FOR OFFICIAL USE ONLY

AIR PUBLICATION 1578 D

Pilots Notes

PILOT'S NOTES

WELLINGTON IV AEROPLANE

TWO TWIN WASP R 1830 S3C4G ENGINES

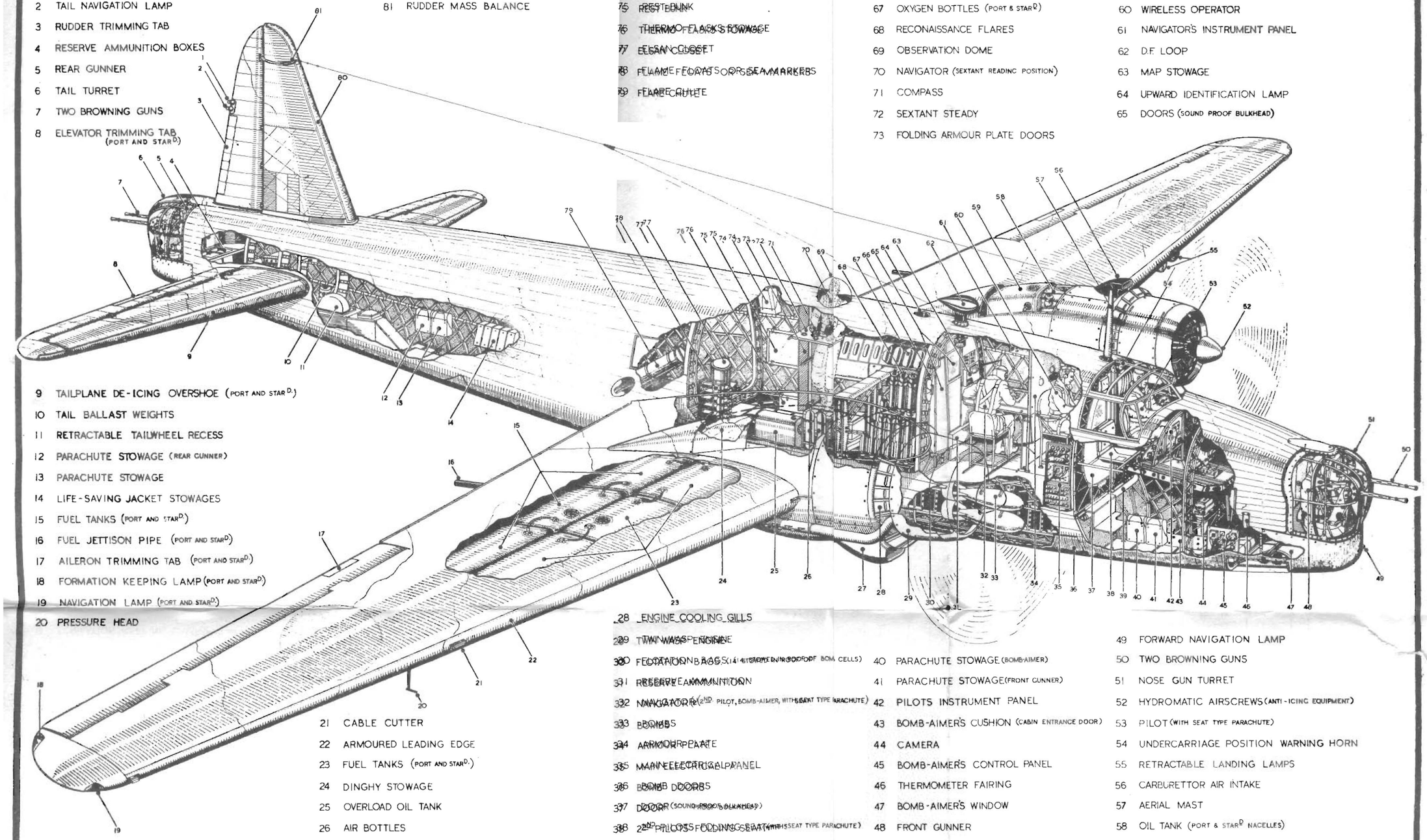
Prepared by direction of the

Minister of Aircraft Production

A. C. Rowlands.

Promulgated by order of the Air Council.

AIR MINISTRY.



1 TAIL FORMATION KEEPING LAMP
2 TAIL NAVIGATION LAMP
3 RUDDER TRIMMING TAB
4 RESERVE AMMUNITION BOXES
5 REAR GUNNER
6 TAIL TURRET
7 TWO BROWNING GUNS
8 ELEVATOR TRIMMING TAB (PORT AND STARD.)
9 TAILPLANE DE-ICING OVERSHOE (PORT AND STARD.)
10 TAIL BALLAST WEIGHTS
11 RETRACTABLE TAILWHEEL RECESS
12 PARACHUTE STOWAGE (REAR GUNNER)
13 PARACHUTE STOWAGE
14 LIFE-SAVING JACKET STOWAGES
15 FUEL TANKS (PORT AND STARD.)
16 FUEL JETTISON PIPE (PORT AND STARD.)
17 AILERON TRIMMING TAB (PORT AND STARD.)
18 FORMATION KEEPING LAMP (PORT AND STARD.)
19 NAVIGATION LAMP (PORT AND STARD.)
20 PRESSURE HEAD
21 CABLE CUTTER
22 ARMOURED LEADING EDGE
23 FUEL TANKS (PORT AND STARD.)
24 DINGHY STOWAGE
25 OVERLOAD OIL TANK
26 AIR BOTTLES
27 OIL COOLER DUCT
28 ENGINE COOLING GILLS
29 TWIN WASP ENGINE
30 FLOTATION BAGS (4 STORED IN ROOF OF BOMB CELLS)
31 RESERVE AMMUNITION
32 NAVIGATOR (2ND PILOT, BOMB-AIMER, WITH SEAT TYPE PARACHUTE)
33 BOMBS
34 ARMOUR PLATE
35 MAIN ELECTRICAL PANEL
36 BOMB DOORS
37 DOOR (SOUND PROOF BULKHEAD)
38 2ND PILOTS FOLDING SEAT (WITH SEAT TYPE PARACHUTE)
39 CABIN HEATING DUCT
40 PARACHUTE STOWAGE (BOMB-AIMER)
41 PARACHUTE STOWAGE (FRONT GUNNER)
42 PILOTS INSTRUMENT PANEL
43 BOMB-AIMER'S CUSHION (CABIN ENTRANCE DOOR)
44 CAMERA
45 BOMB-AIMER'S CONTROL PANEL
46 THERMOMETER FAIRING
47 BOMB-AIMER'S WINDOW
48 FRONT GUNNER
49 FORWARD NAVIGATION LAMP
50 TWO BROWNING GUNS
51 NOSE GUN TURRET
52 HYDROMATIC AIRSCREWS (ANTI-ICING EQUIPMENT)
53 PILOT (WITH SEAT TYPE PARACHUTE)
54 UNDERCARRIAGE POSITION WARNING HORN
55 RETRACTABLE LANDING LAMPS
56 CARBURETTOR AIR INTAKE
57 AERIAL MAST
58 OIL TANK (PORT & STARD. NACELLES)
59 FUEL TANK (PORT & STARD. NACELLES)
60 WIRELESS OPERATOR
61 NAVIGATOR'S INSTRUMENT PANEL
62 D.F. LOOP
63 MAP STOWAGE
64 UPWARD IDENTIFICATION LAMP
65 DOORS (SOUND PROOF BULKHEAD)
66 HAND FIRE EXTINGUISHER
67 OXYGEN BOTTLES (PORT & STARD.)
68 RECONAISSANCE FLARES
69 OBSERVATION DOME
70 NAVIGATOR (SEXTANT READING POSITION)
71 COMPASS
72 SEXTANT STEADY
73 FOLDING ARMOUR PLATE DOORS
74 PARACHUTE STOWAGE
75 REST BUNK
76 THERMO FLASKS STOWAGE
77 ELSAN CLOSET
78 FLARE CHUTES OR SEA MARKERS
79 FLARE CHUTE
80 FIN DE-ICING OVERSHOE
81 RUDDER MASS BALANCE

WELLINGTON IV AEROPLANE

A.P. 1578 D. VOL. I
FRONTISPIECE.

MAP

LIST OF SECTIONS

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

R.T.P./868 1,200 6/41

SECTION 1

CONTROLS AND EQUIPMENT FOR PILOT

AND GENERAL EMERGENCY EQUIPMENT AND EXITS

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

CONTROLS AND EQUIPMENT FOR PILOT AND GENERAL EMERGENCY EQUIPMENT AND EXITS

INTRODUCTORY

1. The location of the flying and other controls and equipment in the pilot's cockpit is illustrated and referenced in figs.1 to 3 at the end of this Section, a key to the various items referenced facing each illustration. Explanatory notes on the function and operation of particular items are given in the text, and reference to items appearing in the illustrations is accompanied by the relevant key number in brackets. Diagrams of emergency exits, dinghy installation and other emergency equipment are also included in this Section.

AEROPLANE CONTROLS

2. Flying controls.- The ailerons, elevator and rudder are operated in the normal manner by the control column (20) with hand wheel, and rudder bar (17). The rudder bar is adjustable for leg reach by means of a starwheel (94) at the rear of its mounting. It is possible to adjust leg reach while in flight by disengaging one foot temporarily from the rudder bar and rotating the starwheel (94) in the direction required by the toe of the boot. Clockwise rotation of the starwheel shortens reach and vice versa.

3. Trimming tab controls.- These controls are mounted in a group alongside the pilot's seat on the port side of the cockpit floor. The elevator and rudder trimming tabs are operated by a single control knob (68) 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 starwheel (69) 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 when the arrow on the knob points directly forward. The directions of movement of both these controls follow the sense in which it is desired to correct the trim.

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

5. Interconnection of elevator trimming tabs with trailing edge flaps.- When the flaps are lowered in normal flight, they cause the aeroplane to become "tail-heavy" to the extent that, when they are fully down, it is necessary for the elevator trimming tabs to be in the fully "nose-heavy", or raised, position to maintain longitudinal trim. For this reason, the flaps are so interconnected with the elevator trimming tab control cables that, providing the elevator trimming tab control (68) is in the neutral position, lowering of the flaps, either fully or partially, automatically raises the elevator tab into the "nose-heavy" position by the amount necessary to counteract the effect of the flaps.

6. Considering the case when the flaps are fully down, the effect of the interconnection is to limit the possible travel of the elevator trimming tab to between the "nose-heavy" and neutral positions; the quadrant settings of the pilot's control (68) corresponding with these positions then become the neutral and "tail-heavy" positions, respectively. Hence, under normal flying conditions, the tab control should be set to neutral before lowering the flaps, in accordance with the instruction plate alongside the flap control lever (10).

7. Flying controls locking gear.- The flying controls can be locked in their neutral positions by means of a triangular spring-loaded frame (83) hinged beneath the window ledge at the port side of the cockpit, and a detachable hinged "nuisance bar" (see fig.6). When not in use, the former is secured by a strap to the side of the cockpit, and the latter is stowed on the starboard side of the cabin gangway.

8. The controls are locked by first pushing the control column forward, with the aileron hand wheel rotated in a clockwise direction, and pulling down the triangular frame (83). The control column is then returned to the central position and the hand wheel rotated to engage with the frame 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" is then placed over the rudder bar adjustment slide so that the rudder bar is locked by the square pillar on the platform floor. The pin provided at one end of the hinged upper portion of the "nuisance bar" is then inserted through the aligned holes in the frame and hand wheel while the other end projects across the pilot's seat, preventing its use (see fig.6).

9. 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 fitted between the front of the pilot's platform floor and the starboard side of the cockpit.

10. Trailing edge flaps (hydraulic) control.- The flap control lever (10) is mounted beneath the centre of the instrument panel; the control is retained in the neutral position by a spring-loaded catch; this catch is released by depressing 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. For partial raising or lowering, however, the lever must be returned to neutral immediately the desired flap setting as shown by the indicator (48), is reached. The flap setting indicator (48) is graduated in degrees to show the angular setting of the flaps throughout their range of movement. The indicator is switched on by the alighting gear position-indicator switch (29). In case of failure of the engine-driven pump, or for testing purposes, the flaps can be operated by means of a hydraulic hand pump in the pilot's cockpit (see para. 18).

11. Alighting gear (hydraulic) control.- Raising and lowering of the undercarriage and tail wheel units are controlled by a lever (12) alongside the flap control lever. Automatic safety catches retain the lever in its UP and DOWN positions, and must be freed by the catch release (14) before the lever can be operated.

12. The alighting gear, in common with the other general hydraulic services, can be operated by the normal hydraulic system working on the engine-driven pump. In addition, for lowering the alighting gear only, a complete independent hydraulic system, also operated by the hand pump, can be selected in the event of complete failure of the normal system prior to a landing. Operation of this emergency system is described in paras. 20 and 21.

13. Alighting gear position indicator.- The positions of the undercarriage and tail wheel units when fully lowered and retracted are shown by a visual indicator (47) at the centre of the instrument panel. A switch (29) for the indicator is provided at the port side of the instrument panel and carries a catch bar that so engages with the adjacent bank of magneto switches (28) 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 indicator switch also closes the circuits for the undercarriage position audible warning system (see para.15) and flaps setting indicator (48).

14. The alighting gear position indicator unit (47) consists of a circular dial provided with an upper and lower group of three lamps. The upper group is red-coloured and is illuminated when the alighting gear units are retracted, while the lower group is green-coloured and is illuminated when the units are lowered. The side lamps in each group show the undercarriage unit positions and the centre one the tail wheel position. 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.

15. Undercarriage warning horn.- An electric horn, mounted above the pilot's seat, gives 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 (29) is on, the horn circuit being closed by switch units operated by the throttle mechanism in the engine control box. When the aeroplane is on the ground, the horn can be tested for satisfactory operation by closing the alighting gear position indicator switch (29) and pressing the horn push-switch (8).

16. Undercarriage wheel brake control.- Twin operating levers (33) mounted on the aileron handwheel, can be used singly or together to apply both wheel brakes. The brakes can be locked in the fully-applied position by compressing the levers to the end of their travel and engaging the catch bar (85) on the control column head. To unlock the brakes, the levers should be again pressed and the catch bar disengaged, after which the pressure should be released gradually. The braking system provides for differential application of the brakes by virtue of the rudder bar movement when taxying. A triple pressure gauge (54) registering the main supply pressure and operating pressure at each wheel brake, is mounted on the starboard side of the instrument panel.

GENERAL SERVICES HYDRAULIC SYSTEM

17. The alighting gear, trailing edge flaps and bomb doors are operated by hydraulic power normally derived from a pump driven by the port engine. The operation of the controls for these services is described in paras. 11, 10, 59 and 60, respectively.

18. 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, the fault possibly lies with the engine-driven pump, in which case the service must be operated by using the hand pump (72) located at the right-hand side of the pilot's seat. When the pump is required for operation, the actuating lever is lowered from its stowage clip and engaged with the pump by means of the spring catches at its base; the pump is then operated by working the lever up and down over the full available travel (see also para.21). The lever can be disengaged from the pump again for stowage by depressing the plunger in the knob.

19. If efforts to operate a service through the normal hydraulic system by using the hand pump are unsuccessful, it will be in consequence of a defect or break in the hydraulic system. For lowering the alighting gear only, recourse must then be had to the EMERGENCY hydraulic system (see paras. 20 and 21).

20. Hydraulic system EMERGENCY lowering of the alighting gear.- In the event of the normal hydraulic system failing to operate on the engine-driven pump or hand pump, an independent EMERGENCY hydraulic system can be operated by the hand pump for the sole purpose of lowering the undercarriage and tail wheel, preparatory to a landing being made. The system is supplied from a subsidiary header tank below the main one so that, in the event of the latter completely emptying, the fluid supply is maintained. The system is brought into use by moving the selector lever (70) on the hand pump from the downmost (NORMAL) position to the uppermost (E) position; before the lever can be moved from the NORMAL

position it must be released from the quadrant by pulling out the spring-loaded knob.

21. With the alighting gear hydraulic control lever (12) in the DOWN position, the hand pump should then be operated (see para.18) until all the alighting gear units are fully lowered, as shown by the position indicator (47). For this purpose approximately 250 double strokes of the handle are normally required. When alighting gear DOWN is first selected, the undercarriage wheels will drop some distance from the retracted position, allowing a space to form on one side of the lowering jacks. For this reason, the hand pump will work quite freely at first, but once this space is filled by fluid from the hand pump, considerable effort will be found necessary to work the handle. (These remarks also apply to lowering the alighting gear by the hand pump when using the normal hydraulic system).

Note.- The emergency system will only lower the alighting gear. It will neither raise the alighting gear 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 extension to the flying control platform. An induction system priming pump, for use when starting, is mounted in each engine nacelle forward of the fireproof bulkhead; the fuel supply to each of these priming pumps is controlled by a cock located aft of the fireproof bulkhead. The main oil supply to each engine is from a tank of 16 gallons capacity, mounted on the front face of the nacelle fuel tank.

23. Engine starting system.- Each engine is started by an inertia flywheel which is rotated up to the required speed either electrically by the use of the appropriate push-switch (3 or 38) on the instrument panel or manually by the use of a turning handle with an external shaft drive provided in each engine nacelle, adjacent to the priming pump. On attaining the required speed, the starter flywheel is engaged with the engine through a clutch mechanism which is also operable electrically or manually by depressing the corresponding push-switch (44) on the instrument panel or pulling a control handle provided against the hand-turning shaft, respectively. During engine-starting, an ignition booster coil is employed by depressing the appropriate push-switch (45) adjacent to the clutch engagement switches (44).

24. Throttle, mixture and slow-running cut-out controls.- Two throttle control levers (88) and corresponding mixture control levers (89) are mounted at the forward end of the engine control box. The mixture control positions are FULL RICH, AUTO RICH, AUTO WEAK and CUT-OFF. FULL RICH is only for use if AUTO has failed. In CUT-OFF,

the control cuts off all jets. The lever must be at CUT-OFF whenever the engine is stationary, and this position is used for starting and stopping.

25. For the prevention of movement, under vibration, of the throttle and mixture levers, a friction damper control lever (87) enables them to be given increased stiffness of movement or to be locked. When dual throttle controls are fitted, no attempt must be made to move them while the first pilot's controls are locked in this way, otherwise the latter will probably sustain damage.

26. Two-speed supercharger control.- The two-speed supercharger change-over gear is controlled by the outboard lever (91) aft of the throttle and mixture levers, and is moved forward for FULL (high gear) and aft for MEDIUM gear. During an operation, the lever should be moved smartly, without pausing, from one position to the other. The lever can be locked in the two operating positions by a spring-catch; this is released by depressing the lever handle.

27. Boost pressure gauges.- The boost pressure is registered by gauges (42 and 50) at the centre of the instrument panel. In the event of failure of one of the gauges, the boost gauge for the other engine can be used in its stead to register the boost pressure by pulling out the boost gauge reversal control (16).

28. Cowling gills controls.- The position of the engine cowling gills is controlled by the handles (19 and 24) 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 or open, respectively.

29. Hot and cold air intake control.- When operating conditions so require, hot air can be admitted to both engine carburettor intakes by operation of the lever (92) next to the two-speed supercharger control. The lever is moved forward for HOT and back for COLD air intake conditions, being locked in either position by a spring-catch which is disengaged for an operation by depressing the lever handle.

30. Oil cooler shutters control.- Each engine oil cooler duct is provided with shutters to regulate oil temperature. Separate control handles (93) for each engine are mounted aft of the engine control box, the handles being pulled out to close the shutters and vice versa.

31. Fuel cock controls.- (See diagram of fuel cock settings). The pilot has control over the pressure side of the fuel supply from all sources by means of two remote-control handles operating the cocks (Ep and Es) in the delivery pipes to the carburettors of both engines; these remote control handles are located immediately aft of the elevator trimming-tab control quadrant, and are pulled out to close the cocks and vice versa. A further remote control handle, outboard of the foregoing pair, operates the cock (A) in the balance pipe connecting together the pressure sides of both fuel pumps; this handle is operated in a contrary sense to the first pair, being pushed in to close the cock and vice versa.

32. The fuel supply from the port and starboard main tank groups, each comprising two tanks in the outer main plane and one in the engine nacelle, have main supply cocks (Cp and Cs) controlled by a member of the crew using separate handles mounted on the port and starboard sides of the fuselage, immediately forward of the main plane spar. Each nacelle tank is also provided with a supply cock, enabling these tanks to be isolated from the wing tanks and their fuel contents, totalling 116 gals., to be held in reserve; the nacelle tank cocks are operated by separate remote-control cables adjacent to the main cock control just referred to. The suction side balance pipe cock (B) and the cocks (Dp and Ds) for the overload tanks, carried in the bomb cells, are located immediately aft of the spar.

33. Manually-operated fuel pump.- A hand pump, mounted immediately aft of the spar centre section, is provided for raising the necessary pressure in the fuel system before starting. In the event of both engine-driven fuel pumps failing, this pump can also be employed to feed the engines, provided the fuel cocks are set as stated for this condition in the fuel cock setting diagram (see para.32).

34. 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 on the starboard side of the cabin, immediately aft of the pilot's cockpit. The gauges are visible to the pilot who can operate them by means of the push-switch (13) at the centre of the instrument panel. A further operating push-switch is provided on the control panel, adjacent to the fuel gauges.

35. 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 fuel-jettison and air-vent valves are opened simultaneously by the operation of a handwheel (26) engraved with OPEN and CLOSED positions, at the port side of the pilot's instrument panel. Before operating this handwheel, however, the adjacent compressed air supply valve (25) must be unscrewed about four turns.

36. 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 must be closed by the handwheel (26) before the aeroplane alights, to conserve the increased buoyance due to the empty tanks.

37. Engine auxiliary oil supply.- For use on long-range flights, an auxiliary engine oil tank of 15 gallons capacity, together with a hand pump, is mounted at the starboard side of the fuselage, aft of the main plane spar. The contents can be delivered to each nacelle main oil tank separately by setting the adjacent two-way cock to supply each tank in turn and operating the hand pump. In flight, the hand pump should be used to supply oil to the main tanks at the rate of ½ gallon per tank per hour. This is equivalent to 11 double strokes

of the handle per hour while the pump is supplying each tank in turn.

38. Airscrew speed controls.- Early aeroplanes are equipped with Hamilton or de Havilland constant-speed airscrews having a 20° pitch range. The airscrew speed control levers are at the rear of the engine control box. The extreme forward position is marked HIGH R.P.M. and the extreme rear position LOW R.P.M., intermediate positions being marked with a numbered scale. When the lever is at LOW R.P.M, the airscrew is locked in positive coarse-pitch and the speed governor is out of action. On aeroplanes fitted with Curtiss airscrews the same type of control as described above is provided, with the difference that it does not lock the airscrew in positive coarse-pitch.

39. Curtiss airscrew electrical controls.- Three electrical controls for each airscrew are provided at the centre of the instrument panel. They are the master switch (41A and 50A) in which is incorporated an overload release device, the three-position selector-switch (36A and 50C) and the feathering switch (39A and 50B).

40. The master switch (41A and 50A) should always be ON in flight as it controls the supply to the airscrew pitch control and feathering system. If an excessive electrical load is applied during any operation, the master switch is thrown into OFF automatically. When this occurs the switch should be reset to ON after about a minute has elapsed.

41. The airscrew selector switch (36A and 50C) can be moved to three positions other than the central one in which the airscrew operates in fixed-pitch. The two lower positions are for MANUAL INCREASE and MANUAL DECREASE of the airscrew R.P.M., respectively, and when the switch is moved to either of these positions it must be held there until the desired R.P.M.are attained; upon release, it will return to the central position of its own accord. In the upper (AUTOMATIC) position the airscrew operates at constant-speed.

42. Feathering.- The feathering switch (39A and 50B) has a spring-loaded cover marked with the two switch positions, NORMAL and FEATHER. This switch brings an electric booster into operation when moved to FEATHER and acts whatever the selector switch (36A and 50C) setting. Feathering should normally be carried out after throttling back the engine and switching off the ignition. and the time taken to stop the engine is then about 10 to 15 seconds. In an emergency, however, the feathering switch may be moved first to reduce the total time necessary.

43. Feathering can be carried out more slowly without the use of the feathering switch by holding the selector switch in the DECREASE R.P.M. position.

44. Unfeathering.- Before unfeathering the airscrew, the selector switch is set to the central position and the feathering switch returned to NORMAL. The airscrew is then unfeathered by moving the selector switch to INCREASE R.P.M. but operating it so as to increase the engine speed gradually. The ignition should not normally be switched on until at least 1,000 R.P.M.are reached. The selector switch is then moved to AUTOMATIC and the throttle opened slowly.

45. Suction pump EMERGENCY change-over cock.- The artificial horizon, direction indicator and turn indicator on the instrument-flying panel (35) are operated by a suction pump, one such pump being driven by each engine. In the event of one pump failing, the other can be selected by means of the change-over cock (65) on the floor at the right-hand side of the pilot's seat. Under normal conditions, the suction pump not in use for operating the instruments is connected by the change-over cock (65) to the de-icing system distributor valve (see para.50), for the purpose of keeping the overshoes flat when the de-icing system is not in operation.

46. Signalling switchboxes.- Two signalling switchboxes are mounted beneath the instrument-flying panel. The starboard switchbox (22) 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 (109) 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 (23) provides for signalling or steady illumination from the formation-keeping lamps; on this switchbox, the DOWN switch only should be used.

47. 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.

48. Signal pistol.- The signal pistol is clamped in the firing position in the roof of the wireless compartment, provision being made for plugging the barrel when the pistol is not in use. A rack for eight signal cartridges is mounted at the base of the navigator's chart board stowage at the starboard side of the cabin gangway.

49. Airscrew de-icing system.- The airscrew de-icing system is operated by an electrically-driven pump mounted along with a de-icing fluid reservoir, of approximately 6½ galls. capacity, 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, the quantity of fluid in the reservoir being sufficient for approximately four and a half hours continuous operation at the normal working pressure, equivalent to a delivery of six pints per hour per airscrew. The pressure, governed by the motor speed, is regulated by a rheostat (2) at the starboard side of the instrument panel, operated by a control knob marked with an arrow. For normal working pressure the arrow should be set to a mark on the dial corresponding with this pressure. The pressure can be increased by rotating the knob

further, but there will be a consequent reduction in the endurance; it is advisable, when icing conditions are first encountered, however, to turn the knob fully on for about a minute. A switch incorporated in the rheostat switches off the system when the arrow is set to the OFF position. Before taking off, when icing conditions are likely to be encountered, the system should be primed with the airscrews stationary.

50. Tail unit de-icing system.- The de-icing system for the tail unit consists of pulsating tubes situated on the leading edges of the flying surfaces. The tubes are supplied with air under pressure from the exhaust of both engine-driven suction pumps; the air passes through a distributor valve unit, incorporating a control lever and pressure gauge, mounted on the starboard side of the cabin gangway. The control lever on the unit is arranged to switch on the distributor valve motor and admit the air supply. When the system is not in operation, the distributor valve is in communication with the suction side of one of the suction pumps for the purpose of keeping the overshoe surfaces flat during flight (see para.45).

51. Windscreen de-icing.- The windscreen de-icing system consists of a de-icing fluid tank mounted forward of the instrument panel and connected to a small hand pump, for operation by the pilot, mounted on the instrument panel, a further pipe from this pump leading outside and terminating in a nozzle in front of the first pilot's windscreen. The pump is operated periodically, as necessary, with the windscreen wiper (see para.52) in operation. The fluid emitted from the nozzle by operation of the hand pump is directed on to the iced windscreen where it is distributed, and the resultant sludge cleared, by the wiper.

52. Windscreen wiper.- The first pilot's windscreen is provided with an electrically-driven wiper for clearing the screen of rain and, in conjunction with the windscreen de-icing system, of ice (see para.51). The wiper control (67) is mounted on the floor at the right-hand side of the pilot's seat, and consists of a rheostat incorporating a switch, similar to the airscrew de-icing control (see para. 49).

53. Pilot's wireless and intercommunication equipment.- Two microphone and telephone sockets provided with holding clips (76) are connected to a panel at the left-hand side of the pilot's seat, for use with the general purpose and T.R.9F transmitter-receiver, the latter being also used for intercommunication and for beam approach signals. A "mixer" listening switch unit (49A) is mounted beneath the starboard side of the cockpit coaming and has three switch positions marked B.A., MIX and I/C. This enables intercommunication and beam approach systems to be heard independently or, in the "MIX" position, together. The T.R.9F unit is mounted beneath the navigator's table, and is provided with a remote control unit (86) comprising send-receive, tuning and volume controls on the port side of the pilot's cockpit and, further aft, a special switch (77). A send-receive control for the T.R.9F unit is also provided at the sextant dome. The independent aerial for the T.R.9F installation is suspended from the general-purpose installation fixed aerial and led down into the port side of the fuselage.

54. Beam approach system.- The main signal receiver for the Standard 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, amidships, and the dipole aerial is mounted beneath the fuselage.

55. The beam approach remote control box (53) is mounted 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 intercommunication telephone socket (see para.53) and the visual indicator (41) at the port side of the instrument panel, are employed.

56. R.3003 wireless installation.- This installation is mounted on the port side near the tail of the fuselage. It is provided with an aerial led from its mounting to the port tail plane tip and a corresponding one from a bracket on the opposite side to the starboard tail plane tip. The controls for the installation are mounted on the starboard side of the cabin gangway, opposite to the wireless compartment. A main control switch (117) is mounted at the starboard side of the cockpit, together with two shrouded push-switches (116); these push-switches are for use only in an emergency. An inertia switch unit having a similar function to the push-switches is carried forward of the installation.

57. Landing lamp control.- Two retractable landing lamps, mounted together in the lower surface of the port main plane, are raised and lowered hydraulically by means of the control lever (75) at the left-hand 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 can be released for 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 (84) at the port side of the cockpit.

58. Forced-landing flares release control.- Two forced-landing flares carried in the port inner main plane can be released mechanically by means of the control lever (71) 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 on its mounting. To release one flare, the lever is pulled out and rotated downwards until the cam central stop is reached; to release the second flare the same process is repeated through the remainder of the cam slot.

59. Bomb doors control.- The front hinge units on the foremost outer three doors on each outer bomb cell incorporate double-acting hydraulic jacks for opening and closing these doors; the rear hinge units on these doors and the hinge units on all the remaining doors incorporate single-acting jacks for closing them only. When the hydraulic control (see para.60) in the cockpit is set to the OPEN position, the doors are opened under the action of compression springs in the single-acting jack hinge units, assisted by the double-acting jacks where provided.

60. All the bomb doors are opened and closed simultaneously by operation of the hydraulic control valve handle (31) at the port side of the instrument panel. The control handle can be rotated to the OPEN or CLOSED position, after releasing the handle lock by depressing the spring-loaded thumb knob provided. The handle is linked up with a master switch (32) so as to prevent the release of bombs until the bomb door control is in the OPEN position. Provided the bomb release master switch (114) 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. For operation of the bomb doors by means of the hydraulic hand pump, reference should be made to para.18.

61. Bomb release control.- The pilot has supervision over the bomb release master switch (114) at the starboard side of the cockpit, and also controls the bomb doors master switch (see para.60). 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 (30) at the port side of the instrument panel. A bomb-loading instruction plate (108) is provided on the starboard side of the cockpit and a further loose instruction plate is contained in a stowage bag (118) further aft.

62. Bomb jettisoning controls.- A bomb jettison remote control (37) for the use of the pilot, is mounted at the port side of the instrument panel, making the electrical jettison switch (112), at the starboard side of the cockpit, redundant; the latter switch is accordingly covered by a metal plate. Bomb jettisoning is also under the control of the bomb aimer.

Note.- Before bombs are jettisoned by the use of the above control, any bomb containers carried must first be jettisoned by use of the bomb container jettison switch (115) at the starboard side of the cockpit. If this is not observed, operation of the bomb jettison control (37) will release the contents of only one compartment of each container, and they will be "live".

63. Pilot's steering indicator.- The steering indicator (34) at the port side of the instrument panel is employed in conjunction with the course-setting bomb sight to indicate 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 which are illuminated by separate push-switches at the bomb-aiming station.

64. Earth fault and bomb release indicator.- Selection of one or more bombs, prior to their being released by the bomb aimer, causes two lamps (113) 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. When the firing switch is closed, both lamps should be extinguished, indicating that all selected bombs have been released.

65. Bomb cell lamps.- Three lamps providing a measure of lighting in the bomb cells, are located at their forward ends, and are controlled by a switch on the electrical distributor panel, aft of the pilot's cockpit. The lamps enable a member of the crew to inspect the interior of the bomb cells through the rear inspection windows, to guard against the possibility of any bombs accidentally remaining after the bomb load should have been disposed of. It is important that these lamps should be switched off, when the bomb doors are open, during night flying.

66. Oxygen supply.- A standard oxygen regulator unit (27) 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 left-hand side of the pilot's seat. A similar regulator unit (56) and socket (102) are provided at the opposite side of the cockpit for the oxygen supply to the occupant of the starboard seat.

GENERAL EQUIPMENT

67. Pilot's seat.- The seat is adjustable for height by means of a lever (64) at its right-hand side, and has hinged arm rests that are also adjustable for position by screwed stops. The seat height-adjusting lever is locked by a spring-loaded catch and can be released for adjustment by depressing the knob at the top. A cushion (95) at the front of the seat is adjustable for position by releasing a spring-loaded pin at the left-hand side. The seat has a well for a seat-type parachute and is provided with Sutton-type safety harness 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 resumed. The pilot is afforded protection against gun fire from the rear by the armour plating provided at the rear of the wireless station and beneath the navigator's table.

68. Cockpit starboard seat.- A folding seat (101) 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 a lever at the left-hand side of the seat. An adjustable padded back rest strap (73) 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 also folding foot rests (63 and 103) for use when dual controls are not fitted.

69. Cockpit windows.- The windscreen is provided at each side with an inwardly opening hinged panel for direct vision should the windscreen be obscured. These panels are opened by rotating the two retaining catches clear of their bases and pulling the moulded knob. The knob fits into a clip on the cockpit roof to secure the panel when open. At each side of the cockpit are sliding windows operated by hand rails at their forward ends; the openings are provided with guard rails bearing a warning to keep clear of the airscrew blades.

70. 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 (40) with dimmer switch (36) 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 (119). Below the latter and near the main entrance hatch is a master switch in series with the two foremost roof lamps in the cabin; these lamps, in common with all roof lamps, have self-contained switches and these should be left on and use made of the master switch to extinguish the lamps when leaving the aeroplane, so enabling the same switch to be used to give illumination if necessary when entering.

71. "Call" lamps.- A visual signalling system for calling the attention of all personnel can be operated by means of the switch unit (60) incorporating a clear lamp, at the starboard side of the instrument panel. Similar units are provided at all crew stations and operation of the push-switch on any one unit will illuminate all lamps.

72. Heating and ventilating system.- Two air outlet pipes with control valves that can be 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 spar centre section, is open or closed. A further air outlet pipe (106) is provided at the starboard side of the cockpit.

73. Sun blinds.- Two sun blinds (100) 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 facing outwards.

74. Entrance ladder.- A wooden ladder for use with the forward lower entrance hatch is strapped to the base of the fuselage at the starboard side of the circular hatch amidships.

EMERGENCY EXITS AND EQUIPMENT

75. A diagram showing the location of 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.

76. Parachute exits.- The exits which is is permissible to use for the purpose of abandoning the aeroplane by parachute are the forward lower hatch, the circular lower hatch amidships, the push-out panel at the starboard lower side of the fuselage aft of this and, for the use of the rear gunner if he is wearing a parachute at his station, the doorway of the turret after rotating it fully to one side and jettisoning the doors by means of the handles provided for this purpose. 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.

77. Crash exits.- In addition to the foregoing exits, 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 to open downwards by either of two spring-loaded bolt levers at the front and rear of the mounting. These exits, in conjunction with other unobstructed exits, can be used for escape by personnel in the event of a crash landing.

78. Parachutes.- The pilot, navigator and wireless operator are each provided with a seat-type parachute. 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 for the rear gunner is provided in the rear turret. A parachute stowage also exists above the rest bunk.

79. Life-saving waistcoats.- When required, life-saving waistcoats are stowed in bags immediately aft of the midship and rear gunners' parachute stowages (see para.78).

80. Dinghy.- An inflatable type J dinghy, with CO_2 charging cylinder and necessary equipment, is carried in a container in the starboard engine nacelle. The dinghy is released automatically, on the aeroplane alighting on salt water, by the action of an immersion switch at the base of the nacelle. Alternatively, the dinghy can be released manually by pulling handles located on the starboard side of the fuselage at the sextant station and immediately forward of the rear gun turret. The manual release handles are also accessible from the outside through inscribed tear-off patches (see fig.5).

81. 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 inner main planes. The cylinders are discharged separately by pulling each of three handles contained in a box covered by an inscribed tear-off patch and fixed to the rear of the spar centre section. An immersion switch mounted on the truss aft of the front turret and possessing an open pipe leading to the base of the fuselage, produces 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 doors must be opened and the bomb load jettisoned; the doors must then be closed again.

82. Turret external rotation.- To gain access to them in cases of emergency, the front and rear gun turrets can be rotated to the central position by means of nearby external rotation valves in the hydraulic supply lines on the port and starboard sides of the fuselage, respectively.

83. Fire extinguishers.- A Graviner-type fire-extinguishing system is installed, possessing separate fire extinguishers with spray heads in each engine nacelle. The contents of either or both of these fire extinguishers are released electrically by two push-switches (55) at the starboard side of the instrument panel. Automatic operation of this fire-extinguishing system is provided by a flame switch on the forward face of each fire proof bulkhead, and by inertia and gravity switches within the fuselage. One or more hand fire extinguishers are provided at convenient points within the fuselage.

84. Fireman's axe.- A fireman's axe, for cutting a way out of the fuselage in an emergency, is stowed immediately aft of the navigator's seat.

85. First-aid outfits.- Two first-aid outfits are stowed on the port side of the fuselage, amidships; they are also accessible from outside through an inscribed tear-off patch.

KEY TO FIG. 1

1. Camera indicator wedge plate
2. Airscrew de-icing system control rheostat
3. Starboard engine inertia starter motor push-switch
4. Oil pressure gauge (starboard engine)
5. Suction gauge
6. Oil temperature gauge (starboard engine)
7. Compass deviation card holder
8. Undercarriage warning horn push-switch
9. Clock mounting
10. Trailing edge flaps hydraulic control lever
11. Compass
12. Alighting gear hydraulic control lever
13. Fuel gauges push-switch
14. Safety catch release for alighting gear control lever
15. Oil temperature gauge (port engine)
16. Engine boost gauges reversal control
17. Rudder bar
18. Oil pressure gauge (port engine)
19. Cowling gills control handle (starboard engine)
20. Control column
21. Course-and-height and height-and-airspeed computor stowage
22. Signalling switchbox for upward and downward identification lamps
23. Signalling switchbox for formation-keeping lamps
24. Cowling gills control handle (port engine)
25. Compressed air supply control for fuel jettisoning system
26. Fuel jettisoning and vent valves control
27. Oxygen regulator unit
28. Magneto switches
29. Alighting gear position indicator switch and catch bar
30. Bomb-firing key
31. Bomb doors hydraulic control handle
32. Safety switch operated by bomb doors control handle
33. Wheel brake levers
34. C.S.B.S. steering indicator
35. Instrument-flying panel
36. Dimmer switch for compass lamp
36A. Port airscrew selector switch (for Curtiss airscrews only)
37. Bomb jettison remote control handle (making item 112 redundant)
38. Port engine inertia starter motor push-switch
39. Auto-controls "nose-heavy", "tail-heavy" and main pressure gauge
39A. Port airscrew feathering switch (for Curtiss airscrews only)
40. Compass lamp
41. Beam approach system visual indicator
41A Starboard airscrew control master switch and overload release (for Curtiss airscrews only)
42. Boost pressure gauge (port engine)
43. Cylinder temperature gauge (port engine)
44. Port and starboard engine inertia starter clutch engagement push-switches
45. Port and starboard engine booster coil (ignition) push-switches
46. Engine speed indicator
47. Alighting gear position indicator
48. Trailing edge flaps setting indicator
49. Cylinder temperature gauge (starboard engine)
49A. Intercommunication and beam approach listening "mixer" switch
50. Boost pressure gauge (starboard engine)
50A. Starboard airscrew control master switch and overload release
50B. Starboard airscrew feathering switch
50C. Starboard airscrew selector switch

} for Curtiss airscrews only

51. Ground signal card holder
52. Beam approach system cable plug stowage
53. Beam approach system control box
54. Wheel brake system triple air pressure gauge
55. Graviner-type fire extinguishing system shrouded push-switches
56. Oxygen regulator unit
57. Air temperature gauge
58. Fuel pressure gauges
59. D.F. loop scale setting indicator
60. "Call" lamp and switch

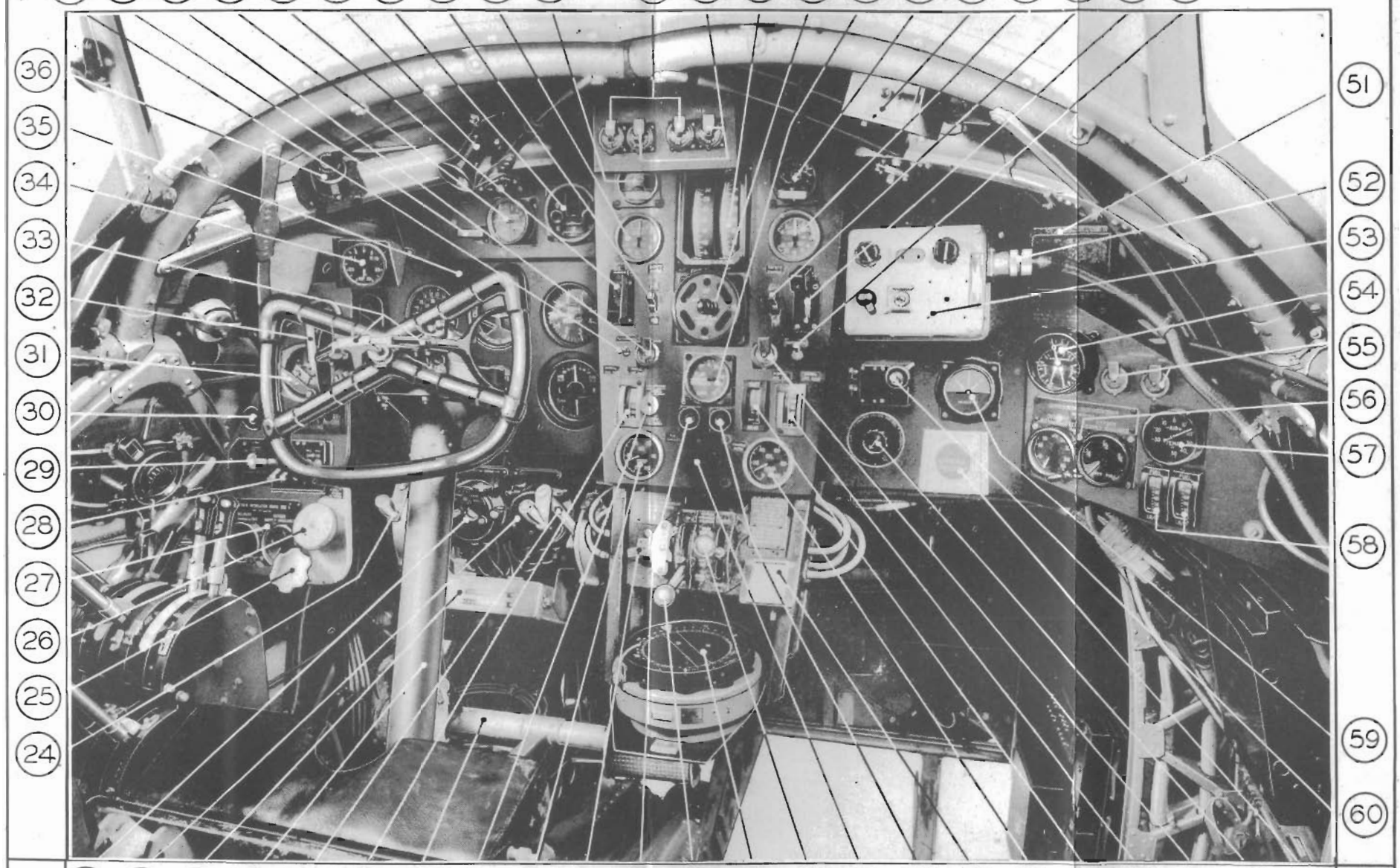


FIG. 1

INSTRUMENT PANEL

FIG. 1

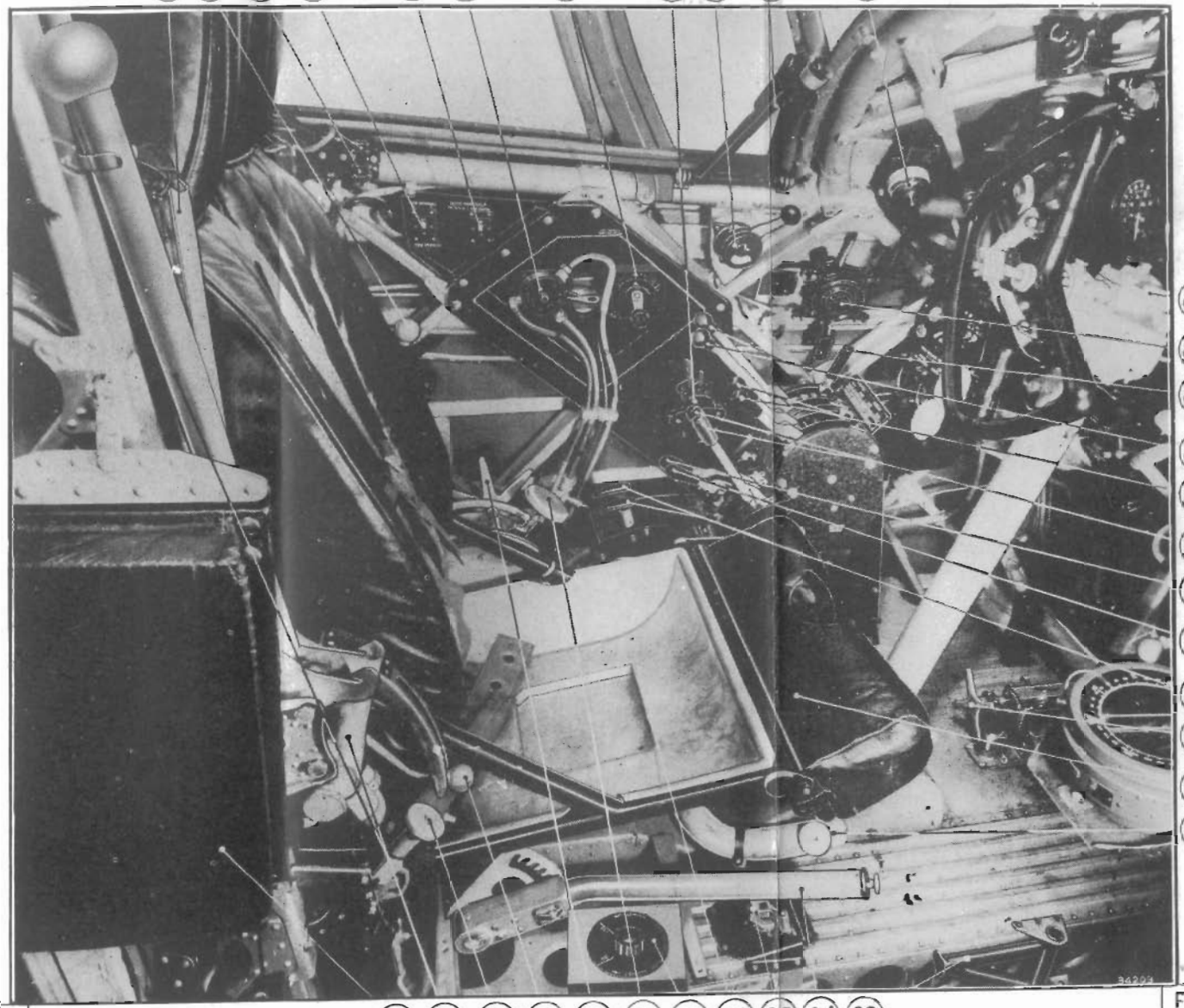


FIG. 2 PORT SIDE OF COCKPIT FIG. 2

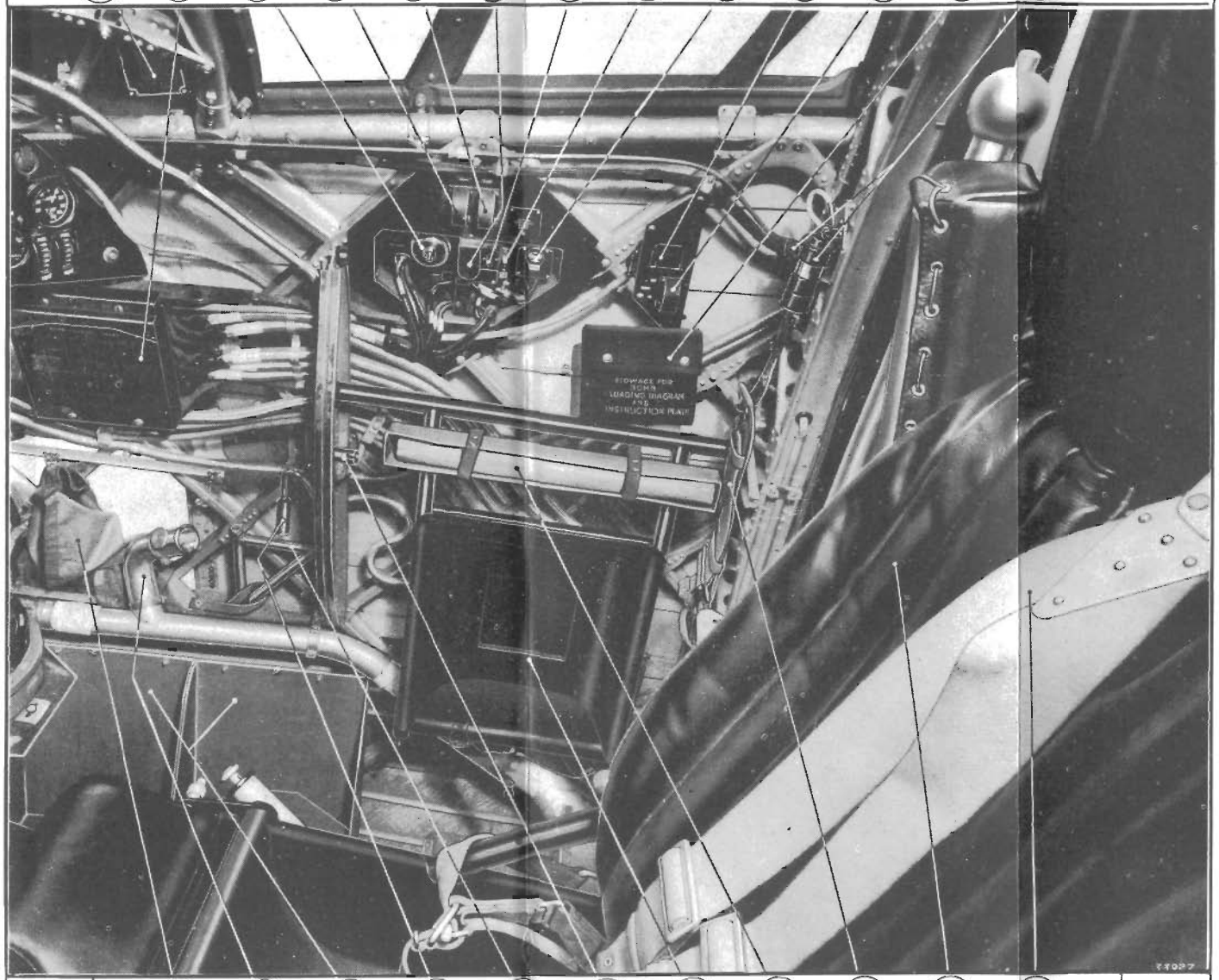
KEY TO FIG. 2

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

KEY TO FIG. 3

97. Pilot's Sutton-type safety harness
98. Pilot's back rest
99. Starboard seat safety belt
100. Cockpit roof sun blind stowage
101. Starboard seat
102. Oxygen supply socket
103. Starboard seat folding footrest
104. Microphone and telephone socket
105. Parachute stowages
106. Warm air supply outlet and control valve
107. Window curtain
107A. Engine data plate
108. Bomb loading instruction plate
109. Headlamp switch (independent and signalling)
110. A.S.I. pressure head heating switch
111. Navigation lamps switch
112. Bomb electrical jettison switch (made redundant by item 37)
113. Bomb release indicator and earth fault lamps
114. Bomb release master switch
115. Bomb container jettison switch
116. R.3003 shrouded emergency switches
117. R.3003 main switch
118. Bomb loading instruction plate stowage
119. Cockpit lamp and dimmer switch

107a 108 109 110 111 112 113 114 115 116 117 118 119



107 106 105 104 103 102 101 100 99 98 97

FIG. 3

STARBOARD SIDE OF COCKPIT

FIG. 3

F.S.12

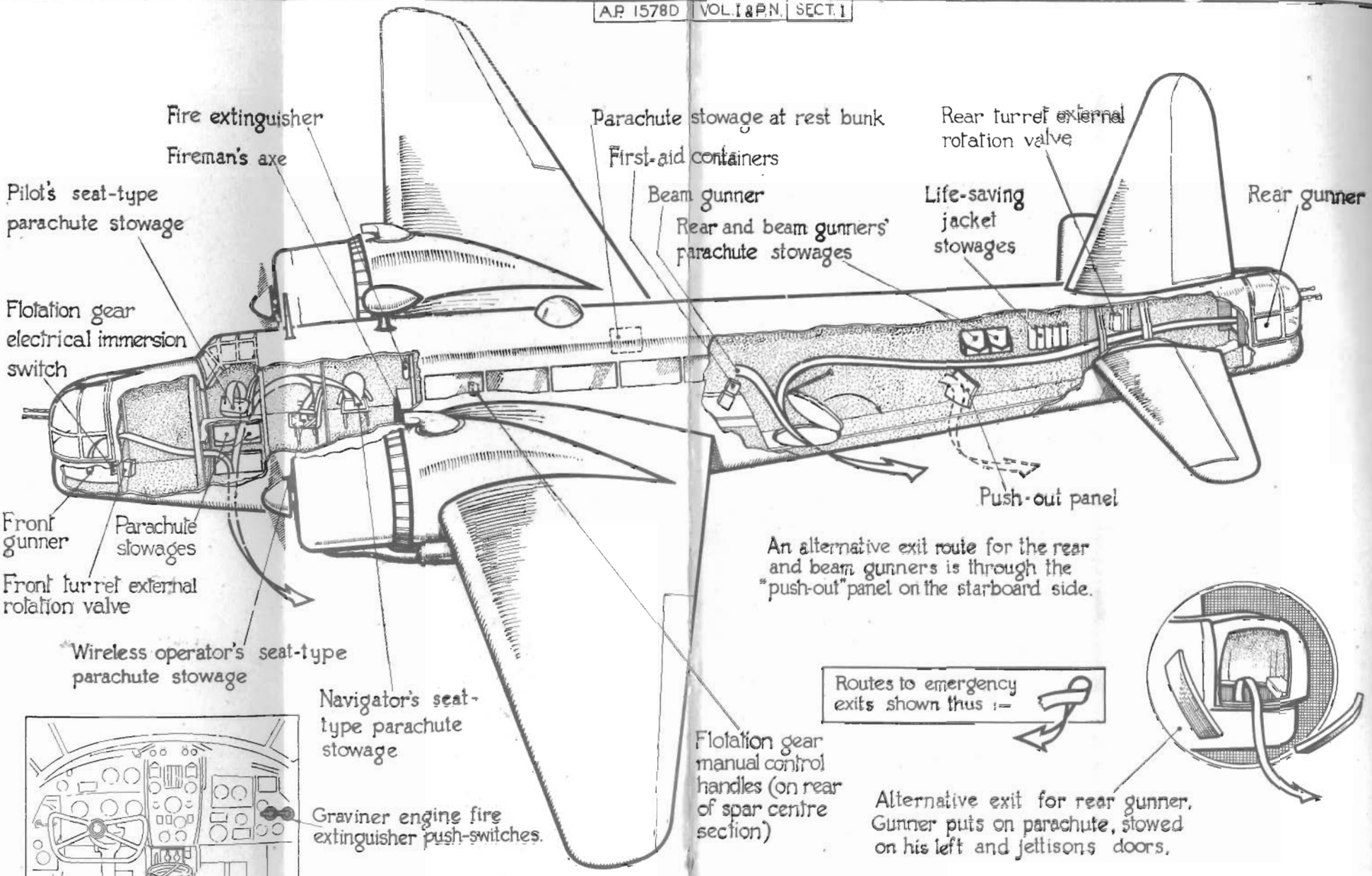


FIG. 4

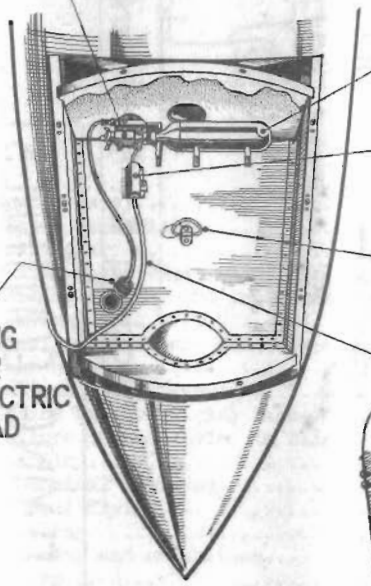
PARACHUTE EXITS AND EMERGENCY EQUIPMENT

FIG. 4

F TYPE ELECTRICAL OPERATING HEAD

2ND PILOT PULLS DINGHY RELEASE AND CLIMBS OUT OF SEXTANT HATCH FOLLOWED BY OBSERVER AND BEAM GUNNER

PILOT'S AND FRONT GUNNER'S EXIT



CO_2 CYLINDER

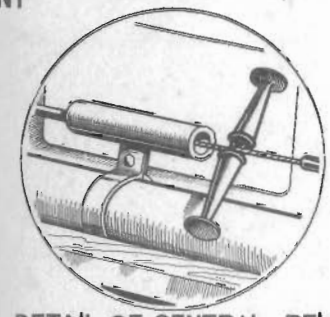
CENTRAL RELEASE

DISCONNECTOR

ANCHORING CORD ATTACHMENT

PLUG FOR ELECTRIC LEAD

RELEASE CABLE



DETAIL OF CENTRAL RELEASE

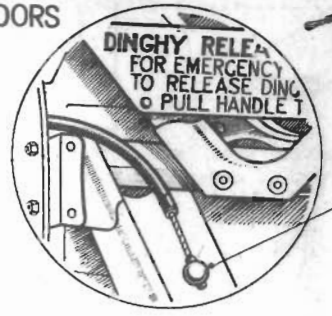
ELECTRICAL IMMERSION SWITCH

RELEASE CABLE
PAINTER CORD
} ATTACHED TO SURFACE BY DOPED-ON STRIP

TEAR-OFF PATCHES

TOPPING-UP PUMP, DISTRESS FLARES ETC. IN VALISE BENEATH NACELLE LID AND ANCHORED TO DINGHY

REAR GUNNER ROTATES TURRET FULLY TO PORT AND ESCAPES THROUGH DOORS



REAR DINGHY RELEASE

STABILIZING POCKETS

ROPE LADDER

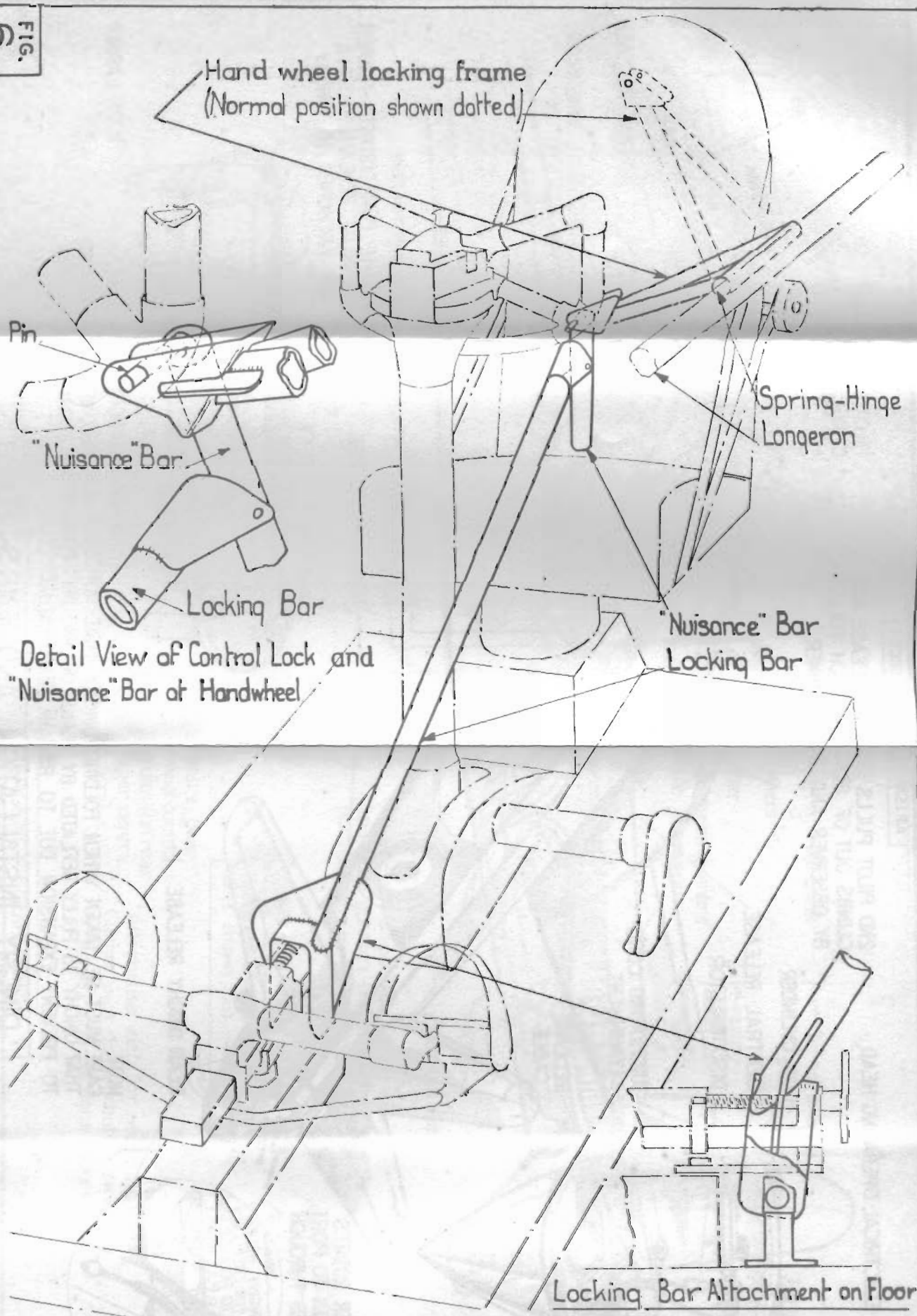
NOTE :-
CARE MUST BE TAKEN WHEN FOLDING DINGHY THAT ROPES DO NOT BECOME ENTANGLED AND THAT DINGHY IS FULLY DEFLATED BY MEANS OF THE DEFLATING PUMP STORES REF. 4C/1310 TO PREVENT EXPANSION DUE TO RISE IN TEMPERATURE

FIG. 5

DINGHY INSTALLATION AND EXITS FOR USE

FIG. 5

FIG. 6



LOCKING OF FLYING CONTROLS

FIG. 6

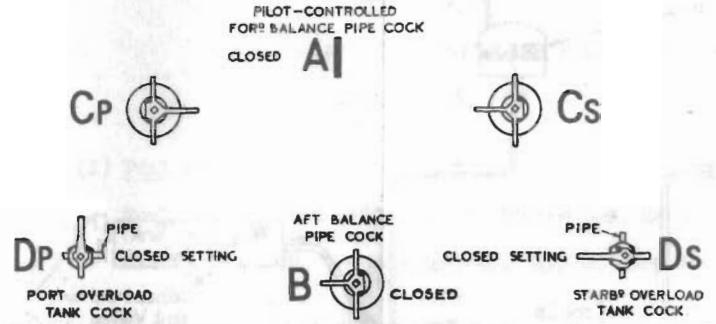
SECTION 2.

LIST OF CONTENTS.

LIST OF ILLUSTRATIONS

SYSTEM USING NORMAL TANKS

① KEY DIAGRAM AND SETTING OF COCKS FOR NORMAL OPERATION



② TAKE OFF AND EMERGENCY OPERATION FOR PORT OR STARB P PUMP FAILURE.

OPEN A — PILOT-CONTROLLED

REMAINING COCK SETTING AS IN DIAGRAM ①

③ EMERGENCY OPERATION

TO TRANSFER FUEL IN PORT WING TANKS TO STARB P PUMP

OPEN A — PILOT-CONTROLLED

CS

OPEN B

REMAINING COCK SETTINGS AS IN DIAGRAM ①

④ EMERGENCY OPERATION

TO TRANSFER FUEL IN STARB P WING TANKS TO PORT PUMP

OPEN A — PILOT-CONTROLLED

CP

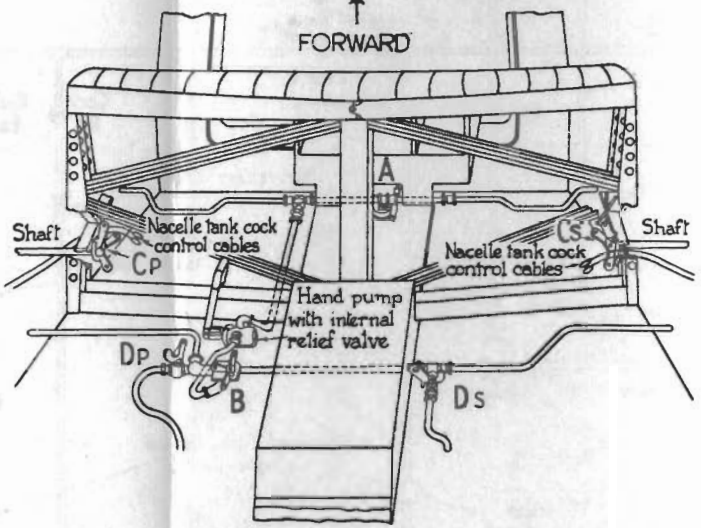
OPEN B

REMAINING COCK SETTINGS AS IN DIAGRAM ①

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 & BALANCE COCK B CAN BE SET EITHER TO SUPPLY HANDPUMP FROM ALL WING TANKS OR FROM PORT WING TANKS ONLY (OVERLOAD FUEL USED UP)



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

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 WHILE USING OVERLOAD TANKS

OPEN A — PILOT-CONTROLLED

REMAINING COCK SETTINGS AS IN DIAGRAM ⑤

⑦ EMERGENCY OPERATION

TO TRANSFER FUEL IN PORT OVERLOAD TANK TO STARB P PUMP

OPEN A — PILOT-CONTROLLED

B OPEN — DS CLOSED

REMAINING COCK SETTINGS AS IN DIAGRAM ⑤

⑧ EMERGENCY OPERATION

TO TRANSFER FUEL IN STARB P OVERLOAD TANK TO PORT PUMP

OPEN A — PILOT-CONTROLLED

DP CLOSED — B OPEN

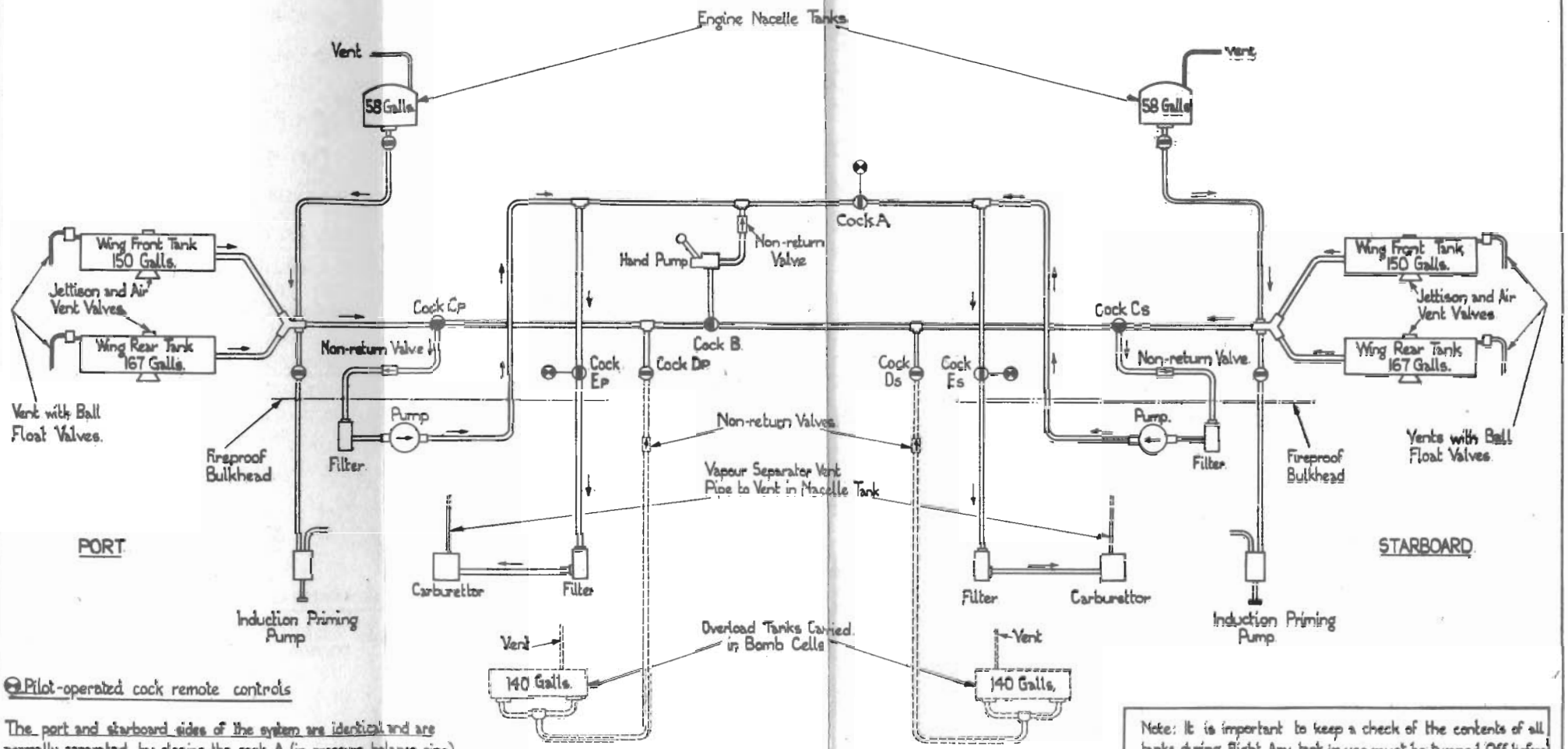
REMAINING COCK SETTINGS AS IN DIAGRAM ⑤

FIG. 1

NOTE :- THE NACELLE TANK COCKS (CONTROLLED BY CABLES SHOWN IN DIAGRAM) ARE NORMALLY CLOSED TO ISOLATE THESE TANKS AND HOLD THEIR CONTENTS IN RESERVE

DIAGRAM OF FUEL COCK SETTINGS

FIG. 1



⊖ Pilot-operated cock remote controls

The port and starboard sides of the system are identical and are normally separated by closing the cock A (in pressure balance pipe) and the cock B (in suction balance pipe). The remotely controlled cocks (see fig.1) on the nacelle tanks are used to hold the fuel in these tanks in reserve. The cocks are shown set for normal operation and the direction of flow is indicated by arrows.

Auxiliary system shown dotted

Note: It is important to keep a check of the contents of all tanks during flight. Any tank in use must be turned Off before it is completely empty to prevent air from being sucked into the fuel system. Before doing so, a further tanks supply must be brought into use.

FIG. 2

FUEL SYSTEM DIAGRAM

FIG. 2

SECTION 2.

HANDLING AND FLYING NOTES FOR PILOT

ENGINE DATA.

1. (i) Fuel and oil:-

Fuel, R.D.E/F/100 (100 octane), Stores Ref. No.34A/75.

Oil, D.T.D. 109, Stores Ref. No. 34A/32. Key letter X.

(ii) The cockpit data plate is as follows:-

ENGINE TWIN WASP S3C4-G.

MAX. OPERATIONAL LIMITATIONS.

		R.P.M.	BOOST LB/SQ.IN.	TEMP. °C. CYLR.	TEMP. °C. OIL INLET.
TAKE - OFF 3 MINS. LIMIT.		2,700	+ 9	260	85
CLIMBING ½ HR. LIMIT	M	2,550	+ 5	260	85
	H	2,700	+ 5	260	85
CRUISING RICH MIXTURE	M	2,325	+ ½	232	85
	H	2,325	+ ½	232	85
CRUISING WEAK MIXTURE	M	2,200	- 1	232	75
	H	2,200	- 1	232	75
EMERGENCY 5 MINS. LIMIT	M	2,700	+ 5½	260	100
	H	2,700	+ 5½	260	100

OIL PRESSURE LB/SQ.IN.

NORMAL 80/100

CRUISING WEAK MINM. 65

OIL TEMPERATURE FOR TAKE-OFF

°C. MINIMUM 40

(iii) The following limitation must also be observed:

DIVING	Maximum boost	+ 7½ lb/sq.in.
	Maximum r.p.m.	3,060

2,700 r.p.m. may be exceeded only for 20 seconds with throttle open, and in M ratio only.

(iv) When necessary in operations, the following boosts may be used in M ratio:-

CLIMBING	+ 5½ lb/sq.in for ½ hour.
CRUISING RICH	+ 1¼ lb/sq.in.
ALL OUT	+ 7½ lb/sq.in. for 5 minutes.

FLYING LIMITATIONS.

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

Diving	320
Undercarriage down	120
Flaps down	120
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 flap selector lever is at NEUTRAL.
the bomb doors are closed.

(ii) Switch on the undercarriage and flap indicators.

(iii) Test undercarriage warning horn.

STARTING THE ENGINES AND WARMING UP.

4. The starboard engine must be started first as the hand pump can deliver fuel to the starboard engine only when the balance cock is ON. Once the starboard engine is running, the balance cock must be turned OFF, or the fuel pressure for the port engine will be maintained at 15 lb/sq.in. by the starboard engine driven pump.

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

(ii) Set the engine controls as follows:-

(a) Throttles	½ inch open.
(b) Mixture	CUT OFF.
(c) Superchargers	MEDIUM.
(d) Airscrew speed controls	LOW R.P.M. (fully back)
(e) Air intake heat control	COLD.
(f) Cowling gills	open.
(g) Oil cooler shutters	closed.

Note.- When electric airscrews are fitted, set:
Airscrew speed controls HIGH R.P.M. (fully forward).
Airscrew master switches ON.
Airscrew selector switches AUTO.

(iii) Have each engine turned six revolutions by hand.

(iv) Instruct crew to work hand pump in fuselage until fuel pressure is 3 lb/sq.in.

(v) Instruct ground crew to prime the induction system, giving 2 or 3 strokes if the engines are hot or 12 to 15 if they are cold. Have the priming pump panels closed.

(vi) Switch ON ignition of starboard engine.

(vii) Press starter motor button for about 20 seconds.

(viii) After releasing starter motor button, press starter clutch and booster coil buttons.

(ix) When engine fires, bring mixture control to AUTO RICH. Keep the hand on this control, and if the engine does not fire regularly or shows signs of being over rich, return to CUT OFF until it is running smoothly. The fuel pressure should rise to 15 lb/sq.in; if it does not it must be raised by the hand pump.

(x) If the engine fails to start, switch OFF and have the airscrew turned by hand half a revolution forwards to ensure that the starter clutch is disengaged.

(xi) If the engine fails to run after the mixture control has been brought back to AUTO RICH, return mixture control to CUT OFF, switch OFF and have the engine turned several revolutions by hand with the throttle wide open.

(xii) Turn OFF balance cock and start the port engine in the same way.

(xiii) When the engines have been running for about a minute, set airscrew speed controls to HIGH R.P.M.

(xiv) Warm up at a fast tick-over until the oil inlet temperature is 70°C, (although the minimum oil inlet temperature for this engine remains at 40°C it is essential for this aeroplane that it should be 70°C.) and the oil pressure is steady at 80-100 lb/sq.in.

Running the engine below 1000 r.p.m. for more than 20 seconds will result in flooding the crank case with oil.

TESTING ENGINES AND INSTALLATIONS.

5. While warming up:-

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

(ii) Check vacuum on each engine pump.

After warming up:-

(iii) Open up to zero boost and test operations of constant speed units. Bring the airscrew speed control slowly back; the r.p.m. should fall. Set the control fully forward and the original r.p.m. should be restored.

(iv) Test the operation of the two speed supercharger by changing to FULL. The boost should rise by ½ lb/sq.in, and the r.p.m. may drop slightly. Change back to MEDIUM and check that the original boost and r.p.m. are restored.

(v) Test each magneto in turn at zero boost. The drop should not exceed 100 r.p.m. and there should be no sign of rough running.

(vi) Open the throttle to give + 9 lb/sq.in. boost and check for smooth running, and that oil pressure is 80-100 lb/sq.in.

TAXYING.

6. Check the brake pressure (100 lb/sq.in.) before taxying.

FINAL PREPARATIONS FOR TAKE-OFF.

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

T - Trimming tabs - Normal load; all NEUTRAL.
Overload; elevator slightly tail heavy, others NEUTRAL.

M - Mixture - AUTO RICH.

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

Fuel - Check contents and cock settings; balance cock OFF.

Flaps - 15° DOWN.

Gills - Closed.

Superchargers - MEDIUM.

Note.- When electric airscrews are fitted, check:

P - Pitch - HIGH R.P.M. (fully forward). Airscrew master switches ON. Airscrew selector switches AUTO.

TAKE - OFF.

8. (i) With normal load get the tail well up, and counteract any tendency to swing left by use of the rudder.

(ii) With overload the tendency to swing left is more pronounced, and the aeroplane should not be pulled off the ground at speeds less than 85 m.p.h. A.S.I.R.

(iii) Open the throttle lever to the position where resistance is offered by the spring-loaded catch fitted on the throttle lever quadrant. This position will give the correct boost for take-off.

ACTIONS AFTER TAKE-OFF.

9. (i) Increase speed to 125 m.p.h. A.S.I.R. 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.

ENGINE FAILURE DURING TAKE-OFF.

10. (i) This aeroplane cannot be kept straight with the live engine at full power at speeds below 140 m.p.h. A.S.I.R.

(ii) Safety speed at climbing boost and r.p.m. is 129 M.P.H. A.S.I.R.

(iii) At normal load or overload it is impossible to maintain height. Close throttles, switch off, set mixture control to IDLE CUT OFF and land straight ahead.

Note.- When fully feathering electric airscrews are fitted, the single engine performance will be improved. This paragraph will be amended in due course.

FAILURE OF ONE ENGINE IN FLIGHT.

11.(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) At light load it may be possible to maintain height on one engine.

(iii) Pull the airscrew speed control of the failed engine fully back.

When fully feathering electric airscrews are fitted.-

(iv) Feather the airscrew of the dead engine.

CLIMBING.

12.(i) The best climbing speed at normal load is 130 m.p.h. A.S.I.R. up to 14,000 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 11,000 feet.

(iii) To climb to the aeroplane's ceiling the cylinder temperatures should be reduced in the early part of the climb and the gills closed for the last 5,000 feet.

ECONOMICAL CRUISING.

13.(i) The greatest range will be obtained at about 140 m.p.h. A.S.I.R.

(ii) The greatest endurance will be obtained at about 110 m.p.h. A.S.I.R.

(iii) Reduce r.p.m. as far as possible without rough running; it may be possible to run as low as 1,600 r.p.m. Use AUTO WEAK mixture; and MEDIUM supercharger ratio if the necessary boost can be obtained.

GENERAL FLYING.

14.(i) The shutter controls, which are provided for the oil coolers in addition to the automatic bye-pass, must be kept closed as far as possible consistent with maintaining the oil temperature between 70°C and 80°C.

(ii) 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.

(ii) The trimming tabs are powerful, but sluggish in operation. They must not be used for manoeuvring, except in case of necessity in recovery from a dive when the elevator tab may be used slowly and carefully.

(iii) For all-out level flight use FULL supercharger ratio above 11,000 feet.

STALLING.

15 (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. Recovery is normal.

(ii) Stalling Speeds:- At the normal weight of 28,000 lb. the stalling speeds are approximately:-

Flaps and undercarriage up	75 m.p.h. A.S.I.R.
Flaps and undercarriage down	65 m.p.h. A.S.I.R.

SPINNING AND AEROBATICS.

16. Spinning and aerobatics are not permitted.

DIVING.

17. (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 anyway with the control of the aeroplane and can be ignored.

(iii) When diving with throttles open, it is necessary to watch the boost gauges as there is no automatic boost control and the boost rises with loss of height.

(iv) Ease the aeroplane very slowly out of the dive, and if the throttles have been closed open them very slowly to avoid momentary overspeeding.

APPROACH AND LANDING.

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

(ii) Set elevator tab control to the central position See para. 14 (i).

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

U	-	Undercarriage	- DOWN.
M	-	Mixture	- AUTO RICH.
P	-	Pitch	- HIGH R.P.M. (fully forward).
Supercharger			- MEDIUM.
Flaps			- Fully DOWN.

Note.- When electric airscrews are fitted, check:

P	-	Pitch	- HIGH R.P.M. (fully forward) Airscrew master switches ON. Airscrew selector switches AUTO.

(iv) Correct speeds for approach:-

(a) Engine assisted.	85 m.p.h. A.S.I.R.
(b) Glide	95 m.p.h. A.S.I.R.
(c) The creeper	80 m.p.h. A.S.I.R.

MISLANDING.

19. (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 safe height of 400 - 500 feet.

PROCEDURE AFTER LANDING.

20. (i) Raise the flaps, open cowling gills and check brake pressure (100 lb/sq.in.) before taxying.

(ii) Before stopping engines, set airscrew speed controls to LOW R.P.M. and open up the engine sufficiently to change pitch to coarse. (When electric airscrews are fitted, leave airscrew speed controls at HIGH R.P.M.) Do not stop engines until cylinder temperature is below 205°C.

(iii) To stop engines, set mixture controls to CUT OFF.

(iv) Switch off ignition when engine has stopped.

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 an independent emergency hydraulic system, in the following manner:-

(i) Operate the catch release to free the lever near the handpump. RAISE the lever to the EMERGENCY (uppermost) position and leave it there.

(ii) Select undercarriage DOWN.

(iii) LOWER the handpump lever 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:-

At 120	m.p.h.	A.S.I.R.	add	11	m.p.h.
" 140	"	"	"	4	"
" 160	"	"	"	1	"
" 180	"	"	subtract	2	"
" 200	"	"	"	4	"
" 220	"	"	"	6	"

These figures apply to a total weight of 30,000 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.

F.S/7.

(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 CONSUMPTIONS.

24. Consumptions in gallons per hour per engine are :

At maximum boost and r.p.m. for		Height feet	Gallons per hour per engine
Climbing	M	7,600	109
½ hr. limit	H	14,500	114
Cruising	M	11,800	67
Rich	H	16,700	66
Cruising	M	11,800	49
Weak	H	16,500	48
Emergency	M	7,500	120
5 mins limit	H	13,100	118

OIL CAPACITY.

25. Each engine has one oil tank holding 16 gallons, and there is one auxiliary oil tank in the fuselage holding 15 gallons. The total effective oil capacity is therefore 47 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
return is some credit.
~JimSan