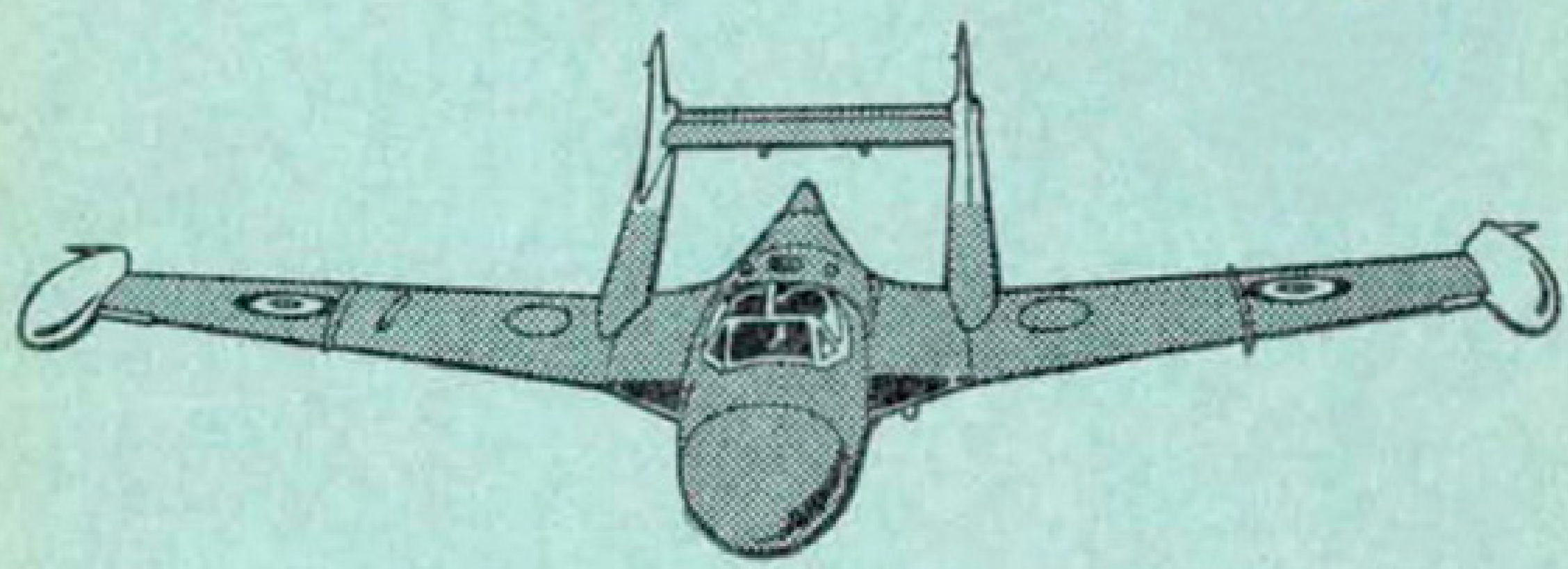
2nd Edition
October, 1957

A.P. 4360A—P.N.

PILOT'S NOTES

SEA VENOM

F.A.W. 20



Prepared by Direction
of the
Minister of Supply

R. Musgrave

Promulgated by Command
of
Their Lordships

J. F. Lang

NOTES TO USERS

These Notes are complementary to A.P.129 (6th Edition), Flying, and it is assumed that all concerned have a thorough knowledge of the chapters which are relevant to the operation of this type of aircraft.

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.4360A—P.N. (2nd Edition).

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

AMENDMENTS

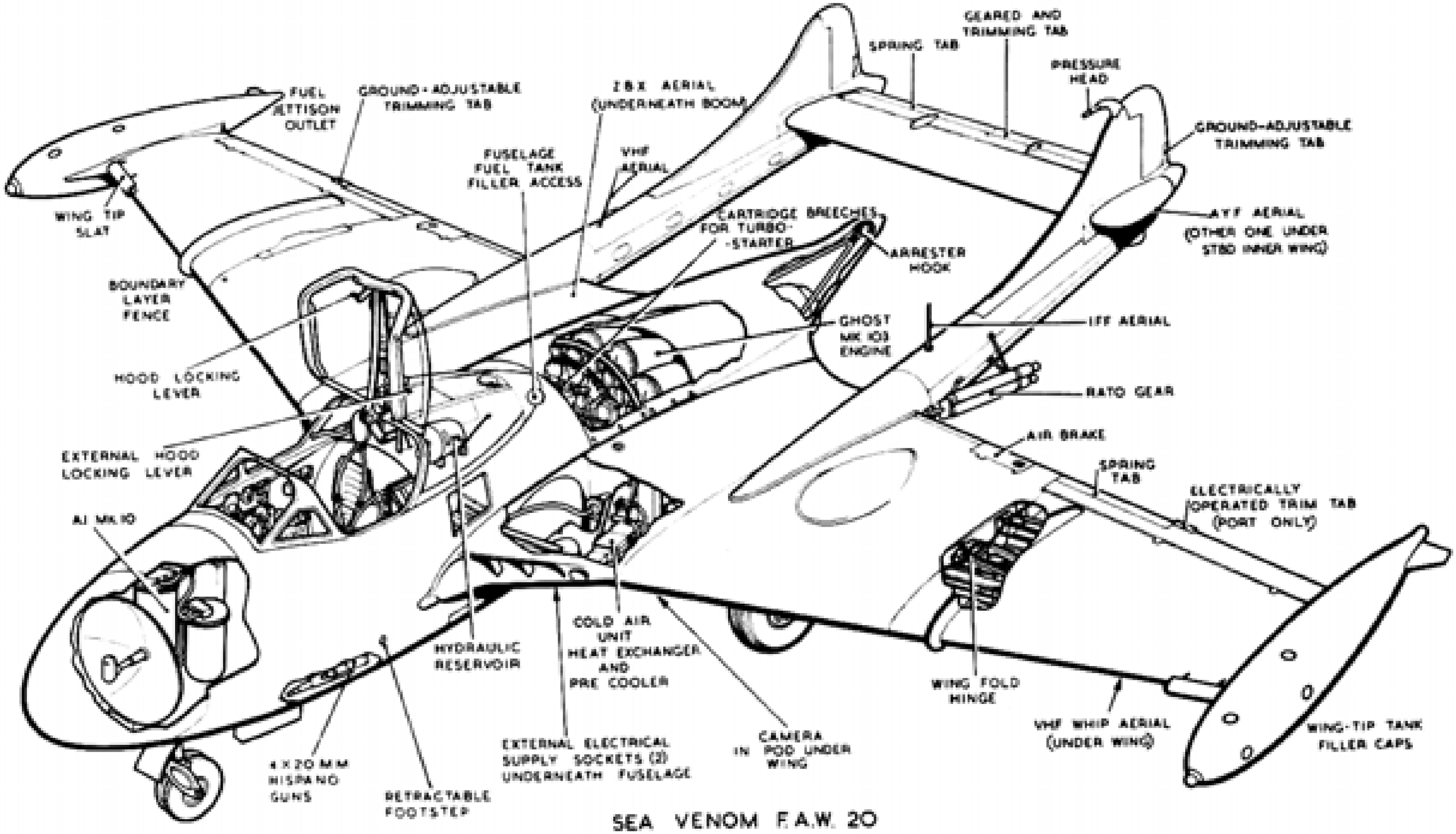
Amendment Lists will be issued as necessary and will be gummed for affixing to the inside front cover of these Notes. Each amendment list will, where applicable, be accompanied by gummed slips for sticking in the appropriate places in the text. Incorporation of an amendment list must be certified by inserting the date of incorporation and initials below.

A.L. No.	INITIALS	DATE	A.L. No.	INITIALS	DATE
1			4		
2			5		
3			6		

SEA VENOM F.A.W. 20

LIST OF ASSOCIATED PUBLICATIONS

Title	*A.P. No.*
Sea Venom F.A.W. 20, general and technical information	4360A Vol. 1
Ghost Mk.10300 series E.C.U.	4320A
Fuel system components for gas turbine aero engines	4282 series
Electrical equipment manual	1095 series 4343 series
Starting systems for aero engines	1181 series
Aircraft hydraulic equipment—Lockheed ..	1803B
Aircraft undercarriage equipment—Lockheed	1803C
Aircraft pneumatic equipment, Hymatic ..	4303C
Aircraft pressurising and air conditioning equipment	4340
Aircraft wheels, tyres, and brakes	2337
R.A.F. signals manual	1186 series
Instrument manual	1275 series
Safety equipment	1182 series
Cine-cameras and accessories	1355D
Hispano 20 mm guns	1641F
Air pump units	1519



SEA VENOM F.A.W. 20

ADMIRALTY
October, 1957

A.P.4360A—P.N.
Pilot's Notes
2nd Edition

SEA VENOM F.A.W. 20

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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 VI.

(c) Unless otherwise stated, all airspeeds and mach numbers quoted are "indicated".

1. Introduction

(a) The Sea Venom F.A.W.20 is a two-seat, all-weather fighter, powered by a Ghost 103 turbo-jet engine, developing approximately 4,850 lb. static thrust at sea level.

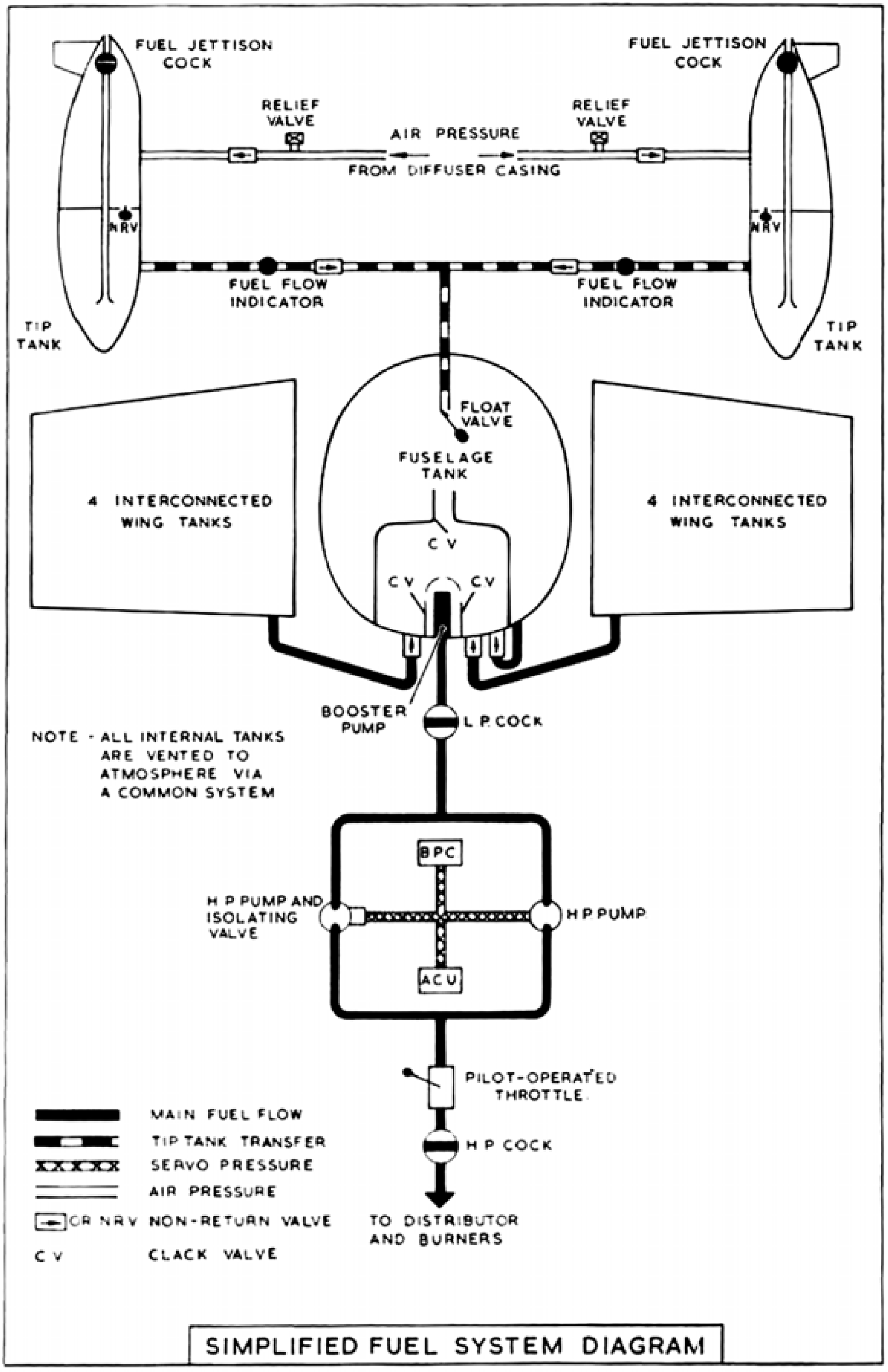
(b) The armament consists of four 20 mm. guns and provision is made for the carriage of R.P.s. A.I. Mk. 10 is fitted.

(c) The aircraft is fully equipped for carrier operation, with folding wings, arrester hook and R.A.T.O.G. The cockpit is pressurised and has an air conditioning unit. Ejection seats are not fitted.

FUEL AND OIL SYSTEMS

2. Fuel tanks

(a) Nine internal fuel tanks are carried, one in the fuselage, one in each wing root and three in each inner wing. Wing-tip tanks are fitted: the fuel from these tanks is jettisonable but the tanks themselves are not.



SIMPLIFIED FUEL SYSTEM DIAGRAM

(b) The tank capacities are as follows:—

	Gallons	*lb. AVTUR (8 lb./gall.)*
Fuselage tank	92	736
Two wing-root tanks (2 × 57½) ..	115	920
Six wing tanks	106	848
Total internal capacity	313	2,504
Two wing-tip tanks (2 × 75) ..	150	1,200
Total capacity	463	3,704

All internal tanks are pressure-vented to atmosphere via a common outlet. Transfer from the wing-tip tanks is by air pressure and from the wing tanks by gravity.

(c) *Collector box*

The collector box in the base of the fuselage tank contains enough fuel to keep the engine running up to the limit of ten seconds under negative G loading or when flying in attitudes near the vertical.

(d) *Unusable fuel*

Between 10 and 22 gallons of fuel (80 to 175 lb.) are unusable, depending on the aircraft attitude, the amount increasing as the tail-down attitude increases.

3. Fuel contents gauge

A two-scale Pacitor-type, electrically-operated fuel contents gauge (41), at the top right of the instrument panel, shows the combined contents of all the internal tanks. When the button to the left of the gauge is pushed, the gauge will then indicate the contents of the fuselage tank only. There is no gauge for the tip tanks but, when tip-tank transfer ceases, the fuselage tank gauge reading will probably drop rapidly to 30–40 gallons (240–320 lb.). Post-Mod. N.209, the fuel contents gauge is calibrated in pounds, instead of gallons; this type of gauge is more accurate.

4. Fuel transfer system

All fuel is transferred to the fuselage tank and from there to the engine. The sequence is as follows:—

(a) *Tip tanks*

Transfer commences by air pressure, tapped from the engine diffuser casing, when the level in the fuselage tank has fallen by approximately 15 gallons (120 lb.). When transfer is taking place, the appropriate magnetic indicators (49) show black. When transfer pressure is insufficient or when transfer is complete, they should show white.

NOTE.—Unless Mod. N.327 has been incorporated, to relieve excessive pressure in the fuel venting system, the indicators may remain black whether transfer is complete or not.

(b) *Internal wing tanks*

When the level in the fuselage tank has fallen sufficiently, 30–40 gallons (240–320 lb.) remaining, transfer starts from the internal wing tanks, by gravity only.

5. **Booster pump**

(a) A booster pump in the base of the fuselage tank delivers fuel through the L.P. cock to the two engine-driven H.P. fuel pumps. If the booster pump fails, fuel bypasses the pump by gravity. A low pressure warning light (50), at the right-hand side of the instrument panel, comes on when the pump delivery pressure falls below 1½ lb./sq. in., or when the pump is switched off.

(b) The booster pump is controlled by a switch (62) marked FUEL PUMP SWITCH, at the right-hand side of the instrument panel. The circuit breaker (at 65) is on the starboard side of the cockpit and the test socket (81) to the rear on the starboard side.

6. **L.P. cock**

The L.P. cock lever (21) is on the underside of the engine control box and is marked FUEL OFF (down and aft) and FUEL ON (forward and up). The L.P. cock should be closed in the event of an engine fire but, except in an emergency, must not be used to stop the engine, as the H.P. pumps will be damaged and the fuel system aerated. It should always be closed after stopping the engine, to prevent fuel by-passing the H.P. cock and seeping into the combustion chambers.

7. **Wing-tip tanks fuel jettison switch**

The guarded jettison switch (11) on the port shelf is marked TIP TANK FUEL–JETTISON/CLOSE. When put to JETTISON, two ports, one at the aft end of each wing-tip tank, are opened and fuel is driven out by air pressure from the engine, through pipes which communicate with *the front compartments* of the tanks only. The ports can be closed at any time, so that partial jettisoning of the fuel load is possible. It takes approximately one minute for the full load to be jettisoned. The jettison switch must always be set to JETTISON when transfer from the tip tanks is complete and at any time when the tanks are empty.

8. **Oil system**

Oil is carried in the engine sump, the capacity of which is 16 pints. An oil temperature gauge (63) is at the bottom of the instrument panel. In addition to the sump capacity, four pints of oil are contained in the system, over-filling of which may cause high oil temperatures and/or a visible loss of oil in flight.

ENGINE CONTROLS

9. **Ghost Mk. 103 engine**

(a) *General*

The engine is a centrifugal turbo-jet engine, developing 4,850 lb. static thrust at sea level. The main systems include:—

A two-shot cartridge starter system (see para. 10)
A relighting system (see para. 11)
A self-contained oil system

(b) *High-pressure fuel system, isolating valve and H.P. cock*

(i) The engine-driven H.P. fuel pumps are duplicated, as a safety device, but either is capable of supplying the engine up to maximum power.

(ii) To ensure correct and equal fuel delivery from each pump at a given throttle setting, their output pressure is servo-controlled by a barometric control unit (B.P.C.). However, should this fail, or should there be a leak in the servo-line, *both* pumps would then go to

zero delivery. To prevent this happening, one pump can be isolated from the other so that at least one of them will continue to deliver fuel to the engine. The isolating valve is controlled by a switch (51), marked FUEL PUMP EMERGENCY, beside the FUEL PUMP SWITCH.

(iii) To prevent a rich extinction when the throttle is opened quickly, an acceleration control unit (A.C.U.) —sometimes referred to as an air/fuel ratio control (A.F.C.)—temporarily overrides the B.P.C. and ensures that an acceptable air/fuel mixture is maintained under these conditions.

(iv) *H.P. fuel cock lever*

The H.P. fuel cock lever (12), on the engine control box, controls the fuel flow from the throttle to the distributor. A catch secures the lever in the ON (up) position. This lever must always be used to stop the engine and must also be closed if the engine fails.

(c) *Throttle control*

The throttle lever (14) is in a quadrant, marked SHUT–THROTTLE–OPEN, on the throttle box on the port side of the cockpit. The lever incorporates a G.G.S. range control and a V.H.F. press-to-transmit button. A friction damper (15) is on the inboard side of the box and is rotated clockwise to tighten.

10. **Starting system**

(a) The engine is started by a cartridge system. The engine STARTER MASTER switch (57) on the starboard control panel must be ON to energise the firing circuit. The cartridge is fired by pressing in the STARTER button (58) next to the master switch; the button is then held in electro-magnetically for 20–30 seconds and during this time the high energy ignition system is in operation. During a normal start, the turbo-starter brings the engine r.p.m. up to approximately 1,500, when light-up should occur. The engine should then accelerate up to the normal idling r.p.m. of 3,000 ± 200.

(b) The starter system contains two cartridges; the second one is auto-selected as the starter button resets. Four spare cartridges are stowed in the aircraft, two in each flap compartment.

11. **Relighting control**

An engine relighting pushbutton is incorporated in the end of the H.P. cock lever. It should be pressed to energise the igniter plugs when relighting in flight and may be used as an audible check that the high energy ignition is functioning, before starting up. The relight system will operate regardless of the position of the engine starter master switch.

12. **Engine instruments**

The following engine instruments are provided:—

R.P.M. indicator
J.P.T. gauge
Oil temperature gauge (63)

13. **Engine fire-warning light and extinguishers**

(a) *Fire warning*

There is a combined fire-warning light and extinguisher pushbutton (45) above the starboard coaming. Pre-Mod. N.779, the button is pulled out to test the light; post-Mod. N.779 a separate adjacent pushbutton is provided for testing the light. The light is operated by flame switches in the engine; these switches are of the resetting type and the light will go out when the fire is extinguished.

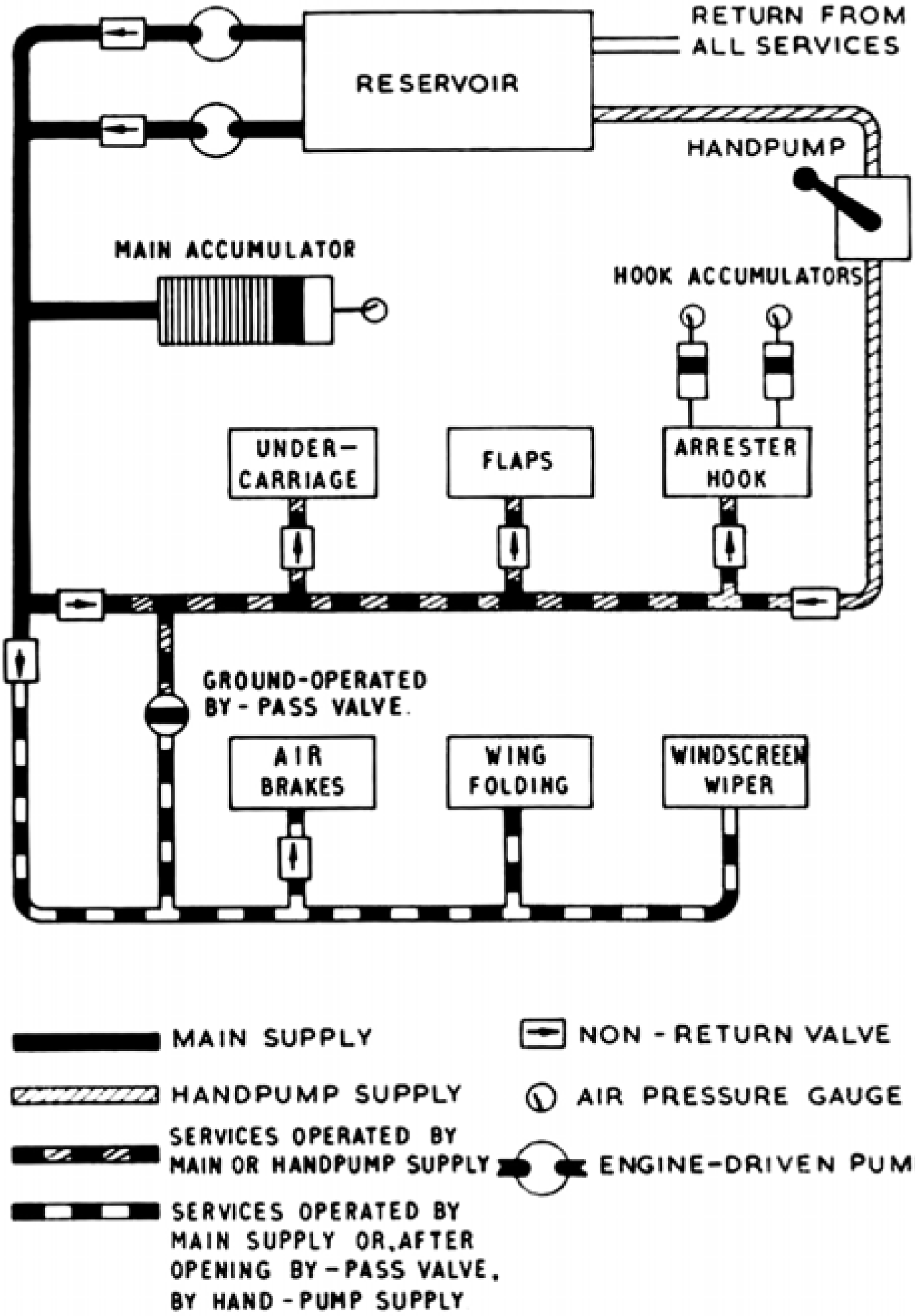
(b) Two fire-extinguisher bottles, one in each flap shroud, are operated by pressing the extinguisher button. The contents of the extinguishers are discharged from spray nozzles on either side of the diffuser casing. The cockpit pressure control must be OFF before the system is operated. The system will operate irrespective of the position of the Ground/Flight switch.

MAIN SERVICES

14. **Hydraulic system**

(a) Two engine-driven hydraulic pumps on separate shafts provide pressure at 2,500 lb. for the operation of the:—

Undercarriage
Flaps
Airbrakes
Wing folding
Arrester hook
Windscreen wiper



SIMPLIFIED HYDRAULIC SYSTEM DIAGRAM

(b) The main accumulator, if fully charged, will provide enough pressure for the one-way operation of the flaps, the undercarriage and the arrester hook. The correct air pressure for this accumulator is 1,250 lb./sq. in.

(c) Two subsidiary damper accumulators (air pressure 1,700 lb./sq. in.) are connected to the arrester hook circuit. These absorb the fluid displaced by the partial retraction of the hook during deck landing.

(d) If complete hydraulic failure occurs, the handpump between the seats can be used to provide pressure for the operation of the undercarriage, flaps and arrester hook. On the ground it may also be used to operate the airbrakes, wingfold circuit and winsdcreen wiper, after opening a valve in the port gun bay. The handpump will not charge the accumulator. Unless Mod. N.335 is incorporated, operation of the handpump must not be continued after the required service has reached the selected position.

15. **Pneumatic system**

(a) The pneumatic system is used to provide air pressure for the brakes, the hood seal, the anti-G system (if fitted) and the R.A.T.O.G. jettison mechanism.

(b) An engine-driven compressor charges an air-bottle below the cockpit. A ground charging connection is on the pneumatic panel beside the bottle.

(c) The main air bottle pressure is 450 lb./sq. in. A pressure-maintaining valve operates to conserve all available pressure for the brakes, if the main supply pressure falls below 250 lb./sq. in. A pressure-reducing valve in the supply to the brakes reduces the pressure to 220 lb./sq. in. It is further reduced to 150 lb./sq. in., by the brakes relay valve. Further pressure-reducing valves reduce the pressure at the hood seal to 10 lb./sq. in., and at the anti-G valves to 10–20 lb./sq. in.

(d) The main supply pressure and the pressure at each wheel brake are shown on a triple-pressure gauge (18) on the port shelf.

16. Electrical system

(a) *Battery supply*

A battery master (GROUND/FLIGHT) switch (88) is on the starboard shelf. When set to GROUND, it disconnects the two 12-volt batteries from the electrical system.

(b) *D.C. generators*

(i) There is one 3 kW., 24-volt, D.C., engine-driven generator. The generator field circuit breaker (67) is on the starboard shelf and must be in for starting and at all times while the engine is running.

(ii) There is a generator failure warning light (35) on the left of the instrument panel. The light should go out when the engine r.p.m. reach approximately 3,500.

(iii) Mod. N.420 introduces a voltmeter (64) on the main instrument panel. The voltmeter shows the generator output or, when the generator is not charging, the battery voltage. When the voltmeter reading falls to 21, no electrical services will be available.

(c) *External D.C. supply*

Ground testing of the electrical services may be carried out with an external battery plugged in to one of the two external sockets on either side of the fuselage under-surface. (The sockets are similar in purpose and are so placed for convenience on a flight deck.) The Gr ound/ Flight switch must remain at GROUND all the time when an external source or its adaptor, is connected, otherwise chattering of the relay will cause damage.

(d) *Flight instruments A.C. supply*

(i) Current for the A.C.-operated flight instruments is provided by one of two inverters run off the D.C. supply. The circuit breakers (at 65) for the two inverters are on the starboard panel and are labelled INVERTER A and INVERTER B: they must be made before the inverters will operate. Inverter A (the main inverter) is switched on by the FLIGHT INSTRUMENTS master switch (48) on the instrument panel and Inverter B (the stand-by inverter) by the switch (at 87) on the starboard panel.

(ii) If Inverter A fails a torque switch operates and automatically connects the supply from Inverter B to the flight instruments. There is no indication in the cockpit that automatic changeover has taken place.

(iii) An instruction panel on the starboard wall of the cockpit gives the drill for starting up the inverters. In addition to the stated drill, inverter A may be reset by switching off the FLIGHT INSTRUMENTS master switch for one second and then switching it on again.

(e) *Radar A.C. supply*

A 1.2 kW alternator provides alternating current for the radar equipment. It is controlled by the A.C. SUPPLY switch (at 87) on the electrical panel.

(f) *Emergency D.C. supply*

In the event of electrical failure, a 24-volt alkaline battery provides power for the emergency lamp on the port side of the cockpit. Post-Mod. N.352, this battery also supplies emergency power for the turn and slip indicator. The endurance of the battery is approximately 1 hour with both services in use.

AIRCRAFT CONTROLS

17. Flying controls

The flying controls are conventional. The rudder pedals can be adjusted for length by lifting them and then sliding them forward or aft into the required slot.

18. Trimming controls

(a) *Elevator*

The elevator is fitted with a spring balance tab and a geared-cum-trimming tab which is controlled by a hand-wheel (20) on the engine control box. The indicator (13) is on the back of the box.

(b) *Ailerons*

(i) The ailerons have spring-balance tabs. The starboard aileron has a ground-adjustable trimming tab and the port aileron an electrically-operated trimming tab controlled by a spring-loaded switch (17) on the port shelf. The switch works in the natural sense and should be held over to trim out lateral stick forces. No indicator is fitted.

(ii) Later aircraft are fitted with variable-ratio gearing on the ailerons, adjusted by a knob on the forward face of the control column. Anti-clockwise movement of the knob selects HIGH (high speed), clockwise movement selects LOW (low speed). Any intermediate setting may be selected. When at LOW, use of approximately only 50% of stick movement available at HIGH is possible. A stud, moving in a slot at the rear of the control column, gives an indication of the position of the knob.

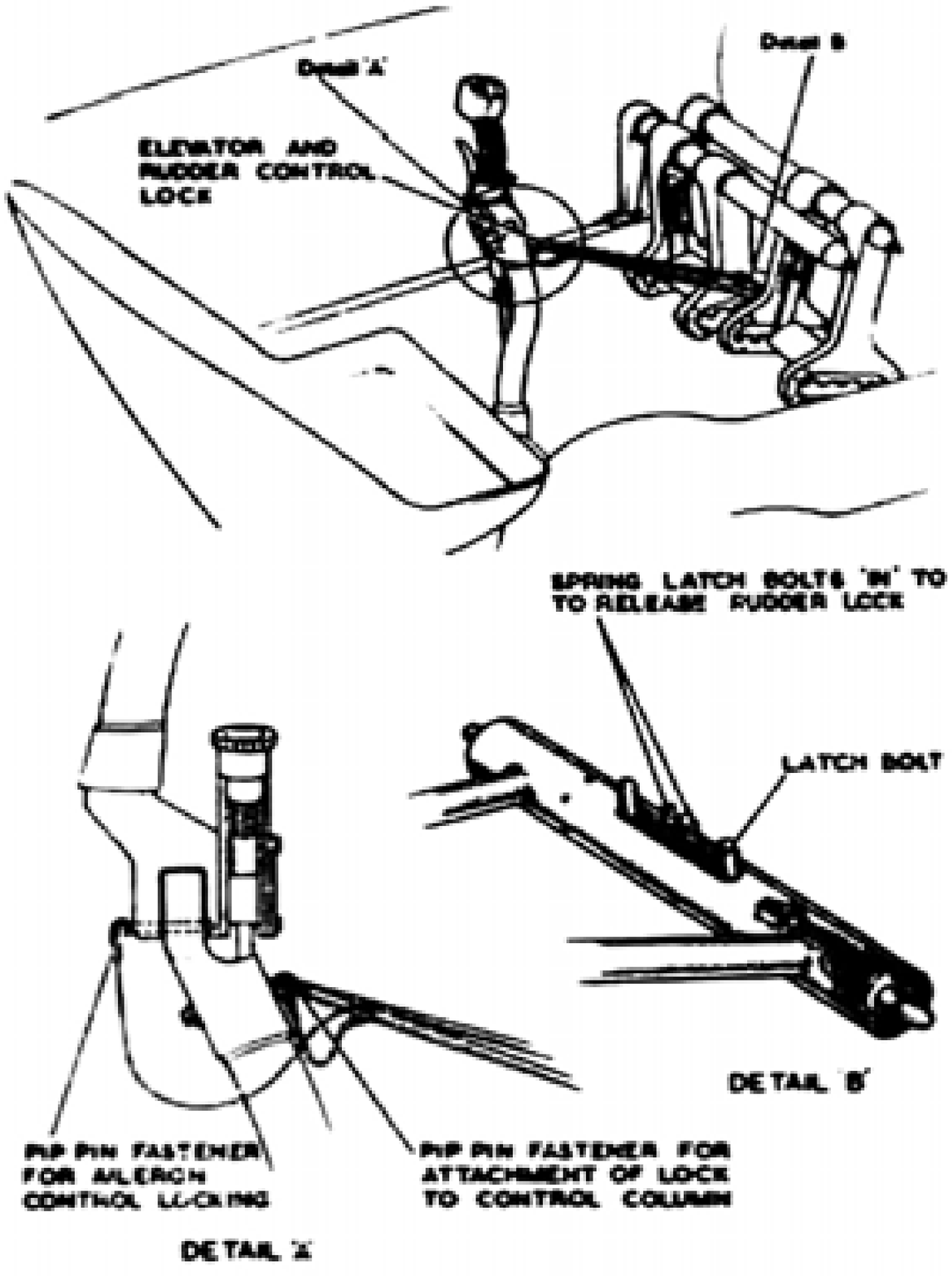
(c) *Rudder*

A ground-adjustable trimming tab is fitted to each rudder. A spring in the rudder circuit supplements the aerodynamic forces in centralising the rudder.

19. Flying controls locking gear

(a) *Internal*

A single triangular bar assembly secures the pedals and prevents fore and aft movement of the control column. The quick-release pin secured to this assembly is inserted through the hinge of the upper portion of the column to prevent aileron movement. The spring bolts which lock the rudder pedals are released by pulling the two latch bolts towards each other. When not in use, the locking gear is stowed behind the pilot's seat.



(b) *External*

Clamping blocks are provided for the ailerons. They must be removed before wing folding and before removing the internal locks.

20. Undercarriage

(a) *Normal operation*

The undercarriage selector lever (33) is on the left of the instrument panel and is pulled *out and up* to select UP. *When selecting* DOWN, *the lever must always be moved fully down into its slot*. With the lever thus set, with the weight of the aircraft on the undercarriage, it is held in the down position by a solenoid-operated plunger.

(b) *Position indicator*

A standard undercarriage position indicator (30) is next to the lever.

Indications are:—

Undercarriage locked up	. .	No lights
Undercarriage unlocked	. .	Three red lights
Undercarriage locked down	. .	Three green lights

A red light (29), just to the right of the indicator, comes on only if any of the three wheels are not locked down and the throttle is less than a quarter open. The light is extinguished when *all* the wheels are locked down.

(c) *Emergency operation*

If the engine-driven hydraulic pumps fail and accumulator pressure is exhausted, the handpump to the right of the pilot's seat can be used to operate the undercarriage after normal UP or DOWN selection. Up to 115 strokes may be necessary to lower the undercarriage fully and lock it down. To prevent possible inadvertent dumping of hydraulic fluid through the flaps pipelines, it is recommended that the flaps selector lever is set to neutral as soon as hydraulic failure is suspected.

(d) *Undercarriage emergency override*

The undercarriage can be retracted in emergency, when the aircraft is on the ground, by first operating the guarded switch (19) on the port shelf and then using the normal undercarriage selector.

(e) *Undercarriage safety locks*

Safety locks, each with a red flag, may be inserted in the radius rods of the main undercarriage struts. Stowage for these locks is provided in the starboard gun-bay door. Mod. N.854 deletes this stowage.

21. Flaps

(a) *Normal operation*

The flaps selector lever (22) is on the rear face of the engine control box. There are three positions on the selector lever quadrant, UP-neutral-DOWN. Any degree of flap movement may be obtained by selecting UP or DOWN and then returning the lever to neutral after the required position is reached. The lever should be returned to neutral when the flaps are fully down, if it is necessary in emergency to conserve accumulator pressure, but may be left in the UP position when the flaps are fully up.

(b) *Position indicator*

A flaps position indicator (31) is fitted at the left-hand side of the instrument panel. It is connected to the right-hand flap only and may give a false reading for intermediate flap settings on the ground. When the flaps are under air load, the indication is correct.

(c) *Emergency operation*

The flaps may be operated by the handpump after normal selection, if the engine-driven pumps fail and the accumulator is exhausted.

22. Airbrakes

(a) *Normal operation*

The airbrakes are selected by a lever (16) extending from the top of the engine control box. The lever is marked OUT (aft)—DIVEBRAKES—IN (forward). No intermediate settings are available.

(b) *Emergency operation*

The airbrakes cannot be operated in flight by the handpump.

23. **Arrester hook**

(a) *Normal operation*

The arrester hook is hydraulically operated and is controlled by a lever (25) on the rear face of the engine control box. The selector lever is retained by a catch in the up position. The hook is lowered by gravity, and raised and held in the up position by hydraulic pressure.

(b) *Indicator*

A green hook-indicator light (23) is adjacent to the selector lever. Pre-Mod. N.236 the light *goes out* when the hook is lowered and the undercarriage is locked down. Post-Mod. N.236, the light *comes on* when the hook is lowered.

(c) *Deck approach light*

Mod. N.383 introduces a deck approach light on the nose-wheel fairing. The associated CARRIER/AIRFIELD switch is on the starboard shelf. When set to CARRIER, the light comes on when both hook and undercarriage are lowered. When set to AIRFIELD, it comes on when the undercarriage is locked down but will go out if the hook is lowered.

(d) *Emergency operation*

To lower the arrester hook, select down in the normal way: to raise, select up and use the handpump.

24. **Wheel brakes**

The pneumatic wheel brakes are operated by a lever on the control column which incorporates a parking catch: differential braking is controlled by the rudder bar. The available pressure in the system and at each wheel brake is indicated on the triple-pressure gauge (18) on the port shelf. The maximum pressure at each wheel brake is 150 lb./sq. in. Maxaret units are not fitted.

25. **Wing folding and spreading**

(a) The wings are folded and spread by hydraulic power direct from the engine-driven pump. They may also be folded by operating the handpump, provided the by-pass valve is opened (see paragraph 14 (d)). They are automatically locked in the spread position by hydraulically-operated bolts at the front and rear spar attachments. Selection is by means of a SPREAD/FOLD lever (2) to the rear of the port side of the cockpit.

(b) *Safety devices*

(i) *Folding*

The lever is positively held in the SPREAD position until a similar LOCKED/UNLOCKED (3) lever immediately outboard is moved to UNLOCKED. This action withdraws a *locking pin* manually, allowing the hydraulically-operated wing bolts to move. It also mechanically raises and illuminates indicators which protrude from the upper wing surface. The position of the four hydraulically-operated wing bolts can be checked by means of two magnetic indicators (10) on the port shelf. Provided that electrical power is available, the appropriate indicator will show *white* when either of the two locking bolts on one side are not fully home.

(ii) *Spreading*

The LOCKED/UNLOCKED lever must not be moved to LOCKED until the wings are spread and the hydraulically-operated locking bolts are fully home, with the appropriate cockpit indicators showing black.

NOTE.—The magnetic indicators will show white whenever there is an electrical power failure.

26. **Mach number warning device**

A "stick shaker" device gives warning at high altitudes of the onset of compressibility. It should operate at 0.83M to 0.84M at 40,000 ft. and above, giving an oscillation backwards and forwards of about one quarter of an inch. The guarded switch (89) is on the starboard panel and is marked STICK SHAKER. It may be switched off when desired.

27. **R.A.T.O.G.**

(a) *Selection*

The R.A.T.O.G. master and safety switches (44) and yellow warning light (46) are grouped together above the instrument panel, on the right. When the safety switch (at the bottom) is moved to the left, the yellow warning light comes on; this indicates that the firing circuit inertia switch is open. The R.A.T.O.G. is then selected by closing the master switch; as this is done, two amber lights come on, one on either side of the nose of the aircraft.

(b) *Firing*

The rockets are automatically fired during catapult operation (at 2.4G) by the closing of the inertia switch. A sliding switch, for firing the rockets manually, is on the control column.

(c) *Jettisoning*

The R.A.T.O.G. attachments are jettisoned electro-pneumatically by a guarded switch (7) on the port shelf.

28. Flight instruments

(a) *A.S.I. and associated instruments*

(i) A pressure-head on the port tail fin provides pressure for the A.S.I., V.S.I., altimeter and machmeter.

(ii) The pressure-head is electrically heated and the controlling switch (at 87) is on the starboard shelf.

(b) *Turn and slip indicator*

The turn and slip indicator is electrically operated. On Pre-Mod. N.352 aircraft, the supply is fed through two fuses connected in parallel and through a relay. If the normal supply fuse fails, the supply will be routed through the alternative fuse. On Post-Mod. N.352 aircraft, the indicator may be operated by the emergency battery, after putting on the switch beside the generator warning light. The instrument has an OFF flag to indicate power failure.

(c) *Artificial horizon*

The artificial horizon operates whenever alternating current is available, provided that the flight instruments master switch and the main inverter circuit breaker are both on. A Mk.3C instrument is introduced by Mod. N.412 and a Mk. 4 by Mod. N.720. Both instruments have fast-erection buttons and OFF flags to indicate power failure.

(d) *Mk. 4B gyro compass*

A Mk. 4B compass indicator (36) is at the bottom of the pilot's instrument panel. The master indicator is behind the pilot and the control unit (82) is on the starboard wall. Alternating current is required to operate the system and the flight instruments master switch and main inverter circuit breaker must both be on.

(e) *E2A stand-by compass*

An E2A magnetic stand-by compass (32) is at the forward end of the cockpit port wall.

(f) *A.Y.F. radio altimeter*

The radio altimeter indicator (34) is on the left of the pilot's instrument panel.

(g) *Air position indicator and air mileage unit*

The A.P.I. and A.M.U. are behind the pilot's seat.

(h) *Air temperature gauge*

There is an air temperature gauge to starboard of the radar crate.

(j) *Accelerometer*

An accelerometer may be fitted on a bracket above the instrument panel.

COCKPIT EQUIPMENT

29. **Access to cockpit**

The cockpit is reached by a retractable footstep on the port side of the fuselage: this footstep normally retracts as the weight of the foot is removed. Alternatively, the cockpit may be entered by a ladder which can be locked in a ferrule on either side of the cockpit.

30. **Hood operation**

(a) *Opening the hood from outside*

The flush-fitting external release handle is housed centrally just aft of the hood. A pushbutton on the handle is pressed to make the handle spring out of its housing; the handle is then turned anti-clockwise through 90° to release the hood lock (some force may be necessary). The hood can then be raised by hand; a mechanism balances the hood in any position, making movement up or down easy. When fully open, it is locked by a spring-loaded catch acting on the hood strut.

NOTE.—To prevent damage to the hood locking mechanism, care must be exercised to avoid snatching when opening the hood in high winds.

(b) *Closing the hood from inside*

The spring-loaded catch on the hood strut is released by pulling forward the knob (74), marked HATCH STRUT RELEASE, on the starboard wall of the cockpit. The hood may then be lowered by hand; it is locked, when closed, by pulling back and up the large handle, at the top centre of the windscreen. When this is done, a locking catch, next to the internal handle, should snap forward on to the handle; if it does not, it should be pushed forward. The locking catch, when fully forward, inflates the hood seal in addition to preventing any inadvertent operation of the handle.

31. **Hood jettisoning**

NOTE.—Explosive or manual hood jettisoning also lowers the gunsight if electrical power is available.

(a) *Explosive jettisoning*

The hood may be jettisoned explosively by pulling up the handle (61) on the cockpit floor, forward and to the right of the pilot's seat. When the handle is pulled up, a trigger is operated by Bowden cable, a cartridge fired and the hood jettisoned. The trigger is made inoperative by inserting a locking pin in a socket on the bulkhead behind the pilot's seat, to port of the hinge mechanism; the pin has a red pennant attached to it. When not in use, the pin and pennant are stowed in a canvas bag behind the pilot's seat on the cockpit port wall.

(b) *Manual jettisoning*

If the explosive mechanism fails, either through the Bowden cable breaking, or the cartridge failing to fire, the hood can be jettisoned manually as follows: the ring handle just to the right of the hinge mechanism is pulled out—this releases the rear end of the hood, which may then be opened normally at the front by releasing the locking lever and pushing the internal handle down and forwards. Care must be taken to keep the hand unclenched to avoid snatch on the wrist when the hood suddenly lifts.

WARNING.—Attempts to jettison manually, by first opening the hood in the normal way and then pulling the ring handle, must never be made.

32. Oxygen system and pressure-breathing equipment

(a) *Supply*

Oxygen is carried in three Mk. 5C cylinders, two behind the cockpit bulkhead and one in the nose of the aircraft. The charging point is accessible through the starboard ammunition loading door. The supply is taken to the pilot's Mk. 11D regulator (54), on the right-hand side of the instrument panel, and thence to the observer's Mk. 11E regulator (70) on the starboard wall. From the regulators, supply lines pass to the selector valves marked P.B. and ECON., on the cockpit floor, to the right of the pilot's seat. From the valves, the supply is directed to the pressure-breathing waistcoats and oxygen masks (when pressure-breathing equipment is used) or to the economisers and then to the masks, via flexible tubes, depending on the position of the selector valves.

(b) *With pressure-breathing equipment*

Turn on the oxygen and put the selector valve to P.B. The oxygen then by-passes the economiser and flows directly to the type J oxygen mask. The flow selector lever on the regulator is used in the normal way to vary the flow according to the cockpit altitude.

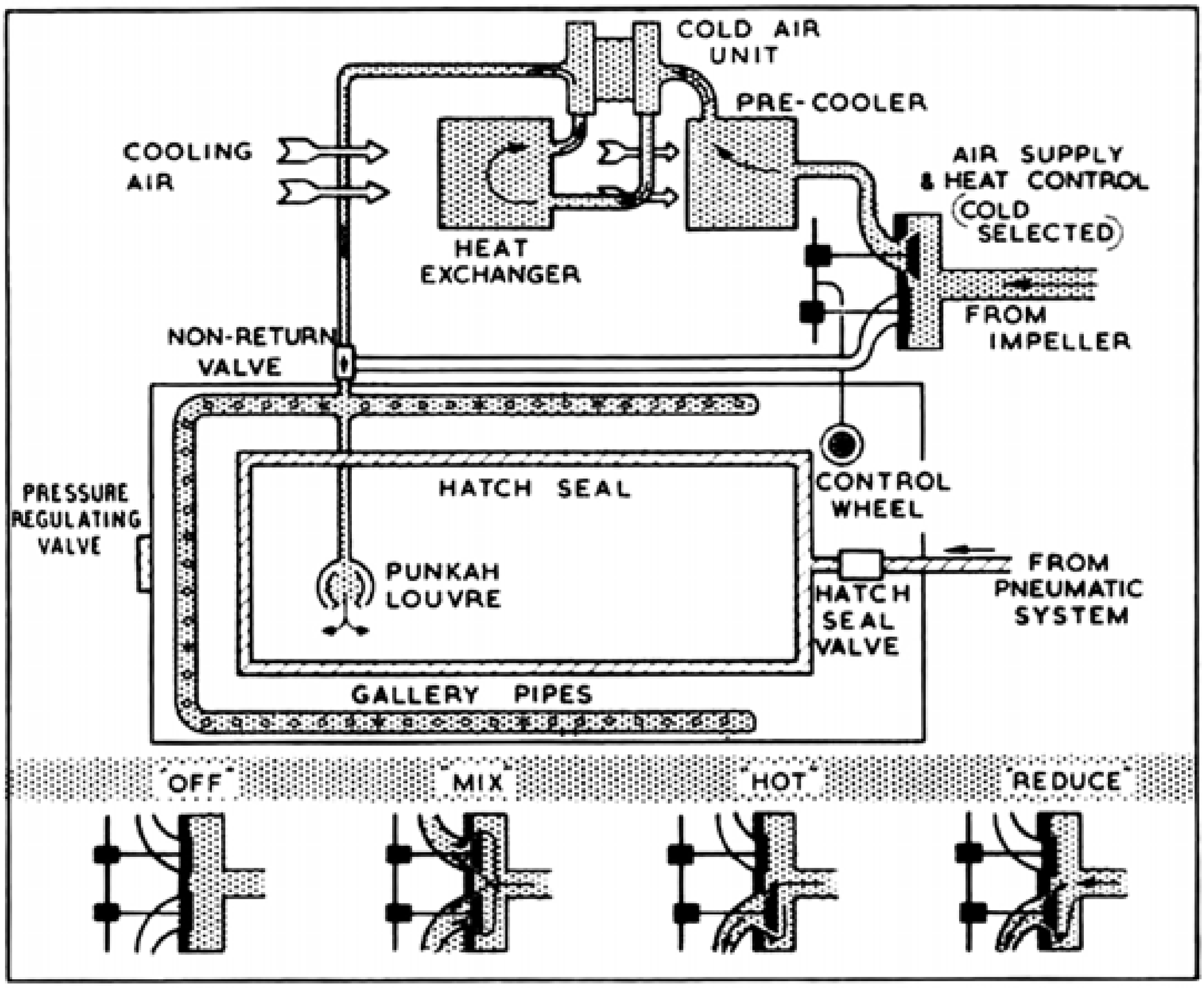
(c) *Without pressure-breathing equipment*

After turning the oxygen on and setting the selector valve to ECON., the oxygen flows through the economiser and thence to the mask.

NOTE.—The economiser will be damaged if pressure-breathing equipment is used with the selector valve in the ECON. position. The ECON. position must always be used when wearing an H-type mask. The selector should be wire-locked in the required position.

33. Cockpit air conditioning

(a) Cockpit pressurising, heating and cooling is controlled by movement of the wheel (24) on the port shelf. The wheel rotates through 270 and has five marked positions: OFF–COLD–MIX–HOT–REDUCE.



COCKPIT PRESSURISATION AND HEATING

(b) *Pressure*

With the hood seal control on (i.e., with the hood handle lock in the forward position) and the wheel set other than OFF, the cockpit pressure is automatically controlled by a valve which allows a steady build-up of differential cockpit pressure above approximately 12,000 feet until, at 35,000 feet, the full differential pressure is reached. The cockpit pressure is indicated on an altimeter (53) at the bottom right of the instrument panel. A warning light (52) beside the altimeter comes on when the cockpit altitude falls below the allowable minimum for a given true altitude. The table below shows the cockpit altitudes corresponding to the minimum pressures. When the control is at REDUCE the amount of air entering the cockpit will be reduced.

Actual altitude (ft.)	Equivalent altitude (cockpit)	Approx. cockpit altitude at which light comes on
20,000	14,100	18,000
30,000	18,800	22,000
40,000	24,000	28,000
50,000	28,000	32,000

(c) Air for pressurising enters the cockpit through a louvre (68) and also through holes in the gallery pipe for windscreen and hood demisting. The amount of air passing to the windscreen can be controlled by adjusting the louvre.

34. **Windscreen de-icing**

The windscreen de-icing system is controlled by a hand-operated pump (59) below the starter master switch. The pump handle is released by rotating it anti-clockwise. As the handle comes out under pressure the windscreen is sprayed. Pressure is raised again by pushing the handle in.

35. **Direct-vision panel**

A direct-vision panel is fitted in the port quarter of the front windscreen and is opened by turning a screw knob at the top. When the panel is open, it lies at an angle across the top of the cockpit; in this position it presents a hazard to the pilot in a crash landing. It can, however, be removed and handed to the observer—no stowage is provided.

36. **Windscreen wiper**

A hydraulically-operated windscreen wiper may be fitted. It is controlled by an OFF–ON–PARK knob (28) below the instrument panel, on the left.

37. **Anti-G equipment**

Anti-G equipment may be fitted but must not be used.

38. **Seats, headrests and harness adjustment**

(a) *Seats*

The pilot's seat can be raised or lowered by a lever on the right of the seat; a plunger at the top must be depressed before the lever can be moved. The observer's seat is not adjustable.

(b) *Headrests*

Both the pilot's and observer's headrests can be adjusted fore-and-aft, after releasing locking pins at the sides of the mounting tubes. When the hood is jettisoned, the pilot's headrest goes with it, the observer's headrest stays with the aircraft. In Pre-Mod. N.382 aircraft, in the forward position the observer's headrest fouls the observer's parachute as he attempts to abandon the aircraft and, as there is no means of retracting the headrest in flight (either by the pilot or observer), it must be at the fully back position before take-off.

(c) *Harness release*

Pre-Mod. N.219 the pilot's harness release lever is on the front left-hand side of the seat. Post-Mod. N.219 the lever (9) is on the cockpit port wall. The observer's release lever (72) is on the starboard wall.

(d) *Harness stowage clips*

Mod. N.310 introduces harness stowage clips. The pilot's is on his seat frame and the observer's is on the starboard shelf.

39. Internal lighting

(a) *Ultra-violet lamps*

The instrument panel ultra-violet lamps are controlled by the centre dimmer switch (4) on the port shelf.

(b) *Red lamps*

The instrument panel red lamps are controlled by the forward dimmer switch (5) on the port shelf; the master switch adjacent to the dimmer switch must be on before the lamps will come on. The port shelf red lamps are controlled by the rearmost dimmer switch (1) and the observer's red lamps by the dimmer switch (83) behind the starboard shelf.

(c) A socket (71) is provided for inspection and chartboard lamps. The supply is controlled by a switch (69) on the starboard shelf.

(d) *Emergency lamp*

This is controlled by a switch (38) at the top of the instrument panel. Power is supplied from a separate dry battery.

Modified aircraft are fitted with two emergency lamps, a red lamp for the E2 compass and an amber lamp for the main instrument panel. The power supply is a separate 24-volt battery, which also provides an emergency supply to the turn and slip indicator. (See para. 16 (f).)

40. External lighting

(a) A circuit breaker (66) marked EXTERNAL LIGHTS protects the circuit.

(b) *Navigation lights*

The navigation lights are controlled by a DIM–off or morse–BRIGHT switch (85) on the starboard shelf. A pushbutton beside the switch is used for morsing.

(c) *Downward identification light*

The MORSE–off–ON switch (86) for the downward identification light is on the starboard shelf. A pushbutton beside the switch is used for morsing.

(d) *Landing lamp*

The landing lamp OFF–LOW–HIGH switch (84) is on the starboard shelf. After switching the lamp from OFF, there is a short delay before the light comes on, while the lamp extends. The lamp should not be extended at speeds above 175 knots.

RADIO AND RADAR

41. V.H.F. (A.R.I.5491)

(a) The V.H.F. installation, which provides airborne relay facilities, comprises two ten-channel sets, types T.R. 1934 and T.R. 1935, with a type 383 controller; whip aerials are on the starboard tail boom and under the port wing.

(b) The controller (26), which includes two channel-selectors and a selector switch, is on the port shelf. The selector switch is marked OFF–R.T.1–DUAL–REL–RT2.

(c) The pilot's R/T–MIX–BEACon switch (80) and the observer's R/T TELS–BEACON switch (77) are on the starboard wall of the cockpit.

(d) The pilot's press-to-transmit button is incorporated in the throttle lever and the observer's foot-operated muting switch (60) is on the cockpit floor.

(e) The pilot has a normal mic/tel socket on the side of his seatpan and a quick-release socket (8) on the cockpit port wall.

(f) A Naval modification introduces an interlock between the oxygen and the R/T. The R/T cannot be used until a switch marked MIC, on the oxygen regulator, has been put on (down); this switch cannot be put on until the oxygen is on.

42. **Z.B.X. (Homing beacon receiver)**

The beacon receiver is behind the pilot and the controller (73) is on the starboard wall. Signals can only be received by the pilot if the R/T–MIX–BEACon switch is set to MIX or BEAC and by the observer if his R/T TELS–BEACON switch is at BEACON or if the pilot's switch is at MIX.

NOTE.—Mod. N.248 introduces Green Salad as a replacement for Z.B.X. The indicator is on the bottom left-hand corner of the instrument panel and the controls are on the port shelf, in the position at present occupied by the signal discharger switch (27).

43. **Intercomm.**

Intercomm. is normally through a type A.1961 amplifier: this is controlled by the I/C ON–off switch (75) on the starboard wall. The NORMAL/EMERGENCY switch (76) should be at NORMAL. In emergency, one of the V.H.F. sets can be used for intercomm. by setting the NORMAL/EMERGENCY switch to EMERGENCY. When the switch is thus set, all conversation will be broadcast if the press-to-transmit switch is pressed. There is an external intercomm. plug on the underside of the wing, just outboard of the wing fold.

44. **A.I.10 (search radar)**

The scanner, modulator and R.F. unit are mounted within the nose of the aircraft. The indicator, synchroniser and control box are on the radar crate forward of the observer. The search radar takes 40 amps; therefore, when at engine idling r.p.m., the radar should be switched off, or the system will be overloaded. It should also be switched off immediately in the event of electrical failure.

NOTE.—Fading will occur if r.p.m. are reduced below 6,000. Approximately two minutes are required before the A.I. again becomes operative after increasing power.

45. **I.F.F.**

The controls (78, 79) are on the cockpit starboard wall and the F and D switches (6) are on the port shelf. The code selector unit is behind the pilot's seat.

ARMAMENT EQUIPMENT

46. **Gunsight**

(a) A retractable gyro gunsight Mk. 4E (37) is mounted above the instrument panel and is normally raised or lowered by means of a switch (40) beside the sight, provided that the circuit breaker (at 65) on the electrical panel is in. If the electrical system fails, it is possible to lower the sight by a lever (39) on the right of the sight; this control should only be used in an emergency, since servicing is necessary before the sight can be used again. The sight is automatically lowered when the hood is jettisoned, provided electrical power is available.

(b) *G.G.S. dimmer-selector control*

The control (56) is mounted on the starboard instrument panel; the range control is incorporated in the throttle lever.

(c) *G.G.S. master switch*

The G.G.S. guns/RP MASTER SWITCH (47) is to port of the radar crate. It has four positions:—OFF–GUNS–GUNS & BOMBS–GUNS & ROCKETS.

47. **Cameras**

(a) *G.G.S. recorder camera*

(i) A recorder camera can be fitted to the top of the gunsight. With the G.G.S. master switch at GUNS, the camera will operate each time the guns are fired, or when the camera button is pressed, provided the CAMERA GUN master switch (at 87) is on. When R.P.s are selected and the camera button is pressed, the camera will run until the R.P. button is pressed.

(ii) To prevent electrical failure of the sight, the recorder camera should be neither plugged in nor unplugged while the sight is in the raised position.

(b) *G.45 camera*

A G.45 camera is pod-mounted under the port wing and is operated by either the camera button or the gun button, provided the camera master switch is on. If the camera is to be operated by the gun button, the G.G.S. master switch must first be set to GUNS. A SUNNY/CLOUDY aperture switch (42) is above the instrument panel, on the right.

48. **Guns**

Four 20 mm. Hispano Mk. 5* guns are installed, two on each side of the nose, and are fired electrically by the trigger on the control column, after the safety catch has been released and the G.G.S. master switch has been set to GUNS. It is possible to fire the guns when the aircraft is on the ground.

49. **Rockets**

(a) Rockets may be carried under the wings, either in double tier stowage using No. 8 Mk. 4 saddles or in single tier stowage using No. 5 Mk. 2 saddles. Either 25 lb., 60 lb. or flare heads may be used.

(b) The rockets are fired by a button on the control column, after the safety catch has been released and the G.G.S. master switch has been set to GUNS & ROCKETS. There is a PAIRS/SALVO selector switch (43) above the instrument panel, to the right. The R.P. auto-distributor (55) is beside the radar crate.

(c) Rockets may be fired with the airbrakes out.

PART II

LIMITATIONS

50. Engine limitations—Ghost Mk. 103

(a) The main engine limitations are as follows:—

Power rating	Time limit	R.p.m.	Max. j.p.t. C.
Max. take-off, climb and operational necessity	30 mins. combined	10,250*	725
Max. continuous	Unrestricted	9,750	625
Ground idling	Unrestricted	3,000 ± 200	450

* Maximum permissible r.p.m. are to be reduced to 10,100 above 25,000 ft. when climbing and above 35,000 ft. in level flight.

(b) *Oil temperature limitations*

Maximum .. .. 135° C.

Minimum for starting and opening up using oil:—

OEP–71 or OM–71 .. .. .. – 10° C.
OX–38 .. .. – 40° C.

51. Flying limitations

(a) The Sea Venom F.A.W.20 is cleared for Service use ashore, in temperate climates only. Aerobatics with tip tanks full or empty and practice spins of up to two turns are permitted.

(b) *Speed and mach number limitations*

(i) *Clean aircraft*

Maximum airspeed .. .. .. 500 knots

Maximum mach number

Above 15,000 feet 0.85M
Below 15,000 feet 0.83M

(ii) *When carrying R.P.s*

Maximum airspeed	500 knots
Maximum mach number, at all heights	0.80M

(iii) *For gun firing*

The maximum speed for gun firing is 455 knots unless Mod. N.198 is embodied.

(iv) *For the operation of the following and flight with them extended*

Flaps	
Between 0° and 30°	190 knots
Between 30° and fully down ..	170 knots
Undercarriage	220 knots

(c) *Weight limitations*

The maximum all-up weights are as follows. For typical service loads, see Part V para. 98.

Max. Weight lb.	Permitted Manœuvres
15,090	Overload take-off and gentle manœuvres
14,270	Take-off and all forms of flying
13,890	Overload non-arrested landing
13,070	Normal non-arrested landing
11,600	Arrested landing

NOTE—Landings with fuel in the tip tanks must not be made except in an emergency.

(d) *C.G. limitations*

The permissible limits, with the undercarriage down, are:—

Forward limit	6.2 ins. aft of datum
Aft limit	
Tip tanks full, ammo. tanks full ..	10.6 ins. aft of datum
Tip tanks full, ammo. tanks empty or ballasted for full ammo. ..	11.6 ins. aft of datum
Tip tanks empty, ammo. tanks empty or ballasted for full ammo. ..	9.6 ins. aft of datum

(e) *Flight without tip tanks* is prohibited.

(f) *An accelerometer reading* of +6G must not be exceeded.

(g) *The maximum angles* for firing rockets are:—

Dive	45°
Climb	10°

52. **Other limitations**

(a) The use of anti-G suits (if provision is made) is prohibited.

(b) The signal discharger (if fitted) must not be used.

PART III

HANDLING

MANAGEMENT AND USE OF SYSTEMS

53. Management of the fuel system

(a) The fuel booster pump should be on at all times in the air. If it fails or is switched off, the fuel pressure warning light will glow; in normal flight, engine failure is unlikely to result but above 20,000 feet full r.p.m. may be unobtainable and large fluctuations in r.p.m. may be experienced.

(b) The rate of fuel transfer should be sufficient to maintain the level in the fuselage tanks to within 240–320 lb. (30–40 gallons) of fuel at all altitudes and engine powers. There is sufficient air pressure to effect fuel transfer from the tip tanks when the indicators on the instrument panel show black. They should show white when transfer is completed or when the transfer pressure is insufficient, but see para. 4(a) NOTE. As soon as tip tank transfer is complete, the jettison switch must be set to JETTISON.

NOTE.—1. In rapid descents, it is usual for the indicators to show white intermittently *before* transfer is complete.

2. The jettison switch must be at JETTISON at all times when the tip tanks are empty.

(c) When descending rapidly from high altitudes, the total contents fuel gauge will under-read but should re-adjust itself shortly after resuming level flight.

(d) A negative G trap in the fuselage tank ensures sufficient fuel for about 10 seconds flight with negative G. Flight in attitudes near the vertical should also be restricted to 10 seconds for the same reason. If less than 480 lb. (60 gallons) remain, the aircraft should be restricted to normal flying attitudes only.

(e) Between 10 and 20 gallons of fuel are unusable, the amount increasing with tail-down attitudes.

(f) *Fuel jettison*

Provided that all is clear astern, fuel may be jettisoned from the tip tanks at any time. It takes approximately one minute to jettison all fuel and there may be a slight nose-down trim change during the process. The jettison switch should be left at JETTISON until after stopping the engine, when it should be moved to CLOSE.

(g) *Tip tanks transfer failure*

In case of unsatisfactory transfer of one tip tank, the aircraft will become very one wing heavy. Every attempt should be made to jettison fuel from the faulty tank before a landing is attempted. If transfer from a tip tank is faulty, denoted by one-wing heaviness or by one indicator showing white well before the other, it may not be possible to jettison the contents of the faulty tank, due to lack of air pressure. In such cases, the jettison switch should be left at JETTISON and, if time is available, some of the contents of the faulty tank may be partially emptied by alternately climbing and diving the aircraft. It may also be possible to transfer about the first quarter of the contents of a tip tank by gravity.

54. Engine handling

(a) Although the engine r.p.m. may be within limits before take-off, forward movement of the aircraft may result in a creep-back in r.p.m. of up to 150. This will not appreciably affect the take-off. Take-off should not be attempted if the r.p.m. on run-up are less than 10,150 or if, during take-off ground run, they fall below 10,050.

(b) During the climb, the r.p.m. show a marked tendency to increase above the limitations. Great care should be taken to avoid exceeding the r.p.m. limitations when operating at high altitude.

(c) All throttle corrections in the air should be made slowly and smoothly, particularly at high altitudes or when increasing power from low engine settings.

(d) With variations in airspeed, the r.p.m. will alter from those set—particularly at high altitudes—and constant small throttle corrections are necessary. If, at any time, the jet pipe temperature or engine speed reaches the appropriate limitation, power must be reduced or airspeed increased.

(e) With the isolating switch ON, throttle movements must be made carefully. Whenever possible, and especially above 20,000 feet, engine accelerations should be so controlled that the j.p.t. does not exceed 725° C. In an emergency, *below* 20,000 feet, slam accelerations are permissible from 6,500 r.p.m.: they must not be attempted above 20,000 feet.

55. **Management of the pressurising and demisting systems**

(a) The control wheel for regulating the supply and temperature of the pressurised air must be set to OFF, HOT or REDUCE when the aircraft is on the ground with the engine running, in order to avoid overheating the cold air unit. COLD or MIX must not be selected on the ground.

(b) Unless the cockpit is kept pressurised, severe internal misting and icing is likely to occur at high altitudes and on descending. Therefore, it is recommended that the cockpit is pressurised before take-off.

(c) Engine idling r.p.m. should normally be sufficient to maintain full cockpit pressure at any altitude. Misting may occur if power is low for long periods, due to the reduced supply of hot air available to the hood and windscreen through the gallery pipes. The supply may be increased by:—

(i) Partially closing the main louvre, thus diverting the supply to the gallery pipes.

(ii) Increasing engine r.p.m.

(d) If a reduction in cockpit temperature is desired at altitude, MIX is to be preferred to REDUCE, otherwise the reduced volume of air entering the cockpit may adversely affect the pressure differential.

(e) During a rapid descent, the cockpit pressure warning light may come on temporarily.

56. **Management of the electrical system**

(a) Before starting the engine, test the main and standby inverters as follows:—

GROUND/FLIGHT switch (88)	FLIGHT
Voltmeter (64)	Needle out of red sectors
Inverter circuit breakers (at 65)	Made
FLIGHT INSTRUMENTS switch (48)	ON. Check inverter aurally and note that A/H and Mk. 4B compass erect. Then switch OFF.
INVERTER B switch (at 87)	ON. Check inverter aurally and note that A/H and Mk. 4B compass erect. Then switch OFF

(b) Combined ground idling and taxying time should be kept to a minimum, to avoid battery failure. In the air, engine r.p.m. should not be allowed to fall below 6,500, except in an emergency or when A.I.10 is not in use.

57. **Management of the wing-fold mechanism**

(a) *Spreading*

Move the inboard spread/fold lever up and aft. When the wings have spread, move the outboard wing locking lever up and aft, ensuring that it is fully home. Check that the locking pin indicators on the wings are flush. Check that the magnetic indicators are black, if electrical power is available.

(b) *Folding*

Move the outboard wing locking lever fully forward and down. Check that the locking pin indicators protrude from the wings and that the magnetic indicators show white. Move the spread/fold lever forward and down and the wings will fold.

(c) The control column should be held central while folding or spreading the wings.

(d) Severe stresses are placed on the wing-fold mechanism when taxying with the wings folded, especially if the tip tanks are full; the aircraft must be moved at slow walking pace over smooth surfaces only. Taxying with wings folded must be kept to a minimum and should normally be avoided.

STARTING TAXYING AND TAKE-OFF

58. External checks

The outside of the aircraft should be systematically checked for obvious signs of damage, security of panels, filler caps, doors, wheel fairings, wing-fold mechanism and tip tanks. The engine intakes and tank vents should be free of debris; the jet pipe should be checked for wrinkling and the turbine and compressor blades for damage. The screws on the fairings forward of the intake should be checked for security. Oleos should be checked for equal extension and the tyres for creep, excessive wear or cuts and brake leads for damage. The pressure-head cover, the undercarriage ground locks and the external locks for the control surfaces must be removed. The elevator trimmer tab position should be checked (with the elevator held central). Check that the hood external locking handle is flush and that the hood is prevented from accidental closing by the knob marked HATCH STRUT RELEASE (74) on the starboard wall.

59. Internal checks

NOTE.—Switches are not always marked ON/OFF but normally the ON position is either fully forward or up.

Enter the cockpit and check that the hood rear hinge release ring is fully aft, the observer's headrest is fully aft and all the observer's radar switches are off. Strap in and make the necessary oxygen and R/T connections. Then, before switching on electric power, check:—

Tip tank jettison switch (11)	CLOSE (tip tanks full) JETTISON (tip tanks empty)
Undercarriage selector lever (33)	DOWN. Handle pushed into slot

R.A.T.O.G. master switch (44)	Off
R.A.T.O.G. safety switch (44)	Engaged (to starboard). Yellow warning light (46) out
Hood jettison lever (61)	Fully down
Hood jettison detonator safety pin	Removed and stowed
Armament switches	Safe or off
Rudder pedals	Adjust. Equal both sides
Hood	Lock closed (handle up, locking catch fully forward)

NOTE.—When opening or closing the hood, it is advisable to support it. This is essential in strong winds.

Then:—

All circuit breakers (six) (65, 66, 67)	Made
GROUND/FLIGHT switch (88)	FLIGHT
Wing-fold levers (2, 3)	Corresponding to the position of the wings (up for spread). Levers locked in their gates (*serious damage may occur to the wing locking mechanism unless this is so*). Magnetic indicators as appropriate
Cockpit lamps (1, 4, 5, 83)	As required
Signal discharger switch (27) (if fitted)	Off
V.H.F. (26)	OFF, channels selected
I.F.F. F and D switches (6)	OFF
Cockpit pressurisation (24)	OFF
Arrester hook lever (25)	Up. Catch engaged. (If the hook is not fully up, it *must* be raised by the hand-pump before starting, to avoid heat damage.) Green light out

H.P. cock (12)	ON (up). Press relight button. (If serviceable, an irregular clicking sound should be heard)
Flap selector lever (22)	UP
Throttle (14)	Freedom of movement. Friction adjusted
Airbrakes (16)	IN
Elevator trim (20)	Test through range, set neutral
L.P. cock (21)	ON (up)
Wheel brakes	On. Check pressure at each wheel (150 lb./sq. in. max.)
Aileron gear change	Halfway position
Undercarriage emergency retraction switch (19)	Off (cover wired closed)
Aileron trimmer (17)	Check operation. Set neutral visually
Windscreen wiper (28)	PARK
E.2A compass (32)	Serviceability
Flap indicator (31)	Serviceability
Undercarriage indicator (30)	Three green lights. Test change-over
Undercarriage warning light (29)	Out
Machmeter	Serviceability
Generator warning light (35)	On
Turn and slip switch	NORMAL
Radio altimeter (34)	Off
Flight instruments	Serviceability
Oil temperature gauge (63)	Reading within limits
Emergency lamp switch (38)	OFF
Fuel transfer indicators (49)	White
G.G.S. control switch (40)	Off

Fire warning light (45)	Press adjacent button to test (post-Mod. N.779) Pull to test (pre-Mod. N.779)
SUNNY/CLOUDY switch (42)	As required
SALVO/PAIRS switch (43)	As required
Guns/R.P. switch (47)	OFF
Fuel contents gauge (41)	Reading appropriately
FLIGHT INSTRUMENTS switch (48)	Check operation of flight instruments then OFF
Fuel pressure warning light (50)	On
FUEL PUMP SWITCH (62)	On. Check warning light goes out
FUEL PUMP EMERGENCY switch (51)	Off
CABIN PRESS LOW light (52)	Out
Oxygen (54, 70)	Selector to P.B. or ECON as appropriate. Contents and delivery. LOW flow selected. EMERGENCY toggle OFF. Reaching mask. Observer's off if flying solo
MICrophone switch	ON
STARTER MASTER switch (57)	ON
Windscreen de-icing pump (59)	Locked in
STICK SHAKER switch (89)	On
CARRIER/AIRFIELD switch	AIRFIELD
PITOT HEAD heater switch (at 87)	Off
INVERTER B switch (at 87)	Check operation of flight instruments then off
All other switches	Off

Hydraulic handpump	Check operation against flap indication, after exhausting main accumulator
Clear vision panel	Locked

60. **Checks before starting**

H.P. cock	ON
L.P. cock	ON
Throttle	2 ins. open
FUEL PUMP SWITCH	ON. Red warning light out
STARTER MASTER switch	ON
GROUND/FLIGHT switch	FLIGHT

61. **Starting the engine**

(a) (i) Press the starter button.

(ii) The r.p.m. will rise rapidly to approximately 1,500 r.p.m., when light-up should occur. The r.p.m. will then rise until idling speed is reached. If light-up does not occur until the r.p.m. have fallen below 1,000, excessive j.p.t. may result, in which case the H.P. cock should be set OFF before the limit is reached.

(b) If the engine does not start correctly, it will be in one of the following sets of circumstances. The pilot should carry out whichever instructions are applicable.

(i) *Cartridge fails to fire*
If a cartridge does not fire, close the H.P. cock and wait at least 15 seconds before reopening it. Should the first cartridge fail to fire, the starter pushbutton will be held in electrically and will return to the starting position only at the end of the automatic starting sequence. The remaining cartridge may then be fired after reopening the H.P. cock.

(ii) *Engine fails to rotate*
If the engine does not rotate or does so at low r.p.m. and there is a heavy discharge of yellow smoke from the starter exhaust for a period of approximately 10 seconds, the safety disc has probably blown. The H.P. cock should be closed and the cause of failure rectified before attempting a further start.

(iii) *Failure to light up*

If the starter accelerates the engine normally but the r.p.m. continue to drop below 1,100 without any indication of light-up, the H.P. cock must be closed before the r.p.m. have fallen below 1,000. If the engine is allowed to light up below this speed, there is a risk of damage to the tailplane from possible torching and, in any event, the start will be slow and laboured, with a risk of exceeding the j.p.t. limitations. Also, if the r.p.m. are allowed to drop below 1,000 before closing the H.P. cock, a wet start is likely on the next attempt.

(c) Two successive failures to start indicate a fault which should be investigated before a further start is attempted.

(d) After failure to light up, all surplus fuel must be allowed to drain from the jet pipe.

(e) The cartridge breeches should not be reloaded until they have cooled down; expended cartridges can be removed, however, and the breeches left open to assist in cooling. The starter master switch must be off during reloading.

62. **Checks after starting**

(a) Fire-warning light	Out
R.p.m.	3,000 ± 200 r.p.m.
J.p.t.	Below 450° C.
Generator warning light	Out
Voltmeter	Reading
INVERTER B switch	ON. Instruments erecting
Intercomm.	ON and NORMAL
V.H.F.	On
Downward ident. lights	As required

(b) While at idling r.p.m. switch on the FUEL PUMP EMERGENCY switch; this should result in an increase in r.p.m. If a decrease is observed the aircraft must not be flown. If there is no increase at idling, repeat the check at 6,000 r.p.m., return the switch to off and check that the r.p.m. drop to the original figure. If there has been no increase, or if there has been a decrease in r.p.m., the aircraft should not be flown.

(c) Then before taxying out check:—

Hydraulics	Wings spread, indicators black, visual indicators flush. Locking levers both up. Check operation of airbrakes and flaps
Flying controls	Full and free movement
Pneumatic pressure	Sufficient (450 lb./sq. in. max.)
Instruments	Check and set
Mk. 4B Compass	Synchronise and check with E.2A. Correct variation set on master unit

63. Taxying

Check that there is equal braking effect in each wheel (150 lb./sq. in. minimum). Due to the rudder centralising spring, considerable foot force is necessary to apply rudder for differential braking when taxying: otherwise taxying is easy on dry surfaces. The brakes are powerful and, when manœuvring on wet or slippery surfaces, great care should be taken that the wheels do not lock.

64. Checks before take-off

(a) *Free take-off*

Trimmers	All neutral
Aileron gear setting	Halfway position
Airbrakes	IN
Wings	Spread and locked. Indicators black. External indicators flush with wing top surfaces. Both levers in their gates in the fully up position. Wing fold doors closed

Fuel	H.P. and L.P. cocks fully on Contents Booster pump ON H.P. fuel pump isolating switch as required Tip tank fuel jettison switch CLOSED (JETTISON if tanks empty)
Flaps	30
Instruments	FLIGHT INSTRUMENTS switch ON INVERTER B switch ON Artificial horizon erect Turn indicator functioning PITOT HEAD heater switch ON Mk. 4B compass synchronised with E.2A
Oxygen	ON, connected — reaching mask, EMERGENCY toggle OFF, low flow selected (high flow if cockpit altitude likely to exceed 25,000 ft.)
Hood	Shut and locked, catch engaged, seal inflated Direct vision panel closed Pressurisation wheel OFF, HOT or REDUCE
Harness	Tight and locked

(b) *R.A.T.O.*

The following alterations and additions should be made to the check list above:—

Trimmers	Elevator 1 div. nose-down
Flaps	45
R.A.T.O.G. safety switch	Disengaged (to port) Yellow warning light on

65. Take-off

(a) *Free take-off*

(i) Line up with the nosewheel straight and apply the brakes. Increase r.p.m. to above 6,000 and switch on the FLIGHT INSTruments switch and the API. Then open up smoothly to full power and release the brakes.

(ii) During the early stages of the take-off the rudder is ineffective and small amounts of brake must be used if it is necessary to correct the aircraft's heading. The tendency to wander from the take-off path is slight, however, even in strong crosswinds.

(iii) Between 90–100 knots, depending on the A.U.W. and C.G. position, raise and hold the nosewheel clear of the ground. A strong pull-force is required initially.

(iv) The aircraft should be flown off at between 115 and 125 knots. It does not unstick cleanly and, though it may be pulled off at lower speeds, this may lead to temporary one wing heaviness, particularly in cross-winds.

(v) When comfortably airborne, brake the wheels and retract the undercarriage. Then raise the flaps. There may be a small resultant nose-down trim change but normally the trim change due to flap retraction from 30 is counteracted by the nose-up trim change as the undercarriage retracts.

(vi) Set cockpit air conditioning as required and check that the wing-tip tanks transfer indicators are black. Check engine and flight instruments.

(vii) If the fuel pump isolating switch has been set ON before take-off, switch it off 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, corresponding to the amount the throttle has been moved from the fully open position.

NOTE.—If the isolating switch is on for take-off, the maximum r.p.m. are liable to hunt between approximately 9,900 and 10,400 r.p.m. This hunting, although unpleasant, is not in itself dangerous and can be eliminated by throttling back to 10,000 r.p.m., i.e., below the governed range. If Ghost Mod. 1129 is incorporated, r.p.m. hunting should not occur.

(b) *R.A.T.O.*

NOTE.—It is preferable to fire the rockets slightly late rather than early, to ensure full flying speed when burning ceases. Attention is also drawn to A.P. 2802B, Volume 1, Section 6, Chapter 1.

(i) Align the aircraft in the direction of take-off, set the R.A.T.O.G. master switch on and obtain a check that the two amber warning lights on either side of the nose come on.

(ii) Run up to full power against the brakes. When releasing the brakes use extra care in keeping the aircraft straight. Fire the rockets at 65–70 knots by sliding up the firing switch; the rockets should fire simultaneously within half a second.

(iii) Raise the nosewheel at approximately 95 knots: the aircraft becomes airborne at 105–115 knots, depending on the A.U.W. Take care not to adopt too steep an attitude during the ground run, as this reduces the acceleration provided by the rockets.

(iv) The aircraft becomes airborne just before the rockets cease burning and it is then necessary to apply a firm backward pressure on the control column, to prevent the aircraft sinking.

(v) When at a safe height, raise the undercarriage and flaps, set the R.A.T.O.G. master switch off and engage the safety switch.

(vi) The rocket carriers may be jettisoned at speeds below 175 knots in straight and level flight.

HANDLING IN FLIGHT

66. **Climbing**

(a) The recommended climbing speeds for maximum rate of climb, using 10,250 r.p.m. reducing to 10,100 r.p.m. above 25,000 feet are:—

Altitude feet	Tip tanks empty		Tip tanks full	
	Knots	Mach. No.	Knots	Mach. No.
Sea level	355	0.54	350	0.53
5,000	345	0.57	340	0.56
10,000	330	0.60	325	0.59
15,000	320	0.63	315	0.62
20,000	305	0.66	300	0.65
25,000	290	0.69	285	0.68
30,000	265	0.71	260	0.70
35,000	240	0.71	235	0.70
40,000	215	0.71	210	0.70
45,000	190	0.71	185	0.70

(b) After take-off, the aircraft may be allowed to accelerate to the recommended speed while climbing, provided that it is reached below 5,000 feet.

(c) Above 40,000 feet, it is important that the correct speeds are maintained; should the speed fall below that recommended, the rate of climb will suffer and it may be found necessary to assume level flight to regain climbing speed.

(d) During the time that fuel is being used from the aft compartment of the tip tanks, the C.G. will move forward fairly fast and small amounts of nose-up trim will be required to maintain the climbing speed.

67. **Flying controls**

(a) *Ailerons*

Response below 115 knots is sluggish and full control movement may be required when landing, particularly in rough weather. As speed increases up to 300 knots, the ailerons become progressively more effective but become heavy above this speed. At altitudes above 40,000 feet, the ailerons are light and effective at normal operating speeds.

(b) *Elevator*

The elevator is very heavy at all speeds and manœuvres involving its use may at times be arduous. Above about 0.8M, both the elevator and trimmer become progressively less effective and, by 0.84M, full use of the elevator or trimmer has little effect. It is recommended that the elevator trimmer setting is not altered in this region of reduced control, because of the large changes of trim which may occur when speed is eventually reduced and the trimmer re-asserts itself.

(c) *Rudders*

The rudder centralising forces are assisted by a powerful spring. The rudder lacks feel and effectiveness at low speeds but becomes more effective at high speeds. Directional control in all conditions of flight is, however, adequate.

(d) *Trimmers*

(i) *Aileron*

The aileron electrical trimmer has little effect at low speeds, becoming progressively moderately effective at high speeds. On aircraft fitted with variable-ratio gearing, LOW should not be used at high I.A.S. or M.N., as the aileron forces may be excessive. Pilots making their first flights in these aircraft should take off in LOW.

(ii) *Elevator*

The elevator trimmer is powerful and should be used carefully at high airspeeds.

(e) *Airbrakes*

Use of the airbrakes causes mild buffet and small aileron oscillations at speeds above about 150 knots. They are moderately effective at speeds above 250 knots. Below this speed they become progressively less effective and have no noticeable effect below 150 knots. There may be some small longitudinal oscillations of the aircraft as they are selected but changes of trim at all speeds are small.

(f) *Changes of trim*

(i)

Flap down—one quarter	Nose-up
Flap down—full	Strong nose-up
Undercarriage down	Slight nose-up

(ii) With airbrakes out, there is a slight nose-up change of trim at low airspeeds, which becomes more marked at higher airspeeds.

(iii) When full flap is lowered, the strong nose-up change of trim will necessitate a large forward movement of the control column to counteract it.

68. **Night flying**

Night flying presents no particular problems but right-hand circuits are difficult to judge, due to visual distortion. The maximum speed for lowering the landing lamp is 175 knots. This speed limitation also applies with the lamp in the extended position.

69. **Flying for endurance**

The speed for maximum endurance is 150 knots but control is more comfortable at 175 knots, which latter speed gives a slight decrease in endurance.

70. **Flying at reduced speed**

(a) Reduce speed to 160 knots. If the flaps are lowered to 30 speed may be further reduced to 130 knots (140 knots with full fuel).

(b) In conditions of severe icing, the direct-vision window may be opened at speeds below 240 knots but it is not effective in increasing the view straight ahead. Before opening the panel, the gyro gunsight should be retracted to avoid damage and the panel then removed entirely and handed to the observer.

(c) Visibility in rain is poor and, unless a windscreen wiper is in use, night landings are hazardous.

71. **Flying in conditions of severe turbulence**

(a) There is normally considerable wing flexing with and without fuel in the tip tanks; this is particularly apparent when flying in turbulent conditions.

(b) Speeds should, if possible, be kept within the following band:—

(i) Up to 15,000 feet	300–360 knots
(ii) Above 15,000 feet	
Upper limit	0.72M
Lower limit	300 knots at 15,000 feet, reducing to 205 knots at 40,000 feet

(c) It should be noted that, even within this speed band, control may be marginal in severe turbulence above 30,000 feet.

72. **Stalling**

(a) Stalling speeds at the same weight may vary considerably from one stall to another and between one aircraft and another, depending particularly on the technique used.

(b) On some aircraft stall speeds under *approach* conditions may occur slightly *above* those of engine-off stalls: this may be due to a change in the air flow characteristics as power is applied. Normally, however, these speeds are approximately the same and may even be slightly less under *full power* conditions.

(c) At the lowest speeds obtained, there may be some A.S.I. fluctuations at the stall.

(d) The stalling speeds in knots, engine on and engine off, are within the following speed bands:—

Loading	U/C and flaps up	U/C and flaps fully down
1 crew, 100 gallons	95–105	85–95
2 crew, full ammunition, 130 gallons ..	100–110	90–100
2 crew, full ammunition, full internal fuel (maximum landing weight)	105–115	95–105

(e) At all weights and with flaps down there is no adequate warning of the stall. It usually occurs with mild buffet and a tendency for either wing to drop gently. If full aileron is used to raise it, the stall of that wing may be completed but, if small aileron angles are used, the wing-drop may be held. The rudder is almost ineffective at the stall and full movement is necessary to correct yaw when it occurs. There is no tendency to spin, however. Recovery is straightforward and is effective immediately stick pressure is released. There will be a rapid rate of descent following the stall and this will continue until the airflow re-establishes itself some 20 knots above the speed at which the stall occurred.

(f) Use of flap causes buffet and this masks any pre-stall warning that may be present.

(g) With flaps up, a strong pull-force is required to hold the nose up as the stall is approached.

(h) Airbrakes do not alter the stall speed significantly but may lead to slight aileron buffet and wing heaviness on one side; this first becomes apparent some 5–10 knots above the stall.

(j) If either or both the wing fold doors are open on one side, wing heaviness occurs some 10 knots above the stall and the stall of that wing occurs 5 knots earlier.

(k) *G-stalling*

It is difficult to G-stall the aircraft, particularly at low and medium altitudes, due to the high stick forces involved. At high altitudes, the onset of the stall may be preceded by an increase in aerodynamic noise and by slight buffet. With further backward stick movement, either wing may tend to drop and, at the same time, the elevator pull forces to hold the aircraft in the turn may lighten. Recovery is immediate on releasing the stick.

73. Spinning

(a) Practice spins up to two turns are permitted. The nature of the spin is unusual, in that the aircraft apparently performs a series of rolls whose axis, in the first two turns, is only slightly inclined to the horizontal. Because of this, it is possible for rotation to cease in the inverted position. Inappropriate use of the controls may then result in an inverted spin.

(b) Recovery is standard, *with the ailerons central*. As soon as rotation ceases, centralise the rudder. If recovery is unduly delayed, ensure that the stick is laterally central. If difficulty is still experienced, pull the stick right back and apply a little out-spin aileron, then move the stick fully forward in this displaced position. If rotation ceases when inverted, forward movement of the stick should not be continued beyond the central position until the aircraft has been rolled out. *Do not* pull through from the inverted position, because of the great loss of height and rapid increase in M at altitude.

74. High speed flying

NOTE.—1. The mach number limitation of 0.85M can be exceeded very easily, particularly at heights above 40,000 feet. Pilots are advised to investigate the high speed flying characteristics with great care.

2. The mach number limitation of 0.85M above 15,000 feet can be exceeded in a 10° dive at 10,100 r.p.m. when above 40,000 feet and in a 15° dive at heights between 30,000 feet and 40,000 feet. Acceleration from 0.80M to 0.85M is very rapid.

3. The airbrakes have little or no deceleration effect at 40,000 feet and above and throttling back produces only a slow deceleration at these high altitudes.

4. The elevator becomes progressively less effective above 0.80M and ceases to be effective as a means of applying more than small values of G above 0.83M.

5. The high mach number characteristics vary to an appreciable extent from aircraft to aircraft; they also depend, particularly at high altitudes, on the angle of dive (i.e. rate of increase in speed), on G and on the condition of the aircraft.

(a) *Clean aircraft*

(i) The mach number limitation is 0.85M above 15,000 feet and 0.83M below 15,000 feet.

(ii) *Above 40,000 feet*

The first sign of compressibility is at 0.80M, when the elevator begins to lose effectiveness. As 0.82M is reached, a gradual nose-down trim change develops which, because of elevator ineffectiveness, cannot always be held (see para. 67 (b)). As speed increases, further deterioration in elevator and trimmer effectiveness occurs and at 0.85M there is mild buffet and lateral unsteadiness, together with an easing of the nose-down trim change. Should 0.85M inadvertently be exceeded, there is a nose-up trim change between 0.85M and 0.87M and, in shallow dives, this may take the form of an uncontrollable nose-up pitch with little warning of its onset. The G associated with this may cause temporary wing dropping but a measure of lateral control is usually possible up to 0.88M. If the dive is comparatively steep (i.e. over 25°), the nose-up pitch may be transient and the aircraft may

continue in the dive and accelerate beyond 0.88M. Above this mach number there may be aileron oscillation, which can be severe at times, together with uncontrollable wing dropping. Yaw *towards* the down-going wing may be effective in helping to raise the wing when flying in the region of the shock stall. Recovery from a steep dive in these conditions may not be achieved until considerable height, possibly 20,000 feet or more, has been lost.

(iii) *25,000 feet–40,000 feet*

Up to 0.84M, the trim changes and elevator fade characteristics are the same as in (a) (ii) above but initially the nose-down trim change may be stronger. However, the lessening of the nose-down trim change may occur at a slightly lower mach number than it does above 40,000 feet and may develop into a nose-up trim change above 0.84M, leading in some cases to a violent nose-up pitch at about 0.86–0.87M. Because of the nose-up pitch, this mach number cannot normally be exceeded, except in dives over 30°.

(iv) *Below 25,000 feet*

In this height band the mach number characteristics do not vary appreciably between aircraft. At about 0.82M a moderate nose-down trim change develops and may revert to a nose-up trim change as the limit of 0.85M is reached. At high mach number/I.A.S. combinations above 0.83M there is hood roar and tail buffet may be considerable.

(b) *With R.P.s*

(i) The mach number limitation is 0.80M at all heights.

(ii) The limitation is lower than that for clean aircraft, because of the marked increase in elevator heaviness and the loss of effectiveness which occurs slightly in excess of 0.80M. There is also an increase in elevator heaviness at high airspeeds; aiming accuracy is likely to suffer at speeds in excess of 420 knots. The increased stick forces encountered at high airspeeds are not considered dangerous when pulling out from attacks made at speeds above 420 knots.

(c) *Recovery*
Recovery from high speed dives should in all cases be initiated by extending the airbrakes and throttling back.

75. **Aerobatics**

(a) The aircraft is fully aerobatic with full tip tanks.

(b) Until experience is gained, the following are the recommended minimum speeds (in knots) for aerobatics:—

Slow roll	270
Barrel roll	270
Loop	370
Roll off	370
Climbing roll	400 plus

76. **Descent**

(a) *Descent with airbrakes IN*
Maintain a speed of 0.67M in the descent to 25,000 feet (270 knots below 25,000 feet), with the engine set as near as possible to 7,000 r.p.m. to ensure a sufficient charging rate. Start the descent at a point which will ensure that 85 gallons remain at circuit height. (See para. 53 (c).) This allows for 15–20 minutes loiter at sea level at about 160 knots and a safe margin for joining the circuit and one overshoot and landing, plus a 15–20 gallon allowance for unusable fuel.

(b) *Descent with airbrakes OUT*
Descend as in (a) above but with the airbrakes OUT.

CIRCUIT PROCEDURE AND LANDING

77. **Checks before landing**

Airbrakes	IN
Arrester hook	Up, light out
Undercarriage	Locked down, selector lever in slot. Three green lights
Brakes	Check pressures. Off
Fuel	Contents
Flaps	Fully down on final approach
Harness	Tight and locked
Radar	Off

78. **Approach and landing**

(a) Reduce speed to below 220 knots before lowering the undercarriage and to below 190 knots before lowering the flaps to 30 . The nosewheel may not lock down until speed has been reduced to 150 knots.

(b) Make the turn on to the final approach at 130–140 knots and select full flap on the final approach. Cross the runway threshold at 110–120 knots, depending on the weight. At speeds below 110 knots the drag characteristics are such that if a rate of sink is allowed to develop a large r.p.m. increase is required to check it. To ensure prompt and even response to throttle opening, it is recommended that the r.p.m. are kept above 7,000 until the decision to land has been made.

(c) If the surface is free from bumps and is dry, very small amounts of brake may be applied directly the nosewheel is on the ground. Braking may then be slowly increased as speed is reduced. If touchdown speeds are normal and it is necessary to pull up quickly, continuous braking may be used provided the brake drums are cold at touchdown. However, intermittent braking may be required to prevent overheating if the brake drums are hot at touchdown, or if the landing weight or speed is abnormally high.

(d) If the surface is in poor condition or is wet, or when a landing at an abnormally high speed is inevitable, very careful braking is required if wheel locking is to be avoided. There is little indication that the wheels are locked, except a slight tendency to yaw, together with decreased braking effect. In these circumstances, the brakes should always be used intermittently as a guard against wheel locking and a 50 per cent longer landing run should be expected. (See para. 80. Flapless landings.)

(e) *Going round again*

(i) With full flap and undercarriage down, it is easy to go round again from ground level using 9,000 r.p.m.; using this technique, there is less vibration before flaps are raised and the stick is in a more central position. Full power may be preferred, however, especially at night, in order to clear the ground quickly and to raise the undercarriage and flaps safely. With full power, the stick may be near its forward limit.

(ii) 1. Increase power as required.

2. Raise the undercarriage as required.

3. Raise the flaps to 30°. The nose-down trim change as the flaps retract may cause loss in height and they should not therefore be selected up until the aircraft is at least 200 feet above ground level.

79. Instrument approach

The following speeds and approximate power and flap settings are recommended for use during instrument approaches, with the undercarriage down. The figures apply with wing-tip tanks empty.

	R.P.M.	Flap setting	Airspeed knots
Pattern ..	7,500	One quarter	145
Final	7,500–8,000	One half	120–125
Glide path ..	6,500–7,000	One half*	115–120

* When the runway comes into view, lower the flaps fully and reduce airspeed to 115 knots.

80. Flapless landing

(a) The aircraft must be *at the minimum all up weight* before a flapless landing is attempted.

(b) Make the turn on to the final approach at 140 knots, reduce speed early and make a long flat approach. Cross the threshold at 125 knots. Below this speed, a strong pull force is required to hold the nose up, particularly in the engine-off condition and this may lead to difficulty if the speed is allowed to drop much below 125 knots on the approach.

(c) The landing run is considerably longer than usual, and *at least 2,000 yards will be required on good surfaces*. Be prepared to use airfield arrester gear when available.

81. Cross-wind landing

Particular care must be taken not to lock a wheel when landing in a cross-wind. Apply the brakes very gently at the beginning of the landing run.

82. Checks after landing

Flaps	Up
Brakes	Pressure sufficient for taxying
Cockpit pressurisation	OFF
PITOT HEAD heater switch	Off

83. Shut-down procedure

Allow the engine to idle for approximately 30 seconds to stabilise engine temperatures, lower the flaps fully, then:—

V.H.F.	OFF
Booster pump	OFF
H.P. cock	OFF
Tip-tank jettison switch	CLOSE
All other switches	Off
Chocks	In position
Brakes	Off
MICrophone switch	Off
Oxygen	Off
Hood jettison detonator	Safety pin in position
External control locks	In position
Wings	Wing-fold selector lever corresponding to position of wings. Wing fold struts in place
L.P. cock	OFF when engine has stopped turning. (This will prevent seepage of fuel to the combustion chambers and subsequent hot starts)
GROUND/FLIGHT switch	GROUND when generator warning light has come on and the engine has stopped
Flaps	Lower fully

PART IV

EMERGENCY HANDLING

84. Action in the event of engine failure in flight

(a) *Mechanical defect*

If the engine fails due to an obvious mechanical defect set:—

Throttle	SHUT
H.P. and L.P. cocks	Closed
Booster pump	Off
Non-essential electrical services	Off

Do not attempt to relight

(b) *Sudden drop in engine r.p.m.*

If an inexplicable drop in r.p.m. occurs in flight, close the throttle and set the H.P. pump isolating switch ON (i.e. pump isolated). Since, in these circumstances, the rate of fuel flow to the burners may not be under automatic control, reopen the throttle with care, to prevent overfuelling and a consequently high j.p.t. or even flame extinction. When the isolating switch is ON and Mod. 1129 is not incorporated, the maximum r.p.m. are liable to hunt between 9,900 and 10,400; this, though unpleasant, is not dangerous and can be eliminated by throttling back to 10,000 r.p.m. Large changes in r.p.m. (increasing with altitude) may be experienced for relatively small throttle movements and, during the descent, the throttle will have to be opened progressively to maintain constant r.p.m. Leave the switch ON until after landing and, because the idling thrust will be higher than normal, close the H.P. cock after touch-down if it is necessary to ensure the shortest possible landing run. If, following the use of the isolating switch, there is a flame-out, carry out the relighting procedure in paragraph 85 *but with the isolating switch ON and the throttle CLOSED.*

(c) If failure of the engine fuel system is suspected, set the H.P. pump isolating switch ON. If failure occurs following aerobatics or rapid acceleration of the engine, a flame-out is indicated, as distinct from a fuel system failure.

(d) *Flame-out*

(i) If a flame-out occurs, a relight may be attempted immediately, while r.p.m. are decreasing, by closing the throttle and pressing the relight button with the H.P. cock open. A successful relight will be indicated by the r.p.m. stabilising and then commencing to rise.

(ii) If no relight occurs within 10 seconds, release the relight button and proceed as follows:

Throttle	¼ open (shut if isolating switch ON)
H.P. cock	Closed
All non-essential electrics	Off (to conserve electric power)
Booster pump	ON if an immediate relight is to be made, otherwise OFF

85. **Relighting**

(a) Relighting may be accomplished at altitudes of up to 40,000 feet but is more certain at 30,000 feet and below. If the H.P. pump isolating switch is ON, no attempt must be made to relight above 30,000 feet.

(b) Check and/or set:—

Maximum altitude	See (a) above
Airspeed	180–250 knots
Windmilling speed	Not more than 1,800 r.p.m.
All non-essential electrics	Off (to conserve electric power)
Throttle	¼ open (shut if isolating switch ON)
Ground/flight switch	FLIGHT
H.P. pump isolating switch	As required (see 84 (c))
Booster pump	ON

(c) Press the relight button and, at the same time, move the H.P. cock *quickly* to the fully open position, keeping the relight button pressed for 15–20 seconds. Immediately a rise in r.p.m. or j.p.t. is observed, or after 5–6 seconds (see NOTE), close the throttle if it is open. The engine should then accelerate to the normal idling speed for the altitude.

NOTE.—It is possible that the two igniter combustion chambers may relight satisfactorily but combustion may not spread to the other chambers if the throttle is open. If, therefore, the engine has not relit normally within 5–6 seconds of reopening the H.P. cock, the throttle should be closed to encourage combustion to spread.

(d) When r.p.m. increase to idling speed, open the throttle *carefully* to the desired power setting. This is essential if the H.P. pump isolating switch is ON.

(e) If the engine has not relit within 30 seconds of opening the H.P. cock, close the cock again and wait about one minute before repeating the cycle of operations.

86. **Action in the event of the throttle jamming open**

In aircraft fitted with Ghost Mod. 470, the H.P. cock is tapered; this allows a measure of engine control in extreme emergency, the cock being used as a coarse throttle. Very small movements of the lever result in large r.p.m. changes and great care is needed to avoid stopping the engine.

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

WARNING.—Fire in the engine bay may render the flying controls and pressure instruments useless, necessitating immediate abandoning of the aircraft.

(a) Should the fire warning light come on, close the throttle immediately. If the light goes out within 5 seconds of closing the throttle, a hot gas leakage, as distinct from fire, is indicated. It is safe to use the engine in this condition but a landing should be made as soon as practicable. Reduced power should be used but, unless the power used is low, the light will probably come on again. It is therefore advisable frequently to throttle back fully, to ensure that a fire has not started.

(b) If the light does not go out after closing the throttle, proceed as follows:—

(i) Close the L.P. and H.P. cocks

(ii) Switch off the booster pump,

(iii) Turn emergency oxygen ON and turn cockpit pressurisation OFF.

(iv) Reduce speed as much as possible and press the fire-extinguisher button. If the fire is extinguished the fire-warning light should go out.

88. **Action in the event of hydraulic failure**

If the engine-driven hydraulic pump fails and the accumulator is exhausted, use the handpump between the seats to operate the undercarriage and flaps; it will not operate the airbrakes. To avoid possible dumping of hydraulic fluid, set the flap lever to neutral immediately hydraulic failure is suspected. Do not attempt to lower the flaps by the handpump until the undercarriage is down and locked. Up to 115 strokes of the handpump may be necessary to lock the undercarriage down.

89. **Undercarriage emergency retraction**

To retract the undercarriage in an emergency when the aircraft is on the ground, first operate the emergency retraction switch (19) and then raise the normal selector lever. This will not be possible if complete electrical failure has occurred.

90. **Action in the event of electrical failure**

If the generator fails, switch off all non-essential electrical services and set the turn and slip switch to EMERGENCY. The endurance of the main battery is approximately as follows:—

All services on	20 mins.
Radar off immediately, all other services on	40 mins.
V.H.F. and flight instruments only ..	1 hour

NOTE.—1. When the voltmeter reading falls to 21, all electrical services become inoperative.
2. With the booster pump inoperative, maximum r.p.m. will not be obtainable above 20,000 feet. This may cause engine surging and rough running.

91. **Action in the event of cockpit pressure failure**

(a) Cockpit pressure failure will be indicated by the red warning light (52) and the cockpit altimeter (53).

NOTE.—Should cracks, or other signs of failure appear in the perspex of the hood or windscreen, reduce cockpit pressure and speed to a safe minimum.

(b) If a type J mask is fitted, proceed as follows:—

(i) Set the emergency lever on the oxygen regulator to ON.

(ii) Turn the valve on the type J mask to the position marked H to inflate the pressure breathing waistcoat.

(iii) Descend as rapidly as possible to 30,000 feet or below, when the emergency lever may be switched OFF, the valve on the type J mask turned back to the normal position and high flow selected.

(c) If a type H mask is fitted, proceed as follows:—

(i) Set the emergency lever on the oxygen regulator to ON.

(ii) Descend as rapidly as possible to 30,000 feet or below.

(iii) Set emergency lever to OFF and check supply on HIGH flow.

92. **Action in the event of oxygen failure**

If the main oxygen supply fails, use the emergency bottle on the parachute and make an immediate descent to below 10,000 feet. The endurance of the emergency supply is about 10 minutes.

93. **Landing with a full tip tank on one side**

The minimum speed at which a straight approach can be made with a full tip tank on one side and an empty one on the other, is 130 knots. At speeds below this, there may not be sufficient aileron control to raise a wing.

94. **Hood jettisoning**

(a) If possible, reduce speed to below 240 knots, lower the seat fully and pull the jettison handle. If the hood is jettisoned below 150 knots, there is a danger of it striking the tail plane. Both occupants should lower their heads before the jettison handle is pulled.

(b) If operation of the explosive hood jettisoning has no effect, pull the ring handle behind the observer, to release the hood rear hinges *and after this* operate the opening handle to release the hood. Care must be taken to keep the hand unclenched to avoid a snatch on the wrist when the hood suddenly lifts. Attempts to jettison the hood by *first* operating the normal hood opening handle must never be made.

95. **Forced landing**

NOTE.—Experience suggests that it is preferable to lower the undercarriage when making a forced landing on an aerodrome or in open country. In the down position, it absorbs most if not all of the initial impact, assists in retarding the aircraft and, provided that electrical power is available, it may be retracted after touchdown if necessary. With the undercarriage up, the aircraft must be lowered gently on to the ground *at the normal speed*; if the speed is too low, a wing drop is likely to occur and if the speed is too high, the aircraft is prone to bounce, the initial impact having a damaging effect on the cockpit.

(a) In all cases of engine failure, when a relight is not possible, the following actions should be carried out:—

L.P. and H.P. cocks	OFF
Booster pump	OFF
All non-essential electrics	Off
Glide at 160 knots	

(b) Transmit distress call.

(c) If circumstances permit, jettison the hood and external stores and fuel.

(d) Release the emergency oxygen supply tube, the parachute harness and the dinghy pack and lanyard attachments to the life jackets.

(e) Turn off cockpit pressurisation if the hood has not been jettisoned.

(f) When manœuvring to land, maintain 140 knots until the selected area is within reach. Lower the flaps as required, aiming to cross the threshold of the landing area at 120 knots.

96. **Abandoning the aircraft**

Reduce speed, if possible, to between 150 and 200 knots and trim the aircraft as nose-heavy as stick forces permit. Invert the aircraft, release harnesses and fall out.

97. **Ditching**

(a) Ditching characteristics are believed to be poor, because of the probability of the tail booms hitting the water and causing a nose-down pitch and subsequent dive in. The tail booms may in some cases break off. It is therefore recommended that the aircraft be abandoned rather than ditched.

(b) Successful ditching in ideal conditions may be possible using the following technique:—

(i) The water must appear calm (but not glassy) and free from swell.

(ii) Jettison the hood, tip-tank fuel and all external stores.

(iii) Make a normal approach, using 10° to 15° of flap *only*, using engine assistance where possible.

(iv) The speed at touchdown must be 10 knots above the *normal* speed and any nose-up attitude likely to cause the tail booms to hit the water first must be avoided.

(v) Provided that the tail booms do not hit the water first at touchdown and if the sea is calm, the aircraft should plane well on its fuselage with the radome clear. To reduce any tendency to porpoise, the rate of descent at touchdown must be at a minimum.

PART V

OPERATING DATA

98. Loading and C.G. data

NOTE.—1. When making C.G. calculations, reference should always be made to A.P.4360A, Vol. 1, Section 2, Chapter 3.
2. All data below assumes the use of AVTUR fuel (8 lb./gall.).

(a) *Weight and C.G. limitations*

These are given in Part II (Limitations) para. 51.

(b) *Loading data*

(i) *Take-off*

The following loading conditions must be observed:—

1. *Pilot only—tip tanks empty.* The aircraft may be flown without equivalent ballast for the observer or ammunition.
2. *Pilot only—tip tanks full.* The aircraft may only be flown with full ammunition or ballast in lieu. If ammunition is carried, it may only be fired when at least 50 gallons of fuel have been used.
3. *Pilot and observer.* If a crew of two is carried, the ammunition may be fired at any stage of the flight, provided that the C.G. is not aft of 10.6 ins. a.o.d. initially.

(ii) *Landings*

Landings may be made at any time, provided that the wing-tip fuel has been used or jettisoned.

(c) *Effect of expendable stores*

(i) Consumption of tip-tank fuel causes the C.G. to move forward.

(ii) Consumption of internal fuel causes the C.G. to move aft initially, reaching the aftmost position when 2,320 lb. (290 galls.) remain. The C.G. then moves forward, reaching the most forward point when 280 lb. (35 galls.) remain.

(iii) Firing ammunition causes the C.G. to move aft.

(iv) Firing 60 lb. head R.P.s causes negligible C.G. movement.

(v) Firing other R.P.s causes the C.G. to move forward.

(d) *Typical service loadings*

The following are approximate weights for various loading conditions:—

Loading	A.U.W. (lb.)
2 crew, full fuel, full ammo. (600 rds.). R.P.s. ..	15,090
2 crew, full fuel, full ammo.	14,270
2 crew, full internal fuel, full ammo. R.P.s. ..	13,890
2 crew, full internal fuel, full ammo.	13,070
2 crew + 130 galls., full ammo. .. .. } 2 crew + 180 galls., no ammo. .. .. }	11,600

99. Pressure error correction

(a) *Airspeed*

The corrections (in knots) shown in the table below should be applied to the A.S.I. reading to obtain R.A.S. A Mk. 4 computor should be used to convert R.A.S. to T.A.S., as this computor allows for calibration compressibility error.

Height	A.S.I. reading	150	200	250	300	350	400	450	500
Sea Level	Correction	−2	−1	−1	−1	−1	−1	−2	−4
35,000 ft.	Correction	−2	−1	−2	−6				

(b) *Altitude*

The corrections shown below should be applied to the altimeter to obtain the true height.

Height	A.S.I. reading	150	200	250	300	350	400	450	500
Sea Level	Correction ft.	−20	−20	−20	−20	−30	−50	−110	−250

100. Fuel consumptions

The following are the approximate fuel consumptions in pounds per hour for various altitudes and power settings. If it is required to know the consumptions in gallons per hour, divide the figures by the weight of fuel per gallon:—

Normal AVTAG = 7.7 lb./gallon

AVTUR = 8.0 lb./gallon

Normal AVCAT = 8.3 lb./gallon

Height feet	At Max. r.p.m.	At 10,000 r.p.m.	At 9,750 r.p.m.	At best range speed
0	7,080	6,240	5,520	2,560
10,000	5,460	5,220	4,380	1,720
20,000	4,080	3,600	3,360	1,330
30,000	3,000	2,520	2,400	1,190
40,000	1,860	1,800	2,340	1,130

101. Take-off distances

The approximate distances (in yards) to unstick and to clear 50 ft., for various wind and temperature conditions, are given below:—

Aircraft configuration and weight	Temperature C.		−15	0	+15	+30	+45
Clean 14,270 lb.	Zero wind	Ground run	520	630	740	850	960
		To clear 50 ft.	850	1,030	1,220	1,400	1,590
	20 Kt. wind	Ground run	350	440	530	620	710
		To clear 50 ft.	610	770	920	1,070	1,220
With 8 × 60 lb. R.P.s.	Zero wind	Ground run	590	720	850	980	1,100
		To clear 50 ft.	970	1,190	1,410	1,620	1,840
15,090 lb.	20 Kt. wind	Ground run	410	520	630	730	840
		To clear 50 ft.	710	890	1,080	1,260	1,450

102. Flight planning data

(a) The tables on the following pages show the flight planning data for:—

(i) *Climbing*

The climb table gives the data for climb in I.S.A. conditions, using the speeds recommended in para. 66. Since the climb performance is dependent on temperature, corrections are given for each 10 C. rise in temperature above I.S.A.

(ii) *Cruising at best range speed*

Each separate altitude block in the cruise table shows:—

1. The speed for maximum range, the approximate A.N.M. per 100 lb. fuel and the approximate fuel consumption for the particular height. In addition, a speed band is given; use of any speed within this band should not cause more than a 5% reduction in range.

2. The range obtainable for various amounts of available fuel when flying at the best range speed for that height. The range given is to the point of let-down, allowance being made for the descent fuel required.

3. The range obtainable for various amounts of available fuel, including the distance covered on the climb, if a climb is made to another altitude. In this case the climb must be made at the speeds quoted in para. 66 and the flight continued at the new altitude, at the best speed for that height.

(iii) *Descent*

The descent table gives the data for descending from one height to another.

(b) *Use of the tables*

(i) *Pre-flight planning*

Enter the cruise data table in the sea-level block, at the fuel state applying immediately after take-off. Select the height at which maximum range is available at that fuel state. The distance available includes distance covered on the climb but not on the descent.

(Absolute maximum range is obtained by adding on the descent distance, provided that the let-down commences at that distance from the destination.) For short range flights, inspect the sea level block and select the height at which the distance to be covered requires the least amount of fuel. This is the best altitude for the flight.

(ii) *In-flight planning*

At any stage of the flight, the available range may be ascertained by applying the fuel state to the level flight range in the particular altitude block. If an increase in range is required, or if a climb has to be made, the new available range may be obtained by entering the existing altitude block at the particular fuel state and moving vertically downwards within the block until the new altitude is reached. Figures in heavy type indicate the best altitude for the maximum increase in range. Above these heights, no further range increase is possible. If a descent is necessitated, the new range is shown by moving direct from the existing altitude level flight range for the particular fuel state to the new altitude level flight range.

(c) *Cruise data charts*

The cruise data charts show aircraft performance and fuel consumption in level flight at various heights and r.p.m., both for the clean aircraft and when carrying rockets.

103. **Endurance**

At any altitude, maximum endurance will be obtained by flying at the I.A.S. which requires the lowest r.p.m. to maintain height. This speed is about 150 knots but the minimum comfortable speed is 175 knots. Increase in altitude gives increase in endurance: however, the overall endurance may not be improved by climbing above 15,000 feet, except when maximum fuel is available, owing to the proportion of fuel used on the climb and the descent. All climbs should be made at full power (within the limitations) and the descent made as quickly as is practicable.

CLIMB DATA—CLEAN AIRCRAFT

Climb at 10,250 r.p.m. below 25,000 ft.
10,100 r.p.m. above 25,000 ft.
and at speeds quoted in para. 66.

From	To	Lb. Fuel	Dist. N.M.	Mins.
Sea Level	10,000 ft.	220	12	2.5
	20,000 ft.	440	29	6.0
	30,000 ft.	655	52	10.0
	40,000 ft.	905	92	17.0
10,000 ft.	20,000 ft.	220	17	3.5
	30,000 ft.	435	40	7.5
	40,000 ft.	685	80	14.5
20,000 ft.	30,000 ft.	215	23	4.0
	40,000 ft.	465	63	11.0
30,000 ft.	40,000 ft.	250	40	7.0

Temperature correction to climb. For each 10 C. rise in ambient temperature apply the following corrections:—

From	To	Fuel	Dist.	Time
Sea Level	10,000 ft.	18%	17%	15%
10,000 ft.	20,000 ft.	19%	19%	15%
20,000 ft.	30,000 ft.	20%	21%	17.5%
30,000 ft.	40,000 ft.	21%	23%	20%

FUEL CONTENTS: 463 galls.
3,704 lb. AVTUR (8 lb./gall)
3,838 lb. Normal AVCAT (8.3 lb./gall)

TAXY AND TAKE-OFF ALLOWANCE . . . . 370 lb.

LANDING ALLOWANCE (excluding descent fuel) 620 lb.
(20 min. loiter 500 lb. unusable 120 lb.)

CRUISE DATA

NO EXTERNAL STORES

FUEL AVAILABLE	Pounds	3,400	3,000	2,500	2,000	1,500	1,000
	Gall. (AVCAT)	410	362	301	241	181	121
Sea Level	Range	309	264	209	153	98	**42**
ANM/100 lb. = 11.1	10,000 ft.	406	344	267	190	112	35
Lb./min. 42.7	20,000 ft.	512	429	325	221	**116**	—
Best range IAS 285 kts.	30,000 ft.	590	487	359	**230**	102	—
	40,000 ft.	**658**	**535**	**381**	226	—	—
95% range 210 kts.—0.51M							
10,000 ft.	Range	—	366	289	212	134	**57**
ANM/100 lb. = 15.5	20,000 ft.	—	463	359	254	**150**	46
Lb./min. = 28.7	30,000 ft.	—	531	403	275	146	—
Best range IAS = 233 kts.	40,000 ft.	—	**591**	**436**	**282**	128	—
95% range 175 kts.—0.535M							
20,000 ft.	Range	—	492	387	283	179	**75**
ANM/100 lb. = 20.8	30,000 ft.	—	571	442	314	**186**	58
Lb./min. 22.2	40,000 ft.	—	**642**	**488**	**333**	179	—
Best range IAS 206 kts.							
95% range 175 kts.—0.56M							
30,000 ft.	Range	—	—	475	346	218	**90**
ANM/100 lb. 25.7	40,000 ft.	—	—	**531**	**376**	**222**	68
Lb./min. 19.8							
Best range IAS 194 kts. (0.52M)							
95% range 175 kts.—0.625M							
40,000 ft.	Range	—	—	**568**	**414**	**259**	**105**
ANM/100 lb. 30.9							
Lb./min. 18.8							
Best range IAS 181 kts. (0.61M)							
95% range 0.575M—0.67M							
FUEL AVAILABLE	**Pounds**	3,400	3,000	2,500	2,000	1,500	1,000
	Gall. (AVTUR)	425	375	313	250	188	125

DESCENT DATA—CLEAN AIRCRAFT

Airbrakes .. .. Out

R.P.M. 6,500

Speed .. .. .. 0.67 M above 25,000 ft.
270 knots below 25,000 ft.

From	To	Lb. Fuel	Dist. N.M.	Mins.
40,000 ft.	30,000 ft.	10	9	1.5
	20,000 ft.	20	15	2.5
	10,000 ft.	30	24	4.0
	Sea Level	40	35	6.0
30,000 ft.	20,000 ft.	10	6	1.0
	10,000 ft.	20	15	2.5
	Sea Level	30	26	4.5
20,000 ft.	10,000 ft.	10	9	1.5
	Sea Level	20	20	3.5
10,000 ft.	Sea Level	10	11	2.0

CLIMB DATA

WITH 8×60 LB. R.P.s

Climb at 10,250 r.p.m. below 25,000 ft.
10,100 r.p.m. above 25,000 ft.
and at speeds quoted in para. 66.

From	To	Lb. Fuel	Dist. N.M.	Mins.
Sea Level	10,000 ft.	290	17	3.5
	20,000 ft.	580	41	8.0
	30,000 ft.	880	79	14.5
	40,000 ft.	1,290	155	27.0
10,000 ft.	20,000 ft.	290	24	4.5
	30,000 ft.	590	62	11.0
	40,000 ft.	1,000	138	23.5
20,000 ft.	30,000 ft.	300	38	6.5
	40,000 ft.	710	114	19.0
30,000 ft.	40,000 ft.	410	76	12.5

Temperature correction: As for clean aircraft.

Fuel contents and allowances: As for clean aircraft.

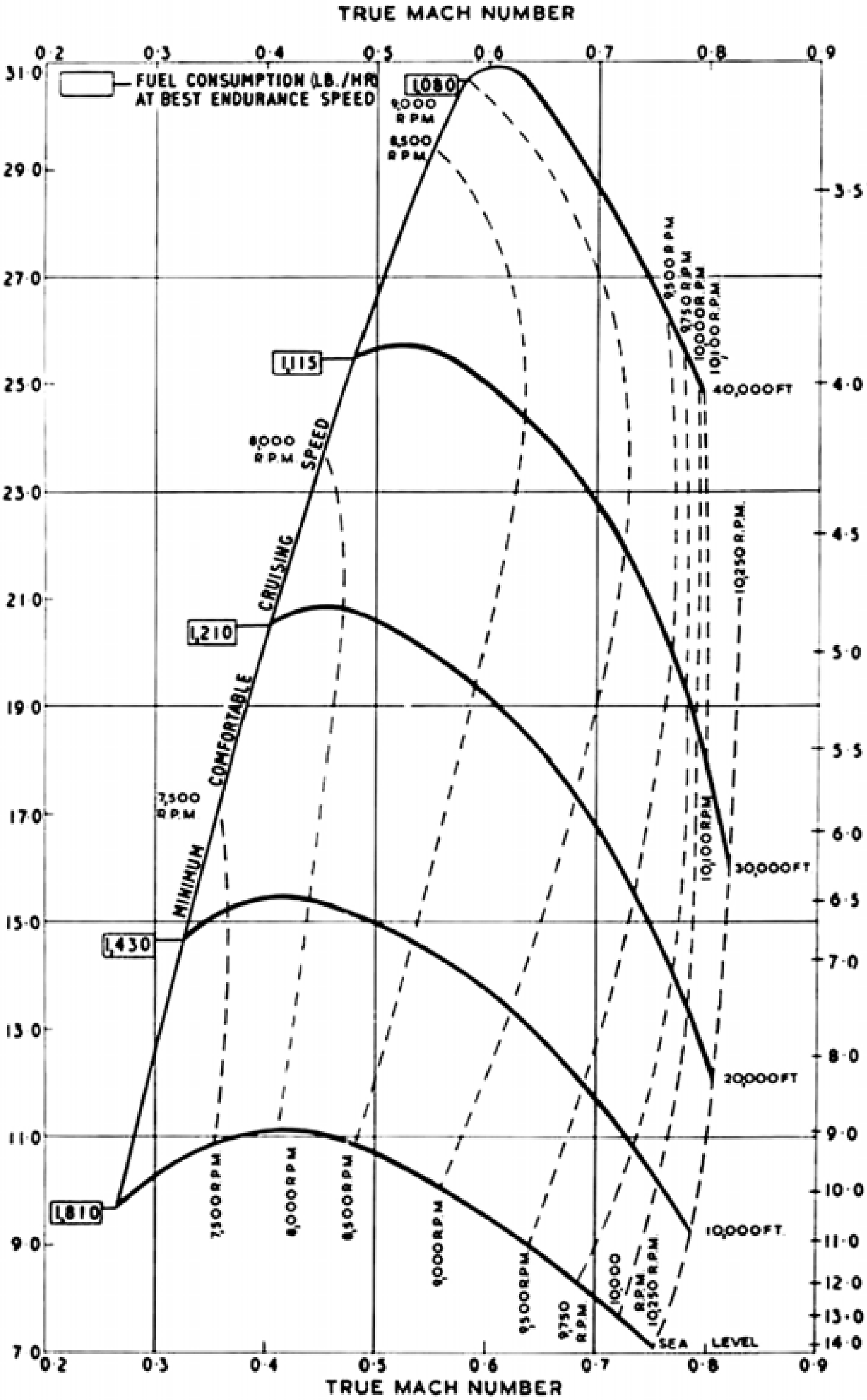
DESCENT DATA

As for clean aircraft.

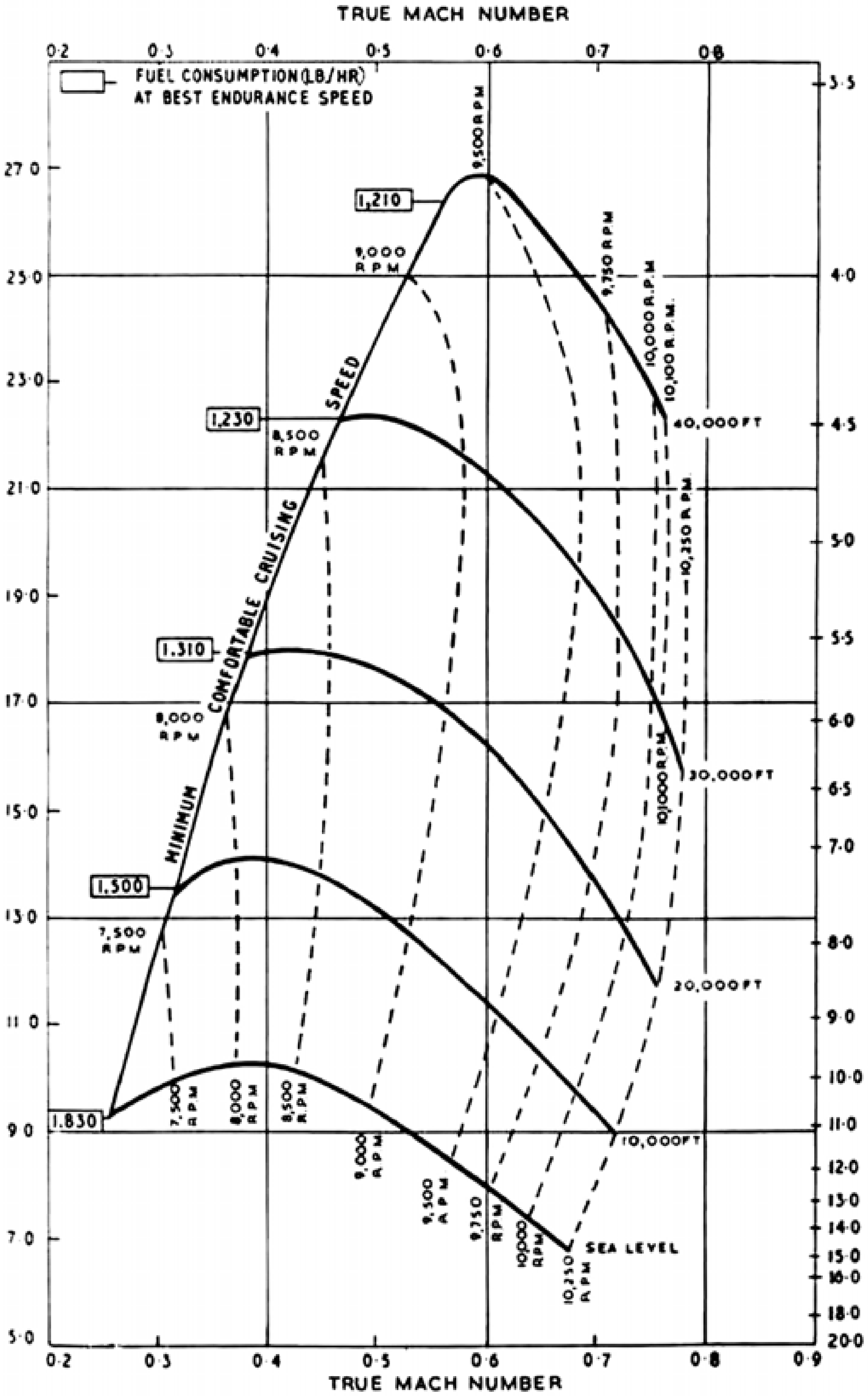
CRUISE DATA

WITH 8×60 LB. R.P.s

FUEL AVAILABLE	Pounds	3,400	3,000	2,500	2,000	1,500	1,000
	Gall. (AVCAT)	410	362	301	241	181	121
Sea Level	Range	286	245	194	142	91	**39**
ANM/100 lb. 10.3	10,000 ft.	365	310	240	169	**99**	28
Lb./min. 43.3	20,000 ft.	433	361	271	181	91	—
Best range IAS 268 kts.	30,000 ft.	498	408	298	**184**	—	—
	40,000 ft.	**546**	**438**	**303**	169	—	—
95% range 200 kts.—310 kts.							
10,000 ft.	Range	—	334	264	193	123	**52**
ANM/100 lb. 14.15	20,000 ft.	—	397	307	217	**127**	37
Lb./min. 29.5	30,000 ft.	—	456	344	**232**	120	—
Best range IAS 218 kts.	40,000 ft.	—	**499**	**364**	230	—	—
95% range 165 kts.—260 kts.							
20,000 ft.	Range	—	—	335	245	155	**65**
ANM/100 lb. 18.0	30,000 ft.	—	—	385	273	**161**	49
Lb./min. 24.0	40,000 ft.	—	—	**418**	**284**	149	—
Best range IAS 191 kts.							
95% range 165 kts.—0.546M							
30,000 ft.	Range	—	—	414	302	190	**78**
ANM/100 lb. 22.4	40,000 ft.	—	—	**461**	**327**	**192**	—
Lb./min. 21.3							
Best range IAS 180 kts.							
95% range 165 kts.—0.598M							
40,000 ft.	Range	—	—	—	**361**	**226**	**92**
ANM/100 lb. 26.9							
Lb./min. 20.7							
Best range IAS 173 kts. (0.584M)							
95% range 0.562M—0.66M							
FUEL AVAILABLE	**Pounds**	3,400	3,000	2,500	2,000	1,500	1,000
	Gall. (AVTUR)	425	375	313	250	188	125



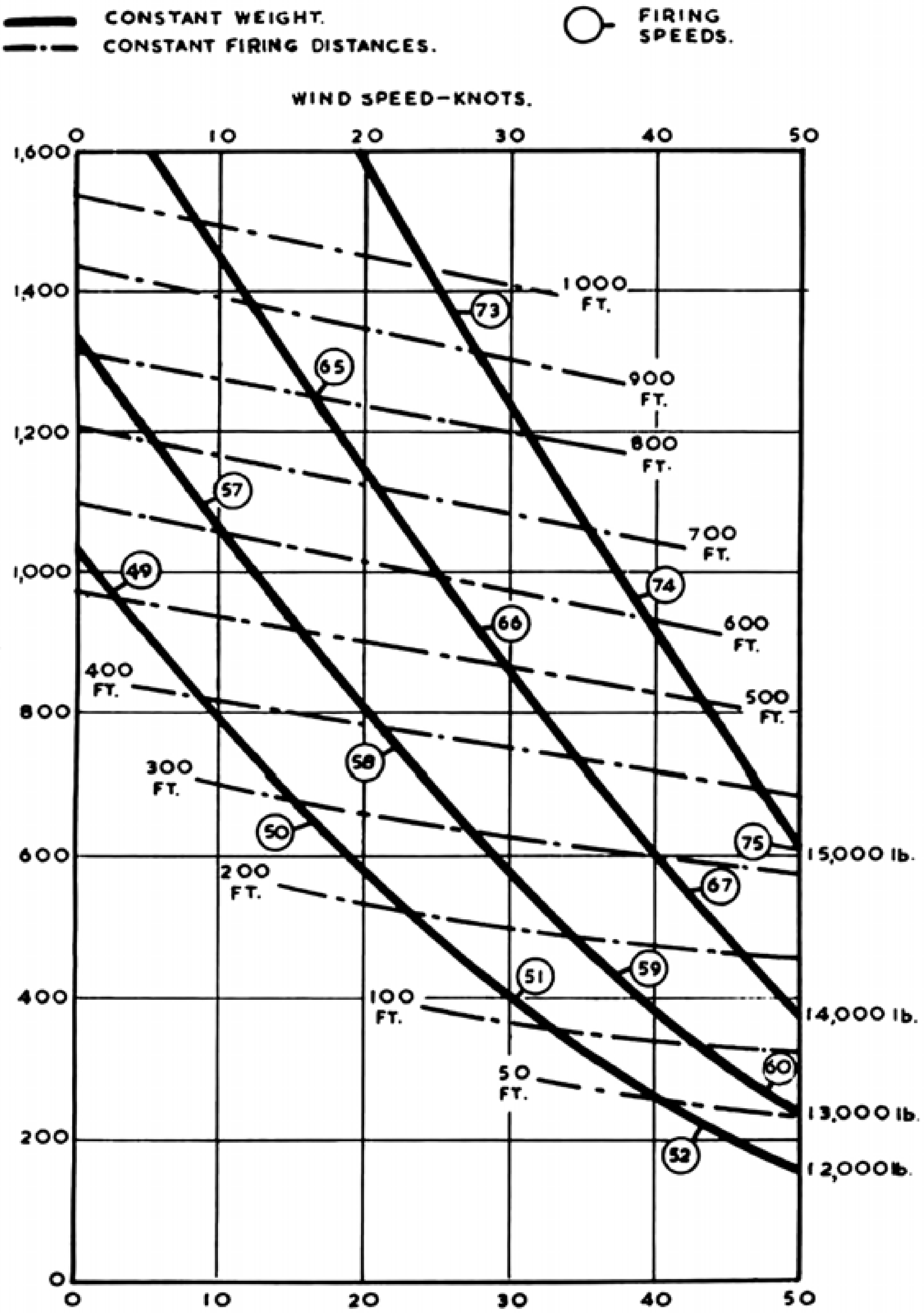
CRUISE DATA CHART – NO EXTERNAL STORES



CRUISE DATA CHART — 8 X 60 LB R.P.s

104. Use of the R.A.T.O. chart

The chart is used to determine the take-off distance for a given A.U.W. and wind speed when using $4 \times 1{,}100$ lb. thrust rockets. The dotted lines show the distance from the start of the run at which the rockets should be fired and the numbers in the circles show the appropriate airspeed (in knots) for firing.



ROCKET-ASSISTED TAKE-OFF.

PART VI

ILLUSTRATIONS

KEY TO FIGURES 1, 2 and 3

1. Port shelf lamps dimmer switch
2. Wing spread/fold lever
3. Wing locking lever
4. U.V. lamps dimmer switch
5. Red lamps master switch and dimmer
6. I.F.F. F and D switches
7. R.A.T.O.G. jettison switch
8. Pilot's quick-release mic/tel socket
9. Pilot's harness release lever
10. Wing lock magnetic indicators
11. Tip-tank fuel jettison switch
12. H.P. cock lever and relight button
13. Elevator trim indicator
14. Throttle lever, press-to-transmit button and G.G.S. range control
15. Throttle friction damper
16. Airbrakes control lever
17. Aileron trim switch
18. Pneumatic triple-pressure gauge
19. Undercarriage emergency override switch
20. Elevator trim control
21. L.P. cock lever
22. Flap selector lever.
23. Arrester hook indicator light
24. Cockpit air conditioning control
25. Arrester hook control lever
26. V.H.F. controller
27. Signal discharger switch (inoperative)
28. Windscreen wiper control
29. Undercarriage warning light
30. Undercarriage position indicator
31. Flap position indicator
32. E.2A compass
33. Undercarriage selector lever
34. Radio altimeter
35. Generator failure warning light
36. Mk. 4B compass
37. Gyro gunsight
38. Emergency lamp switch
39. Gunsight emergency retraction lever
40. G.G.S. control switch
41. Fuel gauge and main tanks contents button
42. Camera sunny/cloudy switch

43. R.P. salvo/pairs selector switch
44. R.A.T.O.G. safety and master switches
45. Engine fire-warning light and extinguisher pushbutton
46. R.A.T.O.G. yellow warning light
47. Guns/R.P. master switch
48. Flight instruments master switch
49. Fuel transfer magnetic indicators
50. Fuel pressure warning light
51. H.P. pump isolating valve switch
52. Cockpit pressure warning light
53. Cockpit pressure altimeter
54. Pilot's oxygen regulator
55. R.P. auto-distributor
56. G.G.S. selector-dimmer control
57. Starter master switch
58. Starter pushbutton
59. Windscreen de-icing control
60. Observer's foot-operated muting switch
61. Hood jettison control
62. Fuel booster pump switch
63. Engine oil temperature gauge
64. Voltmeter
65. Four circuit breakers, from left to right:—
    - Inverter B
    - Inverter A
    - Gunsight
    - Fuel booster pump
66. External lights circuit breaker
67. Generator field circuit breaker
68. Louvre
69. Inspection and chartboard lamps switch
70. Observer's oxygen regulator
71. Inspection and chartboard lamps socket
72. Observer's harness release
73. ZBX controller
74. Hatch strut release
75. Intercomm. switch
76. Intercomm. normal/emergency switch
77. R/T tels/beacon switch
78. IFF controller
79. IFF controls
80. R/T-mix-beacon switch
81. Fuel booster pump test sockets
82. Mk. 4B compass control
83. Observer's red lamps dimmer switch
84. Landing lamp switch
85. Navigation lights switch and morse pushbutton
86. Identification lights switch and morse pushbutton
87. Four switches, from left to right:—
    - Pressure head heater
    - Inverter B
    - Camera master
    - Radar A.C. supply
88. Ground/flight switch
89. Stick shaker switch

7 8 9 10 11 12 13 14 15 16

6

5

4

3

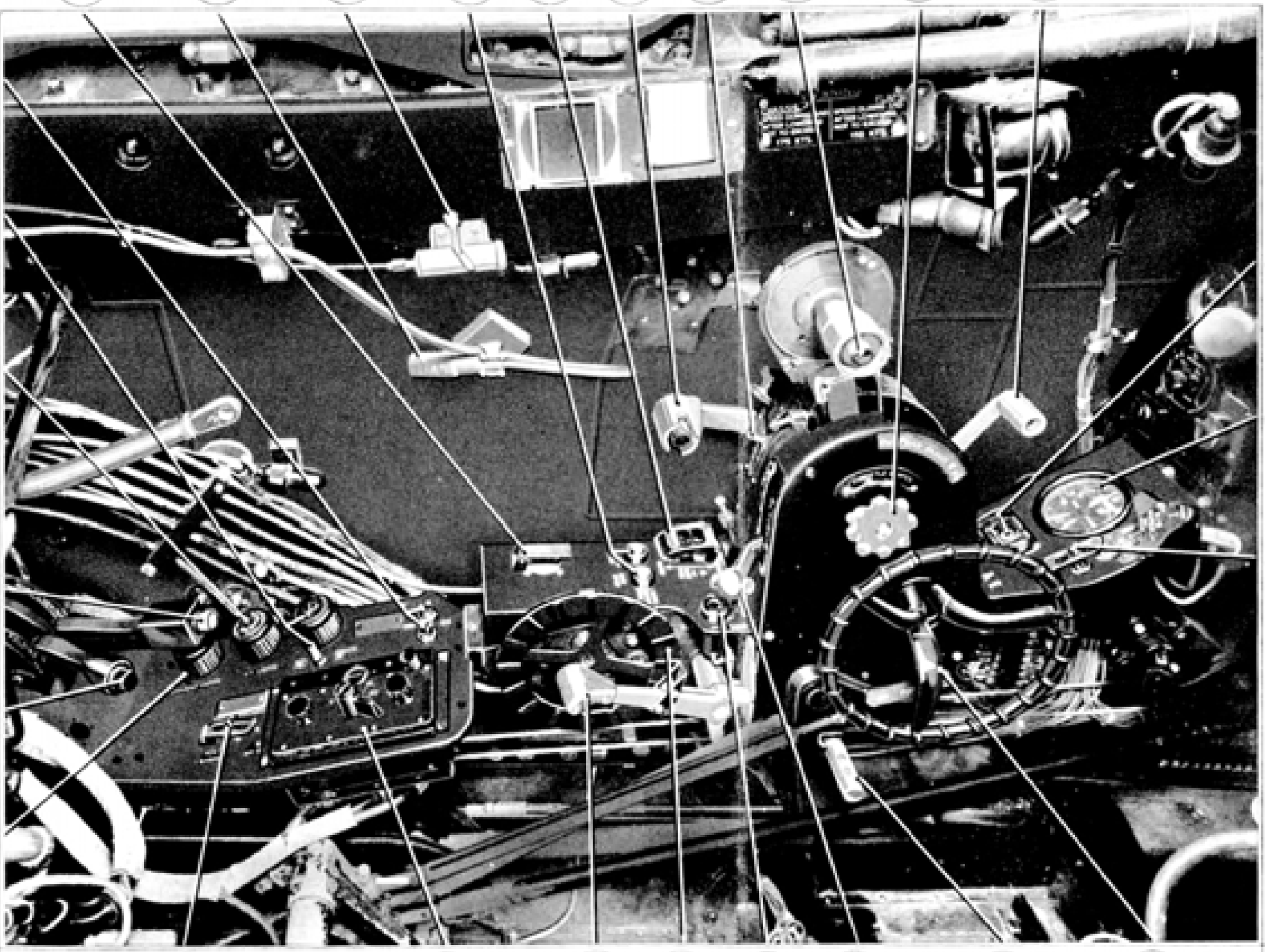
2

1

17

18

19



27 26 25 24 23 22 21 20

FIG 1

FIG 1

COCKPIT-PORT SIDE

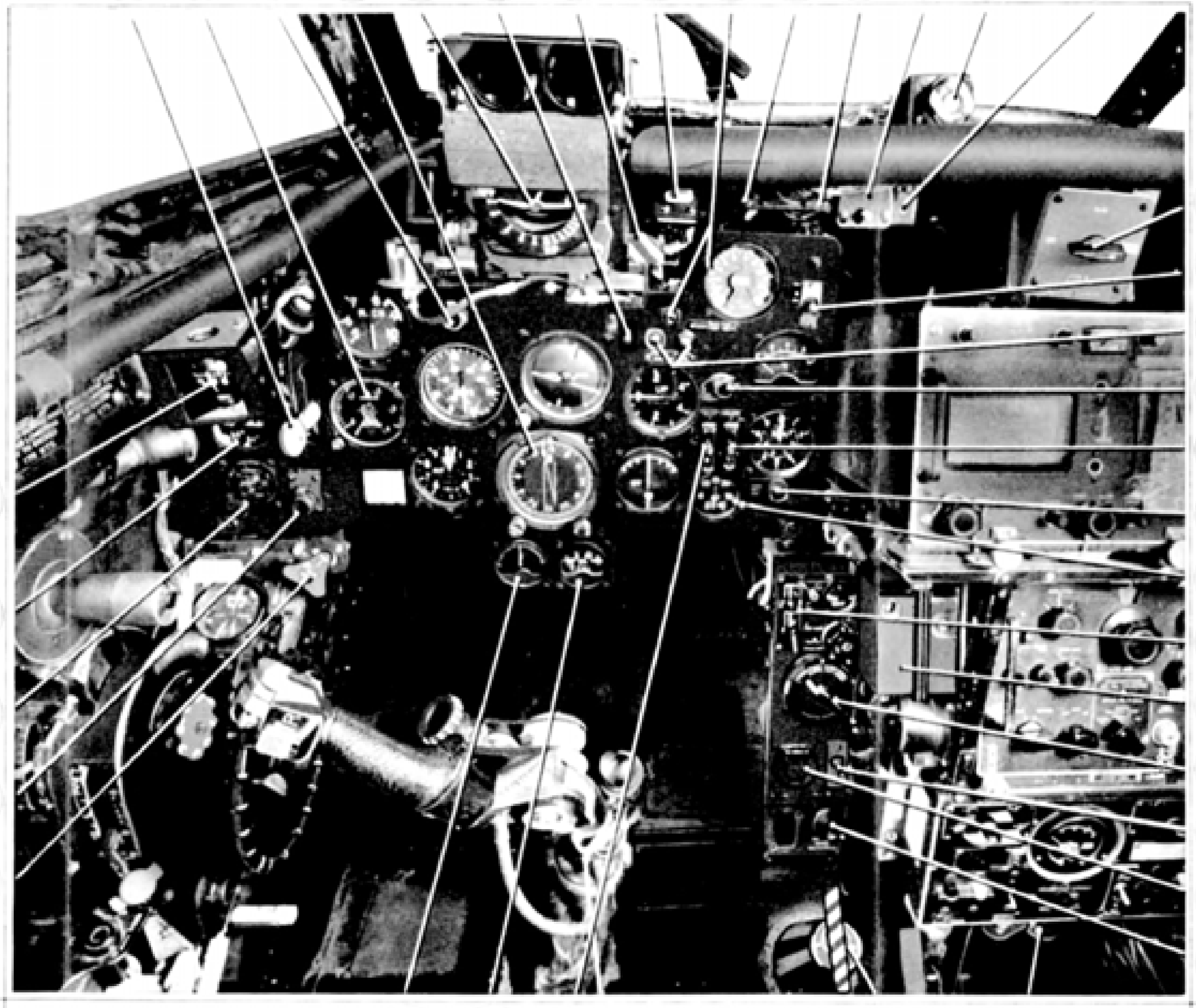


FIG 2

COCKPIT — FORWARD VIEW

FIG 2

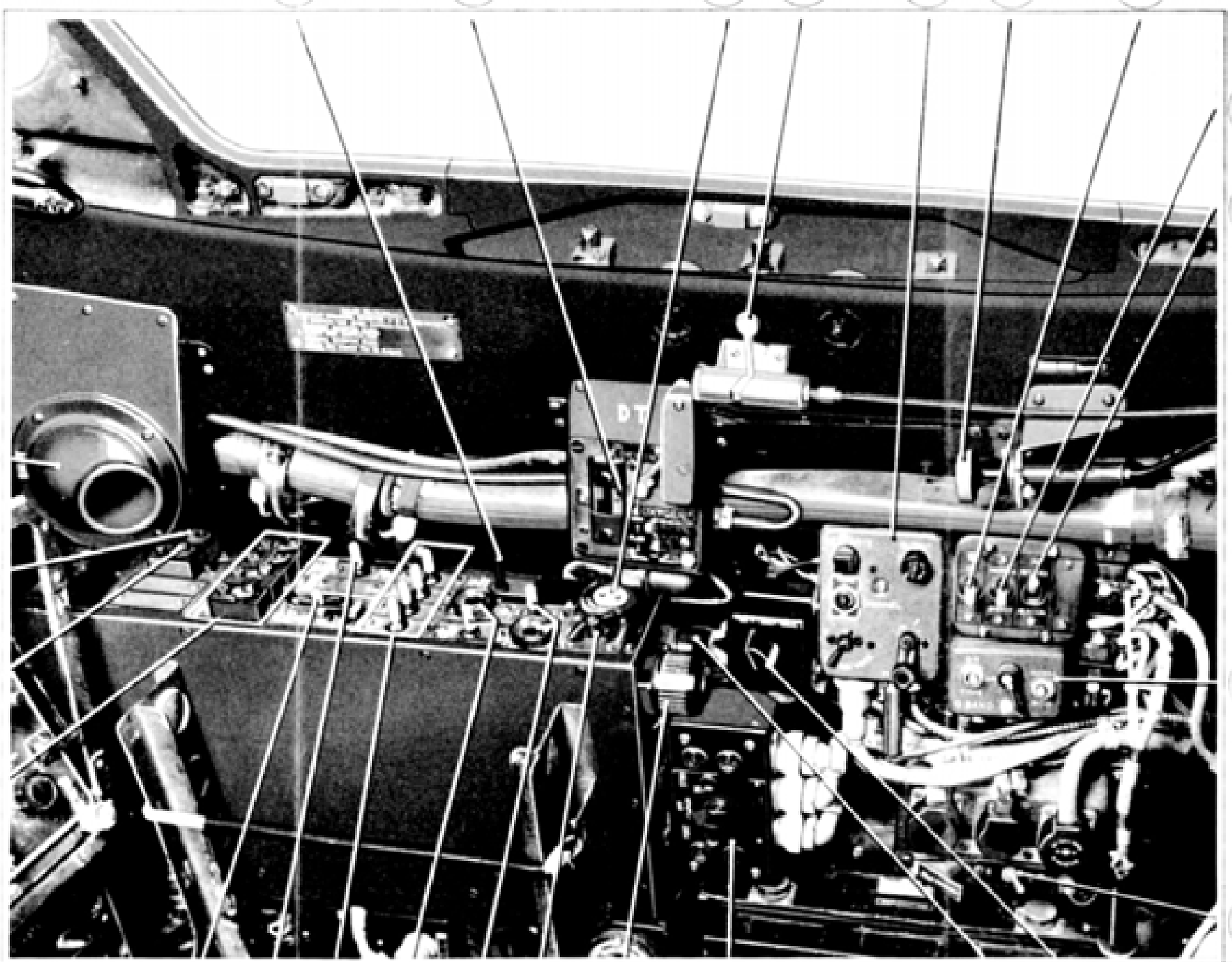


FIG 3

COCKPIT- STARBOARD SIDE

FIG 3

EMERGENCY DRILLS

ENGINE FAILURE

1. If mechanical failure DO NOT RE-LIGHT

Throttle	Shut
H.P. and L.P. cocks	Closed
Booster pump	OFF
Non-essential electrics	Off

2. Flame-out
Attempt relight immediately. If no re-light within 10 seconds

Throttle	¼ open (shut if isolating switch ON)
H.P. cock	Closed
Non-essential electrics	Off
Booster pump	ON if immediate relight to be made, otherwise OFF

RELIGHTING

Height	Below 40,000 ft. if isolating switch OFF. Below 30,000 ft. if isolating switch ON.
Speed	180–250 kts.
Windmilling speed	Not more than 1,800 r.p.m.
Non-essential electrics	Off.
Throttle	¼ open (shut if isolating switch ON).
Ground flight switch	FLIGHT.
Booster pump	ON.

Press relight button and open H.P. cock quickly, keeping button pressed 15–20 seconds. Close throttle when r.p.m. rise or after 5–6 seconds. Open throttle carefully when idling r.p.m. attained.

ENGINE FIRE

1. Close throttle immediately.
2. If light remains on:—

L.P. and H.P. cocks	Closed
Booster pump	OFF
Emergency oxygen	ON
Pressurisation	OFF
Speed	Minimum

3. Press extinguisher button. Light goes out if fire extinguished.

HOOD JETTISON

1. Speed below 240 kts.
2. Pull jettison handle.
3. If unsuccessful:—
Pull rear ring, then open normally, keeping hand unclenched.

ABANDONING

1. Speed	150–200 kts.
2. Trim	Nose-heavy.

3. Invert aircraft, release harness, fall out.

HYDRAULIC FAILURE

Set flap lever to neutral.

Use handpump after making normal selection.

Lower undercarriage before operating flaps.

LOSS OF COCKPIT PRESSURE

1. Type J mask

Emergency oxygen	ON
Valve on mask	H

Descend rapidly to 30,000 ft. or below.

2. Type H mask

Emergency oxygen	ON

Descend rapidly to 30,000 ft. or below.

OXYGEN FAILURE

1. Use emergency oxygen on parachute.
2. Descend below 10,000 ft.

CHECK LISTS

CHECKS BEFORE TAKE-OFF

(a) Free take-off.

Trimmers	All neutral.
Aileron gear	Halfway.
Airbrakes	IN.
Wings	Spread and locked. Indicators black. External indicators flush. Both levers fully up in gates. Wing fold doors closed.
Fuel	H.P. and L.P cocks fully on. Contents. Booster pump ON. Isolating switch as required. Tip-tank fuel jettison switch CLOSED (JETTISON if tanks empty).
Flaps	30°.
Instruments	FLIGHT INSTRUMENTS switch ON. INVERTER B switch ON. Artificial horizon erect. Turn indicator functioning. PITOT HEAD heater ON. Mk. 4B compass synchronised with E2A.
Oxyger	ON, reaching mask, EMERGENCY OFF, low flow (high if cockpit altitude to exceed 25,000 ft.)
Hood	Shut and locked, catch engaged, seal inflated. D.V. panel closed. Pressure OFF, HOT or REDUCE.
Harness	Tight and locked.

(b) R.A.T.O.

The following alterations and additions should be made to check list (a):

Trimmers	Elevator 1 div. nose-down.
Flaps	45°.
RATOG safety switch	Disengaged (to port). Yellow warning light on.

CHECKS BEFORE LANDING

Airbrakes	IN.
Arrester hook	Up, light out.
Undercarriage	Locked down, selector lever in slot. Three green lights.
Brakes	Check pressures. Off.
Fuel	Contents.
Flaps	Fully down on finals.
Harness	Tight and locked.
Radar	Off.

INSTRUMENT APPROACH

1. Downwind

   7,500 r.p.m. ¼ flap. 145 knots.

2. Base Leg

   7,500–8,000 r.p.m. ½ flap. 120–125 knots.

3. Glide path

   6,500–7,000 r.p.m. ½ flap. 115–120 knots.

4. When runway in view, lower flaps fully and reduce speed to 115 knots.

ENGINE LIMITATIONS

Take-off and operational necessity (30 mins)	10,250 r.p.m.*	725° C.
Max. continuous	9,750 r.p.m.	625° C.
Approach (min.)	5,000 r.p.m.	—
Ground idling	3,000 ± 200 r.p.m.	450° C.

* Max. r.p.m. to be reduced to 10,100 above 25,000 ft. in climb and above 35,000 ft. in level flight.