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AIR PUBLICATION 1807 B

Pilots Notes

PILOT'S NOTES

HAVOC II AEROPLANE
TWO CYCLONE
G.R. 2600 A 5 B ENGINES

Prepared by direction of the
Minister of Aircraft Production

A. C. Poulton

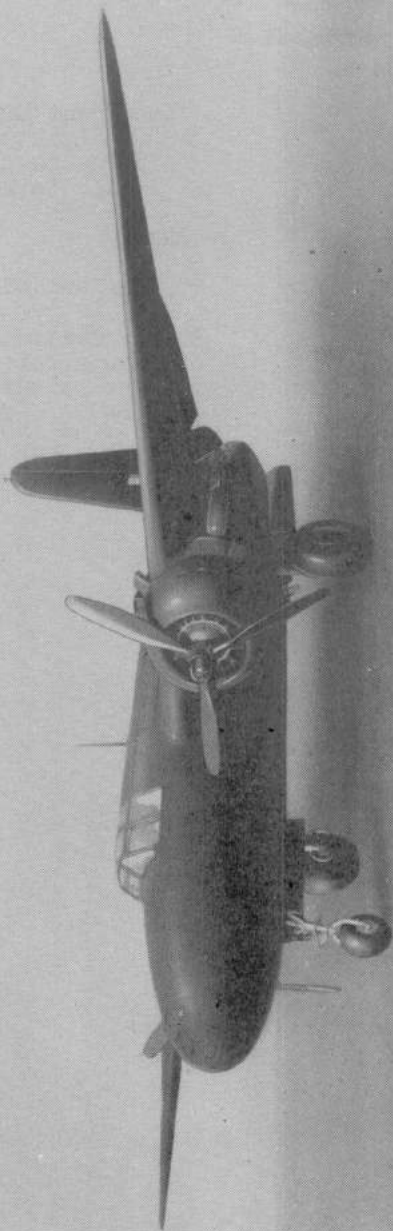
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AIR MINISTRY.

A.P.1807B

P.N.



HAVOC II

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January 1943
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Amendment List 6/D
to
AIR PUBLICATION 1807B
Pilot's Notes.

HAVOC II AIRCRAFT

TWO CYCLONE G.R. 2600 A5B ENGINES

Note.- Amendment Lists to this Air Publication which affect the Pilot's Notes are now allotted a letter as well as a number. The letters will run consecutively, omitting I and O. The Pilot's Notes will be complete if the following Amendment Lists have been incorporated.

4/B 5/C 6/D

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|-----|-----------|--|
| (1) | SECTION 1 | <u>Para. 30</u> sub-para. (c). <u>Delete</u> this sub-para. |
| (2) | SECTION 2 | <u>Para. 5</u> sub-para. (ix) second line. <u>Delete</u> "not more than 15 seconds" and <u>substitute</u> "about 20 seconds. Never exceed 30 seconds."
sub-para (xi) second line. <u>Delete</u> "15" and <u>substitute</u> "30".
sub-para (xiii) third line. <u>Delete</u> "15 to 20 seconds" and <u>substitute</u> "two to three minutes"
sub-para (xvi) second line. <u>Delete</u> "15" and <u>substitute</u> "30". |
| (3) | SECTION 2 | <u>Insert</u> this sheet at end of Section 2 as authority for the above manuscript amendments. |

AMENDMENT CERTIFICATE

Incorporation of an amendment list in this publication should be certified by inserting the amendment list number, initialling in the appropriate column and inserting the date of incorporation.

Holders of the Pilot's Notes will receive only those amendment lists applicable to the preliminary matter, introduction and sections 1 and 2.

Amendt. List No.	3	4	5						
Prelimy. matter									
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Section 1		✓							
Section 2	✓	✓	✓						
Section 3									
Section 4									
Section 5									
Section 6									
Section 7									
Section 8									
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JUL 1943

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Where amendment action has taken place, the number of the amendment list concerned will be found at the top of each page affected, and amendments of technical importance will be indicated by a vertical line on the left-hand side of the text against the matter amended or added. Vertical lines relating to previous amendments to a page are not repeated. If complete revision of any division of the book (e.g. a Chapter) is made this will be indicated in the title page for that division and the vertical lines will not be employed.

July, 1941

AIR PUBLICATION 1807B

Pilot's Notes

LIST OF SECTIONS

- Section 1 - Controls and equipment for pilot
- Section 2 - Handling and flying notes for pilot

SECTION 1

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SECTION 1

PILOT'S CONTROLS AND EQUIPMENT

AND

GENERAL EMERGENCY EQUIPMENT AND EXITS

Note.- This section covers the controls and equipment in the pilot's cockpit together with that equipment with which the pilot should be acquainted, situated elsewhere in the aeroplane. The layout of the various items is illustrated and annotated in figs. 1-3 at the end of the section. The number quoted after an item in the text refers to the reference number on the illustrations.

INTRODUCTION

1. The Havoc II aeroplane is a British adaption of the Douglas D.B.7A, and there are two variations of it in service, the Fighter and the Turbinlite. The aeroplane is fitted with two Cyclone G.R.2600-A5B engines, Hamilton hydromatic propellers, and tricycle undercarriage.

MAIN SERVICES

2. Fuel system.

- (1) Havoc II Turbinlite.- There are two fuel tanks, one fitted in each wing forward of the main spar between the fuselage and the engine nacelle. The tanks are protected by armour plate and sponge rubber, and each has a capacity of 113 gallons as a MAIN supply, and 22 gallons as a RESERVE. The reserve supply is carried in the main fuel tank, and is segregated by a stand pipe in each tank. Fuel from the main supply is taken through the stand pipe. When the main fuel supply is exhausted, the reserve fuel is drained through an outlet at the bottom of the tank by turning the tank selector cock from MAIN to RESERVE. The fuel systems for the port and starboard engines are separate so that the port wing tank feeds the port engine and the starboard wing tank feeds the starboard engine,

but the systems are connected by a pressure balance cock (84) marked ENGINE CROSS-FEED and a suction balance cock (85) marked TANK CROSS-FEED. These tanks are normally kept shut, but the ENGINE CROSS-FEED may be opened in the event of failure of either pump, and the TANK CROSS-FEED may be opened to enable either engine pump to be fed by tanks on the other side. (See fig.5 for Fuel System Diagram.)

- (11) Havoc II Fighter.- There are four fuel tanks, one fitted in each wing as on the Turbinlite, and two auxiliary tanks fitted in the bomb compartment. These two tanks are joined by a pipe at the bottom, and from this, two pipes are led - one to each tank selector cock. They are connected to the selector cocks (marked AUXILIARY) in place of the "main" pipes from the wing tanks. The "main" pipes are plugged up. The MAIN fuel supply from the wing tanks is now taken through the original "reserve" pipe. The wing tanks each have a capacity of 135 gallons and the two auxiliary (bomb cell) tanks have a combined capacity of 107 gallons. The Havoc II Fighter has ENGINE CROSS-FEED and TANK CROSS-FEED connections as described for the Havoc II Turbinlite (See fig.6 for Fuel System Diagram).
3. Oil system.- There are two oil tanks, one serving each engine. These tanks are fitted, one in each inboard wing directly above the nacelle, and they each have a capacity of 12½ gallons.
4. Hydraulic system.- An engine-driven hydraulic pump on the starboard engine supplies pressure to the complete hydraulic system, through a hydraulic pressure accumulator.
- Services: Undercarriage
brakes
flaps
landing lamps
bomb doors
cowling gills
nose wheel steering controls.

5. Electrical system.- There are two 600w generators, one on each engine, and two batteries one on each side of the nose wheel well. On aeroplanes fitted with A.I. the 600w generators are replaced by one-1500w generator on the starboard engine and an alternator on the port engine. Charging of the batteries by either or both generators is controlled by the generator control switches on the gunner's electrical panel. A ground battery connection is provided in the left hand side of the nose wheel well just forward of the battery and relays in the plug box automatically disconnect the aeroplane's battery when a ground battery is plugged in. The generators feed the following services through the batteries:-

- ignition booster coils
- starting
- feathering
- landing and navigation lights
- electrical instruments
- instrument and cockpit lights
- gun sights and firing switches
- undercarriage signal lamps
- undercarriage warning horn
- pressure head heater
- oxygen and suit heat control

An electric inertia starter is also mounted on each engine.

AEROPLANE CONTROLS

6. General.- The primary flight controls and several engine controls are duplicated in the gunner's cockpit, so that the aeroplane may be flown from the latter position in an emergency. The control column in the rear cockpit has been removed, however from Havoc II Turbinlites.
7. Control column.- A conventional control column and wheel (25) are provided in the pilot's cockpit for controlling the movement of the elevators and ailerons. When the aeroplane is on the ground, turning the control wheel also operates the steerable nose wheel (see para.18). A control stick is installed in the Havoc fighter in the gunner's cockpit for emergency control of the aircraft; this stick is stowed on the aft face of the gunner's forward bulkhead.

8. Rudder control.- Rudder movement is controlled by the conventional rudder pedal operation, the pedals being adjustable fore and aft as required by a lever attached to the inboard edges of each rudder pedal. To adjust a pedal, rotate the lever downward to disengage the plunger, slide the pedal fore or aft to the desired position, and release the lever, ensuring that the plunger is again properly engaged.
9. Control locking device.- To lock the controls, place the rudder and aileron controls in the neutral position, and push the control column forward. Depress the lever on the upper right hand side of the control column and pull out the rudder lock hook (24) which is in the instrument panel directly forward of the control column lock hook. Engage both hooks by pressing forward on the control column lock lever. When the hook on the panel is pulled out it causes pins to be inserted in the rudder pedal arms preventing movement of the rudder.
10. Trimming tabs.- Control wheels are mounted on the starboard side of the cockpit for operating the elevator tab (48), the rudder tab (36), and the starboard aileron tab (45); these control wheels operate in the natural sense. The port aileron tab is adjustable on the ground only.
11. Undercarriage controls.- The tricycle undercarriage is operated by a selector lever (82) at the bottom of the bulkhead behind and on the left of the pilot's seat. This lever has a large orange coloured cylindrical knob which has to be pulled out before the lever can be disengaged from the UP or DOWN positions. The lever also has to be moved sideways when passing through the neutral position. The main wheels are held up by locking bolts but the front wheel is held up by hydraulic pressure only. When in flight with the undercarriage retracted the selector lever should be returned to the NEUTRAL position, but when the undercarriage is lowered the selector should be left in the DOWN position. Two hydraulic pressure gauges are fitted at the right side of the instrument panel. The top gauge (17) indicates the pressure in the accumulator, and the bottom gauge (54) indicates the pressure in the down pipelines to the undercarriage jacks. The lower gauge should give the same reading as the upper gauge when the undercarriage is down, and should read zero when the undercarriage is up.

12. Undercarriage visual indicators.- A combined undercarriage and flaps indicator (29) is fitted in the bottom left hand corner of the instrument panel. The indicator has four pointers which are all horizontal when the wheels and flaps are up, and vertical when they are down. The flaps pointer is at the top right hand corner and the nose wheel pointer is at the top left. The port and starboard wheel pointers are at the bottom left and right respectively. When the wheels are locked down a green light appears; this is mounted below the undercarriage and flaps indicator at the bottom left hand corner of the instrument panel. When the wheels are locked up and the throttles are closed, a red light (4) mounted at the bottom left hand side of the windscreen, lights up.
13. Undercarriage warning horn.- This is fitted on the forward side of the pilot's switch panel, and operates when the throttle is closed and the undercarriage is in any position other than fully down and locked. The horn warning system may be disconnected by pushing down on the warning horn release switch (73) on the electrical control panel. The horn circuit automatically re-engages when the throttles are opened again.
14. Flaps control.- The flaps are of the trailing-edge type (i.e. not "split"). They are operated by a lever (83) mounted on the port side of the bulkhead behind the seat. The lever has three notched positions; UP, NEUTRAL and DOWN. The flaps can be locked in any position by moving the lever to NEUTRAL as soon as the flaps reach the desired setting. After the flaps have been raised or lowered the selector should always be returned to NEUTRAL.
15. Hydraulic handpump.- If the hydraulic engine pump fails, the undercarriage and flaps can be lowered completely by using the hydraulic hand pump, which is operated by a horizontal lever (80) at the left of the pilot's seat. The system can still be operated by means of the hand pump even if one of the pipes between the engine pump and the accumulator is broken, as the quantity of fluid which can be drawn out of the reservoir by the engine is limited by a stand pipe. This leaves a reserve for use by the hand pump, which pumps the fluid from the reservoir to the jack through an independent pipeline via the appropriate selector valves.

For servicing operations when on the ground, a hand pump by-pass valve may be used. This is controlled by a small lever under a cover on the bulkhead behind the pilot's left shoulder. If the cover is lowered and the lever is raised to the up position, the hand pump may be used to pump up the pressure in the accumulator. When in flight this lever must always be down, and its cover in position.

16. Undercarriage emergency operation.- If the hydraulic system fails completely the undercarriage can be lowered by setting the control in DOWN position and pulling out the red toggle (43) at the bottom rear corner of the cockpit, on the starboard side. When pulled out to its fullest extent this toggle withdraws the locks holding the main wheels up, and the wheels are then pulled down and locked by the action of strong shock absorber cords. The toggle also releases the hydraulic pressure which holds the nose wheel up, and allows it to be forced down and locked by the action of a strong coil spring. The toggle must be held out until all wheels are locked down and the green light shows. The position of the front wheel may be seen through a small window in the cockpit floor just forward of the control column. The action can be assisted by diving slightly and pulling up fairly sharply two or three times.
17. Wheel brakes.- These are operated hydraulically by means of pedals on the rudder bar. If the brakes fail through loss of accumulator pressure, keep the pedals depressed and work the handpump. The brakes may be set on for parking by depressing the pedals, pulling out the black knob below the centre of the instrument panel, and then releasing the pedals before the knob. If the pedals are again depressed momentarily, the brakes are automatically released.
18. Nose wheel steering controls.- The nose wheel can be steered from the pilot's cockpit as explained in para.7. This is accomplished hydraulically by means of a steering cylinder and normally the steering controls are operative at all times when the aeroplane is on the ground, but a shut-off valve control (59), fitted on the left-hand side of the cockpit just forward of the fuel valve control box, will disconnect the steering mechanism if required.
19. Pressure head heater.- The switch (65) controlling this heater is on the pilot's electrical panel.

ENGINE CONTROLS

20. Throttle controls.- These controls (33) are mounted on the left-hand side of the pilot's seat in a quadrant which also contains the propeller speed controls, the supercharger and mixture controls.
21. Mixture controls.- These controls (31) are mounted on the throttle quadrant and have four positions which, reading from rear to front, are:-
- (a) FULL RICH. This cuts out the automatic altitude compensation and should only be used when the automatic control unit is believed to be inoperative.
 - (b) AUTO RICH. For all conditions of flight except economical cruising.
 - (c) AUTO LEAN. For economical cruising.
 - (d) IDLE CUT-OFF. For use when starting and stopping the engines.
22. Propeller speed controls.- Hamilton hydromatic constant speed propellers are fitted. The propeller control levers (32), located on the throttle quadrant between the throttle levers and mixture controls, enable the pilot to set the constant speed units to give any desired r.p.m. within the speed range of the unit. Forward movement of the controls increases the engine r.p.m.
23. Propeller feathering controls.- Two electrically-operated oil pumps, one for each propeller, actuate the feathering mechanism. They are controlled by two red push-button switches (1) mounted on the electrical controls switch panel. To operate, push in the respective switch for the propeller to be feathered; the switch will automatically release when the blades reach the fully feathered position. To unfeather, push in the switch and hold until the propeller windmills at the required speed and then release the switch.

24. Two-speed superchargers.- These are controlled by two levers (30), one above the other, on the side of the throttle quadrant. The top lever operates the supercharger on the port engine. The superchargers are in "M" (low) ratio when the levers are fully back. The change from one gear to the other must always be made rapidly and firmly to prevent clutch slip.
25. Carburettor air-intake heat controls.- These controls (86) are situated on the left hand side of the cockpit behind the fuel tank selector cocks. When the control levers are fully back cold air is admitted, and when they are moved forward pre-heated air is admitted. They may be set in any position between fully back and fully forward to adjust the intake temperature as required. Air intake thermometers for both engines are fitted at the bottom right hand corner of the two square instrument dials (18) and (19) on the right side of the instrument panel.
26. Cowling gills.- These controls are fitted on the starboard side of the bulkhead behind the pilot's seat, and operate hydraulically:-
- Upper gills: For ground use only.
OPEN (up) on ground, CLOSED (down) in air.
Controlled by single lever (41) with orange knob.
Pull out to move.
Return lever to NEUTRAL after each operation.
- Lower gills: OPEN (down) on ground.
1/3 OPEN for take-off and climb.
CLOSED (up) for normal flight
Controlled by two levers (42) with white knobs.
Move levers sideways to operate.
Return levers to NEUTRAL
27. Oil cooling.- This is thermostatically controlled, the oil radiators being automatically regulated to give an optimum temperature of 65°C to 75°C.

28. Fuel cock controls.- Two tank selector cocks (87) are fitted on both the Havoc II Fighter and the Havoc II Turbinlite and are on the port side of the cockpit. Each selector cock has three positions.

(a) On the Havoc II Turbinlite these are marked CLOSED, MAIN TANK, and RES.TANK.

(b) On the Havoc II Fighter they are marked CLOSED, MAIN TANK, and AUXILIARY TANK.

Situated below the tank selector cocks are the controls for the pressure balance cock (INTER-FEED ENGINES) (84) and the suction balance cock (INTER-FEED TANKS) (85); each has two positions CLOSED and OPEN.

29. Wobble pump.- Two hand fuel pumps are connected between the TANK INTER-FEED pipeline and the ENGINE INTER-FEED pipeline, one pump being fitted on each side of the balance cocks. They are operated together by a handle (77) marked WOBBLE PUMP, fitted on the left of the pilot's control column, and are used for raising the fuel pressure for priming or in the event of failure of one of the engine-driven pumps.

30. Fuel pressure warning lights.- Two red warning lights (11), one for each engine, are situated at the top right hand corner of the instrument panel and light up when the fuel pressure falls below about 12 lb/sq.in. The immediate action if a red light comes on during flight is to operate the hand fuel pump, then proceed as follows:-

(a) If operation of the hand pump puts the light out, a pump failure is indicated, and the engine balance cock must be turned to OPEN. This will allow the sound pump to supply fuel to both engines. The tank balance cock should be opened.

(b) If operation of the hand pump fails to put the light out, lack of fuel on the affected side is the probable cause, and the tank selector cock should be turned to RES. TANK (or AUXILIARY TANK).

(c) If the light still remains on, failure of the pump relief valve is indicated. In this case the engine balance cock must be turned to OPEN and, to prevent fuel from passing through the faulty valve and back to the tank, the tank selector cock on the affected side must be CLOSED.

31. Fuel pressure gauges.- These are fitted at the top right hand corners of the square instrument dials (18) and (19) on the right hand side of the instrument panel. If these gauges begin to oscillate violently when in flight and the red warning lights begin to flicker, this indicates that there is air in the engine balance pipeline. In this event the air may be expelled by opening the engine balance cock and turning one of the tank selector cocks to CLOSED. After a few seconds the air will be expelled and the cocks should be returned to their normal positions.
32. Fuel contents gauges.- Two gauges (23) are fitted centrally at the bottom of the instrument panel, to measure the contents in the wing tanks, and on the Havoc II Fighter another gauge is fitted below the instrument panel, and measures the contents in the auxiliary tanks.
33. Ignition switches.- Two wing-type ignition switches (2), one for each engine, are mounted on the top left hand side of the pilot's electrical panel. Each switch has three positions marked "1" "2" and "1 + 2". Both must be turned to "1 + 2" when in flight. Originally a master ignition switch was fitted above the individual ignition switches but this has now been deleted.
34. Engine starter switches.- Two switches are provided on the electrical panel for engine starting. The inertia starter is energised by the INERTIA switch (69) and engaged by the clutch switch (70). To start the starboard engine lift up the INERTIA switch and when the inertia wheel is up to speed, lift up the CLUTCH switch, still keeping the INERTIA switch depressed. In starting the port engine, depress the switches while proceeding in a similar manner as when starting the starboard engine.

35. Battery switches.- Two batteries are fitted and their switches are situated at the extreme left of the pilot's electrical controls panel. These switches (63) and (64) must be turned on (by moving downwards) before the engines are started.
36. Generator switches.- Each generator circuit includes a control panel in each nacelle; the two on-off switches, two ammeters and one voltmeter are all fitted on the gunner's electrical controls panel which is on the port side of the rear cockpit.
37. Telegon Instrument System.- The following instruments are controlled electrically, and are switched on by a single switch (68) on the pilot's electrical panel:- Boost gauges, fuel and oil pressure gauges, oil temperature and air intake temperature gauges, undercarriage and flaps indicator. (The battery switches must also be on).

COCKPIT ACCOMMODATION AND EQUIPMENT

38. Pilot's seat.- This is mounted on a steel tube frame by means of four guides. The seat may be raised or lowered when a lever, located on the forward right side, is moved into the full aft position and may be locked when the lever is in the full forward position.
39. Safety harness release control.- This is fitted on the right hand side of the pilot's seat to allow the pilot to lean forward without undoing his safety harness. A catch is provided to hold the control in the released position, and this catch must be released to allow the harness to re-engage.
40. Cockpit entrance.- Normal entrance and exit is made from the port side through the roof which is hinged on the starboard side. From outside, it is unlatched by a handle flush with the surface of the rear corner of the roof. From inside, it is unlatched by a handle at the left side between the forward and aft transparent panels. A brace is provided at the aft end to hold the roof in the open position. When closing the roof from the pilot's seat the knee joint of the brace must be broken by turning a handle fitted on the centre line between the forward and aft transparent panels.

41. Cockpit windows.- The windshield is composed of three panels, the centre panel is of glass and the two side panels are of Plexiglass. There are two side windows on each side of the pilot's cockpit. The forward window on the right hand side of the fuselage is hinged at the top, and may be opened from either inside or outside the fuselage. The forward window on the left hand side is of the sliding type and may be moved aft. The two aft side windows are stationary.
42. Pilot's heating equipment.- An electrical connection (52) is provided on the pilot's right-hand pedestal, to permit the plugging in of connections from an electrically-heated flying suit consuming five amperes.
43. Cockpit lighting.- The switch (74) controlling the cabin lights is fitted on the pilot's electrical panel, also an instrument panel light dimmer switch (62).
44. Oxygen.- The pilot's oxygen panel is on the starboard side of the cockpit in line with the gun charging brackets, and the supply socket is on the bulkhead above the cowling gill controls on the starboard side.
45. Windscreen De-icing.- A glycol spray is provided for the pilot's windscreen, and the hand pump (16) for operating the spray is fitted above the instrument panel on the starboard side of the cockpit.
46. Relief tube.- A relief tube (81) for the pilot is fitted near the floor on the left hand side of the pilot's seat.
47. Map case.- The pilot's map case (34) is on the right side of the cockpit.

OPERATIONAL EQUIPMENT AND CONTROLS

48. General.-
 - (i) The Havoc II Fighter carries a battery of twelve fixed Browning .303 calibre machine guns mounted in a special easily detachable nose section. No bombs are carried, but the bomb door controls (79) and (47) have not been removed from the cockpit.

- (ii) The Havoc II Turbinlite carries no armament, but the armament controls such as the gun-charging handles (53) and (76) and the bomb door controls have not been removed from the cockpit.
49. Gun controls.- The guns are automatically fed and the gun-firing switch (21) is mounted on the right side of the control column wheel. Two gun charging handles (53) and (76) are mounted on brackets just below the instrument panel, but are not required for use with the present twelve-gun installation.

NAVIGATIONAL, SIGNALLING AND LIGHTING EQUIPMENT

50. Radio control box.- A remote contactor (60) and electric controller (61) are fitted on the port side of the pilot's cockpit.
51. I.F.F. Master switch.- This switch (56) is fitted below the window on the port side of the pilot's cockpit.
52. Intercommunication.- The pilot's mic./tel. socket (38) is fitted on the starboard side of the cockpit, aft of the trimming tabs controls.
53. Signal pistol.- A signal pistol holster is fitted in the floor of the pilot's cockpit on the starboard side near the seat, and six cartridge stowages (51) are located below the compass (50).
54. Call light.- A pilot's call light and switch (20) is fitted at the bottom right hand corner of the instrument panel.
55. Identification lights.- These are controlled by two switches (57) (one an on-off switch for STEADY and the other a press-button switch for SIGNALLING) mounted on the port side of the cockpit, immediately below the window.
56. Formation lights.- These are controlled by an ON-OFF switch (58) mounted beside the identification lights switches.

57. Landing lamps.- Two landing lamps are fitted, one in the under surface of each wing, and may be lowered hydraulically by two levers (39) (one for each lamp) mounted on the bulkhead behind and to the right of the pilot's seat. The levers have white disc-shaped knobs at their ends, and to lower a lamp the appropriate lever must be held to LOWER (up) until the lamp is at the desired angle. The lever returns to neutral automatically when released. The lamp is retracted by holding the lever to STOW (down) until the operation is complete, and then releasing it. A single switch (67) is provided on the electrical panel and lights both lamps simultaneously.

EMERGENCY EQUIPMENT AND CONTROLS

58. Fire extinguisher system.- Each engine nacelle contains a separate fire extinguishing system which discharges C.O₂ gas through distribution lines running into the engine accessory section and nacelle. The systems are automatically worked by means of flame and impact switches. Two hand type fire extinguishers are also provided, one stowed in the bulkhead on the starboard side of the pilot's seat, and the other in the rear compartment.
59. Parachutes.- Both the pilot's seat and the seat in the rear compartment are constructed to accommodate seat type parachutes.
60. Emergency exits.- These are shown in figure 4 and are as follows:

- (1) Pilot's cockpit.- The pilot's roof is fitted with an emergency release handle at the aft transparent panel. Pulling this handle unlatches the roof and also pulls the pins from the hinges at the right-hand side and from the brace at the aft end. A push on the roof allows the airstream to carry it away. If the emergency exit becomes inoperative or is inaccessible, the right forward cockpit window, hinged at the top of the cockpit frame, may be used as a crash exit by opening from inside or from outside. To open from within, pull aft on latch at base of window. The latch may be reached from the exterior by removing the fabric patch marked EMERGENCY - PULL.

- (11) Rear cockpit.- Emergency exit should be made through the lower door which is opened by means of a latching handle in the centre of the door or by operating the crank mechanism on the right side of the compartment. The upper hatch may be used as a crash exit and is opened by releasing the two latches at the upper forward end of the sliding section, allowing the forward end to drop down and then sliding it forward under the fixed section as far as it will go. A latch is provided to hold the section in the fully forward position. The hatch may be opened from the exterior by tearing open a fabric patch covering the upper left latch access opening and releasing the latch.

Note: The upper right latch, when engaged, prevents the hatch being opened from the exterior.

61. Dinghy.- Both members of the crew are provided with a K type dinghy.
62. Flares.- Two flare racks are fitted on the bulkhead at the aft end in the nose wheel well. The flare release handles (45) and (47) are on the floor on the right of the pilot's seat.
63. I.F.F. Radio emergency switches.- Two emergency destruction switches (55) for the I.F.F. receiver are mounted under a small flap marked DANGER on the port side of the pilot's cockpit below the window.

Key to fig. 1.

GENERAL VIEW OF COCKPIT.

1. Propeller feathering buttons
2. Ignition switches
3. Rate of climb indicator
4. Undercarriage Red warning light
5. Airspeed indicator
6. Altimeter
7. Directional Gyro
8. Beam approach visual indicator
9. Artificial horizon
10. Radio compass
11. Fuel pressure warning lights
12. Boost gauge
13. Engine speed indicator } port engine
14. Boost gauge } starboard engine
15. Engine speed indicator }
16. Windscreen de-icing pump
17. Hydraulic pressure gauge
18. Port engine gauge unit
19. Starbd. engine gauge unit
20. Pilot's call light and switch
21. Gun firing switch
22. Engine temperature indicators
23. Fuel contents gauges
24. Rudder lock hook
25. Control column and handwheel
26. Time of flight clock
27. Suction gauge
28. Turn and Bank indicator
29. Undercarriage and flaps indicator
30. Supercharger controls
31. Mixture controls
32. Propeller speed controls
33. Throttle controls

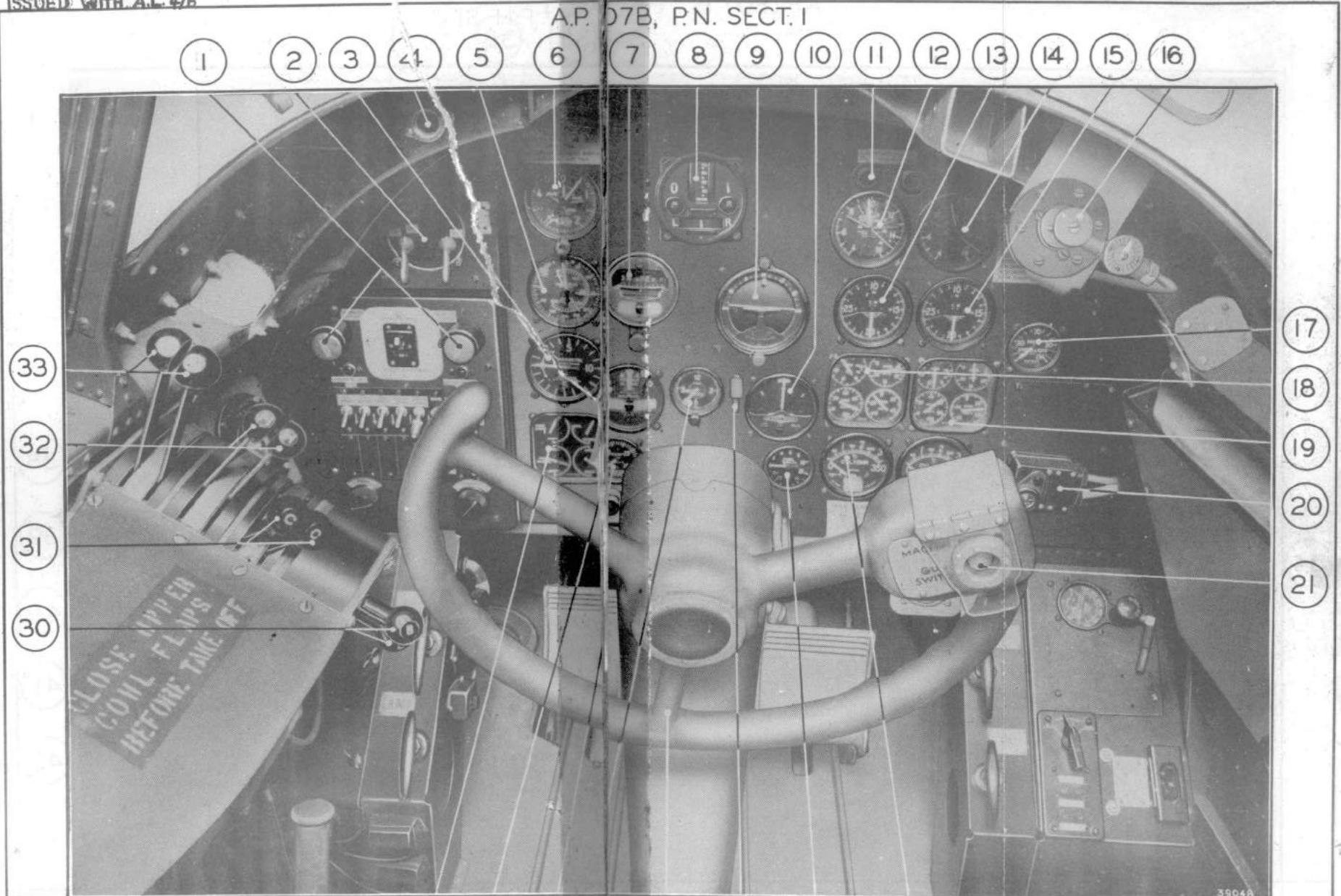


FIG. 1

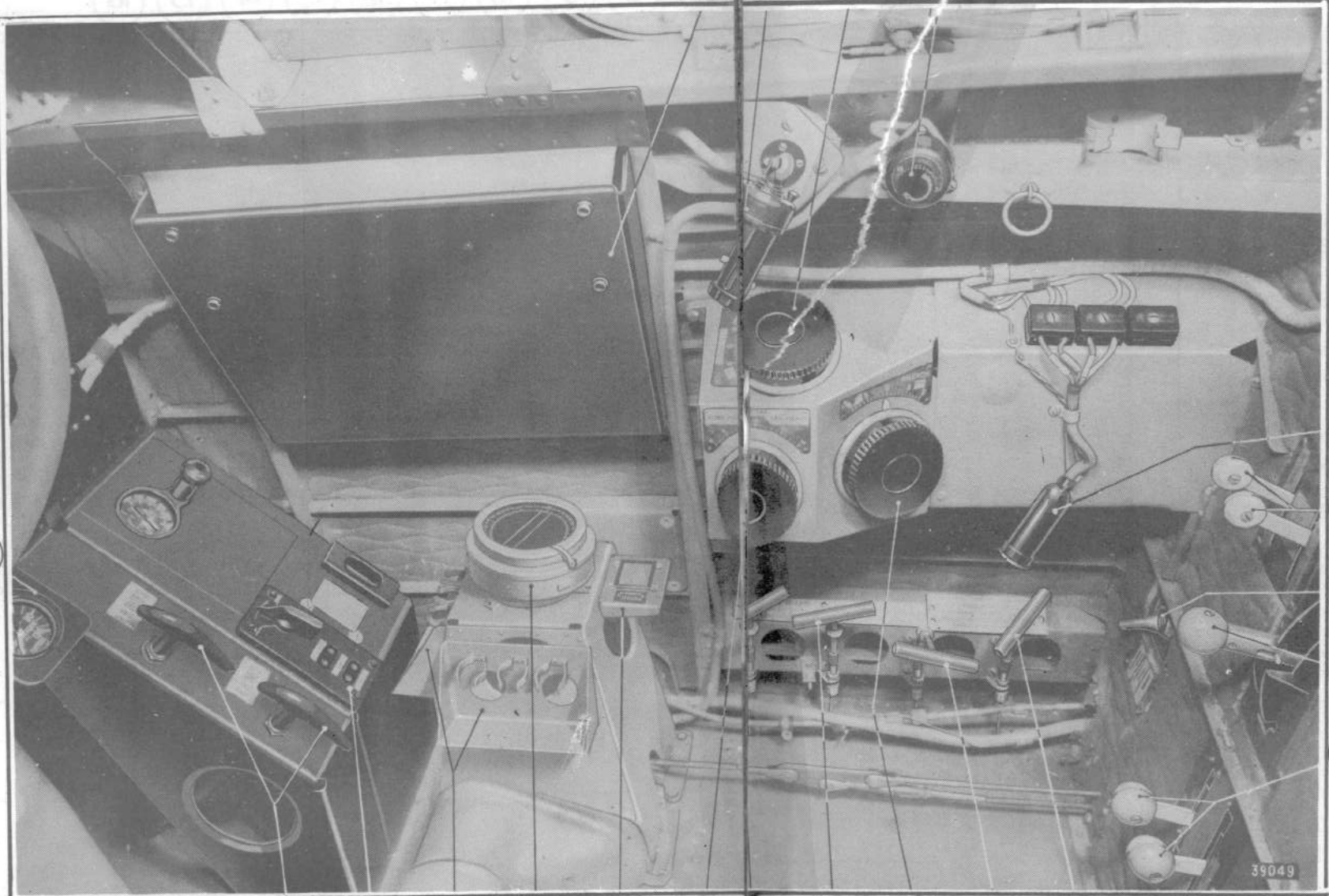
29 28 27 25 24 23 22

GENERAL VIEW OF COCKPIT

FIG. 1

F.S./10.

(34) (35) (36) (37)



(54)

(38)

(39)

(40)

(41)

(42)

(53)

(52)

(51)

(50)

(49)

(48)

(47)

(46)

(45)

(44)

(43)

FIG. 2

STARBOARD SIDE COCKPIT

FIG. 2

39049

Key to fig. 2.

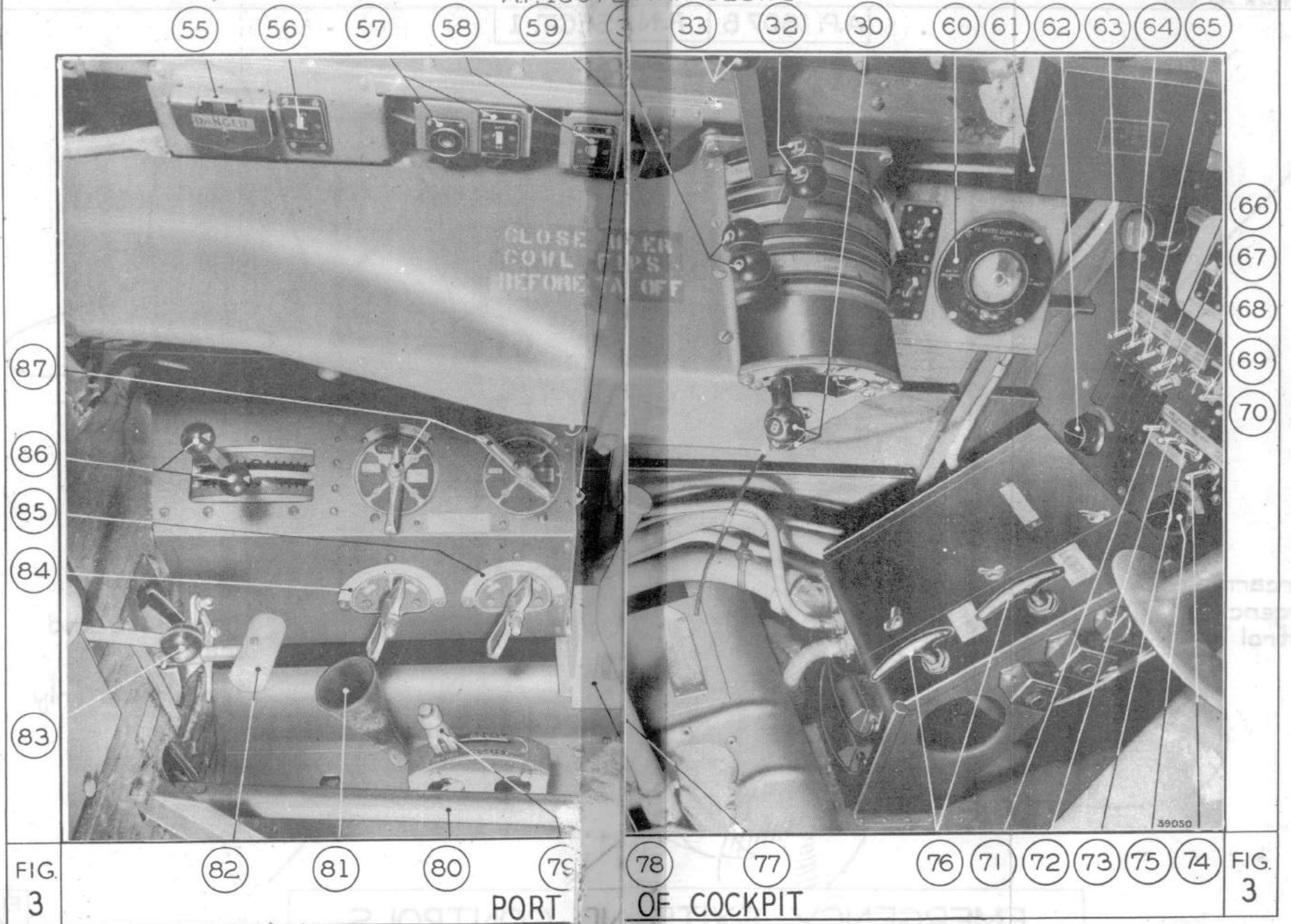
STARBOARD SIDE OF COCKPIT.

- 34. Pilot's map case.
- 35. Light for illuminating trimming tabs
controls
- 36. Rudder trimming tab control
- 37. Dimmer switch for light (35)
- 38. Pilot's mic/tel. socket
- 39. Landing lamps lowering controls
- 40. Vacuum pump selector cock
- 41. Upper cowling gill control
- 42. Lower cowling gills controls
- 43. Undercarriage emergency release control
- 44. Flare release.
- 45. Aileron trimming tab control
- 46. Flare release.
- 47. Emergency bomb release (not now required)
- 48. Elevator trimming tab control
- 49. Compass deviation card holder
- 50. P.4. compass
- 51. Signal pistol cartridge stowages
- 52. Flying suit heating control
- 53. Gun charging handles (not now required)
- 54. Undercarriage hydraulic pressure gauge

Key to fig.3.

PORT SIDE OF COCKPIT.

30. Supercharger controls
31. Mixture controls
32. Propeller speed controls
33. Throttle controls
55. I.F.F. emergency switches.
56. I.F.F. master switch
57. Identification lights switches
58. Formation lights switch
59. Nose wheel steering valve
60. Wireless remote contactor
61. Wireless controller
62. Panel lights switch
63. L.H. Battery switch
64. R.H. Battery switch
65. Pressure head heater switch
66. Running lights switch
67. Landing lamps switch
68. Instruments switch
69. Starter INERTIA switch
70. Starter CLUTCH switch
71. Fuel warning light test switch
72. Undercarriage warning system test switch
73. Warning horn switch
74. Cockpit lights switch
75. Compass light dimmer switch
76. Gun charging handles (not now used)
77. Wobble pump
78. Radio mixer box.
79. Bomb doors control (not now used)
80. Hydraulic hand pump
81. Pilot's relief tube
82. Undercarriage control lever
83. Flaps control lever
84. Engine cross feed cock.
35. Tank cross feed cock.
86. Carb. air intake heat controls.
87. Fuel tank selector cocks.



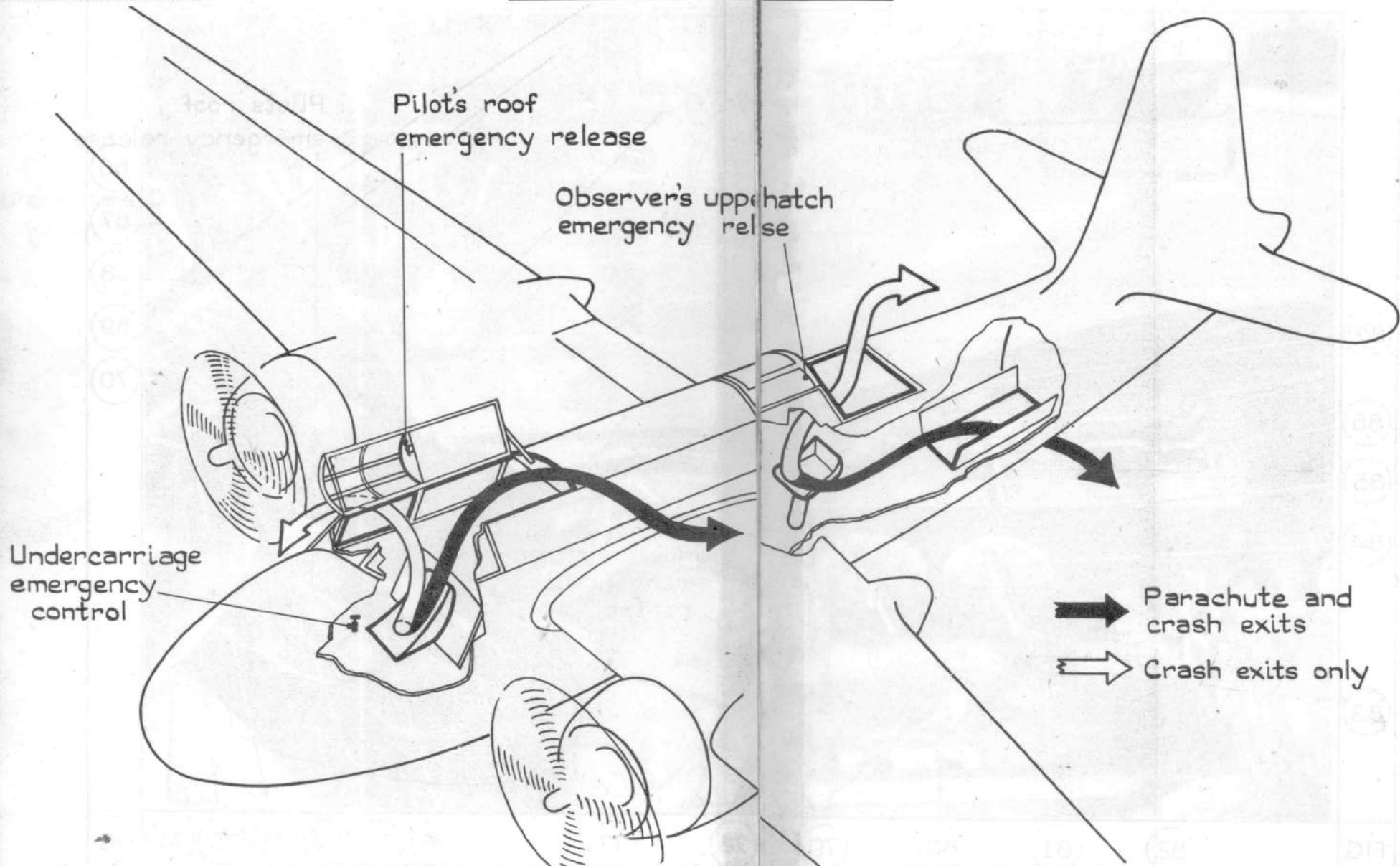
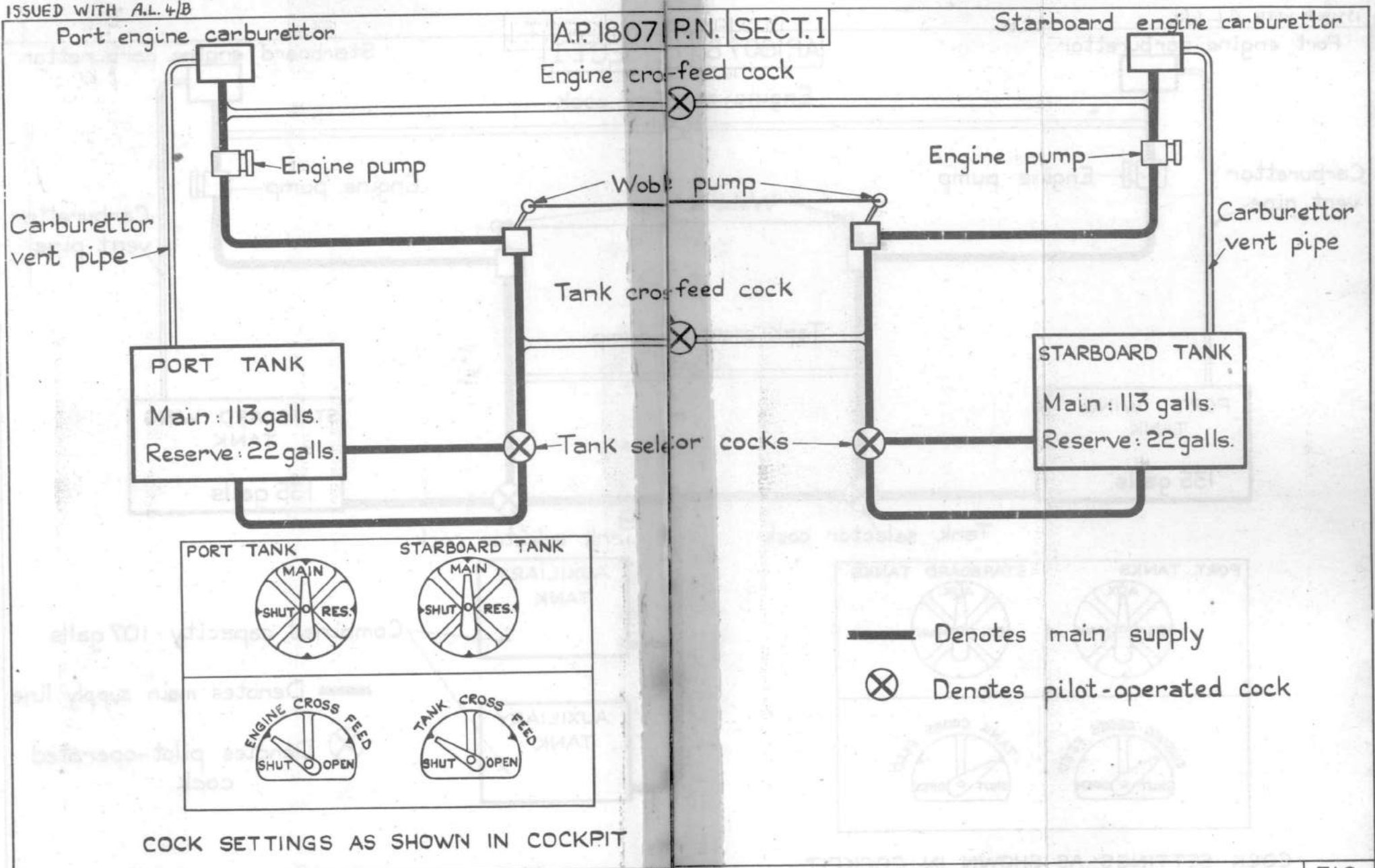




FIG. 4

EMERGENCY EXITS AND CONTROLS

FIG. 4

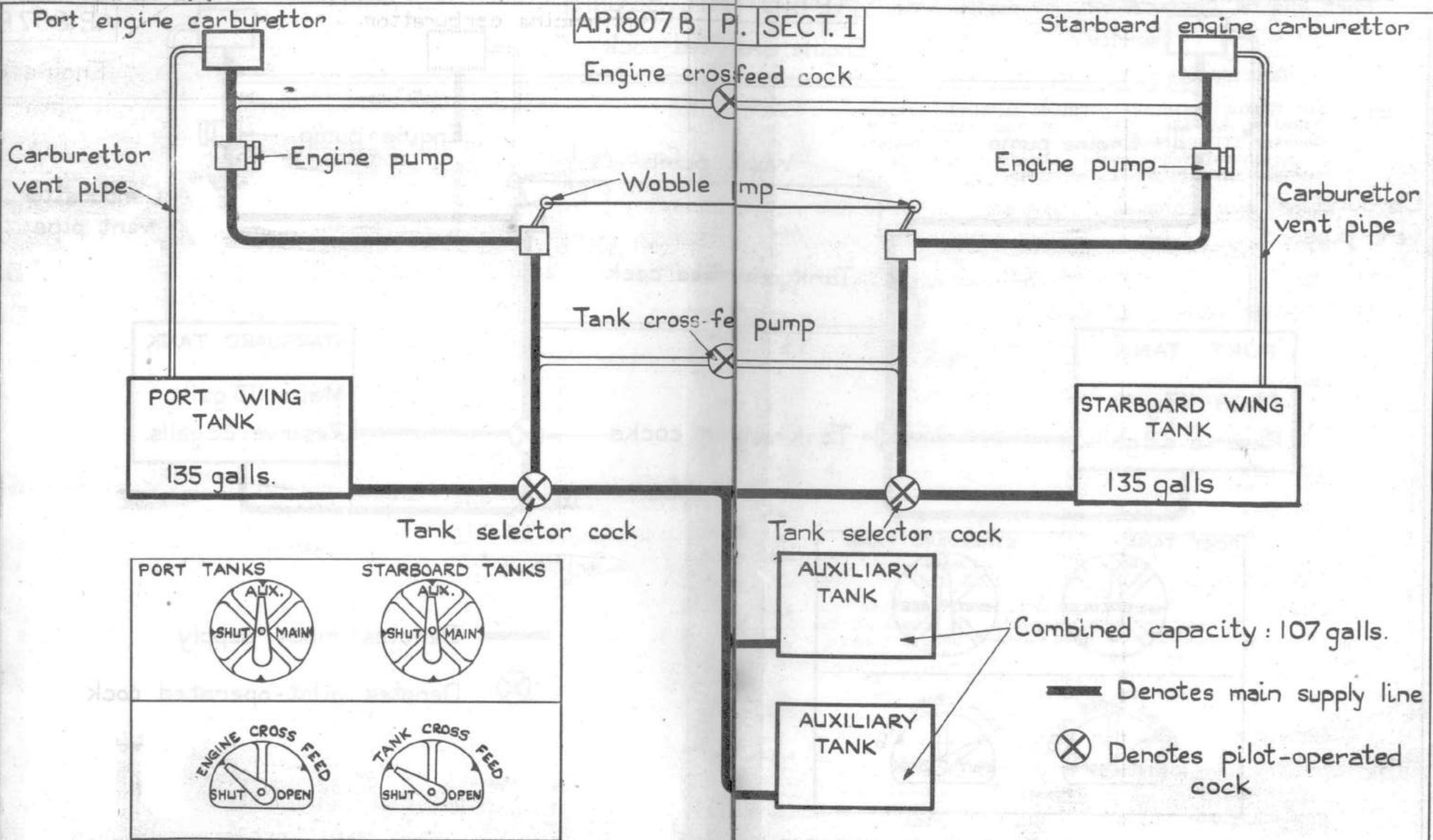


COCK SETTINGS AS SHOWN IN COCKPIT

 Denotes main supply
 Denotes pilot-operated cock

ISSUED WITH A.L. 4/8.

AP.1807 B P. SECT. I



Combined capacity: 107 galls.

COCK SETTINGS AS SHOWN IN COCKPIT

SECTION 2

HANDLING AND FLYING NOTES FOR PILOT

Note. - The flying technique outlined in these notes is based on A.P.129, Flying Training Manual, Part I, Chapter III and A.P.2095, Pilot's Notes General, to which reference should always be made if further information is required.

1. ENGINE DATA - CYCLONE G.R.2600 A5B.

- (i) Fuel. - 100 octane only.
 (ii) Oil. - See A.P.1464/C.37.
 (iii) Principal engine limitations.

	R.p.m.	Boost in.Hg.	(Pz x 10)	Temp. °C. Cylr. Oil inlet
MAX. TAKE-OFF TO 1,000 FT. M	2,400	45	15.2	
MAX. CLIMBING $\frac{1}{2}$ HR. LIMIT S	2,300	37	12.4	220 (230) 105
	2,300	41 $\frac{1}{2}$	14.1	220 (230) 105
MAX. RICH CONTINUOUS M	2,050	31	10.5	205 95
	2,050	34	11.5	205 95
MAX. WEAK CONTINUOUS M	2,050	28 $\frac{1}{2}$	9.6	205 95
	2,050	31 $\frac{1}{2}$	10.7	205 95
MAX. ALL-OUT 5 MINS LIMIT M	2,400	45	15.2	230 105
	2,400	44 $\frac{1}{2}$	15.0	230 105

Note (a) Where different boost limitations are quoted for M and S gears, the lower of the two should be used, except when necessary in operations.

(b) The climbing cylinder temperatures in brackets are permissible for 15 minutes only.

OIL PRESSURE: Maximum in flight: 90lb/sq.in. (82.1Pz x 10)
 Normal: 85lb/sq.in. (58.6Pz x 10)
 Minimum in flight: 75lb/sq.in. (51.7Pz x 10)
 Idling: 30lb/sq.in. (20.7Pz x 10)

MINM. TEMPS. FOR TAKE-OFF OIL: 10°C rise
 CYLR: 120°C

Stopping engine: Max. cylinder temp: 150°C.

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- (iv) Fuel pressure 12 - 16 lb/sq.in.
- (v) Important note.- Owing to the fact that certain r.p.m. cause high tip stresses in the propellers, it is most important that these ranges should at all times be avoided. The ranges are 1,500 - 1,650 r.p.m. and 2,050 - 2,150 r.p.m.

2. FLYING LIMITATIONS AND SPEEDS

- (1) Maximum weight for all forms of flying:- 16,700 lb.

Maximum overload weight for take-off
and straight flying only:- 19,245 lb.

- (1i) Maximum speeds for:-

Diving 375 m.p.h.I.A.S. (600 k.p.h.)

Flaps down 168 " " (270 k.p.h.)

Undercarriage down 355 " " (570 k.p.h.)

3. MANAGEMENT OF FUEL SYSTEM

- (1) Without fuselage tanks.- Take-off with cocks set to MAIN, unless the tanks are not more than half full, in which case take-off with the cocks set to RESERVE, and change over to MAIN when a safe height is reached. If one tank is found to be emptying, turn off its cock and then open the TANK CROSS FEED (suction balance) cock.
- (1i) With fuselage tanks.- Take-off should be made on MAIN tanks but the AUXILIARY tanks should be used as soon as possible after take-off.
- (1ii) The ENGINE CROSS FEED (pressure balance) cock is normally kept shut, but may be opened in the event of failure of either engine pump.
- (1iv) The TANK CROSS FEED (suction balance) cock is normally kept shut, but may be opened in emergency to enable either engine to be fed by tanks on the other side.

4. PRELIMINARIES

- (1) Before entering the cockpit, check that the flaps are fully up, as the flaps indicator is not entirely reliable.
- (ii) On entering the cockpit check:-
- | | |
|---|----------------------------|
| Undercarriage selector lever | - LOWER |
| Both battery switches on left of auxiliary switch panel | - ON (Check green lights). |
| Generator switches (in rear cockpit) | - ON |
| Instrument switch | - ON |
| Flaps | - UP (Check by indicator) |
| Flap selector lever | - Neutral |
| Fuel tanks | - Check contents. |

5. STARTING THE ENGINE AND WARMING UP

Note:- Start the starboard engine first.

- (1) Cooling is inadequate on the ground at engine speeds above about 1,400 r.p.m., and the engine should only be run at higher speeds for the minimum time required to make the necessary tests. All cowling gills must be fully OPEN for all ground running.
- (11) If the engines have been standing idle for 4 hours or more they must always be turned over by hand in the normal direction of rotation for four or five revolutions. This is to ensure that sufficient oil has not drained into the bottom cylinders to fill the compression spaces and damage the engines.
- (111) Turn the fuel tank selector cocks to MAIN.

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(iv) See that both balance cocks are CLOSED (it is very important that the engine balance cock should be CLOSED, otherwise when one engine is started the induction system of the other will be flooded with neat fuel.)

(v) Set:-

Throttles	- about 1 inch open
Mixture controls	- CUT OFF
Propeller speed controls	- Fully forward
Two speed super-charger	- "M" ratio (levers fully back)
Upper and lower cowling gills	- OPEN
Carburettor air-intake heat controls	- COLD (fully back)

(vi) Work the hand fuel pump slowly to obtain a pressure of 10 lb/sq.in. (7.0 Pz x 10).

(vii) If the engine is cold, instruct the crew to prime it. About 4 - 5 full pumps are required.

Note:- Over-priming should be avoided, as this causes fuel to flow from the exhaust pipe and may result in a fire.

(viii) Set switch for starboard engine "1 + 2".

(ix) Energise the starboard inertia starter by holding the LEFT hand switch UP for not more than 15 seconds.

Note:- If the engine begins to turn, return the switch to neutral and turn the propeller forward about half a revolution. This will free the starter from the engine.

- (x) With the left hand switch still in the up position, maintain fuel pressure as in (vi) and engage the starter by holding the RIGHT hand switch UP.
- (xi) Keep both switches in the up position until the engine starts, but not for more than 15 seconds.
- (xii) As soon as the engine is firing regularly move the mixture control back slowly to AUTO RICH, and give the hand fuel pump one quick stroke to bring the fuel pressure up to about 15 lb/sq.in.
- (xiii) If the engine fails to pick up, return both switches to neutral, stop pumping at once, move the mixture control to CUT-OFF, wait 15 to 20 seconds and make another attempt.
- (xiv) If the engine is hot, do not prime it, but act as follows:-
 - (xv) Put the left hand (energising) switch to the UP position and immediately afterwards put the right hand (engaging) switch UP.
 - (xvi) Keep both switches in the up position until the engine starts, but not for more than 15 seconds.
 - (xvii) As soon as the engine is firing act as in (xii).
 - (xviii) If the engine fails to pick up, act as in (xiii).

6. TESTING ENGINES AND INSTALLATIONS

- (1) While warming up, make the usual checks of temperatures, pressures and operation of controls.
Hydraulic pressure should be 900-950 lb/sq.in. (59-62 HPz).
- (ii) After warming up, open throttle to give 20 in.Hg. boost (8.5Pz x 10) and test the operation of the constant speed units and superchargers.
- (iii) Open up to full throttle momentarily and check static r.p.m. and boost.
- (iv) Reduce to 30 in.Hg. boost (10 Pz x 10) and test magnetos. Drop in r.p.m. should not exceed 100. Also check oil pressure.

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7. TAXYING OUT

- (1) Before taxiing out, instruct the ground crew to remove and hold up the safety locking pins (if fitted) from the undercarriage and see that the hydraulic pressure is at least 500 lb/sq.in. (34 HPz.)
- (ii) When starting from rest, the engines must not be opened up on one side only for turning, unless the nose wheel is also turned in the same direction.
- (iii) When taxiing do not overstrain the nose wheel by turning sharply.
- (iv) The brakes are smooth but rather heavy in operation.
- (v) If the nose wheel steering control is not being used, a damper, fitted to prevent shimmying, also prevents the wheel from castoring freely at very low speeds. If the nose wheel is found to shimmy when taxiing, taking off or landing, the aeroplane must be brought in at once.

8. DRILL OF VITAL ACTIONS FOR TAKE-OFF

Drill is "T.M.P., Fuel, Flaps, Gills and Superchargers".

- | | | |
|---------------|--------------------|--|
| T | - Trimming tabs | - Elevator: about zero.
Rudder: 2° right.
Aileron: neutral. |
| M | - Mixture controls | - AUTO RICH |
| P | - Propeller | - Controls fully forward. |
| Fuel | | - Both tank selector cocks set to MAIN TANK (On Turbinlite aeroplanes if the latter are not half full, the take-off should be made on the reserve tanks and changed over to main tanks when at a safe height). |
| Flaps | | - UP (for take-off with a heavy load on a small aerodrome, flaps may be set one-third down). |
| Gills | - Upper Gills | - CLOSED |
| | - Lower Gills | - One third open or less. |
| Superchargers | | - M ratio (levers fully back). |

V.IMP. ||

9. TAKE-OFF

- (1) Taxi forward for a few yards to straighten the nose wheel, then, taking care to keep the toes clear of the brake pedals, open the throttles steadily, taking care not to exceed the maximum take-off boost.
- (ii) Hold the control column back slightly as the aeroplane accelerates, then as the speed approaches 100-110 m.p.h. (160-175 k.p.h.) move it steadily further back until the aeroplane leaves the ground. Considerable backward pressure is required on the control column, as the aeroplane is nose heavy when on the ground and will never fly itself off. After leaving the ground the nose heaviness disappears.
- (iii) Do not start to climb until safety speed of 135 m.p.h. I.A.S. (220 k.p.h.) has been reached.

Note:- On the Havoc II (Turbinlite) the above speeds should be increased by 5 - 10 m.p.h. (10 - 20 k.p.h.).

10. CLIMBING

- (1) The speed for maximum rate of climb is 150 m.p.h. I.A.S. (240 k.p.h.) up to a height of 12,000 feet (3,600 m), after which reduce speed by 3 m.p.h. (5 k.p.h.) per 2,000 feet (600 m).
- (ii) For maximum rate of climb, change to 3 ratio when boost has fallen to 32 inches (about 9,500 feet). When climbing in weak mixture, change to 3 ratio when boost has fallen to 24½ inches (about 15,000 feet).
- (iii) When changing supercharger gear throttle back in order to avoid the maximum permissible boost from being exceeded when high gear is engaged.

11. GENERAL FLYING

- (1) Stability.- This aeroplane is exceptionally stable and all the controls are excellent.

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(ii) Change of trim.-

Undercarriage down - Nose down
Flaps down - No change
Gills closed - Nose down.

(iii) Maximum range.- Fly in weak mixture at $28\frac{1}{2}$ inches boost and reduce speed by reducing r.p.m., which may be as low as 1,650 if this will give the recommended speed. S ratio should not be used if the recommended speed can be obtained in M ratio. Recommended speeds:

Out (fully loaded)	190 m.p.h. I.A.S. (306 k.p.h.)
Home (light)	175 m.p.h. I.A.S. (281 k.p.h.)

(iv) Maximum performance.- For all out level flight, use S ratio above 9,000 feet.

(v) Flying in bad visibility.-

The flaps may be lowered 15° and the speed reduced to 140 m.p.h. I.A.S. (225 k.p.h.) The propeller speed control should be set to give about 1,900 r.p.m.

(vi) Minimum drag.-

In the event of total engine failure, fully close the cowlings gills and feather both propellers (one at a time). Glide at about 140 m.p.h. I.A.S. (225 k.p.h.).

12. FUEL AND OIL CAPACITIES AND CONSUMPTION

(i) Fuel capacity:-

Havoc II Fighter

Main tanks 2 x 113 gallons	- 226 gallons
Reserve " 2 x 22 "	- 44 "
Auxiliary" 107 "	- <u>107</u> "
Total effective capacity	377 gallons (1710 litres)

Havoc II Turbinlite.

Main tanks 2 x 113 gallons	- 226 gallons
Reserve " 2 x 22 "	- <u>44</u> "
Total effective capacity	270 gallons (1225 litres)

(ii) Oil capacity:-

2 x 12½ gallons

24½ gallons

(iii) Fuel consumptions.(a) Rich mixture

<u>R.p.m.</u>	<u>boost in.Hg.</u>	<u>Total galls/hr</u> (both engines)
2,400	43	approx. 350
2,300	36½	" 260

(b) Weak mixture at 15,000 ft. M ratio.

1,850	23½	approx. 100
1,500	21½	" 75

(c) Weak mixture at 15,000 ft. S ratio.

1,850	27	approx. 105
1,500	27	" 90

13. STALLING

- (1) Owing to the position of the pressure head, it is impossible to define an exact stalling I.A.S. reading. With flaps up some warning of the stall is given by slight oscillation fore and aft on the elevator; with flaps down there is little warning other than some tail vibration with the control column right back. The control is good right down to the stall. At the stall a wing drops quickly, but can be easily recovered. The aeroplane is not very prone to spin and the incipient spin is easily checked.

- (ii) The approximate stalling speeds in m.p.h. I.A.S. are:-

At 15,000 lb. At 17,000 lb. At 19,000 lb.
m.p.h. (k.p.h.) m.p.h. (k.p.h.) m.p.h. (k.p.h.)

Flaps and
undercarriage
UP. 98 (155) 104 (165) 110 (175)

Flaps and
undercarriage
DOWN. 86 (150) 91 (145) 96 (150)

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14. SPINNING AND AEROBATICS

Spinning and aerobatics are not permitted.

15. DIVING

- (i) In a dive the aeroplane tends to become tail heavy and the trimming tabs should be used carefully to correct this.
- (ii) As no automatic boost controls are fitted the boost pressures will rise as altitude is lost in a dive, and care must therefore be taken when diving with large throttle openings, that the maximum permissible boost is not exceeded.
- (iii) For speeds up to 355 m.p.h. I.A.S., the under-carriage may be lowered and used as a dive brake.

16. APPROACH AND LANDING

- (i) Close gills and turn fuel cock to RESERVE, or, on aeroplanes with auxiliary tanks, to the tanks containing most fuel.
- (ii) Check hydraulic pressure on top gauge.
- (iii) Depress brake pedals and check that pedal pressure can be felt, and that hydraulic pressure shows a momentary small drop.
- (iv) Reduce speed to 180 m.p.h. I.A.S. and carry out the Drill of Vital Actions.

U - Undercarriage - Down (Check green lights and that hydraulic pressure builds up on bottom gauge to the same figure as on top gauge).

M - Mixture controls - AUTO RICH

P - Propeller - Controls fully forward.

Superchargers - M ratio

Flaps - Fully down (not above 165 m.p.h. I.A.S.)

- (v) After lowering flaps, check that hydraulic pressure is still adequate on top gauge. If not, handpump will be needed for brakes.
- (vi) Landing is easy. When there is ample landing space, the easiest landing is as follows. Approach in the normal manner but when flattening out ease the control column back just too slowly for normal landing, so that the aeroplane sinks slowly on to the main wheel in a slightly tail down attitude. On touching down continue to move the control column back so that the aeroplane pitches gently forward on to the nose wheel.
- (vii) The aeroplane must not be landed nose wheel first nor "three point" nor with a high rate of descent. The brakes must not be applied until the nose wheel is on the ground, nor should they be applied harder than necessary. Without them, however, the aeroplane has a very long landing run. This must be borne in mind when the ground is wet or slippery, when the brakes may be almost completely ineffective.
- (viii) The landing run may be considerably reduced by increasing the tail down attitude. Care must be taken not to drop the aeroplane on to the main wheels, otherwise it will pitch forward violently on to the nose wheel.

Note.- For particulars of the tricycle under-carriage technique see A.P.2095/17.

- (ix) The recommended approach speeds with the aeroplane loaded to about 17,000 lb. are:-

Engine assisted	105 m.p.h. I.A.S. (170 k.p.h.)
Glide	115 " " (185 ")

Note.- On the Havoc II (Turbinlite) these speeds should be increased by 5-10 m.p.h. (10-20 k.p.h.)

17. MISLANDING

- (1) The aeroplane will climb satisfactorily with flaps and undercarriage down at a speed of about 125 m.p.h. I.A.S. (200 k.p.h.).

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- (ii) The tail heaviness which results from opening the throttles with the elevator trimming tab set for landing increases as the undercarriage retracts, and the elevators should be retrimmed.

18. AFTER LANDING

- (i) Before taxiing in, the nose wheel steering control may be engaged.
- (ii) After taxiing in change supercharger gear to S ratio and back to M.
- (iii) Stop the engines by running them at a fast tick over and then put the mixture controls to CUT-OFF (see para.1 (iii)).
- (iv) After the engines have stopped switch OFF the ignition, turn OFF the fuel cocks and switch off all other electrical switches.

19. ENGINE FAILURE

- (i) This aeroplane has very good single engine performance and is exceptionally easy to control.
- (ii) Safety speed is 135 m.p.h. I.A.S. (220 k.p.h.)
- (iii) Recommended climbing speed on one engine is 170 m.p.h. I.A.S. (275 k.p.h.)
- (iv) When on the final approach great care must be taken not to lower the flaps too early and thereby undershoot, as it is impossible to fly level with flaps and undercarriage down.
- (v) The initial speed of approach should be about 130 m.p.h. I.A.S. (210 k.p.h.) reducing to about 115 m.p.h. I.A.S. (185 k.p.h.) after lowering the flaps.

20. FEATHERING

- (i) Hold the button in only long enough to ensure that it stays in by itself; then release it so that it can spring out when feathering is complete.

- (11) Close throttle immediately.
- (111) Switch off only when the engine has stopped.

21. UNFEATHERING

- (1) Set throttle closed or slightly open, propeller control fully back and ignition on.
- (11) Hold the button in until r.p.m. reach 1,000 to 1,300.
- (111) If the propeller does not return to normal constant speed operation, open throttle slightly.

22. PROCEDURE IN EVENT OF HYDRAULIC FAILURE

- (1) If the checks of paras 16(11) and (111) are not satisfactory, or if after these checks the undercarriage fails to go down under power, then the flaps should be lowered before the undercarriage, so that any hand pumping of the flaps may be followed by a check of the brakes, and the undercarriage only lowered if this check is satisfactory.
 - (a) Select flaps down.
 - (b) If the handpump has to be used, watch the flap indicator; if the flaps do not begin to move, stop pumping and return selector to neutral to conserve fluid for brakes.
 - (c) Check brake pedal pressure again while working handpump.
 - (d) If the brake operation is satisfactory, do not risk wasting fluid by using the handpump to lower the undercarriage.
Use the mechanical lowering system.
- (11) If no hydraulic failure is apparent until after undercarriage has been lowered normally, and flaps then fail to go down under power.
 - (a) Do not risk wasting fluid by handpumping to lower flaps.
 - (b) Return flap selector to neutral.
 - (c) Check brake pedal pressure without operating handpump. If not satisfactory, handpump will be needed for brakes.

23. UNDERCARRIAGE AND BRAKES EMERGENCY OPERATION

- (i) To lower undercarriage mechanically.
 - (a) Select undercarriage down.
 - (b) Reduce speed to 140 m.p.h. I.A.S.
 - (c) Pull out emergency lowering handle and keep it fully out until all three wheels are locked down.
 - (d) Depress the nose and pull up sharply to assist the undercarriage into place. Repeat if necessary.
 - (e) Return selector to neutral.
- (ii) To supply pressure to brakes with handpump
 - (a) Depress pedals fully, and lock on.
 - (b) Work handpump until required degree of braking is obtained.

Note.- A check valve directs the handpump output first to the brakes, whatever the position of the selector levers; but it is preferable, as a precaution against loss of fluid, that all selectors should be neutral while the brakes are being supplied by the handpump.

24. CORRECTION FOR POSITION ERROR.

At any weight the correction may be taken as constant at -5 m.p.h. (8 k.p.h.) at all speeds from 140 to 300 m.p.h. I.A.S. (225-485 k.p.h.)

