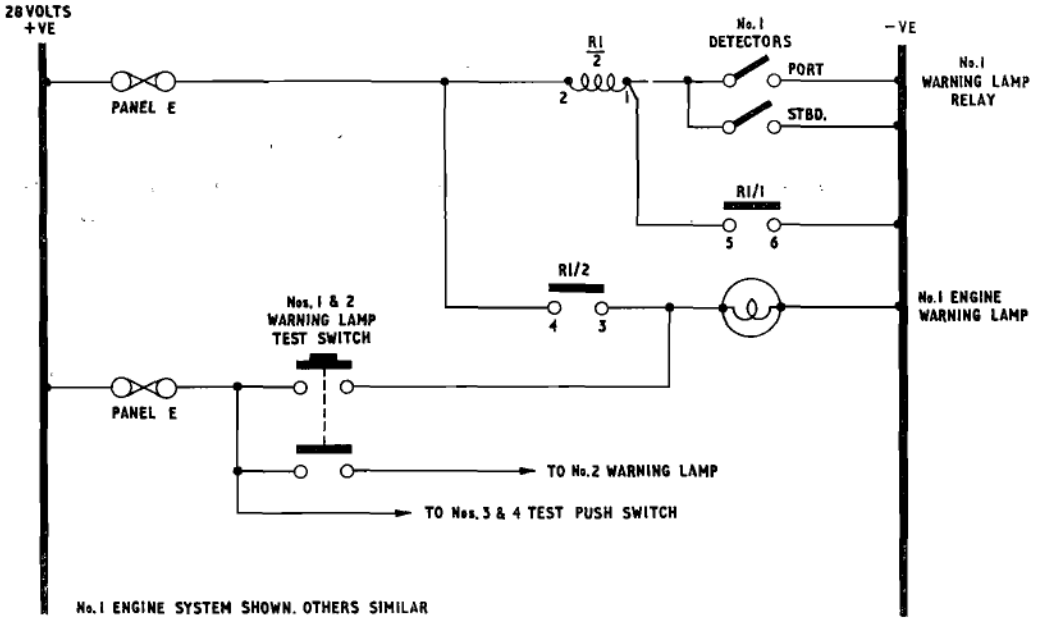


Fig. 1. Engine rear bearing warning system (Mod. 3094)

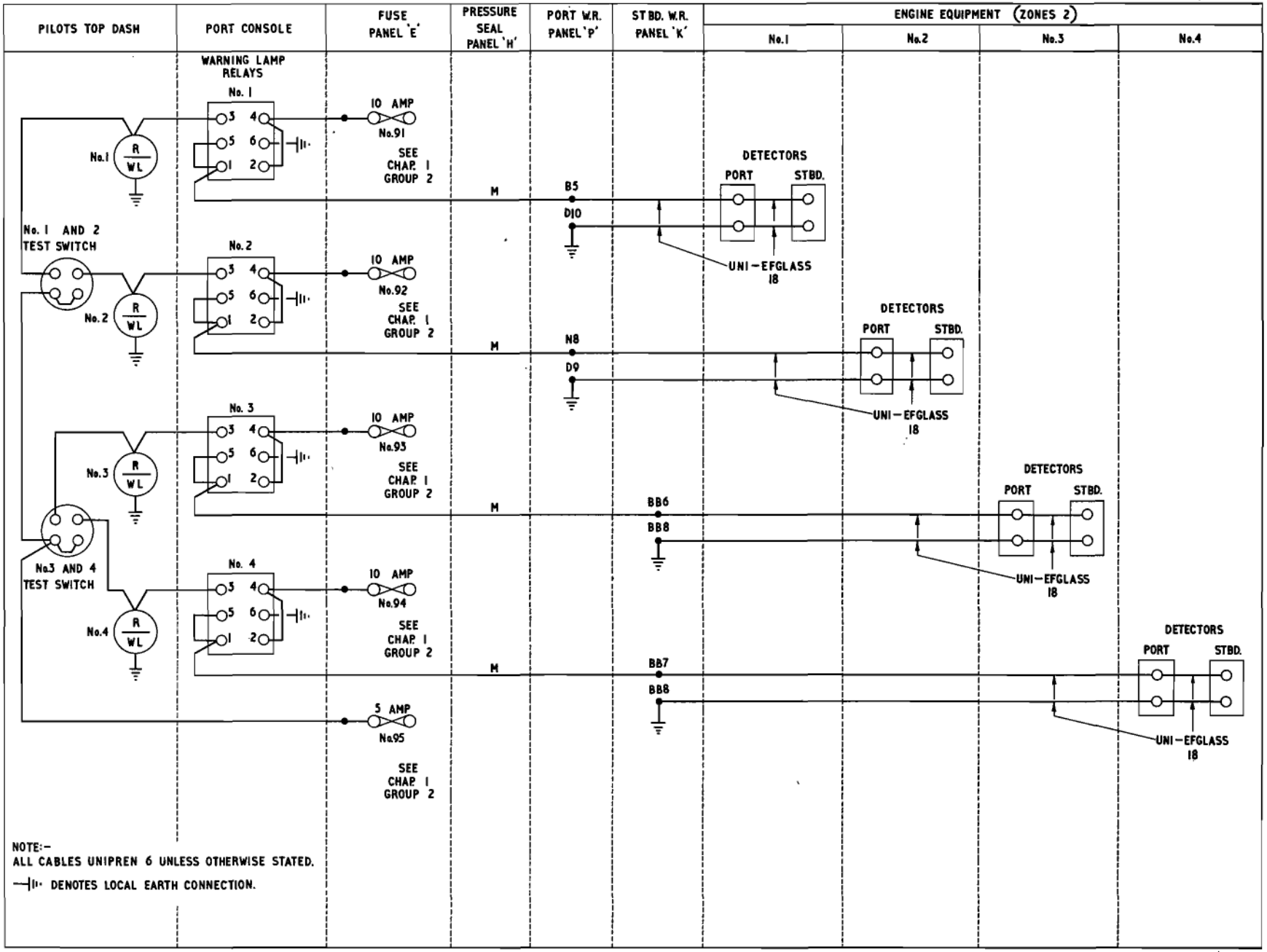


Fig.2. Engine rear bearing warning (Mod. 3094)

Appendix 3

QUICK RELEASE SIMSTART CONNECTORS (Mod. 3087)

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. This appendix describes the simultaneous engine starting facility introduced by Mod. 3087; the modification introduces four NATO type plugs located in the nose wheel bay. Schematic and routeing diagrams are included in this appendix and the position of equipment is shown in Group 4 location diagrams.

DESCRIPTION AND OPERATION

General

2. Four NATO type plugs are located in the nose wheel bay to connect the supply from the Simstart trolley Mk. 1, Type 1A, (A.P.4343V, Vol. 1, Book 1) direct to the starter motors and high-energy igniter units, thus by-passing the aircraft supply. Two plugs are mounted on the port side of the bay for the port engines, two on the starboard side for the starboard engines.

3. The NATO plug has two large heavy-duty pins and one small pin, the positive heavy-duty pin connects direct to the starter motor, the second heavy-duty pin is earthed to the airframe and the small pin is connected to the igniter units. The plugs are surrounded by a metal shroud and are mounted in metal boxes, each box contains two plugs and is closed by a spring-loaded lid. The boxes are positioned at an angle to permit the sockets to be automatically disengaged as the a/c moves forward.

Operation

4. (1) A Simstart trolley should be connected to the aircraft.

(2) Ensure that the START MASTER switch is at SAFE.

(3) Switch 96-volt battery OFF or NORMAL (pre Mod. 2260), 24-volt battery ON.

(4) Check Nos. 1, 2 and 3 generators OFF and No. 4 ON.

(5) Select the instrument master switch to ON.

(6) Check all rotary transformers OFF.

(7) During Simstart the aircrew must follow the drill developed by Bomber Command, for rapid starting of engines and switching on of power supplies.

(8) Simstart the engines.

(9) Check No. 4 generator comes on-line and switch on remaining generators.

(10) Switch on all three rotary transformers.

SERVICING

General

5. After every Simstart ensure that on damage is sustained by the plugs/sockets of the NATO connectors.

6. The general tests to be applied are contained in the General Information group contained in this Book immediately after Section 5 marker card.

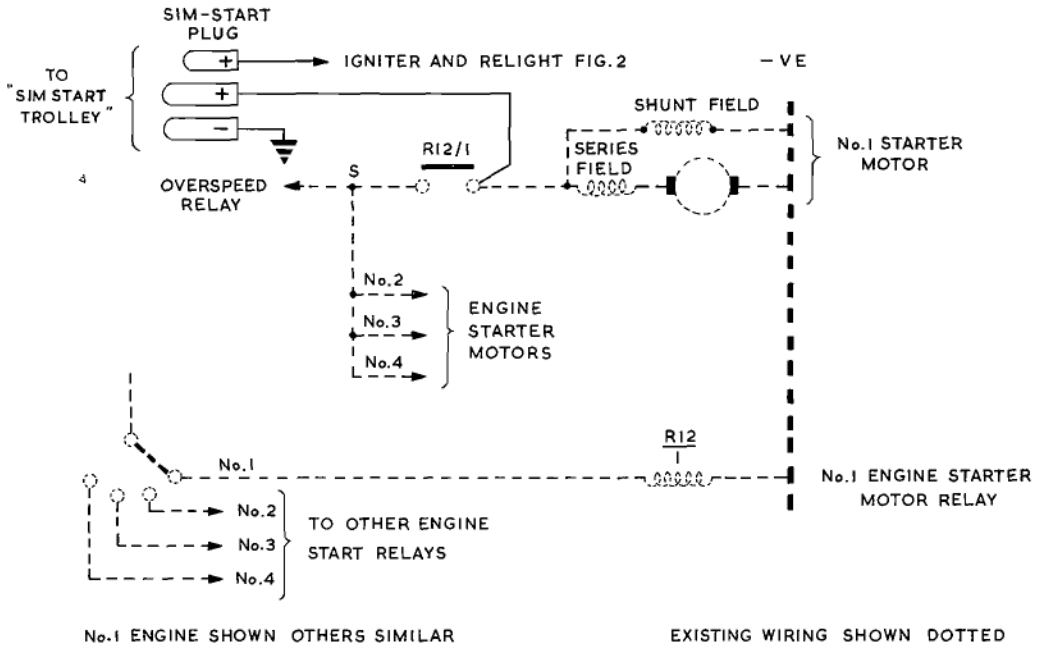


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Fig.1 Simstart – Alterations to Fig.1 (post Mod 3087)

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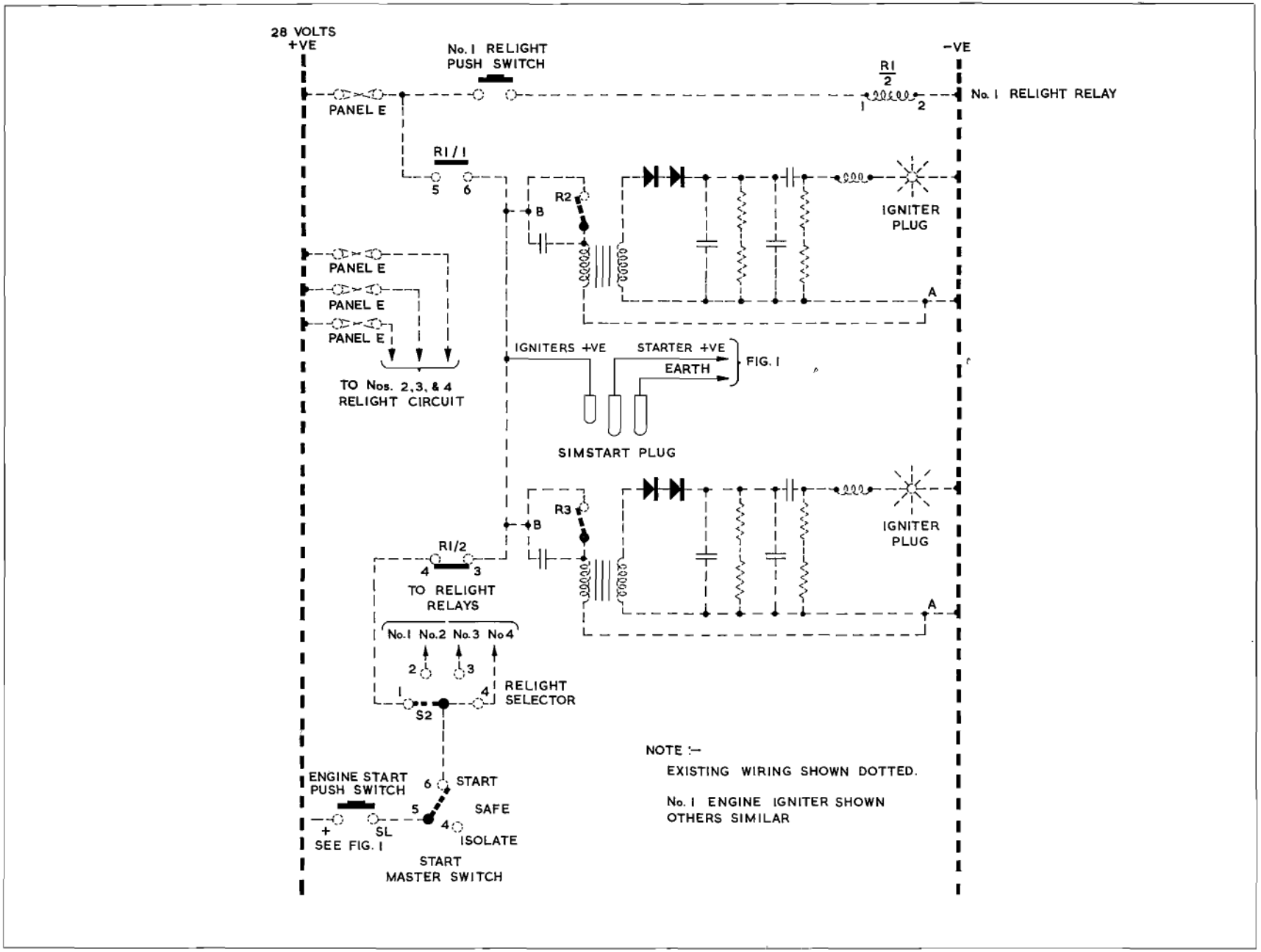

Fig. 2 Simstart – Alterations to Fig. 2 (post Mod. 3087)

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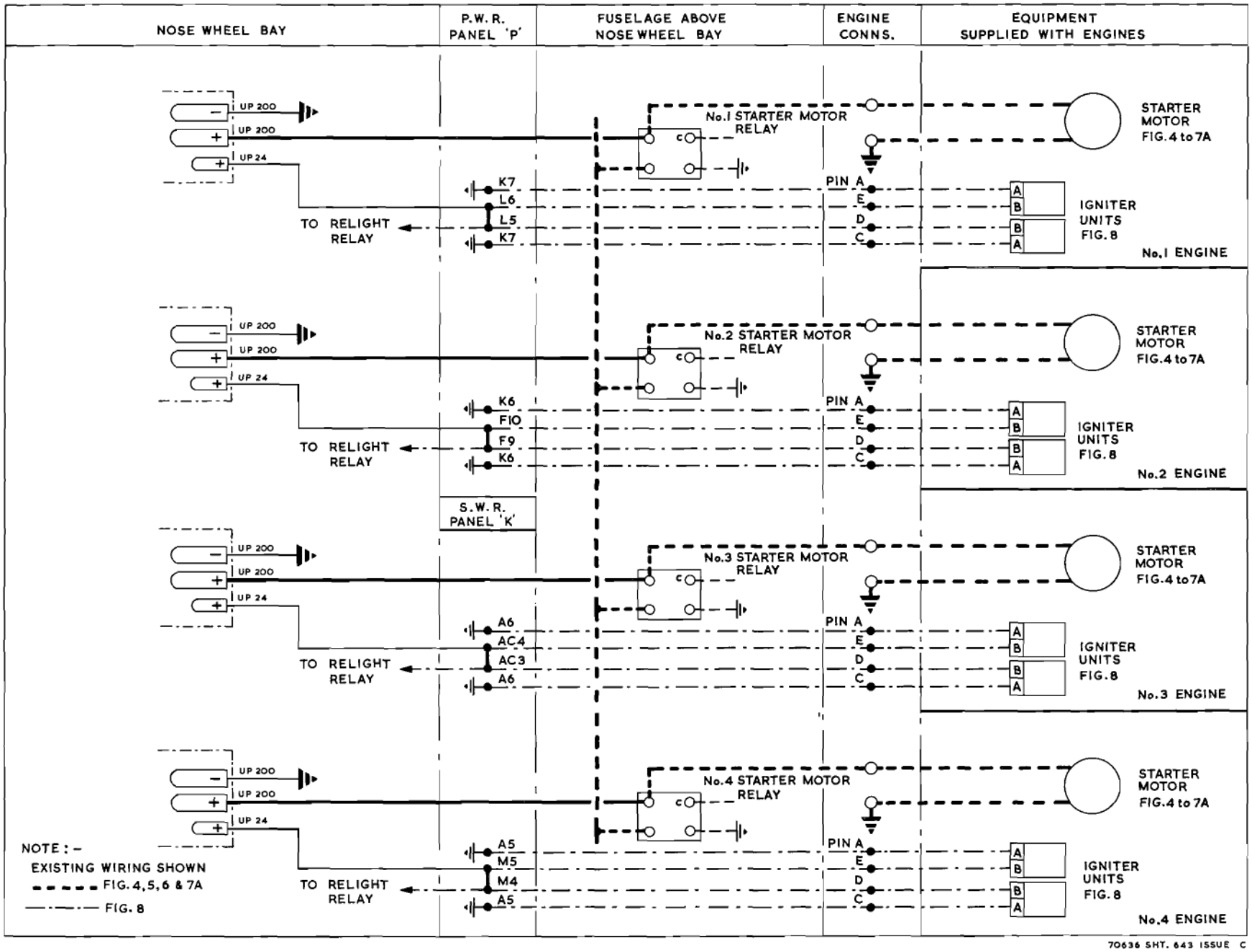

Fig. 3. Simstart — Alterations to Fig. 4, 5, 6, 7, 7A and 8 in Group 1 (Mod. 3087)

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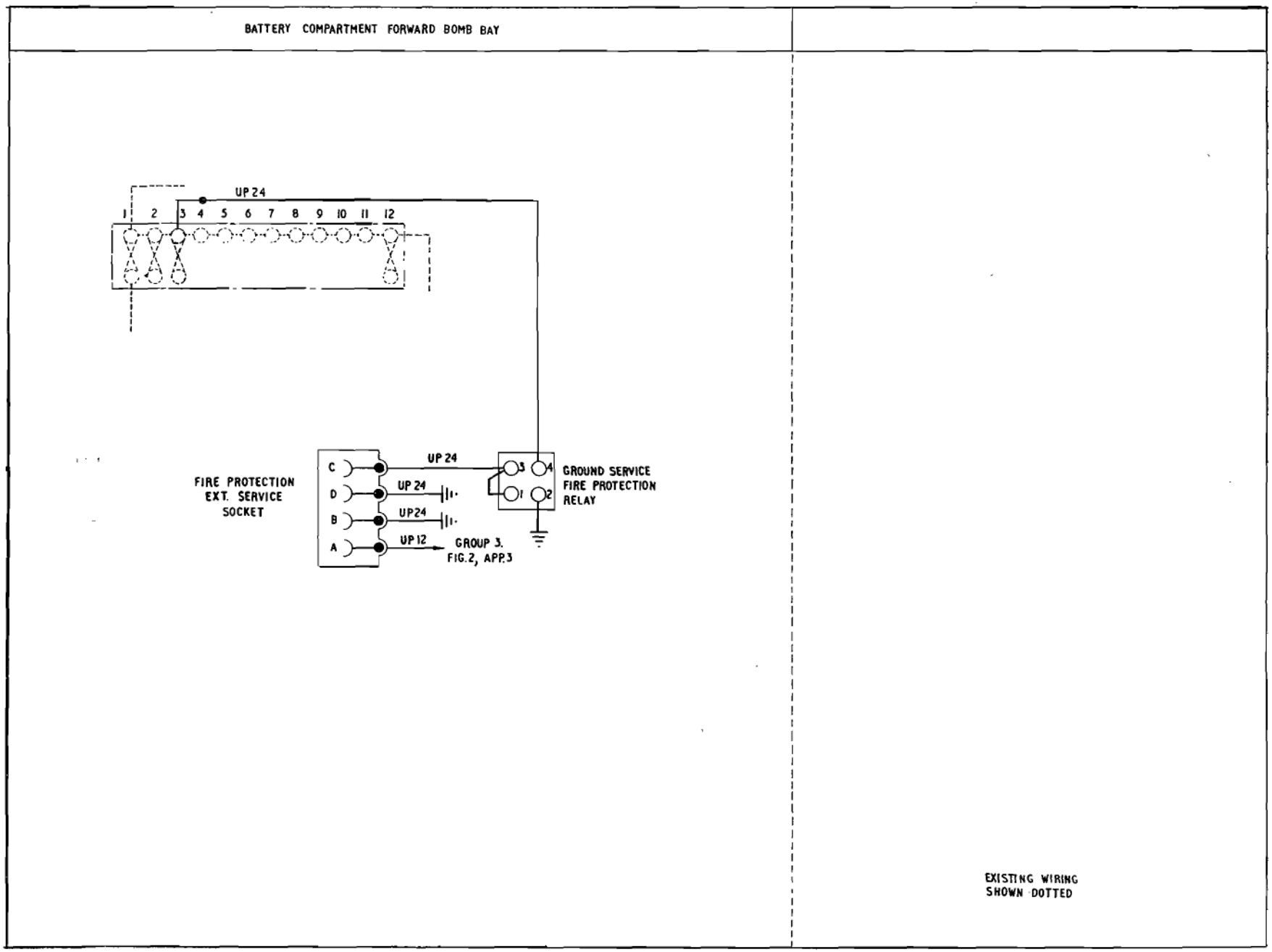
Appendix 4

GROUND SERVICING FIRE PROTECTION (Mod. 2810)

Introduction

1. Mod. 2810 introduces the aircraft wiring to provide fire protection during servicing of the aircraft. The installation is fully described in Group 3, Appendix 3. The wiring for the supplies is shown on fig. 1 of this appendix and is illustrated on fig. 6 of Group 4.



71036 SHT 125 ISS. AF
75H36 SHT 125 ISS. AE
67436 SHT 125 ISS. BL

Fig. 1. Alterations to Figs. 4(2), 5(2), 6(2), 7(2), 7A(2) (Mod. 2810)