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AIR PUBLICATION 1578 A

Pilot's Notes

PILOT'S NOTES

THE WELLINGTON I IA AND IC AEROPLANES

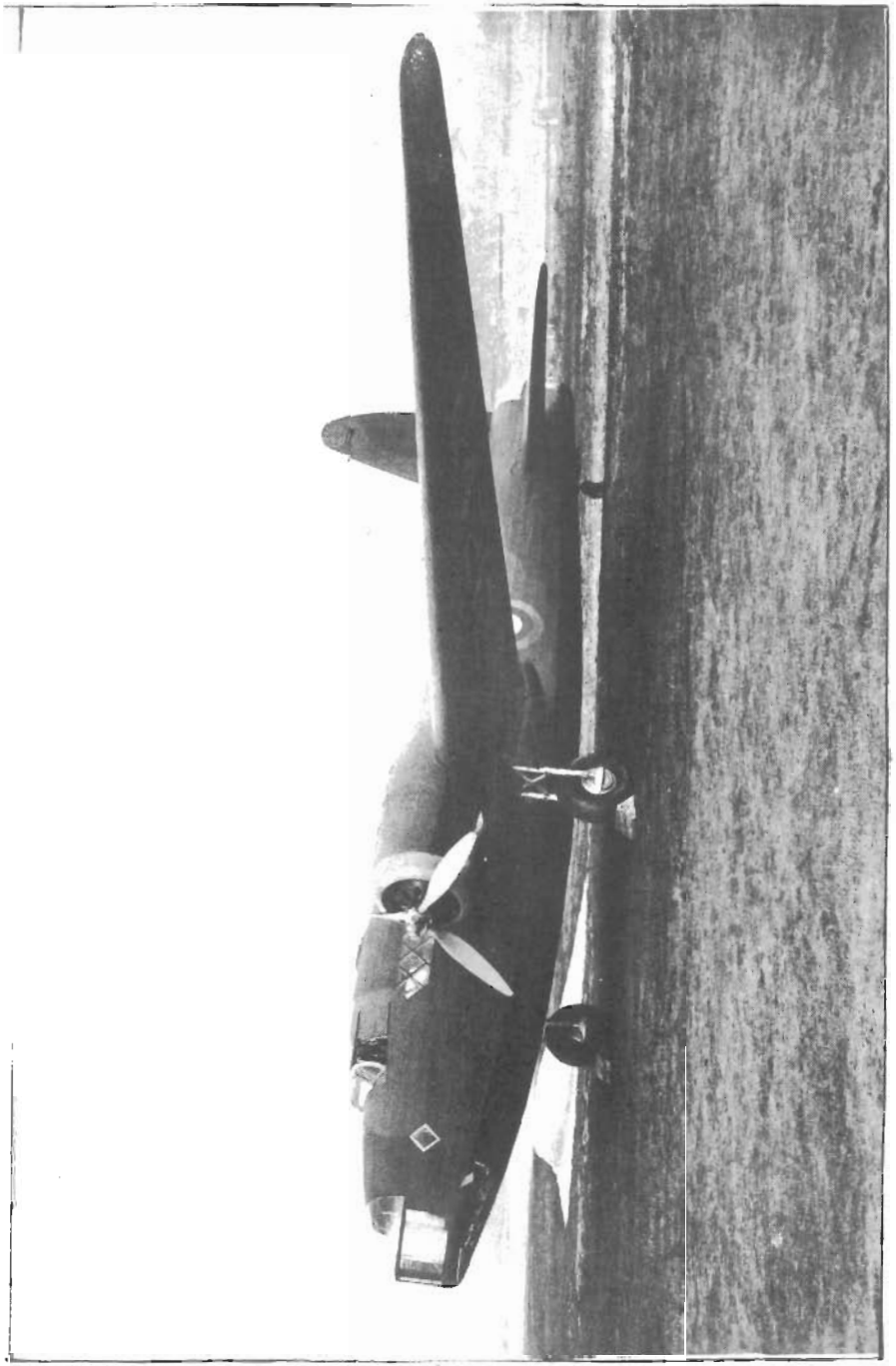
TWO PEGASUS XVIII ENGINES

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

By Command of the Air Council

A.W. STREET

AIR MINISTRY



THE WELLINGTON I AEROPLANE

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Volume I

Pilot's Notes

AMENDMENT CERTIFICATE

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

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

LIST OF SECTIONS

(A detailed Contents List is given at the beginning of each Section)

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Issued with A.L. No. 5

INTRODUCTION

1. The first part of this introduction gives a brief description of the Wellington I aeroplane and is followed by notes on the main differences between that aeroplane and the Wellington IA and IC aeroplanes.

Wellington I aeroplane

2. The Wellington I aeroplane is a mid-wing monoplane of geodetic construction with a covering of fabric, and has two Pegasus XVIII engines driving constant-speed-operated variable-pitch airscrews. It is designed and equipped for the duties of a medium bomber and carries a nominal crew of four, consisting of pilot, navigator (also acting as the front gunner and bomb aimer), wireless operator and rear gunner.

3. The fuselage is a light-alloy geodetically-braced structure of open frames, permitting free passage from front to rear, and has upper and lower tubular longerons extending along each side. Entrance to the fuselage is gained through a forward lower hatchway. The main plane, tail plane and fin are geodetically-braced cantilever structures, tapered uniformly in chord and thickness, with a covering of fabric, a sheet metal covering being employed for the leading edges and tips, in addition. The main plane has an open-braced spar with tubular booms, passing through the fuselage and built in four sections pin-jointed together at the engine nacelles and at the aeroplane centre line. Split flaps, each operated by an inboard hydraulic jack, are incorporated in the trailing edge at each side, extending from the wing roots to the Frise-type ailerons. The starboard aileron incorporates a trimming tab, adjustable on the ground only, to correct any inherent tendency of the aeroplane to fly out of balance. The tail plane consists of separate components at each side of the fuselage, provided with upper and lower unbraced tubular booms and carrying horn-balanced elevators. The fin, which is fixed centrally to the fuselage, is of similar construction to the tail plane components and carries a tab-balanced rudder.

4. The alighting gear consists of two retractable undercarriage units fixed to the main plane structure within the engine nacelles, and a retractable castoring tail wheel unit. Each undercarriage unit is actuated by a single hydraulic jack and, on retracting, folds upwards and rearwards into the engine nacelle, the gap in the base of the nacelle being closed automatically by hinged doors. The tail wheel unit is retracted simultaneously with the undercarriage units, folding back completely within the fuselage where it is

enclosed by automatically operated doors. All units are retained in the retracted position solely by the action of the hydraulic pressure in the jacks and, in the lowered position, by mechanical locks. Visual and audible warning systems are interconnected with the alighting gear so as to indicate its position to the pilot. In the event of failure of the normal hydraulic system, the alighting gear can be lowered by means of a manually-operated emergency hydraulic system.

5. The flying controls are orthodox in operation and consist of a handwheel-type control column and a rudder bar that is adjustable for leg reach. The controls are connected to the control surfaces by a system of rigid rods. Dual controls for operation from the cockpit starboard seat, can be linked up with the main controls. Longitudinal, directional and lateral trimming are controllable in flight from the cockpit through cable systems actuating trimming tabs on the elevators, rudder and port aileron, respectively, the rudder trimming tab being also arranged to balance the rudder automatically by virtue of the latter's movement. Provision is made for fitting Mark IV automatic controls, the actuating units of which are grouped together beneath the flying control platform.

6. The two Pegasus XVIII engines are mounted on nacelle structures built into the main plane. Fuel is normally drawn from two pairs of main plane tanks arranged fore and aft of the spar outboard of the engine nacelles, and from two smaller tanks carried in the engine nacelles. Overload fuel can be carried in two additional tanks installed in place of bombs in the outer bomb cells. The oil supply for each engine is contained in a tank mounted on the forward face of the fuel tank in each engine nacelle. The oil tanks can be replenished if necessary from an auxiliary tank mounted, along with a hand pump for this purpose, within the fuselage at the starboard side. The airscrews are provided with de-icing fluid slinger rings and feed nozzles to distribute fluid over the blades after it has been delivered to the slinger rings by an electrically driven pump, controlled by the pilot. Two engine-driven pumps are mounted on the port engine for the operation of the general services and gun turret hydraulic systems, the general services comprising operation of retractable alighting gear, bomb doors and main plane flaps. Separate air compressors, working at high and low pressure, for the operation of the pneumatic system and automatic controls, respectively, are driven by the starboard engine. A suction pump for operation of the instrument-flying panel is driven by the port engine. Each engine is started by an electrical motor or, alternatively, by the use of a starting handle.

7. Two Vickers hydraulically-operated turrets in the nose and tail are armed with Browning ·303 in. guns, one being carried in the nose and two in the tail. Various alternative bomb loads are carried in three long bomb cells in the belly of the fuselage. The bomb doors are arranged in five longitudinal rows of six doors each, the outer cells possessing double doors and the central one single doors. With the exception of the foremost three doors in

each outer bomb cell, which are actuated in both directions by double-acting hydraulic jacks, all the doors are opened by the action of compression springs upon the pressure being released in the single-acting hydraulic retaining jacks which are employed to close them.

8. A 12-volt electrical generator is driven by the starboard engine, but on some aeroplanes, separate generators of half the output are mounted on each engine for operation in parallel. In conjunction with the generating system, a 12-volt 40 amp.-hr. accumulator within the fuselage provides for all electrical services other than engine starting, for which a further 40 amp.-hr. accumulator is employed. Engine starting can also be carried out by the use of an external electrical supply source connected to a socket under the starboard main plane. The wireless compartment, immediately aft of the pilot's cockpit contains the wireless transmitting and receiving equipment, which can be employed alternatively with fixed or trailing aerials, and also the D.F. equipment. Telephone and microphone sockets are provided for intercommunication at the various crew stations.

9. On later aeroplanes sound-proofing material is inserted inside the fuselage fabric covering forward of the leading edge frame which is itself provided with a sound-proof bulkhead. The interior of the aeroplane can be warmed by a heating duct system into which air enters through slots in the port main plane leading edge and is heated by means of a boiler jacket round the exhaust pipe of the port engine. The warmed air is conveyed to the various crew stations where it is discharged through openings provided with control valves. Outlets are also provided in the bomb cells for use when the smoke curtain installation is fitted; otherwise the valves on these outlets should remain closed to avoid wastage of heat.

10. The usual emergency equipment, comprising parachutes, life-saving jackets, fire extinguishers, fireman's axes and first-aid outfits are carried, in addition to an inflatable rubber dinghy carried within a container in the starboard engine nacelle.

11. Other equipment includes oxygen apparatus, reconnaissance and landing flares, flare signal pistol, hand signal lamp, rest bunk, sanitary equipment, entrance ladder, starting handle, ballast weights, etc. When required, an instrument-flying hood can be fitted.

Wellington IA aeroplane

12. The Wellington IA aeroplane is similar in general design to the Wellington I but is provided with a larger undercarriage unit in consequence of increased load. Nash and Thompson gun turrets are substituted in the fuselage nose and tail and an additional retractable one is introduced amidships in the undersurface, all being hydraulically-operated and carrying an armament of two Browning

•303 in. guns each; the mid-turret is operated by an additional pump driven by the starboard engine. The provision of a further gun station increases the nominal crew complement to five. An additional soundproof bulkhead with a gangway door is built across the frame at the rear of the pilot's cockpit, and armour plating is provided behind the wireless operator's seat, giving protection to the wireless operator and pilot against gun fire from the rear.

13. Provision is made for jettisoning the fuel from the four main plane tanks. An armour plating protection is provided for these tanks but will give place to the provision of protected tanks. The oil tanks, similarly, are being replaced by the protected type. A fluid de-icing system is provided for the carburettor air-intakes. Flotation gear, consisting of inflatable bags, is provided in the fuselage bomb cells. A T.R.9.F. transmitter-receiver and beam approach equipment, both operated by the pilot, are installed.

Wellington IC aeroplane

14. The Wellington IC aeroplane is almost identical to the Wellington IA, with the main exception that the electrical system, including engine-starting, is operated from a 24-volt supply provided by two 12-volt accumulators in series, in conjunction with a 24-volt generator driven by the starboard engine. A complete rearrangement of the wiring system is also involved, and an automatic bomb distributor unit is added. The pump for the general services hydraulic system is replaced by one of a different design and the same hydraulic system is modified.

Issued with A.L. No.6

SECTION 1

CONTROLS AND EQUIPMENT FOR PILOT

AND GENERAL EMERGENCY EQUIPMENT AND EXITS

LIST OF CONTENTS

Amended by A.L. No. 9

LIST OF ILLUSTRATIONS

CONTROLS AND EQUIPMENT FOR PILOT AND GENERAL EMERGENCY EQUIPMENT AND EXITS

INTRODUCTORY

1. The information given in this Section applies mainly to the Wellington 1A and IC aeroplanes and in the case of the Wellington I aeroplane, therefore, some differences, may occur, but the same operational directions nevertheless remain applicable to equivalent controls. The location of the controls and equipment in the pilot's cockpit of the Wellington IC is illustrated and referenced in figs.1 to 3 at the end of this Section, a key to the items referenced being given facing each illustration. Explanatory notes on the function and operation of particular items are given in the text and reference to such items as appear in the illustrations is accompanied by the relevant key number in brackets.

FUEL AND OIL

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

Fuel ..... Specification D.T.D.230 (Stores Ref.34A/59)
Oil ..... Specification D.T.D.109 (Stores Ref. 34A/32 and 33)

AEROPLANE CONTROLS

3. Flying controls.- The ailerons, elevators and rudder are operated in the normal manner by a handwheel-type control column (18) and rudder bar (15). The rudder bar is adjustable for leg reach by means of a starwheel (99) at the rear of its mounting.

4. Trimming tab controls.- These controls are mounted in a group alongside the pilot's seat at the port side of the cockpit floor. The elevator and rudder trimming tabs are operated by a single control knob (71) mounted on a quadrant; the knob is rotated for directional trim and moved fore and aft for longitudinal trim, a fine adjustment control for the latter operation being provided by a star wheel (72) at the side of the quadrant. The quadrant is provided with division lines over the elevator trimming tab control range of movement, the neutral position line being indicated by an arrow head. The rudder trimming tab control is in the neutral position with the arrow on the knob pointing directly forward. The directions of movement of the above controls follow the sense in which it is desired to correct the trim.

5. For lateral trim adjustment, a control is mounted on a bracket immediately outboard of the quadrant and consists of a rotating handle provided with a lock-release grip. The handle is rotated clockwise to raise the starboard wing and counter-clockwise to raise the port wing. The lock consists of a spring-loaded rotating arm engaging in various hole positions on the mounting, and the control is in the neutral position when this arm, with the arrow on the handle, points directly aft.

6. Flying controls locking gear.- The flying controls can be locked in their neutral positions by means of the triangular spring-loaded bracket (89) secured by a strap when disengaged, mounted below the window ledge at the port side of the cockpit, and a hinged "nuisance bar" stowed on the starboard side of the cabin aft of the cockpit.

7. To lock the controls, the control column should be pushed forward with the aileron handwheel rotated in a clockwise direction and the triangular bracket (89) pulled down. On then returning the control column to the central position the handwheel should be rotated to engage with the bracket fork so that the holes in the latter and in the end of the handwheel lower spoke approximately coincide. With the rudder bar central, the fork on the "nuisance bar" should then be placed over the rear of the rudder bar leg reach adjusting slide so that the rudder is locked by the square pillar on the cockpit floor and, with the hinged end of the "nuisance bar" projecting across the pilot's seat, thereby preventing its use, the pin on the hinged portion should be inserted through the aligned holes in the bracket and handwheel.

8. Dual flying controls.- Dual flying controls coupled mechanically to the main controls can be mounted in front of the cockpit starboard seat position, on a special floor extension attached between the front of the pilot's platform floor and the starboard side of the cockpit.

9. Main plane flaps (hydraulic control).- The flap control lever (9) is mounted beneath the centre of the instrument panel, and is held by a spring-loaded catch in the neutral position, from which it is moved for an operation by pressing in the knob. For a complete raising or lowering operation, the lever is moved to the appropriate position and need not necessarily be returned to neutral. If only partial raising or lowering is required, however, the control lever must be returned to neutral immediately the desired flap setting, as shown by the indicator (54), is reached. The flap setting indicator (54) has a scale graduated in degrees and is switched on by the alighting gear position indicator switch (27). For operation by the hydraulic hand pump, should the engine-driven pump fail, reference should be made to para.20.

10. Interconnection of elevator trimming tabs with main plane flaps.- For correct longitudinal trim when the flaps are fully down, it is necessary for the elevator trimming tabs to be fully raised. For

this reason, the flaps are so interconnected with the elevator trimming tabs that, providing the elevator trimming tab control (71) is in the neutral position, lowering of the flaps, either fully or to intermediate positions, automatically adjusts the elevator trimming tab to maintain longitudinal trim. A plate alongside the flaps control lever bears the instruction: "Set elevator trim lever to mid-position before lowering flaps".

11. Alighting gear (hydraulic) control.- Raising and lowering of the retractable undercarriage and tail wheel units are controlled by the lever (11) alongside the flap control lever. In order to prevent inadvertent selection of the "up" and "down" positions when the aeroplane is on and off the ground, respectively, an automatic safety catch engages with the lever in each operating position and must be freed by the catch release (12) before the lever can be operated. A further hydraulic control lever (73) concerned with alighting gear operation is mounted at the starboard side of the pilot's seat and must occupy the downmost position for normal operation by the engine-driven pump or the hand pump, and the uppermost position for emergency lowering by the handpump (see also paras.19 to 21).

12. Undercarriage position indicator.- The position of the undercarriage and tail wheel units when fully lowered and retracted is shown by a visual indicator (49) at the centre of the instrument panel. A switch (27) for the indicator is provided at the port side of the instrument panel and carries a catch bar so engaging with the adjacent bank of magneto switches (26) that the latter can only be switched on when the indicator switch is on; conversely, the indicator cannot be switched off until the magneto switches are off. The switch also closes the circuits for the flap setting indicator (54) and undercarriage audible warning system (see para.14).

13. The indicator possess an upper group of three red-coloured lamps illuminating when the alighting gear is raised and a similar lower group of green-coloured lamps illuminating when it is lowered. The central lamp in each group denotes the tail wheel position and the side lamps the undercarriage unit positions. In case of failure of any of the undercarriage unit position lamps, a complete duplicate set of side lamps can be substituted by pulling out the switch knob at the centre of the indicator. In addition, counter-clockwise rotation of this knob brings a dimmer screen over all lamps for night flying.

14. Undercarriage warning horn.- An electric horn is mounted above the pilot's seat on the cockpit rear bulkhead, and provides an audible warning should the undercarriage units not both be safe for landing when both throttle levers are at less than one quarter of their travel forward from the SHUT position. The system is ready for operation when the alighting gear position indicator switch (27) is on, the horn circuit being closed by switch units operated by the throttle mechanism in the engine control box. The horn can be tested for satisfactory operation when the aeroplane is on the ground by

closing the alighting gear position indicator switch (27) and pressing the horn push-switch (5).

15. Undercarriage wheel brake controls.- The aileron handwheel incorporates the pneumatic wheel brake twin operating levers (32) which are used either singly or together to apply both wheel brakes. The brakes can be locked in the fully-applied position, for parking, by compressing the operating levers to the end of their travel and engaging the catch bar (90) on top of the control column. To unlock the brakes, the levers should again be compressed and the catch bar disengaged, after which the pressure should be released gradually. A triple pressure gauge (59) registering the main supply pressure and the operating pressure at each wheel brake is provided at the starboard side of the instrument panel.

16. The braking system provides for differential application of the brakes by virtue of the rudder bar movement when taxying and, in this connection, attention is drawn to A.M.O. A114/38 which states the precautions to be observed when parking the aeroplane with the brakes locked.

HYDRAULIC SYSTEM

17. The undercarriage and tail wheel, main plane flaps and bomb doors are operated by hydraulic power normally supplied by a pump driven by the port engine. The operation of the controls for these services is described in paras.11, 9 and 47, respectively. Double-acting jacks are employed for opening and closing the foremost three doors in each outer bomb cell, and single-acting jacks for closing the remainder which are self-opening by the action of hinge compression springs.

18. Power valve.- On Mark I and IA aeroplanes, a master control valve handle, with a thumb release knob, for the hydraulic system is located on a bracket immediately to the right of the pilot's seat, aft of the change-over cock for the instrument-flying panel. This valve enables the engine-driven pump to idle when not in use and must be put into the ON position in order to operate any hydraulic service by the normal system (apart from the gun turrets, which have a separate system) and returned to the OFF position after each operation. If left in the ON position during non-operation of services, a relief valve operates, causing a chattering noise which serves as a reminder. When using the hand pump for the normal operation of services (see para.20) the valve must be in the ON position, but for the emergency lowering of the undercarriage and tail wheel (see para.21) the position of the power valve is immaterial. On Mark IC aeroplanes, the pump incorporates an automatic by-pass which eliminates the power valve entirely.

19. Alighting gear hydraulic system pressure gauge.- A gauge (63) is provided at the starboard side of the instrument panel to register the hydraulic pressure for normal operation in the alighting gear raising and lowering system.

20. Hydraulic system HAND PUMP operation.- If it is found that the normal hydraulic system, working on the engine-driven pump, will not operate the service selected, a member of the crew should be detailed to examine the contents of the hydraulic header tank. If,

on examination, it is found that the level of the fluid is approximately normal, i.e. is level with the line scribed on the inspection glass, it should be possible to operate the service required by means of the handpump (75) at the starboard side of the pilot's seat. The handpump is provided with an actuating lever which, for operation, is fully lowered so as to engage the spring-loaded catches at the base with the pump, which is then operated by moving the lever to and fro; for stowage, the lever is disengaged by the plunger in the knob. If, however, it is found that the header tank is empty, no useful purpose will be served by attempting to operate any hydraulic service on the normal system; in these circumstances the undercarriage and tail wheel can be lowered, but not raised, by means of the EMERGENCY system (see para.21).

21. Hydraulic system EMERGENCY lowering of the undercarriage and tail wheel.- An independent hydraulic system can be used in EMERGENCY for lowering the undercarriage and tail wheel only and is brought into operation by moving the selector lever (73) to the uppermost position and allowing it to remain there. To move this lever from the downmost position it is necessary to release it by pulling out the spring-loaded knob. With the alighting gear hydraulic control lever (11) in the DOWN position, the handpump should be operated. At least 500 strokes of the handpump will be required. The landing wheels will drop from the retracted position when alighting gear DOWN has been selected, allowing a space to form on one side of the undercarriage jacks. Until this space has been filled by fluid from the handpump the pump works quite freely, but when the space has been filled, considerable pressure on the pump is required. The emergency system will only lower the undercarriage and tail wheel. It will neither raise the undercarriage nor operate the flaps or bomb doors.

ENGINE CONTROLS

22. The engine controls are grouped together in a control box at the port side of the cockpit. When dual flying controls are installed, dual throttle controls mechanically coupled with the main throttle controls are mounted at the outboard side of the starboard floor extension. The engine data plate (113) is mounted at the starboard side of the cockpit, below the windscreen coaming. An induction system priming pump with supply cock, for use when starting, is mounted within the base of each engine nacelle along with the starting magneto switch, both being accessible through a door in the inner cowling.

23. Throttle and mixture controls.- Two throttle control levers (93) and corresponding mixture control levers (94) are mounted at the forward end of the control box; each corresponding pair of throttle and mixture levers is interconnected by a spring-release mechanism that prevents either engine from being run on a weak mixture with a throttle lever setting outside the CRUISING RANGE limits marked on the quadrant. For the prevention of movement, under vibration, of the throttle and mixture levers, a friction damper control lever (92) enables these controls to be given increased stiffness of movement or to be locked. When dual throttle controls are installed, care should be taken to avoid attempts to move them with the main throttle controls locked in this way, otherwise damage may be caused to the linkage system.

24. Two-speed supercharger control.- This control is operated by the outboard lever (96) aft of the throttle and mixture levers and is

moved forward for FULL and aft for MEDIUM boost. The lever is locked in the two operating positions by a spring-catch which can be released by depressing the lever handle.

25. Boost pressure gauges.- The boost pressure is registered by the gauges (44 and 53) at the centre of the instrument panel. In the event of failure of either of the gauges, the boost gauge for the other engine can be employed in its stead to register the boost pressure by pulling out the boost gauge reversal switch (47).

26. Hot and cold air intake control.- Hot or cold air can be admitted to both engine carburettor intakes by the operation of the lever (97) immediately inboard of the two-speed supercharger control. The lever is moved forward for HOT and aft for COLD air intake conditions and is locked in either position by a spring-catch which can be released by depressing the lever handle.

27. Slow-running cut-out controls.- Slow-running cut-out controls (98) are provided aft of the control box. Each control consists of a spring-loaded handle which is pulled out and held for operation, immediately upon the engine being switched off.

28. Fuel cock controls.- The pilot has control over the pressure side of the fuel supply from all sources by means of two remote control handles operating cocks in the delivery pipes to the carburettors of both engines. The remote controls consist of a pair of handles located immediately aft of the elevator trimming tab control quadrant, the handles being pulled out to close the cocks and vice versa. A further remote control handle, outboard of the first pair of handles in the cockpit, operates a cock in the balance pipe which connects the pressure sides of both fuel pumps; the handle is operated in a contrary sense to the first pair, being pushed in to close the cock and vice versa.

29. The fuel supply from the port and starboard main tank groups, each comprising two in the outer main plane and one in the engine nacelle, are controlled by a member of the crew by means of cocks mounted on the port and starboard sides of the fuselage, immediately forward of the main plane spar. The suction side balance pipe cock and the cocks for the overload tanks, carried in the bomb cells, are located immediately aft of the spar. A diagram of the fuel system and of the various combinations of fuel cock settings to meet given operating conditions appears in Section 2. The latter diagram is also provided on a plate fixed to the rear of the spar.

30. Manually-operated fuel pump.- A hand pump is provided, immediately aft of the spar, for priming the fuel system before starting. In the event of both engine fuel pumps failing, this pump can also be employed to feed the engines, provided that the fuel cocks are set as stated for this condition in the fuel cock setting diagram.

31. Fuel contents gauges - Contents gauges for all fuel tanks, with the exception of the nacelle tanks, are mounted at the top of the main electrical control panel which is at the starboard side

immediately aft of the pilot's cockpit. The gauges are visible to the pilot, who can operate them by means of the push-switch (8) at the centre of the instrument panel. A further operating push-switch is provided on the control panel, adjacent to the fuel gauges.

32. Fuel jettisoning controls.- Provision is made for jettisoning the fuel from the four main plane tanks through outlet pipes extending aft along the undersurface of each main plane and projecting beyond the flaps. Pneumatically-operated jettisoning and air vent valves are opened simultaneously by the operation of the handwheel (24), engraved with OPEN and CLOSED positions, at the port side of the instrument panel after first unscrewing the compressed air supply valve (23), immediately below, about four turns.

33. Assuming all main plane fuel tanks to be full, the bulk of their contents can be jettisoned in nine minutes, with the flaps up, and in six minutes with the flaps down to increase the head. When jettisoning fuel prior to a forced descent on water, the jettison valves should be closed by the handwheel (24) immediately before the aeroplane alights, to conserve the increased buoyancy due to the empty tanks.

34. Cowling gills controls.- The position of the engine cowling gills is controlled by the handles (16 and 21) beneath the port side of the instrument panel. Each handle possesses a rotating scale marked uniformly from zero to ten, the extreme positions indicating that the gills are fully closed and open, respectively.

35. Airscrew pitch controls.- The airscrew pitch, and consequently engine speed, is controlled by the two inboard levers (95) at the rear of the engine control box. The two extreme positions for the levers at the front and rear, respectively, are marked HIGH R.P.M. and LOW R.P.M., intermediate positions being denoted by a numbered scale. In the rear position of the control levers, the airscrew blades are held by the centrifugal action of the airscrew counter-weights at their maximum coarse-pitch angles and the airscrews operate in fixed pitch. For all other positions of the controls, the airscrews operate under constant-speed conditions provided that the airscrew blades and the constant-speed governor units are within their limiting positions. Forward movement of the controls will then increase engine r.p.m. and rearward movement will decrease engine r.p.m. For further information, A.P.1538, Vol. I, should be consulted.

OPERATIONAL EQUIPMENT

36. Suction pump EMERGENCY change-over cock.- The artificial horizon, direction indicator and turn indicator on the instrument-flying panel (34) are normally operated by a suction pump driven by the port engine. In the event of failure of this pump, an alternative operating source consisting of a venturi, mounted beneath the fuselage nose, can be

selected by the change-over cock (69) at the starboard side of the platform floor. The suction available is registered by the gauge (50) at the centre of the main instrument panel.

37. Signalling switchboxes.- Two signalling switchboxes are mounted beneath the instrument-flying panel. The starboard switchbox (19) provides for independent or simultaneous use of the upward and downward identification lamps for signalling through the morsing key or, alternatively, a steady illumination from either or both lamps. The three-position headlamp switch (114) at the starboard side of the cockpit permits the headlamp to be put into circuit with the downward identification lamps and used in conjunction with them for steady illumination or signalling. The port signalling switchbox (20) provides for signalling or steady illumination from the formation-keeping lamps; on this switchbox, the DOWN switch only should be used.

38. The range of movement of the morsing keys on the signalling switchbox can be adjusted to suit the operator by opening the cover and adjusting the screw with a locknut at the centre. The spring pressure on the key also can be adjusted by disengaging the lock at the upper left-hand side and turning the ring until the required pressure is obtained, when the lock should be released to engage in one of the slots.

39. Signal pistol.- On later aeroplanes, the signal pistol stowage is moved from the original position, at the starboard side aft of the cockpit bulkhead, to the firing position in the roof of the wireless compartment, provision being made for plugging the barrel when the pistol is not in use. The rack for eight signal cartridges is also moved from alongside the former pistol stowage to the base of the navigator's chart board stowage at the starboard side of the cabin gangway.

40. Airscrew de-icing system.- The airscrew de-icing system is operated by an electrically-driven pump mounted, along with the de-icing fluid reservoir, in the port engine nacelle. The fluid is pumped to a slinger ring on each airscrew where it is distributed through nozzles over the airscrew blades, sufficient fluid being contained in the reservoir for about four and a half hours continuous operation at full pressure. The pressure is regulated by a rheostat (2) mounted at the starboard side of the instrument panel and in the OFF position of the rheostat, the pump motor is switched off.

41. Carburettor de-icing system.- Provision is made for de-icing the carburettor air intake pipes on each engine by means of two manually-operated pump units (46) mounted centrally above the instrument panel. When it becomes apparent that the speed of either engine is falling owing to ice-formation in the carburettor, the pump for that engine should be actuated to clear the system. The action of the pumps is to inject a spray of alcohol into the carburettor air intake pipes, an independent alcohol supply for each pump being provided by a tank of two gallons capacity mounted

in the upper structure of the main plane immediately inboard of each engine nacelle.

42. Pilot's wireless and intercommunication equipment.- Two microphone and telephone sockets provided with holding clips (79) are connected to a panel on the port side by the pilot's seat, for use with the general purpose and T.R.9.F. transmitter-receivers, the latter being used also for intercommunication. The T.R.9.F. unit is mounted beneath the navigator's table and is provided with a remote control unit (91) comprising send-receive, tuning and volume controls on the port side of the pilot's cockpit and, further aft, a special switch (80). A send-receive control for the T.R.9.F unit is also provided at the sextant dome.

43. Beam approach equipment.- The main signal receiver in the Lorenz beam approach equipment is mounted, along with the motor generator, on the port side of the fuselage aft of the leading edge frame, the aerial for this receiver being housed within the fixed aerial mast. The marker beacon receiver is mounted on the starboard side of the fuselage aft of the mid-turret, and the dipole aerial is mounted beneath the fuselage aft of the mid-turret.

44. The beam approach remote control box is mounted on the panel (56) at the starboard side of the instrument panel but does not include the mechanical wave-change remote control, which it is necessary to operate from a further control box mounted on the map case at the navigator's station. During operation of the system, the telephone socket (22) and visual indicator (43) at the port side of the instrument panel are employed.

45. Landing lamp control.- Two retractable landing lamps, mounted together in the lower surface of the port main plane, are lowered for use hydraulically by means of the control lever (73) at the port side of the pilot's seat. The lever is moved forward to lower the lamps and vice versa and is locked in any desired position by a spring-loaded catch which is released for an operation by the lever at the top. Either landing lamp can be illuminated independently, the other acting as a reserve, by the three-position switch (31) at the port side of the cockpit. The landing lamps must not be lowered at an indicated air-speed in excess of 100 m.p.h.

46. Forced landing flares release control.- Two forced landing flares carried in the port inner main plane are released mechanically by means of the control lever (74) located below the hydraulic hand pump. The lever is spring-loaded so as to engage through a retaining pin with grooves in a cam slot at its base. To release one flare, the lever is pulled out and rotated downwards until the central cam stop is reached, and to release the second flare the same process is repeated through the remainder of the cam slot.

47. Bomb doors control.- With the exception of the three foremost doors in each outer bomb cell, the bomb doors are closed by single-acting hydraulic jacks and when the hydraulic pressure is released, are self-opening under the action of compression springs; the remaining six doors are operated by double-acting jacks. The control consists of a valve handle (29), at the port side of the instrument panel, which can be rotated to the OPEN or CLOSED position upon releasing the handle lock by depressing the spring-loaded thumb knob provided. The handle is linked up with a master switch (30) so as to prevent the release of bombs until the bomb door control is in the OPEN position. Provided the bomb release master switch (120) on the starboard side of the cockpit is also closed, an indicator on the bomb-aimer's switch panel is illuminated when the bomb doors are open.

48. Bomb release control.- The pilot has supervision over the bomb release master switch (120) on the bomb jettison switch unit at the starboard side of the cockpit, and also controls the bomb doors master switch (see para. 47). Provided that bombs have first been selected and fuzed by the appropriate switches on the bomb-aimer's switch panel, the pilot can release bombs, in addition to the bomb-aimer, by operating the firing key (28) at the port side of the instrument panel. A bomb loading instruction plate (64) is provided on the starboard side of the cockpit and a further loose instruction plate is contained in a stowage bag (122) further aft.

49. Bomb jettisoning controls.- A shrouded electrical bomb jettison switch (118) is provided on the switch unit at the starboard side of the cockpit but if the automatic bomb distributor system is installed this switch becomes redundant and is covered by a metal plate. In the latter case, a bomb jettison remote control handle (40) for the use of the pilot is mounted on the port side of the instrument panel. Bomb jettisoning is also under the control of the bomb-aimer.

NOTE.- Whichever method of jettisoning is employed, the jettisoning of bomb containers, if any, must be carried out first by the bomb container jettison switch (121) adjacent to the bomb jettison switch unit, at the starboard side of the cockpit. If this is not observed, the operation of the bomb jettison control will release the contents of only one compartment of each container and they will be "live".

50. Pilot's steering indicator.- The steering indicator (33) at the port side of the instrument panel is employed in conjunction with the course-setting bomb sight and indicates to the pilot the angular divergence of the aeroplane's course relative to the target. The indicator also possesses red and green coloured signalling lamps illuminated by separate push-switches at the bomb-aiming station.

51. Earth fault and bomb release indicator.- Selection of one or more bombs prior to their being released by the bomb aimer, causes two lamps (119) on the jettison switch unit at the starboard side of the cockpit to become illuminated. The lamps should normally be equally bright, unequal brightness, or the fact that one lamp only is lighted, indicating an earth fault in the wiring system. On the firing switch being closed, both lamps should be extinguished, indicating that the bombs have been released, until further bombs are selected.

52. Bomb cell lamps.- Three lamps providing a measure of lighting in the bomb cells, are located at their forward end, and are controlled by a switch on the electrical system control panel. The lamps enable an observer, such as a mid-gunner, to inspect the interior of the bomb cells after the bomb load has apparently been disposed of, to guard against the possibility of any bombs accidentally remaining. It is important that these lamps should be switched off when the bomb doors are open, during night flying.

53. Oxygen supply.- A standard oxygen regulator unit (25) is fitted at the port side of the instrument panel and controls the low pressure supply for the pilot's oxygen mask through a bayonet socket on the bulkhead at the port side of the pilot's seat. A similar regulator unit (61) and socket (106) are provided at the opposite side of the cockpit for the oxygen supply to the occupant of the starboard seat.

GENERAL EQUIPMENT

54. Pilot's seat.- The seat has hinged arm rests and is adjustable for height by means of a lever at the right-hand side of the seat. The lever is locked by a spring-loaded catch which is released for an adjustment by depressing the knob at the top. A cushion (100) at the front of the seat is adjustable for position by releasing a spring-loaded pin at the left-hand end. The seat has a well for a seat-type parachute and is provided with Sutton-type safety harness (102) for which a release lever is mounted on the seat left-hand back stay; the lever is moved upwards for release, permitting the pilot to lean forward when desired, and must again be returned to the locked position when the normal position is assumed. The pilot is afforded protection against gun fire from the rear by the armour plating provided at the rear of the wireless station.

55. Cockpit starboard seat.- A folding seat with a parachute well is hinged to the starboard side of the cockpit, being secured in the stowed position by a clip at the back. When required for use, the seat is raised and the spring-loaded hinged frame on the inboard side swung down to rest in support grooves in the floor, being locked in position by spring-catches that can be withdrawn by the upper lever (108) at that side. A padded back rest strap (76) hinged

to the cockpit rear bulkhead is hooked across the cabin door for use with the seat in conjunction with a head rest pad above the door. The seat is provided with a safety belt secured to the structure at each side of it and folding footrests (67 and 109) for use when dual controls are not fitted.

56. Cockpit windows.- The windscreen is provided at each side with an outwardly-opening window for direct vision should the windscreen be obscured. These windows are operated by handles (86 and 116) through compression link chains. At each side of the cockpit are sliding windows operated by hand rails at the forward ends.

57. Cockpit lighting.- When required, lighting for the port and starboard sides of the instrument panel is obtained from two lamps mounted at the top of the cockpit rear bulkhead and controlled by adjacent dimmer switches. The rear dimmer switch operates the lamp for the port side and also operates an adjustable lamp, fixed to the left-hand arm rest on the pilot's seat, for illumination of the engine controls, etc. A lamp (41) with a dimmer switch (38) is mounted beneath the windscreen coaming to illuminate the compass. On the starboard side at the rear of the cockpit are a further lamp and dimmer switch (123) while lower down is a master switch for all cabin roof lamps.

58. "Call" lamps.- A visual signalling system for calling the attention of all personnel can be operated by means of the switch unit (66) incorporating a clear lamp, at the starboard side of the instrument panel. Similar units are provided at all crew stations and operation of any one push-switch will illuminate all lamps.

59. Heating and ventilating system.- Two air outlet pipes with control valves that can be either fully or half opened or closed, are provided beneath the pilot's seat. The pipes deliver warm or cold air according to whether the heating system main control valve knob, located on the port side of the fuselage against the main plane spar, is open or closed. A further air outlet pipe(110) is provided in the cockpit, at the starboard side.

60. Sun blinds.- Two sun blinds for screening the cockpit transparent roof are stowed in a box mounted on the structure of the starboard seat. When required, each blind should be attached to the correct side of the roof, by means of the press-stud fasteners provided, with the silvered side facing outwards.

61. Entrance ladder.- A collapsible metal ladder, for use with the forward lower entrance hatch, is strapped to the starboard side of the gangway aft of the cockpit, immediately below the flying controls locking "nuisance bar". This ladder will be later replaced by a wooden ladder stowed at the starboard side of the fuselage, immediately aft of the bomb cells or alongside the mid-turret,

if installed. At the opposite side to this, stowage for a maintenance ladder will be provided also.

EMERGENCY EQUIPMENT

62. A diagram showing the arrangement of the emergency equipment and the exit routes to be followed by the personnel, when abandoning the aeroplane by parachute, appears in fig. 4 of this Section.

63. Parachute exits.- The exits which it is permissible to use for the purpose of abandoning the aeroplane by parachute are the forward lower hatch, marked PARACHUTE EXIT on the inside, the push-out panel on the starboard side of the fuselage, aft of the mid-turret and, for the use of the rear gunner if he is wearing a parachute at his station, the doors of the rear gun turret when it is rotated fully to one side. A foot lever to the starboard side of the forward lower hatch enables the door to be released for opening, independently of the door release handle. Instructions on the exits to be used by each member of the personnel and the order and method of abandoning the aeroplane after the "Abandon Aircraft" signal (see para. 65) has been given by the captain, are stated in Section 2.

64. Crash exits.- In addition to the exits mentioned above, roof exits are provided in the pilot's cockpit and at the sextant station. In the former case, two outwardly-opening doors in the cockpit roof are released by a central lever and, in the latter case, the sextant dome mounting is released by two spring-loaded bolt levers at the rear of the mounting which can then be swung down. These exits, in conjunction with other unobstructed exits, may be used for escape by personnel in the event of a crash landing.

65. "Abandon Aircraft" warning system.- The "Abandon Aircraft" visual warning system is operated from switches at the port side of the instrument panel. Operation of the shrouded push switch (37) gives the initial warning by igniting flash bulbs at the front, midship and rear gun stations and at the wireless station and rest bunk. A row of clear lamps (52) enables return signals to be received from the members of the crew at these positions, and operation of the second switch (36) illuminates red lamps at the same positions, giving the final order to "Abandon Aircraft".

66. Parachutes.- The pilot is provided with a seat-type parachute as are also the navigator and wireless operator. A parachute for the front gunner and a spare parachute are stowed on the starboard side of the fuselage below the pilot's cockpit. Parachute stowages for the midship and rear gunners are provided on the starboard side of the fuselage forward of the rear turret and a further stowage is provided above the rest bunk.

67. Life-saving waistcoats.- When required, life-saving waistcoats are stowed in bags immediately aft of the central and rear gunner's parachute stowages (see para. 65).

68. Dinghy.- An inflatable type H dinghy with CO_2 charging cylinder and necessary equipment, is carried in a container in the starboard engine nacelle, the cylinder operating head being controlled by an immersion switch at the base of the nacelle or, alternatively, by manual release handles located on the starboard side of the fuselage at the sextant station and immediately forward of the rear gun turret. The manual release handle at the sextant station is also accessible from the outside through an inscribed tear-off patch .

69. Flotation gear.- Fourteen inflatable flotation bags are stowed at the top of the bomb cells. The bags are inflated from three CO_2 cylinders stowed in the port and starboard inboard main planes. Operating heads for each cylinder are controlled from three handles contained in a box fixed to the rear of the main plane spar, within the fuselage, and covered by an inscribed tear-off patch. An immersion switch mounted on the truss aft of the front turret and possessing an open pipe leading to the base of the fuselage, provides automatic inflation of the flotation bags when immersed in salt water but, in view of the time lag and the fact that the bomb doors may collapse upon impact unless supported, the bags should normally be inflated by means of the manual controls while still in the air .

WARNING.- Before inflating the flotation bags the bomb load must be jettisoned and the bomb doors afterwards closed again.

70. Fire extinguishers.- A Graviner-type fire-extinguishing system is fitted and the operation of two shrouded push-switches (60) at the starboard side of the instrument panel releases the contents of two fire-extinguishers, one in each engine nacelle. Automatic operation of this fire-extinguishing system is provided by a flame-switch within each engine cowling and by inertia and gravity switches within the fuselage. In addition, hand fire extinguishers are carried within the fuselage at points convenient to the various crew stations.

71. Fireman's axes.- Two fireman's axes, for cutting a way out of the fuselage in the event of a crash, are stowed immediately aft of the navigator's seat and at the port side of the fuselage immediately forward of the rear turret.

72. First-aid outfits.- Two first-aid outfits are stowed on the port side of the fuselage immediately forward of the mid-turret, and are also accessible from outside through inscribed tear-off patches.

KEY TO FIG. 1

1. Camera indicator wedge plate
2. Airscrew de-icing system control rheostat
3. Oil pressure gauge (starboard engine)
4. Oil temperature gauge (starboard engine)
5. Undercarriage warning horn push-switch
6. Clock mounting
7. Compass deviation card holder
8. Fuel gauges push-switch
9. Main plane flaps hydraulic control lever
10. Compass
11. Alighting gear hydraulic control lever
12. Safety catch release for alighting gear control lever
13. Oil temperature gauge (port engine)
14. Oil pressure gauge (port engine)
15. Rudder bar
16. Cowling gills control handle (starboard engine)
17. Course-and-height and height-and-airspeed computor stowage
18. Control column
19. Signalling switchbox for upward and downward identification lamps.
20. Signalling switchbox for formation-keeping lamps
21. Cowling gills control handle (port engine)
22. Beam approach system telephone socket
23. Compressed air supply control for fuel jettisoning system
24. Fuel jettisoning and vent valves control
25. Oxygen regulator unit
26. Magneto switches
27. Alighting gear position indicator switch and catch bar
28. Bomb firing key
29. Bomb doors hydraulic control handle
30. Safety switch operated by bomb doors control handle
31. Landing lamps three-position switch.
32. Wheel brake levers
33. C.S.B.S. steering indicator
34. Instrument-flying panel

F.S./9

35. Auto-controls instruction plate
36. "Abandon Aircraft" final signal switch
37. "Abandon Aircraft" initial signal shrouded push-switch
38. Dimmer switch for compass lamp
39. Auto-controls "nose-heavy", "tail-heavy" and main pressure gauge
40. Bomb jettison remote control handle (making item 118 redundant)
41. Compass lamp
42. Port engine starting shrouded push-switch
43. Beam approach system visual indicator
44. Boost pressure gauge (port engine)
45. Cylinder temperature gauge (port engine)
46. Carburettor air-intake de-icing fluid pumps
47. Engine boost gauges reversal switch
48. Engine speed indicator
49. Alighting gear position indicator
50. Suction gauge
51. Cylinder temperature gauge (starboard engine)
52. "Abandon Aircraft" return signal lamps
53. Boost pressure gauge (starboard engine)
54. Main plane flaps setting indicator
55. Starboard engine starting shrouded push-switch
56. Beam approach system control box mounting
57. Beam approach system cable plug stowage
58. Ground signal card holder
59. Wheel brake system triple air pressure gauge
60. Graviner-type fire extinguishing system shrouded push-switches
61. Oxygen regulator unit
62. Air temperature gauge
63. Alighting gear normal hydraulic system pressure gauge
64. Bomb loading instruction plate
65. D.F. loop scale setting indicator
66. "Call" lamp and switch

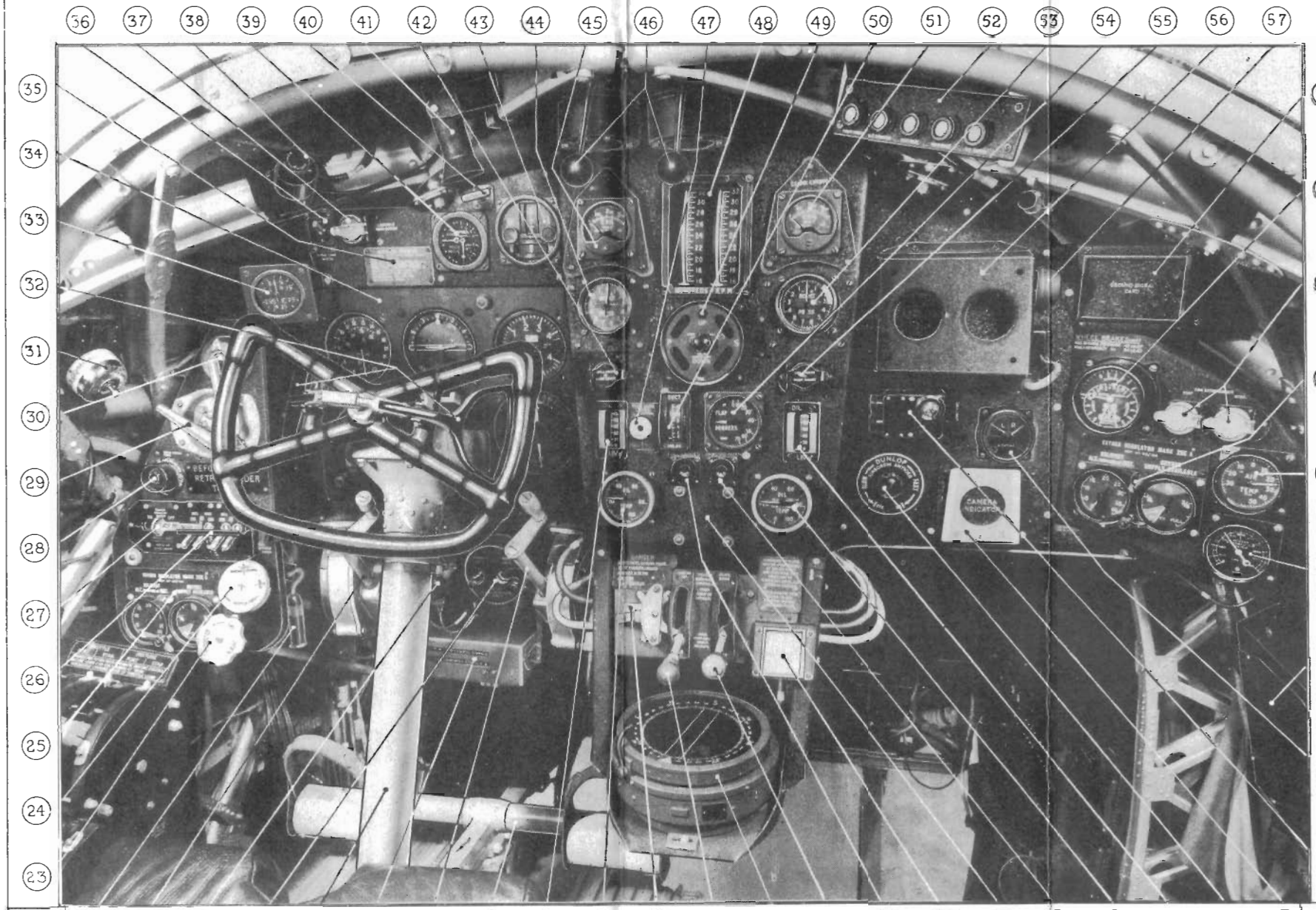


FIG. I

INSTRUMENT PANEL

FIG. I

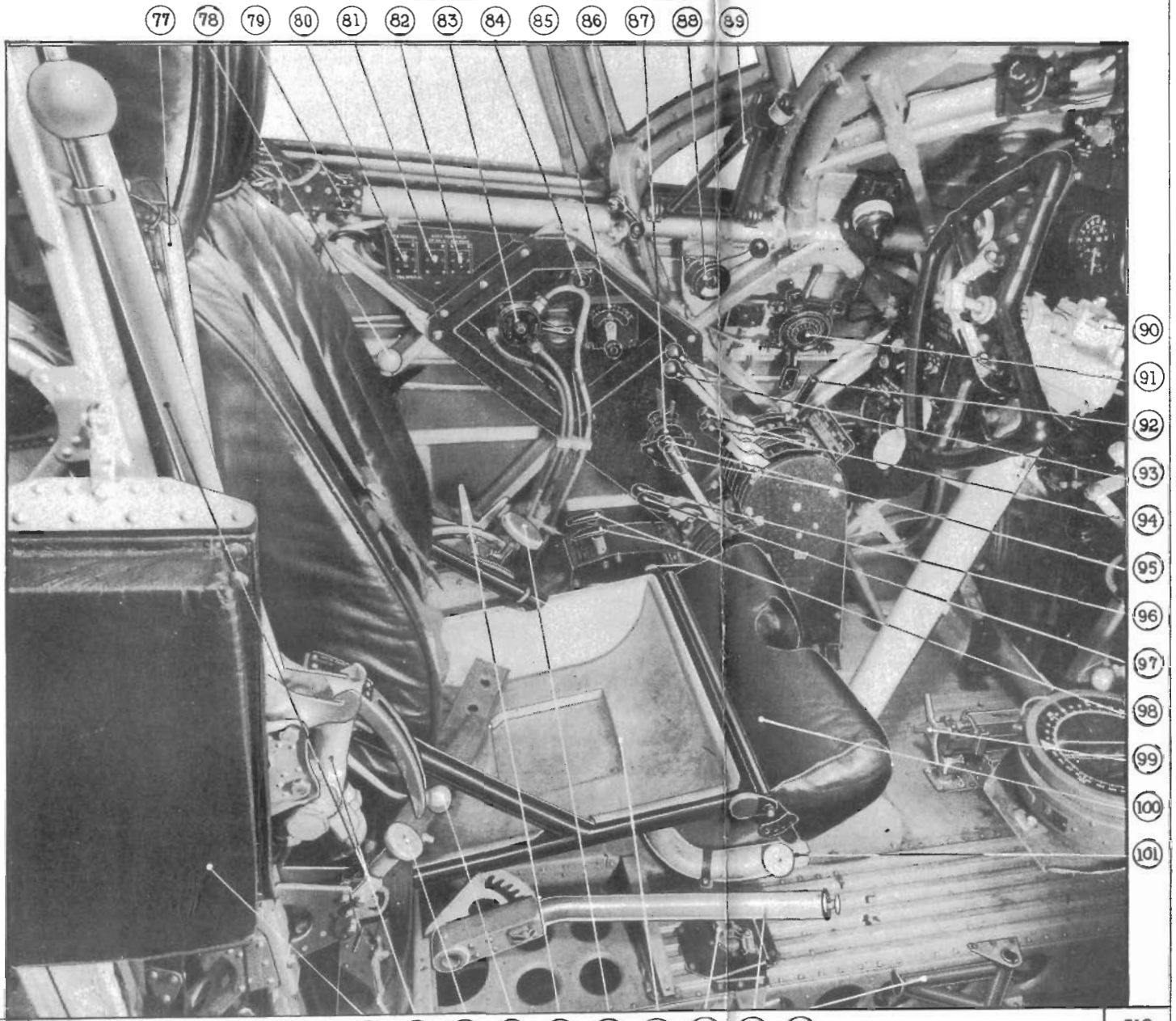


FIG. 2

PORT SIDE OF COCKPIT

FIG. 2

Key to fig. 2

67. Starboard seat folding footrest
68. Pilot's seat height adjusting lever
69. Instrument-flying panel suction pump and venturi change-over cock
70. Pilot's seat
71. Rudder and elevator trimming tabs control
72. Elevator trimming tabs fine adjustment wheel
73. Alighting gear selector lever for normal and emergency operating systems
74. Forced landing flares release control
75. Hydraulic system emergency hand pump and actuating lever
76. Starboard seat back rest
77. Pilot's folding arm rest.
78. Landing lamps control lever
79. Clips for general-purpose and T.R.9.F. or intercommunication telephone and microphone sockets
80. T.R.9.F. transmitter-receiver special switch
81. Auto-controls main switch
82. Auto-controls cut-out switch (if fitted)
83. Auto-controls main control cock
84. Auto-controls re-setting switch (if fitted)
85. Auto-controls attitude control
86. Direct-vision window operating handle
87. Auto-controls speed and steering levers
88. Auto-controls clutch lever
89. Control column spring-loaded locking bracket
90. Catch bar for locking wheel brakes
91. T.R.9.F. transmitter-receiver remote control unit
92. Throttle and mixture controls friction damper lever
93. Throttle control levers
94. Mixture control levers
95. Airscrew pitch control levers
96. Two-speed supercharger control lever
97. Hot and cold air intake control lever
98. Slow-running cut-out controls
99. Rudder bar leg reach adjuster
100. Seat adjustable cushion
101. Warm air supply outlet and control valve

Key to fig. 3

64. Bomb loading instruction plate
102. Pilot's Sutton-type safety harness
103. Pilot's back rest
104. Cockpit roof sun blind stowage
105. Starboard seat
106. Oxygen supply socket
107. Microphone and telephone socket
108. Starboard seat support frame locking catches release handle
109. Starboard seat folding footrest
110. Warm air supply outlet and control valve
111. Parachute stowages
112. Window curtain
113. Engine data plate
114. Headlamp switch (independent and signalling)
115. A.S.I. pressure head heating switch
116. Direct-vision window operating handle
117. Navigation lamps switch
118. Bomb electrical jettison switch (redundant if item 40 is installed)
119. Bomb release indicator and earth fault lamps
120. Bomb release master switch
121. Bomb container jettison switch
122. Bomb loading instruction plate stowage
123. Cockpit lamp and dimmer switch
124. Starboard seat safety belt

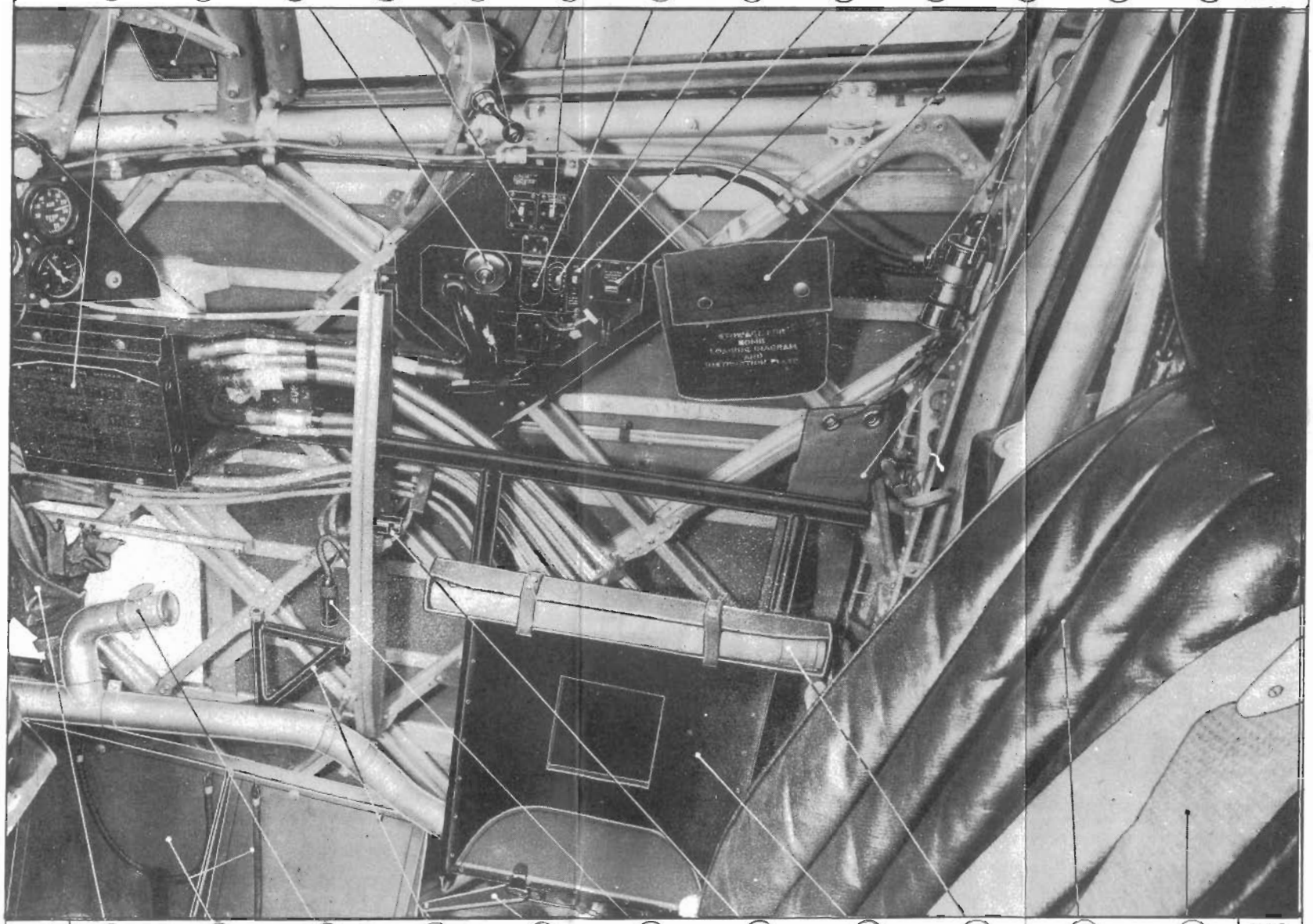


FIG. 3 STARBOARD SIDE OF COCKPIT FIG. 3

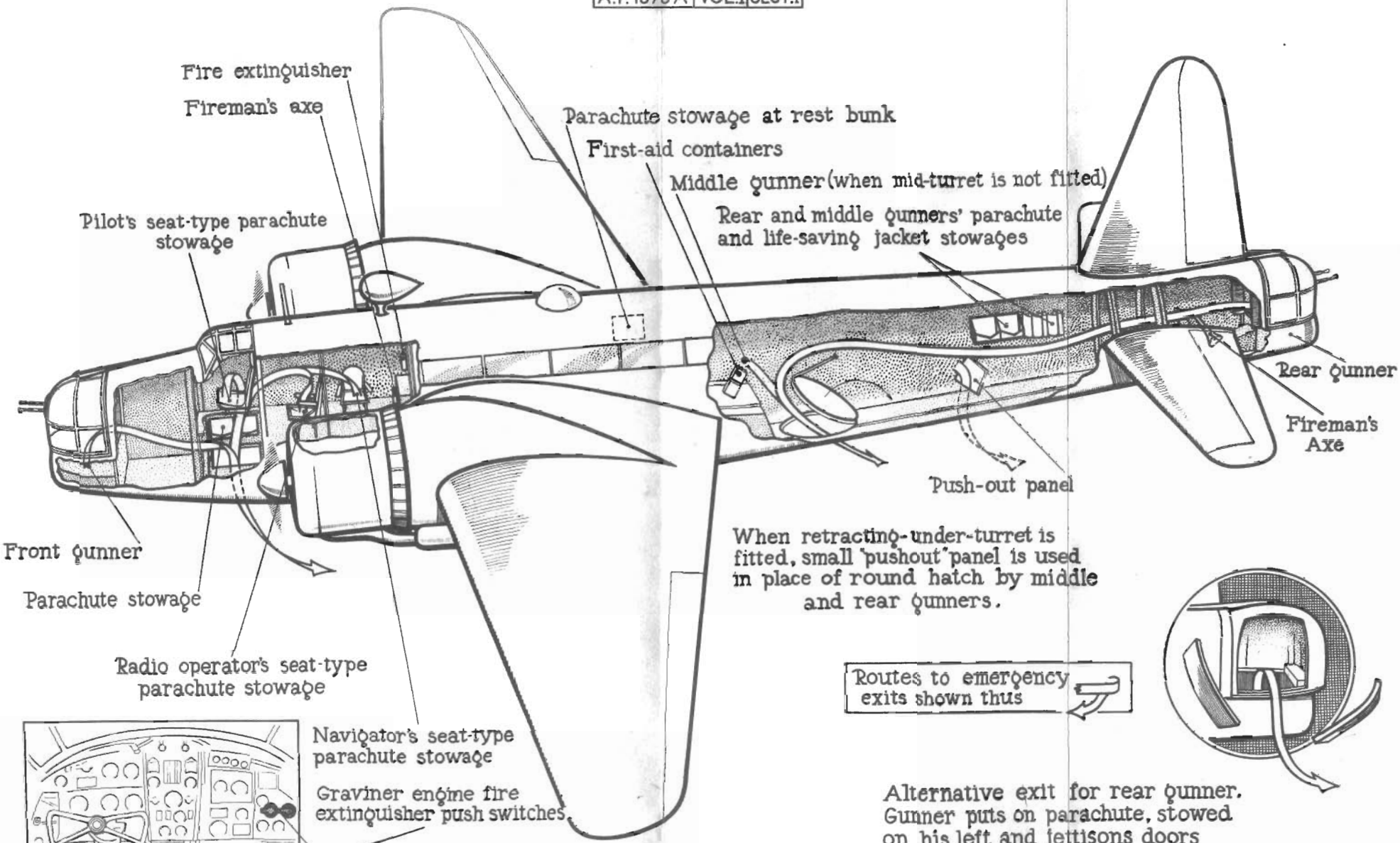
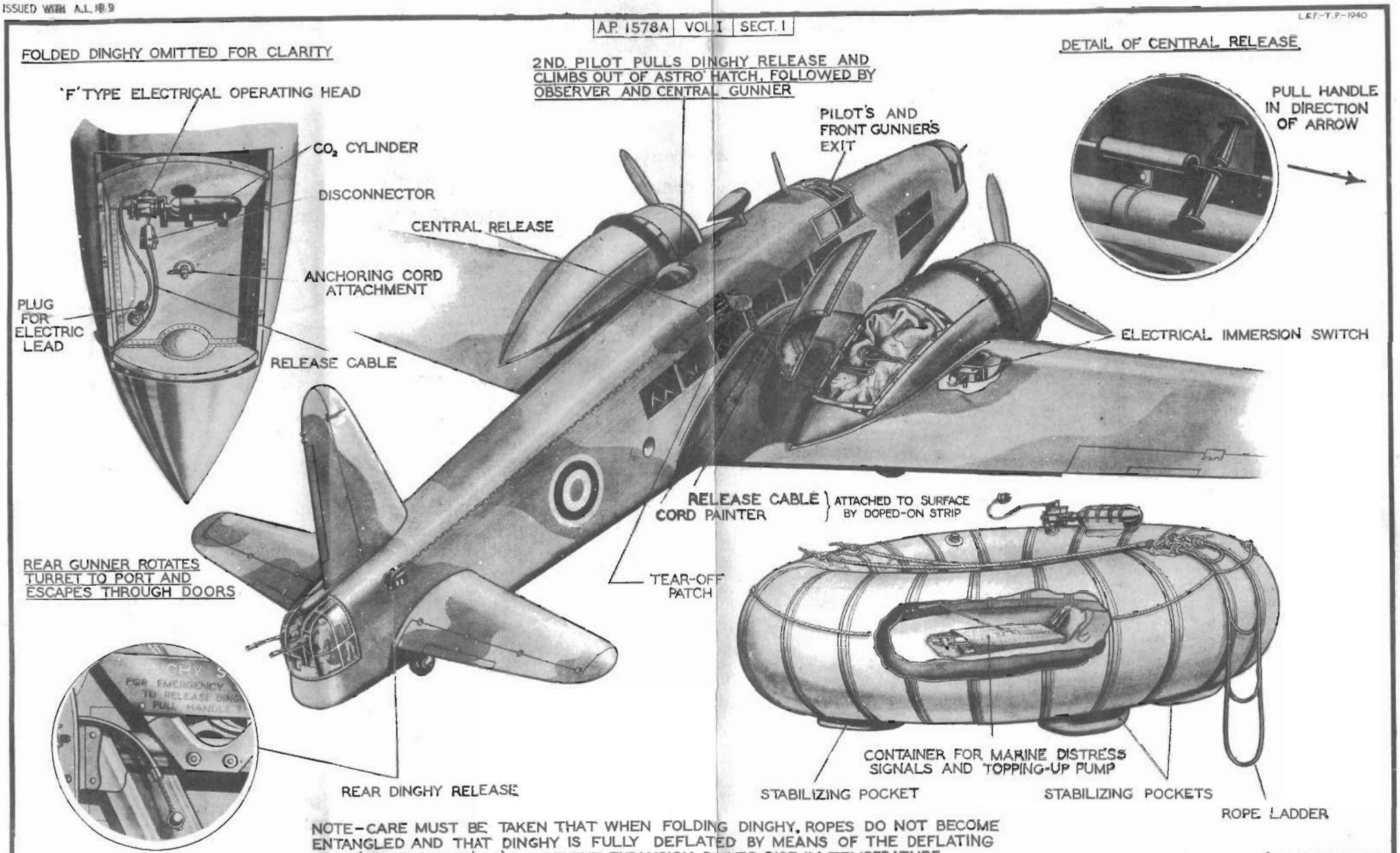


FIG. 4

PARACHUTE EXITS AND EMERGENCY EQUIPMENT

FIG. 4



NOTE – CARE MUST BE TAKEN THAT WHEN FOLDING DINGHY, ROPES DO NOT BECOME ENTANGLED AND THAT DINGHY IS FULLY DEFLATED BY MEANS OF THE DEFLATING PUMP (STORES REF. 4C/1310) TO PREVENT EXPANSION DUE TO RISE IN TEMPERATURE

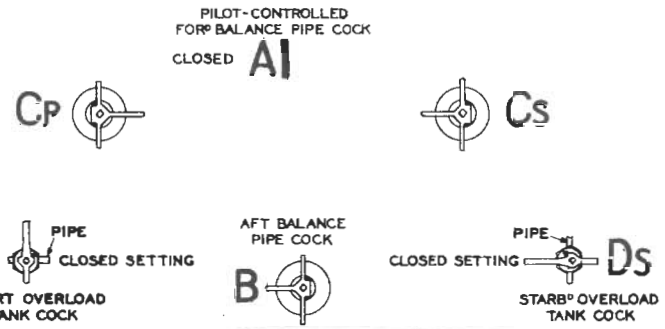
FIG. 5

DINGHY INSTALLATION AND EXITS FOR USE

FIG. 5

SYSTEM USING NORMAL TANKS

① KEY DIAGRAM AND SETTING OF COCKS FOR STARTING AND NORMAL OPERATION



② TAKE OFF

ALSO PRIMING SYSTEM WITH HAND PUMP AND EMERGENCY OPERATION FOR PORT OR STARBD PUMP FAILURE

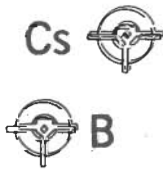
OPEN A — PILOT-CONTROLLED

REMAINING COCK SETTING AS IN DIAGRAM ①

③ EMERGENCY OPERATION

TO TRANSFER FUEL IN PORT WING TANKS TO STARBD PUMP

OPEN A — PILOT-CONTROLLED

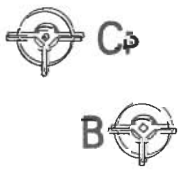


REMAINING COCK SETTINGS AS IN DIAGRAM ①

④ EMERGENCY OPERATION

TO TRANSFER FUEL IN STARBD WING TANKS TO PORT PUMP

OPEN A — PILOT-CONTROLLED



REMAINING COCK SETTINGS AS IN DIAGRAM ①

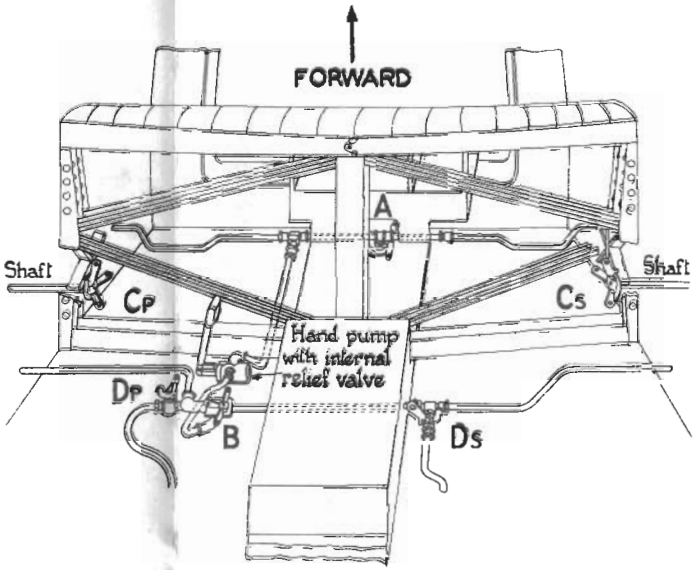
FIG. 1

FS/2

SETTINGS OF COCK LEVERS ARE AS VIEWED BY OPERATOR

⑨ BOTH ENGINE PUMPS FAIL

USE HANDPUMP WITH COCKS SET AS IN ① EXCEPT THAT COCK A IS OPEN AND COCK B SET TO DRAW FUEL FROM PORT OR STARBD WING TANKS (OVERLOAD FUEL USED UP)



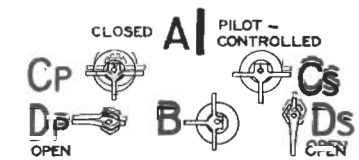
VIEW SHOWING LOCATION OF COCKS IN FUSELAGE AND SETTINGS OF LEVERS FOR NORMAL OPERATION

DIAGRAM OF FUEL COCK SETTINGS

SYSTEM USING NORMAL AND OVERLOAD TANKS

⑤ FLYING WITH WING AND OVERLOAD TANKS FILLED

USE OVERLOAD FUEL FIRST



WHEN OVERLOAD TANKS ARE ALMOST EMPTY CHANGE TO SETTINGS IN DIAGRAM ①, CLOSING COCKS DP AND DS LAST

⑥ EMERGENCY OPERATION

FOR PORT OR STARBOARD PUMP FAILURE

OPEN A — PILOT-CONTROLLED

REMAINING COCK SETTINGS AS IN DIAGRAM ⑤

⑦ EMERGENCY OPERATION

TO TRANSFER FUEL IN PORT OVERLOAD TANK TO STARBD PUMP

OPEN A — PILOT-CONTROLLED

REMAINING COCK SETTINGS AS IN DIAGRAM ⑤

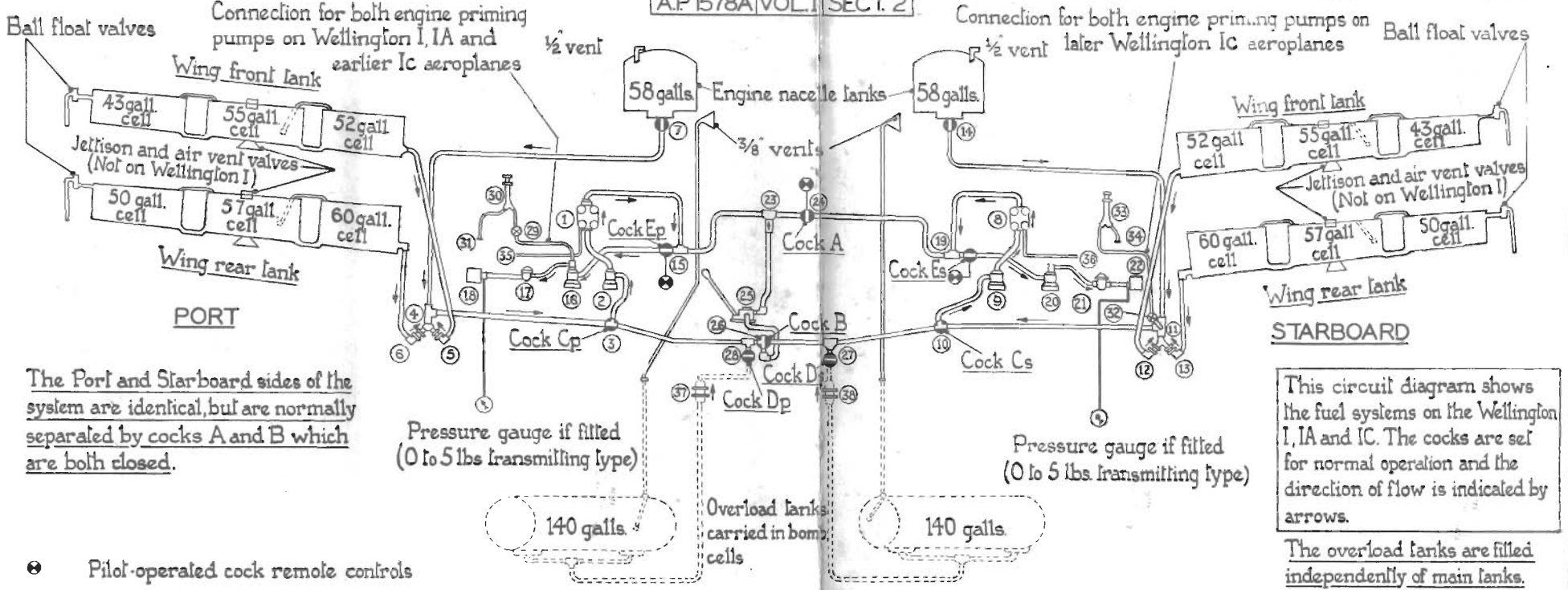
⑧ EMERGENCY OPERATION

TO TRANSFER FUEL IN STARBD OVERLOAD TANK TO PORT PUMP

OPEN A — PILOT-CONTROLLED

REMAINING COCK SETTINGS AS IN DIAGRAM ⑤

FIG. 1



The Port and Starboard sides of the system are identical, but are normally separated by cocks A and B which are both closed.

This circuit diagram shows the fuel systems on the Wellington I, IA and IC. The cocks are set for normal operation and the direction of flow is indicated by arrows.

The overload tanks are filled independently of main tanks.

● Pilot-operated cock remote controls

① Port engine pump (Relief valve set to 8 lbs/sq.in.)
② Shallow type filter
③ 3-way cock (operated by member of crew)
④ T-piece
⑤ Non-return valve
⑥ Non-return valve
⑦ ¾" cock (wired open)
⑧ Starboard engine pump (Relief valve set to 8 lbs/sq.in.)
⑨ Shallow type filter
⑩ 3-way cock (operated by member of crew)
⑪ T-piece
⑫ Non-return valve
⑬ Non-return valve
⑭ ¾" cock (wired open)
⑮ T-piece and cock (operated by pilot)
⑯ Shallow type filter
⑰ Amal governor valve (2½lbs/sq.in.)
⑱ Carburettor (port)
⑲ T-piece and cock (operated by pilot)
⑳ Shallow type filter
㉑ Amal governor valve (2½lbs/sq.in.)
㉒ Carburettor (starboard)
㉓ T-piece and non-return valve
㉔ 1" cock (operated by pilot)
㉕ Zwicky hand pump (Relief valve set to 8 lbs./sq.in.)
㉖ 3-way cock (operated by member of crew)
㉗ T-piece and cock (cock wired shut when overload tanks are not fitted)
㉘ T-piece and cock (cock wired shut when overload tanks are not fitted
㉙ ⅛" engine priming cock
㉚ Engine priming pump (type B)
㉛ Primer connection on engine
㉜ ⅛" engine priming cock
㉝ Engine priming pump (type B)
㉞ Primer connection on engine
㉟ Drain pipe to carburettor air intake
㊱ Drain pipe to carburettor air intake
㊲ Non-return valve
㊳ Non-return valve

Note: It is important to keep a check of the contents of all tanks during flight. Any tank that is emptying should be turned OFF before it is completely exhausted to prevent sucking air into the fuel system

FIG. 2

FUEL SYSTEM DIAGRAM

FIG. 2

SECTION 2.

HANDLING AND FLYING NOTES FOR PILOT.

ENGINE DATA.

1. (i) Fuel: 100 octane only.

Oil: Summer - key letter X/Z.
Winter - key letter W/Z.

(ii) The principal engine limitations are as follows:-

ENGINE PEGASUS XVIII

MAX. OPERATIONAL LIMITATIONS.

		R.P.M.	BOOST LB/SQ.IN.	TEMP °C CYLR.	TEMP °C OIL INLET
TAKE-OFF 3 MINS. LIMIT		2,600	+ 6¾		
CLIMBING ½ HR. LIMIT	M	2,250	+ 2½	210	80
	S	2,250	+ 2½	210	80
CRUISING RICH MIXTURE	M	2,250	+ 2½	190	70
	S	2,250	+ 2½	190	70
CRUISING WEAK MIXTURE	M	2,250	zero	190	70
	S	2,250	zero	190	70
EMERGENCY 5 MINS. LIMIT	M	2,600	+ 6¾	235	90
	S	2,600	+ 6¾	235	90

Note:- On modified engines (marked XVIIIF) the permissible oil inlet temperatures are increased by 10°.

OIL PRESSURE LB/SQ.IN.

NORMAL 80 EMERGENCY MINM (5 MINS) 70

OIL TEMPERATURE FOR TAKE-OFF.

°C MINIMUM 5.

(iii) The following limitations must also be observed

At 6¾ lb/sq.in. boost.	Minimum r.p.m. 2,400
DIVING	Maximum boost + 6¾ lb/sq.in. Maximum r.p.m. 2,825. 2,600 r.p.m. may be exceeded for 20 secs. only, with the throttles at least one third open.

When carburettors have not been adjusted to permit a boost of 6¾ lb/sq.in. for take-off, or when 87 octane fuel is being used, the following limitations must be observed.

		R.P.M.	BOOST LB/SQ. IN.
TAKE-OFF 3 MINS. LIMIT.		2,475	+ 5½
EMERGENCY 5 MINS. LIMIT.	M	2,600	+ 5½
	S	2,600	+ 5½

FLYING LIMITATIONS.

2. (i) Maximum speeds in m.p.h. I.A.S.

Diving	329
Undercarriage down	120
Flaps down	129
Landing lamp lowered	100

(ii) Bomb clearance angles:

Diving	60°
Climbing	20°

PRELIMINARIES.

3. On entering the cockpit.

(i) Check that the brakes are ON
the undercarriage selector lever is at DOWN
the bomb doors are closed
the hydraulic power valve is OFF (not fitted on Wellington IC)

(ii) Switch on the undercarriage and flap indicators.

(iii) Test undercarriage warning horn.

STARTING THE ENGINES AND WARMING UP.

4. (i) Set Pilot's fuel cock controls with main feed cocks ON and pressure balance cock OFF. Give order for fuel cocks at crew's stations to be set as appropriate.

(ii) Set engine controls as follows:-

(a)	Throttles	- ½ inch open.
(b)	Mixture control	- NORMAL.
(c)	Airscrew speed controls	- Low R.P.M. (fully back)
(d)	Superchargers	- MEDIUM.
(e)	Air intake heat control	- Cold.
(f)	Cowling gills	- Open.

(iii) The port engine should be started first when possible. If the starboard engine is started first, it must not be running at more than a fast tick-over when the port engine is started, or the generator may deliver an excessive current, and blow a fuse, or damage the generator circuit if no fuse is fitted.

(iv) Instruct the ground crew to work the priming pump for the induction system until the suction and delivery pipes are primed. This may be judged by a sudden increase in resistance to the plunger. The ground crew should then give four strokes of the priming pump at normal temperatures. The number may be increased to nine in winter; only one or two strokes should be given in summer or if the engine is hot.

(v) Switch ON the main magnetos and instruct the ground crew to switch on the starting magnetos.

(vi) Press the starter button for each engine in turn for periods of not more than 10 seconds with a 10 seconds wait between each.

(vii) At temperature below 0°C it will probably be necessary for the ground crew to continue priming after the engine has fired and until it picks up on the carburettor.

(viii) The ground crew will switch off the starting magnetos and screw down the priming pumps.

(ix) After about a minute, set airscrew speed controls fully forward.

(x) Warm up at a fast tick-over.

TESTING ENGINES AND INSTALLATIONS.

5. During warming up.-

(i) Test the hydraulic system by lowering and raising the flaps.

(ii) Check brake pressure - 100 lb/sq.in.

(iii) Turn ON the steam heater valve and air release cock. Close the air release cock as soon as steam issues from the vent.

After warming up, for each engine in turn.-

(iv) Open up to weak mixture cruising boost and test operation of constant speed units.

(v) Open up to rich mixture cruising boost and check operation of two speed supercharger.

(vi) At rich mixture cruising boost test each magneto in turn. The drop should not exceed 100 r.p.m.

(vii) Open the throttle fully and check take-off boost and oil pressure.

TAXYING OUT.

6. Brake pressure must not fall below 100 lb/sq.in.

FINAL PREPARATIONS FOR TAKE-OFF.

7. The drill of vital actions is H,T,M,P, Fuel, Flaps, Superchargers and Gills.

H - Hydraulic power valve	- ON (not fitted on Wellington IC).
T - Trimming tabs	- Normal load; all NEUTRAL Overload; elevator slightly tail heavy, others NEUTRAL.
M - Mixture	- NORMAL.
P - Pitch	- Airscrew speed controls fully forward.
Fuel	- Check contents and cock settings; pressure balance cock OFF.
Flaps	- 15° DOWN.
Superchargers	- MEDIUM.
Gills	- One third open.

TAKE-OFF.

8. (i) With normal load (about 25,000 lb), get the tail well up and keep straight with rudder and a touch of brake against any tendency to swing.

(ii) With overload (28,000 lb), the tendency to swing is more pronounced. Get the tail up as soon as possible and hold the aeroplane straight and level until a speed of not less than 80 m.p.h. I.A.S. is attained. Then ease the aeroplane off the ground; this needs a strong backward pull on the control column.

(iii) Safety speed is 120 m.p.h. I.A.S. at + 6¾ lb/sq.in. boost.

ACTION AFTER TAKE-OFF.

9. (i) Increase speed to 125 m.p.h. I.A.S. then throttle back to climbing boost and reduce to climbing r.p.m.

(ii) At a safe height of 600-800 feet, raise the flaps.

(iii) Turn OFF hydraulic power valve (not fitted on Wellington IC).

CLIMBING.

10. (i) The speed for maximum rate of climb is 125 m.p.h. I.A.S. up to 12,000 feet; above this height reduce speed by 2 m.p.h. per thousand feet.

(ii) For maximum rate of climb, change superchargers to FULL at about 8,000 feet.

ECONOMICAL CRUISING.

11. (i)

	At 22,000 lb. m.p.h. I.A.S.	At 27,000 lb. m.p.h. I.A.S.
Speed for greatest range	130	140
Speed for greatest endurance	100	110

(ii) Weak mixture should be used, and the airscrew speed control set back to positive coarse pitch. The supercharger should be in M ratio if the necessary boost can be obtained. The gills should be closed.

GENERAL FLYING.

12. Change of trim:-

Undercarriage up or down - no change

Flaps down - nose up.

The change of trim on lowering flaps is reduced by the permanent interconnection of the elevator trimming tab with the flaps, but is not entirely eliminated. It is essential that the elevator trimming tab control should be in the central position before the flaps are lowered, otherwise damage to the tab control mechanism may result. On some aeroplanes a spring catch is fitted which allows the pilot to feel the central position as the control is moved.

STALLING.

13. (i) This aeroplane has a normal stall with flaps and undercarriage down. The left wing usually drops fairly quickly and as the aeroplane heels over the nose falls below the horizon.

(ii) Stalling Speeds:-

Total weight	24,000 lb.	28,000 lb.
Flaps and under-carriage up.	67 m.p.h. I.A.S.	72 m.p.h. I.A.S.
Flaps and under-carriage down	58 m.p.h. I.A.S.	63 m.p.h. I.A.S.

SPINNING AND AEROBATICS.

14. Spinning and aerobatics are not permitted.

DIVING.

15. (i) Leave the airscrew speed controls at cruising setting.

(ii) In diving this aeroplane pilots may experience a slight "kick" on the control column, originating from the elevator. This does not interfere in any way with the control of the aeroplane and can be ignored.

(iii) Ease the aeroplane very slowly out of the dive, and open the throttles slowly to avoid momentary overspeeding.

APPROACH AND LANDING.

16. (i) Set carburettor air intake heat control to COLD and close gills.

(ii) Set elevator tab control to the central position. See para.12.

(iii) Reduce speed to 140 m.p.h. I.A.S. and carry out the drill of vital actions, H,U,M,P, Superchargers and Flaps. Speed must be further reduced to 120 m.p.h. I.A.S. before the undercarriage is fully down or the flaps past the mid position.

H - Hydraulic power valve - ON (not fitted on Wellington IC)

U - Undercarriage - DOWN

M - Mixture - NORMAL

P - Pitch - HIGH R.P.M. (fully forward)

Superchargers - MEDIUM

Flaps - Fully DOWN.

(iv) Correct speeds for approach

	At 22,000 lb. m.p.h. I.A.S.	At 28,000 lb. m.p.h. I.A.S.
Engine assisted	75	85
Glide	85	95

MISLANDING.

17. (i) The aeroplane will climb satisfactorily at full throttle with undercarriage and flaps down.

(ii) Raise the undercarriage immediately.

(iii) Raise the flaps at a height of about 500 feet.

AFTER LANDING.

18. (i) Raise the flaps, open cowling gills and check brake pressure before taxying.

(ii) Turn OFF hydraulic power valve (not fitted on Wellington IC).

(iii) Set airscrew speed controls fully back, and open up the engines sufficiently to change pitch to coarse.

(iv) Put the supercharger controls to FULL for 10 seconds and return to MEDIUM.

(v) To stop engines, pull out the slow running cut-out controls.

(vi) Switch off ignition when engine has stopped.

ENGINE FAILURE DURING TAKE-OFF.

19.(i) This aeroplane cannot be kept straight with the live engine at + $6\frac{3}{4}$ lb/sq.in. boost at speeds below 120 m.p.h. I.A.S.

(ii) Ensure that the undercarriage is up or rising.

(iii) At more than about 24,000 lb. it is impossible to maintain height. Close throttles, lower the flaps as far as possible, switch off, turn fuel off and land straight ahead.

FAILURE OF ONE ENGINE IN FLIGHT.

20.(i) Turn ON the fuel delivery balance cock. If the dead engine does not pick up, showing that the fuel pump is not the cause of failure, turn OFF the delivery balance cock and instruct the crew to turn ON the suction balance cock so that the live engine draws from both sets of tanks.

(ii) Set the airscrew speed control of the failed engine fully back to positive coarse pitch.

(iii) At light load it may be possible to maintain height on one engine at cruising boost and r.p.m.

UNDERCARRIAGE EMERGENCY OPERATION.

21. If the undercarriage cannot be lowered in the normal way, either by the engine driven pump or the handpump, it may be lowered by using the handpump in conjunction with the independent emergency hydraulic system, in the following manner:-

(i) Operate the catch release to free the lever which is near the handpump and which controls the independent hydraulic system. Raise the lever to the EMERGENCY (uppermost) position and leave it there.

(ii) Select undercarriage DOWN.

(iii) Lower the handpump handle to engage the catches at the base with the pump.

(iv) Operate the handpump: at least 250 double strokes are required.

Note:- The emergency system will only lower the undercarriage. It will not raise the undercarriage, nor operate the flaps or bomb doors. After using the emergency system, the lever near the handpump may be returned to the normal position for an attempt to lower the flaps, but this will not be successful if the original failure of the main hydraulic system was due to loss of oil.

POSITION ERROR.

22. The corrections for position error are as follows:-

m.p.h. I.A.S.	Correction
100	add 12
110	" 10
120	" 8
135	" 6
145	" 4
160	" 2
175	no correction
190	subtract 2
210	" 4
225	

These figures apply to a total weight of 26,600 lb. but will not be appreciably affected by variations in weight.

FUEL CAPACITY.

23. Note the following:-

(i) Normal fuel system:

	Port	Starboard
Nacelle tank	58 gallons	58 gallons
Front wing tank	150 "	150 "
Rear wing tank	167 "	167 "
	375 "	375 "

The normal total effective capacity is therefore 750 gallons.

(ii) Overload fuel system:- Two tanks, each holding 140 gallons, may be fitted in the bomb-cells, giving an overload total effective capacity of 1,030 gallons.

FUEL CONSUMPTION.

24. The approximate consumptions per engine are:-

Mixture	r.p.m.	boost lb/sq.in.	Consumption Gallons/hour.
Rich	2,250	+ $2\frac{1}{2}$	61
Weak	2,250	zero	40
Weak	1,750	- 4	28

OIL CAPACITY.

25. Each engine has one oil tank holding 16 gallons, and when the overload fuel tanks are fitted there is one auxiliary oil tank in the fuselage holding 15 gallons.


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
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~JimSan