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AIR PUBLICATION 1592 A

Volume I

THE DEFIANT I AEROPLANE
MERLIN III ENGINE

Prepared by direction of the
Minister of Aircraft Production

A. C. Portal

Promulgated by order of the Air Council.

AIR MINISTRY.

FOR OFFICIAL USE ONLY

AIR PUBLICATION 1592A
Volume I

THE DEFIANT I AEROPLANE

MERLIN III ENGINE

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

By Command of the Air Council

September, 1939. A.W.STREET

AIR MINISTRY

F.S./2

AIR PUBLICATION ...

Volume I

Pilot's Notes

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. List No.	1	2	3	4	5	6	7	8	9	10
Prelimy. matter				✓	✓					
Leading Partics.										
Introducn.										
Section 1	✓									
Section 2			✓							
Section 3										
Section 4										
Section 5										
Section 6		✓								
Section 7						✓				
Section 8							✓			
Section 9								✓		
Section 10										
Section 11									✓	
Section 12										
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Amendt. List No.	11	12	13	14	15	16	17	18	19	20
Prelimy. matter										
Leading Partics.		✓								
Introducn.										
Section 1	Pkts'		✓							
Section 2				✓						
Section 3					✓					
Section 4	Mtes					✓				
Section 5							✓			
Section 6										
Section 7	Only							✓		
Section 8										
Sectior 9									✓	
Section 10										
Section 11										✓
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Prelimy. matter	✓									
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Section 7										
Section 8						✓				✓
Section 9										
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Amendt. List No.	31	32	33	34	35	36	37	38	39	
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Introducn.								✓		
Section 1		✓						✓		
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Section 11										
Section 12										
Date of incorpn.										

NOTES TO OFFICIAL USERS

Air Ministry Orders and Vol. II leaflets as issued from time to time may affect the subject matter of this publication. It should be understood that amendment lists are not always issued to bring the publication into line with the orders or leaflets and it is for holders of this book to arrange the necessary link-up.

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.

LIST OF SECTIONS

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

Note.- Section 10 will be issued later by Amendment List.

LEADING PARTICULARS

Name	Defiant I
Duty	Two-seater fighter
Type	Single engine, low-wing monoplane.

PRINCIPAL DIMENSIONS

(Aeroplane in rigging position unless otherwise stated.)

Span	39 ft. 4 in.
Length, overall	35 ft. 4 in.
Height, max. - over rudder	12 ft. 2 in.
Height, tail down - over vertical airscrew blade	11 ft. 4 in.
Ground angle, tail down	12° 21'

Main planes

Span, overall	39 ft. 4 in.
Aerofoil section	M6 modified
Incidence	1° ±15'
Outer planes - chord at root	7 ft. 2½ in.
- chord at 15 in. from tip	3 ft. 11 in.
- dihedral	5° 20' ±30'
Centre plane - total span	18 ft. 4 in.
- chord at centre line of aeroplane	8 ft. 0.55 in.
- chord at outboard extremity	7 ft. 2½ in.
- dihedral	1° 8' ± 15'

Tail plane

Span, including elevators	13 ft. 10 in.
Chord - at centre line of aeroplane	3 ft. 1 1/16 in.
- at outboard extremities	1 ft. 2⅝ in.
Incidence	1° ± 15'

Fuselage

Length, overall - to front of engine mounting	29 ft. 10¼ in.
- to front of fireproof bulkhead	24 ft. 4½ in.
Width, maximum	3 ft. 7½ in.
Height, maximum - excluding turret, radiator and radiator cowling	5 ft. 9½ in.

AREAS

Main planes, with ailerons and flaps	250 sq.ft.
Ailerons, total	13.9 sq.ft.
Flaps, total	21.6 sq.ft.
Tail plane, with elevators and trimming tabs	43.66 sq.ft.
Elevators with trimming tabs	18.32 sq.ft.
Trimming tabs (2)	1.34 sq.ft.
Fin	7.82 sq.ft.
Rudder with trimming tab	13.35 sq.ft.
Rudder trimming tab	0.44 sq.ft.

CONTROL SURFACES, SETTINGS AND RANGES OF MOVEMENT

Aileron movement	Up	$15^{\circ} \pm 2^{\circ}$
	Down	$15^{\circ} \pm 2^{\circ}$
Elevators movement	Up	$22^{\circ} {}^{+0^{\circ}}_{-2^{\circ}}$
	Down	$10^{\circ} {}^{+2^{\circ}}_{-0^{\circ}}$
Rudder movement	Each way	$25^{\circ} {}^{+0^{\circ}}_{-2^{\circ}}$
Flaps inner - range at 2nd. bracket from centre line of fuselage	11.5 in.	± 0.4 in.
- at 4th. bracket	10.7 in.	± 0.4 in.
Flaps outer - at inboard bracket	9.9 in.	± 0.4 in.
- at outboard bracket	8.6 in.	± 0.4 in.
Elevator trimming tabs	Each way	$6^{\circ} \pm 1^{\circ}$
Rudder trimming tab - as a trimmer	Port trim	$6^{\circ} \pm 1^{\circ}$
	Stbd.trim	$1^{\circ} {}^{+1^{\circ}}_{-15'}$
Rudder trimming tab - as a servo (with 25° rudder and trimming tab control zero)	Port	$21^{\circ} {}^{+0^{\circ}}_{-2^{\circ}}$
	Stbd	$21^{\circ} {}^{+0^{\circ}}_{-2^{\circ}}$

UNDERCARRIAGE

Type	Retractable.
Track	11 ft. $2\frac{1}{2}$ in.
Shock-absorber struts - type	Lockheed airdraulic
- air pressure, strut free	216 lb./sq.in.
Wheels - type	Dunlop $31\frac{1}{2}$ in. x $9\frac{1}{2}$ in. heavy.
- air pressure	35 lb./sq.in.
- brakes	Dunlop pneumatic $10\frac{1}{2}$ in. dia.

Tail wheel unit

Type	Cantilever, fully-castoring.
Shock-absorber strut - type	Lockheed airdraulic.
- air pressure	112 lb./sq.in.

Tail wheel - type .....Dunlop 12½ in. x 5½ in. heavy
- tyre pressure .....45 lb./sq.in.

ENGINE

Name .....Merlin III
Type .....12 cylinder-V, glycol-cooled, geared and supercharged, right-hand tractor.
Fuel .....See A.P.1464, Vol.II/C.37
Oil .....See A.P.1464, Vol.II/C.37
Coolant .....Specification D.T.D. 344, type B treated (Stores Ref.33C/559).
Oil dilution system -
Type of valve 5U/1567
Voltage of valve 24
Fuel pressure on valve .....8 to 10 lb./sq.in.
Valve orifice diameter .....0.046 in.

AIRSCREW

Type .....de Havilland variable-pitch, type 5/25

Control .....Constant speed

Pitch settings .....Basic 44°
Coarse 44°
Fine 24°

TANK CAPACITIES

Fuel tanks
Port wing tank .....52 gallons
Starboard wing tank .....52 gallons
Total fuel capacity .....104 gallons

Oil tank
Oil .....10 gallons
Air space ..... 2 gallons

AIR-SPEED INDICATOR PRESSURE HEAD

Position .....On port outer plane
Incidence .....Nil
Distance from centre line of aeroplane ....11 ft. 5 in.
Distance forward from leading edge .....3 ft. 0 in.

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INTRODUCTION

1. The Defiant I aeroplane is a low-wing monoplane powered with a Merlin III engine driving a de Havilland constant-speed airscrew. It is designed and equipped for day and night fighting duties and accommodation is provided for a crew of two consisting of pilot and air gunner.

2. The aeroplane is of all-metal construction except for the fabric-covered rudder, elevators and ailerons, the wooden fairings fore and aft of the gun turret, and the undercarriage fairing doors. The fuselage and the main planes are of stressed-skin construction, the planes being constructed in three portions, viz. the port and starboard outer planes and the centre plane, all of which are tapered in chord and thickness. The fin and tail plane are cantilever structures constructed mainly of alclad sheet.

3. A sliding hood of inverted-U-form, provides means of entry to and exit from the cockpit, whilst a service hatch in the bottom of the rear fuselage, immediately aft of the gun turret provides alternative means of entrance or exit for the air gunner, the gunner's normal entrance and exit being through the sliding window panels in the turret dome roof. Two footrests, the upper one serving also as a hand grip, and a non-slip walkway on the main plane are provided on the port side. The pilot's seat, of the bucket type, is centrally positioned in the cockpit whilst the seat for the air gunner is incorporated in the turret which is electro-hydraulically operated.

4. The alighting gear consists of two retractable undercarriage units and a non-retractable castering tail wheel unit. The undercarriage units are operated hydraulically and, when retracting, swing inwards and upwards into recesses in the underside of the centre plane. Electrical indicators and a buzzer in the pilot's cockpit indicate the position (fully up or fully down) of the undercarriage units, the shock-absorber legs of which are oleo-pneumatic in operation. The operation of the tail wheel shock-absorber leg is also oleo-pneumatic.. Dunlop pneumatically-operated brakes, with differential control by means of a relay valve connected to the rudder bar, are fitted to the undercarriage wheel units.

5. Flying controls of conventional type, including trimming tab controls for elevator and rudder, are fitted. The rudder tab also acts as a servo. The ailerons are of the Frise type, whilst hydraulically-operated flaps of the split-trailing-edge type are fitted to the outer and centre planes.

6. The engine is installed at the nose of the fuselage and the fuel is carried in two main tanks, one on each side of the centre plane, the fuel being supplied to the engine by an engine-driven pump. An oil tank is mounted at the top of the fuselage behind the firewall and a header tank for the coolant is mounted over the forward end of the engine, the coolant flow through the radiator being thermostatically controlled. The engine may be started either electrically or by hand.

7. The armament consists of four Browning guns mounted in an electro-hydraulically operated revolving turret mounted approximately at the mid-fuselage position. The guns are rigidly interconnected, being traversed and elevated together. Light-series carriers are provided for carrying reconnaissance flares and practice bombs.

8. Power for the electrical services is obtained from a 24-volt, 1,000-watt engine-driven generator which charges two 12-volt, 25-Ah. accumulators housed in the centre plane. The electrical services include engine starting, ignition, bomb release, landing lamps, undercarriage indicator lights, warning horn, turret operation, etc. Breeze electrical system is installed in aeroplanes N.1535 and subsequent. Miscellaneous equipment includes reconnaissance flares, high pressure oxygen for pilot and gunner, signal pistol, automatic fire extinguisher, first-aid outfit and axe. The aerial is fitted between two masts on the underside of the fuselage, the rear mast being retracted when the undercarriage is down. Provision is made for fitting tropical equipment.

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SECTION 1

PILOT'S CONTROLS AND EQUIPMENT

AND GENERAL EMERGENCY EQUIPMENT AND EXITS

CONTENTS

LIST OF ILLUSTRATIONS

SECTION 1

PILOT'S CONTROLS AND EQUIPMENT

AND GENERAL EMERGENCY EQUIPMENT AND EXITS

INTRODUCTION

1. The layout of the flying and operational controls and equipment in the pilot's cockpit is illustrated and referenced in figs. 1 to 4 at the end of this Section. Each item is given a number which is quoted when the item is referred to in the text; a key to the items referenced is given facing each illustration. Explanatory notes where necessary, on the function and operation of particular items, are given in this Section.

Aeroplane controls

Control column

2. The control column is operated in the normal way and is secured at its fulcrum ball-joint to the forward edge of the pilot's seat and thus moves with the seat when the latter is adjusted for height (see para. 38). The spade grip incorporates a brake-operating lever (19) and a catch for retaining the brake lever in the ON position when parking the aeroplane. The spade grip also incorporates a gun-firing push-button (20) for use when the gun-firing control is taken over by the pilot. This pushbutton can be turned to either the SAFE or FIRE position.

Rudder control

3. The rudder bar and pedals are of normal design and operation and can be adjusted for leg reach by means of a foot-operated star-wheel at the centre of the rudder bar.

Rudder trimming tab control

4. This control consists of a hand-lever (33) mounted on the lower port side of the cockpit. The forward end of the lever forms a pointer which moves over a scale to indicate the extent of tab movement, the scale being marked one division from neutral to port and six divisions from neutral to starboard. The control linkage in the rudder is arranged to give servo action.

Elevator trimming tab control

5. This control consists of a geared hand winch (44) mounted on the port side of the cockpit. The handle (45) should be rotated clockwise to counteract tail heaviness and anti-clockwise to counteract nose heaviness. Tab movement is indicated by a pointer on a scale calibrated in tenths of tab movement from the neutral position. The forward end of the scale is marked DIVE and the aft end is marked STALL.

Undercarriage and flaps (hydraulic) controls

6. The undercarriage units and the flaps are raised and lowered hydraulically by means of an engine-driven pump or a hand pump (74), the operations being controlled by means of selector levers (36) and (34) respectively. An emergency selector lever (37) for lowering the undercarriage when the normal system has failed, is also provided (see para. 10). These three levers are mounted in a control box on the port side of the cockpit. A safety catch is provided on the undercarriage selector lever to prevent its being inadvertently moved to the UP position when the aeroplane is on the ground.

7. The undercarriage and flaps may be operated separately or together, but in the latter case, the service requiring the lesser hydraulic pressure will operate first. When the selector levers are in the neutral position the fluid is circulating idly in the system.

8. Raising of undercarriage.- To raise the undercarriage, the normal procedure is as follows :-

(i) Ensure that the emergency selector lever (37) is fully up and secured.

(ii) Release the safety catch, pull the selector lever (36) fully up and release. The lever should return automatically to neutral when the raising operation is complete.

(iii) If the raising has to be carried out by means of the hand pump, select UP (as in (ii)) and operate the hand pump for approximately 110 full strokes (one full stroke comprises a complete up-and-down movement of the pump handle). On completion of the raising operation as shown by the indicators, if the selector lever does not return automatically to neutral, move it by hand.

The undercarriage units are locked UP by spring-loaded catches which engage locking pins to secure the wheel axles. In the fully raised position, red lamps in the warning light indicator (3) are automatically switched on (see para. 11) and a valve opens to admit fluid to the fairing door jack, thus closing the doors.

9. Lowering of undercarriage.- To lower the undercarriage, the normal procedure is as follows :-

(i) Ensure that the emergency selector lever (37) is fully up and secured.

(ii) Push the selector lever (36) fully down and release. The lever should return automatically to neutral when the lowering operation is complete.

(iii) If the lowering has to be carried out by means of the hand pump, select DOWN (as in (ii)) and operate the hand pump approximately 170 full strokes (one full stroke comprises a complete up-and-down movement of the pump handle). On completion of the lowering operation as shown by the indicators if the selector lever does not return automatically to neutral, move it by hand.

Before the undercarriage is lowered fluid is diverted to the fairing door jack to open the doors. When the undercarriage units have been released from the UP locks, the red lamps on the warning indicator (3) go out and when the folding struts are fully extended to lock the units DOWN, green lamps on the indicator are illuminated.

10. EMERGENCY lowering of undercarriage.- For lowering the undercarriage when both normal systems have failed, a separate pipe-line is brought into use carrying fluid from the hand pump direct to DOWN side of the jacks; the exhaust fluid returns along the normal pipe-lines. The procedure for EMERGENCY lowering is as follows :-

(i) Set the normal selector lever (36) in its neutral position.

(ii) Push the emergency selector lever (37) fully DOWN; this lever has a safety catch which must be released before the lever can be moved.

(iii) Operate the hand pump; up to 200 full strokes of the hand pump may be required to lower the undercarriage by this system.

After the emergency system has been used, the normal system must be examined to determine the cause of the failure and before the services can be operated again the system must be returned to normal (see Sect. 4, Chap.2).

11. Undercarriage indicators.- The positions of the undercarriage units are indicated on an instrument (3) mounted at the top of the instrument panel, the operation being as follows :-

(i) Two green lights indicate that the units are locked DOWN.

(ii) Two red lights indicate that the units are locked UP.

(iii) For intermediate positions of the units, there are no lights.

If any one of the lamps does not light, the failure may be in the lamp itself. The lamps in the indicator are duplicated, and to bring the reserve set into operation, the knob in the centre of the indicator should be pulled. If a reserve lamp does not light, then either the lamp is defective or its corresponding undercarriage unit is not locked in the appropriate position.

12. If both normal and reserve green lamps fail to illuminate after both the normal and the emergency lowering systems have been used, the reason may be that the lighting fuse has failed. This particularly, may

be suspected if the hydraulic pressure gauge (48) shows 700 lb./sq.in. or more during the attempts to lower the undercarriage. In this case, throttling back to one-third throttle should be tried. A warning buzzer will sound if both the undercarriage units are NOT locked DOWN, as this circuit is independently fused. If the buzzer does not sound it may be assumed that both units are locked DOWN.

Note.- Bright or dim lighting can be obtained by rotating the knob in the centre of the indicator.

13. Operation of flaps.- To operate the flaps, move the flaps selector lever (34) to the appropriate position and release. When the operation is completed, the lever should return automatically to neutral.

14. For partial lowering or raising of the flaps, the lever should be lowered or raised over part of its full travel only and held in position until the desired flap setting is obtained as shown on the indicator, when the lever should be released; the lever should then return to neutral.

15. An instrument (25) to indicate the setting of the flaps is mounted on the port side of the instrument panel and is calibrated in degrees of flap movement.

Engine controls

Fuel, oil and coolant

16. The fuel, oil and coolant to be used with the Merlin III engine are as follows :-

Fuel	87 octane, Specification D.T.D.230 (Stores Ref. 34A/59) or 100 octane, Provisional Specification R.D.E./F/100 (Stores Ref. 34A/75)
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)

The fuel tanks must be filled independently through the filler cap filter at the top of each tank, access being obtainsd through doors in the top surface of the centre plane near the main plane joints. Access to the oil tank filling point is obtained through a door in the top skin of the fuselage, forward of the windscreen. The oil tank should be filled while the aeroplane is in the tail-down attitude and care should be taken to allow for the correct air space. The method of replenishing the cooling system is described in Sect. 4, Chap. 1.

Throttle and mixture controls

17. The throttle lever (24) and mixture lever (43) are mounted in

a control box on the port side of the cockpit. The throttle lever operates the magneto control, accelerator pump and boost control change-over cock. Incorporated in the throttle lever is the bomb-release button which is housed in a recess in the knob of the lever, to avoid its accidental operation.

18. The mixture lever (43) is provided with a safety catch which must be lifted in order that the lever may be moved forward to the WEAK position from the NORMAL (AUTOMATIC RICH) position. The action of closing the throttle automatically returns the mixture lever to NORMAL. If it is necessary to exceed the economical cruising limitation at any time by opening the throttle, it is essential that the mixture lever be first returned to NORMAL by hand as it will not return automatically when the throttle is opened.

Fuel cock control

19. The fuel cock control handle (26) is mounted on the port side of the instrument panel and is of star form. The four positions of the cock are engraved ALL ON PORT ON, STARB. ON, and ALL OFF, a pointer on the handle indicating the setting of the cock.

Priming pumps

20. Two priming pumps are provided, one (59) for priming the induction pipes and one (12) for priming the engine-driven fuel pump. Both pumps are mounted on the starboard side of the instrument panel.

Slow-running cut-out

21. On aeroplanes N.1535 and subsequent, a slow-running cut-out is provided and operated by a pull on a knob (86) on the starboard side of the instrument panel.

Boost control cut-out

22. The boost control on the engine is automatic but a cut-out (22) is provided should it be necessary to override the automatic control; the cut-out control is mounted on the port side of the instrument panel. If this cut-out is used during flight, it must be re-set on the ground (see Sect. 4, Chap. 2).

Engine electric starting

23. When starting the engine it is necessary to press both the pushbutton (58) for the starter motor and the one for the booster coil; both are mounted on the starboard side of the instrument panel.

Airscrew speed control

24. The control lever (38) for the constant-speed airscrew is mounted in the port side of the control box. On early aeroplanes the control lever is mounted just forward of the control box. In

the extreme aft position of the lever, the airscrew blades are held in their maximum coarse pitch angles and the airscrew functions as a fixed-pitch airscrew. For all other positions of the lever, the airscrew is under constant-speed control and movement of the lever forward will increase the engine r.p.m. and movement aft will decrease the engine r.p.m.

Magneto switches

25. These switches (29) are mounted on the port side of the instrument panel and are locked in their OFF position by a finger-operated slide bar (30) which controls the undercarriage indicator master switch. Before the magnetos can be switched ON the slide bar must first be moved to port, which operation switches ON the undercarriage indicator, and prevents the engine being started prior to the indicator being switched ON.

Radiator flap control

26. The coolant radiator is mounted between the auxiliary spar and the trailing edge of the centre plane, and is provided with a flap at the rear by means of which the flow of air can be adjusted and thus the rate of cooling. The flap is controlled by means of a hand winch (60) mounted on the starboard side of the cockpit.

Operational equipment

Instrument panel

27. The layout of the instruments on the pilot's instrument panel is shown in fig. 1. The flying instruments are grouped on the centre panel which is mounted on anti-vibration mountings and the engine instruments are grouped on the starboard side.

Oxygen equipment

28. The pilot's oxygen supply is obtained from a container mounted in the starboard undercarriage recess. A standard regulator (28) is mounted on the port side of the instrument panel and the bayonet connection (73) for the mask hose is mounted on the starboard side of the seat.

Landing lamp control

29. The landing lamps are controlled by a switch (42) mounted on the control box. When the switch is in the central position the lamps are off, when moved to port the port lamp is switched on, and when moved to starboard, the starboard lamp is switched on; the lamps cannot both be on together. The dipping of the lamps is controlled by the lever (23) mounted in the control box.

Radio controls

30. The aeroplane is equipped with a combined transmitter-receiver, either type T.R.9D or T.R.1133A, located behind the pilot's seat.

31. T.R.9D installation.- With this installation, a type C mechanical controller is fitted on the port side of the cockpit, the remote contactor (82) and contactor ON/OFF switch are fitted on the starboard side of the cockpit, and the master contactor is mounted in the rear fuselage, on the port side. The microphone-telephone socket (72) is fitted on the starboard side of the fuselage, adjacent to the seat.

32. T.R.1133A installation.- With this 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 pushbutton electrical control unit.

33. R.3003 installation.- The master switch (85) for this installation and two pushbutton switches (83) are located on a panel on the starboard side of the cockpit, the pushbutton being covered with a flap marked DANGER. The controller unit is mounted in the fuselage aft of the gun turret.

Call lights

34. Besides the normal intercommunication system between the pilot and the gunner, connected to the T.R.9D installation, red and green call lights are provided for signalling between the cockpit and the gun turret. The pilot's lamps (4) are mounted at the top centre of the instrument panel and are fitted with flap screens for dimming purposes. The switchbox (18) for controlling the lamps is mounted at the base of the control column spade grip and fitted with two finger levers, the shorter, red lever controlling the red lamp in the gun turret and the longer, green, lever controlling the green lamp.

Signal discharger

35. Mounted in the top surface of the starboard portion of the centre plane is a multi-breech holding six signal cartridges each of which is fired by a pull on a control handle (13) on the starboard side of the instrument panel. The breech is loaded before flight with coloured cartridges in code order.

Windscreen de-icing

36. To protect the windscreen against ice formation, a spray consisting of glycol, alcohol and distilled water is used. The mixture is pumped from a tank just forward of the control column to a perforated pipe at the base of the windscreen. On early installations a Ki-gass type pump is fitted in the tank but later installations have a Rotax type pump (51) and a metering valve.

Station-keeping lamps

37. Mounted on each side of the fuselage just aft of the cockpit is a lamp which illuminates the top surface of the main plane to facilitate station keeping when flying in formation. The lamps are flush with the fuselage skin and are controlled by a switch (80) and two dimmer switches (68) on the starboard side of the cockpit.

Seat and hooding

Seat and harness

38. The pilot's seat can be adjusted for height by means of a lever (78) on the starboard side of the seat. The raising of the seat against the weight of the pilot is assisted by springs (55), one on each side of the seat. The harness release lever (67) is mounted on the starboard side of the cockpit.

Hooding

39. The cockpit hood slides fore-and-aft and contains sliding panels in the roof and port side; the sliding panel in the roof can be locked open by means of a press-stud fastener. The hood can be locked in the closed, fully open and two intermediate positions by means of spring-loaded plungers which are released by a small lever at the port top corner of the hood. To open the hood beyond its third position, a further catch (39) must be released, thus cautioning the pilot that the hood is encroaching on the gun sweep. On early aeroplanes no sliding panels are provided but the forward panel on the port side is of the knock-out type to provide direct vision in the event of the view through the windscreen becoming obscured. On these early aeroplanes a pressbutton is provided at the top port corner of the hood to actuate the release lever and permit the hood to be opened from the outside.

General emergency equipment and exits

General

40. The disposition of the emergency equipment, the positions of the exits and the method of abandoning the aeroplane in flight (see Sect. 2) are shown in fig. 4.

Jettisoning cockpit hood

41. The normal means of opening the hood are described in para.39. In addition, an emergency device enables the hood to be jettisoned in flight; the device is operated by a red-painted lever at the top starboard side of the hood. A sharp blow on the lever breaks a locking wire and enables a spring to force the hood upwards into the airstream, the resulting air pressure carrying the hood clear of the aeroplane.

Forced landing flares

42. The flare release levers (71) are mounted on the starboard

side of the cockpit. To release a flare, the knob on the appropriate lever must be pulled to release a safety catch and the lever then pulled upwards.

Fire extinguisher

43. The fire extinguisher system is operated manually by a push-button switch (66) on the starboard side of the cockpit, or automatically by a flame switch, an inertia or crash switch and a gravity switch.

Crash axe and first-aid outfit

44. These items are stowed in the fuselage aft of the gun turret, the crash axe on the starboard side and the first-aid outfit on the port side.

Gunner's emergency exits

45. Whenever possible the gunner should abandon the aeroplane through the opening made by sliding aside the cupola doors; this action also retracts the adjacent fairing. If the cupola cannot be used, the gunner should escape through the service hatch in the floor of the fuselage aft of the gun turret, but first the turret must be rotated to the "guns forward" position, and the undercarriage lowered to retract the rear aerial mast.

Portfires

46. Mounted on the port side of the cockpit are two portfires which, when rubbed together, ignite, and can be used to set fire to the aeroplane.

Miscellaneous

Cockpit heating

47. The flow of warm air into the cockpit can be adjusted by means of a ratchet-controlled lever (32) on the port side of the cockpit.

Cockpit ventilation

48. A pipe, leading from the front of the oil cooler to the cockpit, provides the pilot with the means of passing a stream of cool air over his face. The volume and direction of the flow are governed by a valve (1) mounted on the port side of the instrument panel.

Locking of flying controls

49. Gear (50) is provided to lock the flying controls in the

neutral position when the aeroplane is parked. The gear consists of a barrel clamp and two rigidly-attached tubular arms. The clamp fits round the control column and the longer arm plugs into a socket at the top of the rudder bar pivot. The shorter arm extends over the pilot's seat and prevents the aeroplane being flown with the controls locked. The pilot's seat must be in the lowest position before the controls can be fitted. Stowage for the controls is provided in the port undercarriage recess.

Key to fig. 1

INSTRUMENT PANEL

1. Ventilating valve
2. Instrument-flying panel
3. Undercarriage position indicator
4. Call lights
5. Clock
6. Oil pressure gauge
7. Engine-speed indicator
8. Oil temperature gauge
9. Boost gauge
10. Radiator temperature gauge
11. Fuel pressure gauge
12. Fuel pump priming control
13. Signal discharger control
14. Fuel contents indicators
15. Heel boards
16. Compass correction card
17. Magnetic compass
18. Call-lights switchbox
19. Brake operating lever
20. Gun-firing pushbutton
21. Rudder pedal
22. Boost control cut-out
23. Landing lamps dipping lever
24. Throttle lever
25. Flaps position indicator
26. Fuel cock control
27. Locknut for boost control cut-out
28. Oxygen regulator
29. Magneto switches
30. Undercarriage indicator switch

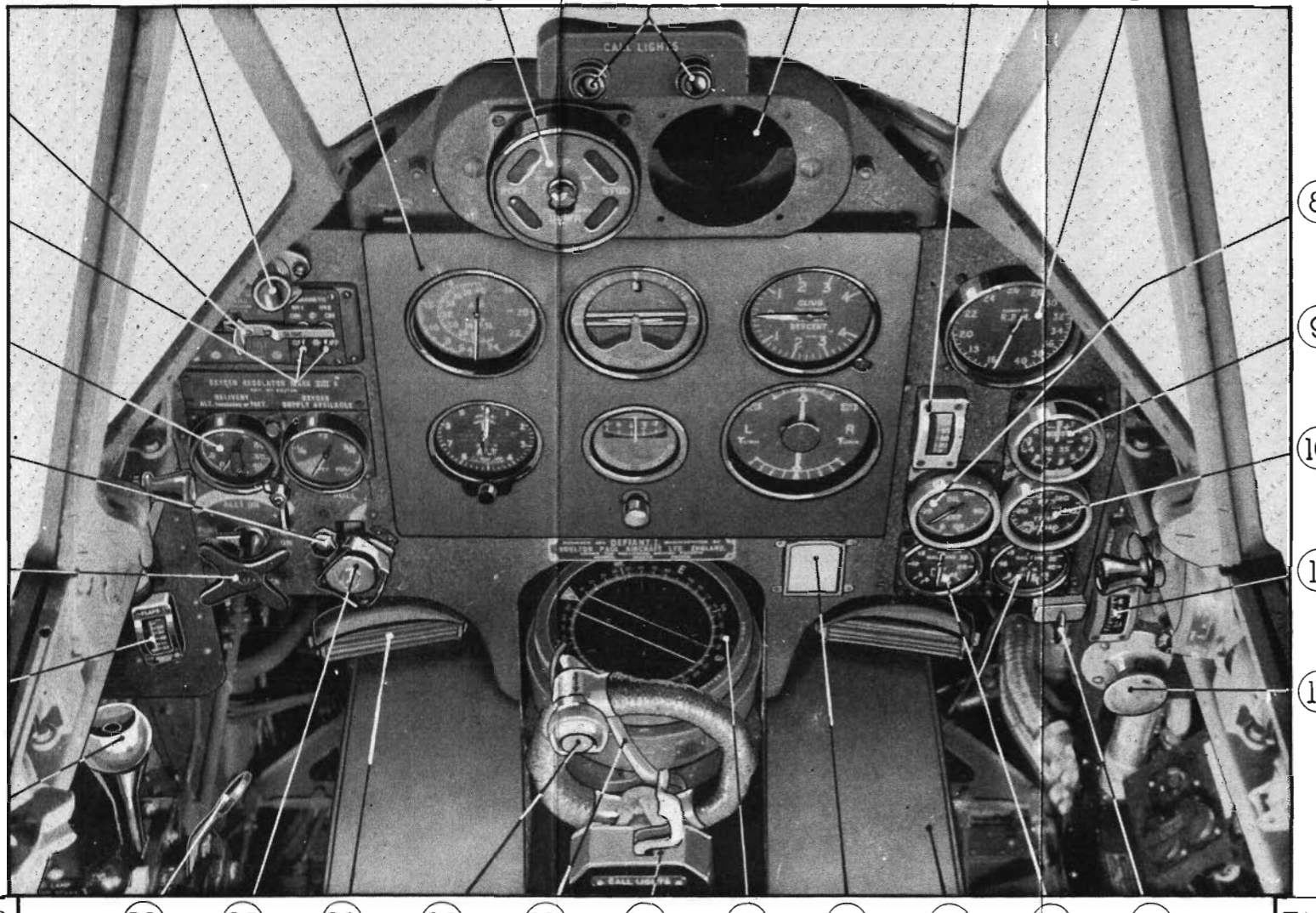


FIG. 1

INSTRUMENT PANEL

FIG. 1

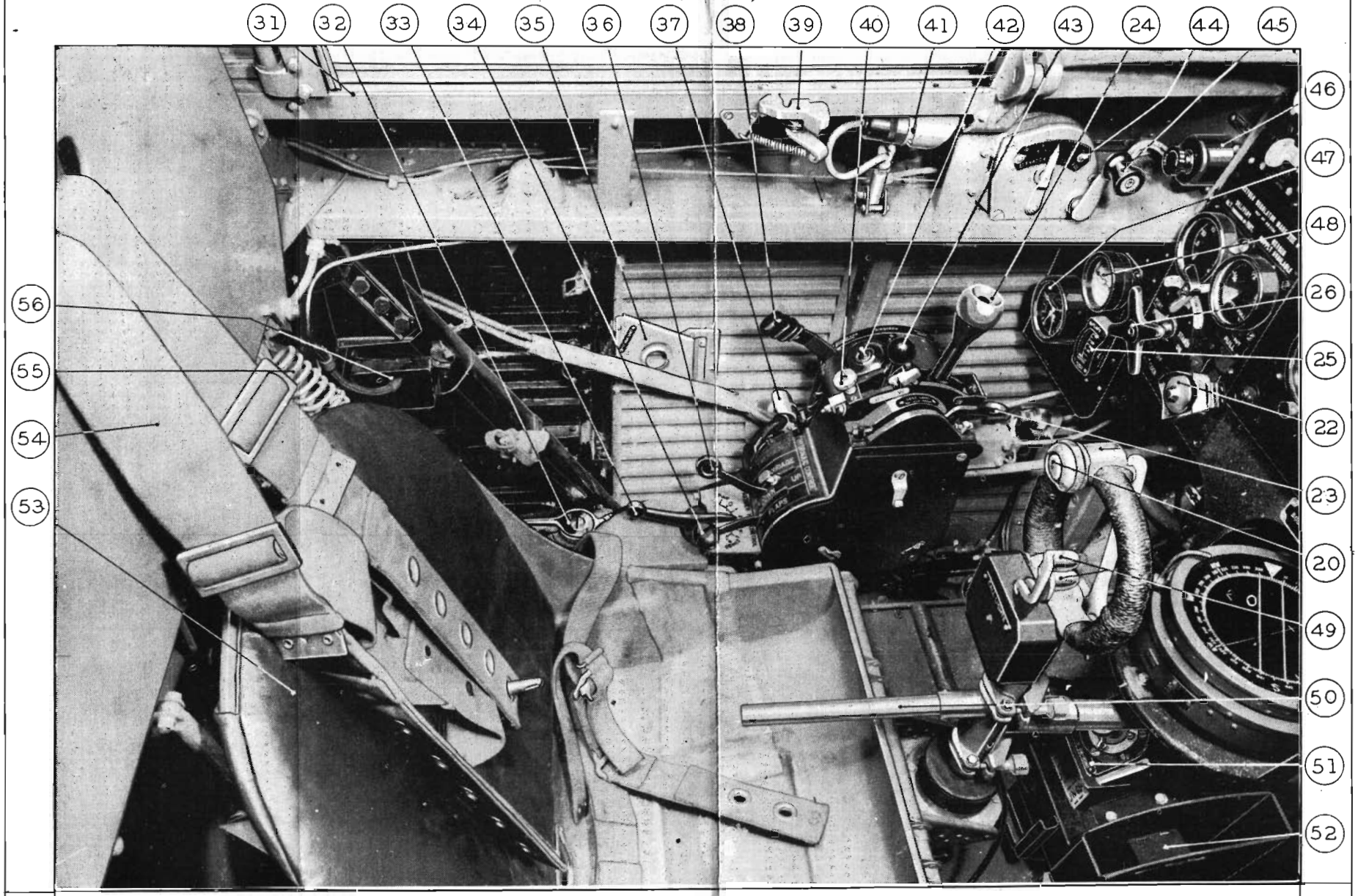


FIG. 2

PORT SIDE OF COCKPIT

FIG. 2

Key to fig. 2

PORT SIDE OF COCKPIT

20. Gun-firing pushbutton
22. Boost control cut-out
23. Landing lamps dipping lever
25. Flaps position indicator
26. Fuel cock control
31. Rail for sliding hood
32. Cockpit heating control
33. Rudder trimming tab control
34. Flap selector lever
35. Mounting for Radio controller
36. Undercarriage selector lever
37. Emergency selector lever
38. Airscrew speed control
39. Hooding catch
40. Adjustable stop for mixture lever
41. Cockpit floodlamp
42. Landing lamp switch
43. Mixture lever
44.) Elevator trimming tab control
45.)
46. Dimmer switch for floodlamp
47. Brake triple pressure gauge
48. Hydraulic pressure gauge
49. Call lights switch levers
50. Flying control locking gear
51. Windscreen de-icing pump
52. Map stowage
53. Cockpit seat
54. Harness
55. Seat-raising springs
56. Accumulator stowage

Key to fig. 3

STARBOARD SIDE OF COCKPIT

6. Oil pressure gauge
8. Oil temperature gauge
9. Boost gauge
11. Fuel pressure gauge
12. Fuel pump priming control
13. Signal discharger control
14. Fuel contents indicators
18. Call lights switchbox
19. Brake operating lever
51. Windscreen de-icing pump
53. Cockpit seat
54. Harness
55. Seat-raising springs
57. Dimmer switch for floodlamp
58. Starter-motor pushbutton
59. Induction priming pump
60.) Radiator flap control
61.)
62. Bomb selector switches
63. Bomb jettison switch
64. Cockpit floodlamp
65. Signalling switchbox
66. Fire-extinguisher switch
67. Harness release lever
68. Station-keeping lamps dimmer switches
69. Voltmeter
70. Fuseboxes
71. Flare release levers
72. Microphone-telephone socket
73. Oxygen bayonet connection
74. Hydraulic hand pump
75.) Radio switches
76.)
77. Generator field switch
78. Seat adjusting lever
79. Pressure head heating switch
80. Station-keeping lamps switch
81. Navigation lamps switch
82. Remote contactor
83. R.3003 pushbutton switches
84. Electrical junction box
85. R.3003 master switch
86. Slow-running cut-out

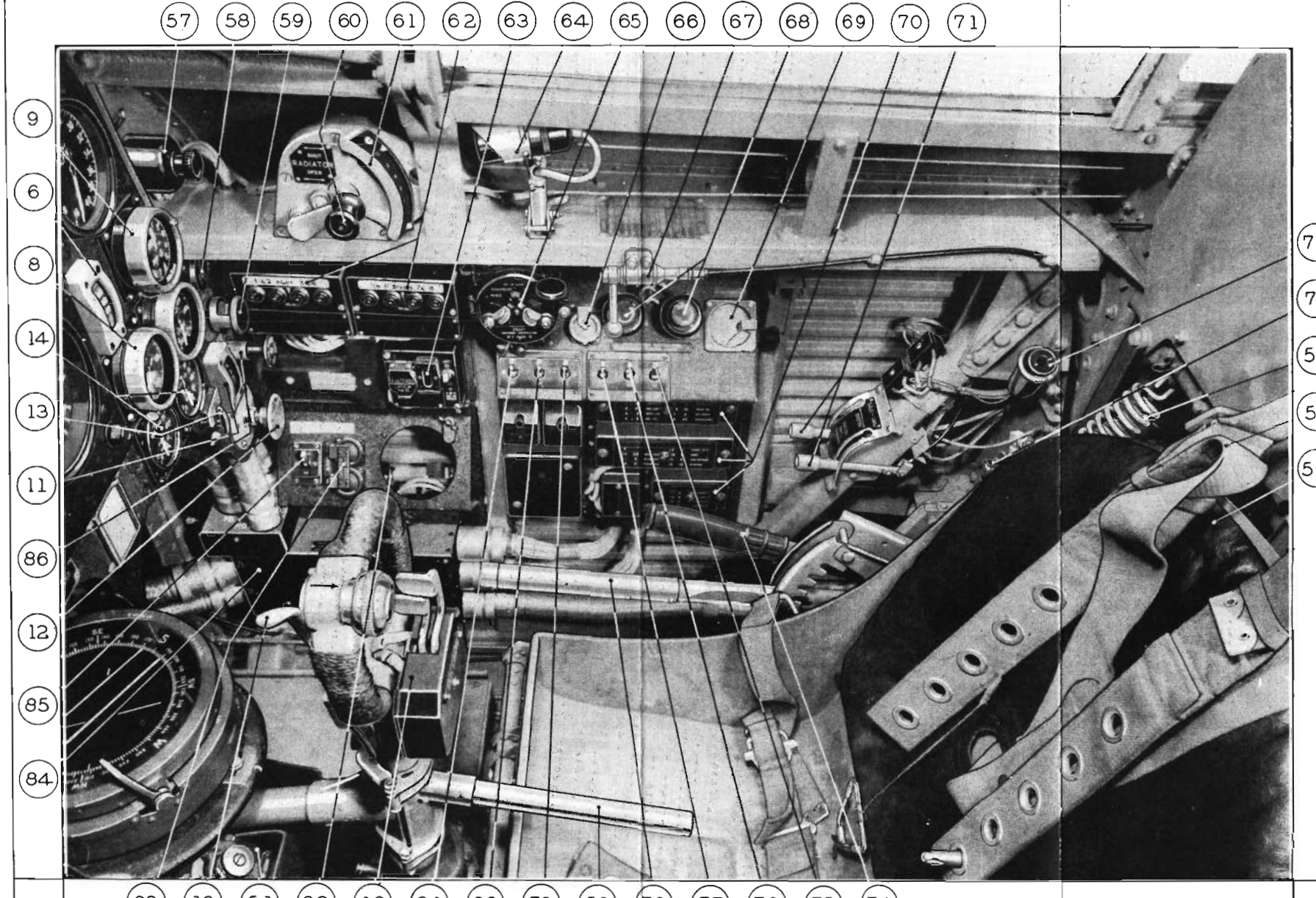
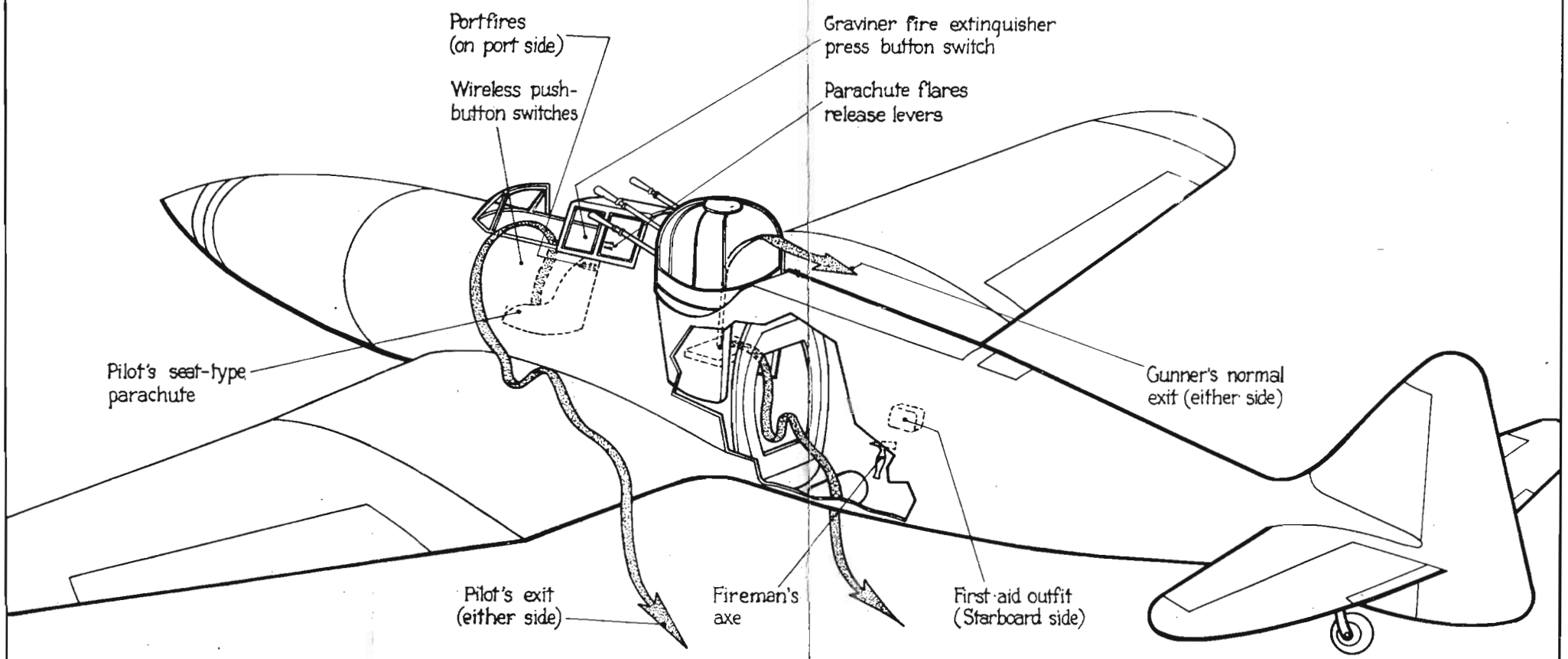


FIG. 3

STARBOARD SIDE OF COCKPIT

FIG. 3

Amended by A.L 38



Gunner's alternative exit guns must be pointing forward and rear wireless mast retracted.
(To be used only when normal method is impossible)

FIG. 4

PARACHUTE EXITS AND EMERGENCY EQUIPMENT

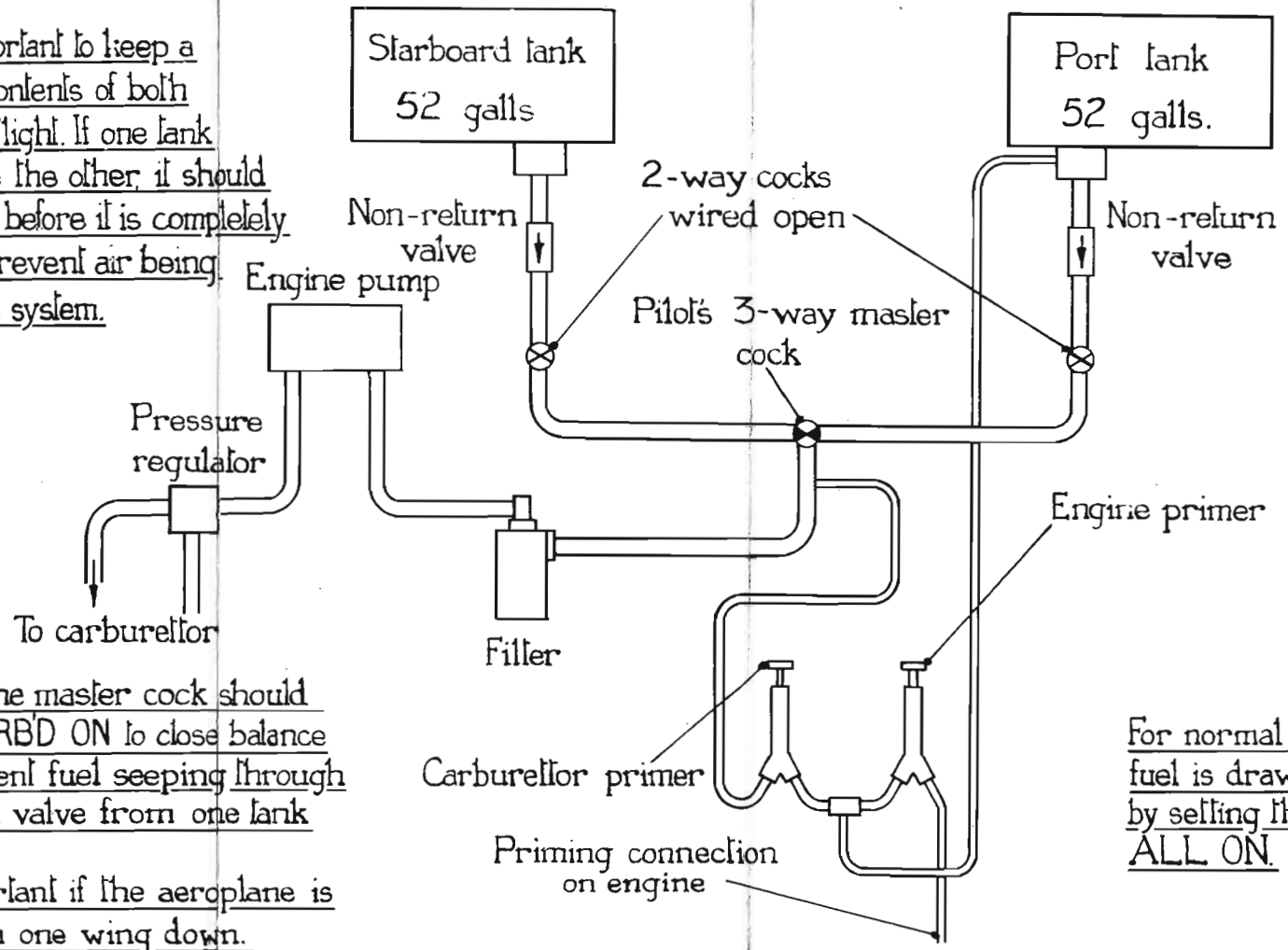
FIG. 4

SECTION 2

HANDLING AND FLYING NOTES

FOR PILOT

Note:- It is important to keep a check of the contents of both tanks during flight. If one tank empties before the other, it should be turned OFF before it is completely exhausted to prevent air being drawn into the system.



After flight the master cock should be set to STARB'D ON to close balance pipe and prevent fuel seeping through a non-return valve from one tank into the other.
This is important if the aeroplane is standing with one wing down.

For normal condition of flight, fuel is drawn from both tanks by setting the master cock at ALL ON.

FIG. 1

FUEL SYSTEM DIAGRAM

FIG. 1

SECTION 2

HANDLING AND FLYING NOTES FOR PILOT

1. ENGINE DATA, MERLIN III.

(i) Fuel.- Operational units, 100 octane only.
Others; unmodified engines, 87 octane or higher.
modified engines, 100 octane only.

(ii) Oil.- Key letters Y/Y.

(iii) Coolant.- Treated ethylene glycol, stores ref. No. 33C/559.

(iv) Principal engine limitations.-

	r.p.m.	Boost lb/sq.in.	Temp. °C Coolant outlet.	Temp. °C Oil inlet.
TAKE-OFF TO 1,000 FT.	3,000	+6¼		
CLIMBING ½ HR. LIMIT	2,600	+6¼	120	90
CRUISING RICH	2,600	+4½	95	90
CRUISING WEAK	2,600	+2¼	95	90
ALL OUT 5 MINS LIMIT	3,000	+6¼	120	95

OIL PRESSURE: Normal 60 lb/sq.in.
Emergency minm. (5 mins) 45 lb/sq.in

TAKE-OFF MINM. TEMPERATURES: Oil 15°C.
Coolant 60°C.

(v) Other limitations.-

Minimum r.p.m. at +6½ lb/sq.in boost: 2,080.

Diving: Maximum boost + 6¼ lb/sq.in.
Maximum r.p.m. 3,600
3,000 r.p.m. may be exceeded only for 20 seconds, and with throttle not less than one-third open.

(vi) Combat concessions with 100 octane fuel.- The following may be used for short periods when necessary in operations. All occasions must be reported and an entry made in the engine log book.

Climbing r.p.m. up to 20,000 feet: 2,850.
above 20,000 feet: 3,000.

The boost control cut-out may be operated; this will give +12 lb/sq.in boost up to about 10,000 feet.

(vii) Fuel pressure.- 2½ to 3½ lb/sq.in.

2. FLYING LIMITATIONS.

Maximum speeds in m.p.h. I.A.S.-

Diving	390
Undercarriage down	160
Flaps down	140

3. PRELIMINARIES.

(i) Check that the undercarriage selector is at NEUTRAL.

(ii) Check that the flap selector is at NEUTRAL.

(iii) Switch on the undercarriage indicator and check that undercarriage is locked (green lights).

(iv) See that turret is locked GUNS FORWARD. See para 10.

4. STARTING THE ENGINE AND WARMING UP.

(i) Set fuel cock to ALL ON, if the contents of the two tanks are approximately equal. See para 9 (iv).

(ii) Set controls as follows:-

(a)	Throttle	- ½ inch open.
(b)	Mixture control	- RICH.
(c)	Airscrew speed control	- Fully back.
(d)	Air intake heat control	- COLD.
(e)	Radiator shutters	- OPEN.

(iii) Operate the upper priming pump until the suction and delivery pipes are primed; this may be judged by a sudden increase in resistance. The number of strokes which must then 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
Number of strokes	3	4	7	13	30	60

(iv) Switch on ignition, press the starter and booster coil buttons, and prime the engine as rapidly and vigorously as possible. The engine should start without greatly exceeding the above number of strokes, or after not more than two if it is hot. Turning periods must not exceed 20 seconds, with a 30 seconds wait between them.

(v) At temperatures below 0°C it may be necessary to continue priming after the engine fires until it picks up on the carburettor.

(vi) Release the starter button, and when the engine is firing evenly, release the booster coil button. Screw down the priming pump.

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

(viii) After a minute or more, move the airscrew speed control slowly to the fully forward position.

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5. TESTING ENGINE AND INSTALLATIONS.

(i) While warming up.-

(a) Check main air pressure; minimum 100 lb/sq.in.
maximum 300 lb/sq.in.

(b) Check the operation of the engine-driven hydraulic pump by lowering and raising the flaps.

(ii) After warming up.-

(a) Open up to weak mixture cruising boost and check the operation of the airscrew.

(b) Test each magneto in turn at rich mixture cruising boost. The drop should not exceed 100 r.p.m.

(c) Open throttle fully and check boost, r.p.m. and oil pressure.

6. FINAL PREPARATIONS FOR TAKE-OFF.

Drill of vital actions.- T.M.P., Fuel, Flaps and Radiator.

T - Trimming tabs - Elevator zero.
Rudder fully STARBD.

M - Mixture - RICH

P - Pitch - Airscrew speed control fully forward.

Fuel - Check contents; cock to ALL ON if contents equal.

Flaps - UP.

Radiator - OPEN.

Note.- Flaps may be set 30° down if the take-off is restricted.

7. TAKE-OFF.

(i) There is a tendency to swing left as the aeroplane gathers speed.

(ii) On reaching 120 m.p.h. I.A.S. reduce to climbing r.p.m.

(iii) Climb at about 160 m.p.h. I.A.S.

(iv) Close the cockpit hood to at least its third position so that the turret can be rotated. See para 10.

8. CLIMBING.

The speed for maximum rate of climb is 140 m.p.h. I.A.S. up to 12,000 feet, but at this speed the nose is high, and 160 m.p.h. I.A.S. is recommended. Above this height reduce speed by one m.p.h. per thousand feet.

9. GENERAL FLYING.

(i) The recommended speed for greatest range is 150 m.p.h. I.A.S.

(ii) Stability is satisfactory.

(iii) There is practically no change of trim when the undercarriage or flaps are lowered.

(iv) The fuel cock should be at ALL ON in flight so long as the contents of the tanks are approximately equal, but a watch must be kept on the contents, and if one contains appreciably more than the other the cock should be set to the fuller tank.

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10. COCKPIT HOOD AND TURRET.

(i) The turret should not be rotated to or from the guns fully forward position when the cockpit sliding hood is open past the third position without first ensuring that the guns are elevated sufficiently to clear the hood. An additional safety catch is fitted at the third position to remind the pilot that the hood will then encroach on the gun sweep when the turret is operated. The rear fairing will retract automatically on opening the cupola doors when the doors are in the aft position and the front fairing when the doors are in the front position.

(ii) For take-off and landing the turret must be locked in the GUNS FULLY FORWARD position and cupola doors locked closed. This will allow the cockpit hood to be opened fully and will also provide an exit for the gunner through the service hatch, below the turret, in the event of an emergency such as the aeroplane "nosing over".

(iii) After take-off, the pilot must close the cockpit hood to at least the third position, otherwise the turret cannot be operated correctly.

(iv) To obtain maximum performance during all conditions of flight, the cockpit hood must be closed fully, the turret locked in the GUNS FULLY AFT position so that the fairing will be UP.

(v) To obtain emergency exits with the turret in any position and the cockpit hood closed, the pilot must open the hood fully and the gunner must open the cupola doors; the fairing will then retract automatically and so facilitate exit.

11. STALLING.

(i) The stalling speeds at 7,700 lb. are

Flaps and undercarriage up	91 m.p.h. I.A.S.
Flaps and undercarriage down	77 m.p.h. I.A.S.

(ii) With flaps and undercarriage up, one wing drops to a vertical position, but not violently. This may develop into a gentle flick roll if the control column is held back. With flaps and undercarriage down one wing drops gently.

12. SPINNING.

Spinning is not permitted.

13. AEROBATICS.

Aerobatics are permitted, when no bomb load is carried, by pilots who have written authority of their squadron commander. Before aerobatics are begun, the pilot must warn the air gunner. High accelerations are to be avoided.

14. DIVING.

(i) Maximum speed 390 m.p.h. I.A.S.

(ii) Set the airscrew speed control to cruising r.p.m.

(iii) The aeroplane is stable longitudinally and should be trimmed into a dive.

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15. APPROACH AND LANDING.

(i) Reduce speed to 140 m.p.h. and carry out the drill of vital actions; U.M.P. and Flaps.

U -	Undercarriage	- DOWN
M -	Mixture	- RICH
P -	Pitch	- Airscrew speed control fully forward.
	Flaps	- Fully down.

(ii) Correct speeds for the approach.-

Engine assisted	100 m.p.h. I.A.S.
Glide	110 m.p.h. I.A.S.

16. MISLANDING.

Climb at about 110 m.p.h. I.A.S. and delay raising the flaps until a safe height of about 400 feet has been reached.

17. AFTER LANDING.

(i) Set airscrew speed control fully back, and open up the engine sufficiently to change pitch to coarse.

(ii) Let the engine idle for a short time, then operate the slow running cut out. Switch off ignition after the engine stops.

(iii) If the aeroplane is to be left standing for some time, turn the fuel cock to STARBOARD ON. This is important if standing one wing down.

18. UNDERCARRIAGE AND FLAPS EMERGENCY OPERATION.

If the green lamps fail to light after selecting undercarriage down, the following action should be taken:-

(i) Pull knob on indicator to see if the lamps are defective.

(ii) Reselect DOWN and see if pressure builds up on the hydraulic pressure gauge on the left side panel.

(iii) If no pressure is indicated the pump must be considered broken and the hand pump must then be used.

(iv) If the undercarriage will still not operate the special emergency hydraulic system must be brought into use. To do this the procedure is as follows:-

(a) Set the undercarriage selector lever in its NEUTRAL position.

(b) Press the thumb release on the emergency lever and lower it to the DOWN position.

(c) Work the handpump. About 200 full strokes are required.

Note:- The emergency system will only lower the legs and will not raise them. The flaps cannot be lowered after the undercarriage emergency system has been used.

19. POSITION ERROR.

The corrections for position error at 7,700 lb. are as follows:-

m.p.h. I.A.S.	correction
95	subtract 4 m.p.h.
105	subtract 2 m.p.h.
115	no correction
125	add 2 m.p.h.
140	add 4 m.p.h.
160	add 6 m.p.h.
185	add 8 m.p.h.
220	add 10 m.p.h.
250	

20. FUEL CAPACITY.

There are two tanks, each having a capacity of 52 gallons.

21. FUEL CONSUMPTIONS.

The approximate fuel consumptions are

Mixture	r.p.m.	boost lb/sq.in.	Galls/hr.
Rich	3,000	+6¼	89
Rich	2,600	+6¼	81
Rich	2,600	+4½	68
Weak	2,600	+2¼	49

22. OIL CAPACITY.

The effective oil capacity is 10 gallons.

23. ABANDONING BY PARACHUTE.

(i) The wireless mast must be retracted by lowering the undercarriage, and the turret must be rotated to the GUNS FORWARD position.

(ii) The air gunner should leave through the service hatch in the floor immediately aft of the turret. If this is not possible, he should leave through the turret cupola doors.

(iii) The pilot should climb out onto either main plane and drop over the trailing edge.

FOR OFFICIAL USE ONLY

June 1941

AIR MINISTRY

Amendment List No.40
to
AIR PUBLICATION 1592A
Volume I
and Pilot's Notes

DEFIANT I AEROPLANE

MERLIN III ENGINE

Note.- The last Amendment List to this Air Publication affecting the Pilot's Notes was A.L. No.38.

---

(88) SECTION 2. Mark fig.1 (fuel system diagram) and para.4(iii) to refer to this sheet, and note the following:

The fuel cock should be set to ALL ON in flight so long as the quantity of fuel in each tank is approximately equal, but a watch must be kept on the contents of each tank, and if one contains appreciably more than the other, the fuel cock should be set to the fuller tank.

(89) SECTION 2. Insert this sheet at end of section 2.

R.T.P/877. 2150. 6/41

November 1941.
AIR MINISTRY.

Amendment List No. 42.
to
AIR PUBLICATION 1592A.
Volume I
and Pilot's Notes.

DEFIANT I AEROPLANE.

MERLIN III ENGINE.

Note.- Previous amendment lists which still affect the Pilot's Notes are as follows:- 37,38,40. A.L. No.40 made manuscript alterations and the instruction sheet should still be at the end of Section 2 as authority, Item (88) still affects the fuel system diagram; the instruction has been included in the text of Section 2 as now reissued.

---

(1)	SECTION 1, Fig.4.	Delete the word "normal" which appears immediately above the rear fuselage.
(2)	SECTION 1, Fig.4.	Delete the word "alternative" and the words "(to be used only when normal method is impossible)" which appear immediately above the title at the bottom of the figure.
(3)	SECTION 2.	Remove and destroy sheet bearing list of contents.
(4)	SECTION 2.	Remove and destroy sheets bearing paras 1 to 37 and substitute new sheets bearing paras 1 to 23 supplied herewith.
(5)	SECTION 2.	Insert this sheet at end of Section 2.

R.T.P./1071 2150 11/41

SECTION 3

CONTENTS

LIST OF ILLUSTRATIONS

SECTION 3

CONTROLS AND EQUIPMENT IN TURRET

General

1. A layout of the controls and equipment in the air gunner's turret is given in figs.1, 2 and 2A at the end of this Section and a key to the referenced items is given facing each illustration. The turret controls are briefly described in the following paragraphs.

Cupola

2. Normal entry to and access from the turret is obtained on the port side of the aeroplane where footrests are provided. The two vertical posts (11) supporting the cupola should be used as handgrips and not any other part of the turret. The spring-loaded cupola doors (18) are freed from the closed position by means of a cable and pull-ring situated on the forward port side of the cupola when the turret is in the "guns forward" position. The opening of the cupola doors automatically depresses the adjacent fairing. Each of the doors is closed from within the turret by means of a ratchet control (1), and freed by a ball-ended release lever (2). The turret must always be operated from the gunner's seat (30), and for take-off and landing must always be locked in the "guns forward" position to permit the gunner to escape through the service hatch in the floor (see para.8) should the aeroplane overturn.

Air gunner's seat

3. The turret seat (30) is of the hinged drop-down pattern and is supported on three columns (31) each provided with a series of holes which permit adjustment of the seat height. The seat is hinged at its port side and is secured in the "up" position by means of a spring-loaded catch (38) on its starboard side. To release the seat, the sliding collar catch must be moved inboard.

Intercommunication

4. Microphone-telephone socket.- This socket (35) is located below the centre of the turret instrument panel.

5. Call lights.- These lamps (4), one red and one green, are mounted on the port side of the turret instrument panel and allow communication by signals between the air gunner and pilot. The lamps in the turret are operated by the pilot and similar lamps on the pilot's instrument panel are operated by pushbuttons (3) mounted beneath the lamps in the turret.

Oxygen equipment

6. A self-contained oxygen supply is provided in the turret by a standard 750-litre cylinder (39) housed in a cradle in the lower portion of the turret. The air gunner's bayonet socket (34) is mounted on the port side instrument panel. A delivery meter (7) scaled in thousands of feet, a supply meter (9) and a regulator valve (8) are mounted in the centre of the turret main instrument panel.

Turret heating control

7. Doors fitted in a duct at the rear of the glycol radiator pass warm air into the turret. The doors can be locked in selected positions by a lever and ratchet mounted on the starboard side of the turret bay (see fig.3). With the turret in the "guns aft" position, the gunner can reach the operating lever by extending his left arm behind him. If the system is working properly, a temperature difference of approximately 30°C. should be obtained between the outside air and inside the turret. The warm air is fully ON when the operating lever is in the DOWN position. The turret compartment is air-sealed by canvas screens fitted at frames 8 and 13.

Service hatch

8. This is situated in the underside of the fuselage immediately aft of the gun turret. The hatch cover is secured by four pins operated by links attached to a central rotary disc. The disc can be operated either from inside or outside the aeroplane by means of handles; the handle on the outside of the cover is enclosed by a small door which can be shut when the cover is secured.

Armour plate

9. For the protection of the air gunner, a sheet of armour plate (6) is mounted just below the sight bracket.

EMERGENCY equipment and exits

10. The air gunner should abandon the aeroplane by opening the cupola doors and climbing out (see Sect.1, fig.4). When the release lever (2) is operated, the doors will spring open.

11. If it is impossible for any reason to abandon the aeroplane through the cupola doors, exit should be made through the service hatch by climbing out feet first and facing the tail.

Note.- The turret must be rotated to the "guns forward" position to enable this exit to be used.

12. Crash axe and first-aid outfit.- An axe is stowed adjacent the service hatch on the starboard side of the fuselage and a first-aid

outfit is stowed about halfway up the port side of the fuselage slightly aft of the service hatch.

13. Signal pistol.- A 1½ in. signal pistol, and eight cartridges, are stowed immediately aft of the service hatch, the pistol being on the starboard, and the cartridges on the port side of the fuselage.

TURRET OPERATION

General

14. The turret is rotated and the guns are elevated electro-hydraulically. The guns are fired electrically by means of a press button (19) on top of the turret-and-guns control column (20). The operating speed of the turret is in no way affected by external wind loads. Full details of the construction of the turret are contained in A.P.1659C, Vol.I.

Hydraulic system

15. This contains two hydraulic circuits, one controlling the rotation of the turret and the other controlling the elevation and depression of the guns.

(i) The rotation circuit includes a hydraulic generator and a hydraulic motor.

(ii) The elevation circuit includes a hydraulic generator (common to the rotation circuit), a pressure regulator, and a hydraulic ram.

16. Hydraulic generator.- This generator (37) is driven by an electric motor (36) which derives its power from the engine-driven electrical generator. The hydraulic generator is a duplex pump which builds up hydraulic pressure to rotate the turret and elevate and depress the guns. It is controlled directly from the air-gunner's control column.

17. Hydraulic motor.- This motor rotates the turret and is energized by pressure supplied by the hydraulic generator, the rotation of the turret being effected by the motor reduction-gear pinion engaging in the toothed circumferential ring of the turret.

18. Hydraulic ram.- This double-acting ram which elevates and depresses the guns is also energized by pressure from the hydraulic generator.

19. Pressure regulator.- This is provided to maintain pressure on both sides of the ram piston when the turret is in operation and thus to prevent "gun creeping" and to assist in hydraulically locking the elevating ram when it is stationary. A by-pass valve, operated by the disengaging gear lever (25) (see para.26) provides the means of disengaging the ram

thus permitting manual elevation of the guns.

Electrical system

20. This contains four circuits; (i) a power circuit comprising the electric motor and its controls, (ii) a gun firing circuit, (iii) a turret and sight illumination circuit, and (iv) intercommunication circuits including microphone, telephone and call light system.

(i) The power circuit includes:-

(a) An electric motor (36) which drives the hydraulic generator (37) and is energized by the 24-volt, 1,000-watt engine-driven generator.

(b) A radio interference suppressor which prevents electrical interference with the wireless.

(c) The main switch (14) by which the field of the electric motor is energized before the armature switch is closed.

(d) A warning lamp (15) which warns the gunner that the main switch is ON, and that the field of the electric motor is still energized after the control column (20) has been released.

(e) An armature switch which is operated by grasping the operating lever (22) on the control column, and energizes the electric motor.

(f) A high-speed switch (23) and resistance which enables the turret to be operated at approximately twice normal speed for short periods.

(g) Condensers which reduce the sparking across the contacts of the main switch.

(ii) The gun firing circuit includes:-

(a) A master firing switch (16) for the purpose of isolating the firing button except when firing is imminent. This is a three-way switch to enable firing of the turret guns to be transferred to the pilot.

(b) A gun fire interrupter which prevents obstructing parts of the aeroplane from being shot away during fire traverse.

(c) A firing button (19) by which all four guns are fired simultaneously, mounted in the top of the control column.

(d) A circuit breaking switch which is connected to the disengaging gear lever and prevents firing when the turret is not hydraulically locked, i.e. when the disengaging gear lever is in the FREE position as opposed to the ENGAGED position (see para. 26).

(e) A solenoid switch for each pair of guns which is provided to relieve the firing button of the heavy load required by the firing solenoids.

(f) A firing solenoid fitted to each gun.

(iii) The turret and sight illumination circuit includes:-

(a) An instrument panel lamp (28) and dimmer switch (29) which provide variable illumination for the instrument dials situated on the port side of the turret.

(b) A main panel lamp (12) and dimmer switch (26) which provide variable illumination for the turret controls.

(c) A sight lamp and switch (27) which provide illumination for the reflector gun sight.

(iv) The intercommunication circuits include:-

(a) A microphone-telephone socket (35) which provides normal telephonic communication between air gunner and pilot. The socket is situated below the centre of the turret instrument panel.

(b) A call light system which enables the air gunner to call the pilot by pre-arranged signals by operating call lights through press button switches (3).

Turret controls

21. Except where an external battery of large capacity is employed, the turret must not be power operated without the engine running, otherwise the installed accumulator will become discharged too rapidly.

22. To turn the main switch (14), the safety lever (13) must first be swung clear. This lever is interlocked with the main switch so that power rotation of the turret is impossible until the forward fairing has been depressed. After closing the cupola doors and swinging clear the safety lever, the raising and lowering of the fore-and-aft turret fairings are automatic and dependent on the rotation of the gun turret.

23. Upon turning the main switch to the ON position, the lamp (15) lights up, warning the gunner that the field circuit of the electric motor is energized and that the motor will start when the operating lever (22) on the control column has been depressed.

24. The control column (20) is connected to both pumps of the hydraulic generator (37), and by controlling the pump output it also controls the speed of rotation and/or elevation. The control column moves in a diamond-shaped slot and when it is in the mid-position of the slot, with the electric motor on, the pumps are

at zero stroke and no movement of the turret or guns occurs. Movement of the control column forward or aft gives depression or elevation respectively, while movement to port or starboard gives a corresponding turret rotation. Diagonal movement of the control column results in simultaneous rotation of the turret and movement of the guns.

25. Approximately twice the normal speed of turret rotation or gun elevation can be obtained, for momentary periods only, by depressing the high-speed switch button (23). High speed operation should be limited to short duration periods only and on no account should the high speed switch be operated before the operating lever on the column has been depressed.

Note.- 15 seconds is the maximum permissible time for each operation of the high speed switch. It is not possible to obtain full speed in rotation and elevation simultaneously.

26. A disengaging gear lever (25) enables both the rotation and elevation movements to be freed from the hydraulic system allowing the gunner to rotate the turret by means of the hand turning gear (17), and to elevate the guns manually. When the lever is moved towards the gunner the turret is freed. The handle for rotating the turret is stowed on the starboard side of the instrument panel and must be engaged in the socket (21) for hand rotation.

27. When the turret is rotated, obstructing fairings are depressed by means of cam-operated valves which actuate compressed-air rams.

Gun controls

28. A pushbutton (19) on the top of the turret control column and an alternative pushbutton (see Sect.1) on the pilot's control column provide the means of firing the guns. The guns are fired electrically and simultaneously. It is impossible to fire the guns until:-

(i) The switch (16) is turned to GUNNER (or PILOT),

(ii) The disengaging gear lever (25) is in the ENGAGED position. It is essential that this lever be moved to the ENGAGED position after the manual operation of the turret and guns.

29. An automatic gun fire interrupter breaks the firing circuit as soon as the fire traverse of one or both pairs of guns is obstructed by any part of the aeroplane.

30. To enable to pilot to operate the guns, it is necessary for the air gunner to :-

(i) Lock the turret in the "guns forward" position with the guns at the lowest elevation in which they will fire; i.e, where the guns are just clear of the interrupter which prevents the guns firing into the airscrew disc.

(ii) Turn the switch (16) to the PILOT position.

31. A detailed description of the firing mechanism of the Browning guns will be found in A.P.1641E.

Key to fig. 1

GUN TURRET (UPPER PORTION)

1. Ratchet control
2. Cupola doors release lever
3. Call light switches
4. Call lights
5. Gun rear trunnions
6. Armour plate
7. Oxygen delivery meter
8. Oxygen regulator valve
9. Oxygen supply meter
10. Reflector sight bracket
11. Supporting posts
12. Main panel lamp
13. Safety lever
14. Main switch
15. Warning lamp
16. Transfer switch
17. Manual control handle
18. Cupola door
19. Gun firing button
20. Control column
21. Socket for manual control handle
22. Operating lever
23. High-speed switch
24. Intercommunication socket lead
25. Disengaging gear lever
26. Panel lamp dimmer switch
27. Sight lamp switch
28. Side panel lamp
29. Side panel lamp dimmer switch

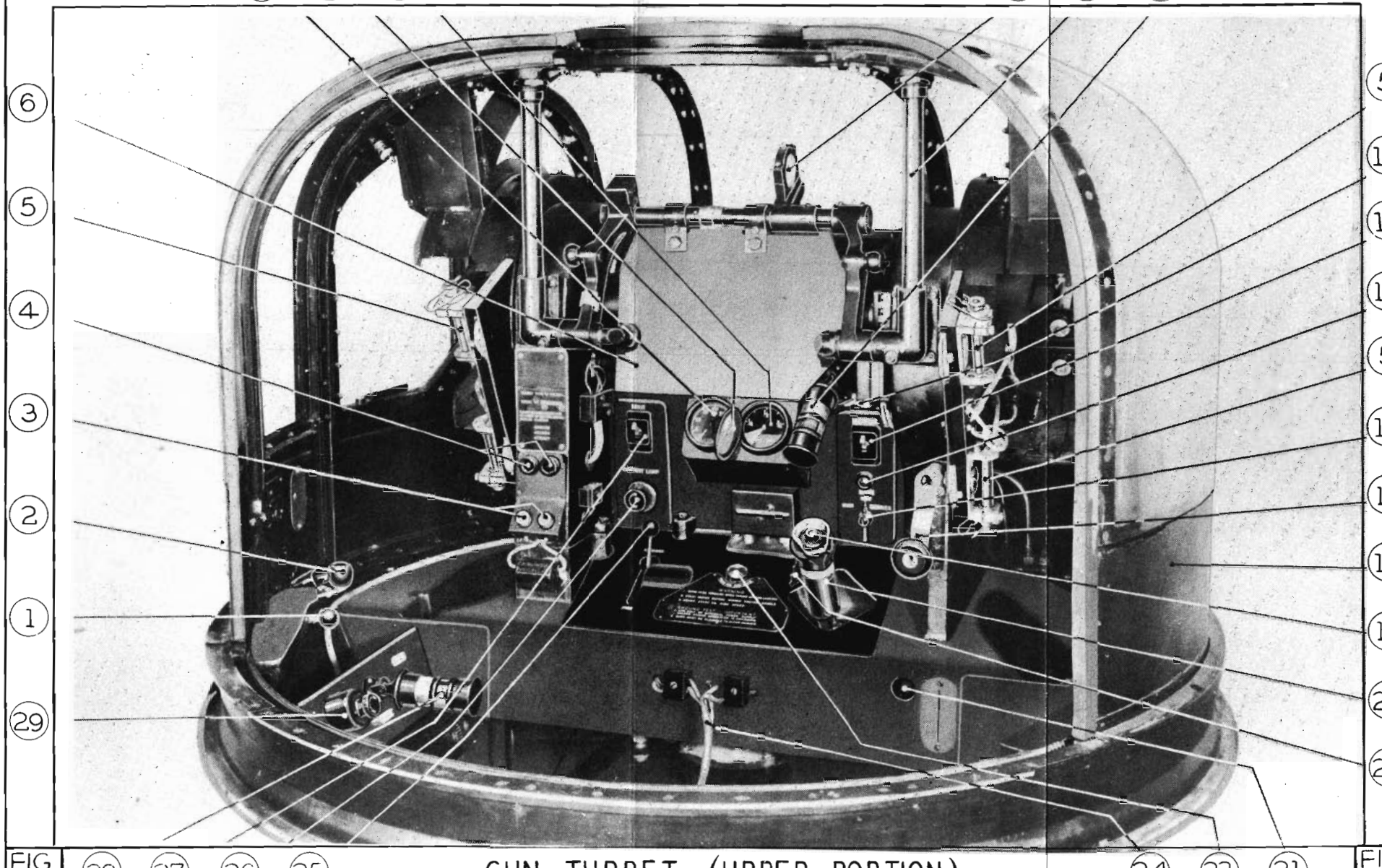

FIG. 1 GUN TURRET (UPPER PORTION) FIG. 1

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Key to fig. 2

GUN TURRET (LOWER PORTION)

30. Turret seat
31. Seat supporting columns
32. Safety strap
33. Ammunition containers
34. Oxygen bayonet connection
35. Microphone-telephone socket
36. Electric motor
37. Hydraulic generator
38. Seat catch
39. Oxygen container

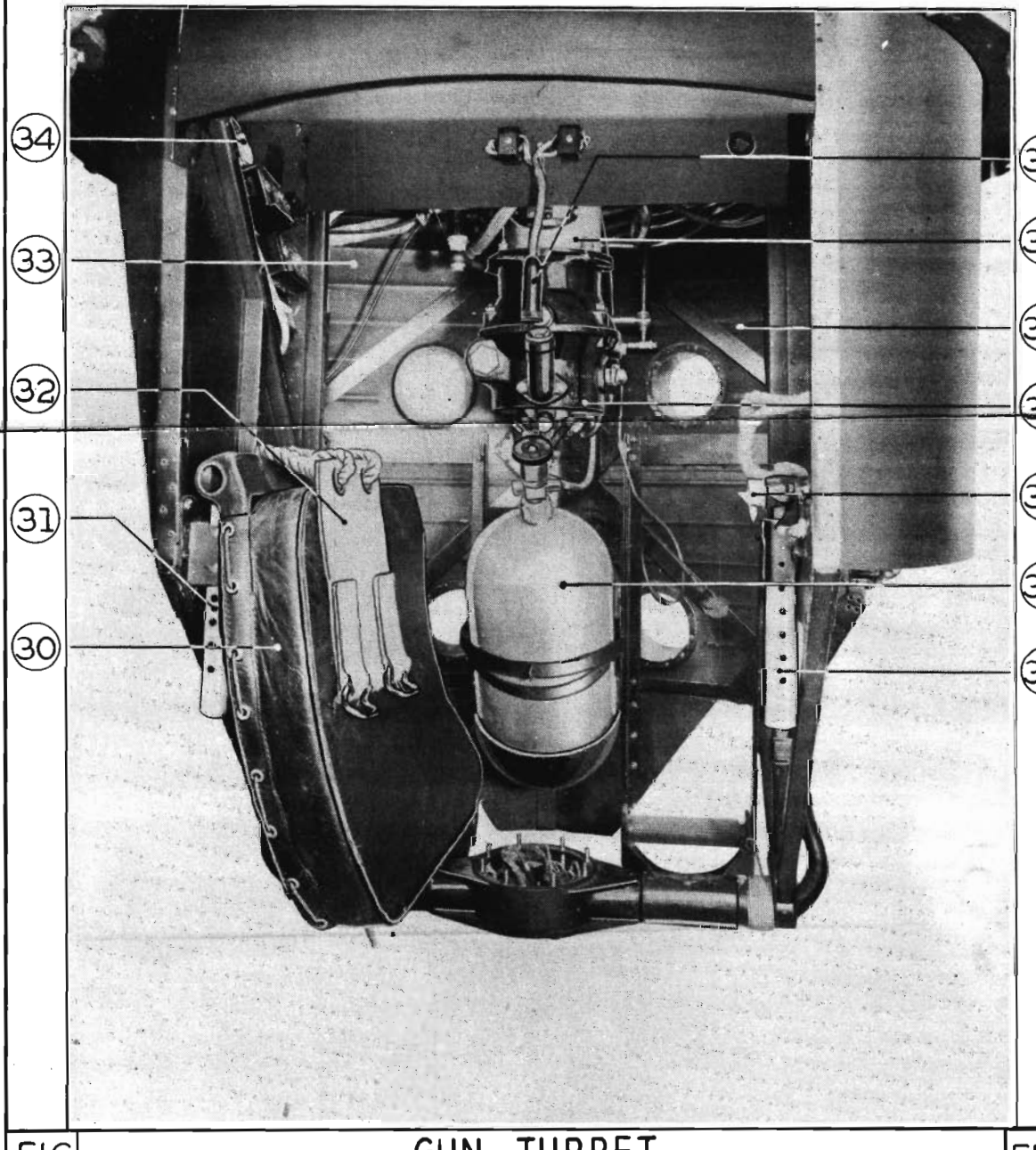

FIG. 2 GUN TURRET (LOWER PORTION) FIG. 2

Key to fig.2A

GUN TURRET (LOWER PORTION - AMMUNITION CONTAINER)

33. Ammunition containers
40. Access door for empty links and cases
41. Ammunition feed necks
42. Extra container for empty links and cases

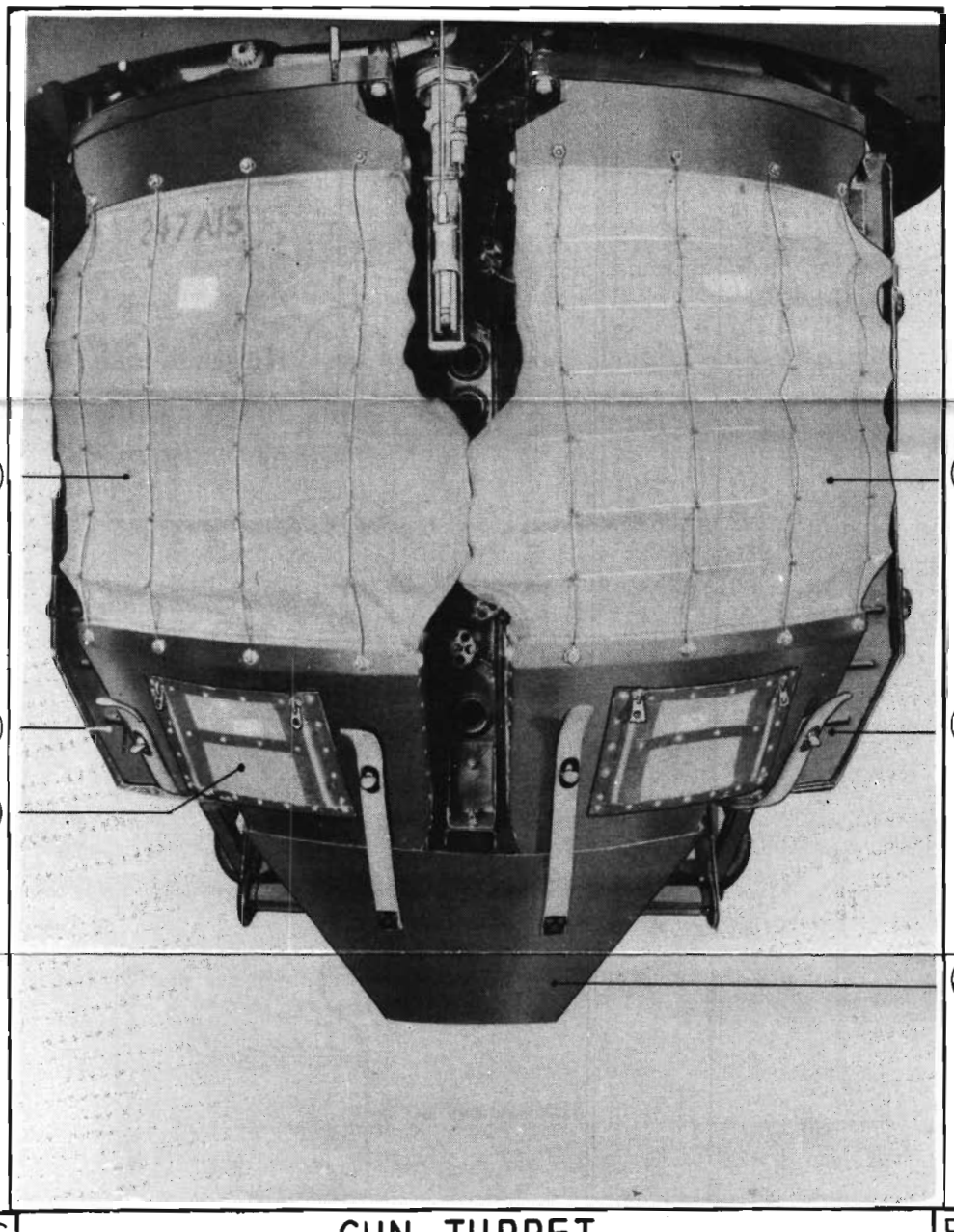

FIG. 2A GUN TURRET (LOWER PORTION-AMMUNITION CONTAINER) FIG. 2A

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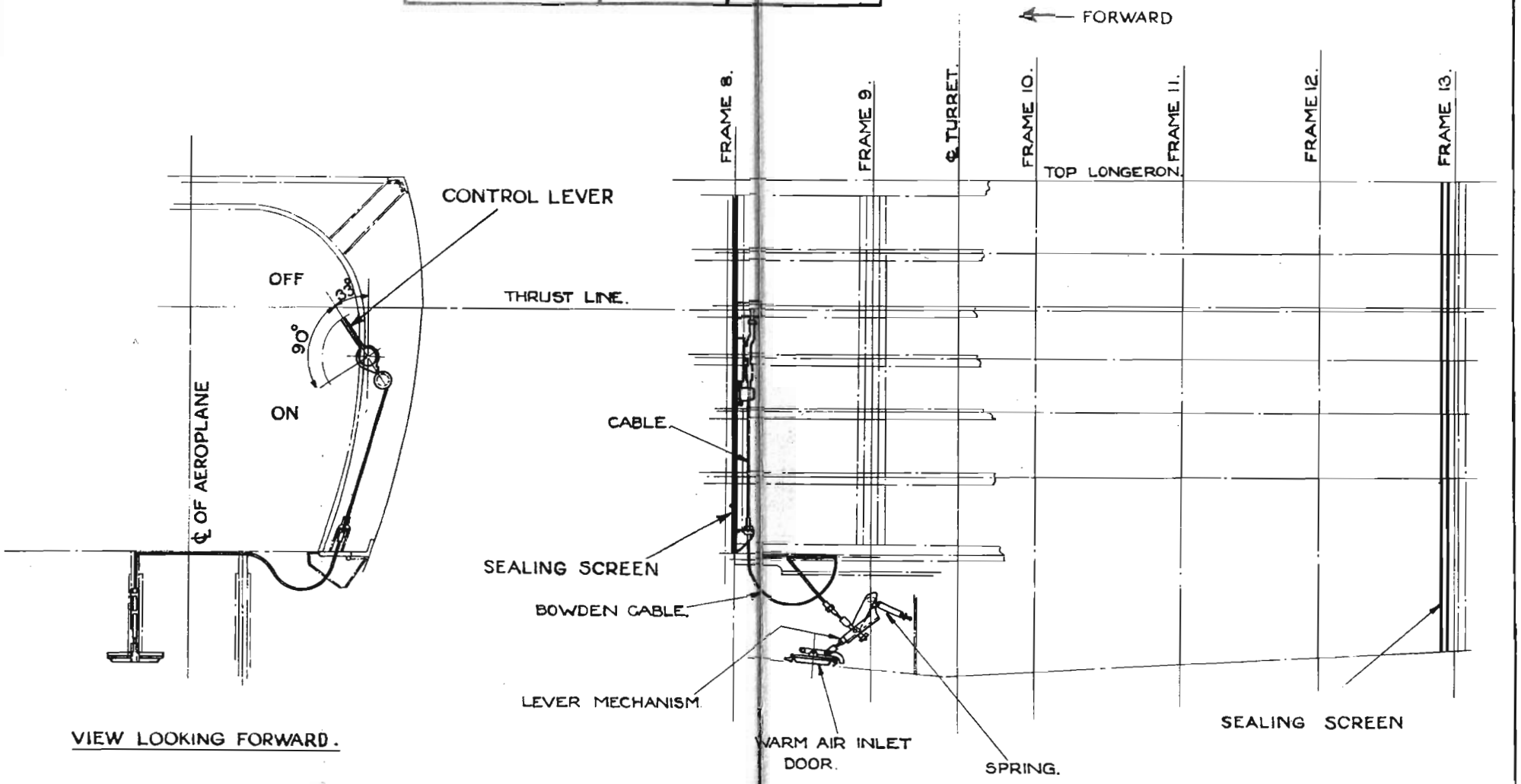

FIG. 3

TURRET HEATING CONTROL

FIG. 3


These are being listed for the
benifit for people interested
in British or Commonwealth
Aircraft
While it did cost me a great
sum of money to aquire
these documents, all I ask in
return is some credit.
~JimSan