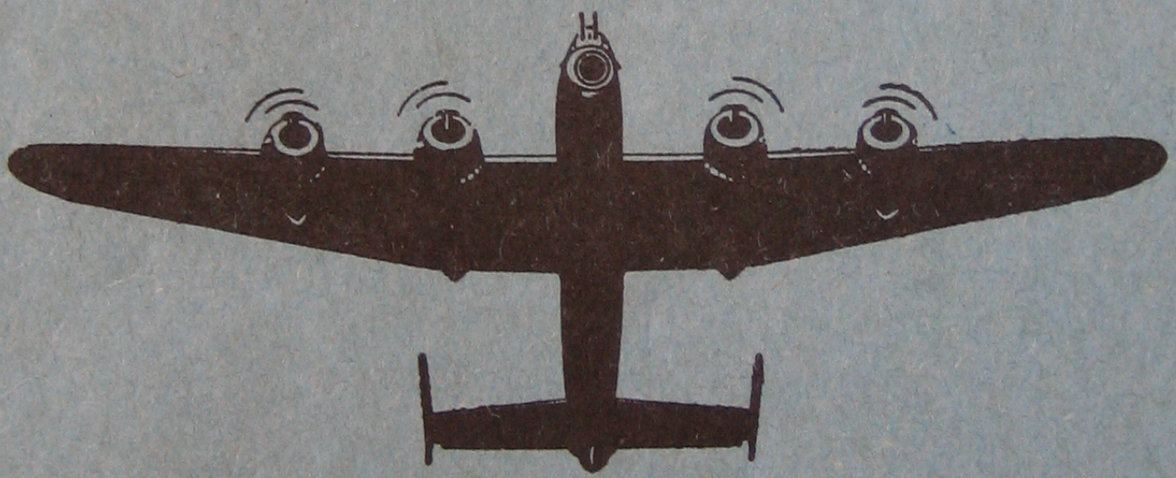
A.P. 2062B—P.N.

PILOT'S NOTES

FOR

LANCASTER II

FOUR HERCULES VI OR XVI ENGINES



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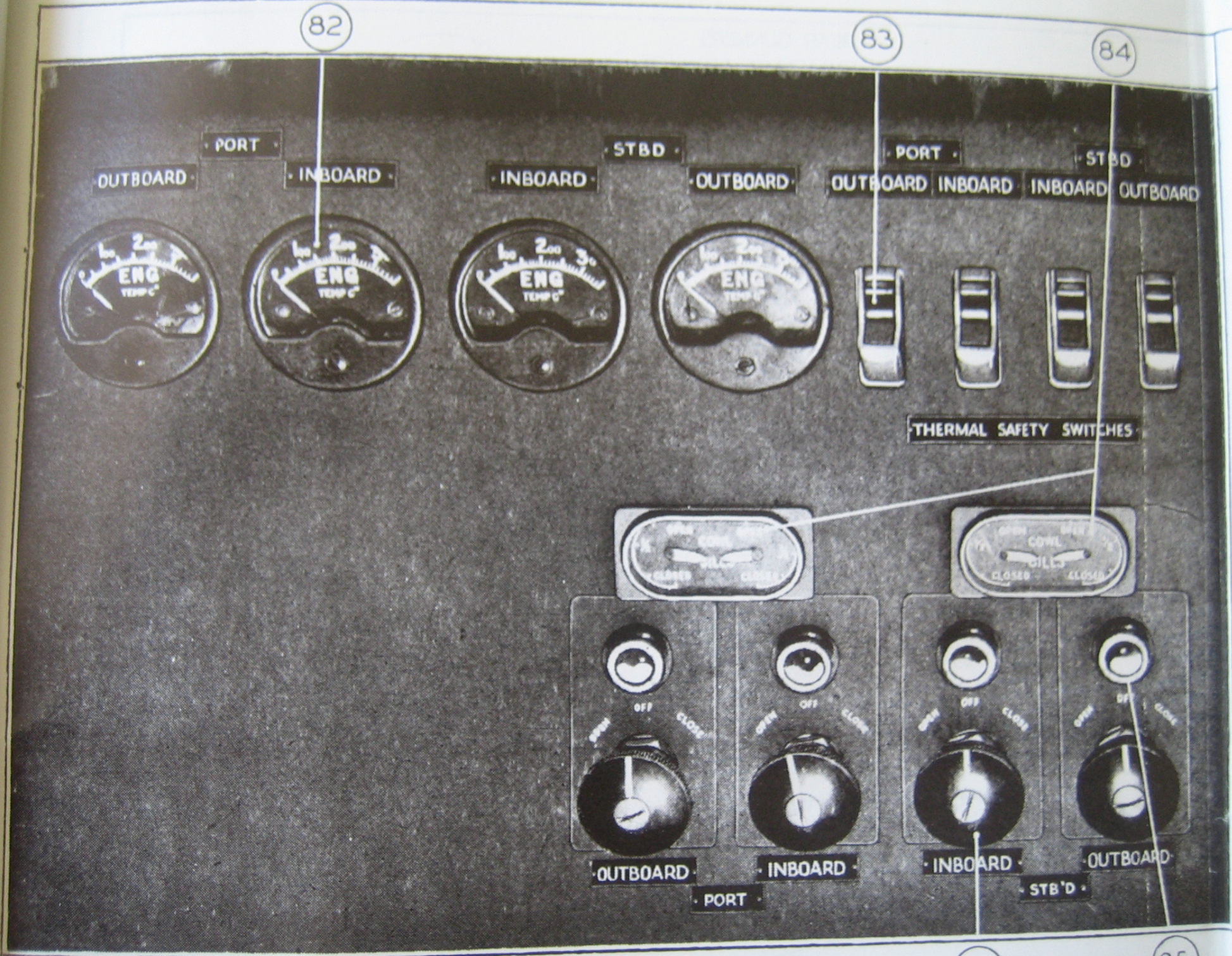


PILOT'S AUXILIARY PANEL.

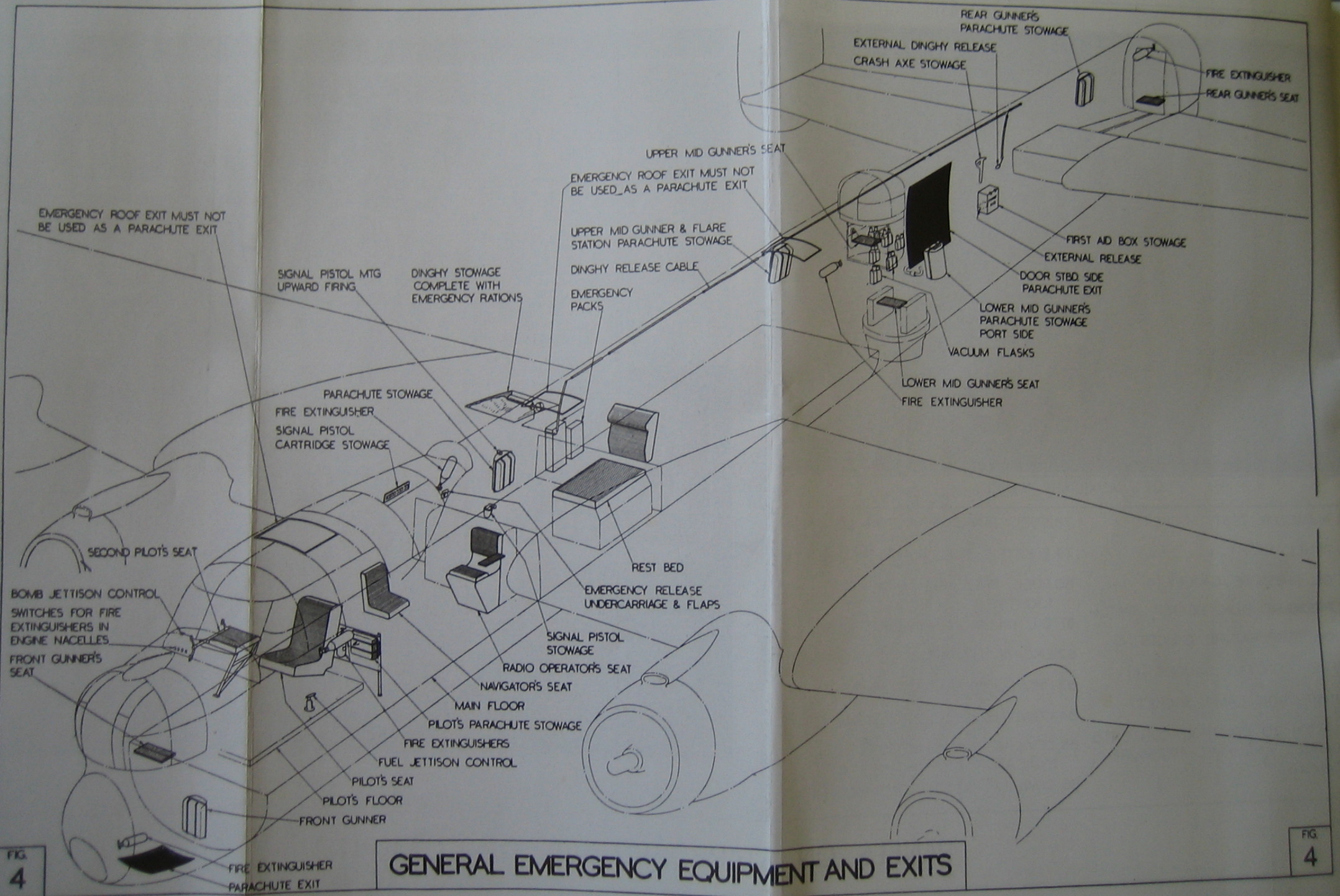
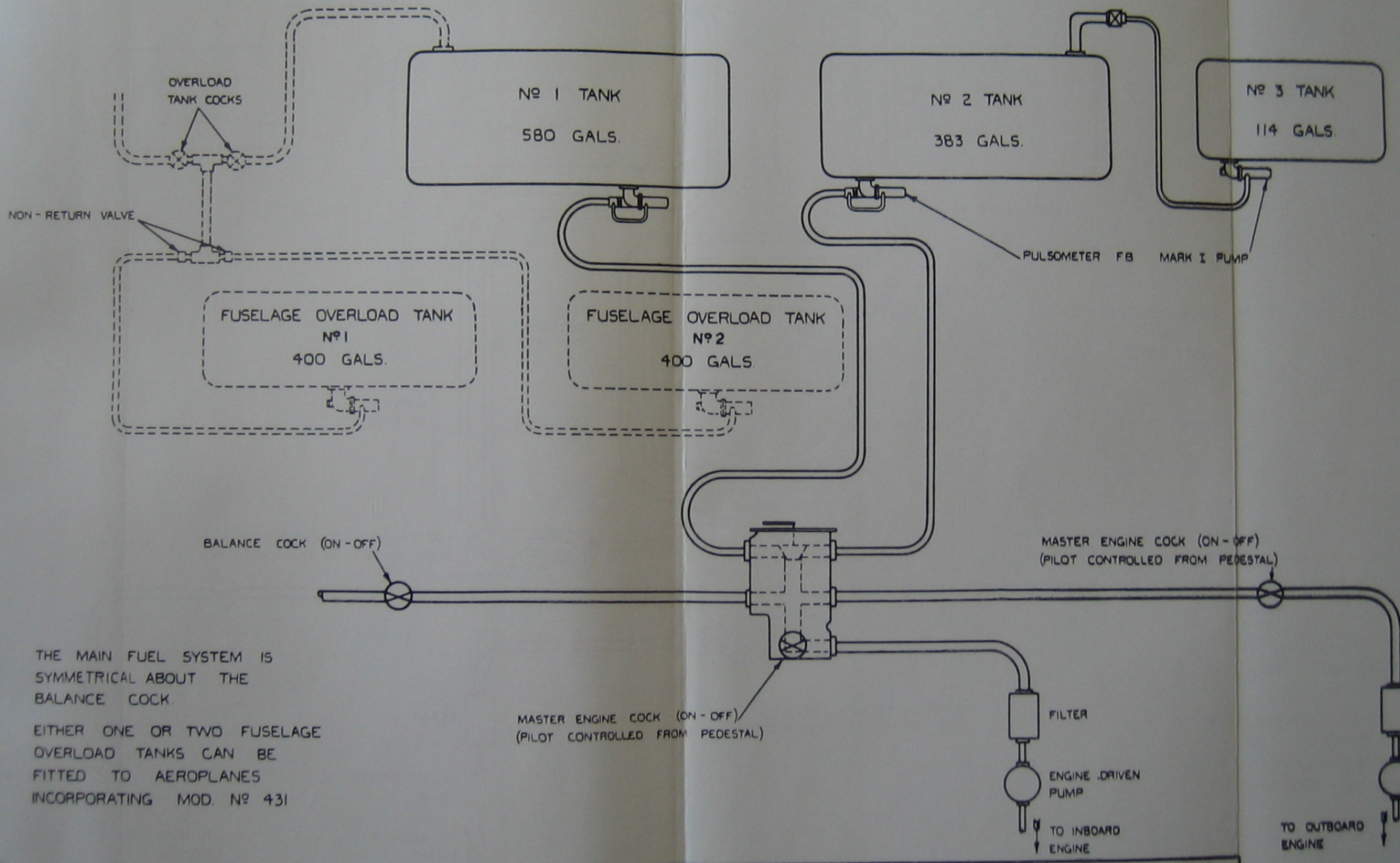


FIG. 4

GENERAL EMERGENCY EQUIPMENT AND EXITS

FIG. 4



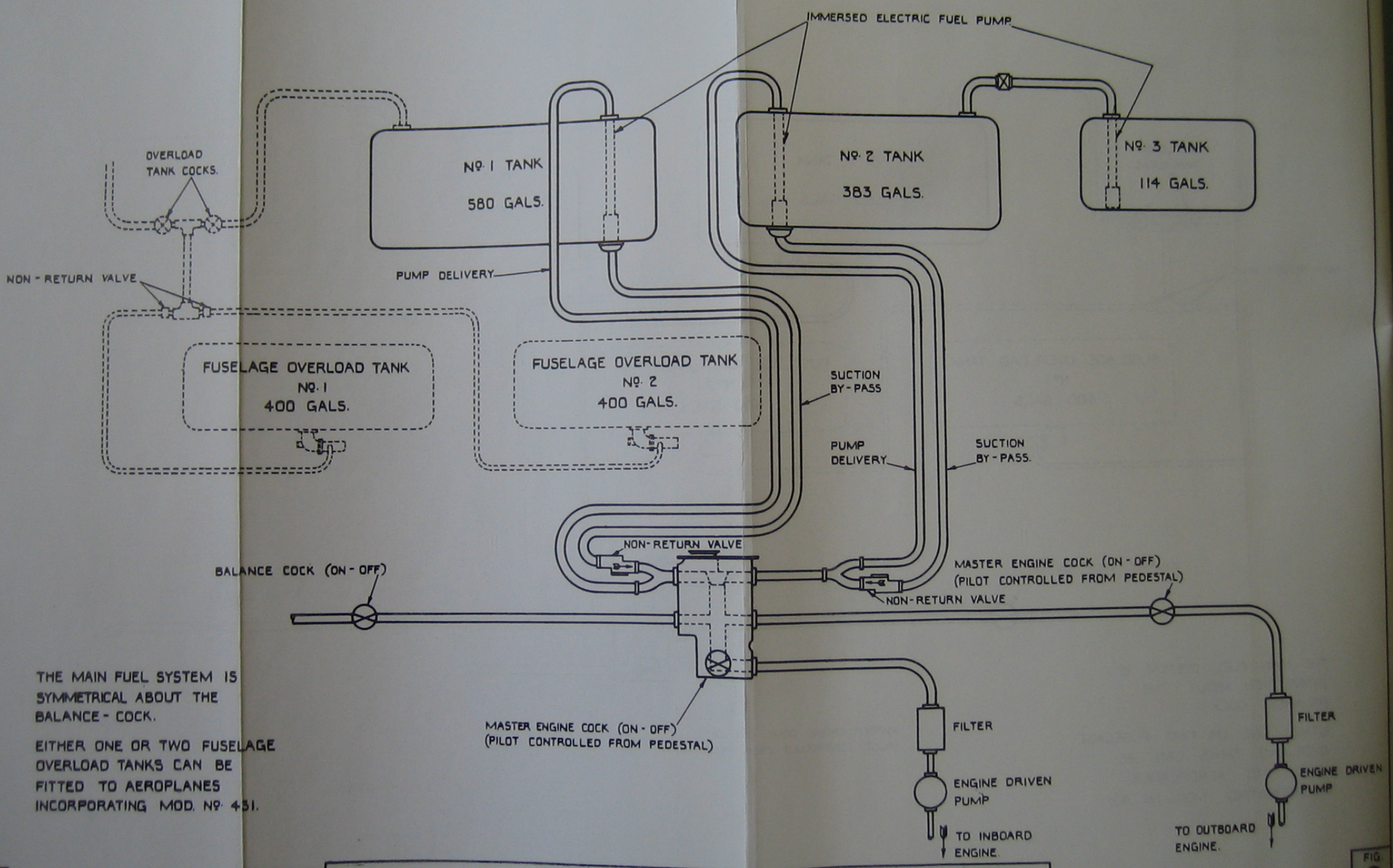
THE MAIN FUEL SYSTEM IS SYMMETRICAL ABOUT THE BALANCE COCK.

EITHER ONE OR TWO FUSELAGE OVERLOAD TANKS CAN BE FITTED TO AEROPLANES INCORPORATING MOD. Nº 431

FIG 5

SIMPLIFIED FUEL SYSTEM DIAGRAM. PULSOMETER PUMPS.

FIG 5



THE MAIN FUEL SYSTEM IS SYMMETRICAL ABOUT THE BALANCE-COCK.

EITHER ONE OR TWO FUSELAGE OVERLOAD TANKS CAN BE FITTED TO AEROPLANES INCORPORATING MOD. Nº. 431.

FIG. 6

SIMPLIFIED FUEL SYSTEM DIAGRAM E.P.I. PUMPS.

FIG. 6

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 include all current amendments and 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	EJP	4/4/46	7		
2			8		
3			9		
4			10		
5			11		
6			12		

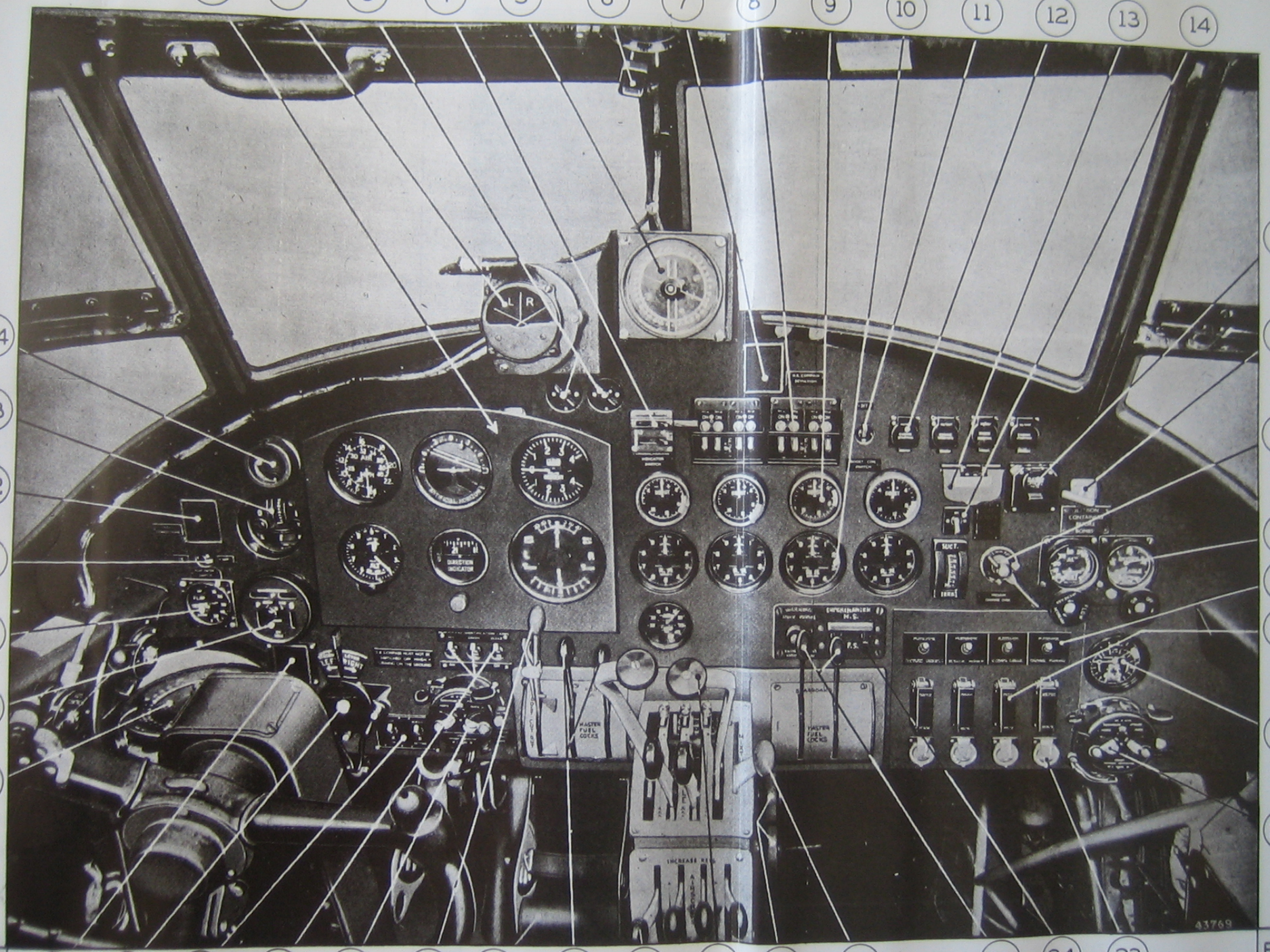


FIG. 1

INSTRUMENT PANEL

FIG. 1


DS771

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). Flight Engineers should also have a copy of A.P. 2764 when issued.

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

Additional copies may be obtained from A.P.F.S. Fulham Road, S.W.3, by applicationon R.A.F. Form 294A, in duplicate, quoting the number of this publication in full A.P. 2062B, P.N.

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

AIR MINISTRY
June 1943
(*Reprinted August*, 1943)

AIR PUBLICATION 2062B—P.N.
Pilot's Notes

LANCASTER II PILOT'S NOTES

LIST OF CONTENTS

PART IV—EMERGENCIES

PART V—ILLUSTRATIONS

PART I

DESCRIPTIVE

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

INTRODUCTION

1. The Lancaster II aircraft is a heavy bomber fitted with four Hercules VI or Hercules XVI engines, and Rotol electric propellers.

FUEL AND OIL SYSTEMS (see Figs. 5 & 6, Part V)

2. **Fuel tanks.**—Three self-sealing tanks are fitted in each wing, numbered 1, 2 and 3 outboard from the fuselage and of the following capacities—

Port and starboard	No. 1 ..	580	gallons	each
,, ,, ,,	No. 2 ..	383	,,	,,
,, ,, ,,	No. 3 ..	114	,,	,,
		1,077	,,	,, side
	or	2,154	,,	in all

On some aircraft the tanks may be marked Inner, Centre and Outer instead of Nos. 1, 2 and 3.

Provision is made on some aircraft for carrying one or two 400-gallon tanks fitted in the bomb cells; these tanks are connected so that their contents may be transferred into either or both No. 1 wing tanks and thence to the engines.

When the maximum bomb load is carried, the No. 2 tanks should be filled first, and the remainder of the fuel put in No. 1 tanks. This is on account of strength considerations of the aircraft structure.

3. **Fuel cocks.**—The pilot controls four master engine cocks (25) and (30). The flight engineer controls two tank selector cocks (78) which select No. 1 tank or No. 2 tank on each side. (No. 3 tank replenishes No. 2, see below.) A cross-feed cock (marked BALANCE COCK) connects the port and starboard supply systems, and is on the

floor just forward of the front spar, with the handle visible through a hole in the spar cover. When the 400-gallon tanks are fitted in the bomb cells they each have an ON-OFF cock situated behind the front spar in the centre of the fuselage.

4. **Electric fuel booster pumps.**—A Pulsometer electric

A.L. 1
Part I
Para. 4

4. **Electric fuel booster pumps**

(i) A Pulsometer electric booster pump (either F.B. Mk. I, or F.B. XI Mk. I) is fitted to each tank, and a suction bypass provided at No. 1 and No. 2 tanks allows fuel to be drawn from the tanks when the booster pumps are not in use. No. 3 tank is used to replenish No. 2 tank (*see* Fig. 5) by switching on the No. 3 tank pump. On some early aircraft an immersed pump is fitted in each tank (*see* Fig. 6) instead of a Pulsometer pump, and bypasses are also provided at Nos. 1 and 2 tanks. When the 400-gallon tanks are fitted in the bomb cells they each have a Pulsometer F.B. Mk. I pump fitted, to enable their contents to be transferred to the No. 1 tanks.

(ii) The main use of the electric fuel pumps in No. 1 and No. 2 tanks is to maintain fuel pressure at altitudes of approximately 17,000 feet and over in temperate climates, but they are also used for raising the fuel pressure before starting and to assist in restarting an engine during flight. If one engine fails during take-off and the electric fuel pump is not ON, air may be drawn back into the main fuel system before the master engine cock of the failed engine can be closed, thus causing the failure of the other engine on the same side; therefore at take-off the pumps in Nos. 1 and 2 tanks must be switched on; this is also a precaution against fuel failure during take-off as an immediate supply is available by changing over the tank selector cock. The pump in each tank in use should also be switched on at any time when a drop in fuel pressure is indicated or when it is necessary to run all engines from one tank by opening the cross-feed cock.

5. **Fuel pressure warning lights** (80).—The lights show when the fuel pressure at the carburettor falls below normal working pressure. They are switched off by the fuel contents gauges switch (77), and this switch must, therefore, always be on in flight.

6. **Priming pumps.**—There is one cylinder priming pump type K.40 (40 c.c.), with two priming cocks, in each inboard engine nacelle. Each pump serves one inboard and one outboard engine.

7. **Oil tanks.**—Each engine has its own tank; capacity 37½ gallons of oil with 4½ gallons air space.

8. **Oil dilution.**—The four push-buttons (81) are on the flight engineer's panel.

MAIN SERVICES

9. **Hydraulic system.**

(i) A twin pump on the starboard inboard engine operates the front and mid-upper gun turrets, and two single pumps on the port inboard engine operate the mid-under and rear turrets.

(ii) Two pumps (one on each inboard engine), with a hand-pump as an alternative, charge a small accumulator and feed the following services:

Undercarriage	Flaps
Bomb doors	Carburettor air intake shutters
Fuel jettisoning.	

Owing to the large capacity of the flap and undercarriage jacks, it is not normally possible to operate them by the hand-pump in the time available.

10. **Pneumatic system.**

(i) A compressor is fitted on the starboard inboard engine, and supplies the wheel brakes system and the super-charger rams, if Mod. 749 is incorporated, by means of an air container which is behind the front turret.

(ii) A vacuum pump is fitted on each inboard engine for operating the instruments on the instrument flying panel. The change-over cock (17) is beside the suction gauge on the right of the instrument panel.

(iii) An RAE compressor fitted on the port outboard engine operates the Mk. IV automatic controls.

11. **Electrical system.**—One 24v. 1,500w. generator is fitted on each of the inboard engines. These generators are connected in parallel and feed the following services:

Charging accumulators
Propeller feathering and pitch-changing
Supercharger controls (if Mod. 749 incorporated)
Flap and undercarriage indicators
Pressure head heating
Electric fuel pumps
Radio equipment
Landing lamps control
Engine starting and booster coil
Cowling gills control
Dinghy inflation
All the usual lighting services.

The electrical services control panel, inside which are the split-negative switches and the majority of the fuses, is on the starboard side of the fuselage opposite the navigator's table. The split-negative switches enable a defective circuit to be isolated.

A master electrical switch, on the starboard side of the fuselage behind the front spar, enables the aircraft batteries to be isolated when the aircraft is parked, or when using a ground battery.

AIRCRAFT CONTROLS

12. **Trimming tabs.**—The elevator (63), rudder (64) and aileron (62) tab controls (on the right of the pilot's seat) all operate in the natural sense and each has an indicator.

13. **Undercarriage control.**—The undercarriage lever (65) is locked in the DOWN position by a safety bolt (66) which has to be held aside in order to raise the lever. The bolt engages automatically when the lever is set down. The undercarriage may be lowered in an emergency by compressed air (*See* Part IV, para. 57).

WARNING.—There is no automatic lock to prevent the undercarriage being raised by mistake when the aircraft is on the ground.

A.L. 1 Part I Para. 14–17

14. **Undercarriage indicator** (39).

The indicator shows:—

Undercarriage locked down	..	Two green lights.
,, unlocked	..	Two red lights.
,, locked up	..	No lights.

The indicator switch (4) is interlocked to that it must be on when the ignition switches are on. A switch below the indicator switch brings an auxiliary set of green lights into operation if failure of the main set is suspected. The red lamps are duplicated so that failure of one lamp does not affect the indication of undercarriage unlocked. The lights can be dimmed by turning the central knob.

15. **Undercarriage warning horn.**—The horn sounds if either inboard throttle is closed when the undercarriage is not locked down. The outboard throttles do not operate the horn. A testing pushbutton and lamp are behind the pilot's seat, on the cockpit port rail.

16. **Flap control**—The push-pull handle (61) should be moved to the neutral position (located by a spring-loaded catch) after each flap movement. The flaps indicator is switched on by a separate switch adjacent to it. If the flaps have been selected partly down, and it is desired to lower them fully, it may be found that the flaps will not lower further for some considerable time. This is due to the pressure in the accumulator having fallen below the pressure required to operate the flaps, but not sufficiently to cause the hydraulic pumps to cut in. To overcome this, move the flaps selector to UP, and then immediately put it fully DOWN; this causes the hydraulic pumps to cut in. In an emergency the flaps may be lowered by compressed air after lowering the undercarriage (see Part IV, para 58).

17. **Bomb doors.**—The control (45) has two positions only. The bomb release system is rendered operative soon after the doors begin to open and before they are fully open. The position of the doors must therefore be checked visually before releasing bombs. If the bomb doors open only part way and then stop, it is probably due to icing around the hinges and joints, which raises the hydraulic pressure sufficiently to bring the cut-out into operation, which stops any further movement of the doors. If the bomb doors selector is moved to SHUT and then immediately to OPEN, the doors will usually open further; it may be necessary to repeat this several times to get the doors fully open.

As strenuous pumping for 15 minutes is required to open the doors with engines stopped, they should be opened before stopping engines if the aircraft is to be bombed up before the next flight.

ENGINE CONTROLS

18. **Throttle and mixture controls.**—The four throttle levers (28) are mounted in the centre of the cockpit, and when Hercules VI engines are fitted there is a single mixture control (26) which is interlocked with the throttles so that when one or more of the throttles are either fully opened or closed, the mixture lever (if in the WEAK

position) is returned to NORMAL. When Hercules XVI engines are fitted, there is no pilot's mixture control lever, the mixture control being entirely automatic. In this case an economical mixture strength is obtained by keeping at or below +2 lb./sq.in. boost.

19. **Propeller controls.**—The controls for each electric propeller are as follows:—

(i) *Speed control levers*—The four levers (29) are fitted below the throttle levers and are moved upwards to increase the speed.

(ii) *Safety switches* (83), normally ON. Each switch, which is mounted on the cowling gill control panel, incorporates an overload relay which breaks the circuit if the current is excessive. If this happens, wait about 30 seconds, then re-set to ON.

(iii) *Selector switches* (19).—Each switch can be moved to three positions other than the central one in which the propeller operates in fixed pitch. The two lower positions are for manual INCREASE and DECREASE of the r.p.m. respectively, and when the switch is moved to either of these positions it must be held there until the desired r.p.m. are attained; upon release it will return to the central position. In the upper (AUTOmatic) position the propeller operates under constant-speed control. Owing to switch failures, the manual INCREASE and DECREASE R.P.M. positions should not be used more than is necessary.

(iv) *Feathering switches* (20) provide for rapid feathering, for which they are moved upward, and will act whatever the position of the selector switches. In either case, when the propeller is fully feathered, the selector switch should be set to central.

20. **Supercharger control.**—If Mod. 749 is not incorporated the supercharger gear change is operated by a lever on the right side of the starboard master engine cocks and must be moved to the up position to engage S ratio. On aircraft in which Mod. 749 is incorporated, the

supercharger gear change is operated by an electro-pneumatic ram, of the single-acting spring-return type, compressed air being supplied from the compressor on the starboard inboard engine.

In the case of electrical or pneumatic failure the rams will return to the M ratio position.

A switch (24) fitted to the pilot's instrument panel immediately below the engine speed indicators, controls all four engines simultaneously, and a red warning light beside it indicates S ratio on the ground only (i.e. when the undercarriage is down).

21. **Cowling gill controls.**—The gills are controlled electrically, the gill motor switches (86), red lights (85) which show when the gill motors are operating, and the gills indicators (84) being fitted on a panel beside the main instrument panel.

22. **Slow-running cut-outs.**—These are operated by closing the pilot's master fuel cocks.

23. **Ignition and starting controls.**—The ignition switches (8), booster-coil switch (11) and the starter push-buttons (12), are all at the top of the pilot's instrument panel.

LOCATION OF CONTROLS

24. **Aircraft controls and instruments.**

A.L. 1 Part I Para. 24

24. **Aircraft controls and instruments**

Trimming tab controls (62) (63) and (64) and indicators	R.H. side of pilot's seat
Flaps control (61)	R.H. side of pilot's seat in front of trimming tab controls
Flaps indicator	Bottom centre of instrument panel
Flaps indicator switch ..	Beside flaps indicator
Undercarriage control (65)	R.H. side of pilot's seat aft of trimming tab controls

Undercarriage control safety bolt (66)	On top of undercarriage control.
Undercarriage indicator (39)	Left of instrument panel.
Undercarriage indicator switch (4)	Top centre of instrument panel.
Undercarriage warning horn test push-button	Behind pilot's seat.
Wheel brakes lever (57) ..	Pilot's control column.
Brakes and air supply pressure gauge (21)	Extreme right of instrument panel.
Instrument flying panel (1) ..	Left centre of instrument panel.
Suction pump change-over cock (17)	Right of instrument panel.
Suction gauge	To the left of change-over cock.
P 4 compass (38)	Below instrument panel on left-hand side of cockpit.
D.R. compass repeater (5) ..	Above instrument panel in centre.
D.R. compass switches (35)	At bottom of instrument panel to the left.
Pressure head heater switch (72)	On flight engineer's panel

25. **Automatic flying controls.**

Main switch (48)	Port side of cockpit.
Steering lever (36)	Bottom of instrument panel to the left.
Clutch lever (56)	Port side of cockpit.
Control cock (55)	Port side of cockpit.
Attitude control (54) ..	Port side of cockpit.
Pressure gauge (58)	Below instrument panel to the left.

26. **Fuel system controls and instruments.**

Master engine cocks (25) and (30)	On either side of engine controls pedestal.
Cross-feed cock	On floor just forward of the front spar.

Tank selector cocks (78) ..	On flight engineer's panel.
Booster pump switches (79)	On flight engineer's panel.
Ammeter or ammeter test socket (69) for testing booster pumps	On flight engineer's panel.
Contents gauges (75) ..	On flight engineer's panel.
Contents gauges switch (77)	On flight engineer's panel.
Priming pump and cock ..	One in each inboard engine nacelle.
Pressure warning lamps (80)	On flight engineer's panel.

27. **Engine controls and instruments.**

Throttle levers (28)	Engine controls pedestal.
Propeller speed controls (29)	Engine controls pedestal.
Propeller safety switches (83)	On panel on starboard side of cockpit.
Propeller selector switches (19)	Right-hand side of instrument panel.
Propeller feathering switches (20)	Right-hand side of instrument panel.
Friction adjusters (27) ..	Right of engine controls pedestal.
Air-intake heat control ..	Left of pilot's seat.
Supercharger control and warning light (24)	On instrument panel above starboard engines master cocks.
Cowling gill controls (86) ..	On panel on starboard side of cockpit.
Cowling gill motor indicators (85)	On panel on starboard side of cockpit.
Cowling gill indicators (84)	On panel on starboard side of cockpit.
Ignition switches (8) ..	Centre of instrument panel
Booster-coil switch (11) ..	To the right of ignition switches.
Engine starter push-buttons (12)	To the right of booster-coil switch.
Boost gauges (9)	Centre of instrument panel
Engine-speed indicators (10)	Centre of instrument panel
Cylinder temperature gauges (82)	On panel on starboard side of cockpit.

Oil temperature gauges (73)	On flight engineer's panel.
Oil pressure gauges (71) ..	On flight engineer's panel.
Oil dilution push-buttons (81)	On flight engineer's panel.
Master electrical switch ..	On starboard side just aft of front spar.

28. **Cabin equipment.**

Pilot's seat, height-adjusting lever (49)	On left of pilot's seat.
Pilot's Sutton harness release lever (68)	On right arm of pilot's seat.
2nd pilot's seat	Starboard side of cockpit.
Direct vision panels	Each side of windscreen.
Entrance door	Starboard side of fuselage forward of tail plane.
Windscreen de-icing control (60)	On floor on left of pilot's seat.
Cockpit heating controls ..	One on each side of fuselage forward of front spar. Two adjustable louvres in fuselage nose.
Oxygen line valve	At forward end of oxygen crate between front and rear spars.
Oxygen regulator (18) ..	On right of instrument panel.
Pilot's oxygen connection (52)	On port side of cockpit.
Pilot's portable oxygen set (67)	Behind pilot's seat.
Sanitary accommodation ..	Elsan closet just forward of tail plane.

29. **Operational equipment.**

Camera push-button control	On starboard rail of cockpit.
Bomb doors control (45) ..	On left of pilot's seat.
Bomb firing switch	On pilot's control column handwheel.
Reconnaissance flares stowage	On either side of fuselage forward of flare chute.
Flame floats or sea markers stowage	On either side of fuselage adjacent to flare chute.

30. **Navigational, signalling and lighting equipment**

Pilot's Mic/Tel socket (59) ..	On front of pilot's seat
Pilot's radio control unit ..	Port side of pilot's seat
D switch	Port side of cockpit

Pilot's TR9 NORMAL/SPECIAL switch (47) ..	Port side of cockpit.
Beam approach control panel (51)	Port side of cockpit.
Beam approach visual indicator (43)	Left side of instrument panel.
Beam approach mixer box (50)	Port side of cockpit.
I.F.F. master switch (14) ..	Right centre of instrument panel.
D.F. indicator (2)	Top left of instrument panel.
Navigation lamps switch (46)	Port side of cockpit.
Identification lamps switchbox (22)	Extreme right bottom of instrument panel.
Formation lamps switchbox (33)	Bottom of instrument panel forward of pilot's control column.
Identification lamps colour selecting switches (34) ..	Below instrument flying panel.
Pilot's call lamp (53)	Port side of cockpit.
Landing lamps switches (3), also control dipping of lamps	Top centre of instrument panel
Signal pistol	Stowed on top of front spar; firing position in roof forward of stowed position.
Signal pistol cartridges stowage	Starboard side of fuselage just forward of front spar.

31. **Emergency equipment and controls.**

Hydraulic handpump ..	On port side aft of front spar.

Undercarriage and flaps emergency control	On early aircraft the control is just aft of front spar; on later aircraft it is a knob just forward of the flight engineer's panel.
Bomb containers jettison switch (15)	Right of instrument panel.
Bomb jettison handle (16) ..	Right of instrument panel.
Fuel jettison control	On left of pilot's seat.
Dinghy manual release ..	Along fuselage roof aft of the rear spar.
Dinghy emergency packs ..	On starboard side, just aft of rear spar.
Parachute stowages	*See* Part V, Fig: 4.
Crash axe	Starboard side of fuselage aft of main entrance door.
First-aid equipment ..	Starboard side of fuselage aft of main entrance door.
I.F.F. emergency switches (13)	Below engine starter buttons on instrument panel.

PART II

HANDLING INSTRUCTIONS

NOTE.—All speeds quoted are for aircraft with the Pilot's A.S.I. connected to the static vent (*see* para. 49). For handling speeds of aircraft not so connected, *see* Lancaster I Pilot's Notes, A.P.2062A.—P.N.

A.L. 1
Part II
Para. 32

32. Management of fuel system

(i) *Testing electric fuel booster pumps.*—Before starting the engines each booster pump should be tested by ammeter (some aircraft have a permanent ammeter fitted on the flight engineer's panel, while others have an ammeter test socket (69) into which the ammeter must be plugged). To do this the switch for each pump should in turn be set to the up (test) position. The ammeter reading should be perfectly steady and should be between 2 and 4 amps. for an immersed pump, between 3 and 7 amps. for an F.B. Mark I Pulsometer pump, or between 5 and 10 amps for an F.B. XI Mark I Pulsometer pump.

(ii) *Use of tanks*

(*a*) *Starting, warm-up and take-off.*—Either No. 1 or No. 2 fuel tanks may be used first, but it is recommended to use No. 2 tanks first since the contents of No. 1 tanks only can be jettisoned. The electric fuel booster pumps in Nos. 1 and 2 tanks must be switched on for take-off, so that if for any reason the fuel supply from No. 2 tanks should fail, fuel pressure will be immediately available on turning the tank selectors to No. 1 tanks. *See* also Part I, para. 4.

(*b*) *In flight.*—After climbing to 2,000 feet switch off booster pumps. Continue running on No. 2 tanks until 200 gallons remain in each, then change over to No. 1 tanks. Switch on No. 3 booster pumps to transfer their

A.L. 1
Part II
Pa a. 32
(*contd.*)

fuel to No. 2 tanks. Switch off the pumps when No. 3 tanks are empty. If overload fuel tanks are carried, continue to fly on No. 1 tanks until enough fuel has been used from them to enable the contents of the fuselage tanks to be transferred to them. Then change over to No. 2 tanks; turn on both long-range fuel cocks (behind front spar) and switch on overload tank pump switches and fuel contents gauge. Transfer of fuel from the long-range tanks takes approximately one hour. Watch No. 1 fuel contents gauges and turn off each long-range tank cock as soon as its respective No. 1 tank is filled. Turn off pumps when both No. 1 tanks are filled.

When over enemy territory, keep contents of Nos. 1 and 2 tanks approximately the same by running on each alternately for about half an hour.

(iii) *Use of cross-feed cock.*—The cock should be closed at all times, unless it is necessary in an emergency to feed fuel from the tanks in one wing to the engines in the other wing. If the cross feed cock is open for this purpose, only one tank should be turned on to feed all working engines, and the pump in this tank should be switched on.

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33. **Preliminaries**

On entering the aircraft the pilot should:

(i) Check oxygen main cock on (if required).

(ii) Check emergency air bottle Normal pressure 1,200 lb. sq. in.
Minimum ,, 800 lb. sq. in.

(iii) Turn master electrical switch to FLIGHT.

(iv) Check that fuel cross-feed cock is OFF.

(v) Switch on fuel contents gauges switch and leave it on, and check fuel contents.

(vi) Switch on the undercarriage indicator and flaps indicator switches, and check the indicators.

A4 1 (vii) ~~Switch D.R. compass to SETTING and when it stops "turning" switch to NORMAL.~~

(viii) Have a ground starter battery (24-v.) plugged in and turn the master electrical switch to GROUND.

34. Starting engines and warming up

(i) Turn on the engine master cocks and test the performance of the fuel booster pumps with the fuel pressure warning lights (*see* para. 32), thus priming the carburettors.

(ii) Set engine controls as follows:—

Throttles	½ inch open
Mixture control (if fitted) ..	NORMAL
Propeller controls	Fully up Safety switches—ON Selector switches—AUTO
Superchargers control ..	M Ratio (warning light not showing)
Air-intake heat control ..	COLD (aft)
Cowling gills	OPEN

NOTE.—In very cold weather, the gills and chains may be iced up; in this case start the engines with the gills shut and run the engines for two minutes before operating the cowling gill motors. Failure to observe this precaution may damage both the driving shaft and the motor.

(iii) Have each engine turned slowly by hand for at least two revolutions of the propeller, to avoid the danger of hydraulicing.

(iv) Switch on the electric booster pump in the No. 2 tank to be used.

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

(vi) Switch on the ignition and booster coil, and press the starter button. Turning periods must not exceed 20 seconds with a 30-seconds wait between each. The ground crew will work the priming pump as firmly as possible while the engine is being turned; it should start after the following number of strokes, if cold:—

Air temp. ° C. ..	+30	+20	+10	0	−10	−20
Normal fuel	1	1	2	3		
High volatility fuel ..				1	2	4

It will probably be necessary to continue priming after the engine has fired and until it picks up on the carburettor.

(vii) When all the engines are running satisfactorily, switch off the booster-coil switch. The ground crew will screw down the priming pumps and turn off the priming cocks.

(viii) Have the master electrical switch turned to FLIGHT and the ground starter battery removed.

A.L. 1 Part II Para. 34 (ix) & (x) & 35

(ix) Open each engine up slowly to 1,000 r.p.m. and warm up at this speed. If the engine has been started with gills shut (*see* Note after sub-para. (ii)) open them.

(x) Switch D.R. compass ON and SETTING.

35. Testing engines and installations

While warming up

(i) Check temperatures and pressures, and test operation of hydraulic system by lowering and raising the flaps.

(ii) Switch off electric fuel booster pumps so as to test engine-driven pumps.

After warming up

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

(iii) Open up to 1,500 r.p.m. with propeller switch at AUTO, and check that no magneto is completely unserviceable.

(iv) At 1,500 r.p.m. exercise and check operation of two-speed superchargers. Oil pressure should drop momentarily at each change, and, if fitted, warning light should come on when S ratio is engaged.

(v) At +2 lb./sq.in. boost, check response of the propeller to movement of the lever.

(vi) Open throttle, and check take-off boost and static r.p.m., which should be 2,800.

(vii) Throttle back to +6 lb./sq.in. and test each magneto in turn. The momentary drop should not exceed 50 r.p.m. (The r.p.m. will then be restored to 2,800 by the C.S.U.)

NOTE.—The propeller switch should not be moved from the AUTO position unless the ignition is suspected and a more accurate check of the r.p.m. drop is required, in which case the propeller switch should be moved to the manual position. If this is done, return the switch to AUTO after the test, and check the response of the propeller speed control lever to ensure that the C.S.U. is in control.

36. Check list before taxying

Entrance door	Fastened
Undercarriage jury struts (if fitted)	Removed
Master electrical switch ..	FLIGHT
Pressure head	Cover removed and heater switch ON
Auto controls—Clutches ..	IN
Control cock	OUT
D.R. compass switch ..	NORMAL
Instrument flying panel ..	Check vacuum on each pump
Brakes pressure	Supply 250–300 lb./sq. in.

37. Check list before take-off

T—Trimming tabs ..	Elevator slightly forward. Rudder and aileron neutral
M—Mixture control (if fitted)	NORMAL
Air intake	COLD
P—Propeller speed controls	Fully up
	Safety switches—ON
	Selector switches—AUTO
F—Fuel	Master engine cocks ON
	Tank selector cocks to No. 2 tanks
	Cross-feed cock OFF
	Fuel booster pumps: No. 2 pumps only ON
F—Flaps	15°–20° down
Superchargers	M. (low) ratio
Gills	~~One third open~~ Closed ~~one third~~ open

AL

38. Taking off

(i) Open the throttles to about 2,000 r.p.m. against the brakes, then release the brakes and open throttles fully with the starboard slightly ahead. There is a slight tendency to swing to starboard, but this can be checked initially on the throttles and, as speed increases, by the rudders.

(ii) The aircraft should be eased off the ground at not less than 95 m.p.h. I.A.S. if loaded to 50,000 lb. or 105 m.p.h. I.A.S. if loaded to 60,000 lb.

(iii) Safety speed is 130 m.p.h. I.A.S.

(iv) Raise flaps at not below 800 feet when heavily loaded and return selector to neutral. Raising flaps causes a nose-down change of trim.

(v) Switch off electric fuel booster pumps of No. 2 tanks after initial climb, but if a warning light comes on, switch on the pumps immediately.

39. Climbing

(i) The speed for maximum rate of climb is 155 m.p.h. I.A.S. but this should be increased if cylinder temperatures become excessive. The most comfortable climbing speed is about 175 m.p.h. I.A.S.

(ii) Switch on electric fuel pumps of tanks in use, at any sign of fuel starvation (at approximately 17,000 feet in temperate climates).

40. General flying

(i) *Stability.*—At normal loadings and speeds, stability is satisfactory.

(ii) *Controls.*—The elevators are relatively light and effective but tend to become heavy in turns. The ailerons are light and effective but become heavy at speeds over 260 m.p.h. The rudders also become heavy at high speeds.

(iii) *Change of trim.*

Undercarriage UP (20 seconds):	slightly nose up.
,, DOWN (40 seconds)	slightly nose down.
Flaps up to 25° from fully DOWN:	slightly nose down.
,, up from 25°:	strongly nose down.
,, down to 25°:	strongly nose up.
,, fully DOWN from 25°:	slightly nose up.
Bomb doors open:	slightly nose up.

(iv) *Flying at low airspeeds.*—Flaps may be lowered about 15° to 20° and the speed reduced to about 130 m.p.h. I.A.S.

41. Stalling

(i) There is no tendency for a wing to drop.

(ii) The stalling speeds in m.p.h. I.A.S. at 50,000 lb. are:—

Undercarriage and flaps up:	110
Undercarriage and flaps down:	92

42. Diving

The aircraft becomes increasingly nose heavy in a high-speed dive. The elevator tab control should not be used to help the entry into the dive but it should be used to trim out the pull necessary in the later stages of the dive.

43. Check list before landing

Auto controls: control cock . .	OUT (Clutches may be left IN).
Superchargers	M. (low) ratio.
Air intake	COLD.
Gills	One third open.
Brake pressure	Supply 250-300 lb./sq.in.
Reduce speed to below 200 m.p.h. I.A.S.	
U—Undercarriage	DOWN (check by indicator and horn)
M—Mixture control (if fitted) . .	NORMAL.
P—Propeller	Controls fully up. Safety switches—ON Selector switches—AUTO.
F—Flaps	20° down on circuit DOWN on final approach (handle neutral).
F—Fuel	Booster pumps ON in tanks in use.

44. Approach speeds

Recommended speeds for the approach in m.p.h. I.A.S.

	45,000 lb.	55,000 lb.
Engine assisted . .	110	120
Glide	120	130

45. Mislanding

(i) The aircraft will climb satisfactorily with the undercarriage and flaps down.

(ii) Climb at about 140 m.p.h. I.A.S. and after raising the undercarriage, start raising the flaps a little at a time, retrimming as necessary.

46. After landing

(i) Before taxying, raise the flaps, and open the gills.

(ii) The outer engines may be stopped and taxying done on the inners. This is preferable to stopping the inner engines, as the brakes compressor is on the starboard inner engine.

(iii) Open the bomb doors for bombing up (if required).

A.L. 1 Part II Para. 46 (iv)

(iv) *Shutting down procedure:*

(*a*) Open up gradually and evenly, and run the engine for about 5 seconds at −2 lb./sq.in. boost.

(*b*) Close the throttle slowly and evenly taking about 5 seconds until speed is reduced to 800–1,000 r.p.m.

(*c*) Run at this speed for a further two minutes.

(*d*) Operate the slow-running cut-outs by turning OFF the master engine cocks and, when the engine has stopped, switch OFF ignition. Should a backfire occur at any stage the above procedure should be repeated.

(v) Switch off

Pressure head heater switch
Undercarriage indicator switch
Flaps indicator switch
Fuel contents gauges switch
D.R. compass switches.

and turn master electrical switch to GROUND.

(vi) *Oil dilution.*—See Pilot's Notes General A.P.2095. The correct dilution period for this aircraft is 4 minutes, and the dilution operation is to be carried out at an engine speed not exceeding 1,000 r.p.m.

PART III

OPERATING DATA

47. Engine data—Hercules VI and XVI

(i) *Fuel.*—100 octane only.

(ii) *Oil.*—See A.P. 1464/C.37.

A.L. 1 Part III para. 47 (iii)

(iii) *Engine limitations with 100 octane fuel:*

		R.p.m.	Boost lb.sq./in.	Temp. °C. Cyldr.	Oil
MAX. TAKE-OFF TO 1,000 FEET	M	2,800	+8¼		
MAX. CLIMBING 1 HOUR LIMIT	M	2,400	+6	270	90
	S	2,500			
MAX. RICH CONTINUOUS	M	2,400	+6	270	80
	S				
*MAX. WEAK CONTINUOUS	M	2,400	+2	270	80
	S				
COMBAT 5 MINS. LIMIT	M	2,800	+8¼	280	100
	S				

*Weak mixture is obtained on Hercules XVI by keeping at or below +2 lb./sq.in.

OIL PRESSURE:		
NORMAL	80–90	lb./sq.in.
MINIMUM	65	,,
OIL TEMP. FOR TAKE-OFF: MINIMUM	5°C.	
MAXIMUM CYLINDER TEMP. FOR STOPPING ENGINE	230°C.	

48. Flying limitations

(i) The aircraft is designed for manœuvres appropriate to a heavy bomber and care must be taken to avoid imposing excessive loads in recovery from dives and turns at high speed. Spinning and aerobatics are not permitted. Violent use of the rudder should be avoided at high speeds.

(ii) *Maximum speeds in m.p.h. I.A.S.*

Diving: 360.
Bomb doors open: 360.
Undercarriage down: 200.
Flaps down: 200.

(iii) *Maximum weights:*

Take-off and straight flying ..	63,000 lb.
All forms of flying	55,000 lb.
Landing	56,000 lb.

(iv) *Bomb clearance angles:*

Dive	30°
Climb	20°
Bank	10° (with S.B.C. 25°).

49. Position error corrections

All handling speeds are quoted for aircraft with the pilot's A.S.I. connected to the static vent, in the port side of the fuselage. The position error for the static vent connection is less than 1 m.p.h. at all speeds from 140 m.p.h. I.A.S. upwards.

50. Maximum performance

(i) *Climbing:* 155 m.p.h. I.A.S. to 12,000 ft.
150 m.p.h. I.A.S. from 12,000 to 17,000 ft.
145 m.p.h. I.A.S. above 17,000 ft.

Change to S ratio when boost has fallen to + 4 lb./sq.in. (approximate height 8,000 ft.).

Follow the boost back with the throttles as far as +2 lb./sq.in. (but watch temperatures) as this improves fuel consumption and power.

(ii) *Combat.*—Use S ratio if maximum boost obtainable in M ratio drops below + $5\frac{1}{4}$ lb./sq.in.

51. Maximum range

(i) *Climbing.*—Use same conditions as for maximum performance. See para. 50 (i).

(ii) *Cruising.* (including descent).

(*a*) Fly in M ratio at maximum obtainable boost not exceeding +2 lb./sq.in. obtaining the recommended airspeed by reducing r.p.m., which may be as low as 1,600 if this will give the recommended airspeed, but if rough running is experienced increase r.p.m. as necessary to about 1,900 and do not alter the throttle setting. In these circumstances an airspeed above the recommended will give practically no reduction in range. *Higher speeds than those recommended may be used if obtainable in M ratio at the lowest possible r.p.m.*

(*b*) The recommended speeds are

Fully loaded, outward journey (over 18,000 ft. reduce as necessary to a minimum of 150 m.p.h. I.A.S.)	165 m.p.h. I.A.S.
Lightly loaded, homeward journey	160 m.p.h. I.A.S.

(*c*) Engage S ratio when the recommended speed cannot be maintained at 2,300 r.p.m. in M ratio.

52. Fuel capacity and consumptions

(i) *Capacity.*—

Two No. 1 tanks	1,160	gallons
Two No. 2 tanks	766	,,
Two No. 3 tanks	228	,,
Total=	2,154	,,

(ii) *Rich mixture consumptions* (*approximate*).—M ratio at 5,000 ft.

R.p.m.	Boost lb./sq.in.	Approx. total consumption gals./hr.
2,800	+8¼	640
2,400	+6	478

(iii) *Weak mixture consumptions* (*approximate*) in gals./hr.

Boost lb./sq.in.	*M ratio at* 5,000 *ft.* *R.p.m.*				*S ratio at* 15,000 *ft.* *R.p.m.*			
	2,400	2,200	2,000	1,800	2,400	2,200	2,000	1,800
+2	236	220	204	188	232	220	212	192
0	212	196	184	160	208	200	192	176
—2	188	176	164	148	188	180	172	160
—4	168	160	148	136	172	164	156	—

M. gear.

For every 1,000 ft. above height quoted add 1 gal./hr.
,, ,, 1,000 ft. below ,, ,, deduct 1 gal./hr.

S. gear.

For every 1,000 ft. above height quoted add 2 gal./hr.
,, ,, 1,000 ft. below ,, ,, deduct 2 gal./hr.

PART IV

EMERGENCIES

53. Engine failure during take-off

(i) If for any reason the electric fuel pumps in the tanks being used are not ON, the master fuel cock of the failed engine must be turned off before feathering.

(ii) If one outer engine fails, the aircraft can be kept straight provided 130 m.p.h. I.A.S. has been reached.

(iii) Climbing speed on three engines should be 135 m.p.h. I.A.S. at moderate loads, or 140 m.p.h. I.A.S. if heavily loaded.

(iv) As soon as the undercarriage is up, raise the flaps a little at a time, retrimming as necessary.

A.L. 1
Part IV
Para. 54

54. Engine failure in flight

(i) If an engine is stopped, air may be drawn into the fuel system through the carburettor of the failed engine. To prevent this, the master fuel cock must be turned off before feathering, unless the electric fuel pump for the tank in use is on. If an engine seizes up, its master fuel cock should be turned off immediately to ensure that the fuel supply to the other engine on the same side is not affected.

(ii) If the failed engine cannot be made to pick up again, feather its propeller and switch off.

(iii) *Handling on three engines.*—The aircraft will maintain height at full load on any three engines at 5,000 feet, and can be trimmed to fly without footload. Maintain at least 145 m.p.h. I.A.S. The automatic pilot has sufficient power to maintain a straight course with the starboard outboard engine out of action, but only if assisted by the rudder trimming tab.

(iv) *Landing on three engines.*—Lowering of flaps to 20° and of the undercarriage may be carried out as normally on the circuit, but further lowering of the flaps should be left until final straight approach. The final approach should be made at 120–125 m.p.h. I.A.S., using as little power as possible, and rudder trim should not be wound off until definitely committed to landing. Use all good engines to regulate approach (*see* A.P. 2095, Part IV, Note D).

(v) *Handling on two engines.*—It should be possible to maintain height at 5,000 feet at 140 m.p.h. I.A.S. on any two engines after release of bombs; but with two engines dead on one side, the footload will be very heavy. The automatic pilot will not cope with two engines dead on one side.

A.L. 1 Part IV Para 54 (*contd.*)

(vi) *Landing on two engines.*—The circuit should be made with the good engines on the inside of the turn, and undercarriage and flaps left as late as practicable. Keep extra height in hand, if possible, and lower the undercarriage later than usual, but have it locked down just before the final approach. The approach should be made at 130–135 m.p.h. I.A.S. in a glide. When certain of getting into the airfield, lower flaps for landing. Do not wind off trim until final approach can be made in a glide, as some power may be necessary in the early stages. (*See* A.P. 2095, Part IV, Notes C and D.)

(vii) *Fuel system.*—The cross-feed cock should only be turned on when it is desired to feed fuel from port (or starboard) tanks to starboard (or port) engines. In this case all live engines should be fed from one tank and the fuel booster pump for this tank should be on. The fuel selector for the tanks on the other side of the aircraft should be off. At all other times the cross-feed cock should be off.

55. **Feathering**

WARNING—*See* para. 54 (i).

(i) Set feathering switch to FEATHER.

(ii) Close throttle immediately.

(iii) Set selector switch central.

(iv) Switch off only when the engine has stopped.

56. **Unfeathering**

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

(ii) Set feathering switch NORMAL and hold selector switch to INCREASE R.P.M. until about 1,000 r.p.m. is reached. Then set selector switch to AUTOMATIC.

57. Undercarriage emergency operation

If the hydraulic system fails, the undercarriage can be lowered by compressed air from a special bottle irrespective of the position of the undercarriage lever. On early aircraft the control is just aft of the front spar, but on later aircraft the knob for working the air system is just forward of the flight engineer's panel. The undercarriage cannot be raised again by this method. Although the undercarriage will lower by this method, irrespective of the position of the normal control, the control should be left in the down position for and after landing; otherwise, any leakage of air pressure may cause the undercarriage locks to be released and the undercarriage to collapse.

58. **Flaps emergency operation**

After lowering the undercarriage by turning on the emergency air cock, the flaps may be lowered by operating the flaps control, which admits the air pressure to the flaps system. The flaps can be raised again, but this should only be done in extreme emergency as it may cause the header tank to burst, and there may not be sufficient air pressure to lower the flaps again; also in raising the flaps by this method, *extreme care must be taken to raise them slowly by stages.*

If the flaps are lowered by the emergency method before landing, remember not to raise them as usual before taxying, owing to the likelihood of bursting the header tank.

59. **Bomb jettisoning**

(i) Open bomb doors.

(ii) Jettison containers first by switch (15) on right of dash.

(iii) Jettison bombs by handle (16) beside container jettison switch.

(iv) Close bomb doors.

60. **Fuel jettisoning**

NOTE.—Contents of No. 1 tanks only can be jettisoned.

(i) Reduce speed to 150 m.p.h. I.A.S. and lower flaps 15°.

(ii) Lift and turn jettison control on left of pilot's seat. Return control after jettisoning.

A.L. 1 Part IV Para. 60 (111)

(iii) The jettison valve should be closed while there is still about 100 gallons remaining in each tank; if the jettison valve is left open, all the fuel will be jettisoned less approximately 70 gallons, but the last 30 gallons of fuel runs out slowly and is inclined to get splashed over the fuselage. The jettison valve may be closed at any time during jettisoning. Approximate weight of jettisonable fuel, leaving 100 gallons in the tank, is 6,900 lb.

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61. **Parachute exits**

(i) Hatch in floor of nose should be used by all members of the crew if time is available and it is released by handle in centre, lifted inwards and jettisoned.

(ii) Main entrance door should be used as a parachute exit only in extreme emergency.

62. **Crash exits**

Three push out panels are fitted in the roof, one above the pilot, one just forward of the rear spar, and one forward of the mid-upper turret.

63. **Dinghy and ditching**

(i) A type J dinghy stowed in the starboard wing may be released and inflated:

(*a*) from inside by pulling the release cord running along the fuselage roof aft of the rear spar.

(*b*) from outside by pulling the loop on the starboard side rear of the tail plane leading edge.

(*c*) automatically by an immersion switch.

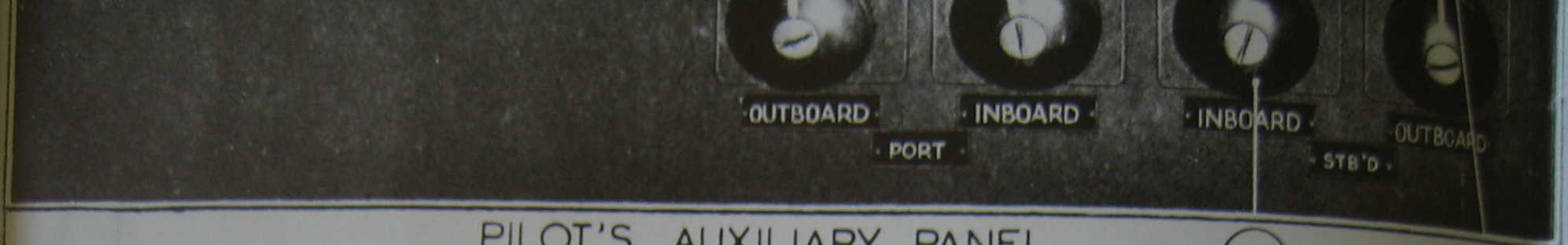
(ii) The flaps should be lowered 30° for ditching, but if the flaps will not lower by the hydraulic system, do not attempt to lower them by the compressed air system, as this will also cause the undercarriage to lower (see paras. 57 and 58).

NOTE.—See Fig. 4: General Emergency Equipment and Exits.

PART V—*ILLUSTRATIONS*

Fig.—1 INSTRUMENT PANEL.

1. Instrument flying panel.
2. D.F. indicator.
3. Landing lamps switches.
4. Undercarriage indicator switch.
5. D.R. repeater compass.
6. T.R.9 remote controller.
7. D.R. compass deviation card holder.
8. Ignition switches (eight).
9. Boost gauges (four).
10. Engine-speed indicators (four).
11. Booster-coil switch.
12. Engine starting pushbuttons (four).
13. I.F.F. emergency switches.
14. I.F.F. master switch.
15. Bomb containers jettison switch.
16. Bomb jettison control.
17. Suction pump change-over cock.
18. Oxygen regulator.
19. Propeller selector switches (four).
20. Propeller feathering switches (four).
21. Brakes triple pressure gauge.
22. Signalling switch box (identification lamps).
23. Fire extinguisher push buttons (four).
24. Two-speed superchargers control.
25. Starboard master engine cocks (two).
26. Mixture control (if fitted).
27. Friction adjusters.
28. Throttle levers (four).
29. Propeller speed controls (four).
30. Port master engine cocks (two).
31. Rudder pedal.
32. Boost control cut-out.
33. Signalling switch box (recognition lamps).
34. Downward identification lamp selector switches.
35. D.R. compass switches.
36. Auto controls—steering lever.
37. P.4 compass deviation card holder.
38. P.4 compass.
39. Undercarriage indicator.
40. Flaps indicator.
41. Flaps indicator switch.
42. A.S.I. correction card holder.
43. Beam approach visual indicator.
44. Watch holder.



PILOT'S AUXILIARY PANEL. (86) (85)

69. AMMETER TEST SOCKET.

70. PANEL LIGHT.

71. OIL PRESSURE GAUGES. [4]

72. PRESSURE HEAD HEATER SWITCH.

73. OIL TEMPERATURE GAUGES. [4]

75. FUEL CONTENT GAUGES [6]

76. INSPECTION LAMP SOCKET.

77. SWITCH TO CONTROL CONTENTS GAUGES AND FUEL PRESSURE GAUGES.

78. FUEL TANKS SELECTOR COCKS. [2]

79. ELECTRIC FUEL PUMP SWITCHES. [6]

80. FUEL PRESSURE INDICATOR LIGHTS.

81. OIL DILUTION PUSHBUTTONS.

82. ENGINE TEMPERATURE GAUGES. [4]

83. PROPELLER SAFETY SWITCHES. [4]

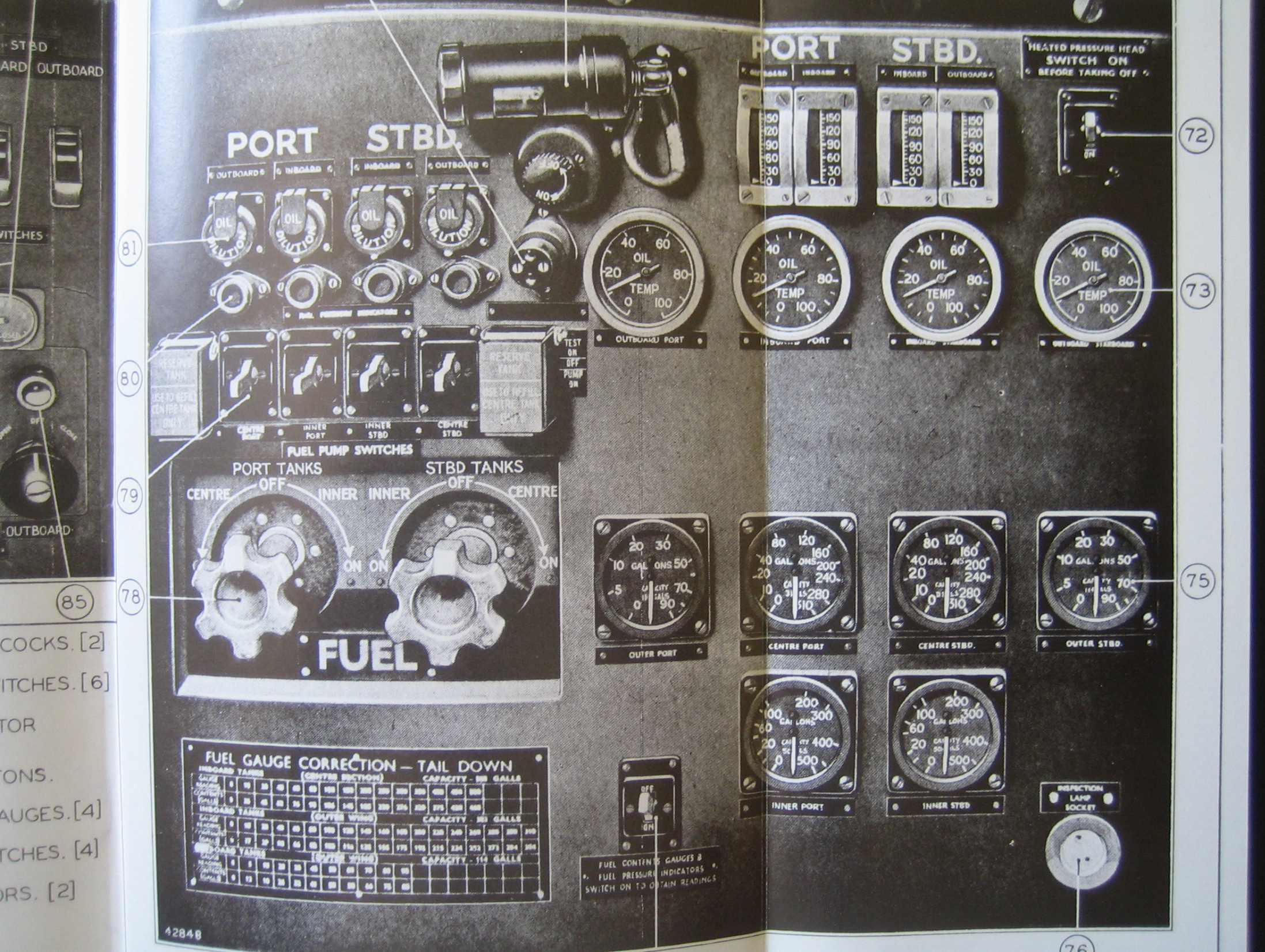
84. COWLING GILLS INDICATORS. [2]

85. COWLING GILLS MOTORS INDICATOR LIGHTS. [4]

86 COWLING GILLS CONTROLS. [4]

FIG 3

PANELS ON STA


PORT
STBD.
OUTBOARD
INBOARD
OIL DILUTION
PORT STBD.
INBOARD OUTBOARD
HEATED PRESSURE HEAD
SWITCH ON
BEFORE TAKING OFF
ON
OIL TEMP
OUTBOARD PORT
INBOARD PORT
INBOARD STARBOARD
OUTBOARD STARBOARD
TEST
ON
OFF
PUMP
ON
RESERVE TANK
USE TO REFILL CENTRE TANK ONLY
CENTRE PORT
INNER PORT
INNER STBD
CENTRE STBD
FUEL PUMP SWITCHES
PORT TANKS
STBD TANKS
CENTRE
OFF
INNER
INNER
OFF
CENTRE
ON
ON
ON
ON
FUEL
OUTER PORT
CENTRE PORT
CENTRE STBD.
OUTER STBD.
INNER PORT
INNER STBD
FUEL GAUGE CORRECTION – TAIL DOWN
INBOARD TANKS (CENTRE SECTION) CAPACITY - 222 GALLS
INBOARD TANKS (OUTER WING) CAPACITY - 283 GALLS
INBOARD TANKS (OUTER WING) CAPACITY - 114 GALLS
OFF
ON
FUEL CONTENTS GAUGES & FUEL PRESSURE INDICATORS SWITCH ON TO OBTAIN READINGS
INSPECTION LAMP SOCKET
72
73
75
76
78
79
80
81
85
42848

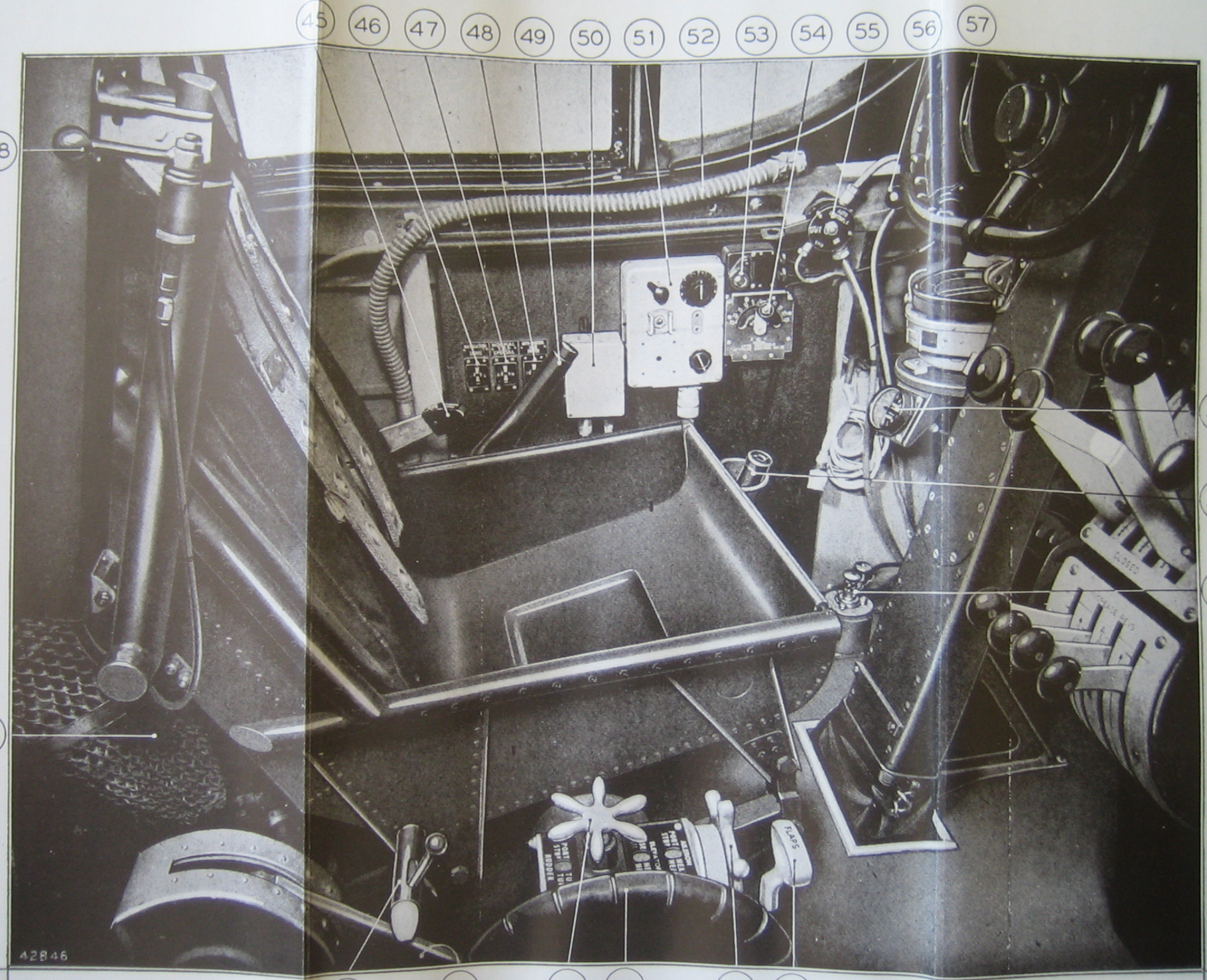


FIG. 2

PORT SIDE OF COCKPIT

FIG. 2

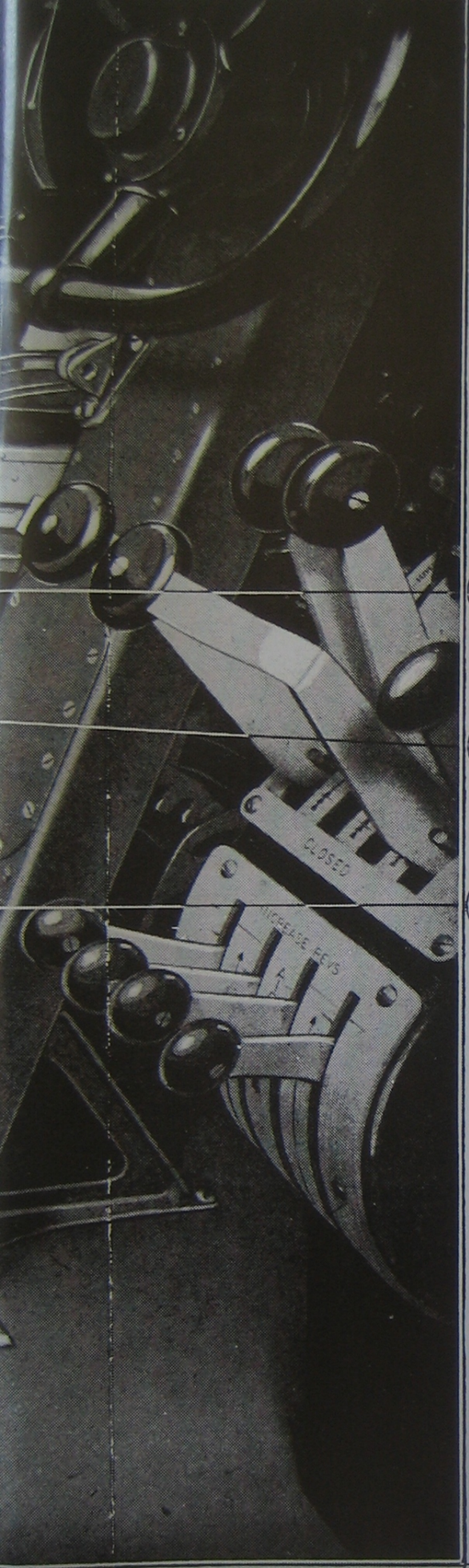


FIG. 2

Fig. 2

COCKPIT—PORT SIDE

45. Bomb doors control.
46. Navigation lamps switch.
47. T.R.9 switch.
48. Auto-controls main switch.
49. Seat operating lever.
50. Mixer box.
51. Beam approach control unit.
52. Oxygen connection.
53. Pilot's call light.
54. Automatic controls—attitude control.
55. Automatic controls—cock control.
56. Automatic controls—clutch control.
57. Brakes lever.
58. Automatic controls—pressure gauge.
59. Pilots mic./tel. socket.
60. Windscreen de-icing pump.
61. Flaps control.
62. Aileron trimming tab control.
63. Elevator trimming tab control.
64. Rudder trimming tab control.
65. Undercarriage control lever.
66. Undercarriage control safety bolt.
67. Portable oxygen container stowage.
68. Pilot's harness release lever on folding arm rest.