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AIR PUBLICATION 1564 A

Pilots Notes

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PILOT'S NOTES

HURRICANE I AEROPLANE

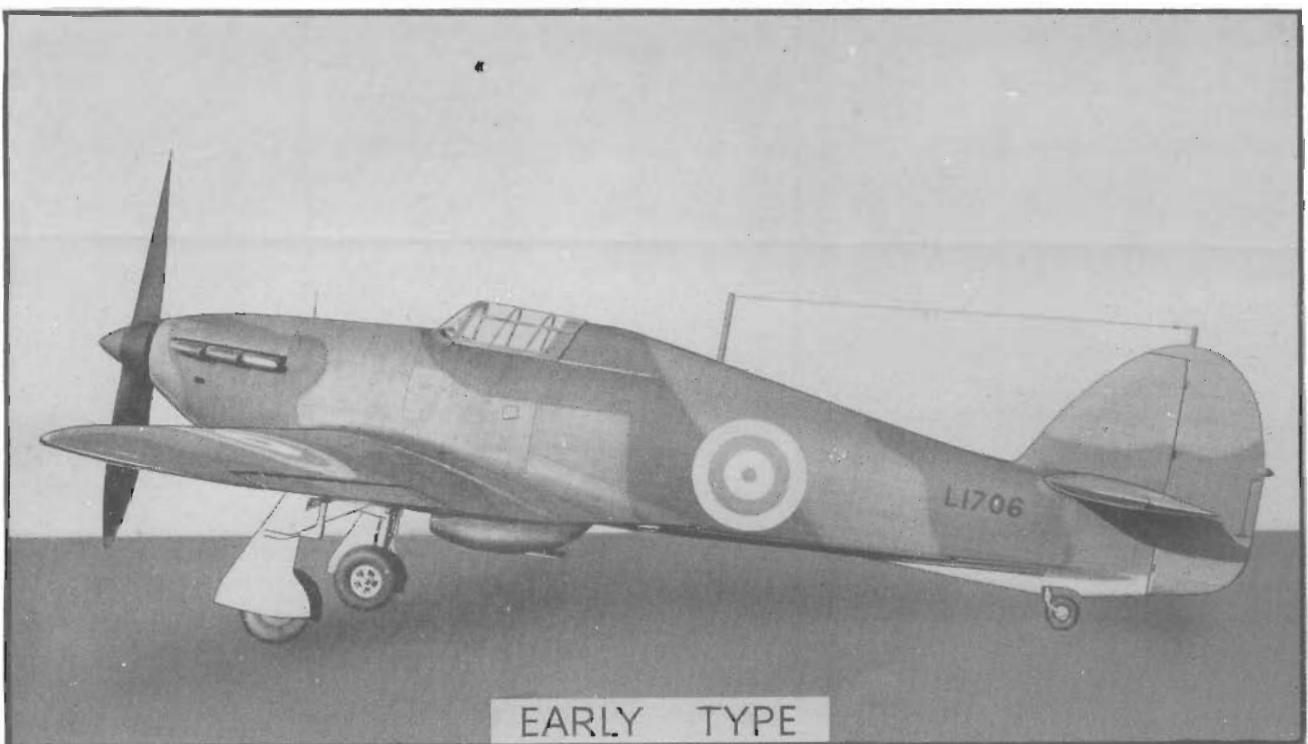
MERLIN II or III ENGINE

Promulgated for the information and guidance of all concerned

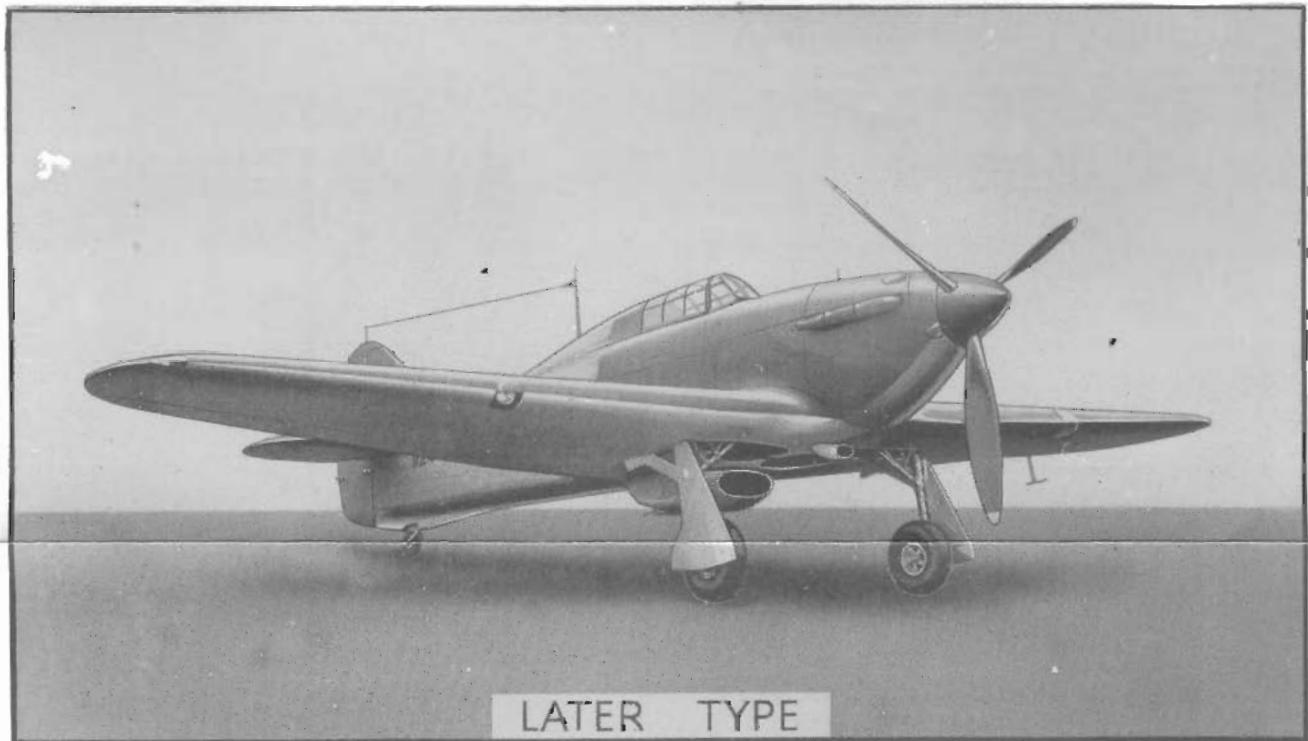
By Command of the Air Council,

A.W. STREET.

AIR MINISTRY.



EARLY TYPE



LATER TYPE

THE HURRICANE I AEROPLANE

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the beginning of each Section.)

Introduction

Section 1. Controls and equipment in cockpit

" 2. Handling notes for pilot

1. The Hurricane I is a single-seater low-wing cantilever land monoplane with retractable undercarriage and enclosed cockpit. It is powered by a Merlin II or III engine which drives a right-hand tractor airscrew. The airscrew is one of the following types: wooden two-bladed fixed-pitch; de Havilland variable-pitch with a two-pitch control; Rotol variable-pitch with a constant-speed control. The main dimensions of the aeroplane are: span, 40 ft.; length, 35 ft. 6 in., approximately.

2. The cockpit is heated indirectly from the radiator circuit and is totally enclosed under a transparent hood which slides towards the rear for entry and exit purposes; the seat is adjustable vertically at any time. In some aeroplanes, the pilot is protected by armour plating against attack from front and rear. An emergency exit panel is provided in the starboard side of the decking and a knock-out panel is incorporated in the sliding hood at its port front bottom corner to provide a clear view when landing should the windscreen be covered with ice. Flying controls are of the conventional stick type with a rudder bar which is adjustable horizontally for leg reach; the cockpit is fitted with a normal set of instruments as well as those necessary for instrument flying. A combined oil and coolant radiator is hung beneath the fuselage behind the undercarriage well; it is contained in a low-velocity cowling with a flap shutter hand-operated from the cockpit. Above the longons, a reserve fuel tank is carried between the fireproof bulkhead and the instrument panel.

3. The cantilever main plane is built in three sections, port and starboard outer planes and centre section, the latter being integral with the fuselage and faired into it; the underside of the centre section is flush with the bottom of the fuselage. The centre section is of the same construction on all aeroplanes but the outer planes may be of either the fabric-covered or the stressed-skin type; the two types are interchangeable.

4. The main fuel tanks are housed within the centre section between the spars, one tank being fitted on each side of the fuselage; the oil tank forms the port leading edge of the centre section. The mass-balanced ailerons have a differential action and hydraulically-operated split flaps are fitted to the trailing edges of the outer planes and centre section; the flaps extend between the inner ends of the ailerons except at the position of the radiator fairing. Eight Browning guns, together with the necessary ammunition, are housed four aside at the inner ends of the outer planes; the guns

fire through the leading edge and are pneumatically controlled from a single button on the control column spade grip. Landing lamps are also mounted in the leading edges of the outer planes, one on each side just outboard of the guns, their dip being controllable from the cockpit.

5. A non-adjustable cantilever tail plane is attached to the top of the rear end of the fuselage; longitudinal trimming is obtained by elevator tabs adjusted from the cockpit through an irreversible gear mounted within each horn-balanced elevator. The rudder has a small horn balance, which houses the mass-balance weight, and it is fitted with a balance flap operated automatically from the rudder hinge so as to produce a servo action; the fin is slightly offset to counteract engine and airscrew torque. The tail unit surfaces are faired into the fuselage and into one another, external bracing not being employed.

6. The undercarriage consists of two oleo-pneumatic shock-absorber struts which retract inwards and backwards into a well between the centre section spars, the struts being hydraulically-operated and fitted with mechanical locking, and electrical indicating devices; an audible warning signal operates when the undercarriage is not locked down and the throttle is less than one-third open. Each shock-absorber strut carries a stub axle with a medium-pressure pneumatic wheel fitted with a pneumatically-operated brake controlled by a lever on the control column; differential action is provided for the brakes and operates in conjunction with the rudder bar. When on the ground, the tail is supported by a non-retractable spring-loaded shock-absorber strut which is fully-castoring and self-centring; the leg carries a wheel fitted with a self-earthing tyre.

7. A remotely-controlled radio-telephony transmitter-receiver is situated behind the pilot's seat and, behind this instrument, two parachute flares are carried in their launching tubes. Oxygen equipment is also installed and a camera gun (pneumatically-operated from the gun-firing button on the control column) may be mounted on, or in, the leading edge of the starboard outer plane. The electrical installation provides for navigation, identification, landing, formation-keeping, and cockpit lamps, for which power is derived from an engine-driven generator.

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Volume I

SECTION 1
CONTROLS AND EQUIPMENT

SECTION 1

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SECTION I

CONTROLS AND EQUIPMENT

INTRODUCTION

1. This section gives the location of the controls and equipment and, where necessary, explains their function and operation. The controls and equipment in the cockpit are illustrated and annotated in figs. 1 to 4, each annotated item being given an individual number; where such items are referred to in the text, the item number is quoted in brackets.

FUEL, OIL, AND COOLANT

2. The fuel, oil, and coolant to be used with the Merlin II or III engine are:-

Fuel	Specification D.T.D. 230 (Stores Ref. 34A/59)
Oil	Specification D.T.D. 109 (Stores Ref. 34A/32 and 33)
Coolant ..	Ethylene glycol (type B, treated) Specification D.T.D. 344 (Stores Ref. 33C/559)

Refuelling

3. Each tank must be filled separately since fuel cannot pass from the reserve tank to the main tanks owing to the presence of non-return valves in the pipes connecting the main tanks to the fuel cock. The filler necks for the main tanks are accessible through doors in the port and starboard portions of the centre section; the doors are situated just aft of the front spar. Access to the filler neck of the reserve tank is obtained through the rearmost door in the tank cowling.

AEROPLANE CONTROLS

Control column

4. The upper portion of the control column (46), carrying the spade grip, pivots sideways about the lower portion to give aileron control; elevator control is obtained by fore-and-aft pivotal movement of the control column as a whole about its lower end.

5. The rudder bar (61) is carried by a vertical spindle on which it is adjustable for leg reach by means of a starwheel (62).

Brakes control

6. A control lever (45) for the pneumatic brakes is pivoted on the spade grip and is accessible to the pilot's right hand, the brakes being operated differentially by the rudder bar for steering on the ground. A triple pressure-gauge (47), showing the air pressure in the reservoir and in each brake, is mounted forward of the foot of the control column. The brakes can be locked "on" for parking by operating a retaining catch near the lever pivot; in addition, when parking the aeroplane in the open, other than for short periods in calm weather, the rudder bar should be locked in the neutral position (see para. 47) or the undercarriage wheels chocked (Ref. A.M.O.A.L4/38).

Elevator trimming tabs control

7. A handwheel (50), controlling the tabs, and an indicator (51), showing their position, are situated to the left of the seat; forward rotation of the handwheel corrects tail heaviness.

Undercarriage and flaps controls

8. These controls are of two types, some aeroplanes being fitted with a non-automatic hydraulic system and others with an automatic system. In the non-automatic system, it is necessary to select the desired operation of the undercarriage or flaps by means of one control and then manipulate a separate control to start the operation; in the automatic system, the function of the latter control is performed automatically. In each system, the flaps cannot be fully lowered when the aeroplane is travelling at more than 120 m.p.h.; if this speed is exceeded when the flaps are fully down, they will be blown partially up.

9. Non-automatic system.—The controls consist of a selector lever, a control lever, and a handpump lever. The selector lever (66) is situated to the right front of the seat and works in a gate. It has a central NEUTRAL position and four working positions, i.e. UP and DOWN for both undercarriage units and flaps, the flaps positions being outboard. The knob of the lever must be pulled outwards to release the lever for movement from an operative position, but the lever can be moved from the NEUTRAL position without first pulling out the knob. The control lever (67) is outboard of the selector lever and the handpump lever (71) is situated to the right of the seat. The method of operation is to move the selector lever to the position required and then depress the control lever until the selected operation is completed. If the engine-driven pump is not working, the handpump should be operated until the selected operation is completed but the control lever must not be depressed. The flaps may be placed in any position between "up" and fully "down", subject to the limitation described in the preceding paragraph, by releasing the control lever or the handpump lever immediately the desired position is reached. To obviate inadvertent selection on the ground of the undercarriage UP position, a safety catch (65) is provided comprising a swinging plate which normally covers the slot of the gate and prevents entry of the selector lever.

10. Automatic system.—The operation of this system is the same as that of the non-automatic system except that no control lever is provided, movement of the selector lever being sufficient to effect the desired operation. If it is desired to partially lower the flaps, the selector lever must be returned to NEUTRAL immediately the flaps reach the desired position. If, with the selector lever at NEUTRAL, the flaps attain an intermediate position owing to the speed of the aeroplane being excessive, they will automatically move to the fully down position if the aeroplane subsequently slows down to less than 120 m.p.h. Should the engine-driven pump fail, causing loss of pressure to be shown by the pressure gauge (69) (which is provided in the automatic system only), the handpump should be operated until the appropriate indicator registers the desired position of the undercarriage or flaps.

Undercarriage visual indicator

11. The "up" and "down" positions of the undercarriage units are indicated separately by red and green lamps respectively; the indicator (28) is mounted on the port side of the instrument panel and has duplicate pairs of lamps. Two switches are provided to the left of the indicator, the left-hand one (26) being the ON-OFF switch for the green lamps and the right-hand one (27), the charge-over switch for the duplicate sets of lamps. The duplicate lamps are for use should it be suspected that any of the lamps normally in use have failed. A dimmer switch (29) for the lamps is mounted in the centre of the indicator. When the undercarriage is "up", the wheels are visible through two windows in the bottom of the cockpit.

Undercarriage audible indicator

12. Should the undercarriage units not be locked "down" at any time when the trimmable lever is less than one-third open, the pilot will immediately be warned by the sounding of a buzzer (98) mounted on the port side of the cockpit.

Undercarriage EMERGENCY releases

13. In aeroplanes having the non-automatic hydraulic system, separate foot-operated buttons (57 and 54), painted red and situated outboard of each heel rest, are provided to unlock each undercarriage unit should the catches fail to open when the selector lever is moved to the undercarriage DOWN position. If the automatic hydraulic system is fitted, a single foot-operated lever is provided outboard of the port heel rest to unlock both units.

Flaps indicator
14. A mechanical indicator (68), showing the setting of the flaps, is situated to the right of the seat, directly below the hydraulic selector lever. The indicator pointer moves along a graduated scale marked UP and DOWN at its extremities.

ENGINE CONTROLS

Throttle and mixture controls

15. The throttle control lever (55) and the mixture control lever (54) are mounted on the port upper longeron and work in slots in the cockpit decking. The mixture lever has two positions only viz. RICH and WEAK, the adjustment of the mixture strength to meet varying conditions of altitude being effected by an automatic unit on the engine. The knob of the mixture lever projects behind the throttle lever so that when the latter is moved to the CLOSED position it pushes the former to the RICH position. In order to prevent movement due to vibration, the stiffness of the mixture and throttle control levers can be varied by friction adjusters (52 and 53) on the inboard ends of the lever spindles. The knurled wheel adjusts the mixture control lever and the serrated larger wheel, the throttle control lever.

Slow-running cut-out control
16. The slow-running cut-out on the carburettor is operated by pulling out a knob (58) mounted under the extreme left-hand corner of the instrument panel.

Fuel cock control

17. On some aeroplanes, the fuel cock control (56) has a spring safety plate (not shown in the illustrations), which prevents the fuel supply being turned off unintentionally. The control can only be turned to the OFF position whilst the safety plate is held depressed.

Fuel priming pump

18. The fuel priming pump (63) is operated by a push and pull actuation of the knob, the quantity of fuel injected being estimated by counting the number of strokes. The knob should be screwed on to the pump casing after use.

Ignition switches

19. The main ignition switches (17), controlling the two main magnetos, are on the left of the instrument panel; the starting switch (1) is on the right of the panel.

Electric starter

20. The electric starter pushbutton (18), immediately to the

left of the main ignition switches, controls the starter motor, the current being drawn from the aeroplane accumulator or from an external supply. A socket for the external supply, mounted on the starboard lower strut of the engine mounting, is accessible through a door in the engine cowling. A hook is fixed to the door to receive a lanyard attached to the external supply cable to relieve the socket of the weight of the cable.

Hand starting

21. Two starting handles are stowed in the undercarriage wheel recess beneath the centre section, one on each side "wall". To remove a handle, unscrew the wing nut on the securing bracket and swing the bolt downwards; then lift the clip, disengage the starting handle and withdraw it forwards. For starting the engine, the handles are inserted through holes, one in each foremast side panel of the cowling, close to the lower end.

Airscrew control

22. In aeroplanes having a variable-pitch airscrew, the control lever (93) is mounted on the port side of the cockpit; a milled wheel (94) provides friction adjustment for the lever. If the airscrew has two-pitch control the lever must be moved fully forwards for COARSE pitch and fully backwards for FINE pitch. If the airscrew has constant-speed control, the lever must be moved forwards to increase the engine speed and backwards to decrease the speed; when the lever is fully back, the airscrew is in the "positive coarse pitch" condition but the control is interlinked with the throttle control so that this condition cannot be obtained when the throttle is fully open.

Radiator flap control

23. The flap controlling the air flow through the coolant and oil radiator is adjusted by a long hand-lever (49) at the left of the seat. The lever is released for movement by pressure on a thumb-button in the end. A mechanical indicator (48), showing the radiator flap setting, is situated on the structure tube just forward of the elevator trimming tabs handwheel.

Automatic boost EMERGENCY cut-out

24. This control is situated on the left of the instrument panel. It consists of a red-painted knob (22) and must be pulled out to operate and locked by a clockwise turn. It is intended for use should the automatic boost control fail in flight or should it be necessary in an emergency to override the automatic control in order to increase the boost.

Fuel contents gauge

25. A single gauge (41) on the starboard side of the instrument panel indicates selectively the contents of each of the three tanks - two main and one reserve. A switch unit, comprising a selector arm (39) and a pushbutton (40) is mounted above the gauge. To read the contents of a tank, move the selector arm to the required position and then depress the pushbutton. The gauge scale has upper and lower graduations, the former indicating for the reserve tank and the latter for either of the main tanks.
26. It should be noted that when the aeroplane is on the ground, the gauge readings are incorrect. A conversion table (110) showing the actual contents of the reserve and main tanks in relation to tail-down readings, is fixed to the exit panel on the starboard side of the cockpit.

Oxygen equipment

27. A single oxygen cylinder is stowed behind the seat. A standard regulator unit (22, 24 and 25) is mounted on the left-hand side of the instrument panel and a bayonet socket (76) for the low-pressure supply to the mask is fitted on the decking shelf alongside the port longeron.

Wireless unit controls

28. A radio-telephony transmitter-receiver, type T.R. 9B or D, is installed in the fuselage aft of the bulkhead behind the cockpit seat; this equipment is fully described in A.F. 1165, Vol. I. The mechanical controller is mounted on the port side of the cockpit deckling above the throttles and mixture control levers. The controls comprise a central knob and two levers, one of which projects upwards and the other, downwards. The upper lever, which operates a three-position switch on the wireless unit, must be pushed forward for "receive", pulled backward for "transmit", and moved to the vertical position to switch off the wireless unit; this lever can be locked in the "off" position by means of a latch which engages a notch in the controller casing. The lower lever operates the fine tuning control on the receiver and is used during flight to make slight adjustments only, the main tuning of the receiver being pre-set on the ground. The central knob is the volume control and must be turned clockwise to increase the volume. The microphone-telephone socket is located on the front edge of the seat in some aeroplanes and on the electrical panel on the port side of the cockpit in others. When a T.R. 9D transmitter-receiver is installed, a remote contactor and a contactor IN-OUT switch (73) are clipped just above, and on the same diagonal strut as, the elevator trimming tabs control handwheel.

Generator charge-regulator

29. In some aeroplanes, a generator charge-regulating switch and an instruction plate regarding its use are mounted on the decking above the electrical panel. In other aeroplanes, this equipment is superseded by an automatic voltage-regulator mounted on the back of the decking bulkhead behind the cockpit seat.

Navigation lamps control

30. Navigation lamps are fitted on the rudder and in the port and starboard extremities of the leading edge of the main plane; the switch (16) controlling them is the centre one of three switches on the left of the instrument panel, next to the main ignition switches.

Identification lamps controls

31. Upward and downward identification lamps are mounted in the upper and under surfaces of the fuselage respectively, at approximately the centre of its length. The identification lamps switchbox comprises a switch (100) for each lamp and a Morse key (101) and lamp for steady illumination or Morse signalling from either lamp or from both. The switch lever for each lamp has three positions: MORSE, OFF, and STANDBY, in that order from top to bottom. The spring pressure on the Morse key may be altered by turning a small thumbwheel (102) at the top left-hand corner of the switchbox, the adjustment being maintained by a latch engaging one of a number of notches in the thumbwheel. The range of movement of the key may be adjusted by turning a screw in the centre of the switchbox cover after first slackening a locknut behind the cover; to enable the locknut to be reached, the cover is hinged at its left-hand edge.

Landing lamps controls

32. A two-way switch (99) on the decking shelf at the extreme left-hand corner of the instrument panel enables either the port or the starboard landing lamp to be used as required; both lamps are off when the switch knob is upright. A dipping control lever (74) is situated on the port side of the cockpit just aft of the engine control levers; the lamps are dipped by pushing the lever forward. The lever can be held in any position by tightening a knurled wheel (75); when the knurled wheel is unscrewed, the lever is pulled aft into the UP position by a return spring in each of the lamp units.

Formation-keeping lamps control

33. Formation-keeping lamps are mounted, one in each side of the fuselage, so as to direct a beam of light along the trailing edges of the wings.

of the main plane. The ON-OFF switch (81) for the lamps is on the decking shelf on the port side of the cockpit.

Parachute flares release controls

34. Control handles (70) for releasing the port and starboard parachute flares are located outboard of, and below, the flaps indicator. The handles must be pulled upwards to release the flares.

Gun firing controls

35. The guns are fired by a pneumatic circuit controlled by a pushbutton (44) fitted in the spade grip and accessible to the thumb of the left-hand. The air supply is taken from the same reservoir cylinder as the brake supply. The available pressure being shown by the gauge referred to in para. 6. A milled sleeve, surrounding the pushbutton, can be rotated to a position in which it prevents operation of the button. The SAFE and FIRE positions are engraved on the sleeve and can also be identified by touch since the end of the sleeve has an indentation which is at the bottom when the sleeve is in the SAFE position and comes to the side when the sleeve is turned to the FIRE position.

Camera gun controls

36. Provision is made in the gun-firing pneumatic circuit for connecting either a G.22A or B camera or a pneumatically-operated electrical switch for making exposures on a G.42 or G.42B cine-camera. The connection is blanked off when no camera is fitted and the branches leading to the guns are blanked off when a camera is being used. Exposures are made by depressing the gun-firing button (44) on the spade grip, a single exposure being made with a G.22 camera each time the button is pressed; with either of the cine-cameras, a succession of exposures is made during the whole period the button is depressed.

37. When a G.22 camera is fitted, the film is advanced, the shutter re-set, and an exposure counter operated, by means of a loading handle mounted on the starboard upper longeron; the handle must be pulled out to its full extent and pushed in again. The exposure counter is mounted on the loading handle casing.

38. In conjunction with the G.42 or G.42B cine-camera, a footage indicator and an aperture switch are mounted on the port side of the cockpit; the switch enables either of two camera apertures to be selected, the smaller aperture being used in sunny weather. A storage clip (91) is provided to receive the cable when an indicator and switch are not fitted. A main ON-OFF switch (14) for the camera gun electrical circuits is mounted on the instrument panel; it is the right-hand switch of the group of three situated immediately to the left of the instrument-flying panel.

Seat control

39. The seat is adjustable for height by movement of a long lever (45) on the right-hand side of the seat. The seat locking device is released by pressing a thumb-button in the end of the lever.

Safety harness locking control

40. A control lever (113) is provided on the starboard longeron for releasing and locking the safety harness shoulder straps; the lever must be moved up to release the straps. To re-lock the straps, the pilot should lean fully back before operating the lever.

Cockpit hood locking control

41. The cockpit hood slides fore and aft and can be locked in the fully open position by means of a control lever (77) on the port longeron just aft of the engine controls. The hood is unlocked for closing when the control lever is down, but it can be opened even if the lever is in the "locked" position.

Break-out panel

42. To give the pilot a clear view when landing with the windscreen covered with ice, a break-out panel is incorporated in the sliding hood at its port front bottom corner. The panel is jettisoned by pushing forward a sliding plate on the top edge of the panel, by means of a handle at its rear end, and then punching out the panel into the air stream by means of the elbow.

EMERGENCY EXIT

43. A large detachable panel on the starboard side, dowelled at the bottom to the decking shelf, is held at the top by horizontal sprung-loaded plungers controlled by a lever (108) on the inside of the panel; the rear top corner is also held by a bolt operated by the cockpit hood. To release the panel, the hood must be moved to its fully open position to withdraw the bolt and the lever must then be moved backwards and upwards to withdraw the plungers.

MISCELLANEOUS EQUIPMENT

First-aid outfit

44. This is attached by means of elastic cords to the inside of

a detachable fairing panel on the port side, aft of the cockpit. In case of emergency the panel must be kicked in, breaking the stringers and tearing the fabric. The position of the outfit is clearly indicated on the fuselage covering.

Navigation equipment

45. A metal case (107) for maps, books, etc. is fixed to the forward end of the exit panel on the starboard side of the cockpit and a canvas case (106) for a course and height indicator is fixed to the face of the map case. A canvas case (109) for a height and airspeed computer is mounted on the exit panel, aft of the map case.

Fuel and oil systems diagram

46. A diagram (111) of the fuel and oil systems is fixed to the exit panel below the fuel contents gauge conversion table.

Flying controls locking gear

47. This gear is kept in a canvas bag which, in aeroplanes fitted with rear armour plating, is clipped to a fuselage strut in the starboard side of the wireless bay; in aeroplanes not fitted with rear armour plating the gear is stowed in a locker behind the pilot's head. The locking gear comprises a hinged bracket for attachment to the control column, a pair of tubes for locking the rudder bar to the bracket, and a telescopic interference tube connected to the bracket and adapted to be passed through a slot in the back of the seat. To lock the controls, the bracket should be clamped round the top of the lower portion of the column with its projecting lugs embracing the aileron actuating tie-rods and in contact with the tie-rod fork-end nuts; movement of the hinged upper portion of the column, and hence the ailerons, is thereby prevented. The rudder bar locking tubes, which are pinned to the bracket, have quick-attachment ends for connection to spigot bolts clipped to the rudder bar. The interference tube prevents occupation of the seat whilst the controls are locked.

Picketing rings

48. A pair of picketing rings, stowed in a pocket of the flying controls locking gear bags, are provided for attachment to screwed sockets in the undersurface of the wing spars just inboard of the wing tips.

Weatherproof covers

49. A weatherproof cover for the cockpit hood is stowed in the starboard side of the wireless bay in aeroplanes fitted with rear

Desert equipment

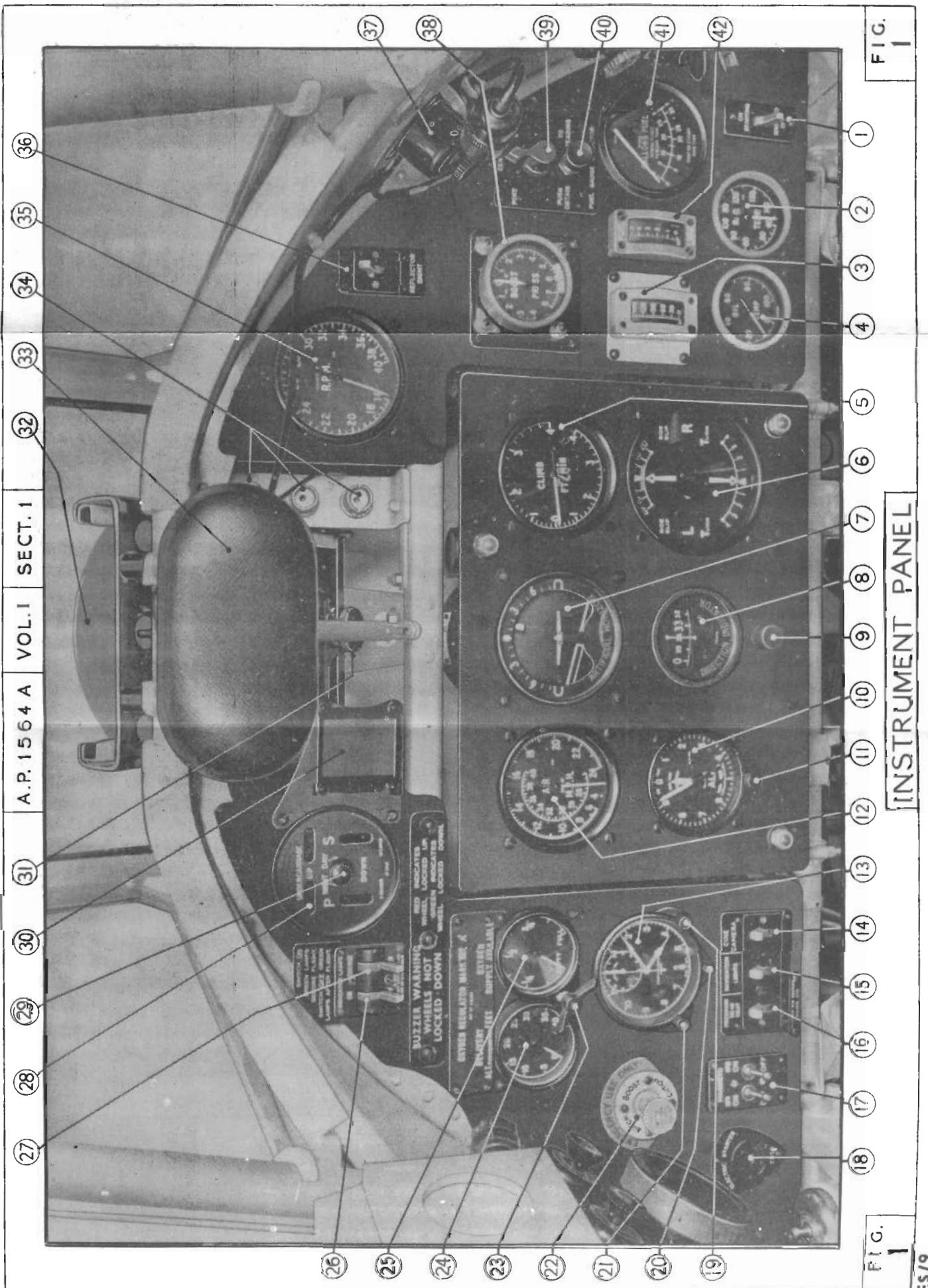
50. Certain aeroplanes are provided with desert equipment which is stowed in the fuselage, aft of the wireless unit. A tray, mounted between port and starboard side struts, contains the following items: flying and emergency rations; drinking water tank and water bottle; screwdriver, adjustable spanner, and pair of pliers; five signalling strips; and a mirror. A signal pistol is stowed on the fuselage strut at the starboard rear corner of the tray and a container for six cartridges is mounted above the pistol.

Exhaust glare shields

51. To prevent the pilot from being dazzled by glare from the exhausts when flying at night, shields can be fitted to the port and starboard sides of the tank cowl.

Key to fig. 1

- 1 Starting magneto switch
- 2 Radiator temperature gauge
- 3 Oil pressure gauge
- 4 Oil temperature gauge
- 5 Rate-of-climb indicator
- 6 Turning indicator
- 7 Artificial horizon
- 8 Direction indicator
- 9 Adjusting knob for (8)
- 10 Altimeter
- 11 Zero-adjusting knob for (10)
- 12 Air-speed indicator
- 13 Clock
- 14 Cine-camera switch
- 15 Navigation lamps switch
- 16 Pressure-head heater switch
- 17 Main magnetos switches
- 18 Electric starter pushbutton
- 19 Chronograph knob for (13)
- 20 Arrester knob for (13)
- 21 Winding and setting knob for (13)
- 22 Automatic boost cut-out control
- 23 Oxygen regulator control valve
- 24 Oxygen delivery indicator
- 25 Oxygen supply indicator
- 26 "ON-OFF" switch for (28)
- 27 Change-over switch for (28)
- 28 Undercarriage position visual indicator
- 29 Dimmer switch for (28)
- 30 Compass correction card holder
- 31 Control knob for (32)
- 32 Reflector sight dimming screen
- 33 Crash pad
- 34 Spare lamps stowage for reflector sight
- 35 Engine-speed indicator
- 36 "ON-OFF" switch for reflector sight
- 37 Dimmer switch for reflector sight
- 38 Boost pressure gauge
- 39 Tank selector switch for (41)
- 40 Pushbutton for (41)
- 41 Fuel contents gauge
- 42 Fuel pressure gauge



INSTRUMENT PANEL

FIG. 1

1

FIG.

1

27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

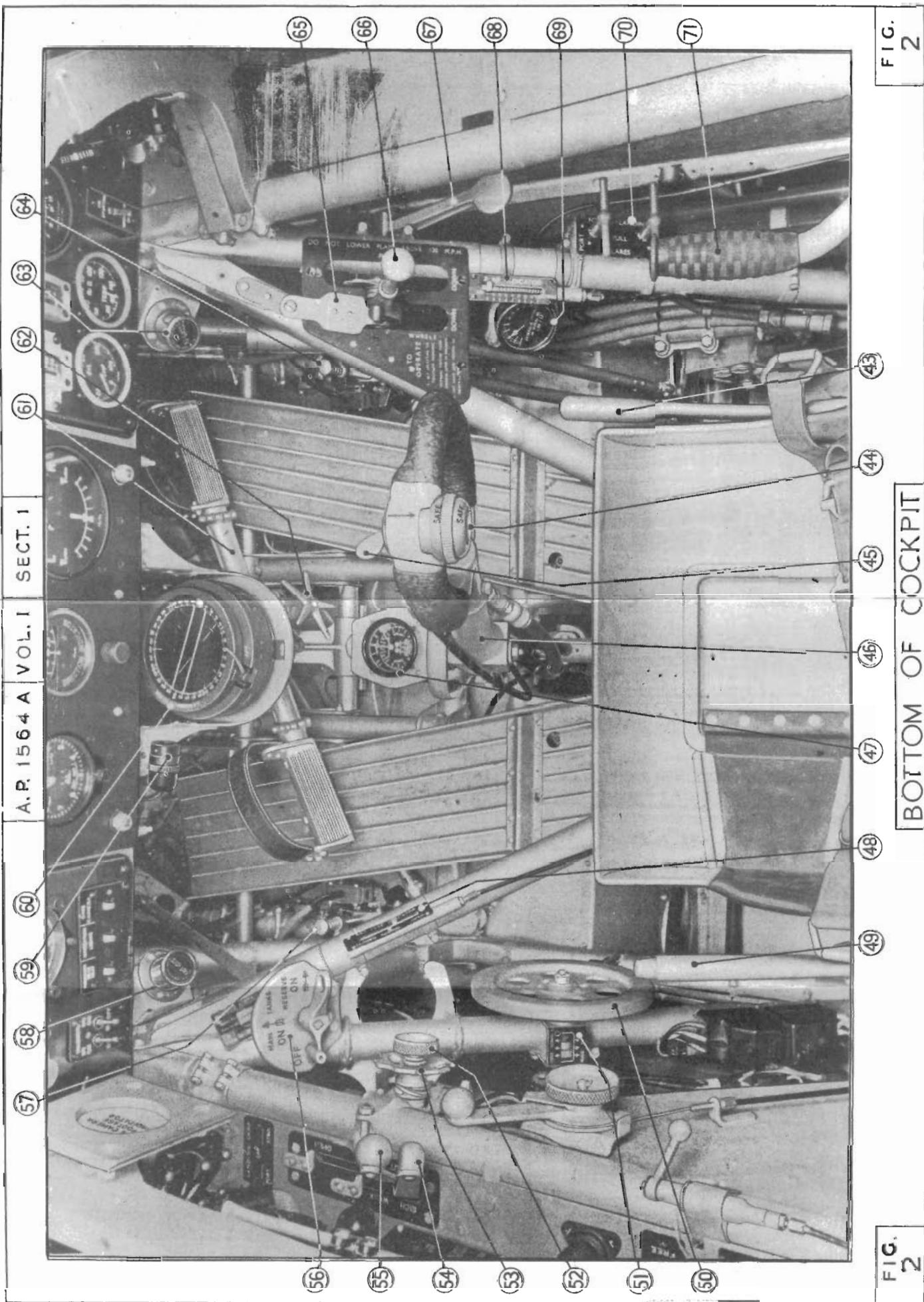
FIG.

1

1

9

BUZZER WARNING
WHEELS NOT LOCKED DOWN
INDICATES UP WHEEL LOCATED UP
INDICATES DOWN WHEEL LOCATED DOWN



Key to fig.2

- 43 Seat height-adjusting lever
- 44 Gun firing button
- 45 Brakes control lever
- 46 Control column
- 47 Triple air-pressure gauge
- 48 Radiator flap position indicator
- 49 Radiator flap control lever
- 50 Elevator trimming tabs control handwheel
- 51 Elevator trimming tabs position indicator
- 52 Friction adjuster for (54)
- 53 Friction adjuster for (55)
- 54 Mixture control lever
- 55 Throttle control lever
- 56 Fuel cock control
- 57 Undercarriage EMERGENCY release - port
- 58 Slow-running cut-out control
- 59 Cockpit floodlamp
- 60 Compass
- 61 Rudder bar
- 62 Rudder bar adjusting starwheel
- 63 Fuel priming pump
- 64 Undercarriage EMERGENCY release - starboard
- 65 Safety catch for (66)
- 66 Hydraulic selector lever
- 67 Hydraulic control lever
- 68 Flaps position indicator
- 69 Hydraulic pressure gauge
- 70 Parachute flares releases
- 71 Hydraulic handpump operating lever

FIG.
3

PORT SIDE OF COCKPIT

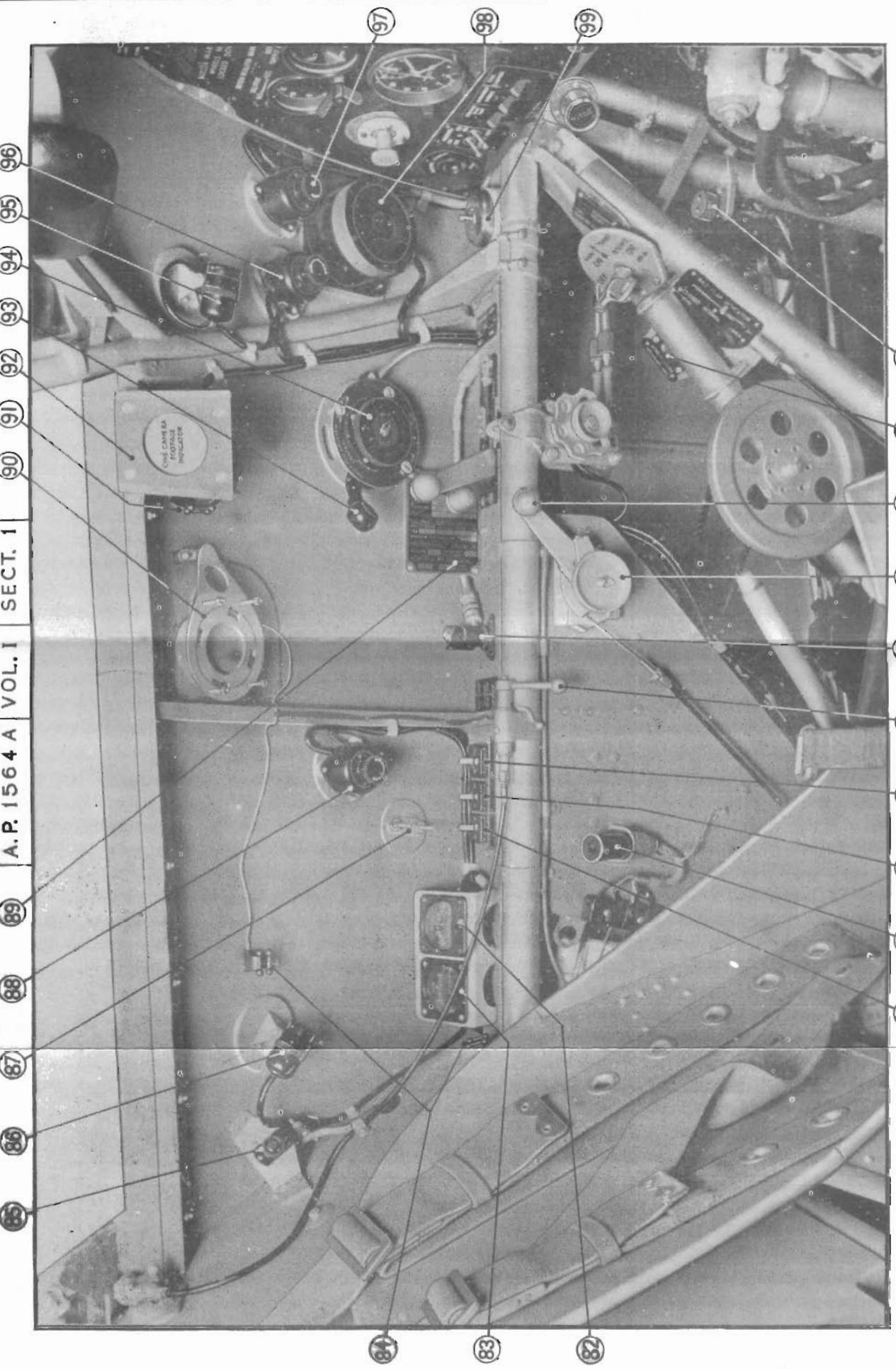


FIG.
3

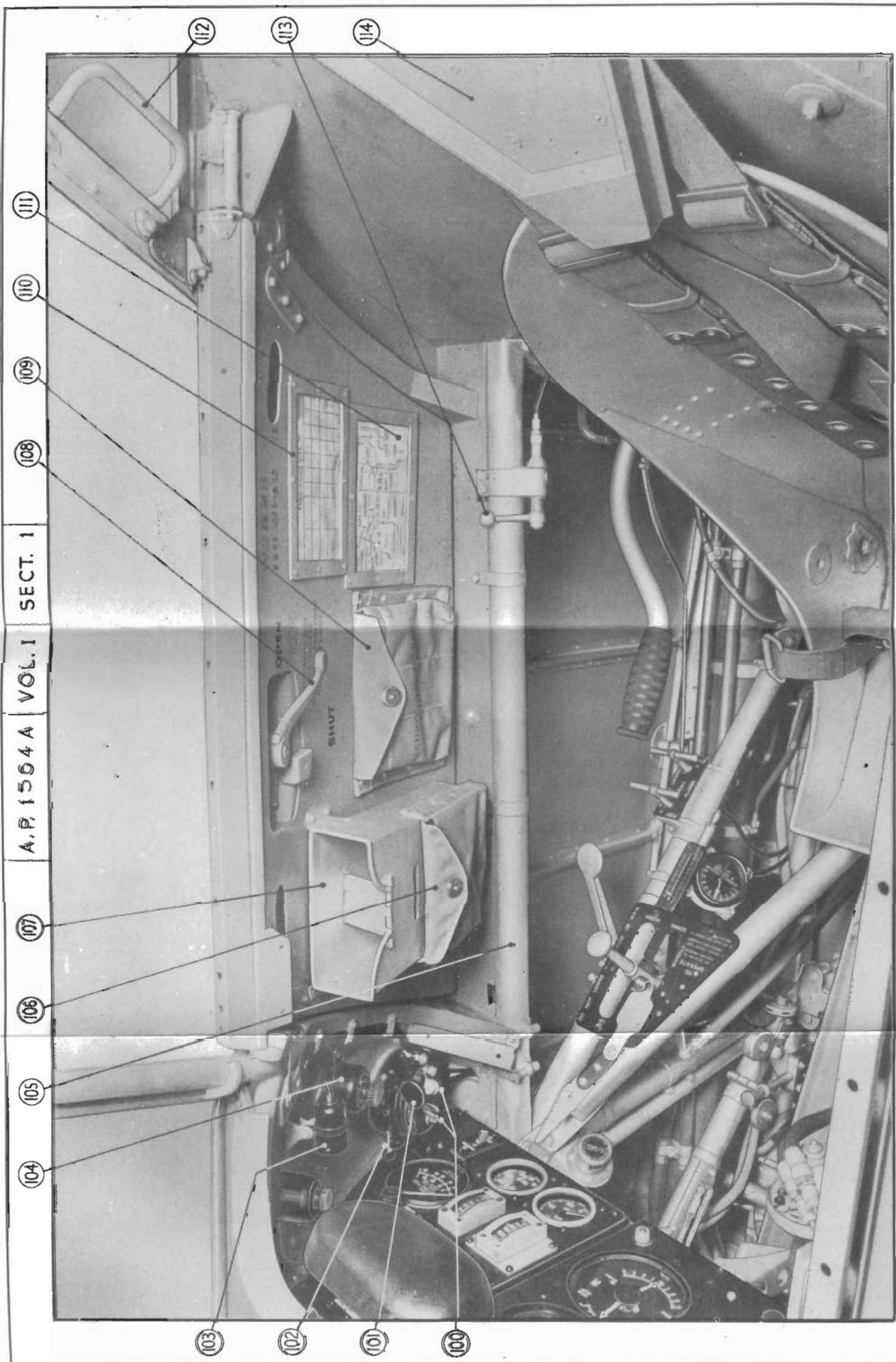
Key to fig. 3

- 72 Socket for remote contactor cable
- 73 Contactor "IN-OUT" switch and mounting bracket
- 74 Landing lamps dipping control lever
- 75 Friction adjuster for (74)
- 76 Oxygen bayonet socket
- 77 Cockpit hood locking control
- 78 Generator switch
- 79 Wireless supply switch (for T.R. 9D or T.R. 1133)
- 80 Microphone-telephone socket
- 81 Formation-keeping lamps switch
- 82 Ammeter
- 83 Voltmeter
- 84 Clips for T.R.1133 controller cable
- 85 Socket for T.R. 9B or D volume control cable
- 86 Cockpit floodlamp
- 87 Stowage for T.R. 1133 controller cable
- 88 Dimmer switch for (86)
- 89 Engine data plate
- 90 Mounting for wireless unit controller
- 91 Stowage for cine-camera footage-indicator cable
- 92 Mounting for cine-camera footage indicator
- 93 Airscrew control lever
- 94 Friction adjuster for (93)
- 95 Cockpit floodlamp
- 96 Dimmer switch for (95)
- 97 Dimmer switch for (59)
- 98 Undercarriage position audible indicator
- 99 Landing lamps switch

FIG.
4

STARBOARD SIDE OF COCKPIT

FIG.
4



Key to fig 4

- 100 Identification lamps switches
- 101 Identification lamps morse key
- 102 Spring pressure control for (101)
- 103 Cockpit floodlamp
- 104 Dimmer switch for (103)
- 105 Position of loading handle for G.22A or B camera
- 106 Course and height indicator case
- 107 Map case
- 108 EMERGENCY exit panel control lever
- 109 Height and airspeed computer case
- 110 Fuel contents gauge conversion table
- 111 Fuel and oil systems diagram
- 112 Cockpit hood handle
- 113 Safety harness locking control
- 114 Locker door - shown open (inaccessible when rear armour plating is fitted)

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Volume I

SECTION 2

HANDLING AND FLYING NOTES
FOR PILOT

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Volume I

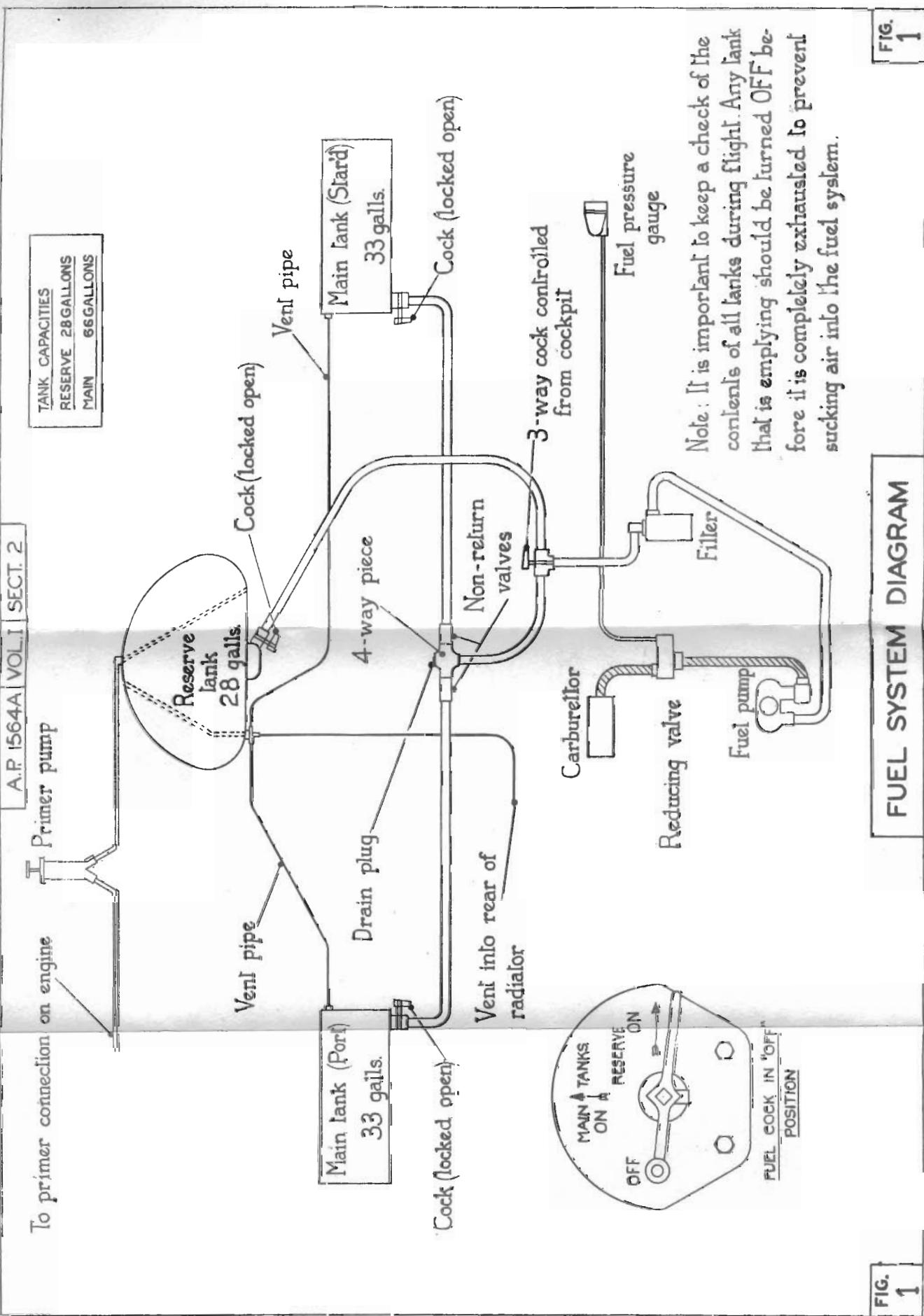
SECTION 2

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SECTION 2

HANDLING AND FLYING NOTES FOR PILOT

INTRODUCTORY NOTES

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

- (i) Hydraulic system.- This operates the undercarriage and the flaps. The hydraulic system may be operated (a) by an engine-driven pump or (b) by a hand pump which is employed in the event of the engine pump failing or to operate the system without running the engine. The pilot's controls for the system are of two types, i.e. automatic and non-automatic (see Sect.1, para.8) one of which is fitted to a particular aeroplane.
- (ii) Flaps.- The split trailing-edge flaps may be set at any position throughout their range. The effect of the flaps fully down is (a) to increase the drag and so steepen the gliding angle for the approach and (b) to increase the lift coefficient and so reduce the stalling speed. For take-off the maximum lift is obtained with the flaps 28° down (two divisions on the indicator); this gives a better take-off with a fixed pitch airscrew but normally is unnecessary, especially with a variable pitch airscrew. The time taken to LOWER the flaps is 8 - 10 secs. and to RAISE them 3 - 4 secs.

Note.-

The flaps cannot be lowered fully at speeds above 120 m.p.h. A.S.I. If they have been lowered fully and 120 m.p.h. is exceeded, they will be raised partially by the airflow and it may be necessary to operate the system to again lower them fully (see Sect.1). The position of the flaps can be checked by means of the flap indicator.

- (iii) Trimming tabs.- Adjustable trimming tabs, controlled by the pilot, are provided on the elevator and a fixed pre-set tab is fitted to the rudder. The elevator tabs function as a fine adjustment for trimming purposes and are powerful in operation. They may be used for manoeuvring and to assist recovery from

a dive, provided they are used very slowly and carefully.

(iv) Mixture control.— The control lever has two effective positions only, i.e. RICH and WEAK. Adjustment of the mixture strength to meet the varying conditions of altitude is effected by the automatic unit on the engine.

(v) Emergency control for automatic boost.— The maximum permissible boost of $+6\frac{1}{4}$ lb./sq.in. is automatically controlled but a control is provided to cut-out the automatic unit if full boost is required in an emergency. If this cut-out is used, it should be returned to normal as soon as possible and on landing it must be reported that it has been used, in order to ensure that the engine is examined and an entry made in the log book.

(vi) Airscrew pitch controls.— This aeroplane is provided with one of three airscrews, i.e. (a) fixed pitch airscrew (b) variable pitch two position controlled and (c) variable pitch constant speed controlled.

(a) The fixed pitch airscrew has, of course, no control.

(b) The two position variable pitch airscrew is controlled by the pilot to give either FINE or COARSE pitch. Fine pitch is used for take-off and when landing and coarse pitch for all other conditions of flight, except perhaps when flying slowly in very bad visibility.

(c) The variable pitch constant speed controlled airscrew is operated by a separate unit which varies the pitch of the airscrew and by so doing keeps the engine r.p.m. at a constant speed. A control is provided enabling the pilot to vary the setting of the constant speed unit and so maintain desired r.p.m. to suit the condition of flight. This control is linked to the throttle lever in such a manner as to prevent opening up to full throttle with the engine speed less than 2,600 r.p.m.

(vi) Undercarriage.— The undercarriage is hydraulically operated and retracts inwards and backwards into the fuselage. There is very little change of trim when the undercarriage is raised or lowered. In the event of the undercarriage failing to lower and lock after selecting WHEELS DOWN and operating the normal system an emergency device is provided, (see Sect. I.) The time taken to LOWER the undercarriage is 3 - 4 secs., and to RAISE it 7 - 8 secs.

FITNESS OF AEROPLANE FOR FLIGHT

2. Ensure that the total weight and disposition of the load are in accordance with the Weight Sheet Summary.

PRELIMINARIES

3. On entering the cockpit make the following preparations:

- (i) Switch on the undercarriage indicator lamps (port switch) when two green lights should show. Test the change-over switch.
- (ii) See that the safety plate of the hydraulic selector is covering the WHEELS UP position.
- (iii) Set radiator shutter fully OPEN, unless very quick warming up is necessary.
- (iv) Check throttle lever friction adjustment. The larger serrated hand adjustment should be set to hold the lever firmly to prevent it working back during take-off.
- (v) If fitted with two-pitch airscrew, set control to FINE pitch position. If constant speed controlled airscrew, set the governor control to give maximum r.p.m. (fully fine pitch).
- (vi) Check movement of flying controls.

STARTING THE ENGINE

Note.— For full particulars of the Merlin II engine see A.F.1590B, Volume I, 2nd Edition.

4. For starting purposes the engine should be supplied preferably from the reserve tank as this provides a gravity feed to the engine fuel pump. It is important to note that the run-up and take-off must be made on reserve supply if the main tanks are less than half full. Therefore a decision must be made, before running-up, as to which supply is to be used for the take-off. The supply having been chosen, the fuel distributor cock must not again be moved until after the take-off, because such movement may disturb the flow and cause a stoppage.

IMPORTANT.

To obviate any danger of sucking air into the fuel system with consequent risk of engine failure during flight, the reserve (gravity) tank must not be exhausted completely before changing over to the main tanks. Likewise to prevent temporary stoppage of the engine, it is preferable not to empty completely the main tanks before changing over to the reserve tank.

To start the engine:-

- (i) Check contents of fuel tanks and decide which supply is to be used for run-up and take-off.
- (ii) Turn the fuel distributor cock to RESERVE.
- (iii) Move the throttle lever forward about $\frac{1}{4}$ in. on the quadrant.
- (iv) With a cold engine give four to five strokes of the primer pump. It is most important to avoid over-priming when the engine is hot; in this instance a start should be tried without priming at all, but if the engine fails to start one or two strokes only of the primer pump may be given.
- (v) Ensure that ground crew are clear of the airscrew.
- (vi) Switch on main and starting magneto switches.
- (vii) Press starting button or begin hand starting. The electric starter should not be used continuously for periods of more than 30 seconds.
- (viii) If the engine fails to start immediately, one or two additional strokes of the primer pump should be given; this number should not be exceeded. If the mixture becomes too rich it should be blown out with the throttle fully open, and the switches off.
- (ix) As soon as the engine has started, switch off the starting magneto. Turn the fuel distributor cock to the MAIN TANKS position and so test the engine fuel pumps for satisfactory working. If the run-up and take-off are to be made on the reserve tank supply, turn the fuel cock to RESERVE and leave in this position until the take-off has been completed.
- (x) Warm up the engine until the inlet oil temperature is at least 15°C , and the coolant temperature is not less than 70°C , before opening up to full throttle. Care should be taken whilst warming up to find a throttle position where the engine will not be running rich and will be firing as evenly as possible. For the first minute the engine should be run at a fast tick-over and then at a speed about midway between idling and 1,600 r.p.m., until the above temperatures are obtained.

TESTING ENGINE AND INSTALLATION

5. During these tests the throttle may be opened fully only for the shortest time necessary for the tests to be made:-

During warming-up

(i) Check fuel pressures:-

Main tank	2 - $\frac{2}{3}$ lb./sq.in.
Reserve tank	$\frac{2}{3} - \frac{3}{2}$ lb./sq.in.

- (ii) Check operation of hydraulic engine pump by operating the flaps; select flaps DOWN and if not fitted with automatic system, depress the control valve lever.

- (iii) Check the hydraulic handpump by returning the flaps to the fully up position by means of the handpump. Afterwards select neutral.

During running-up

(iv) Fixed pitch airscrew: check:-

(a) Ground r.p.m. :	2,100 - 2,200 (full throttle)
Boost :	+6 lb./sq.in. (approx.)

- (b) Oil pressure : a pressure of $70 - 80$ lb./sq.in. will be obtained initially and will fall to the normal pressure of 60 lb./sq.in. as the oil temperature rises to its normal value.

- (c) Magnetos: normal drop 80 r.p.m. at full throttle.

(v) Two pitch airscrew (fine pitch): Check:-

(a) Ground r.p.m. :	2,850 (full throttle)
Boost :	+ $\frac{6}{2}$ lb./sq.in.

- (b) Oil pressure : as (iv) (b) above.

- (c) Magnetos: normal drop 80 r.p.m. at full throttle.

(vi) Constant speed controlled airscrew (Maximum r.p.m.)
Check:-

- (a) Operation of airscrew governor unit: at about 2,000 r.p.m. move the pitch control lever from maximum r.p.m. position to positive coarse pitch position. The r.p.m. should drop appreciably. After the check return the lever to the fully fine pitch position; the original r.p.m. of 2,000 should be restored.

(b) Ground r.p.m. : 2,850 (Max. for take-off at full throttle).

Boost : +6½ lb./sq.in.

(c) Oil pressure: as (iv)(b) above.

(d) Magnetos. : normal drop 80 r.p.m. at maximum r.p.m. and full throttle.

TAXIING-OUT

5. Before taxiing-out check the brake pressure; there should be at least 100 lb./sq.in. for efficient braking:-

(i) See that the brakes are off.

(ii) Ensure that the cockpit hood is locked open.

(iii) During prolonged taxiing check the brake pressure and the radiator temperature which must not exceed 120°C before take-off.

(iv) Clearing engine after prolonged slow running. - If the take-off is delayed the engine should be cleared by opening it up against the brakes. Whilst doing this the wheels or brakes may slip slightly but the tail will not lift if the elevator control is held back fully. The engine should not "tick-over" for more than two or three minutes without being cleared in this manner.

FINAL PREPARATION FOR TAKE-OFF - DRILL OF VITAL ACTIONS

7. On reaching take-off position stop across wind so that approaching aircraft can be seen. Then check the following vital actions. The cockpit hood should be locked open for take-off (A.L.O. A.250/57).

(i) Fixed pitch airscrew - Catch phrase T.M. and flaps:-

T - Trimming tabs - NEUTRAL

M - Mixture control - RICH

and

Flaps - UP, unless the take-off space is short, when flaps may be lowered 28° (2 divisions on the indicator).

(ii) Two position airscrew - Catch word T.M.F. and flaps:-

T - Trimming tabs - NEUTRAL

M - Mixture control - RICH

F - FITCH - FINE

and

Flaps - UP (flaps are not required with fine pitch, unless the shortest possible take-off run is needed).

(iii) Constant speed airscrew - Catch phrase T.M.F. and flaps:-

T - Trimming tabs NEUTRAL

M - Mixture control - RICH

F - FITCH - Control set fully forward (fine pitch)

and

Flaps - UP (flaps are not required with this airscrew unless the shortest possible take-off is needed).

TAKING-OFF

8. For the take-off proceed as follows:-

(i) Open the throttle steadily and raise the tail; the tail should be well lifted in the type with the fixed pitch airscrew fitted.

(ii) Hold the aeroplane in a constant attitude, preventing any tendency to swing by means of the rudder until the aeroplane leaves the ground. Do not pull the aeroplane off the ground by lowering the tail, except as described in the note below.

Note:-

With a fixed pitch airscrew and full load, it is advisable to glance at the A.S.I. every few moments during the take-off (without keeping the attention in the cockpit) until a speed of 80 m.p.h. is reached and then ease the aeroplane off the ground.

Immediate action after take-off

(iii) As soon as the aeroplane has FINALLY left the ground wait for a few seconds (not more than about 5 secs.)

R.S. /?

to ensure ample flying speed and that the aeroplane will not touch the ground again, then RAISE THE UNDERCARRIAGE.

(iv) Hold the aeroplane down to about level flight until a safe speed of 140 m.p.h. A.S.I. is attained then:-

(a) Fixed pitch air screw. - Continue to climb at 155 - 160 m.p.h. A.S.I.

(b) Two position air screw. - Increase the speed to 160 m.p.h. A.S.I. then change to coarse pitch and continue to climb.

(c) Constant-speed air screw. - Move the pitch control lever slowly back to LIVE 2,600 r.p.m. and climb at 170 m.p.h. A.S.I.

(v) If flaps have been used, raise them at a safe height (about 500 ft.).

Subsequent action at leisure

(vi) Check oil pressure.

(vii) Close cockpit hood.

(viii) If the take-off has been made from the gravity tank, the fuel cock should be moved over to the MAIN TANKS position as soon as a safe height has been attained.

(ix) Check radiator temperature and set shutter as required. The temperature must not exceed 120°C.

(x) Check fuel pressure.

(xi) Set throttle and mixture control as required for condition of flight.

ENGINE FAILURE DURING TAKE-OFF

9. If the engine fails during take-off, if still on the ground and there is doubt as to the possibility of keeping within the aerodrome boundary, switch OFF the ignition switch and turn OFF the fuel if possible. Raise the undercarriage. If the engine fails immediately after take-off maintain ample flying speed, select WHEELS UP and operate system to unlock the undercarriage, attempt to lower the flaps if there is ample time and height, and land straight ahead. If the undercarriage has been raised it should be left up.

Note. - The hand-jump is in direct communication as soon as the selector lever has been positioned and may be used to lower the flaps.

10. The best climbing speed at full throttle for all loadings is 157 m.p.h. A.S.I. with fixed pitch and two position airscrews, and 170 m.p.h. A.S.I. with a constant-speed airscrew, up to 10,000 ft. after which a reduction of 1 m.p.h. for each additional 1,000 ft. should be made.

(i) The engine speed must not exceed 2,600 r.p.m. and the boost $\frac{6}{4}$ lb./sq.in. during the climb. With a constant speed operated airscrew the engine speed should be maintained at 2,600 r.p.m.

(ii) Check the radiator temperature frequently. It must not exceed 120°C. or fall below 70°C. Operate shutter as required.

(iii) Check oil temperature frequently. It must not exceed 90°C. during the climb.

THE ENGINE IN CRUISING FLIGHT

11. The engine normally should be run at the lowest power output necessary for the occasion. This will economise fuel and reduce maintenance, but do not run at a rough engine period:-

(i) All-out level flight. - For this condition of flight the throttle is fully forward, with the mixture control back at HIGH. At these settings the r.p.m. must not exceed 3,000 and the boost $\frac{6}{4}$ lb./sq.in.; the r.p.m. must not be maintained for periods of more than five minutes. All-out level flight should only be used in emergency. With a constant speed controlled air screw it will be necessary in order to attain the maximum r.p.m., to move the "pitch" control slowly forward, almost fully, afterwards bringing it back slightly if the r.p.m. tend to rise above the limit.

(ii) Maximum cruising (mixture control HIGH). - The boost must not exceed $\frac{4}{4}$ lb./sq.in. and the r.p.m. 2,600.

Note. - (i) The mixture control must be in the HIGH position at any boost in excess of $\frac{4}{4}$ lb./sq.in.]

(iii) Maximum cruising (mixture control WEAK). - This condition of flight may be employed at any altitude down to sea level, but the r.p.m. must not exceed 2,600 and the boost $\frac{4}{4}$ lb./sq.in. With a constant speed airscrew the pitch control lever should be set to give about 2,400 r.p.m. and the throttle set to give $\frac{4}{4}$ lb./sq.in. boost, if operation at maximum condition is necessary.

(iv) Most economical cruising (Mixture control WEAK). - The lowest fuel consumption is obtained with the mixture control in the WEAK position and by throttling down the engine to the lowest speed at which the aeroplane will fly level with the engine running smoothly. This, however, will not give most miles per gallon on a long distance flight, which in normal conditions usually requires a slightly higher speed than that for lowest fuel consumption. With a constant speed airscrew, the r.p.m. should be maintained at approximately 1,900.

GENERAL FLYING

12. Note the following:-

- (i) Stability. - The aeroplane is stable in pitch and in roll. It has good weathercock stability and can be flown with feet off the rudder.
- (ii) Trim. - On lowering the flaps fully, the aeroplane becomes appreciably nose-heavy, but this is easily counteracted by use of the elevator trimming tabs. There is very little change of trim when the undercarriage is raised or lowered.
- (iii) In a dive the aeroplane becomes tail-heavy as the speed increases. It is important not to trim this out with the tabs, otherwise difficulty will be experienced in recovery.

STALLING

13. With the flaps up and undercarriage raised, the aeroplane stalls at a speed of 78 - 80 m.p.h. A.S.I. With flaps and undercarriage down the stalling speed is 66 m.p.h. A.S.I. A wing drops sharply at the stall, often over the vertical, either with flaps UP or DOWN and considerable height may be lost. Care must be taken to gather ample speed before easing out of the resulting dive, as described in para.14 under "Spinning". Information on stalling when attempting to side-slip, is given in para.15 under "Side-slipping".

SPINNING

14. Spinning of this aeroplane is prohibited (A.M.O. A.15/1938). If, however, an accidental spin occurs, there is no difficulty in recovering from it, provided the standard method of recovery is correctly used. At least 2,000 ft. will be lost during recovery and considerably more if it is not correctly done. The correct method is as follows:-

- (a) Pilots must be careful not to misuse or apply any rudder during the approach glide or during gliding turns.

(i) Hard opposite rudder should be applied and held hard on, after which it is important that the stick should be eased slowly forward until the spin stops. The wings will remain in a partly stalled condition until ample speed is gained, and therefore no attempt should be made to ease out of the dive too soon, or the aeroplane will flick into a spin again. Speed should be increased to 150 - 160 m.p.h. before the aeroplane is eased out. Bear in mind that it is easy to reach stalling incidence at any speed by pulling the stick back too far, and so this should not be done at any stage of recovery.

SIDE-SLIPPING

15. This aeroplane cannot be side-slipped in the ordinary way, but an attempt to side-slip (or application of rudder while gliding) will cause increased rate of descent and a steeper gliding angle. Note the following:-

- (i) It has been found that, if rudder is used during the approach glide, with undercarriage and flaps fully down, there is a considerable increase in nose-heaviness (except at speeds close to the stall), in rate of descent and angle of glide-path; near the stall the aeroplane becomes unstable in pitch and the nose tends to go up. With full rudder and enough opposite bank to keep straight, (i.e. maximum sustained side-slip) at 80 - 90 m.p.h. A.S.I. reading, the increase in rate of descent is about 17 per cent. during a left side-slip. This is quite useful if done deliberately, but the slightest misuse of rudder on the glide increases the rate of descent, and this increase persists until the rudder is returned to neutral by relieving all pressure either way. The increased nose-heaviness is well within the pilot's power of control.
- (ii) The stall. - If, with rudder applied either way partially or fully, the nose is slowly raised and speed decreased, the nose-heaviness disappears near the stall and the nose then tends to go up of its own accord (this is the same in the normal stall). At the moment of stall, the aeroplane half-rolls sharply to an inverted position, in the direction of the rudder, opposite to the bank, however gradually the stall is approached. This is probably due mainly to the effect of opposite aileron control.

(iii) Summary. -

- (a) Pilots must be careful not to misuse or apply any rudder during the approach glide or during gliding turns.

- (b) Side-slipping is useful in a forced landing or forced landing practice, but speed should be increased to at least 90 m.p.h. A.S.I., and the side-slip should not be continued below about 50 ft., at the latest. Recovery is effected by removing all pressure from the rudder, keeping straight by ailerons.
- (c) Stall.— Great care must be used, when flying or manoeuvring at low speeds, not to misuse the rudder control, as the stall is thereby rendered much more "vicious".

GLIDING

16. The best gliding speed for covering distance, with flaps and undercarriage up, is about 110 m.p.h. A.S.I.. With flaps and undercarriage down and the engine off, during an approach to land, the correct gliding speed is 85 m.p.h. A.S.I.. For gliding turns with engine idling, the airspeed should be between 100 and 120 m.p.h. A.S.I.. Care should be taken not to apply rudder while gliding, owing to the increased rate of descent it causes, as described in para.15.

DIVING

17. The maximum diving speed permitted is 380 m.p.h. A.S.I.:—
- (i) If fitted with a two position variable pitch airscrew, diving must be done in coarse pitch only, and the pitch should be in this position well before the commencement of the dive.
- (ii) If fitted with a constant speed airscrew, the r.p.m. will remain constant up to the maximum permitted diving speed.
- (iii) At less than one-third throttle opening the r.p.m. must not exceed 5,000.
- (iv) At more than one-third throttle opening the r.p.m. may exceed 5,000 for periods of not more than 2Q seconds with a momentary maximum r.p.m. of 3,000. On no account must the throttle be closed, in an attempt to reduce excessive r.p.m., during a dive.
- (v) When diving the trimming tabs should be set as for level flight. They may be used to assist recovery provided they are used very slowly and carefully.
- (vi) The radiator shutter should be in the closed or normal position during a dive, and the cockpit hood may be open or closed.

APPROACH AND LANDING

18. General remarks.— This aeroplane may be landed either with or without engines. The normal method is the Engine-Assisted Approach and landing. The fundamental method (necessary in forced landing) is the Glide Approach and landing, and a useful practice method is the Preliminary Approach with Engine and Final Glide. The Creeper (formerly known as the power approach for landing in small spaces) is the method used in emergency for landing "short" in very small fields, if necessary.

19. Preparation for Landing—Drill of Vital Actions.— Before making the approach, reduce speed to about 140 m.p.h. A.S.I., and lock the cockpit hood in the open position. Then carry out the following drill of vital actions. A convenient catch phrase for this is—U.P. and Flaps!—

- (i) U—Undercarriage DOWN (check that green lights appear)
- (ii) F—Pitch to FINE (fully forward for constant speed airscrew) and
- (iii) Flaps—DOWN (not before starting to turn in to land, unless for any reason, the turn is made at rather a low height).

Important:-

- (a) Flaps.— The information regarding the operation of lowering flaps, given in Sect. I and in para. I of this section should be carefully noted.
- (b) Undercarriage.— After lowering the undercarriage, and before putting the selector in neutral, one or two strokes of the hand pump should be made until increased resistance is felt; this will ensure that the wheels are locked in the down position.

20. Engine-Assisted Approach.— This method of approach should be made at a speed of about 90 m.p.h. A.S.I. and the throttle should not be closed finally until after flattening-out is completed, but should then be closed without a moments further delay.

21. Approach with engine and final glide.— This is a convenient method of practising the final glide and landing without use of engine. After carrying out the Drill of Vital Actions, including lowering of flaps, make an engine-assisted approach down to a height of 500—600 ft.; the final glide should not be quite straight at first, but at an angle on a

a slight curved path to the wind. When within gliding distance, not less than about 500 - 600 ft., close the throttle fully and put the nose down to maintain a speed of about 85 - 90 m.p.h. A.S.I. Land in the normal manner.

22. Glide approach.— Close the throttle at about 2,000 ft., and carry out the drill of vital actions including lowering of flaps. Approach in a half circuit, regulating the descent by the curve of the approach with flaps up at a speed of about 90 - 95 m.p.h. A.S.I. Turn in with a very little surplus height (at about 500 ft.). Flaps must be lowered fully immediately after the undercarriage as they go down too slowly to be used in regulating the final glide. Make the final glide at a speed of about 85 m.p.h. A.S.I. If it should be necessary to land with flaps up, an approach speed of at least 95 - 100 m.p.h. A.S.I. should be maintained to ensure flattening-out, but not exceeded or overshooting will occur.

23. The Creerer (formerly known as the power approach for landing in short spaces).— After carrying out the drill of vital actions, make a low approach close to the ground or obstacles for the last 200 - 300 yards with ample engine power to maintain height with the flaps lowered fully at a speed of about 70 - 75 m.p.h. A.S.I. On passing over the last obstruction, come close to the ground, close the throttle fully, hold-off and land tail down with the stick fully back. The brakes can usually be used fully, but if the tail lifts, owing perhaps to soft ground, release them and try again.

24. Mislanding.— In the event of an unsuccessful attempt to land the aeroplane should be taken off again at full throttle and on no account must the flap control be touched. It can be climbed at 80 - 90 m.p.h. A.S.I. with undercarriage and flaps down. The undercarriage should be raised as soon as possible, but the speed must be increased to at least 120 m.p.h. A.S.I. and a safe height attained before the flaps are raised. In emergency the engine power can be increased by using the automatic boost cut-out control. If this control is used, it should be returned to normal as soon as possible, and on landing it must be reported that the control has been in use, so that the engine will be examined and an entry made in the log book.

LANDING ACROSS WIND

25. Landing can be made across wind, but as landings should not be made with one wing down, a limited strength of wind for a cross-wind landing should be considered. Cross-wind landings should not be made if the wind exceeds about 20 m.p.h. on the surface.

PROCEDURE AFTER LANDING

26. It is recommended that the flaps are raised before taxying in, but the aeroplane should be taxied clear of the landing run before this is done. On reaching the apron:-

(i) If the aeroplane is fitted with a variable two-pitch airscrew and is to be put away, leave the airscrew in coarse pitch by placing the control in COARSE pitch position and then running up the engine.

- (ii)
 - (a) Engines not fitted with slow-running cut-out.— Allow the engine to idle for a short time, then turn the fuel cock to OFF and switch OFF the ignition only when irregular firing becomes noticeable.
 - (b) Engines fitted with slow-running cut-out.— Allow the engine to idle for a short time, then operate the cut-out control and when the engine stops release the control to obviate difficulty when the engine is next started. Turn the fuel cock to OFF and switch OFF the ignition.
- (iii) Switch OFF all electrical switches.

- (iv) See that the flaps are up and that the safety plate of the hydraulic selector is covering the wheels UP position.
- (v) If the aeroplane is parked by means of the brakes only, lock the rudder, otherwise there is a danger of the rudder bar moving and so releasing one or other of the wheel brakes.

FLYING IN BAD VISIBILITY

27. When necessary to fly at low altitude, speed should be greatly reduced to avoid risk of collision with suddenly rising ground. It may be advisable to open the cockpit hood. Flaps may be lowered about 40° (about 3 divisions) and speed may be reduced to about 100 m.p.h. A.S.I. in extreme conditions of bad visibility, but the pilot should remember that sudden change of direction at such a speed will be difficult. Fine pitch may be necessary and more power should be used on turns. In hot weather it may be necessary to lower the radiator flap fully owing to the reduction of air flow through the radiator occasioned by the depressed flap and low speed.

FORCED LANDING OWING TO ENGINE FAILURE

- (26. If the engine fails, maintain speed, select a suitable landing ground and attempt to rectify the fault. Unless a field of ample size is available the undercarriage should be left up. If a landing is inevitable, turn OFF fuel, switch OFF ignition and make a glide approach as described in para. 20.)

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POSITION ERROR TABLE

29. The correction for position error is as follows:-

At 80 m.p.h. A.S.I. reading add	6.0 m.p.h.
At 100 m.p.h. A.S.I. reading add	3.2 m.p.h.
At 120 m.p.h. A.S.I. reading add	0.5 m.p.h.
At 140 m.p.h. A.S.I. reading subtract	1.7 m.p.h.
At 160 m.p.h. A.S.I. reading subtract	4.0 m.p.h.
At 180 m.p.h. A.S.I. reading subtract	6.0 m.p.h.
At 200 m.p.h. A.S.I. reading subtract	7.5 m.p.h.
At 220 m.p.h. A.S.I. reading subtract	8.7 m.p.h.
At 240 m.p.h. A.S.I. reading subtract	9.5 m.p.h.
At 260 m.p.h. A.S.I. reading subtract	9.7 m.p.h.

AEROBATICS

30. Aerobatics may be carried out only by pilots who have adequate flying experience of this aeroplane and who have received written authority from their Squadron Commander. Aerobatics must not be performed below 5,000 ft., and spinning is prohibited, on this aeroplane. Note the following:-

(i) General remarks.- Aerobatics are normal and easy on this aeroplane, provided the pilot fully understands the characteristics common to all high-speed modern aeroplanes of high wing-loading. These are:-

(a) The ease with which the pilot can induce high load factors or "g" by elevator control. This control must therefore be used with great care at all times, to avoid straining or breaking the aeroplane, or "blackening out".

(b) The great amount of height which may be lost in regaining control after a faulty manoeuvre.

(c) The persistence of the stalled condition of the wings after stalling the aeroplane, until considerable excess speed is gained in the recovery dive.

(ii) Precautions.- The usual precautions should be taken, such as ensuring that there are no loose articles, such as maps, in the cockpit; that the harness is tight enough, and so on. Existing regulations about minimum height and locality must be strictly obeyed. Ensure that the sky, especially beneath, is clear of aircraft. Maximum r.p.m., boost, and airspeed must not be exceeded.

(iii) Looping.- Ample speed should be attained for a loop, as otherwise it will be easy to put the aeroplane at stallling incidence if the speed is too slow at the top of the loop, and the aeroplane will either hang and fall out of the loop (if the stick is not pulled back) or flick out, or spin (if it is); considerable height will be lost in any of these events. Speed should be about 300 m.p.h. A.S.I., and a slight dive will help to gain this speed quickly. When the pilot is thoroughly

proficient, however, the loop can safely be done at speeds between 200 and 250 - but too much speed is safer than too little, provided smooth control is used. In easing up into the loop, the pilot should endeavour to maintain a constant load factor of "g" by the feel of it (weight in the seat, effect on vision, and so on). Start the loop smoothly and slowly, but not too slowly, or loss of speed will be too great - increase the "g" until the effect on the eyes and ears (warning of blacking out) becomes faintly apparent and maintain this loading. (Vision begins to fade at high "g", and there is a feeling of downward drag behind the ears). If vision begins to fade, immediately slacken off the loop slightly - if the loop seems too slow and there is no trace of high "g" tighten it up a little. Otherwise the loop is quite normal. A little right rudder may be needed to keep straight. Glance at the wing tips if there is a clear and featureless sky, to ensure that the loop is progressing correctly. Ease out of the dive slowly and smoothly, and if the aeroplane tends to become nose-heavy as it gathers speed, the elevator tab control may be used, the greatest care being taken to move it slowly and smoothly, and not to induce high "g" by continuing to wind it back too far.

(iv) Rolling.- Speed should not be less than about 180 for the slow roll, but it is preferable to start with a speed nearer 250 until fully proficient. At this higher speed aileron control should be used gently and the roll should be slow. It is best to keep the engine running by maintaining a trace of "pitch" during the roll, that is, make a slightly "barrel" roll. Start by easing the nose well up, about 45° above the horizon, and then roll by applying aileron, assisted, if desired, by rudder. Allow the nose to come down gradually, as the aeroplane rolls on to its back (maintaining a very slight backward pressure on the stick), but it is important that the nose should still be above the horizon when the aeroplane is inverted. Do not move the stick forward at any time during the inverted part of the roll, or the engine will stop. Use ample top rudder to keep the nose above the horizon as the aeroplane rolls out. The secret of a good roll is to keep the nose above the horizon. When fully proficient a straight roll can be made, with the nose up to a lesser degree at the start. An almost axis roll can be made, and in this the engine should be partly throttled when inverted, and then opened up again. A continuous series of rolls may be done in this way, but it is necessary to allow the nose to go slightly below the horizon just before the aeroplane rolls out into normal upright position, and essay the roll, to enable the aeroplane to gather enough speed for the next roll, which is again started by easing the nose well up.

(v) Half-roll off the loop. Start the loop with, if anything, rather higher speed than for a plain loop (at least 300 m.p.h. A.S.I.). Maintain an adequate rate of loop so that speed shall not be too low on top. Look "up", and when the opposite horizon begins to come into view (while the nose is still well above it) apply full aileron, assisted by rudder in the same direction, maintain a very slight backward pressure on the stick, and roll out so that the nose is still just above the horizon as the aeroplane levels. Do NOT put the stick forward at the top of the loop as the engine would stop. Both the slow-roll and the half-roll off the loop may be done equally well either way, but many pilots find it easier one way than the other, owing to one-sided practice.

(vi) Upward roll. Initial speed should be between 300 and the maximum permissible. Great care should be taken at the higher speeds to ease the nose up gently to maintain a constant and moderate "g" until the nose is pointing vertically upwards. Then apply enough aileron to induce a smooth and moderately rapid rate of roll, assisted by rudder in the same direction. The aeroplane should rotate about its longitudinal axis, with the nose (gun sights or similar guide) pointing straight at a suitable spot on the clouds. In a clear sky it is necessary to glance at the wing tips as a guide. Level off before speed drops too low, either by completing the loop, and half-rolling out, cartwheeling sideways and quarter-rolling, or dropping the nose forward (but in this, unless it is done very gradually, the engine will stop, and the aeroplane will fall crookedly). This manoeuvre is an exercise which is more spectacular than useful, though it is good training in accurate control, but it should not be overdone - engine r.p.m., and boost must be kept well within the limits, and the controls handled smoothly, as at all times.

(vii) Flick manoeuvres. These can be done, but lack neatness, and if badly done, are liable to cause strain. The flick roll should only be done at very low speed (140 or so), and low power (2,600 r.p.m. and low boost), and stick gently, glass back - rudder gently applied. After starting to raise the nose and yaw (and so bank), the aeroplane will flick over gently; the stick should be put forward well before the aeroplane assumes normal level, to check the roll and prevent a spin developing. Unless this form of slow gentle flick roll is done, the manoeuvre is NOT recommended. If done very smoothly and gently it is a good exercise in control at low speed, and stopping an incipient spin. Ample height should be allowed. Stalling turns (at a safe height), falling leaf, and other manoeuvres, can also be carried out, in the normal way. Care should be taken to time the rudder changes and regulate the stick position, in the falling leaf, to prevent the flicks becoming too violent - if this happens the aeroplane must be brought out to normal flight.

(viii) Inverted flying. The Hurricane can be flown inverted quite normally; it tends to become very nose heavy, and the tab control has to be wound well forward, when upside-down, to keep the nose up. Care should be taken not to do inverted flying unless adequate provision exists to prevent oil being thrown all over the engine and fuselage. The engine must not be opened up, on assuring the upright position, if oil pressure does not immediately return to normal, but a slight pressure must be made until it does. Harness should be tight and free - it is disconcerting if a kink in the harness, caught up somewhere, suddenly frees itself and allows the pilot to drop a few inches.

(ix) Combat manoeuvres. These should be as simple as possible. Set aerobatics, through a vital part of a Pilot's training, are useless for combat, as they take too long. For instance, a smooth climbing turn is far more effective than a loop and half-roll, and, a combination of roll, cartwheel, dive, and pull out on an enemy's tail, than (for example) a half-roll, dive, downward roll, and pull out to achieve the same result. Smoothness and accuracy are essential, but as use of rudder may often assist aileron control in producing rapid roll, skidding may be permissible at times during sudden turns; but aerobatics "by numbers" are a waste of valuable seconds.

(x) Recovery from stall. In practising aerobatics, it may sometimes happen that the aeroplane will be stalled, and get out of control. Recovery from a spin, if this occurs, is decided under SPINNING. In recovering from the stalled condition, ample speed must be gained in a dive, and the aeroplane eased out gently, as otherwise the wings will tend to remain stalled (even though the speed appears to be well above "stalling speed"). This is because it is particularly easy to bring the stick back to give stalling incidence, when the aeroplane is falling at low speed, even well over 100 m.p.h. A.S.I. - the stall can occur at any speed if the stick is brought back far enough.

NOTES CONCERNING THE MERLIN II AND III ENGINE

31. The following should be carefully noted:-

(i) Limiting operational conditions.

Take-off	Maximum r.p.m.	2,850 *
	Minimum r.p.m. at	
for 3 mins.)	Maximum boost (+6½ lb./sq.in.)	2,080

* These r.p.m. will not be obtained with a fixed-pitch airscrew.

Climb	Maximum r.p.m. at maximum boost (+6½ lb./sq.in.)	2,600
Maximum cruising (mixture control RICH)	Maximum r.p.m. at maximum boost (+4½ lb./sq.in.)	2,600
Maximum cruising (mixture control WEAK)	Maximum r.p.m. at maximum boost (+2½ lb./sq.in.)	2,600
All-out level (5 mins. limit)	Maximum r.p.m. at maximum boost (+6½ lb./sq.in.)	3,000
Maximum drive	Momentary maximum r.p.m. at maximum boost (+6½ lb./sq.in.)	3,600

*These r.p.m. will not be obtained with a fixed-pitch airscrew.

(ii) Oil pressures. -

Normal	60 lb./sq.in.
Emergency minimum	45 lb./sq.in.

(iii) Oil inlet temperatures. -

Maximum for opening up	15°C.
Maximum for continuous cruising	90°C.
Maximum for climbing	90°C.
Emergency maximum	95°C.
(iv) <u>Coolant temperature.</u> -	

The engine which employs ethylene glycol as the cooling medium, should not be opened up to full power until the radiator temperature exceeds 70°C. The maximum permissible temperature in flight is 120°C and the recommended cruising temperature should not exceed 95°C.

FUEL AND OIL CAPACITY AND CONSUMPTIONS

32. Note the following:-

- (i) Oil capacity. - The oil tank has a total capacity of 10½ gallons and an effective capacity of 7½ gallons.

(iii) Effective fuel capacity. -

Two main tanks	- 33 gallons each	= 66 gallons
One reserve tank		= 28 gallons
Total effective capacity		94 gallons

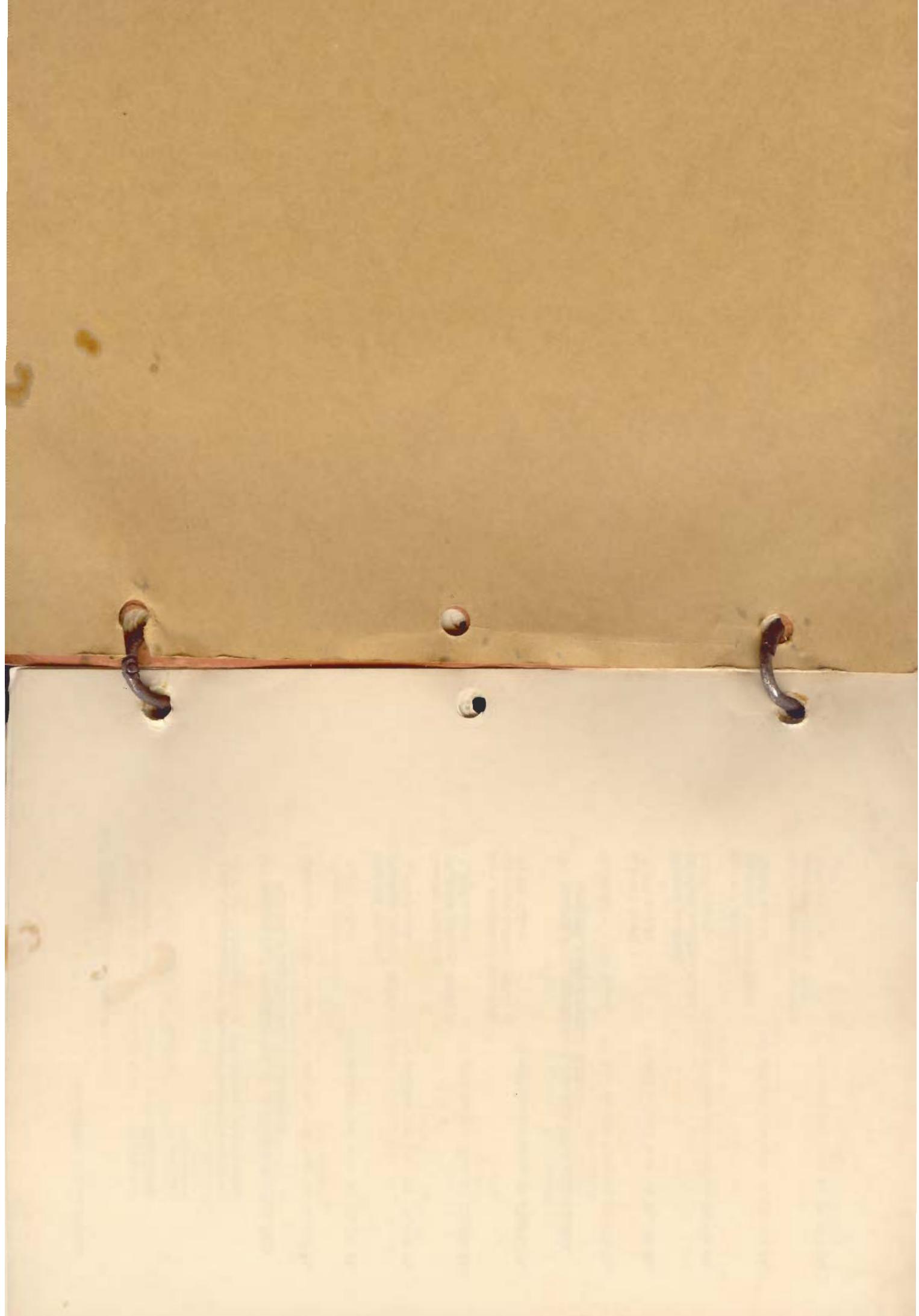
(iv) Fuel consumptions. - The following information will be found useful in determining endurance:-

(a) Maximum fuel consumptions (at altitudes stated with a fixed pitch or two pitch airscrew: -

Climbing - 2,600 r.p.m.	81 gallons per hour at 12,000 ft.
All-out level - 3,000 r.p.m.	89 gallons per hour at 17,000 ft.
Maximum cruising (Mixture control RICH) 2,600 r.p.m.	64 gallons per hour at 8,000 ft.

Maximum cruising (Mixture control WEAK) - 2,600 r.p.m.	47 gallons per hour at 12,000 ft.
Most economical cruising (Mixture control WEAK) - 1,900 r.p.m.	23 gallons per hour at 17,000 ft.
(b) <u>Maximum fuel consumptions (at altitudes stated with constant speed governed airscrew: -</u>	
Climbing - 2,600 r.p.m.	81 gallons per hour at 12,000 ft.

All-out level - 3,000 r.p.m.	89 gallons per hour at 17,000 ft.
Maximum cruising (Mixture control RICH) - 2,600 r.p.m.	68 gallons per hour at 14,500 ft.
Most economical cruising (Mixture control WEAK) - 1,900 r.p.m.	23 gallons per hour at 18,500 ft.
Maximum cruising (Mixture control WEAK) - 2,600 r.p.m.	49 gallons per hour at 17,000 ft.



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

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

- JimSan