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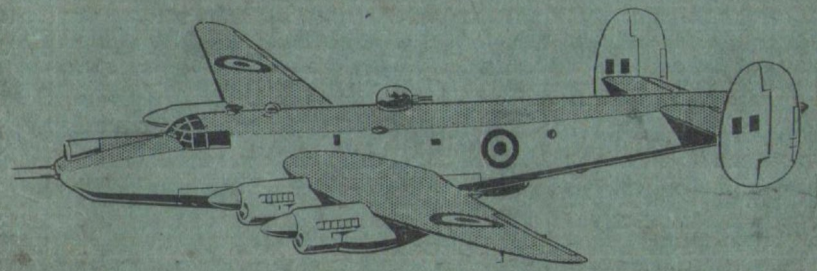
A.P.4267B—P.N.

PILOT'S NOTES

FOR

SHACKLETON

M.R. MK. 2



PREPARED BY DIRECTION OF THE MINISTER OF SUPPLY

J. R. C. Helmore

PROMULGATED BY ORDER OF THE AIR COUNCIL

J. H. Barnes.

RESTRICTED

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).

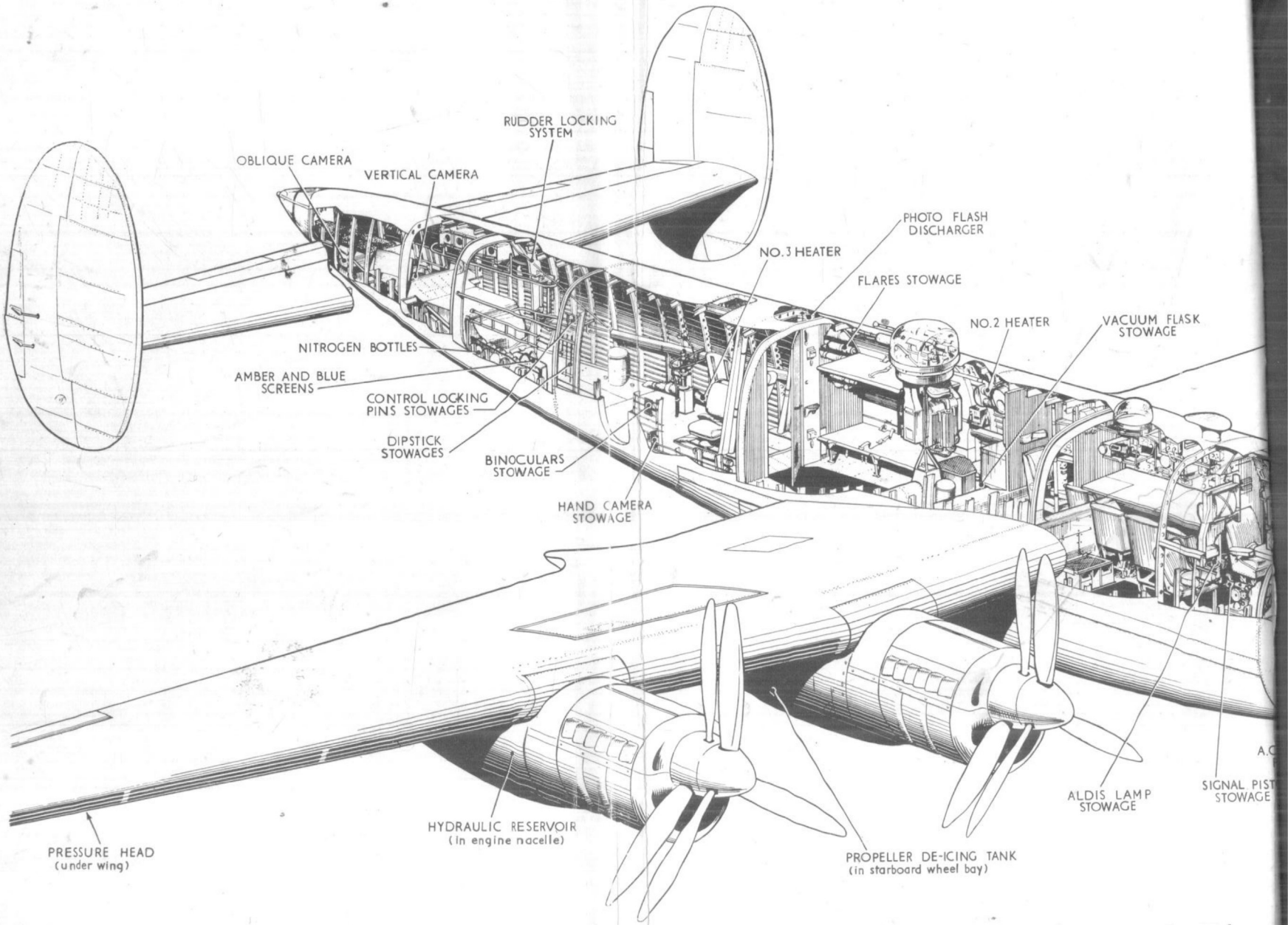
Additional copies may be obtained by the station publications officer by application on R.A.F. form 294A in duplicate to Command Headquarters for onward transmission to A.P.F.S. (see A.P. 113). The number of this publication must be quoted in full—A.P. 4267B—P.N.

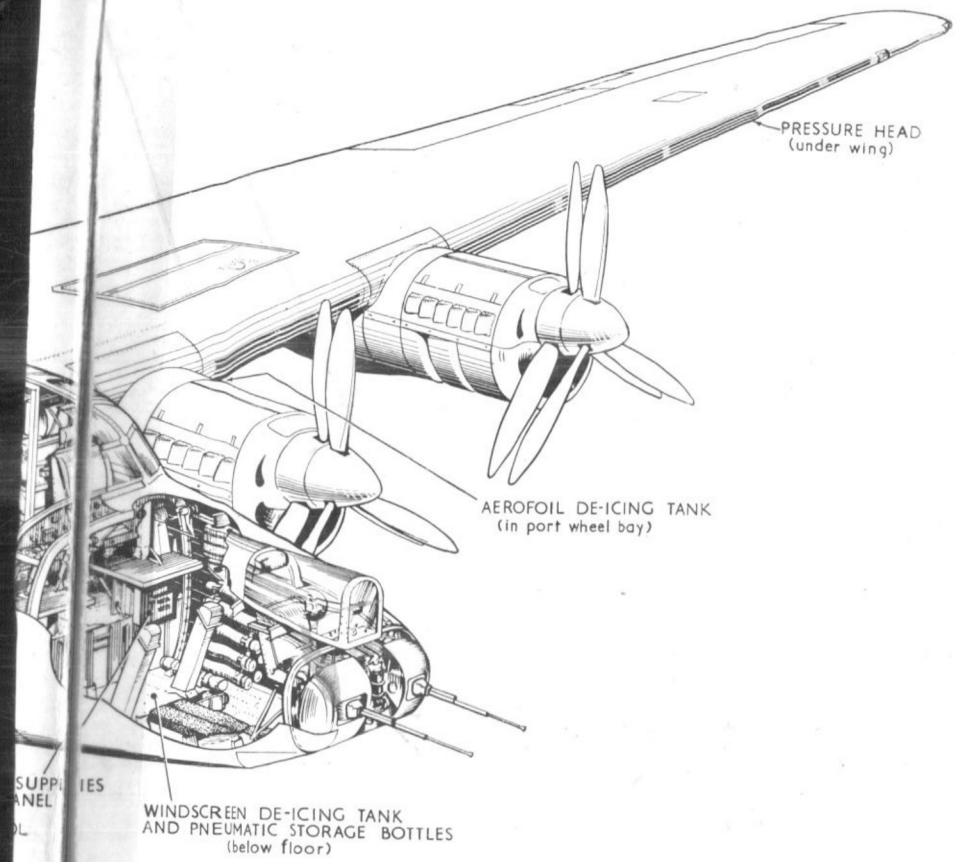
Comments and suggestions should be forwarded through the usual channels to the Air Ministry (T.F.2).

SHACKLETON M.R. MK. 2

LIST OF ASSOCIATED PUBLICATIONS

Auto pilot	1469D
Bombsight	1275D
Cameras	1355C
Compass Mk. 4B	1275B
Daniel heaters	4340
De icing equipment	1464D
Electrical equipment	1095A and C
Electro-hydraulic components	1803D
Fire-extinguisher systems	957C
Front guns equipment	2796N
Fuel cock actuators	4343D
Fuel pumps	2241
Griffon 57 engine	2234E
Griffon 57 power plant	4275A
Gun turret	2768E
HF/MF wireless equipment	2548A
Hydraulic equipment	1803D
Ignition equipment	1374E
Instruments	1275A and B
Inter-communication equipment	2876B
Photoflash discharger	1641H
Pneumatic equipment	4303B and C
Propeller	1538K
Pyrotechnics	1661E
Radio compass	2530D
Shackleton aircraft—general and technical information	4267B
Undercarriage equipment	1803E
Vacuum pump	4203C
V.H.F. equipment	2538HA
Wheels, tyres and brakes	2337


RUDDER LOCKING SYSTEM
OBLIQUE CAMERA
VERTICAL CAMERA
PHOTO FLASH DISCHARGER
NO. 3 HEATER
FLARES STOWAGE
NO. 2 HEATER
VACUUM FLASK STOWAGE
NITROGEN BOTTLES
AMBER AND BLUE SCREENS
CONTROL LOCKING PINS STOWAGES
DIPSTICK STOWAGES
BINOCULARS STOWAGE
HAND CAMERA STOWAGE
ALDIS LAMP STOWAGE
SIGNAL PIST STOWAGE
PRESSURE HEAD (under wing)
HYDRAULIC RESERVOIR (in engine nacelle)
PROPELLER DE-ICING TANK (in starboard wheel bay)


PRESSURE HEAD
(under wing)
AEROFOIL DE-ICING TANK
(in port wheel bay)
WINDSCREEN DE-ICING TANK
AND PNEUMATIC STORAGE BOTTLES
(below floor)

SHACKLETON M.R. 2

PILOT'S EXTERNAL CHECK LIST

N.B.—Start at the entrance door and work clockwise around the aircraft.

Item	Check
Tail wheels	Condition of doors, tyres for cuts and creep, extension of oleo
Starboard rudder and elevator	Condition and position of trimming and spring tabs
Camera doors	Condition
Tail cone	Inspect for cracks
Port rudder and elevator	Condition and position of trimming and spring tabs
Port fuselage	Security of first-aid kit Static vent plug removed Condition of scanner cupola
Port mainplane	Condition and position of flaps Condition of aileron, spring and trimming tabs Pressure head cover removed Condition of landing and taxying lamps All inspection panels secure
No. 1 engine	Cowlings secure Free from oil and coolant leaks
Port undercarriage	Condition of doors Tyre for cuts and creep Extension of oleos
No. 2 engine	Cowlings secure Free from oil and coolant leaks
Nose	Parachute exit secure Condition of bomb aiming panel Condition of front gunner's position

Item	Check
Bomb bay	Check emergency air pressures (1,800 lb./sq. in. each)
No. 3 engine	Cowlings secure Free from oil and coolant leaks
Starboard undercarriage	Conditions of doors Tyre for cuts and creep Extension of oleos Hydraulic hand pump secured
No. 4 engine	Cowlings secure Free from oil and coolant leaks
Starboard mainplane	All inspection panels secure Condition of landing and taxying lamps Pressure head cover removed Condition of aileron, spring and trimming tabs Condition and position of flaps
Starboard fuselage	Static vent plug removed Condition of scanner cupola

SHACKLETON M.R. MK. 2

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EMERGENCY HANDLING

PART V—ILLUSTRATIONS AND CHARTS

A.P. 4267B—P.N.
Pilot's Notes

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

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1. (i) The Shackleton M.R. Mk. 2 is a four-engine, mid-wing monoplane designed for reconnaissance and anti-submarine duties. It is powered by Griffon Mk. 57 or Mk. 57A engines equipped with two-speed single-stage superchargers and fuel injector units, driving six-bladed contra-rotating propellers. The Mk. 57A engine limitations differ from the Mk. 57 limitations (see para. 86)

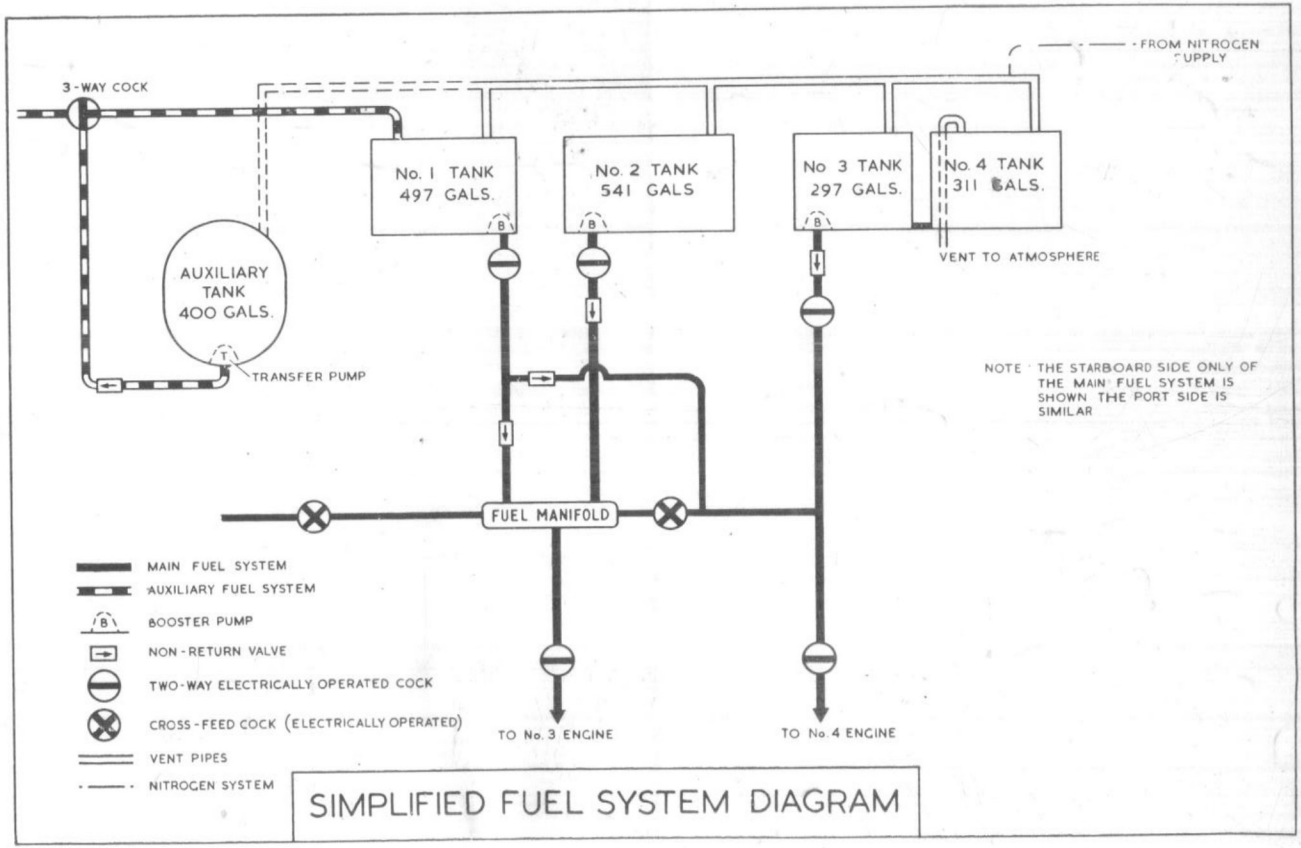
(ii) Armament consists of four 20 mm. guns, two in a nose gun mounting and two in a mid-upper turret. A retractable A.S.V. scanner is mounted in the rear centre section.

(iii) The aircraft normally carries a crew of ten including two pilots. Many of the controls for the various services are grouped behind the pilots' cockpit on two panels, the main and the side, at the flight engineer's station.

FUEL, OIL AND COOLANT SYSTEMS

2. **Fuel system**

(i) There are four tanks in each wing (numbered outboard 1, 2, 3 and 4) and an auxiliary tank equipped with a pump can be fitted in the bomb bay. Fuel is delivered under



SIMPLIFIED FUEL SYSTEM DIAGRAM

pressure from each tank (except the No. 4 tanks which feed direct into their associated No. 3 tanks) by a pump integral with the tank. In addition to a cross feed cock in the inter-connecting pipe between the port and starboard systems, two cross-feed cocks are provided to isolate Nos. 3 and 4 tanks (common delivery) from the No. 2 tank, under which arrangement, the former pair of tanks can be selected to feed the associated outboard engine, and the latter tank the associated inboard engine after the No. 1 tank (and the auxiliary tank, if fitted) are empty. The tank capacities are as follows:—

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

(ii) Fuel is pumped from each set of tanks to a manifold situated in the associated centre plane trailing edge section, 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 manifold. Each manifold supplies fuel to the inner and outer engines on one side through separate pipe lines.

(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 crash-proof covering and Nos. 2, 3 and 4 tanks are of self-sealing flexible construction. The auxiliary tank has no self-sealing covering.

3. **Fuel cocks and indicators**

(i) In each of the engine feed pipes there is an electrically-operated engine master cock, controlled by one of four switches (17) mounted on the top centre portion of the pilot's main instrument panel.

(ii) Tank isolating cocks for Nos. 1, 2 and 3 tanks are controlled by six switches (119) (122) (123) (126) (127) and (130) on the flight engineer's main panel.

(iii) Twenty-two "doll's eye" type indicators are mounted on the flight engineer's main panel, and are utilised as follows:—

(a) Four engine master cock indicators (94) located on the port side showing ON when the cocks are open.

(b) Six indicators (131) (132) and (133) (two for each cross-feed cock switch) marked ON and OFF respectively, controlled by the three electrically-operated cross-feed cocks.

(c) Twelve indicators (two for each selector cock switch) marked ON and OFF respectively, controlled by six tank selector cocks, located in two vertical rows, on the right-hand side of the panel.

Whilst a fuel cock is moving between the fully open and fully closed positions, no indication is shown by any associated indicator.

(iv) 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.

4. Fuel booster and transfer pumps

(i) Six booster pumps are fitted, one in each Nos. 1, 2 and 3 tanks. Each pump is controlled by a 3-way switch on the flight engineer's main panel. The positions are labelled ON, OFF and TEST. An ammeter test socket (114) also on the panel allows for testing the current consumption of each pump which should not be more than 7 amps. The socket is common to all six circuits and is brought into circuit when any one of the switches is placed in the TEST position. This test should be carried out with the engine master cocks OFF.

(ii) The transfer pump for transferring fuel from the auxiliary tank to the No. 1 tanks is controlled by a similar switch (118) also on the flight engineer's main panel, and the pump may be tested by use of the ammeter test socket.

5. **Fuel contents gauges and flowmeters**

Two "gallons gone" flowmeters (134) and (135) each serving two engines, are mounted on the flight engineer's main panel. No flowmeter by-passes are fitted. Electrically-operated fuel contents gauges for all the wing tanks (120) (121) (124) (125) (128) and (129) and for the auxiliary tank (117) are mounted on the flight engineer's main panel. The combined contents of tanks Nos. 3 and 4 are shown on one gauge (port and starboard respectively).

6. **Engine priming system**

The engines are primed by means of a rotary selector switch (140) on the flight engineer's side panel. Two electrically-driven pumps are situated one on the aft face of each inboard engine bulkhead and deliver fuel under pressure to four electrically-operated valves, one for each engine. The pump motors are controlled by the rotary selector switch and the appropriate valve solenoids are energised using the switch as a pushbutton at each selected position. Two indicating lights are fitted, one on each side of the rotary selector switch, one light for port and the other for starboard indication. Under normal operating conditions a light will indicate when its associated pump, after being started, has built up a pressure of 35 to 40 lb./sq. in. to close the fuel pressure switch in the priming pump line concerned. This will indicate that the priming valve solenoid can now be energised by pressing the switch.

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 rear 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 when boost pressures exceeding $+18\frac{1}{2}$ lb./sq. in. are obtained, the flow increasing with boost pressures up to a maximum of +25 lb./sq. in. To prevent the system being operated in low gear, the con-

trol switch (111) is ganged to the supercharger gear change switch (110) on the flight engineer's main panel. This ensures that the system is on only when the superchargers are in high gear. Facilities for testing the current consumption of each pump are provided by four double-pole switches (151) labelled WATER/METHANOL TEST SWITCHES and an ammeter socket (153) on the flight engineer's side panel. The switches are spring-loaded to OFF and the ammeter socket is common to all four test circuits.

8. **Nitrogen system**

Nitrogen is carried in seven bottles in a crate mounted in the fuselage. The bottles have a common pipe system terminating in a charging point and a delivery connection, both of which are fitted with screw valves. A pressure gauge is fitted on top of the crate at the forward end.

NOTE.—Until suitable nitrogen vent valves are available, the system is not usable.

9. **Oil system**

Each engine has an independent oil system with its own oil tank which holds 26 gallons of oil and has a 6 gallon air space. Each tank is equipped with an electrically-operated oil cock which, pending the issue of a modification, is left in the open position with its actuators disconnected. An oil cooler forms part of the semi-circular assembly at the lower front of the power plant, and oil temperature (99) and pressure (100) gauges are provided on the flight engineer's main panel. An oil dilution system is fitted and four spring-loaded switches (146) one for each engine, 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 shutters will trail open.

ENGINE CONTROLS

11. 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 pilot's seats respectively. Both pedestals have four throttle control levers (69) and (87), each set having a damping lever (68) and (88) located inboard. Moving the damping lever forward increases the friction to locking point.

12. Propeller controls

(i) Four r.p.m. control levers (71) and (85) are mounted below each set of throttle levers and are provided with damping levers (70) and (86) 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 (16) are mounted on the top centre of the pilots' panel and each button incorporates an engine fire warning light (see para. 94).

13. Superchargers

The engines are fitted with two-speed single-stage superchargers. The gearchange control is electrically operated by a switch (110) marked MS and FS on the flight engineer's main panel. Four "doll's eye" indicators (93) on the flight engineer's main panel indicate when the superchargers are in high gear.

14. Radiator shutters control

Four 4-position switches (98) on the flight engineer's main panel provide for automatic or manual control of the radiator shutters which form part of the 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" open and closed automatically according to the coolant temperature, and take up a position giving a coolant temperature between 100° and 125°C. When they are in the OPEN or CLOSE position the shutters fully open or close according to the setting, but can be stopped in any desired position by placing the switches to STOP. In the event of electrical or pneumatic failure, the shutters will trail in an intermediate position.

15. Air-intake 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. 17).

(iii) The air-intake system incorporates an arrangement of filter elements and a shutter allowing cold filtered air to be supplied to the engine when required by operating a switch (115) on the flight engineer's main 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. Charge temperature control is not effective when clean air is selected.

(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 automatically to the engine through the filtered air intakes. In this event charge temperature control is maintained.

16. 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 (115) marked NORMAL and CLEAN on the flight engineer's main panel. Each flap is spring loaded to the NORMAL position and will remain so if either the electrical or the pneumatic system fails.

17. 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 (96) below the charge temperature indicators on the flight engineer's main 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.

18. Engine starting and stopping controls

(i) The ignition switches are at the top of the first pilot's instrument panel and the engine-starting switches (141) are on the flight engineer's side panel.

(ii) Four 3-position switches (142) on the flight engineer's side panel perform the dual function of switching on the booster coils (up) or operating the fuel cut-offs.

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19. **Engine instruments**

The boost gauges and the tachometers for each engine are mounted in the centre of the pilots' instrument panel. The oil temperature (99), coolant temperature (97) and charge temperature (95) indicators, all of which are electrically operated, are on the flight engineer's main panel; also on the panel are the oil pressure gauges (100) which are pressure-operated through capillary tubing.

On aircraft embodying Mod. 362 a synchroscope is mounted above the tachometers on the pilots' instrument panel. To synchronise the engines, the r.p.m. of No. 1 engine is set to the desired speed and the others adjusted until the three pointers on the synchroscope remain stationary.

MAIN SERVICES

20. 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

21. 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
Scanner cupola
Undercarriage and tailwheel
Windscreen wipers

(ii) The undercarriage, flaps, bomb doors and scanner cupola 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.

22. Pneumatic system

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(i) There are two separate pneumatic systems supplied by compressors on No. 2 and No. 3 engines. The port compressor charges two bottles which are under the floor of the nose of the aircraft and the starboard compressor charges one bottle which is beside the bottles fed from the port compressor. If Mod. 392 is fitted, the starboard compressor charges two bottles, the second bottle being above the starboard gun beam. All bottles are charged to a maximum pressure of 1,000 lb./sq. in.

(ii) The following services are pneumatically operated:—

Wheel brakes
Camera jacks
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 port system with two air bottles supplies all the services including the brakes, except when the latter are used for parking. The starboard system operates the brakes only, including the parking brake. A pressure-maintaining valve in the port system ensures that only the brakes are supplied should the pressure fall below 250 lb./sq. in.

23. Vacuum system

Two vacuum pumps are fitted, one on each of the inboard engines, and a changeover cock (139) is mounted on the right-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 (136) fitted above the changeover cock indicates the suction in the pipeline to the instrument panel.

24. Electrical system

(i) *Description*

Four 6kW. generators, one on each engine, supply the whole electrical system and 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 inverters.

(ii) *Generator control*

(a) The main power panel assembly (see Fig. 6 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. Manual controls for each generator circuit are fitted to the flight engineer's main and side panels, and consist of field circuit-breakers (92) and two-way double-pole switches (150). The circuit breakers provide protection for the generator field-windings; the double-pole switches are used to switch off individual generators and can be used to re-set the main circuit breaker when overload conditions have caused it to open the generator main line.

(b) Four "doll's-eye" indicators (91) situated on the flight engineer's main panel will indicate, one for each generator circuit, failure of power due to any fault which causes the tripping of their associated circuit breakers.

(c) A voltmeter (113) fitted on the flight engineer's main panel indicates the controlled voltage at the bus-bars. Facilities for checking the voltage and current output of individual generators are provided by eight test sockets (157) and (159), suitably labelled, on the power panel.

(iii) *Batteries control*

(a) A master electrical switch (164) on the power panel has two positions, GROUND and FLIGHT. With the switch in the GROUND position the batteries are disconnected, leaving the electrical services connected direct to the generators and bringing in the external supply socket. With the switch in the FLIGHT position the batteries are connected to the main bus-bar and are automatically charged during flight.

(b) A relay (166) at the aft end of the power panel is controlled manually by the Ground/Flight switch, but in the event of a crash landing, the relay is de-energised automatically by the action of two crash switches in the fuselage nose. This ensures that in such circumstances the batteries will be isolated from the main bus-bar and only those circuits connected to the battery through the essential services main fuse will be operative.

(c) 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 twenty fusebanks below the power panel assembly, and the twenty-five circuit-breakers (nineteen type A, four type B and two type D) which are on the power panel assembly. The type A circuit breakers (154) 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 breakers for sonobuoy heating (155) and for the front guns (156) are at the forward end of the power panel, while those for the turret (168) and galley services (167) and the type D circuit breakers (163) and (165) for the radar motor generators 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 (175) to (194) 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 appropriate stations. The supply cables from the main bus-bar to these panels are protected by one of the type A circuit breakers (154) referred to above.

(v) *Control of supply to Mk.4B 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 Mk. 4B compass, two inverters No. 1 and No. 2 are fitted below the floor in the nose of the aircraft, 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 Mk. 4B compass and the scanner, but in the event of failure of No. 2 inverter, it can be switched off and No. 1 inverter can be transferred from the auto pilot services to the essential services of the Mk. 4B compass and the scanner.

(b) No. 1 inverter is controlled by an on/off switch (109) (labelled CONVERTER) 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 (108) on the flight engineer's main panel.

(c) A faulty A.C. supply from No. 2 inverter will cause a power failure "doll's eye" indicator (106) adjacent to the control switches on the flight engineer's main panel to indicate; in this event the two-way switch (105) on the flight engineer's main panel, labelled NORMAL—A.S.V. GYRO TEST AND EMERGENCY should be placed in the EMERGENCY position and the single-pole switch (107) beside it labelled NORMAL-EMERGENCY should be put to EMERGENCY. This action disconnects the auto pilot from, and connects the Mk. 4B 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

25. Flying controls

The dual flying controls comprise pendulum-type rudder pedals, fitted with toe-operated brakes, and two hand-wheel-type control columns. Each rudder pedal is adjustable for leg reach by manual operation of a knob (28) and (41) immediately above the pedal.

26. Flying controls locking gear

(i) The rudder locking gear is designed so that the rudders may be locked when taxying in a strong wind to prevent them being damaged. Steering is then effected by use of the engines and the toe-operated wheel brakes.

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(ii) The rudder locking lever (60) forms a bridge across the first pilot's engine control pedestal and is pulled back to lock the rudder. With the lever in the locked position the throttles can only be opened up sufficiently to provide taxying power. The lever is held in the locking position by a pawl which is released by a small lever under the handgrip, and the rudder locking lever should then return easily to the fully forward position. If any difficulty is experienced in engaging the rudder lock, it should not be forced, but the rudder pedals should be moved gently a few degrees either side of central until the locking pins engage.

(iii) The ailerons and elevators are locked by manually-inserted pins. The aileron locking pin is inserted at the centre of the aft face of the rear spar inside the fuselage and the elevator locking pin aft of the tailplane rear spar. Neither of these two pins can be inserted until the rudder lock is engaged, and the latter cannot be unlocked before the pins have been removed.

27. Trimming tab controls

The elevator (53), rudder (55) and aileron (56) trimming controls to port of the first pilot's seat, and duplicated

to starboard of the second pilot's seat (81), (82) and (84), all operate in the natural sense and each has an adjacent indicator showing the setting of the tab.

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28. Undercarriage control

The undercarriage (including the tailwheel) is raised and lowered by electro-hydraulic power and the control, which consists of two buttons (22) marked UP and DOWN, is on the left of the second pilot's instrument 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 lowered by an emergency compressed air system controlled by a lever (103) on the flight engineer's main panel. (See para 89.)

NOTE.—If the DOWN button is selected when the scanner is in the extended position, almost a minute may elapse before all the undercarriage unit lock down (see para. 55).

29. Undercarriage position indicator

An electrically-operated undercarriage indicator (29) is mounted on the second pilot's panel below the undercarriage control buttons, and indicates as follows:—

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

When the undercarriage is locked up, if the throttles are less than one-third open, warning is given by the tailwheel red light in the indicator coming on. This red light can be tested on the ground by means of a switch (152) on the flight engineer's side panel.

30. **Flaps control and indicator**

(i) The flaps are raised and lowered by electro-hydraulic power, and the control lever switch (34) beside the undercarriage selector 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. 89).

(ii) The flap position indicator (31), which is electrically operated, is below the flap selector.

31. **Wheel brakes**

(i) Two sets of brakes are fitted to each main wheel, one set being served by the compressor on No. 2 engine and the other set by the compressor on No. 3 engine. Both sets are entirely independent of each other but are operated simultaneously by pedals mounted above each rudder pedal.

(ii) The parking brake, which works from the No. 3 engine compressor system, is operated by a control lever (8) on the extreme left of the first pilot's panel.

(iii) The total pressure available to each set of brakes, is shown on the gauges (6) and (7) mounted below the brake parking lever.

32. **Automatic pilot**

A Mk. 9 Automatic Pilot is fitted; the switch box (51) is on the roof panel, the controller (44) is on the right-hand arm of the first pilot's seat and an auxiliary cut-out switch (61) and (77) is fitted on each control column.

GENERAL EQUIPMENT AND CONTROLS

33. **Internal lighting**

(i) Five red floodlamps and eight u/v lamps light the instrument panel, and nine red floodlamps provide

general cockpit lighting. The u/v lamps and four red floodlamps are mounted under the coaming above the instrument panel, one red lamp is attached to the centre panel, and the others are mounted three in the cockpit roof, two on each trimmer control box, and one on each control column. The magnetic compass is provided with a lamp attached to the body of the compass.

(ii) The u/v lamps and the red floodlamps for the instrument panel, control columns and roof panel are controlled by dimmer switches (63), (64), (74) and (75), two at each side of the instrument panel and one on the forward face of the roof panel. An ON/OFF switch (4) on the instrument panel controls the compass lamp, and two similar switches (54) and (83), one on each trimmer control box, serve their respective floodlamps.

(iii) Three emergency floodlamps are on the instrument panel. Two of them are controlled by an ON/OFF switch (5) on the left side of the panel and the third one by a similar switch (26) on the right side. These lamps are fed from two small batteries, fitted on the aft face of the starboard ammunition box in the fuselage nose, and are independent of the aircraft electrical supply.

34. External lighting

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(i) A switch on the starboard side of the instrument panel is the master switch for all external lights, and must be up 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 switches one on each side of the pilot's panel. (The port one is illustrated at (10).) The lamps come on automatically when they are extended, providing the master switch is on.

(iii) The wing and tail navigation lights are controlled by a three-position switch (25) marked OFF—HIGH—LOW at the starboard side of the pilot's panel.

(iv) Retractable taxy lamps are situated, one in each outer wing, and are controlled by switches one on each side

of the pilots' panel. (The port one is illustrated at (9)). The lamps come on automatically when they are extended, providing the master switch is on.

(v) The red, green and amber identification lights are fitted in the undersurface of the rear fuselage. When the master switch is on, the circuit is controlled by a 3-position switch marked STEADY—OFF—MORSE, which is spring-loaded from MORSE to OFF, and a colour selector switch labelled RED—GREEN—AMBER. Both switches are on the starboard side of the pilot's panel.

35. **Heating system**

(i) Three Daniel Dragonfly heater units provide heating for the various crew stations. No. 1 heater is at the starboard side of the fuselage nose and heaters No. 2 and No. 3 are on the port side of the rear centre section.

(ii) Three airscoops are fitted in the fuselage, each one near the position of one of the combustion heaters. The scoops serving No. 2 and No. 3 heaters project from the fuselage surface and combine an inlet for ventilating air, an inlet for heater combustion air and an outlet for heater combustion exhaust gases. The scoop for No. 1 heater has a small combustion inlet and a larger ventilating air inlet at its aft end. A separate exhaust outlet is fitted to the nose skin further aft. The ventilating air passes round the heater combustion chamber (and is thus heated if the heater is on), and along pipes to the various crew positions where it emerges either through adjustable louvres, diffusers or open pipe-ends. If a heater is not on, the ventilating air can be shut off by a manual lever beside each heater, moving in a quadrant marked OPEN—SHUT.

(iii) Fuel for the three combustion heaters is drawn from the starboard fuel manifold by an electric pump, and is controlled by a switch (116) labelled CABIN HEATERS FUEL SUPPLY on the flight engineer's main panel. The heater control circuits cannot be put into operation until the contacts of an "airspeed-operated" switch, fitted at

the starboard side of the fuselage nose, have been closed by the aircraft attaining a flying speed above 104 knots. This precludes the use of the heaters at airspeeds which supply insufficient airflow through the airscoops to ensure complete combustion of the fuel supplied to the heater. The fuel pump is also protected by one of the type A circuit breakers (154) which should normally be closed.

(iv) A control panel is fitted close by each heater and has the following controls mounted on it: —

a heater switch,

a heater control switch marked OFF, HALF HEAT and FULL HEAT,

an ignition switch, spring-loaded to ON,

a NO HEAT, IGNITION OFF indicator and

a fuel pressure switch, spring-loaded to ON.

(v) *Operation of system:—*

(a) Check that fuel pump circuit breaker is closed.

(b) Switch on cabin heaters fuel supply switch.

(c) Check that airspeed is above 104 knots.

Then for each heater:—

(d) Set the ventilating air lever to OPEN and the heater switch ON. The ignition warning indicator will now show white.

(e) Set heater control switch to FULL HEAT.

(f) Hold on the fuel pressure and the ignition switches simultaneously for 25 to 30 seconds and then release.

(g) When the ignition switch is released the warning indicator should not show white; if it does the ignition switch should be held over for one or two more periods of 15 seconds. If by then the indicator still shows white when the ignition switch is released the heater may be unserviceable. As a check the heater should be switched off for 5 minutes and the starting procedure then repeated.

(h) After a few minutes running, the heater can be switched to HALF HEAT if it is necessary to reduce output.

(vi) *Failure during operation*

Failure may be due to the following:—

(a) Overheating, in which case the NO HEAT, IGNITION OFF warning indicator will show immediately.

(b) Blowing out of the flame, or

(c) Fuel starvation.

In the two latter cases the warning indicator will show white when the heater has cooled off.

(d) A fuel leak will cause the heater solenoid to close and the warning indicator will show white when the heater has cooled off.

In all cases set the heater control switch to OFF and switch off the relevant heater switch.

(vii) *Restarting after failure*

After an interval of five minutes attempt to re-start the heater by carrying out operations (d) to (g) of sub-para. (v) above. If failure is due to a fuel leak the fuel pressure switch will fail to open the heater solenoid and the heater will not start. If failure is due to fuel starvation the attempt to light will also fail. Should the heater start up, the cause of failure will have been a blow-out or overheating. If the heater subsequently fails again whilst on FULL HEAT, carry out the re-start procedure once more and run the heater at HALF HEAT after starting. A further failure will indicate that the heater is definitely unserviceable and it should be shut down completely.

(viii) *Shutting down*

(a) Turn the heater control switch to OFF, and switch off the heater switch. The warning indicator will not come on if the heater control switch is at OFF.

(b) If all heaters are shut down, switch off the cabin heaters fuel supply switch.

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. It holds 23 gallons, and a contents gauge (148) controlled by a switch (149) is fitted on the flight engineer's side panel. The de-icing controller (174) is on the power panel at the flight engineer's station and a control panel (147) incorporating two "doll's eye" indicators, and two switches marked NORMAL and EMERGENCY, is mounted on the flight engineer's side panel.

(iii) When the NORMAL 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, one "doll's eye" indicator showing during each running period of the pump motor. The NORMAL switch should be put on five minutes before icing commences, if the onset of icing can be foreseen, to wet the surfaces and speed up initial ice removal.

(iv) Use of the EMERGENCY switch causes the pump motor to run continuously and both "doll's eye" indicators show.

(v) The endurance of the system is 5 hours on NORMAL 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 (173) on the power panel, and the controls (143) (144) and (145) on the flight engineer's side 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 NORMAL than with the aerofoil system. The endurance

of the system is 5 hours on NORMAL and approximately 1½ hours on EMERGENCY.

NOTE.—Pending modification action, only the rear propellers are fed with de-icing fluid.

38. **Windscreen de-icing system**

Sprays are provided for the three panels of the pilots' 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 a control cock (3), on the lower edge of the first pilot's panel. Three sprays are mounted, one forward of each pilot's windscreen and one forward of the centre vision panel. The system operates as soon as the cock is turned on.

39. **Windscreen wipers**

Two hydraulically-operated windscreen wipers are fitted, one in front of each pilot's windscreen and are controlled by two valves (1) and (27) 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 second pilot's instrument panel, the navigator's instrument panel, the V.G. recorder (if fitted) and the airspeed switch for the undercarriage up-button lock; the port head serves the first pilot's instrument panel and the air mileage unit (137). The heating elements of the two pressure heads are controlled each by its own switch (23) on the starboard side of the pilots' panel. A test socket (24) alongside the switches provides facilities for testing the current consumption of each heater element.

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 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 first pilot's delivery tube (57) at once, and at other crew stations as soon as the bayonet socket of each delivery tube is removed from its stowage. Flow indicators (80) are fitted to indicate to each crew member, except the first 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 "doll's eye" indicator showing 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 (167) at the aft end of the power panel assembly, this breaker being normally controlled by its own 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 spring-loaded switch (112) 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 operated.

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

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 on the starboard side of the fuselage just aft 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 at the inboard side of the seats. Each pilot has a quick-release Z type harness with a handle 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 (58) and (79) 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 (59) and (78) 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 (32) on the right-hand side of the pilots' panel has two positions OPEN and CLOSE. A "doll's eye" indicator (30) beside the pilots' control switch shows OPEN when the doors are fully open. In the event of electric or hydraulic failure the doors may be opened or closed by an emergency air system (see para. 91).

47. **Bomb release**

The bomb fuzing and release controls are duplicated at the air bomber's and navigator's stations, and a relay changeover switch marked NAVIGATOR and BOMB AIMER is on the navigator's bomb control panel. When the switch is at BOMB AIMER 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 BOMB AIMER position.

48. **Pyrotechnics**

(i) Three launching chutes Mk. 9 are installed, two in the fuselage nose and one at the port look-out station. Directly below each launching chute is an electrically-operated door which must be opened before any stores can be released. All three doors open simultaneously when any one of four switches (under the control of the pilot, navigator, air bomber and rear observer) is operated. Stores in the fuselage nose chutes can be released by the bomb aimer or the navigator, and stores in the rear fuselage chute can be released by the air bomber, the rear observer or the pilot. The pilot's door switch (37), release switch (38) and doors "doll's eye" indicator (36) are mounted below the first pilot's instrument flying panel. In addition to all the above remote controls, local controls are fitted to a panel at each launching chute.

(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 (62) and (76) one on each control column handwheel. The flares may be jettisoned by operating the switch (20) 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 switches (21) and (43) 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. Photoflash installation

(i) A maximum of six 4.5 inch 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.

(ii) A maximum of twenty-four 1.5 inch photoflashes can be carried, eighteen in a container on the aft face of the rear centre section bulkhead, and six loaded in the barrels of the cartridge discharger mounted in the fuselage roof at the flare station. Firing of the cartridges is electrically controlled by the bomb-firing switches, operating in conjunction with a bomb distributor at the flare station control panel, and a photoflash master switch on the air bomber's port panel.

50. Cameras

(i) The main cameras for low level and medium level day or night photography are installed in two retractable cupolas in the rear fuselage. The cupolas are extended and retracted by a pneumatic jack controlled by an electrically-operated valve. The camera required is selected by a 3-position switch on the air bomber's port panel, and an adjacent indicator shows when the cupola selected is in the extended position.

(ii) A stowage for a hand-held camera is provided at the starboard side of the fuselage just forward of the entrance door.

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 second 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 switch (42) on the pilot's 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 transmitter/receiver, a twin V.H.F. installation, and an intercom. system coupled to both installations. A separate special intercom. system is also provided, and a radio compass is fitted.

(ii) The MF/HF equipment is under the control of the wireless operator and the twin V.H.F. sets are controlled by the pilots through two control units (45) and (50) mounted centrally on the cockpit roof panel.

(iii) The radio compass is controlled either from the pilots' control unit (49) on the cockpit roof panel, or from the navigator's control unit on the navigator's fixed panel. Only one control unit can have control of the equipment at any one time, but one can take over from the other by the operation of the appropriate pushbutton switch.

(iv) Seventeen station boxes or control units are installed at the various crew positions on the aircraft, consisting of

six type 349 units and eleven type 350. Type 349 units (66) and (90) carry the MF/HF services, the No. 1 and No. 2 V.H.F. services, the radio compass service and the intercommunication and call circuits. They are equipped with press-to-transmit facilities and those at the first and second pilot's stations are also connected to remote press-to-transmit switches (2) and (72) situated one on each control column. At the radar operator's station a foot-operated call-switch is installed. Type 350 units 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 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.

55. **Retractable scanner cupola**

A scanner-control and call-box panel is located on the radar operator's lower shelf and incorporates a rotary switch, operation of which energises the solenoids of an electrically operated control unit in conjunction with a selector circuit, and provides four selected operating positions. Four "doll's eye" indicators denoting scanner position are mounted on the panel. A "doll's eye" indicator (33) is located in the lower centre portion of the pilots' main panel, and denotes when the scanner is fully retracted or otherwise. To prevent the scanner remaining in any selected lowered position when the aircraft is about to effect a landing, and to eliminate inadvertent lowering whilst the aircraft is parked on the ground, the operating system is so arranged that when undercarriage DOWN is selected, the scanner is automatically retracted irrespective of any selected position of the rotary control switch, which will afterwards require returning to the UP position

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to prevent the unexpected extension of the scanner when the undercarriage is next retracted. Should emergency air be used for lowering the undercarriage the scanner will retract, providing its associated hydraulic system is operative and undercarriage DOWN has first been selected. A red warning light on the radar operator's control will then denote that the selector switch is to be returned to the UP position. If the scanner does not retract in these circumstances, an attempt should be made to retract it by use of its normal selector switch. Provision is made on the controller for retraction by emergency air in the event of hydraulic failure.

PART II
HANDLING

56. Internal checks

Entrance door	Secured; handle pulled in
Ladder	Stowed
Aileron and elevator locking pins	Stowed
Fuel tank dipsticks	Stowed
Covers and safety equipment	Stowed
First-aid packs	Stowed
Axes	Stowed
Fire-extinguishers	Stowed
Dinghy release handles	In
Flare launching control	Switches off
All side fuselage hatches	Secured
Cabin heaters	OFF
Mid upper turret	Locked central
Scanner selector	UP
Auxiliary fuel tank cock	OFF
Ground/Flight switch	FLIGHT. Check voltage. Then to GROUND and external battery switched on
Oxygen (if carried)	Contents and flow
Forward parachute exit	Secure

With the crew in their normal positions, carry out the following cockpit checks:—

Intercommunication	On and check
Flying controls	Full and correct movement

Trimmer controls	Full and correct movement
R.P.M. controls	Maximum R.P.M.
Throttles	Closed
Cockpit lighting	As required (both pilots)
Brake pressure	Contents
Parking brakes	ON
Taxying lamps	Off (both pilots)
Landing lamps	OFF (both pilots)
Emergency lighting	OFF (both pilots)
Windscreen wiper	Off (both pilots)
Windscreen de-icer	Off
Compass light	Off
Flare doors switch	Off
IFF switches	Off
Radio altimeter	Off
Ignition switches	Off
Master fuel cocks	Off
Feathering buttons	Out
Flap indicator	Note reading
Undercarriage selector	DOWN button in UP button out
Undercarriage indicator	Three green lights Check lamp changeover
Bomb door selector	CLOSED
Pressure head heater switches	Off
External lights master switch	As required
Navigation and downward identification lights	As required
Bomb jettison toggle	In
Pilots' ditching exits	Secured
Mk. 4B compass	OFF
Radio compass	OFF
VHF	OFF
Automatic pilot	Switches off

57. **Checks at flight engineer's station**

Engine priming switch	OFF
Propeller de-icing switches	Off. Check tank contents
Aerofoil de-icing switches	Off. Check tank contents
Generator switches	OFF
Undercarriage test switch	TEST. Check tailwheel red indicator light comes on
Generator failure indicators	On
Generator field circuit breakers	In
Inverter emergency switches	Normal
No. 1 inverter switch	Off
Supercharger indicators	Off
Engine master cock indicators	Off
Supercharger selector	M.S.
Air intake switch	CLEAN
Cabin heater fuel supply switch	Off
Auxiliary fuel tank pump switch	Off
Charge temperature controls	COLD
Radiator shutter controls	OPEN
Fuel tank cocks	Off
Booster pumps	Off. Check with ammeter (if carried)
Cross-feed cocks	Off
Emergency air selectors	All OFF (Up)
Emergency air pressure gauge	1,800 lb./sq. in.
Fuel flowmeters	Set to zero
Air mileage unit	Set to zero
Vacuum change-over cock	NORMAL
Electric power panel	All circuit breakers in

FINAL CHECKS FOR TAKE-OFF

TRIM ...	ALL NEUTRAL
SUPERCHARGERS ...	LOW GEAR HIGH GEAR (with (W/M)
AIR INTAKE FILTER ...	CLEAN
CHARGE TEMP. CONTROLS ...	COLD
R.P.M. LEVERS ...	MAX. R.P.M.
FUEL ...	CONTENTS BOOSTER PUMPS ON TANK COCKS ON CROSSFEED COCKS OFF ENGINE MASTER COCKS ON
FLAPS ...	TAKE-OFF
RAD. SHUTTERS ...	OPEN
AUTO-PILOT ...	OFF

FINAL CHECKS FOR LANDING

FUEL ...	CONTENTS APPROP. BOOSTER PUMPS ON APPROP. TANK COCKS ON CROSSFEED COCKS OFF
SCANNER ...	UP
BRAKES ...	PARKING BRAKE OFF SUPPLY PRESSURE 1000 lb./sq. in. (both bottles)
UNDER-CARRIAGE ...	LOCKED DOWN THREE GREEN LIGHTS
SUPERCHARGERS ...	LOW GEAR
AIR INTAKE FILTER ...	CLEAN
R.P.M. LEVERS ...	2,400 R.P.M. 2,600 R.P.M. ON FINAL
FLAPS ...	TAKE-OFF DOWN ON FINAL
RAD. SHUTTERS ...	AUTO
CHARGE TEMP. CONTROLS ...	COLD

58. Management of the fuel system

(i) *Testing the booster pumps*

Before starting the engines, check that all engine master cocks are OFF, and then test each booster pump as follows:—

(a) Plug in the ammeter to the fuel pumps ammeter socket, and then select TEST on each booster pump switch in turn. The ammeter reading should be steady at not more than 7 amps.

(b) If no ammeter is carried, switch each booster pump ON in turn, and carry out an aural check.

(ii) *Use of the booster pumps*

To prime the fuel lines and injectors before starting the engines switch ON the fuel tank cocks and engine master cocks and then switch ON the No. 1 booster pumps on each side for not more than 15 seconds. At no other time when the engines are not running and the engine master cocks are ON should the booster pumps be ON. All the booster pumps should be ON for take off and initial climb, but when cruising only those pumps serving tanks from which it is desired to use fuel should be switched ON. When a tank is empty its booster pump must be switched off immediately. Before landing, the booster pumps in all tanks containing fuel should be switched on.

(iii) *Use of fuel tanks*

All fuel tank cocks should be switched ON before starting the engines, and should be left ON until a tank is empty, and the appropriate cock then switched OFF. To prevent undue upward flexing of the wings during flight, the weight of fuel should be kept outboard as much as possible by using fuel from the No. 1 tanks first. The following method of using the tanks is therefore recommended:—

Take-off with all tank cocks ON, all booster pumps ON, and all cross-feed cocks OFF. At cruising height, switch OFF the No. 2 and 3 booster pumps, and fly on the No. 1 tanks until they each contain 60 gallons. Then switch

on the No. 3 tank booster pumps and when the No. 1 tanks are empty switch on the No. 2 booster pumps. The No. 1 booster pumps should be switched off as soon as the No. 1 tanks are empty and the No. 1 tank selector cocks switched OFF.

(iv) *Use of the auxiliary fuel tank*

If a bomb bay auxiliary tank is carried, proceed as in (iii) above, and as soon as space is available, transfer the fuel from the auxiliary tank into the No. 1 tanks.

(v) *Use of the cross-feed line and cross-feed cocks*

All the cross-feed cocks should be kept closed except when it is necessary to feed fuel from the tanks in one wing to the engines in the other, or if for any reason it is necessary to feed an outboard engine from No. 2 tank or an inboard engine from Nos. 3 and 4 tanks. When cross-feeding, the cross-feed cocks should be switched ON as required, the booster pump(s) on the side from which the fuel is being used must be ON, and the booster pumps on the other side must be OFF.

59. Management of the air-intake filters

(i) Filtered air should normally be used for all ground running, taking off, flying in dusty conditions, and for landing. For cruising, NORMAL air should be used.

(ii) Filtered air should not be used when high supercharger gear is engaged, except during take-off using water/methanol.

(iii) Should the airfield height exceed approximately 800 ft., a small increase in take-off power may be obtained by selecting NORMAL air.

(iv) Filtered air should be selected in certain circumstances should the automatic charge temperature control fail. (See para. 61).

60. Management of the charge temperature controls

(i) The following maximum charge temperatures 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

*Existing charge temperature gauges only read up to 120°C.

(ii) 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.

61. Failure of the automatic charge temperature control

(i) Should excessively high charge temperatures be experienced it may be due to failure of the temperature control unit, causing the hot air-intake 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.

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

(iii) If when flying in high gear the charge temperatures become excessively high, a substantial reduction can always be obtained by changing to low gear.

(iv) If at any time the charge temperature falls below 40°C. and cannot be raised by operating the charge temperature control or radiator shutters 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.

(v) Normally with the charge temperature control set to AUTO, no action is required in the event of icing conditions. If, however, a progressive falling off in boost pressure and rough running 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.

62. **Checks before starting**

Ignition switches	OFF
Fuel cocks	Tank cocks ON Cross-feed cocks OFF Engine master cock switches ON
Booster pumps	Off
Superchargers	M.S.
Throttles	1½″ open
Propellers	Max. r.p.m.
Radiator shutters	OPEN
Charge temperature controls	COLD
Air-intake switch	CLEAN
Ground/Flight switch	GROUND

63. **Starting the engines**

NOTE.—Start Nos. 1, 2, and 3 engines first, and check the operation of the hydraulic pump on No. 3

engine by operating the flaps before starting No. 4 engine.

(i) Have a fully charged ground starter battery plugged in.

(ii) Prime the injectors.

(iii) Switch on the engine priming pump by selecting the appropriate engine, and noting that the light comes on. Switch on the ignition. Press the engine starter switch and when the engine starts turning, press the booster coil switch, and press the priming switch for a period which will vary according to atmospheric conditions. When the engine fires, release the starter switch, but keep the booster coil switch pressed, and continue to give short bursts of priming until the engine is running smoothly at 1,200 r.p.m.

(iv) The engineer should check the oil pressure as soon as an engine is started.

(v) When all engines are running smoothly the engineer should switch off the priming pump, and set the Ground/Flight switch to FLIGHT before the external battery is switched off and disconnected.

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

(vii) Switch ON the generators, and check that they are charging.

64. **Checks after starting**

Ground/Flight switch	FLIGHT
Mk. 4B compass	Switch to PORT or STARBOARD Synchronise and compare with P.12 compass
Pneumatic supply	Increasing, if there is less than 1,000 lb. in either bottle
Flaps	UP
Bomb doors	CLOSED
Charge temperature controls	COLD

Vacuum pumps	Vacuum gauge reading on both positions of change-over cock
Fuel flowmeters	Operation

65. **Testing the engines and services**

(i) Warm up to 40°C. coolant temperature and 15°C. oil temperature, then for each engine: —

(ii) Test each magneto as a precautionary check before increasing power further.

(iii) Open up to the static boost reading and engage high supercharger gear. Note the flicker on the boost gauge and that the r.p.m. drop by approximately 50. Return the supercharger to low gear, and check that the r.p.m. are restored.

(iv) At the same boost, exercise and check the operation of the constant speed unit by moving the r.p.m. control lever slowly until the r.p.m. are reduced to 1,500, and then returning to fully forward at least twice. If the r.p.m. are reduced appreciably below this figure on the ground, there is a tendency for the engine to stop.

(v) At the same boost, test each magneto in turn. If the single ignition drop exceeds 100 r.p.m. but is not accompanied by marked vibration a full power check should be carried out. If there is marked vibration and rough running the engine should be stopped and the cause investigated. The full power check should also be carried out after repair, inspection other than daily, or at the discretion of the pilot. Except in these circumstances, if the checks above are satisfactory, no useful purpose will be served by a full power check.

(vi) For a full power check, open the throttle fully and check 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 static boost or at full power, throttle back steadily to the fully closed position and check the minimum idling r.p.m. at 600-700. Check also that the generator cuts out before idling

r.p.m. are reached. Open up to 1,200 r.p.m. and check that the generator cuts in again.

66. Checks before taxying

Pneumatic pressure	1,000 lb./sq. in. in each bottle or increasing
Pressure head heaters	As required
Whilst taxying	Test brakes as soon as possible
	Serviceability of instruments

67. Taxying

The aircraft has a good field of vision, with the exception of the starboard bow, where the view is obstructed by the front gunner's position, and it is essential that a good look-out should be maintained in this direction by the second pilot. In calm conditions the aircraft can be directionally controlled to some extent by the rudders alone, but in wind strengths in excess of 10 knots it is recommended that the aircraft is taxied with the rudder lock engaged, and brakes and outboard engines used to initiate turns. Ensure that the radiator shutters are in the OPEN position to keep the oil temperatures as low as possible before take-off.

68. Checks before take-off

Trim	All neutral
Throttle friction lever	Adjusted
Superchargers	Low gear
	High gear (using water/methanol)
Air-intake switch	CLEAN
Charge temperature controls	COLD
R.p.m. control levers.	Maximum r.p.m. Friction lever adjusted

Temperatures and pressures	Normal
Fuel	Check contents Booster pumps—ON Tank cocks—ON All cross-feed cocks—OFF Pilots' master cocks—ON
Flaps	TAKE-OFF
Bomb doors	CLOSED
Radiator shutters	OPEN
Hatches	Closed
Harnesses	Adjusted and locked
Auto-pilot	All switches OFF
Controls	Unlocked and full range of movement

69. **Take-off**

(i) *Without water/methanol* (See Fig. 8 Part V)

(a) Make sure that the tailwheel is straight, and then open the throttles smoothly and quickly to take-off power.

(b) There is no tendency to swing and the aircraft can be kept straight in a cross-wind by use of the rudders, which are very effective as soon as power is applied.

(c) When the tailwheel leaves the ground, a steady backward pressure should be maintained on the control column until the aircraft becomes airborne at 90 to 100 knots, dependent upon the weight.

(d) When comfortably airborne, brake the wheels and retract the undercarriage.

(e) The safety speed at +18 lb./sq. in. boost is 105 knots.

(f) When the safety speed has been attained, reduce power to maximum intermediate. The boost should be reduced before the r.p.m.

(g) 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.

(h) Set the air-intake switch to NORMAL when clear of the dust layer, and set the radiator shutters to AUTO.

(ii) *Using water/methanol* (See Fig. 9 Part V)

(a) Proceed as in (a) to (d) in sub-para. (i) above. It is important that when opening the throttles there should be no pause between boost pressures of +12 lb./sq.in. and +18½ lb./sq.in. so that high power using high supercharger gear without water/methanol is used for the shortest possible time.

(b) The safety speed at +25 lb./sq. in. boost is 125 knots.

(c) When the safety speed has been attained, power should be reduced as follows:—

Throttle back to +20 lb./sq. in.
Select low supercharger gear.
Adjust the throttles to give +18 lb./sq. in. boost.

(d) At a safe height, raise the flaps and reduce power to the maximum intermediate setting.

70. Climbing

(i) The recommended climbing speed, which is governed by oil cooling considerations, is 135 knots. The aircraft maintains its trimmed speed well.

(ii) Climb in low gear at maximum intermediate power with the charge temperature controls set to COLD and the radiator shutters to AUTO.

(iii) Change to high gear when the boost has fallen to +9 lb./sq. in. and continue the climb at maximum intermediate power.

NOTE.—If CLEAN air has been retained, NORMAL air should be selected, and the climb continued until the boost falls to +9 lb./sq. in. again, before changing to high gear.

(iv) High gear should not be used on the climb below 5,000 ft. or in CLEAN air.

(v) If the maximum rate of climb is not required, a reduced power climb may be carried out at +9 lb./sq. in. boost

and 2,400 r.p.m. with the charge temperature controls set to AUTO. Climb at 135 knots as in the previous case.

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

71. General flying

(i) The aircraft is pleasant to fly and control is good at all weights and airspeeds.

(ii) *Controls*

The controls are well harmonised and the elevator is relatively light and effective under all conditions, but a slight "hunt" is noticeable whilst cruising, becoming more marked as airspeed is increased. The rudders are very effective.

(iii) *Changes of trim*

Flaps UP from TAKE-OFF	...	Nose down
Flaps down to TAKE-OFF	...	Nose up

(iv) *Trimming tabs*

Response to the trimming tabs on all controls is good, but it will be noticed that when the rudder trimmers are being adjusted the indicator window is obscured by the hand.

72. 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 to 90 knots depending on the weight.

73. Flying in turbulent conditions

The best speed for flying in conditions of severe turbulence is 180 knots but a speed of 160 knots provides an adequate margin of safety in all but the worst conditions.

74. Range and endurance

(i) *Range*

(a) The recommended speed for maximum range varies with weight between 140 and 155 knots, depending on the weight.

(b) Continuous operation of the engines at r.p.m. between 2,200 and 2,400 and between 1,350 and 1,550 is not permissible.

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

(d) 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 2,200 and 1,550 or between 1,350 and 1,250. If with 1,250 r.p.m. the desired airspeed is exceeded, the boost should be reduced as required. If speeds are required which entail the use of power settings in excess of +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./sq. in. to +9 lb./sq. in. and then, if necessary, setting the r.p.m. to 2,400.

(e) 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 (d) above. High gear should not be used below 5,000 ft. or when clean air is selected.

(f) 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 $\frac{3}{4}$″ to 1″.

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

(h) The reduction in range due to flying with the scanner in either of the "search" positions is approximately 3%.

(i) If it is necessary to cruise on 3 engines, the loss in range at the optimum range speed is approximately 20% at weights above 80,000 lb., reducing to less than 5% at 61,000 lb.

(ii) *Endurance*

(a) The speed for maximum endurance varies with the weight between 120 and 130 knots.

(b) Fly as low as possible commensurate with safety and obtain the recommended speed by setting 1,250 r.p.m. and adjusting the boost as required up to +7 lb./sq. in. If this power is insufficient to maintain the desired airspeed set the throttles at the gate and adjust the r.p.m. as required between 1,250 and 1,350 or between 1,550 and 2,200.

75. **Flight planning charts**

Flight planning charts for weights up to 86,000 lb. and for heights of 1,000 ft., 5,000 ft., 10,000 ft. and 15,000 ft. are shown in Part V, Figure 7.

76. **Pressure error corrections**

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76. **Pressure error corrections**

The pressure error corrections are negligible throughout the cruising speed range with flaps, undercarriage and radome up.

77. **Stalling**

(i) (a) *Without Mod. 420.* With all configurations and power settings there is no warning of the approach to the stall, except a very slight tremor of the control column at approximately five knots before the stall, and which will only be felt in calm conditions. A noticeable lightening of the pull force required on the control column also takes place about five knots before the stall. At the stall aileron snatching occurs, and may be accompanied by marked wing dropping.

Normal recovery action is effective, but with wheels and flaps down a considerable amount of height may be required for recovery.

(b) *With Mod. 420* (which fits spoilers on the mainplane leading edge inboard of each inner engine). The stalling speeds are unchanged but at the stall the wing drop is less marked. In the "power on" case with bomb doors open there is little or no warning of the stall and with bomb doors closed warning of the approaching stall is given by elevator buffeting. In the "power off" case with bomb doors open there is no warning of the stall and with bomb doors closed there is only slight pre-stall buffeting.

as follows:

	72,000 lb.	82,000 lb.
Power off		
Undercarriage and flaps up ...	95	100
Undercarriage and flaps down ...	85	
Power on (*normal final approach power*)		
Undercarriage and flaps up ...	90	
Undercarriage and flaps down ...	80	

NOTE.—Owing to wing dropping at the stall the aircraft must not be stalled intentionally at weights above 82,000 lb. Above this weight, gentle manoeuvres only are permitted. The stalling speeds at 86,000 lb. are approximately five knots above those at 82,000 lb.

78. Diving

The aircraft should be trimmed gently into the dive. The controls remain effective and do not become excessively heavy.

79. Checks before landing

(i) *Before entering the circuit*

Trailing aerial	In
Auto-pilot	All switches OFF

Fuel	Check contents Appropriate booster pumps—ON Tank cocks (unless empty)—ON All cross-feed cocks—OFF Pilots' master cocks—ON
Cabin heaters	All OFF
Scanner cupola	UP

(ii) *Down wind*

Brakes	Parking brake—OFF Pneumatic supply—1,000 lb. in each bottle
Undercarriage	DOWN and locked. Check three green lights
Supercharger	Low gear
Air-intakes switch	CLEAN
R.p.m. control levers	2,400 2,600 on final
Flaps	TAKE-OFF DOWN on final
Radiator shutters	AUTO
Charge temperature controls	COLD

80. **Approach and landing**

(i) The turn into wind should be made at approximately 120 knots, airspeed and power then being reduced progressively and flaps selected as required so that the airfield boundary is crossed at 100 knots at the maximum landing weight.

(ii) 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 throttles are then closed and the control column moved backwards a three-point landing will be made. Care should be taken not to hold the control column fully back, as it is easy to touchdown tailwheel first.

81. Instrument approach

The following speeds, flap settings, and approximate power settings, are recommended for use during instrument approaches with the undercarriage lowered:—

	Boost lb./sq. in.	R.p.m.	Flaps	Airspeed knots
Pattern ...	+4	2,400	TAKE-OFF	135
Final	+2	2,600	TAKE-OFF	120
Glide path ...	0	2,600	Full	110

82. Going round again

(i) The aircraft will climb away satisfactorily at the maximum landing weight with wheels and flaps down, using intermediate power.

(ii) When the decision is made to go round again, increase power to maximum intermediate, and select flaps to TAKE-OFF and undercarriage UP in quick succession. Adjust the elevator trimmer and climb away at 125 knots. At a safe height raise the flaps.

83. **Checks after landing**

Flaps	UP
R.p.m. control levers	Max. r.p.m.
Radiator shutters	OPEN
Charge temperature controls	COLD
Booster pumps	Off
Pressure-head heaters	Off or as required
Brake pressure	Sufficient for taxying

84. **Stopping the engines**

(i) Before stopping the engines, if the serviceability of an engine is in doubt, such items of the run-up given in para. 65 as may be necessary, should be carried out.

(ii) 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.

(iii) Stop the engines by pressing the fuel cut-off switches.

NOTE.—Stop No. 3 engine first, and check the hydraulic pump on No. 4 engine by operating the flaps.

85. **Checks after stopping the engines**

Pilot

Ignition switches	Off
Master fuel cocks	OFF
V.H.F.	OFF
Mk. 4B compass	OFF
Rudders	Locked
Chocks	In position
Brakes	OFF

Engineer

Fuel	Tank cocks—**OFF**
Generators	**OFF**
Inverter re-set relay	Press
Ground/Flight switch	**GROUND**
Elevators and ailerons	Insert locking pins

PART III
LIMITATIONS

86. Engine data

(i) *Griffon 57*

The principal maximum engine limitations are as follows:—

	Supercharger gear	R.p.m.	Boost lb./sq. in.	Temp. °C. Coolant	Oil
Take-off	Low	2,750	+18	135	105
5 mins. limit	*High	2,750	+25	135	105
Intermediate *1 hour limit*	Low High	2,600	+12	125	90
Continuous weak mixture	Low High	2,400	+ 9	105	90
Operational necessity *5 mins. limit*	Low High	2,750	+18	135	105

*With water/methanol injection.

(ii) *Griffon 57A*

The principal maximum engine limitations are as follows:—

	Supercharger gear	R.p.m.	Boost lb./sq. in.	Temp. °C. Coolant	Oil
Take-off	Low	2,750	+18	135	105
5 mins. limit	*High	2,750	+25	135	105
Intermediate *1 hour limit*	Low High	2,600	+14	125	90
Continuous weak mixture	Low High	2,400	+ 9	115	90
Operational necessity *5 mins. limit*	Low High	2,750	+18	135	105

*With water/methanol injection.

(iii) *Griffon 57 and 57A*

Oil pressure

Normal minimum in flight ... ... 45 lb./sq. in.

Minimum temperatures for take-off

Oil ... ... +15°C.

Coolant ... ... +40°C.

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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 t keep below the above air-intake temperature limitations, th charge temperatures must be maintained below the figure quoted in the table in para. 60 (i).

(ii) Continuous operation of the engines at r.p.m. betwee 1,350 and 1,550 and between 2,200 and 2,400 is not per missible due to propeller limitations.

87. Flying limitations

(i) The aircraft is designed for manoeuvres appropriate to long-range reconnaissance aircraft. Gentle manoeuvre only are permitted at weights above 82,000 lb. and i order to maintain adequate wing strength factors the fue in the inboard tanks should be used first. The aircraf is cleared for operation in the tropics, but aircraft per manently based in tropical areas must be fitted wit Griffon 57A engines.

(ii) *Maximum speeds*

Diving (at weights above 82,000 lb.) ...	260 kts
Diving (at weights below 82,000 lb.) ...	300 kts
With bomb doors open	300 kts
With undercarriage down	225 kts
With flaps down	155 kts

(iii) *Maximum permissible all-up weights*

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

(iv) Dropping of T1946 sonobuoys from the bomb bay wit the scanner in all positions is permitted at speeds up t 250 knots, at angles of dive up to 15°, and at heights u to 2,500 feet. Jettisoning up to any height is permissibl in an emergency.

(v) One of the pilot's side windows must be open durin firing of the nose guns and for a minute after firing ceases

PART IV
EMERGENCIES

EMERGENCY EQUIPMENT AND CONTROLS

88. Emergency air systems

(i) Air is stored at 1,800 lb. per sq. in. pressure in five bottles for the emergency operation of the undercarriage, flaps, bomb doors and A.S.V. scanner. Four of the bottles are mounted on a rack under the front spar step, the fifth being mounted above the floor on the starboard side of the fuselage.

(ii) One pair of bottles provides air for operating the bomb doors, the other pair is for the undercarriage and flap systems, and the single bottle in the fuselage is for the scanner system. The bottle serving the undercarriage also serves the flaps but the bottle serving the flaps does not serve the undercarriage.

(iii) Three pressure gauges and charging points are in the bomb bay and a further pressure gauge (102) at the bottom of the flight engineer's main panel indicates the pressure in the bottle which serves the undercarriage.

89. Undercarriage and flaps emergency operations

(i) The compressed air system for the emergency operation of the undercarriage and flaps is controlled by two levers (103) and (104) at the bottom centre of the flight engineer's main panel. 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 (103) for the emergency control of the undercarriage is operated, the three wheel units are lowered irrespective of the position of the normal hydraulic control buttons, nevertheless the DOWN button 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 undercarriage 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 more quickly than when the normal method is used.

(b) In the event of either electric or hydraulic failure the flaps may be lowered by means of the compressed air system. The normal flaps control lever must be set to DOWN before operating the emergency lever (104) which is then held down until the desired flap position has been obtained.

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90. Retractable scanner emergency operation

Emergency operation of the scanner is possible by two methods:

(i) In the event of electrical failure only, the up and down valves in the control valve unit can be opened manually by pressing and holding in the respective pushbutton on the valve body, until the desired position of the scanner is obtained. The "doll's eye" indicators denoting scanner position may or may not function, depending on the extent of the electrical failure.

(ii) In the event of either electrical or hydraulic failure, the scanner may be fully raised by the compressed air system, controlled by depressing a lever on the port side of the radar operator's scanner control panel.

The scanner cannot be lowered by this system, and before any attempt is made to raise it by this system the undercarriage should be fully lowered, the undercarriage DOWN button pushed in and the scanner selector switch set to UP.

91. **Bomb door emergency operation**

The compressed air system provided for emergency opening and closing of the bomb doors is controlled by two levers (101) at the bottom of the flight engineer's main panel on the port side. The left-hand lever is labelled OPEN and the right-hand one 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.

92. **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 BOMB AIMER position. Above this handle are switches (19) and (20) for jettisoning the photoflashes and flares carried in the bomb bay.

93. **Auxiliary tank jettisoning**

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

94. **Engine fire-extinguishers**

Each engine is provided with a fire extinguisher system, and warning lights are mounted in 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 (14) on the pilot's panel as well, when the propeller has stopped turning. If the warning light is not on, pressing the feathering push-button will not operate the extinguisher. The fire-extinguishers are also operated automatically by crash switches in the nose of the aircraft.

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

A fire-extinguisher system for the fuel tanks in the main-planes and for the water/methanol tanks in the outboard engine nacelles is automatically operated in the event of fire. If the automatic system fails to function, the extinguishers can be electrically operated from two push-buttons on the pilots' panel, the left hand button (15) for the port tanks, and the right-hand button (18) for the starboard tanks. The system is also operated by the crash switches in the nose of the aircraft.

96. **Crew warning horns**

A switch (39) 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.

97. **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 air-craft. 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.

98. **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 located between the door hinges. The parachute hatch in the nose is covered by two doors to which are fitted the air bomber's leg cushions. The hatch will jettison satisfactorily at all speeds but at very low speeds it may have to be pushed out by hand.

99. **Escape hatches**

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In addition to the main entrance door and the nose parachute exit there are five escape hatches, two in the canopy above the pilot's position, one in each side of the fuselage between the spars, and one in the roof just forward of the entrance door. Each hatch is released by operating a turn handle near the hatch. The handle is protected against inadvertent operation by a locking device which must be released by use of an adjacent pushbutton before the handle can be turned to open the exit. Mod. 344 introduces handles with integral grip levers to free them for operation.

100. **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.

101. **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) Ten stowages are provided for K-type single-seat dinghies.

EMERGENCY HANDLING

102. **Use of fuel system in emergency**

(i) In the event of an engine failure No. 2 tank may be used to feed an outboard engine, or Nos. 3 and 4 tanks may be used to feed an inboard engine by opening the wing cross-feed cock. The fuel from one wing may be used to feed the engines in the opposite wing by opening the centre (inter-wing) cross-feed cock, and the appropriate wing cross-feed cock.

(ii) If an excessive fuel drop is shown on a contents gauge it may indicate either a damaged tank or a damaged pipeline. The aim must be to decide which it is, and should it be a damaged pipeline, whether the damage is on the tank side or the engine side of an engine master cock.

(iii) If an excessive fuel drop is shown on the No. 1 gauge when flying on No. 1 tanks, change over to Nos. 2 and 3 and shut off the No. 1 tank and pump. If this tank continues to show a drop of fuel this indicates the tank is leaking. The tank cock should be opened, the booster pump switched on, all cross-feed cocks opened, and then all the other tank pumps switched off so that the damaged tank will feed all four engines until almost empty. If, in the first place, the tank level remains steady when the tank cock is closed, an excessive drop may begin to show in either No. 2 or Nos. 3 and 4 tanks (unless the leak is between No. 1 tank and the fuel manifold). If the loss

is from No. 2 tank, stop the pump and close the inboard engine master cock, or if from Nos. 3 or 4 tanks stop the corresponding pump and close the outboard engine master cock. If the fuel level then remains constant, the leak is on the engine side of the master cock and the affected engine should not be re-started and its master cock must be kept closed.

(iv) If a drop is shown on either No. 2 or Nos. 3 and 4 gauges when flying on No. 1 tank, it indicates a leaking tank and this should immediately be used to feed all four engines until almost empty by opening the tank selector cock, switching on its booster pump, opening all the cross-feed cocks and switching off the other booster pumps.

(v) If an excessive drop is shown on either No. 2 or Nos. 3 and 4 gauges when flying on these tanks (after the No. 1 tanks have been used) the drill given in (iii) above should be used to decide if the leak is on the engine side of the engine master cock. If so, the engine master cock should be kept closed and the remaining fuel used as required to feed the live engine. If not, the leaking tank should be used immediately to feed all four engines until it is almost empty.

103. Feathering

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

(ii) Press and release the feathering switch which should spring out when the propeller is fully feathered. If it does not do so it must be pulled out.

(iii) Switch OFF the master fuel cock immediately the engine stops.

(iv) If the engine failure is accompanied by fire, operate the fire-extinguisher.

(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.

NOTE.—After action (i) above, the propeller will feather without pressing the feathering switch, but at a reduced rate, and not quite fully.

104. **Unfeathering in the air**

(i) Set the throttle closed.

(ii) Set the r.p.m. control lever to minimum r.p.m. just forward of the feathering gate.

(iii) Switch ON the ignition.

(iv) Switch ON the fuel master cock, and then, without delay, if the booster pumps are ON, press the feathering switch and check that it releases itself when the r.p.m. rise to 1,000. If it does not do so it must be pulled out.

(v) Warm up the engine at 0 lb./sq. in. boost and 1,350 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.

(vi) It is advisable not to unfeather at speeds higher than normal cruising in order to avoid the risk of overspeeding.

NOTE.—The propeller will not unfeather without pressing the feathering switch.

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

(i) After taxying clear of the runway in use, stop the aircraft, carry out the normal checks after landing, and then set the engine controls for the engine to be started as follows:—

(ii) (a) Throttle one-third open.

(b) R.p.m. control lever to maximum r.p.m. position.

(c) Ignition switches ON.

(d) Engine master cock ON.

(e) Fuel booster pumps ON for not more than 15 seconds, then OFF.

(iii) Open up the other engines to 1,500 r.p.m. and check that the generators are charging. Start the engine in the normal way, and when it has started and is running evenly, press the feathering pushbutton. The button

should spring out when the r.p.m. rise to 1,000, but if it does not do so it must be pulled out.

(iv) After warming up the engine, open up to 0 lb./sq. in. boost and check that the r.p.m. are normal. Check the operation of the constant-speed unit, switch on the generator and check that it is charging.

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

(i) The safety speed at +18 lb./sq. in. boost is 105 knots and at +25 lb./sq. in. boost it is 125 knots.

(ii) The failure of an outboard engine results in yaw and marked roll towards the failed engine.

(iii) If at +18 lb./sq. in. boost corrective action is taken quickly, control can be maintained at speeds as low as 100 knots even at the higher weights. At +25 lb./sq. in. boost the roll when engine failure occurs is more marked and at speeds below 120 knots response to corrective action is slow.

(iv) In temperate conditions at 86,000 lb. the aircraft will climb at +18 lb./sq. in. boost with undercarriage DOWN and flaps at TAKE-OFF while the failed engine is being feathered.

(v) While the propeller of the failed engine is being feathered and the undercarriage raised, speed should be increased to 130 knots, the flaps raised at a safe height and power reduced to the intermediate setting.

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

107. **Flying on three engines**

(i) *In flight*

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.

(ii) *Landing*

With the aircraft trimmed to maintain straight and level flight on three engines the circuit and approach should be

made in the same way 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.

(iii) *Going round again*

(a) The aircraft will go round again easily at weights up to 72,000 lb. using maximum intermediate power.

(b) Maintain a minimum airspeed of 105 knots, and when the decision to go round again is made, increase power to the maximum intermediate setting, and select undercarriage UP and flaps to TAKE-OFF in quick succession.

(c) Allow the airspeed to build up to 120 knots, and at a safe height raise the flaps.

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

(i) *In flight*

Below 7,000 feet in low gear in temperate conditions the aircraft should maintain height at an airspeed of 130-135 knots at 72,000 lb. at +9 lb./sq. in. boost, and 2,400 r.p.m. The aircraft can be trimmed to fly straight and level at this power and speed. Control can be maintained 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 straight and level. No hydraulic power is available when Nos. 3 and 4 engines are stopped.

(ii) *Landing*

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 down wind 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*

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. Increase power to +18 lb./sq. in. boost and 2,750 r.p.m. and retract the undercarriage and flaps; then reduce power to the maximum intermediate setting 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 power 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).

109. **Flapless landings**

When landing without flaps, a minimum airspeed of 120 knots should be maintained until the final turn into wind is completed, when power should be progressively reduced so that the aircraft crosses the airfield boundary at 115 knots at the maximum landing weight. Little power is required, and the aircraft is practically in the three-point attitude on the approach. Excessive braking is not necessary to stop within 2,000 yards.

110. **Ditching**

The ditching qualities of this aircraft are known to be very poor, owing to the likelihood of the bomb doors breaking when the aircraft hits the water. If ditching is unavoidable the following drill should be observed:—

(a) Open all ditching exits.

(b) All crew take up correct ditching stations. (See para. 100.)

(c) The touchdown speed should be kept as low as possible and the flaps lowered to the TAKE-OFF position.

(b) The approach should be flattened out near the water surface to enable the aircraft to touchdown at as low a forward speed and rate of descent as possible.

(e) The approach should be made along the swell, or into the wind if the swell is not steep.

PART V
ILLUSTRATIONS AND CHARTS

KEY TO Figs. 1 and 2

1. Windscreen wiper control valve.
2. "Press-to-transmit" switch.
3. Windscreen de-icing control valve.
4. P.12 compass lamp switch.
5. Emergency lights switch.
6. Starboard pneumatic supply pressure gauge.
7. Port pneumatic supply pressure gauge.
8. Brake system parking lever.
9. Taxying lamp switch.
10. Landing lamp switch.
11. Mounting for time clock.
12. Radio compass indicator.
13. Radio altimeter and limit indicator with lights.
14. Engine fire-extinguisher pushbuttons (4).
15. Fuel tank fire-extinguisher pushbutton—port.
16. Feathering pushbuttons (4)
17. Engine master fuel cock switches (4).
18. Fuel tank fire-extinguisher pushbutton—starboard.
19. Photoflash jettison switch.
20. Flares jettison switch.
21. Illuminator flare start/stop switches.
22. Undercarriage selector buttons.
23. Pressure head switches (2).
24. Pressure head test socket.
25. Navigation lights switch.
26. Emergency lights switch.
27. Windscreen wiper control valve.
28. Rudder pedal adjusting starwheel.
29. Undercarriage position indicator.
30. Bomb door indicator.
31. Flaps position indicator.
32. Bomb doors selector switch.
33. "Scanner retracted" indicator.
34. Flaps selector switch.
35. I.F.F. switches.
36. Flare chute doors indicator.
37. Flare chute doors switch.
38. Flare chute release switch.
39. Crew warning horn switch.
40. Emergency call light.
41. Rudder pedal adjusting starwheel.
42. Lifeboat release switch.
43. Illuminator flare start/stop switches.
44. Auto-pilot controller.
45. No. 1 V.H.F. set controller.
46. First pilot's escape hatch jettison handle.
47. Mk. 4B compass controller.
48. Second pilot's escape hatch jettison handle.
49. Radio compass controller.
50. No. 2 V.H.F. set controller.
51. Auto-pilot control box.
52. P.12 magnetic compass.

NOTE.—The following items are hidden by the second pilot's control column handwheel:
External lighting master switch.
Landing lamp switch.
Taxy lamp switch.
Identification lights switches.
Bomb jettison handle.

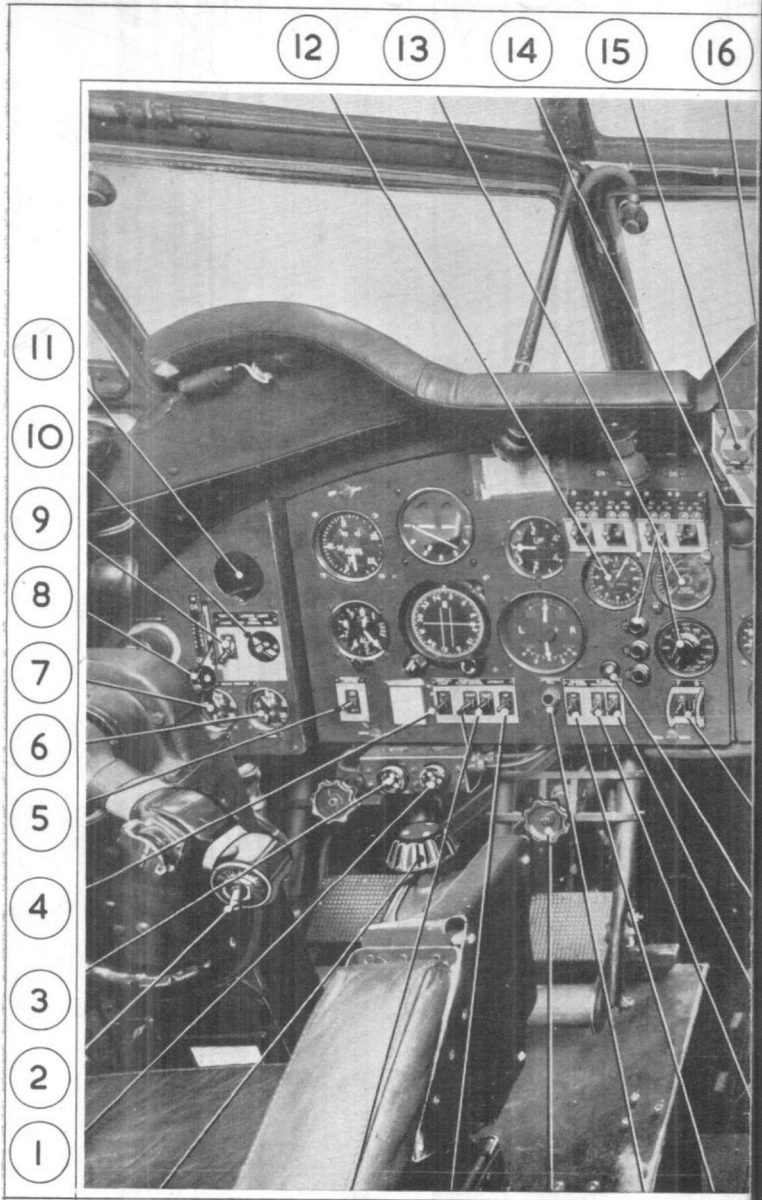
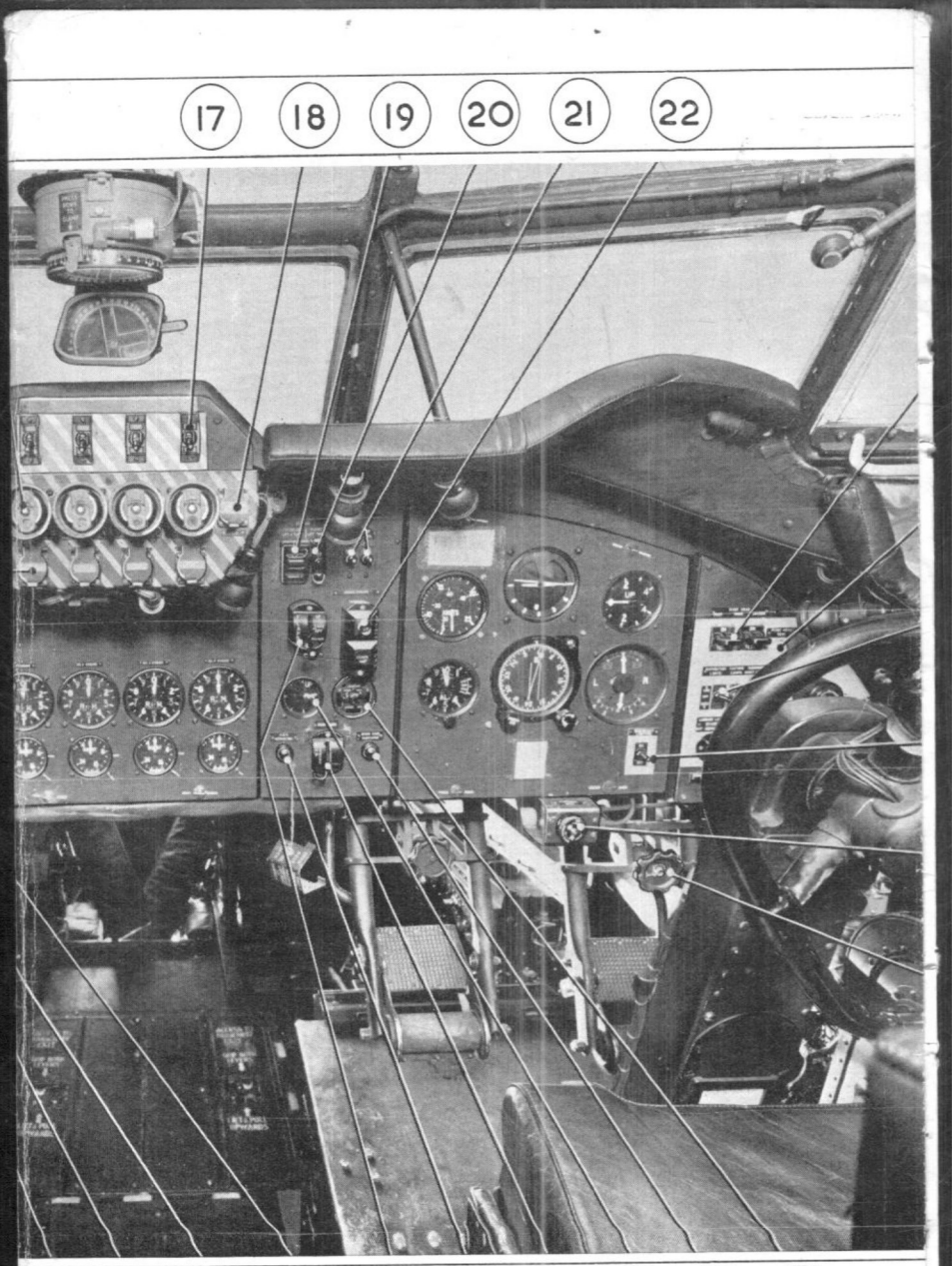


FIG 1

COCKP



PIT – FORWARD VIEW

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FIG 1

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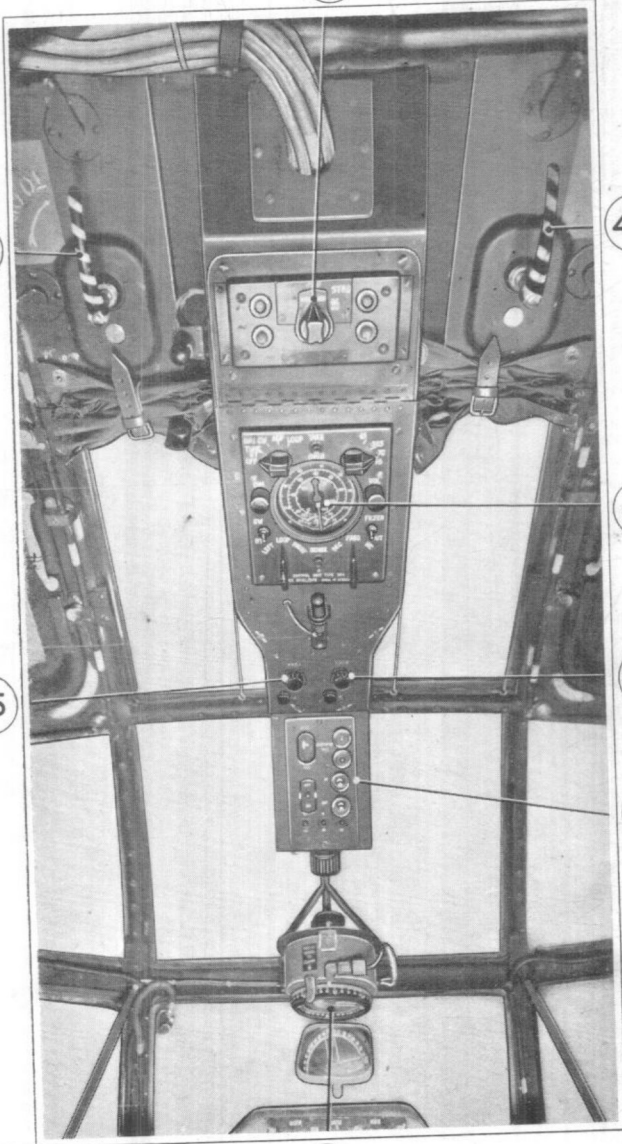


FIG 2

COCKPIT ROOF PANEL

FIG 2

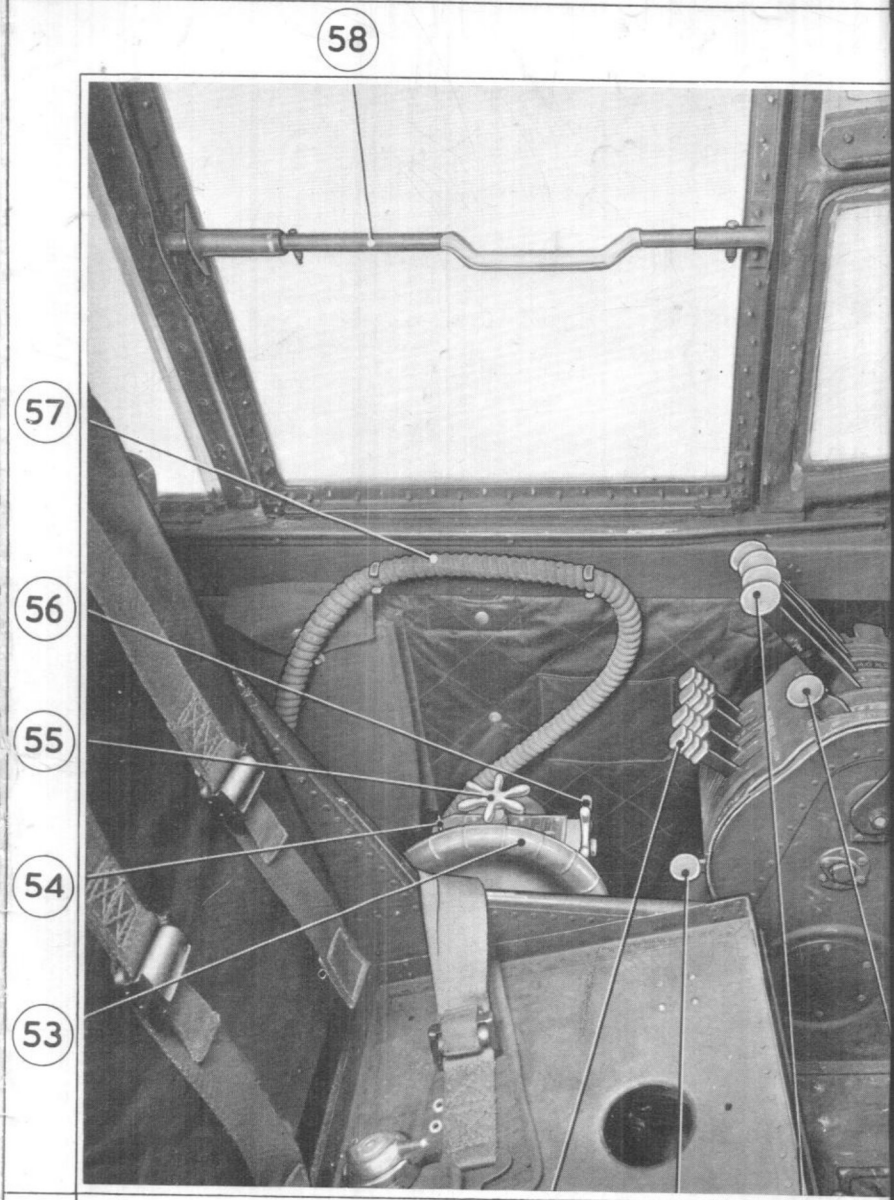
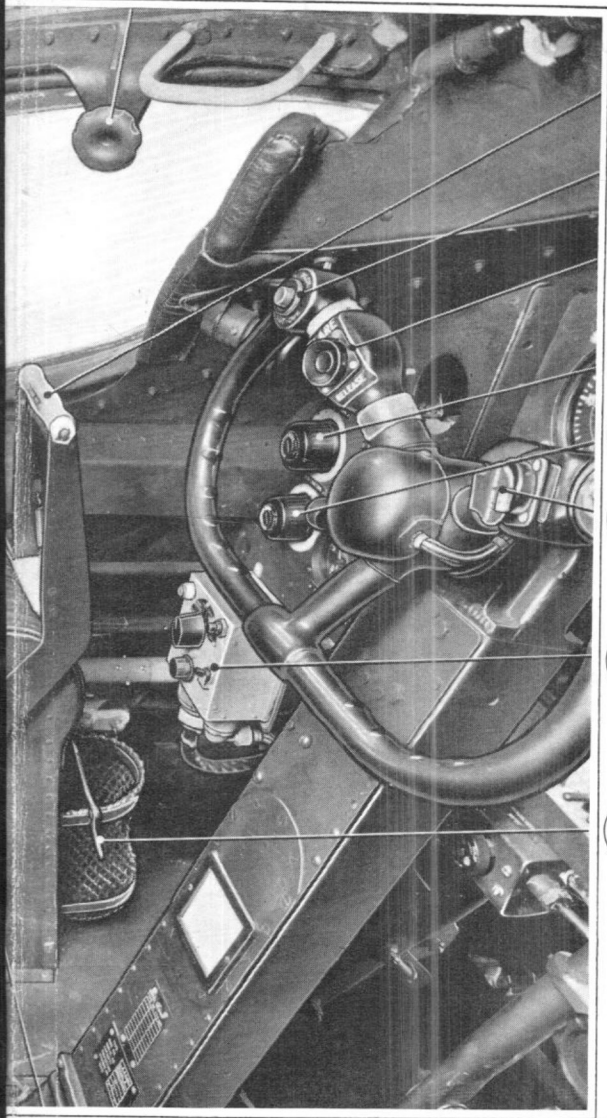


FIG 3

COCKPIT– PORT S



53. Elevator trim
54. Trimmer lamp
55. Rudder trimm
56. Aileron trimm
57. First pilot's ox
58. Window locki
59. Direct vision
60. Rudder lockin
61. Auto-pilot cut
62. Flare release
63. U/v lamps di
64. Red lamps d
65. Bomb release
66. Type 349 sta
67. Portable oxyg
68. Throttle frictio
69. Throttle levers
70. Propeller fric
71. Propeller leve

IDE

FIG 3

KEY TO Fig. 3

ıer handwheel.
switch.
ıer handwheel.
ıer handwheel.
xygen lead.
g handle.
anel fastener.
g control handle.
-out pushbutton.
ushbutton.
ımer switch.
ımer switch.
ushbutton.
on controller.
n bottle stowage.
n damping lever.
s (4).
on damping lever.
s (4).

K

72. Press-to-transmit s
73. Bomb release pus
74. Red lamps dimm
75. U/v lamps dimme
76. Flares release pus
77. Auto-pilot cut-out
78. Direct vision pan
79. Window locking h
80. Second pilot's oxy
81. Elevator trimmer
82. Rudder trimmer h
83. Trimmer lamp sw
84. Aileron trimmer h
85. Propeller levers (
86. Propeller friction
87. Throttle levers (4)
88. Throttle friction
89. Portable oxygen b
90. Type 349 station

EY TO Fig. 4

witch.
button.
r switch.
switch.
hbutton.
pushbutton.
l fastener.
andle.
gen point.
handwheel.
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tch.
andwheel.
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damping lever.

amping lever.
ottle stowage.
ontroller.

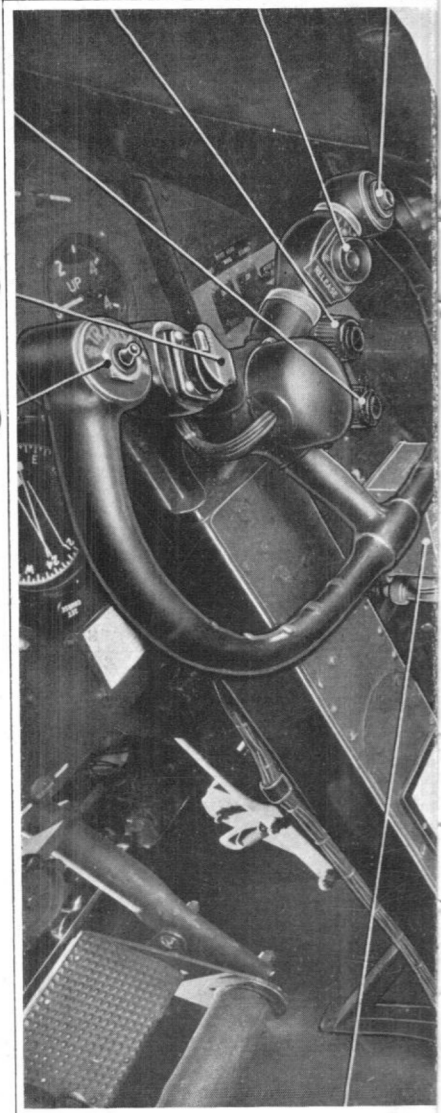

FIG 4

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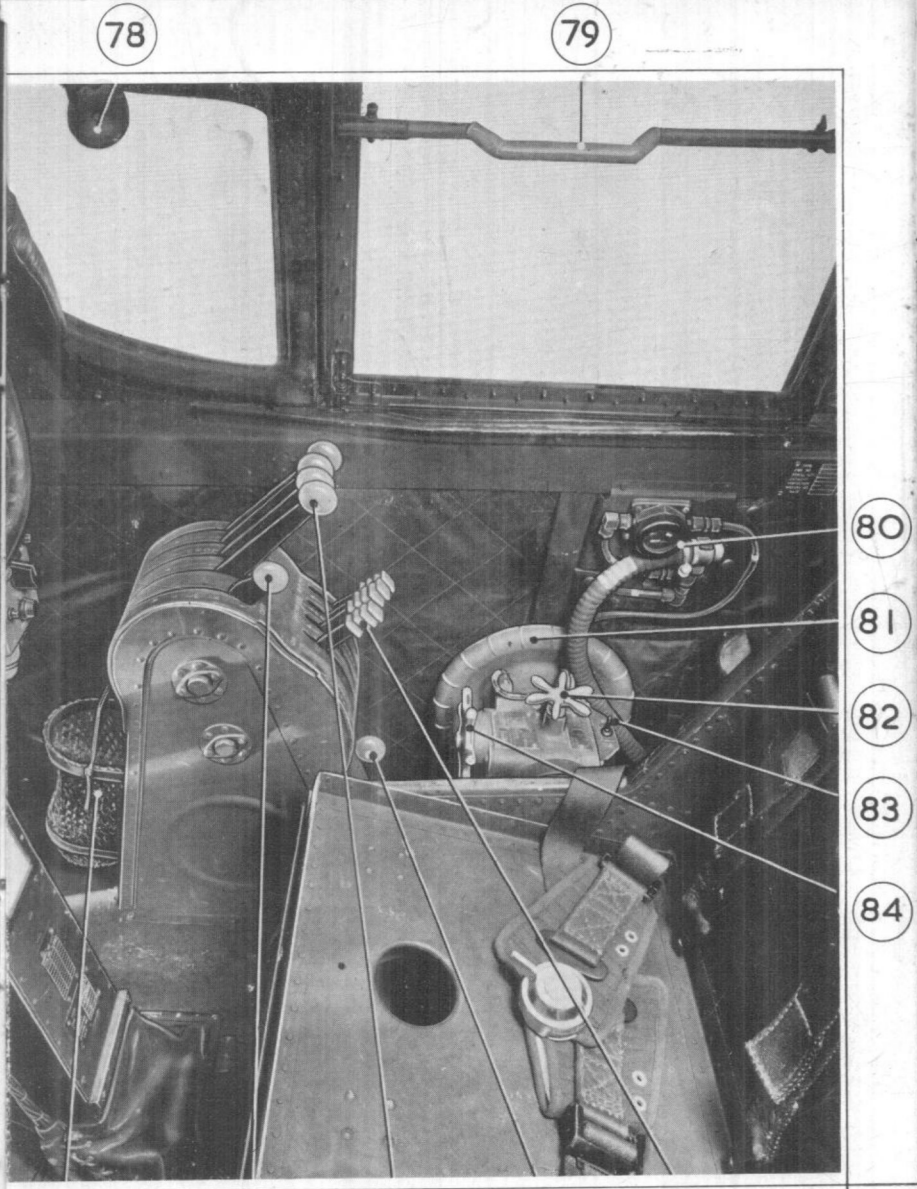
COCKP



IT – STARBOARD SIDE

FIG 4

FIG 5 FLIGHT ENGINEER'S PANELS

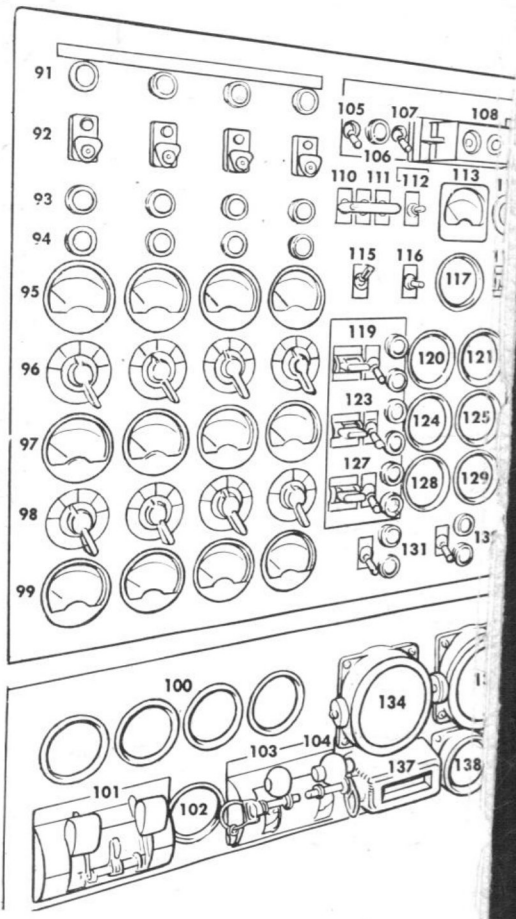

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FIG
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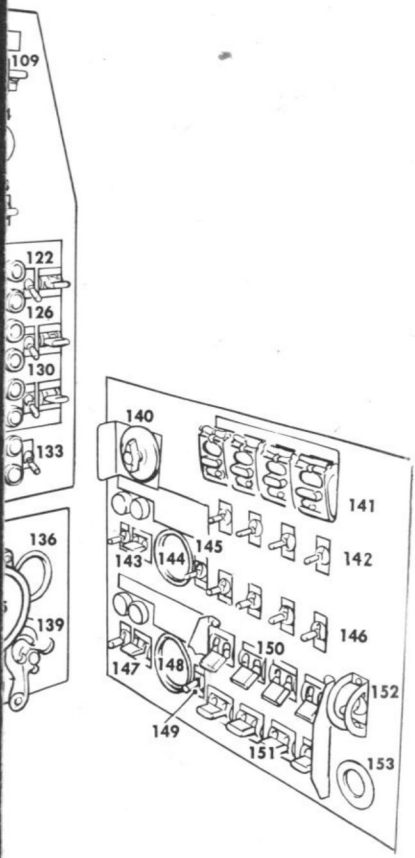
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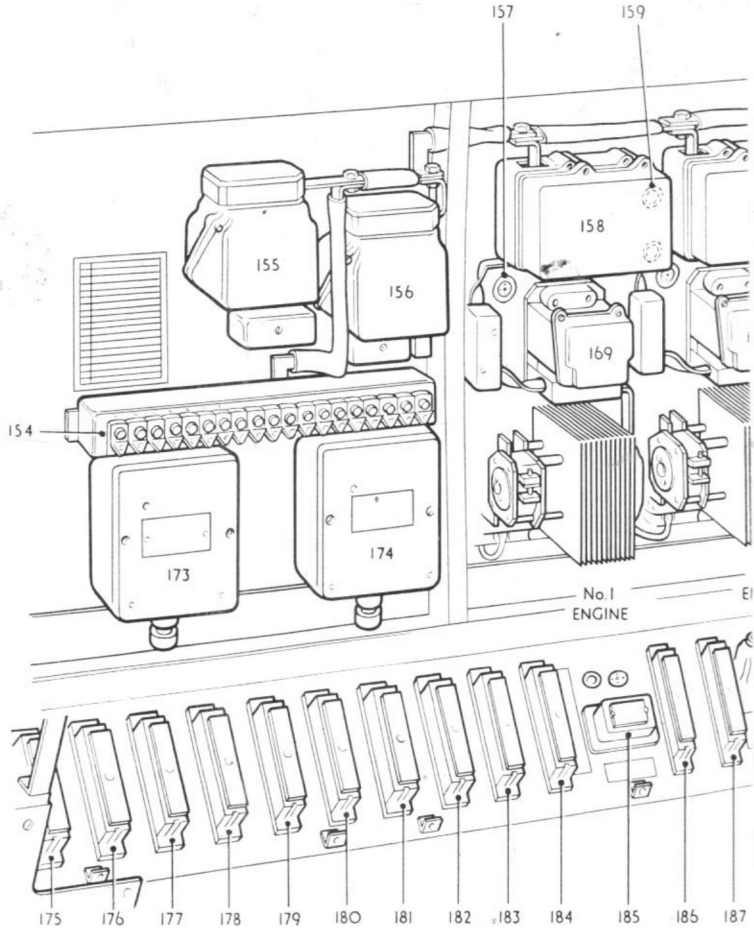

FIG
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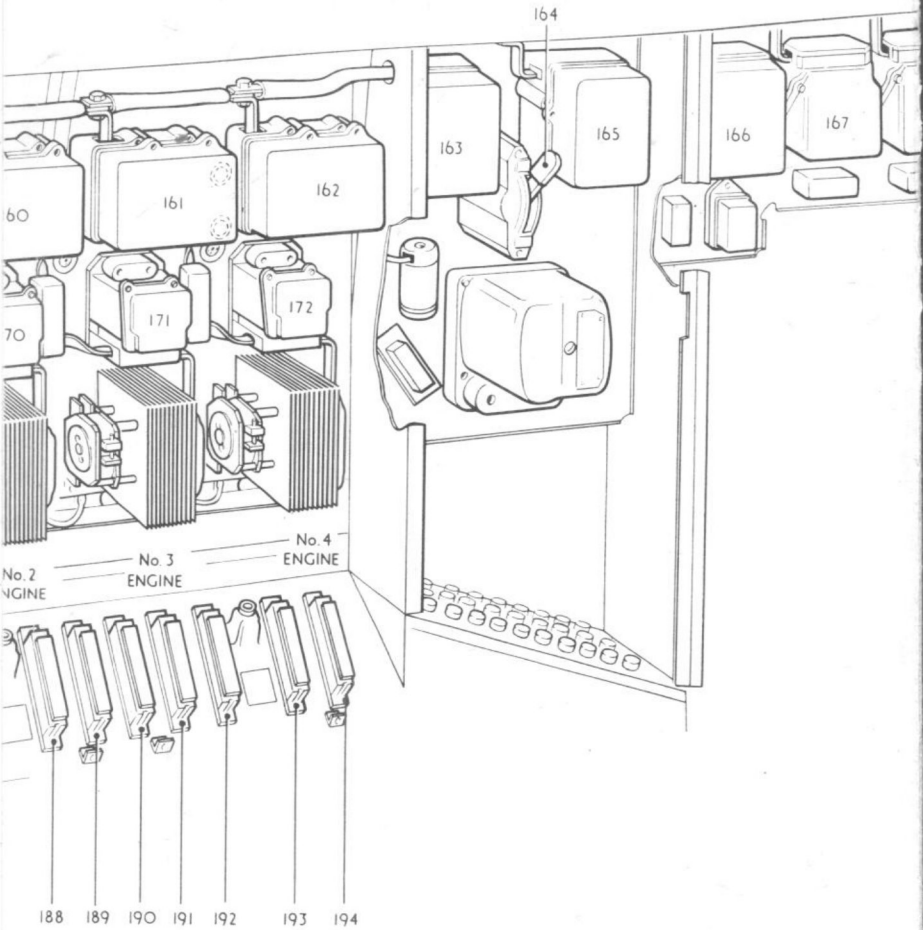
ELECTRICAL MA



IN POWER PANEL ASSEMBLY

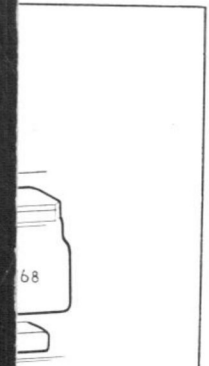


FIG
6

Main panel

91. Generator failure indicators (4).
92. Generator field circuit breakers (4).
93. Supercharger indicators (4).
94. Engine master cock indicators (4).
95. Charge temperature gauges (4).
96. Charge temperature controls (4).
97. Coolant temperature gauges (4).
98. Radiator shutter controls (4).
99. Oil temperature gauges (4).
100. Oil pressure gauges (4).
101. Bomb doors emergency controls.
102. Emergency air supply gauge.
103. Undercarriage emergency control.
104. Flaps emergency control.
105. Inverter emergency switch.
106. Inverter failure indicator.
107. Inverter emergency switch.
108. Inverter reset relay switch.
109. No. 1 inverter switch.
110. Supercharger switch.
111. Water/methanol switch.
112. Galley isolation switch.
113. Voltmeter.
114. Fuel pump ammeter test socket.
115. Air cleaner switch.
116. Cabin heater fuel supply switch.
117. Auxiliary tank contents gauge.
118. Auxiliary tank transfer pump switch.
119. No. 1 port tank pump switch, selector cock switch and indicators.
120. No. 1 port tank contents gauge.
121. No. 1 starboard tank contents gauge.
122. No. 1 starboard tank pump switch, selector cock switch and indicators.
123. No. 2 port tank pump switch, selector cock switch and indicators.
124. No
125. No
126. No
s
127. No
s
128. No
129. No
130. No
c
131. Po
132. Ce
133. Sta
134. Po
135. Sta
136. Va
137. Air
138. Ox
139. Va

Side pan

140. En
141. En
142. Co
143. Pr
144. Pr
145. Fr
146. Oi
147. Ac
148. Ac
149. Ac
150. Ge
151. Wa
152. Un
153. Wa

2 port tank contents gauge.
2 starboard tank contents gauge.
2 starboard tank pump switch, selector cock witch and indicators.
s. 3 and 4 port tanks pump switch, selector cock witch and indicators.
s. 3 and 4 port tanks contents gauge.
s. 3 and 4 starboard tanks contents gauge.
s. 3 and 4 starboard tanks pump switch, selector ock switch and indicators.
t cross-feed cock and indicators.
ntre cross-feed cock and indicators.
rboard cross-feed cock and indicators.
rt fuel flowmeter.
rboard fuel flowmeter.
cuum gauge.
mileage indicator.
ygen flow indicator.
cuum change-over cock.

el

gine priming switch.
gine starting switches (4).
mbined booster coil and fuel cut-off switches (4).
peller de-icing switches and indicators.
peller de-icing fluid contents gauge.
peller de-icing fluid contents gauge switch.
dilution switches (4).
rofoil de-icing switches and indicators.
rofoil de-icing fluid contents gauge.
rofoil de-icing fluid contents gauge switch.
nerator switches (4).
ter/methanol test switches (4).
dercarriage test switch.
ter/methanol pump test socket.

154. Nineteen Type A circuit brea
right:
1. Cabin heaters fuel supply.
2. Fuel pump No. 1—port.
3. Fuel pump No. 2—port.
4. Fuel pump No. 3—port.
5. Spare
6. Engine priming pump.
7. Wireless operator's panel su
8. Flight instruments supply p
9. Fuse panel at former 2.
10. Fuse panel at former 12.
11. Preselector panel.
12. Spare
13. Flight instruments control.
14. Flight instruments control.
15. Flight instruments control.
16. Fuel pump No. 1—starboar
17. Fuel pump No. 2—starboar
18. Fuel pump No. 3—starboar
19. Spare.

155. Type B circuit breaker—sonobu
156. Type B circuit breaker—front g
157. Ammeter test socket.
158. Type D circuit breaker—No. 1
159. Voltmeter test socket.
160. Type D circuit breaker—No. 2
161. Type D circuit breaker—No. 3
162. Type D circuit breaker—No. 4
163. Type D circuit breaker—radar.
164. Ground/Flight switch.
165. Type D circuit breaker—radar.
166. Battery isolation relay.
167. Type B circuit breaker—galley s
168. Type B circuit breaker—mid-upp
169. Type J cut-out—No. 1 engine.
170. Type J cut-out—No. 2 engine.
171. Type J cut-out—No. 3 engine.
172. Type J cut-out—No. 4 engine.
173. Propeller de-icing controller.
174. Aerofoil de-icing controller.
175. Fuse box AA:—
No. 1 engine propeller feathe
Bomb doors control.
Crew warning horn.
176. Fuse box BB:—
No. 2 engine propeller feather
Heated pressure head (port).
Undercarriage indicator.
Undercarriage control.
177. Fuse box CC:—
No. 3 engine propeller featheri
Heated pressure head (starboar
Identification lights.
Navigation lights.
Taxy lamp filament (port).
Taxy lamp filament (starboard)

178. Fuse box DD:—
No. 4 engine propeller feathering.
Landing lamp motor (port).
Landing lamp motor (starboard).
Flaps control.

179. Fuse box EE:—
Fuel gauges (starboard).
Radiator shutters (No. 3 engine).
Oil temperature gauge (No. 3 engine).
Coolant and charge temperature gauges (No. 3 engine).
Fuel flowmeter (No. 3 engine).

180. Fuse box FF:—
Fuel cock (No. 1 engine).
Fuel cock (No. 2 engine).
Fuel cock (No. 3 engine).
Fuel cock (No. 4 engine).
Fuel cock No. 2 tank (port).
Fuel cock No. 1 tank (port).
Fuel cock No. 2 tank (starboard).
Fuel cock No. 1 tank (starboard).

181. Fuse box GG:—
Cabin heater control
Fuel contents gauges (port).
Propeller de-icing.
Radiator shutters (No. 1 engine).
Oil temperature gauge (No. 1 engine).
Coolant and charge temperature gauges (No. 1 engine).
Fuel flowmeter (No. 1 engine).

182. Fuse box HH:—
Oil dilution.
Charge temperature control (No. 1 engine).
Booster coil (No. 1 engine).
Engine priming.
Water/methanol pump No. 2
Water/methanol pump No. 1.
Supercharger gear change (No. 1 engine).

183. Fuse box JJ:—
Water/methanol pumps (test).
Auxiliary fuel pump.
Cross-feed cock (port).
Aerofoil de-icing.
Radiator shutters (No. 2 engine).
Oil temperature gauge (No. 2 engine).
Coolant and charge temperature gauges (No. 2 engine).
Fuel flowmeter (No. 2 engine).

184. Fuse box KK: —
Auxiliary fuel contents gauge.
Charge temperature control (No. 2 engine).
Cross-feed cock (starboard).
Booster coil (No. 2 engine).
Engine starting.
Fuel cock No. 3 tank (port).
Fuel cock No. 3 tank (starboard).
Supercharger gear change (No. 2 engine).

185. Fuse box LL:—
Landing lamp filament (port).
Landing lamp filament (starboard).
External lights main supply.
Water/methanol main switch.

186. Fuse box MM:—
Air cleaner control.
Charge temperature control (No. 3 engine).
Booster coil (No. 3 engine).
Water/methanol pump No. 4.
Water/methanol pump No. 3.
Supercharger gear change (No. 3 engine).

187. Fuse box NN:—
Cabin heater control.
Galley services.
Radiator shutters (No. 4 engine).
Oil temperature gauge (No. 4 engine).
Coolant and charge temperature gauges (No. 4 engine).
Fuel flowmeter (No. 4 engine).

188. Fuse box PP:—
Supercharger relays.
Charge temperature control (No. 4 engine).
Cross-feed cock (centre).
Booster coil (No. 4 engine).
Illuminating flares.
Supercharger gear change (No. 4 engine).

189. Fuse box QQ:—
De-icing fluid contents gauges.
Taxy lamps motor.
Emergency call lights.
Fuel cut-off No. 1 engine.
Fuel cut-off No. 2 engine.
Fuel cut-off No. 3 engine.
Fuel cut-off No. 4 engine.

190. Fuse box AL:—
Joint feed to relay from generator circuit breakers.
Generator failure indicator (No. 1 engine).
" " " (No. 2 engine).
" " " (No. 3 engine).
" " " (No. 4 engine).

191. Fuse box AM:—
Voltmeter.
Battery isolation relay.
Fire-extinguishers (port wing tanks).
Fire-extinguishers (starboard wing tanks).
Fire-extinguishers (wing tanks).
Fire-extinguishers (engines).

192. Fuse box AN:—
Fire-extinguisher (No. 1 engine).
" (No. 2 engine).
" (No. 3 engine).
" (No. 4 engine).
Fire warning light (No. 1 engine).
" " (No. 2 engine).
" " (No. 3 engine).
" " (No. 4 engine).

193. Fuse box AP:—
No. 1 flare chute actuator.
No. 2 flare chute actuator.
Rear flare chute actuator.
Flare chute door switches.
Flare chute warning.
Inspection lamp socket.

194. Fuse box AQ:—
(Reserved for spares and future possible additions).

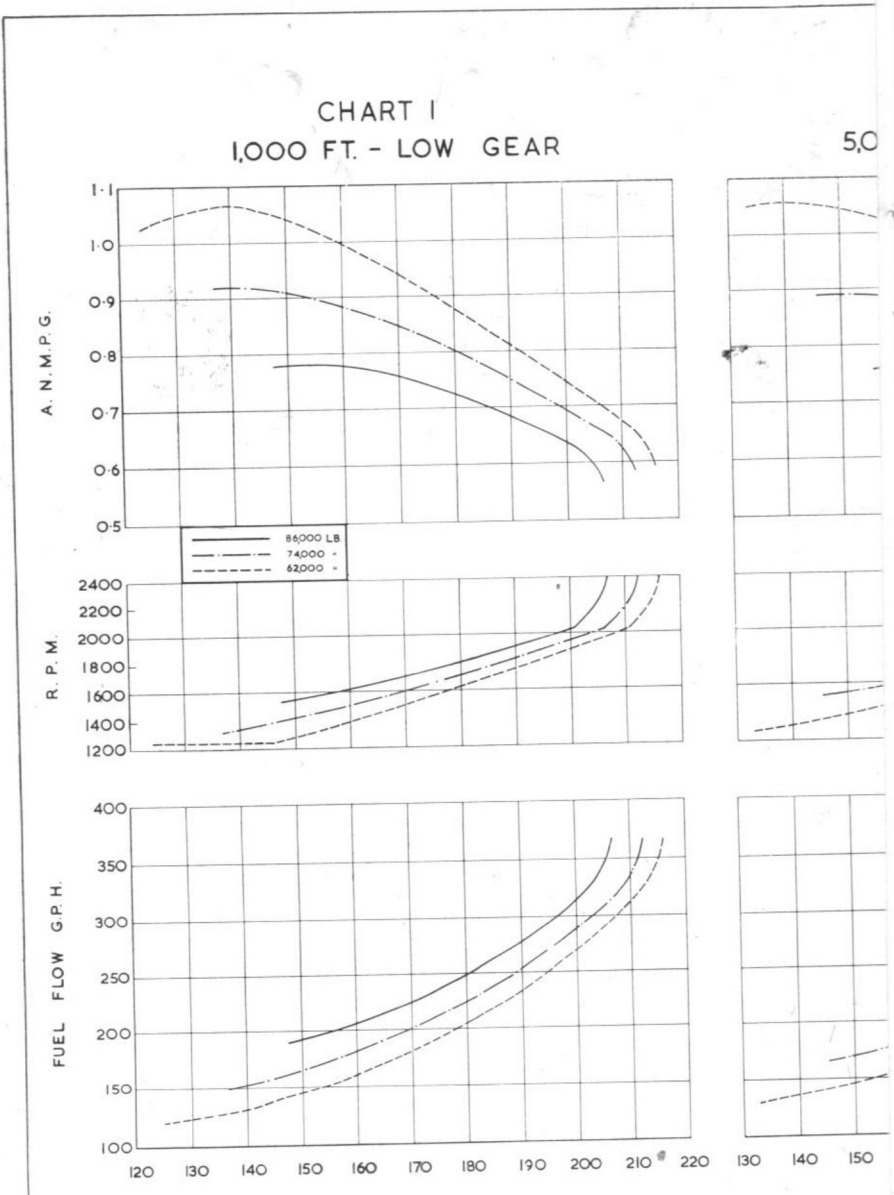


CHART I
1,000 FT. - LOW GEAR
5,0
A. N. M. P. G.
1·1
1·0
0·9
0·8
0·7
0·6
0·5
86000 LB
74000 "
62000 "
R. P. M.
2400
2200
2000
1800
1600
1400
1200
FUEL FLOW G.P.H.
400
350
300
250
200
150
100
120
130
140
150
160
170
180
190
200
210
220
130
140
150

FIG. 7

FLIGHT PLANNING CHARTS

CHART 2
)00 FT. - LOW GEAR

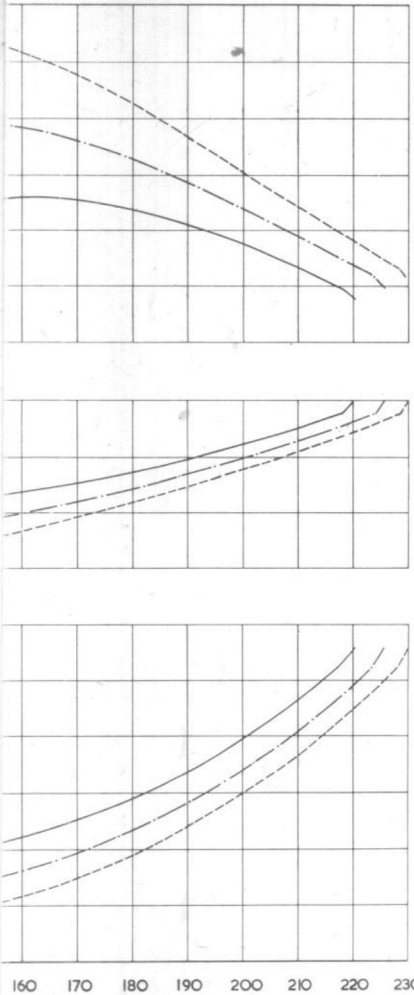
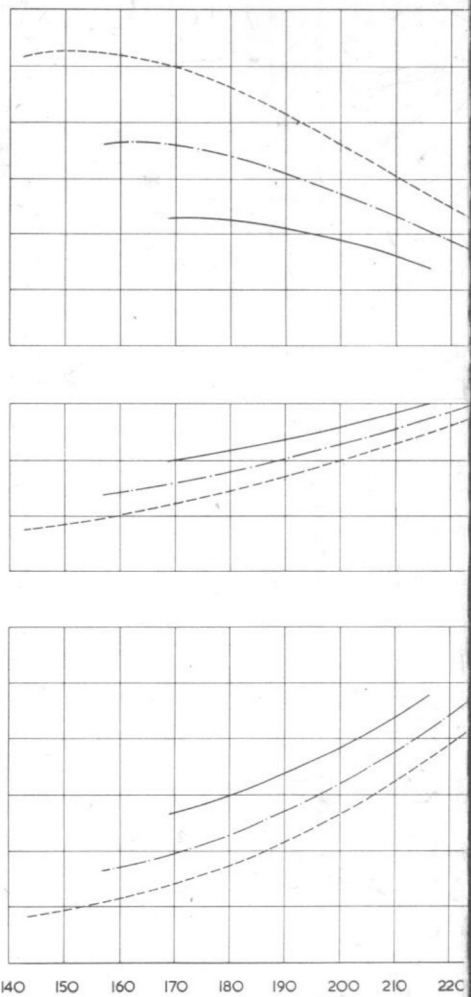


CHART 3
10,000 FT. - LOW GEAR



TRUE AIRSPEED - KNOTS

CHART 4
15,000 FT. - HIGH GEAR

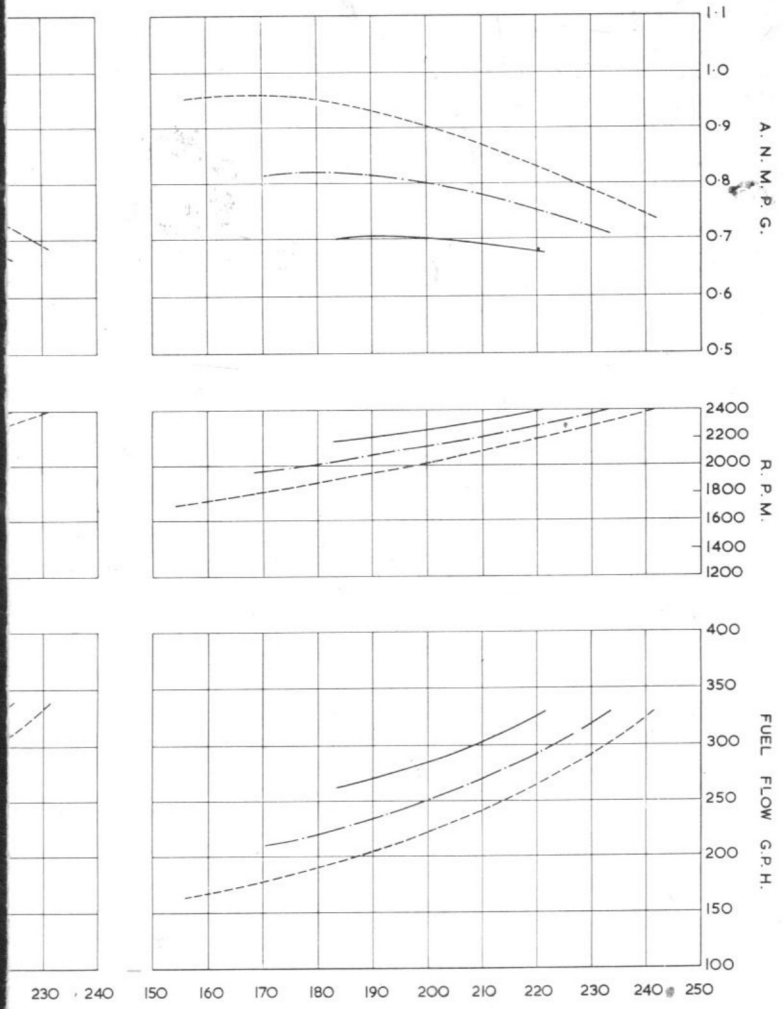
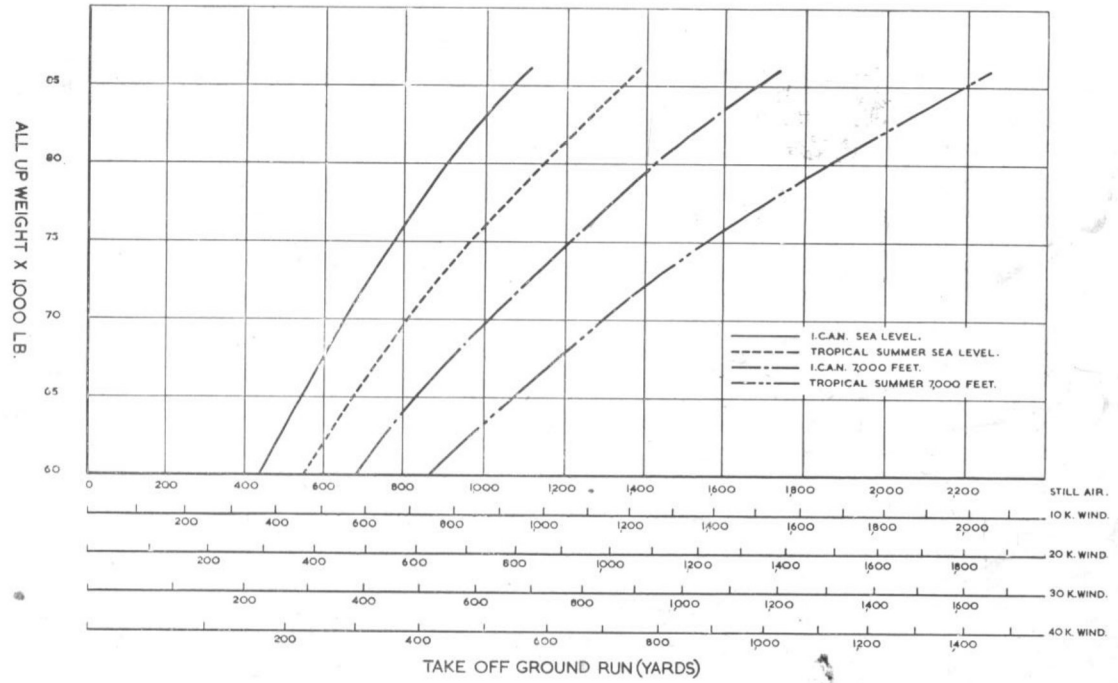


FIG. 7



TAKE-OFF DISTANCE CHART.
(WITHOUT METHANOL/WATER INJECTION)

FIG. 8

FIG. 8

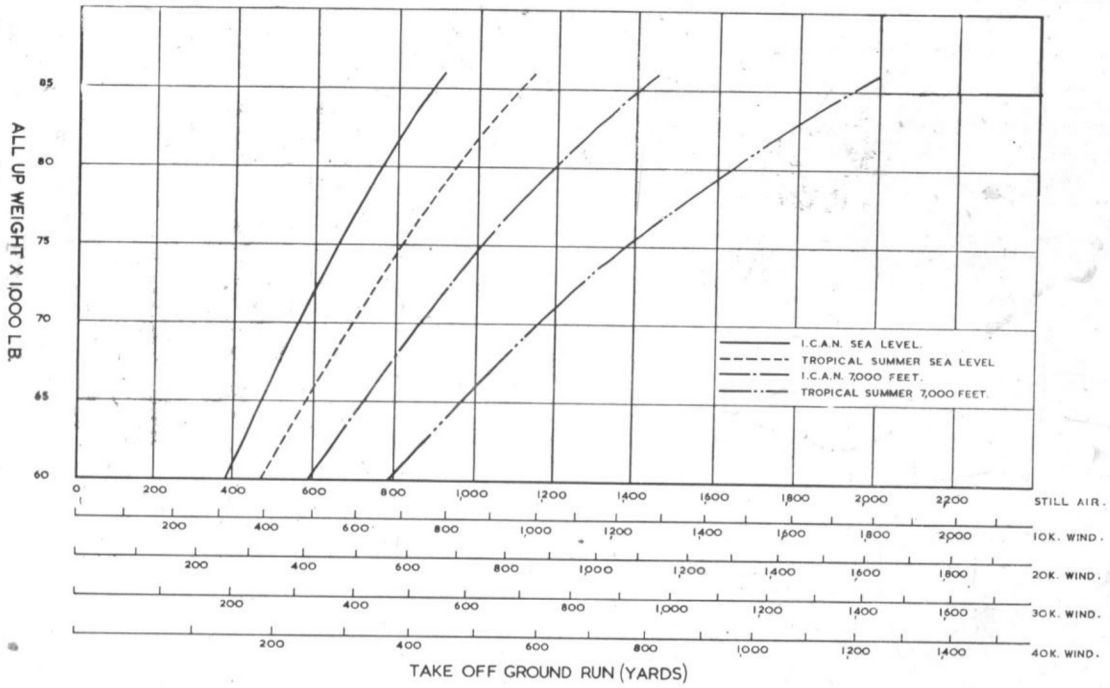


FIG. 9

TAKE-OFF DISTANCE CHART. (WITH METHANOL/WATER INJECTION.)

FIG. 9

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		