2nd EDITION

A.P. 2019B & G—P.N.

F/LT. BILL MARR AFC.

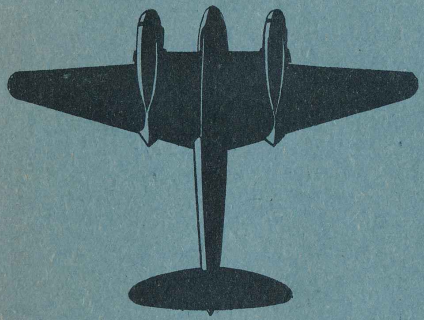
PILOT'S NOTES

FOR

MOSQUITO

MARKS F II and NF XII NF.XIII NF. NF.XVII.

MERLIN 21 or 23 ENGINES OR 25.



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AMENDMENTS

Amendment lists will be issued as necessary and will be gummed for affixing to the inside back cover of these notes.

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Incorporation of an amendment list must be certified by inserting date of incorporation and initials below.

A.L. NO.	INITIALS	DATE	A.L. NO.	INITIALS	DATE
1		23/5/44	7		5/9/44
2		23/5/44	8		
3		16/3/44 K.F.	9		
4		30/4/44	10		
5		29/5/44	11		
6		21/7/44	12		

Bill Marr. 409 Sqdn.
N.F. Mosquito Mk XIII

NOTES TO USERS

THIS publication is divided into five parts: Descriptive, Handling, Operating Data, Emergencies, and Illustrations. Part I gives only a brief description of the pilot's controls and of other controls with which the pilot, as captain, should be acquainted.

These Notes are complementary to A.P. 2095 Pilot's Notes General and assume a thorough knowledge of its contents. All pilots should be in possession of a copy of A.P. 2095 (see A.M.O. A93/43).

Words in capital letters indicate the actual markings on the controls concerned.

Additional copies may be obtained from A.P.F.S., Fulham Road, S.W.3, by application on R.A.F. Form 294A, in duplicate, quoting the number of this publication in full—A.P. 2019B & G—P.N.

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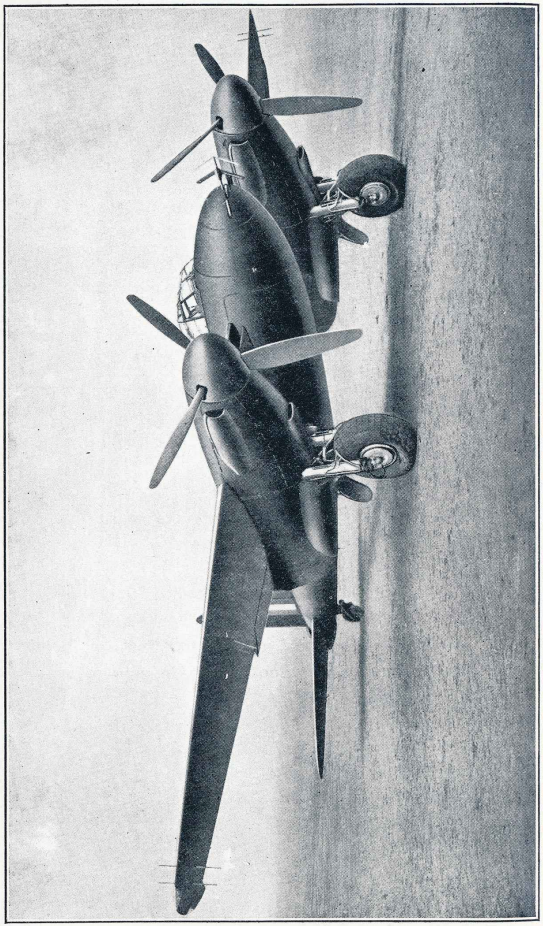

MOSQUITO F II & NF XII

AIR MINISTRY
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Pilot's Notes

MOSQUITO MARKS F II and NF XII NF.XIII. NF.XVII. NF.XIX.
PILOT'S NOTES

Second Edition. This edition supersedes all previous issues.

LIST OF CONTENTS

PART I

DESCRIPTIVE

FUEL AND OIL SYSTEMS

A.L.1 PART I PARA. 1 (page 6)

1. **Fuel tanks**

(i) *Marks II, XII and XVII.* (*See* Fig. 4)
Fuel is carried in four inner wing tanks and four outer wing tanks. In addition, two auxiliary long-range tanks can be carried in the fuselage. The fuel capacities are as follows:—

MAIN SUPPLY		
(Inner wing tanks)	287 gals.	(143 gals. per side)
OUTER TANKS	116 ,,	(58 ,, ,, ,,)
Total permanent tanks	403 ,,	
If carried, long-range fuselage tanks	150 ,,	
Total fuel capacity	553 ,,	

(ii) *Mark XIII.* (*See* Fig. 6) AND MARK XIX
Fuel is carried in four outer wing tanks, four inner wing tanks, and two centre tanks above the gun bay. In addition, one auxiliary long-range tank can be carried in the gun bay, and a drop tank can be carried under each wing.

The fuel capacities are as follows:—

MAIN SUPPLY —		
(Centre tanks)	50 gals.	
(Inner tanks)	287 ,,	(143 gals. per side)
OUTER TANKS	116 ,,	
Total permanent tanks	453 ,,	
If carried—		
Long-range fuselage tank	63 ,,	
Drop tanks (wood)	100 ,,	(50 gals. per side)
(metal)	84 ,,	(42 ,, ,, ,,)
Total fuel capacity	616 ,,	with wooden drop tanks
	600 ,,	,, metal ,, ,,

(iii) The centre tanks and the inner wing tanks supply both engines through a fuel collector box, when the two fuel cocks behind the pilot's seat are set to MAIN SUPPLY; if long-range fuselage tanks are carried, these also supply both engines through the fuel collector box, with the two fuel cocks set to MAIN SUPPLY and the immersed fuel pump switch (56) ON (on junction box B on the starboard cockpit wall).

When the fuel cocks are set to OUTER TANKS the port outer wing tanks supply the port engine and the starboard outer wing tanks supply the starboard engine; it is not possible to cross-feed from the outer wing tanks.

A.L.1 PART I PARA. 1 (page 7)

(iv) On Mark XIII AND MK XIX the fuel from the drop tanks is fed to the outer wing tanks by pneumatic pressure from the pressure side of the port vacuum pump. The cock which controls pneumatic pressure to the drop tanks is to port of the fuel cocks. The drop tanks are jettisoned by pressing the release button under the hinged safety cover on the left side of the cockpit.

2. **Fuel pressurising.**—The inner wing tanks and long-range tanks are provided with automatic air pressure regulation to reduce fuel vaporisation at high altitudes. The control above the fuel cocks, behind the pilot's seat, is marked PRESSURE VENTING, OFF and ON.
An aneroid-operated valve controls air pressure from the pressure side of the starboard engine vacuum pump, when the PRESSURE VENTING cock is set ON. At low altitudes no pressure will be admitted to the tank but as the altitude increases the aneroid valve will progressively admit more air pressure to the tanks. When the PRESSURE VENTING cock is OFF, the pressure from the vacuum pump is shut off and the tanks are vented direct to atmosphere. See Part II, para. 42 (iii) for use of PRESSURE VENTING control.

3. **Immersed fuel pump.**—When the long-range fuselage tanks are fitted, an immersed fuel pump is provided to feed the fuel to the engines via the collector box. A warning light (18) on the starboard side of the front cockpit coaming indicates when the fuselage tanks are emptied. (LIGHT ON—PUMP PRESSURE LOW.) The immersed fuel pump switch (56) should be turned off immediately the light glows.

A.L.1 PART I PARA. 4

4. **Fuel gauges.**—Three fuel gauges (62) are provided on junction box B on the starboard cockpit wall. They will indicate when the electrical services switch, linked with the ignition switches, is on. The forward fuel gauge shows the contents of the inner wing tanks, port and starboard, the centre fuel gauge shows the contents of the long-range fuselage tank(s) and the centre tanks, if fitted. The aft fuel gauge shows the contents of the outer wing tanks.

NOTE.—On some early Mark II aircraft the forward gauge shows the contents of the outer wing tanks and the aft gauge shows the contents of the inner wing tanks. They are, however, always labelled.

5. **Fuel-pressure warning lights.**—Two fuel pressure warning lights (6) are provided on the port instrument panel. These indicate when the fuel pressure drops below 6 lb./sq.in.

6. **Priming system.**—A Ki-gass priming pump is fitted at each engine nacelle and is accessible through a hinged flap on the right-hand side. The Ki-gass pumps draw fuel from the outer wing tanks. On some aircraft a priming cock is fitted which permits high volatility fuel to be drawn from an outside source for starting in cold weather. The cocks are adjacent to the Ki-gass pumps and will draw fuel irrespective of the position of the fuel cocks.

7. **Oil system**

(i) Two 15-gallon oil tanks are provided, one in each engine nacelle.

(ii) There are no oil cooler controls for the pilot, but the coolant radiator flaps also serve the oil coolers.

(iii) Oil dilution is provided; the oil dilution buttons are behind the pilot's seat.

MAIN SERVICES

8. **Hydraulic system**

(i) Two engine-driven pumps, one on each engine, supply hydraulic pressure for operation of:

Undercarriage and tailwheel
Flaps

The system will function on one pump only at a reduced rate.

(ii) A handpump for operating all the services through the normal system, when the engine pumps are not running, is mounted beneath the pilot's seat. The detachable handle is stowed on the cockpit floor below the observer's seat. The approximate time to lower the undercarriage by handpump is four minutes.

(iii) The handpump may also be used to operate the separate emergency undercarriage lowering system when the emergency selector valve marked PUSH FOR EMERGENCY on the right of the pilot's seat is pushed down. *See* Part IV, para. 69.

9. **Pneumatic system**

(i) An air compressor on the port engine operates:

Brakes
Radiator flaps (electro-pneumatic rams)
Automatic supercharger control (electro-pneumatic rams)
Tropical air filter (if fitted) (electro-pneumatic rams)
20 m.m. guns and ·303-inch guns (if fitted).

(ii) Two vacuum pumps, one driven by each engine, together operate the instrument flying panel. The system is so arranged that if one pump breaks down it is automatically isolated from the suction system.

10. **Electrical system.**—A generator on the starboard engine and a battery supply electrical power at 24 volts for:

Undercarriage warning lights and horn
Fuel pressure warning lights
Oil dilution valves
Engine starters and booster coils
Camera gun
Controls for operating radiator flaps, automatic superchargers, tropical air filters, ·303-inch guns
20 m.m. guns
Fire extinguishers
Radio
Pitot-head heater
Air recognition, identification and landing lights
Instrument panel and ultra violet lighting
Feathering pump motors
Windscreen wiper

On early aircraft a generator switch is provided on junction box B on the starboard cockpit wall. This should always be ON.

A warning light (70) on junction box B, on the starboard cockpit wall, shows when the generator is not delivering current. On the ground with the engine stopped the light will be on so long as the aircraft battery is connected. The current consumed is negligible. (MK. XVII. has 2 GENERATORS AND WARNING LIGHTS, AND MK XIX

As the instruments are not luminous, an emergency 2-volt, 20-ampere/hour accumulator is provided to supply current to the left-hand instrument floodlight in the event of complete electrical failure; this accumulator is stowed under the pilot's seat, and is connected to the floodlight at all times.

A ground starter battery socket is provided on the port side of the rear fuselage.

AIRCRAFT CONTROLS

11. **Flying controls.**—The rudder pedals can be adjusted for reach by the toes during flight.

12. **Trimming tab controls.**—The elevator trimming tab wheel is on the left of the pilot's seat; the indicator (38) is on the port sidewall. The rudder tab control (13) and indicator is on the front cockpit coaming. The port aileron tab control (26) and indicator is on the lower right-hand side of the main instrument panel. All trimming tab controls work in the natural sense.

13. **Flying control locking gear.**—The rudder pedals are locked by a spool which fits between them and is secured by a wing nut. The spool is connected to the control column locking tube by a cable, so that one cannot be removed without the other. Controls are locked in the neutral position. The gear is stowed in the fuselage opposite the rear hatch. It should be ensured that the locking pins are attached to the gear.

14. **Undercarriage**

(i) The undercarriage and tail wheel selector lever (23) is the left-hand lever on the hydraulic control box. A safety catch must be released before UP can be selected. The selector should always be moved smartly to the UP or DOWN positions, as it may become locked if it is moved slowly. For emergency operation *see* Part IV, para. 69.

(ii) The selector should return automatically to neutral when the UP or DOWN operation is completed. If the lever does not return when it is certain that the operation is complete, it should be returned by hand. If the lever

returns prematurely, the undercarriage indicators showing that the wheels are not locked UP or DOWN, the selector lever should be held UP or DOWN for not more than five seconds. This will occur only when the system is not properly adjusted.

(iii) In cold weather, or when coming down from high altitudes, before landing, the system should be exercised a few times by alternately selecting UP or DOWN: owing to the hydraulic oil congealing, when the undercarriage selector is put DOWN the main wheels may come down and the selector return to neutral before hydraulic pressure reaches the tail wheel.

(iv) It is not desirable to hold the selector DOWN for long as this subjects the lines to high pressures.

15. **Undercarriage position indicator.**—The undercarriage position indicator (21) is on the centre of the main instrument panel, and will indicate the position of the main wheels when the electrical services switch (14) is on. The indicator lamps have dimmer screens for night flying. Indications are:

Main wheels locked up	No lights
Main wheels locked up but throttles less than one quarter open ..	Two red lights.
Main wheels between UP and DOWN locks	Two red lights.
Main wheels locked DOWN ..	Two green lights.

There is no tail wheel indicator.

When the main wheels are lowered the red lights do not go out until the down locks engage.

16. **Undercarriage warning horn.**—The warning horn sounds when the undercarriage is not locked down and throttles are less than one-quarter open.

17. **Undercarriage ground locking**

(i) Ground locking caps are stowed in a bag on the rear bulkhead of each wheel well, and should be fitted after landing in place of the dust caps which cover the end of the locking latches. Make sure that the ground locking caps are replaced by the dust caps and stowed before taking off.

(ii) If the aircraft is taken off with the locking caps on, and an attempt is made to retract the undercarriage, the tailwheel will retract. Therefore, the undercarriage selector lever should be held DOWN for five seconds before landing to ensure that the tailwheel is down.

18. **Wing flaps.**—Operation of the wing flaps is controlled by the lever (24) marked F to the right of the undercarriage selector lever. A safety catch must be pulled to the right before flaps DOWN can be selected. The selector should return automatically to neutral on completion of a full operation. Any flap angle up to 45° can be obtained by returning the lever to neutral when the desired angle is reached according to the position indicator (22) situated next to the undercarriage position indicator (21). The maximum flap angle obtainable is 45° although the gauge is marked up to 70°.

19. **Brakes.**—The brake control lever (32) and parking catch (33) are on the control column. Differential braking is obtained by operating the rudder pedals with the handbrake on.

ENGINE CONTROLS

A.L.1 PART I PARA. 20

20. **Throttle controls.**—The throttle friction control is the black knob on the engine control box. Stops on the throttle quadrant prevent the throttle levers (45) being moved beyond climbing boost (+9 lb./sq.in.) unless spring catches are pulled back.
On Merlins 21 and 23 the fully forward position will produce normal take-off boost (at sea-level only) and the separate boost-control cut-out (8) must be operated to obtain Max. Take-off or Combat boost.
Some aircraft with Merlin 25 engines have no separate boost-control cut-out, and moving the levers beyond the quadrant stops produces up to 18 lb./sq.in. in the fully forward position.
NOTE.—The automatic boost control on Merlins 21, 23 and 25 cannot control fully at smaller throttle openings than +9 lb./sq.in. If climbing at less than +9 lb./sq.in. it will, therefore, be necessary to advance the levers progressively to maintain the desired boost, and, of course, to bring them back correspondingly during subsequent descents, to prevent over-boosting. On Merlins 25 which have not been modified, this will apply at +9 lb./sq.in., as well as at smaller boosts, and it may be necessary to advance the throttle levers even beyond the stops.

A.L.1

21. ~~**Boost control cut-out.**—The boost control cut-out (8) at the top of the port instrument panel is pulled out to give~~
~~+ 14 lb./sq.in. in M gear (up to about 9,000 ft.)~~
~~+ 16 lb./sq.in. in S gear (at about 15,000 ft.)~~
~~The throttle levers should be set to the climbing gate.~~

22. **Mixture controls.**—S.U. Carburettors are fitted. Mixture strength is automatically controlled by boost pressure, and no cockpit control is provided. The slow-running cut-out controls for each engine are behind the pilot's seat.

23. **Propeller controls.**—Three-blade fully feathering Hydromatic propellers are fitted. The speed control levers (42) operate in the normal manner. The feathering buttons (19) are on the right-hand front panel. To feather, push the feathering button in and let go; it will be held in by a solenoid until feathering is complete. (It may be necessary to hold the button in 2–3 seconds before it locks electrically.) Care must be taken not to operate these buttons when reaching for nearby switches, etc. When unfeathering, the button must be held in until sufficient r.p.m. are obtained. *See* Part IV, para. 68 (ii).

A.L.1 PART I PARA. 24

24. **Two-speed supercharger control.**—When the cockpit supercharger switch (46) is set to AUTO, the two-speed supercharger is automatically changed to S gear by an aneroid-operated switch when the aircraft has reached about 15,000 feet (Merlin 21 or 23 engines) or 12,000 feet (Merlin 25 engines). The switch can be set to MOD. for cruising in M gear above the change-gear height. The automatic supercharger gear change will not be operated if the pneumatic pressure is less than 150 lb./sq.in.

25. **Radiator flaps.**—The flaps are controlled by two switches (12) on the front cockpit coaming, which operate electro-pneumatic rams. It is not possible to set the shutters at intermediate positions between CLOSED and OPEN.

26. **Air-intake filter.**—For tropical operation Vokes air intake filters are provided. They are brought into operation by the switch beside the engine control box.

OPERATIONAL CONTROLS

27. **Gun and camera controls**

(i) The gun master switch (25), below the undercarriage and flap selector levers, must be on before the guns can be fired.

(ii) A thumb-operated machine-gun trigger (29), a fore-finger operated cannon-firing trigger (30), and a push-button (28) for the camera gun, are provided on the control column. On some aircraft, the thumb-operated trigger fires machine-guns and cannon. The air pressure must be 200 lb./sq.in. for operation of the guns.

(iii) The camera gun master switch (52) on junction box B on the starboard wall must be on before the camera can be operated, either independently, or with either gun trigger when the gun master switch is on.

28. **Oxygen.**—The pilot's Mark VIIIC oxygen regulator (35) is on the front instrument panel; the observer's Mark VIIIC oxygen regulator (65) is on the starboard sidewall, adjacent to the high pressure oxygen control valve (64), which controls the oxygen supply to both pilot and observer.

COCKPIT EQUIPMENT

29. **Heating.**—The cabin heat control is behind the pilot's seat, and is rotated forward to permit hot air from the port coolant radiator to enter the cabin.

30. **Cockpit cooling.**—There are two controlled vents (20). The pilot's is on the lower middle of the main front panel, and the observer's on the right-hand front panel. The most effective means of cooling the cockpit is by opening the roof clear-view panel.

31. **Windscreen wiper.**—The windscreen wiper should not be used on a dry screen as it may injure the surface. When not in use, make sure that the rheostat (69) on junction box B on the starboard wall is off; it is possible for the rheostat to be slightly on without the wiper functioning, and this wastes battery power.

32. **Night flying screens.**—There are dimmer screens on the warning lights for generator and immersed fuel pump. When flying by day these screens must be opened, otherwise indications will not be noticed.

33. **Cockpit lighting**

(i) *Ultra-violet lighting.*—Ultra-violet lighting is provided for the flying instruments; one lamp is above the throttles,

and another lamp is below the gunsight. To operate the ultra-violet lamps, turn ON the master switch on junction box B on the starboard cockpit wall, press the exciter button on the port wall near the top of the instrument panel, until the lamps begin to glow, and adjust the intensity of the lighting by rotating the screens on the front of the lamps.

(ii) Three floodlights are provided, one above the compass, one to the right of the instrument flying panel, and one above the front switch panel. Each is controlled by an adjacent rheostat.

(iii) If the electric supply should fail, the top left-hand emergency flood-light can be switched on; it is supplied by the emergency accumulator beneath the pilot's seat.

LOCATION OF CONTROLS

34. **Aircraft controls and instruments**

Elevator trimming tab control wheel	On left-hand side of pilot's seat.
Elevator trimming tab control wheel indicator (38)	On port cockpit wall
Rudder trimming tab control and indicator (13)	On front cockpit coaming
Aileron trimming tab control and indicator (26)	On lower part of main instrument panel.
Flaps selector lever (24) ..	Right-hand lever on main instrument panel.
Flaps position indicator (22)	On centre of main instrument panel.
Undercarriage selector lever (23)	Left-hand lever on main instrument panel.
Undercarriage position indicator (21)	On centre of main instrument panel.
Wheel brakes control (32) and parking catch (33)	On control column handwheel.
Brake pressure gauge (34) ..	Bottom of main instrument panel.
Instrument flying panel (11)	Top of main instrument panel.

R.I. COMPASS DIAL.

ABOVE R.P.M. INDICATORS, TOP OF LEFT HAND INSTRUMENT PANEL.

Compass (41)	Port side of cockpit below left-hand instrument panel
Pitot heater switch (55) ..	On junction box B on starboard wall.
Electrical services switch (14) (controls u/c position indicator and fuel gauges)	On right-hand front panel.

35. **Fuel and oil system controls and equipment**

A.L.1 PART I PARA. 35

Fuel cocks	Behind pilot's seat.
Immersed fuel pump switch (56) for long-range fuselage tanks	Junction box B on starboard wall.
Air pressure cock to the drop tanks	Behind pilot's seat.
Jettison button for drop tanks ..	On left side of cockpit under hinged safety cover.
Warning light (18) for long-range fuselage tanks	On right-hand side of front cockpit coaming.
Fuel pressurising (PRESSURE VENTING) cock	Behind pilot's seat.
Fuel pressure warning lights (6)	Left-hand instrument panel.
Fuel gauges (62)	Junction box B on starboard wall.
Priming pumps	In each engine nacelle.
Oil dilution buttons	Behind pilot's seat.

36. **Engine controls and instruments**

Throttle levers (45) ..	Engine control box on port cockpit wall.
Boost control cutout (8) ..	Top of left-hand instrument panel.
Propeller speed controls (42)	Engine control box.
Supercharger switch (46) ..	Engine control box.
Throttle friction controls ..	Engine control box.
Vokes air intake filter switch	Forward of engine control box.
Feathering buttons (19) ..	On right-hand front panel.
Radiator flap switches (12) ..	On front cockpit coaming.
Magneto switches (15) ..	On right-hand front panel.
Engine starter switches (16)	On right-hand front panel.
Booster-coil switches (17) ..	On right-hand front panel.
RPM indicators (7)	Left - hand instrument panel.

Boost gauges (5)	Left - hand instrument panel.
Coolant temperature gauges (2)	Left - hand instrument panel.
Oil temperature gauges (3) ..	Left - hand instrument panel.
Oil pressure gauges (4) ..	Left - hand instrument panel.

37. **Electrical system**

Generator warning light(70)	On junction box B on starboard cockpit wall.
Voltmeter (71)	Junction box B on starboard wall.
Fusebox	On starboard side of cockpit behind observer.

38. **Cockpit equipment**

Pilot's seat height-adjusting lever	On left of pilot's seat.
Pilot's harness release lever	On right of pilot's seat, or between pilot's legs.
Entrance door	On starboard side of cockpit.
Windscreen de-icing pump (27)	At bottom of main instrument panel.
Windscreen wiper rheostat (69)	On junction box B on starboard cockpit wall.
Ventilation	Cold air control knob (20) on starboard cockpit wall. Ventilators on right-hand front panel and centre of main instrument panel.
Cockpit heat control ..	Behind pilot's seat.
Cockpit roof light and control knob	Above pilot's head.
Instrument lights (9) and rheostats	One above compass. One to right of instrument flying panel. One above front switch panel.

Ultra-violet lighting	Master switch (54) on junction box B on starboard cockpit wall. Exciter button on port cockpit wall. One lamp above throttle. One lamp below gunsight.
Sanitary funnel	Under pilot's seat.
Desert equipment	In rear fuselage.

39. **Operational controls**

Gun master switch (25)	On main instrument panel
Machine gun trigger (29)	On control column.
Cannon firing trigger (30)	On control column.
Gun heat control	Starboard cockpit wall beside observer's seat.
Camera gun master switch (52)	On junction box B on starboard wall.
Camera gun button (28)	On control column.
Pilot's oxygen regulator (35)	On main instrument panel
Observer's oxygen regulator (65)	On starboard cockpit wall.
High pressure oxygen control valve (64)	Aft of observer's regulator on starboard cockpit wall.

40. **Navigational, signalling and lighting controls**

A.L.1 PART I PARA. 40

Two V.H.F. Sets	Two pushbutton units (44) and, on later aircraft, a set-selector switch (43) on left-hand side of cockpit floor. On some early aircraft, contactor supply switch on junction box B on starboard wall.
Beam Approach (37)	Switch on bracket on port cockpit wall.
R.I. Compass Switches	Alongside beam approach switch.
G Switches	On port cockpit wall, side by side (one pushbutton, and one ON/OFF).
Intercom. Switches (when T.R. 1133 sets fitted)	On later aircraft, foot operated switch. On early aircraft pilot's intercom. switch on port

Intercom. switches (when T.R. 1133 sets fitted)	On later aircraft, foot-operated switch. On early aircraft, pilot's intercom switch on port cockpit wall; observer's intercom switch on starboard cockpit wall forward of oxygen regulator.
Signal pistol	Roof behind pilot's head.
Signal cartridges	On front of observer's seat
Identification lights	Selector switch (51) and signalling switchbox (49) on junction box B on starboard cockpit wall.
Air recognition lights (50)	Switch on starboard side of cockpit.
Navigation lights	Switch (53) on junction box B on starboard wall. Headlamp switch (58) on junction box B on starboard wall.
Landing lights (1)	Bottom of left-hand instrument panel.

41. **Emergency equipment**

Hydraulic handpump	Socket beneath pilot's seat handle beneath observer's seat.
Undercarriage emergency selector	Beside pilot's seat.
Graviner fire extinguishers (61)	Junction box B on starboard wall.
Hand fire extinguishers	One on right of pilot's seat. One on right of observer's seat.
Fireman's axe	Back of pilot's seat.
First-aid kit	Under pilot's seat.
I.F.F. destruction switches (60)	Junction box B on starboard wall.

PART II
HANDLING

A.L. 1 PART II PARA. 42

42. Management of fuel system

(i) Start engines and take-off with cocks set to OUTER TANKS, as these tanks give a flow of fuel which is more direct.

(ii) (*a*) *If wing drop tanks are not fitted:*
If long-range fuselage tanks are fitted, at 500–1,000 feet change over to MAIN SUPPLY and switch ON immersed fuel pump so that these tanks are emptied as soon as possible; this will improve trim and stability. Switch OFF immersed pump immediately the warning light indicates that the fuselage tanks are empty.
(*b*) *If wing drop tanks are fitted* (*NF Mark XIII*), continue to fly on OUTER TANKS until the fuel pressure warning lights show that the tanks are emptied. Change over to MAIN SUPPLY, and, if the long-range bomb bay tank is fitted switch on immersed fuel pump. Then turn ON pneumatic pressure to the drop tanks. When OUTER TANKS fuel gauge shows that all fuel from the drop tanks has been transferred to the OUTER TANKS, turn off pneumatic pressure to the drop tanks. Transfer of fuel from the drop tanks to the wing tanks will take approximately 20 minutes. The drop tanks should not be jettisoned unless operationally necessary; the extra drag due to these tanks is very low and the top speed of the aircraft is only slightly improved by dropping them, so that the effect on range will be almost negligible.

NOTE.— It is generally advisable to jettison drop tanks only whilst flying straight and level, particularly metal ones, which have been known to damage aircraft if dropped in other conditions of flight.

(*c*) When long-range fuselage tank is emptied, switch OFF immersed fuel pump and turn fuel cocks back to OUTER TANKS, which should be used early as it is not possible to cross-feed from them; but if during a climb to high altitude, fuel pressure falls off, it may be necessary to use the pressurised MAIN SUPPLY.

(iii) Use of pressurising (MAIN SUPPLY and fuselage tank only). The PRESSURE VENTING should normally be ON and the cock is therefore wired in this position. Since pressurising to some extent nullifies the self-sealing properties of tanks, the wire is of sufficiently light gauge to be easily breakable in case of emergency, such as the holing of pressurised tanks by enemy action.

43. Starting engines and warming up

(i) Switch on electrical services switch

(ii) Check the following:

Voltmeter ..	should show 24 volts if battery fully charged.
Generator switch	ON (if fitted).
Undercarriage ..	Emergency knob in normal position, safety catch engaged. Selector neutral, safety catch engaged. Warning lights green.

Air pressure ..	Normal pneumatic pressure 200 lb./sq.in. Radiator flaps and automatic supercharger will not operate below 150 lb./sq.in.

(iii) Set fuel cocks to OUTER TANKS.

(iv) Set controls as follows:

Throttles	½ inch open.
Propeller speed controls ..	fully forward.
Supercharger	MOD.
Radiator flap switches ..	OPEN.

(v) High volatility fuel (Stores ref. 34A/111) should be used, if an external priming connection is fitted, for priming at air temperatures below freezing. The ground crew will work the priming pump until the fuel reaches the priming nozzles; this may be judged by a sudden increase in resistance.

(vi) Switch on ignition and press the starter and booster-coil buttons. The ground crew will work the priming pump as rapidly and vigorously as possible while the engine is being turned; it should start after the following number of strokes when cold:

Air temperature °C.	+30	+20	+10	0	−10	−20
No of strokes, normal fuel	3	4	7	12		
No. of strokes, high volatility fuel ..				4	8	18

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

(viii) As soon as the engine is running satisfactorily, release the booster-coil button and instruct the ground crew to screw down the priming pump and close the priming panels.

(ix) Open the throttle slowly and warm up at 1,200 r.p.m.

44. Testing engines and installations

While warming up:

(i) Check temperatures and pressures.

After warming up:

(ii) Check the operation of each engine-driven hydraulic pump. Open up one engine to 2,000 r.p.m., and lower and raise the flaps. Throttle back, open up the other engine to 2,000 r.p.m. and again lower and raise the flaps. Failure of one engine-driven pump will be indicated by sluggish movement of the flaps during one of these tests.

(iii) With starboard engine opened up to 2,000 r.p.m., check that generator is charging; voltmeter should show 29 volts.

(iv) Open up to +4 lb./sq.in. boost and check the operation of the constant-speed propeller.

A.L.1 PART III PARA. 44

(v) Open throttle to the take-off position (*see* para. 20) and check take-off boost and r.p.m. which should be 3,000.

(vi) Throttle back to +9 lb./sq.in. boost and test each magneto in turn. The drop should not exceed 150 r.p.m.

45. Taxying

Check:

Brake pressure ..	200 lb./sq. in.; if the pressure is low ensure that the pump is definitely building up pressure; if not, the aircraft should not be flown.
Undercarriage ground locking caps	Removed and replaced by dust caps.
Flaps	Fully up. Selector neutral.

46. Check list for take-off

T—Trimming tabs ..	Elevator: flaps up, 1 division nose heavy. flaps 15° down, 1½ divisions nose heavy.
	Rudder: slightly right.
	Aileron: neutral.
P—Propeller	Speed controls fully forward.

F—Fuel	Check contents and cocks to OUTER TANKS.
F—Flaps	UP, or 15° down. Do not open up engines separately after setting flaps down.
Superchargers ..	MOD.
Radiator flap switches	OPEN.

NOTE.—15° flap is recommended to improve the take-off, when necessary, but up to 25° may be used for the shortest run. If flaps are used, the lowering should be done after clearing engines and turning into wind, and with both engines throttled to the same idling speed.

47. Take-off

(i) There is a slight tendency to swing to port which can be checked by opening the port throttle slightly ahead. Raise the tail by a light forward pressure on the control column. Keep hand on throttles until well under way. When load and take-off run permit, the throttles need only be opened to the climbing gate.

(ii) Raise undercarriage (move selector smartly to UP) and check that the undercarriage locks up; if the red indicator lights do not go out, return the selector to UP for five seconds.

(iii) Do not start to climb until the safety speed of 170 m.p.h. I.A.S. (148 knots) is reached.

(iv) Before raising the flaps (if used), trim the aircraft slightly tail heavy.

(v) If climbing to high altitude, set supercharger gear control to AUTO.

48. Climbing

The speed for maximum rate of climb is 170 m.p.h. I.A.S. (148 knots) up to 20,000 feet.

49. General flying

(i) *Stability.*—The directional and lateral stability are satisfactory. The fore-and-aft stability is satisfactory in level flight but the aircraft is slightly unstable on glide and climb with the C.G. aft.

(ii) *Change of trim*

Undercarriage up ..	Nose up slightly.
Flaps up	Nose down sharply.
Radiator flaps open ..	Nose up.

(iii) *Controls.*—The controls are light and effective and manœuvrability is good. The rudder must not be used violently at high speeds.

(iv) *Flying at reduced air speeds.*—In bad visibility near the ground flaps should be lowered 15–20° and the propellers set to give 2,650 r.p.m. Speed may then be reduced to 150 m.p.h. I.A.S. (130 knots).

50. **Stalling**

(i) The stalling speeds (engine off) in m.p.h. I.A.S. are:

Weight	18,050 lb.	15,500 lb.
Undercarriage and flaps up	123 (107 knots)	114 (99 knots)
Undercarriage and flaps down ..	106 (92 knots)	99 (86 knots)

(ii) At the stall there is considerable vibration, and the nose drops followed by one wing, if the control column is held back. The stall is not violent and control is quickly regained when the speed is increased.

51. **Diving**

The aircraft becomes tail heavy in the dive, but forward trim is not required except at high speeds.

52. **Aerobatics**

The following speeds in m.p.h. I.A.S. are recommended for aerobatics:

Roll	220 to 270 (191 to 235 knots).
Climbing roll ..	350 plus (304 knots).

Rolls should be barrelled sufficiently to keep the engines running.

Loop	350 plus (304 knots).
Roll off	380 (330 knots).

The nose should be kept down on the horizon when rolling off.

53. **Before landing**

If the flight has been of any duration, operate the undercarriage up and down a few times before finally lowering for landing.

54. **Check list for landing**

Brake pressure	200 lb. /sq. in.
Superchargers	MOD.
Radiator flaps	Open.
Reduce speed to 180 m.p.h. I.A.S. (157 knots).	
U—Undercarriage	DOWN. Selector should return to neutral. Check by indicator and horn that undercarriage is down.
P—Propeller	Speed controls fully forward.
F—Fuel	Turn cocks to fullest tanks.
Reduce speed to 150 m.p.h. I.A.S. (130 knots).	
F—Flaps	Fully down. It will be necessary to trim forward considerably to counteract tail heaviness.

55. **Approach speeds**

(i) The approach speeds at 17,000 lb. (approximately half fuel) are:

	Flaps down	*Flaps up*
Engine assisted	125 m.p.h. I.A.S. (109 knots)	140 m.p.h. I.A.S. (122 knots)
Glide ..	140 m.p.h. I.A.S. (122 knots)	150 m.p.h. I.A.S. (130 knots)

At full load these speeds should be increased by about 5 m.p.h.

(ii) With the undercarriage and flaps lowered, the aircraft has a high rate of descent. Until used to this, pilots will tend to undershoot, and correction entails the use of much more power than might be expected.

56. **Mislanding**

(i) Open throttles to take-off position.

(ii) Raise undercarriage immediately.

(iii) Climb at about 140 m.p.h. I.A.S. (122 knots).

(iv) The flaps come up quickly and should not be raised until a safe height is reached, and may be kept at 25° to complete the circuit. There is then no need to retrim the aircraft.

57. **After landing**

(i) After landing and before taxying, raise flaps.

(ii) Idle the engines at about 800 r.p.m. for a short time, then pull out the slow-running cut-outs and hold until engines stop, then release smartly. Switch OFF ignition after engine stops and turn OFF fuel. Switch off electrical services switch.

(iii) *Oil dilution.—See* A.P. 2095. The oil dilution period is:
One minute at temperatures above −°10C
Two minutes at temperatures below −°10C

PART III

OPERATING DATA

A.L.1 PART II PARA. 58 (i), (ii) & (iii)

58. **Engine data, Merlin 21, 23 or 25**

(i) *Fuel.*—100 octane only.

(ii) *Oil.—See* A.P. 1464/C.37.

(iii) *The principal engine limitations are as follows:—*

		R.p.m.	Boost lb./sq.in.	Temp °C. Coolant	Oil
MAX. TAKE-OFF TO 1,000 FEET		3,000	+14*. +18†		
MAX. CLIMBING ONE HOUR LIMIT	M	2,850	+9	125	90
	S				
MAX. CONTINUOUS	M	2,650	+7‡	105 (115)	90
	S				
MAX. WEAK CONTINUOUS (MERLIN 21 ONLY)	M	2,650	+4	105 (115)	90
	S				
COMBAT	M	3,000	+14*. +18†	135	105
5 MINS. LIMIT	S	3,000	+16*. +18†	135	105

NOTE.—The temperatures shown in brackets may be used if necessary for short periods.

* Merlins 21 and 23 only.

† Merlin 25 only.

‡ On Merlin 23 and 25 engines, weak mixture is obtained at boosts up to +7 lb./sq.in. On Merlin 21 engines the mixture richens up progressively above +4 lb./sq.in.

OIL PRESSURE:	
NORMAL	60/80 lb./sq.in.
MINM.	45 lb./sq.in.
MINM. TEMP. FOR TAKE-OFF:	
OIL	15°C.
COOLANT	60°C.

(iv) *Fuel pressure.*—6 to 10 lb./sq.in.

(v) *Fuel temperatures.*—Every endeavour should be made to keep fuel in the aircraft and in storage tanks as cool as possible by shielding the wing and storage tanks from direct rays of the sun. If this is not done, fuel is likely to vaporize in the pipelines at high altitudes.

59. Position error correction

The corrections for position error are as follows:

At stall (flaps up or down)	Subtract 9 m.p.h. (8 knots)
From 150 to 350 m.p.h. I.A.S. (130 to 305 knots)	Subtract 2 m.p.h. (2 knots)
Above 350 m.p.h. I.A.S. (305 knots)	Subtract 4 m.p.h. (4 knots)

60. Flying limitations

A.L.1 PART III PARA. 60

(i) The aircraft is designed for the duties of night fighter. Intentional spinning is not permitted. Care is to be taken in pulling out of dives. At high speeds violent use of the rudder, and large angles of yaw, are to be avoided.

(ii) Aerobatics are permitted at weights below 19,100 lb. to pilots experienced in this aircraft.

(iii) Maximum speeds—m.p.h. I.A.S.

Diving	450 (390 knots)
Undercarriage down	180 (157 knots)
Flaps down	150 (130 knots)

(iv) Maximum weights:

For take-off and straight flying	22,000 lb.
„ all forms of flying	19,100 lb.
„ landing	20,500 lb.

61. Maximum performance

(i) *Climbing:*

(*a*) The speeds for maximum rate of climb are as follows:
170 m.p.h. I.A.S. (148 knots) from S.L. to 20,000 feet.
165 m.p.h. I.A.S. (143 knots) from 20,000 to 25,000 feet.
160 m.p.h. I.A.S. (139 knots) above 25,000 feet.

(*b*) Set r.p.m. to 2,850, throttles to the gate, and supercharger gear change switch to AUTO.

(ii) *Combat:*

Set supercharger switch to AUTO.
R.p.m. to 3,000.
Throttles to climbing gate, boost control cut-out pulled.

62. Maximum range

Climb.—Fly at + 4 lb./sq.in. boost if Merlin 21 engines are installed, + 7 lb./sq.in. if Merlin 23 or 25 engines are installed, and 2,650 r.p.m. at about 175 m.p.h. I.A.S. (152 knots). Set supercharger gear change switch to AUTO.

Cruising.

(*a*) Fly at + 4 lb./sq.in. boost (if obtainable) and 2,000* r.p.m. Set supercharger gear change switch to MOD. For maximum range do not reduce boost even if these engine conditions give speeds above the recommended speed given in sub-para. (*b*). If the speed falls below the recommended speeds, increase r.p.m. as necessary to maintain these speeds.

(*b*) The recommended speeds in m.p.h. I.A.S. for greatest range are as follows:

	Out (fully loaded)	Home (lightly loaded)
Up to 26,000 feet ..	220 (191 knots)	210 (182 knots)
Above 26,000 feet	—	190 (165 knots)

(*c*) Change to AUTO if at 2,600 r.p.m. in MOD. the recommended speed cannot be obtained.

63. Fuel capacity and consumptions

A.L.1 PART III PARA. 63 (i)

(i) *Fuel capacity*

(*a*) Marks II, XII and XVII

MAIN SUPPLY	287	gals.
OUTER TANKS	116	„
Total permanent tanks	403	„
Long-range fuselage tanks	150	„
Total fuel capacity, with long-range tanks	553	„

(*b*) Mark XIII AND MK XIX.

MAIN SUPPLY	337	gals.
OUTER TANKS	116	„
Total permanent tanks	453	„
Long-range fuselage tank	63	„
Drop tanks (wood)	100	„
(metal)	84	„
Total fuel capacity	616	„ with wooden drop tank
	600	„ „ metal „ „

(ii) The total fuel consumption in gallons per hour in the weak mixture range at medium and high altitudes is as follows:—

Boost lb./sq.in.	R.P.M. 2,650	2,300	2,000
+7*	130*	115*	106*
+4	114	102	94
+2	106	94	86
0	96	86	78
−2	86	78	70
−4	76	68	62

*Merlin 23 ~~only~~ AND 25 ONLY

These figures are approximately constant between 8,000 and 20,000 feet in M gear and between 14,000 and 30,000 feet in S gear.

(iii) The total fuel consumption in gallons per hour in the weak mixture range at 2,000 feet are as follows:

Boost lb./sq.in.	R.P.M. 2,650	2,300	2,000
+7*	126*	112*	102*
+4	100	94	86
+2	94	84	78
0	84	74	74
−2	74	66	62
−4	66	60	

*Merlin 23 ~~only~~. AND 25 ONLY.

(iv) The total fuel consumption in the rich mixture range is approximately as follows:

Boost lb./sq.in.	R.p.m.	gallons/hour
+14	3,000	250
+12	3,000	230
+ 9	2,850	190
+ 7†	2,650†	160†

†*Merlin 21 only.*

PART IV

EMERGENCIES

64. **Engine failure during take-off**

(i) Safety speed is 170 m.p.h. I.A.S. (148 knots).

(ii) If safety speed has been attained, provided that flaps are up, the aircraft will climb on one engine. Set live throttle FULLY FORWARD ~~to gate~~ and pull boost control cutout, if carrying full load. Feather the dead propeller, close the throttle and close radiator flap.

(iii) The climb-away on the port engine is usually better than on the starboard.

65. **Engine failure during flight**

(i) Feather the dead propeller, close the throttle and close the radiator flap.

(ii) Watch temperature on live engine and open radiator flap if necessary.

(iii) Maintain at least 170 m.p.h. I.A.S. (148 knots), and up to 200 m.p.h. I.A.S. (174 knots) if possible, at 2,650 r.p.m. and boost below +7 lb./sq.in. In unfavourable weather conditions and at heavy load it may be necessary to use +9 lb./sq.in. boost and 2,850 r.p.m. Level flight should be possible at any load at heights below 12,000 feet.

66. **Landing on one engine**

(i) It should be remembered that, owing to the high drag of the undercarriage, height will be lost rapidly when it is lowered.

(ii) The early stages of the approach should be made at a speed of at least 150–160 m.p.h. I.A.S. (130–140 knots) with undercarriage down and 15° of flap.

(iii) The final approach should be made without engine at the normal glide-in speed, i.e., at least 140 m.p.h. I.A.S. (122 knots.)

(iv) Going round again is only possible if the decision is made in the early stages of the approach, and with at least 500 feet in hand to allow flaps and undercarriage to be raised and speed to be increased.

67. **Feathering**

(i) Hold the button in only long enough to ensure that it stays in by itself, then release it so that it can spring out when feathering is complete.

(ii) Close throttle immediately.

(iii) Switch off only when the engine has stopped, and close radiator flap.

68. **Unfeathering**

(i) Set throttle slightly open, propeller speed control fully back, and ignition on.

(ii) Hold the button in until r.p.m. reach 1,500 to 1,800.

(iii) If the propeller does not return to normal constant-speed operation, open the throttle slightly.

69. **Undercarriage and flaps emergency operation**

(i) *Red indicator lights go out but green indicator lights fail to show after selecting undercarriage down.*
To check if the down locks are engaged and the indicator lights are at fault, reselect DOWN. The undercarriage selector lever should return to neutral immediately if locks are engaged, and if warning horn does not sound when throttles are closed it should be safe to land.

(ii) *If undercarriage has lowered but not locked down:*
If warning horn sounds when throttles are closed, but the selector has returned to neutral, first lower the flaps and then maintain pressure in the jacks by holding the selector DOWN until landing is complete, and the units can be locked by the ground staff. Avoid using the brakes, if possible. Do not attempt to taxy and turn, and do not raise the flaps.

(iii) *If undercarriage fails to lower at all on engine pumps:*

(*a*) Leave undercarriage selector neutral.
Push emergency selector DOWN.
Operate the handpump until the undercarriage indicator shows that the wheels are locked down, or very considerable resistance is felt for several strokes. (See sub. para. iii (*d*) for procedure if downlocks fail to engage.)

NOTE.—This will not lower the tailwheel.

(*b*) Return emergency selector neutral.
Put flap selector DOWN and handpump until flap position indicator shows that flaps are 30° down, then return selector neutral.

NOTE.—If the flaps fail to go down, the approach should be made at 140 m.p.h. I.A.S. (122 knots).

(*c*) Put undercarriage selector down, and attempt to lower tailwheel with handpump, through normal system. As there is no indication whether the tailwheel has lowered, it is advisable to land on grass.

(*d*) If the downlocks have failed to engage, after attempting to lower the flaps and tailwheel as in (*b*) and (*c*), push emergency selector DOWN and operate the handpump until landing is complete.

70. **Fire extinguishers**
The engine Graviner fire extinguisher buttons (61) are on junction box B on the starboard wall. The Graviner extinguishers operate automatically in the event of a crash. A hand fire extinguisher is provided to the right of the pilot's seat.

71. **Parachute exit**
Through main entrance door. To jettison, pull the red handle (48) on the door, and kick out. Do not touch the normal handle. Feather starboard propeller if possible.

72. **Parachutes.**—A lap-type parachute is provided for the observer.

73. **Crash axe** is stowed at the back of the pilot's seat.

74. **First-aid outfit** is stowed under pilot's seat.

75. **Crash exit.**—Roof panel—pull down red lever in front of panel and push panel out.

76. **Ditching**

(i) The aircraft has been successfully ditched by day, but whenever possible, bale out rather than ditch.
When ditching:

(ii) Jettison roof panel but keep entrance door closed.

(iii) Lower flaps 25°.

(iv) If one engine has failed the final approach should be made without engine.

77. **Dinghies**

(i) A K dinghy in C-type pack is provided for the observer. A K dinghy in A-type pack is provided for the pilot.

(ii) On some aircraft, an L-type dinghy with an emergency pack is stowed in the fuselage above the centre section; to release dinghy, pull the release control in the roof above and behind the pilot's head. An immersion switch is also provided for automatically inflating the dinghy.

PART V
ILLUSTRATIONS

KEY TO *Fig. 1*

1. Landing lights switches.
2. Coolant temperature gauges.
3. Oil temperature gauges.
4. Oil pressure gauges.
5. Boost pressure gauges.
6. Fuel pressure warning lights.
7. R.P.M. indicators.
8. Boost control cut-out.
9. Instrument light.
10. Gun sight.
11. Instrument flying panel.
12. Radiator flap switches.
13. Rudder trimming tab control and indicator.
14. Electrical services switch.
15. Magneto switches.
16. Engine electric starter switches.
17. Booster coil switches.
18. Immersed fuel pump warning light.
19. Propeller feathering buttons.
20. Ventilator.
21. Undercarriage position indicator.
22. Flaps position indicator.
23. Undercarriage selector lever.
24. Flaps selector lever.
25. Gun master switch.
26. Aileron trimming tab control and indicator.
27. Windscreen de-icing pump.
28. Camera gun button.
29. Machine gun firing control.
30. Cannon firing trigger.
31. Control column.
32. Brake control lever.
33. Parking brake catch.
34. Triple pressure gauge.
35. Mark VIIIc oxygen regulator.

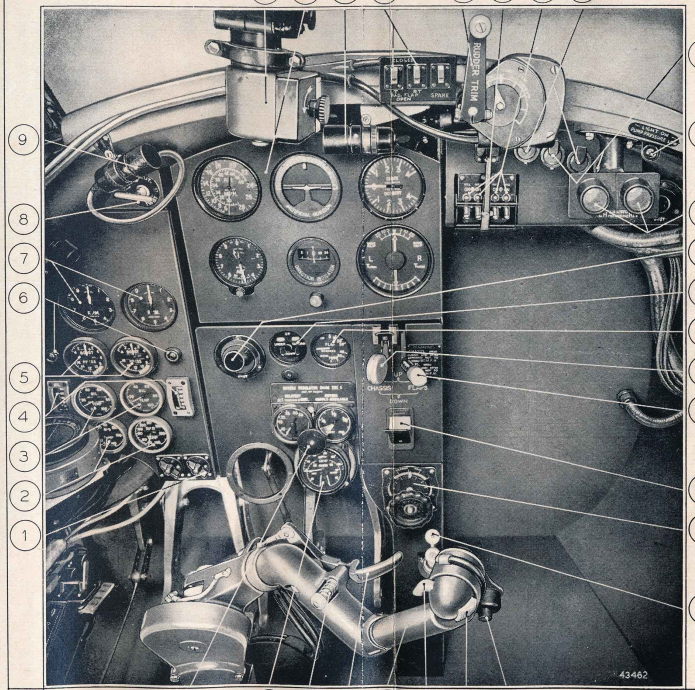

FIG. 1 — INSTRUMENT PANEL — FIG. 1

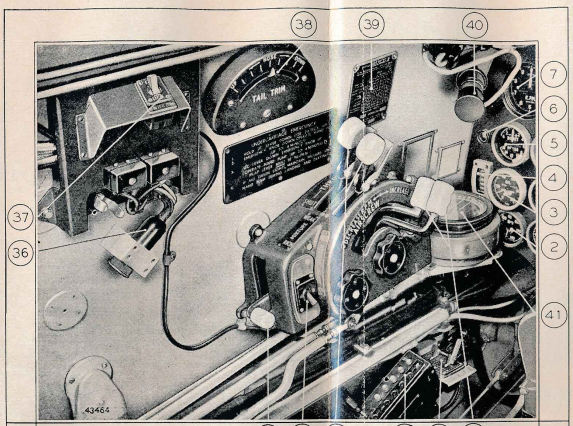

FIG. 2 — COCKPIT—PORT SIDE — FIG. 2

2. Coolant temperature gauges.
3. Oil temperature gauges.
4. Oil pressure gauges.
5. Boost pressure gauges.
6. Fuel pressure warning lights.
7. R.P.M. indicators.
36. Intercom jack.
37. Beam approach switch.
38. Elevator trimming tab indicator.
39. Engine limitations data plate.
40. Compass light.
41. Compass.
42. Propeller speed control levers.
43. Radio set-selector switch.
44. Radio control unit.
45. Throttle levers.
46. Supercharger gear change switch.
47. Mixture control lever (locked in WEAK position).
48. Emergency door-jettison handle.
49. Identification switch box and key.
50. Air recognition lights switch.
51. Identification lights selector switch.
52. Camera gun switch.
53. Navigation lights switch.
54. Ultra-violet lighting switch.
55. Pitot head heater switch.
56. Immersed fuel pump switch (if pump fitted).

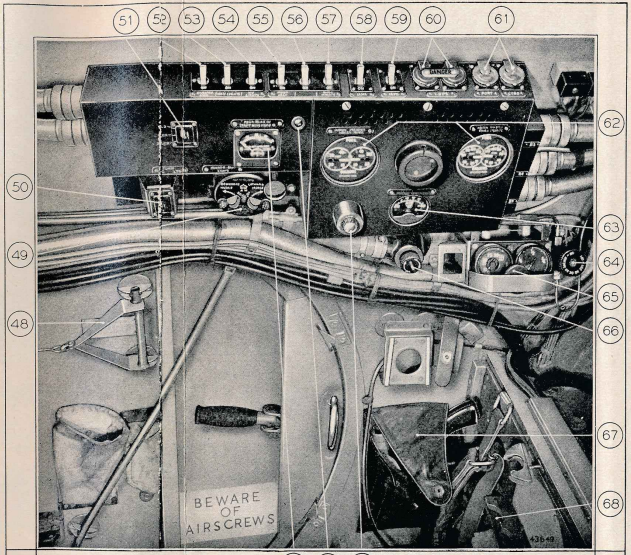

FIG. 3 — COCKPIT—STARBOARD SIDE — FIG. 3

57. Generator switch (not in use).
58. Navigation headlamp switch.
59. I.F.F. switch.
60. I.F.F. detonator buttons.
61. Fire extinguisher switches.
62. Fuel contents gauges.
63. Air temperature gauge.
64. High pressure oxygen master valve.
65. Mark VIIIc oxygen regulator.
66. Ventilation control.
67. Stowage for signal pistol.
68. Stowage for signal pistol cartridges.
69. Windscreen wiper rheostat.
70. Generator warning light.
71. Voltmeter.

MARKS II, XII AND XVII ONLY.

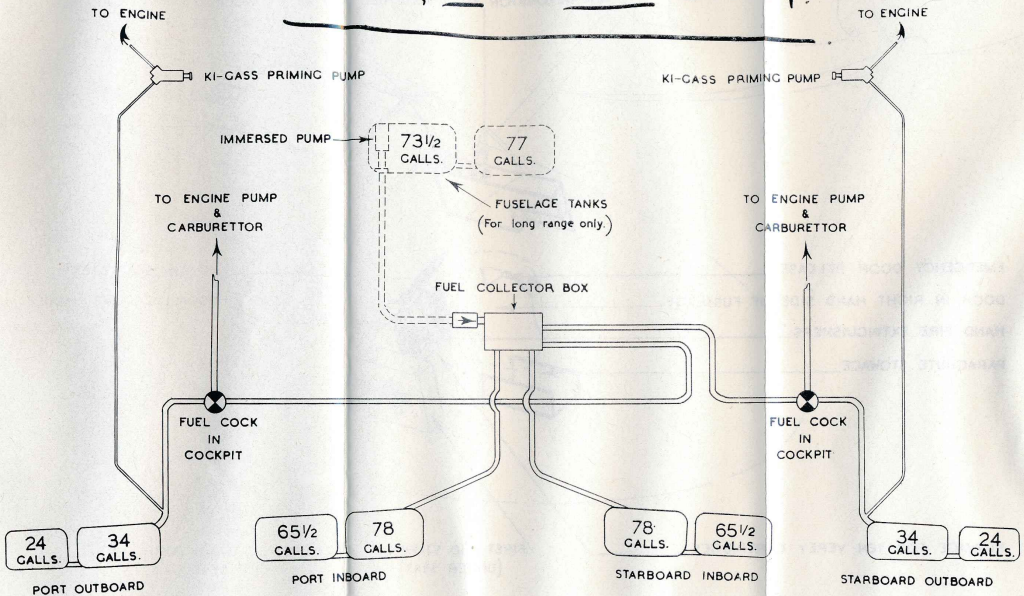

FIG. 4

SIMPLIFIED FUEL SYSTEM DIAGRAM

MARKS II, XII AND XVII ONLY.

FIG. 4

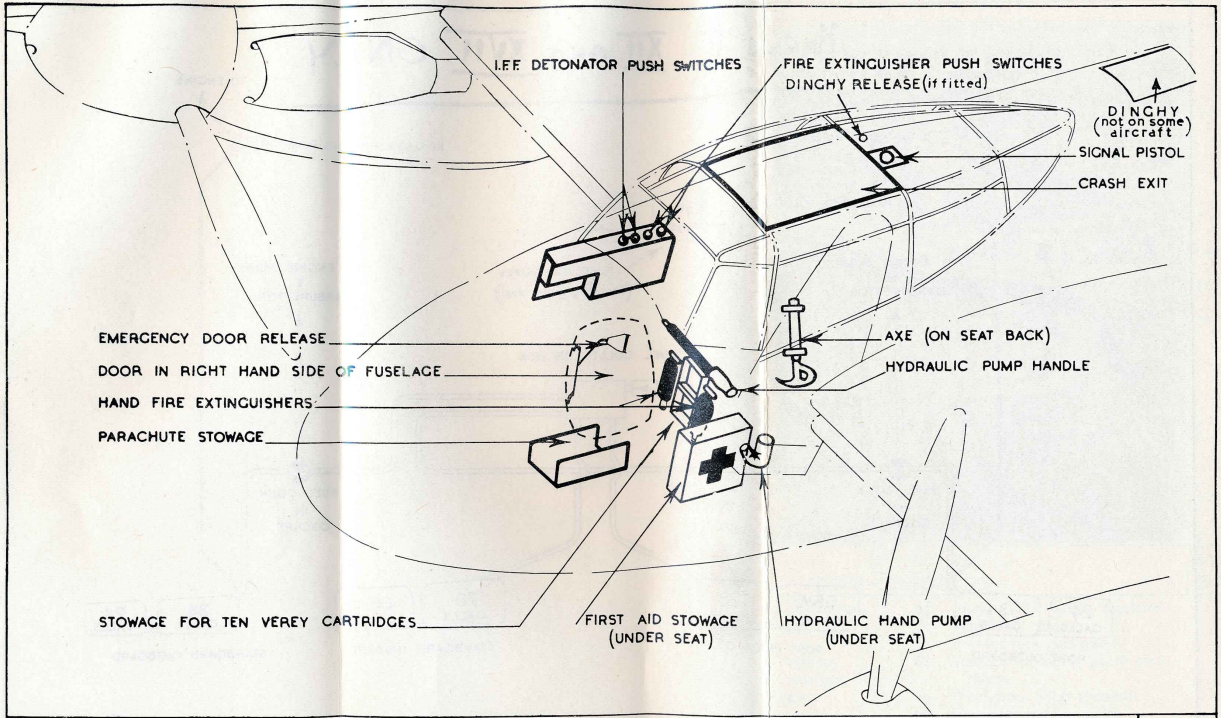

FIG. 5

EMERGENCY EQUIPMENT DIAGRAM

FIG. 5