2nd EDITION

A.P. 2210 D.—P.N.

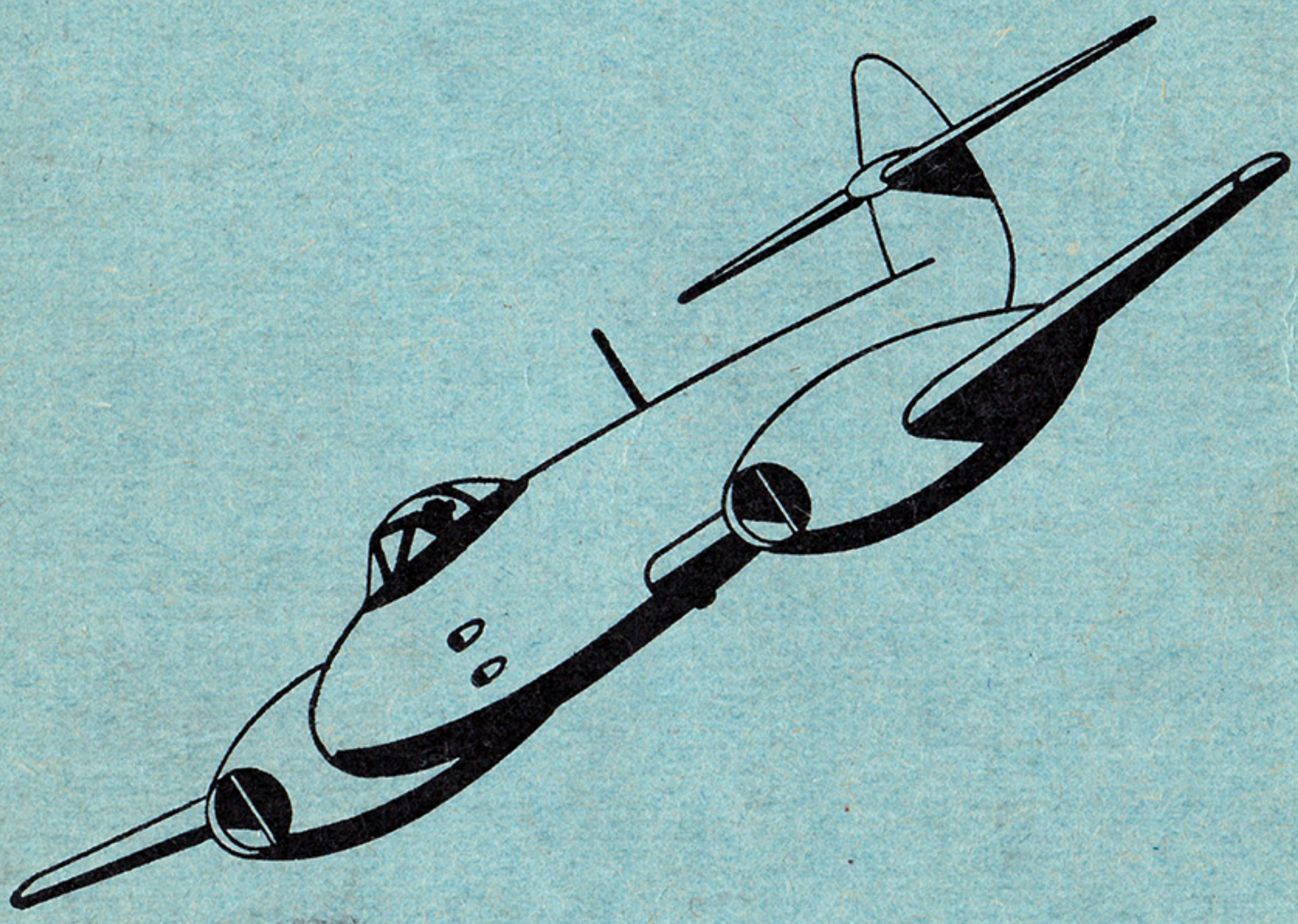
PILOT'S NOTES

FOR

Fighter

METEOR 4

TWO DERWENT 5 ENGINES



PREPARED BY DIRECTION OF THE MINISTER OF SUPPLY

A. C. Powlett.

PROMULGATED BY ORDER OF THE AIR COUNCIL

J. H. Barnes.

AMENDMENTS

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

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

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

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

NOTES TO USERS

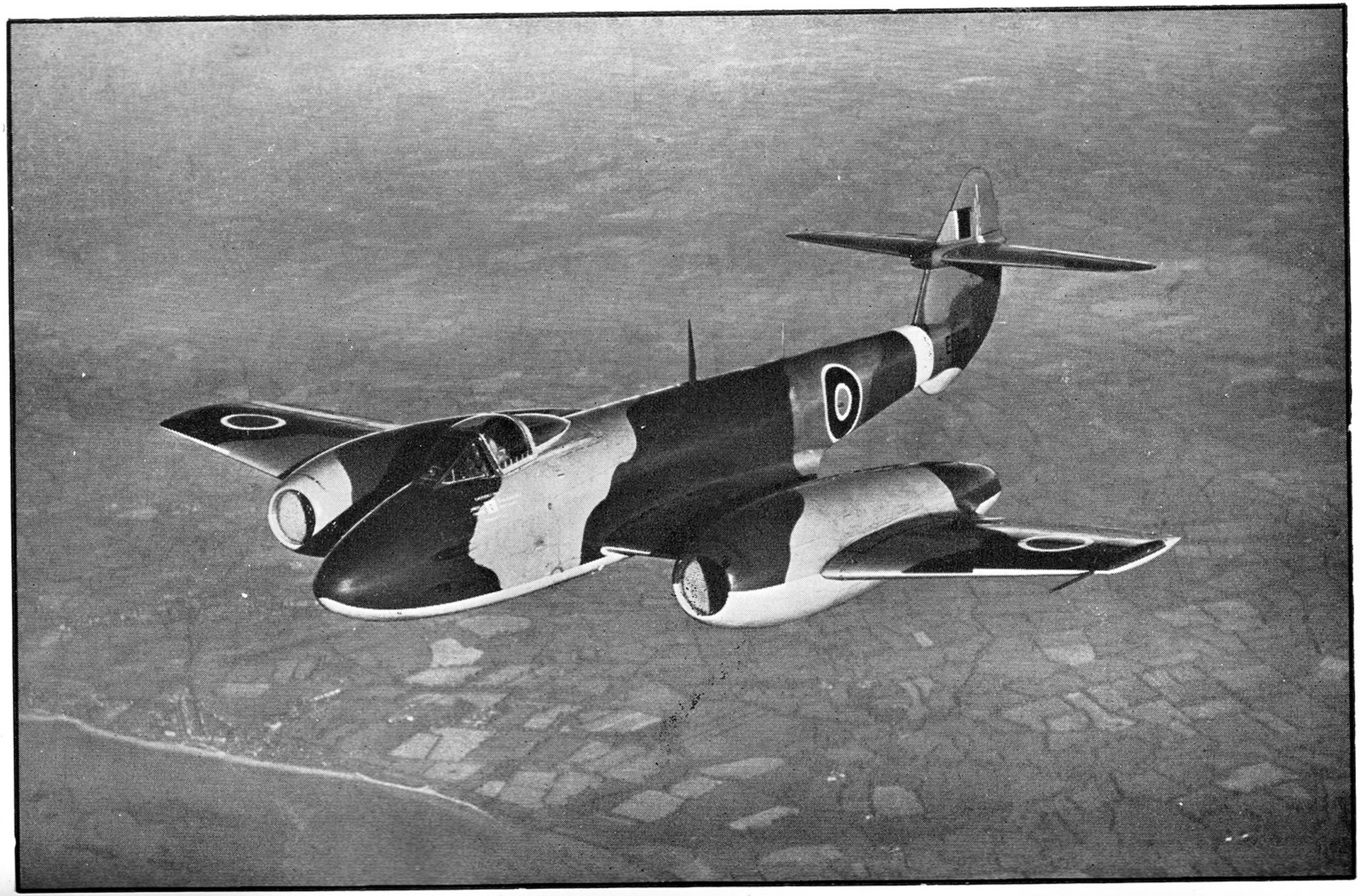
THIS publication is divided into five parts : Descriptive, Handling, Operating Data, Emergencies and Illustrations.

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

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

Additional copies may be obtained by the Station Publications Officer by application on Form 294A, in duplicate, to Command headquarters for onward transmission to A.P.F.S. (see A.M.O. A1114/44). The number of this publication must be quoted in full —A.P. 2210D—P.N.

Comments and suggestions should be forwarded through the usual channels to the Air Ministry (D.T.F.)



AIR MINISTRY
July, 1948
2nd Edition

A.P. 2210D—P.N.
Pilot's Notes

NOTE.—This 2nd edition supersedes and cancels edition dated October, 1947.

METEOR 4

LIST OF CONTENTS

PART III—OPERATING DATA

PART IV—EMERGENCIES

PART V—ILLUSTRATIONS

METEOR 4

PILOT'S CHECK LIST

(Excluding Checks of Operational Equipment).

	ITEM	CHECK
1.	Weight and balance.	Ballasted as necessary.
2.	Authorisation book.	Sign.
	External checks. N.B.—Start at the port side of the nose and work clockwise round the aircraft.	
3.	Cockpit hood (port side).	Condition. Absence of cracks. Security.
4.	External hood jettison handle.	Secure.
5.	Nose wheel mechanical indicator.	Protruding.
6.	Nose wheel.	Extension of oleo. Security of mudguard. Tyre for cuts and creep. Valve free. Condition of doors and fairings.
7.	External fire-extinguishers.	In position.
8.	Cockpit hood (starboard side).	Condition. Absence of cracks. Security.
9.	Starboard centre section.	Condition of leading edge.
10.	Starboard nacelle.	All cowlings secure. Intake cover removed.
11.	Starboard undercarriage.	Condition of doors. Brake leads secure. Tyre for cuts and creep. Valve free. Chock in position. Pump and ignition isolating switches on.
12.	Starboard mainplane.	Condition of leading edge.
13.	Starboard navigation light.	Condition.
14.	Starboard aileron.	Condition. External control lock removed.
15.	Starboard mainplane.	Condition of upper and lower surfaces. Picketing ring removed. Condition of flaps and air brakes.
16.	Starboard nacelle.	Jet pipe cover removed.
17.	Starboard fuselage.	Condition.
18.	External aerial.	Secure.
19.	Fin.	Condition. Leading edge.
20.	Starboard tailplane.	Condition. Leading edge.
21.	Starboard elevator.	Condition. Trimmer. External control lock removed.

	ITEM	CHECK
22.	Rudder.	Condition. Trimmer. External control lock removed.
23.	Tail light.	Condition.
24.	Port elevator.	Condition. Trimmer. External control lock removed.
25.	Port tailplane.	Condition. Leading edge.
26.	Emergency skid.	Condition.
27.	Port fuselage.	Condition.
28.	Port nacelle.	Jet pipe cover removed.
29.	Port mainplane.	Condition of upper and lower surfaces. Picketing ring removed. Condition of flaps and air brakes.
30.	Port aileron.	Condition. External control lock removed.
31.	Port navigation light.	Condition.
32.	Pressure head.	Cover removed.
33.	Port mainplane.	Condition of leading edge.
34.	Port nacelle.	All cowlings secure. Intake cover removed.
35.	Port undercarriage.	Condition of doors. Brake leads secure. Tyre for cuts and creep. Valve free. Chock in position. Pump and ignition isolating switches on.

	ITEM	CHECK
36.	Ground/flight switch.	Flight.
37.	Port centre section.	Condition of leading edge.
38.	Ventral drop tank.	Secure.
39.	Dispersal area.	All clear around aircraft.
	Internal checks.	
40.	Internal control locks.	Removed.
41.	Pilot's seat.	Adjust for height.
42.	Rudder pedals.	Adjust for length.
43.	Flying controls.	Full and correct movement.
	Cockpit check.	
	N.B.—Work from left to right.	
44.	Port high pressure cock.	On.
45.	Port low pressure cock.	On.
46.	Balance cock.	Shut.
47.	Crowbar.	In position.
48.	Air pressure gauge.	Supply. Delivery to each wheel brake.
49.	Rudder trim control.	Full and correct movement.
50.	Elevator trim control.	Full and correct movement.
51.	Air brakes lever.	Off (forward).
52.	Pressurising control.	Cold.
53.	Port low pressure pump switch.	Off.

	ITEM	CHECK
54.	Starboard low pressure pump switch.	Off.
55.	Fuel pressure warning lights.	On.
56.	Landing lamp switch.	Operation. Retract lamp.
57.	Flap lever.	Neutral.
58.	Undercarriage selector lever.	Down.
59.	Undercarriage indicator.	Operation.
60.	Undercarriage warning light.	Out.
61.	Flap indicator.	Compare with position of flaps.
62.	Ventral drop tank transfer control.	Off. Handle in.
63.	Altimeter.	Set.
64.	Direction indicator.	Caged.
65.	Hood jettison handle.	In.
66.	Fuel gauges.	Contents.
67.	Cabin altimeter.	Reading.
68.	Oxygen.	Delivery.
69.	Generator failure warning light.	On.
70.	Navigation lights switch.	As required.
71.	Identification lights switch.	As required.
72.	R.I. compass switch.	Off.
73.	Pressure head heater switch.	Off.
74.	Hood.	Rubber seal deflated. Operation of winding handle.
75.	Hydraulic handpump.	Pump flaps down and up.
76.	Windscreen de-icer.	Operation.
77.	Starboard high pressure cock.	On.
78.	Starboard low pressure cock.	On.
79.	Pilot's harness.	Adjust. Test lock.
80.	Form 700.	Sign.
81.	Ground/flight switch.	Ground.

Start and test engines (see paras. 37 and 38).

82.	Generator failure warning light.	Out.
83.	Fuel pressure warning lights.	Out.
84.	Fire warning lights.	Out. (later aircraft only).
85.	Vacuum change-over cock.	Operation.

ITEM		CHECK
86.	Flaps.	Lower. Indicator reading. Raise Selector neutral.
87.	R.I. compass.	Switch on.
88.	Direction indicator.	Set with R.I. compass. Uncage.
89.	Radio.	Test V.H.F. and other radio aids. Check altimeter setting with Control.
90.	Pneumatic pressure.	Supply increasing. (later aircraft with compressor).
91.	Cabin pressure warning light.	Out.
92.	Chocks.	Clear.
93.	Taxying.	As soon as possible test brakes. Direction indicator for accuracy. Artificial horizon for accuracy. Check temperatures and pressures. Check brake pressures. Pressure head heater on if required. Check accuracy of R.I. compass against known heading.

Checks before take-off (see para. 41).

Checks in flight as necessary

Checks before landing (see para. 49 (i)).

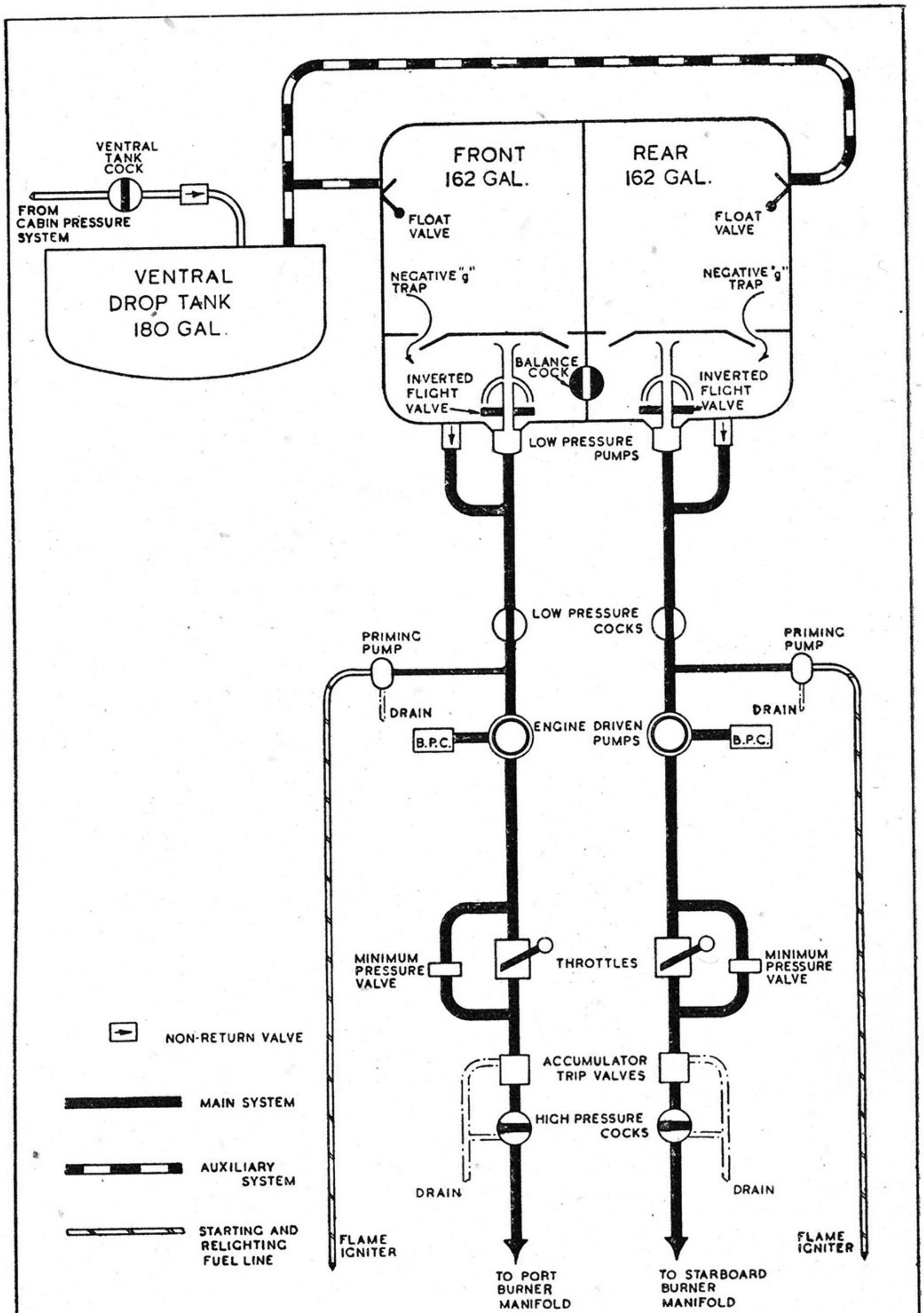
After landing.		Clear runway.
94.	Pneumatic pressure.	Supply.
95.	Flaps.	Up. Selector neutral.
96.	Pressure head heater.	Off if necessary.

On reaching dispersal.

97.	High pressure cocks.	Turn off.
98.	Low pressure pumps.	Switch off.

When the engines have stopped.

99.	Low pressure cocks.	Off.
100.	Electrical services.	All off.
101.	Direction indicator.	Caged.
102.	Chocks.	In position.
103.	Brakes.	Off.
104.	Internal control locks.	On.
105.	Ground/flight switch.	Ground.
106.	Pressure head.	Cover on.
107.	Form 700.	Sign.
108.	Authorisation book.	Sign.



SIMPLIFIED FUEL SYSTEM DIAGRAM

PART I
DESCRIPTIVE

NOTE.—The numbers quoted in brackets after items in the text refer to the illustrations in Part V.

INTRODUCTION

The Meteor 4 is a single-seat jet-propelled fighter powered by two Derwent 5 engines. It is a low-wing monoplane of all metal construction with a tricycle alighting gear ; it has clipped wings and is fitted with a pressure cabin.

FUEL AND OIL SYSTEMS

1. Fuel system operation

Normally each engine is fed independently from its own compartment of the main tank. Fuel is fed by the low-pressure fuel pump through the low-pressure cock at the tank outlet to the engine-driven fuel pump, and then through the throttle valve which regulates the amount of fuel passing to the burners. A barometric pressure control (B.P.C.) helps to regulate the output of the fuel pump with changes of altitude and/or barometric conditions, but to maintain constant r.p.m. on the climb it is necessary to throttle back progressively, and at high altitude high r.p.m. will be obtained with a relatively small throttle opening. From the throttle valve fuel flows to the fuel accumulator, then through the trip valve to the high pressure cock, and thence to the burners. The spring-loaded trip valve does not open until a pre-determined pressure has built up in the fuel accumulator thus ensuring that a combustible spray is delivered to the burners for the initial start. The trip valve, and high pressure cock which incorporates a by-pass back to the pump inlet as well as a drain to atmosphere, are located in the body of the fuel accumulator. When the high pressure cock is closed the by-pass to the pump inlet and the drain to atmosphere are opened ; in addition a spring-loaded valve in the lowest combustion chamber opens when the pressure therein falls to a low value allowing any surplus fuel in

the lower combustion chambers, which are inter-connected, to drain to atmosphere.
On engines with Derwent Mod. 321 a minimum burner pressure valve is fitted. It by-passes the throttle valve and ensures that with the throttle closed, the burner pressure does not fall too low to support combustion at high altitude. Thus regardless of throttle setting a certain minimum r.p.m. is obtainable and this minimum increases with altitude.

2. **Fuel tanks**

(i) The main fuel tank, which on some aircraft is self-sealing, holds 325 gallons and is divided into two equal compartments. The front compartment normally feeds the port engine and the rear compartment the starboard engine, but they may be interconnected by a balance cock (54) which is under the control of the pilot. Each compartment contains an "inverted-flight" trap and valve which under negative "g" conditions ensure a supply of fuel to the engines for about 15 seconds.

(ii) A 180 gallon ventral drop tank may be fitted ; the fuel from this tank is transferred to both compartments of the main tank by air pressure from the cabin pressure system. Float valves in each compartment of the main tank cut off the supply of fuel from the ventral drop tank when the main tank is full.

NOTE.—The air pressure to the tank is available whether the cabin is being pressurised or not.

3. **Fuel cocks**

(i) The low and high-pressure fuel cocks for each engine, (34), (35), (66) and (65), are on either side of the pilot's seat, and are marked L.P. and H.P. The outer lever of each pair controls the H.P. cock.
The L.P. cocks cut off the flow of fuel from the main tank ; they should not be closed to stop the engines, as this action will starve the engine-driven fuel pumps, and fill the pipelines with air. The appropriate L.P. cock should, however, be closed in the event of an engine failure (see paras. 36 (iii) and 58).
The H.P. cocks cut off the fuel supply to the engine burners and should be used for stopping the engines, and also in the event of engine failure.

(ii) *Ventral drop tank transfer control*

The transfer control handle (6) which permits air from the pressure cabin system to feed into the ventral tank is mounted on the top left-hand side of the instrument panel.

This handle has a dual function : it is rotated anti-clockwise to transfer fuel to the main tank and is pulled out to jettison the ventral drop tank. It cannot be pulled out unless it is in the OFF (vertical) position.
When the handle is set to transfer fuel from the ventral tank a red warning light (1) comes on until the pressure in the transfer pipeline rises above 2 lb./sq. in. ; it will then go out.

When all the fuel has been transferred from the ventral tank, or in the event of failure of the transfer system, the warning light will come on and remain on. After it has remained on for at least 5 minutes the control handle should be returned to the OFF position, when the warning light will go out again.

(iii) *The balance cock*

The balance cock (54) on the cockpit floor just aft of the rudder trimming tab control, is pulled up to interconnect the two compartments of the main tank. If an engine should fail, opening the balance cock will enable both compartments to feed the live engine. The H.P. and L.P. cocks of the failed engine should both be turned OFF before opening the balance cock.

4. Low-pressure pumps

The low-pressure pump switches (46) are on the engine starting panel below the left-hand side of the instrument panel ; they are labelled START AND TANK PUMP. The pumps must be switched ON before the engines can be started and should remain ON whenever the engines are running.

5. Fuel pressure warning lights

Two fuel pressure warning lights (3) are fitted above the left-hand switch panel. The appropriate light comes on when the fuel pressure from the low-pressure pump falls

appreciably below normal. Should a light come on during flight, it will be impossible to obtain maximum r.p.m. at high altitudes on the engine concerned, but no other effects will result.

6. **Fuel contents gauges**

Two electrical fuel contents gauges (25), one for each main tank-compartment, are fitted on the right-hand side of the instrument panel. They will indicate whenever electrical power is available.

7. **Oil system**

An oil tank is fitted in each engine nacelle. Each tank holds 22 pints of oil leaving 7 pints air space.

ENGINE OPERATION AND CONTROLS

8. **Engine operation**

Air enters the intakes, is compressed by a turbine-driven impeller, and passes into the combustion chambers. Fuel is injected through the burner nozzles, and burns in the combustion chambers. The heated gasses then pass through guide vanes to the turbines and thence through the propelling nozzle at high velocity, imparting by reaction a forward thrust to the aircraft.

9. **Throttle controls**

The throttle levers (38) are on the left-hand cockpit wall. No friction damping control is fitted.

10. **Engine starting system**

(i) The shielded pushbuttons (47) on the left-hand switch panel should be pressed only for about 2 seconds. They operate time-switches which bring into operation the starter motors and the flame-igniters, which are used only for starting combustion. (*Note*.—The throttle must be closed and the low-pressure pump switch must be ON before the starting circuit can be completed.) Current to the starter panel is cut off after 30 seconds.

(ii) A main ignition isolating switch for each engine is fitted in the undercarriage bay. In the OFF position it isolates the boost coils and flame igniters from the starter panel. This enables the engine to be blown through, using the normal starting gear, after a false start. Isolating switches for the priming pumps are also provided.

11. **Relighting switches**

The two pushbuttons (44) marked ENGINE RELIGHT SWITCH at the top of the left-hand switch panel should be used to energise the flame-igniters for relighting the engines in flight ; the normal starting system should never be used.

12. **Engine instruments**

The following engine instruments are provided :—

R.p.m. indicators (26) and (30).
Jet pipe temperature gauge (29).
Oil pressure gauges (28).

NOTE.—Burner pressure gauges and oil temperature gauges may be fitted on some early aircraft.

MAIN SERVICES

13. **Hydraulic system**

A Dowty live-line hydraulic pump, driven by the starboard engine, operates the :—

Undercarriage,
Flaps.
Air brakes.

A hydraulic accumulator is fitted and provides a reserve of pressure for operating any of the services when the engine is not running ; it is designed to provide sufficient pressure for the operations described in para. 59 (iii).

NOTE.—A handpump (22) on the right of the seat will operate all services through the normal pipelines, and may be used in the event of failure of the engine-driven pump and lack of accumulator pressure.

14. **Pneumatic system**

A compressor on the port engine supplies air pressure to two storage cylinders at 450 lb./sq. in. for operating the brakes and cocking the guns. The available pressure is shown by the top needle of the triple pressure gauge (37) on the cockpit left-hand wall, level with the pilot's shoulder.

NOTE.—Early aircraft have no engine-driven compressor, but the two storage cylinders are charged to 450 lb./sq. in. before flight by the ground crew.

15. **Electrical system**

(i) A 24-volt generator on the port engine charges two batteries which in turn supply the whole of the electrical system.

(ii) The ground starter battery socket and ground/flight switch are in the port engine nacelle.

(iii) A generator failure warning light (15), which comes on when the generator is not functioning, is mounted on the switch panel on the right-hand cockpit wall.

16. **Vacuum system**

A vacuum pump is fitted on each engine and there is a vacuum pump selector cock (67) on the right-hand cockpit wall, below the fuel cocks.

AIRCRAFT CONTROLS

17. **Flying controls**

A spade grip is hinged at the top of the control column for aileron control, the whole column being moved for elevator control. The rudder pedals are adjustable, there being a knob (31) on the centre instrument panel to release the locking mechanism. The pedals are mechanically interconnected to ensure equal adjustment.

18. **Flying controls locking gear**

The flying controls are locked in the neutral position by four rods fitted at each end with small pegs.

Two of the rods are used to lock the rudder pedals to the elevator torque tube and the second two to connect the control column to attachment points on the right-hand cockpit wall and the bulkhead behind the pilot's seat. When not in use the locking gear is stowed on the decking beneath the fixed part of the cockpit hood.

19. **Trimming tabs**

The elevator trimming tabs are controlled by a handwheel (52) on the left-hand side of the cockpit. The rudder trimming tab is controlled by a smaller handwheel (53) aft and to the left of the elevator trimming tab control. Both controls work in the natural sense and each has an adjacent indicator (51).

20. **Undercarriage control**

The undercarriage selector lever (43) on the left-hand side of the instrument panel has two positions, UP and DOWN. It cannot be set to UP while the weight of the aircraft is on the wheels, and there is no emergency override switch to permit the undercarriage to be raised on the ground.

21. **Undercarriage position indicators**

(i) The electrical visual indicator (33) on the left-hand side of the instrument panel operates as follows :—

Undercarriage locked down ...	...	3 green lights
Undercarriage between locks	...	3 red lights
Undercarriage locked up ...	...	All lights out

(ii) A warning light (4) on the instrument panel comes on if any wheel is not locked down and either throttle is less than one-third open.

NOTE.—At moderate and high altitudes this light will probably remain on continuously since the throttles are usually less than one-third open in cruising flight.

(iii) *Nosewheel mechanical indicator.* When the nose wheel is down a small rod protrudes through the nose of the aircraft.

22. **Flaps control and indicator**

(i) The flaps selector lever (42), on the left-hand side of the instrument panel has three positions—UP, NEUTRAL, DOWN. To obtain an intermediate position of the flaps, the lever should be moved to DOWN, and returned to NEUTRAL when the flaps have reached the desired setting. The selector lever should always be returned to NEUTRAL after each operation is complete.

(ii) The flaps position indicator (32) is on the instrument panel above the undercarriage visual indicator.

23. Air brakes

The air brakes control (41) is on the left-hand cockpit wall below the throttle levers ; the control is pulled back to open the brake flaps.

24. Wheel brakes

The control lever (55) and parking catch are fitted on the control column. Differential braking is obtained by use of the rudder pedals when the control lever is operated.

OPERATIONAL CONTROLS

25. Gyro gun-sight

The selector (58) and master (60) switches for the gyro gun-sight (9) are mounted together on the switch panel on the right-hand cockpit wall, while the ranging control is incorporated in the top of the port engine throttle lever.

26. Gun firing

The guns are fired electrically by the wobble button (56) on the control column ; when the safety flap is open, pressing any part of the button normally fires all four guns, together with the cine-camera if the camera master switch (16) is ON.

27. Cine Camera

The master switch (16) is on the switch panel on the right-hand cockpit wall. The camera operates with the guns, or can be fired independently by the cine-camera button which is visible when the gun safety flap is at SAFE. The footage indicator is on the left-hand cockpit wall.

OTHER CONTROLS

28. Cockpit pressurising and heating

(i) The control lever (40) on the left-hand cockpit wall above the air brakes lever has three positions, COLD, HOT, and PRESSURE.

(ii) When the control is set to COLD, air from outside is fed into the cabin. When set to HOT, the flow of cold air is reduced and warm air is fed into the cabin through a spray pipe at the base of the windscreen.

(iii) When set to PRESSURE, compressed and heated air is obtained from each engine. The air enters the cabin through the spray pipe at the base of the windscreen and the cabin pressure is controlled by a valve mounted on the floor of the cabin, in which is incorporated emergency relief valves.

(iv) The hood is sealed by an inflatable rubber gasket. When the hood winding handle (61) is locked in the slot, and the control is set to PRESSURE, the seal is inflated by air taken from the cabin pressure pipe ; when the handle is pulled out of the slot the air is allowed to escape, thus enabling the hood to be opened without damaging the seal, should the control inadvertently be left at PRESSURE.

NOTE.—The control should not be set to PRESSURE when the aircraft is on the ground as this can cause excess pressure on the hood seal if the engines are opened up fully.

(v) The cabin altimeter (14) on the right-hand side of the instrument panel shows the altitude corresponding to the cabin pressure and the pilot should regulate his oxygen to correspond with this altitude.

(vi) A cabin pressure warning light (23) is also fitted on the right-hand side of the instrument panel. This light comes on above the pre-determined height to which it is adjusted (approx. 8,000 ft.), when the pressurising system is not in use. When the control is set to PRESSURE the light will come on above this height if the cabin altitude is approx. 1,000 ft. above the correct cabin-controlled altitude which at 20,000 ft. is 12,000 ft (cabin pressure) and at 40,000 ft. is 24,000 ft. (cabin pressure).

29. **Sliding hood**

The sliding hood is opened and closed by the crank handle (61) on the right-hand cockpit wall. The hood is locked in the closed, open, or any intermediate position, by folding the crank outwards and engaging it in the slot below the right-hand side panel of the windscreen.

30. **Windscreen**

The windscreen (on most aircraft) and sliding hood are of the " dry air sandwich " type. They should remain free from internal misting while the silica-gel remains active. The silica-gel containers should be replaced when the crystals turn from blue to pink.

31. **Windscreen de-icing pump**

The windscreen de-icing pump (68) and the flow control for the de-icing fluid are on the cockpit floor to the right of the pilot's seat.

32. **R.I. compass**

The switch (21) for the R.I. compass is on the switch panel on the right-hand cockpit wall.
NOTE.—There is no " stand-by " magnetic compass.

33. **Cabin lighting**

(i) *Red lights.* The three instrument panel lights are controlled by a dimmer switch (13) on the top right-hand side of the instrument panel. Two auxiliary lights, one to illuminate the trimmer handwheels and the other for the compass are controlled by a dimmer on the left-hand decking.

(ii) *Ultra-violet lights.* Two u.v. floodlights, one on each side of the cabin illuminate the fluorescent instruments. Both are controlled by a dimmer (5) on the left-hand side of the instrument panel.

(iii) *Emergency light.* An emergency light is mounted above the centre instrument panel. Its master switch (63) and its accumulator are on the right-hand side of the cabin.

34. **Seat-raising mechanism and harness release**

The seat can be adjusted for height by the lever (69) on the right-hand side. The harness is released by a lever (62) on the right-hand side of the cabin. After the lever has been returned to its normal position, the harness returns automatically to the locked position when the pilot leans back.

35. Footsteps

Footsteps and handholds are provided on the port side of the front fuselage to give access to the cabin. A retractable footstep is lowered by pulling down the external handle and is automatically retracted when the undercarriage selector lever is moved to UP ; no attempt should be made to push the step into its recess by hand. A second footstep which can be used as a first handhold, has a spring-loaded flap and is midway up the fuselage below the hood. The top handhold, which also has a spring-loaded flap, is in the top decking directly above the retractable footstep.

PART II
HANDLING

36. Management of the fuel system

(i) *Starting the engines.* Before an engine can be started its L.P. and H.P. cocks and the low pressure pump (START AND TANK PUMP) must be ON. The throttle must be closed and the balance cock should be OFF (pushed down).

(ii) *In flight.* The low pressure pumps must be ON whenever the engines are running. When a ventral drop tank is carried its contents should be transferred to the main tank early in flight. While transferring fuel the balance cock should be closed ; it should not be opened unless the two compartments of the main tank have been replenished unevenly, in which case it should be opened, and then closed as soon as the contents have equalized.

(iii) *Engine failure*

(a) If engine failure is due to an obvious mechanical defect, relighting should not be attempted. Close the appropriate H.P. and L.P. cocks and switch off the low pressure pump concerned. Closing the L.P. cock is a precaution against loss of fuel should a fuel pipeline be broken.

(b) If the cause of failure is not apparent, it is probably due to combustion ceasing either through engine mishandling or through burner pressure dropping too low at high altitude. (This should not normally occur when minimum burner pressure valves—Derwent Mod. 321—are fitted.) In this case only the H.P. cock should be turned off. This avoids starving the engine-driven fuel pump and relighting may be attempted at 15,000 ft. or below.

NOTE.—For practice single-engine flying the engine should be stopped by closing the H.P. cock. Then switch off the low-pressure pump.

(iv) *Stopping an engine on the ground.* Turn OFF the H.P. fuel cock, and when the engine has stopped, switch OFF the low pressure pump.

37. Starting the engines

(i) Before starting the engines carry out the external and internal checks detailed in the Pilot's Check List. (See pages 6-9).

(ii) Have a ground-starter battery plugged in and set the ground/flight switch to GROUND.

(iii) Ensure that no personnel or loose equipment are in the vicinity of either the intakes or the wake of the jet pipes. The engines should not be started with the tail into a strong wind.

(iv) Set the controls as follows :—

Throttle levers	...	...	...	fully back
H.P. fuel cocks	...	...	...	ON

(v) Start the port engine first as this drives the generator. Switch on the low pressure pump, then when the fuel pressure warning light goes out press the starter pushbutton for about 2 seconds and release it.

(vi) The engine should accelerate to 3,300 to 3,700 r.p.m. without further throttle adjustment. The jet pipe temperature may momentarily exceed the idling limit but it should soon settle down to not more than 500°C. Do not open the throttle before idling speed is attained.

(vii) Repeat above procedure for the starboard engine and when both engines are running at idling r.p.m. and not before, have the ground/flight switch set to FLIGHT and the ground starter battery disconnected.

NOTE.—(a) It is important that the ground starter battery is fully charged and switched on the whole time during the starting sequence as the engine requires assistance from the starter to accelerate up to idling r.p.m.

(b) Although it is possible to start the engines on the aircraft batteries, this should not be done except in extreme emergency.

(c) If the engine accelerates very slowly up to idling r.p.m. and there is jet pipe resonance, this may be cured by partially closing the H.P. cock and immediately opening it when the resonance ceases. In no circumstances should resonance be allowed to con-

tinue unchecked. If resonance has necessitated shutting down the engine, sufficient time must be allowed for excess fuel to drain away before a re-start is attempted.

(d) Should the jet pipe temperature reach 600° C. close the H.P. cock to stop the engine.

(e) The ground battery should not be disconnected until the ground/flight switch has been moved to FLIGHT.

(viii) In the event of a "wet start," i.e., opening of the trip valve without light-up occurring, proceed as follows:

(a) Turn off the H.P. cock.

(b) Switch off the appropriate ignition and priming pump isolating switches in the undercarriage wheel bay.

(c) Ensure that the aircraft is facing into wind and that the impeller has stopped turning; wait until fuel stops draining from the nacelle and then dry out the engine by carrying out the normal starting procedure with the H.P. fuel cock in the off position.

(d) Have the ground crew remove any surplus fuel from the jet pipe.

(e) Switch on the ignition and priming pump isolating switches. When the impeller has stopped turning start the engines as in sub. paras. (iv) and (v) above.

NOTE.—If for any reason the engine fails to start after two attempts, it should be shut down and the cause investigated.

38. **Testing the engines and services**

(i) While idling the engine at 3,300-3,700 r.p.m. carry out the checks detailed in the Pilot's Check List items 82 to 91.

(ii) To check the operation of each vacuum pump see that the artificial horizon erects properly and maintains the correct position after the vacuum change-over cock is operated.

(iii) If it is required to check the engine-driven hydraulic pump the flaps must be lowered and raised at least four times to exhaust the accumulator, and then lowered and raised once more to check the pump.

NOTE.—If during engine starting a severe hammering is encountered it is due to air in the hydraulic system and should disappear when one of the hydraulic services is operated.

METEOR IV

FINAL CHECKS FOR TAKE-OFF

TRIM ... ELEVATOR : 1 DIV. TAIL HEAVY

RUDDER : NEUTRAL

FUEL ... L.P. COCKS — ON

H.P. COCKS — ON

L.P. PUMPS — ON

FLAPS ... UP OR 1/3rd DOWN

PNEUMATIC SUPPLY ... 200 LB/SQ. IN. MINM.

AIR BRAKES ... CLOSED

FINAL CHECKS FOR LANDING

BRAKES ... OFF. CHECK PRESSURES

WHEELS ... LOCKED DOWN

FLAPS ... FULLY DOWN ON FINAL

AIR BRAKES ... CLOSED

39. Checks before taxying

Pneumatic supply pressure		200 lb./sq. in. (minm.)
Brakes pressure ...	...	120 lb./sq. in.
Jet pipe temperature	...	Not more than 500°C.
Oil pressure ...	...	5 lb./sq. in. (minm.)
R.I. compass ...	...	ON

40. Taxying

(i) Rapid and unnecessarily frequent opening and closing of the throttles should be avoided as it will result in excessive jet temperatures and possibly a momentary surge.

(ii) Response to throttle opening is slow, and it is not easy to turn without assistance from the brakes.

(iii) When taxying, fuel consumption is high, being over one gallon for each engine per minute at idling r.p.m.

41. Checks before take-off

Trimming tabs ...	...	(at all loads)
Elevator ...	...	1 div. tail heavy
Rudder ...	...	Neutral
Fuel ...	...	Check contents and that all cocks are fully ON. Ventral drop tank transfer cock OFF Balance cock closed (pushed down) Low pressure pumps ON
Flaps ...	...	Up. Selector neutral. ($\frac{1}{3}$ down for shortest run or when carrying ventral drop tank)
Air brakes ...	...	CLOSED
Sliding hood ...	...	Closed and winding handle locked in slot.
Pneumatic supply pressure		200 lb./sq. in. (minm.)
Brakes pressure ...	...	120 lb./sq. in.
Direction indicator	...	Set and uncaged
Harness ...	...	Locked

42. **Take-off**

(i) Taxy forward a few yards to straighten the nose wheel. Apply the brakes and open up to 12,000 to 13,000 r.p.m. If the brakes will not hold at 11,000 r.p.m. they should be regarded as unserviceable and the aircraft should not be flown. Check all the engine instruments. If the readings are satisfactory release the brakes and open the throttles fully. There is no tendency for the aircraft to swing.

(ii) Ease the nosewheel off the ground at 80 knots I.A.S. Care should be taken not to get the nose wheel too high, and coarse backward movement of the control column may cause the tail to touch the ground. The aircraft, which does not unstick cleanly, should be flown off at 120 knots I.A.S. at all loads.

(iii) When comfortably airborne brake the wheels and then retract the undercarriage.

(iv) With the flaps up or $\frac{1}{3}$ down, wheels up or down, safety speed at full normal load at take-off power is 150 knots I.A.S.

(v) Safety speed with full ventral drop tank, flaps $\frac{1}{3}$ down and undercarriage up or down is 155 knots I.A.S.

(vi) When safety speed has been attained, raise the flaps if used, returning the selector to NEUTRAL, and throttle back to climbing r.p.m. (14,100). If a ventral drop tank is fitted, turn on the transfer cock.

(vii) Unless it is necessary to clear obstacles, allow the speed to reach 270-280 knots I.A.S. before starting to climb.

43. **Climbing**

(i) The recommended climbing speeds together with the indicated Mach. numbers are given below :—

Altitude	I.A.S. knots	Indicated Mach. No.
Sea level	285	.42
10,000 ft.	260	.45
20,000 ft.	235	.50
30,000 ft.	210	.55
40,000 ft.	185	.60

i.e., start to climb at 285 knots I.A.S. and reduce speed by 25 knots per 10,000 feet.

(ii) A governor on the engine-driven fuel pump restricts the r.p.m. to 14,550 for take-off but on a combat climb, with the throttles fully open, r.p.m. will increase progressively to 14,700 at about 10,000 feet. Normally the throttles should be adjusted on the climb to maintain the r.p.m. at 14,100 up to 35,000 feet. To maintain a reasonable rate of climb above this height r.p.m. should be increased as necessary to 14,500 providing a jet pipe temperature of 630°C. is not exceeded.

(iii) During the climb the cabin pressure warning light will come on at the predetermined height (see para. 28 (vi)). The control lever should then be set to PRESSURE and the warning light should go out. If with the control set to PRESSURE the cabin altimeter indicates the same height as the aircraft altimeter or if the warning light comes on, the climb should not be continued above 30,000 feet. If a prolonged flight is to be carried out at high altitude it is advisable to set the control to PRESSURE soon after take-off. This will help to conserve the heat in the cabin.

44. General flying

(i) *Stability*

Stability about all axes is satisfactory at medium altitudes (see sub. para. (v) (a)).

(ii) *Changes of trim*

Operation of the undercarriage, the flaps or the air brakes promotes little change of trim. Closing the throttles at high speed, or in a dive, causes a strong nose-down change of trim.

(iii) *Controls*

(a) The trimming controls are spongy in operation and at altitude accurate trimming requires great patience; it is almost impossible to trim the aircraft accurately at high altitude.

(b) The controls are well balanced and effective throughout most of the speed range. At very high speeds all the controls become heavier, especially the ailerons.

(c) The air brakes are very effective, but decrease lateral stability. (See para. (v) (a).)

42. **Take-off**

(i) Taxy forward a few yards to straighten the nose wheel. Apply the brakes and open up to 12,000 to 13,000 r.p.m. If the brakes will not hold at 11,000 r.p.m. they should be regarded as unserviceable and the aircraft should not be flown. Check all the engine instruments. If the readings are satisfactory release the brakes and open the throttles fully. There is no tendency for the aircraft to swing.

(ii) Ease the nosewheel off the ground at 80 knots I.A.S. Care should be taken not to get the nose wheel too high, and coarse backward movement of the control column may cause the tail to touch the ground. The aircraft, which does not unstick cleanly, should be flown off at 120 knots I.A.S. at all loads.

(iii) When comfortably airborne brake the wheels and then retract the undercarriage.

(iv) With the flaps up or $\frac{1}{3}$ down, wheels up or down, safety speed at full normal load at take-off power is 150 knots I.A.S.

(v) Safety speed with full ventral drop tank, flaps $\frac{1}{3}$ down and undercarriage up or down is 155 knots I.A.S.

(vi) When safety speed has been attained, raise the flaps if used, returning the selector to NEUTRAL, and throttle back to climbing r.p.m. (14,100). If a ventral drop tank is fitted, turn on the transfer cock.

(vii) Unless it is necessary to clear obstacles, allow the speed to reach 270-280 knots I.A.S. before starting to climb.

43. **Climbing**

(i) The recommended climbing speeds together with the indicated Mach. numbers are given below :—

Altitude	I.A.S. knots	Indicated Mach. No.
Sea level	285	.42
10,000 ft.	260	.45
20,000 ft.	235	.50
30,000 ft.	210	.55
40,000 ft.	185	.60

i.e., start to climb at 285 knots I.A.S. and reduce speed by 25 knots per 10,000 feet.

(ii) A governor on the engine-driven fuel pump restricts the r.p.m. to 14,550 for take-off but on a combat climb, with the throttles fully open, r.p.m. will increase progressively to 14,700 at about 10,000 feet. Normally the throttles should be adjusted on the climb to maintain the r.p.m. at 14,100 up to 35,000 feet. To maintain a reasonable rate of climb above this height r.p.m. should be increased as necessary to 14,500 providing a jet pipe temperature of 630°C. is not exceeded.

(iii) During the climb the cabin pressure warning light will come on at the predetermined height (see para. 28 (vi)). The control lever should then be set to PRESSURE and the warning light should go out. If with the control set to PRESSURE the cabin altimeter indicates the same height as the aircraft altimeter or if the warning light comes on, the climb should not be continued above 30,000 feet. If a prolonged flight is to be carried out at high altitude it is advisable to set the control to PRESSURE soon after take-off. This will help to conserve the heat in the cabin.

44. General flying

(i) *Stability*

Stability about all axes is satisfactory at medium altitudes (see sub. para. (v) (a)).

(ii) *Changes of trim*

Operation of the undercarriage, the flaps or the air brakes promotes little change of trim. Closing the throttles at high speed, or in a dive, causes a strong nose-down change of trim.

(iii) *Controls*

(a) The trimming controls are spongy in operation and at altitude accurate trimming requires great patience; it is almost impossible to trim the aircraft accurately at high altitude.

(b) The controls are well balanced and effective throughout most of the speed range. At very high speeds all the controls become heavier, especially the ailerons.

(c) The air brakes are very effective, but decrease lateral stability. (See para. (v) (a).)

(iv) *Flying at low altitude in conditions of poor visibility*
Use the air brakes to decrease speed to 195 knots I.A.S., then lower the flaps $\frac{1}{3}$ and close the air brakes. Speed may then be reduced to not less than 150 knots I.A.S.

(v) *High altitude flying*

(a) Above 35,000 feet there is a marked decrease in stability about all axes and steady flight requires great concentration. Use of the air brakes accentuates this instability and the aircraft is not pleasant or comfortable to fly.

(b) Considerable elevator buffeting may be felt at indicated Mach numbers of .74 to .76 above which the buffeting becomes quite violent and compressibility may readily be encountered. High Mach numbers are easily attained and care must be taken not to exceed the limitations. If buffeting, or other symptoms of compressibility are experienced before reaching the limiting Mach number, speed must not be further increased.

(c) High-speed stalls in turns are more readily encountered but recovery action is normal. (See para. 45. (iv)).

(d) *Combustion*

At high altitudes the engines become most sensitive to throttle movements which must be made slowly. To ensure that fuel atomisation does not deteriorate and so cause a combustion failure, engine speed must not fall below 10,000 r.p.m. above 30,000 feet on engines not fitted with minimum burner pressure valves.

On engines with minimum burner pressure valves fitted (Derwent Mod. 321) the throttles may be closed completely (but see sub. para. (e) below), but opening up must always be done very slowly.

(e) *Cabin Pressure.* When Derwent Mod. 321 (minimum burner pressure valves) is fitted, the minimum engine speed to maintain cabin pressure above 40,000 feet exceeds the idling limitation of the engine. Throttling back above 40,000 feet should be carried out very cautiously, one engine at a time when possible, watching the cabin pressure warning light.

Should the latter come on, engine speed must be increased. In the event of failure of the cabin pressure system or the oxygen system it is essential to descend to a moderate altitude as quickly as practicable without exceeding the limiting Mach number or I.A.S. (see para. 46). The oxygen regulator should be set to the emergency position immediately symptoms of oxygen starvation occur and height should be reduced. The same action should be taken should the cabin pressure warning light come on and the cabin altimeter show a defect in the pressure system.

(f) A total of 100 gallons of fuel should be left for the descent and landing. It will often be necessary to fly at low altitude for 5-10 minutes for the purpose of de-misting or de-icing the windscreen.

45. **Stalling**

(i) The stalling speeds, engines " off," in knots I.A.S. :—

	With full internal fuel and ammunition	With full internal fuel full ventral drop tank and ammunition
Undercarriage and flaps up	100	105
Undercarriage and flaps down ...	90	94

(ii) With the air brakes extended or the sliding hood open, the stalling speeds quoted above are increased by 3-5 knots I.A.S., and the pre-stall buffeting is more pronounced.

(iii) Warning of the approach of the stall is given by :—

(a) Slight elevator buffeting some 10 knots before the stall and becoming more pronounced as the stall approaches.

(b) Fore and aft pitching accompanied by considerable vibration before the aircraft stalls.

At the stall either wing may drop slightly, followed by the nose. Lateral control remains quite effective and recovery is in all cases straightforward.

(iv) *High-speed stall.* Warning of the approach of the stall in a steep turn is given by elevator buffeting.

46. **Diving from high altitudes**

(i) Since it is inadvisable to throttle back to any extent when above 35,000 feet (unless minimum burner pressure valves are fitted—Derwent Mod. 321) the air brakes must be

used to avoid exceeding the limitations during the descent. Even with them open the limiting Mach number can easily be attained. With the air brakes open there is a marked instability and considerable juddering which must not be confused with compressibility effects.

(ii) As height is lost r.p.m. will decrease without any throttle adjustment, and to maintain a constant Mach number the angle of dive will become steeper and the indicated airspeed will progressively increase.

(iii) Before closing the air brakes reduce the angle of dive as the rapid acceleration may well cause the aircraft to exceed the limiting speed.

(iv) If trim is used to assist in recovery from a dive it must be applied carefully as it is both effective and somewhat spongy in operation.

47. **High-speed flying**

(i) The limiting speeds for which this aircraft is cleared are for *calm air* conditions. In order to avoid imposing excessive accelerations no attempt must be made to fly at the limiting speeds when conditions are bumpy. If the limitations are observed the aircraft should not enter compressibility, the symptoms of which are as follows :—

(a) Increase of sensitivity of the elevator.

(b) Rather quick nose-up change of trim which can and must be held without using the trimming tabs.

(c) Elevator buffeting and slight nose-down change of trim. At this juncture movement of the elevators may not be sufficient to keep the aircraft level, and although the control column is well back, the nose may continue to drop.

Under most conditions of flight the aircraft will come out of compressibility immediately on throttling back or opening the air brakes, but great care must be taken when throttling back at low altitudes as this produces a marked nose-down change of trim. No use must be made of the trimming tabs when the elevators are ineffective due to shock stalling because on reducing speed they may suddenly become effective and excessive accelerations may be imposed.

(ii) " Snaking " or rapid oscillations from side to side may be encountered at high speeds. If this occurs, throttle back until it ceases, then gradually increase speed paying particular attention to directional trim and engine synchroni-

sation. If snaking is still apparent the airframe should be checked on landing for loose cowlings, play in the rudder control circuit, or other airframe defects.

(iii) It need hardly be emphasised that the turning circle at high speeds is very large and in conditions of bad visibility it is strongly recommended that speed be reduced to not less than 150 knots I.A.S. (see para. 44 (iv)) as at this speed the aircraft is quite comfortable to fly.

48. Aerobatics

(i) The following speeds in knots I.A.S. are recommended :

Roll	260–280
Loop	370–380
Roll off the top	380–400
Climbing roll	390 plus

(ii) In manœuvres in the looping plane much height may be gained or lost and an ample margin must always be allowed for recovery to normal flight.

NOTE.—The negative " g " traps in the main tank ensure a supply of fuel for not more than 15 seconds inverted flight.
Aerobatics are prohibited when carrying a 180 gallon ventral drop tank.

49. Approach and landing

(i) Checks before landing

Pneumatic supply pressure	150 lb./sq. in. (minm.) (If below 150 lb./sq. in. it is advisable to use the longest runway available).
Brakes pressure	120 lb./sq. in.
Fuel	Check tank contents, and if uneven, open balance cock.
Reduce speed to 175 knots I.A.S.	
Undercarriage	Down and locked. Check u/c lights green, warning light out, and nose wheel mechanical indicator showing.
Flaps	$\frac{1}{3}$ down (fully down on final approach).
Air brakes	Closed

(ii) The recommended speeds at which the airfield boundary should be crossed in knots I.A.S are :—

With less than 100 gals. remaining (13,000 lb. approx)	105
Full internal fuel 14,700 lb. (max. landing weight)	110

The initial approach should be made some 15 knots above these figures. When landing with a 180 gallon ventral drop tank (empty) the above speeds should be used.

NOTE.—(a) The response to throttle manipulation is not so prompt as on a propeller-driven aircraft and early corrective action must be taken if undershooting. Owing to the absence of propeller drag and the time taken for r.p.m. to drop, deceleration is much slower and it is therefore advisable to have the power off before crossing the airfield boundary. It is advisable to keep the r.p.m. above 7,500 until a landing is certain, to ensure an even and prompt response to throttle opening, in the event of having to go round again.

(b) The use of air brakes is not recommended for landing, since apart from increasing the stalling speed, their effect at low speeds is small.

50. **Going round again**

NOTE.—A minimum of 60 gallons fuel should be allowed for going round again once.

(i) The aircraft will climb away easily at climbing power with the undercarriage and flaps down.

(ii) Open the throttles slowly to give climbing r.p.m. and retrim. If the throttles are opened quickly the engines may surge, causing a temporary loss of power.

(iii) Raise the undercarriage.

(iv) At a safe height raise the flaps.

51. **After landing**

(i) Before taxying, check pneumatic pressure, raise the flaps and return the selector to NEUTRAL.

(ii) *Stopping the engines.* Turn off the H.P. fuel cocks, then, when the engines have stopped, switch off the low-pressure pumps, and turn off the L.P. fuel cocks. Switch off all electrical services, and on leaving the cockpit set the ground/flight switch to GROUND.

PART III

OPERATING DATA

52. Engine data—Derwent 5

The principal engine limitations are as follows :—

	R.P.M.	Jet Pipe Temperature °C
MAX. TAKE-OFF 5 MINS. LIMIT	14,550*	660
MAX. CLIMBING 30 MINS. LIMIT	14,100	630
MAX. CRUISING	13,600	580
MAX. COMBAT 10 MINS. LIMIT	14,700	680
MINIMUM IDLING ON GROUND	3,300–3,700	500

NOTE.—The jet temperature limitations listed above must not be exceeded under steady conditions ; they may be exceeded momentarily if the throttles are opened rapidly.

* See para. 43 (ii).

OIL PRESSURE

Minimum at 13,600 r.p.m. and above	30 lb./sq. in.
Minimum for idling	5 lb./sq. in.

OIL TEMPERATURE

Maximum	80°C
Minimum for opening up	minus 40°C

53. Flying limitations

(i) The aircraft is designed for the duties of a single-seat fighter but intentional spinning is not permitted. Spinning trials indicate that normal recovery action is effective, but that during the spin much tail buffeting will be

felt. Should an unintentional spin develop full opposite rudder should be applied at once and the control column then pushed fully forward. The rudder should be centralised immediately the spin stops; if this is not done the aircraft will probably spin in the opposite direction.

(ii) Maximum speeds :—

(a) The speed of the aircraft should be assessed by reference to the Machmeter as well as the A.S.I. but as the Machmeter is designed to correct for temperature as well as for pressure at any height it, rather than the A.S.I., should be used when flying at speeds approaching the limits quoted below.

On account of trim changes resulting from distortion and compressibility effects a Mach. No. of .76 must not be exceeded below 20,000 feet. Above this height, distortion effects are not so pronounced and a Mach. No. of .78 is permitted. These Mach. numbers correspond approximately to the following I.A.S. at the higher of the two altitudes quoted in each case.

	Knots	
Sea level to 1,000 ft.	510	.76M
1,000 ft. to 5,000 ft.	470	
5,000 ft. to 10,000 ft.	430	
10,000 ft. to 20,000 ft.	360	
20,000 ft. to 30,000 ft.	300	.78M
30,000 ft. to 40,000 ft.	235	
Above 40,000 ft.	200	

(b) For lowering undercarriage ... 175 knots I.A.S.
With undercarriage locked down 195 knots I.A.S.

(c) For lowering flaps $\frac{1}{3}$ down ... ... No limit (relief valve in system prevents excessive strain)
For flaps fully down 150 knots I.A.S.

(d) For opening air brakes ... ... No limit, but brakes will not open fully above 365 knots I.A.S.

PART IV

EMERGENCIES

57. Engine failure during take-off

With the flaps $\frac{1}{3}$ down, undercarriage up or down, safety speed at normal load is 150 knots I.A.S., and with a full 180 gallon ventral drop tank is 155 knots I.A.S. Providing safety speed has been attained the aircraft can be held level and the flaps can be raised without any change of trim or sink occurring. Allow the speed to build up to 200 knots I.A.S., then climb away. Turn off the H.P. and L.P. cocks and the low pressure pump of the failed engine, and open the balance cock.

58. Engine failure in flight

(i) This aircraft has an exceptionally good single-engine performance, and flying on one engine presents no difficulty. At cruising r.p.m. at 5,000 ft., a speed of 260 knots I.A.S. can easily be attained.

(ii) In the event of engine failure, turn off the H.P. and L.P. cocks and the low pressure pump of the failed engine, then open the balance cock (see para. 36 (iii)) but when practising single-engine flying the L.P. cock should not be turned off.

NOTE.—(a) No attempt should be made to restart an engine above 15,000 feet. Practice relights should be restricted to a minimum.

(b) In the event of failure of the port engine it is important to conserve the batteries as much as possible. The vacuum change-over cock should be set to STARBOARD and the direction indicator synchronised with the R.I. compass while the latter is still working.

59. Single-engined landing

(i) Maintain a speed of at least 150 knots I.A.S. while manœuvring with the undercarriage and flaps up.

(ii) A single-engined landing presents no difficulty and a circuit in either direction can safely be made irrespective of which engine has failed. Lower the undercarriage and $\frac{1}{3}$ flap as on a normal circuit, maintaining a speed of 130 knots I.A.S. until the decision to land has been made. Then lower the flaps fully when required and use the approach speeds quoted in para. 49.

(iii) With the wheels and $\frac{1}{3}$ flap down, going round again on one engine from 130 knots I.A.S., using full power, involves no loss of height. If the starboard engine has failed the undercarriage and $\frac{1}{3}$ flap should be left down for the circuit as the aircraft will climb away satisfactorily. Rudder foot loads are heavy and although some pilots may be able to control the aircraft at speeds slightly below 130 knots I.A.S., it is advisable to keep at or above this speed until the decision to land is made and full flap is lowered.

NOTE.—If the starboard engine has failed, the hydraulic accumulator, if fully charged, will operate :—

1. Air brakes open
2. Undercarriage down
3. $\frac{1}{3}$ flap down
4. Air brakes closed
5. Flaps fully down

If the air brakes have been operated earlier, or if for any other reason the accumulator is not fully charged there may be insufficient pressure to carry out all the above operations. If the undercarriage will not lower by accumulator pressure, it should be locked down by using the handpump. Airspeed should not exceed 160 knots I.A.S. as the handpump may not lock the nosewheel in the down position above this speed. Flaps may be lowered with the handpump as desired. Even if fully charged the accumulator pressure will not be sufficient to raise the undercarriage and flaps in the event of going round again.

60. Restarting an engine in flight

(i) Ensure the H.P. cock is closed, then :—
Close the throttle.

Reduce the windmilling r.p.m. to 1,000-1,200 by decreasing the airspeed.

Press the re-lighting button and after 5 seconds turn on the H.P. cock, keeping the button pressed until the jet pipe temperature starts to rise. When the engine is running satisfactorily, with normal jet-pipe temperature, release the re-lighting button and open up to desired r.p.m.

NOTE.—(a) Do not attempt to restart an engine above 15,000 feet.

(b) Better re-lighting is obtained if the I.A.S. is as low as possible when the H.P. cock is turned on.

(c) If an engine fails to re-start the H.P. cock must not be left on for more than 30 seconds and at least one minute should be allowed before the next attempt to start is made, to enable the engine to "dry out."

(ii) If the above method fails, no attempt should be made to relight the engine by using the ground starter method.

61. Undercarriage, flaps and air brakes emergency operation

In the event of failure of the starboard engine, or of the hydraulic pump the residual pressure in the accumulator should operate the services in para. 59 (iii).

NOTE.—If, however, any of the services do not reach the desired setting after normal selection, lack of accumulator pressure is indicated. The hand-pump will operate any of the services through normal pipelines, and in this case should be used immediately.

62. **Hood jettisoning**

(i) The hood may be jettisoned from inside the aircraft by pulling the yellow handle (11) on the top right-hand side of the instrument panel. Before jettisoning the hood, the seat should be lowered fully and the pilot should keep his head well down.

(ii) There is an external jettison handle covered by a rip-patch on the port skin below the windscreen.

63. **Failure of cabin pressurising system**

(i) At high altitudes, should either partial or complete failure of the cabin pressurising occur, or cracks appear in the sliding hood the pilot should :—

(a) Open the air brakes and descend immediately.

(b) Turn the oxygen supply to EMERGENCY.

(c) Leave the cabin pressurising control on until below 38,000 feet.

(ii) If one engine fails at altitude, the remaining one will normally maintain the cabin pressure.

64. **Fire-extinguishers**

(a) The engine fire-extinguishers are operated electrically by two shielded pushbuttons (12) on the top right-hand side of the instrument panel. They are also automatically operated by an impact switch, in the event of a crash landing.

(b) If a fire is observed in an engine nacelle the H.P. and L.P. cocks should be turned off, the throttle closed and the low-pressure pump switched off. Airspeed should be reduced as much as possible before the fire-extinguisher is operated.

(c) If fumes enter the cockpit the heating and ventilating control (40) should be set to COLD. This action will render the cabin pressure system inoperative.

(d) On later aircraft fire warning lights (7) and (10) one for each engine, are fitted on the scuttle each side of the gun sight.

65. **Crowbar**

A light crowbar is clipped to the left-hand side of the pilot's seat.

66. **IFF**

The distress switch together with the master switch (59) is mounted on the right hand cockpit wall.

67. **Ditching**

Model tests indicate that in calm weather the aircraft should ditch well.

(i) If a ventral drop tank is fitted it should be jettisoned.

(ii) The sliding hood should be jettisoned.

(iii) The undercarriage should be kept retracted but the flaps should be lowered fully to reduce the touchdown speed as much as possible.

(iv) The safety harness should be kept tightly adjusted but the R/T and oxygen leads should be disconnected.

(v) The engines (if available) should be used to help make the touchdown in a tail-down attitude at as low a forward speed as possible.

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

PART V

ILLUSTRATIONS

KEY TO *Fig.* 1

1. Ventral drop tank fuel pressure warning light.
2. R.I. Compass.
3. Low pressure pumps warning lights (2).
4. Undercarriage warning light.
5. U.V. lights dimmer switch.
6. Ventral drop tank air control and jettison handle.
7. Port engine fire warning light.
8. Mach. meter.
9. Gyro gunsight.
10. Starboard engine fire warning light.
11. Hood jettison handle.
12. Engine fire-extinguisher pushbuttons (2)
13. Red lights dimmer switch.
14. Pressure cabin altimeter.
15. Generator warning light.
16. Camera master switch.
17. Navigation lights switch.
18.. Pressure-head heater switch.
19. Resin lights switch.
20. Identification lamp push switch.
21. R.I. compass switch.
22. Hydraulic emergency handpump.
23. Cabin air pressure warning light.
24. Oxygen regulator.
25. Main tank fuel contents gauges (2).
26. Starboard engine r.p.m. indicator.
27. Red light.
28. Oil pressure gauges (2).
29. Dual jet pipe temperature gauge.
30. Port engine r.p.m. indicator.
31. Rudder pedals adjuster release.
32. Flaps position indicator.
33. Undercarriage position indicator.

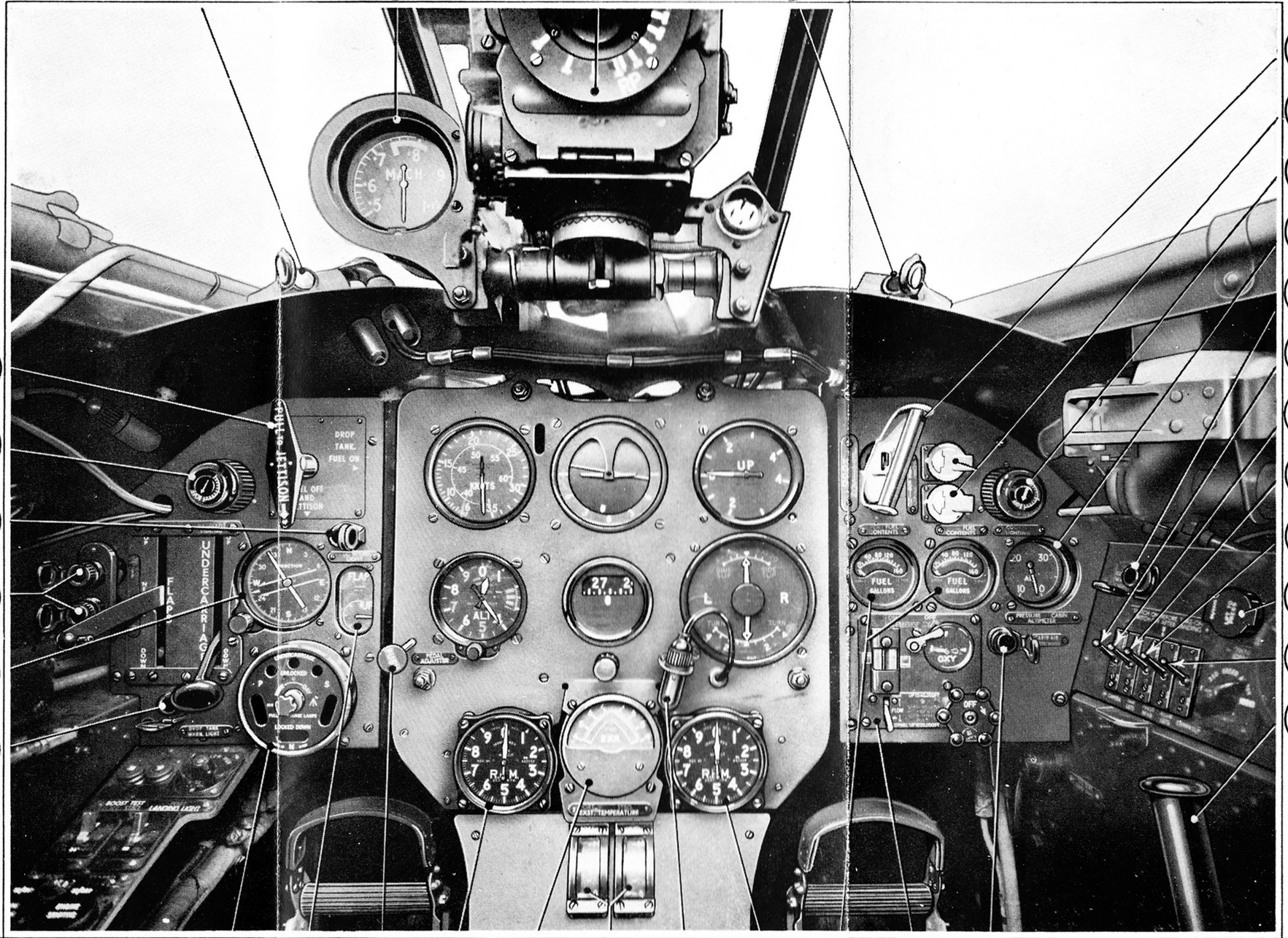


FIG. 1

COCKPIT FORWARD VIEW.

FIG. 1

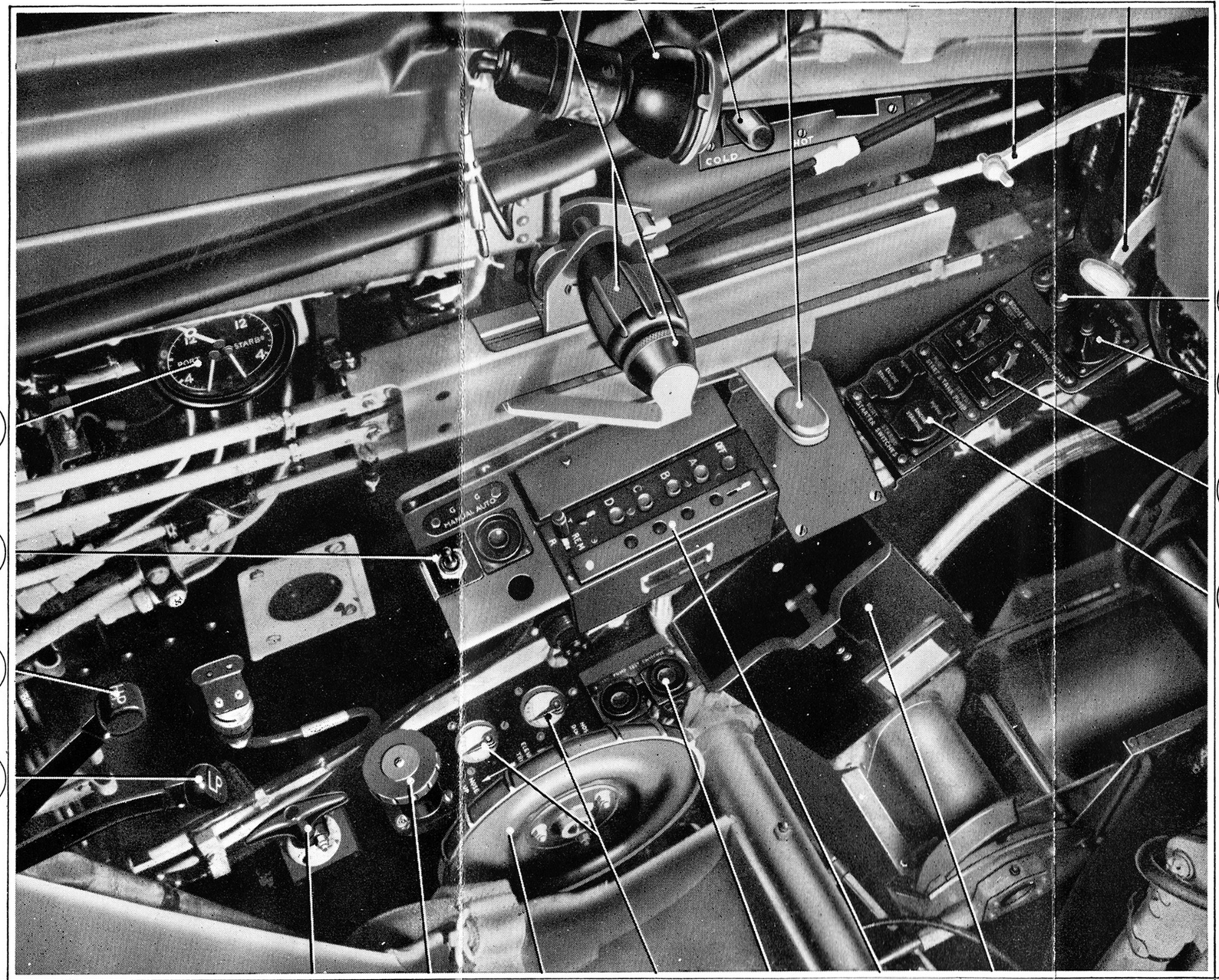


FIG. 2

COCKPIT — LEFT HAND SIDE

FIG. 2

KEY TO *Fig.* 2

34. Port engine L.P. cock.
35. Port engine H.P. cock.
36. G switches.
37. Pneumatic supply and brakes pressure gauge.
38. Throttle levers (2).
39. U.V. floodlight.
40. Cabin pressure and ventilating control.
41. Air brakes control.
42. Flaps selector lever.
43. Undercarriage selector lever.
44. Re-lighting pushbuttons (2).
45. Landing light control switch.
46. Low pressure pumps switches (2).
47. Engine starter pushbuttons (2).
48. Maps case.
49. Radio controller.
50. Low pressure pumps test push-buttons (2).
51. Elevator and rudder trimming tab indicators (2).
52. Elevator trimmer handwheel.
53. Rudder trimmer handwheel.
54. Fuel balance cock control.

KEY TO *Fig.* 3

55. Wheel brakes lever.
56. Gun " wobble " switch.
57. Identification light selector switch
58. Gyro gunsight dimmer selector control.
59. IFF switches (2).
60. Gyro gunsight master switch.
61. Hood winding handle.
62. Harness release lever.
63. Emergency light switch.
64. U.V. floodlight.
65. Starboard engine H.P. cock.
66. Starboard engine L.P. cock.
67. Vacuum pump change-over cock.
68. Windscreen de-icing pump.
69. Seat adjusting lever.

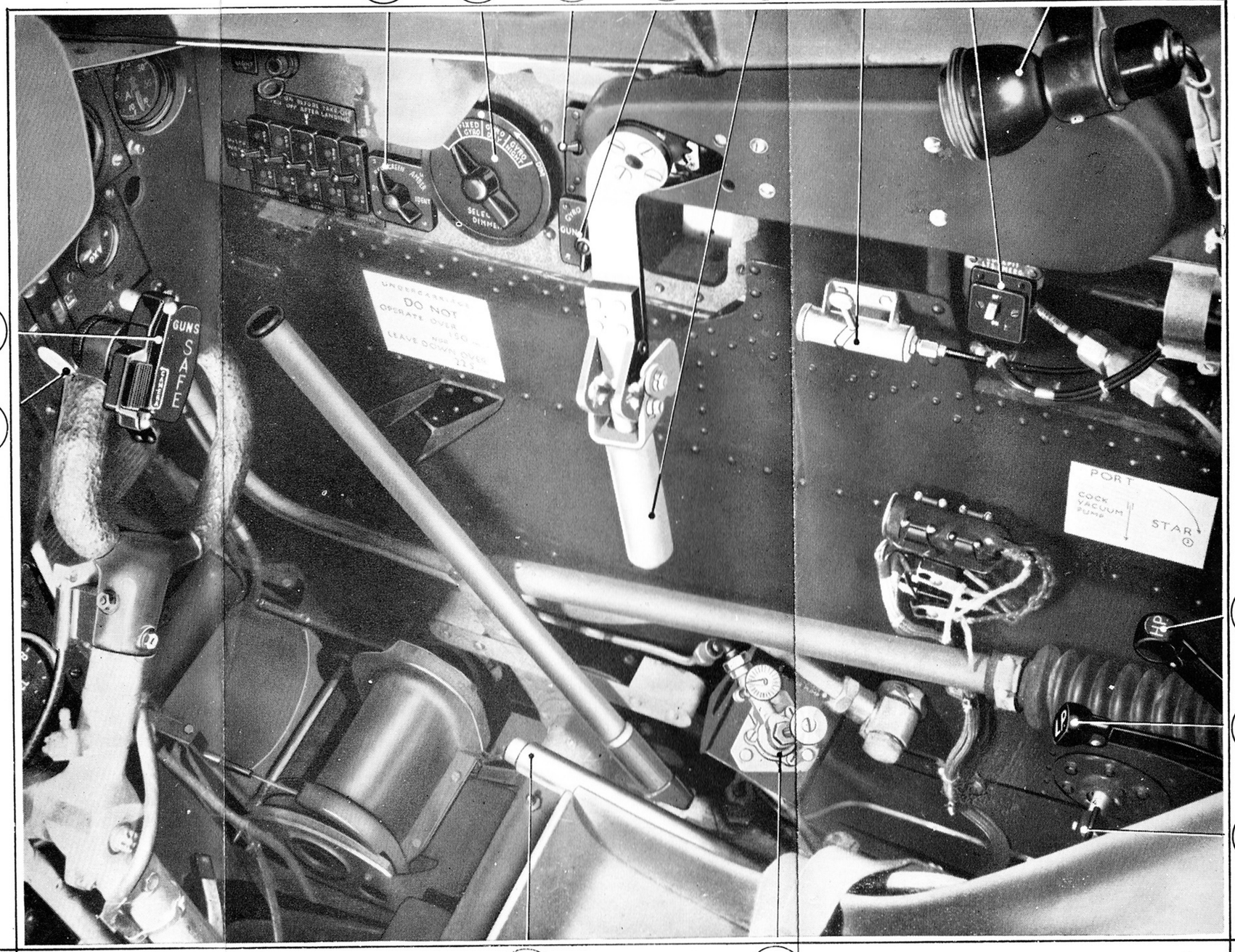


FIG. 3

COCKPIT – RIGHT HAND SIDE

FIG. 3

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