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AIR PUBLICATION 1579 A
Pilot's Notes

PILOT'S NOTES

THE HAMPDEN I AEROPLANE

TWO PEGASUS XVIII ENGINES

This handbook is promulgated for the information and guidance of all concerned

By Command of the Air Council

A.W. STREET

AIR MINISTRY

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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.	1	2	3							
Prelimy. matter	JH									
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Section 2										
Section 3										
Section 4										
Section 5										
Section 6										
Section 7										
Section 8										
Section 9										
Section 10										
Section 11										
Section 12										
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Introducn.										
Section 1										
Section 2										
Section 3										
Section 4										
Section 5										
Section 6										
Section 7										
Section 8										
Section 9										
Section 10										
Section 11										
Section 12										
Date of incorpn.										

Note to official users

Air Ministry Orders and Volume II leaflets as issued from time to time will affect the subject matter of this publication. It should be understood that amendment lists are not always issued to bring the publication into line with the orders or leaflets and it is for holders of this book to arrange the necessary linking-up.

Where an order or leaflet contradicts any portion of this publication, an amendment list will generally be issued, but when this is not done the order or leaflet must be taken as the overriding authority.

LIST OF SECTIONS

Introduction

Section 1 - Controls and equipment in pilot's cockpit

Section 2 - Handling and flying notes for pilot

R.T.P./246. 1200. 10/39.

INTRODUCTION

Note:- This Introduction and Sections 1 and 2 are also issued separately as "Pilot's Notes"

1. The Hampden I is an all-metal mid-wing monoplane powered with two Pegasus XVIII engines, fitted with constant-speed airscrews. It is designed and equipped for the duties of a medium bomber, and carries a crew of four, consisting of pilot, front gunner (who is also the navigator and bomb aimer), upper rear gunner (who is also the wireless operator), and lower rear gunner. The aeroplane has an overall length of 53 ft. 7 in. an overall wing span of 69 ft. 4 in. and an overall height of 15 ft. 0 in. when at rest on its undercarriage and tail wheel.

2. Entrance to the aeroplane may be made either (i) through a door on the port side forward of the lower gun station, or, (ii) through the sliding hood over the pilot's cockpit, which is reached with the aid of a short ladder (stowed in the fuselage), a walkway on the port plane, and a footstep on the cockpit cover coaming. Emergency exits may be made (i) through a trap door on the underside of the fuselage aft of the nose cockpit, (ii) by sliding back the pilot's hood (iii) by tilting back the upper rear gunner's hood, (iv) through a sextant observation hatch in the roof aft of the pilot's cockpit, and (v) by jettisoning the main entrance door. Bomb-aiming instruments and controls together with the front gun and the navigating equipment are located in the nose cockpit, which is fitted with an optically-true flat window to facilitate bomb-aiming. The pilot's cockpit is aft of and slightly above the nose cockpit. Accommodation for the wireless operator and rear upper gunner is provided at the rear of the fuselage and the lower gunner's station is below and slightly aft of the upper gunner.

3. The fuselage is of light-alloy monocoque construction and is in three portions, the front and rear fuselage which together form the main portion, and a tail boom of rounded rectangular section which carries the tail unit. The main plane, consisting of a centre plane and two outer planes, is a single-spar stressed-skin cantilever structure, tapering in chord and thickness. The spar is a torsionally stiff D-section member consisting of a built up main beam forward of which are ribs carrying a false spar and alclad covered nosing. Fabric covered flaps and ailerons are fitted to the trailing edges of the centre plane and outer planes respectively, and automatic slats are fitted on the leading edge of each outer plane. The tail unit comprises a two-spar alclad covered tail plane, twin alclad covered fins, a fabric covered elevator, and twin fabric covered rudders.

4. The alighting gear consists of two retractable undercarriage units, one under each engine nacelle, and a retractable tail wheel unit.

The units are normally raised and lowered by a hydraulic system operated by an engine-driven pump on the starboard engine, but in the event of failure of this engine they may be operated by a hand-pump in the pilot's cockpit. Should the hydraulic system fail the alighting gear may be lowered by compressed air. All three units retract upward and backward, leaving a small portion of each tyre protruding. Electrical indicators, consisting of lamps operated from switches on catches on the units, show the position of the undercarriage and tail wheel units; should either throttle lever be less than about one-fifth open with the alighting gear retracted, a warning horn behind the pilot's head is operated. Each undercarriage unit has two oleo-pneumatic shock-absorber legs and the tail wheel unit has a single coil spring shock-absorber leg. Palmer pneumatically operated brakes, with differential control by means of a relay valve connected to the rudder bar, are fitted to the undercarriage wheels.

5. The primary flying controls are operated by means of a handwheel type control column and a centrally pivoted rudder bar, Mark IV automatic controls being fitted. Trimming tabs controllable from the cockpit, are fitted to the rudders, the elevator and the port aileron; the starboard aileron is fitted with a ground adjusted tab. The slotted flaps are hydraulically operated, the leading edge slats being automatic in operation.

6. The air-cooled engines, which are of a radial type, are mounted on steel tube structures attached to the centre plane. This structure embodies a flexible mounting for the engine itself. Controllable gills are fitted at the rear of the engine cowling to regulate the flow of cooling air. Fuel is carried in six tanks mounted in the centre plane, three on each side. An oil tank and oil cooler are mounted inside each engine nacelle and air is led through the cooler from a duct at the top of the cowling. The engines are normally started by electric motors, but hand turning gear is provided for use when necessary. The engines are fitted with two-speed superchargers having two gear ratios - "M" low gear and "S" high gear. The gear required is selected by moving a lever in the pilot's cockpit.

7. The gun armament of the aeroplane consists of :-

(i) a fixed Browning gun, operated by the pilot, mounted on the port side of the fuselage nose above the bomb aimer's position and firing forward;

(ii) 3 Vickers "K" guns, one in the nose cockpit covering a forward and downward field of fire, one at the rear upper gun station covering a wide field of fire in an aft direction, and one at the rear lower gun station covering a downward field of fire aft.

Provision is made for stowing the Vickers nose gun along the starboard side of the fuselage aft of its mounted position. Various alternative bomb loads may be carried in a cell, fitted with hydraulically-operated doors, which is incorporated in the bottom of the fuselage; two universal bomb carriers may also be fitted under the centre plane, outboard of the engine nacelles.

8. A 12 volt, 500 watt generator on the starboard engine, charges a 12 volt 40 Ah accumulator, mounted on the starboard side of the fuselage forward of the rear upper gun station, providing for lighting and power services, and another 12 volt 40 Ah accumulator forward of the D spar, providing for engine starting. The lighting services comprise indicating lamps for the alighting gear, and lamps for navigation, recognition, formation-keeping, landing, inspection and signalling, together with interior lighting and lighting for the bomb sights and reflector gun sights. The power services provide for camera operation, bomb selecting, fuzing and releasing, automatic control, operation of fuel contents gauges and flap indicators, pressure head heating, intercommunication, and (where applicable) automatic fire-extinguisher operation.

9. The wireless equipment is mounted aft of the rear upper gun position and comprises a transmitter and reciever; both a fixed and trailing aerial are fitted and also a retractable D.F. loop. Intercommunication between members of the crew is provided by an independent amplifier mounted near the wireless equipment. Later aeroplanes are fitted with the Lorenz beam-approach system.

10. Other equipment includes training and reconnaissance parachute flares, signal pistol, Elsan closet, oxygen apparatus, F.24 camera, crash axe, hand fire-extinguishers, first-aid outfit, flame-float, sea-marker, and life-saving waistcoat stowage, and a system for heating and ventilitating the fuselage. Later aeroplanes are fitted with Graviner automatic fire-extinguishers.

SECTION 1

CONTROLS AND EQUIPMENT IN PILOT'S COCKPIT

SECTION 1

LIST OF CONTENTS

	Para.
Introduction	1
Fuel and oil	2
Aeroplane controls -	
Control column and rudder bar	3
Trimming tabs, controls and indicators	4
Wheels and flaps control	7
Wheels and flaps position indicators	9
Wheels warning horn	11
EMERGENCY CONTROL - Wheels lowering	12
Brakes control	13
Locking of primary controls	14
Engine controls -	
Throttle and mixture controls	15
Constant-speed airscrew controls	17
Fuel cock controls	18
Priming pumps and selector cocks	20
Air-intake heater control	21
Cowling gills control	22
Ignition switches	23
Electrical starter switches	24
External supply socket for electrical starting	25
Hand starting	26
Refuelling	27
Operational and flying equipment -	
Fixed gun control	28
Bomb release controls	29
Vacuum pump and venturi system selector cock	31
Fuel contents gauges	32
Navigation, identification and formation-keeping lamps control	33
Landing lamps control	36
Parachute flares	37
Signal pistol	38
Wireless remote controls	39
Intercommunication	40
Camera-exposure indicator lamp	41
Oxygen equipment	42
Sea-marking equipment	43
Lorenz beam-approach equipment	44
Seating, windows, entrances and exits -	
Seat control	45
Cockpit hood	46
Entrances	47
EMERGENCY EXITS	48

Para.

Miscellaneous equipment -
Safety harness 49
Parachutes 50
First-aid outfits 51
Fire-extinguishers 52
Life-saving jackets 53
Crash axe 54
Picketing equipment 55
Ballast weights 56
Mirror 57
Heating and ventilating equipment 58

LIST OF ILLUSTRATIONS

Fig.

Pilot's instrument panel - early type 1
Pilot's instrument panel - later type 2
Port side of pilot's cockpit 3
Lower port side of pilot's cockpit - including Lorenz controller unit 4
Starboard side of pilot's cockpit - early type 5
Starboard side of pilot's cockpit - later type 6

SECTION 1

CONTROLS AND EQUIPMENT IN

PILOT'S COCKPIT

INTRODUCTION

1. This section covers the controls and equipment in the pilot's cockpit together with that equipment with which the pilot should be acquainted but which is situated elsewhere. The layout of the various items is illustrated and referenced in figs.1 to 6, each item being given an individual number; a key to the items referenced faces each illustration. Explanatory notes are only given where the function or operation of any item is not obvious or where the position of any item is not shown in figs.1 to 6. Two different arrangements of the pilot's instrument panel are in use, the early arrangement is shown in fig.1, and the later arrangement fitted with Lorenz beam-approach equipment in fig.2.

FUEL AND OIL

2. The fuel and oil to be used with the Pegasus XVIII engines are as follows:-

Fuel .... Specification D.T.D.230
(Stores Ref. 34A/59)

Oil .... Specification D.T.D.109
(Stores Ref. 34A/32 and 33)

AEROPLANE CONTROLS

Control column and rudder bar

3. The control wheel (13) is rocked fore-and-aft for elevator control and for aileron control is fitted with a "spectacle-type" handwheel (14). The rudder bar is of the normal centre-pivoted type and is adjustable for leg reach by means of a centrally-placed star-wheel; to increase leg reach the starwheel should be rotated by the foot in a counter-clockwise direction.

Trimming tabs, controls and indicators

4. The elevator trimming tabs are controlled by a knurled handwheel (63) situated on the floor at the port side of the pilot's seat, a position indicator (64) being fitted just outboard of the wheel. The top of the handwheel should be moved forwards to counteract tail heaviness.

5. The rudder trimming tabs are controlled by a smaller handwheel (104) situated on the port side of the cockpit, the wheel being rotated in a clockwise direction to trim the aeroplane to starboard; a position indicator is fitted along the side of the cockpit behind the handwheel.

6. The ailerons are each fitted with a trimming tab, that on the starboard aileron being pre-set on the ground, whilst the port trimming tab may be controlled in flight from the pilot's cockpit. The control handwheel (39) which is fitted with an integral position indicator, is situated on the port bottom corner of the instrument panel; for right bank, the knurled rim of the handwheel should be rotated in a clockwise direction.

Wheels and flaps control

7. The alighting gear and the flaps are hydraulically operated, being controlled by a power "on-off" valve and a selector lever situated on the starboard side of the cockpit. In the event of failure of the starboard engine or the engine-driven hydraulic pump, the alighting gear and flaps may be operated by means of a handpump, the handle (83) being situated on the starboard side of the seat; the handpump should not be used whilst the engine pump is in action. The power valve control bolt (88) works in a slot beneath the starboard side window, the bolt being pushed forwards and then downwards to put the power "on". The selector lever (7) is situated on the starboard side of the cockpit just forward of the seat and works in a gate which has a central neutral position and four working positions (i.e. UP and DOWN for both WHEELS and FLAPS, the flap positions being outboard). To obviate inadvertent retraction of the alighting gear whilst the aeroplane is on the ground, the WHEELS UP position is provided with a spring-loaded hinged plate (38) which must be raised before the selector lever can be moved into this position.

8. The method of operation is to move the selector lever to the appropriate position in the gate and, after checking that the bomb doors control wheel (91) is in the SHUT position (<u>see</u> para.30), to move the power valve control bolt to the ON position until the operation is complete (<u>see</u> para.9). If, owing to failure of the starboard engine or the engine-driven hydraulic pump, it becomes necessary to use the handpump, it must be checked that the bomb doors control wheel is in the SHUT position, before the selector lever is moved to the required position and the handpump is operated.

Wheels and flaps position indicators

9. The positions of the alighting gear units are indicated by three lamps (46) on the port side of the instrument panel whilst the positions of the flaps are shown by two electrical indicators (41) also on the port side. The alighting gear indicator lamps and the flaps position indicators are switched "on" or "off" by a switch adjacent to the lamps, the switch being covered by a spring-loaded hinged plate to prevent its accidental operation; the switch is also mechanically interconnected (44) with the engine ignition switches to ensure that the indicators are "on" whenever the engines are switched "on".

10. The red, top lamp is illuminated when the alighting gear is fully retracted and locked, the green, middle lamp is illuminated when the undercarriage units are locked DOWN, the green, bottom lamp being illuminated when the tail wheel is locked DOWN; the lamps are provided with hinged dimmer glasses for use at night.

Wheels warning horn

11. Should the alighting gear units not be locked DOWN at any time when either throttle lever is less than one-fifth open (approx.), the pilot will immediately be warned of the potential danger of this position by the sounding of a horn (71) situated immediately behind his head on the port side of the cockpit.

EMERGENCY CONTROL - Wheels lowering

12. Should it be impossible to lower the alighting gear by either the engine-driven pump or the handpump, an emergency compressed air system may be brought into operation by pulling upwards on a control handle (6) situated beneath the hydraulic selector lever; the handle is provided with a wire hinged catch to prevent its accidental operation and should be held in the UP position until the indicator lamps show that the alighting gear is locked DOWN.

Brakes control

13. The pneumatic brakes, which may be differentially operated in conjunction with the rudder bar, are controlled by the thumb lever (15) mounted in the centre of the aileron control handwheel. For parking purposes, the lever may be retained in the "brakes on" position by passing a spring-loaded pin (16) through two holes in the lever bracket. Attention is drawn to A.M.O. A.114/38 which lists precautions to be observed when parking aeroplanes with differentially-controlled brakes; in this connection the words LOCK RUDDER BEFORE PARKING are engraved in the centr of the handwheel. A triple pressure gauge (61) is mounted in the starboar bottom corner of the instrument panel to show the air pressure existent i both brake pipelines and the pressure in the air reservoir cylinder.

Locking of primary controls

14. For parking and rigging purposes, the primary flying controls may be locked against movement by special gear (18) which is stowed, when not in use, on the floor behind the fuselage bulkhead door on the port side; the gear comprises a tubular H-frame with telescopic legs. The upper ends of the side tubes are arranged to butt against the lower rim of the aileron control handwheel, whilst the lower ends are fitted with balls which are engaged in sockets in a tube situated beneath and connected to the rudder bar; the cross tube of the H-frame is pinned to the control column. The locking gear should be fitted as follows:-

(i) Remove the pins from the side tubes and extend the lower ends; re-insert the pins.

(ii) Centralize the rudder bar and rotate the starwheel in a counter-clockwise direction until the rudder bar is against its stop. Insert the lower ends of the locking gear side tubes into the ball sockets on the tube beneath the rudder bar.

(iii) Move the locking gear to starboard as far as possible and then move the control column forward to engage with the handwheel clamps.

(iv) Screw the wing-nut, situated in the centre of the locking gear cross tube, into the screwed socket provided on the front face of the control column.

ENGINE CONTROLS

Throttle and mixture controls

15. These controls are mounted in a quadrant on the floor at the port bottom corner of the instrument panel and comprise a throttle control lever for each engine (26) and a single mixture control lever for both engines (23) ; the levers are moved upward and forward to open the throttle valves and to weaken the mixture. To prevent either engine being run on an excessively weak mixture, the throttle levers are interconnected with the mixture lever, the interconnection being adjusted to return the mixture lever to normal at 20% throttle opening.

16. A set of friction plates (27) are incorporated in the control quadrant to prevent the throttles being moved from their set positions by engine vibration. These plates are non-adjustable.

Constant-speed airscrew controls

17. The two airscrew control levers (28) are mounted on the outboard side of the quadrant for the engine throttle levers. Normally, the levers are coupled together by a splined collar on the port airscrew lever, the collar engaging with a peg on the starboard lever.

To synchronise the airscrews, the peg on the starboard lever may be moved fore-and-aft along a cross tube at the top of the lever by means of a knurled thumb screw at the rear end of the cross tube. With the levers in their rearmost positions, the airscrews are in positive coarse pitch, increase in airscrew speed being obtained by moving the levers forward.

Fuel cock controls

18. Each engine is supplied by a separate fuel system, each system having one inboard tank and two outboard tanks, front and rear; the source of supply is governed by the settings of four selector cocks, two in each system. The selector cocks are remotely controlled (by a member of the crew other than the pilot) from the control handles situated two on each side of the fuselage gangway, behind the bulkhead door (see Sects.2 and 3).

19. Two ON-OFF master cocks, which directly control the supply to each engine, are remotely controlled by the pilot from two levers (25) fitted beneath the airscrew speed controls (see para.17); the levers are self-locking in each position, but it is necessary to pull the lever knobs outwards before they can be moved from one position to the other.

Priming pumps and selector cocks

20. The priming pump for each engine is mounted at the bottom on the rear face of each fireproof bulkhead, and a selector cock, with three positions marked OFF, PUMP and CYLINDERS, is fitted to port of the priming pump. A fuel pressure gauge is mounted on the inboard side of each engine nacelle and is visible through a small window from the pilot's cockpit or from the ground.

Air-intake heater control

21. The temperature of the air supply to the carburettors may be varied to suit the atmospheric or other conditions prevailing by operating a lever (65) at the forward end of a quadrant beside the pilot's seat on the port side of the aeroplane. When the lever is in the HOT position the air is drawn through ducts from behind the two lower cylinders, and when in the COLD position, it is drawn from between these two cylinders. The lever is moved forward to admit cold air.

Cowling gills control

22. Gills are fitted round the sides of the aft edge of the engine cowling to govern the flow of cooling air over the cylinders. They

are controlled by a handle (66) situated on the quadrant carrying the air-intake control on the port side of the pilot's seat; clockwise movement of the handle, opens the gills, and vice versa.

Ignition switches

23. Two twin-knob switches (43) one for each engine, are fitted on the left-hand side of the instrument panel. The two knobs of each switch are ganged together, but they can be operated separately if desired; in addition they are interconnected with the alighting gear indicator lamp switch (see para.9).

Electrical starter switches

24. The pushbutton switches for the electric starters are mounted in the port bottom corner of the instrument panel and are each covered by a hinged plate (50) as a precaution against their accidental operation.

External supply socket for electrical starting

25. For use when starting electrically from a ground supply, a switch socket for the supply plug is situated in the starboard side of the fuselage just beneath the leading edge of the main plane; access to the switch socket may be obtained through a small hinged door.

Hand starter

26. For starting the engine by hand, a handle is stowed in two straps in each undercarriage wheel housing. In use, the handles are inserted through the hole in the left-hand side of the bottom front engine cowling.

Refuelling

27. Each fuel system is normally power replenished through a refuelling connection situated in the underside of the main plane between the engine nacelle and the fuselage. Alternatively the tanks may be filled by hand after unscrewing the vent outlets in the top of the engine cowlings and removing the dipstick covers. Should the fuel content gauges fail to register, the quantity of fuel present may be checked by the dipstick in each tank. Three cocks are fitted to each system, a master cock in the pilot's control box, and two cocks (one beneath the other) by the inner fuselage door. The lower of these cocks is referred to as Cock I and the upper as Cock II. The procedure for power refuelling is as follows, the instructions being read as applicable to whichever fuel system, port or starboard, is being filled:-

(i) Preliminary procedure.-

(a) Move master cock in pilot's control box to "off" position to prevent fuel flow to carburettor.

(b) Move Cock I to "all off" (Note.- In later aeroplanes this wording has been ammended to read "Inboard tank off").

(c) Move Cock II to "Front and Rear Tank-Balance".

(d) Remove cap from filling point and attach filling hose connection.

(ii) To fill tanks.- Move the cocks to the positions indicated below and pump in fuel.

Tank to be filled	Pilot's Master cock position	Cock I position	Cock II position
Inboard tank	"off"	"Refuelling inboard and outboard tanks"	"Front and rear tank balance (Engine off)"
Rear outboard tank	"off"	"Refuelling outboard tanks"	"After tank on"
Front outboard tank	"off"	"Refuelling outboard tanks"	"Forward tank on"

(iv) Procedure after filling.-

(a) Move cocks to combination described in "Preliminary procedure", and remove filling hose.

(b) Replace and lock the cap over the filling point.

OPERATIONAL AND FLYING EQUIPMENT

Fixed gun control

26. A fixed Browning gun is mounted on the port side above the bomb aimer's position, and fires through the fuselage nose. The gun is pneumatically controlled by the pilot, the firing button (12) being secured to the front face of the control column beneath the aileron control handwheel.

Bomb release controls

29. The operations of selecting, fuzing and releasing, or jettisoning of the bombs are performed electrically. A panel, carrying the switches and indicator lamps, is fitted on the port side of the cockpit, the pilot's bomb-firing switch (30) being mounted in the bottom front corner of the automatic controls panel; a bomb-firing switch and a jettison switch are also provided in the bomb-aiming position. The master switch (1) is interconnected with the bomb doors (<u>see</u> para.30), and it is therefore necessary to open the latter before the bombs can be dropped. Bombs must be selected and fuzed in the numerical order engraved beneath the selector switches (5), and the nose-and-tail fuzing switches (90) must be returned to their "off" positions after use. When containers for small bombs, together with separate bombs are fitted, it is essential that the containers are jettisoned first by operating jettison switch No.1(89); the operation of jettison switch No.2 (3) will then jettison all remaining bombs.

30. Before bombs can be released from the fuselage, the bomb doors closing the fuselage cell must be opened. The doors are operated from the main hydraulic system and are controlled from a two-position rotary valve, the power being obtained either from the engine-driven pump or the handpump. To open the bomb doors, the control wheel (91) on the starboard side of the cockpit is turned counter-clockwise until against its stop, and the power applied until the green lamp (4) in the centre of the bomb release panel is illuminated; the doors are closed by reversing this procedure.

Vacuum pump and venturi system selector cock

31. A vacuum pump is fitted to one engine and a set of venturis are fitted to the starboard side of the fuselage, to provide suction for the blind-flying instruments. The vacuum pump is normally used but in the event of failure the venturi system may be brought into action by moving the selector cock (94), situated behind the pilot's head on the starboard side, to the VENTURI position. The suction existent is shown by a gauge on the port side of the pilot's instrument panel.

Fuel contents gauges

32. Three electrical fuel contents gauges (20) are provided in the centre of the pilot's instrument panel, each gauge serving both the port and starboard tank in the corresponding position. The port gauge shows the contents of the front outer tanks, the starboard gauge the contents of the rear outer tanks, and the centre gauge the contents of the inner tanks, the required tank (port or starboard) being selected in each case by a switch (19) mounted beneath the respective gauge. To obtain a reading, the appropriate selector switch should be set to the required position and the switch knob pressed inwards. Although the gauges are graduated with the tail of the aeroplane on the ground, the difference between that position and the flying position is very slight and may be ignored.

Navigation, identification and formation-keeping lamps control

33. The navigation lamps are controlled from an ON-OFF switch (21) at the bottom of the instrument panel on the port side. The identification and formation-keeping lamps are controlled from two signalling switchboxes situated on the starboard side of the cockpit; the front switchbox (87) controls the identification lamps and the rear switchbox (86) the formation-keeping lamps. The spring pressure of the morsing key may be adjusted by disengaging the lock at the upper left-hand corner and turning the ring until the required pressure is obtained; the lock should then be released to engage in the appropriate slot. The range of movement of the morsing key may be adjusted by turning the screw in the centre of the cover.

34. The identification lamps switchbox (87) provides independent or simultaneous use of the upward and downward identification lamps through the morsing key or, alternatively, a steady illumination from either or both lamps. The upward identification lamp is controlled by the right-hand thumb lever and the downward lamp by the left-hand lever. Each lever may be placed in one of three positions; the top position is marked MORSE, the middle position is marked OFF and the bottom position STEADY. The formation-keeping lamps are controlled from their switchbox (86) by the left-hand thumb lever and the morsing key, the right-hand lever not being used; again, the thumb lever may be placed in any one of the three positions marked MORSE, OFF and STEADY.

35. A three-position switch (98), mounted on the port bottom edge of the instrument panel, controls a headlamp which is interconnected with the circuit for the downward identification lamp. When the switch knob is in its upper position, signalling may be effected in conjunction with the morsing key of the identification lamps switchbox (87), steady illumination is obtained when the knob is in its lower position and the lamp is off when the knob is central. In early aeroplanes, however, a two-position switch (22) only is fitted. With this type of switch the headlamp cannot be used for signalling with the morsing key on the identification lamps switchbox.

Landing lamps control

36. The switch (31) and dipping lever (34) for the landing lamps are mounted at the front on the port side of the cockpit, the switch being beneath the lever. Both lamps are off when the switch knob is central, the outer lamp is on when the knob is moved rearwards and the inner lamp is on when the knob is moved forwards. The angular position of each lamp is controlled by the dipping lever, the lamp beams being dipped when the lever is moved in a clockwise direction; the lever is retained in the desired position by a small spring-loaded ratchet lever. The lamp is spring-returned by pressing the ratchet lever against the dipping lever.

Parachute flares

37. Two 4-in. training flares are carried in chutes and may be separately released by pulling on one of the two handles (103) situated behind and on the port side of the pilot's seat. As an alternative to the F.24 camera, two chutes, for $4\frac{1}{2}$ or $5\frac{1}{2}$-in. reconnaissance flares, may be fitted in the fuselage aft of the wireless station; a release handle for each flare is fitted on the starboard side above the lower rear gunner's station.

Signal pistol

38. A signal pistol (8) is mounted in the starboard side in front of the pilot's seat and fires downwards through a tube, the pistol being held in position by two spring clips. Stowage for eight cartridges (85) is provided on the floor to starboard of the pilot's seat.

Wireless remote controls

39. A standard wireless remote controller (72, 73 and 74) is fitted on the port side of the cockpit. When a general purpose transmitter and receiver only is carried, the SEND-RECEIVE lever only is connected up but when a combined transmitter-receiver is also carried all three controls on the controller are connected to the combined transmitter-receiver. For receiving, the switch lever (73) should be pushed forward to the position marked RECEIVE and, for transmitting, should be pulled back to the position marked SEND; in the mid-position the transmitter-receiver is switched off. The tuning lever (74) should be pre-set before taking-off but may be used for making any fine adjustments that may subsequently be necessary. The central knob (72) on the controller is a remote volume control; it should be turned clockwise to increase the volume.

Intercommunication

40. For intercommunication between the pilot and the crew, a combined microphone and telephone socket is fixed underneath the front edge of the pilot's seat. The pilot is also provided with a push-button switch (47) for calling-up the wireless operator, the switch controlling a lamp on the starboard side of the wireless-operator's station.

Camera exposure-indicator lamp

41. A lamp (92), with red cover glass, is mounted on the starboard side of the pockpit and is illuminated approximately four seconds before an exposure is made to warn the pilot to maintain a steady course.

Oxygen equipment

42. A standard oxygen regulator unit (48, 49) is fitted in the

port side of the pilot's instrument panel, and a bayonet union socket for the low pressure supply to the oxygen mask is located on the starboard side of the cockpit.

Sea-marking equipment

43. A stowage for sea-markers is provided on the port side of the fuselage beneath the sextant hatch and a stowage for flame floats on the starboard side of the nose cockpit below the pilot's floor.

Lorenz beam-approach equipment

44. The later aeroplanes have provision for fitting Lorenz beam-approach equipment (see figs. 2 and 4). In these later aircraft the instrument panel has been rearranged for this purpose, and the beam-approach indicator (99) is fitted on the left-hand side of the panel. The controller unit (102) is fitted to a bracket aft of the parachute flare release handles on the port side of the cockpit, just behind the pilot's seat. When aircraft having this type of panel are flown without the Lorenz beam-approach equipment, the time of flight clock (58) may be moved from above the engine speed indicators (59) and fitted in place of the beam-approach indicator (99).

SEATING, WINDOWS, ENTRANCES AND EXITS

Seat control

45. The height of the pilot's seat may be varied by moving the handle (84) on the starboard side, upward movement of the handle raises the seat, and vice versa. The knob at the end of the handle must be pressed inwards with the thumb to free the handle, and re-locks the seat when released. The seat has hinged armrests (70) which may be raised out of the way when so desired. To facilitate access to the rear of the fuselage, the back of the pilot's seat may be swung backwards and downwards after pulling upwards on the small handle (68) on the port side of the seat.

Cockpit hood

46. The cockpit hood slides fore-and-aft and may be locked in either the "closed" or "open" positions, or at an approximately half-way position. The hood may be released from the outside by turning the handle in a counter-clockwise direction, whilst from the inside, it may be opened by pulling in the required direction on the handle at the top. The front bottom panel on the port side of the hood is secured in such a manner that it may be knocked out (and jettisoned) by the fist when in conditions of poor visibility. In addition a hinged window (100) is fitted in each side cockpit window to provide a clear view if necessary.

Entrances

47. Entrance to the pilot's cockpit may be made either through a door on the port side at the lower rear gun position or through the cockpit hood aperture via the walkway on the port plane and a footstep in the fuselage side. The entrance door at the lower rear gun position may be opened from the outside by lifting on the centrally-placed handle and rotating it in a clockwise direction; the door is opened from the inside by pushing outwards on the inner handle and rotating it in a counter-clockwise direction. For access to the pilot's cockpit via the port plane, a ladder is stowed on brackets and secured by a strap on the port side of the wireless operator's station; in use, the peg on the top rung of the ladder is inserted in a hole in the trailing edge fillet. Two handles are recessed within the port side of the fuselage; to extend the handles, the rear ends should be pressed inwards, whilst to return them flush with the fuselage side they should be pulled outwards and then released. A footstep, with a flush-fitting spring-loaded door, is fitted in the port side beneath and aft of the cockpit hood aperture.

EMERGENCY EXITS

48. For abandoning the aeroplane in an emergency, parachute jumps may be made through the following exits:-

(i) Pilot: Through the aperture obtained by sliding back the cockpit hood (see para. 45).

(ii) Front gunner or bomb aimer: Through the trap door on the underside of the fuselage, just aft of the nose cockpit; the handle on the port door should be turned in a counter-clockwise direction and the door swung upwards when it will be automatically held in the open position; the starboard door may then be swung upwards and will also be automatically retained in position.

(iii) Upper rear gunner or wireless operator: Through the aperture obtained by tilting back the hood over the upper rear gun or through the sextant hatch in the roof aft of the pilot's cockpit. The hood over the upper rear gun is released by pulling on the handle situated in the middle of the bottom edge. The sextant hatch doors may be opened by squeezing together the two bolts in the top edge of each door and swinging the doors inwards; the doors may be retained in the open position by spring-loaded pegs attached to the fuselage sides.

(iv) Lower rear gunner: By jettisoning the entrance door on the port side of the lower gun position. The door is jettisoned by pulling on the cord running along its top edge.

MISCELLANEOUS EQUIPMENT

Safety harness

49. In order to allow the pilot to lean forward in his seat without undoing his safety harness, the shoulder straps of the harness may be partially released by pulling upwards on the knob(11) situated in the centre front of the seat tray (9).

Parachutes

50. The pilot's seat takes a seat-type parachute, stowage for other parachutes being disposed as follows:-

(i) For the occupant of the nose cockpit: On the port side of the fuselage below the pilot's floor.

(ii) For the sextant-observer's position: On the starboard side of the fuselage beneath the wireless mast.

(iii) For the upper rear gunner: On the rear face of the fuselage bulkhead door.

(iv) For lower rear gunner: Above the window on port side of lower gun position.

First-aid outfits

51. A stowage ror a first-aid outfit is fitted on the port side of the fuselage behind the pilot's head; another, which may also be reached from the outside through a small door, is fitted on the starboard side just forward of the bottom rear gun position.

Fire-extinguishers

52. One hand-operated fire-extinguisher is mounted on the port, and another on the starboard side of the fuselage roof aft of the sextant hatch. In use, the hand-operated extinguisher is removed from its mounting and its disc-ended operating rod struck against some solid part of the aeroplane; the ensuring jet of liquid is then directed to the base of the flames. After use, it is necessary to replace the old with a new extinguisher and this, for safety reasons, should be done at the earliest possible moment. Later aeroplanes are also to be equipped with automatic Graviner type fire-extinguishers. These are mounted in each engine nacelle and may be manually operated from two pushbutton switches (101) situated in the left-hand bottom corner of the starboard side panel. In these later aeroplanes the identification lamps switchbox (87) has been moved

further forward to permit this. The Graviner switches are covered by a spring-loaded hinge plate as a precaution against their inadvertent operation.

Life-saving jackets

53. A stowage for life-saving jackets is provided on the starboard side of the fuselage immediately above the window of the lower rear gun position.

Crash axe

54. For possible use in the event of a crash, an axe is stowed in a tray-and-clip mounting on the rear face of the fuselage bulkhead door.

Picketing equipment

55. Provision is made at the tail of the aeroplane for a special mooring cable, and on the outer planes for mooring with ropes.

Ballast weights

56. Standard ballast weights may, if necessary, be carried in a cradle under the main spar in the bomb compartment. Certain loadings necessitate the removal of some or all of these weights to a position at the rear of the tail boom as follows:-

(i) Pilot only (no crew) with wireless equipment - 2 weights at tail

(ii) Pilot only (no crew) without wireless equipment - 4 weights at tail.

To remove and reposition the cradle and ballast weight the following procedure must be adopted:- Open the bomb doors and withdraw the four cradle attachment bolts taking care to support the cradle and weights before removing them. Fit the cradle to the rear underside of the tail boom by inserting the attachment bolts previously used in the holes provided and lock the bolts with 18 s.w.g. wire.

Mirror

57. A mirror (52) is fitted at the top of the pilot's windscreen to provide the pilot with a view to the rear, a limited degree of adjustment being provided by a clamping screw on the starboard side.

Heating and ventilating equipment

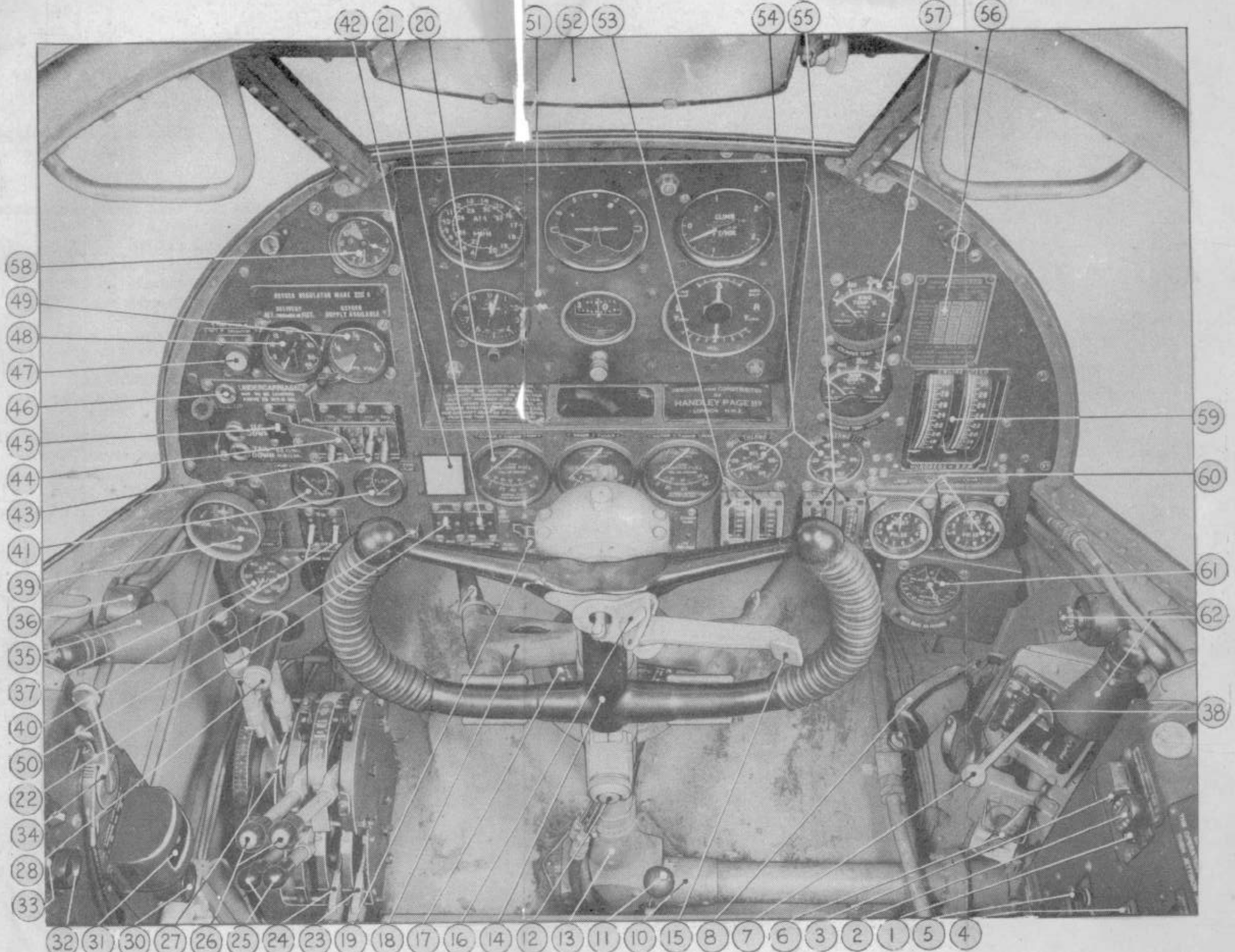
58. Heated air is conducted into the cabin through a pipe with open ends (82) which runs along the starboard side from behind the pilot's seat to the rear gun position. The heating is regulated by the steam valve control mounted on the main spar on the port side of the fuselage; this valve must not be entirely shut off, except in case of

emergency. When starting up the starboard engine, the air release valve on the starboard side of the fuselage just forward of the bulkhead door must be opened until steam blows off, and then closed. Should the cabin heating not be required, the water may be drained from the boiler system at a plug on the rear face of the starboard engine fireproof bulkhead.

Key to fig.1

Pilot's instrument panel-
Early type

1. Master switch - bomb releasing
2. Indicator lamp - bomb releasing
3. Jettison switch No.2 - bomb releasing
4. Indicator lamp for position of bomb doors
5. Bomb selector switches
6. Handle for emergency lowering of wheels
7. Selector lever for wheels and flaps
8. Very pistol
9. Pilot's seat
10. Control transmission
11. Release knob for safety harness shoulder straps
12. Firing button for fixed gun
13. Control column
14. Aileron control wheel
15. Brakes thumb lever
16. Brakes lever locking pin
17. Magnetic compass
18. Control locking mechanism
19. Fuel contents gauge switch
20. Fuel contents gauges
21. Navigation lamps switch
22. Head lamp switch - original type
23. Mixture control lever, for both engines
24. Two-speed supercharger - gear lever.
25. Master fuel cocks
26. Port and starboard throttle levers
27. Friction pads
28. Airscrew control levers
29. Control clock for automatic controls
30. Pilot's bomb firing switch
31. Landing lamps switch
32. Resetting switch for automatic controls
33. Automatic control cut-out switch
34. Landing lamps dipping lever
35. Cockpit lamp
36. Dimmer switch for (35)
37. Combined nose and tail heavy indicator and pressure gauge, for automatic controls
38. Spring-loaded hinge plate for (7)
39. Aileron tab trimming control
40. Starting magneto switches port and starboard
41. Flap position indicators - port and starboard
42. Compass deviation correction card
43. Ignition switches
44. Interconnection lever between (43 and 45)
45. Alighting gear indicator lamps switch
46. Alighting gear indicator lamps
47. Pushbutton for calling wireless operator
48. Oxygen delivery altitude gauge
49. Oxygen delivery contents gauge
50. Engine starter switches
51. Standard instrument-flying panel
52. Mirror
53. Main oil pressure gauges
54. Oil inlet thermometer
55. Fuel pressure gauges
56. Instruction panel
57. Pyrometers - port and starboard
58. Time-of-flight clock
59. Engine speed indicators - port and starboard
60. Boost gauges,-port and starboard
61. Wheel brake air pressure gauge
62. Cockpit lamp and dimmer switch



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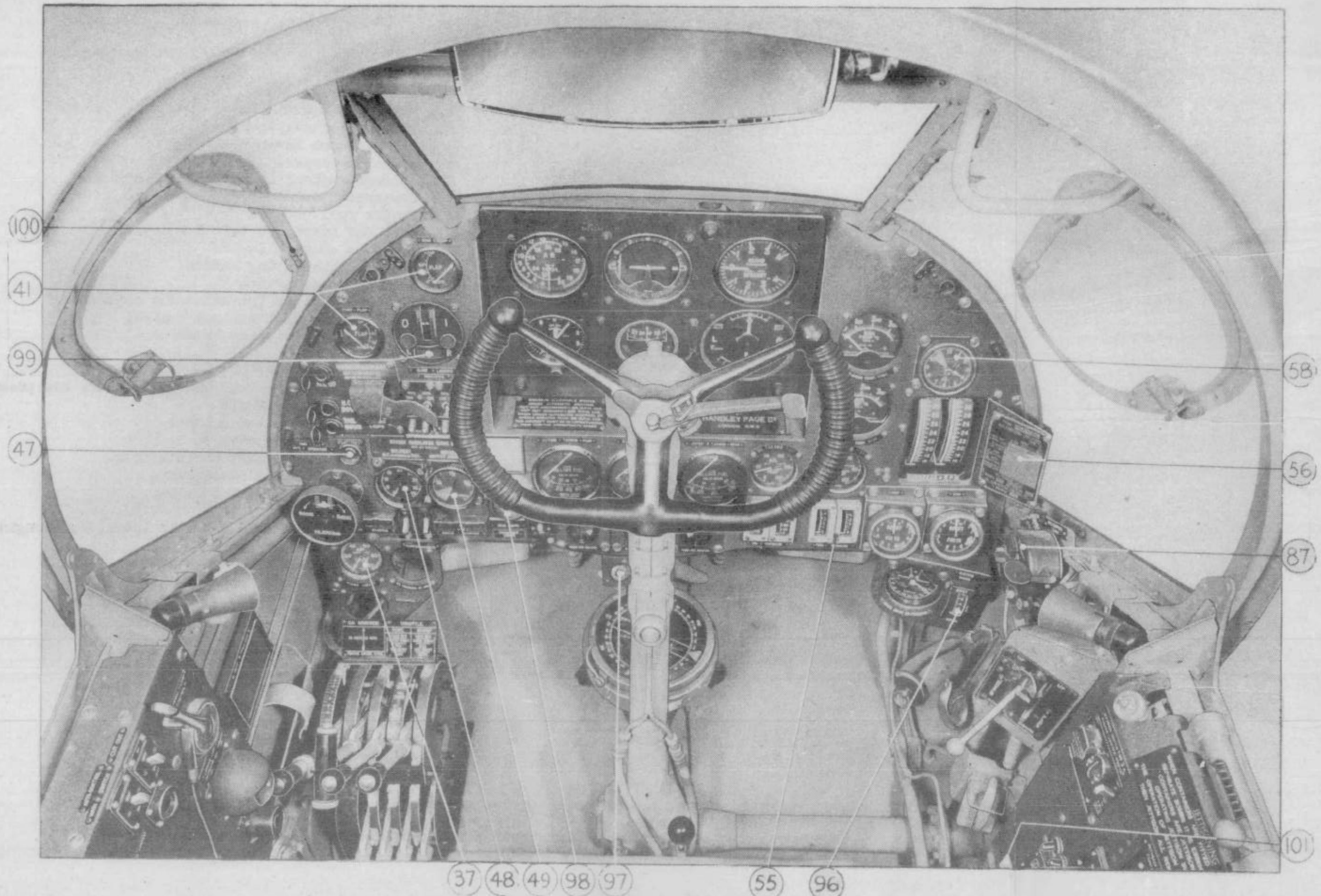
Pilot's instrument panel - early type

Key to fig.2

Pilot's instrument panel - later type

37. Combined nose and tail heavy indicator and pressure gauge, for automatic controls
41. Flap position indicators
47. Pushbutton for calling wireless operator
48. Oxygen delivery altitude gauge
49. Oxygen delivery contents gauge
55. Fuel pressure gauges
56. Instruction panel
58. Time-of-flight clock
87. Identification lamps switchbox
96. Blind flying panel suction gauge
97. Compass lamp
98. Three-position head lamp switch for signalling or independent use of headlamps
99. Lorenz beam-approach indicator
100. Hinged clear vision panel
101. Switches for Graviner fire-extinguishers (where applicable)

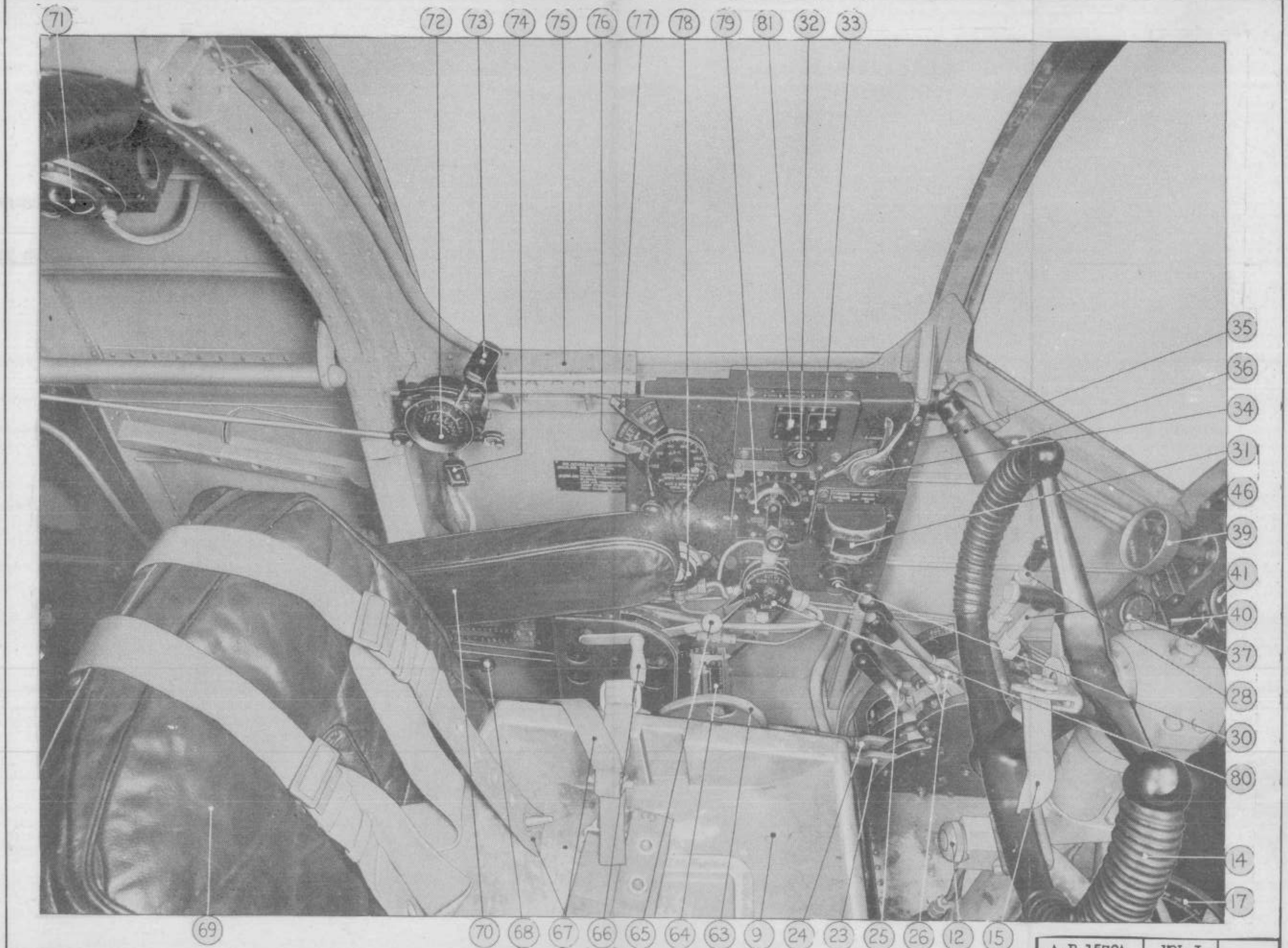


Pilot's instrument panel - later type

Key to fig.3

Port side of pilot's cockpit

9. Pilot's seat
12. Firing button for fixed gun
14. Aileron control wheel
15. Brakes thumb lever
17. Magnetic compass
23. Mixture control lever for both engines
24. Two-speed supercharger gear lever
25. Master fuel cocks
26. Port and starboard throttle levers
28. Airscrew control levers
30. Pilot's bomb firing switch
31. Landing lamps switch
32. Resetting switch for automatic controls
33. Automatic control cut-out switch
34. Landing lamps dipping lever
35. Cockpit lamp
36. Dimmer switch for (35)
37. Combined nose and tail heavy indicator and pressure gauge, for automatic controls
39. Aileron trimming tab control
40. Starting magneto switches
41. Flap indicators, port and starboard
46. Alighting gear indicator lamps
63. Elevator trimming wheel
64. Elevator trim indicator
65. Carburettor air intake heater lever. both engines
66. Cowl gill control handle
67. Pilot's harness
68. Release handle for back of pilot's seat
69. Back of pilot's seat.
70. Seat arm-rest
71. Warning horn, wheels position
72. Volume knob, wireless remote control
73. Switch lever, wireless remote control
74. Tuning lever, wireless remote control
75. Footstep
76. Speed lever for automatic controls
77. Steering lever for automatic controls
78. Clutch lever for automatic controls
79. Attitude control for automatic controls
80. Control clock for automatic controls
81. Automatic control main switch



F.S./13

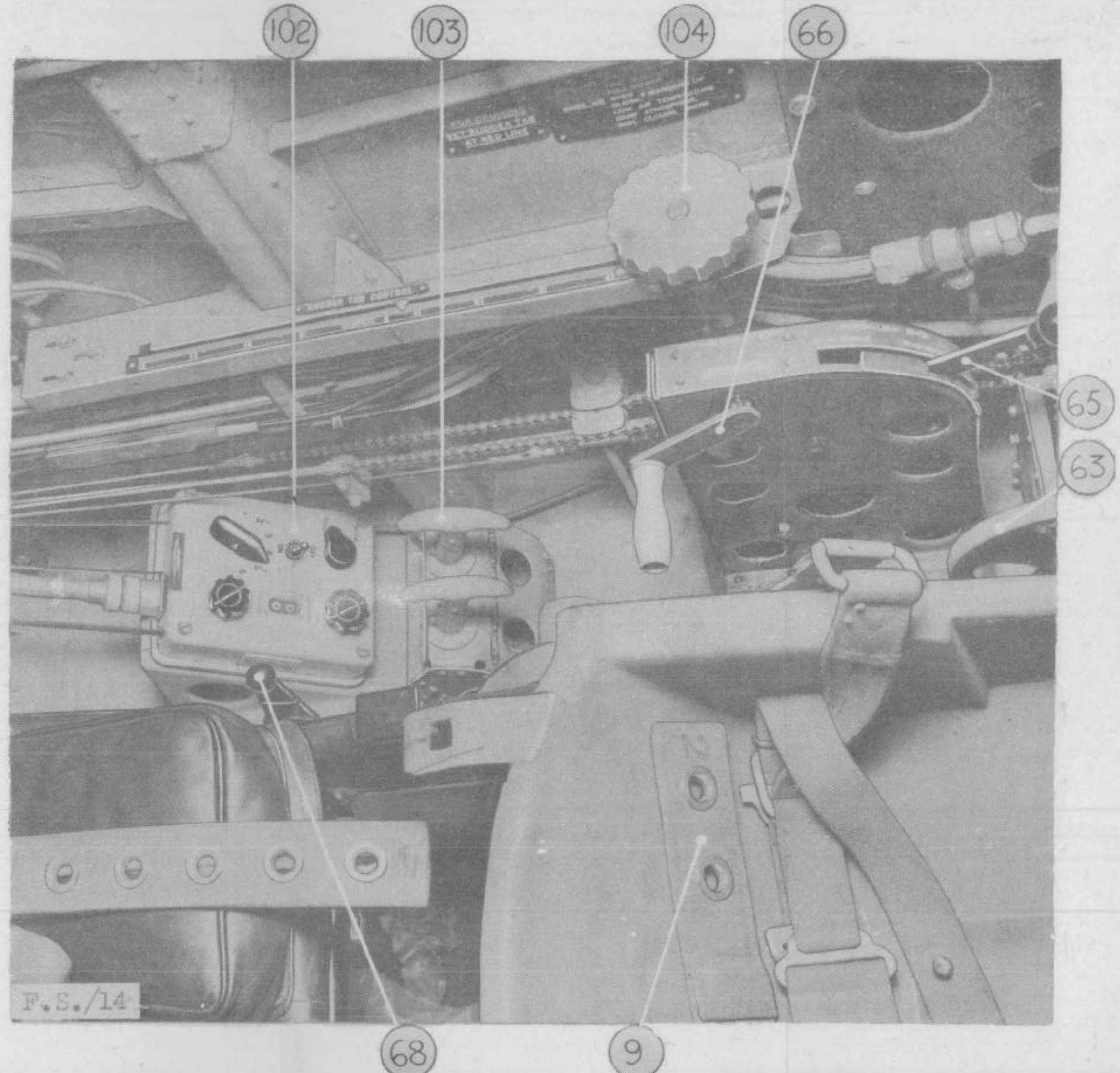
Port side of pilot's cockpit

A.P.1579A VOL.I SECTION 1 FIG.3

Key to fig. 4.

Lower port side of pilot's cockpit -
including Lorenz controller unit

9. Pilot's seat (shown with back hinged down)
63. Elevator trimming wheel
65. Carburettor air intake heater lever - both engines
66. Cowl gill control handle
68. Release handle for back of pilot's seat
102. Lorenz controller unit - mock-up only shown in photograph
103. Parachute flare release handles
104. Rudder tab control wheel



Lower port side of pilot's cockpit - including Lorenz controller unit.

A.P.1579A	VOL.I	FIG.4
SECTION 1		

Key to fig.5

Starboard side of pilot's cockpit - early type

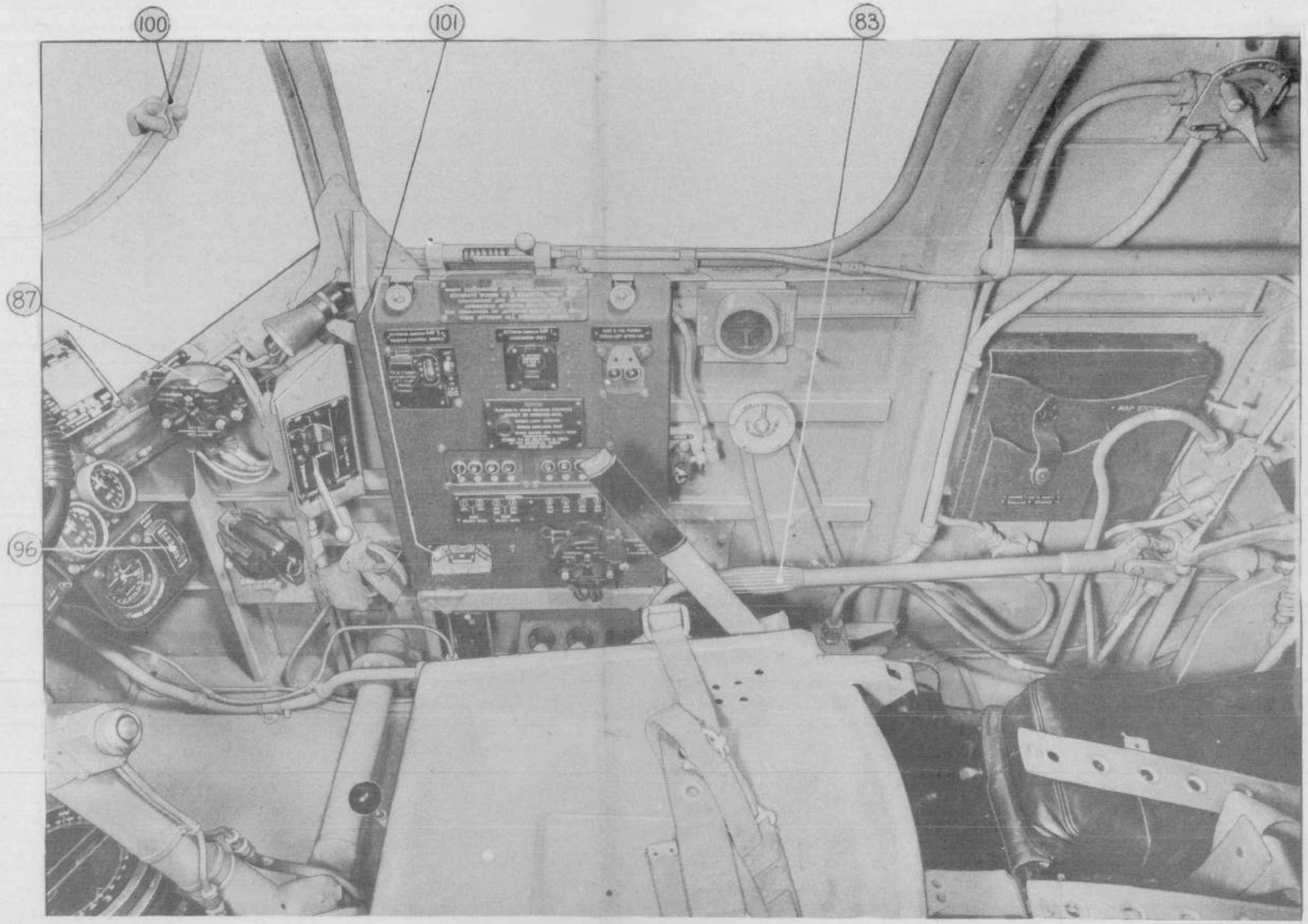
1. Master switch, bomb releasing
2. Indicator lamp, bomb releasing
3. Jettison switch No.2, bomb releasing
4. Indicator lamp for position of bomb doors
5. Bomb selector switches
6. Handle for emergency lowering of wheels
7. Selector lever for wheels and flaps
62. Cockpit lamp and dimmer switch
82. Louver of cabin heating system
83. Handle of hydraulic handpump
84. Seat adjustment lever
85. Very pistol cartridges (stowage)
86. Formation-keeping lamps switchbox
87. Identification lamps switchbox
88. Bolt controlling hydraulic power valve
89. Jettison switch No.1, bomb container releasing
90. Bomb nose-and-tail fuzing switches
91. Bomb doors control wheel
92. Camera exposure indicator lamp
93. Map stowage
94. Change-over cock, for vacuum pump or venturi
95. Cockpit cover locking device

Starboard side of pilot's cockpit - early type

Key to fig. 6

Starboard side of pilot's cockpit - later type

83. Handle of hydraulic handpump
87. Identification lamps switchbox
96. Blind flying panel suction gauge
100. Hinged clear vision panel
101. Switches for Graviner fire-extinguishers (where applicable)



Starboard side of pilot's cockpit - later type

SECTION 2

HANDLING AND FLYING NOTES

FOR PILOT

SECTION 2

LIST OF CONTENTS

	Para.
Introductory notes	1
Fitness of aeroplane for flight	2
Preliminaries	3
Starting engines and warming up	4
Testing engine and installations	5
Taxying out	6
Final preparation for take-off - drill of vital actions	7
Taking off	8
Actions after take-off	9
Engine failure during take-off	10
Failure of one engine immediately after take-off	11
Failure of both engines during take-off	13
Failure of one engine during cruising flight	14
Practice flying on one engine	15
Flick stall when flying on one engine	16
Climbing	17
The engines in cruising flight	18
General flying	19
Flying by instruments	20
Stalling	21
Spinning	22
Gliding	23
Diving	24
Approach and landing	25
Engine-assisted approach and landing	26
Approach and landing without engine	27
Power approach for emergency landing in small space	28
Landing across wind	29
Approach speeds	30
Undercarriage EMERGENCY operation	32
Bomb doors	33
Space needed for precautionary landing	34
Flying in rain and bad visibility	35
Forced landing owing to engine failure	36
Position error table	37
Notes concerning the Pegasus XVIII engine	38
Fuel capacity and consumptions	39
Oil capacity	40
Location of engine-driven auxiliary pumps	41

ADDENDUM

Notes on night flying	
Setting landing lights	2
Before take-off	3
Approach and landing	4

LIST OF ILLUSTRATIONS

	Fig.
Fuel system diagram	1

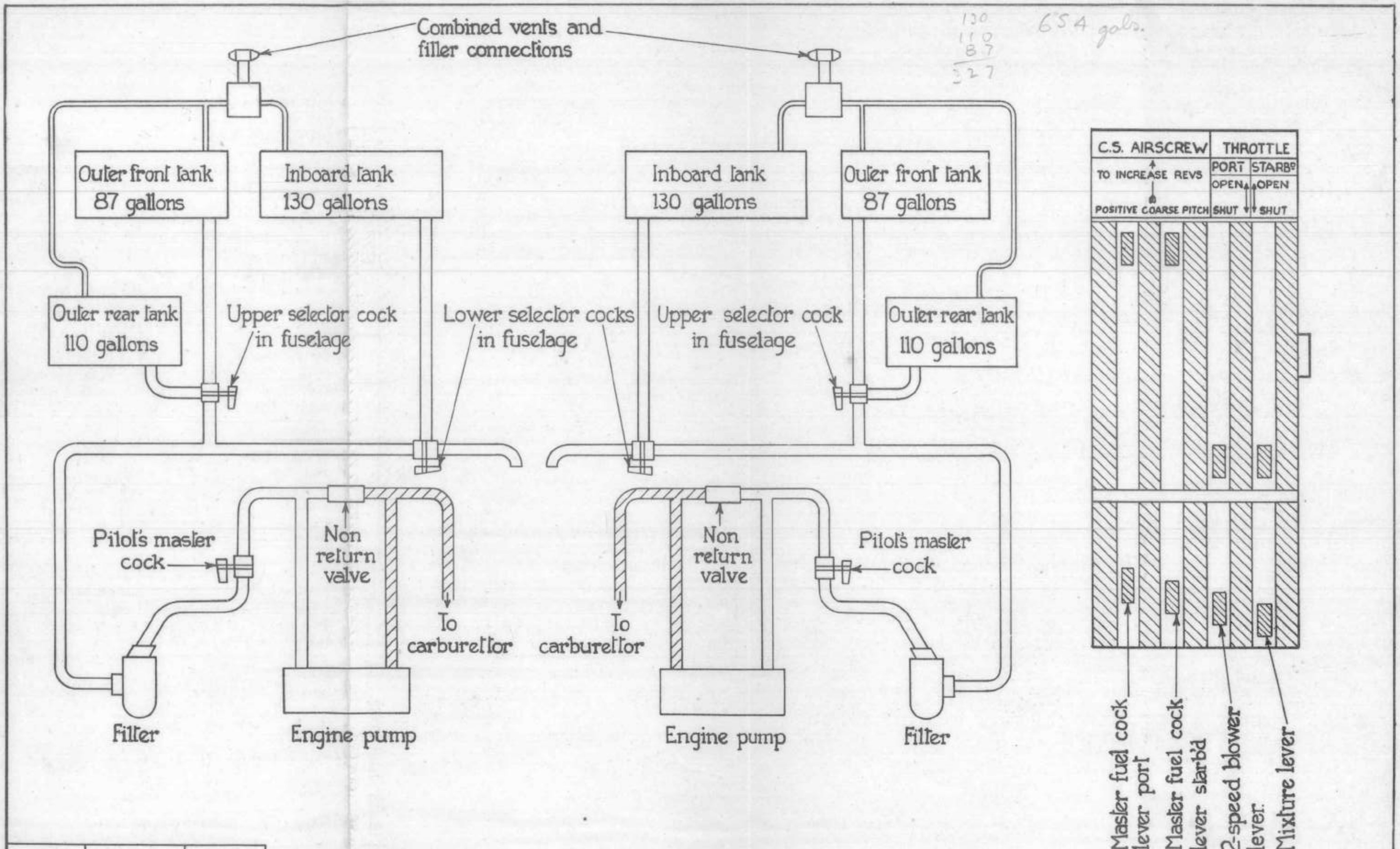


FIG. 1	A.P. 1579 A.	VOL. I.
	SECT. 2.	

FUEL SYSTEM DIAGRAM

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SECTION 2

HANDLING AND FLYING NOTES FOR PILOT

INTRODUCTORY NOTES

1. The information given in this paragraph is complementary to the description of the equipment included in Section 1.

(i) Hydraulic system.- The engine-driven pump is on the starboard engine. If this engine, or the pump itself, fails, the hand pump can be used. If this is done, the hydraulic power control must be in the OFF position, otherwise the oil in the system will become emulsified.

(ii) Flaps.- The flaps are of the slotted type and can be set and locked in any position. At small angles they have low drag and their use at 15° slightly inproves the take-off. Fully down, they reduce the landing speed and float, and steepen the gliding angle. They must always be fully lowered for landing.

(iii) Cowling gills.- These are for regulating engine temperature within limits, and when fully closed allow enough air to pass the cylinders to give adequate cooling during normal cruising flight. For ground running they should be fully open, but for take-off fully closed, because drag is increased by opening them, and height could not then be maintained if one engine were to fail.

(iv) Mixture control.- This is automatic and the lever has two positions, WEAK and NORMAL. To economize fuel the pilot must set it, when within cruising range, to WEAK. At throttle settings outside the cruising range this control automatically returns to NORMAL.

(v) Carburettor air-intake heat control.- This shoubd be set in the COLD position for the following conditions:-

(a) When starting the engines.

(b) When the boost pressure is +2½ lb./sq.in. or higher.

(c) When the air temperature exceeds 15°C.

Note.- When conditions of excessive humidity are known to exist, i.e., when flying through or beneath heavy cloud, in snow or rain, the air-intake heat control should be set to the HOT position irrespective of the boost pressure or the air temperature.

(vi) Automatic boost control.- Boost control is partly automatic. Maximum permissible boost cannot be exceeded, but the pilot must control cruising boost by use of throttle levers.

(vii) Airscrew pitch control.- The airscrews are of the constant speed governed type. At any particular setting of the governer control levers the r.p.m. of the engines are kept constant, in spite of variations in engine power and air-speed, by automatic variations of airscrew pitch. The range of angles between fully coarse and fully fine pitch is limited (21^{o} to $39\frac{1}{2}^{o}$), and so the r.p.m. will only remain constant while the airscrew pitch is between these limits; therefore the r.p.m. will drop if the engines are run at low power, and they will increase if the aeroplane is dived. There is a device by which the airscrews can be kept fixed at fully coarse pitch if the control levers are pulled right back.

(viii) Undercarriage.- The undercarriage is hydraulically operated by an engine pump on the starboard engine. To raise or lower the undercarriage, the pilot must first push ON the hydraulic power control, and then put the selector lever to wheels UP or DOWN. A safety catch operated by the right thumb makes it more difficult to raise the undercarriage accidentally. The hydraulic power control should be kept in the OFF position when not required, as the system would otherwise overheat. There is also a hand-pump, which must only be used with the hydraulic power control in the OFF position; and an emergency operating handle, painted red, which is used as a last resort to lower the undercarriage. Further details are given in "Undercarriage emergency operation" para.32.

(ix) Trimming tabs.- These are fitted to elevator, rudder and ailerons. Those on the rudder and ailerons are for fine adjustment of trim. Those on the elevator must be set correctly for take-off, used to trim during flight and wound back for landing; but it must not be used for assisting manoeuvres. The pilot must be prepared to use it in a steep dive, but only if recovery is otherwise difficult, and then very slowly and carefully. It may be emphasized here that the aeroplane must not be allowed to yaw when recovering from a dive. With this aeroplane, the trim in all three planes varies continually with every change of speed, engine power, and so on, and frequent re-trimming is necessary if it is desired to fly without load on the controls. There is a little lost motion in the rudder tab control and it will seem at first to be ineffective, and then, with further movement, very effective. Full rudder bias must be used for flying on one engine. For diving, the rudder bias tab should be aerodynamically neutral, that is, the aeroplane trimmed, and the tab should be so set before speed is increased. This is because the aeroplane becomes very nose-heavy in a dive if allowed to yaw.

(x) Fuel system.- A diagram and particulars of the fuel system are given in fig.1. Each engine is fed from the three tanks on the same side. Any one, two or three tanks can be used, but there is no connection whatever between the port and starboard systems. The pilot has only ON and OFF control. Selection of tanks is done by the crew at the fuel cocks aft of the fuselage doorway.

FITNESS OF AEROPLANE FOR FLIGHT

2. Note the following:-

(i) Ensure that the total weight and the disposition of the load are in accordance with the weight sheet summary.

(ii) During take-off and landing the crew must occupy their normal stations, with the exception of the navigator, who should sit immediately behind the pilot. The top rear gunner must be on his seat at the top gun station and the bottom rear gunner seated on the cabin floor, with his feet above the bottom seat.

(iii) When the aeroplane is flown light with pilot only and without W/T or I/C gear fitted, five standard ballast weights must be carried on the mounting at the rear of the tail boom. If the W/T or I/C gear is carried there must be three ballast weights in place of crew. If there is one passenger, he must occupy one of the rear gun stations.

(iv) The bomb load is to be distributed evenly between the front and rear carriers, and if an odd number of 250 lb. and 500 lb. bombs is carried, the odd bomb is to be loaded on one of the rear carriers. Single bombs should be dropped alternately from front and rear, beginning at the front.

PRELIMINARIES

3. On entering the cockpit make the following preparations:-

(i) Ensure that the fuel cocks in the after cabin are correctly turned ON.

(ii) See that the ignition switches are OFF.
" " " hydraulic selector is NEUTRAL.
" " " hydraulic power control is OFF.
" " " flaps are UP.
" " " bomb doors are CLOSED.
" " " brakes are ON.
" " " electric indicators (undercarriage and flaps) are switched ON.
See that the steam heater cock is OPEN.

(iii) Check contents of fuel tanks.

(iv) Test the movement of all flying controls.

STARTING ENGINES AND WARMING UP

Note.- Refer to A.P.1451H, Vol.I for full details of Pegasus XVIII engines.

4. It is strongly recommended that the pilot should always start engines himself; this will ensure that he has ample time to carry out all the checks and that unnecessary running of engines is avoided.

(i) Set the following:-

Cowling gills fully OPEN
Mixture controls down at NORMAL
Blower control down at M
Airscrew controls fully forward to FINE
Carburettor heat controls - COLD
Throttle levers slightly open

(ii) Set both fuel cock levers to ON. Shout "Petrol on, switches off". Ground crew will prime engines (about eight strokes in cold weather - one or two only when engines are hot).

(iii) When ground crew reports that both engines are primed, shout "All clear both engines - contact", and ensure that personnel are clear. Switch on main switches and starter switches and start each engine in turn by pressing electric starter buttons one at a time (for not more than 10 seconds). If an engine is difficult to start, wait at least half a minute before using the starter again. Do not oscillate the throttle lever, but open it up slowly to get the engine running slowly and smoothly; if the engine begins to "fade" or backfires, close the throttle quickly and open it up again very slowly.

(iv) Check oil pressure.

(v) Warm up at a fast tick-over for two or three minutes, until oil temperature is at least +5°C., and oil pressure has come down to normal.

TESTING ENGINE AND INSTALLATIONS

5. Engines should not be run up at full power for more than a few seconds, just long enough to test magnetos and check oil pressures, boost and r.p.m.

Checks during warming up

(i) Fuel pressure ($2\frac{1}{2}$ - 3 lb.)

(ii) Brake pressure (at least 120 lb.)

(iii) Test hydraulic system. Put hydraulic control to ON, lower and raise flaps. Return control to OFF until ready to taxy out.

(iv) Set altimeter to 0. Cage directional gyro. Make any other general preparations for the flight.

(v) Turn off the steam heater cock as soon as steam issues from the vent.

Final checks and running up

(vi) When ready to run up, test each engine in turn as follows:-

(a) Open up to about +$2\frac{1}{2}$ lb./sq.in. boost.

(b) Test airscrew governor control by moving the control back to the POSITIVE COARSE position. There should be a large drop in r.p.m.

(c) With engine at +$2\frac{1}{2}$ lb./sq.in. boost and governor control at POSITIVE COARSE, test two-speed blower control by moving it sharply up to S, then back to M. At S there should be an appreciable drop in r.p.m.

(d) Change pitch to fully fine and open up to full throttle.

Check oil pressure	(80 lb./sq.in.)
Check boost	(+$5\frac{1}{2}$lb./sq.in.)
Check r.p.m.	(2475)

(e) Test switches. See that there is not more than 100 r.p.m. drop and no rough running. (If airscrews are controlled there will be practically no drop in r.p.m., but they should normally be fully fine when there will be a slight drop.)

(f) Throttle down and wave away chocks. Receive the salute from the ground crew when everything is ready for taxying out, and the crew are all aboard in their correct positions (<u>see</u> para.2(ii)).

TAXYING OUT

6. Release the parking brake and lock the pin in the OFF position. Taxy at moderate speed and steer by rudder and engines

as far as possible to save the brakes. Do not taxy unless there is ample brake pressure. If this fails for any reason stop immediately if possible. If taxying without brake pressure must be done, there should be at least eight men on the tail to stop and steer the aeroplane, but no flight should be made except in operational emergency.

(i) In case of prolonged taxying, watch engine temperatures and brake pressure.

(ii) Clearing of engines after excessive slow-running.- If the take-off is delayed for any reason, the engines should be cleared in turn by opening up to about zero boost against the brakes. Engines must not tick-over for more than two or three minutes without being cleared.

FINAL PREPARATION FOR TAKE-OFF - DRILL OF VITAL ACTIONS

7. On reaching take-off position, stop across wind, facing the circuit so that approaching aircraft can be seen, ensure that the hood is locked open and then carry out the drill of vital actions. Some of these may be done before or during taxying out; but they must invariably be checked in the correct sequence whether already done or not, before every take-off. A convenient "catch-phrase" for remembering this drill is "H-T-M-P Gills and Flaps".

(i) Hydraulic power control - ON

(ii) Tabs (trimming) - NEUTRAL (or as found by experience for a particular aeroplane).

(iii) Mixture controls - NORMAL

(iv) Pitch controls - FINE (fully forward)

(v) Gills - Fully closed

(vi) Flaps - UP (or 15° down, if necessary)

Note.- In normal conditions flaps need not be used, but with overload of 21,000 lb. or where take-off run is restricted, 15° must be used.

(vii) Method of lowering flaps to 15°.- Open up starboard engine to about half throttle and select flaps DOWN until flaps read 15°, then put selector lever in NEUTRAL. The starboard flap tends to go down more quickly than the port, unless retarded by slip stream.

TAKING OFF

8. After checking the drill of vital actions, search the sky for approaching aircraft, then turn into wind and start to take-off without further delay; but to prevent a swing from developing owing to uneven response as throttles are opened, it is best to

apply the brakes for a few moments, until engines are almost at full speed; then release brakes as the throttles are pushed fully forward.

(i) Bring the tail up by pushing the control column forward at first, and prevent any tendency to swing by use of rudder. As the aeroplane gathers speed it will become slightly nose heavy, and this must be counteracted by easing the control column slightly backward, but not enough to pull the aeroplane off the ground too early.

(ii) Normal load - No flaps.- Hold to a constant attitude until the aeroplane flies itself off.

(iii) Overload - 15° flaps.- Hold to a constant attitude until the speed is at least 80 m.p.h. A.S.I. (or more if there is room and the aerodrome surface is smooth); then ease the aeroplane off the ground and hold it in the air against the nose heaviness, which disappears a few moments after the aeroplane takes off. This is a ground effect.

Note.- It is preferable not to look at the A.S.I. during take-off, but to concentrate attention outside the cockpit. However, this aeroplane, owing to the ground effect, tends to remain on the ground well after the speed at which it will take-off, and so, when heavily loaded, it is better to ease the aeroplane off the ground, provided speed is not less than 80 m.p.h. The nose-heaviness tends to increase if the aeroplane is allowed to swing during take-off owing to an aerodynamic effect.

ACTIONS AFTER TAKE-OFF

9. Proceed as follows:-

Immediate action

(i) As soon as the aeroplane is finally clear of the ground, raise the undercarriage.

(ii) Hold the aeroplane down almost to level flight until a speed of at least 120 m.p.h. A.S.I. is attained.

(iii) Begin to climb gradually, throttle down to $+2\frac{1}{2}$ lb./sq.in. boost and reduce r.p.m. to 2,250 by bringing back the airscrew controls to about 6 on the quadrant.

(iv) If flaps have been used, raise them as soon as a safe height of at least 300 - 400 feet is reached. There will, however, be no "sink" at the speed attained (over 120 m.p.h.). There will be a slight "nose up" change of trim.

Note.- The easiest way to operate the lever for raising the undercarriage is to place the fingers under it, palm uppermost, and move the safety catch aside with the thumb.

Subsequent action

Note.- Carry out the remaining drill at leisure, though without undue delay.

(v) Check oil pressures.

(vi) Return hydraulic power control to OFF and selector lever to NEUTRAL.

(vii) Close cockpit hood.

(viii) Adjust throttle, airscrew and mixture control levers as desired.

(ix) Note cylinder and oil temperatures. Open cowling gills slightly if necessary.

(x) Look round the cockpit and check all instruments and equipment systematically.

ENGINE FAILURE DURING TAKE-OFF

10. If one engine fails while the aeroplane is still on the ground, pull back the throttle levers and apply the brakes. If it is impossible to stop within the aerodrome boundary, raise the undercarriage.

11. Failure of one engine immediately after take-off.- At normal full load, this aeroplane can be climbed and brought back to the aerodrome on one engine.

Immediate action

(i) Keep straight by an instant and coarse use of rudder before swing can develop. Keep nose down to level flight. Keep full throttle. Do not sideslip, that is, do not assist rudder by bank if it can be avoided, as this has the effect of making the aeroplane nose-heavy.

(ii) Make sure the undercarriage is up. (If not rising, pump it up by hand, after releasing hydraulic power control to OFF).

(iii) Gather speed as quickly as possible in absolutely level flight to at least 120 m.p.h. A.S.I.

DO NOTHING ELSE AT THIS STAGE

Subsequent action

(iv) As soon as the aeroplane is under full control, maintaining height at 120 m.p.h. proceed as follows:-

(v) Put airscrew control of failed engine to POSITIVE COARSE (being careful to separate the levers). This can be done in "Immediate action", but may be ineffective.

(vi) Apply full rudder bias (Turn wheel "Left" for left turn and vice versa).

(vii) Reduce speed by raising the nose very gradually to climb at 110 m.p.h. (never less than 105).

(viii) Climb to at least 1,000 feet, but do not start to turn under 500 feet. It is safer and better to turn by banking towards the live engine, but if the approach is made easier by a circuit the other way, ample top rudder to prevent skid must be used. Whether flying straight, or turning left or right, always use enough rudder, assisted by full rudder bias, to counteract the pull of the live engine. If this is not done, so much aileron control may be needed that the aeroplane will tend to roll over into a spiral dive (opposite to aileron control), if speed were allowed to drop.

(ix) Fly to the leeward side of the aerodrome, keeping far enough out to be able to turn in. When in a good position, not too far away, lower the undercarriage by the normal means or by hand-pump and approach the aerodrome until almost within gliding distance (for flaps down); then lower flaps and approach, using the power of the live engine to regulate the angle of glide.

(x) Concentrate the attention on the angle of glide, remembering that it is vital neither to overshoot nor to undershoot, because, once committed to a landing (that is, below about 300 - 400 ft. with flaps down) this aeroplane cannot be kept in the air, as it is impossible to go round again. If it undershoots, it is impossible to "stretch the glide" by flying in flat on one engine, because a swing and roll cannot be prevented as speed drops. There is a little latitude and it is not difficult to keep the angle of glide within the required limits; but if the pilot does find he is tending to undershoot or overshoot, he must make up his mind in ample time (above 300 - 400 feet), sacrifice a little height by increasing speed and raising flaps; then raise the undercarriage, open full throttle, climb up again and repeat the whole procedure. This ought never to become necessary.

(xi) Glide straight into the aerodrome, flatten out, close the throttles and land. Full rudder bias must be maintained. Its effect when the throttle is closed is not disconcerting; but keep straight, as the fore and aft trim is upset if a flat turn (yaw) is not prevented.

12. With overload - 21,000 lb. - 15° flap for take-off.- If one engine fails at this loading, a landing must be made straight ahead, unless at least half power is available from the failed engine.

Immediate action

(i) Keep straight by ample rudder. Keep nose down to level flight.

(ii) Make sure the undercarriage is coming up.

(iii) Close throttles, maintain speed, select flaps DOWN, land straight ahead, and switch off ignition if possible. Little damage will be done if flying speed is maintained and a skid landing made, provided serious obstacles can be avoided. (Flaps may not go down far, but the pilot cannot do more).

Note.- If power is only slightly reduced, ease back the throttle of the defective engine slightly to see if it will run smoothly at slightly reduced boost. (It is obviously unnecessary to attempt a hazardous landing in case of a temporary spasm of misfiring). If almost full power is available proceed as described in para.11 but do not use more rudder bias than is needed.

13. Failure of both engines during take-off.- Act as in para. 12(iii).

FAILURE OF ONE ENGINE DURING CRUISING FLIGHT

14. At normal load this aeroplane will maintain height on one engine, provided cowling gills are closed and flaps are up. At 21,000 lb. this is doubtful, and, in the event of engine failure, if weight cannot be reduced by dropping of bombs or other means, a forced landing must be made by the procedure described in para. 36, "Forced landing owing to engine failure". At cruising speeds the yaw due to failure of one engine can easily be corrected. Speed will eventually drop considerably if height is not lost. Full rudder bias should be applied in the proper direction and enough rudder control in addition to counteract the pull of the live engine. This will enable the pilot to fly straight without the assistance of bank, which is to be avoided.

Action

(i) If the fault cannot be rectified, pull bac_ the throttle lever of the failed engine and put its airscrew at POSITIVE COARSE.

(ii) See that cowling gills are closed.

(iii) Throttle down the live engine to the lowest power needed to maintain height, plus a little margin, in order to nurse the engine.

(iv) Close fuel cock lever to the failed engine but maintain a speed of at least 120 m.p.h. A.S.I.

(v) Fly to the nearest aerodrome and make an approach and landing as described in para.11.

Note.- The most satisfactory conditions are as follows:-

Airscrew of live engine	2,300 r.p.m. (lever about "7" on quadrant).
Airscrew of dead engine	POSITIVE COARSE
Boost	0 lb./sq.in.
Airspeed	110 m.p.h. A.S.I. for climb 120 m.p.h. A.S.I. for level flight.
Cowling gills	Open 2 turns of crank.
Rudder trimming tab	Full
Undercarriage and flaps	UP

PRACTICE FLYING ON ONE ENGINE

15. In starting and finishing one engine flying practice the pilot must:-

(i) Prevent the aeroplane from yawing

(ii) Maintain ample speed of at least 110 m.p.h. A.S.I. (the climbing speed on one engine).

(iii) Avoid using large aileron angles at low speed.

FLICK STALL WHEN FLYING ON ONE ENGINE

16. This should never occur and must be avoided just as a stall and spin at 50 feet are avoided. It is due to loss of speed and insufficient use of rudder or rudder bias to counteract yaw, combined with excessive aileron angle. The pilot should be able to recognize it immediately the aeroplane begins to flick over, and apply the instant correction "control column forward, opposite rudder". If this is done without delay, recovery from the dive is easy. If action is delayed, it may be difficult to apply opposite rudder at first. The loss of considerable height is inevitable.

CLIMBING

17. The engine limits for continuous climb are 2,250 r.p.m. and +2½ lb./sq.in. boost.

(i) To obtain the fastest climb, the throttle should be progressively opened to maintain +2½ lb./sq.in.boost; climbing speed is about 125 m.p.h. A.S.I. reading up to 15,000 ft. and should then be reduced by 2 m.p.h. every 1,000 feet.

(ii) Above 6,000 feet boost will begin to fall below +2½ lb./sq.in. at full throttle. When it drops to +½ lb./sq.in. (at 8,000 feet) change blower gear to S. To do this, reduce r.p.m. (with airscrew controls) to 2,000 and throttle down below 0 boost. Then snap the blower control quickly up to the S position. Fine the pitch to give 2,250 r.p.m. and open throttles to give +2½ lb./sq.in. boost.

(iii) Watch the cylinder and oil temperatures, and keep below the permissible limits given on the engine data plate in the cockpit by opening cowling gills partly. This is normally unnecessary.

(iv) Weak mixture should be used on the climb when boost and r.p.m. are less than 0 and 2,250 r.p.m. respectively.

THE ENGINES IN CRUISING FLIGHT

18. The engine should normally be run at the lowest power necessary for the occasion in order to reduce maintenance and fuel consumption; but never run at a rough "period". The upper limit of engine speed is 2,600 r.p.m. at +5½ lb./sq.in. boost, but the lower figures for maximum cruising conditions should never be exceeded, except at take-off.

(i) Maximum cruising conditions.- Bear in mind that these figures represent maximum permissible conditions. Longer life between overhauls will be obtained if much lower boost pressures are used; the maximum of +2½ lb./sq.in. should not be used at lower r.p.m. than 2,250.

(a) Mixture control - NORMAL (Automatic rich)
2,250 r.p.m. at +2½ lb./sq.in. boost.

(b) Mixture control - WEAK (automatic)
2,250 r.p.m. at 0 lb./sq.in. boost.

(ii) Economical cruising.- It is more economical to cruise with the blower in the M ratio up to any height. Greatest economy (most "miles per gallon") is obtained by setting airscrew control to POSITIVE COARSE, and throttling down until the aeroplane is flying at an airspeed of about 120 m.p.h. A.S.I. reading. This speed applies in calm conditions high up; at low altitudes and in bumpy conditions speed should be increased a little, to about 140 m.p.h. When flying against a head-wind increase speed slightly; add about 10 m.p.h. in the case of a 50 m.p.h. wind - or lesser amount in proportion.

(iii) Engine temperatures.- Ensure that the upper limits of cylinder and oil temperatures are not exceeded. Do not run engines below a cylinder temperature of about 100°C. if it can be avoided.

(iv) Synchronizing engines.- The engines should be synchronized by the fine adjustment on the airscrew control levers.

(v) Mixture controls.- Always put the mixture control lever in the WEAK position when boost is below 0 lb./sq.in. An automatic device returns this lever to NORMAL when throttles are opened or closed outside cruising range.

(vi) Airscrew operation in low air temperature.- For continuous cruising flight in air temperatures below -10°C. the airscrew levers must be set in POSITIVE COARSE PITCH. This should give about 2,250 r.p.m. at full throttle in level flight at rated height (14,750 ft). The airscrew lever must not be returned to the normal constant speed setting until after a quarter of an hour in warm air (above 0°C.) or for the approach to land, except in the case of failure of one engine, when the airscrew of the live engine must be returned to constant speed setting (to give 2,250 r.p.m.), the other being left in POSITIVE COARSE.

GENERAL FLYING

19. For its size this aeroplane is quite handy and controllable. Provided the pilot thoroughly understands its characteristics there should never be any difficulty in flying it, whether in clear weather or in clouds.

(i) Its most noticeable characteristic during normal flying is the change of trim about all three axes with changes of speed. If speed is increased after flying at low speed with the aeroplane trimmed (hands and feet off), a tendency to drop the left wing and the nose, and to yaw to the left will be noticed. During straight flying, trimming tabs must be used to counteract this; otherwise the slight pull on the controls is a little tiring.

(ii) The aeroplane is just unstable in pitch, and its directional stability is not good. In a turn with feet off rudder control, rudder bias being trimmed neutral, there will be a little sideslip - about $2\frac{1}{2}^{\circ}$ on the indicator on both left and right turns. Feet should be kept on the rudder to prevent yawing, especially at high speed, though steering should be done, as with all other modern type aeroplanes, by aileron control.

(iii) This aeroplane must not be allowed to yaw, or flat turn, while diving, owing to the fact that, if it does yaw it may become very nose heavy and difficult to pull out until the yaw is stopped. The reasons for this are aerodynamic and need not be explained here. For this reason, rudder control should be used to assist directional stability; that is, to prevent yaw, skidding or sideslipping or in other words to "keep the bubble in the middle", and for the same reason, it is important that the aeroplane should be kept trimmed by the rudder trimming tab, especially if diving.

(iv) Use of trimming tabs.- Pay particular attention to the following notes:-

(a) During normal flight. The aeroplane should be kept trimmed by all three tab controls. During cruising flight this need only be approximate, because perfect trim entails continuous adjustment of the three tabs every minute or two. There is no difficulty in trimming the elevator, but, as the aileron and rudder trim affect one another, the following method should be used. Fly level laterally, using aileron control to left or right as necessary, and trim directionally by rudder tab control until the aeroplane flies straight "feet off". Keep speed absolutely constant; then trim laterally, keeping straight by rudder, until the aeroplane will fly level laterally. Owing to the directional and fore-and-aft instability of this aeroplane it is almost impossible to get perfect trim.

(b) For diving. The rudder trim should be altered to that which is correct for about 270 m.p.h., though the pilot can, when not in clouds, easily counteract the yaw caused by incorrect rudder tab setting, by use of the rudder. General control in the dive is easier if the aileron tab control is turned to the right about two divisions, and elevator tab "back" about ½ division. These settings should be used for manoeuvring which entails changes of speed.

(c) For cloud flying. To guard against the effects of temporary loss of control when flying in cloud, rudder tab should previously be set as for high speed. This makes the rudder slightly out of trim at normal speed, but is safer in case of an accidental increase in speed.

(d) For flying on one engine. Full rudder bias is required, with elevator trimmed. It is essential fully to counteract the yaw due to the thrust of the live engine, otherwise excessive aileron control is needed, and this is dangerous at low speed. Ample speed must be maintained (not less than 120 m.p.h. A.S.I.).

(e) For recovering from a dive. The pilot should always be prepared to use the elevator tab for this purpose and therefore should know where to feel for it in an emergency; but it must be used very slowly and carefully.

(v) Slow flying.- Flying at slow speeds down to the stall should be practised at a safe height in order that the pilot may become familiar with the feel of the controls. Excessive aileron angle must not be used. Rudder tab should be neutral (as for high speed) and if a dive does start, yaw should be counteracted by rudder. This will make recovery easy.

(vi) Effects on trim.-

Gills open	- Nose down
Undercarriage down	- Nose down
Flaps down	- Nose down
Throttles closed	- Nose down

FLYING BY INSTRUMENTS

20. The technique applicable to practically all modern aeroplanes is not fully suitable for this one owing to its poor directional stability and adverse yaw when using aileron control. Steering can and should be done by ailerons, but feet should be kept on the rudder control in order to keep it steady and counteract yaw when flying in cloud or when recovering from a dive. The pilot should ensure that instruments are in working order before their use becomes necessary. The rudder trimming tab should be set neutral (as for high speed), as a safeguard in case of difficulty, even though a slight pull on the rudder may have to be counteracted. The other tabs may be used to trim the aeroplane.

(i) Method.- Fly by the indications of the artificial horizon and directional gyro, using aileron control to steer, with feet on the rudder control simply to keep it steady. Turns may be made entirely by aileron and elevator control. The Reid and Sigrist turn indicator should not be used unless the others have become upset owing to sharp turns or for other reasons. It is, however, the only instrument which will continue to function in violent manoeuvres.

(ii) The chief rules for flying this aeroplane by instruments are:-

(a) Constant attention to instruments.

(b) The pilot must trust his instruments, and use the aeroplane controls accordingly to maintain a straight and level course or an accurate turn, however strange the feel of the controls may be, owing to change of trim, at any moment.

(iii) Recovery after loss of control.- There is no circumstance (apart from such a case as structural failure) in which loss of control need occur. If it does, either through inattention to instruments or mishandling of controls, recovery can always be effected provided the aeroplane is not already near the ground.

(iv) Recovery from a dive, or diving turn.-

(a) Keep both hands on the control wheel (unless the left hand is used for the elevator tab), and feet on rudder control. Watch the Reid and Sigrist turn indicator while in clouds. Do not attempt to adjust the rudder tab control. If it is causing yaw, this must be counteracted by rudder control until recovery has been made.

(b) Stop any yaw by rudder control while in cloud, centralize the TURN pointer (lower) of the turn indicator by rudder, assisted by ailerons.

(c) When diving straight, without yaw, ease out of the dive. The severe nose-heaviness due to yaw should now have been almost eliminated, and it should be easy to pull out by control column alone, but the elevator tab may be used slowly and carefully.

(d) When full control is regained (and not till then), if still in cloud, see that the rudder bias tab is trimmed neutral as for high speed, as a safeguard in case of further difficulty.

(v) Failure of instruments.- Though the artificial horizon and possibly the directional gyro may become upset through sharp manoeuvres, deliberate or otherwise, yet it is extremely unlikely that the Reid and Sigrist turn indicator will fail. If the latter is available, cloud flying may be continued by its use, but a little more concentration is needed (or practice). In the most unlikely event of all instruments being out of action, if a steady course by compass cannot be held, with fairly constant airspeed, it will not be possible to recover control while in cloud, owing to the instability and change of trim, without instruments. In such circumstances the aeroplane would have to be abandoned, if the cloud base were low, but it must again be emphasized that recovery can always be effected if any one of the gyro instruments is available.

STALLING

21. This aeroplane is almost stable at the stall and in a stalled glide, owing to the action of the automatic slots. That is, although a wing may drop slowly, it will recover by itself or may be brought up by use of rudder, but there are circumstances when the stall is rather more vicious, such as when a tendency to yaw

in one direction is counteracted by excessive opposite aileron control at low speed. This may happen when flying on one engine with insufficient rudder to counteract yaw. The aeroplane then rolls over into a spiral dive opposite to aileron control. This should be prevented from developing by putting the control column forward and applying opposite rudder (as for recovery from a spin).

(i) The stall should be practised (slowly) at a safe height. The use of aileron control should be avoided as it tends to have reverse effect at the stall, and may cause trouble in emergency. It is ineffective at the stall.

(ii) The stalling speeds are as follows:-

Undercarriage and flaps down - about 65 m.p.h. A.S.I. reading.
Undercarriage and flaps up - about 72 m.p.h. A.S.I. reading.

(iii) Opening cowling gills has a slight effect on the <u>indicated</u> speed at the stall, increasing it by 3 - 4 m.p.h. Stalling speed at full load or overload is also higher by about the same amount.

(iv) The <u>true</u> stalling speed with flaps down is about 68 m.p.h.

SPINNING

22. It is almost certain that this aeroplane cannot be spun, even deliberately, owing to the automatic slots. Attempts must not be made to do so. There is, however, a remote chance of the slots becoming iced up in clouds, and a spin might then be possible. The standard method of recovery must be used in such an event. The use of the inner engine will also help to stop rotation if it has not stopped as a result of the spin.

GLIDING

23. With undercarriage and flaps up gliding may be done at any speed down to about 100 m.p.h. A.S.I. Add about 20 m.p.h. to this for turns. The best speed for covering long distances in case of necessity is about 110 m.p.h. With flaps and undercarriage down gliding speed should be within the range 90 - 110 m.p.h. A.S.I.

(i) <u>Gliding from a height</u>.- Set carburettor heat control to WARM AIR if necessary.
Move blower control down to M.
Close cowling gills, if not already closed.
Set airscrew controls at POSITIVE COARSE, and throttles about 1/3 open.
See that rudder trimming tab is neutral before gliding at high speed.

(ii) Approach glide.- The correct gliding speed for the final approach, flaps down, (without engines), is about 90 m.p.h. A.S.I.

(iii) Engine assisted glide.- With engines running at about double idling r.p.m. a speed of about 80/85 is ample.

(iv) Side slipping.- This aeroplane must not be sideslipped, as very large aileron angles are needed to sustain even 10^{o} of bank, and with full opposite rudder a rather dangerous condition is approached where lateral control might be lost. Furthermore, sideslipping is almost ineffective.

DIVING

24. The maximum permissible diving speed is 290 m.p.h. A.S.I.-

(i) The airscrew must be set to POSITIVE COARSE PITCH well before beginning a dive; otherwise, if throttles are closed, pitch will become fully fine and the engine r.p.m. will dangerously exceed the upper limit.

(ii) Throttle levers should be about mid-cruising range ($\frac{1}{3}$ throttle). R.p.m. should never exceed 2,600 during the dive. The dive in these conditions is not very steep, if sustained, and is better described as a power glide.

(iii) Important.- Particular care must be taken to set the rudder bias tab neutral for the dive, to ensure that yaw shall not occur. Aileron bias may also be set, and the elevator bias should be kept trimmed. Prevent any yaw by rudder control, otherwise the aeroplane may become very nose heavy, as already explained. The elevator bias tab may be used in recovery, provided it is moved very slowly and carefully, but it should not usually be necessary

APPROACH AND LANDING

25. Always land this aeroplane with flaps fully down. A tail-down landing can always be made provided approach speed is not too low for complete flattening-out.

(i) Preliminary approach.- High speed may be maintained until the aeroplane nears the aerodrome. All non-vital preparations for landing should now be made, such as closing of cowling gills, caging of gyro instruments and adjusting fuel cocks if necessary; then open the cockpit hood, throttle right back, raise the nose to slow down quickly, and, as the speed drops to 115 m.p.h. A.S.I. carry out the drill of vital actions, (see sub-para.ii).

(ii) Drill of vital actions before landing.- A convenient catch phrase is applied to this drill, "H - U - P and Flaps".-

H - Hydraulic power control	-	ON
U - Undercarriage lever	-	DOWN
P - Pitch	-	FINE (fully forward)
and Flaps	-	DOWN (Lowering of flaps should be delayed until the leeward side of the aerodrome is reached).

(iii) Watch the undercarriage coming down, and make sure that both U.C. DOWN and TAIL DOWN lights show green.

ENGINE-ASSISTED APPROACH AND LANDING

26. The approach should normally be the Engine-Assisted Glide. This method is also used in forced landing with partial engine failure, and the night-flying approach is similar, though on a slightly flatter path. It is most important that the engine-assisted approach on this aeroplane should be fairly steep, not much flatter than the glide, because, when it is being used in forced landing with one engine failed (or if one engine fails to pick up during a normal approach) it is highly dangerous to allow the path of approach to become too flat, for two reasons; (a) it may become impossible to reach the aerodrome, and (b) it may be impossible to prevent a swing and "cartwheel" if speed drops as a result of trying to "stretch" the approach when flaps and undercarriage are down. The approach is best carried out as follows:-

(i) Keep at about 1,000 feet, turn towards the aerodrome and lower flaps. They will not go down fully at speeds over about 90 m.p.h., but leave the selector at flaps DOWN.

(ii) Regulate the approach by use of engines, keeping just beyond gliding distance all the way down, and maintain a speed of 80 - 85 m.p.h. A.S.I. When heading comfortably into the aerodrome set the throttles to give about double idling r.p.m., flatten out and then fully close the throttles and land.

(iii) Three-point landing.- It is important to land tail-down ("three-point") with the wheel right back, otherwise the landing run may be of indefinite length.

(iv) Hold the control column back during the landing run. This helps to keep the tail down when wheel-brakes are used and prevents the elevators flapping.

(v) Wheel-brakes.- Avoid using the brakes if there is ample room. If the tail lifts when brakes are applied, release instantly and start to apply again. On wet grass the wheels may lock and the aeroplane slide. If the pilot feels the aeroplane beginning to skid sideways, he must release the brakes; otherwise there may be a sudden strain on the undercarriage if the wheels reach a patch of dry ground. Do not swing until nearly all speed is lost, as it is bad for the tyres, but it may be useful in emergency.

(vi) Raising flaps.- Do not touch the selector lever until the aeroplane has stopped. Then look down at the control and raise the flaps. It is not essential to raise flaps before taxying clear of the landing area.

Note.- Always make a mental note of the point on the aerodrome short of which the tail-down landing must be made. If the landing is not made before this point (a touch of the wheels is not a landing) the throttle must be opened fully and another circuit made.

IF IN DOUBT GO ROUND AGAIN.

(vii) Mislanding.- If the landing cannot be completed for any reason, the aeroplane will climb satisfactorily with flaps and undercarriage down, though it would be necessary to close throttles and land if one engine were to fail before flaps could be raised.

(a) Open to full throttle smoothly and maintain a speed of at least 100 m.p.h. A.S.I.

(b) Raise the undercarriage at once and then begin to climb at 100 m.p.h. Increase speed to about 120 m.p.h. and raise the flaps as soon as 300 - 400 feet has been gained; then continue to climb, reducing r.p.m. and boost as after a normal take-off.

(c) Mislanding should be avoided if possible, owing to the danger of one engine failing to "pick up". It cannot be too strongly emphasized that no attempt must ever be made to fly level on one engine with flaps down.

APPROACH AND LANDING WITHOUT ENGINE

27. This is the fundamental method, as it may be necessary in case of forced landing, especially during operations. The preliminary approach is the same as before, the drill of vital actions being carried out while still above 2,000 - 3,000 feet if possible, but lowering of flaps is left until later, as it gives the pilot a means of adjusting his glide path in the final stages of the approach.

(i) Lose height in S-turns or spiral down to about 2,000 ft. then make a half circuit of the leeside of the landing ground, regulating the approach by the radius of turn, and keeping the landing point in view. Turn in not lower than about 500 ft. for the final straight approach and lower flaps as soon as it is certain that this will adjust the glide-path nicely into the landing ground. Ample gliding speed should be maintained - about 90 m.p.h. A.S.I. In a strong wind or gusty conditions, speed may be even higher - 95 - 100 m.p.h. An actual forced landing (described under that heading) would usually be done with undercarriage UP.

(ii) Training method.- Regular practise is necessary to accustom pilots to this steep glide path, and in order that this important part of training shall not be neglected, a convenient method of practising the final glide and landing without engine is described below.

(a) Carry out the preliminary approach and drill of vital actions as for the engine assisted approach. Turn towards the aerodrome and then lower flaps.

(b) Approach with assistance of engines to within gliding distance at not lower than about 600 ft., and not much higher, as it is less easy to judge. It is important to regulate this accurately.

(c) Close throttles, put the nose down and glide at 90 m.p.h. A.S.I. This provides a little surplus speed so that flattening out may be started in good time, almost imperceptibly at first, and a smooth and gentle curve made, with a little float before the tail-down landing.

POWER APPROACH - FOR EMERGENCY LANDING IN SMALL SPACE.

28. This is a method of landing the aeroplane accurately close to the lee boundary of a landing ground, to be used only in case of necessity. It is an easy method, because no judgement of angle of descent is needed, full use being made of the engines. Practice should not be carried out at the minimum speed given; but in emergency it is most important to keep this speed dead accurate.

(i) Carry out the preliminary approach and drill, and approach with undercarriage and flaps fully down, tending to undershoot by 300 - 400 yds. Fly in as low as possible, using ample engine power; (it will be found that, with airscrews in fine pitch, at least-2 lb./sq.in. boost is needed), keep safely clear of obstacles, and reduce speed (if there are no high obstructions) to about 75 m.p.h. Speed must not be allowed to drop below 75 m.p.h. Immediately after crossing the boundary, get close to the ground (within 2 - 3 ft.), close throttles and hold off to land tail-down. Apply the brakes, keeping the wheel right back.

(ii) If the approach is over trees, speed should be slightly higher, and on no account close the throttles until after descending close to the ground.

(iii) Concentrate attention on the airspeed and the ground. If the landing ground is barely large enough, more than one attempt may be necessary before an absolutely accurate approach is made. Remember that if one engine fails during this type of approach no attempt to "stretch" the approach must be made, but an immediate landing after closing throttles must be carried out.

LANDING ACROSS WIND

29. This aeroplane can safely be landed across wind, owing to the wide track of the undercarriage, and to the fact that landing speed in still air is nearly 70 m.p.h. For this reason a cross-wind landing using the full length should always be preferred in a case where an aerodrome or landing space is long and narrow, with the wind blowing across it. This also applies to prepared run-ways.

(i) To approach accurately the aeroplane must be headed partly upwind, and not "straightened-up" until the last fifty feet or so. Otherwise, if headed straight for the run-way, it will naturally drift off the line. Do not try to sideslip.

(ii) Drift when landing may be partly counteracted in two ways:-

(a) By keeping one wing <u>slightly</u> down into wind until near the ground. Do not land on one wheel, but level off in good time.

(b) By making a slight and very careful flat turn towards the direction the aeroplane is drifting by means of a little rudder just before landing. Do this carefully.

APPROACH SPEEDS

30. It will have been noticed that the approach speed varies a little according to the amount of engine power used; from 75 m.p.h. with enough power for completely level flight to 90 m.p.h. or more without engine. Airspeed indicators sometimes vary slightly, so the pilot should know the stalling speed of his aeroplane (A.S.I. reading). If, through a faulty instrument the stalling speed appeared to be 85 m.p.h., considerably more than 90 m.p.h. would be needed for the approach. Generally speaking, 40% is added to the stalling speed for the glide approach, and about 33% for the engine-assisted glide.

31. After raising flaps, release the hydraulic power control to OFF, and taxy in towards the tarmac. It is only necessary to open the cowling gills if cylinder temperatures rise.

(i) Change the airscrews to POSITIVE COARSE PITCH while taxying (or afterwards). High r.p.m. may be needed to do this. Apply parking brakes.

(ii) Run the engine slowly for about a minute to allow oil to settle and be removed from the sump.

(iii) Shut OFF fuel cocks, thereby at the same time operating the slow-running cut-out.

(iv) Switch off ignition and indicator lamp switches.

Note.- If the air pressure for brakes fails while taxying, immediately apply the brakes fully, while some pressure remains, and stop. If there is no pressure, use the engines carefully to turn away from any obstacles, and allow the aeroplane to come to rest, switching off as quickly as possible.

UNDERCARRIAGE EMERGENCY OPERATION

32. The hydraulic pump is on the starboard engine. If this engine stops or the hydraulic system fails for any other reason, there are two other means of lowering the undercarriage.

(i) The hand-pump (which will also lower flaps). To operate:-

(a) Turn OFF hydraulic power control.

(b) Selector undercarriage DOWN.

(c) Pump until fully down and locked (check green lights).

(ii) The EMERGENCY control: a red handle below the hydraulic selector gate. To operate:-

Lift the safety wire and pull the handle out as far as it will come. The undercarriage should go fully down (check indicator).

Important.- Once the undercarriage has been lowered by this means it must not be raised again. The system requires attention by ground personnel.

BOMB DOORS

33. Bombs cannot be dropped until the bomb doors are opened. To do this:-

(i) See that the selector lever is in neutral.

(ii) Set bomb door control to OPEN.

(iii) Put hydraulic power control to ON and leave it there until the green light appears on the bombing panel. Then return it to OFF.

To close doors:-

(iv) See that selector lever is in neutral.

(v) Put bomb door control at SHUT.

(vi) Put hydraulic power to ON and leave it there until the sound of blowing off is heard, then return it to OFF.

SPACE NEEDED FOR PRECAUTIONARY LANDING

34. A precautionary landing should on no account be made away from an aerodrome unless it is unavoidable. The pilot must be able to judge whether the landing ground selected is of ample size for a safe landing to be made, and subsequent take-off.

Note.- This paragraph is also applicable to landing grounds for operational purposes, except when carrying an overload.

(i) Landing.- This aeroplane, at normal full load in a light wind and on level ground, has a landing run of about 350 yds, provided that a fully tail-down landing is made, and effective wheel-brakes used.

(ii) Margins must be added for:-

(a) Approach over obstacles.

(b) Downward slope of ground.

(c) Defective brakes.

(d) Inaccurate approach or fast landing.

(e) Safety.

(iii) The smallest possible space in which this aeroplane could be landed, with no obstacles to a low approach, is about 550 yds; but the available landing run for a precautionary landing by any pilot (that is, the least experienced trained pilot) should be at least:-

(a) 800 yards with clear approaches.

(b) 1,100yards over average height trees.

(iv) Take-off.- The distances in (iii) are ample for take-off with this aeroplane.

FLYING IN RAIN AND BAD VISIBILITY

35. When flying in conditions of bad visibility with the ground in sight, or in formation, open the cockpit hood if vision becomes too bad with it closed. In rain, the front triplex panel tends to

become opaque, but it is usually possible to see through the side panels. Break-out panels are fitted which can, in emergency, be pushed out by a sharp blow with the heel of the hand or fist, if for any reason it is impossible to open the hood.

(i) It is advisable in order to facilitate navigation and to obviate the risk of collision with suddenly rising ground, greatly to reduce speed. In extreme cases flaps should be lowered, partly or fully, and airscrews set to give the normal 2,250 r.p.m. Reduce speed to between 100 and 120 m.p.h. A.S.I. When flaps are raised, ensure that speed is ample, to prevent sinking. Engine temperatures must be watched and gills partly opened. Use discretion about the speed suitable to weather conditions.

(ii) There is no advantage in lowering the undercarriage, unless a precautionary landing is decided upon, because the extra drag makes the aeroplane less efficient. If a landing is absolutely unavoidable, the undercarriage should not be lowered unless the pilot is able to select a field suitable for a safe landing.

FORCED LANDING OWING TO ENGINE FAILURE

36. Attention is drawn to the following:-

(i) <u>If one engine has failed</u>.- This type of forced landing is the one most likely to occur because, other factors being equal, the chance of engine failure with a twin-engined aeroplane is doubled. It is recommended that every normal landing should be made by the same general method, particularly avoiding a flat approach. The method is quite easy if the sequence and instructions given in para.11 are carefully followed; but carelessness will result in difficulty.

<u>Important</u>.- Flying on one engine should be practised by the pilot to accustom him to the "feel" of the controls in this condition, - <u>see</u> para.15.

(ii) <u>If both engines have failed</u>.- The principles of forced landing this aeroplane are the same as those for any other type, the first actions being to maintain ample gliding speed, select a landing ground or suitable-looking country, glide towards it, and then try to rectify the trouble. If a landing without engines is inevitable, act as follows:-

(a) Switch off the engines and shut off fuel cocks.

(b) Decide whether the undercarriage is to be used or not and act accordingly.

(c) Approach and land as described in para.27.

(iii) Glide path control.- S-turns or a spiral may be employed above 2,000 - 3,000 ft, but are less easy to judge at lower heights than the half circuit of the lee side, when the approach is regulated by gliding across wind and gradually turning in to land, close or wide, early or late, according to whether the aeroplane tends to overshoot or undershoot the near side.

(a) A further adjustment of the angle is provided by the flaps, the lowering of which may be delayed until the last 400 - 500 ft., provided the starboard engine (hydraulic pump) is revolving. If not, they should be pumped down earlier by hand-pump. Use full flaps if possible.

(b) Undercarriage.- If in doubt as to whether the field is of ample size for a safe landing to be made, land with undercarriage up (or unlocked and partly up, which comes to the same thing, provided both sides are unlocked) It should be left up to extend the glide if necessary, whether or not it is to be lowered finally; but it must be lowered in good time. It can easily be raised again, or unlocked.

POSITION ERROR TABLE

37. Note the following:-

A.S.I. reading	Correction
80 m.p.h.	+ 11½ m.p.h.
100 m.p.h.	+ 8 m.p.h.
120 m.p.h.	+ 5 m.p.h.
140 m.p.h.	+ 2½ m.p.h.
160 m.p.h.	+ ½ m.p.h.
180 m.p.h.	- 1 m.p.h.
200 m.p.h.	- 2 m.p.h.
220 m.p.h.	- 3½ m.p.h.

NOTES CONCERNING THE PEGASUS XVIII ENGINE

38. The following should be carefully noted:-

(i) Limiting operational conditions

		Low gear	High gear
Take-off	Maximum r.p.m.	2,475	-
(up to 1,000 ft. or for 3 minutes)	Minimum r.p.m. at maximum boost (+5½ lb./sq.in.)	1,950	-

		Low gear	High gear
Climb	Maximum r.p.m. at maximum boost ($+2\frac{1}{2}$ lb./sq.in.)	2,250	2,250
Maximum cruising (Mixture control NORMAL)	Maximum r.p.m. at maximum boost ($+2\frac{1}{2}$ lb./sq.in.)	2,250	2,250
Economical cruising (Mixture control WEAK)	Maximum r.p.m. at maximum boost (zero lb./sq.in.)	2,250	2,250
Maximum level flight (5 minute limit)	Maximum r.p.m. at maximum boost ($+5\frac{1}{2}$ lb./sq.in.)	2,600	2,600
Maximum dive	Momentary maximum r.p.m. at maximum boost ($+5\frac{1}{2}$ lb./sq.in.)	2,825	2,825

(ii) Oil pressures

Normal	80 lb./sq.in.
Emergency minimum	70 lb./sq.in.

(iii) Oil inlet temperatures

Minimum for take-off (with H.I.O.P. pump)	5°
Maximum for continuous cruising	70°
Maximum for climbing	80°
Emergency maximum	90°

(iv) Cylinder temperatures

Maximum climbing	210°
Maximum cruising	190°
Maximum all-out level (5 minute limit)	235°

(v) Operation of two-speed supercharger

For taking off, the supercharger must be in low gear. The possibility of inadvertently taking off in high gear should be particularly guarded against, since at this setting, the power output will be substantially curtailed at ground level.

It is more economical to cruise with the low supercharger ratio at any height. If the optimum cruising power is required it will be advantageous to change into the high ratio at approximately 15,000 ft. and above. This will, however, be at the expense of fuel consumption.

The supercharger gear ratio control is to be used as follows:-

Engage M (low) ratio	for	Ground running and taxying; Take-off; High speed below approx. 10,000 ft.; Economical cruising wherever possible.
Engage S (high) ratio	for	Climbing above the height (approx. 8,000 ft.) at which the boost pressure has fallen to $+\frac{1}{2}$ lb./sq.in.; High speed above approx. 10,000 ft.; Economical cruising where altitude prevents requisite boost being obtained in low ratio.

FUEL CAPACITY AND CONSUMPTIONS

39. There are six tanks with a total fuel capacity of 674 gallons (see fig.1).

Fuel consumptions

The following information will be found useful in determining endurances.

Maximum consumptions per engine at the altitudes indicated:-

	Boost	R.p.m.	Low gear	High gear
Climbing	$+2\frac{1}{2}$lb./sq.in.	2,250	66 galls/hr. at 4,750 ft.	69 galls./hr. at 14,750 ft.
Max.cruising (Mix. control NORMAL)	$+2\frac{1}{2}$lb./sq.in.	2,250	66 galls/hr. at 4,750 ft.	69 galls/hr. at 14,750 ft.
Max. cruising (Mix. control WEAK)	zero	2,250	43 galls/hr. at 9,500 ft.	$42\frac{1}{2}$ galls/hr. at 19,500 ft.
Max. level flight (5 min. limit)	$+5\frac{1}{2}$ lb./sq.in.	2,600	94 galls/hr. at 3,000 ft.	$99\frac{1}{2}$ galls/hr. at 15,500 ft.

OIL CAPACITY

40. The total oil capacity is 36 gallons. There are two tanks, one per engine, each having an oil capacity of 18 gallons, with an air space of 2 gallons.

LOCATION OF ENGINE-DRIVEN AUXILIARY PUMPS

41.

Port engine	Starboard engine
Air compressor (wheel brakes and guns)	Vacuum pump
Air compressor (auto-controls)	Hydraulic pump

ADDENDUM

NOTES ON NIGHT FLYING

1. This aeroplane is quite easy to fly and land at night, provided the sequences are strictly observed.

SETTING LANDING LIGHTS

2. In addition to the normal preparation for night flying (testing lights and so on), the following should be done:-

(i) Switch on one landing light to see where the beam is, and quickly move the lever to get the light in the best spot for landing. This is fairly well forward, about 50 yards. Then change the switch over, and see where the other beam comes. Use the better one and set this, but note the position of the other. Remember when to switch fore or aft for the better beam. Note the position of the lever. Do not keep these powerful lights on for more than a few seconds at a time, on the ground.

(ii) The landing light should not be used for taxying. Taxy slowly towards the flare path (taxying post).

BEFORE TAKE-OFF

3. Note the following:-

(i) Increase the light of the instrument board floodlights until instruments can be seen, if the luminous markings are not good enough for taking off or landing. (Lights should not be too bright owing to reflection from the windscreen). It is most important to be able to see the airspeed, altimeter and gyro instruments clearly, both when taking off and landing.

(ii) Carry out drill of vital actions exactly as in daylight. When permission to take off is received, taxy well down towards the obstruction light to get all possible benefit from the flare path.

(iii) Take off in the normal way, getting the undercarriage up as quickly as possible, and continue the normal sequence.

(iv) On a dark but starlit night when the last light has been left behind, it is impossible to see the ground, or any horizon (and the altimeter usually registers below zero just after the take-off); therefore get into the habit of keeping the window panels steady on the stars ahead, to maintain a constant climbing angle, and watch the airspeed and altimeter.

(v) On a moonlit night there is no difficulty, but on a dark night with sky overcast, the landing light must be used to light up the ground until a safe height of 200 - 300 feet is reached, if permitted. If not, instruments must be used if nothing is visible outside the cockpit.

(vi) The landing light, or the stars, or the moonlight, will enable an accurate initial climb to be made, with the aid of the instruments, and if an engine fails the pilot can keep the aircraft straight and level until speed is gained, provided these rules are observed.

APPROACH AND LANDING

4. The following is the sequence:-

(i) Make a left-hand circuit with undercarriage down at about 1,000 feet.

(ii) Send aircraft letter in signalling sector and when permission to land is received, switch on recognition lights.

(iii) Fly away to leeward and check the setting of the landing light lever.

(iv) Turn in, lower flaps and approach by the normal engine-assisted approach method at about 80 m.p.h. A.S.I. At about 300 feet switch on landing light. At 100 - 150 feet set engines to a very fast tick-over. Test landing light once on the way down. Aim to flatten out between the obstruction light and No.1 flare.

(v) Keeping an eye on the airspeed indicator, concentrate on the ground in the circle of light, focussing the eyes on the surface of the ground. Flatten out; then shut off the engines, and land as in daylight.

(vi) Switch off landing light and recognition light at once.

These are being listed for the benifit for people interested in British or Commonwealth Aircraft

While it did cost me a great sum of money to aquire these documents, all I ask in return is some credit.

~JimSan