COPY II

1st EDITION

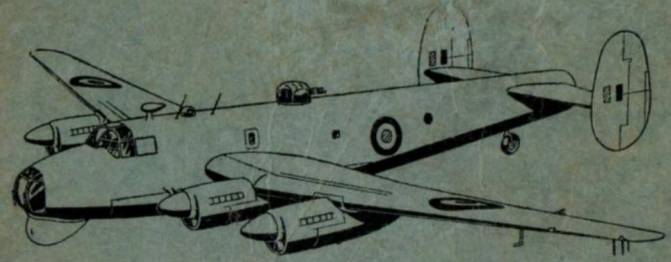
A.P. 4267A—P.N.

PILOT'S NOTES

FOR

SHACKLETON

M.R. MK. 1



PREPARED BY DIRECTION OF THE MINISTER OF SUPPLY

A. E. Rowlands

PROMULGATED BY ORDER OF THE AIR COUNCIL

J. H. Barnes.

AMENDMENTS

Amendment lists will be issued as necessary and will be gummed for affixing to the inside back cover of these notes.

Each amendment list will, where applicable, be accompanied by gummed slips for sticking in the appropriate places in the text.

Incorporation of an amendment list must be certified by inserting date of incorporation and initials below.

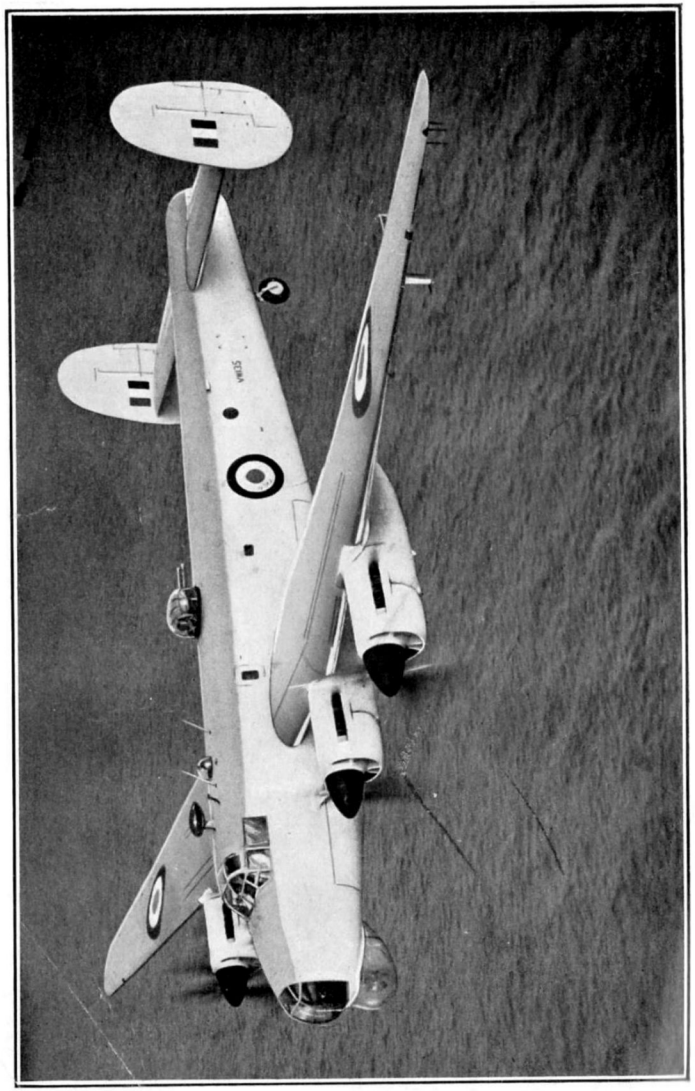
A.L. NO.	INITIALS	DATE	A.L. NO.	INITIALS	DATE
1			7		
2			8		
3			9		
4			10		
5			11		
6			12		

NOTES TO USERS

THESE Notes are complementary to A.P. 2095 Pilot's Notes General and assume a thorough knowledge of its contents. All pilots should be in possession of a copy of A.P. 2095 (See A.M.O. A718/48).

Additional copies may be obtained by the station publications officer by application on form 294A in duplicate, to Command Headquarters for onward transmission to A.P.F.S. (see A.P. 113). The number of the publication must be quoted in full—A.P. 4267A—P.N.

Comments and suggestions should be forwarded through the usual channels to the Air Ministry (T.F.2).



SHACKLETON M.R. Mk. 1

LIST OF CONTENTS

PART V—ILLUSTRATIONS

PILOT'S CHECK LIST.

(Excluding Items of Operational Equipment.)

	ITEM	CHECK
	The second pilot should enter the aircraft and check :—	
1.	Under-carriage selector buttons.	DOWN button in. UP button out.
2.	Ignition switches.	OFF.
3.	Trimmer controls.	All set neutral.
4.	Internal control locks.	Removed.
	The Captain and Flight Engineer then carry out the following checks, starting at the entrance door and working clockwise round the aircraft.	
	External checks :	
5.	Starboard rudder and elevator.	External locks removed. Trimming tabs secure and central. Spring and balance tabs for security and correct movement.
6.	Tail wheel.	Correct extension of oleo. Tyre for cuts and creep.
7.	Port rudder and elevator.	External locks removed. Trimming tabs secure and central. Spring and balance tabs for security and correct movement.
8.	Port fuselage.	Static vent plug removed.
9.	Port mainplane.	Condition of flap. Condition of aileron. Trimming tab control. Condition of surfaces. All inspection panels secure. Pressure-head cover removed.
10.	No. 1 engine.	Cowlings secure. Free from oil and coolant leaks.
11.	Port under-carriage.	Doors secure. Jury strut removed. Tyre for cuts and creep. Correct extension of oleo. Priming pump screwed down. Priming cock NORMAL.
12.	No. 2 engine.	Cowlings secure. Free from oil and coolant leaks.
13.	Nose.	Condition of radome. Parachute exit secure.
14.	No. 3 engine.	Cowlings secure. Free from oil and coolant leaks.
15.	Starboard under-carriage.	Doors secure. Jury strut removed. Tyre for cuts and creep. Correct extension of oleo. Priming pump screwed down. Priming cock NORMAL.

	ITEM	CHECK
16.	No. 4 engine.	Cowlings secure. Free from oil and coolant leaks.
17.	Starboard mainplane.	Condition of flap. Condition of aileron. Trimming tab central. Condition of surfaces. All inspection panels secure. Pressure-head cover removed.
18.	Bomb bay.	Emergency air gauges—Pressure 1,800 lb./sq. in. (on each).
19.	Starboard fuselage.	Static vent plug removed.
	Internal checks.	
20.	Entrance door.	Secured; handle pulled in.
21.	Ladder.	Stowed.
22.	Covers and safety equipment.	Correctly stowed.
23.	First-aid packs.	Correctly stowed.
24.	Axes.	Correctly stowed.
25.	Fire-extinguishers.	Correctly stowed.
26.	Dinghy release handles.	In.
27.	Flare launching control.	Switches off.
28.	All side fuselage hatches.	Secured.
29.	Cabin heaters.	Off.

	CHECK	ITEM
30.	Mid-upper turret.	Locked central.
31.	Auxiliary fuel tank cock.	Off.
32.	Crossfeed cock.	Off.
33.	Ground/flight switch.	FLIGHT. Check voltage. Then to GROUND and external battery switched on.
34.	Oxygen.	Contents and flow.
35.	Forward parachute exit.	Secure.
	With the crew in their normal positions, carry out the following cockpit checks.	
36.	Intercomm.	On and check.
37.	Flying controls.	Full and correct movement.
38.	Trimmer controls.	Full and correct movement.
39.	R.p.m. controls.	Maximum R.P.M.
40.	Throttles.	Closed.
41.	Flap selector and gauge.	Flap position corresponds with that selected.
42.	Undercarriage indicator.	Green lights on. Check lamp changeover.
43.	Windscreen de-icing.	Off. (Both pilots.)
44.	Windscreen wiper.	Off. (Both pilots.)

	ITEM	CHECK
45.	Supercharger control switch.	M.S.
46.	Air-intake filter switch.	Clean.
47.	Landing lamp switch.	Off. (Both pilots.)
48.	Taxying lamp switch.	Off. (Both pilots.)
49.	G.IVB compass.	Off.
50.	Radio altimeter.	Off.
51.	Ignition switches.	Off.
52.	Feathering buttons.	Out.
53.	Pressure-head heater switches.	Off.
54.	External lights master switch.	As required.
55.	Navigation and downward identification lights.	As required.
56.	Pilots' ditching exits.	Secured.
57.	Automatic pilot.	Switches off.
	Checks at Flight Engineer's Station.	
58.	Propeller de-icing switches.	Off. Check tank contents.
59.	Aerofoil de-icing switches.	Off. Check tank contents.
60.	Undercarriage test switch.	Press. Check starboard red indicator light comes on.

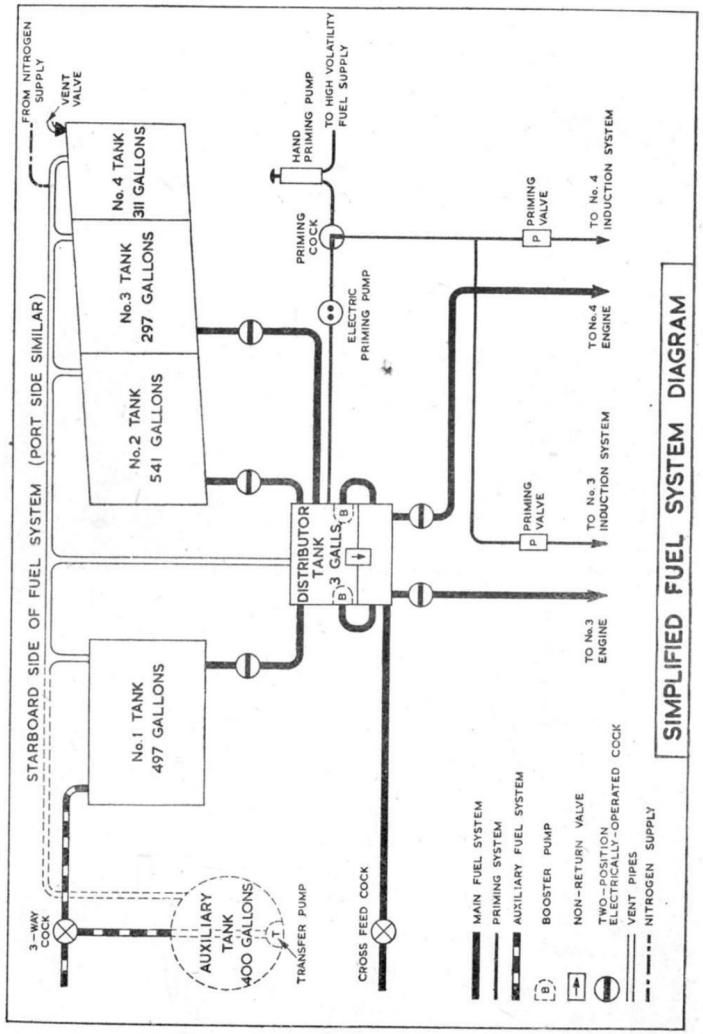
	ITEM	CHECK
61.	Inverter emergency switches.	Normal.
62.	Fuel tanks selector cocks.	Off.
63.	Supercharger warning lights.	Out.
64.	Power failure warning lights.	On.
65.	Fuel gauges.	Check contents.
66.	Fuel flowmeters.	Set to zero.
67.	Vacuum change-over cock.	Normal.
68.	Air mileage unit.	Set to zero.
69.	Pneumatic pressure.	Minimum 150 lb./sq. in.
70.	Emergency air selectors.	All off (up).
71.	Emergency air pressure gauge.	1,800 lb./sq. in.
72.	Fuel pressure warning lights.	On.
73.	Fuel booster pumps.	Off. Check with ammeter if carried.
74.	Radiator shutter controls.	Open.
75.	Charge temperature controls.	COLD.
76.	Auxiliary tank switch.	Off.

ITEM		CHECK
77.	Cabin heaters fuel supply switch.	Off.
78.	Oil dilution switches.	Off.
79.	Generator field circuit breakers.	Out.
80.	Electric power panel.	All circuit breakers in.
	Start engines (see para. 57). **Checks while warming up :—**	
81.	Hydraulics.	Operation of flaps. Close bomb doors.
82.	G.IVB compass.	Set and check with P.10.
83.	V.H.F.	Switch on and check.
84.	Vacuum pumps.	Suction on both positions of changeover cock.
85.	Pneumatic pressure.	Increasing if there is less than 1,000 lb. in either bottle.
86.	Charge temperature control.	COLD.
	Run-up the engines (see para. 58).	
87.	Fuel flow-meters.	Operation.
88.	Altimeter.	Check setting.
89.	Taxying.	Test brakes. Flight instruments for correct functioning. Pressure head heaters ON if required.

ITEM		CHECK
	Checks before take-off.	
90.	Trim.	All neutral.
91.	Super-chargers.	Low gear. High gear (with water/methanol).
92.	Air-intake filter switch.	Clean.
93.	Charge temperature controls.	Cold.
94.	Temperatures and pressures.	Normal.
95.	R.p.m. control levers.	Max. r.p.m. position, friction lever tightened.
96.	Fuel.	Tanks selected as required. Contents. Master cocks ON. Booster pumps ON.
97.	Flaps.	TAKE-OFF.
98.	Bomb doors.	CLOSED.
99.	Auto-pilot.	Switched off.
100.	G.IVB compass.	Correct operation.
101.	Generators.	ON when opening up on runway.
102.	Radiator shutters.	AUTO.
103.	Hatches.	Closed.
104.	Harness.	Adjusted and locked.

ITEM		CHECK
	Checks before landing :—	
	When entering the circuit :—	
105.	Auto Pilot.	OFF.
106.	Super-chargers.	Low gear.
107.	Air-intake filter control.	CLEAN.
108.	Charge temperature control.	COLD.
109.	Fuel.	Contents Booster pumps on.
	Reduce speed to 150 knots and check :—	
110.	R.p.m. control levers.	2,200. 2,600 on final.
111.	Flaps.	At TAKE-OFF. DOWN on final.
112.	Under-carriage.	DOWN and locked.
113.	Pneumatic supply.	Pressure sufficient.
114.	Harness.	Locked.
	Checks after landing :—	
115.	Flaps.	Up.
116.	Radiator shutters.	Open.
117.	Charge temperature controls.	COLD.

ITEM		CHECK
118.	R.p.m. control levers.	Max. r.p.m. position.
119.	Booster pumps.	Off.
120.	Pressure-head heaters.	Off or as required.
121.	Generators.	Off.
122.	Brake pressure.	Sufficient for taxying.
	Stop the engines (see para. 71).	
	Checks after stopping the engines :—	
123.	Ignition switches.	Off.
124.	Master fuel cocks.	Off.
125.	Fuel tank cocks.	Off.
126.	Intercomm. and V.H.F.	Off.
127.	Air-intake filter control.	NORMAL.
128.	G.IVB compass.	Off.
129.	Chocks.	In position.
130.	Brakes.	Off.
131.	Flying controls.	Locked if necessary.
132.	Ground/Flight switch.	Ground.
133.	Static vents.	Plugs in.
134.	Pressure heads.	Cover on.



PART I

DESCRIPTIVE

NOTE.—Throughout this publication the following conventions apply :—

(a) Words in capital letters indicate the actual markings on the controls concerned.

(b) The numbers quoted in brackets after items in the text refer to the illustrations in Part V.

(c) Unless otherwise stated, all speeds quoted are indicated airspeeds.

INTRODUCTION

The Shackleton M.R. Mk. 1 is a four-engine, mid-wing monoplane designed for reconnaissance and anti-submarine duties. It is powered by Griffon Mk. 57 power plants with 6-bladed contra-rotating propellers. Many of the controls for the different services, as well as the majority of the engine instruments, are grouped on two panels, the main panel and the side panel, at the flight engineer's station, behind the pilots' cockpit.

FUEL, OIL AND COOLANT SYSTEMS

1. Fuel tanks

(i) Fuel is supplied to the engine injector pumps from 8 tanks mounted in the mainplane. There are four tanks in each wing (numbered outboard 1, 2, 3 and 4), and an auxiliary tank can be fitted in the bomb bay. The port and starboard sides of the fuel system normally function independently but they are interconnected by a crossfeed line and cock to allow all four engines to be fed with fuel from either side. The tank capacities are as follows :—

No. 1 tanks	each 497	gallons
No. 2 tanks	each 541	,,
No. 3 tanks	each 297	,,
No. 4 tanks	each 311	,,
Total fuel capacity (normal)	3,292	,,
Auxiliary long-range tank ...	400	,,
Total fuel capacity (overload)	3,692	,,

(ii) Fuel flows by gravity from each set of tanks to a distributor tank, situated behind each inboard firewall, through separate fuel lines from Nos. 1, 2 and 3 tanks; No. 4 tank feeds No. 3 tank and is not directly connected to the distributor tank. Each distributor tank supplies fuel to the inner and outer engines on one side through separate pipelines.

(iii) The fuel from the auxiliary tank (when fitted) is fed by means of a transfer pump and a three-way cock to either of the No. 1 tanks.

(iv) No. 1 tanks, are fitted with self-sealing protective covering, and Nos. 2, 3 and 4 tanks are of self-sealing flexible construction. The auxiliary tank has no self-sealing covering.

2. **Fuel cocks and indicators**

(i) At each outlet from the two distributor tanks (four outlets in all) there is an electrically operated engine master cock, controlled by one of four switches mounted behind the first pilot's seat.

(ii) Tank isolating cocks for No. 1, No. 2 and No. 3 tanks are controlled by six switches (139) on the flight engineer's main panel.

(iii) When Mod. 171 is fitted sixteen flag-type indicators are mounted on the flight engineer's main panel, one (showing ON and OFF) for each of the engine master cocks and two (one showing ON and the other showing OFF) for each of the tank isolating cocks. When an engine master cock is fully open, the appropriate indicator moves from OFF to ON.

(iv) A manually-operated crossfeed cock for connecting the port and starboard fuel systems is fitted on the forward face of the front spar.

(v) A three-way cock mounted on a bracket on the aft face of the centre-section front spar is manually operated to allow fuel to be fed from the auxiliary tank (if fitted) to either of the No. 1 tanks, or to be shut OFF.

3. **Fuel booster and transfer pumps**

(i) Two booster pumps are fitted in each distributor tank and are controlled by four ON-OFF switches (156) on the flight-engineer's side panel. Four push switches (157) and an ammeter test socket (148) also on the flight

engineer's side panel allow for testing the current consumption of each pump, which should not be more than 7 amps. This test should be carried out with the engine master cocks and the booster pump selector switches OFF.

(ii) A transfer pump for transferring fuel from the auxiliary tank to the No. 1 tanks is controlled by a switch (151) on the flight engineer's side panel. A pushbutton (153) for testing the current consumption of the pump in a similar manner to the booster pumps, is beside this switch.

4. **Fuel contents gauges and flowmeters**

Two "gallons-gone" flowmeters (119) and (160) each serving two engines, are mounted on the flight engineer's main panel. Electrically-operated fuel contents gauges (144) for all the wing tanks and for the auxiliary tank (142) are also on this panel. The combined contents of tanks Nos. 3 and 4 are shown on one gauge; in the air this gauge reads up to 450 gallons but on the ground only up to 420 gallons.

5. **Fuel pressure warning lights**

Four fuel pressure warning lights (159) fitted on the flight engineer's side panel come on when the fuel pressure at the injector pumps falls appreciably below normal.

6. **Engine priming system**

(i) Normally the engines on either side are primed by an electric pump located in the inboard nacelle above the fuel distributor tank. Each pump feeds fuel under pressure from the distributor tank to two solenoid-operated priming valves via a priming cock mounted on a panel in the main-wheel bay and marked ALL OFF, NORMAL DOPING and HIGH VOLATILITY. The four solenoids operating the priming valves are controlled by four pushbuttons (121) on the flight engineer's main panel. Immediately below the buttons is a rotary switch (120), marked PORT ON, OFF and STARBOARD ON, which selects either of the two priming pumps, selection being confirmed by indicating lights one on either side of the switch.

(ii) An alternative hand priming system facilitates engine starting in cold weather by the initial use of high-vola-

tility fuel. The hand priming pump, mounted on a panel attached to the starboard undercarriage beam of each main-wheel unit, has an open-ended pipe through which high-volatility fuel can be pumped from a suitable container into the priming system when the priming cock is turned to HIGH VOLATILITY. The appropriate priming pushbutton on the flight engineer's main panel must be held in while the handpump is being operated. The handpump cannot be used to prime the engines when the priming cock is in any position other than HIGH VOLATILITY.

7. **Water/Methanol system**

Two water/methanol tanks are located one in the rear end of each outer engine nacelle. Each tank has a sump at its forward end in which are mounted two electric self-priming pumps, each pump feeding one engine. The system introduces the water/methanol fluid into the supercharger intake at boost pressures above 18½ lb./sq. in., the flow increasing with boost pressures up to 25 lb./sq. in. To prevent the system being operated in low gear the control switch is ganged to the supercharger gear-change switch (24) on the pilots' panel. This ensures that the system is ON only when the superchargers are in high gear. Four pushbuttons (158) on the flight engineer's side panel and the ammeter socket used for testing the booster pumps, allow for testing the current consumption of each water/methanol pump which should be approximately 4-5 amps.

8. **Nitrogen system**

Nitrogen is carried in 8 bottles mounted in a crate at the forward end of the bomb bay. The eight bottles have a common pipe system terminating in a charge point and a delivery connection, both of which are fitted with screw valves. When required, the nitrogen system is turned on before flight and, as the fuel level decreases, any air present is diluted with nitrogen beyond the point at which the proportion of oxygen is sufficient to support combustion.

9. **Oil system**

Each engine has an independent oil system with its own oil tank which holds 26 gallons oil and has 6-gallon air

space. An oil cooler forms part of the semi-circular assembly at the lower front of the power plant, and oil temperature (146) and pressure (147) gauges are provided on the flight engineer's main panel.
An oil dilution system is fitted and four switches (155) each for selecting one engine and the pushbutton (154) for operating the system are on the flight engineer's side panel.

10. **Coolant system**

(i) A mixture of water and glycol, the proportions of which vary with climatic conditions is used as coolant. A separate supply for each engine is circulated through a header tank and radiator.

(ii) Pressure in the systems is controlled by thermostatic relief valves in the header tanks and airflow through the radiators is regulated by shutters which can be either manually or automatically controlled, by electro-pneumatic rams.

(iii) In the event of electrical or pneumatic failure, the shutter will trail open.

MAIN SERVICES

11. **General**

The following table shows the distribution of the power supply for the aircraft main services :—

No. 1 ENGINE	...	D.C. Generator
No. 2 ENGINE	...	D.C. Generator
		Air Compressor
		Vacuum Pump
No. 3 ENGINE	...	D.C. Generator
		Hydraulic Pump
		Air Compressor
		Vacuum Pump
No. 4 ENGINE	...	D.C. Generator
		Hydraulic Pump

12. **Hydraulic system**

(i) Two pumps (fitted on No. 3 and No. 4 engines) draw fluid from a pressurised reservoir and operate the following services :—

Bomb doors
Flaps
Undercarriage
Windscreen wipers.

(ii) The undercarriage, flaps and bomb doors are electro-hydraulically operated, and in the event of electrical or hydraulic failure provision is made for operating these services by compressed air.

(iii) A handpump, provided for ground servicing, is mounted on the front wall of the starboard wheel bay.

13. Pneumatic system

(i) There are two separate pneumatic systems supplied by compressors on No. 2 and 3 engines, each compressor feeding a storage bottle to maintain a pressure of 1,000 lb./sq. in.

(ii) The system supplied by No. 2 engine operates :—
Main wheel outer brakes
Pressurisation of windscreen de-icing fluid tank
Pressurisation of the hydraulic fluid tank
Engine air cleaner rams
Engine radiator shutter rams
Engine charge temperature control rams.

(iii) The system supplied by No. 3 engine operates :—
Main wheel inner brakes.

(iv) The storage bottle for the No. 2 engine system is the forward cylinder in the fuselage roof and its gauge (165) is the lower of the two gauges on the flight engineer's main panel. The bottle is fitted with a pressure-maintaining valve which ensures that only the brakes are supplied should the pressure fall below 150 lb./sq. in.

(v) The storage bottle for the No. 3 engine system is the aft cylinder in the fuselage roof and its gauge (166) is the upper of the two pressure gauges on the flight engineer's main panel.

14. Vacuum system

Two vacuum pumps are fitted, one on each of the inboard engines, and a change-over cock (170) is mounted on the left-hand side of the flight engineer's main panel. When this cock is set to NORMAL :—

No. 2 engine serves the bombsight and camera
No. 3 engine serves the instrument flying panel.

When the cock is set to EMERGENCY these connections are reversed. A vacuum gauge (171) fitted beside the change-over cock indicates the suction in the pipeline to the instrument panel.

15. Electrical system

(i) *Description*

Four 6,000-watt generators, one on each engine, charge the four aircraft batteries (24 volts) which are situated at the starboard side of the fuselage immediately forward of the rear spar. Alternating current is provided by D.C. to A.C. inverters.

(ii) *Generator control*

(a) The main power panel assembly (see Fig. 4, Part V) at the starboard side of the fuselage, forward of the front spar, contains all the controlling equipment for the generator and battery supply circuits and is accessible through detachable panels secured by quick-release fasteners. Four generator circuit breakers Type D (107), (109), (110) and (113) are provided to give overload protection for their associated generators, and if the circuit is broken the appropriate one of the four resetting push switches (85) on the power panel must be operated to bring the generator back into circuit. Also four generator field circuit breakers Type A (82), in the field circuit of each generator, are mounted beside the main circuit-breaker re-setting push switches. To disconnect a generator the appropriate reset pushbutton should be held in and the generator field circuit breaker tripped. Four generator failure warning lights (140), one in each generator circuit, are mounted on the flight engineer's main panel.

(b) The generators cut in at an engine speed of approximately 1,150 r.p.m. and cut out at approximately 750 r.p.m. To avoid a heavy discharge of the batteries when operating in this range of r.p.m., e.g. when taxying, the generators should be disconnected. They should be brought back into circuit immediately before opening up the engines for take-off.

(c) A voltmeter (79) fitted immediately above the main

power panel indicates the controlled voltage at the bus-bars. Facilities for checking the electrical circuits of each generator are provided by an ammeter test socket (80) and a six-position selector switch (81).

(iii) *Batteries control*

(a) A master electrical switch (88) on the power panel has two positions, GROUND and FLIGHT. With the switch in the GROUND position the batteries are disconnected and the electrical services are connected direct to the generators and to the external supply socket. With the switch in the FLIGHT position the batteries are connected to the main bus-bars and are automatically charged during flight.

(b) An external supply socket is fitted on the starboard side of the fuselage for engine starting and test purposes.

(iv) *Circuit breakers and fuses*

(a) The combined output of the four generators is fed via the power panel main bus-bars to the feeders which supply the fifteen fusebanks below the power panel assembly, and the seventeen circuit-breakers (twelve type A, three type B and two type D) which are on the power panel assembly. The Type A circuit breakers (77), have direct manual control, and protect some of the heavier circuits. They are grouped together at the forward end of the power panel, and each is identified for its particular service by an adjacent label. The type B and type D circuit breakers are remotely controlled by push-switches ; the type B circuit breaker (106) for sonobuoy heating is at the forward end of the power panel, while those for the turret (118) and galley services (117) and the type D circuit breakers (115) and (116) for the radar are at the aft end of the power panel. They are each labelled for their respective services and their push switches are located at the relevant crew stations.

(b) Most of the electrical services in the aircraft are fed from and protected by the fusebanks (89) to (103) situated below the power panel assembly, but some of the equipment in the vicinity of crew stations is fed from fusebanks or panels at or near the appro-

priate stations. The supply cables from the main bus-bar to these panels are protected by one of the Type A circuit-breakers (77) referred to above.

(v) *Control of supply to G4B compass, auto pilot and A.S.V. scanner.*

(a) To provide A.C. supply to the A.S.V. scanner, the auto pilot and the G4B compass, two inverters, No. 1 and No. 2, are fitted at the starboard side of the fuselage nose, and obtain the D.C. supply via the Type A circuit-breakers. Normally No. 1 inverter supplies the auto-pilot and No. 2 inverter the G4B compass and the scanner, but in the event of failure of No. 2 inverter No. 1 inverter can be transferred from the auto-pilot services to the essential services of the G4B compass and the scanner.

(b) No. 1 inverter is controlled by an ON-OFF switch (138) on the flight engineer's main panel. No. 2 inverter is switched on automatically before flight by the operation of any one of the engine starting push switches and should be switched off after flight by operating the re-set relay (129) on the flight engineer's main panel.

(c) A faulty A.C. supply from No. 2 inverter will cause a power failure warning light (132) on the flight engineer's main panel to come on ; in this event the two-way switch (128) on the flight engineer's main panel, labelled NORMAL—EMERGENCY OR TEST should be placed in the EMERGENCY OR TEST position and the single-pole switch (126) beside it labelled NORMAL—EMERGENCY should be put to EMERGENCY. This action disconnects the auto-pilot from and connects the G4B compass and the scanner unit to No. 1 inverter ; it also starts up No. 1 inverter if it is not already running and switches off the faulty No. 2 inverter.

AIRCRAFT CONTROLS

16. **Flying controls**

The dual flying controls comprise pendulum-type rudder pedals and two handwheel-type control columns. Each rudder is adjustable by holding aside the spring-loaded latch on each inside pedal arm and raising and moving the foot-rest over the ratchet mechanism.

17. **Flying controls locking gear**

(i) The flying controls internal locking gear which, when not in use, is stowed on the starboard side of the fuselage nose compartment, consists of :—

(a) A strut, to be fastened to the top of the first pilot's seat and to a bracket on the control column.

(b) A strut, one end of which is to be inserted into the cockpit port rail and the other end secured by two screwed hooks to the handwheel.

(c) A T-strut, the transverse member of which is to be inserted in the hollow footrest of each rudder pedal, and the other end attached to the bracket on the control column.

(ii) External locking devices are provided for both the ailerons and the rudder and, when not in use, are stowed on the starboard side of the fuselage just aft of the main door.

18. **Trimming tab controls**

The elevator 6), rudder (4) and aileron (7) trimming controls to port of the first pilot's seat, and duplicated to starboard of the second pilot's seat (70), (71) and (69), all operate in the natural sense and each has an adjacent indicator showing the setting of the tab.

19. **Undercarriage control**

The undercarriage is raised and lowered by electro-hydraulic power and the control, which consists of two buttons, marked UP and DOWN, is on the extreme left-hand side of the pilots' panel. Operation of either button causes the other button to spring out.
At airspeeds below 80-85 knots, a spring-loaded locking device engages with the up button and prevents inadvertent selection of undercarriage up. In an emergency, however, it is possible to raise the undercarriage on the ground by exerting a force of at least 40 lb. on the button. In the event of electrical or hydraulic failure the undercarriage may be operated by an emergency compressed air system controlled by a lever (163) on the flight engineer's main panel. (See para. 83).

20. **Undercarriage position indicator**

An electrically-operated undercarriage indicator is mounted on the pilot's panel beside the undercarriage control buttons, and indicates as follows :—

Two green lights ...	main wheels down and locked
Two red lights ...	main wheels unlocked
No lights...	main wheels locked up.

When the undercarriage is locked up, if the throttles are less than one third open, warning is given by the starboard red light in the indicator coming on. This red light can be tested on the ground by means of a pushbutton (127) at the top left-hand corner of the flight engineer's main panel.

21. **Flaps control and indicator**

(i) The flaps are raised and lowered by electro-hydraulic power, and the control lever switch on the left-hand side of the pilots' instrument panel has three positions UP, TAKE-OFF and DOWN. In the event of electrical or hydraulic failure the flaps can be operated by emergency methods (see para. 83).

(ii) The flaps position indicator, which is electrically-operated, is on the left-hand side of the pilots' panel.

22. **Wheel brakes**

Two sets of brake drums are fitted to each main wheel, one set being served by a compressor on No. 2 engine and the other set by a compressor on No. 3 engine. Both sets are entirely independent of each other but are operated simultaneously by spectacle-type controls (26) and (43) which are fitted on each control column. A parking catch is also fitted at the centre of the 1st pilot's control column. No gauges are fitted to show the pressure at each main wheel, but the total pressure available to each set of brakes is shown on the gauges (165) and (166) on the flight engineer's main panel.

23. **Automatic pilot**

A Mk. 9 Automatic Pilot is fitted ; the switch box is in the canopy roof, the controller (18) is on the right-hand arm of the 1st pilot's seat and an auxiliary cut-out switch (28) and (42) is fitted on each control column.

ENGINE CONTROLS

24. Throttle controls

Two engine control pedestals are mounted, one on the port side and the other on the starboard side of the first and second pilots' seats respectively. Both pedestals have four throttle control levers (9) and (65), each set having a damping lever (10) and (66) located inboard. Moving the damping lever forward increases the friction to locking point.

25. Propeller controls

(i) Four r.p.m. control levers (8) and (67) are mounted below each set of throttle levers and are provided with damping levers similar to the throttle control damping levers. The r.p.m. control levers vary the governed r.p.m. from 1,150 to 2,750.

(ii) The feathering pushbuttons (34) are mounted on the centre of the pilots' panel and each button incorporates an engine fire warning light (see para. 87).

26. Superchargers

The engines are fitted with two-speed single-stage superchargers. The gear-change control is electrically-operated by a switch (24) on the pilots' instrument panel marked M.S. and F.S.; four red warning lights (141) on the flight engineer's main panel indicate when the superchargers are in high gear.

27. Radiator shutters control

Four 4-position switches (149) on the flight engineer's side panel provide for automatic or manual control of the radiator shutters which form part of the lower side cowling of each engine and are operated by electro-pneumatic rams. They control the temperature of both the oil and coolant.

When these switches are in the AUTO position, the shutters are "inched" opened and closed automatically according to the coolant temperature. When they are in the OPEN or CLOSE position the shutters are fully opened or closed according to the setting, but the shutters can be

stopped and retained in any desired position by placing the switches to the STOP position. In the event of electrical or pneumatic failure, the shutters will trail in an intermediate position.

28. Air-intakes system

(i) The air-intake system consists of a duct situated under each engine so that air at atmospheric temperature enters the forward facing entry between the two radiators and thence along the duct to the engine.

(ii) The duct also incorporates an intake at each side to allow hot air which has passed through the radiators to be mixed with the normal intake air. The amount of hot air entering the duct through these intakes is regulated by flaps which normally operate automatically but can be manually controlled by the pilot, if desired, to raise or lower the charge temperature (see para. 30).

(iii) The air-intake system incorporates an arrangement of flaps, filter elements and shutters allowing clean filtered air to be supplied to the engine when required by operating a switch (25) on the pilots' panel. Operating this switch closes a flap in the rear of the intake system, sealing off the front part of the duct. Air is then drawn through louvres in the rear bottom cowling panel through the air filters and through shutters actuated by the pressure difference between the air-intake system and the atmosphere.

(iv) A gapless iceguard is fitted in the forward end of the air-intake duct; in the event of the iceguard becoming blocked with ice, cold air is fed to the engine through the filtered air intakes.

29. Air-intake cleaner controls

The air cleaner flaps situated one at the rear of the main air intake of each engine are operated by pneumatic rams controlled by a switch (25) marked NORMAL and CLEAN AIR on the pilots' panel. Each flap is spring-loaded to the NORMAL position and will remain so if either the electrical or the pneumatic system fails.

30. **Charge temperature controls**

Engine charge temperature control is effected by the two shutters in the side of each main air intake duct admitting hot air from behind the radiators. The pneumatic rams which operate the shutters are controlled by 4-position switches (150) below the radiator shutter switches on the flight engineer's side panel, labelled AUTO—COLD—STOP and HOT. Automatic operation during flight of both radiator and hot air intake shutters should normally keep the charge temperature above the minimum of 40°C. If charge temperatures are excessively high or low the air-intake shutters can be manually opened or closed as required.

31. **Engine starting and stopping controls**

(i) The four engine starting pushbuttons (123) and the four booster-coil pushbuttons (122) are on the flight engineer's main panel, and the ignition switches are on the pilots' panel.

(ii) Four fuel cut-off pushbuttons (124) on the flight-engineer's main panel are held in to shut off the engines.

32. **Engine instruments**

The boost gauges and the tachometers for each engine are mounted in the centre of the pilots' instrument panel. The oil temperature (146), coolant temperature (145) and charge temperature (143) indicators, all of which are electrically-operated are on the flight engineer's main panel; also on the panel are the oil pressure gauges (147) which are pressure-operated through capillary tubing.

GENERAL EQUIPMENT AND CONTROLS

33. **Internal lighting**

(i) The cockpit lighting system consists of a duplicate installation of ultra-violet and red floodlamps. With the exception of the red floodlamp illuminating the flap position indicator and those for the trimmer controls, all the lamps and their control switches are on the cockpit

coaming. The red internal floodlamps for the trimmer controls and the compass lamp are controlled by ON-OFF switches (3), (13) and (73), and the remaining floodlamps and the ultra-violet lamps are controlled by dimmer switches, (12), (14), (62) and (63).

(ii) Two emergency lamps, situated one at each side of the coaming above the pilots' panel, are controlled each by an ON-OFF switch, one at each side of the panel. These lamps are fed from a small battery behind the pilots' panel, and are independent of the aircraft electrical supply.

34. **External lighting**

(i) Two mechanically-linked switches (46) on the starboard side of the pilots' panel are the master switches for all external lights, and must be down before any of the navigation lights, taxying lamps, identification lights or landing lamps will come on. The landing lamp motor circuits are, however, independent of this master switch.

(ii) Two retractable landing lamps are installed, one in each outer wing, and are controlled by two switches (48) and (60) on the pilots' panel.

(iii) The wing and tail navigation lights are controlled by a 3-way switch marked OFF—DIM—HIGH at the starboard side of the pilots' panel.

(iv) Taxying lamps are situated one in each outer wing and are controlled by ON-OFF switches (49) and (59) at each side of the pilots' panel.

(v) The red, green and amber identification lights are fitted in the undersurface of the rear fuselage. The circuit is controlled by an identification switchbox (44) which provides for steady lighting or signalling. It is on the right-hand side of the pilots' panel together with the three-way colour selector switch.

35. **Heating system**

To be issued by amendment.

36. **Aerofoil de-icing system**

(i) De-icing fluid is pumped through porous metal inserts in the leading edges of the wings, the tailplane and the fins, and is spread over the remainder of each aerofoil by the airflow.

(ii) The tank containing the de-icing fluid is fitted in the port wheel-bay on the front face of the rear spar and holds 23 gallons. The de-icing controller (104) is on the power panel at the flight engineer's station and a control panel, (131), incorporating green and red warning lights and three switches, marked AUTOMATIC, MANUAL and EMERGENCY is mounted at the top of the flight engineer's main panel. Automatic operation is not available and the automatic switch is labelled NOT IN USE.

(iii) When the MANUAL switch is ON, the controller starts the pump motor which runs for an initial period to prime the system. The controller then switches the motor off and on automatically at frequent intervals, the green lamp lighting during each running period of the pump motor.

(iv) Use of the EMERGENCY switch causes the pump motor to run continuously and the red and green lights both remain on.

(v) The endurance of the system is 5 hours on MANUAL and 1 hour on EMERGENCY.

37. **Propeller de-icing system**

This system is similar to that for the aerofoils, and the tank which is fitted in the starboard wheel-bay has a capacity of 33 gallons. The fluid is fed to the blades via slinger rings, and the controller (105) on the power panel, and the controls (130) on the flight engineer's main panel are similar to those described for the aerofoil de-icing system. The operation is also similar but the pump is switched on more frequently when on MANUAL than with the aerofoil system. The endurance of the system is 5 hours on MANUAL and approximately 1½ hours on EMERGENCY.

38. **Windscreen de-icing system**

Sprays are provided for the three panels of the pilot's windscreen and the air bomber's window, and the fluid, which is supplied from a 7-gallon tank mounted at the port side of the fuselage nose section, is spread over the panel surfaces by the airflow.

The tank is pressurised, through a pressure-reducing valve, from the pneumatic system, and the pipes feeding the pilots' windscreens are led to two control cocks (23), one on the lower edge at each side of the pilots' panel. Three sprays are mounted, one forward of each pilot's windscreen and one forward of the centre vision panel. Each outer spray is fed from the corresponding control cock and the centre spray is fed when either or both of the cocks are opened. To operate the sprays the cocks are turned ON.

39. **Windscreen wipers**

Two hydraulically-operated windscreen wipers are fitted in front of each pilot's windscreen and are controlled by two valves (22) and (47) mounted one at each side on the lower edge of the pilots' panel. The wipers should not be operated on a dry windscreen.

40. **Pressure heads**

Two pressure heads are fitted, one on the undersurface of each outer wing ; the starboard head serves the 2nd pilot's instrument panel, the V.G. recorder (if fitted) and the

airspeed switch (78) for the undercarriage up-button lock; the port head serves the 1st pilot's and the navigator's instrument panels and the air mileage unit (169).
The heating elements of the two pressure heads are controlled each by its own switch (38) on the starboard side of the pilots' panel.

41. **Oxygen system**

All crew positions, except the galley, are provided with an oxygen feed point. The eight oxygen bottles are carried in a crate slung in the bomb compartment, and a Mk. 10A★ oxygen regulator (74) is mounted on a small panel immediately forward of the inboard edge of the flight engineer's main panel.
To operate the system, the master stop valve on the panel must be turned ON, the H.P. ON-OFF valve on the regulator turned ON and the flow control valve adjusted. Oxygen will flow from the 1st pilot's delivery tube (15) at once, and at other crew stations as soon as the bayonet socket of each delivery tube is removed from its stowage. Flow indicators (72) and (161) are fitted to indicate to each crew member, except the 1st pilot, whether oxygen is flowing satisfactorily. The pilot can observe the oxygen regulator dials to check delivery.

42. **Galley services**

(i) Equipment in the galley includes a ten-gallon water tank feeding an electric urn which is controlled by a circuit-breaker switch with an adjacent red light indicating when the urn is being supplied with current. There is also a hotplate controlled by a 4-position switch to give HIGH, MEDIUM or LOW heating.

(ii) The supply line for these galley services is fed through a main circuit breaker (117) at the aft end of the power panel assembly, this breaker being normally controlled by its own push switches marked START and STOP on the aft face of the galley bulkhead. In an emergency, however, such as the failure of a generator, the circuit breaker can be tripped by operating the normally closed push-switch (133) marked GALLEY ISOLATION SWITCH on the flight engineer's main panel. When this switch has been operated the galley services cannot be brought into operation again until the START switch in the galley is pushed.

43. **Pilots' seats and safety harness**

Access to the pilots' seats is gained through the fuselage from the main entrance door at the aft end. A ladder which, when not in use, is stowed in the roof of the fuselage just forward of the door, is attached to the bottom of the door frame to assist entry. The pilots' seats are mounted on raised platforms and may be adjusted for height by means of levers (19) at the inboard side of the seats. Each pilot has a quick-release Z type harness with a handle (21) and (75) fitted on the inboard arm of each seat to allow the harness to be unlocked to give necessary freedom of movement.

44. **Canopy windows and direct-vision panels**

The cockpit side windows may be opened by pushing the handles (5) and (68) forward to release the catches and then sliding the windows backwards. Two panels, one on each side of the cockpit, are hinged along the upper edge so that direct vision may be obtained. Each panel is retained in the closed position by a fastener (11) and (64) which is released by rotating the rubber grip and pressing it downwards. A toggle is provided on the canopy to hold the panel fully open.

45. **Instrument flying practice equipment**

Clips and fasteners are provided for securing the amber or blue screens which, when assembled, completely cover the cockpit. A stowage is provided for the screens in the rear fuselage on the starboard side.

OPERATIONAL EQUIPMENT AND CONTROLS

46. **Bomb door operation**

The bomb doors are opened and closed by electro-hydraulic power and the control switch (52) on the right-hand side of the pilots' panel has two positions OPEN and CLOSE. In the event of electric or hydraulic failure the doors may be opened or closed by an emergency air system (see para. 84). A warning light (51) beside the pilot's control switch comes on when the doors are fully open.

47. **Bomb release**

The bomb fuzing and release controls are duplicated at the air bomber's and navigator's stations, and a relay change-over switch marked NAVIGATOR and AIR BOMBER is on the navigator's control panel. When the switch is at AIR BOMBER the release of bombs selected at the air bomber's station can be controlled by the air bomber or either of the two pilots from pushbutton switches on their control columns; with the switch at NAVIGATOR, however, the release of bombs selected at the navigator's station can be controlled only by the navigator. Jettisoning of bombs will normally be carried out by pulling the handle on the extreme right of the pilots' panel, but for this to be effective the change-over switch must be at the AIR BOMBER position.

48. **Flares**

(i) A flare chute is installed on the port side of the aircraft opposite the entrance door. The control panel is mounted near the chute alongside the flares stowage, and release switches are provided at four stations—the 1st pilot's (20), the air bomber's, the flare chute and the port look-out.

(ii) Provision is made for the carriage of up to twenty-four 4.5 inch reconnaissance flares in the bomb bay and they may be released singly by either of two push switches (27) and (41), one on each control column handwheel. The flares may be jettisoned by depressing the push switch, marked FLARE JETTISON, on the right of the pilots' panel.

(iii) Installed at the flare station just forward of the entrance door is a battery of four six-barrelled cartridge flare dischargers. The main control unit is mounted at this station and remote control is effected by a duplicated set of stop and start push switches (50) and (58) at each side of the pilots' panel. A flare distributor at the flare station enables the flares to be automatically discharged at half or one second intervals, and the operation of the bomb firing switch automatically stops the further discharge of flares.

49. **Cameras**

Installed in the camera bay below the floor of the fuselage rear centre section are the mountings for cameras intended

FINAL CHECKS FOR TAKE-OFF

TRIM	... ALL NEUTRAL
SUPER-CHARGERS	... LOW GEAR HIGH GEAR (with W/M)
CHARGE TEMP. CONTROLS	... COLD
AIR INTAKE FILTER	... CLEAN
PROPS.	... MAX. R.P.M.
FUEL	... TANKS SELECTED CONTENTS BOOSTER PUMPS ON
FLAPS	... TAKE-OFF
AUTO PILOT	... OFF
RAD. SHUTTERS	... AUTO

FINAL CHECKS FOR LANDING

BRAKES	... CHECK PRESSURES OFF
WHEELS	... DOWN AND LOCKED
SUPER-CHARGERS	... LOW GEAR
AIR INTAKE FILTER	... CLEAN
CHARGE TEMP. CONTROLS	... COLD
PROPS.	... 2,200 R.P.M. 2,600 R.P.M. ON FINAL
FLAPS	... TAKE-OFF DOWN on final
FUEL	... CONTENTS BOOSTER PUMPS ON

for either medium or low level, day or night photography. Selection of the required camera and the operation of the camera doors is controlled from the air bomber's panel. The cameras can be put into operation either by the bomb firing push switches or by an independent camera push switch on the air bomber's panel. For night photography the cameras operate in conjunction with the photoflash installation.

50. **Photoflash installation**

A maximum of twenty-four photoflashes may be carried in the bomb bay and are so arranged that they may be released by operation of either the camera push switch or a bomb-firing push switch. The control unit for the photoflash distributor is mounted on the starboard side of the fuselage nose.

51. **Signal pistol and signal lamp**

(i) A signal pistol is stowed aft of the wireless operator's seat, and the cartridge stowage is above the electrical power panel assembly at the flight engineer's station. The signal pistol firing position is in the fuselage roof above the cartridge stowage.

(ii) A signalling lamp is stowed behind the 2nd pilot's seat, and may be plugged into any of the "inspection lamp" sockets throughout the aircraft.

52. **Lifeboat release**

If a lifeboat is carried below the bomb bay, the bomb doors must remain closed in flight. The lifeboat release master switch is on the air bomber's panel, and when this switch is on, the lifeboat can be released by pressing either the pushbutton (56) on the pilots' instrument panel or the one on the air bomber's panel.
A cover is provided and should be fitted over the bomb doors control switch when the lifeboat is carried.

53. **Radio**

(i) The wireless equipment consists of an MF/HF/DF transmitter/receiver, a twin V.H.F. installation and an intercom. system coupled to both installations. A separate special intercom, system is also provided.

(ii) The MF/HF equipment is under the control of the wireless operator who is also responsible for operating the receiver for D.F. work. Two visual indicators, one immediately forward of the D.F. loop and the other (31) on the pilots' panel provide facilities for homing.

(iii) The twin V.H.F. sets are controlled by the pilot through two control units (35) mounted above the centre of the cockpit coaming, each control unit having a single rotary switch.

(iv) Fifteen station boxes are installed at the various crew positions in the aircraft, consisting of five type 349 units and ten type 350. Type 349 units (45) and (61) carry the MF/HF services, the No. 1 and No. 2 V.H.F. services and the intercom. and call circuits. They are equipped with press-to-transmit facilities and those at the first and second pilots' stations are also connected to remote press-to-transmit switches (30) and (39) situated one on each control column. At the radar operator's station a foot-operated call-switch is installed.
Type 350 units (125) are equipped only with normal intercommunication and pushbutton call services.
Connected to each type 349 or type 350 unit is a mic/tel. socket.

54. **Radar**

The radar equipment comprises an A.S.V. scanner and indicating system, Gee and Loran navigational aids, Rebecca, I.F.F. and an A.Y.F. radio altimeter. Provision is made for a sonobuoy installation and an operator's station is provided. Separate independent aerials are fitted for sets but the starboard aerial, normally used with Loran, can be switched to the MF/HF equipment in the event of the port fixed aerial becoming defective.

PART II
HANDLING

NOTE.—The handling information contained in these Notes covers the operation of the aircraft up to an all-up weight of 72,000 lb. only. Information regarding handling at weights above 72,000 lb. will be issued by amendment.

55. **Management of the fuel system**

(i) *Use of the booster pumps*

To prime the fuel lines and injectors before starting the engines, one booster pump on each side should be switched ON for not more than fifteen seconds, after the fuel tank cocks and engine master cocks have been switched ON. At no other time should the booster pumps be ON when the engines are not running and the engine master cocks are ON. All the booster pumps must be ON for take-off, climbing, and for landing, but they may be switched OFF when cruising. They should, however, be switched ON whenever there is any sign of fuel starvation.

(ii) *Use of the fuel tanks*

When flying with all the fuel tank cocks switched ON, the fuel from the Nos. 3 and 4 tanks will flow into the distributor tank before that from the Nos. 1 and 2 tanks. To prevent undue upward flexing of the wings during flight, the weight of fuel should be kept outboard as much as possible by using Nos. 1 and 2 tanks first. The following method of using the tanks is therefore recommended :—

Take off on No. 1 and No. 2 tanks and use them until a total of 550 gallons on each side remains in these tanks. Then switch on No. 3 tank cocks and continue with all the wing tank cocks ON.

(iii) *Use of the auxiliary fuel tank*

If a bomb bay auxiliary tank is carried, take off on No. 1 tank, and as soon as space is available, transfer the fuel from the auxiliary tank into the No. 1 tanks. When the

bomb bay tank is empty, switch ON the No. 2 tank cocks and continue as in (ii) above.

(iv) *Use of the cross-feed line and cock*

The cross-feed cock should be kept closed except when it is necessary to feed fuel from the tanks in one wing to the engines in the other. In this case, the booster pumps on the side from which the fuel is being used must be ON, and the booster pumps on the other side must be OFF.

56. **Management of air-intake filter and charge temperature controls**

(i) *Air intake filter*

(a) Clean air should never be selected when high supercharger gear is engaged unless water/methanol is used.

(b) Clean air should be used for all ground running, taking off, flying in dust conditions and for landing.

(c) If airfield restriction make the use of maximum take-off power essential, or severe icing conditions exist, unfiltered air should be selected before take-off.

(d) Clean air should be selected under certain circumstances should the automatic charge temperature control fail. (See sub para. (iii) (c) below).

(ii) *Automatic charge temperature control*

(a) The following maximum charge temperature must not be exceeded :—

R.P.M.	°C.
2,750	145
2,600	135
2,400	120
2,200	110
2,000	95
1,800	80
1,600	70
1,400	60

Minimum charge temperature at any cruising r.p.m. 40°C.

(b) COLD air should be used for take-off, climbing, when using "operational necessity" powers, and landing. At all other times the control may be set to AUTO unless the charge temperature at any given r.p.m. rises to within 5°C. of the limit given above.

(iii) *Failure of the automatic charge temperature control*

(a) If excessively high charge temperatures are experienced it may be due to failure of the temperature control unit, causing the shutter to open fully with a consequent rapid temperature rise. In this case the shutter must be "inched" manually to keep the charge temperatures within the limits.

(b) Failure of the electrical supply will cause the shutters to remain in the position at the moment of failure and, depending on this position, may result in either excessively high or low charge temperatures. In this case charge temperatures may be brought within limits by manually "inching" the coolant radiator shutter. Opening the radiator shutter causes a reduction in charge temperature and vice-versa. If, with the coolant radiator shutter fully open, the charge temperature cannot be brought within limits, CLEAN air should be selected and low gear engaged.

(c) When flying in high gear the charge temperature may be substantially reduced by selecting low gear.

(d) If at any time the charge temperature falls below 40°C. and cannot be raised by operating the charge temperature control or coolant temperature control manually, the engine should be cleared every hour by running at 12 lb./sq. in. boost, or with the throttle at the gate, and 2,600 r.p.m. for one minute.

(iv) *Icing conditions*

Normally with the charge temperature control set to AUTO sufficient heat will be available at the intake to provide de-icing under all conditions. If, however, a progressive falling off in boost pressure indicates that engine icing has occurred, the charge temperature control should be set to HOT until the charge temperature reaches the maximum permissible for the r.p.m. being used. The control should then be set to STOP. Prior to take-off and landing, the correct degree of intake heating should be obtained by selecting unfiltered air, increasing power to give 2,600 r.p.m. and adjusting the charge temperature control to give 120°C.

57. **Starting the engines and warming up**

(i) After completing the Pilot's Check List to item 80, continue as follows :—

Fuel cocks	Tank cocks ON as required Engine master cocks ON
Booster pumps ...	ON for 15 secs., then OFF
Priming pump selector	PORT ON or STARBOARD ON as required

(ii) Then, for each engine :—

Ignition switches ...	On
Throttle	One quarter open
Starter pushbutton ...	Press
Booster-coil pushbutton	Press

As the engine is turning, the priming pushbutton should be pressed for a period depending on the air temperature, as shown in the following table :—

Outside air temperature	Priming Period 100 Oct.
20°C. and above	1 second
10°C. to 20°C.	2 seconds
5°C. to 10°C.	3 seconds
0°C. to 5°C.	4 seconds
−5°C. to 0°C.	6 seconds
−10°C.	15 seconds
−20°C.	22 seconds

When the engine fires, release the starter pushbutton and if necessary assist the engine to run smoothly by use of the primer. When the engine is running evenly, release the priming and booster-coil pushbuttons, and set the throttle to give 1,200 r.p.m. until the oil pressure is steady.

(iii) If an engine fails to fire within 20 seconds, wait for 30 seconds before turning it again. No further priming should be given until another attempt to start has been made.

(iv) If high-volatility fuel is used for priming at air temperatures below freezing, the priming pump selector must be kept at OFF and the priming pushbutton must be held depressed to allow the priming fuel to reach the induction system. Before starting an engine the ground crew should work the hand priming pump until the fuel reaches the priming nozzles ; this may be judged by an increase in resistance. Then while the engine is being turned the ground crew should work the pump as required until the engine is running steadily.

(v) When all the engines are running, switch OFF the priming pump selector and set the ground/flight switch to FLIGHT.

(vi) Open up each engine to 1,500 r.p.m. and warm up at this speed.

(vii) Whilst warming up, carry out the checks detailed in the Pilot's Check List, items 81 to 86.

58. **Exercising and testing**

(i) When the oil temperature is 15°C. and the coolant temperature 40°C., test each magneto as a precautionary check before increasing power. Then for each engine :—

(ii) Open up to the static boost reading, close the generator field circuit breaker and press the resetting pushbutton. Check that the generator is charging.

(iii) At the same boost check the operation of the supercharger.

(iv) At the same boost check the operation of the constant-speed unit by moving the r.p.m. control lever slowly through the full governing range at least twice.

(v) At the same boost, test each magneto in turn. If the single ignition drop exceeds 100 r.p.m. or is accompanied by rough running, a full power check should be carried out (see sub para. (vi) below). If there is no drop in r.p.m., the switch is suspect.

NOTE.—The following checks may be carried out after repair, inspection other than daily, or at the discretion of the pilot.

(vi) Open the throttles fully and check the take-off boost and r.p.m. Throttle back to +11 lb./sq. in. boost, and test each magneto. If the single ignition drop exceeds 100 r.p.m. the aircraft should not be flown.

(vii) After completing the checks, either at the static boost or full power, switch off the generator and throttle back to the fully closed position, and check that the engine idles steadily at 600-700 r.p.m. Then open up to 1,200 r.p.m.

(viii) Before taxying, carry out items 87 to 89 of the Pilot's Check List.

59. **Taxying**

Heavy footloads are necessary to control the aircraft when taxying across or down wind, and when standing across wind it is necessary for the second pilot to assist in keeping the rudders central. In calm conditions the aircraft can be directionally controlled to some extent by use of the rudders, with the inboard engines set at 1,000 r.p.m. Ensure that the radiator shutters are in the OPEN position to keep oil temperatures as low as possible before take-off. Check that the generators are off.

60. **Take-off (without water/methanol)**

(i) Carry out the checks laid down in the Pilot's Check List, items 90 to 104.

(ii) Align the aircraft carefully on the runway, making sure that the tail wheel is straight. Then hold the brakes on and open up to 0 lb./sq. in. boost to ensure even response.

(iii) Release the brakes and open up smoothly and quickly to take-off power. There is no tendency to swing and the aircraft can be kept straight in a cross wind by use of the rudders. The rudders are very effective as soon as full power is on.

(iv) At a weight of 72,000 lb. the aircraft should be eased off the ground at a speed of 95 to 100 knots.

(v) When comfortably airborne, brake the wheels and retract the undercarriage. There is a slight nose-up change of trim as the undercarriage retracts.

(vi) The safety speed at a weight of 72,000 lb. at +18 lb./sq. in. boost is 105 knots.

(vii) When the undercarriage is retracted, reduce power to +14 lb./sq. in. boost, 2,600 r.p.m. At a safe height raise the flaps. There is a nose-down change of trim but no tendency to sink as the flaps come up.

61. **Take-off (using water/methanol)**

To be issued later by amendment.

62. **Climbing**

(i) *Maximum rate of climb*

(a) The speed for maximum rate of climb is 125 knots but for oil cooling considerations a speed of 135 knots is recommended. The aircraft is easy to trim to maintain this speed.

(b) Climb in low gear at +14 lb./sq. in. boost and 2,600 r.p.m. with the charge temperature control set to COLD. Unfiltered air should be selected as soon as the aircraft is clear of any dust layer.

(c) When, with the throttles at the gate, the boost has fallen to +11 lb./sq. in. high gear should be engaged, and the throttles then adjusted to give +14 lb./sq. in. If, however, CLEAN air has been retained until this boost drop occurs, unfiltered air should be selected and the climb in low gear continued until the boost again falls to +11 lb./sq. in. before changing gear.

(d) High gear should never be used on the climb below 5,000 feet or in filtered air.

(ii) *Reduced power climb*

(a) Climb at 135 knots using +9 lb./sq. in. boost and 2,400 r.p.m. with the charge temperature control set to AUTO.

(b) When, with the throttles at the gate, the boost has fallen to +6 lb./sq. in. high gear should be engaged and the throttles adjusted to give +9 lb./sq. in. boost.

63. **Cruising**

(i) Continuous operation of the engines at r.p.m. below 1,550 is not permissible. Continuous operation of r.p.m. between 2,200 and 2,400 should be avoided as much as possible.

(ii) The recommended speed for maximum range varies between 150 and 170 knots depending upon weight.

(iii) Although +9 lb/sq. in. boost and 2,400 r.p.m. is permissible for continuous cruising power, powers of +7 lb./sq. in. boost and 2,200 r.p.m. and below are recommended.

(iv) Fly in low gear with the charge temperature control set to AUTO and set the throttles to give the maximum obtainable boost but not exceeding +7 lb./sq. in. Obtain the recommended airspeed by adjusting the r.p.m. between 1,550 and 2,200. If with 1,550 r.p.m. the required airspeed is exceeded, the boost should be reduced as required. If speeds are required which entail the use of powers higher than +7 lb./sq. in. boost and 2,200 r.p.m. they should be obtained by retaining the r.p.m. at 2,200, increasing the boost progressively from +7 lb to +9 lb./sq. in. and then, if necessary, setting the r.p.m. to 2,400.

(v) If more than 2,400 r.p.m. are required in low gear to maintain the desired airspeed, change to high gear and adjust the r.p.m. and boost as in (iv) above. High gear should not be used below 5,000 feet or when clean air is selected.

(vi) When flying with the throttles at or near the gate to obtain the required boost, greater economy due to more advanced ignition will be obtained by throttling back until a sharp drop in boost occurs and then moving the throttles forward $\frac{3}{4}$ inch to 1 inch.

(vii) The use of higher charge temperatures than those normally obtained with the charge temperature control set to AUTO will result in a reduction in range.

(viii) The speed for maximum endurance is 120 to 130 knots.

64. **Flight planning charts**

To be issued by amendment.

65. **Position error corrections**

(i) The position error on the starboard pressure head serving the 2nd pilot's A.S.I. varies from $-\frac{1}{2}$ knot at 120 knots to $-2\frac{1}{2}$ knots at 240 knots, with the undercarriage and flaps up.

(ii) The position error on the port pressure head serving the 1st pilot's A.S.I., the navigator's A.S.I. and the air mileage indicator varies from 0 at 120 knots to $-4\frac{1}{2}$ knots at 240 knots, with the undercarriage and flaps up.

(iii) The airspeeds quoted throughout these Notes refer to the 1st pilot's A.S.I.

66. **General flying**

(i) The aircraft is pleasant to fly and easy to trim under all normal conditions of flight.

(ii) *Controls*

The controls are well harmonised and the elevator is relatively light and effective under all conditions except when landing at the forward c. of g. (see para. 68 (iv)). The ailerons are moderately light and effective, becoming heavier with increasing speed ; at low speeds the response is sluggish. The rudders are moderately light and very effective.

(iii) *Change of trim*

Undercarriage up ...	Slightly nose up
Undercarriage down	Negligible
Flaps up	Nose down
Flaps down	Nose up
Bomb doors open ...	Slightly nose up
Bomb doors closed ...	Slightly nose down
Radiator shutters open or closed ...	No change

(iv) *Flying at reduced airspeed*

Reduce speed to 150 knots and lower the flaps to TAKE-OFF. Set the r.p.m. to 2,400, and adjust the throttles to give the required speed, which may be reduced to 125 knots. The stalling speed under these conditions is 85-90 knots depending on weight.

(v) *Diving*

There is a progressively increasing nose-up change of trim as speed is increased ; the aircraft should, therefore, be trimmed gently into the dive.

(vi) *Flying in turbulent conditions*

In turbulent conditions, the aim should be to maintain a speed of approximately 180 knots.

67. **Stalling**

(i) There is no warning of the approach to the stall except that, with the engines fully throttled back, a slight tremor of the control column may be felt when the airspeed has fallen to approximately 5 knots above the stalling speed.

At the stall aileron snatching accompanied by a wing dropping may occur. Normal recovery action is effective.

(ii) The approximate stalling speeds at a weight of 72,000 lb. are as follows :—

Power off	
Undercarriage and flaps up ...	100 knots
Undercarriage and flaps down	90 „
Power on (normal final approach power)	
Undercarriage and flaps up ...	95 „
Undercarriage and flaps down	85 „

68. **Approach and landing**

(i) Carry out the checks laid down in the Pilot's Check List, items 105 to 114.

(ii) At the maximum landing weight the speed on the initial straight approach should be approximately 115 knots, and the speed over the airfield boundary should be 100 knots.

(iii) The round-out should be made with some power still on so that the aircraft crosses the end of the runway in a level attitude ; if the control column is then moved progressively backwards and the throttles closed, a three-point landing can comfortably be made.

(iv) If the engines are throttled back before the round-out is made, the elevator loses effectiveness and it becomes difficult to check the descent and achieve a three-point attitude. This is particularly apparent when the aircraft is loaded to a forward c. of g.

69. **Mislanding and going round again**

The aircraft will climb away satisfactorily at the maximum landing weight with the undercarriage and flaps down, using intermediate power. After increasing power, select undercarriage UP and the flaps to TAKE-OFF in quick succession. Climb at 125 knots and at a safe height

select flaps UP. There is a strong nose-up change of trim when power is increased.

70. **Instrument approach**

To be issued by amendment.

71. **After landing**

(i) After turning off the runway, carry out the checks laid down in the Pilot's Check List, items 115 to 122.

(ii) Before stopping the engines, if the serviceability of an engine is in doubt, such items of the run-up given in para. 58 as may be necessary should be carried out.

(iii) Run each engine at 1,800 r.p.m. for two minutes in order to scavenge oil from the propeller translation bearings. Then throttle back to 1,200 r.p.m.

(iv) Idle the engines at 1,200 r.p.m. for a short period, and if no other check of the ignition has been made, the magnetos should be tested for a " dead cut ".

(v) Stop the engines by pressing the fuel cut-off pushbuttons until the engines stop. Then carry out the checks detailed in the Pilot's Check List, items 123 to 134.

PART III
LIMITATIONS

72. **Engine data—Griffon 57**

The principal maximum engine limitations are as follows :—

	Supercharger gear	R.p.m.	Boost lb./sq. in.	Temp. °C Coolant	Temp. °C Oil
TAKE-OFF 5 MINS. LIMIT	Low	2,750	+18	135	105
	*High	2,750	+25	135	105
INTERMEDIATE 1 HR. LIMIT	Low	2,600	+14	125	90
	High				
CONTINUOUS WEAK MIXTURE	Low	2,400	+9	115	90
	High				
OPERATIONAL NECESSITY 5 Mins. Limit	Low	2,750	+18	135	105
	High				

* With water-methanol injection.

OIL PRESSURE :
Minimum in flight ... ... 45 lb./sq. in.

MINIMUM TEMPERATURES FOR TAKE-OFF :
Oil ... ... +15°C.
Coolant ... ... +40°C.

MAXIMUM AIR INTAKE TEMPERATURES :
In low gear, or at Max. power with Water/Methanol in high gear ... ... 45°C.
In high gear—all conditions without Water/Methanol ... ... 35°C.

NOTE.—(i) No air-intake temperature gauges are fitted. In order to keep below the above air-intake temperature limitations, the charge temperatures must be maintained below the figures quoted in the table in Para. 56 (ii) (a).

(ii) Continuous operation of the engines at r.p.m. below 1,550 is not permissible due to propeller limitations. Continuous operation at r.p.m. between 2,200 and 2,400 should be avoided as much as possible.

73. **Flying limitations**

(i) The aircraft is designed for manœuvres appropriate to a long-range reconnaissance aircraft. Gentle manœuvres only are permitted at weights above 82,000 lb. and when loaded to maximum all up weight a total of 1,000 gallons

fuel should be used from the No. 1 and No. 2 tanks before turning on the No. 3 tanks ; this is on account of wing strength consideration.

(ii) Maximum speeds (in knots)

Dive	300
Bomb doors open	300
Undercarriage down	225
Flaps down	155

(iii) Maximum permissible all-up-weights

Take-off and gentle manœuvres only	86,000 lb.
All permitted forms of flying (provided that fuel is kept outboard)	82,000 lb.
Landing	72,000 lb.

PART IV
EMERGENCIES

74. **Feathering**

(i) Close the throttle immediately.

(ii) Push the r.p.m. control lever down through the feathering gate.

(iii) Press the feathering button long enough to ensure that it stays in by itself, then release it so that it can spring out when feathering is complete. If it does not do so, it must be pulled out.

NOTE.—Pressing the button accelerates the feathering. The propeller will feather slowly at a decreasing rate, and not quite fully, on the control lever alone.

(iv) Turn off the engine master cock immediately the engine stops.

(v) Switch OFF the ignition and generator and set the radiator shutter control to CLOSE.

(vi) If No. 3 engine has been feathered, set the vacuum change-over cock to EMERGENCY.

75. **Unfeathering**

(i) Switch ON the ignition, set the throttle closed and the r.p.m. control lever just forward of the feathering gate.

(ii) Switch ON the fuel master cock and then, without delay, if the booster pumps are on, press the feathering push-button, and release it, or pull it out, when the r.p.m. rise to 1,000.

(iii) Warm up the engine at 0 lb./sq. in. boost and 1,400 r.p.m. until the minimum coolant and oil temperatures are attained. Then set the radiator shutter control to AUTO and open up to the power required.

(iv) It is advisable not to unfeather at speeds higher than normal cruising in order to avoid the risk of over-speeding.

(v) The propeller will not unfeather unless the pushbutton is pressed.

76. **Starting an engine on the ground after a "practice feathered" landing**

After carrying out the normal checks after landing, set the controls of the engine to be started as follows:—

Throttle	... ...	One third open
R.p.m. control lever	...	Max. r.p.m. position
Ignition switches	...	ON
Engine master cock	...	ON
Fuel booster pump	...	ON for not more than fifteen seconds, then OFF.

Open up the other engines to 1,500 r.p.m. and switch ON the generators. Start the engine in the normal way, except that no priming should be required. When the engine is running, press the feathering pushbutton until the r.p.m. reach 1,000 and then release it. If the button does not spring out it must be pulled out. After warming up the engine, open to 0 lb./sq. in. and check that the r.p.m. are normal. Check the operation of the constant-speed unit and then switch OFF the generators.

77. **Engine failure during take-off**

(i) The safety speed is 105 knots. At this speed the aircraft can be climbed away easily.

(ii) When the propeller of the failed engine is feathered, and the undercarriage raised, speed should be increased to 120 knots, the flaps raised at a safe height and power reduced to the intermediate setting.

(iii) If No. 3 or No. 4 engine fails, the undercarriage and flaps will take longer than normal to retract.

78. **Handling on three engines**

The aircraft can easily be trimmed to fly straight and level, and normal cruising speeds can be maintained with the engines operating within the weak mixture range.

79. **Landing on three engines**

With the aircraft trimmed to maintain straight and level flight on three engines, the circuit and approach should be made in the same way and at the same speeds as on four engines. If either No. 3 or No. 4 engine is stopped, the undercarriage and flaps will take longer than normal to lower.

80. **Going round again on three engines**

(i) The decision to go round again should be made before full flap is lowered. Increase power to +18 lb./sq. in. boost and 2,600 r.p.m. and re-trim. Then in quick succession select undercarriage and flaps up and climb at the normal climbing speed.

(ii) If in emergency it is necessary to go round again after the flaps have been fully lowered, power may be increased to +18 lb./sq. in. boost provided that the airspeed is not allowed to fall below 105 knots. Power should be increased and the aircraft retrimmed, then the undercarriage selected UP and the flaps set to TAKE-OFF. At 120 knots when climbing away, the flaps should be selected UP and the power reduced to +14 lb./sq. in. boost and 2,600 r.p.m.

81. **Flying on asymmetric power on two engines**

(i) Below 7,000 feet in low gear the aircraft should maintain height at an airspeed of 130-135 knots at 72,000 lb. at +9 lb./sq. in. boost, 2,400 r.p.m. The aircraft can be trimmed to fly straight and level at this power and speed. The aircraft can be controlled at any speed down to 115 knots, but at low speeds a large force on the aileron controls is necessary in conjunction with the rudders, to keep the aircraft straight and level. No hydraulic power is available when Nos. 3 and 4 engines are stopped.

(ii) *Landing*

A circuit in either direction can be made irrespective of which engines have failed. The flaps may be lowered to

TAKE-OFF on the down-wind leg, and the undercarriage should be locked down by the end of the downwind leg. If the two starboard engines are stopped, the undercarriage and flaps must be lowered by means of the compressed air emergency system. A speed of 120 knots should be maintained until the final approach. The r.p.m. should be set at 2,600 on entering the circuit, and the boost adjusted as necessary to maintain height and airspeed. Full flap must not be lowered until it is certain that the airfield is within easy reach. On the final part of the approach, power and speed should be reduced gradually, and the airfield boundary crossed at the normal engine-assisted approach speed.

(iii) Going round again must not be attempted if the two starboard engines are stopped, as the undercarriage cannot be retracted. If the two starboard engines are running, it is possible to go round again at weights up to 72,000 lb., provided that the speed is not allowed to fall below 115 knots, and full flap has not been lowered. Open up to +18 lb./sq. in. boost and retract the undercarriage and flaps. Reduce power to +14 lb./sq. in. boost and 2,600 r.p.m. and climb at 125 knots until a height of 1,000 feet is reached ; then increase speed to 140 knots.

NOTE.—To prevent undue drag from the radiator shutters when flying at high powers on two engines, the shutters on the two live engines should be manually operated to the trail position (in line with the cowling ahead of the shutter).

82. **Flapless landings**

When landing with the flaps up, the initial approach should be made at 120 knots, reducing to 115 knots over the airfield boundary. Little power is required and the approach is flat, a small change of attitude only being necessary to carry out the round-out and landing. The aircraft can be brought to rest easily within 2,000 yards.

83. **Undercarriage and flaps emergency operations**

(i) A compressed air system is provided for emergency operation of the undercarriage, and for operation of the flaps through the flaps control valve.
The system is controlled by two levers (162) and (163) at the bottom of the flight-engineer's main panel on the starboard side. Both levers have safety pins which must be withdrawn before the levers can be operated, and each lever must be held down whilst the relevant service is being used as the levers are spring-loaded to OFF.

(ii) When the lever (163) for the emergency control of the undercarriage is operated the main wheel units are lowered irrespective of the position of the normal hydraulic control buttons, nevertheless the DOWN buttons should be pressed to prevent any loss of air pressure which may cause the undercarriage locks to be released and the undercarriage to collapse. It is not possible to retract the main wheels again once the emergency system has been used.

(iii) Emergency operation of the flaps is possible by two methods :—

(a) In the event of electrical failure only, two push-buttons give mechanical operation of the valves. The buttons are reached through a hole in the front of the starboard end of the flap operating rod and jack cover, on the fuselage floor below the mid-upper turret ; an instruction plate is fixed to the cover and labelled TOP-FLAPS DOWN, BOTTOM-FLAPS UP. The buttons are spring-loaded to "off" and therefore the selected one must be kept depressed until the desired operation of the flaps is complete. When the flaps are raised by this method, they come

up much quicker than when the normal method is used.

(b) In the event of either electric or hydraulic failure, the flaps may be lowered (and raised, if Mod. 98 has been incorporated) by means of the compressed air system. The normal flaps control lever must be set to DOWN before operating the emergency lever (162) which is then held down until the desired flap position has been obtained. Aircraft not incorporating Mod. 98 have a label on the pilot's panel which reads FLAPS UP MUST NOT BE SELECTED WHEN EMERGENCY AIR HAS BEEN USED.

84. **Bomb door emergency operation**

A separate compressed air system is fitted for emergency opening and closing of the bomb doors and is controlled by two levers at the bottom of the flight engineer's main panel on the port side. The left-hand lever (168) is labelled OPEN and the right-hand one (167) CLOSED and a slide pin with a lug forms a manually-operated catch which holds the two levers OFF. Movement of the catch to one side frees the lever on the other side only, thus preventing the inadvertent operation of both levers simultaneously. The appropriate lever must be held down until the bomb doors are fully opened or closed as required. A check may be made through the inspection door in the forward bomb compartment bulkhead.

85. **Bomb, photoflash and flare jettisoning**

The complete bomb load may be jettisoned (after the bomb doors have been opened) by means of the pull handle on the right of the pilots' panel but for this to be effective the bomb release change-over switch must be set to the AIR BOMBER position. Above this handle are pushbuttons for jettisoning the photoflashes and flares carried in the bomb bay.

86. **Auxiliary tank jettisoning**

The auxiliary fuel tank (if fitted) may be jettisoned by operation of the bomb jettison handle.

87. **Engine fire-extinguishers**

Each engine is provided with a fire-extinguisher system, and warning lights are mounted on the respective feathering pushbuttons ; if a fire warning light comes on, pressing the feathering button also operates the fire-extinguisher system. The pilot should, however, press the appropriate one of the four pushbuttons (36) on the pilots' panel as well, when the propeller has stopped turning. If the warning light is not on, pressing the feathering pushbutton will not operate the extinguisher. The fire-extinguishers are also operated automatically by a crash switch in the nose of the aircraft.

88. **Fuel tanks and water/methanol tanks fire-extinguisher system**

Twelve fire-extinguishers for the fuel tanks in the main planes and two for the water/methanol tanks in the outboard engine nacelles are automatically operated in the event of fire. If the automatic system fails to function the extinguishers can be electrically operated from two pushbuttons (37) on the pilots' panel, the left-hand button for the port tanks, and the right-hand button for the starboard tanks. The system is also operated by the crash switch in the nose of the aircraft.

89. **Crew warning horns**

A pushbutton (55) on the pilots' panel operates a horn on the front spar bulkhead and another on the bulkhead between the mid-upper turret and the main entrance door.

90. **Emergency equipment**

Stowage for an axe, fire-extinguisher and asbestos gloves is provided in a detachable panel in the main door. This panel is accessible from both inside and outside the aircraft. A second axe is stowed on the starboard side of the fuselage opposite the navigator's station. Hand fire-extinguishers and portable oxygen bottles are stowed near each crew station. Two first-aid kits are provided, one on the port side of the rear fuselage and the other on the starboard side of the navigator's station.

91. **Parachute exits**

The parachute exit in the nose of the aircraft is the most suitable and should be used by as many members of the

crew as possible. The main entrance door in the starboard side of the fuselage should be used by the remainder of the crew and it can be jettisoned inwards by pulling the yellow and black striped handle at the forward edge.

92. **Escape hatches**

There are five escape hatches, two in the canopy above the pilots' position ; one in each side of the fuselage between the spars, one in the roof just forward of the entrance door and one in the floor of the nose. Each hatch is released by operating a turn handle situated near the hatch ; before the handle can be operated an adjacent pushbutton must be pressed in.

93. **Crash stations**

Four members of the crew—both pilots, the wireless operator and the radar operator—remain in their seats ; the navigator seated just forward of the front spar turns in his seat so that his back is against the spar and the other members of the crew take up the following stations :—

One on the step below the astrodome ;

Two sitting on the floor with their backs to the step behind the front spar ;

Two sitting on the floor with their backs to the forward face of the rear spar.

All stations have a Z-type harness and all the stations except the last have crash handles provided to allow the occupant to cradle his head on his arm. The step below the astrodome should be dropped to its lowest position before being used. This is done by releasing the spring-loaded locking pins at each side of the step.

94. **Dinghies**

(i) Two type J dinghies are stowed, one in the centre-section trailing edge of each wing and a manual release cord runs from each dinghy stowage compartment to two pull-off positions one on the starboard wall near the mid-upper turret and the other further aft at the " look out " station. When a cord is pulled the corresponding dinghy is released and inflated. A hand lever is provided to enable

the dinghy release mechanism to be operated from outside the aircraft. When this lever is used the cord to the inflation bottle must also be pulled.

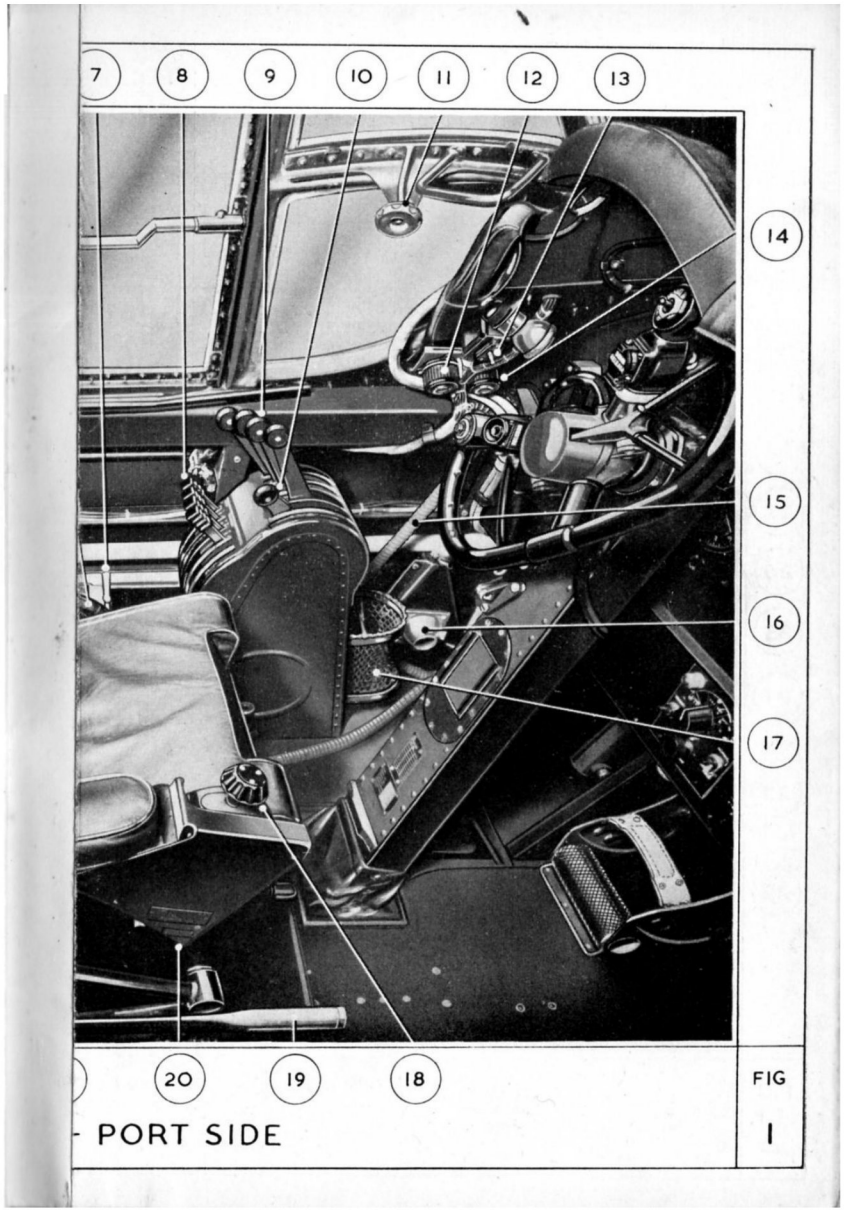
(ii) Twelve stowages are provided for K type single seat dinghies.

95. **Ditching**

(To be issued later by amendment.)

PART V

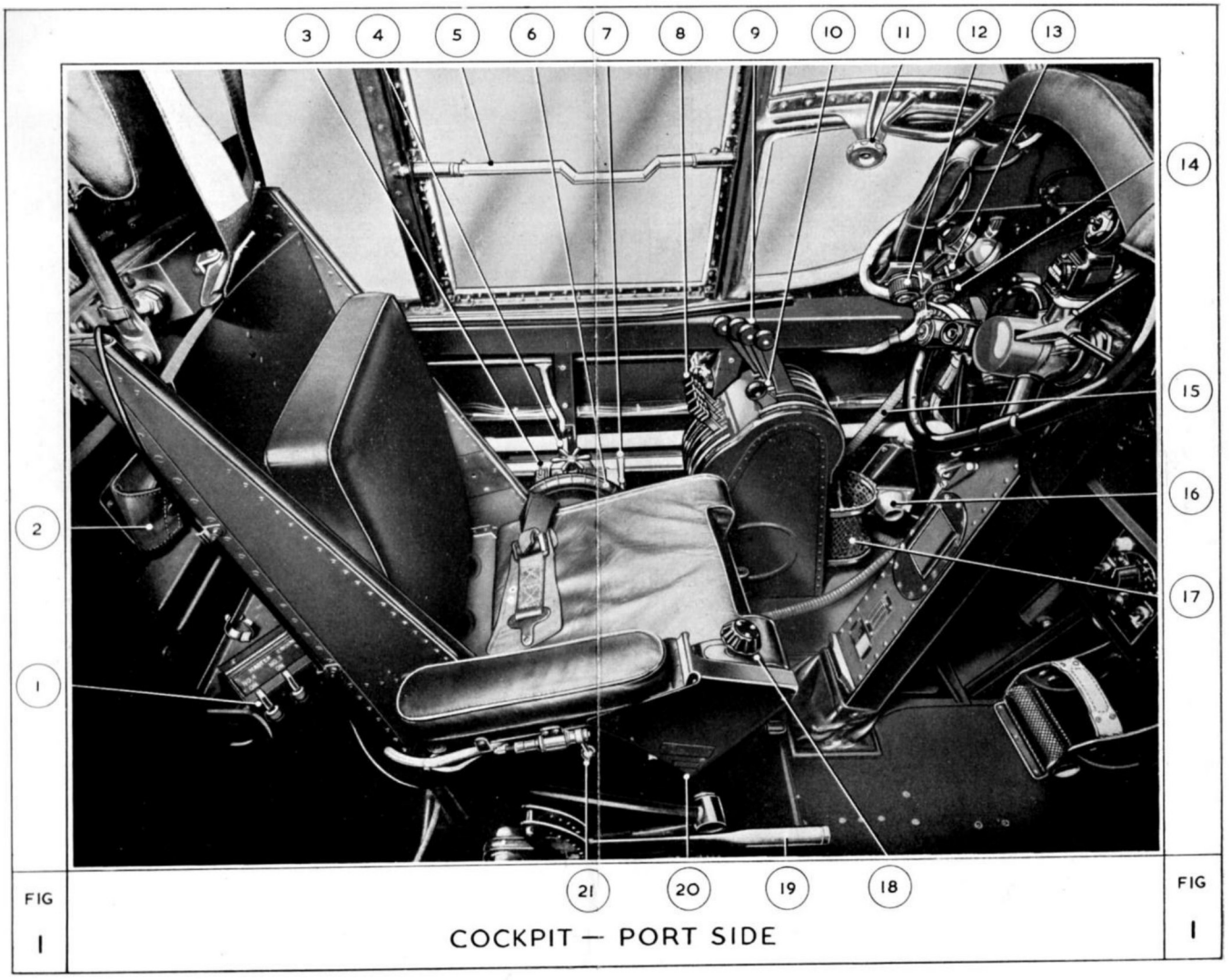
ILLUSTRATIONS



KEY TO *Fig.* 1.

COCKPIT PORT SIDE

1. Engine master cocks (4).
2. Wandering lamp stowage.
3. Trimmer lamp switch.
4. Rudder trimmer handwheel.
5. Window locking handle.
6. Elevator trimmer handwheel.
7. Aileron trimmer handwheel.
8. R.p.m. control levers (4).
9. Throttle levers (4).
10. Throttle friction damping lever.
11. Direct vision panel fastener.
12. Red floodlamps dimmer switch.
13. Compass lamp switch.
14. U.V. lamps dimmer switch.
15. 1st pilot's oxygen pipe.
16. Cockpit heating outlet.
17. Portable oxygen bottle stowage.
18. Auto pilot controller.
19. Seat-raising handle.
20. Flare chute release switch.
21. Harness release.



COCKPIT — PORT SIDE

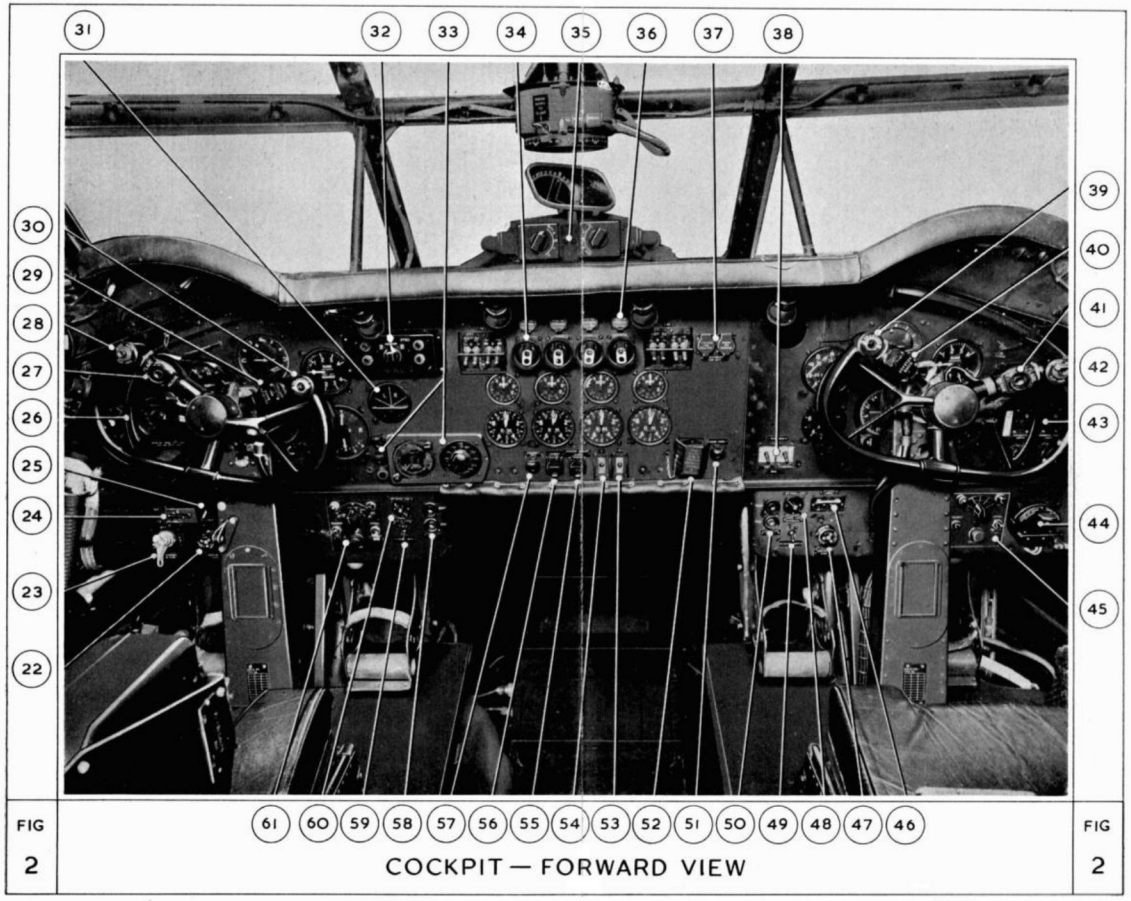


FIG 2 — COCKPIT — FORWARD VIEW

KEY TO *Fig.* 2

COCKPIT—FORWARD VIEW

22. Windscreen wiper control.
23. Windscreen de-icing control.
24. Supercharger and water/methanol switches.
25. Air-intake filter switch.
26. Brakes lever.
27. Bomb-bay flare release pushbutton.
28. Auto-pilot cut-out switch.
29. Bomb release pushbutton.
30. Press-to-transmit switch.
31. D/F visual indicator.
32. G4B compass control.
33. AYF radio altimeter controls.
34. Feathering pushbuttons (4).
35. V.H.F. controllers (2).
36. Engine fire-extinguisher pushbuttons (4).
37. Tank bays fire-extinguisher pushbuttons (2).
38. Pressure-head heater switches (2).
39. Press-to-transmit switch.
40. Bomb release pushbutton.
41. Bomb-bay flare release pushbutton.
42. Auto-pilot cut-out switch.
43. Brakes lever.
44. Signalling switch box.
45. Type 349 station controller.
46. External lighting master switches.
47. Windscreen wiper control.
48. Landing lamp switch.
49. Taxying lamp switch.
50. Flare discharger START and STOP pushbuttons.
51. Bomb doors indicator light.
52. Bomb doors control.
53. I.F.F. distress switch.
54. I.F.F. master switch.
55. "Crew warning" horn pushbutton.
56. Lifeboat release pushbutton.
57. Emergency call light.
58. Flare discharger START and STOP pushbuttons.
59. Taxying lamp switch.
60. Landing lamp switch.
61. Type 349 station controller.

NOTE.—(a) The following items are hidden behind 1st pilot's control column :—
Undercarriage control pushbuttons
Undercarriage indicator
Flaps control lever
Flaps position indicator
G4B compass
Emergency lamp switch.

(b) The following items are hidden behind 2nd pilot's control column :—
Navigation lights switch
Identification lights colour switch
Bomb-bay flares jettison pushbutton
Photo flash jettison pushbutton
Emergency lamp switch
Windscreen de-icing control
Bomb jettisoning control.

KEY TO *Fig.* 3.

COCKPIT—STARBOARD SIDE

62. U.V. lamps dimmer switch.
63. Red floodlamps dimmer switch.
64. Direct vision panel fastener.
65. Throttle levers (4).
66. Throttle friction damping lever.
67. R.p.m. control levers (4).
68. Window locking handle.
69. Aileron trimmer handwheel.
70. Elevator trimmer handwheel.
71. Rudder trimmer handwheel.
72. Oxygen flow indicator.
73. Trimmer lamp switch.
74. Oxygen regulator.
75. Harness release.
76. Portable oxygen bottle stowage.

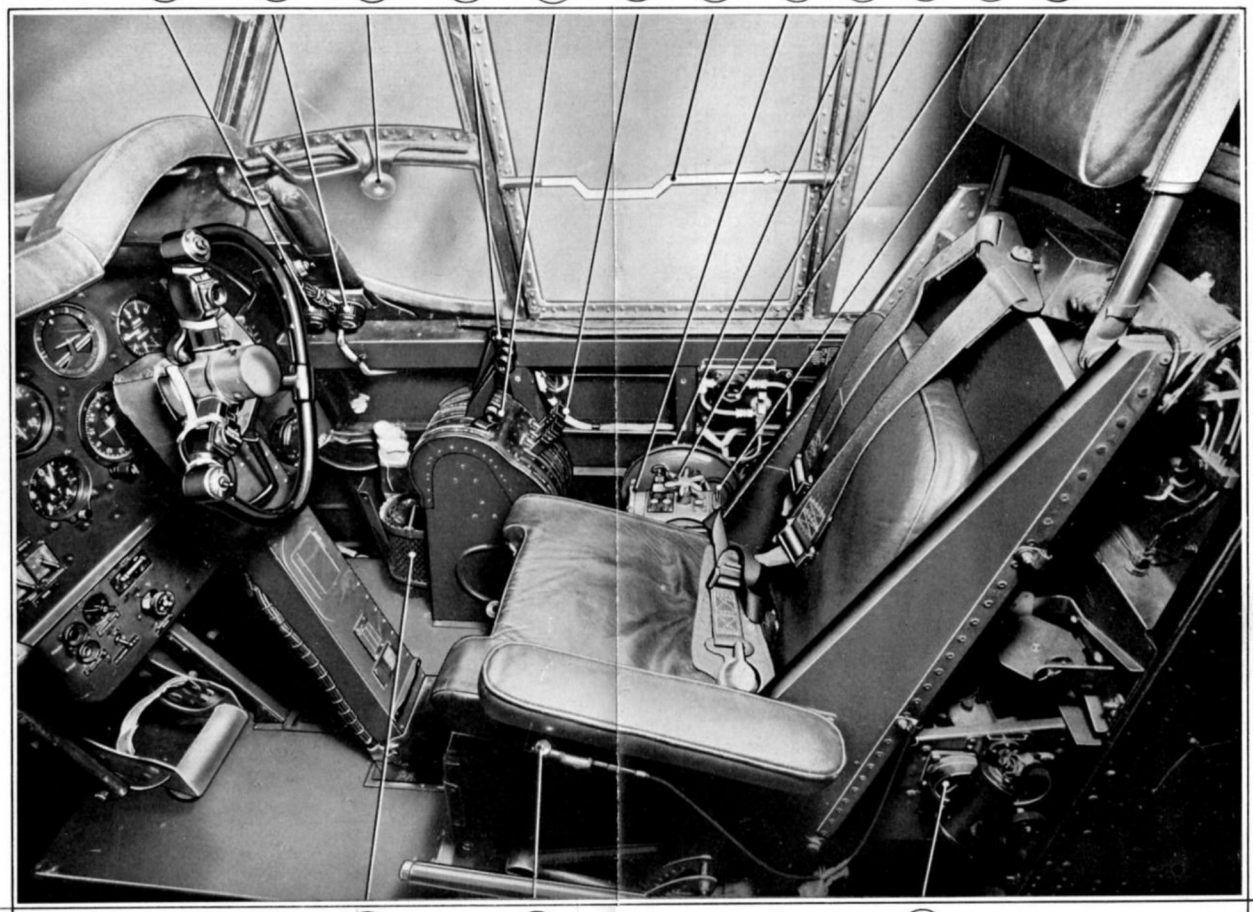


FIG 3

COCKPIT—STARBOARD SIDE

FIG 3

KEY TO *Fig.* 4

ELECTRICAL MAIN POWER PANEL ASSEMBLY

77. Twelve Type A circuit breakers, from left to right.
    1. Air bomber's fuse panel.
    2. Flight instruments.
    3. Flight instruments.
    4. Flight instruments.
    5. Flight instruments.
    6. Wireless operator's fuse panel.
    7. Booster pump No. 1 starboard.
    8. Booster pump No. 2 starboard.
    9. Booster pump No. 1 port.
    10. Booster pump No. 2 port.
    11. Panel at former 2.
    12. Panel at former 12.
78. Airspeed-operated undercarriage switch.
79. Voltmeter.
80. Ammeter socket.
81. Ammeter selector switch.
82. Generator field circuit breakers (4).
83. Fuse box WW :—
    4 fuses for power failure warning lights.
84. Fuse box XX :—
    4 fuses for generator circuit breakers
    1 fuse for voltmeter
    3 spares.
85. Generator circuit breaker reset push switches (4).
86. Cabin heater warning lamps (3).
87. Cabin heater circuit control reset switches (3).
88. Ground/flight switch.
89. Fuse box QQ :—
    De-icing gauges
    Flight instruments
    Special intercom. warning light
    Supercharger relay coils
    Bomb-doors warning light
    Flare chute
    2 spares.
90. Fuse box PP :—
    Charge temperature control (No. 4 engine)
    Fuel cut-off (No. 4 engine)
    Flap indicator
    Flight instruments
    Illuminating flares
    Supercharger (No. 4 engine)
    2 spares.
91. Fuse box NN :—
    2 fuses for Flight Instruments
    Fuel pressure (No. 4 engine)
    Galley services
    Radiator shutters (No. 4 engine)
    Oil temperature (No. 4 engine)
    Radiator temperature (No. 4 engine)
    Fuel flowmeter (No. 4 engine).
92. Fuse box MM :—
    Air cleaner
    Charge temperature control (No. 3 engine)
    Fuel cut-off (No. 3 engine)
    L.T. boost coil
    Water methanol pump No. 4
    Water methanol pump No. 3
    Supercharger (No. 3 engine)
    1 spare.
93. Fuse box LL :—
    Fuel contents (starboard)
    Fuel pressure (No. 3 engine)
    Flare chute
    Radiator shutter (No. 3 engine)
    Oil temperature (No. 3 engine)
    Radiator temperature (No. 3 engine)
    Fuel flowmeter (No. 3 engine)
    1 spare.
94. Fuse box KK :—
    Auxiliary fuel gauge
    Charge temperature control (No. 2 engine)
    Fuel cut-off (No. 2 engine)
    Engine starter
    Fuel selector cock (No. 3 port)
    Fuel tank selector cock (No. 3 starboard)
    Supercharger (No. 2 engine)
95. Fuse box JJ :—
    Water methanol pumps (test)
    Auxiliary tank transfer pump
    Fuel pressure (No. 2 engine)
    De-icing—aerofoils
    Radiator shutter (No. 2 engine)
    Oil temperature (No. 2 engine)
    Radiator temperature (No. 2 engine)
    Fuel flowmeter (No. 2 engine).
96. Fuse box HH :—
    Oil dilution
    Charge temperature control (No. 1 engine)
    Fuel cut-off (No. 1 engine)
    Engine priming
    Water methanol pump No. 2
    Water methanol pump No. 1
    Supercharger (No. 1 engine).
97. Fuse box GG :—
    Cabin heater fuel pump
    Fuel contents (port)
    Fuel pressure (No. 1 engine)
    De-icing—propellers
    Radiator shutters (No. 1 engine)
    Oil temperature (No. 1 engine)
    Radiator temperature (No. 1 engine)
    Fuel flowmeter (No. 1 engine).
98. Fuse box FF :—
    No. 1 engine master cock
    No. 2 engine master cock
    No. 3 engine master cock
    No. 4 engine master cock
    Fuel tank selector cock (No. 2 port)
    Fuel tank selector cock (No. 1 port)
    Fuel tank selector cock (No. 2 starboard)
    Fuel tank selector cock (No. 1 starboard).
99. Fuse box EE :—
    Landing lamp filament (port)
    Landing lamp filament (starboard)
    External lights (main)
    Water methanol (main).
100. Fuse box DD :—
    Fire-extinguisher (No. 4 engine)
    Feathering (No. 4 engine)
    Fire-extinguisher light (No. 4 engine)
    Landing lamp motor (port)
    Landing lamp motor (starboard)
    General lighting
    Flap control
    Tank bays fire-extinguishers (starboard).
101. Fuse box CC :—
    Fire-extinguisher (No. 3 engine)
    Feathering (No. 3 engine)
    Fire-extinguisher light (No. 3 engine)
    Identification lights
    Navigation lights
    Taxying lamp (port)
    Taxying lamp (starboard)
    1 spare fuse.
102. Fuse box BB :—
    Fire-extinguisher (No. 2 engine)
    Feathering (No. 2 engine)
    Fire-extinguisher light (No. 2 engine)
    Pressure-head heaters
    Engine fire-extinguishers inertia switch
    Undercarriage indicator
    Undercarriage control
    1 spare fuse.
103. Fuse box AA :—
    Fire-extinguisher (No. 1 engine)
    Feathering (No. 1 engine)
    Fire-extinguisher light (No. 1 engine)
    Bomb doors control
    Crew warning horns
    Tank bays fire-extinguisher (port)
    Tank bays fire-extinguisher inertia switch
    1 spare fuse.
104. Aerofoil de-icing controller.
105. Propeller de-icing controller.
106. Type B circuit breaker—sonobuoys.
107. Type D circuit breaker—No. 1 engine.
108. Type J cut-out—No. 1 engine.
109. Type D circuit breaker—No. 2 engine.
110. Type D circuit breaker—No. 3 engine.
111. Type J cut-out—No. 2 engine.
112. Type J cut-out—No. 3 engine.
113. Type D circuit-breaker—No. 4 engine.
114. Type J cut-out—No. 4 engine.
115. Type D circuit breaker—radar.
116. Type D circuit breaker —radar.
117. Type B circuit breaker—galley services.
118. Type B circuit breaker—mid-upper turret.

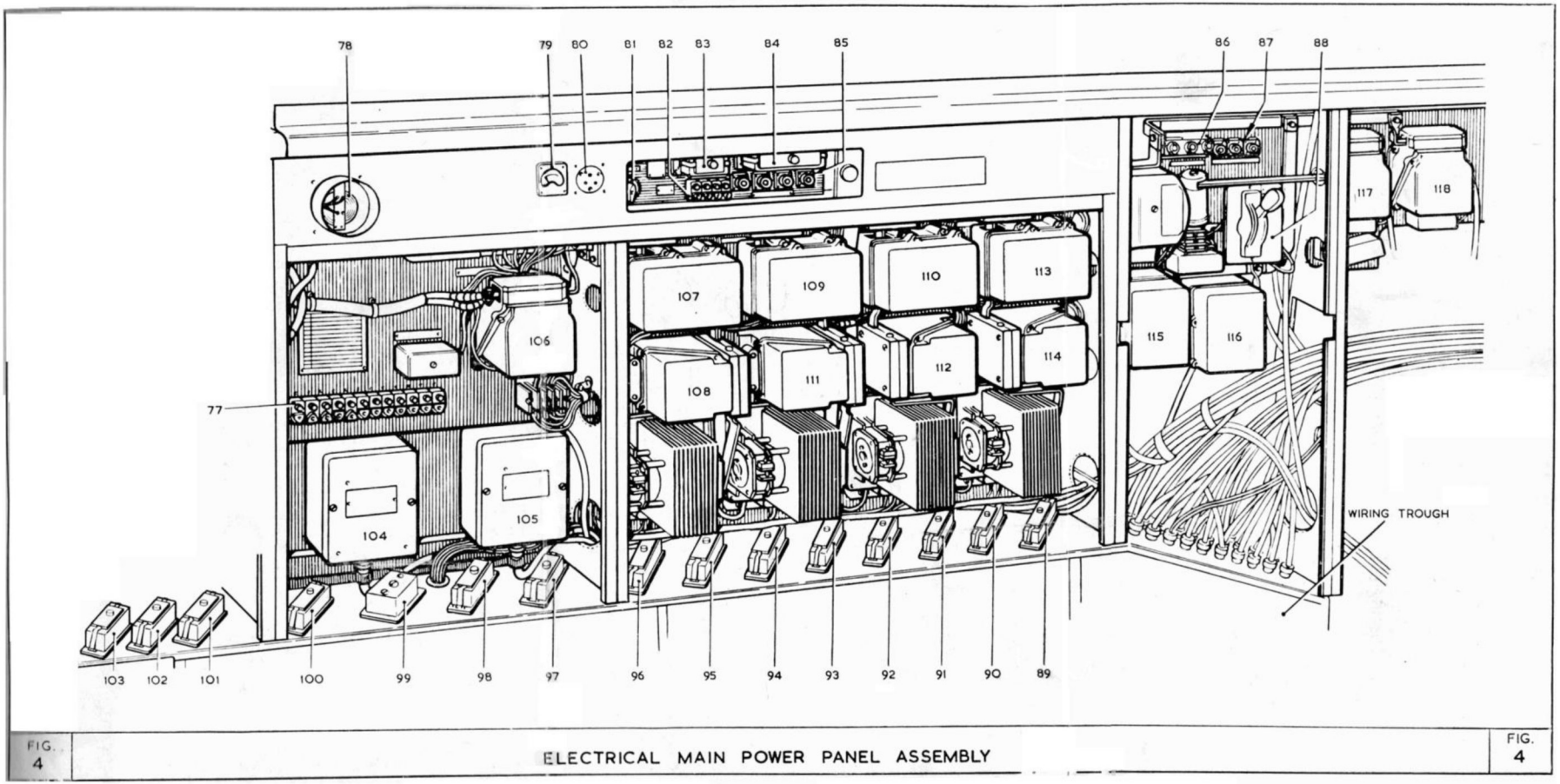


FIG. 4

ELECTRICAL MAIN POWER PANEL ASSEMBLY

FIG. 4

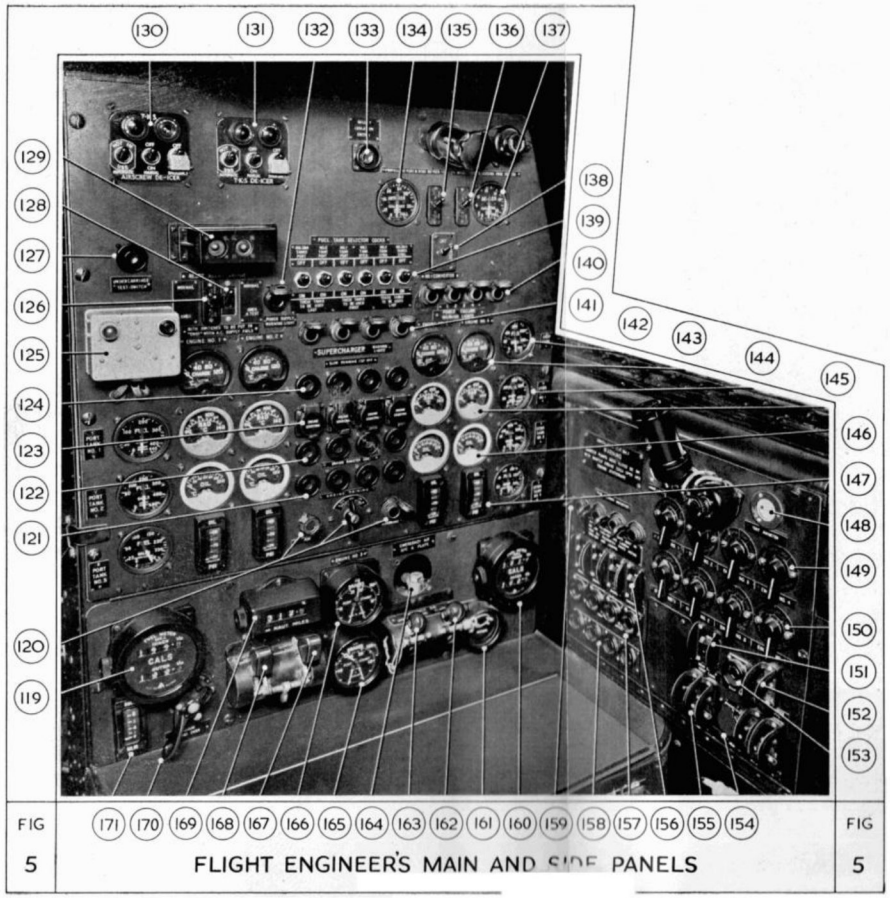


FIG 5 — FLIGHT ENGINEER'S MAIN AND SIDE PANELS — FIG 5

KEY TO *Fig.* 5

FLIGHT ENGINEER'S MAIN AND SIDE PANELS

119. Nos. 1 and 2 engines flowmeter.
120. Electric priming pump selector and indicator lights.
121. Engine priming pushbuttons (4).
122. Engine booster coil pushbuttons (4).
123. Engine starter pushbuttons (4).
124. Fuel cut-off pushbuttons (4).
125. Type 350 station box.
126. A.C. supply emergency switch.
127. Undercarriage warning light test switch.
128. A.C. supply emergency switch.
129. Reset relay switch.
130. Propeller de-icing control panel.
131. Aerofoil de-icing control panel.
132. A.C. supply power failure warning light.
133. Galley isolation switch.
134. Propeller de-icing tank contents gauge.
135. Propeller de-icing tank contents gauge switch.
136. Aerofoil de-icing tank contents gauge switch.
137. Aerofoil de-icing tank contents gauge.
138. No. 1 inverter switch.
139. Tank isolating cocks (6).
140. Generator power failure warning lights (4).
141. Supercharger warning lights (4).
142. Auxiliary fuel tank contents gauge.
143. Charge temperature gauges (4—two on each side of panel).
144. Wing tank contents gauges (6—three down each side of panel).
145. Coolant temperature gauges (4—two on each side of panel).
146. Oil temperature gauges (4—two on each side of panel).
147. Oil pressure gauges (4—two on each side of panel).
148. Ammeter test socket.
149. Radiator shutters control switches (4).
150. Charge temperature control switches (4).
151. Auxiliary tank transfer pump switch.
152. Cabin heaters main switch.
153. Auxiliary tank transfer pump test pushbutton.
154. Oil dilution pushbutton.
155. Oil dilution switches (4—two on each side of item 154).
156. Booster pump switches (4).
157. Booster pump test pushbuttons (4).
158. Methanol/water pumps test pushbuttons (4).
159. Fuel pressure warning lights (4).
160. No. 3 and No. 4 engines fuel flowmeter.
161. Oxygen flow indicator.
162. Flaps emergency control.
163. Undercarriage emergency control.
164. Emergency air gauge for undercarriage and flaps.
165. Air supply gauge (No. 2 engine compressor).
166. Air supply gauge (No. 3 engine compressor).
167. Bomb doors emergency CLOSE control.
168. Bomb doors emergency OPEN control.
169. Air mileage indicator.
170. Vacuum pump changeover cock.
171. Suction gauge.

NOTE.—(a) When Mod. 148 is embodied, item 125 Type 350 control box is superseded by Type 349 control box.

(b) When Mod. 171 is embodied, flag-type indicators for the engine master cocks and for the tank selector cocks are mounted on the flight engineer's main panel.