Chapter 1

BEE Mk. 100 AIRBORNE AUXILIARY POWER PLANT

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LIST OF ILLUSTRATIONS

Introduction

1. The Bee Mk. 100 airborne auxiliary power plant, A.A.P.P. which is fitted to the Beverley Mk. 1 aircraft, is described in A.P.1507B, Vol. 1 and 6, to which this chapter is supplementary. The information given here is confined to a brief description of the unit, followed by details of the operation of the electrical circuit.

Brief description (*fig.* 1)

2. The A.A.P.P., which is designed for installation in aircraft, will provide power for ground charging of the aircraft batteries, ground servicing, and for engine starting in the absence of external ground supply. Power is provided by a 6 kW Type P.3 generator driven at 4,200 rev/min by a 15 H.P. Vee 4 gasoline engine. The unit has no individual fuel tank and can only be run from aircraft fuel supplied via a solenoid valve and a manually-operated cock. The solenoid valve is energized automatically when the unit is plugged in and the battery switch placed to ON/FLIGHT AND A.A.P.P., and the SET ON button pressed. The manually-operated fuel cock will still isolate the fuel from the unit until the exhaust outlet and air inlet vents are opened. These vents are mechanically linked and the vent operating lever is joined to the fuel cock lever, ensuring that the engine cannot be started until the vents are open. Arrangement is made for

electric or hand starting. A sump heater is fitted to assist in cold weather starting. The unit is provided with a 50-0-200 ammeter connected across a shunt, a voltage test socket is also provided and these items, together with the master switch, start and reset buttons, the power failure warning lamp and field circuit breaker, are mounted on the instrument panel at the front of the unit. The remainder of the electrical components are mounted on the electrical control panel at the rear. The location of items on the electrical control panel is shown in figs. 2 and 3.

3. The unit is intended to be used whilst the aircraft is on the ground and should be stopped before take-off. In Beverley aircraft, emergency provision is made for the unit to be automatically switched off when the weight of the aircraft is off the main wheels.

CIRCUIT OPERATION

General

4. The following paras should be read in conjunction with fig. 4 and 5.

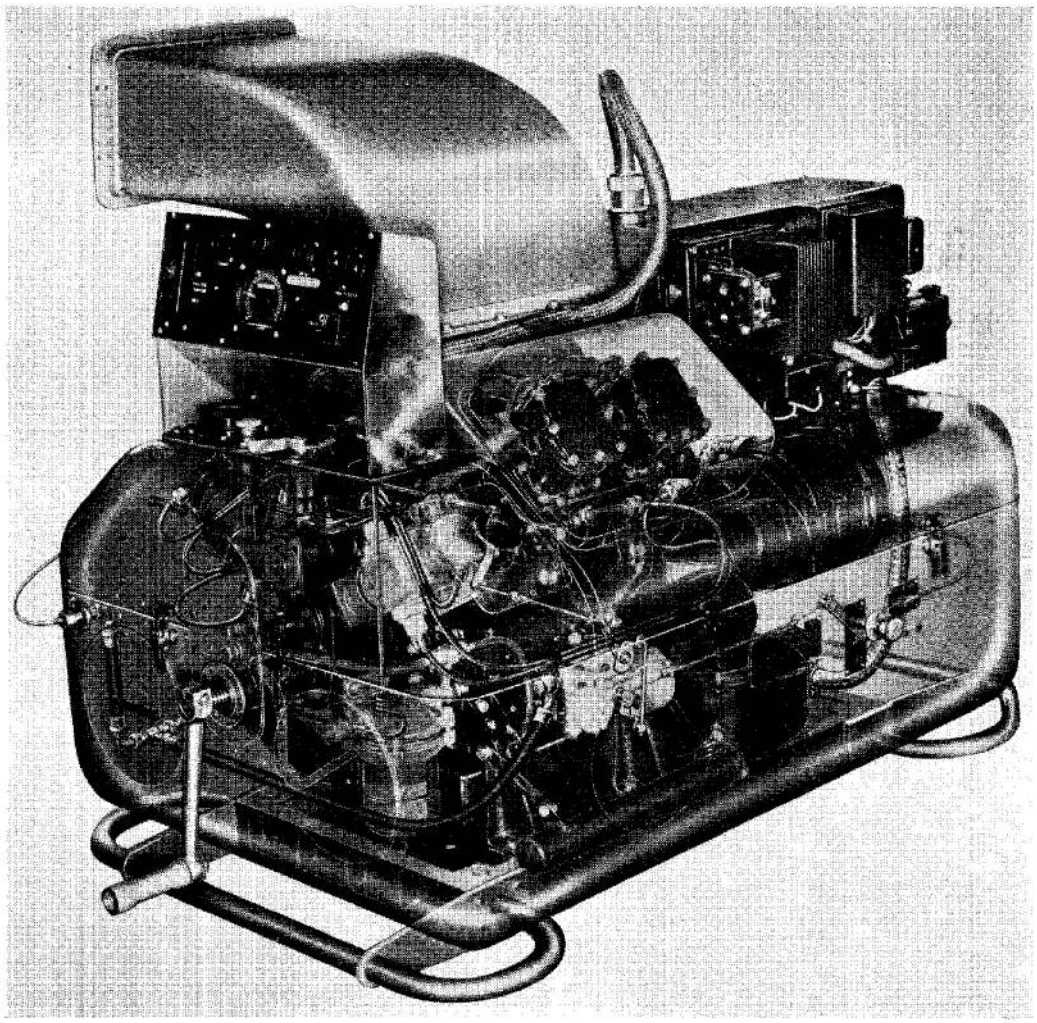

Fig. 1. Composite view of the plant

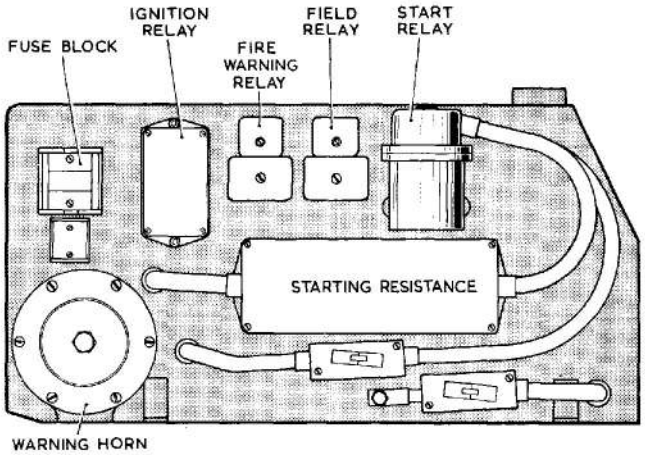

Fig. 3. Electrical control panel, left hand side

Starting

5. With A.A.P.P. socket connected to the supply plug in the aircraft and the battery switch in the ON/FLIGHT AND A.A.P.P. position, a 28-volt supply from fuse E.3 (*fig.* 4) is fed via contacts 2-1 on the switch, and 5-4 on the flash-back relay, to energize the battery isolating relay. Contacts 1-2 on the isolating relay connect the battery to the bus-bar. At the same time a 28-volt supply from fuse E.11 will be fed via contacts 6-6a on crash relay F, 5-4 on the battery switch, the light duty pole on the A.A.P.P. plug and socket, to terminal 2 on the terminal block (*fig.* 5) to feed the two 10 amp. fuses in the unit. One fuse feeds terminal 3 on the ignition relay and is also linked to terminal 3 on the reset relay.

6. When the reset relay is mechanically operated by pressing the SET ON button, a pair of contacts are closed which feed the supply from terminal 3 to terminal 2. This supply is fed via closed contacts 3-4 on the fire warning relay to energize the coil of the ignition relay, and also feeds the positive terminal of the START button. Energizing the ignition relay opens contacts 6-6a, 4-4a and 2-2a, closes contacts 3-3a and 1-1a. Opening contacts 6-6a and 4-4a removes the earthing from the A.A.P.P. magneto, preparing it for starting. The closing of contacts 3-3a feeds the supply to (a) terminal 3 on the differential cut-out, closed contacts 3-5 in the circuit breaker, to light the power failure warning lamp; (b) terminal 1 of the A.A.P.P. terminal block, via pole 1 on plug N-AX, to terminals 8 and 13 on the isolating relay. From terminal 13 a feed is taken to terminal 3 on the flash-back relay, which is connected to the A.A.P.P. fuel solenoid valve. The valve will then be energized and feed fuel from the aircraft tank.

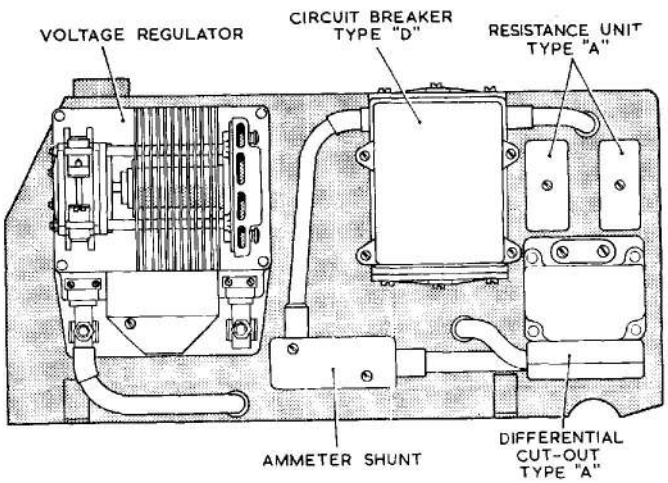

Fig. 2. Electrical control panel, right hand side

7. Completing a supply to terminal 13 of the isolating relay (*fig.* 4) will energize the relay and close contacts 1-2, 3-4 and 7-8, open contacts 5-4 and 12-13. The opening of contacts 12-13 inserts the economy coil in the isolating relay and contacts, 5-4 break the ground supply plug circuit to the flash-back relay. Contacts 3-4 make the A.A.P.P. safety circuit so that, should the ground supply be connected, the reset relay would be tripped. Contacts 8-7

closing feed the supply to terminal 12 of the flash-back relay.

8. The opening of contacts 12-13 in the flashback relay inserts the economy coil, contacts 5-4 opening break the supply from the battery switch to the battery isolating relay, but the relay is now fed by the closing of contacts 3-4, so the battery isolating relay will remain energized. The closing of contacts 7-8 will feed the supply to the generator hold-off relays, to ensure that the aircraft generators are disconnected from the bus-bar. Contacts 1-2 closing connect the positive bus-bar to terminal 2 on the isolating relay.

9. Contacts 2-1 on the isolating relay are closed, so the bus-bar will feed via the supply plug and socket, to the positive terminal in the A.A.P.P. When the START button is pressed the supply from its positive side is switched to energize the A.A.P.P. start and field relays. Contacts 3-4 on the start relay and on the field relay close. The supply from the bus-bar is now fed via 3-4 on the start relay, the starting resistor, to G+ on the generator. At the same time, the supply is fed from terminal 4 on the start relay, via 3-4 on the field relay, to terminal F on the generator. This will motor the generator to act as an electric starting device for the engine.

10. When the engine has started, and the START button is released, the start and field relays are de-energized and the bus-bar supply is disconnected from the generator. The generator, now being driven, will commence to feed its own voltage to terminal 1 on the voltage regulator. The generator field is being fed via the regulator coil, carbon pile, terminal 3 on the voltage regulator and the 15-amp circuit breaker and the generator voltage will build up. The generator voltage is also fed to terminal 1 on the differential cut-out, Type A, Mk. 2.

11. When the generator voltage exceeds the bus-bar voltage by ·35V to ·75V, sufficient current will flow through the cut-out differential coil and (a) the ballast lamp, terminal 3 on the cut-out, terminal 3 on the ignition relay, terminal 1 on the A.A.P.P. terminal block, pole 1 N-AX, and contacts 13-12 of the isolating relay; or (b) contacts 3-5 on circuit breaker and the power failure warning lamp; to operate the cut-out. The generator voltage is then fed from terminal 4 on the cut-out to contacts 2a, and 1a on the ignition relay. Contacts 1a-1 being closed, the supply is fed through the 5 amp. fuse and then via the reset button to terminal 7 on the circuit breaker. This will energize the circuit breaker closing thermal contacts 1-2, opening contacts 3-5 and 7-4. Contacts 7-4 opening insert the economy coil, and contacts 3-5 opening break the supply to the power failure warning lamp. The closing of contacts 1-2 connects the generator to the aircraft bus-bar, the path being:—generator G+, terminal 1 voltage regulator, terminal 1—terminal 2 differential cut-out, ammeter shunt, 1-2 circuit breaker, positive pole of plug and socket N-AY, contacts 1-2 of the isolating relay, 2-1 flash-back relay, to aircraft positive bus-bar. This path includes the current coil of the differential cut-out, which retains the cut-out contacts in the closed position, thus maintaining the feed to the circuit breaker coil.

Reset

12. Pressing the RESET button breaks the feed to the circuit breaker coil, and will open contacts 1-2, and close contacts 3-5. Contacts 1-2 opening isolate the A.A.P.P. from the bus-bar, and the closing of contacts 3-5 light the POWER FAILURE warning lamp. As soon as the RESET button is released, the circuit breaker will be energized, returning the plant to the bus-bar and extinguishing the power failure warning lamp.

Stopping

13. The action of pressing the TRIP button on the reset relay breaks the connection between contacts 3 and 2 on the reset relay. This breaks the supply to the ignition relay coil thus earthing the magneto, de-energizing the fuel valve, and de-energizing the isolating relay and the flash-back relay. The plant is thus stopped and disconnected from the bus-bar. The feed is thereby removed from the circuit breaker which will open, the differential cut-out will open as the A.A.P.P. generator voltage falls.

A.A.P.P. power failure

14. Should the A.A.P.P. generator voltage fall below the aircraft battery voltage, a

reverse current will flow from the bus-bar to the A.A.P.P. As soon as this reverse current through the current coil of the differential cut-out-reaches 15 amps., the cut-out contacts will open. This breaks the feed to the circuit breaker coil, opening contacts 1-2, closing contacts 3-5 of the circuit breaker. The opening of contacts 1-2 disconnects the A.A.P.P. from the bus-bar, and the closing of contacts 3-5 supplies the power failure warning lamp. The unit will remain running, and should the generator voltage rise above the battery voltage, it will be connected to the bus-bar as described in para. 11.

Battery switch placed to OFF with A.A.P.P. running

15. Should the battery switch be placed to the OFF position, a 28-volt supply will be fed from fuse E.11 via contacts 6-6a of crash relay F, 5-6 on battery switch to terminal 3 on the isolating relay, to pole 2 plug N-AX, which feeds the trip coil of the reset relay. This will open contacts between terminals 3-2 in the reset relay and break the feed to the ignition relay. The closing of contacts 4-4a and 6-6a will earth the magneto, thus stopping the A.A.P.P. It will be seen that if the battery switch is in the OFF position it will be impossible to start the plant.

Take-off with A.A.P.P. running

16. If the aircraft should take-off with the A.A.P.P. running, the undercarriage relays will be de-energized when the weight of the aircraft is off the main wheels. Contacts 6-6a on relay A, and 6-6a on relay B will close. The 28-volt supply from fuse E.11 will be fed via contacts 6-6a in crash relay F, 5-4 on battery switch, and contacts 6-6a on undercarriage relays A and B, to terminal 6 on the battery switch. The plant will then be stopped in the same sequence as described in para. 15.

17. It will be seen that as soon as the ignition relay is de-energized, and contacts 3-3a open, the isolating relay will be de-energized, this will de-energize the flashback relay, and also the A.A.P.P. fuel solenoid valve.

Fire warning

18. In the event of fire in the A.A.P.P. an audible warning is given by means of a horn Type C. A 28-volt supply from a 10-amp fuse connected to terminal 2 on the A.A.P.P. terminal block is fed to terminal 5 on the fire warning relay. A flame switch is connected between 5 and 1 on the relay, so that should the flame switch operate, the coil of the fire warning relay will be energized. This action will close contacts 6-5, and open contacts 3-4. The warning horn is connected in parallel with the relay coil so that the audible warning will be given as soon as the flame switch closes. The closing of contacts 6-5 feed the supply to the trip coil of the reset relay and the opening of contacts 3-4 also breaks the supply to the ignition relay coil.

19. This action will stop the A.A.P.P. by earthing the magneto, and also disconnect the unit from the bus-bar, by de-energizing the isolating relay, and flash back relay. The fuel valve will also be disconnected, preventing fuel being fed to the plant. The warning horn will sound until the appropriate A.A.P.P. fuse is removed. The fuse must be replaced when the flame switch has been reset and the capillary renewed.

20. To extinguish an A.A.P.P. fire, use a methyl-bromide hand operated fire extinguisher container. Insert the nozzle into the hole(s) provided in the A.A.P.P. casing, and discharge the contents into the casing.

WARNING . . .

Methyl bromide fumes are toxic and must not be inhaled.

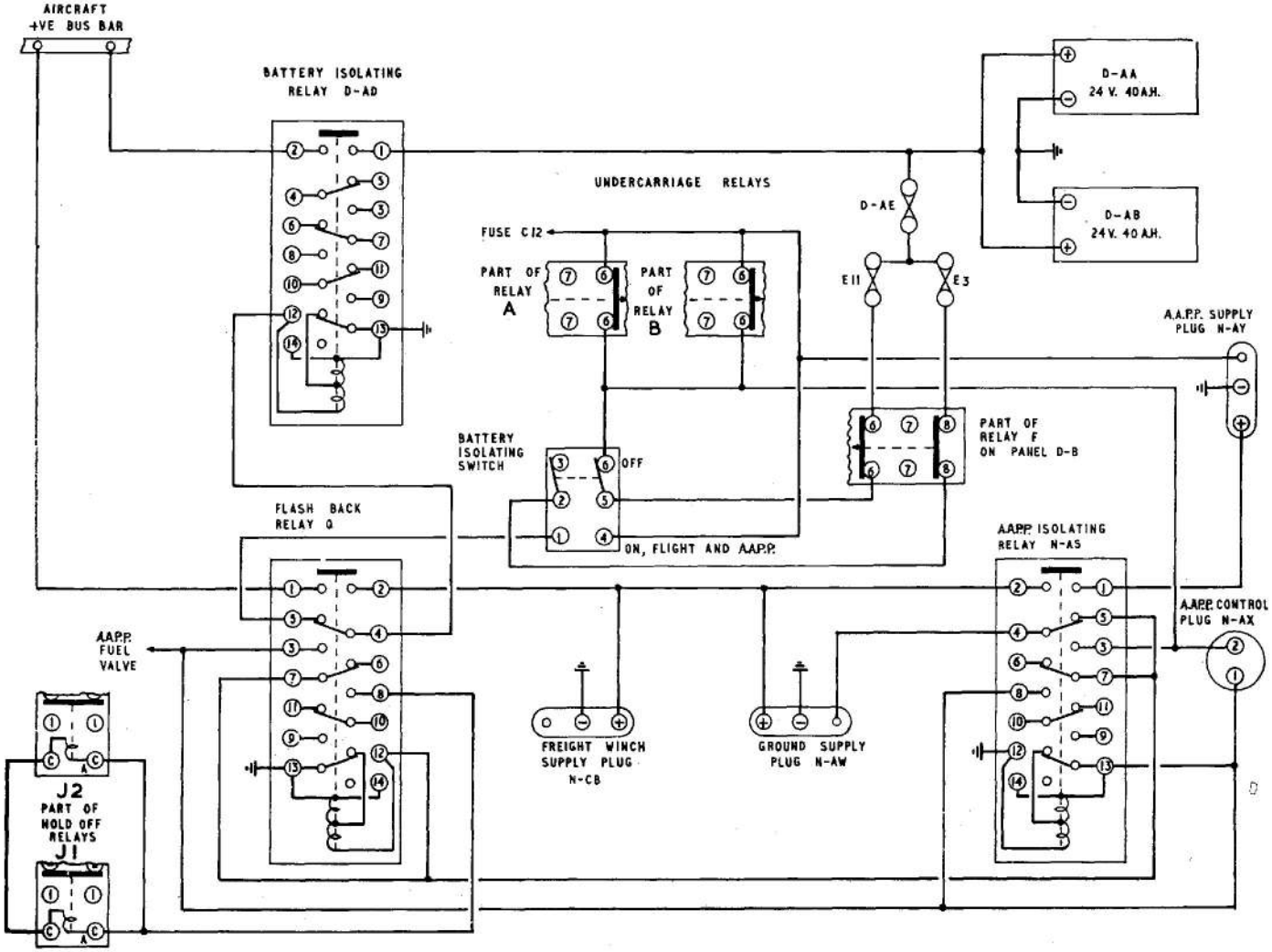

Fig. 4. Associated aircraft circuit diagram

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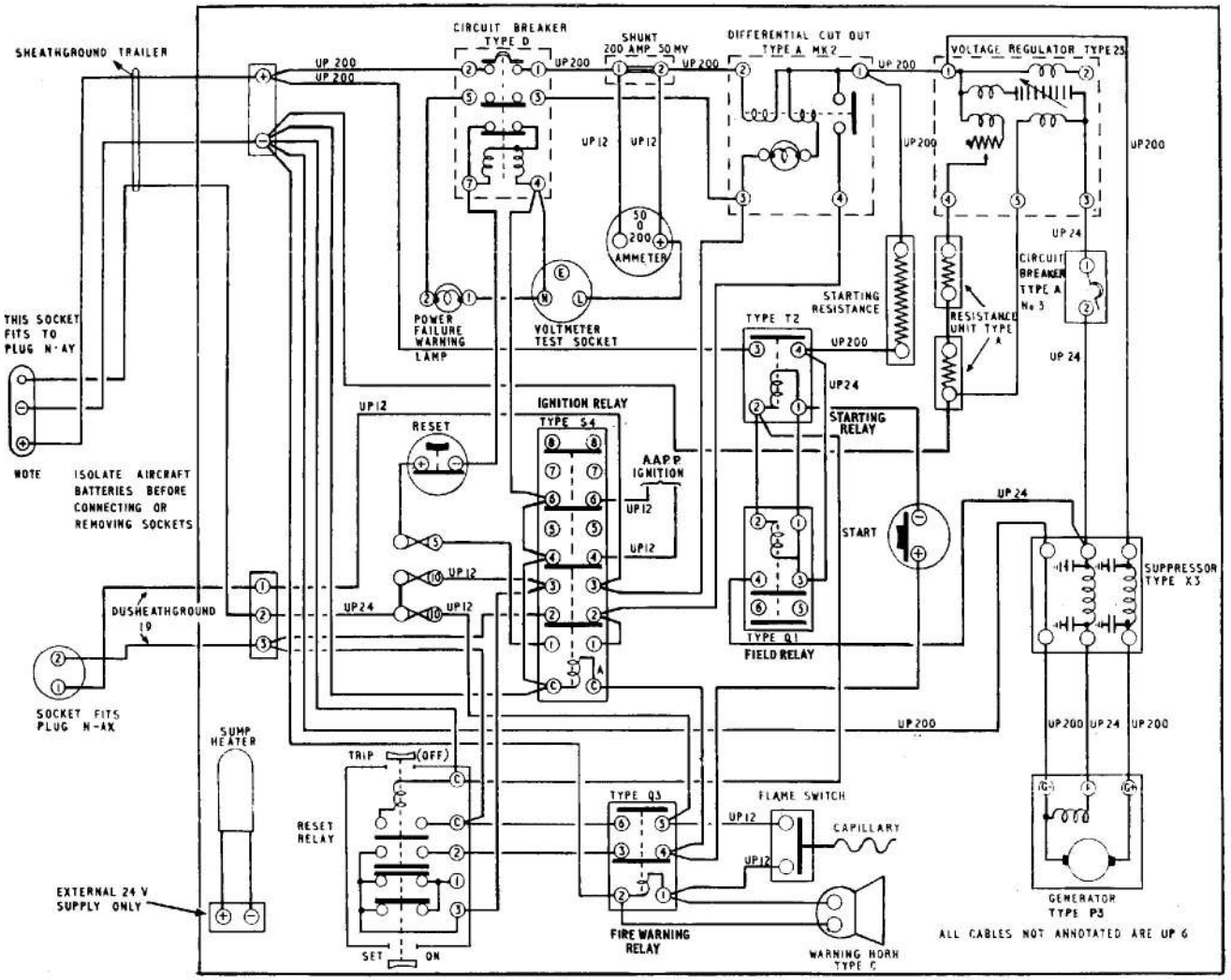

Fig. 5. A.A.P.P. circuit diagram