

FOR OFFICIAL USE ONLY

AIR PUBLICATION 1565 A

Pilot's Notes

PILOT'S NOTES

THE SPITFIRE I AEROPLANE  
MERLIN II OR III ENGINE

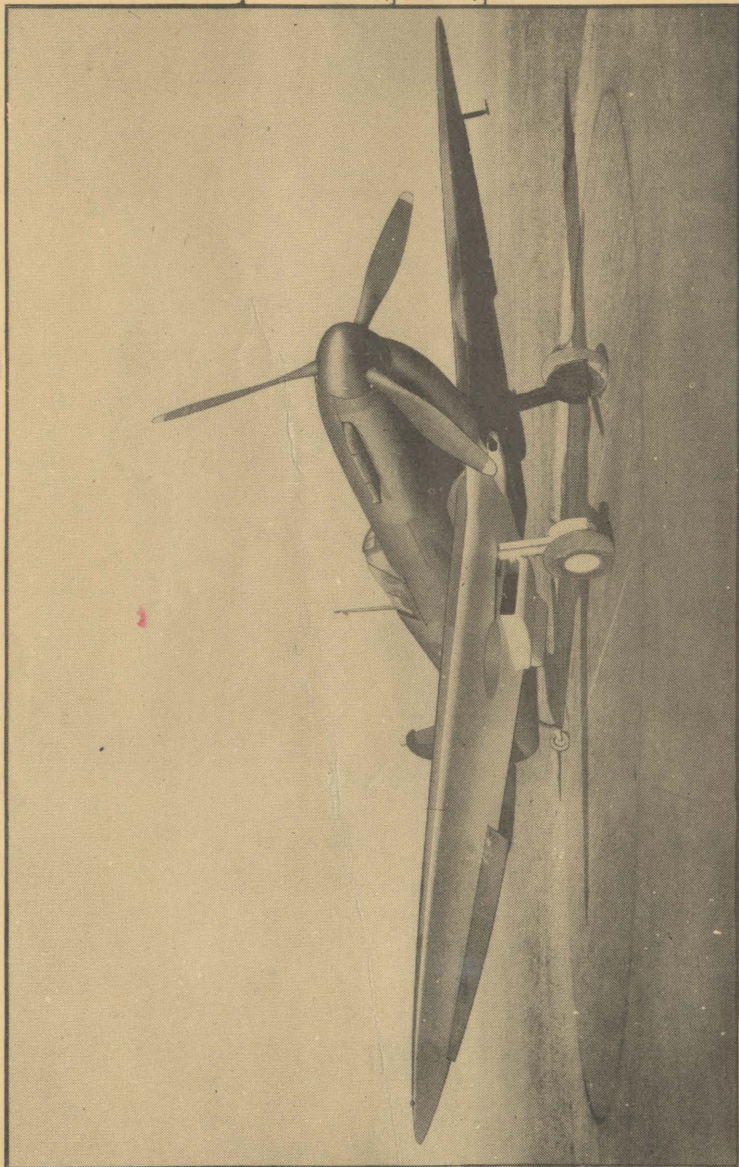
Promulgated for the information and guidance of all concerned.

By Command of the Air Council,

A.W. STREET

AIR MINISTRY

A.P. 1565A, VOL. I,



FRONTISPIECE

SPITFIRE I



## AMENDMENT CERTIFICATE

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

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

| Amendt.<br>List No. | 1 | 2 | 3        | 4 | 10 | 12 | 13           | 14 | 16 | 23 |
|---------------------|---|---|----------|---|----|----|--------------|----|----|----|
| Prelimy.<br>matter  |   |   |          |   |    |    |              |    |    |    |
| Leading<br>Partics. |   |   |          |   |    |    |              |    |    |    |
| Introducn.          | ✓ |   |          |   |    |    |              |    |    | ✓  |
| Section 1           |   | ✓ |          |   | ✓  |    |              | ✓  |    |    |
| Section 2           |   |   | ✓        | ✓ | ✓  | ✓  | ✓            |    | ✓  |    |
| Section 3           |   |   |          |   |    |    |              |    |    |    |
| Section 4           |   |   |          |   |    |    |              |    |    |    |
| Section 5           |   |   |          |   |    |    |              |    |    |    |
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| Section 8           |   |   |          |   |    |    |              |    |    |    |
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| Section 11          |   |   |          |   |    |    |              |    |    |    |
| Section 12          |   |   |          |   |    |    |              |    |    |    |
| Date of<br>incorpn. |   |   | JUN 1945 |   |    |    | INCORPORATED |    |    |    |





SECTION I

PILOT'S CONTROLS AND EQUIPMENT.

INTRODUCTION.

1. The Spitfire I is a single seat, low wing monoplane fighter, fitted with a Merlin II or III engine and a de Havilland 20<sup>0</sup> (P.C.P.) or Rotol 35<sup>0</sup> constant speed airscrew.

MAIN SERVICES

2. Fuel system.- Fuel is carried in two tanks mounted one above the other forward of the cockpit, and is delivered by an engine-driven pump.  
The tank capacities are as follows:-

|              |            |
|--------------|------------|
| Top tank:    | 48 gallons |
| Bottom tank: | 37 gallons |

The top tank feeds into the lower tank, and the fuel cock controls (44 and 45), one for each tank, are fitted below the instrument panel.

3. Oil system.- Oil is supplied by a tank of 5.8 gallons capacity fitted below the engine mounting, and two oil coolers in tandem are fitted in the underside of the port plane
4. Hydraulic system.- An engine-driven hydraulic pump supplies the power for operating the undercarriage.
5. Pneumatic system.- An engine-driven air compressor feeds two storage cylinders for operation of the flaps, brakes, guns and landing lamps. The cylinders are connected in series, each holding air at 200 lb/sq.in. pressure.
6. Electrical system.- A 12 Volt generator, controlled by a switch (60) above the instrument panel supplies an accumulator which in turn supplies the whole of the electrical installation. There is an ammeter (35) on the left of the switch.

AEROPLANE CONTROLS

7. (a) Primary flying controls and locking devices.-  
The control column is of the spade-grip (41) pattern and incorporates the brake lever (40) and gun firing control (39). The rudder pedals (46) have two positions for the feet and are adjustable for leg reach by rotation of star wheels (47) on the sliding tubes.
- (b) Control locking struts are stowed on the right hand side of the cockpit, behind the seat. To lock the control column, the longer strut should be clamped to the control column handle at one end and the other end inserted in a key-hole slot in the right hand side of the seat. The fixed pin on the free end of the arm attached to this strut at the control column end should then be inserted in a lug (75) on the starboard datum longeron, thus forming a rigid triangle between the column, the seat and the longeron.
- (c) To lock the rudder pedals, a short bar with a pin at each end is attached to the other struts by a cable. The longer of the two pins should be inserted in a hole in the starboard star wheel bearing and the shorter in an eyebolt on the fuselage frame directly below the front of the seat. The controls should be locked with the seat in its highest position.
8. Flying instruments.- A standard blind flying instrument panel is incorporated in the main panel. The instruments comprise airspeed indicator (29), altimeter (34), directional gyro (37), artificial horizon (33), rate of climb and descent indicator (36) and turn and bank indicator (38). An air temperature gauge is fitted on the extreme left of the instrument panel.
9. Trimming tabs.- The elevator trimming tabs are controlled by a hand wheel (7) on the left hand side of the cockpit, the indicator (30) being on the instrument panel. The rudder trimming tab is controlled by a small hand wheel (3) and is not provided with an indicator. The aeroplane tends to turn to starboard when the hand wheel is rotated clockwise.



10. (a) Undercarriage control and Indicators (visual and audible).- The undercarriage selector lever (78) moves in a gated quadrant, on the right hand side of the cockpit. An automatic cut-out in the control moves the selector lever into the gate when it has been pushed or pulled to the full extent of the quadrant.
- (b) To raise the undercarriage the lever is pushed forward, but it must first be pulled back and then across to disengage it from the gate. When the undercarriage is raised and locked, the lever will spring into the forward gate.
- (c) To lower the undercarriage the lever is pulled back, but it must first be pushed forward and then across to disengage it from the gate. When the undercarriage is lowered and locked, the lever will spring into the rear gate.
- (d) Electrical visual indicator.- The electrically operated visual indicator (28) has two semi-transparent windows on which the words UP on a red background and DOWN on a green background are lettered; the words are illuminated according to the position of the undercarriage. The switch for the DOWN circuit of the indicator is mounted on the inboard side of the throttle quadrant and is moved to the ON position by means of a striker on the throttle lever; this switch should be returned to the OFF position by hand when the aeroplane is left standing for any length of time. The UP circuit is not controlled by this switch.
- (e) Mechanical position indicator.- A rod that extends through the top surface of the main plane is fitted to each undercarriage unit. When the wheels are down the rods protrude through the top of the main planes and when they are up the top of the rods, which are painted red, are flush with the main plane surfaces.
- (f) Warning horn.- The push switch controlling the horn is mounted on the throttle quadrant and is operated by a striker on the throttle lever. The horn may be silenced, even though the wheels are retracted and the engine throttled back, by depressing the push button (15) on the side of the throttle quadrant. As soon as the throttle is again advanced beyond about one quarter of its travel the

push-button is automatically released and the horn will sound again on its return.

11. Flap control.- The split flaps have two positions only, up and fully down. They cannot therefore, be used to assist take-off. They are operated pneumatically and are controlled by a finger lever (26). A flap indicator is fitted only on early aeroplanes.
12. (a) Undercarriage emergency operation.- A sealed high-pressure cylinder containing carbon-dioxide and connected to the undercarriage operating jacks is provided for use in the event of failure of the hydraulic system. The cylinder is mounted on the right-hand side of the cockpit and the seal can be punctured by means of a red painted lever (79) beside it. The handle is marked EMERGENCY ONLY and provision is made for fitting a thin copper wire seal as a check against inadvertent use.
  - (b) If the hydraulic system fails, the pilot should ensure that the undercarriage selector lever is in the DOWN position (this is essential) and push the emergency lowering lever forward and downward. The angular travel of the emergency lever is about  $100^{\circ}$  for puncturing the seal of the cylinder and then releasing the piercing plunger; it must be pushed through this movement and allowed to swing downwards. NO attempt should be made to return it to its original position until the cylinder is being replaced.
13. Wheel brakes.- The control lever (40) for the pneumatic brakes is fitted on the control column spade grip; differential control of the brakes is provided by a relay valve connected to the rudder bar. A catch for retaining the brake lever in the on position for parking is fitted below the lever pivot. A triple pressure gauge (22), showing the air pressures in the pneumatic system cylinders and at each brake, is mounted on the left hand side of the instrument panel.



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

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

Comments and suggestions concerning the subject matter of this publication should be forwarded through the usual channels to the Under-Secretary of State, Air Ministry.

May, 1940

AIR PUBLICATION 1565A  
Pilot's Notes

LIST OF SECTIONS

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

Introduction

Section 1 - Pilot's controls and equipment

2 - Handling and flying notes for pilot



ENGINE CONTROLS

14. Throttle and mixture controls.- The throttle and mixture levers (16 and 14) are fitted in a quadrant on the port side of the cockpit and an interlocking device between them prevents the engine from being run on an unsuitable mixture. Friction adjusters (12) for the controls are fitted on the side of the quadrant.
15. Automatic boost cut-out.- The automatic boost control may be cut out by pushing forward the small red painted lever (17) at the forward end of the throttle quadrant.
16. Airscrew controls.- The control lever for the de Havilland 20° or Rotol 35° constant speed airscrew is on the throttle quadrant. The de Havilland 20° airscrew has a Positive Coarse Pitch position which is obtained in the extreme aft position of the control lever, when the airscrew blades are held at their maximum coarse pitch angles and the airscrew functions as a fixed airscrew. On early aeroplanes the variable pitch airscrew is controlled by a push-pull lever (9) on the left of the throttle quadrant.
17. Radiator flap control.- The flap at the outlet end of the radiator duct is operated by a lever (11) and ratchet on the left hand side of the cockpit. To open the flap, the lever should be pushed forward after releasing the ratchet by depressing the knob at the top of the lever. The normal minimum drag position of the flap lever for level flight is shown by a red triangle on the top of the map case fitted beside the lever. A notch beyond the normal position in the aft direction provides a position of the lever when the warm air is diverted through ducts into the main planes for heating the guns at high altitude.
18. Slow-running cut-out.- The control on the carburettor is operated by pulling the ring (50) on the right-hand side of the instrument panel.

19. Fuel cock controls and contents gauges.- The fuel cock controls (44 and 45), one for each tank, are fitted at the bottom of the instrument panel. With the levers in the up position the cocks are open. Either tank can be isolated, if necessary. The fuel contents gauges (72 and 77) on the instrument panel indicate the contents of the top and bottom tanks respectively, but only when the adjacent push button is pressed.
20. Fuel priming pump.- A hand-operated pump (51) for priming the engine is mounted below the right hand side of the instrument panel.
21. Ignition switches.- The ignition switches (20) are on the left hand bottom corner of the instrument panel.
22. Electric starting.- The starting magneto switch (68) is at the right hand bottom corner of the instrument panel and the engine starting push-button (53) is under a shield above the fuel cock controls. Current for the starter motor is normally supplied by an external battery, which is connected to the socket on the engine mounting U - frame, accessible through a door in the engine cowling panel on the starboard side. The general service accumulator carried in the aeroplane is also connected to the starter, but as its capacity is small for such heavy duty it should be used only as a stand-by.
23. Hand starting.- A starting handle is stowed behind the seat. A hole in the engine cowling panel on the starboard side gives access for connecting the handle to the hand starting gear.
24. Engine instruments.- The engine instruments are grouped on the right hand side of the instrument panel and consist of an engine-speed indicator (61), fuel pressure gauge (59), boost gauge (63), oil pressure gauge (58), oil temperature gauge (62) and radiator temperature gauge (65).

#### COCKPIT ACCOMMODATION AND EQUIPMENT

25. Pilot's seat control.- The seat (48) is adjustable for height by means of a lever (80) on the right hand side of the seat.



26. Safety harness release.- In order that the pilot may lean forward without unfastening his harness, a release catch (76) is fitted to the right of the seat.
27. Cockpit door.- To facilitate entry to the cockpit a portion of the coaming on the port side is hinged. The door catches are released by means of a handle at the forward end. Two position catches are incorporated to allow the door to be partly opened before taking off or landing in order to prevent the hood from sliding shut in the event of a mishap.
28. Hood locking control.- The sliding hood is provided with spring catches for holding it either open or shut; the catches are released by two finger levers at the forward end of the hood. From outside, with the hood closed, the catches can be released by depressing a small knob at the top of the windscreen. Provision is made on the door to prevent the hood from sliding shut if the aeroplane overturns on landing.
29. Direct vision panel.- A small knock-out panel is provided on the right hand side of the hood for use in the event of the windscreen becoming obscured.
30. Cockpit lighting.- A floodlight (13 and 67) is fitted on each side of the cockpit. Each is controlled by a switch (42) immediately below the instrument panel.
31. Cockpit heating and ventilation.- A small adjustable flap on the starboard coaming above the instrument panel is provided for ventilation of the cockpit. The flap is opened by turning a knurled nut underneath the flap.
32. Oxygen.- A standard regulator unit (25) is fitted on the left hand side of the instrument panel and a bayonet socket (69) is on the right hand side of the cockpit.
33. Mirror.- A mirror providing a rearward view is fitted at the top of the windscreen.

34. Map cases.- A metal case (8) for a writing pad and another (4) for maps, books etc. are fitted on the left hand side of the cockpit. Stowage (74) for a height-and-air-speed computer is provided below the wireless remote contactor.

OPERATIONAL EQUIPMENT AND CONTROLS

- 35.(a) Guns.- The eight machine guns are fired pneumatically by a push-button on the control column spade grip. The compressed air supply is taken from the same source as the brake supply, the available pressure being shown by the gauge (22).
- (b) The push-button is surrounded by a milled sleeve which can be rotated by a quarter of a turn to a safe 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 as the sleeve has an indentation which is at the bottom when the sleeve is in the SAFE position and is at the side when the sleeve is turned to the FIRE position.
- 36.(a) Reflector gun sight.- For sighting the guns and cannon a reflector gun sight is mounted on a bracket (31) above the instrument panel. A main switch (54) and dimmer switch (56) are fitted below the mounting bracket. The dimmer switch has three positions marked OFF, NIGHT and DAY. Three spare lamps for the sight are stowed in holders (64) on the right hand side of the cockpit.
- (b) When the sight is used during the day the dimmer switch should be in the DAY position in order to give full illumination, and if the background of the target is very bright, a sun-screen (57) can be slid behind the windscreen by pulling on the ring (55) at the top of the instrument panel. For night use the dimmer switch should be in the NIGHT position; in this position a low-wattage lamp is brought into circuit and the light can be varied by rotating the switch knob.
- 37.(a) Camera.- A G.42B cine-camera is fitted in the leading edge of the port plane, near the root end, and is operated by the gun-firing button on the control column spade grip, a succession of exposures being made during the whole time the button is depressed. When cannon are fitted the cine-camera is operated off the cannon-firing pipe line.



- (b) A footage indicator and an aperture switch are mounted on the wedge plate (10) above the throttle lever. The switch enables either of two camera apertures to be selected, the smaller aperture being used for sunny weather. A main-switch (6) for the cine-camera is mounted on the left hand side of the cockpit.

NAVIGATIONAL, SIGNALLING AND LIGHTING EQUIPMENT

- 38.(a) Wireless.- The aeroplane is equipped with a combined transmitter-receiver, either type T.R.9D or T.R.1133, and an R.3002 set.
- (b) With the T.R.9D installation a type C mechanical controller (19) is fitted on the port side of the cockpit above the throttle lever and a remote contactor (71) and contactor master switch (73) are fitted on the right hand side of the cockpit. The master contactor is mounted behind the pilot's headrest and a switch controlling the heating element is fitted on the forward bracket of the mounting. The heating element should always be switched OFF when the pilot leaves the aeroplane. The microphone/telephone socket is fitted on the right hand side of the pilot's seat.
- (c) With the T.R.1133 installation the contactor gear and microphone/telephone socket are as for the T.R.9D installation, but the type C mechanical controller is replaced by a push-button electrical control unit.
- 39.(a) Navigation and identification lamps.- The switch (24) controlling the navigation lamps is on the instrument panel.
- (b) The upward and downward identification lamps are controlled from the signalling switchbox (66) on the right hand side of the cockpit. This switchbox has a switch for each lamp and a morsing key, and provides for steady illumination or morse signalling from each lamp or both. The switch lever has three positions: MORSE, OFF and STEADY.

(c) The spring pressure on the morsing key can be adjusted by turning the small ring at the top left hand corner of the switchbox, adjustment being maintained by a latch engaging one of a number of notches in the ring. The range of movement of the key can be adjusted by opening the cover and adjusting the screw and locknut at the centre of the cover.

40. Landing lamps.- The landing lamps, one on each side of the aeroplane, are housed in the undersurface of the main plane. They are lowered and raised by a finger lever (23) below the instrument panel. Each lamp has an independent electrical circuit and is controlled by a switch (32) above the pneumatic control lever (23). With the switch in the central position both lamps are off; when the switch is moved to the left or to the right, the port or the starboard lamp respectively, is illuminated. A lever (18) is provided to control the dipping of both landing lamps. On pulling up the lever the beam is dipped.

#### DE-ICING EQUIPMENT.

41. Pressure head heater switch.- The heating element in the pressure head is controlled by a switch (5) below the trimming tab handwheels. It should be switched off on landing in order to conserve the battery.

#### EMERGENCY EQUIPMENT.

42. Hood jettisoning.- The hood may be jettisoned in an emergency by pulling the lever mounted inside the top of the hood in a forward and downward movement, and pushing the lower edge of the hood outboard with the elbows.
43. Forced landing flare.- A forced landing flare is carried in a tube fixed inside the fuselage. The flare is released by means of a ring grip (1) on the left of the pilot's seat.
44. First aid.- The first aid outfit is stowed aft of the wireless equipment and is accessible through a hinged panel on the port side of the fuselage.



Page 10 (1952)

Foot side of console

- 1. Drive release controls
- 2. Drive release controls (left)
- 3. Drive release controls (right)
- 4. Drive release controls (center)
- 5. Drive release controls (left)
- 6. Drive release controls (right)
- 7. Drive release controls (center)
- 8. Drive release controls (left)
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- 91. Drive release controls (center)
- 92. Drive release controls (left)
- 93. Drive release controls (right)
- 94. Drive release controls (center)
- 95. Drive release controls (left)
- 96. Drive release controls (right)
- 97. Drive release controls (center)
- 98. Drive release controls (left)
- 99. Drive release controls (right)
- 100. Drive release controls (center)

Key to fig.1

Port side of cockpit

1. Flare release controls
2. Signal pistol cartridge stowage
3. Rudder trimming tab control
4. Map stowage box
5. Pressure head heating switch
6. Camera gun master switch
7. Elevator trimming tab control
8. Writing pad container
9. Airscrew pitch control
10. Wedge plate for camera gun footage indicator
11. Radiator flap lever
12. Throttle and mixture friction adjusters
13. Cockpit lamp
14. Mixture lever
15. Push switch for silencing warning horn
16. Throttle lever
17. Boost cut-out control
18. Landing lamp dipping lever
19. Wireless remote controller
20. Main magneto switches
21. Clock
22. Brake triple pressure gauge
23. Landing lamp lowering control
24. Navigation lamps switch
25. Oxygen regulator
26. Flaps control
27. Flaps position indicator
28. Undercarriage position indicator
29. Airspeed indicator
30. Elevator trimming tabs position indicator
31. Reflector gun sight mounting
32. Landing lamp switch
33. Artificial horizon
34. Altimeter
35. Ammeter
36. Rate of climb indicator
37. Direction indicator
38. Turn indicator
39. Gun firing pushbutton
40. Brake lever
41. Control column spade grip
42. Cockpit lamp dimmer switches
43. Compass deviation card
44. Fuel cock lever (top tank)
45. Fuel cock lever (bottom tank)
46. Rudder pedals
47. Rudder pedal leg reach adjusters
48. Seat



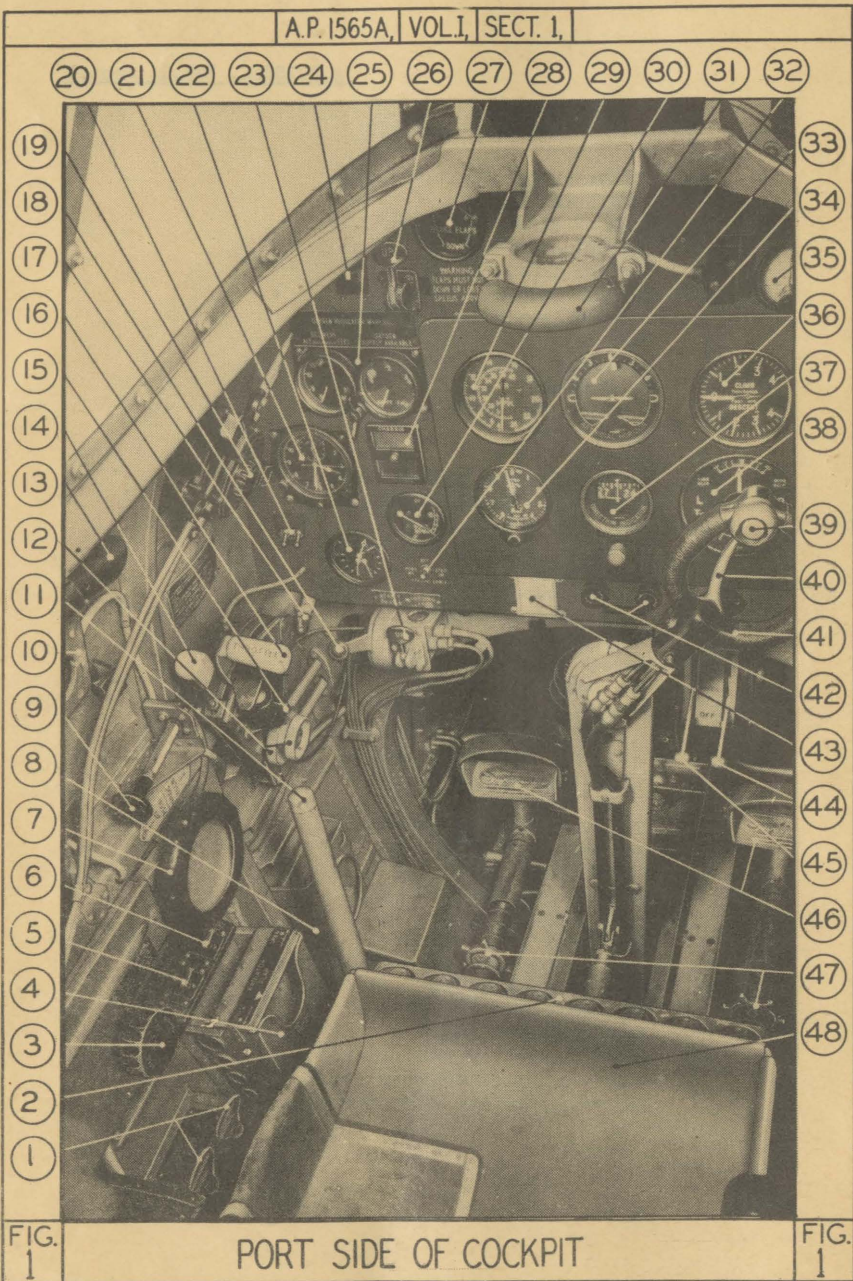


FIG. 1

PORT SIDE OF COCKPIT

FIG. 1

Key to fig.2

31. Reflector gun sight mounting
33. Artificial horizon
36. Rate of climb indicator
37. Direction indicator
38. Turning indicator
41. Control column spade grip
42. Cockpit lamp dimmer switches
44. Fuel cock lever (top tank)
45. Fuel cock lever (bottom tank)
49. Priming cock
50. Slow-running cut-out control
51. Priming pump
52. Compass
53. Engine starting pushbutton
54. Reflector sight main switch
55. Ring grip for sun screen
56. Reflector sight dimmer switch
57. Sun screen
58. Oil pressure gauge
59. Fuel pressure gauge
60. Generator switch
61. Engine-speed indicator
62. Oil temperature gauge
63. Boost gauge
64. Spare filaments for reflector sight
65. Radiator temperature gauge
66. Signalling switch box
67. Cockpit lamp
68. Starting magneto switch
69. Oxygen socket
70. Engine data plate
71. Wireless remote contactor
72. Fuel contents gauge
73. Contactor main switch
74. Height and airspeed computer stowage
75. Control locking lug
76. Harness release
77. Fuel contents gauge
78. Undercarriage control lever
79. Undercarriage emergency lowering lever
80. Height-adjusting lever for seat



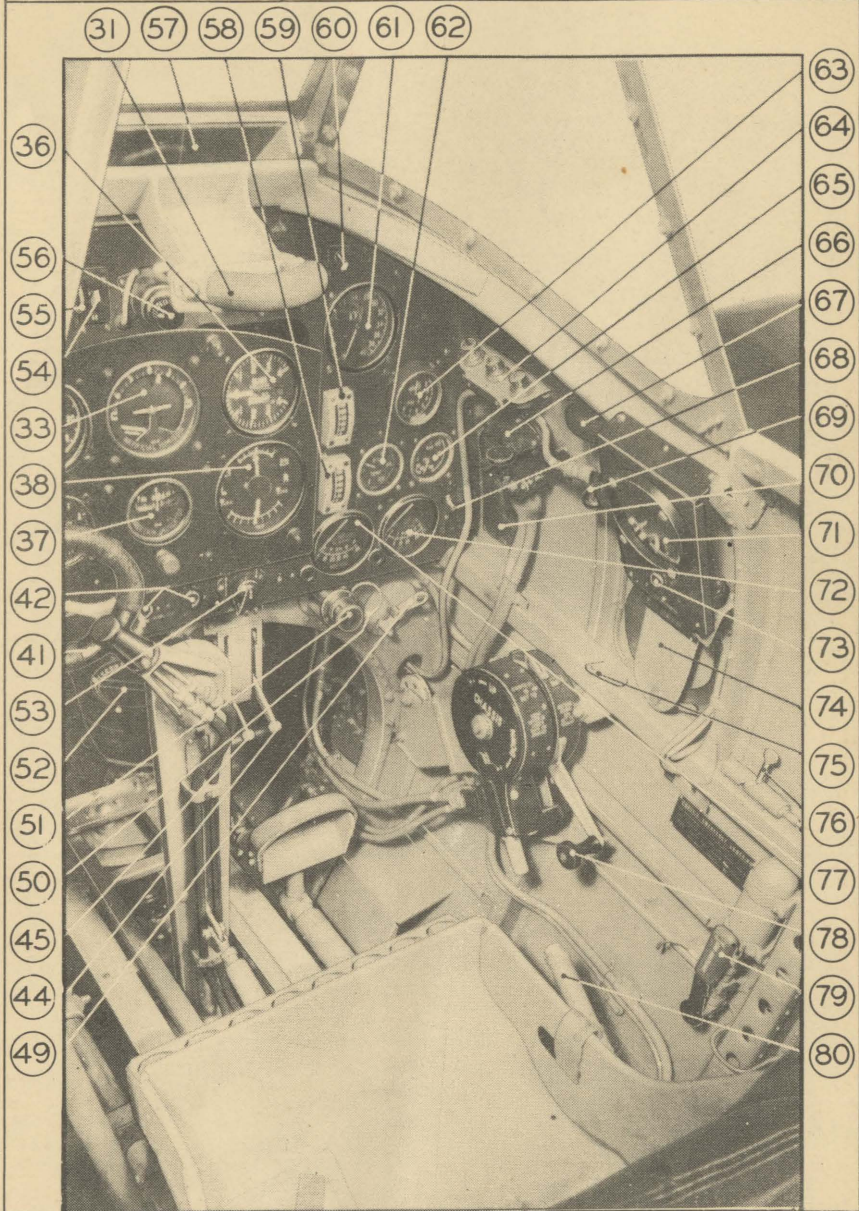
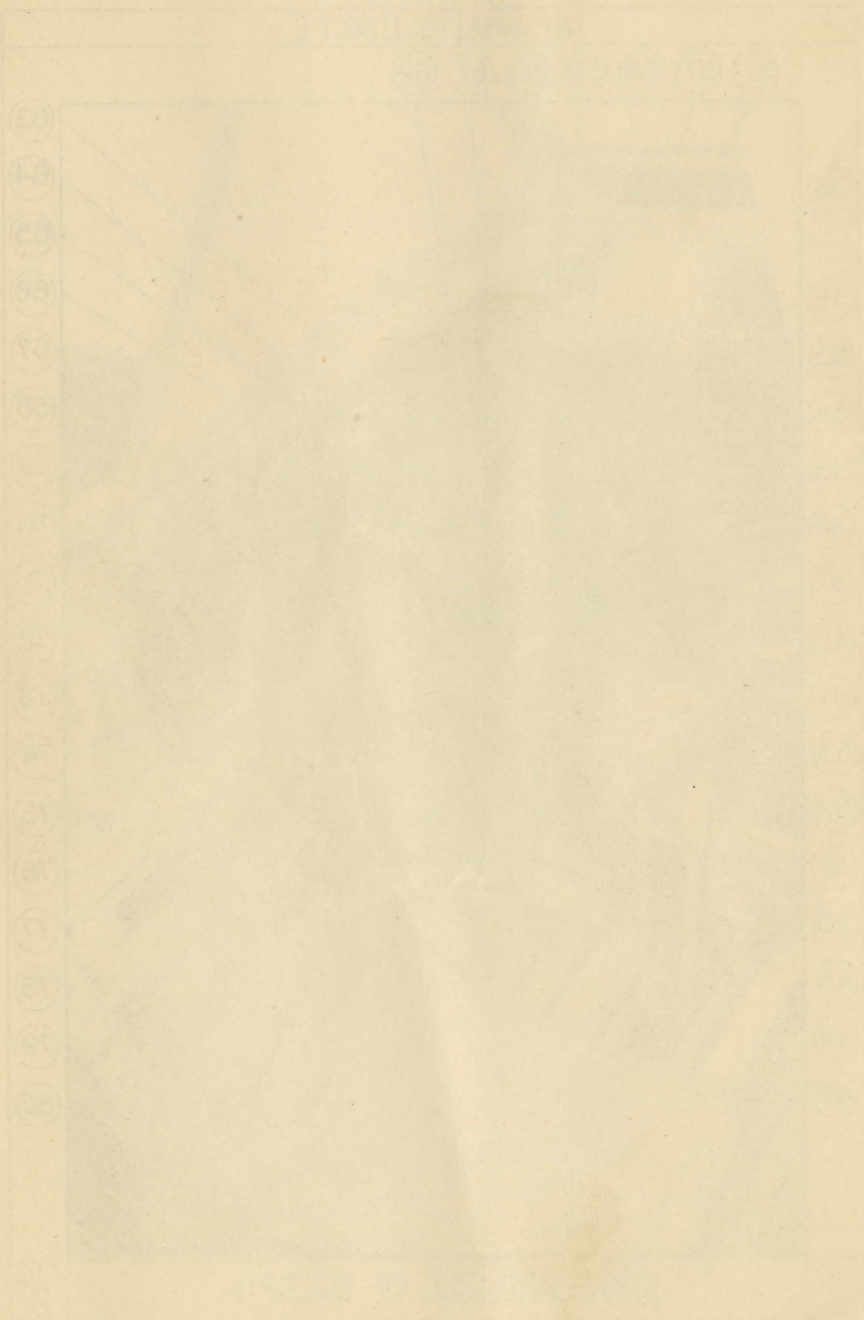


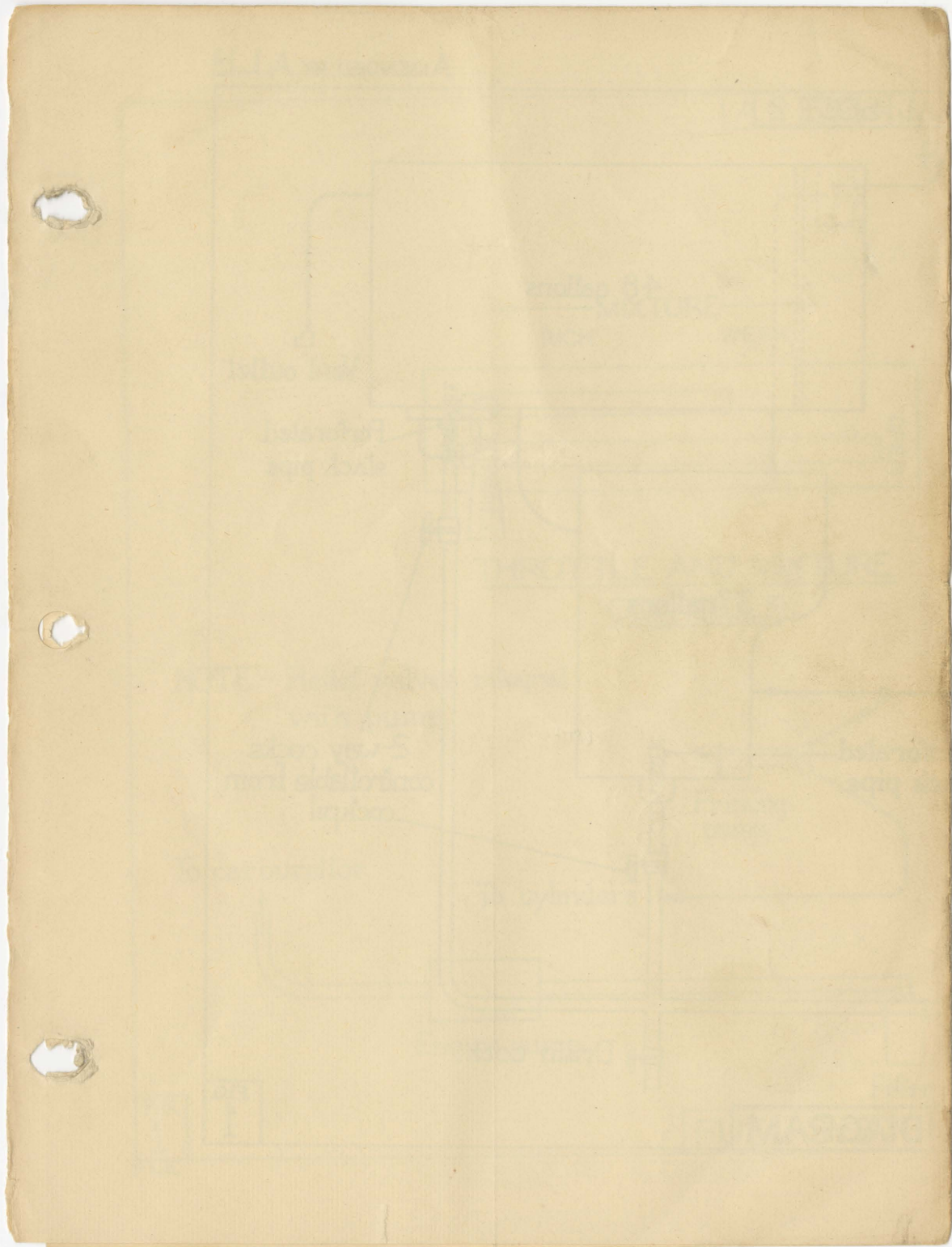
FIG 2

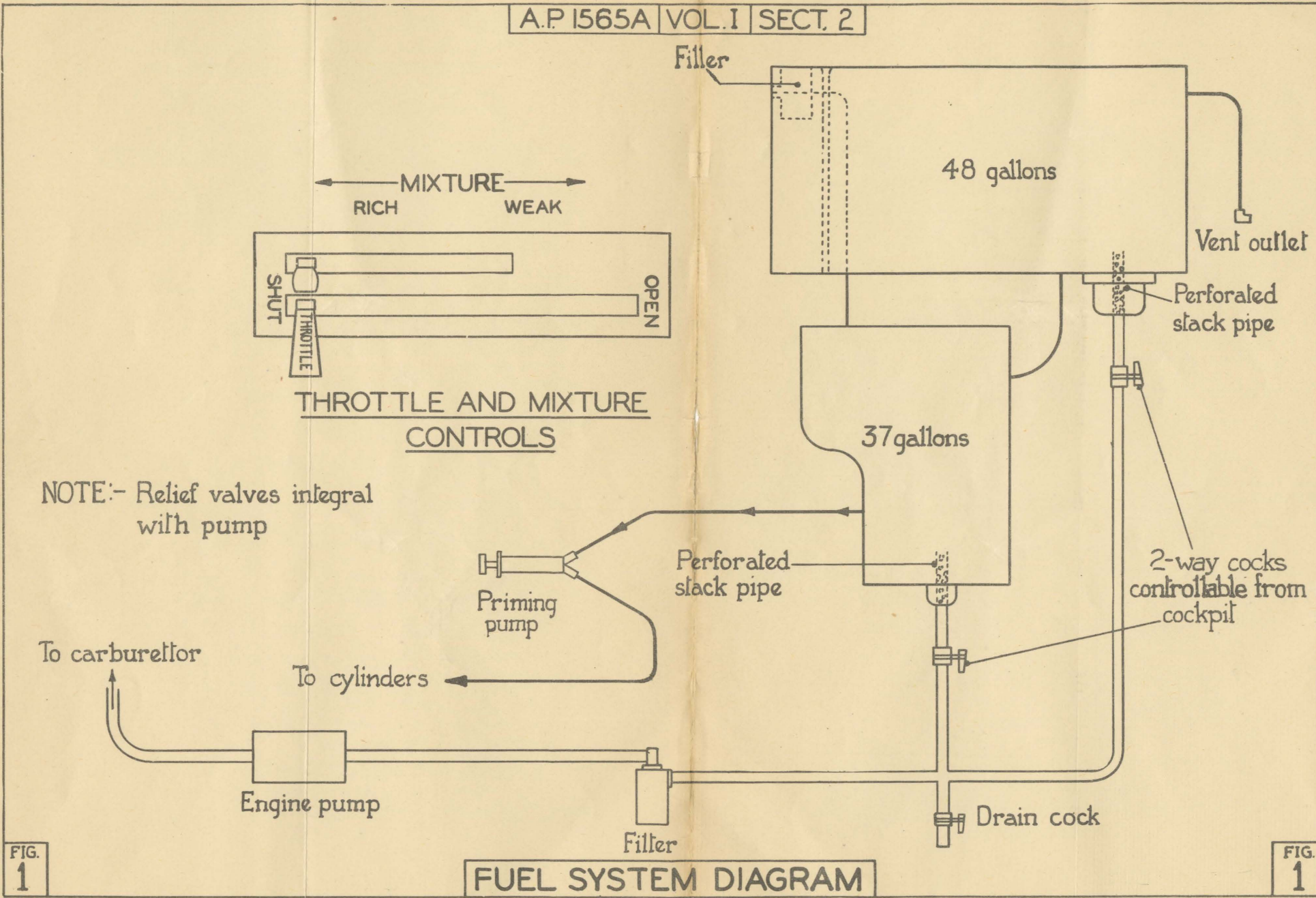
STARBOARD SIDE OF COCKPIT

FIG 2









THROTTLE AND MIXTURE CONTROLS

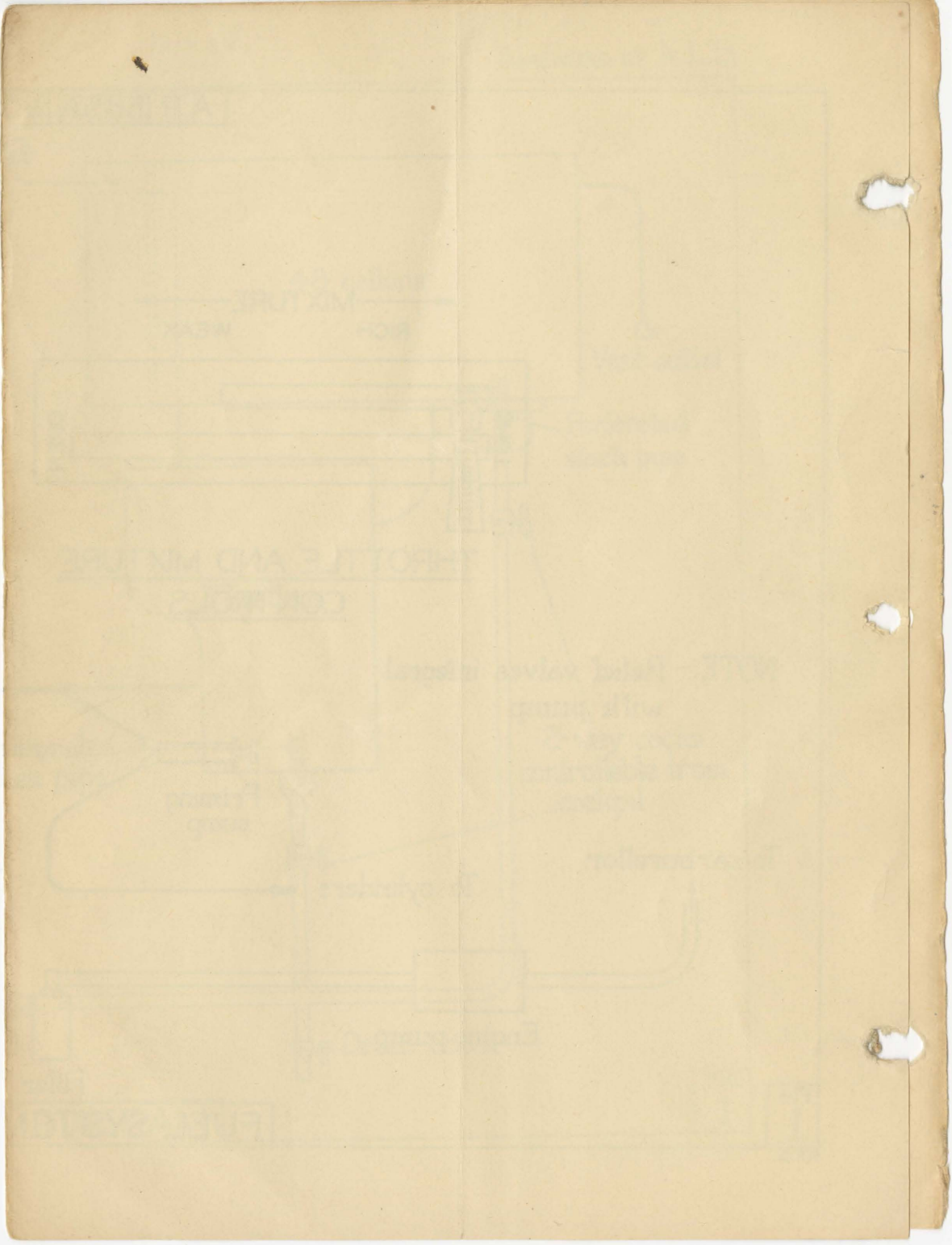
NOTE:- Relief valves integral with pump

FUEL SYSTEM DIAGRAM

FIG. 1

FIG. 1

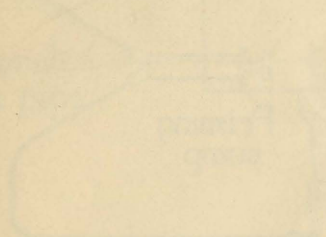




MIXTURE  
WEAR

BOTTLE AND MINOR  
CONTROL

WATER-HEAT EXCHANGER  
with pump



FUEL SYSTEM

SECTION 2

HANDLING AND FLYING NOTES FOR PILOT

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

1. ENGINE DATA : MERLIN II OR III

- (i) Fuel:- Operational units: 100 octane only.  
Other units: 87 octane
- (ii) Oil:- Key letter Y/Y.
- (iii) Coolant:- 30% Treated Ethylene Glycol. Stores ref. 33C/559.
- (iv) The principal engine limitations are as follows:

|                                    | R. p. m. | Boost<br>lb/sq. in.      | Temp. °C.<br>Coolant. Oil. |    |
|------------------------------------|----------|--------------------------|----------------------------|----|
| TAKE-OFF<br>TO 1,000 FT.           | 3,000    | +6 $\frac{1}{4}$         | -                          | -  |
| CLIMBING<br>$\frac{1}{2}$ HR LIMIT | 2,600    | +6 $\frac{1}{4}$         | 120                        | 90 |
| CRUISING<br>RICH                   | 2,600    | +4 $\frac{1}{2}$         | 95                         | 90 |
| CRUISING<br>WEAK                   | 2,600    | +2 $\frac{1}{4}$         | 95                         | 90 |
| ALL OUT<br>5 MINS LIMIT            | 3,000    | +6 $\frac{1}{4}$         | 120                        | 95 |
| OIL PRESSURE:                      |          | NORMAL:                  | 60 lb/sq. in.              |    |
|                                    |          | EMERGENCY MINM (5 MINS): | 45 lb/sq. in.              |    |
| MINM. TEMP. FOR TAKE-OFF:          |          | OIL:                     | 15°C.                      |    |
|                                    |          | COOLANT:                 | 60°C.                      |    |



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(v) The following limitations must also be observed:

At  $+6\frac{1}{2}$  lb/sq.in boost: Minimum r.p.m. 2,080

Diving: Maximum boost:  $+6\frac{1}{2}$  lb/sq.in.  
Maximum r.p.m. 3,600

3,000 r.p.m. may be exceeded only for 20 seconds with throttle not less than one third open.

(vi) Fuel pressure:  $2\frac{1}{2}$  - 3 lb/sq.in.

(vii) Combat concessions:

(a) When using 100 octane fuel,  $+12$  lb./sq.in. boost, obtained by operating the boost control cut-out, may be used for short periods.

(b) Maximum r.p.m. below 20,000 feet ( $\frac{1}{2}$  hr.limit): 2,850  
Maximum r.p.m. above 20,000 feet ( $\frac{1}{2}$  hr.limit): 3,000

Use of these concessions must be reported upon landing and an entry made in the engine log book.

2. FLYING LIMITATIONS

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

Diving: 450  
Undercarriage down: 160  
Flaps down: 140  
Landing lamps lowered: 140

3. PRELIMINARIES

On entering the cockpit check:

Undercarriage selector lever - DOWN  
(Check that indicator shows DOWN: switch on light indicator and check that green lights appear).

Flaps - UP

Landing lamps - UP

Contents of lower fuel tank.

4. STARTING THEN ENGINE AND WARMING UP

(1) Set:

Both fuel cock levers - ON  
Throttle -  $\frac{1}{2}$  inch open.  
Mixture control - RICH  
Airscrew speed control - Fully back.  
Radiator shutter - OPEN

(ii) Switch ON the main and starting magnetos.

(iii) Operate the priming pump to prime the suction and delivery pipes. This may be judged by a sudden increase in resistance of the plunger.

(iv) Press the starting button, or begin hand starting, and at the same time operate the priming pump rapidly. The number of strokes which must be given while the engine is being turned, before it may be expected to start, is as follows:

|                       |     |     |     |    |     |     |
|-----------------------|-----|-----|-----|----|-----|-----|
| Air temperature °C.   | +30 | +20 | +10 | 0  | -10 | -20 |
| Normal fuel:          | 3   | 4   | 7   | 13 |     |     |
| High volatility fuel: |     |     |     | 4  | 8   | 15  |

The engine should start without greatly exceeding the above number of strokes, or after not more than two if the engine is hot.



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- (v) Turning periods should not exceed 20 seconds, with an interval of at least 30 seconds between each attempt.
- (vi) At temperatures below 0°C. it may be necessary to continue priming after the engine fires and until it is running satisfactorily.
- (vii) As soon as the engine is running evenly, switch OFF the starting magneto and screw down the priming pump.

#### 5. TESTING ENGINE AND INSTALLATIONS

- (i)(a) While warming up make the usual check of temperatures, pressures and controls.

Brake pressure should be at least  
120 lb/sq.in.

- (b) See that the cockpit hood is locked open and that the emergency exit door is set at the "half cock" position.
- (ii) After a few minutes move the airscrew speed control slowly forward and then exercise it a few times.

(ii) After warming up, see that there are TWO men on the tail and, with the airscrew speed control fully forward, test as follows:-

- (a) Open throttle to give zero boost and check operation of constant-speed unit.
- (b) Open throttle to give +  $4\frac{1}{2}$  lb/sq.in boost and check magnetos and oil pressure.
- (c) Open up to full throttle momentarily and check static r.p.m. (2650 - 2700) and boost.

(iii) Warming up must not be unduly prolonged because radiator temperature before taxiing out must not exceed 100°C. *THE DROP IN R.P.M. SHOULD NOT EXCEED 150*

*REFER TO AL-25 AT END OF BOOK*

TAXYING OUT.

6. It may be found that one wing tends to remain down while taxiing. This is due to stiffness in the undercarriage leg, especially in a new aeroplane.

FINAL PREPARATION FOR TAKE-OFF - DRILL OF VITAL ACTIONS

7. Drill is "T.M.P., Fuel, Flaps and Radiator."

T - Trimming Tabs - Elevator about one division nose down from neutral.  
Rudder fully to starboard.

M - Mixture control - RICH

P - Pitch - Airscrew speed control fully forward.

Fuel - Both cock levers ON and check contents of lower tank.

Flaps - UP

Radiator shutter - Fully open.



#### TAKE-OFF

8. (i) Open the throttle fully. Any tendency to swing can be counteracted by coarse use of the rudder. If taking off from a small aerodrome with a full load, max. boost may be obtained by operating the boost control cut-out.
- (ii) After raising the undercarriage, see that the red indicator light - UP - comes on (it may be necessary to hold the lever hard forward against the quadrant until the indicator light comes on).
- (iii) Do not start to climb before a speed of 140 m.p.h. A.S.I.R. is attained.

#### CLIMBING

9. For maximum rate of climb the following speeds are recommended:-

|                             |     |        |          |
|-----------------------------|-----|--------|----------|
| Ground level to 12,000 feet | 185 | m.p.h. | A.S.I.R. |
| 12,000 feet to 15,000 feet  | 180 | "      | "        |
| 15,000 " " 20,000 "         | 170 | "      | "        |
| 20,000 " " 25,000 "         | 160 | "      | "        |

#### GENERAL FLYING

10. (i) Stability and control. - This aeroplane is stable. With metal covered ailerons the lateral control is much lighter than with the earlier fabric covered ailerons and pilots accustomed to the latter must be careful not to overstress the wings. Similar care is necessary in the use of the elevators which are light and sensitive.
- (ii) For normal cruising flight the radiator shutter should be in the minimum drag position.

(iii) Change of trim.-

Undercarriage down - nose down  
 Flaps down - nose down.

- (iv) Maximum range: For greatest range fly in WEAK mixture at 160 m.p.h. I.A.S. at the lowest possible r.p.m.
- (v) For combat manoeuvres, climbing r.p.m. should be used.
- (vi) For stretching a glide in the event of a forced landing, the propeller speed control should be pulled right back and the radiator flap put at the minimum drag position.

## STALLING.

- 11.(i) At the stall one wing will usually drop with flaps either up or down and the machine may spin if the control column is held back.
- (ii) This aeroplane has sensitive elevators and, if the control column is brought back too rapidly in a manoeuvre such as a loop or steep turn, stalling incidence may be reached and a high-speed stall induced. When this occurs there is a violent shudder and clattering noise throughout the aeroplane, which tends to flick over laterally and, unless the control column is put forward instantly, a rapid roll and spin will result.
- (iii) Approximate stalling speeds when loaded to about 6,250 lb. are:-

|                            |    |        |        |
|----------------------------|----|--------|--------|
| Flaps and undercarriage UP | 73 | m.p.h. | I.A.S. |
| " " " DOWN                 | 64 | "      | "      |

## SPINNING

- 12.(i) Spinning is permitted by pilots who have written permission from the C.O. of their squadron (C.F.I. of an O.T.U.). The loss of height involved in recovery may be very great, and the following height limits are to be observed:-
- (a) Spins are not to be started below 10,000 feet.
- (b) Recovery must be started not lower than 5,000 feet.



- (ii) A speed of over 150 m.p.h. I.A.S. should be attained before starting to ease out of the resultant dive.

#### AEROBATICS.

- 13.(i) This aeroplane is exceptionally good for aerobatics. Owing to its high performance and sensitive elevator control, care must be taken not to impose excessive loads either on the aeroplane or on the pilot and not to induce a high-speed stall. Many aerobatics may be done at much less than full throttle. Cruising r.p.m. should be used, because if reduced below this, detonation might occur if the throttle is opened up to climbing boost for any reason.
- (ii) The following speeds are recommended for aerobatics:-

Looping.- Speed should be about 300 m.p.h. I.A.S. but may be reduced to 220-250 m.p.h. when the pilot is fully proficient.

Rolling.- Speed should be anywhere between 180 and 300 m.p.h. I.A.S. The nose should be brought up about 30° above the horizon at the start, the roll being barrelled just enough to keep the engine running throughout.

Half roll off loop.- Speed should be 320-350 m.p.h. I.A.S.

Upward roll.- Speed should be about 350-400 m.p.h. I.A.S.

Flick manoeuvres.- Flick manoeuvres are not permitted.

#### DIVING

- 13a(i) The aeroplane becomes very tail heavy at high speed and must be trimmed into the dive in order to avoid the danger of excessive acceleration in recovery. The forward trim should be wound back as speed is lost after pulling out.
- (ii) A tendency to yaw to the right should be corrected by use of the rudder trimming tab.

## APPROACH AND LANDING.

14.(1) During the preliminary approach see that the cockpit hood is locked open, and the emergency exit door is set at half-cock position. Take care not to get the arm out into the airflow.

(ii) Reduce speed to 140 m.p.h. I.A.S. and carry out the Drill of Vital Actions "U.M.P. and flaps".

U - Undercarriage - DOWN (Watch indicators and check green lights)

M - Mixture control - RICH

P - Pitch - Propeller speed control fully forward.

Flaps - DOWN

(iii) When lowering the undercarriage hold the lever fully forward for about two seconds. This will take the weight off the locking pins and allow them to turn freely when the lever is pulled back. The lever should then be pulled back smartly to the down position; if it cannot be pulled fully back, hold it forward again for at least two seconds. If it becomes jammed it may generally be released by a smart blow of the hand. If this fails it is necessary to take the weight of the wheels off the locking pins, either by pushing the nose down sharply or by inverting the aeroplane. The lever can then be pulled straight back.

(iv) If the green indicator light does not come on, hold the lever fully back for a few seconds. If this fails, raise the undercarriage and repeat the lowering. If this fails also, use the emergency system (see Section 1, Para.12.)

Note: Before the emergency system can be used, the control lever must be in the down position. It may be necessary to push the nose down or invert the aeroplane in order to get the lever down.

(v) Correct speeds for the approach:-

Engine assisted - about 85 m.p.h. I.A.S.

Glide - " 90 " "



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- (vi) Sideslips may be performed quite satisfactorily with the flaps either up or down.

MISLANDING.

15. Climb at about 120 m.p.h. I.A.S.

LANDING ACROSS WIND.

16. The aeroplane can be landed across wind but it is undesirable that such landings should be made if the wind exceeds about 20 m.p.h.

AFTER LANDING

- 17.(i) After taxiing in, set the airscrew speed control fully back and open up the engine sufficiently to change pitch to course.
- (ii) Allow the engine to idle for a few seconds then pull the slow running cut-out (if fitted) and hold it out until the engine stops.
- (iii) Turn OFF both fuel cocks.
- (iv) When the engine has stopped, switch OFF the ignition.

FLYING AT REDUCED AIRSPEEDS.

18. Reduce the speed to about 120 m.p.h. I.A.S. and lower the flaps. The radiator shutter must be opened to keep the temperature at about 100°C and the propeller speed control should be set to give cruising r.p.m.

POSITION ERROR TABLE.

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

|          | m.p.h. |     |     |     | I.A.S. |     |     |     |     |       |
|----------|--------|-----|-----|-----|--------|-----|-----|-----|-----|-------|
| From     | 100    | 110 | 120 | 130 | 140    | 150 | 165 | 180 | 195 | 220 & |
| To       | 110    | 120 | 130 | 140 | 150    | 165 | 180 | 195 | 220 | over  |
| Add      | 10     | 8   | 6   | 4   | 2      | -   |     |     |     |       |
| Subtract |        |     |     |     |        | -   | 2   | 4   | 6   | 8     |

FUEL AND OIL CAPACITY AND CONSUMPTION

20.(1) Fuel and oil capacities.-

Fuel capacity:-

|                          |             |                   |
|--------------------------|-------------|-------------------|
| 2 Main tanks             | - top tank  | 48 gallons        |
|                          | bottom tank | 37 gallons        |
| Total effective capacity |             | <u>85 gallons</u> |

Oil capacity:-

Effective capacity 5.8 gallons

(ii) Fuel consumption:-

| Max r.p.m. and<br>boost for:                                       | Height<br>feet | Approximate<br>consumption<br>galls/hr. |
|--|----------------|---|
| Climbing   | 12,000         | 81                                      |
| Cruising RICH  | 14,500         | 68                                      |
| " WEAK   | 18,500         | 49                                      |
| All-out level.   | 17,000         | 89                                      |
| Most economical<br>cruising (1700<br>r.p.m., 150 m.p.h.<br>I.A.S.) | 14,000         | 25                                      |

OIL DILUTION IN COLD WEATHER.

21. See A.P.2095/4. The dilution period should be:

Atmospheric temperatures above - 10°C: 1 $\frac{1}{4}$  minutes  
Atmospheric temperatures below - 10°C: 2 $\frac{1}{2}$  minutes



THE UNIVERSITY OF CHICAGO

PHYSICS DEPARTMENT

PHYSICS 309

PROBLEM SET 1

Due Date: \_\_\_\_\_

Name: \_\_\_\_\_

Section: \_\_\_\_\_

Grading: \_\_\_\_\_

1. (10 points)

A particle of mass  $m$  moves in a circular path of radius  $r$  with constant speed  $v$ . Calculate the magnitude of the centripetal force.

2. (10 points)

A particle of mass  $m$  moves in a circular path of radius  $r$  with constant speed  $v$ . Calculate the magnitude of the centripetal force.

3. (10 points)

A particle of mass  $m$  moves in a circular path of radius  $r$  with constant speed  $v$ . Calculate the magnitude of the centripetal force.

4. (10 points)

A particle of mass  $m$  moves in a circular path of radius  $r$  with constant speed  $v$ . Calculate the magnitude of the centripetal force.

5. (10 points)

6. (10 points)

7. (10 points)

8. (10 points)

May 1942  
AIR MINISTRY

Amendment List No.25/J.  
to  
AIR PUBLICATION 1565A.  
Volume I and  
Pilot's Notes.

SPITFIRE I AEROPLANE  
MERLIN II OR III ENGINE

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

|    |    |    |    |    |
|----|----|----|----|----|
| 13 | 14 | 18 | 19 | 25 |
| A  | B  | D  | F  | J  |

- 
- (1) SECTION 2                      Para.5(iii)(b) Add at end of sub-para.: "The drop in r.p.m. should not exceed 150".
- (2) SECTION 2                      Para.5. Mark end of this paragraph to refer to this sheet and note the following: "When engines are being kept warm in readiness for immediate take-off, de Havilland 20° C.S. propeller should be left in fine pitch - control lever fully forward".
- (3) SECTION 2                      Remove existing sheets bearing Paras.10(iii) to 20(ii) and substitute new sheets supplied herewith.
- (4) SECTION 2                      Remove Amendment List No.24/H and insert this sheet at end of Section as authority for the above amendments.



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AIR MINISTRY.

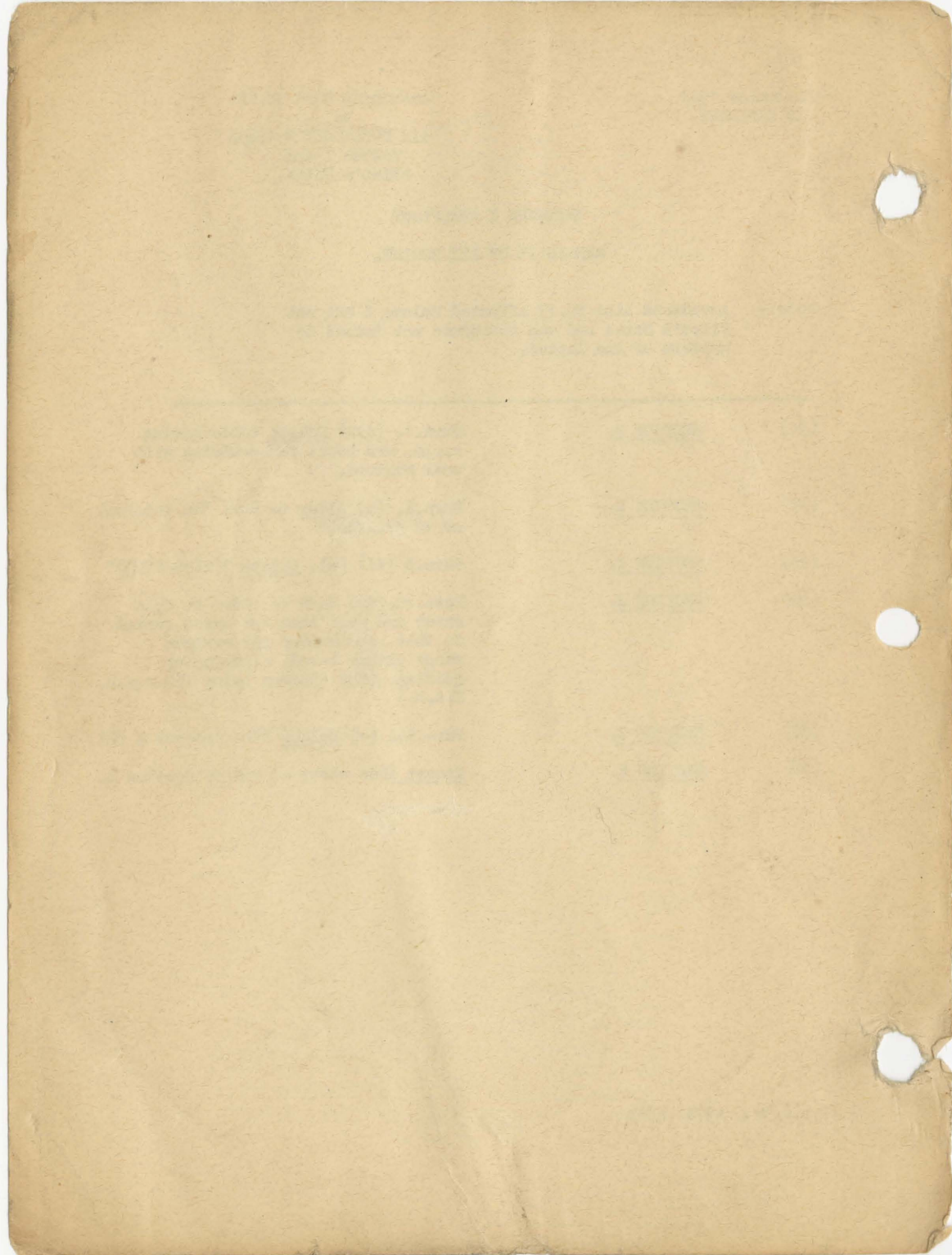
Amendment List No.18.  
to  
AIR PUBLICATION 1565A  
Volume I and  
Pilot's Notes.

SPITFIRE I AEROPLANE  
MERLIN II OR III ENGINE.

Note:- Amendment List No.17 affected Volume I but not Pilot's Notes and was therefore not issued to holders of the latter.

- 
- (31)      SECTION 2.                      Para.1. (iii) Delete table giving r.p.m. and boost for cruising with weak mixture.
- (32)      SECTION 2.                      Para.4. (v) Alter to read "an interval of 15 seconds."
- (33)      SECTION 2.                      Para.5 (ii) (c). Delete "(2650-2700)"
- (34)      SECTION 2.                      Para.10.(iv) Mark to refer to this sheet and note that the speed quoted is that recommended for maximum range either level, climbing or gliding. (The optimum being 150 m.p.h. I.A.S.)
- (35)      SECTION 2.                      Para.14. (v) Delete "The Creeper - 80"
- (36)      SECTION 2.                      Insert this sheet at end of Section 2.





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Type 472 style B  
Metal - 2  
V. + 24 - No - 5<sup>th</sup>