

Chapter 10 FUEL SYSTEM

LIST OF CONTENTS

DESCRIPTION	Para.		Para.		Para.
General	1				
GROUND REFUELLING					
Ground refuelling panel... ..	5				
Ground refuelling indicator panel ...	6				
Main tanks	7				
Ventral tank	8				
Flap tanks	9				
FLIGHT REFUELLING					
Flight refuelling switch	10				
		<i>Flight refuelling indicators</i>	<i>11</i>		
		FUEL TRANSFER			
		<i>Transfer conditions</i>	<i>12</i>		
		<i>Ventral/flap transfer control... ..</i>	<i>13</i>		
		<i>Fuel transfer pumps</i>	<i>14</i>		
		<i>Fuel cock actuators</i>	<i>15</i>		
		<i>Fuel pump and cock switches</i>	<i>16</i>		
		WING-TO-WING FUEL TRANSFER			
		<i>Transfer switch</i>	<i>17</i>		
		<i>Transfer indication</i>	<i>18</i>		
				SERVICING	
				<i>Fuel pump current consumption</i>	
				<i>check</i>	<i>19</i>
				<i>Procedure</i>	<i>20</i>
				<i>Fuel system units</i>	<i>21</i>
				<i>Tank depressurizing</i>	<i>22</i>
				<i>Ventral tank release unit</i>	
				<i>check</i>	<i>23</i>
				REMOVAL AND ASSEMBLY	
				<i>Fuel pumps and cocks</i>	<i>24</i>
				<i>Indicator lamps (ground refuelling)</i>	<i>25</i>
				<i>Indicator lamps (flight refuelling)</i>	<i>26</i>

LIST OF TABLES

	Table
<i>Equipment details... ..</i>	<i>1</i>
<i>Fuses, circuits, and locations</i>	<i>2</i>

LIST OF ILLUSTRATIONS

Fig.		Fig.
	<i>Location diagram</i>	
<i>Refuelling system details... ..</i>	<i>1</i>	<i>Fuel pumps and cocks... ..</i>
<i>Circuit diagram</i>		<i>Circuit diagram</i>
<i>Refuelling system</i>	<i>2</i>	<i>Fuel pumps and cocks... ..</i>
<i>Location diagrams</i>		<i>Routeing diagrams</i>
<i>Ventral tank details</i>	<i>3</i>	<i>Fuel pumps and cocks... ..</i>
		<i>Refuelling system</i>
		<i>...6-6A</i>
		<i>...7-7A</i>

RESTRICTED

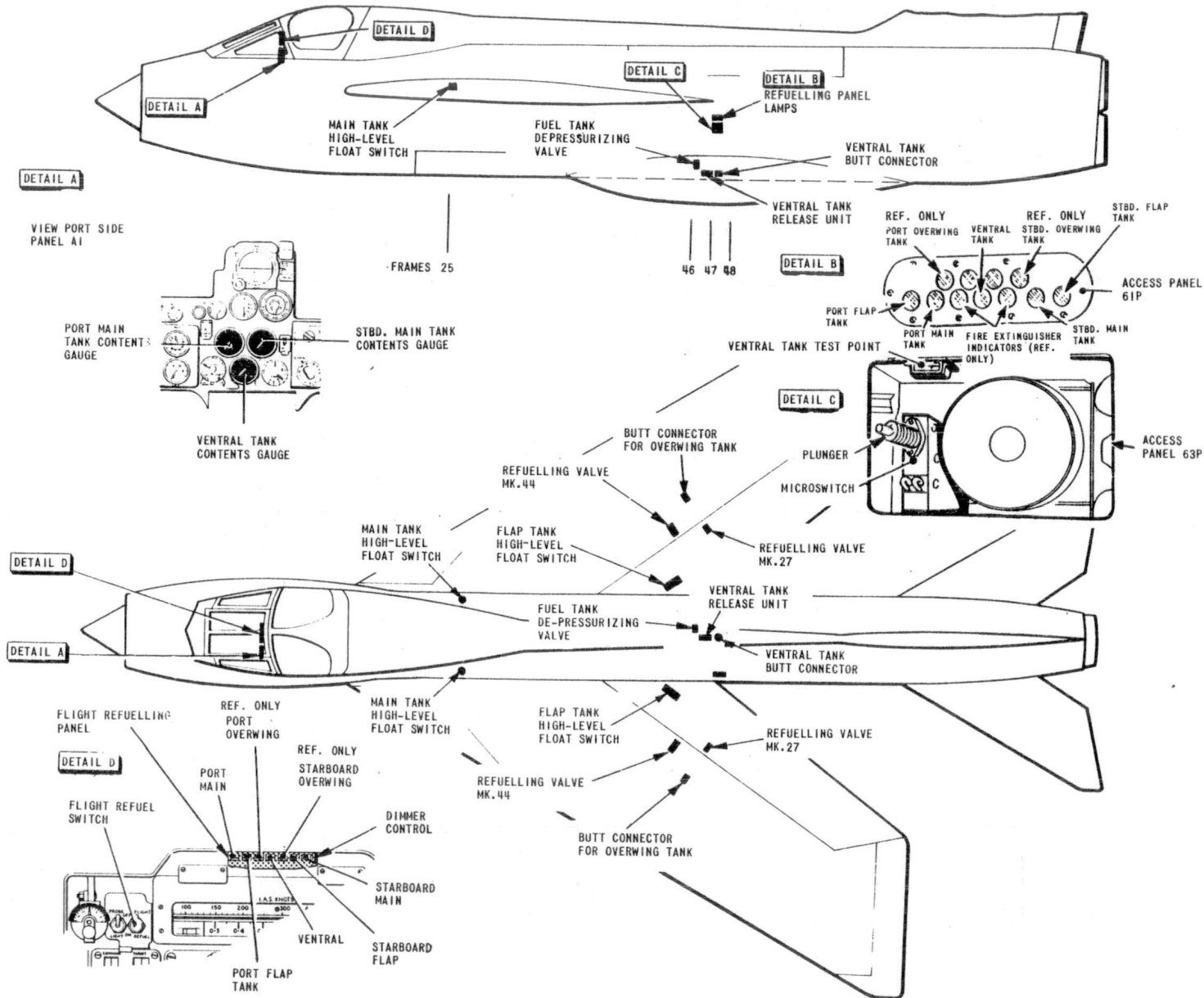


FIG. 1. REFUELLING SYSTEM DETAILS

RESTRICTED

DESCRIPTION

General

1. Fuel is carried in three tanks in each wing, these are the main tank, leading edge tank and flap tank. Extra fuel can be carried in a jettisonable ventral tank fitted to the fuselage. The ventral and flap tank fuel is transferred, in sequence, to the main tanks by air pressure, transfer being controlled by solenoid-operated valves in circuit with float switches and a flow sensing valve. Fuel can also be transferred from one wing tank system to the other. The aircraft can be refuelled in flight.

2. The normal fuel supply to each engine is delivered by a fuel-draulic pump in each collector tank. In each wing electrically-operated transfer pumps augment gravity flow into the collector tank, and supply fuel directly to the associated engine when the fuel-draulic pump is not operating.

3. Warnings of d.c. transfer pumps failure and fuel-draulic system failure are given on the auxiliary warnings panel (*Chap. 12*). The fuel contents gauging system is described in Sect. 7, Chap. 4. When refuelling, 'tank full' indications are given by lights above the ground refuelling panel and in the cockpit.

4. The electrical connections for the ventral tank are through a butt connector assembly on the underside of the aircraft. Electrical connections and services for carrying overwing pylons

and tanks are built into the aircraft. The ventral tank emergency transfer switch and the overwing tank jettison switch are not used on this aircraft.

GROUND REFUELLING

Ground refuelling panel

5. The ground refuelling panel 63P on the port side of the rear fuselage, houses a pressure refuelling adapter, a ventral tank release unit test point and a panel-operated microswitch. With the access panel removed, the microswitch puts a d.c. supply to the ventral tank refuelling relay, the refuelling solenoids of the Mk. 27 valves and the 'tank full' indicators.

Ground refuelling indicator panel

6. The main, flap, and ventral tanks each have 'tank full' indicator lamps located in panel 61P above the ground refuelling panel. During refuelling, with the ground refuelling access panel removed, the indicators are operated by their associated high-level float switches, i.e. when the tanks are full the lights go out. The lamps for the port and starboard tanks are red and green respectively, the lamp for the ventral tank is coloured amber. The indicators are connected in parallel with an equivalent set of indicators in the cockpit.

Main tanks

7. Each main tank has a Mk. 44 solenoid-operated fuel valve, which controls the fuel flow into the tank. On refuelling,

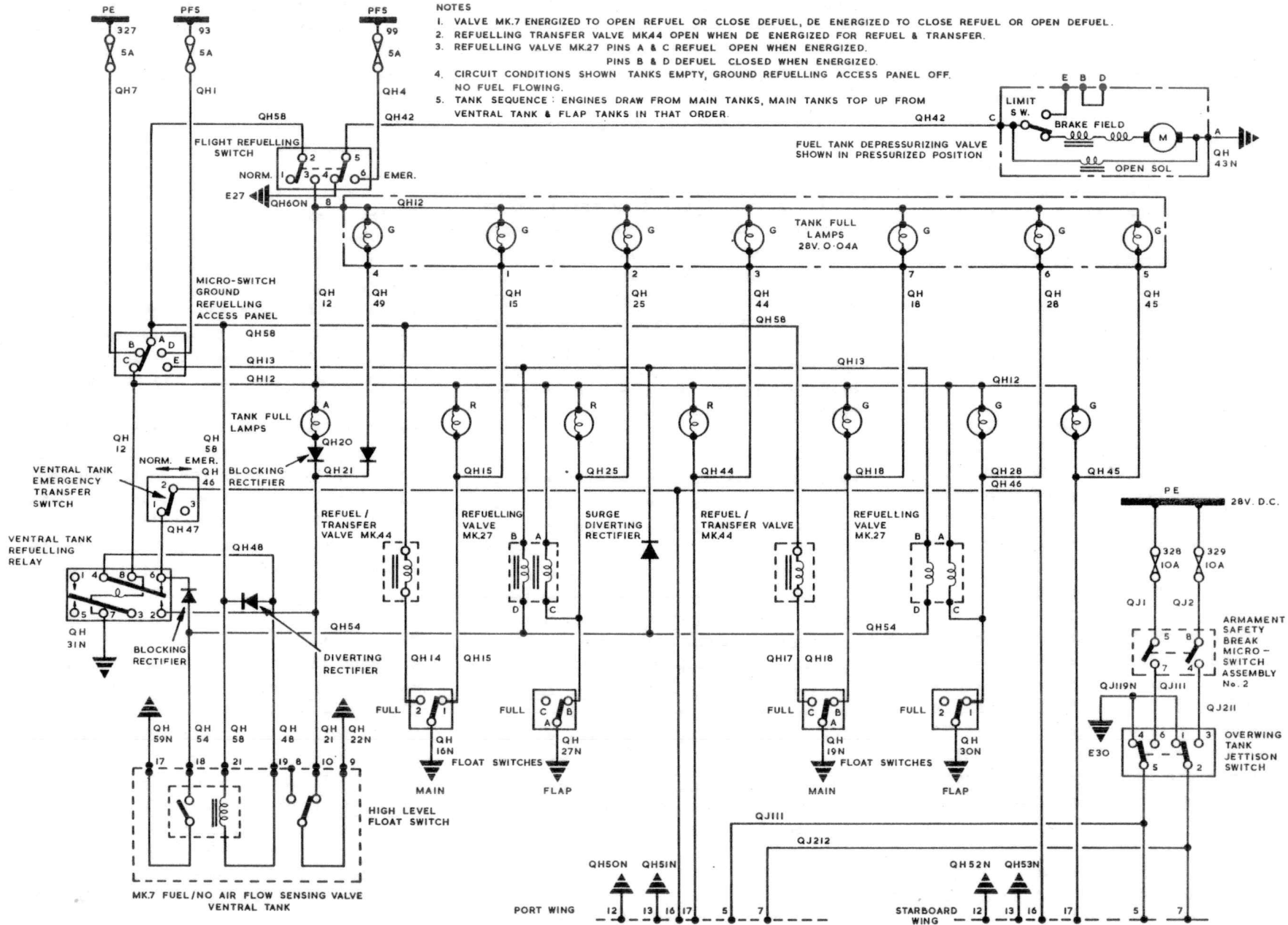
the Mk. 44 valve is de-energized open by the tank high-level float switch and fuel can flow into the tank. When the tank is full the float switch changes over and completes the circuit for the solenoid, this closes the Mk. 44 valve and stops fuel flowing into the tank.

Ventral tank

8. The ventral tank has a Mk. 7 fuel/no air flow sensing valve. To refuel the ventral tank, the solenoid of the Mk. 7 valve must be energized. With the ground refuelling access panel removed, the panel microswitch puts a supply to the refuelling relay coil. The contacts of this relay, plus the contacts of the ventral tank high-level float switch complete the negative circuit for the solenoid, this opens the valve and fuel can flow into the tank. When the tank is full, the high-level float switch changes over, breaking the solenoid circuit and closing the refuelling valve.

Flap tanks

9. Each flap tank has a Mk. 27 refuel/defuel valve which controls the fuel flow to and from the tank. With the ground refuelling access panel removed, the panel microswitch puts a supply to the refuelling solenoid (pins A and C); the contacts of the flap tank high-level float switch complete the negative circuit. This opens the valve and fuel can flow into the tank. When the tank is full, the high-level float switch changes over and breaks the circuit of the solenoid and the refuelling valve closes.



- NOTES
1. VALVE MK.7 ENERGIZED TO OPEN REFUEL OR CLOSE DEFUEL, DE ENERGIZED TO CLOSE REFUEL OR OPEN DEFUEL.
 2. REFUELLING TRANSFER VALVE MK.44 OPEN WHEN DE ENERGIZED FOR REFUEL & TRANSFER.
 3. REFUELLING VALVE MK.27 PINS A & C REFUEL OPEN WHEN ENERGIZED.
PINS B & D DEFUEL CLOSED WHEN ENERGIZED.
 4. CIRCUIT CONDITIONS SHOWN TANKS EMPTY, GROUND REFUELLING ACCESS PANEL OFF.
NO FUEL FLOWING.
 5. TANK SEQUENCE : ENGINES DRAW FROM MAIN TANKS, MAIN TANKS TOP UP FROM VENTRAL TANK & FLAP TANKS IN THAT ORDER.

FIG. 2. REFUELLING SYSTEM

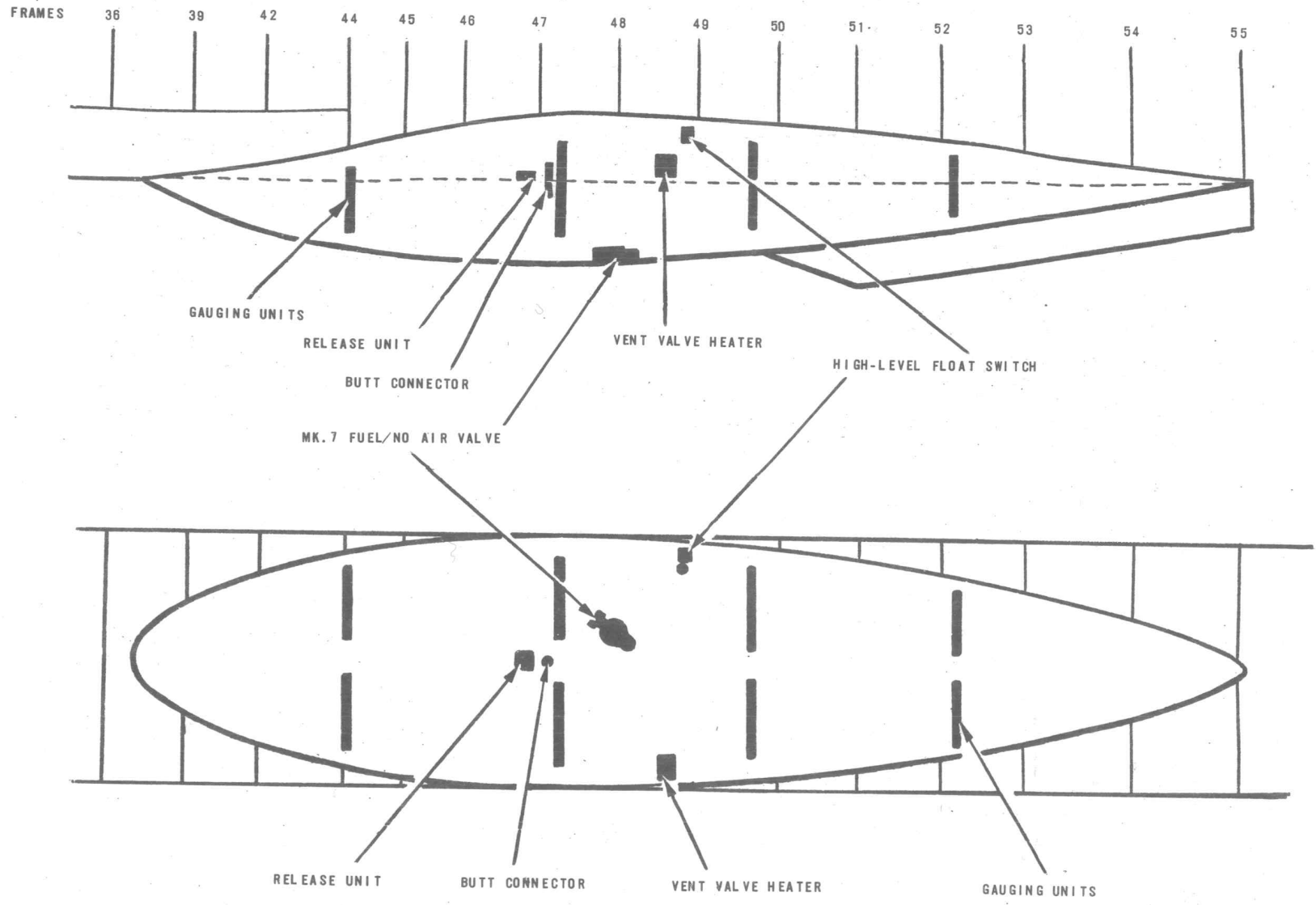


FIG. 3. VENTRAL TANK DETAILS

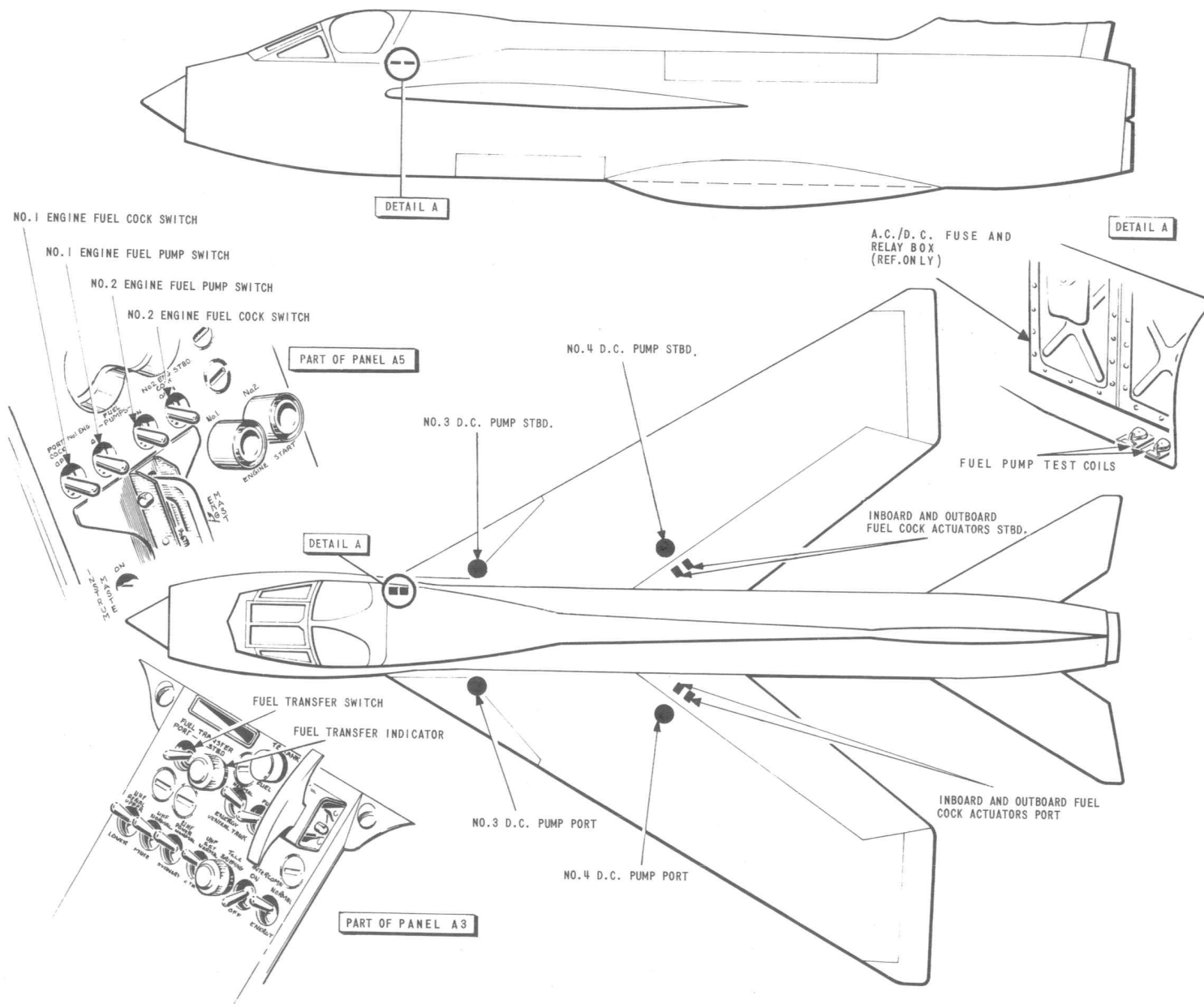


FIG. 4. FUEL PUMPS AND COCKS

FLIGHT REFUELLING

Flight refuelling switch

10. A double-pole, FLIGHT REFUEL switch is in the cockpit above the main flight display panel. When set to ON, one pole of the switch puts a supply to the refuelling valves and 'tank full' indicators, in a similar manner to the ground refuelling access panel micro-switch (*para.5*). The other pole of the switch puts a supply to a motorized multi-way air valve which depressurizes the fuel tanks via their outward vent valves.

Flight refuelling indicators

11. A flight refuelling indicator panel is situated on the shroud above the flight display. During flight refuelling, each indicator light in the panel goes out when the associated high-level float switch operates, indicating that the tank is full. The indicators are connected in parallel with the ground refuelling indicators. A screen, operated by a knob on the panel face, may be used for dimming the lamps.

FUEL TRANSFER

Transfer conditions

12. With the ground refuelling access panel fitted, the flight refuelling switch selected OFF and the engines running, fuel is initially drawn from the main tanks until the high-level float switches operate to open the Mk.44 valves. Fuel is then transferred from the ventral tank into the main tanks.

When the ventral tank is empty, the flap tanks fuel is transferred into the main tanks.

Ventral/flap transfer control

13. When fuel is transferring from the ventral tank to the main tanks, the Mk.27 defuel solenoid (pins B and D) circuit is completed by the Mk.7 valve flow sensing switch; this prevents fuel transfer from the flap tanks. When the ventral tank is empty, the Mk.7 valve flow sensing switch opens to de-energize the Mk.27 defuel solenoid; this allows fuel transfer from the flap tanks to the main tanks.

Fuel transfer pumps

14. In each wing tank system, internal transfer of fuel into the collector tank is assisted by two Lucas TPE. series, d.c. pumps known as No.3 and No.4. The No.3 pump is in the leading-edge tank and the No.4 pump is in the rear of the main tank.

Fuel cock actuators

15. Two Type AE4529 rotary actuators are located at spar 5 of each wing. One actuator operates the L.P. cock in the fuel line to the associated engine, the other operates the cock in the wing-to-wing transfer line.

Fuel pump and cock switches

16. Two double-pole switches on panel A5, control the pumps in the port and starboard wings respectively. Two single-pole switches, on the same panel, control the No.1 and No.2 engine L.P. fuel cocks.

WING-TO-WING FUEL TRANSFER

Transfer switch

17. A three-position double-pole switch marked FUEL TRANSFER PORT - STBD. is on panel A3. The switch controls the wing-to-wing fuel transfer system by operating the actuator that opens or closes the cock in the fuel line to the selected wing.

Transfer indication

18. When the fuel transfer switch is selected to PORT or STBD. an adjacent indicator lamp lights, to indicate that a transfer fuel cock actuator has been selected. The lamp is connected to the positive line of each actuator. According to whichever actuator is selected, the lamp circuit is completed by the opposite actuator's internal limit switch, field winding and armature, to earth.

SERVICING

WARNING

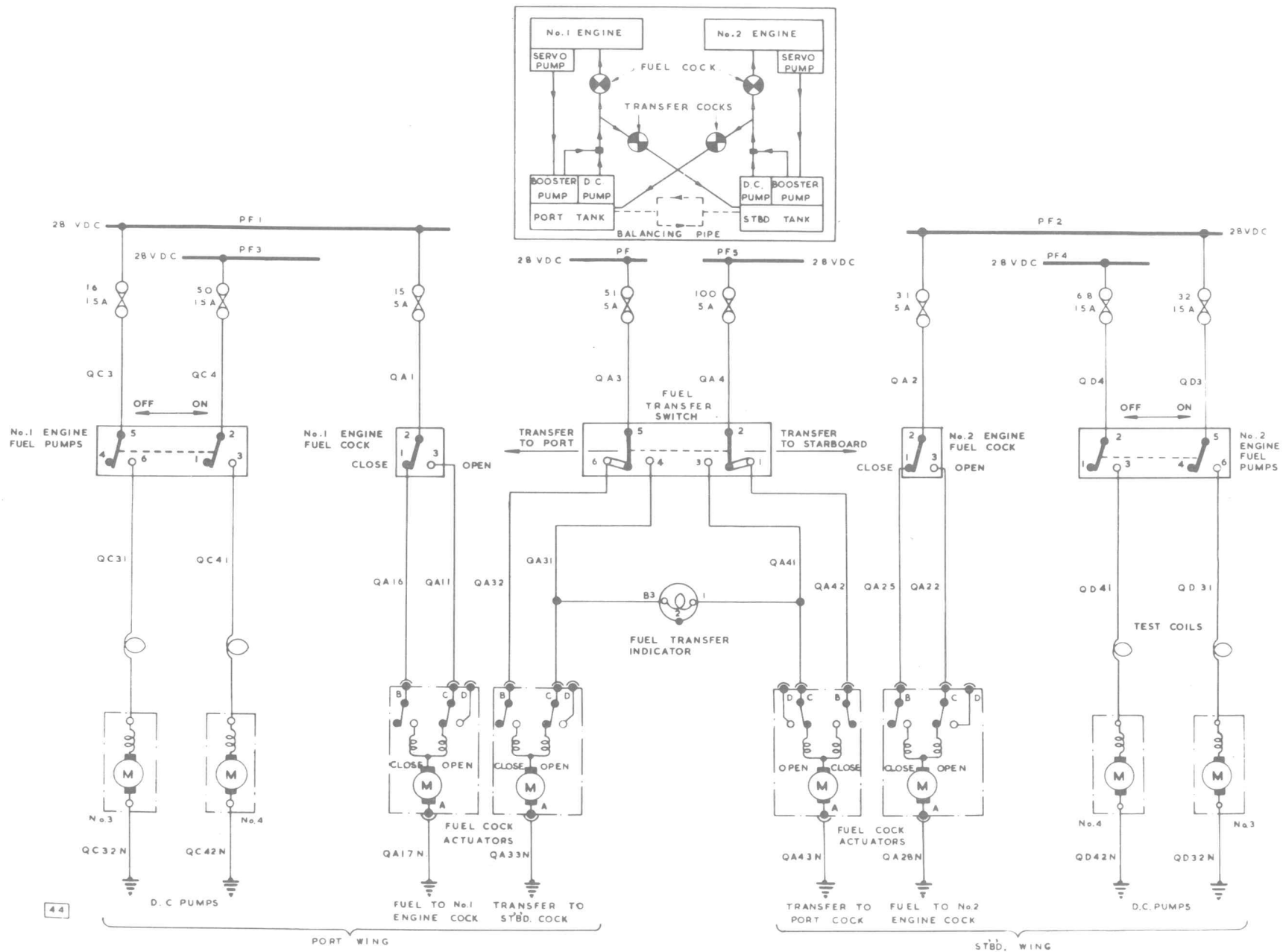
The relevant safety precautions detailed on the LETHAL WARNING marker card must always be observed before entering the cockpit or performing any operations upon the aircraft.

Fuel pump current consumption check

19. Four test loops, one for each pump, are on the floor of the spine adjacent to the a.c. and d.c. fuse and relay box. Each loop is labelled according to its associated pump.

Procedure**20.**

(1) Ensure that the aircraft is fuelled



44

FIG. 5. FUEL PUMPS - AND COCKS

◀ SWITCH CONNECTIONS ADDED ▶

and all fuel pump fuses are fitted and serviceable.

- (2) Connect a suitable 28 volt d.c. supply to the aircraft.
- (3) Select the fuel pump switches to ON.
- (4) Using a tong-test ammeter (preferably Ref.No.5QP/7) in the test loops provided, check that the current consumption of each pump does not exceed 11 amp.
- (5) Select the fuel pump switches to OFF.
- (6) Disconnect the ground supply.

Note...

The tong-tester should be opened and closed smartly immediately before taking a d.c. reading. This has the effect of reducing the error due to hysteresis.

Fuel system units

21. Functional checks on individual units in the fuel system are carried out during normal refuelling and defuelling operations as detailed in Sect.2, Chap.2.

Tank depressurizing

22. Should a refuelling operation be required shortly after engine shut-down, the battery master switch and the flight refuelling switch must be selected to ON for approximately 30 seconds. This action depressurizes the fuel tanks, via the outward vent valves in each tank and normal refuelling can then take place.

Ventral tank release unit check

23. A test point is provided, in the refuelling panel 63P, for checking the cocking of the ventral tank release unit. Continuity between the two pins of the test point indicates that the

contacts in the release unit are closed and the release unit is correctly cocked.

REMOVAL AND ASSEMBLY

Fuel pumps and cocks

24. Instructions covering the removal and installation of the fuel pumps and cocks are given in Sect.4, Chap.2. Before working on any of these items, the appropriate fuses must be removed.

Indicator lamps (ground refuelling)

25. Removing panel 61P gives access to the lamp holders. The lamps may be replaced by removing the screw-on domes. The replacement lamps are 28 volt 2 watt Ref.No.5L/9959122.

Indicator lamps (flight refuelling)

26. The lamps in the flight refuelling panel are behind a clip-on cover; a retaining plate must be unscrewed to gain access. Replacement lamps are 28 volt 0.04 amp Ref.No.5L/9959118.

TABLE 1

Equipment details

Equipment	Location	Access	Air Publication
Fuel pump switches, Type 8824/B104	Panel A5	Cockpit	113D-1110-1
Fuel cock switches, Type 8810/B101	Panel A5	Cockpit	113D-1110-1
Wing-to-wing transfer control switch, Type 8820/B125	Panel A3	Cockpit	113D-1110-1
Wing-to-wing transfer indicator, Type A6/410/C5	Panel A3	Cockpit	
◀ No. 3 fuel pumps, Type TPE.103	Leading-edge tanks, port and starboard	115P and 115S	4343D, Vol.1 Sect.7
No. 4 fuel pumps, Type TPE.103 ▶	Main tanks, port and starboard	120P and 120S	4343D, Vol.1, Sect.7
Port inboard and outboard fuel cock actuators, Type AE 4529	Spar 5 of port wing	122P	4343D, Vol.1, Book.5
Starboard inboard and outboard fuel cock actuators, Type AE 4529	Spar 5 of starboard wing	122S	4343D, Vol.1, Book.5
Test loops (fuel pumps)	Forward spine floor, starboard side	16S	
Refuel/transfer valves, Mk.44 (main tanks)	Forward face of each wing spar 5	Trailing edge panels	106D-0109-16C
Float switches (main tanks)	Port and starboard main tanks	No.2 engine intake duct	112G-1109-1
Refuel/defuel valves Mk.27 (flap tanks)	Trailing edge of spar 5	Trailing edge panels	106D-0112-16C
Float switches (flap tanks)	Port and starboard flap tanks	Inboard edge of flap tank	112G-1109-1
Fuel/no air flow sensing valve Mk.7 (ventral tank)	Bottom of ventral tank	Ventral tank panel	106D-0402-16C
Float switch (ventral tank)	Starboard side of ventral tank	Ventral tank panel	112G-1109-1
Ground refuelling panel	Port rear fuselage	63P	
Access panel microswitch, Type 1HY1 Mk.3	Behind the ground refuelling access panel	63P	
Ventral tank release unit test point	Ground refuelling panel	63P	
Ground refuelling indicator panel	Above ground refuelling panel	61P	
Flight refuelling indicator panel, Type C5570	Shroud above flight display	Cockpit	
Flight refuelling switch, Type 8824/B101	Panel above flight display	Cockpit	113D-1110-1
Ventral tank emergency transfer switch, Type 8810/B101	Panel A3	Cockpit	113D-1110-1
Overwing tanks jettison switch, Type 8830/B105	Panel A4	Cockpit	113D-1110-1
Motorized multi-way air valve, Saunders Type 206-BM-60	Frames 46-47, port side	57P	

TABLE 2
Fuses, circuits, and locations

Fuse No.	Rating	Code	Circuit	Location
15	5A	QA1	Port inboard fuel cock	A.C./D.C. fuse and relay box
16	15A	QC3	No.3 d.c. fuel pump port	
31	5A	QA2	Stbd. outboard fuel cock	
32	15A	QD3	No.3 d.c. fuel pump stbd.	
50	15A	QC4	No.4 d.c. fuel pump port	
51	5A	QA3	Port outboard fuel cock	
68	15A	QD4	No.4 d.c. fuel pump stbd.	
93	5A	QH1	Ground refuelling	
99	5A	QH4	Flight refuelling	
100	5A	QA4	Stbd. inboard fuel cock	
327	5A	QH7	Ground refuelling control	D.C. feeder fuse panel
328	10A	QJ1	Overwing tank jettison, port	
329	10A	QJ2	Overwing tank jettison, stbd.	

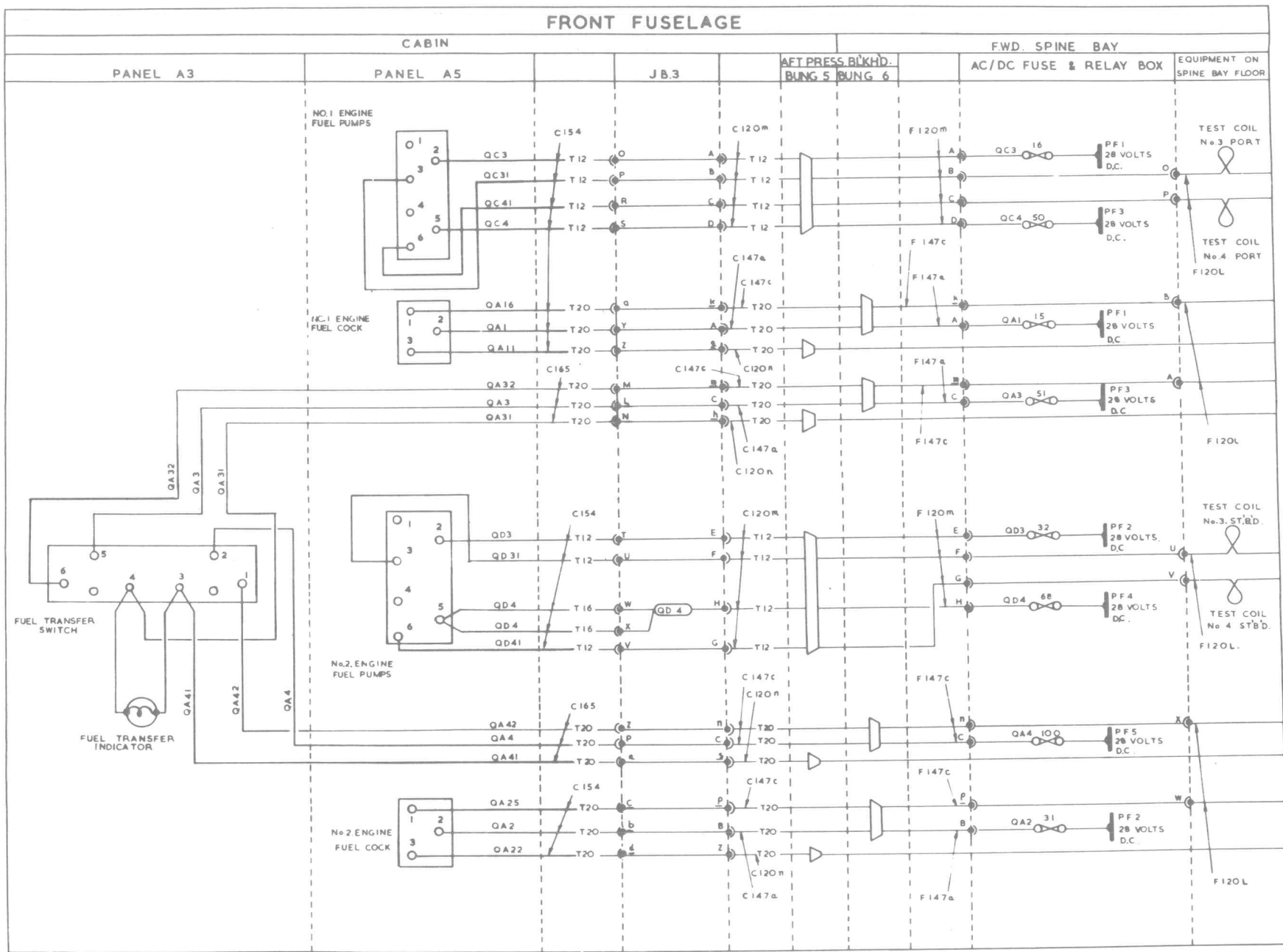


FIG.6. FUEL PUMPS AND COCKS

◀ SWITCH CONNECTIONS ADDED ▶

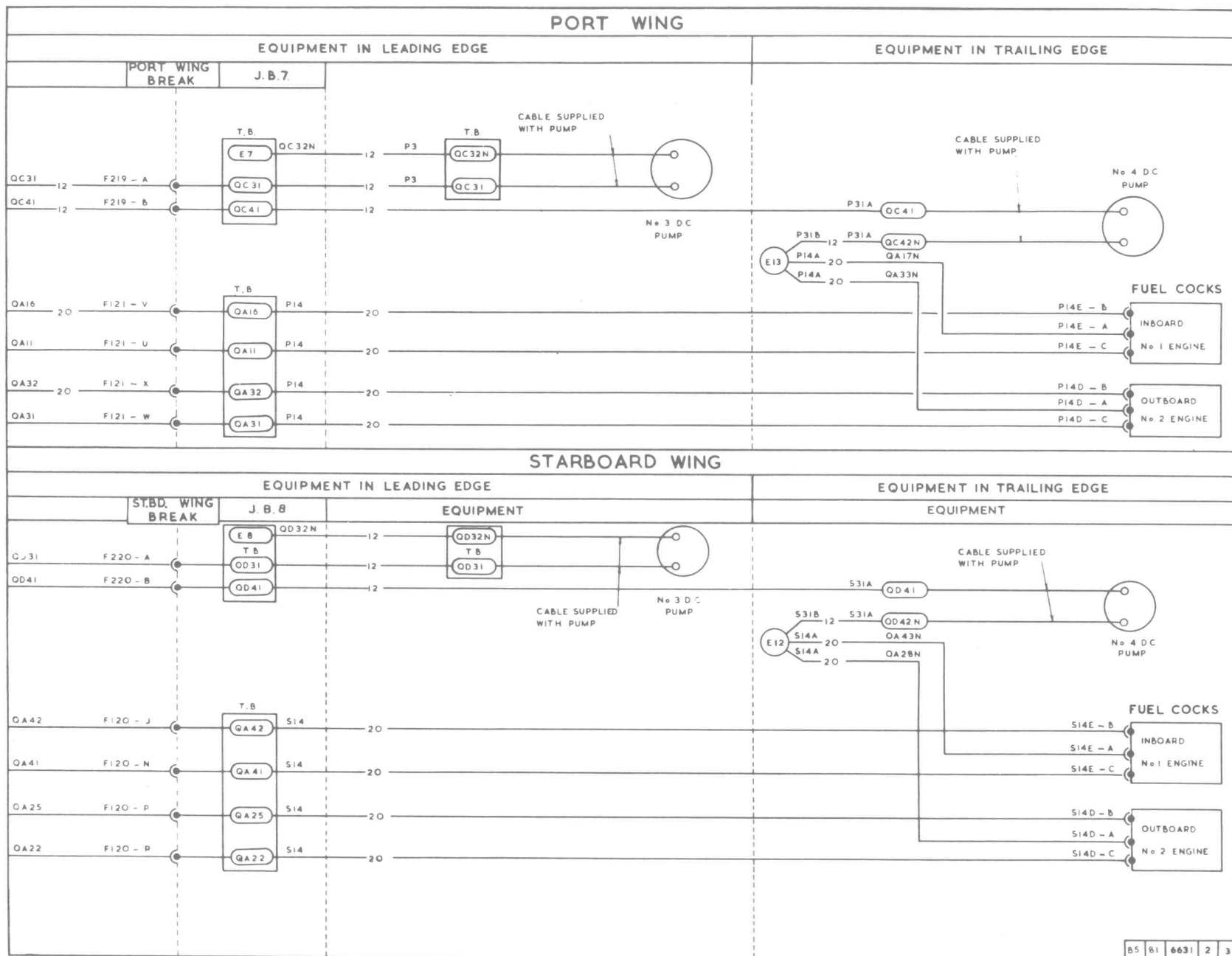


FIG. 6A. FUEL PUMPS AND COCKS

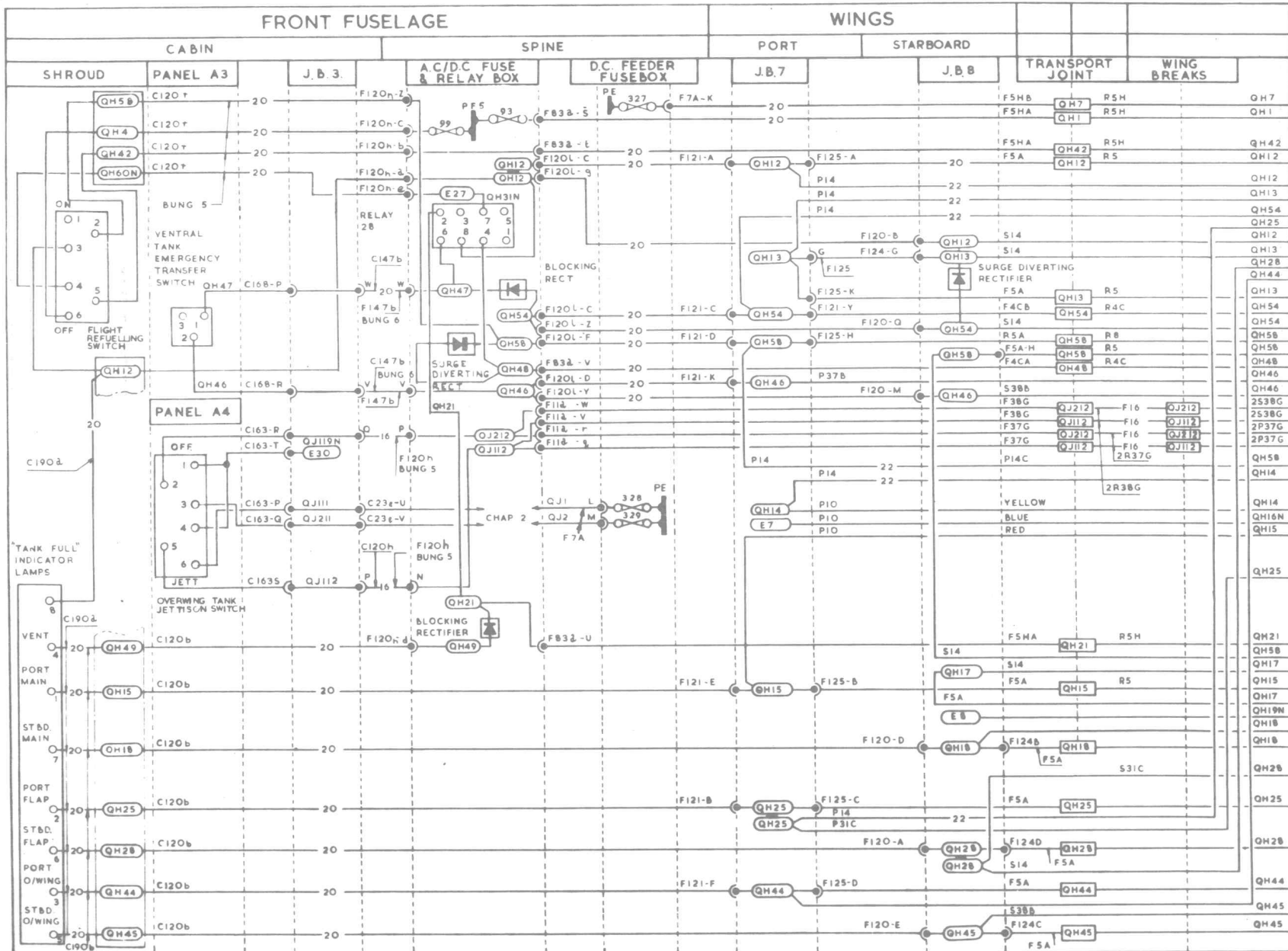


FIG. 7. REFUELLING SYSTEM

◀ SWITCH CONNECTION NUMBERS ADDED ▶

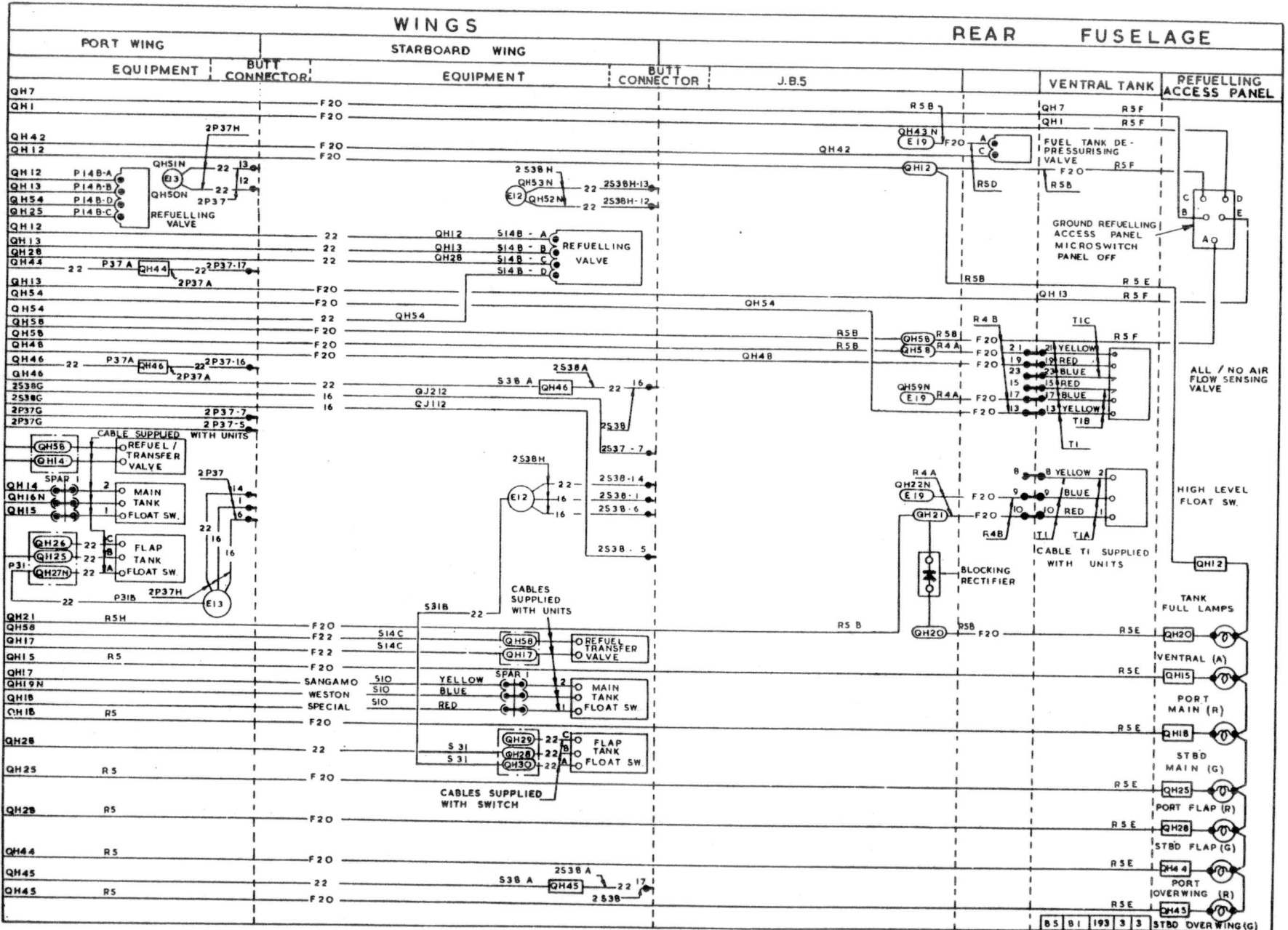


FIG. 7A. REFUELLING SYSTEM