AIR PUBLICATION 1565F

Pilots Notes

# PILOT'S NOTES

# THE SPITFIRE VI AEROPLANE

# MERLIN 47 ENGINE

Prepared by direction of the
Minister of Aircraft Production

A. C. Portal

Promulgated by order of the Air Council

AIR MINISTRY

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ISSUED WITH A.L. N° 1/A.



SPITFIRE F MK. VI

FRONTISPIECE

Pilot's Notes

## AMENDMENT CERTIFICATE

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| Amendt. List No. | 2A | | | | | | | | | |
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| Prelimy. matter | ✓ | | | | | | | | | |
| Leading Partics. | | | | | | | | | | |
| Introducn. | | | | | | | | | | |
| Section 1 | | | | | | | | | | |
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Where amendment action has taken place, the number of the amendment list concerned will be found at the top of each page affected, and amendments of technical importance will be indicated by a vertical line on the left-hand side of the text against the matter amended or added. Vertical lines relating to previous amendments to a page are not repeated. If complete revision of any division of the book (e.g. a Chapter) is made this will be indicated in the title page for that division and the vertical lines will not be employed.

January, 1942. AIR PUBLICATION 1565F
Pilots' Notes

## LIST OF SECTIONS





R.T.P/1168. 1200. 1/42

## SECTION I

## PILOT'S CONTROLS AND EQUIPMENT

### INTRODUCTION

1. The Spitfire VI is a single seat, low wing monoplane fighter, fitted with a Merlin 47 engine and a Rotol 35° four bladed constant speed propeller, and equipped with a high altitude pressure cabin

### MAIN SERVICES

2. Fuel system.- Fuel is carried in two tanks mounted one above the other (the lower one is self-sealing) 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 |

Pressurising of the tanks is controlled by an automatic valve which comes into operation at 20,000 feet. Pressure may be released by a cock on the right of the fuel tank cock. On later aeroplanes a long-range jettisonable tank of 30 or 90 gallons capacity can be fitted beneath the fuselage. See Section 2, Para. 17 for management of jettisonable fuel tank.

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

When a 90 gallons jettisonable fuel tank is fitted the above tank is replaced by a larger tank of 8.5 gallons capacity.

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 300 lb/sq.in pressure.

Amended by A.L.No. 1/A

6. Electrical system.- A 12 Volt generator, controlled by a switch above the instrument panel, supplies an accumulator which in turn supplies the whole of the electrical installation. There is a voltmeter on the left of the switch.

AEROPLANE CONTROLS

7. (a) Primary flying controls and locking devices.- The control column is of the spade-grip pattern and incorporates the brake lever and gun and cannon firing control. The rudder pedals have two positions for the feet and are adjustable for leg reach by rotation of star wheels on the sliding tubes. Control locking struts are stowed on the right hand side of the cockpit, hehind the seat.

(b) 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 on 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 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 cables. 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, altimeter, directional gyro, artificial horizon, rate of climb and descent indicator, and turn and bank indicator.

9. Trimming tabs. - The elevator trimming tabs are controlled by a hand wheel on the left hand side of the cockpit, the indicator being on the instrument panel. The rudder trimming tab is controlled by a small hand wheel and is not provided with an indicator. The aeroplane tends to turn to starboard when the hand wheel is rotated clockwise.

10. Undercarriage control and Indicators. -

(a) The undercarriage selector lever 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. A hydraulic valve indicator in the quadrant shows DOWN, or IDLE, or UP, depending upon the position of the hydraulic valve. UP or DOWN should normally show only when the selector lever is operated to raise or lower the undercarriage and IDLE when the lever has automatically sprung back into the gate after raising or lowering the undercarriage. If, with the engine not running, the indicator shows DOWN, it should return to IDLE when the engine is started.

(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 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 indicatoris 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 mainplane 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 on the side of the throttle quadrant. As soon as the throttle is again advanced beyond about one quarter of its travel the pushbutton 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.

12. Undercarriage emergency operation. -
(a) A 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 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° 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 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, showing the air pressure in the pneumatic system cylinders and at each brake, is mounted on the left-hand side of the instrument panel.

ENGINE CONTROLS.

14. Throttle and mixture controls. - The throttle and mixture levers are fitted in a quadrant on the port side of the cockpit. A gate is provided for the throttle lever in the take-off position and an inter-locking device between the levers prevents the engine from being run on an unsuitable mixture. Friction adjusters for the controls are fitted on the side of the quadrant. On later aeroplanes there is no mixture control lever.

15. Automatic boost cut-out. - The automatic boost control may be cut-out by pushing forward the small red painted lever at the forward end of the throttle quadrant.

16. Propeller control. - The control lever for the Rotol 35°, four-bladed, constant-speed propeller is on the throttle quadrant.

17. Radiator flap control. - The flap at the outlet end of the radiator duct is operated by a lever 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 grip on the right hand side of the instrument panel.

19. Fuel cock control and contents gauge. - The main fuel cock control is fitted at the bottom of the instrument panel. With the lever in the up position the cock is open. The fuel contents gauge on the instrument panel indicates the contents of the lower tank, but only when the adjacent push button is pressed. The jettisonable tank cock control and jettison lever are mounted together on the right hand side of the cockpit below the undercarriage control unit. The jettison lever is pulled up to jettison the fuel tank, but cannot be operated until the cock control is moved forward to the OFF position.

Amended by A.L. No.13/D

20. Fuel tank pressurising. - To meet the possibility of engine cutting due to fuel boiling in warm weather at high altitudes, the main tanks can be pressurised (operative above 20,000 feet). Pressurising, however, impairs the self sealing of the tanks and should, therefore, be turned ON only when fuel pressure drops to 6 lb/sq. in. or the fuel pressure warning lamp (if fitted) comes on. In very warm weather at very high altitudes a rich cut may occur with the tanks pressurised and pressure must then be turned OFF.

21. Fuel priming pump. - A hand-operated pump for priming the engine is mounted on the right hand side of the instrument panel.

22. Ignition switches. - The ignition switches are on the left hand bottom corner of the instrument panel.

23. Electric starting. - The booster coil and engine starting push buttons are under a shield at the bottom of the instrument panel, 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.

24. 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.

25. Oil dilution. - A push button for operating the solenoid valve is on the left hand side of the cockpit.

26. Engine Instruments. - The engine instruments are grouped on the right-hand side of the instrument panel and consist of an engine-speed indicator, fuel pressure gauge, boost gauge, oil pressure gauge, oil temperature gauge, radiator temperature gauge, and fuel contents gauge. On later aeroplanes a fuel pressure red warning light is fitted instead of the pressure gauge.

COCKPIT ACCOMMODATION AND EQUIPMENT

27.(a) Pressure cabin. - The aeroplane is fitted with a pressure cabin for high altitude flying. Air is drawn through an intake just below the starboard exhaust manifold and passes through a filter to an engine-driven blower. On entering the cabin the delivery pipe breaks into a number of individual lines and the air is distributed over the forward side panels, the windscreen and cabin roof by means of small holes in each of the pipe-lines. The cock on each side of the windscreen should be opened only when diving or on descending from high altitudes, and must always be closed on the climb and in normal flight so as to prevent misting-up of the windscreen.

(b) Pressure cabin controls. - A differential pressure of +2 lb/sq.in. is maintained by a valve which is operated by the pilot by means of a Bowden lever on the left-hand side of the cockpit. The valve enables the pilot to apply or release the cabin pressure at will. A second relief valve is provided which equalises the pressure should it tend to become differential in a negative sense. On later aeroplanes a single automatic control valve is fitted, by means of which pressure begins to build up on the climb and the full differential pressure of +2 lb/sq.in is attained. The reverse holds on the descent.

(c) Pressure cabin instruments. - The additional instruments necessary for the pressure cabin are grouped on a panel immediately below the right-hand side of the instrument panel. An altimeter is provided to which the pilot refers when adjusting the oxygen supply. Visual indication of any drop in cabin pressure is given by two red warning lights which come on when the differential pressure has fallen by 1 lb/sq.in, or if the control valve is in the off position.

28. Pilot's seat control. - The seat is adjustable for height by means of a lever on the right hand side of the seat.

29. Safety harness release. - In order that the pilot may lean forward without unfastening his harness, a release catch is fitted on the right hand side of the seat.

Amended by A.L.No.1/A

30. Cabin top locking control. - The cabin top is located by three dowel pins and is tightened down by the wedging action of four dogs; the front and rear dogs are connected together by two metal cables which enable the pilot to release the aft ones when necessary.

31. Direct vision panel. - A small hinged panel is provided on the left hand side of the windscreen for use in event of the windscreen becoming obscured. It may also be used for releasing the hood from outside in order to extricate an injured or unconscious pilot.

32. Cockpit lighting. - A flood light is fitted on each side of the cockpit. Each is controlled by a switch immediately below the instrument panel.

33. Cabin ventilation. - A small adjustable flap on the right-hand side of the instrument panel is provided for ventilation of the cabin. The flap is opened by turning a knurled nut underneath the flap.

34. Oxygen. - Oxygen is supplied by two bottles and an economiser. A standard regulator unit is fitted on the left-hand side of the instrument panel and a bayonet socket is on the right hand side of the cockpit. A separate cock is provided in addition to the regulator.

35. Mirror. - A mirror providing a rearward view is fitted at the top of the windscreen.

36. Map cases. - A metal case for a writing pad and another for maps, books etc. are fitted on the left hand side of the cockpit. Stowage for a height-and-airspeed computor is provided below the wireless remote contactor.

OPERATIONAL EQUIPMENT AND CONTROLS.

37.(a) Guns. - The machine guns and cannon are fired pneumatically by means of push-buttons on the control column spade grip.

(b) The single push-button for firing eight machine guns 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.

(c) The triple push-button for firing machine guns and cannon is fitted with a milled finger which extends out of the bottom and is a means of locking the button in the SAFE position, SAFE and FIRE being engraved on the adjacent casing. When the catch is in the FIRE position a pip also extends out of the top of the casing so that the pilot can ascertain by feel the setting of the push button.

(d) The cannon cocking valve is mounted on the starboard side of the cockpit.

38.(a) Reflector gun sight. - For sighting the guns and cannon a reflector gun sight is mounted on a bracket above the instrument panel. A main switch and dimmer switch 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 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 can be slid behind the windscreen by pulling on the ring 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.

39.(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 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 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 for the cine-camera is mounted on the left hand side of the cockpit. The camera can also be controlled independently by means of an electrical push switch on the control column spade grip, below the gun firing control button.

## NAVIGATIONAL, SIGNALLING AND LIGHTING EQUIPMENT.

40.(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 is fitted on the port side of the cockpit above the throttle lever and a remote contactor and contactor master switch are fitted on the left 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 leave 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 on 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.

41.(a) Navigation and identification lamps. - The switch controlling the navigation lamps is on the instrument panel.

(b) The upward and downward identification lamps are controlled from the signalling switchbox 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 movements of the key can be adjusted by opening the cover and adjusting the screw and locknut at the centre of the cover.

42. Landing lamps - The landing lamps, one on each side of the aeroplane, are housed in the under-surface of the main plane. They are lowered and raised by a finger lever below the instrument panel. Each lamp has an independent electrical circuit and is controlled by a switch above the pneumatic control lever. 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 is provided to control the dipping of both landing lamps. On pulling up the lever the beam is dipped.

43. Signal discharger - A straight pull of the toggle control fires the cartridge out of the top of the fuselage, aft of the cockpit. A pre-selector control is fitted on the left-hand side of the cockpit by means of which one of various cartridges may be selected before firing.

DE-ICING EQUIPMENT.

44. (a) Windscreen de-icing - A tank containing the de-icing solution is mounted on the right hand side of the cockpit directly above the bottom longeron. A cock is mounted above the tank, and a pump and a needle valve to control the flow of the liquid are mounted below the undercarriage emergency lowering control. Liquid is pumped from the tank to a spray at the base of the wind-screen, from which it is sprayed upwards over the front panel of the screen.

Amended by A.L. No. 1/A.

(b) The flow of liquid is governed by the needle valve, after turning ON the cock and pushing down the pump plunger to its full extent. The plunger will return to the extended position on its own, and if required it can be pushed down again. When de-icing is no longer required the cock should be returned to the OFF position.

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

EMERGENCY EQUIPMENT.

46. Cabin top jettisoning - Jettisoning of the cabin top is effected by undoing the dogs and pushing the hood into the slip-stream. On some aeroplanes it may be necessary to detach the rubber hose connections before jettisoning the hood. A crowbar, for use in an emergency, is stowed on the left-hand side of the cockpit.

47. 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.

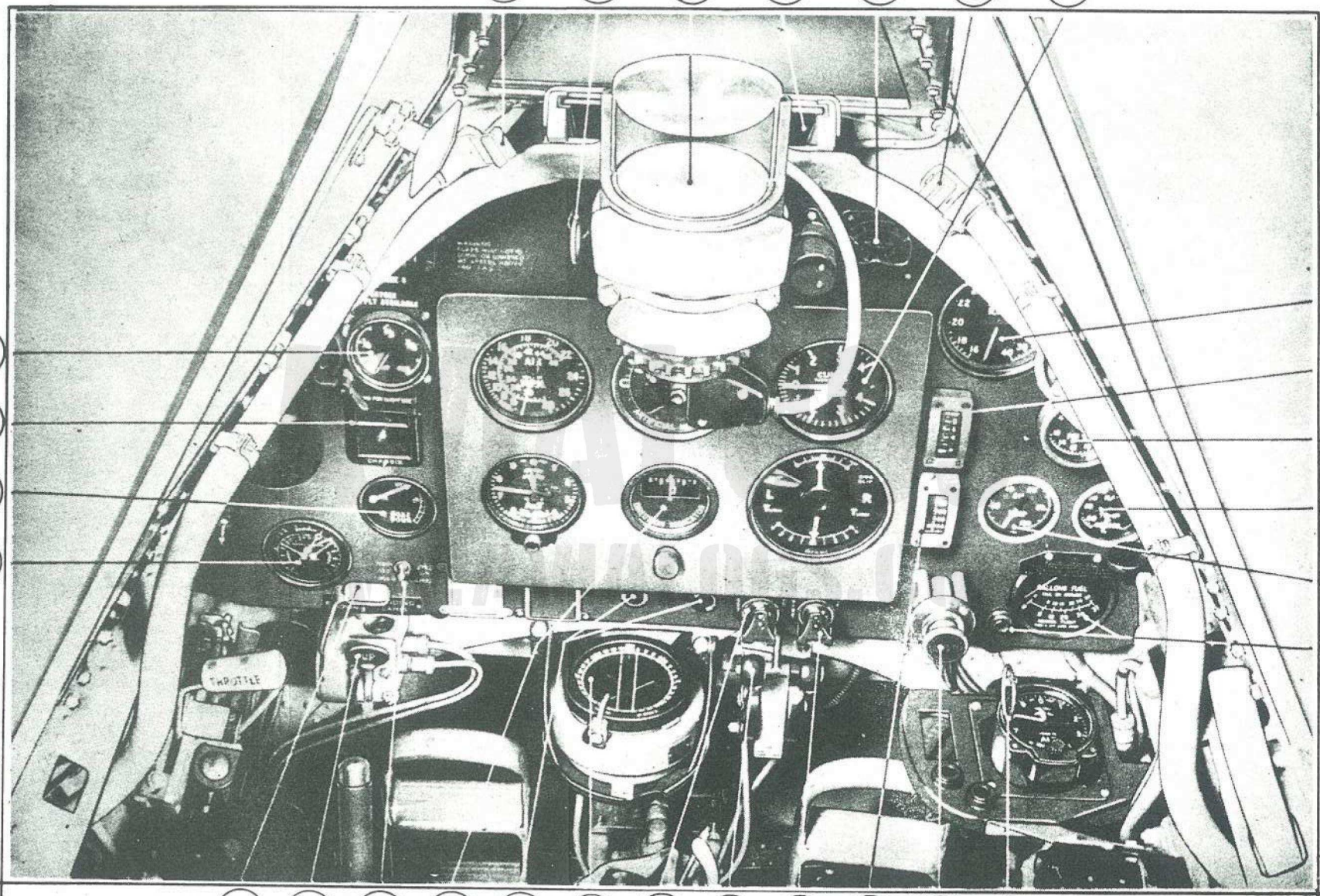



FIG 1

INSTRUMENT PANEL

FIG 1

KEY TO FIG. 1

1. Brake triple pressure gauge
2. Elevator tab position indicator
3. Undercarriage position indicator
4. Oxygen regulator
5. Windscreen air supply cocks
6. Lifting ring for sun screen
7. Reflector sight
8. Sun screen
9. Voltmeter
10. Rate of climb and descent indicator
11. Engine speed indicator
12. Fuel pressure gauge
13. Boost gauge
14. Radiator temperature gauge
15. Oil temperature gauge
16. Fuel contents gauge and push-button
17. Slow-running cut-out
18. Engine priming pump
19. Oil pressure gauge
20. Engine starter push-button
21. Fuel cock control
22. Booster coil push-button
23. Compass
24. Cockpit floodlight switches
25. Directional gyro
26. Landing lamp switch
27. Landing lamp control
28. Landing lamp dipping lever

## KEY TO FIG. 2.

29. Crowbar.
30. Cockpit pressure valve control.
31. Cockpit hood rubber hose connection.
32. Wedge plate for camera footage indicator.
33. Floodlight.
34. Camera indicator supply plug.
35. Mixture control lever.
36. Undercarriage horn switch.
37. Throttle lever.
38. Undercarriage indicator master switch.
39. Boost control cut-out.
40. Ignition switches.
41. Flap control.
42. Airspeed indicator.
43. Altimeter.
44. Cabin pressure warning light actuator.
45. Radiator flap control lever.
46. Engine control friction adjusters.
47. Propeller speed control.
48. Elevator trimming tab handwheel.
49. Map case.
50. Camera gun switch.
51. Pressure head heating switch.
52. Rudder trimming tab handwheel.
53. Immersed fuel pump push-button.

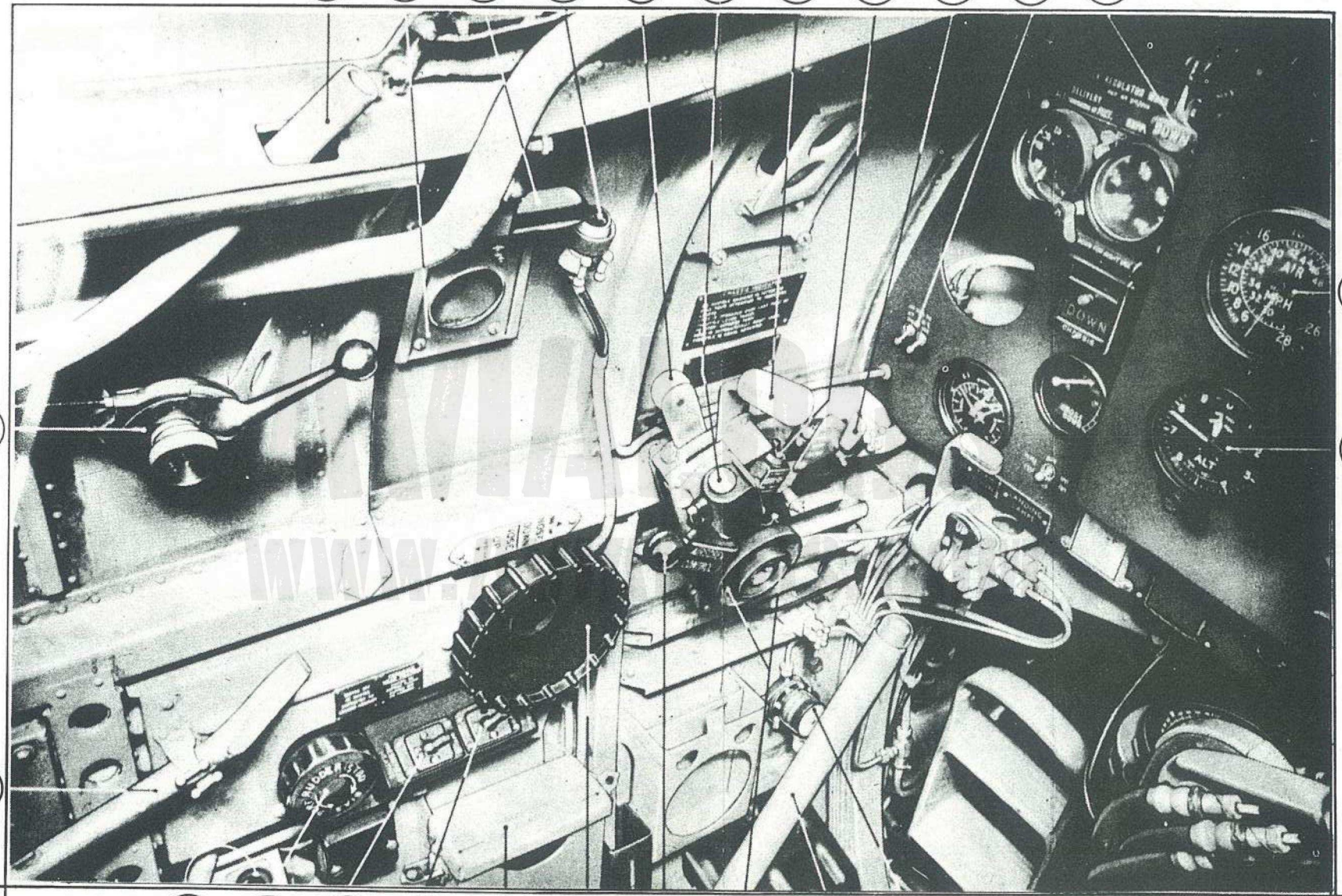



FIG. 2

PORT SIDE OF COCKPIT

FIG 2

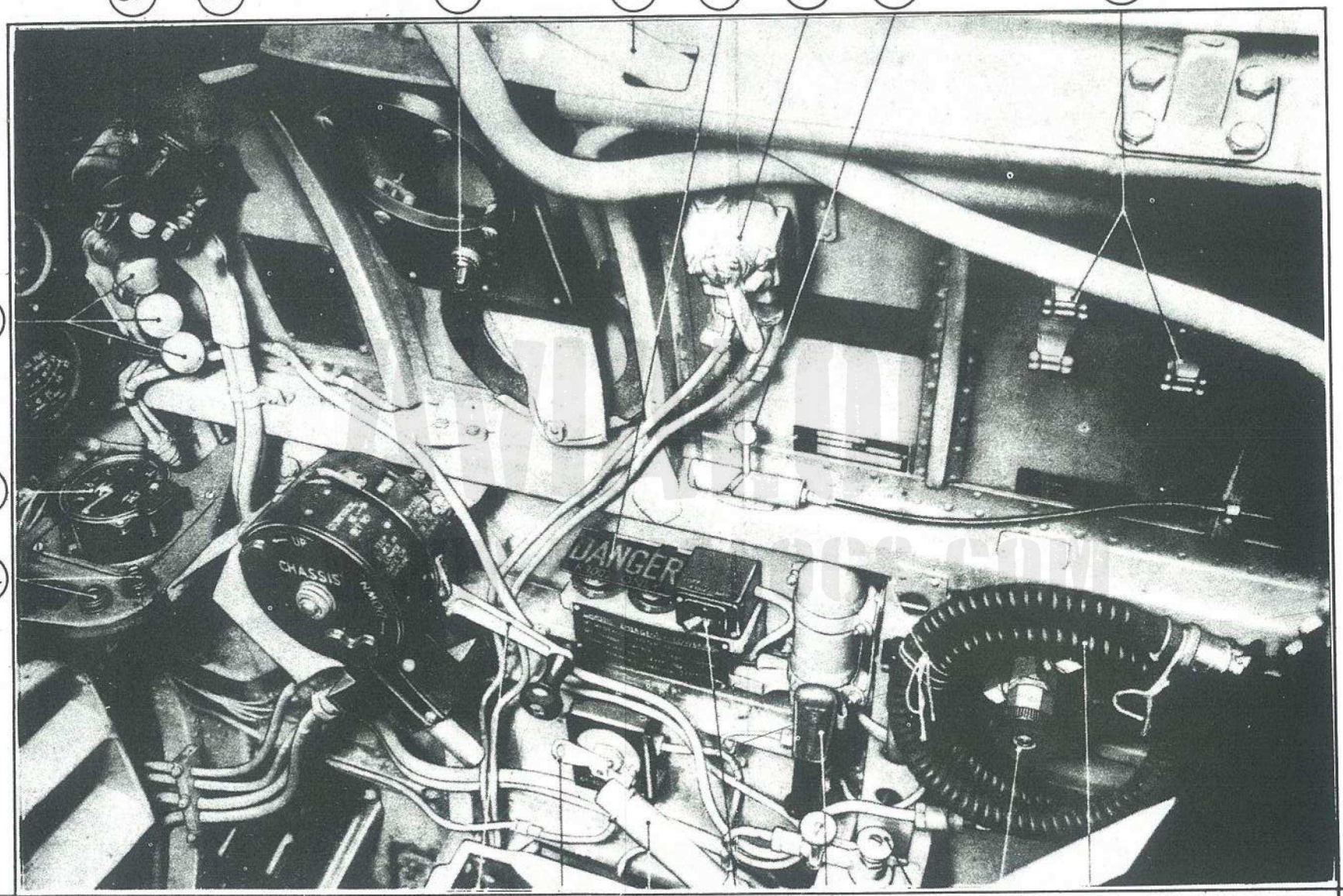


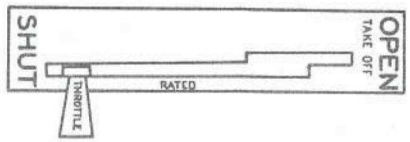

FIG. 3

STARBOARD SIDE OF COCKPIT

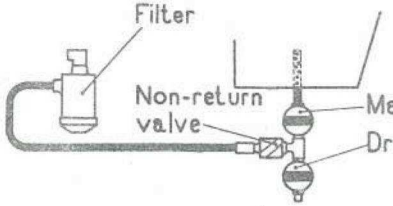
FIG. 3

## KEY TO FIG. 3

54. Cockpit pressure warning lights.
55. Cockpit altimeter.
56. Reflector sight lamps.
57. Signalling switch box.
58. Floodlight.
59. Remote contactor switch.
60. Cockpit hood rubber shoe connection.
61. R3002 push-buttons
62. Cannon cocking valve
63. Harness release control
64. Stowage clips for portfires.
65. Oxygen supply tube.
66. Oxygen supply cock.
67. Windscreen de-icing pump.
68. Undercarriage emergency lower control.
69. R.3002 master switch.
70. Seat adjustment lever.
71. Windscreen de-icing cock.
72. Undercarriage control unit lever.



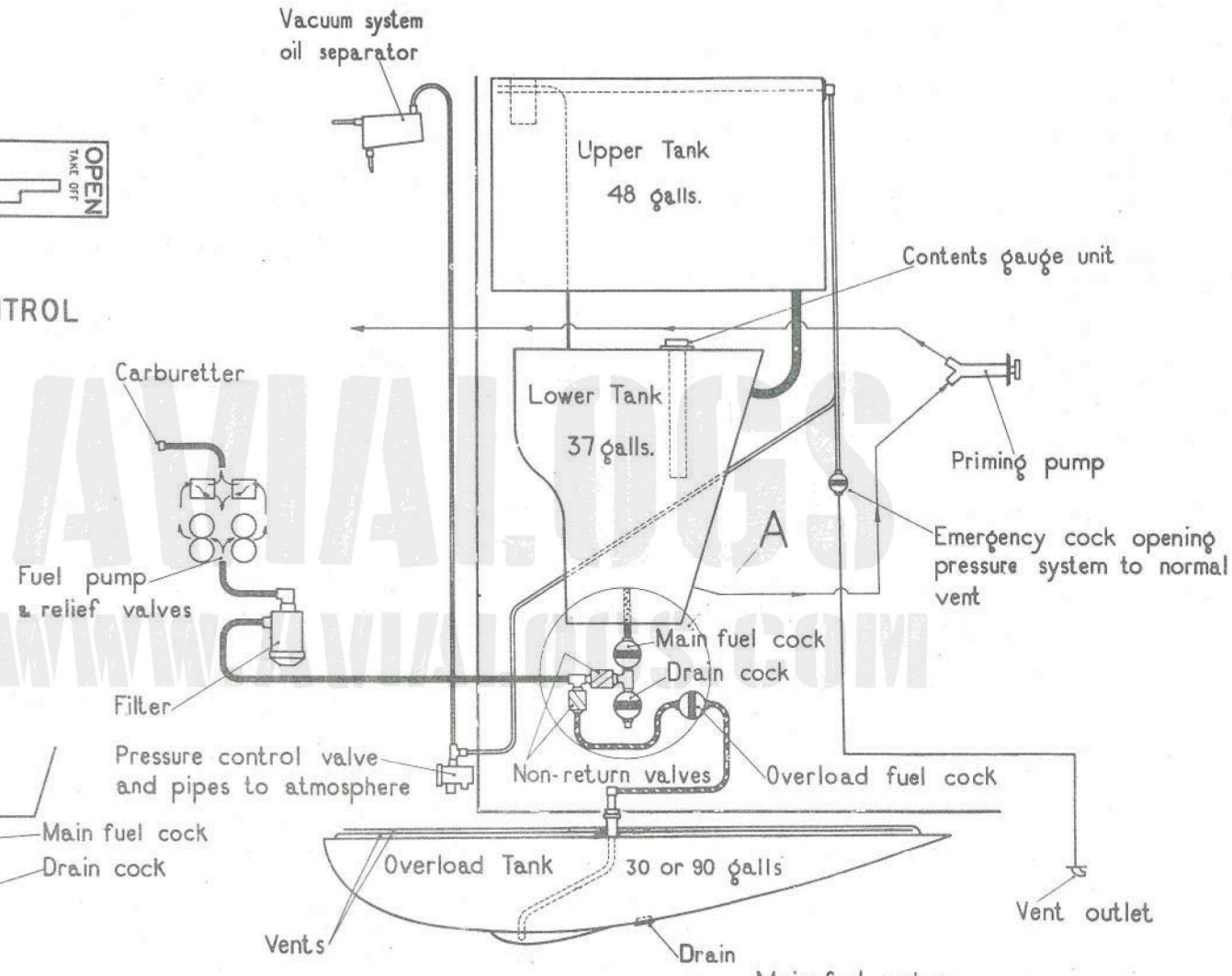

THROTTLE CONTROL




DETAIL A

AEROPLANES WITHOUT OVERLOAD TANK

FIG. 1




# FUEL SYSTEM DIAGRAM

FIG. 1

## 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 information is required.

1. ENGINE DATA: MERLIN 47

(i) Fuel.- 100 octane only

(ii) Oil.- See A.P.1464/C.37

(iii) Engine limitations:

| | R.p.m. | lb/sq.in. | Temp. °C Cylr. | Oil |
|---|---|---|---|---|
| MAX. TAKE-OFF TO 1,000 FT. | 3,000 | +12 | - | - |
| MAX. CLIMBING ½ HR. LIMIT | 2,850 | + 9 | 120(135) | 90(100) |
| MAX. RICH CONTINUOUS | 2,650 | + 7 | 100(115) | 90(100) |
| MAX. WEAK CONTINUOUS | 2,650 | + 4 | 100(115) | 90(100) |
| MAX. COMBAT 5 MINS LIMIT | 3,000 | +16* | 120(135) | (105) |

Note: The figures quoted in brackets are to be used as combat concessions only.
*Obtainable by operating boost-control cut-out.

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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(iv) Other limitations.-

| | |
|---|---|
| Diving: | Maximum r.p.m: 3,600. 3,000 r.p.m. may be exceeded only for 20 seconds, with throttle not less than ⅓ open. |

(v) Fuel pressure: 8 - 10 lb/sq.in.

2. FLYING LIMITATIONS

(i) Maximum permissible speeds for:

| | | | |
|---|---|---|---|
| Diving: | 450 | m.p.h. | I.A.S. |
| Undercarriage down: | 160 | " | " |
| Flaps down: | 160 | " | " |
| Landing lamps lowered: | 140 | " | " |

(ii) When fitted with a 90 gallon fuel tank, the aeroplane is restricted to straight flying until the tank is empty, or has been jettisoned.

Note.- Jettisonable tanks should be jettisoned only in straight and level flight.

3. PRELIMINARIES

(i) On entering the cockpit secure the four hood catches and push on the two rubber hose pipes.

(ii) Check the following:

| | |
|---|---|
| Undercarriage lever | - DOWN (switch on indicator and check that green lights appear). |
| Flaps | - UP |
| Landing lamps | - UP |

Contents of lower fuel tank.

## 4. STARTING THE ENGINE AND WARMING UP

(i) Set:-

| | | |
|---|---|---|
| Fuel Cock Lever | - | ON |
| Throttle | - | ½ inch open |
| Mixture control (if fitted) | - | RICH |
| Propeller control | - | Fully forward |
| Radiator shutter | - | OPEN |
| Windscreen air supply cocks | - | CLOSED |

(ii) High volatility fuel (Stores ref. 34A/111) should be used if possible for priming at air temperatures below freezing. Work the priming pump until the suction and delivery pipes are full; this may be judged by a sudden increase in resistance.

(iii) Switch on the ignition and press the starter and booster coil buttons. Turning periods must not exceed 20 seconds, with a 30 seconds wait between each. Work the priming pump as rapidly and as vigorously as possible while the engine is being turned, and it should start after the following number of strokes.

| Air temperature °C: | +30 | +20 | +10 | 0 | -10 | -20 |
|---|---|---|---|---|---|---|
| Normal fuel: | 3 | 4 | 7 | 12 | | |
| High volatility fuel: | | | | 4 | 8 | 18 |

(iv) At temperatures below freezing it will probably be necessary to continue priming after the engine has fired and till it picks up on the carburettor.

(v) When the engine is running satisfactorily, release the booster coil button and screw down the priming pump.

(vi) Run the engine as slowly as possible for half a minute, then warm up at a fast tick-over.

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5. TESTING ENGINE AND INSTALLATIONS

While warming up.-

(i) Make the usual checks of temperatures, pressures and controls. Brake pressure should be at least 120 lb/sq.in. and machine gun and cannon firing pressure 220 lb/sq.in.

After warming up.-

(ii) See that there are TWO men on the tail and with the propeller speed control fully forward, test as follows:-

(a) Open up to maximum boost for weak mixture cruising; exercise and check operation of constant-speed propeller.

(b) Open the throttle fully and check take-off boost and r.p.m.

(c) At maximum boost for rich mixture cruising test each magneto in turn. The drop should not exceed 150 r.p.m.

(iii) Running of the engine must not be unduly prolonged because, if the coolant temperature before taxying out exceeds 100°C, it may become excessive before take-off is completed.

6. FINAL PREPARATION FOR TAKE-OFF

The Drill of Vital Actions is "T.M.P. Fuel, Flaps, Radiator and Air Cocks":

| | |
|---|---|
| T - Trimming tabs | - Elevator: about one division nose down from neutral. Rudder: fully to starboard. |
| M - Mixture control (if fitted) | - RICH |
| P - Propeller | - Speed control fully forward. |
| Fuel | - Cock lever ON and check contents of lower tank. |
| Flaps | - UP |
| Radiator shutter | - Fully open. |
| Air cocks | - Windscreen air supply cocks closed. |

7. TAKE-OFF

(i) Open the throttle slowly to the gate (RATED BOOST position). 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 opening the throttle through the gate of the TAKE-OFF BOOST position.

(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. I.A.S. is attained.

8. CLIMBING

(i) The speed for maximum rate of climb is 170 m.p.h. I.A.S. to 8,000 feet; above this height reduce speed by 2 m.p.h. per 1,000 feet.

(ii) At about 12,000 feet, turn on the air supply to cabin. The pressure will then fall off less rapidly than that of the air outside, until at 25,000 feet the pressure inside the cabin is 2 lb./sq.in. above that of the air outside, equivalent to a reduction of height of 10,000 feet at 40,000 feet. On aeroplanes fitted with an automatic control valve the cabin pressure is regulated automatically.

(iii) If at any height above 35,000 feet the red warning light comes on, increase the oxygen supply and descend immediately to not more than that height.

(iv) Regulate the oxygen supply by the cabin height altimeter.

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9. GENERAL FLYING

(i) Stability and control.- The aeroplane is generally stable, although at great heights it becomes increasingly unstable longitudinally. The controls are all slightly heavier than usual, due to the cabin sealing arrangements.

(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.- The recommended speed for maximum range is 150 m.p.h. I.A.S. (At low altitudes 200 m.p.h. I.A.S.). Range is greatest at intermediate heights.

(v) For combat manoeuvres climbing r.p.m. should be used.

(vi) When about to descent from great heights, open the two windscreen air supply cocks. Normally however these should always be closed.

(vii) Flying in bad weather.- Reduce speed to about 120 m.p.h. and lower the flaps. The radiator shutters 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.

(viii) For stretching a glide in the event of a forced landing, the propeller speed control should be pulled right back and the radiator flap set at the minimum drag position.

10. STALLING.

(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 repidly 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) Stalling speeds when loaded to about 6,500 lb. are:-

Flaps and undercarriage up: 73 m.p.h. I.A.S.
" " " down: 64 " "

When the aircraft is loaded to 6,740 lbs. stalling speeds are 81 and 69 m.p.h. I.A.S. respectively.

11. SPINNING.

(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 ft.

(b) Recovery must be started not lower than 5,000 ft.

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

12. AEROBATICS.

(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. 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.

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(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.

12a. DIVING.

(i) The aeroplane becomes very tail heavy at high speed and must be trimmed into the dive in order to avoid the dangers 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.

13. APPROACH AND LANDING.

(i) 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 indicator and check green lights).

M - Mixture control - RICH.

P - Pitch - Propeller speed control fully forward.

Flaps - DOWN.

(ii) Correct speeds for approach:

| | | |
|---|---|---|
| Engine assisted | - | about 85 m.p.h. I.A.S. |
| Glide | - | about 95 m.p.h. I.A.S. |

(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 and left there. It should NOT be pushed into the gate by hand. As soon as the undercarriage is locked down the lever should automatically spring into the gate and the hydraulic valve indicator return to IDLE. 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 I, 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) If the undercarriage is lowered too late on the approach, with insufficient engine speed to develop full hydraulic pressure, the selector lever may not automatically spring from the fully back position into the gate, so indicating that the operation is not complete. This may cause the undercarriage to collapse on landing. (As previously mentioned, the lever must NOT be pushed into the gate by hand). It is advisable, therefore, to lower the undercarriage early on the circuit prior to landing and not in the later stages of the approach.

(vi) Mislanding - Climb at about 120 m.p.h. I.A.S.

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14. AFTER LANDING.

(i) Raise the flaps before taxying.

(ii) Run the engine at 800 - 900 r.p.m. for two minutes, then pull the slow-running cut-out and hold it out until the engine stops.

(iii) Turn OFF the fuel cock and switch OFF the ignition.

(iv) Remove rubber hose pipes before releasing the hood catches.

15. POSITION ERROR

| From<br>To | 100<br>140 | 140<br>160 | 160<br>200 | 200<br>240 | 240<br>260 | 260<br>280 | 280<br>320 | m.p.h. I.A.S.<br>m.p.h. I.A.S. |
|---|---|---|---|---|---|---|---|---|
| Add<br>Subtract | 4 | 2 | 0<br>0 | 2 | 4 | 6 | 8 | m.p.h.<br>m.p.h. |

16. FUEL CAPACITIES AND CONSUMPTION

(i) Fuel:

Normal capacity:

| | |
|---|---|
| Top tank: | 48 gallons. |
| Bottom tank: | 37 gallons. |
| Total: | 85 gallons. |

Long-range capacity:

| | |
|---|---|
| With 30 gallons jettisonable tank: | 115 gallons. |
| With 90 gallons jettisonable tank: | 175 gallons. |

(ii) Oil:

Normal capacity: 5.8 gallons

Long-range capacity:

With 90 gallons jettisonable fuel tank: 8.5 gallons.

(iii) Approximate fuel consumptions (galls/hr.):

(a) In WEAK mixture at 6,000 feet:

| Boost lb/sq.in. | R.p.m. | | | | |
|---|---|---|---|---|---|
| | 1,850 | 2,050 | 2,250 | 2,450 | 2,650 |
| +4 | 44 | 48 | 51 | 54 | 56 |
| +2 | 39 | - | - | - | - |
| 0 | 36 | - | - | - | - |
| -2 | 32 | - | - | - | - |
| -4 | 27 | - | - | - | - |

(b) In WEAK mixture at 20,000 feet:

| Boost lb/sq.in. | R.p.m. | | | | |
|---|---|---|---|---|---|
| | 1,850 | 2,050 | 2,250 | 2,450 | 2,650 |
| +3¾ | - | - | - | - | 56 |
| +1½ | - | - | - | 51 | - |
| 0 | - | - | 41 | - | - |
| -1½ | - | 34 | - | - | - |
| -3 | 28 | - | - | - | - |

(c) Climbing in RICH mixture, at 2,850 r.p.m. and + 9 lb/sq.in. boost: 84 gallons/hr.

(d) When +16 lb/sq.in. boost is used consumption will be 140 to 160 galls/hr.

17. MANAGEMENT OF JETTISONABLE FUEL TANK

When fitted with a jettisonable fuel tank:

(i) Start and warm up in the normal way on the main tanks.

(ii) Take-off on the main tanks and change over to the jettisonable tank at a safe height (say 2,000 ft). Turn OFF the main tanks.

(iii) Normally the aeroplane should be flown on the jettisonable tank until the fuel is exhausted. When the engine cuts turn ON the main tanks and turn OFF the jettisonable tank.

(iv) If the tank is to be jettisoned before the overload fuel is exhausted, first turn ON the main tanks and then move the jettisonable tank cock control to OFF before operating the jettison lever.

Note: The jettisonable tank cock must be turned OFF whenever the tank is jettisoned or when the fuel in it is exhausted, otherwise air may be sucked into the main fuel system.

(v) For maximum range and endurance the tank should be jettisoned as soon as the fuel in it has been exhausted.

(vi) When fitted with a 90 gallon tank, the aeroplane is restricted to straight flying until the tank is empty or has been jettisoned.

18. OIL DILUTION IN COLD WEATHER

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

Atmospheric temperature above - 10°C : 1 minute
Atmospheric temperature below - 10°C : 2 minutes.