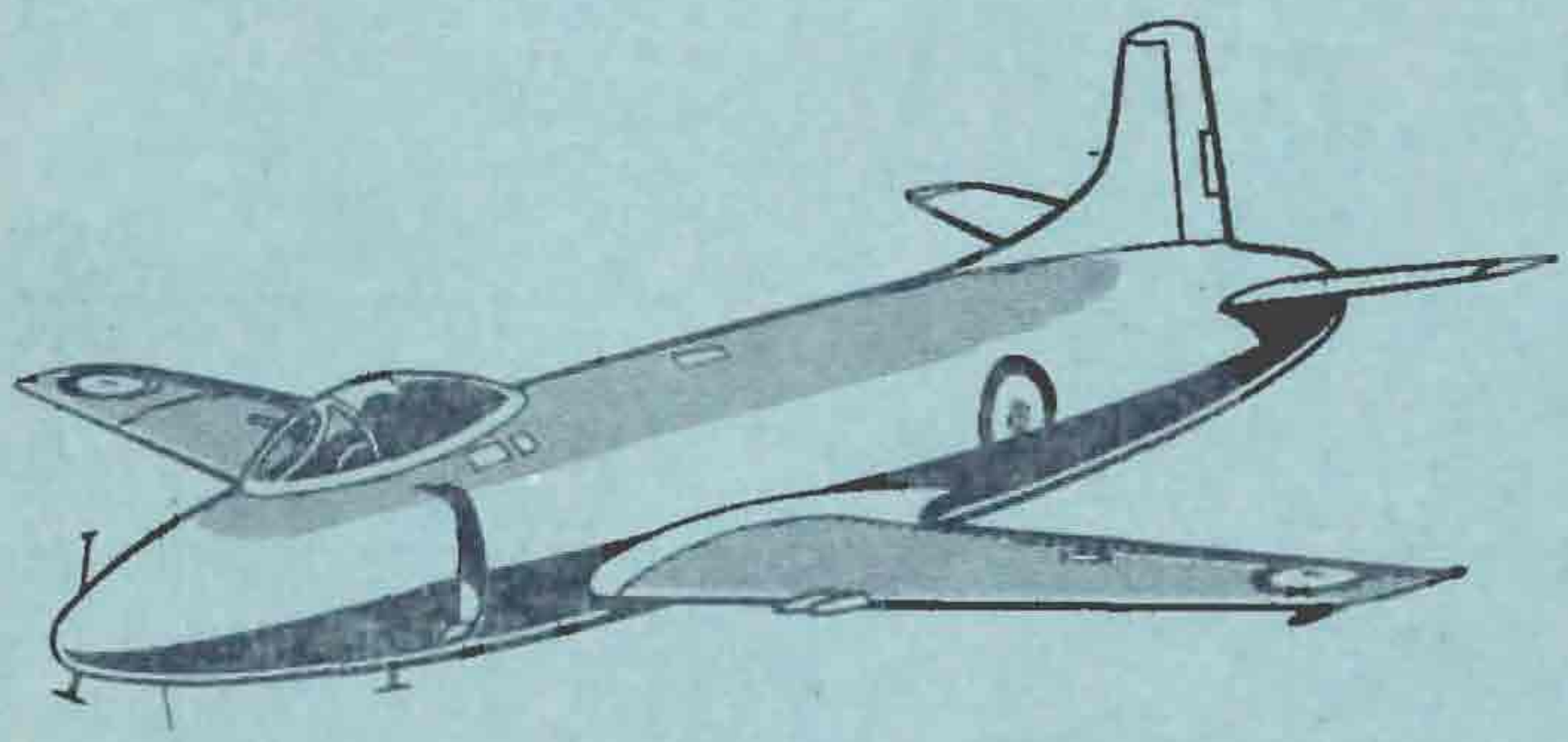
2nd Edition

A.P. 4302A. & B.—P.N.

PILOT'S NOTES

ATTACKER

F1, FB1 & FB2



Prepared by direction
of the
Minister of Supply

J. R. C. Helmore

Promulgated for
information and guidance
of all concerned
by command of
Their Lordships

D. F. Lang

AMENDMENTS

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

Each amendment list will, where applicable, be accompanied by gummed slips for sticking in the appropriate places in the text.

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

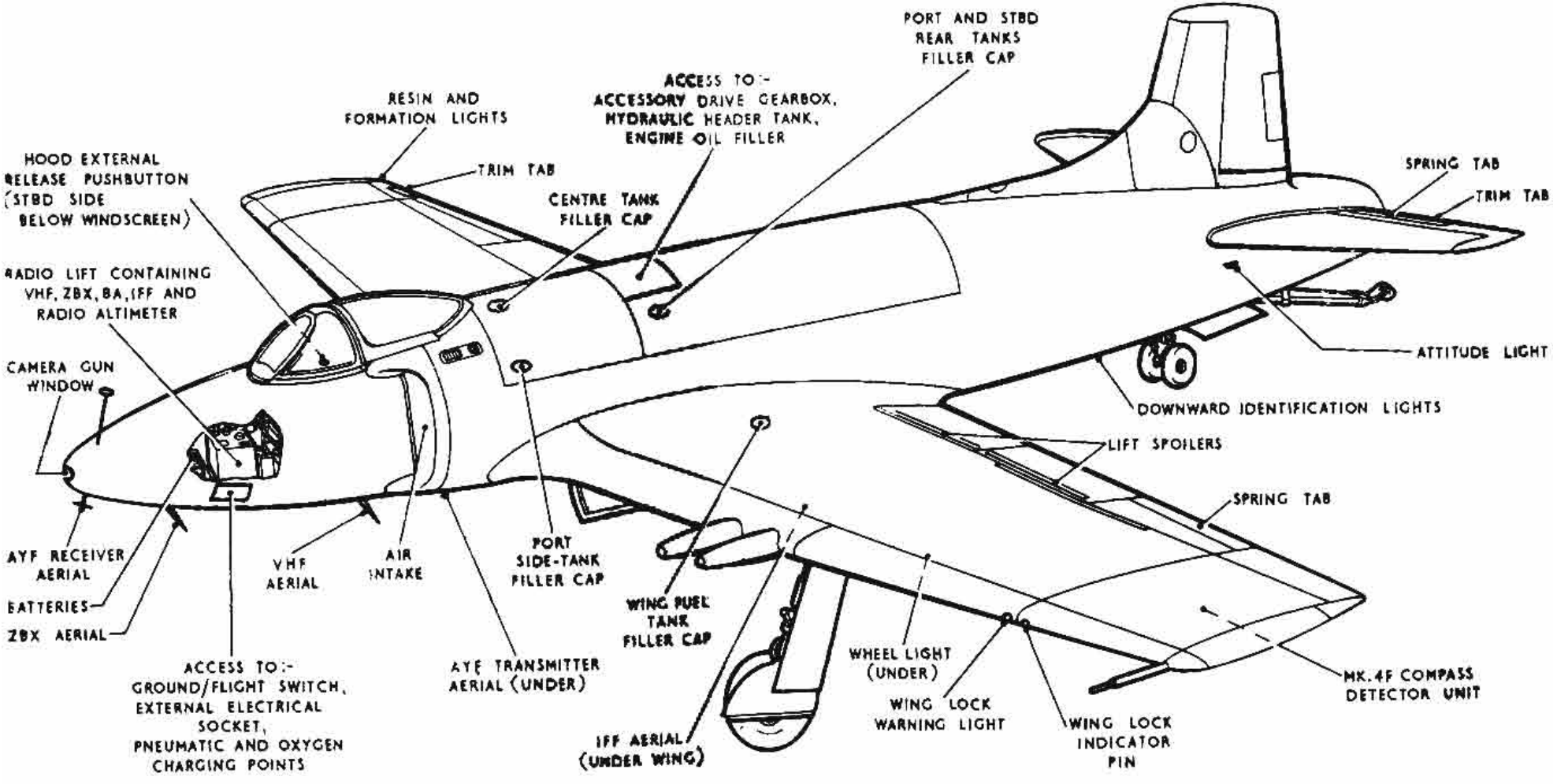
A.L. NO.	INITIALS	DATE	A.L. NO.	INITIALS	DATE
1			7		
2			8		
3			9		
4			10		
5			11		
6			12		

NOTES TO USERS

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.F.O. 3789/48).

Additional copies may be obtained from Head of Military Branch (Books), Admiralty Block C, Station Approach Buildings, Kidbrooke, by application on Royal Navy Form S134D or D397. The number of the publication must be quoted in full —A.P.4302A & B—P.N.

Comments and suggestions should be forwarded through the usual channels to the Admiralty (D.A.W.).



ATTACKER F1, FB1 & FB2

PILOT'S EXTERNAL CHECK LIST

NOTE:—1. Starred items are of particular importance in the operation of this aircraft.

2. RATOG cocking screws are fitted in the upper wing root fairings but are inoperative.

Start at the port side of the nose and work clockwise round the aircraft.

Item	Check
Nose	Condition Radio hatch secure All aerials secure Ground/Flight switch to GROUND G.45 camera
*Starboard intake	Cover removed, free from debris
Starboard undercarriage	Condition of doors Brake lead secure Tyre for cuts and creep Extension of oleo leg and condition of retracting rod Accelerator spools stowed Armament plug position
Starboard mainplane	Condition Gun shields secure Wing lock position Wing tip condition Navigation light Panels and fuel tank cover secure
Starboard aileron	Condition External lock removed Position of trimmer
*Starboard spoiler	Position and condition
Starboard flap	Position and condition
Volute jet pipe bleed (if fitted)	As required

Item	Check
Starboard fuselage	Condition Panels secure
Starboard side of fin	Condition Leading edge
Starboard tailplane	Condition of leading edge, upper and lower surfaces
Starboard elevator	Condition Trimmer position External lock removed
Rudder	Condition Trimmer External lock removed
Tail light	Condition
Jet pipe	Blanking plate removed Security
Arrester hook	Condition and position
Tail wheels	Tyres for cuts and creep Straight Doors condition
Port elevator	Condition Trimmer External lock removed
Port tailplane	Condition of leading edge, upper and lower surfaces
Port side of fin	Condition
Port fuselage	Condition Attitude light Panels and fuel tank covers secure
Port flap	Position and condition
*Port spoiler	Position and condition
Port aileron	Condition External lock removed
Pressure head	Cover removed Security
Port mainplane	Condition Panels secure Gun shields secure Wing lock position Navigation light Aerial secure

Item	Check
Port undercarriage	Condition of doors Brake lead secure Tyre for cuts and creep Extension of oleo leg and condition of retracting rod Accelerator spools stowed Armament plug position
*Port intake	Condition Guard removed, intake free from debris
*Belly tank	Secure Filler caps tight

ATTACKER F1, FB1 AND FB2

This edition supersedes the first edition issued May, 1951

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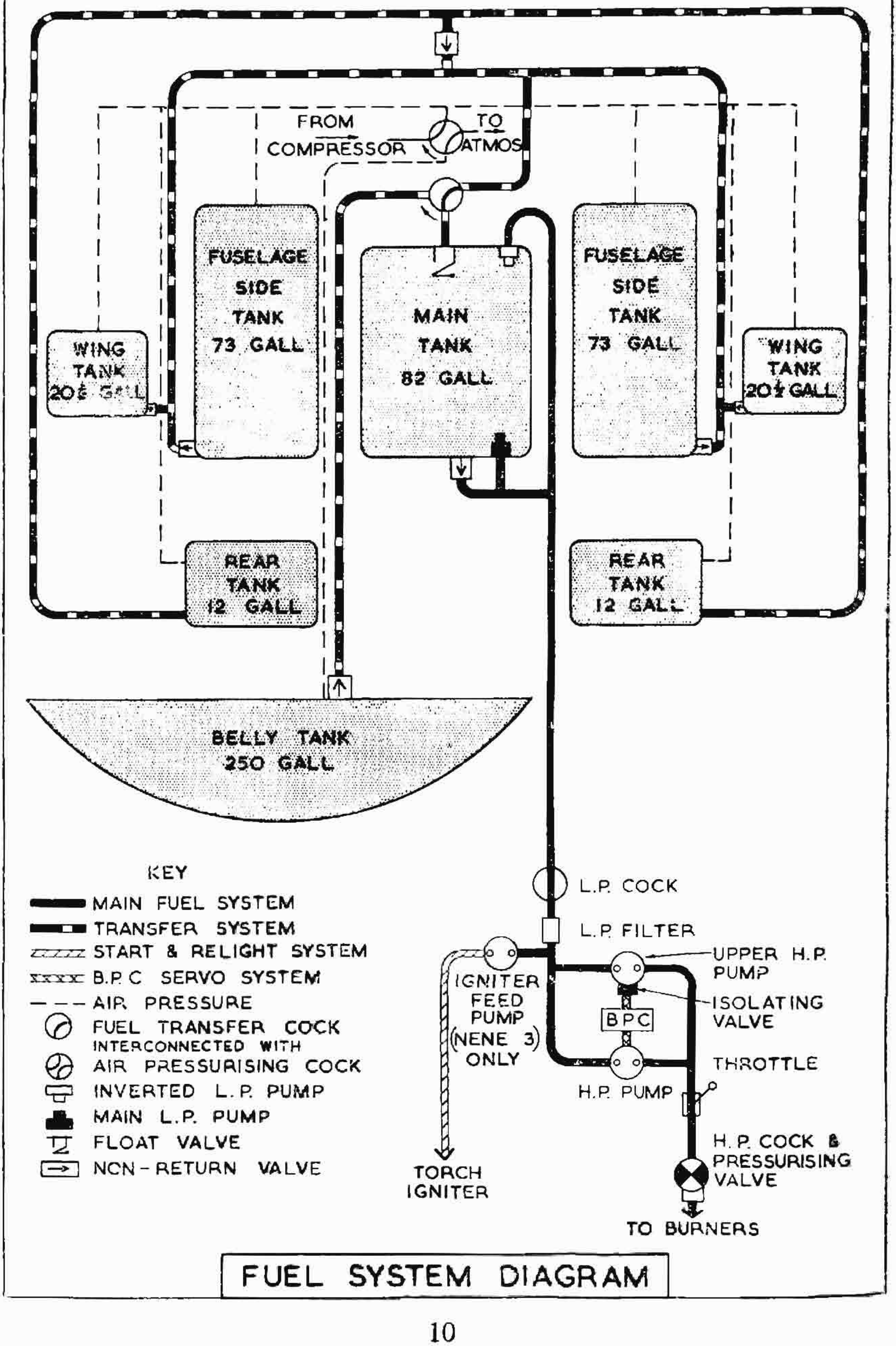

FUEL SYSTEM DIAGRAM

PART I
DESCRIPTIVE

NOTE.—Throughout this publication the following conventions apply:—

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

(b) The numbers quoted in brackets after items in the text refer to the illustrations in Part V.

(c) Unless otherwise stated all airspeeds and Mach numbers quoted are "Indicated".

1. Introduction

(i) The Attacker F1, FB1 and FB2 aircraft are single-seat jet propelled Naval fighters and fighter bombers. The cockpits are pressurised and equipped with Mk. 2A ejection seats. A.L.1

(ii) The F1 and FB1 aircraft are each powered by a single Nene 3 gas turbine engine and the FB2 is powered by a Nene 102. Both Marks of engine develop 5,100 lb. static thrust at sea level; the main difference between the two is that the latter incorporates an acceleration control unit (A.C.U.) and high energy igniter plugs replace the torch igniters of the Nene 3.

(iii) RATO controls are fitted but inoperative.

FUEL AND OIL SYSTEMS

2. Fuel tanks

(i) Fuel is carried internally in five fuselage tanks and two wing tanks. A 250-gallon belly tank may be carried,

which can be jettisoned by operation of a control on the port shelf.

(ii) The tank capacities are:—

Main tank	82	gall.
Wing tanks (2 x 20½)	41	gall.
Fuselage side tanks (2 x 73) ...	146	gall.
Fuselage rear tanks (2 x 12) ...	24	gall.
Total (internal)	293	gall.
Belly tank	250	gall.
Total	543	gall.

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3. Fuel transfer system

(i) Fuel from the fuselage side, rear, and wing tanks or from the belly tank is transferred by air pressure to the main tank, which acts as a collector box. Transfer is controlled by a lever (51) on the starboard shelf and begins when 15-20 gallons have been used from the main tank; the rate of transfer is controlled by a float operated valve at the top of the main tank.

(ii) Forward movement of the lever selects belly tank transfer, rearward movement selects built-in tanks.

(iii) A fuel transfer pressure gauge (54), which should read approximately 4½ lb./sq. in. when transfer is taking place, is mounted aft of the lever.

(iv) A red warning light on the top of the starboard side of the instrument panel comes on whenever the air pressure in the transfer system is below normal, i.e. either on completion of transfer or when there is a fault in the system.

(v) If the float valve sticks in the closed position, indicated by a steady fall in the main tank gauge reading, the valve may be bypassed by operating the control on the cockpit starboard shelf. When this cock is open and transfer again takes place the main tank contents should rise.

4. Fuel supply to the engine

(i) Two electrically-driven booster pumps are fitted in the main tank, one at the top for inverted flight conditions and one at the bottom for normal flight. Either pump delivers fuel through the L.P. cock and filter to two

engine-driven H.P. pumps which together supply fuel to the engine.

(ii) A barometric pressure control (B.P.C.) controls the delivery pressure of the H.P. pumps. From the H.P. pumps, fuel is passed through the throttle valve to the H.P. cock and thence to the burners.

(iii) On Nene 102 engines an acceleration control unit (A.C.U.) is fitted. The unit is ineffective when the fuel pump isolating valve is ON.

5. **L.P. fuel cock control**

The lever (50) on the starboard shelf should be moved forward to permit fuel to flow from the main tank.

6. **H.P. fuel cock control**

The lever (17) aft of the throttle quadrant should be moved forward to OPEN the H.P. fuel cock, and aft to stop the engine.

7. **Booster pumps**

(i) The supply of electrical current to the two booster pumps in the main tank is controlled by two circuit breakers (5), INVERTED and MAIN, aft of the throttle quadrant. The MAIN pump circuit breaker may be switched on and off as required but normally in flight it should be on.

(ii) When the INVERTED pump circuit breaker is in, the inverted pump is switched on and off automatically as required by a gravity-operated switch.

(iii) A red warning light (32) at the bottom of the starboard side of the instrument panel indicates when the delivery pressure from the main tank falls below normal.

8. **H.P. fuel pumps**

(i) Two engine-driven H.P. pumps are controlled by a common servo system through the B.P.C., and, in the Nene

102, through the A.C.U. Together they satisfy the fuel demands of the engine. Should one fail, the thrust available at sea level, at full throttle, with the other pump operating and isolated, is 60 per cent. increasing to 100 per cent. at approximately 16,000 ft.

(ii) A solenoid operated isolating valve is incorporated in the upper pump.

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9. **H.P. pump isolating valve and warning light**

(i) The isolating valve is primarily intended as a means of restoring power in flight in the event of failure of the H.P. pumps servo system causing a sudden loss of power; it may be used as a safeguard against failure of the system during take-off.

(ii) The valve is controlled by a NORMAL/ISOLATED switch (42) on the starboard side of the instrument panel. When the switch is set to ISOLATED, the upper H.P. pump is cut off from the servo system which continues to control only the lower H.P. pump. The isolated pump moves to full stroke and is controlled only by its over-speed governor.

(iii) An adjacent warning light indicates when the isolating switch is on.

10. **Fuel contents gauges**

(i) Two electrical fuel contents gauges (31), on the starboard side of the instrument panel, indicate the contents of the main tank (up to 70 gallons) and the six auxiliary built-in tanks respectively. There is no gauge for the belly tank.

(ii) All aircraft will eventually be fitted with similar gauges recording the fuel contents in pounds. These gauges give a more accurate indication of fuel contents than the volume-measuring gauges.

11. **Oil system**

Oil is carried in the engine sump only, the capacity of which is 9 pints. An oil pressure gauge is on the starboard side of the instrument panel.

ENGINE CONTROLS

12. **Throttle control**

(i) The throttle control lever is in a quadrant on the port side of the cockpit.

(ii) During starting, the throttle lever must always be in the SHUT position since any forward movement operates a micro switch causing the starter circuit to cut out.

13. **Starting system**

(i) The starter circuit is automatically controlled by time switches. When the ignition isolation (40) and starter safety (36) switches are ON, the starting system is brought into circuit. When the starter button (38) is firmly pressed and released the following cycle takes place:—

(a) *Nene 3.* The igniter feed pump is energised and fuel is pumped to the torch igniters. At the same time full current is fed to the booster coils and torch igniters and the fuel spray is ignited. When the H.P. cock is opened fuel is fed to all combustion chambers and the engine becomes progressively self-sustaining.

(b) *Nene 102.* Full current is fed to the booster coils and high energy igniter plugs. When the H.P. cock is opened fuel is fed to the burners: light up is then initiated by the igniter plugs.

(ii) After 30 seconds, or as soon as light up occurs, a delay switch operates to cut off starter motor current and ignition. Should the engine overspeed the starter motor at any stage during starting, an overspeed relay switch cuts off the current.

(iii) The ignition isolating switch, on the starboard shelf, when set .to OFF, isolates the booster coils, igniters, and (Nene 3 only) igniter feed pump from the starting cycle. This enables the engine to be dried out after a false start by use of the starter motor.

14. **Relighting pushbutton**

Pressing the button in the end of the H.P. cock (17) energises the torch igniters or igniter plugs when it is required to relight in flight. On no account should the normal starting system be used for this purpose.

15. **Engine instruments**

A tachometer and a jet pipe temperature gauge are mounted on the starboard side of the instrument panel.

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16. **Engine fire-warning light**

A red warning light (25) on the port coaming indicates fire in the engine bay. No extinguisher system is fitted.

MAIN SERVICES

17. **Hydraulic system**

(i) An engine-driven pump maintains a pressure in the system of 2,500 lb./sq. in. maximum for the operation of the:—

Undercarriage
Flaps
Air brakes
Arrester hook
Wing folding

(ii) No hydraulic pressure gauge is fitted but an indication of the available pressure may be obtained from the hydraulic accumulator air pressure gauge on the port shelf. This accumulator is charged initially to a pressure of 1,800 lb./sq. in. Any reading substantially in excess of this figure, up to 2,500 lb./sq. in., indicates that hydraulic pressure is satisfactory.

(iii) The accumulator is fitted to provide for emergency lowering of the flaps and air brakes.

(iv) A compressed air bottle is fitted for the emergency lowering of the undercarriage only.

(v) A handpump, the handle of which when not in use is clipped to the cockpit starboard wall, will operate all services in the event of hydraulic failure. It is, however, extremely difficult to fit and operate the handle in flight.

18. **Electrical system** (24 volts)

(i) *D.C. supply*

A single engine-driven generator supplies the whole of the electrical system and charges two 12-volt aircraft batteries connected in series giving an output of 24 volts. A generator failure red warning light on the starboard side of the instrument panel indicates whenever the generator is not supplying power.

(ii) *Batteries control*

(a) The batteries can be isolated by a switch (37) on the starboard shelf or by the GROUND/FLIGHT switch in the port side of the fuselage nose. When either the isolation switch is OFF or the Ground/Flight switch at GROUND the batteries are isolated from all services except the crash-operated circuit for the fire-extinguisher.

(b) The battery isolating switch should be used in flight if it is required to isolate the batteries in an emergency.

(iii) *Circuit breakers*

(a) Three circuit breakers under the control of the pilot are provided for:—

Main booster pump (5)

Inverted booster pump (5)

Generator circuit (39)

All circuit breakers should be checked "in" before flight and at intervals during flight. Any circuit

breaker which has tripped due to temporary overload should be reset.

(b) Circuit breakers are also provided for the instrument inverters and gunsight retraction. These are in the fuselage nose and are not under direct control of the pilot.

AIRCRAFT CONTROLS

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19. Flying controls and accelerometer

(i) The flying controls are conventional. The rudder pedals are adjustable for reach by a foot-operated wheel.

(ii) An accelerometer mounted by the side of the G.G.S. indicates all normal accelerations imposed on the aircraft, by means of three concentrically-mounted pointers. One pointer indicates instantaneous G, the other two register the maximum positive and negative G readings respectively until reset.

20. Flying controls locking gear

(i) *Internal locking*

The aileron control is locked by means of a plate attached to the handgrip. The rudder and elevator controls are locked by a fork-end locking plate with a restriction bar.

(ii) *External locking*

The ailerons are locked by plates incorporating rotatable clamps. The rudder and elevators are locked by two adjustable struts.

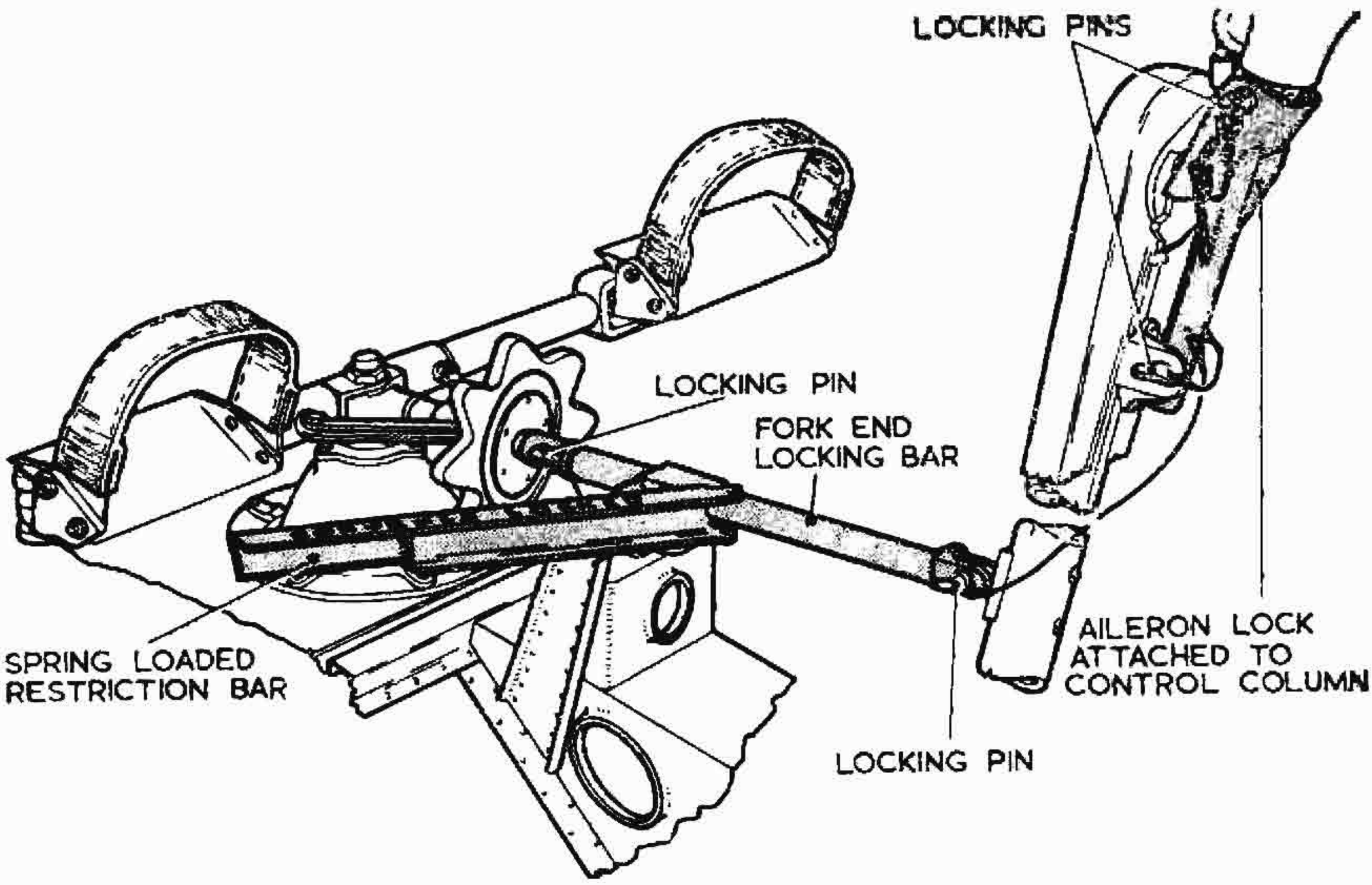
21. Trimming tab controls

(i) The trimming tabs fitted to the starboard aileron and to the rudder are actuated electrically by self-centring switches (3) on the port shelf, with adjacent position indicators.

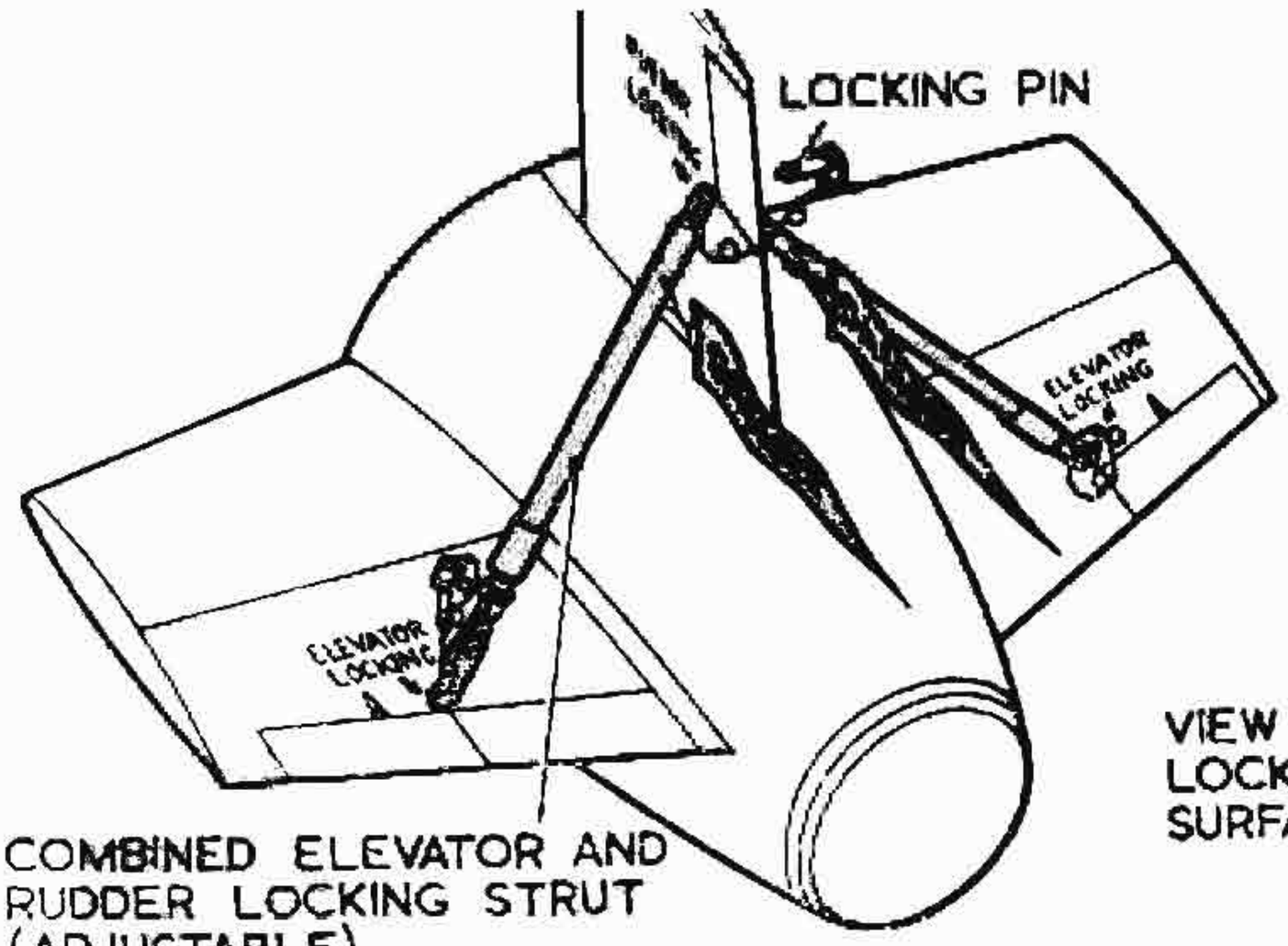
(ii) The elevator trim tabs are operated manually by a handwheel (15) on the port shelf. An electrical trim indicator is mounted forward of the wheel.

22. Undercarriage control

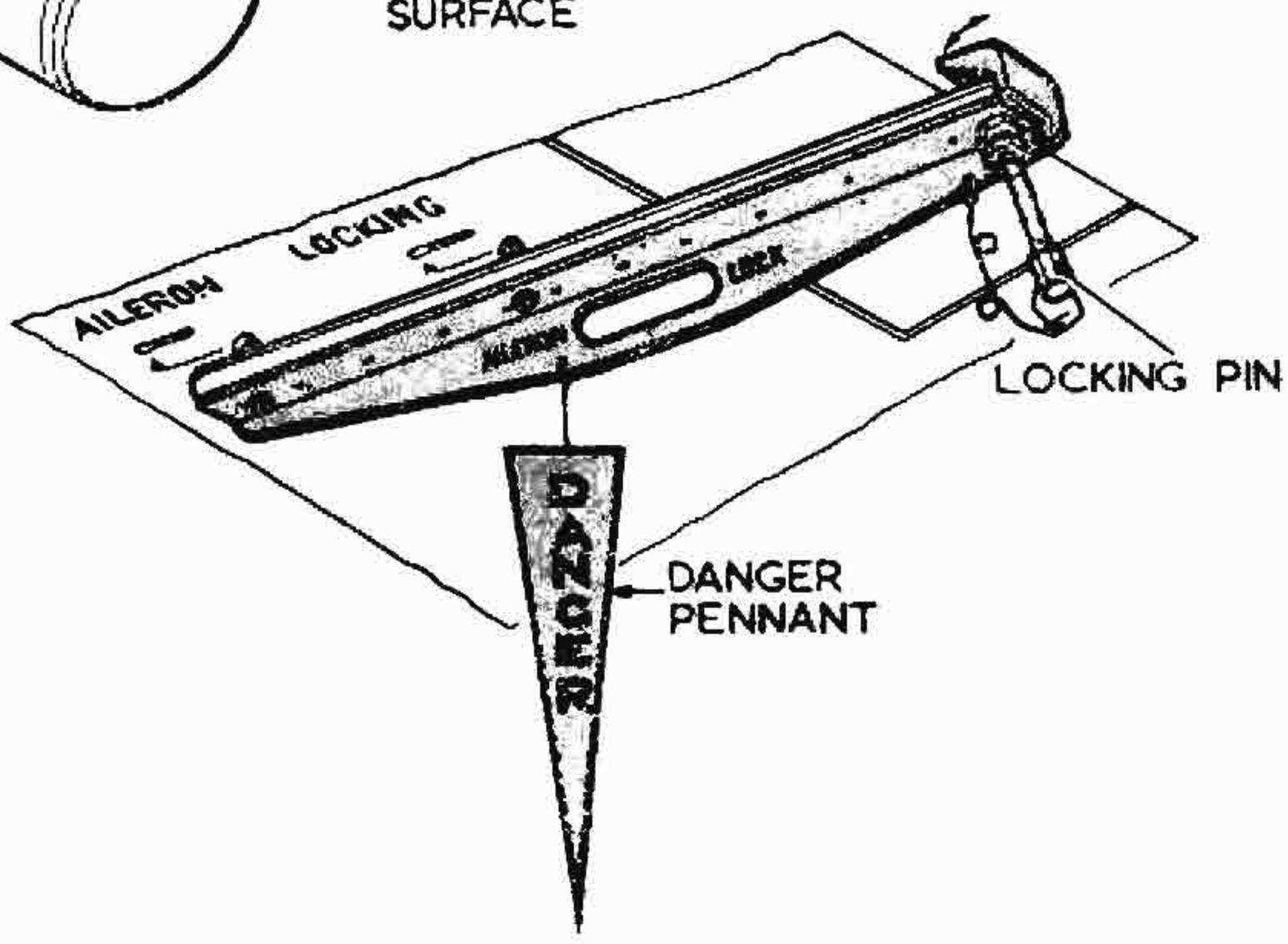
The normal selector lever (14) is on the port side of the instrument panel. To raise the undercarriage the safety



INTERNAL LOCKING



VIEW (LOOKING INBOARD) OF AILERON LOCKING DEVICE. PORT WING UNDER SURFACE



EXTERNAL LOCKING

FLYING CONTROLS LOCKING GEAR

catch should be tripped and the lever raised to the UP position.

23. Undercarriage emergency control

(i) If the hydraulic system fails, the undercarriage may be lowered by a compressed air system. The normal selector lever must be set to DOWN and then the emergency control (52) on the starboard shelf should be moved forward and down. Once the system has been operated, it may not be used again.

(ii) If the emergency system has been used in error when hydraulic power is available, the undercarriage may again be operated normally after returning the emergency lever to the up position.

24. Undercarriage position indicator

A standard indicator (20) on the port side of the instrument panel indicates as follows:—

3 green lights	...	Undercarriage locked down
3 red lights ...	...	Undercarriage unlocked
1 central red light	...	Undercarriage locked up, throttle less than $\frac{1}{3}$ open
No lights	... ...	Undercarriage locked up

25. Tail wheel lock

(i) Tail wheel locking is effected by an electrically-operated lock, controlled by a FIXED /STEER switch (23) on the instrument panel.

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(ii) When the switch is set to FIXED the tail wheel is held in a fore and aft position.

26. Flaps control and position indicator

(i) The flap lever (16), in the throttle quadrant, moves in a slot which is gated at the UP (forward) and LANDING positions. There is no gate for the take-off position,

but this setting is shown on the position indicator (13). The flaps may be set at any intermediate position.

(ii) On the FB versions a hinged gate is provided to restrict the fully down (78°) position of the lever to 50° for use when RP's or certain types of bombs are being carried.

27. Flaps emergency control

In the event of hydraulic failure, the flaps can be lowered, if pressure is available in the hydraulic accumulator, after normal selection.

28. Air brakes control

(i) The air brakes consist of a combination of flaps and lift spoilers.

(ii) The control lever (8) is in the throttle quadrant. The mechanism enables any position between fully IN (fwd) and fully OUT (aft) to be selected.

(iii) When the flaps are up, selection of air brakes fully OUT extends the lift spoilers and lowers the flaps to 17°. This combination of flap with lift spoiler movement is designed to reduce longitudinal changes of trim on selection.

(iv) When the flaps are partially down, movement of the air brake lever out extends the spoilers and further lowers the flaps.

(v) When the flaps are fully down, movement of the air brake lever to OUT will extend the spoilers only.

29. Arrester hook control

(i) The arrester hook is raised hydraulically and lowered by means of the compressed air trapped in the head of the jack. The UP/DOWN selector lever (11) is on the port side of the instrument panel.

(ii) A green indicator light below the lever shows when the hook is lowered. In addition the navigation lights, an attitude light on the port side of the fuselage and a light illuminating the port wheel all come on when the hook is down.

30. **Arrester hook training switch**

When the training switch, below the arrester hook control is on, it simulates the action of the control without lowering the hook.

31. **Wheel brakes control**

(i) An engine-driven compressor charges an air bottle to 450 lb./sq. in. for the operation of the wheel brakes. The main pressure is reduced to 150 lb./sq. in. and then passes to the brakes which are operated by a lever on the control column and differentially by the rudder bar.

(ii) The available pressure in the system is shown on a triple pressure gauge (21).

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32. **Wing folding control**

(i) The control (2) for operating the wing folding mechanism is beneath a flap on the port shelf. When set to WING FOLD, the wing locking pins are withdrawn electrically and the hydraulic system supplies fluid to fold the wings if the engine is running.

(ii) The ailerons are automatically centred and locked when folding commences and remain so until the wings are again spread and locked.

(iii) A red warning light inset in each wing leading edge indicates that the appropriate locking pin is not in engagement. A magnetic indicator (4) on the port shelf shows white if either wing is not safely locked spread.

(iv) Wing locking pin indicators also protrude from the leading edge, when the locking pins are not fully in and electrical power is available.

(v) In the event of electrical or hydraulic power failure or whenever the engine is not running, the wings may be folded by use of the handpump after selection of WING FOLD and manual disengagement of the locking pins.

COCKPIT EQUIPMENT

33. **Entry to aircraft**

(i) Entry to the aircraft is effected via the port leading edge and assisted by a single retractable footstep, between the cockpit and the leading edge of the port wing, and two fixed footsteps covered by spring-loaded flaps.

(ii) The retractable footstep may be released from outside by pressing a button above the step and from inside by a lever on the port wall.

34. **Hood operation**

(i) The hood may be opened or closed by use of the winding handle (47) on the starboard wall. Folding the handle engages a locking pin in a hole and locks the hood in the required position. In the fully closed position the hood is also held by a catch at the rear of the cockpit, provided that the handle is folded.

(ii) The hood may be opened externally by pressing a red painted knob on the starboard side of the fuselage below the windscreen and sliding back the hood manually.

35. **Hood jettisoning control**

The hood may be jettisoned by pulling the T-handle (10), on the instrument panel, after first releasing the retaining clip.

36. **Cockpit pressurisation, heating and ventilation**

(i) The control (49) on the starboard wall should be moved forward to turn ON the pressure system, provided that the hood is closed.

(ii) The hood seal is then inflated and air from the engine compressor is fed to the cockpit. A pressure control valve allows a steady build up of pressure at altitudes above 10,000 ft. until at 43,000 ft. and above, the full pressure differential of 3½ lb./sq. in. is reached.

(iii) A cockpit altimeter (22) may be fitted to show the equivalent cockpit altitude. The pilot should adjust his oxygen to correspond with this altitude. A warning horn sounds whenever the pressure falls below a predetermined minimum. Both the altimeter and the horn should indicate in accordance with the following table:—

Actual height (ft.)	Approx. equivalent Cockpit altitude (ft.)	Warning horn sounds (ft.)
15,000	12,500	14,000
20,000	14,500	17,000
25,000	16,500	19,500
30,000	18,250	21,750
35,000	19,700	23,600
40,000	21,800	26,000

(iv) The ventilator (44) on the starboard side of the cockpit is provided for use at low altitudes. It must be off before the cockpit can be pressurised.

37. **Windscreen and hood de-misting**

(i) The cockpit pressurising system inlet ends in a spray pipe at the base of the windscreen and thus provides for internal de-misting.

(ii) The airspaces in the sandwich type windscreen and side panels are sealed and connected to silica gel containers which are vented to atmosphere.

(iii) The hood, which is also of the sandwich type, is vented to atmosphere via a silica gel container at its rear.

38. **Windscreen de-icing**

The pump, flow regulator and on/off cock (55) are at the aft end of the starboard shelf. The de-icing fluid, which is contained in an adjacent tank, is pumped to a spray tube where it is directed to the curved glass of the windscreen.

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39. Ejection seat Mk. 2A

WARNING.—The firing handle must always be locked against the possibility of accidental withdrawal whenever the aircraft is on the ground. A fabric safety strap, attached to the front edge of the drogue container, should be passed through the firing handle and secured by a spring safety pin. It is the pilot's responsibility to lock the handle after landing and to ensure that the pin is removed and stowed on the port side of the drogue container prior to take-off. All personnel must ensure that the firing handle is locked before entering the cockpit.

(i) A Mk. 2A pilot ejection seat is fitted, which incorporates a type ZD harness, a container to support the weight of the Mk. 8A back-type parachute and a seat-well in which is carried the K-dinghy pack type J and emergency oxygen supply.

(ii) The harness release lever is on the outboard side of the starboard thigh guard and the seat adjustment lever is on the starboard side of the seat.

(iii) The seat is fitted with fully automatic facilities which after ejection separate the occupant from the seat and open his parachute. After ejection, at heights of 10,000 ft. and below, a barostat causes the automatic cycle to commence; after 5 seconds the seat harness is released, as are the face screen, firing handle and headrest pad. An apron attached to the seat drogue then pitches the pilot head-first out of the seat, at the same time opening his parachute. A manual override D-ring is fitted over the rip-cord D-ring, and when pulled disconnects the parachute from the seat. In this event it is subsequently necessary to release the seat harness manually and pull the rip-cord D-ring.

40. Cockpit Lighting

(i) *Ultra-violet, red and shelf lamps*

These are controlled by three on/off dimmer switches (57) on the starboard shelf.

(ii) *Emergency lamp*

A single emergency lamp, controlled by an on/off switch (43) on the starboard shelf, is mounted above the centre of the instrument panel.

41. **External light controls** (30)

(i) *Navigation lights*

These are controlled by a BRIGHT-OFF-DIM switch and a morse pushbutton on the starboard coaming. The lights automatically come on at full brilliance when, with the undercarriage down and locked, the arrester hook is lowered or the training switch is on.

(ii) *Attitude lights*

Two lights, one illuminating the port wheel and one at the aft end of the fuselage port side, are switched on when the arrester hook is lowered or the training switch is on, and the undercarriage is down and locked.

(iii) *Identification lights*

The ON-OFF or MORSE switch, colour selector switch and morse pushbutton are on the starboard coaming.

(iv) *Resin lights*

Two resin lights are fitted and are controlled by an ON/OFF switch on the starboard coaming.

(v) *Formation lights*

These are controlled by a BRIGHT-OFF-DIM switch and a morse pushbutton on the starboard coaming.

42. **Electrically-operated flight instruments**

(i) The instrument supply switch (36), which is ganged to the engine starter safety switch, controls DC to the turn and slip indicator and to the inverters which supply AC for the Mk. 4F compass (34) and the artificial horizon.

(ii) The inverters should be switched on before flight by means of the two switches (29) on the instrument panel.

The upper one controls the No. 1 inverter and the lower the No. 2. *No. 1 inverter must be switched on before No. 2; never switch on both inverters simultaneously*. An adjacent magnetic indicator shows black when both switches are on correctly and electrical power is available.

(iii) If No. 1 inverter fails an automatic changeover relay is operated and the instruments are then fed by No. 2 inverter. A second magnetic indicator in the nose compartment shows white if changeover has occurred during flight.

(iv) Two circuit breakers, one for each inverter, are positioned in the port side of the fuselage nose. They can only be reset on the ground.

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43. Pressure head heater

(i) A switch, connected to the undercarriage, automatically turns on the heater element when the wheels are retracted, and off when they are lowered.

(ii) The on/off test or override switch (28) is positioned in the centre of the instrument panel.

44. Oxygen system

(i) Oxygen is carried in two 750-litre cylinders stowed at the rear of the pilot's seat. With the regulator control set to HIGH the duration of supply is 3½ hours and at NORMAL is 7 hours.

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(ii) The supply is connected to a Mk. 11C. regulator (33) on the starboard side of the instrument panel. From the regulator oxygen flows via a Mk. 4 economiser to the pilot's oxygen mask. A sliding plate may be fitted to the regulator and engage with a MIC ON/OFF switch fitted adjacent. This device ensures that the R/T cannot be switched ON unless the oxygen regulator is first turned on. After flight the MIC switch should be set to OFF *before* turning off the oxygen regulator.

(iii) Two quick release sockets are fitted, one attached to the bottom of the seat and one into which the oxygen mask is fitted. On ejection the former is disconnected and on separation from the seat the latter is disconnected.

(iv) The emergency oxygen system is automatically brought into use on ejection provided the locking pin on the emergency bottle is withdrawn. A manual operating control (53) is on the starboard side of the seat.

45. Navigational equipment

(i) A standby E2 compass is fitted above the centre windscreen panel.

(ii) A chartboard stowage is fitted to the port wall.

45A. Anti-G system

(i) The purpose of the system is to provide air at low pressure for the pilot's anti-G suit. All controls are aft on the starboard side.

(ii) Air under pressure is stored in a bottle, the contents of which are indicated on a pressure gauge. When the anti-G cock is ON and G in excess of about 1½ is applied, a spring-loaded valve opens and allows air to pass to and inflate the anti-G suit. The amount of inflation depends on the amount of G applied.

(iii) The system may be tested, with the cock ON, by pressing the ANTI-G TEST button as gently as possible to avoid severe discomfort due to too rapid inflation.

OPERATIONAL CONTROLS

46. Radio controls

NOTE.—All installations are stowed in the radio compartment in the fuselage nose.

(i) *VHF-TR1936 (AR15489)*
The 10-channel rotary control unit (56) is situated on the starboard shelf. The press-to-transmit button (7) is on the end of the throttle lever.

see para. 44 (ii) A.L.3

(ii) *Beacon homing (AR15301)*
The control and mixer units (18) are situated on the port shelf.

47. Radar controls

NOTE.—All installations are stowed in the radio compartment in the fuselage nose.

(i) *IFF - (ARI5679)*

The control unit, auxiliary control unit, and D and F switches (19) are on the port shelf.

(ii) *Radio altimeter (AR15284)*

The altimeter, indicator lights and setting switch (24) are on the port side of the instrument panel.

48. Contacting altimeter

This (35) is mounted below the Mk. 4F compass. The telephone warning on/off switch (46) is on the starboard shelf.

49. Gyro gunsight Mk. 4E

(i) The GGS is mounted in a retractable mounting above the instrument panel. When the retraction switch, which is ganged to the GGS master switch (27), is on, the GGS moves to the combat position and is available for immediate use.

(ii) The ranging control is operated by the throttle lever twist grip. The dimmer selector (48) is on the starboard wall.

50. GGS emergency lowering controls

(i) If electrical power is still available the gunsight will automatically retract when the hood is jettisoned.

(ii) In the event of an electrical fault the knob at the right of the sight should be hit hard to lower the sight. It may be necessary to assist in retraction by pushing.

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51. G45 and recorder cameras

NOTE.—To prevent electrical failure of the GGS, the recorder camera must not be plugged in or unplugged while the sight is in the combat position.

(i) The G45 cine-camera is mounted in the nose of the aircraft and the recorder camera over the gunsight.

(ii) The camera master switch should be on to energise the heater muff of the G45 camera and to ready both cameras for use. This switch (26), together with the aperture switch, is on the port coaming.

(iii) When in circuit the cameras are operated simultaneously whenever the guns are fired or the camera button is pressed.

52. Gun-firing

(i) The knurled safety catch at the top of the control column has two positions, FIRE and SAFE. The firing control is at the forward side of the control column handgrip.

(ii) An ARMAMENT MASTER switch, situated below the cabin ventilator, is fitted for ground testing the armament and camera circuits.

53. Bomb and RP controls

(i) The main Bomb/RP controls are mounted on a panel (6) on the port wall. In the FB versions the container jettison switch is inoperative, since the bomb pylons are fixtures. The bombs are released or RP's fired by pressing a pushbutton on the control column.

(ii) The bomb manual emergency release mechanism is operated by two levers (1) in a quadrant on the port shelf. A restriction plate must first be moved out of engagement.

PART II
LIMITATIONS

54. Engine limitations—Nene 3 and 102

The permissible limitations are as follows:—

	R.P.M.	Max. Jet pipe temp. °C.
Take-off and Operational necessity *15 Mins. Limit*	12,500 ± 100	720*
Intermediate *30 Mins. Limit*	12,200	680
Max. Continuous	11,800	620
Ground idling	2,500 ± 100	550

*At altitudes above 20,000 ft. 735°C. is permitted for a period not exceeding 10 minutes.

Minimum oil pressures

In flight	20 lb./sq. in.
Ground idling	3 lb./sq. in.

55. Flying limitations

NOTE.—It is recommended that aircraft in the group WA.470 to WA.483 inclusive should not be flown above 35,000 ft. due to inadequate cockpit pressurization.

(i) (a) Aerobatics are prohibited when wing stores are carried.
(b) Intentional spinning is prohibited.
(c) Arrested landings when carrying a full belly tank, R.P's or bombs are permitted *in emergency only*.
(d) Mod. 47 (flat-sided elevators) must be incorporated if bombs or R.P's are to be carried.
(e) Flap deflection is limited to 50° when R.P's and bombs (other than practice bombs) are carried.

(ii) *Maximum speeds, in knots*

Clean, or with belly tank, airbrakes in or out	505 or 0.78M
Flaps and/or undercarriage fully down ...	190

(iii) *G limitations*

The following accelerometer readings must not be exceeded.

Full internal fuel—full belly tank	+5½G
Full internal fuel—empty belly tank ...	+6½G
(pro rata intermediately)	
Clean aircraft	+6½G

The above limitations are not affected by the carriage of any permitted combination of wing stores.

(iv) *Maximum all-up weights*

Condition	All-up weight lb.	Approximate corresponding loading
Overload take-off airfield or catapult	15,834	Full internal fuel Full belly tank 12 × 60 lb. R.P's
Normal carrier operation	14,600	Full internal fuel Full belly tank
Airfield landings	13,000	Full internal fuel Empty belly tank
Arrested landings	11,300	Clean aircraft:—120 galls. remaining or empty belly tank and 85 galls. internal fuel.

(v) *Carriage, release and jettison limitations for external stores.*

Store	Max. Carriage Speed (Knots)	Release		Remarks
		Max. Speed (Kts.)	Max. Angle	
Belly tank	as for clean aircraft	450	Straight & level	May be carried with R.P's.
R.P's (6 or 12 off)				*Double tier stowage*
25 lb. head	475	475	40° dive	Scheme 'B' loading No. 8 Mk. 4 saddles and Mk. 3 fins.
60 lb. head	475	420	40°-60° dive (using airbrakes)	
Flare head	450	450	20° climb	*Single tier stowage* using No. 5 Mk. 2 and No. 8 Mk. 1 or 2 saddles and Mk. 3 fins.
Bombs				
25 lb. practice (4 off)	505	475	60° dive	Tail fuzing wire removed from bomb pylon. Torque spanner setting 2-3 lb. ft.
500 lb. MC Mks. 18 and 21 (2 off)	505	450	60° dive	Nose fuzing only with No. 25 Mk. 3 tails and bomb retaining bands KB.119. Negative G must not be applied on release. Tail fuzing wire should be removed from pylon. Torque spanner setting 6½ lb. ft.
1,000 lb. MC Mk. 6 (2 off)	505	400	45° dive	Airbrakes must not be extended on release. Negative G must not be applied on release. Tail fuzing only (No. 100 Mk. 5 tail must be used). Torque spanner setting 6½ lb. ft.

PART III
HANDLING

56. Cockpit checks

Before entering the cockpit check the following:—

Item	Check
Ground/Flight switch	FLIGHT (or ground battery plugged in)
Hood	Condition and security Operation and locking mechanism
Ejection seat	Safety pin fitted in safety strap

If seat incorporates ML Automatic Parachute and Harness Release, ensure:—

(a) That the harness static line is attached to the aircraft by the spring clip.

(b) That the parachute static line is attached to the seat by the spring clip.

Hydraulic accumulator pressure	1,800 lb./sq. in. minimum
Undercarriage emergency air bottle pressure	1,800 lb./sq. in. minimum
Emergency oxygen (53)	Pin removed

Enter the cockpit and check:—

Undercarriage lever (14)	Down
Seat	Check harness locking and seat height adjustment
Hydraulic handpump	Secure In operating position

Item	Check
Armament switches and controls (6)	Set to SAFE or OFF
Flying controls	Full and correct movement
R.T./Mix Beacon Control (18)	On R.T.
I.F.F. (19)	Off
H.P. cock (17)	Closed
Battery isolating switch (37)	ON
Wing folding warning indicator (4)	Corresponding to position of wings
Wing tip lock indicators	Position, and warning lights as appropriate
Aileron and rudder trimmers (3)	Operation
Main L.P. pump circuit breaker (5)	Out
Inverted flight L.P. pump circuit breaker (5)	In
Throttle	Closed
Flap lever (16)	Position (50° flap stop in, if wing stores carried)
Airbrakes control lever (8)	Fully forward, air brakes closed
Elevator trim control (15)	Full and correct movement
Hood jettison lever (10)	In, locking catch in place
Undercarriage indicator (20)	3 green lights on
Pneumatic pressure gauge (21)	Note pressure
Wheel brakes	On, note pressure on each wheel
Arrester hook control (11)	Up (hook retracted)
Arrester hook warning light (11)	Out

	Item	Check
	Arrester hook training switch (11)	Off
	Radio altimeter (24)	Off
	G.G.S. master switch (27)	Corresponding to position of G.G.S.
	Pressure head heater (28)	Off
	Instrument supply switches (29)	Down (off)
	Generator failure warning light	On
	Fuel transfer warning light (32)	On
	Fuel gauges (31)	Contents
	H.P. fuel pump isolating valve switch (42)	NORMAL (light out) A.L. 4
	Oxygen (33)	Contents and delivery Seat connection plugged in
	Engine starting safety switch (36)	OFF
	Generator field circuit breaker (39)	In
	Ignition isolating switch (40)	OFF
	R.A.T.O.G. master switch (41)	OFF
	Beam approach switch (43)	OFF
	Emergency lighting switch (43)	OFF
	Cockpit ventilator (44)	As required
	Internal and external lighting switches (57) (30)	As required
	V.H.F. control (56)	OFF
A.L. 1	Fuel transfer selector (51)	DROPTANK
	Low pressure cock (50)	ON
	Cockpit pressure control lever (49)	OFF
	Undercarriage emergency control lever (52)	Correct position
	Windscreen de-icing control (55)	Off

57. **Management of the fuel system**

(i) The L.P. cock and the L.P. pumps circuit breakers must be on for starting and at all times while the engine is turning except in cases of fire or engine mechanical failure.

(ii) When a belly tank is carried it should be used before the internal fuel.

(iii) The fuel transfer pressure warning light will come on when the air pressure available for transfer is below normal, i.e. it serves as a warning that transfer from the tanks selected is complete, or that there may be a fault in the system, and that fuel is accordingly being used from the main tank.

(iv) If the transfer selector lever is at DROP TANK (i.e. belly tank) it should be moved to BUILT IN tanks directly the main tank gauge shows that fuel is being used from it, or when the fuel transfer pressure warning light comes on.

(v) There may be small longitudinal changes of trim as fuel is used.

(vi)

- deleted - A.L. 1

58. **Starting the engine**

(i) Have the ground battery plugged in, and the Ground/Flight switch set to GROUND.

NOTE.—It is important that the ground battery is fully charged and that it is switched on during the entire starting cycle, as the engine requires assistance from the starter to accelerate to idling r.p.m. Starting on the internal battery is possible, but not recommended as this may damage it.

(ii) Check that:—

Throttle lever	SHUT
H.P. cock	CLOSED
L.P. cock	ON
L.P. pump circuit breakers	In
Battery isolating switch	ON
Starter safety switch	ON
Ignition isolating switch	ON
Fuel pressure warning light	Out
Fuel pump isolating valve switch	NORMAL (light out)
Fuel transfer selector lever	built-in tanks A.L. 2

NOTE.—In some early aircraft (pre. Eng. Mod. 242) a volute jet pipe bleed was incorporated to improve the starting characteristics. This should be open before starting the engine and closed after starting. However, the use of this control is not essential, provided the normal starting drill is followed.

(iii) Press the starter button firmly, listen for the starter to engage and release the button. The starting cycle will then be automatically regulated by a time mechanism.

(iv) After 6-8 seconds, by which time the r.p.m. should have risen to 800-900, the H.P. cock should be moved from the closed to just beyond the half-open position. When light up has occurred the H.P. cock should be opened progressively as the engine accelerates.

NOTE.—Rapid opening of the H.P. cock should be avoided as resonance and high jet pipe temperatures will occur. Should this persist or be excessive, the H.P. cock should be closed.

(v) When the engine is running at idling r.p.m., 2,500 ± 100, and not before, the Ground/Flight switch should be set to FLIGHT and the ground battery disconnected.

(vi) Should a "wet" start occur:

(a) Close the H.P. cock.

(b) Switch OFF the ignition isolating switch.

(c) Have the ground crew check that the engine has stopped turning, and that fuel has stopped draining from the jet pipe.

(d) Motor the engine over to dry it out by pressing the starter button.

(e) When the engine has stopped turning, have any surplus fuel removed from the jet pipe.

(f) Switch ON the ignition isolating switch and carry out normal starting procedure.

(vii) If flames come from the jet pipe following a "wet" start, turn OFF the H.P. cock, the L.P. cock (and the cockpit pressurising control, if on).

59. Checks after starting

Jet pipe temperature	550° maximum
Engine idling r.p.m.	2,500 ± 100
Oil pressure	3 lb./sq. in. minimum
Fire warning light	Out
Pneumatic pressure	450 lb./sq. in. maximum
Wheel brakes	Operate, check pressures
Air brakes	Operate, check spoilers visually and flaps against gauge
Inverters	Switch on separately in correct order, check indicator is black
Radio	Test

60. Testing the engine and services

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(i) At 5,000 r.p.m. check the fuel pump isolating valve by switching it to ISOLATE when the warning light should come on. A rise in r.p.m. should then occur if the valve is functioning correctly. Return the switch to NORMAL and note that the r.p.m. return to the original figure and that the light goes out. Should no r.p.m. rise be apparent during the test, the engine should be stopped and the cause investigated.

(ii) The generator warning light and fuel transfer pressure warning light should go out at approximately 5,000 r.p.m.

61. **Checks before taxying**

Tail wheel	Unlocked
Artificial horizon	Serviceability
Mk. 4F compass	Serviceability and synchronisation

NOTE.—It is essential that the wings are spread and locked before the Mk. 4F compass is checked with the E.2 compass.

62. **Taxying**

(i) It is important that the tail wheel is straightened by the ground crew before attempting to taxy.

(ii) Taxying is difficult, as the tail wheel does not caster freely and overcorrection by brake may cause an uncontrollable swing.

(iii) Large and frequent throttle movements should be avoided.

(iv) Full use should be made of the tail wheel lock when taxying straight. (Side loads must be relieved before the lock will disengage).

63. **Checks before take-off**

Trimmers	All neutral (elevator $\frac{1}{4}$ division nose up if belly tank fitted)
Air brakes	IN. Check spoilers visually
Fuel	L.P. cock fully ON H.P. cock locked fully OPEN L.P. pumps circuit breakers in H.P. pump isolation valve switch as required — A.L.1 Transfer lever as required

Flaps	Take-off
Instruments	Set. Inverters on (indicator showing black)
Oxygen	On
Hood	Fully closed or fully open Handle stowed and locking catch engaged Cockpit pressurising lever as required
Harness	Tight and locked in rear position
Wings	Spread and locked Check all indicators and wing leading edges for continuity at the wing fold position

64. **Take-off**

(i) Taxy forward a few yards to straighten the tail wheel and engage the tail wheel lock.

(ii) Open the throttle smoothly to take-off r.p.m. There is no tendency to swing but should it be necessary, small changes in direction may be made by careful use of the brakes until the rudder becomes effective at 50-60 knots

NOTE.—If it is necessary to check any of the engine instruments, this should be done against the brakes prior to take-off.

(iii) The elevator forces to raise the tail are very heavy, but this may be done at 75-80 knots. With full internal and external fuel, the aircraft may be flown off at 105-110 knots. At maximum take-off weight the aircraft should be flown off at 115-120 knots.

(iv) Brake the wheels before raising the undercarriage which, to avoid risk of damage, should be locked up before the speed reaches 190 knots. Slight lateral trim changes may be felt due to one leg retracting before the other.

(v) Raise the flaps *a few degrees at a time*, retrimming carefully. There is a *very strong nose-down* change of trim

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on raising the flaps. This is particularly strong if they are raised at high airspeeds.

(vi) If the fuel pump isolating switch has been set to ISOLATED before take-off, return it to NORMAL while still *at full throttle* and *at circuit height*, otherwise over-fuelling will occur. If the throttle is not fully open when this is done, a rapid drop in r.p.m. will occur.

(vii) Shortly after take-off, the pneumatic pressure regulating valve can be heard to discharge.

(viii) *Short take-off*

When conditions make the use of the shortest possible take-off run essential, the brakes should be applied when the aircraft is aligned on the runway, or flight deck, the tail wheel locked and the throttle opened gradually to take-off r.p.m. The brakes should then be released.

(ix) *Catapult take-off*

For a catapult take-off, trim the elevator $\frac{1}{4}$ division nose up and select $\frac{3}{4}$ flap. The tail wheel must be locked and the stick and rudder held firmly central. Ensure that the hood is locked in the fully open position.

65. Climbing

(i) When climbing at a loading equivalent to 95% internal fuel, the following speeds, in knots, are recommended:-

Sea level	310
10,000 feet	285
20,000 feet	260
30,000 feet	240
40,000 feet	215

These speeds should be reduced by 20 knots when carrying a full belly tank.

(ii) *Operational climb*

Start the climb using 12,500 r.p.m., reducing to 12,200 after 15 minutes. It may be necessary to reduce engine r.p.m. before the 15 minutes time limit if the j.p.t. exceeds 720°. (735° above 20,000 feet for a maximum of 10 minutes.)

(iii) *Normal climb*

If maximum rate of climb is not essential, the climb should be made at 12,200 r.p.m. maintaining the recommended airspeeds as before.

(iv) Maintain correct r.p.m. during the climb by throttling back as necessary.

66. **Engine handling**

(i) *Nene 3*

Throttle movements should be made smoothly and slowly, particularly when opening up from low power settings. This is especially important at high altitudes or on the approach to land.

(ii) *Nene 102*

Normal throttle movements may be made between idling and take-off r.p.m. (See (iii) below.)

(iii) *Nene 3 and 102*

When using the fuel pump isolating switch in the air the throttle must be closed before the switch is set to ON otherwise there is a possibility of flame extinction. Whenever the switch is ON, all throttle movements must be made slowly and smoothly otherwise there is a danger of engine stalling or overheating.

67. **General Flying**

(i) *Flying controls*

The ailerons are light and effective throughout the speed range and up to the limiting mach number. The rudder is effective and heavy at low speeds becoming very heavy at high speeds; however, the measure of control required is very small, and rudder heaviness does not affect manoeuvrability. The elevators are effective and heavy at low speeds, becoming very heavy and less effective at high speeds and high mach numbers.

(ii) *Trimmers*

The elevator trimmer is very effective at all except the lowest speeds. The electrically-operated rudder trimmer is moderately effective at low speeds, becoming increasingly effective at high speeds. The aileron trimmer is ineffective at low speeds, becoming slightly more effective at high speeds. The use of this trimmer is not essential nor is it beneficial below speeds of about 350 knots, except when trimming out all but the smallest stick forces.

(iii) *Changes of trim*

Flaps down.	Very strong nose-up
Air brakes out	Moderate nose-up
Undercarriage down	Negligible
Increase in power	Slight to moderate nose-up

(iv) *Use of air brakes*

(a) The air brakes will open, at any airspeed, to the position selected on the control lever. There is a moderate nose-up change of trim when they are fully open, which can, however, easily be held. This is more apparent at high speeds than at high mach numbers.

(b) There is a temporary mild nose-down change of trim as the air brakes open, though this is less noticeable at high mach numbers. Lateral changes of trim may also occur due to uneven opening.

(c) If *less* than full flap has already been selected down, full operation of the air brakes control open, will move the flaps a further 15° to 20°. If the flaps are already *fully* down, moving the air brakes control to open will operate the *spoilers only*. Thus the small changes of longitudinal trim on operating the air brakes control when the flaps are fully down will be in the reverse sense to normal. There is mild buffet and stalling speeds are increased by 4 knots when the lift spoilers only are operated in this way.

(d) Use of the air brakes control is not recommended once full flap has been lowered, and on no account

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should it be operated when flap is selected and external stores are carried, whether or not the 50° flap stop is in position. (See para. 28 (iv)).

(e) It is recommended that the control be used fully open or closed only, as intermediate positions may produce large trim changes with but small braking effect.

NOTE.—Care should be taken not to move the flap lever inadvertently when the air brakes control is used.

67.A Handling with Bombs and R.P's

When bombs are released or R.P's are fired in salvo, a strong nose-up trim change occurs, the higher the airspeed the stronger the trim change. Release of 1,000 lb. bombs produces a more marked trim change than release of stores of lower weight. When carrying out ground attack dives, therefore, the aircraft should be trimmed progressively into the dive. On release of R.P's or bombs due allowance should be made for the trim change, when initiating recovery from the dive. In no circumstances must the carriage limiting speeds or G limitations be exceeded. (See para. 55 (iii) and (v).)

68. Manoeuvrability

Rate of roll is good, but elevator stick forces are high when turning at high airspeeds particularly at forward c.g. At high altitude, the turning circle radius is large due to high wing loading and compressibility effects. The recommended speed to fly for maximum manoeuvrability at high altitude is 0.7M.

69. Flying at reduced airspeed

Reduce speed to 150 knots and lower the flaps to not more than the take-off position.

70. Flying in conditions of severe turbulence

The recommended speed is 250 knots.

71. Flight planning charts

(i) *Description*

(a) The charts in the centre of the book show the range obtainable, for clean aircraft and when carrying a belly tank, at various altitudes when flying at

Optimum range speed
Max. continuous r.p.m. (11,800)

(b) They also show the:—

Climb data (time to height, distance covered and fuel used).

Amount of fuel used, in gallons, at any stage of a flight. Descent data, in tabular form (time of descent, distance covered and fuel used).

(c) The climb shown on the charts is carried out in accordance with para. 65 (i) and (ii) and the descent shown is that recommended in para. 73 (i) (b). Each flight should be planned to allow a landing reserve of 70 gallons minimum to remain *after* the descent.

(d) Altitude is plotted vertically and "gallons gone" horizontally. Distance curves drawn on the charts represent distances of 100 miles interval.

(e) Continuous distance curves relate to flights carried out at the best range speed and "dotted" distance curves relate to flights at 11,800 r.p.m.

(f) The best range speeds and the approximate speeds to be expected at 11,800 r.p.m. are shown graphically on the right of each chart as IAS plotted against altitude. When cruising for range, the use of any speed within the bands quoted below should not cause more than a 5% reduction in the range obtainable at the recommended best speed.

Height ft.	Clean aircraft (knots)	with belly tank (knots)
Sea Level	245-325	250-315
10,000	225-280	230-275
20,000	205-255	210-250
30,000	190-230	195-225
35,000	185-220	185-210
40,000	180-210	—

(g) Several scales for "gallons gone" are given at the bottom of each chart to make allowance for possible differences in the specific gravity of the fuel in use.

(ii) *Use of the charts*

(a) To obtain the minimum amount of fuel required to fly a given distance, select the point furthest to the left of the chart on the appropriate distance line (by interpolation if necessary) and read off the "gallons gone" for the particular specific gravity. From the figure obtained add the fuel required for descent and the landing allowance. This total will indicate the fuel required.

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(b) To obtain the maximum distance it is possible to fly for a given amount of fuel, inspect the appropriate chart to find the height at which maximum distance for that quantity of fuel is obtainable and then subtract the descent and landing allowances for that height. The resulting total should then be applied to the "gallons gone" scale. Moving vertically upwards to the correct altitude line will show the distance to be covered.

(iii) *Range with external stores*

The following figures apply to aircraft carrying various external stores and a belly tank.

Store		Sea level	10,000ft.	20,000ft.	30,000ft.	35,000ft.
2 × 1,000 lb. bombs	IAS knots	290	260	235	220	—
	lb./hr.	3,400	2,800	2,300	2,000	—
	ANM/100lb.	8.5	10.7	13.7	17.5	—
2 × 500 lb. bombs	IAS knots	280	255	230	200	175
	lb./hr.	3,000	2,500	2,100	1,800	1,700
	ANM/100lb.	9.4	11.8	14.7	17.7	18.2
12 × R.P.	IAS knots	265	240	215	190	—
	lb./hr.	3,400	2,800	2,300	1,900	—
	ANM/100lb.	7.8	10	12.6	16.3	—
6 × R.P.	IAS knots	270	245	225	190	170
	lb./hr.	3,200	2,600	2,200	1,800	1,700
	ANM/100lb.	8.4	10.9	13.7	17.2	17.6

NOTE.—To convert to gall/hr. divide by the fuel density. To convert to ANMPG. divide by 100 and multiply by the fuel density.

72. Pressure error corrections

The following are the pressure error corrections at sea level over the cruising speed range of the aircraft:—

From	150	200	250	300	350	400	knots
To	200	250	300	350	400	450	knots
	0	+3	+4	+5	+6	+7	knots

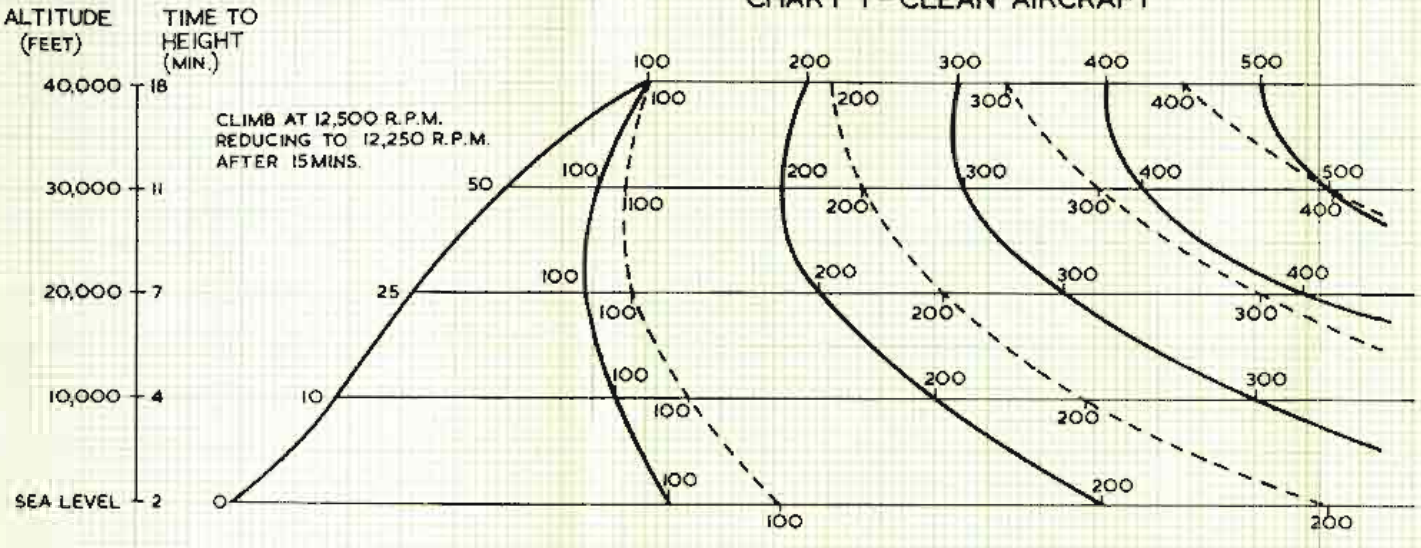
73. Range and endurance

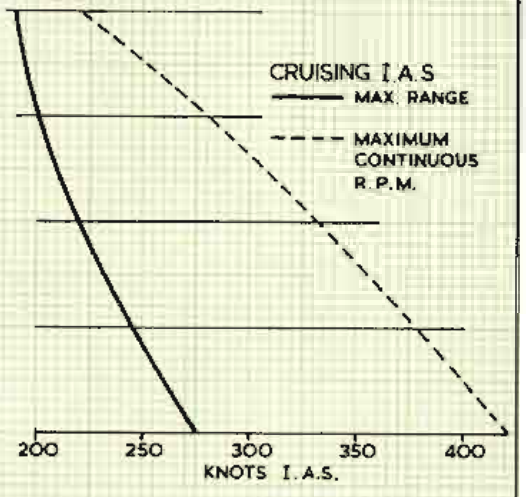
(i) *Range*

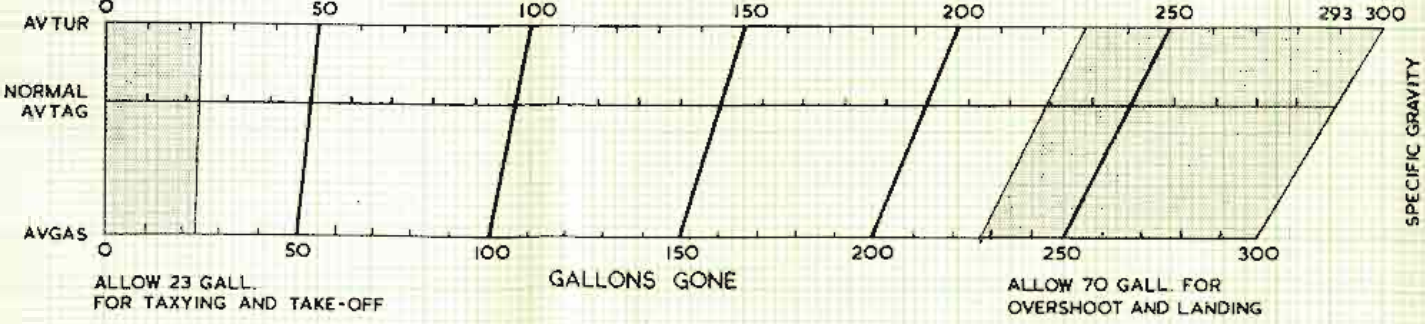
(a) For maximum range in still air climb as quickly as possible to 40,000 feet and cruise at the speed recommended in the Flight Planning Charts. If the belly tank is full it will not pay to climb above 35,000 feet initially. Thus, at this height, the throttle should be adjusted to maintain best range speed. As the aircraft lightens off as fuel is used, the aircraft should be allowed to climb without further throttle adjustment up to 40,000 feet.

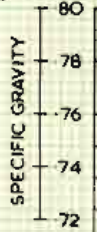
(b) The descent shown on the Flight Planning Charts is a cruising descent in which the engine is fully throttled and a speed of 0.65M is maintained (300 knots below 20,000 feet). This gives a comfortable descent together with good A.N.M.P.G. The descent should be started at a point which ensures that 70-75 gallons remain at circuit height. This allows for 15-20 minutes loiter at sea level at about 160 knots or alternatively a safe margin for joining

CHART 1 – CLEAN AIRCRAFT







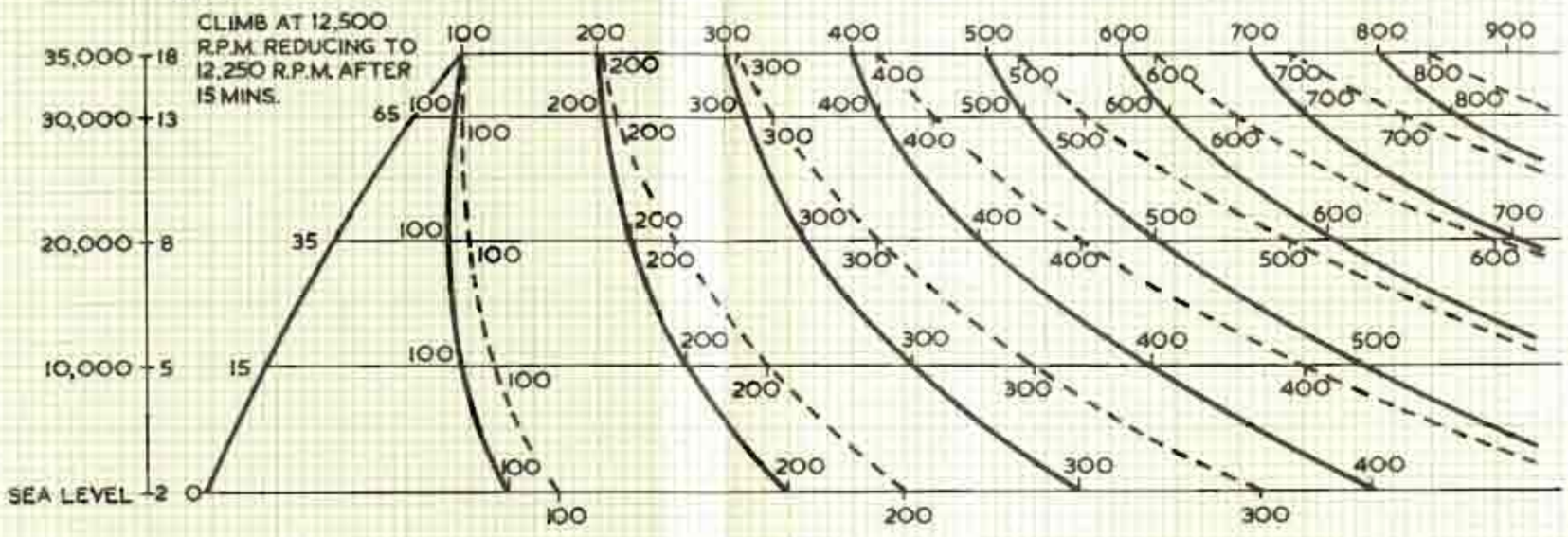


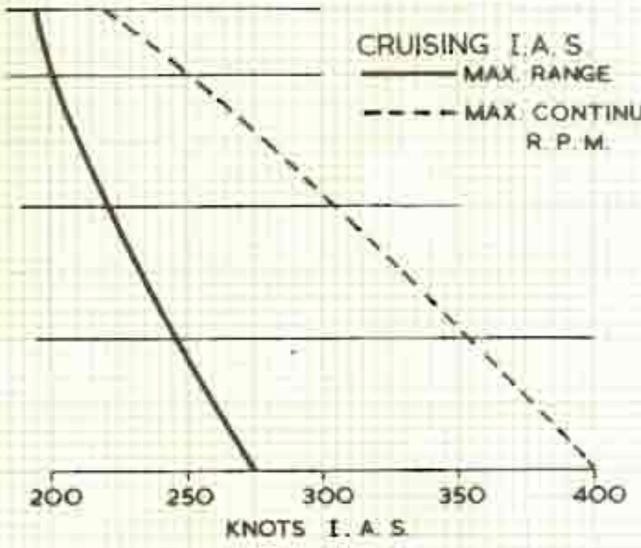
DESCENT DATA

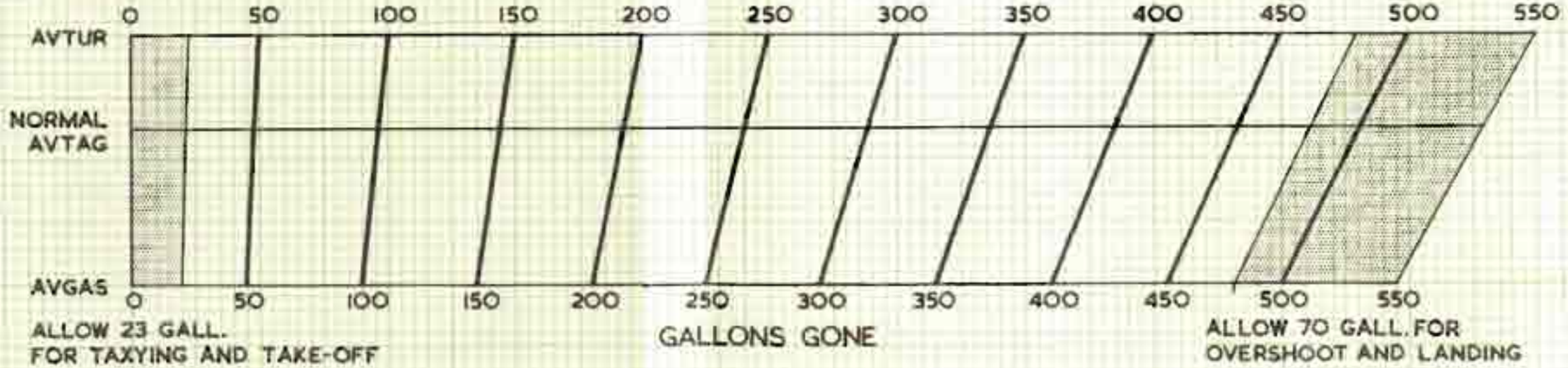
HEIGHT	DISTANCE COVERED	FUEL USED	TIME (MINS)
40,000	30	20	5
30,000	20	16	4
20,000	15	10	3
10,000	10	5	2

DESCEND WITH THROTTLE CLOSED, AIR BRAKES IN, AT 0·65M TO 20,000 FT., THEREAFTER AT 300 KNOTS

CHART 2 - WITH BELLY TANK







DESCENT DATA

HEIGHT	DISTANCE COVERED	FUEL USED	TIME (MINS)
35,000	30	20	5
30,000	20	16	4
20,000	15	10	3
10,000	10	5	2

DESCEND WITH THROTTLE CLOSED, AIR BRAKES IN, AT 0·65M TO 20,000 FT., THEREAFTER AT 300 KNOTS.

A869) Wt. 8292 1,500 8/53 Gp. 961 Fosh & Cross Ltd., London

the circuit and one overshoot and landing. An alternative method is to descend as above but with air brakes open. In this way the least amount of fuel is used during the descent but overall A.N.M.P.G. will be less. The rate of descent is then very high and large altimeter errors must be expected at low altitude. Before closing the air brakes, the angle of dive should be reduced.

(ii) *Endurance*

The speed for endurance varies, according to the weight of the aircraft, from 160-180 knots. At 160 knots the fuel consumption varies from approximately 215 gal. per hour at sea level to 155 gal. per hour at 30,000 feet.

74. **Stalling**

(i) The stalling speeds, correct to the nearest 5 knots, are as follows:—

	U/c and flaps up	U/c and flaps fully, or 50°, down
(a) *Power off*		
With 60 gall. in main tank, belly tank empty and full ammunition (10,750 lb.)	100	90
Full internal fuel and ammunition (12,300 lb.)	105	95
With full internal fuel and ammunition and 90% full belly tank (14,400 lb.)	120	105

NOTE.—The weight of full ammunition is 400 lb. (approx.) and the empty belly tank weighs 300 lb. (approx.).

(b) *Power on*

Under typical approach conditions the stalling speeds are about 3 knots less, with milder pre-stall buffet some 5 knots above the stall.

(ii) There is little warning of the approach of the stall, but there may be some slight airframe buffeting some 10 knots above, increasing down to the stall. Approximately 3-4 knots before the stall occurs there is mild lateral instability. A light pull force is required to stall the aircraft, when either wing may drop. Normal recovery action is immediately effective but some buffeting and aileron snatching may persist up to 15 knots above the stall during the course of recovery.

(iii) With flaps fully down, operation of the lift spoilers only (i.e. when the air brakes control is moved to OUT) increases the stalling speed by about 4 knots.

(iv) There is a large variation of stalling speed with load, and knowledge of the fuel state is particularly important when assessing the correct approach and landing speed.

(v) There is no appreciable change in the stalling speed or characteristics when 50° flap is used, or when the hood is open.

(vi) At medium and low altitudes, warning of the approach of the stall when "g" is applied is given by marked buffeting and aileron snatch and the wing which is on the inside of the turn tends to drop. At high altitudes the stall is less well defined, and may only take the form of pronounced airframe judder as attempts are made to tighten the turn. (See para. 68.)

75. **Spinning**

Intentional spinning is prohibited. Should an accidental spin occur normal recovery is known to be fully effective.

76. **Diving and high speed flying**

(i) Characteristics of individual aircraft are known to vary according to age and condition, but the compressibility effects quoted against indicated mach numbers are those normally obtained.

(ii) Except at high altitudes, where it is difficult to trim, the aircraft is longitudinally stable up to a mach number of 0.74. There is then a *rapidly increasing nose-down* change

of trim up to the limiting mach number of 0.78. Beyond this limit the nose-down change of trim may become too heavy to hold: it is this heavy force which determines the limiting mach number of 0.78. At the limiting mach number the ailerons and elevators may become heavy and much reduced in effectiveness, and may be accompanied by wing dropping.

(iii) There is little change in the compressibility effects throughout the altitude range of the aircraft, or with the belly tank or rockets fitted.

(iv) Operation of the air brakes at high mach numbers reduces compressibility effects if these are at all apparent at the time.

(v) Acceleration in the dive is rapid even with the air brakes open, and great care must be taken not to exceed the limiting mach number.

(vi) *Recommendations*

(a) In view of the very strong nose-down change of trim with increase of mach number, the elevator forces should not be trimmed out above 0.75M-0.76M, otherwise excessive "g" may result as the aircraft slows down to a point where the nose-down change of trim ceases to be effective.

(b) In dives at low altitude the aircraft should be trimmed into the dive but only so far as to be consistent with (a) above.

(c) When diving the aircraft, a one-handed pull force should not be exceeded as it may not afterwards be possible to throttle back or extend the air brakes.

77. Hood operation

(i) The cockpit pressurising lever must be OFF before the hood is opened. The aircraft may then be flown at speeds up to 150 knots without discomfort.

(ii) After winding the hood closed, it is important that the handle is folded in the stowed position allowing the locking catch at the rear of the hood to engage.

(iii) Should the hood blow open in flight due to failure of the locking catch at the rear of the hood to engage properly, it may not be possible to operate the hood satisfactorily by the winding handle. In these circumstances the hood should not be jettisoned except in extreme emergency, as there is a danger that it may strike the tailplane.

78. **Aerobatics**

(i) The following speeds, in knots, are recommended:—

Roll	260
Loop	370
Roll off the top	400
Climbing roll	400

(ii) In manoeuvres in the looping plane, much height may be gained or lost and an ample margin should be allowed for recovery.

(iii) Manoeuvres involving negative "g" are permitted provided that a period of 15 seconds is not exceeded and that the main tank fuel level is maintained throughout at not less than 60 gallons. During such manoeuvres, in order to minimise the risk of fuel aeration, the "g" applied should be at least – 1 to ensure that the gravity-operated switch in the inverted flight booster pump is functioning correctly. Conditions of near zero "g" should be avoided at all times.

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Para.
78 (iv)
Page 50

(iv) Aerobatics, within the G limitations, are permitted, only when wing stores are not carried.

79. **Checks before landing**

Brakes	Off. Sufficient pressure
Air brakes	In
Undercarriage	Down and locked 3 green lights on Tail wheel FIXED (airfield landings only)
Arrester hook	As required

Fuel	Contents. (Assess AUW of aircraft and thus deduce correct approach speed)
Flaps	TAKE-OFF Fully down on final approach
Harness	Tight, locked in rear position
Hood	Locked as required
GGS	Retracted

NOTE.—When lowering the undercarriage the lever must be moved quickly and continuously to the DOWN position, otherwise the undercarriage may become jammed due to the hydraulic system functioning before the UP locks are released, making subsequent lowering impossible.

30. **Approach and landing**

(i) The turn on to the final approach should be made at about 140 knots and the airfield boundary crossed at the following speeds:—

100 gallons remaining	100-105 knots
Full internal fuel plus ammunition (12,300 lb.)	110 knots
Maximum aerodrome landing weight (Full internal fuel, 50 gallons in belly tank, plus ammunition) (13,000 lb.)	115 knots

(ii) The initial approach should be made some 15 knots above these figures.

(iii) To ensure prompt response to throttle opening if undershooting, or when having to go round again, maintain engine r.p.m. above 7,000 until a decision to land is made.

(iv) There is little indication of aircraft attitude and constant reference should be made to the A.S.I. Great care should be taken not to approach at speeds below those recommended as there is a possibility that in a bad case

of undershooting a stall may develop on opening up the engine, possibly due to a change in the airflow characteristics round the air intakes.

(v) The aircraft is easy to land on three points and there is little or no tendency to swing. When the aircraft is firmly on three points the brakes should be applied with care to avoid wheel locking, particularly on a wet runway surface.

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(vi) *Standard deck landing*

(a) The recommended final approach speed at maximum deck landing weight (11,300 lb. full ammunition and about 125 gallons of fuel remaining) is 105 knots, at which speed the aircraft is in the three point attitude.

(b) Engine r.p.m. of between 9,700 and 10,000 will be required on the approach to maintain constant height in the deck landing configuration.

(c) At a lower landing weight, the approach speed may be reduced 2-3 knots, but a speed below 103 knots leaves little margin in hand, and large throttle movements may be necessary to obey the batsman's signals.

(d) ADDLS have shown that a normal deck landing approach technique consistent with the increased AUW is possible with up to three rocket hang-ups on one side. With greater asymmetric loads than this there is insufficient margin of lateral control. In the worst case of one wing heaviness approach and touch-down speed should not be allowed to fall below 120 knots (125 knots in turbulent conditions). It is recommended that the landing weight be reduced to a minimum before a deck landing is attempted at these higher speeds.

(vii) *Mirror deck landing*

(a) The recommended final approach speed at the maximum deck landing weight of 11,300 lb. (i.e. full ammunition and about 125 gallons of fuel remaining) is 110 knots.

(b) Engine r.p.m. should not be allowed to drop below 8,000 during the approach.

(c) At a lower landing weight the approach speed may be reduced to a minimum of 105 knots but this minimum speed should not be used unless the A.U.W. is below 10,500 lb. (i.e. no ammunition and less than 100 gallons of fuel remaining).

81. Instrument approach

The following speeds together with the appropriate flap and approximate power settings are recommended for use during instrument approaches with the undercarriage lowered.

	R.P.M.	Flaps	Airspeed knots
Pattern	10,000	TAKE-OFF	150
Final	10,500	LANDING	125
Glide Path	9,500	LANDING	120

82. Going round again

(i) Open the throttle smoothly to take-off r.p.m.

(ii) Raise the undercarriage, climb initially at about 120 knots, then raise the flaps *in stages* to the TAKE-OFF position, retrimming as necessary.

(iii) On reaching 150 knots begin climbing, and raise the remainder of the flaps.

(iv) Check j.p.t.

83. Checks after landing

Wheel brakes	Sufficient pressure for taxying
Tail wheel	Unlocked
Flaps	UP

84. Stopping the engine

Close the throttle fully, and stop the engine by turning off the H.P. cock. After the engine has stopped turning check:—

Electrical services	Off
Chocks	In position
Wheel brakes	Off
Ejection seat	Secure safety strap with safety pin
Fuel transfer selector lever	DROP TANK

PART IV
EMERGENCY HANDLING

85. **Engine failure and relighting in flight**

A.L.2
Para. 85(i)
to (iii) (a)
Page 54

(i) *Mechanical failure*

If the engine fails due to obvious mechanical causes immediate action should be:—

H.P. and L.P. cocks	OFF
Main booster pump circuit breaker	Tripped off

Switch off all non-essential electrical services. Do not attempt to relight; carry out forced landing procedure.

(ii) *Sudden drop in engine speed and/or flame-out*

(a) If an inexplicable drop in engine speed occurs, close the throttle fully and set the H.P. pump isolating switch to ISOLATE. Then open the throttle carefully to check engine response.

(b) If flame-out has occurred as indicated by no response to throttle movement, close the throttle and H.P. cock, switch off all non-essential electrics and descend to 20,000 ft. or below. (The MAIN pump circuit breaker should be tripped off if there is any delay before relight is begun.)

A.L.2 Para. 85 (iii) (b) to (vi) Page 55

(c) To relight:—

Airspeed	200 knots maximum.
Altitude	Not exceeding 20,000 ft.
Non-essential electrics	OFF
Engine master switch	ON
Ignition switch	ON
Booster pumps circuit breakers	IN
Throttle	Fully closed
H.P. pump isolating switch	ISOLATE
H.P. cock and relight button	Press button and open H.P. cock simultaneously. Keep button pressed for 30 secs. maximum.

(d) When r.p.m. or j.p.t. begins to rise, release the relight button and when at idling r.p.m. for the altitude open up carefully to the desired r.p.m.

(e) Once a relight is accomplished, the isolating switch must remain at ISOLATE for the rest of the flight, including landing. The A.C.U. (if fitted—Nene 102 only) will be ineffective and at low altitudes it may not be possible to obtain maximum r.p.m.

(f) Should the engine fail to relight after 30 seconds turn off the H.P. cock. Attempt a further relight at a reduced altitude and airspeed.

NOTE.—1. Relighting is accomplished more readily at lower altitudes and airspeeds.

2. A warm engine relights more readily than a cold one.

(iii) *Failure due to fuel starvation*

(a) If the engine fails due to emptying the main tank and there is fuel available for transfer there is a reasonable chance of relighting if the aircraft is not below 10,000 feet.

(b) To transfer sufficient fuel into the main tank for relighting will require at least 3 minutes at windmilling r.p.m. of 1,500. This will entail gliding at up to 200 knots, the rate of descent being approximately 2,000 ft./min.

(c) The relighting procedure is then as follows:—

Select internal tanks

Throttle	Closed
Isolation switch	Isolate
H.P. cock	Open (To rid the system of air)
Airspeed	Sufficient to give 1,500 r.p.m.
Altitude	Below 20,000 ft.

Relight as in para. 85 (iii).

NOTE.—If altitude permits, close the H.P. cock for about 20 seconds prior to relight, otherwise leave it open.

A.L.1 Para. 86 (contd.) and 87 Page 56

86. **Relighting following engine failure due to suspected fuel aeration**

(i) Application of negative "g" or incorrect tank selection may result in flame extinction and inability to relight by normal methods, owing to air locking in the engine H.P. fuel pumps. In such cases relighting attempts must be made with fuel pump isolation switch ISOLATED. *The altitude must not exceed* 20,000 *feet and the IAS not exceed* 150 *knots and the switch must remain ISOLATED until after landing.*

(ii) If it is suspected that the main tank float valve has stuck in the closed position, set the manual by-pass valve on and maintain the level in the tank by suitable manipulation of the cock.

87. **Action in the event of fire**

If the fire warning light comes on and fire in the engine bay is suspected *abandon the aircraft.* (See para. 91.)

A.L.3 Page 56 Paras. 88, 89

88. **Hood jettisoning**

(i) Before jettisoning the hood, the seat should be lowered as far as possible and the pilot should keep his head well down.

(ii) *Pre-NS. Mod. 3010*

Except in extreme emergency the hood must not be jettisoned below 130 knots, or when the winding mechanism is faulty, as there is a danger in both cases of the hood striking the tailplane.

(iii) *Post-NS. Mod. 3010*

(a) With the hood seal inflated, manual assistance may be required to jettison the hood at speeds below 190 knots.

(b) With the seal deflated, manual assistance will be required at speeds below 150 knots.

(c) The cockpit must not be pressurised at heights below 1,000 ft. since the hood jettison system and hood seal deflation are not interconnected.

89. **GGS emergency lowering**

The sight may be lowered manually by striking the knob on the starboard side a blow with the hand. The sight is automatically retracted on jettisoning the hood, provided electrical power is available.

90. **Emergency oxygen supply**

(i) The emergency oxygen supply is carried in a bottle forward of the dinghy pack in the seat well. If the lock-

ing pin is withdrawn the supply is automatically brought into operation when the ejection seat is operated, but should it be required in any other circumstances a release control is fitted on the cockpit starboard shelf.

(ii) The duration of the supply is 12 minutes.

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Para. 91
Page 57

91. Abandoning the aircraft

(i) Reduce speed as much as possible.

(ii) Jettison the hood, retract the gunsight, and set parachute container fully back.

(iii) Place the feet in the footrests and at the same time grasp the handle of the blind.

(iv) Press the head against the headrest and draw the handle and face screen firmly over the face. It is not necessary to jerk the handle and in no circumstances should the blind be pulled outwards away from the face as it may not be possible to fire the cartridge.

(v) After ejection, the static line will automatically fire the drogue gun.

(vi) Automatic separation will take place at heights below 10,000 ft.

(vii) *Action should the automatic mechanism fail*
If after ejection, the pilot for any reason doubts the serviceability of the automatic parachute releasing mechanism he should operate the parachute manually as follows:—

(a) Pull the first "D" ring on the parachute harness.

(b) Release the restraining straps from the seat.

(c) Release the safety harness.

(d) After falling clear of the seat pull the second "D" ring to develop the parachute canopy.

(viii) *Action should the seat fail to eject*

(a) Pull first "D" ring on parachute harness.

(b) Proceed as on aircraft not fitted with an ejection seat. (Under these circumstances the parachute will not be opened automatically.)

92. **Undercarriage, flap and arrester hook emergency operation**

(i) If the undercarriage fails to lock down by normal operation, reduce airspeed as far as practicable, leave the undercarriage selector DOWN, and move the emergency lever forward and down thus operating the compressed air system.

(ii) If the compressed air system has been used inadvertently when hydraulic power is available the undercarriage may be operated by the normal selector lever after returning the emergency lever to its normal position. The emergency system can only be used once.

(iii) If the hydraulic pump fails, the flaps may be lowered once only by residual pressure in the hydraulic accumulator using the normal selector lever. The arrester hook may be lowered by the operation of the normal selector lever, but it will be necessary to pump it up again by use of the handpump.

(iv) All services may be operated by the handpump, which is slow in operation and difficult to use.

93. **Belly tank jettisoning**

The belly tank may be jettisoned in straight and level flight at any speed up to 450 knots.

94. **Bomb jettisoning**

See para. 55 (v)

A.L. 1

95. **Flapless landing**

(i) A long flat approach is necessary and with full internal fuel and ammunition, the initial approach should be made at 125-130 knots.

(ii) The airfield boundary should be crossed at 115 knots.

(iii) Speed drops off very slowly and the landing run is approximately 30% longer than landing in similar conditions with the flaps down.

96. Forced landing

If engine failure necessitates a forced landing:—

(i) Keep the undercarriage retracted.

(ii) Jettison external stores and belly tank.

(iii) Jettison hood when below 10,000 feet.

(iv) Close H.P. and L.P. cocks and switch OFF the battery isolating switch.

(v) Lock and tighten the safety harness in the rear position. and lower the seat.

(vi) Maintain a speed of 145-150 knots while manoeuvring for the final approach. Lower the flaps as required and carry out a normal glide landing, rounding out at a speed not less than 125 knots.

97. Ditching

and actual ditchings A.L. 1

(i) Model tests indicate that the aircraft should ditch well.

(ii) If it is decided to ditch, the following procedure should be adopted:—

(a) Jettison the sliding hood and the belly drop tank.

(b) Release the parachute harness and check the dinghy attachment.

(c) Tighten the safety harness and lock in the rear position.

(d) Lower the flaps to the take-off position and endeavour to make a flat, tail down approach touching down as low a forward speed as possible.

(e) Ditching should be along the swell, or into wind if the swell is not steep.

PART V
ILLUSTRATIONS

KEY TO FIG. 1

COCKPIT—PORT SIDE

1. Manual bomb release controls.
2. Wing fold control.
3. Rudder and aileron trim control switches and position indicator.
4. Wing fold warning indicator.
5. Booster pumps circuit breakers.
6. Armament control panel.
7. Press-to-transmit button.
8. Air brakes control.
9. RATOG jettison pushbutton.
10. Hood jettison control.
11. Arrester hook control training switch and warning light.
12. RATO firing pushbutton.
13. Flaps position indicator.
14. Undercarriage control lever.
15. Elevator trim control and position indicator.
16. Flaps control lever.
17. H.P. cock control.
18. Beacon homing panel.
19. IFF controls.

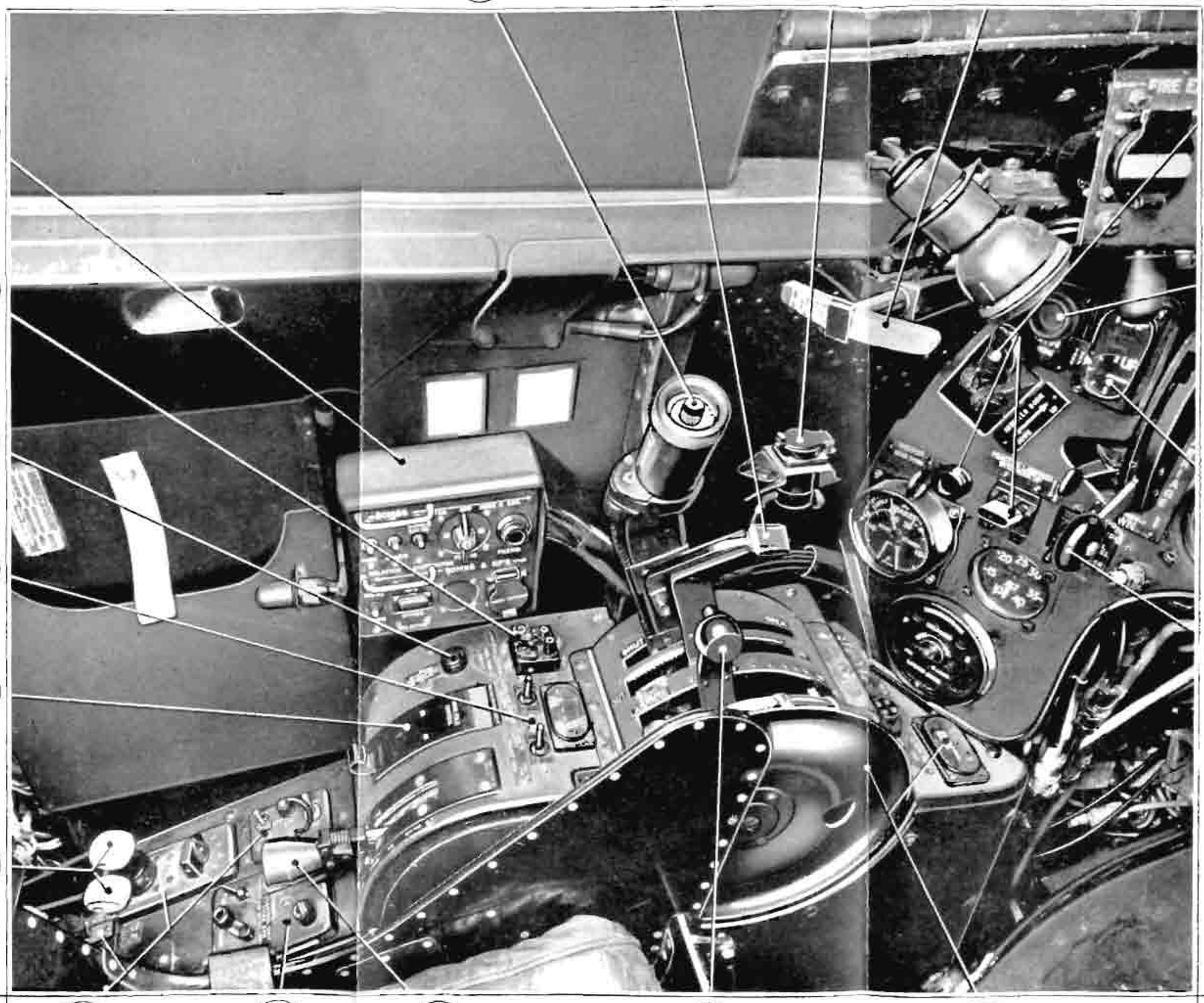

FIG 1

FIG 1

COCKPIT — PORT SIDE

KEY TO FIG. 1

COCKPIT--FORWARD VIEW

20. Undercarriage position indicator.
21. Triple pressure gauge.
22. Cabin altimeter.
23. Tail wheel control switch.
24. Radio altimeter, limit switch and warning lights.
25. Fire-extinguisher button and warning light.
26. Cine camera switches.
27. G.G.S. master switch.
28. Pressure head heater switch.
29. Inverter switches and indicator.
30. External lighting controls.
31. Fuel contents gauges (2).
32. Fuel pressure warning light.
33. Oxygen regulator.
34. Mk. 4F compass.
35. Contacting altimeter.

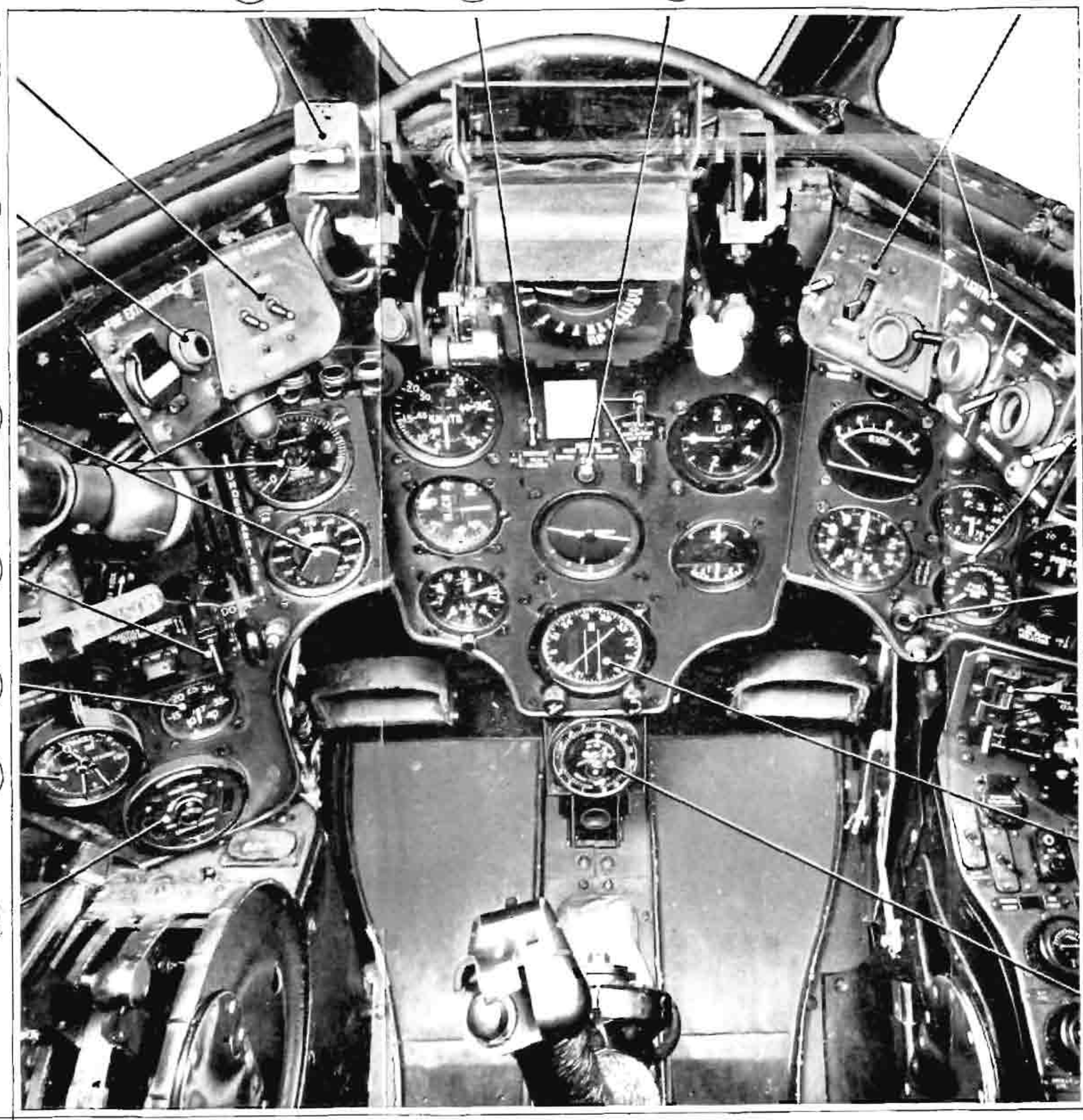

FIG 2

COCKPIT — FORWARD VIEW

FIG 2

KEY TO FIG. 3

COCKPIT STARBOARD SIDE

36. Engine starting safety and instrument supply switches.
37. Battery isolating switch.
38. Engine starter pushbutton.
39. Generator field circuit breaker.
40. Ignition isolation switch.
41. RATO master switch.
42. H.P. pump isolation switch and warning light.
43. Beam approach and emergency lighting switches.
44. Cabin ventilator.
45. Guns/RP selector.
46. Contacting altimeter switch.
47. Hood winding handle.
48. Selector dimmer control.
49. Cabin pressure control.
50. L.P. cock control.
51. Fuel transfer control.
52. Undercarriage emergency control.
53. Emergency oxygen control.
54. Fuel transfer pressure gauge.
55. Windscreen de-icing controls.
56. VHF controller.
57. Internal lamps controls.

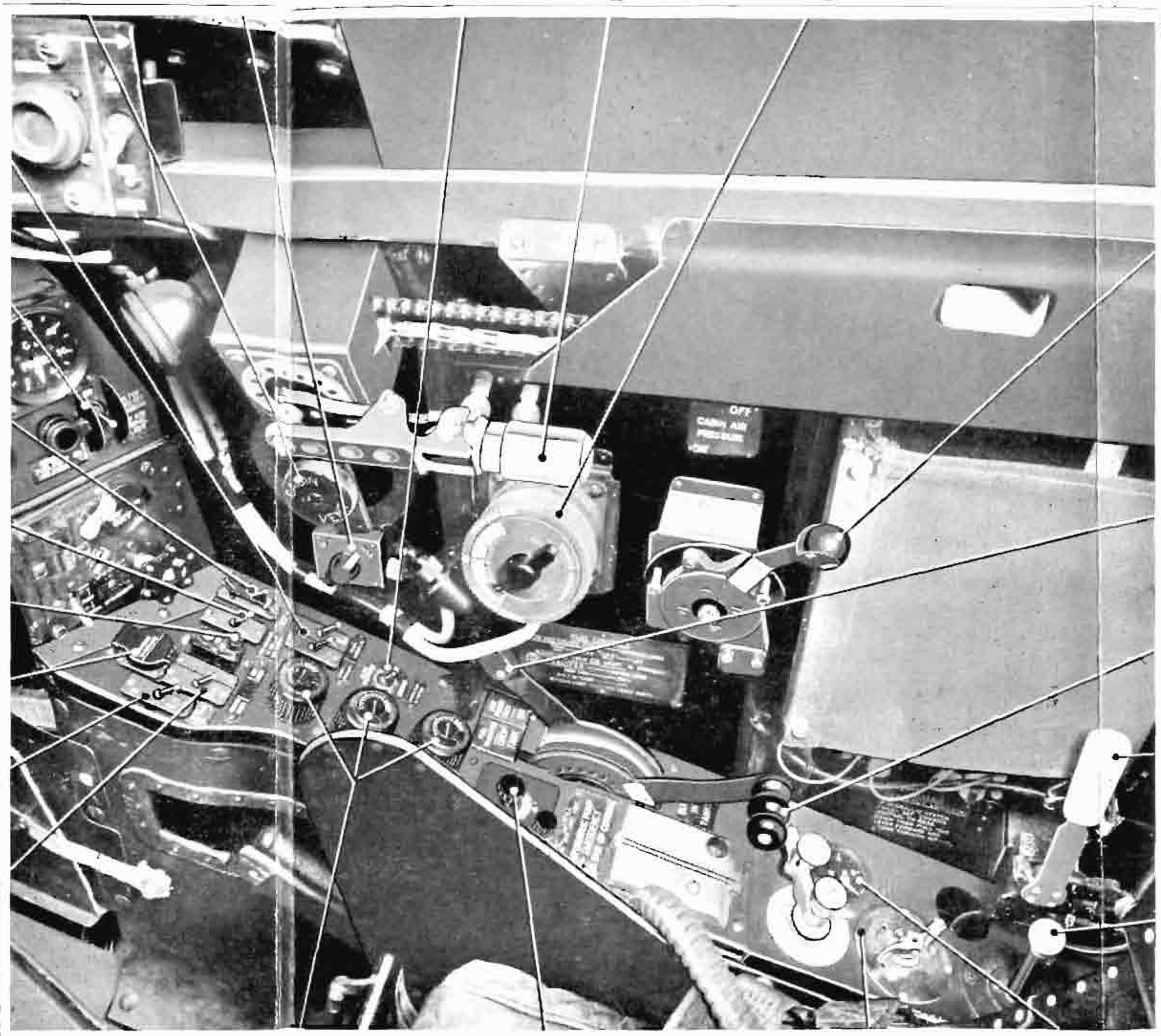

FIG 3

COCKPIT — STARBOARD SIDE

FIG 3

FINAL CHECKS FOR TAKE-OFF

TRIMMERS	All neutral (elevator $\frac{1}{4}$ division nose up if belly tank fitted)
AIR BRAKES	IN. Check spoilers visually
FUEL	L.P. cock fully ON
	H.P. cock locked fully OPEN
	L.P. pumps circuit breakers in
	H.P. pump isolation valve switch as required
	Transfer lever as required
FLAPS	Take-off
INSTRUMENTS	Set. Inverters on (indicator showing black)
OXYGEN	On
HOOD	Fully closed or fully open
	Handle stowed and locking catch engaged
	Cockpit pressurising lever as required
HARNESS	Tight and locked in rear position
WINGS	Spread and locked
	Check all indicators and wing leading edges for continuity at the wing fold position

FINAL CHECKS FOR LANDING

BRAKES	Off. Sufficient pressure
AIR BRAKES	In
UNDERCARRIAGE	Down and locked
	Three green lights on
	Tail wheel FIXED (airfield landings only)
ARRESTER HOOK	As required
FUEL	Contents. (Assess AUW of aircraft and thus deduce correct approach speed)
FLAPS	TAKE-OFF
	Fully down on final approach
HARNESS	Tight, locked in rear position
HOOD	Locked as required
G.G.S.	Retracted