

## GROUP C3

## TANK PUMPS, TANK PUMPS FAILURE WARNING AND PRESSURE REFUELING (CODE BP PF PR)

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**Introduction**

1. This group contains a brief description, including the method of operation, of the tank pumps, tank pumps failure warning and pressure refuelling circuits. Servicing information is also included, together with routing and theoretical diagrams of the circuits. For a general description of the electrical system as a whole, including system wiring details, referencing of components and general servicing, together with the location and removal

of the major items of equipment, reference should be made to Groups A1, A2 and A3 of this chapter. Detailed information on the standard components used will be found in the appropriate volumes of the A.P.4343 series.

**DESCRIPTION****Tank pumps (pre- and post-Mod. 138)**

2. The electrically-driven Type SPE.1003, Mk. 1 fuel booster pumps, incorporated in the inverted flight traps of the port and starboard front fuel tanks, installed in the centre fuselage, are supplied by way of the engine master switch (*Group C1*). The pumps are controlled by two on/off switches, marked PORT and STBD, which are located side by side on the forward end of the cab'n starboard shelf. Each pump is protected by a 25-amp circuit breaker, situated at the rear end of the starboard shelf and, to minimize radio interference, the supply to the pumps is taken through a Type 02 suppressor, mounted on the port side of the keel member between frames 20 and 21. Provision is made for testing each pump, in turn, by means of a two-position test switch, which is marked TANK PUMPS TEST and is mounted, together with an ammeter test socket, on the rear end of the starboard shelf.

**Operation**

3. With the engine master switch made and both tank pump control switches in the ON position, current will flow from the main positive supply line to both tank pumps, which will commence operation and supply fuel to the engine-driven fuel pump. As the tank pumps are matched units, they should empty the front tanks at an equal rate and, in emptying them, allow the fuel in the remaining tanks

to transfer to the front tanks under air pressure; thus both sides of the system should empty uniformly and simultaneously. The individual pump control switches enable the fuel levels to be manually balanced, should such action become necessary, as switching off the pump in the tank with the lowest level allows the tank with the operative pump to supply a greater proportion of fuel to the engine-driven pump. When balance is regained, the inoperative pump should be switched on again or out-of-balance in the opposite sense will result.

4. Should either pump be overloaded, due, for example, to a fuel surge, the appropriate circuit breaker will operate to isolate the pump from the circuit. When this occurs, the affected circuit breaker must be re-set; then, if the fault was temporary, the pump will recommence running in the normal manner. If the circuit breaker refuses to hold on, the fault is of a permanent nature and engine speed must be reduced and the other pump switched off or excessive out-of-balance will result. Under this condition, the fuel will be supplied to the engine-driven pump under gravity and transfer air pressure.

5. The two-position test switch and the ammeter socket, used to test the tank pumps for correct functioning, as described in para. 17, obtain their positive supply by way of the engine starter circuit breaker (*Group C1*). The test switch can feed either pump, irrespective of the position of the control switches, provided that the engine master switch is OFF. For a full description of the fuel system as a whole reference should be made to Section 4, Chapter 2 of this volume.

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#### Tank pumps and balancer (Mod. 332 and 373)

6. Aircraft with Mod. 332 and 373 embodied have an automatic fuel balancing system controlled by a balancer relay linked with the fuel contents gauges (Sect. 5, Chap. 2, Group 2). The electrically-driven fuel booster pumps of these aircraft are supplied by way of the engine master switch; they are suppressed and are protected by circuit breakers in a similar manner to those in aircraft pre- and post-Mod. 138. The pumps are controlled by two single-pole changeover switches marked AUTO, OFF and MANUAL, which are located side by side on the forward end of the cabin starboard shelf. The supply to the pumps is taken direct when the control switches are in the MANUAL position, or through two auto pump failure relays, located beneath the starboard shelf, when the switches are in the AUTO position. The negative return from each pump is taken to earth via an auto control relay mounted on a fuel balance equipment panel situated on the starboard rear face of frame 16. This panel also carries the fuel pump motor control resistor, which is switched in and out of circuit by the control relays. The control relays are themselves controlled, via the auto pump failure relays, by the Type MA.4 balancer relay which is mounted on brackets attached to the inside port skin of the fuselage between frames 17A and 17B, in the radio bay. Provision is also made for testing each pump, in turn, in a similar manner to that on aircraft pre- and post-Mod. 138, as described in para. 2 to 5.

#### Operation

7. With the engine master switch made and both tank pump control switches in the AUTO position, current will flow from the main positive supply line to energize both auto pump failure relays. Contacts in these relays, which are made when the relays are energized, then complete the supply to each pump. The negative return from each pump is taken to earth via the contacts in the auto control relays which are made while the relays are unenergized. Both fuel pumps thus commence operation to supply fuel to the engine-driven fuel pump, and as the pumps are matched units they should empty both sides of the system simultaneously. Should the fuel levels in the port and starboard tank systems

become out of balance, the fuel gauge indicator currents from the two contents amplifiers will be unequal and will operate the balancer relay to slow up the pump on the side with lower fuel content. For example, if the port tank system has the lower content, the balancer relay will operate to supply a positive feed to pin F of the unit; this feed will energize the port control relay, via contacts 3 in the port and starboard pump failure relays, which are made while the relays are energized. When the port control relay is energized, it breaks contacts 2 and 4 and makes contacts 1 and 3. The wiring of the relay is such that the negative return is at no time opened as there is always an alternative path to earth. The negative return of the port pump is now taken to earth, through the pump motor control resistor, to contacts 1 and 3 of the port control relay and contacts 2 and 4 of the starboard control relay. The pump will thus slow up, so allowing the starboard pump to supply more fuel to the engine until the level in the starboard tank system falls and balance is regained. The balancer relay is then de-energized and breaks the supply to the port control relay which is, therefore, de-energized and cuts the resistor out of circuit to allow the port pump to revert to normal operation. A similar process occurs, via pin D of the balancer relay and contacts 1 of the failure relays, when the starboard tank system has the lower fuel level.

8. The MANUAL position of the individual pump control switches enables the fuel levels to be manually balanced, if necessary. When the switches are in the MANUAL position, the pump failure relays are de-energized and the supply to the pumps is taken direct from the control switches. The balancer relay is, therefore, out of circuit, due to the opening of contacts 1 and 3 in the pump failure relays, and the control relays cannot be energized to insert the pump motor control resistor into the negative return lines. Switching off the pump in the tank on the side with the lower fuel level will now allow the side with the operative pump to supply a greater proportion of fuel to the engine-driven pump. When the balance is regained, the inoperative pump should be switched on again or excessive out-of-balance in the opposite sense will result.

9. If either pump is overloaded, due, for example, to a fuel surge, the appropriate circuit breaker will operate to de-energize the pump failure relay, when in AUTO, and thus isolate the pump and balancer relay from the circuit. When in MANUAL, the pump failure relays will already be de-energized and the pump will be isolated by the circuit breaker. When this occurs the affected circuit breaker must be re-set; then, if the fault was temporary, the pump will recommence running in the normal manner. If the circuit breaker refuses to hold on, the fault is of a permanent nature and the engine speed must be reduced and the other pump switched off or excessive out-of-balance will result. Under these conditions, the fuel will be supplied to the engine-driven pump under gravity and transfer air pressure.

#### Tank pumps failure warning (Mod. 374)

10. Two lamps, situated on the cabin starboard shelf, give warning when either of the fuel booster pumps fail. Each lamp is operated by a separate Type T.P.5366 pressure switch, which is piped into the appropriate booster pump outlet pipe. The switches are mounted together at the bottom of the centre fuselage, near frame 23.

#### Operation

11. The pressure switches make on falling pressure. Thus, should either pump fail and its outlet pressure drop, the appropriate switch will close and complete the supply to the warning lamp, which will light to indicate pump failure.

#### Pressure refuelling

12. The aircraft is refuelled under pressure through a standard 1½ in. coupling situated in the port wheel bay, the operation being controlled by a pre-set Type PTA/HA time switch mounted in the port stub wing adjacent to the refuelling coupling. The time switch energizes four Mk. 12 solenoid-operated refuelling valves, located in the port and starboard front and centre fuel tanks, which are controlled by two Type 1696/FG fluid level switches situated one in each front fuel tank and two Mk. 4, series 2, fluid level switches located one in each outboard wing fuel tank.

**Operation**

13. To understand the function of the pressure refuelling circuit it is necessary to trace through the aircraft refuelling procedure. The battery master switch must first be set to the ON position, or an external supply connected, before refuelling can commence, as an electrical supply is required to energize the refuelling valves.

14. Next, the bowser hose is connected to the refuelling coupling and the bowser pump started, with its controls set to RE-FUEL. The time switch is then set and makes contacts C and 2, thus completing the circuit to all four refuelling valve solenoids, which, when energized, open and allow fuel from the bowser to pass into the front and centre tanks. When the front tanks are full, the fluid level switches in these tanks open and de-energize the solenoids of the refuelling valves in the front tanks. The valves then close to cut off the fuel to these tanks. When the centre tanks are full, fuel flows down the transfer pipes to the wing tanks and, when these latter tanks are also full, the fluid level switches in the wing tanks open and de-energize the solenoids of the refuelling valves in the centre tanks. These valves then close to cut off the fuel to the centre and wing tanks.

15. Refuelling is now complete and the time switch should be switched off, if it has not already completed its full travel. The time switch ensures that the refuelling circuit is disconnected from the positive supply at all

times, except during actual refuelling operations. This ensures that the refuelling valve solenoids do not become energized again, when the fluid level switches close as the fuel is consumed, as this would cause cross-transfer between the tanks, via the refuelling pipe lines. If not switched off after refuelling, the time switch will automatically switch itself off after approximately 8 minutes. For a full description of the fuel and refuelling system as a whole, reference should be made to Sect. 4, Chap. 2 of this volume.

**SERVICING****General**

16. For general servicing of the electrical system as a whole, reference should be made to Group A1 of this chapter. The contacts of the pressure refuelling time switch should be kept clean and inspected for signs of pitting, which, if found, must be removed in the approved manner. These operations should only be carried out by competent personnel, as the switch contains a delicate clock-work mechanism. The only other servicing, apart from keeping all the components clean and carrying out the normal routine tests of security and serviceability, as described in the appropriate Air Publications, is the tank pump test, described in the following paragraph.

**Tank pump testing**

17. To test the pumps for correct functioning, connect an ammeter to the test socket

located on the cabin starboard shelf. Ensure that the battery master switch is in the ON position, or that an external supply is connected. Check that the engine starter circuit breaker is CLOSED. Trip each pump circuit breaker or ensure that the engine master switch is OFF and select each pump in turn by operating the test switch, adjacent to the ammeter test socket. If the pumps are operating satisfactorily, the ammeter should show a reading of 11.75 amp, or less, at 24 volts but, if the reading is above this value, the cause must be investigated and rectified before the next flight. After completion of the test, re-set the circuit breakers, if necessary.

**REMOVAL AND ASSEMBLY****General**

18. The removal of the tank pumps, refuelling valve and fluid level switches is fully described and illustrated in the fuel tank removal procedure in Sect. 4, Chap. 2 of this volume. Once access has been obtained, the removal of the remaining components forming the tank pump, failure warning and pressure refuelling circuits should present no unusual difficulties. The removal of the cabin starboard shelf, which carries the control switches, warning lamps and circuit breakers of the tank pump circuit, is fully described in Group A2 of this chapter, while the location and means of access to all components is indicated in Group A3.

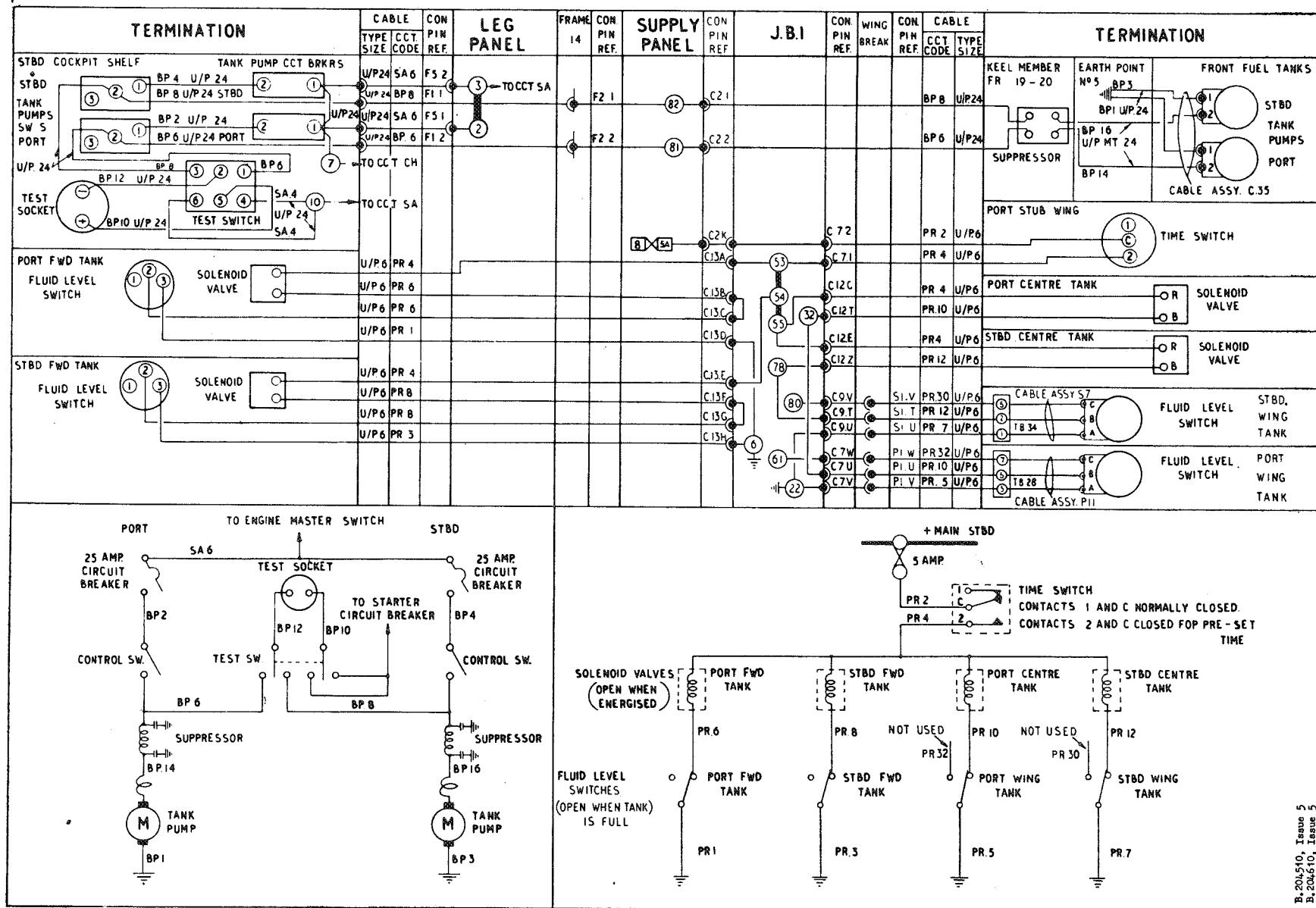


Fig. 1. Tank pumps (pre- and post-Mod. 138) and pressure refuelling

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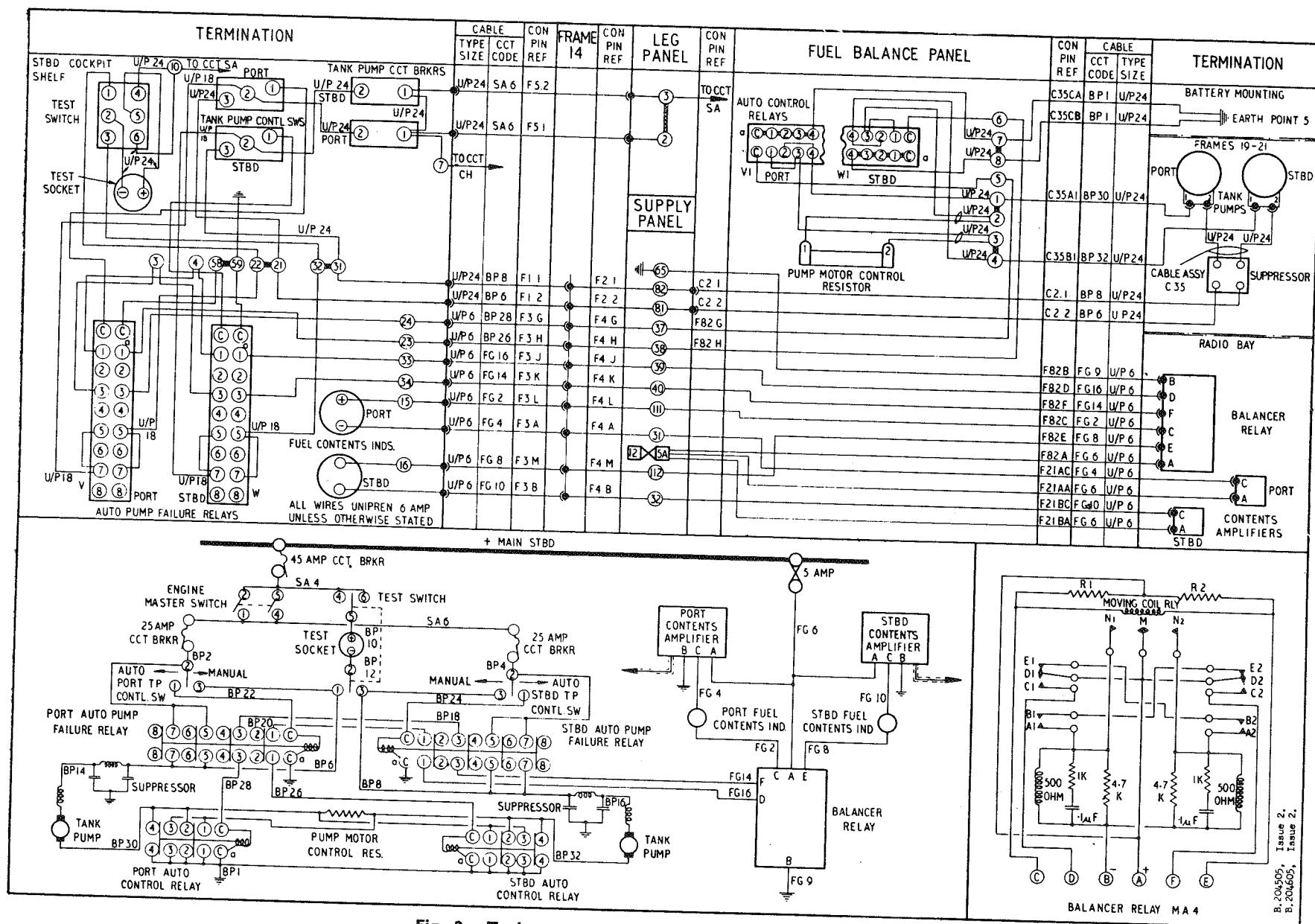
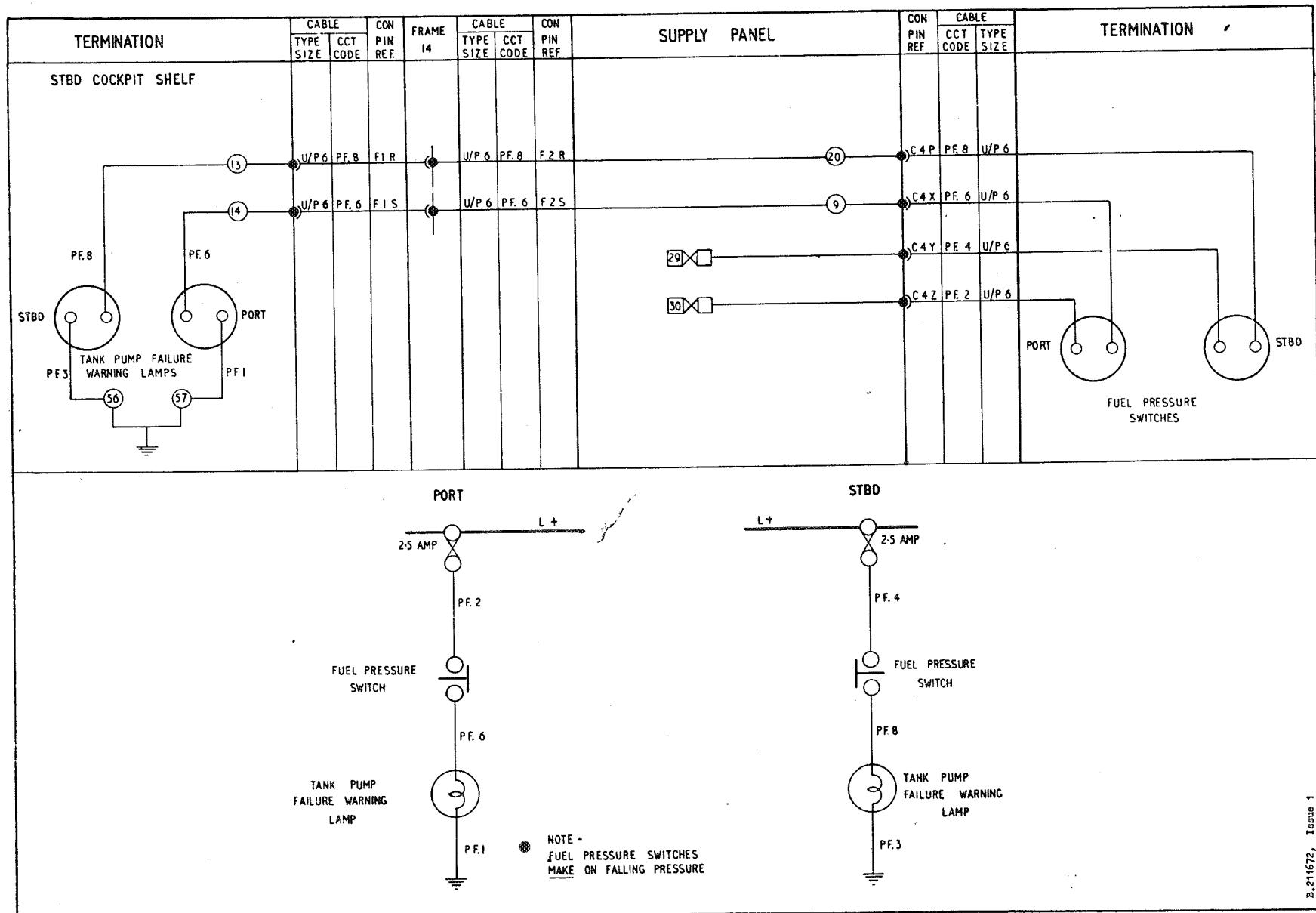


Fig. 2. Tank pumps with balancer (Mod. 332 and 373)



**Fig. 3. Tank pumps failure warning**

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