

PILOT'S NOTES
FOR
BOSTON IV
TWO CYCLONE GR. 2600-23 ENGINES



PROMULGATED BY ORDER OF THE AIR COUNCIL

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BOSTON IV

BOSTON IV

PILOTS NOTES

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PART I DESCRIPTIVE

INTRODUCTION

1. The Boston IV is a medium bomber powered by two Cyclone GR. 2600-23 engines driving Hamilton hydro-matic propellers. It is similar to earlier Bostons, but has a dorsal turret mounting two .5 guns.

MAIN SERVICES

2. **Fuel system.** See page 7.

(i) *Normal tanks.*

Four self-sealing tanks are fitted, numbered 1, 2, 3 and 4, two in each wing. They have a total effective capacity of 332 Imperial (400 U.S.) gallons. The carburettor vent lines feed back to the MAIN tanks on each side.

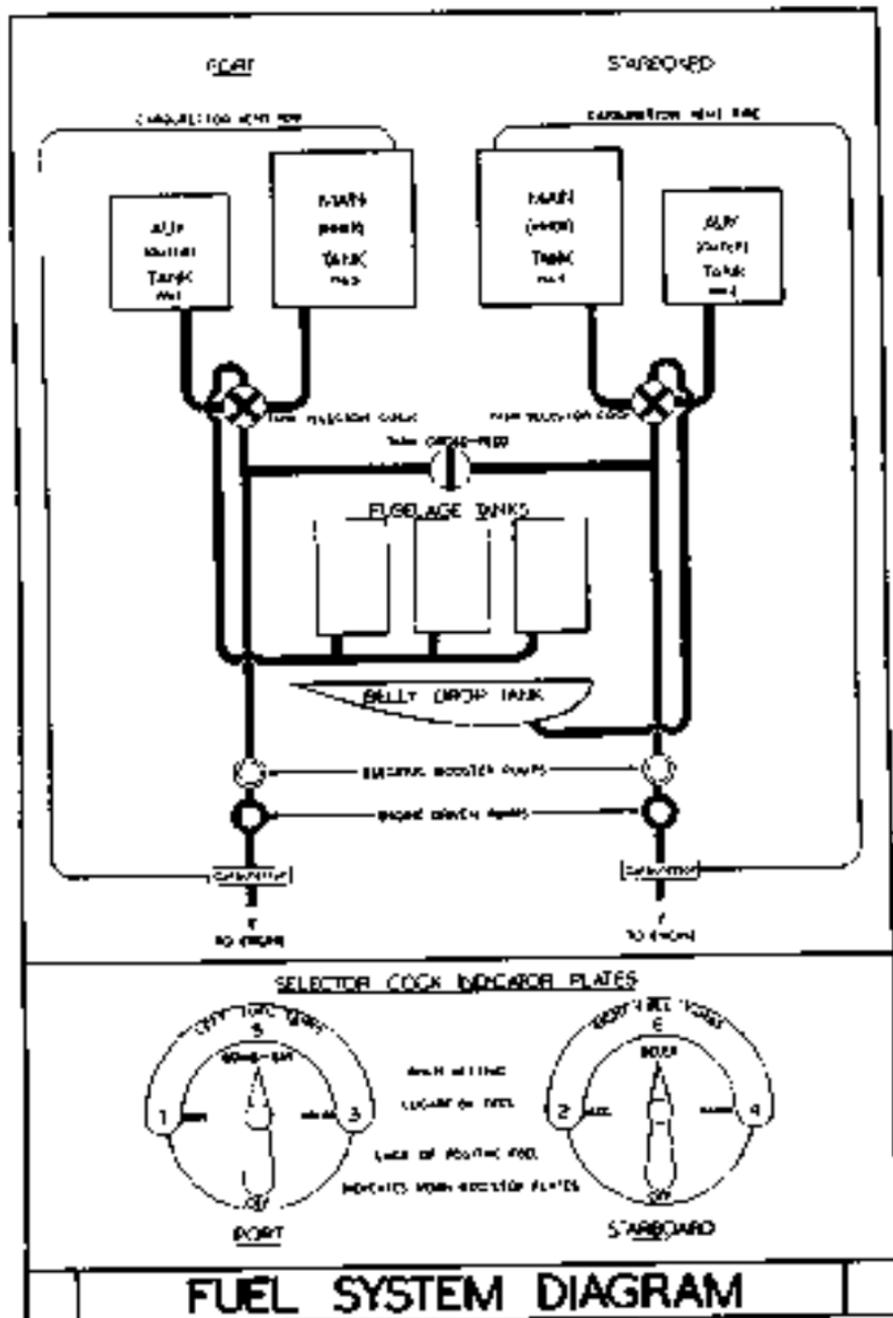
(ii) *Long-range tanks.*

(a) For long-range operation, three interconnected self-sealing tanks are fitted in the fuselage above the bomb-cell. These have a combined capacity of 270 Imperial (325 U.S.) gallons.

(b) For extra long-range operation a belly drop tank can be fitted externally below the bomb doors. This has a capacity of 312 Imperial (375 U.S.) gallons. This tank must be released before the bomb doors can be opened. The control is a "T" handle fitted on the right-hand side of the bulkhead behind the pilot at about waist level: it is pulled forward to drop the tank.

(iii) *Fuel cocks.*

(a) Two fuel tank selector cocks (28) are fitted on a control panel at seat level on the left-hand side of the cockpit. The rear cock controls the port (LEFT) wing tanks and the fuselage (BOMB-BAY) tanks, the forward cock controls the starboard (RIGHT) wing tanks and the BELLY drop tank. Each cock has four positions as shown in the diagram, which also shows the general arrangement of the fuel system.



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(b) A SUCTION CROSS-FEED cock (43) below the selector cocks, has two positions, ON and OFF, and is set to ON, to enable an engine on one side to be run from a tank on the other side, and when fuselage or belly tanks are in use.

NOTE.—These cocks require precise setting and should be positioned by feel. Lack of feel indicates need for replacement of the cock register plates.

(iv) Fuel gauges :

(a) Contents gauges.—A combined selector and gauge (15) registering in U.S. gallons, is fitted on the right-hand side of the instrument panel. The selector knob can be set to any of six positions ; Nos. 1 to 4 for the corresponding wing tanks, No. 5 for the fuselage (BOMB-BAY) tanks, and No. 6—OFF (on some aircraft this position may be connected up to record the belly tank contents). A red warning light above the gauge comes on when a tank is low, provided that the selector is set to that tank. The gauge should be set to whichever of the tanks in use contains the least fuel.

(b) Pressure gauge.—A dual gauge (14) is fitted on the right-hand side of the instrument panel.

(v) Booster pumps :

An electric booster pump is fitted for each engine. These are controlled by two switches, with amber warning lights which come on when the corresponding switch is ON, fitted on the left-hand sloping panel (34).

3. Oil system

A separate self-sealing oil tank is fitted in each engine nacelle and has a capacity of 19 Imperial gallons of oil and 2½ gallons air space (23 and 3 U.S. gallons).

A set of shutters, automatically controlled by a pressure differential valve, is fitted to each oil cooler. In addition each cooler has a hydraulically operated exit flap which is interconnected with the lower cowling gills. An oil dilution system is fitted for both engines and propellers. See para. 26.

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4. Hydraulic system

- (i) Two engine-driven hydraulic pumps, one on each engine, supply pressure to the complete hydraulic system through a hydraulic pressure accumulator. They draw fluid from a stand pipe in the tank, leaving a reserve which can only be used with a hand pump.

The hydraulic system operates :

Undercarriage	Bomb doors
Brakes	Cowling gills
Flaps	Air intake filters

- (ii) The hydraulic handpump, to the left of the pilot's seat, can be used to operate all hydraulic services when the engine pumps are not running. A by-pass valve is controlled by a small lever, on the bulkhead behind the pilot's left shoulder, which must be raised to enable the handpump to be used for charging the hydraulic accumulator ; for direct operation of the services this lever must be left down. The handpump, which draws fluid from the bottom of the tank, is primarily for ground use ; for emergency use in flight see Part IV

5. Electrical system

- (i) Two 3,000-watt, 24-volt generators, one on each engine, charge two 12-volt batteries in series.

- (ii) There are two ammeters (and on some aircraft a voltmeter) on the gunner's switch panel on the right-hand side of the rear cockpit. This panel also carries two generator switches ; these should be ON at all times. A thermal overload circuit breaker is fitted in each generator circuit ; these trip out if the main circuit is overloaded, throwing the generator switches OFF, and reset themselves automatically when cool, but the generator switches must then be switched ON again manually. The circuit breakers will trip out again unless the overload is relieved.

- (iii) On early aircraft a battery switch is on the left-hand sloping panel (34) in the pilot's cockpit ; it should be ON at all times, except when the ground battery is plugged in for starting, when it should be OFF. It should be returned to ON immediately the ground

PART I—DESCRIPTIVE

plug is removed and in any case before the engines are run up to cut-in speed (about 1,200 to 1,400 r.p.m.). On later aircraft an automatic battery isolating switch is incorporated in the ground socket and no manual switch is fitted.

- (ii) The socket for the ground battery plug is in the nose wheel well.
- (iv) The electrical circuits are protected by fuses (35), or by overload circuit breakers which have manual re-set switches on the sloping panel (34). These switches are normally in the "down" position, but trip "up" if the corresponding circuit breaker opens under overload. In emergency the circuit can be re-established by resetting the switch "down" and holding until the operation is completed.

AIRCRAFT CONTROLS

6. Flying controls

These are conventional, the rudder pedals, which incorporate the brake pedals, being adjustable for reach by a lever attached to the inboard edges of the pedals. To adjust, rotate the lever inwards to disengage the plunger, slide pedal to required position, and release lever ensuring that the plunger engages properly.

7. Flying controls locking gear

Four straps, two of which have snap hooks, are used for locking the controls as follows:—
Attach the hooks to the pins at the top of the wind-screen and pass the straps through the segments of the control handwheel. Pass the other two straps round the control column, and one each round its respective rudder pedal adjusting lever, drawing them tight to hold the control column fully forward. Finally tighten the two top straps.

8. Trimming tabs

Handwheels (55) for operating the elevator, rudder, and starboard aileron trimming tabs are mounted on

the right-hand side of the cockpit. All operate in the natural sense and position indicators are provided. There are friction dampers on the elevator and rudder trimming tab controls to prevent creeping. The port aileron tab is adjustable on the ground only.

9. Undercarriage controls

- (i) The undercarriage is operated by a gated selector lever at the bottom of the bulkhead behind and on the left of the pilot's seat. This lever has a square red knob which must be pulled out before the lever can be disengaged from the UP and DOWN positions. The lever is moved sideways when passing through the gate at the NEUTRAL position. The main wheels are held up by locking bolts, but the nose wheel is held up by hydraulic pressure only. In flight, with the undercarriage retracted, the selector lever should be returned to the NEUTRAL position, but when the undercarriage is lowered the selector should be left in the DOWN position. To retract the undercarriage on the ground, the solenoid operated stop in the NEUTRAL gate must be pressed down by hand while the selector lever is moved to UP. For emergency operation *see* Part IV.
- (ii) On the ground, safety locking pins are fitted to all three undercarriage units. Before take-off the pins must be removed and stowed in the bag in the rear fuselage.

10. Undercarriage indicators

A combined undercarriage and flaps indicator (19) is fitted at the bottom left-hand corner of the instrument panel. In addition four lights (20), two red and two green, are fitted to the left of the indicator. The second light of each pair is fitted as a stand-by and provided one light of the pair comes on the locks are home; the defective light, however, should be reported and replaced. The indications are:

Green lights ON ... Undercarriage locked down.

Red lights ON ... Undercarriage up, or between locks.

Dimmer screens are fitted to the lights.

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11. Undercarriage warning horn

The undercarriage warning horn will sound if either or both throttles are less than $\frac{1}{2}$ open when the undercarriage is not locked down.

A spring loaded, warning horn, cut-out switch is mounted on the upper electrical panel (23). This switch cuts out the horn, which will be reset, however, when either or both the throttles are re-opened.

12. Flap control

The flaps are operated by a selector lever mounted on the left-hand side of the bulkhead behind the seat. The lever has three positions: UP, NEUTRAL, and DOWN. Intermediate settings can be obtained by returning the lever to NEUTRAL when the desired setting is reached. The lever should always be returned to NEUTRAL after any operation.

13. Wheel brakes

The hydraulic brakes are applied by depressing the tops of the rudder pedals. They may be set on for parking by depressing the pedals, pulling out the black knob below the centre of the instrument panel, and then releasing the pedals before the knob. If the pedals are again depressed momentarily, the brakes are automatically released. A compressed air emergency brake system, the control for which is a red handle (57) forward of the trimming tab controls, is also fitted—see Part IV.

ENGINE CONTROLS

14. Throttle controls

The throttle levers (31) are mounted in the centre of the quadrant on the left-hand side of the cockpit. A friction adjuster (32) is fitted.

15. Mixture controls

The mixture control levers (30) are mounted on the throttle quadrant and have four positions which, reading from front to rear (on some aircraft reversed), are:—
(a) EMERGENCY. This cuts out the automatic altitude compensation and should only be used when

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the automatic control unit is believed to be inoperative.
(b) **AUTO-RICH.** For all conditions of flight except economical cruising.

(c) **AUTO-LEAN.** For economical cruising.

(d) **IDLE CUT-OFF.** For use when starting and stopping the engines.

16. **Priming**

The electric primer is controlled by a spring loaded switch on the left-hand sloping panel (34). The switch has three positions: **LEFT** engine (up), **OFF** (central), and **RIGHT** engine (down).

17. **Propeller speed controls**

The speed control levers (33), which have white knobs marked "P," are inboard of the throttle and mixture levers. The levers are set forward to increase r.p.m., and a friction adjuster (40) is fitted.

18. **Propeller feathering pushbuttons**

The two red buttons (21), marked **PROP. FEATHER**, are on the upper electrical panel.

19. **Propeller de-icing flow control**

This is on the upper electrical switch panel (23).

20. **Supercharger controls**

The levers (41) marked "B," fitted forward of the fuel cock controls, are set forward for **LOW**, and back for **HIGH**, gear. Gear changes must be made rapidly and firmly to prevent clutch slip.

21. **Carburettor air-intake heat controls**

The hot air controls (42) marked "A" are fitted outboard of the supercharger controls. The levers are set forward for **COLD**, and aft for **HOT** air. The simplest method of moving the air-intake heat controls is to squeeze the levers together and move them simultaneously.

22. **Air filters control**

A single 3-position lever projecting from the floor below the fuel cocks is pulled back and up to **FILTER**; this brings the filter intakes on both engines into operation.

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in the down (RAM) position the normal ram intakes are selected. The control should be returned to the mid (neutral) position after each operation. Under dusty conditions ground running should be carried out with this control set to FILTER; take-off and initial climb may also be made with the filters in action, but, as full take-off boost may not be obtainable, the take-off run may be increased and initial rate of climb reduced.

23. Cowling gills

- (i) The upper gills are controlled on both engines simultaneously by the single red lever which moves in a gated quadrant marked OPEN, NEUTRAL, and CLOSED. To operate, the lever is pulled out and set up to OPEN, or down to CLOSED. These gills must be opened for ground running only.
- (ii) The lower gills are controlled independently by the two purple levers which move in notched quadrants marked CLOSED, NEUTRAL, and OPEN. To operate, the lever is pushed sideways and set up to CLOSED, or down to OPEN.
- (iii) All these levers should be returned to the NEUTRAL (mid) position after any operation.

24. Ignition switches

Two wing-type ignition switches (25), one for each engine, are mounted above the upper electrical panel. Each switch has four positions:

OFF. L. R. BOTH.

The electrical master switch, which when OFF cuts out the magnetos and all electrical services, is mounted above the magneto switches.

25. Starter switches

- (i) Two spring-loaded switches are on the left-hand sloping panel.
- (ii) To start the starboard engine depress the START switch and when the inertia wheel is up to speed, depress the MESH switch, still keeping the START switch depressed.

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- (iii) To start the port engine, proceed as for the starboard but lifting, instead of depressing, the switches.
26. **Oil dilution switches**
- (i) Two engine oil dilution switches, one for each engine, are fitted on the left-hand sloping panel.
- (ii) Separate propeller oil dilution systems are fitted, controlled by two switches, one for each propeller, on the upper electrical panel. Pending the issue of full instructions no attempt should be made to operate these propeller oil dilution systems and the switches should be left set to "off."
27. **Boost gauge drain cock**
- This (59) is fitted in the right, below and forward, of the emergency brake control. During warming up it should be set for a few seconds to each boost gauge in turn to drain the gauge lines.

OTHER CONTROLS AND EQUIPMENT

28. **Cockpit entrance**

Normal entrance and exit is from the port side through a door in the cockpit roof. The door is unlatched from the outside by a handle flush with the surface at the rear corner of the roof. From inside, it is unlatched by a handle fitted at the left side between the forward and aft transparent panels. A brace is provided at the aft end of the door to hold it in the open position. When closing the door from the pilot's seat, the knee joint of the brace must be broken by turning and pulling a handle fitted on the centre line of the door between the forward and aft transparent panels.

29. **Retractable step**

Steps and hand holes are provided in the port side of the fuselage aft of the wing trailing edge for access to the wing walkway and pilot's cockpit. The lower step is retractable and may be extended by pushing a button control fitted in the side of the fuselage just above the wing trailing edge. The step is retracted by pushing it into the fuselage from the outside of the aircraft, or by pulling it up from inside the gunner's compartment.

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30. Pilot's seat

The seat may be raised or lowered when a lever, on the forward right side, is moved into the fully aft position : it is locked when the lever is in the fully forward position.

31. Safety harness release

This is fitted on the bulkhead outboard of the upper cowling gill lever. It is raised to release, and set down to lock, the safety harness.

32. Cockpit windows

The windshield is composed of three panels ; the centre panel is of glass and the two side panels are of Plexiglass incorporating hinged direct-vision panels which spring inwards and can be locked open. There are two panels on each side of the pilot's cockpit, the forward one on each side being of the sliding type. These sliding panels can be locked closed by levers (27) and (51) fitted below the sills.

33. Cockpit lighting

The upper electrical panel incorporates the following lighting controls :

- Compass light switch and rheostat.
- Engine instrument lights rheostat.
- Flight instrument lights rheostat.

An extension light box (39) complete with switch is installed below the engine controls. In addition, two cockpit lights with rheostat and pushbutton controls are fitted, one (36) below the engine controls, and the second (46) on the right forward of the sliding window.

34. Cockpit heating

A sloping panel (61) on the right-hand side carries a master ON-OFF switch and individual switches for the two vapour burning heater units. The master switch should be OFF for take-off and landing and at all times at very low r.p.m.

35. Oxygen system

A semi-portable type oxygen system is installed, the pressure gauge (29) being on the left-hand side.

PART I—DESCRIPTIVE

OPERATIONAL EQUIPMENT AND CONTROLS

36. Guns

The two fixed .50 inch forward firing guns, as well as the camera gun, can be preselected by the switches on the selector panel (24) on the left-hand side below the coaming. They are fired by the trigger switch (18) on the aileron hand-wheel. The two-gun dorsal turret and underbody rear gun are crew operated.

37. Bomb doors control

The bomb doors control lever (38) is mounted on the floor to the left and forward of the pilot's seat and has a thumb button retaining catch; it is set forward to OPEN and back to CLOSE the doors, and should be returned to NEUTRAL after each operation. An indicator light on the right-hand sloping panel (64) comes on when the doors are open.

38. Bomb control panel

The right-hand sloping panel carries selection, fuzeing and jettison switches. The selected bombs are released by pressing the button on the aileron hand wheel. Special firing switches are fitted for the chemical tanks, but they can also be fired by setting the tank selector and bomb nose fuzeing switches on together. If chemical tanks as well as bombs are carried, the tank selector switches must, therefore, be OFF before the bomb nose fuzeing switches are operated prior to bomb release.

RADIO, SIGNALLING AND LIGHTING

39. Radio

American radio and intercom. equipment is fitted. The pilot's controls (50), (62), (63) and (65) are on the right-hand side of the cockpit. A press-to-send switch is fitted on the inboard throttle lever (31). Radio destruction pushbuttons (49) are on the right-hand side. On overseas versions a radio compass is installed; the pilot's indicator (5) is on the left, and the controls (53) are to the right of the pilot's seat.

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40. Landing lights

The switches for these are on the upper electrical panel (23), and are marked EXTEND, OFF, and RETRACT.

41. Identification lights

A combined switch and signalling switch box (45) is on the right-hand side below the coaming. The formation keeping lights switch controls the wing tip or, when fitted, the resin lights.

PART II

HANDLING

42. **Management of the fuel system** —For diagram see Page 7.

(i) The carburettor vapour return lines feed back to Nos. 3 and 4 (MAIN) tanks. These tanks, therefore, should be used for starting the engines, running up, take-off, and climb, and until at least 40 gallons of fuel have been consumed from each tank.

(ii) Use long-range fuselage tanks (if fitted), as soon as sufficient fuel has been used from the MAIN tanks, as follows :

(a) Switch both booster pumps ON.

(b) Set CROSS-FEED—ON.

(c) Set LEFT TANKS selector to No. 5 (BOMB-BAY).

(d) After one minute set RIGHT TANKS selector—OFF.

(e) Set contents gauge to No. 5.

When the fuel pressure gauges indicate that the tank is emptying

(f) Set both tank selectors to ALIX or MAIN.

(g) Set CROSS-FEED—OFF.

(h) Set contents gauge selector to whichever of the tanks selected contains the less fuel.

(iii) Use belly tank (if fitted), before the fuselage tanks, as follows :

(a) As in (ii) above except that at (c) RIGHT TANKS selector should be set to No. 6 (BELLY) and at (d) the LEFT TANKS selector should be set OFF. At (e) set gauge selector to No. 6 position (if connected).

(b) When belly tank empties (if contents gauge is not connected the fuel pressure gauges will give the first warning) select fuselage tanks by setting the LEFT TANKS selector to No. 5 and after a short pause set the RIGHT TANKS selector OFF. The belly tank may then be dropped by pulling the release handle.

PART II—HANDLING

- (iv) The **CROSS-FEED** should be **OFF** at all times except :
- When using fuselage or belly tanks.
 - To supply both engines from wing tanks on one side, should fuel be exhausted on the other side first.
 - When feeding one engine from a tank on the opposite side.
- (v) **Booster pumps** may be **ON** at all times in flight and must be **ON** for starting engines, take-off, on climb, and for landing. They must also be **ON** when using fuselage or belly tanks and, when these empty, for a short time after selecting fresh tanks. They should also be **ON** at any time should fuel pressure show signs of falling.

43. Preliminaries

- Before entering the cockpit, check that the flaps are fully up, as the flaps indicator is not entirely reliable.
- On entering the cockpit check :

Ignition master switch	ON
Ignition switches	OFF
Undercarriage selector lever ..	DOWN
Battery switch (if fitted) ..	ON (check green lights)
Generator switches (in Gunner's cockpit)	ON
Flaps	UP
Flaps selector lever ..	NEUTRAL
Fuel tanks	Check contents
Hydraulic handpump by-pass valve	Locked in down position

44. Starting engines

- Before attempting to start an engine the propeller must always be turned over by hand in the normal direction of rotation for 3 revolutions to avoid the possibility of hydraulic shock damage.
NOTE.—While the propeller is being turned the ignition master switch must be **OFF**.
- Check **CROSS-FEED—OFF**.
Tank selector (for engine to be started)—**MAIN**.

PART II—HANDLING

(iii) Set -

Battery switch (if fitted)	OFF (only if ground battery is used)
Throttles	About 1 inch open
Mixture controls	IDLE CUT-OFF
Propeller speed controls	Fully forward
Two speed superchargers	LOW gear (levers fully forward)
Upper and lower cowling gills	OPEN
Carburettor air-intake heat controls	COLD (fully forward)
Air intakes	RAM (FILTER in dusty conditions)
Booster pumps	ON

(iv) Set ignition switch for port engine to **DOTII**.

(v) Energise the port inertia starter by holding the **START** switch up for about 20 seconds. Never exceed 30 secs.
Note—If the engine begins to turn, return the switch to neutral and have the propeller turned forward (ignition OFF) by hand about half a revolution. This will free the starter from the engine.

- (vi) If engines are cold, hold primer switch on for 3 to 5 seconds during energising period : avoid overpriming.
- (vii) With the **START** switch still in the up position, engage the starter by holding the **MESH** switch up.
- (viii) Keep both switches in the up position until the engine starts. The **START** switch must not be on for more than 30 seconds after cranking, but the **MESH** switch (which also controls the booster coil) should be held up, and in cold weather additional priming given as necessary, until the engine picks up.
- (ix) As soon as the engine is firing regularly, move the mixture control to **AUTO-RICH**.
- (x) If the engine stops, return both switches to neutral, stop priming at once, move the mixture control to **IDLE CUT-OFF** and wait two or three minutes before making another attempt.

PART II—HANDLING

- (xi) To start the starboard engine set tank cock to MAIN and proceed as above (iii) to (x) but setting starter switches down.
- (xii) If a ground battery has been used, check that it is disconnected and set battery switch ON (if fitted).
- (xiii) Warm up at 1,000 r.p.m.

45. Testing engines and installations

- (i) While warming up, make the usual checks of temperatures, pressures, and operation of controls. Check fuel pressure with booster pumps OFF; then switch ON again. Check hydraulic pressure, which should be 825-875 lb./sq. in., and then check the system by lowering and raising flaps.

NOTE.—The following comprehensive checks should be made after repair, inspection other than daily, or otherwise at the pilot's discretion. Normally they may be reduced in accordance with local instructions.

- (ii) After warming up until oil temperature reaches 40°C. and cylinder temperature reaches 120°C., open throttle to give 20 in. Hg. boost, test each magneto as a precautionary check and then test the operation of the constant-speed units and superchargers; r.p.m. should drop and boost rise when HIGH gear is engaged.
- (iii) Open up to take-off boost momentarily and check static r.p.m. (2,400). On FILTER intakes maximum boost may not be obtainable.
- (iv) Throttle back to 30 in. Hg. boost and test each magneto in turn. The drop in r.p.m. should not exceed 100.

46. Taxiing

- (i) Before taxiing, ensure that the rudder pedals are adjusted for equal length, check the hydraulic pressure and then see that the ground crew remove and hold up the safety locking pins from the undercarriage.
- (ii) The brakes are smooth but rather heavy in operation.
- (iii) If the nose wheel is found to shimmy when taxiing, taking off, or landing, the aircraft must be brought in at once.

PART II—HANDLING

47. Check list before take-off

T—Trimming tabs :			
Elevator	...	3 divisions nose down at 23,000 lb.	
		5 divisions nose down at 27,000 lb.	
Rudder	...	Neutral	
Aileron	...	Neutral	
M—Mixture controls	..	AUTO-RICH	
P—Propellers	...	Speed controls fully forward	
F—Fuel	...	Both tank selector cocks set to MAIN tank	
		Booster pumps—ON	
F—Flaps	...	UP (for shortest run 2½" (half) down)	
Gills—Upper Gills		CLOSED	
Lower Gills		½ open	
Superchargers	...	LOW gear (levers fully forward)	
Air intakes	...	RAM (FILTER in dusty conditions—see para. 22)	

48. Take off

- (i) Taxi forward for a few yards to straighten the nose wheel, then, taking care to keep the toes clear of the brake pedals, open the throttles steadily, taking care not to exceed the maximum take-off boost.
- (ii) As the aircraft accelerates raise the nose wheel clear of the ground. When a speed of 100-110 m.p.h. I.A.S. has been attained pull the control column steadily further back until the aircraft takes off. The nose heaviness apparent on the ground disappears when the aircraft is airborne.
- (iii) Safety speed is 160 m.p.h. I.A.S. at 20,000 lb. and 170 m.p.h. I.A.S. at 23,700 lb., if no flap is used for take-off. With half flap the speed should be 10 m.p.h. higher in both cases.

49. Climbing

- (i) The recommended speed is 160 m.p.h. I.A.S.

PART II—HANDLING

- (ii) Change to **HIGH** gear when boost falls to about 32 inches (25 inches if climbing in weak mixture). When changing gear throttle back to prevent excessive boost.

50. **General flying**

(i) *Stability*

The aircraft is slightly unstable longitudinally, but is stable laterally and directionally. At low speeds, in dives, and on the climb, the rudder hunts noticeably. The aircraft tightens up in steep turns to left or right.

(ii) *Change of trim*

Undercarriage down ... Nose down
 Flaps down Slightly nose down
 Gills closed Strongly nose down
 Bomb doors open ... Nose down.

(iii) *Flying in bad visibility*

Set r.p.m. to 2,050, mixture to **AUTO-RICH**, and lower flaps to 22½° (half). Speed may then be reduced to 170 m.p.h. I.A.S.

- (iv) When M-10 tanks are carried they should only be dropped when necessary, and in straight and level flight at a speed of about 220 m.p.h. I.A.S. The outer tanks should be released first, followed by the inner tanks when the outers have cleared.

NOTE—A retrospective modification to the switch wiring ensures that the tanks are released in pairs in the correct order.

51. **Stalling**

(i) *Stalling speeds in m.p.h. I.A.S. are:*

	At		
	20,000 lb.	24,000 lb.	27,000 lb.
Flaps and undercarriage up	115 to 118	123 to 126	127 to 130
Flaps and undercarriage down	100 to 103	107 to 110	113 to 116

- (ii) (a) With flaps and undercarriage up, the stall is preceded by buffeting which commences at about 145 m.p.h.

PART II—HANDLING

I.A.S. This increases in intensity until the stall is reached, at which the nose drops. Recovery is straightforward and easy.

(b) With four M.10 chemical tanks slung, the stall, flaps and undercarriage up, is preceded by violent buffeting which commences at 160 m.p.h. I.A.S. At the stall, which occurs at approximately 130 m.p.h. I.A.S., the A.S.I. needle fluctuates widely and the nose drops. Recovery is again straight forward and easy. If, in either case, the control column is held back at the stall either wing will drop sharply.

(c) With flaps and undercarriage down there is little warning of the stall except for slight aileron and elevator buffet. With four M.10 chemical tanks slung the buffeting is more apparent, commencing at about 121 m.p.h. I.A.S. At the stall either wing (though generally the right) will drop violently and very steeply and cannot be picked up by rudder. Recovery action must be initiated immediately as recovery involves a considerable loss of height.

(iii) *High-speed stall.*

Under an acceleration of 2g. (the acceleration imposed in a sustained 60° banked turn) the stalling speed at 24,000 lb. will be about 170-180 m.p.h. I.A.S.

52. **Diving**

- (i) The aircraft must be trimmed into the dive, but care must be taken to avoid too steep an entry. On pulling out it is easy to induce large accelerations and care should be taken to avoid too rapid a recovery.
- (ii) No automatic boost control is fitted and boost rises rapidly with loss of height.

53. **Approach and landing**

- (i) Check fuel—booster pumps—ON.
Leave gills as set for cruising flight.
- (ii) Check hydraulic pressure.
- (iii) Depress brake pedals and check that pedal pressure can be felt, also that hydraulic pressure shows a momentarily small drop.
- (iv) Reduce speed to 175 m.p.h. I.A.S.

PART II—HANDLING

(v) Check list before landing.

U—Undercarriage	...	Down	(check warning horn, indicator, and that hydraulic pressure builds up)
M—Mixture controls	..	AUTO-RICH	
P—Propeller	..	Controls fully forward	
F—Flaps...	..	Fully down	
Superchargers	...	LOW gear	
Air intake	..	RAM (FILTER in dusty condition)	

(vi) After lowering flaps, check that hydraulic pressure is still adequate. If not, the handpump will be needed for the brakes, or the emergency compressed air brake will have to be used. (See Part IV.)

(vii) Recommended final approach speeds (m.p.h. I.A.S.), flaps down, are :

	At 20,000 lb	At 24,000 lb.
Engine assisted	110/115	120*
Glide	125	130*

*These speeds also apply for approach with four M-10 tanks slung, but with contents jettisoned; approach and landing with the tanks slung presents no difficulty.

(viii) Control is very good and a normal tricycle undercarriage landing should be made with the nose wheel clear of the ground. Care should be taken to avoid landing in an exaggerated tail-down attitude; otherwise, damage may be caused to the rear fuselage. The brakes should not be applied until the nose wheel is firmly on the ground.

54. Mistanding

- (i) Open throttles slowly; the aircraft will climb with flaps and undercarriage down at a speed of about 135-140 m.p.h. I.A.S.
- (ii) Trim out the tail heaviness as the undercarriage comes up.
- (iii) Set gills $\frac{1}{2}$ open and retrim.
- (iv) The flaps come up slowly; there is no change of trim and only slight sink.

PART II—HANDLING

55 After landing

- (i) Before taxiing raise the flaps, open the upper and lower cowling gills fully, and switch OFF the booster pumps.
- (ii) Change superchargers to HIGH gear and after 30 seconds back to LOW.
- (iii) Run the engines at about 800 r.p.m. until cylinder temperatures fall below 150° C. and then stop by setting mixture controls to IDLE CUT-OFF.
- (iv) Turn off fuel and all electrical services.
- (v) Oil dilution—see A.P. 2095. The correct dilution period is 4 minutes.

56. Beam approach—at 20,000 lb. (approx.) :—

	Preliminary Approach	On Q.D.M.	Outer Marker on Q.D.M.	Inner Marker on Q.D.M.
Indicated height	1,500 ft.	1,000 ft.	600 ft.	100 ft.
Action	Lower flaps 22½° (half) Set Gills ½ open	Lower full flap	Lower undercarriage	Throttle back slowly and commence hold off
Resultant change of trim	Nose down	Slightly nose down	Nose down	—
L.A.S. ...	165-170	150	120-125	110-115
R.P.M. ...	2,050	2,050	2,300	2,300
Boost (level flight) ...	22 in	25 in	25 in	
Boost (— 500 ft./min.) ...	19 in	20 in. approx.	20 in. approx.	
Boost (overshoot)	—			27 in.
Remarks	When power is reduced the deceleration is very slow		OVERSHOOT Open throttles to 37 in. Retrim Raise undercarriage Raise flaps at 300-400 ft. Retrim Adjust boost and r.p.m. at 1,000 ft.	
Airmeter error:				
At take-off	0 ft.	Negligible		
At touch-down	+ 20 ft.			

PART III

OPERATING DATA

57. **Engine data.**

(i) *Fuel*—100 octane only.

(ii) *Oil*—see A.P. 1464/C37.

(iii) *Principal engine limitations.*

NOTE.—The limitations quoted below supersede any which may be found on the data plate in the pilot's cockpit.

		R. p. m.	Boost in. Hg	Cylr.	Temp. °C Oil Inlet Max. Desired
MAX. TAKE-OFF	L.	2,400	45	250	105
To 1,000 FT.					
MAX. CLIMBING	L.	2,300	37	230	105 50/70
1 HR. LIMIT	.. H	2,300	41½	230	105 50/70
MAX. R/CIT	.. L	2,050	31	205	90 50/70
CONTINUOUS	.. H	2,050	34	205	90 50/70
MAX. WEAK	L	2,050	28½	205	90 50/70
CONTINUOUS	.. H	2,050	31½	205	90 50/70
MAX. COMBAT	L.	2,400	45	250	105
5 MINS. LIMIT	H	2,400	44½	250	105

NOTE.—Where different boost limitations are quoted for LOW and HIGH gears, the lower of the two should be used, except when necessary in operations.

OIL PRESSURE	MAXIMUM IN FLIGHT	..	90 lb./sq. in.
	NORMAL	..	85 lb./sq. in.
	MINIMUM IN FLIGHT	..	75 lb./sq. in.
	IDLING	..	30 lb./sq. in.

TEMP. BEFORE TAKE-OFF OIL—max 40° C.
CYLR.—120°/205° C.

Stopping Engine Max. cylinder temp.—150° C.

(iv) *Fuel pressure* :—

Max.	..	..	..	..	16 lb./sq. in.
Min.	..	..	..	..	12 lb./sq. in.
Desired	..	..	..	..	14/15 lb./sq. in.

(v) *Important Note.*—Owing to the fact that certain r.p.m. cause high tip stresses in the propellers, it is most important that the ranges 1,500-1,650 r.p.m. and 2,050-2,150 r.p.m. should be avoided at all times.

PART III—OPERATING DATA

58. Position error corrections

From ..	170	220	250	m.p.h. I.A.S.
To ..	220	250	up	
Subtract ..	6	8	10	m.p.h.

59. Flying limitations

- (i) The aircraft is designed for the duties of a medium bomber (see A.P. 2095).

Aerobatics and intentional spinning are not permitted.

- (ii) Maximum speeds in m.p.h. I.A.S. are :-

Diving	400
Diving with underwing loads	300
Flaps down	175
Undercarriage down	175
Bomb doors open	320

- (iii) Maximum weights are :-

For normal take-off and gentle manoeuvres	26,000 lb.
For overload take-off and gentle manoeuvres	27,000 lb.
For all permitted forms of flying and landing	24,000 lb.

60. Fuel capacities and consumptions

- (i) The approximate capacities in Imperial gallons (U.S. gallons in brackets) are :

(a) MAIN tanks (each)	113	(136)
AUX. tanks (each)	53	(64)
	166	(200)
Total (x 2)	332	(400)
(b) Fuselage tanks	270	(325)
Total with fuselage tanks	602	(725)
(c) Belly drop tank	312	(375)
Total with all tanks	914	(1100)

PART III—OPERATING DATA

(ii) Approximate total consumptions in Imperial gallons per hour are :

(a) *Rich mixture*

R.p.m.	Boost in. Hg.	Galls./hr.
2,300	37	265

(b) *Weak mixture at 15,000 ft. in LOW gear*

R.p.m.	Boost in. Hg.	Galls./hr.
1,850	23½	100
1,450	21½	75

(c) *Weak mixture at 15,000 ft. in HIGH gear*

R.p.m.	Boost in. Hg.	Galls./hr.
1,850	27	105
1,450	27	90

PART IV

EMERGENCIES

61. Engine failure during take-off

If safety speed has been reached the aircraft will climb on one engine at climbing power at 175 m.p.h. I.A.S. with flaps up, provided bombs have been jettisoned.

62. Engine failure in flight

(i) If the failed engine cannot be made to pick up :

(a) Feather its propeller (*see* para. 64).

(b) Keep a careful watch on the temperatures of the live engine and open the cowling gills only sufficiently to maintain them within the permissible limits. No attempt should be made to keep temperatures down to cruising limits by opening gills, as the ability to maintain height on one engine is thereby impaired.

NOTE.—In single engine flight at maximum rich mixture cruising conditions a cylinder head temperature of 230°C. is permitted.

- (ii) When wing bomb racks are fitted it should be possible to maintain height on either engine at maximum continuous rich mixture cruising conditions at weights up to 22,000 lb., at 155-160 m.p.h. I.A.S. At climbing power it should be possible to maintain height on either engine at weights up to 23,700 lb., at 165 to 170 m.p.h. I.A.S.
- (iii) Do not attempt to maintain height at speeds below 155 m.p.h. I.A.S. at cruising power, or 165 m.p.h. I.A.S. at climbing power; otherwise, the rudder will hunt unpleasantly.
- (iv) Without wing bomb racks the single engine performance will be improved.

PART IV—EMERGENCIES

63. Single engine landing

- (i) Do not allow the speed to fall below 160 m.p.h. I.A.S. on the circuit, which should be made towards the live engine.
- (ii) When cross wind, preparatory to making the final approach, lower the flaps 22½°.
- (iii) Do not allow the speed to fall below 150 m.p.h. I.A.S. on the turn in, and make the final approach in a glide at 125-130 m.p.h. I.A.S.
- (iv) The undercarriage lowers and locks down rapidly, even with one propeller feathered, and it may therefore, conveniently be left retracted until the completion of the turn-in.
- (v) Do not lower the flaps fully until it is clear that the airfield can be reached comfortably in a glide.
- (vi) The live engine may be used carefully to adjust the rate of descent during the early stages of the approach.

64. Feathering

- (i) Hold the button in only long enough to ensure that it stays in by itself; then release it so that it can spring out when feathering is complete.
- (ii) Close throttle immediately and set mixture control to IDLE CUT-OFF.
- (iii) Close the gills.
- (iv) Switch off only when the propeller has stopped rotating.
- (v) If engine is being stopped for any length of time, switch off the booster pump, and turn off fuel.

65. Unfeathering

- (i) Set throttle closed or slightly open, propeller control fully back and ignition on, fuel cock and booster pump on.
- (ii) Hold the button in until r.p.m. reach 1,000 to 1,300 and set mixture control to AUTO-RICH.
- (iii) If the propeller does not return to normal constant-speed operation, open throttle slightly.
- (iv) Open gills as necessary.

PART IV—EMERGENCIES

66. Hydraulic system—emergency operation

The handpump can be used to operate all hydraulic services, but, if fluid has been lost by leakage or damage to the system, only sufficient fluid for about 75 strokes of the pump may be left; its emergency use in flight should, therefore, be restricted to:

- (i) Locking the undercarriage down (see para. 67).
- (ii) Pumping up the accumulator (if pressure is down) for brake operation (see para. 68).
- (iii) Lowering flaps (see para. 69).

67. Undercarriage emergency operation

If the hydraulic system fails completely the undercarriage can be lowered, after reducing speed to 140 m.p.h. I.A.S. by setting the control DOWN and pulling out the red toggle at the bottom rear corner of the cockpit, on the right-hand side. When pulled out to its fullest extent this toggle withdraws the locks holding the main wheels up, and the wheels are then pulled down and locked by the action of strong shock absorber cords.

The toggle also releases the hydraulic pressure which holds the nose wheel up, and allows it to be forced down and locked by the action of a strong coil spring. The toggle must be held out until all wheels are locked down and the green lights show. The action can be assisted by diving slightly and pulling up fairly sharply two or three times. To ensure that the wheels are locked down, with the undercarriage selector in the DOWN position, a few strokes of the handpump may be given. The handpump by-pass must be left set down.

68. Brakes emergency operation

- (i) If accumulator pressure is low, an attempt can be made to raise it before landing by setting the handpump by-pass up and pumping.
- (ii) Should this prove ineffective, set the by-pass down before landing. During the landing run, operate the handpump while depressing the brake pedals.

PART IV EMERGENCIES

- (iii) If braking is still not obtained the emergency compressed air system must be used. Compressed air is supplied from a bottle normally charged to 400 lb./sq. in. in the nose wheel well. The control is an ON-OFF valve on the right-hand side of the cockpit. To operate, the handle is pushed in and turned clockwise, and it must not be turned off again until reset on the ground. This system is independent of the normal toe brake pedals and the degree of braking cannot be controlled by the pilot.
69. **Flaps emergency operation**
Set flap selector DOWN and use hand-pump; the bypass valve must be down.
70. **Fire-extinguishers**
- No engine fire-extinguishing system is fitted on this aircraft. In the event of fire in an engine nacelle proceed as detailed in A.P.2095, omitting the operation of the fire-extinguisher button.
 - Two hand-type extinguishers are provided, one stowed on the fuselage deck aft of the pilot's seat, and the other stowed in the gunner's compartment.
71. **Bomb jettisoning**
- If still in place, the belly tank must first be released by pulling the handle on the bulkhead (see Part I, para. 2).
 - The bomb doors must be opened.
 - Bombs can then be jettisoned by means of the jettison switches on the right-hand sloping panel. Early aircraft have no jettison switch, and bombs must be jettisoned by selecting and firing as for salvo release. M-10 tanks must be jettisoned in pairs, outers first, followed by inners—see para. 50 (iv).
72. **Emergency exits**
- Pilot's cockpit.** The roof of the pilot's cockpit is fitted with an emergency release handle at the aft transparent panel. Pulling this handle unlatches the roof and also

PART IV—EMERGENCIES

pulls the pans from the hinges on the right-hand side, and from the brace at the aft end. A push on the roof allows the air-stream to carry it away.

(i) *Cannister's compartment*

(a) The lower door is opened by the handle in the centre of the door, or by operating the crank on the right-hand side of the compartment.

(b) To open the upper crash exit, push up and outwards on the enclosure glass.

(ii) *Bomb aimer's compartment*

(a) The lower door is opened by the handle in a recess in the right-hand front edge.

(b) An additional exit is provided on the right-hand side of the compartment; to open, rotate the red lever backwards and push the panel out.

73. *Dinghies and parachutes*

An H type dinghy in valise is stowed beneath the jettisonable roof, at the aft end of the walk way extending rearward from the pilot's cockpit. The valise contains, besides the complete dinghy and weather apron, glove-type paddles and, when available, a T.3180 Transmitter. Immediately forward of the valise is stowed a type 7 emergency pack, containing rations, water, first-aid and signalling equipment for the crew.

Both the valise and pack are retained in place by means of quick-release straps.

Seat-type parachutes and "K" type single-seat dinghies are provided for each member of the crew, that for the Navigator being provided also with a T.3180 Transmitter. This last item is to assist in the subsequent location of the Navigator should only he have baled out. See para. 74.

74. *Ditching*

See A.P. 2095. The navigator should bale out before the aircraft is ditched. A decision to ditch should, if possible, be made, and the navigator instructed to bale out, while at a sufficient height to enable him to do so safely.

PART IV. EMERGENCIES

75. Aircraft destruction

The fuel dump valve control is a red "T" handle (56) fitted on the right-hand side of the cockpit, forward of the undercarriage emergency release toggle. When pulled up it allows fuel to flow from the MAIN tanks on to the ground, where it may be ignited by means of the Very pistol.

WARNING.—On no account must fuel be jettisoned in flight by this method.

I N S T R U M E N T P A N E L

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Free air thermometer. 2. A.S.I. 3. Reflector sight. 4. Altimeter. 5. Radio compass indicator (overseas versions only). 6. Instrument flying panel. 7. Push to mute switch. 8. Gun firing switch (not visible). 9. Dual boost gauge. 10. Dual revolution indicator. 11. Direction indicator (inoperative). 12. Suction gauge. | <ol style="list-style-type: none"> 13. Dual oil pressure gauge. 14. Dual fuel pressure gauge. 15. Fuel contents gauge and selector. 16. Dual carburettor air temperature indicator. 17. Dual oil temperature indicator. 18. Dual cylinder temperature indicator. 19. Undercarriage and flap indicator. 20. Undercarriage indicator lights. 21. Propeller feathering buttons. 22. Pilot's bomb release button. 23. Upper electrical switch panel. 24. Camera and gun selector switches. 25. Ignition switches. |
|--|--|

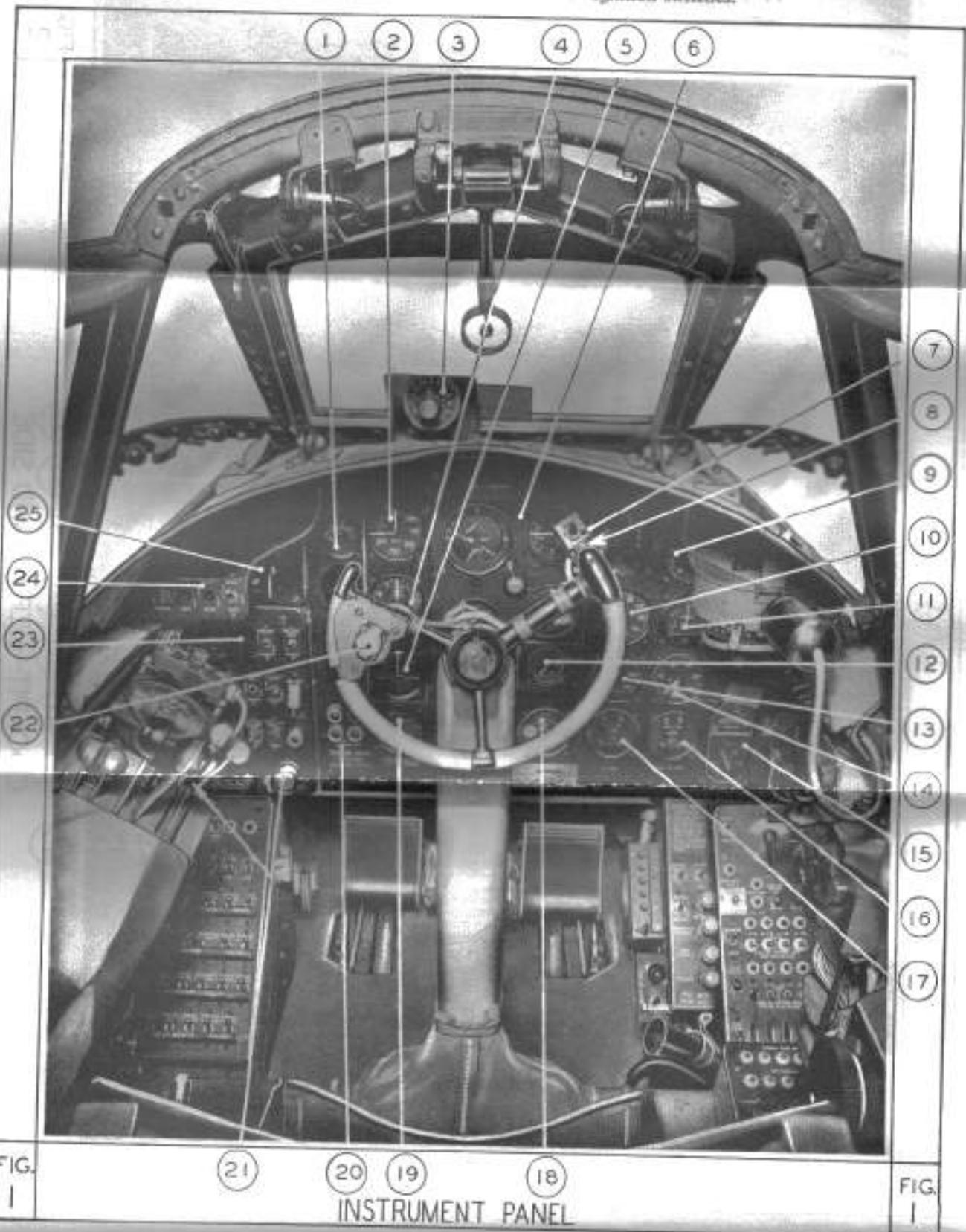
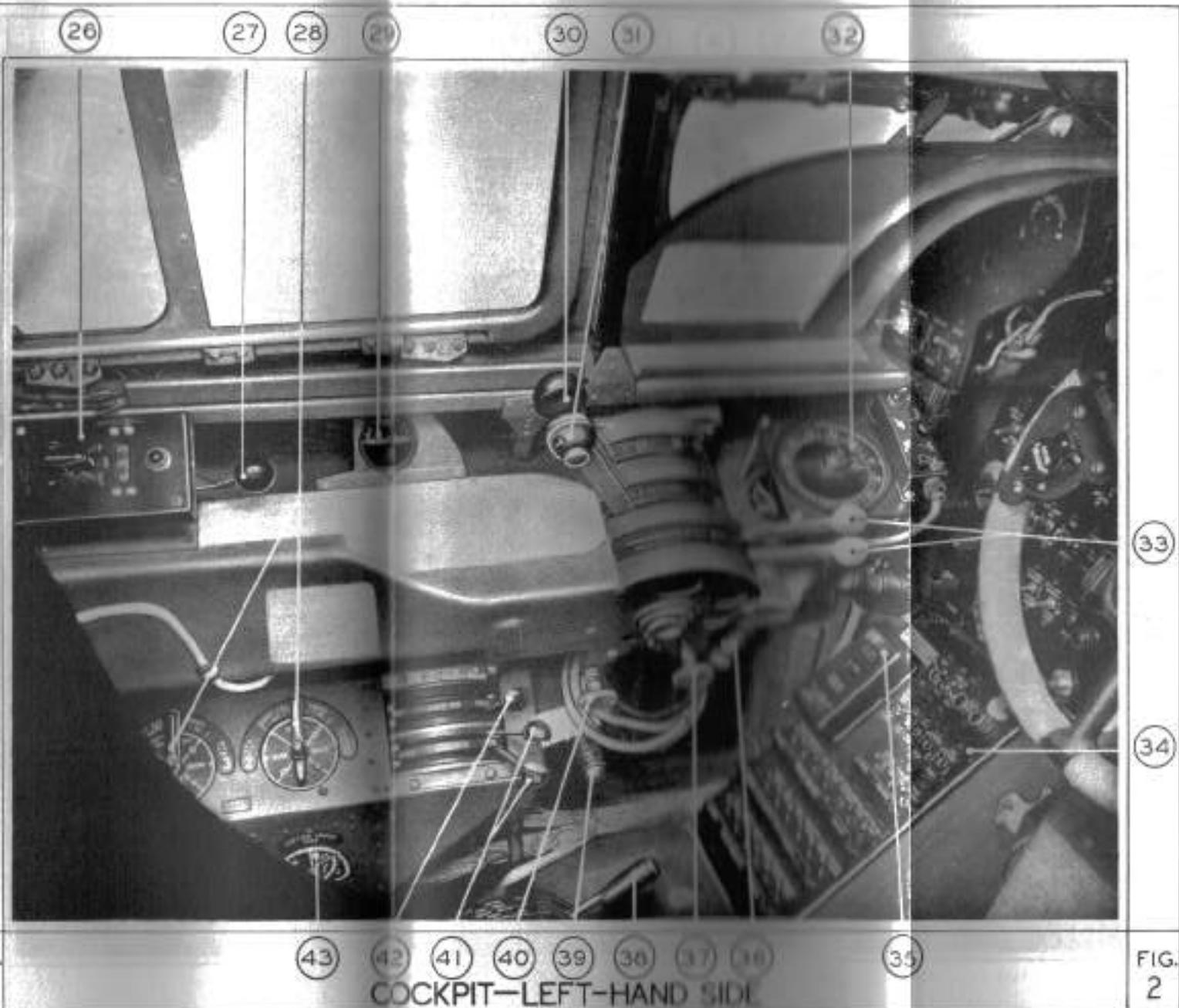


FIG.
1

I N S T R U M E N T P A N E L

FIG.
1



Key to Fig. 2

**COCKPIT—
LEFT-HAND SIDE**

- 26. Trailing aerial control box (O).
- 27. Sliding panel locking lever.
- 28. Fuel tank selector cocks.
- 29. Oxygen pressure gauge.
- 30. Mixture levers.
- 31. Throttle levers (press-to-send button on inboard lever).
- 32. D.R. Compass repeater.
- 33. Propeller speed control levers.
- 34. Left-hand sloping switch panel.
- 35. Fuze box.
- 36. Cockpit light.
- 37. Throttle lever friction adjuster.
- 38. Bomb door control lever.
- 39. Cockpit extension light.
- 40. Propeller lever friction adjuster.
- 41. Supercharger levers.
- 42. Carburettor air intake heat control levers.
- 43. Cross-feed cock.

(O) = Fitted on overseas versions only.

**FIG.
2**

COCKPIT—LEFT-HAND SIDE

Key to Fig. 3
**COCKPIT—
 RIGHT-HAND SIDE**

- 44. Radio remote controller (O).
- 45. Identification light and signalling switchbox.
- 46. Cockpit light.
- 47. Signalling key (Bendix) (O).
- 48. Filter switchbox.
- 49. Radio destruction push-buttons.
- 50. I.F.F. switches.
- 51. Sliding panel locking lever.
- 52. Intercom, station box.
- 53. Radio compass controls (O).
- 54. Pilot's head-set socket.
- 55. Trimming tab controls.
- 56. Fuel dump valve (aircraft destruction) control.
- 57. Emergency air brake control.
- 58. Fragmentation bomb switch panel (inoperative).
- 59. Boost gauge drain cock.
- 60. Relief tube.
- 61. Cockpit heating system controls.
- 62. Radio control "G" switch.
- 63. V.H.F. Controller.
- 64. Right-hand sloping bomb control switch panel.
- 65. Radio remote controller (Bendix) (O).
- 66. S.B.C. jettison switch (O).
- 67. U.V. light projector.
- 68. P.9 Compass.

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FIG.
3

COCKPIT—RIGHT-HAND SIDE

FIG.
3

(O) = Fitted on overseas versions only.