A.P. 2036A, B & D—P.N.

PILOT'S
AND
FLIGHT ENGINEER'S
NOTES

CATALINA
I, IB, II, IV
TWO TWIN WASP R1830—SIC 3-G ENGINES

PROMULGATED BY ORDER OF THE AIR COUNCIL

List of Contents (End)

NOTE.—The Mk. IVA is built by Consolidated, the Mk. IVB by Boeing. There are minor differences which are covered by Amendment List No. 1.

A.L.1 PART II Para. 59 (iii) and (viii)

(iii) When I.A.S. reaches 60–65 knots ease control column back when aircraft should become airborne.

(iv) Safety speed is 80 knots.

(v) When airborne, ease control column forward and climb at 85 knots.

(vi) Reduce power to climbing boost and r.p.m.

(vii) Signal "RAISE FLOATS" as soon as safely airborne.—*see* viii.

(viii) In event of engine failure during take-off, a landing should be made straight ahead. Only if lightly loaded should an attempt be made to continue climbing. It is desirable on taking off to raise the floats so that they do not reach the fully raised position below a safe height, then if the engine failure occurs below that height they may be lowered immediately for a landing ahead. If retraction is commenced too early, or relowering too late, the float gear may, if partially retracted, be damaged by impact with the water.

(ix) In conditions of flat calm, if the hazard resulting from unduly long take-off, particularly in restricted waters, is considered to outweigh the possible risk of damage to the float gear, the floats may be retracted while still on the step at a speed of 60 knots or over. In this case great care should be taken to prevent the aircraft swinging.

NOTE.—At normal operational take-off weight with under-wing loads, and full fuel, the C.G. comes near the aft limit. For take-off, therefore, all crew should preferably be disposed as far forward as possible.

PART II Para. 65 (iii) and (iv)

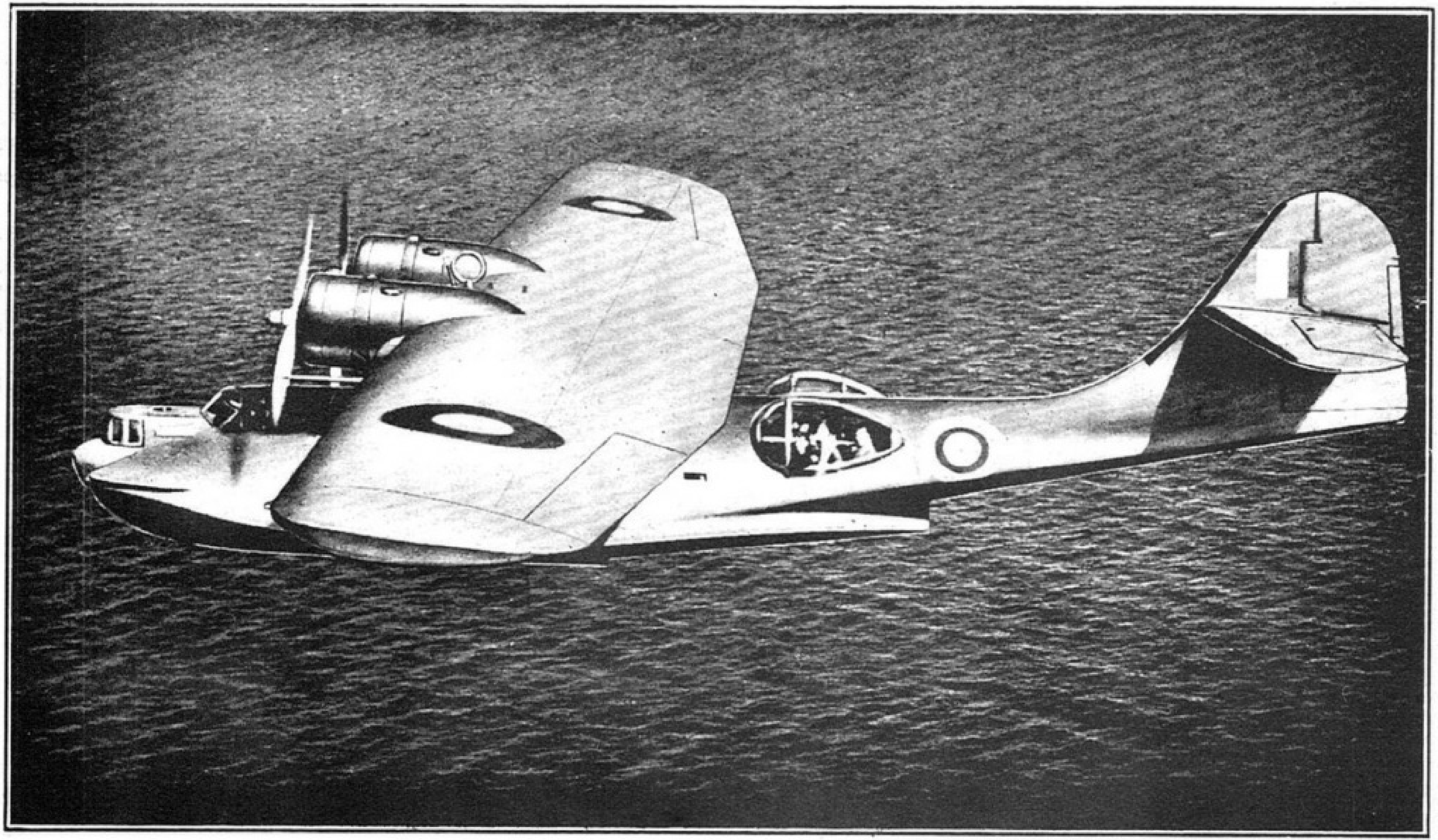
*(iii) *Fully stalled landings.*—(Used in rough seas, wind speeds of 25 knots or over and in conditions of swell.) *It is inadvisable to use this method of landing with fuel in excess of* 1,000 *gallons*. Make an engine assisted approach as detailed above and commence to level off at approximately 30 ft. As the aircraft sinks, ease back the control column so that at the point of stall it is in the fully backward position, and kept in this position after touch-down until the aircraft has lost forward speed.

*(iv) *Night landings.*—Proceed as for (ii) *Engine assisted landings*, but note:—

During preliminary approach from 1,000 ft. down to 200 ft. maintain 12 to 15 inches boost and 80 knots I.A.S. From 200 ft. until touch-down a fixed speed of 70–75 knots I.A.S. must be maintained.

NOTE.—On touching the water when landing, except for fully stalled landings, the control column should be held in the neutral position until the aircraft settles on the water, and may then be eased back to reduce the amount of water coming over the cabin and engines.

*WARNING.—For landings, both by night or day, in conditions of very high swell as encountered at Gibraltar, the aircraft should be levelled off at a height of about 300 ft. Sufficient power should be used to maintain a speed of 60 to 70 knots I.A.S. depending on weight, with a rate of sink of 200 ft. a minute. The throttles should be closed immediately on touching the water, when the aircraft will stall with the tail down, so that any resulting bounce will not be serious.



CATALINA

AIR MINISTRY
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Pilot's and Flight Engineer's Notes

PILOT'S & FLIGHT ENGINEER'S NOTES CATALINA I, IB, II, and IV

Second Edition. This edition supersedes all previous issues.

LIST OF CONTENTS

PART II—HANDLING

PART III—OPERATING DATA

PART IV—EMERGENCIES *Para.*

PART V—DATA FOR FLIGHT ENGINEERS

PART VI—ILLUSTRATIONS *Fig.*

PART I

DESCRIPTIVE

INTRODUCTION

These aircraft are high-wing monoplane flying boats. Two Twin Wasp R1830–82 or –92 engines driving Hamilton fully-feathering propellers provide the power. The leading dimensions are:

Span	104 feet
Length	64 ,,

A crew of eight or nine is normally carried.

The location of certain items of equipment varies to some extent, but the general arrangement is shown in figures 1 to 6 in Part VI, the items being numbered to accord with the numbers in brackets following the items where mentioned in the text.

FUEL AND OIL SYSTEMS

1. Fuel tanks

(i) Two main tanks, one in each wing, are fitted. The capacity of each tank is about 875 U.S. (725 Imperial) gallons. (Total capacity 1,750 U.S. (1,450 Imperial) gallons.)

(ii) Some aircraft have four cylindrical long-range tanks fitted on wooden crutches in the centre compartment; these tanks have a total capacity of about 325 Imperial gallons. An electrically driven pump is mounted on top of the upper tank (except on Mark IV, *see* para. 93) to which current is supplied via a flexible lead from a socket marked RECEPT AFT on the starboard aft face of bulkhead No. 4. The pump is fitted with a flexible suction hose terminating in a length of rigid pipe which can be inserted into any one of the tanks after unscrewing the blanking plug from the filler cap. The flexible delivery is connected by a union on the port side to an external pipe and fuel is pumped through this into the port wing tank via the drain valve.

2. **Fuel cocks and gauges** are mounted on the flight-engineer's instrument panel—*see* para. 27.

3. **Oil tanks.**—There is a 54 Imperial gallon effective capacity tank for each engine.

MAIN SERVICES

4. **Electrical system**

(i) A 24-volt generator is driven by each engine and a third generator by an auxiliary power unit.

(ii) The main distribution switch panel with two main bus-bars, A and B, is situated on the starboard forward face of bulkhead No. 4.

(iii) There is a further switch panel (38), mounted above the door on the forward face of bulkhead No. 2, controlling those electrical services operated by the pilots.

5. **Auxiliary power unit.**—This consists of a petrol motor which (except on Mark IV) can be clutched to drive either the auxiliary electrical generator or the bilge pump; On Mark IV aircraft the motor drives the auxiliary generator only, the electrically driven fuel transfer and bilge pumps being separate. This unit is fitted to starboard in the centre compartment and must be running for engine-starting. *See* para. 92.

6. **Pneumatic system.**—One pump is driven by each engine. A vacuum changeover cock (2) on the left of the pilot's instrument panel connects either pump to the two sets of pilot's flying instruments, the other pump is connected to the gyropilot. These pumps also operate the wing de-icing equipment.

AIRCRAFT CONTROLS

(*A*) *OPERATED BY PILOTS:*

7. **Control column.**—The two hand-wheel type aileron controls are connected by a yoke which operates the elevator control. The control action is conventional.

8. **Rudder controls.**—The two sets of rudder pedals are conventional and are adjustable for leg reach by means of levers (21) outboard of each pedal. The pilots' seats are also adjustable. *See* para. 30.

9. **Control locking gear.**—The control locking gear consists of a bar locking both columns which, when in place, also obstructs the first pilot's entrance to his seat. The rudder is locked by a lever (18) which pulls out from the port side by the first pilot's seat, and cannot escape his notice when in the locked position.

10. **Trimming tab controls**

(i) Elevator trim: 2 cranks (29) and (31) mounted on a box mounting in the roof of the pilot's cockpit.

(ii) Rudder trim: A knob (33) projecting from the underside of the box.

NOTE.—Indicators showing the direction of operation and position of the tabs are fitted on either side of the box above the controls.

(iii) Aileron trim: A knob (15) in the left centre of the pilot's instrument panel with an indicator below it.

11. **Sperry automatic flying controls.**—*See* A.P. 2095 and note:

(*a*) The main oil valve (3) is situated on the left of the instrument panel. (On Mark IV aircraft this is fitted on the port side below the rudder locking lever.)

(*b*) The gyropilot engaging lever (34) is behind the roof trim tab control box.

(*c*) The servo unit oil valves (19) are outboard of the first pilot's seat. (On Mark IB and IV aircraft these are replaced by push-pull controls. The travel is about $\frac{3}{8}$ inch only.)

(*d*) Mark IV aircraft the gyropilots incorporate a proportional bank adaptor unit; as delivered to the Service this is inoperative and the system works exactly like that on earlier marks. There is also a pilot/bomb-aimer changeover selector on the pilot's instrument panel; this too is inoperative.

12. **Flying instruments.**—These are mounted on the centrally placed pilots' instrument panel.

13. **Pilot to Flight Engineer signalling system.**—This provides for the transmission of orders from pilot to flight engineer. A line of switches and marked lights is mounted in a box (8) on the control yoke, and a corresponding set (50) on the flight engineer's instrument panel. From left to right they are labelled RAISE FLOATS, LOWER FLOATS, FULL RICH, AUTO RICH, AUTO LEAN, STOP ENGINES, RECALL, INTERPHONE, SECURE. Each light is out if the corresponding switches on the two panels are both up, or both down. The system can be used both as a signalling device and as an indicator. For example, in the control of floats, before coming in to land the pilot's indicator should show RAISE FLOATS; when he desires to have the floats lowered he switches on LOWER FLOATS which is then illuminated on both indicators. Having lowered the floats the flight-engineer switches off RAISE FLOATS which then goes out on both indicators, leaving LOWER FLOATS illuminated. The switch marked SECURE is for giving a general order, e.g., on completion of other orders or at the end of a flight. A dimming device for the signal lights is mounted on the control yoke. Be careful not to signal RAISE inadvertently, as the switch for this signal is near the first pilot's control wheel.

14. **Pilot's instruments.**—The location of certain instruments and switches varies somewhat with the different marks. Fig. 2 shows the general arrangement on early aircraft, while fig. 1 shows the arrangement on Mark IB aircraft. On Mark IV aircraft the grouping is similar to the Mark IB.

(B) OPERATED BY FLIGHT ENGINEER:

Mk. I & II 15. **Retractable wing-tip floats control.**—The floats are operated electrically by means of the control lever (42) by the flight engineer. A red warning light (6) in the centre of the pilot's instrument panel lights up when a throttle is closed with the floats up.

The lever has three marked positions, UP, OFF, and DOWN, and two unmarked neutral positions between the OFF and UP, and OFF and DOWN positions.

(i) *Raising floats.* The lever will be at OFF.

(*a*) Hold lever up for 3 seconds. This closes the motor "up" circuit. Return lever to OFF. If the motor has started correctly the "up" circuit remains closed until the floats are fully up.

(*b*) If the floats do not come up at the first attempt, repeat the operation of holding lever UP for 3 to 4 seconds, but on no account exceed 4 seconds.

(*c*) When the floats are fully up the motor "up" circuit should be broken automatically. To ensure that it is, immediately the sockets (55) on the bulkhead stop turning, move lever to the *lower* neutral position (this will break the "up" circuit if not already broken) and return to OFF.

(ii) *Lowering floats.*—The exact converse of (i).

(iii) *To stop floats in any intermediate position.*

(*a*) Floats rising. Move lever from OFF to the *lower* neutral and back to OFF.

(*b*) Floats lowering. Move lever from OFF to the *upper* neutral and back to OFF.

(iv) *To restart floats from intermediate position.*

As (i) or (ii).

Mk. IB & IV

(v) *On Mark* IB *and Mark* IV *aircraft* the engineer's control unit (42) is not fitted but there is a three-way switch at the extreme port end of the row of switches by the inter-communication panel. There is also a master switch (FLOATS CONTROL) on the main electrical distribution panel on bulkhead No. 4, which must be on before the engineer's switch is operative.

(vi) *To operate the floats.*

(*a*) the master switch is set on, and the engineer's switch to UP or DOWN as required.

(*b*) On completion of the operation automatic switches cut the motors out. The hand turning gear sockets (55) then stop rotating, when the engineer's switch should be returned OFF as a precaution.

(*c*) As a check that floats are locked the appropriate operation may be reselected, when the hand turning sockets should not rotate.

(*d*) To stop the floats in an intermediate position, the engineer's switch is set to OFF and, when sure that the motor has stopped (watch sockets), the switch may be set to UP or DOWN to continue or reverse the initial operation as required.

NOTE.—(i) When not airborne the floats must not be operated electrically, unless the A.P.U. is running. *For manual operation, the master switch on the main distribution panel must always be OFF* (on Mark IB and IV).

(ii) In checking floats allow time for the A.P.U. generator and motor to cool between each operation. In no case should more than two complete cycles of operation be made without waiting at least ten minutes; after two further cycles wait thirty minutes.

16. **Manual operation of wing-tip floats.**—In the event of failure of the electrical system the floats may be operated manually by a crank normally stowed on the after face of bulkhead No. 4 to starboard.

This crank can be used to turn the high or low speed gears (when airborne the floats are easier to raise so that high gear can be used), the sockets (55) being mounted centrally on the after face of bulkhead No. 4 above the door.

NOTE.—Whenever the aircraft is beached for inspection the floats should be operated manually before launching to ensure that they are working freely.

ENGINE CONTROLS

(*A*) *OPERATED BY PILOTS.*

17. **Ignition switches** are mounted on the yoke connecting the two pilots' hand-wheels. A knob (13) marked PULL OFF switches off all magnetos. There is also a switch (14) for each engine; the positions are marked BOTH, L, R, OFF.

18. **Throttle controls.**—The control levers (32) marked T project downwards from the roof between the two pilots. There is no automatic boost control, and it is necessary to watch the boost gauges when opening the throttles to avoid exceeding the permitted limits.

19. **Propeller controls.**—Hamilton hydromatic fully-feathering propellers are fitted. The constant-speed control levers (28), marked P, project downwards from the throttle control box. The feathering buttons (not shown) are mounted at the front of this box and operate by pushing upwards. When the button is pressed for feathering it is held in electrically until feathering is complete. When the button is pressed for unfeathering it must be held in by hand until the required r.p.m. are reached.

20. **Instruments.**—An electric engine revolution indicator (4) for each engine, as well as a synchroscope (5), are mounted on the pilot's instrument panel.

(*B*) *OPERATED BY FLIGHT ENGINEER.*

21. **Starter switches.**—These are to the left on the engineer's panel and have three positions—central for OFF, up to START (Energise) and down to MESH, to which positions they must be held, returning automatically to OFF on release. The booster coils are brought into circuit automatically when switches are held to MESH.

22. **Hand starting.**—A crank, stowed to port on the engineer's bulkhead, can be fitted to sockets on the top of the engine nacelles between the exhaust collector outlets. A manual engaging control is fitted on the port side of each nacelle under the hinged oil tank cowling.

23. **Mixture controls.**—(49) marked M, are above the instrument panel. There are four positions—FULL RICH, AUTO RICH, AUTO LEAN and IDLE CUT-OFF.

24. **Cowling gills (COWL FLAPS) controls** (54) are below the flight engineer's instrument panel.

25. **Carburettor air intake controls** (51) are on the instrument panel. On later aircraft the controls are of the push-pull T handle type, and for normal operation are pushed home, in the DIRECT AIR (cold) position. For the ALTERNATE AIR (hot) position, the handle is pulled out and

turned anti-clockwise to lock. Any intermediate position is ineffectual, so the handles should be either fully in, or fully out.

26. **Instruments.**—Engine boost and revolution indicators (40) are fitted on the flight engineer's panel as well as temperature, oil pressure, and fuel pressure gauges (53).

27. **Fuel cocks and gauges.**—*See* Fig. 6.

The following are fitted in the engineer's compartment:

(i) (*a*) A main fuel cock for each engine (43). Each cock can be set to LEFT ON, BOTH ON, RIGHT ON or OFF (referring to the tanks in use for its engine); with both cocks at BOTH ON, each tank is feeding both engines.

(*b*) A pressure cross-feed cock (41), normally kept closed, allows fuel to be fed to both engines from one engine pump in case of failure of the other.

(*c*) Two hand-pumps (45) are for starting and emergency use.

(ii) Drain and refuelling valves in the rear of the flight engineer's compartment are used for draining the system or for pressure refuelling via the 1-inch pipe fitted aft of the superstructure. The port drain valve is also used for fuel transfer from auxiliary tanks.

(iii) Two strainers are fitted, with drain cock controls on the engineer's panel.

(iv) A supply cock control for the A.P.U. is on the starboard side of the panel.

(v) The priming pump is on the port side of the engineer's compartment. Engine selection is obtained by depressing the handle and turning to desired setting. The suction line is connected to the port tank selector cock and two delivery pipes lead one to each engine.

(vi) Gauges are fitted as follows:

(*a*) Contents gauges for each tank (47).

(*b*) Flow meters (46) with their associated by-pass valves.

(*c*) Fuel pressure gauges (53) at bottom of instrument panel.

(vii) There is a fuel contents correction chart (48), for correcting gauge readings according to the attitude of the aircraft, on the decking to starboard of the gauges.

(viii) A fuel system diagram (44) is on the decking to port of the gauges.

NOTE.—All gauges are calibrated in U.S. gallons (one Imperial gallon = 1·2 U.S. gallons).

28. **Worth oil dilution system.**—A dilution switch (not shown) controlling the solenoid valve for each engine is on the starboard side of the engineer's panel. Shut-off cocks are fitted in the engine nacelles; these must be opened for dilution.

COCKPIT ACCOMMODATION AND EQUIPMENT

29. **Doors**

(i) There are sliding panels each side of the pilots' plexiglass roof. These are for use when pilots are directing mooring operations, etc. They are secured by catches (26) which are pulled forward to unlatch; the hatches then slide aft to open.

(ii) Normally, entry for all members of the crew, including the pilots, is through the port and starboard gun blisters which can be opened. Latch handles operable from inside and outside the aircraft are fitted, the outside handles being in recesses behind small access doors aft of each blister. The blisters can be sealed by inflated gaskets, but these must be deflated before opening and should normally be kept deflated in flight. When opening, unlatch the door, wait approximately 30 seconds to allow air to escape from the gasket if inflated, then swing open. To close, secure the latch, then, if required, pump up the gasket before taxying with the hand-pump provided.

Mk. IV. NOTE.—On Mark IV aircraft the hinges are mounted on eccentrics with a control lever just aft of each blister. When these levers are set down the doors are moved inwards so that the gaskets clear the framing; they must not be set down before the door is unlatched; otherwise, the fibre locking plate will be broken.

(iii) External ladders for reaching the blisters are provided These are stowed aft of each blister inside the hull. (On Mark IV, one ladder only, stowed in starboard blister.)

30. **Pilots' seats.**—Each pilot's seat slides up and forwards, and is locked in position by a lever outboard of the seat. Each seat is also adjustable for tilt; the locking levers (20) and (24) are in front of the seats.

31. **Cockpit lighting.**—The pilot's instrument panel lights are controlled by rheostat switches so that the intensity of illumination can be varied. There is an adjustable spotlight (30), in the roof of the pilots' cockpit, controlled by a switch (37) on the pilots' electrical switch panel over the access door.

32. **Cockpit heating**

Mk. I, IB & II IVB. (i) There is a Stewart-Warner heating system, the control switch being on the main distribution panel. Radiator units (not shown) with integral fans are outboard of each pilot and the starboard unit has a push-pull control to enable the second pilot to divert the flow through a duct to a manifold below the windshield for de-misting it.

(ii) On all aircraft there are sockets for connecting electrically-heated gloves and boots for the blister gunners. The sockets are on the aft face of bulkhead 6.

Mk. IVA. (iii) On Mark IV aircraft the heating system, installed to port aft of bulkhead No. 2, is entirely independent of the aircraft electrical system and comprises a self-contained, petrol engine driven, hot-air generator incorporating a vaporiser and fuel vapour burner. The blower circulates hot air through ducts which can be regulated by means of shutter controls on the duct junction manifold. These ducts lead to outlets as follows:

(*a*) Aft side of bulkhead 4, port side.

(*b*) Forward side of bulkhead 2, port side.

From this branch pipes also lead to:—The de-misting nozzle for the Captain's windscreen. An outlet to the bow compartment normally closed by a blanking cap, but to which can be fitted a flexible extension carrying a de-misting nozzle for the bomb-aimer's panel; this is stowed on the forward face of bulkhead 2 below the second pilot's seat.

(*c*) There is an engine pre-heating attachment which can be fitted to an outlet on the main junction manifold to enable the installation to be used for engine pre-heating.

33. **Ventilating system.**—Cowl doors are fitted in the decking each side of the pilot's windscreen. These are operated by manual controls (1) outboard of the instrument panel each side. Similar ventilators are just forward of bulkhead No. 6, and above the wireless operator's station. These must be closed for take-off and landing.

OPERATIONAL EQUIPMENT

34. **Bomb releases**

(i) There is a bomb selector switch panel (25) above the electrical switch panel on bulkhead No. 2. On Mark IV aircraft this is fitted on the port side in the bomb-aimer's compartment and no bomb jettison controls are incorporated, these being on the pilot's instrument panel (*see* Part IV, para. 84).
This comprises:

(*a*) A safety control knob which also selects for salvo release.

(*b*) Nose and tail fusing switches.

(*c*) Release selector switches.

(*d*) The jettison control.

(ii) Bomb release firing buttons—1st Pilot's (16)—are on both pilots' control wheels.

(iii) There is an additional firing button only, for use by the bomb aimer.

35. **Flare release.**—There are flare chutes and pyrotechnic stowage each side of the tunnel gun hatch. The flares are released by the pilots, the control pull handles (35) being situated on bulkhead No. 2.

36. **Seamarking equipment.**—Flame floats and sea markers are launched through the blisters. They are stowed aft of bulkhead No. 7, as well as to port between bulkheads Nos. 4 and 5.

Mk. I, IB & II

37. **Camera controls.**—For oblique photography on early aircraft the camera is mounted on the port side of the flight engineer's compartment and is operated by the pilot, who has a button on a bracket on his left for this purpose. A pilot's viewfinder is also installed outboard of the first pilot. Except on Mark IV aircraft the camera may also be mounted in the under-body tunnel for vertical photography, in this position it is operated electrically by the bomb aimer.

Mk. IV

38. **Smoke-making equipment.**—On Mark IV aircraft American smoke-making equipment is installed; this is operated by a pull handle control on the aft face of bulkhead No. 5, high up on the centre line. The equipment is inoperative in R.A.F. service.

NAVIGATION, SIGNALLING AND LIGHTING EQUIPMENT

39. **Radio equipment.**—The main equipment is mounted in the wireless operator's compartment. There is a TR 1196 installation but no pilot's remote control. A pilot's phone jack socket is fitted above and slightly to starboard of the door in bulkhead No. 2.

40. **Intercommunication system.**—There are 8 station boxes with call lights (no lights on Mark IV), switches, and microphone and ear-phone jack sockets; those for the pilots (17) and (23) being situated outboard of each seat.

41. **Signal pistol and cartridges.**—A pistol is carried on the port forward side of bulkhead No. 7 with stowage for cartridges adjacent thereto.

42. **Portable signalling equipment**

(i) Semaphore flags for signalling are stowed on the starboard side forward of the trailing aerial lead-in tube.

(ii) A signalling lamp is stowed below the second pilot's seat. The switch and plug socket being on the underside (on Mark IV on top) of the switch panel on bulkhead No. 2. Later aircraft have a U.S. Grimes lamp which may be plugged into any socket marked RECEPT.

43. **Lights.**—There are master switches controlling the lights on the main distribution panel. Individual lights are controlled by the pilots as follows:

(i) Anchor, navigation, formation keeping and landing lights, by switches on the pilot's switch panel (38) on bulkhead No. 2. (On Mark IB and Mark IV aircraft the arrangement of switches on the panel (38) is different but all are clearly marked.)

(ii) Navigation lights: by a selector switch (10) below the pilot/engineer signalling box on the control yoke.

(iii) UP-DOWN signalling lights: by a selector switch unit (12) and morsing key (11) also on the yoke. (On Mark IB and Mark IV aircraft an American type switch-box replaces the unit (12), the morsing key (11) also being replaced by a pushbutton on top of the switch-box.)

DE-ICING EQUIPMENT

44. **Windscreen de-misting and wipers**

(i) The windcreen and bomb-aimer's window can be de-misted by means of the nozzles, supplied from the heating system (*see* para. 32).

(ii) On Mark IV aircraft tandem windscreen wipers are fitted to the pilot's windscreen. These are driven by an electric motor mounted in the roof, forward of the trim tab control box, and are controlled by an ON-OFF and a 2-speed switch mounted aft of the trim tab controls. These wipers must not be used unless the windscreen is thoroughly wet, as the plastic material is easily scratched.

Mk. IV

45. **Windscreen and bomb-aimer's panel de-icing.**—The windshield and bomb-aimer's panel de-icing hand-pump and selector cock unit (7) is to the right of the instrument panel.

46. **Propeller de-icing flow control** (9) is on the control yoke. The pump and de-icing fluid tank are on the aft face of the bulkhead No. 4 to port.

47. **Wing de-icing.** The push-pull control (27) is in the roof above the pilot's switch panel.

The system comprises "boots" fitted to the main and tail planes. There is a distributor valve, valve motor and oil separator in the leading edge of the centre section near the centre line.

NOTE.—On later aircraft the above system is replaced by:

(*a*) Wing leading edges.—Engine exhaust heated pipes in the leading edges. The control consists of a switch marked OPEN (on) and CLOSED (off) on the control yoke. A small red warning lamp lights when the switch is on; when switched off this light dims and goes out completely after about one minute when the thermostatically controlled shutters close to cut off heat from the wing pipes.

(*b*) Tail plane and fin.—A Stewart-Warner heater in the fin which delivers hot air to pipes in the leading edges. This is controlled by a switch with an indicator light on the forward face of bulkhead No. 7. Fuel for the unit is supplied through a pipe along the starboard side with an ON-OFF cock fitted in the starboard gun blister. The tail unit must not be operated unless the engines are running at not less than 1,300 r.p.m. (preferably 1,500) to provide adequate air flow.

(*c*) Three clearly marked temperature indicators are fitted to the left of the engineer's seat.

48. **Pressure head.**—The heater circuit switch is on the pilot's switch panel (38) on bulkhead No. 2.

MARINE EQUIPMENT

49. **Manœuvring equipment**

(i) Drogues .. .. Two drogues are stowed in the aft gun compartment.

(ii) Towing cable	This is shackled to an eye on the keel below the forefoot and the end can be brought inboard by means of a recovery line. To stow, it is led over fairleads on the stem and secured to a cleat at deck level on the port bow.

50. **Mooring equipment.**—The following items are stowed:

(i) Anchor	In an external locker on the port side in the bow, accessible from outside from the bow compartment.
(ii) Buoy-hook and line ..	Stowed on port side below first pilot's rudder pedals.
(iii) A boat-hook	On the aft face of the bulkhead No. 5.

PART II

HANDLING

NOTE.—With A.S.Is. connected to static vents all speeds quoted in these Notes should be increased by 6 knots.

51. Management of fuel system

(i) Instructions for use of cocks.

Keep balance cock OFF, unless one engine shows signs of starvation due to fuel pump failure then—

Set balance cock OPEN and main cock to sound pump to BOTH ON.

(ii) Instructions for use of auxiliary tanks.

(*a*) To transfer fuel, turn on the master switch marked RECEPT AFT—electrical control panel on bulkhead No. 4—and set the switch of the "recept" socket to ON. The pump switch, which is below the cable entry to the motor,. must then be turned on—forward—as the drain valve, which is controlled by a handle high up on the port side aft of the flight engineer's seat, is opened.

(*b*) During transfer the wing tank gauge should be watched, and when the required amount of fuel has been transferred the pump should be switched off concurrently with the shutting of the drain valve. The port wing tank contents can then be equalised with the starboard tank contents by turning both main fuel cocks (43) to BOTH ON.

After the pumping operations are finished the suction pipe stop cock should be closed and care should be taken that any fuel remaining in the suction pipe is not splashed about indiscriminately. Tank caps should be replaced immediately.

NOTE.—It should also be remembered that a dangerous concentration of vapour may remain in the aircraft for some considerable time, therefore naked lights should be strictly avoided.

52. **Preliminaries** (*see* A.P. 2764).

(i) See that the bilges are pumped out.

(ii) Ensure that all loose items of equipment are correctly secured and hatches closed.

(iii) Unlock the controls, including the rudder.

(iv) Instruct wireless operator to see that the intercommunication system is connected, and test. Check with flight engineer that visual system is on and indicating correctly.

(v) Instruct flight engineer to start auxiliary power unit.

(vi) See pitot head cover has been removed.

(vii) See that the gun blister doors are closed.

(viii) Ensure drogues are available for immediate use and that one man is detailed to stand by in the blister.

(ix) Check, ready to slip from buoy.

(x) Set or check: Automatic Pilot OFF.

(xi) Flight engineer check oil dilution switches OFF.

NOTE.—On ferrying flights, or at times when external stores are not to be carried, the bomb racks should be stowed in the hull as these affect performance and economy to a marked extent.

53. Starting engines

		PILOT	FLIGHT ENGINEER (*see* A.P.2764)
(i)	(*a*)	Set propeller controls—fully forward—INC. R.P.M.—throttles about 1 in. open.	Turn engines over by hand.
	(*b*)	. . . . . .	Start A.P.U. and check voltage.
	(*c*)	. . . . . .	Switch on appropriate switches on distribution panel to bus-bar "B".
	(*d*)	. . . . . .	Main fuel cocks ON.
	(*e*)	. . . . . .	Turn on strainer drain cocks to allow any water in sumps to drain away.
	(*f*)	. . . . . .	Carburetter heat—DIRECT.
	(*g*)	. . . . . .	Set Gills—OPEN, Mixture, IDLE CUT-OFF.
(ii)	(*a*)	Check engines have been turned by hand, then .	Set engine fire extinguisher to engine to be started (except on Mark IV).
	(*b*)	Instruct flight engineer—"Start port or stb'd engine" as required	Raise fuel pressure to 10 lb./sq.in. and maintain with hand-pump.
	(*c*)	Switch ON master ignition switch . .	Prime—four to six strokes—and call for contact. Energise starter until hum becomes constant, or if inaudible for 12 to 15 seconds (on Mark IV, not more than 12 seconds) 20 seconds must never be exceeded.
	(*d*)	Switch port ignition BOTH ON when flight engineer calls contact and signal AUTO RICH. (If engine fails to start *see* Note below)	Engage starter and in cold weather continue priming until engine fires. (If engine fails to start *see* Note below.)

	(e)	Keep engine below 800 r.p.m. . . .	When engine is firing regularly, stop priming, set mixture to AUTO-RICH and raise fuel pressure to 15 lb./sq.in. with hand-pump. If engine shows signs of being over-rich return to AUTO-LEAN or IDLE CUT-OFF until it is running smoothly. Oil pressure should rise to not less than 15 lb./sq.in. in 30 seconds. If so, inform pilot; if not, stop engine and report reason to pilot.
(iii)	(a)	When engine is running smoothly, instruct flight engineer to start other engine	Start other engine (repeat 2 (a) to (e)).
	(b)	Switch ignition BOTH ON when flight engineer calls contact	
(iv)		Do not slip mooring until both engines are running satisfactorily	When both engines are running smoothly stop A.P.U.

NOTE.—If engine fails to start:

(a)	Stop priming and move mixture control to IDLE CUT-OFF.
(b) When engine has stopped, switch ignition—OFF .	To ensure flywheel has stopped set switch to MESH and return central.
(c) If engine has been over-primed open throttle .	Have propeller turned over half a revolution by hand to ensure starter is not engaged, or if over primed—
(d)	Have propeller turned over several revolutions to clear surplus fuel.
(e)	On Mark IV after three unsuccessful attempts wait at least five minutes to allow A.P.U. generator to cool down before making a further attempt. After four unsuccessful attempts suspect defective booster coil; check spark normal, at coil lead.

54. **Leaving moorings** (*see* page 27)

(i) Open the front turret and anchor box door.

(ii) By means of the mooring bridle trip line pick up the bridle, pass the slip line through the grommet of the pendant and make fast hard up to the bollard.

(iii) Unshackle the mooring bridle from the pendant and stow the free end of the mooring bridle and trip line.

(iv) Report ready to cast off to pilot.

(v) When the pilot gives the signal to cast off release the slip line and cast off the pendant.

(vi) Stow the slip line, remove the bollard, close the anchor box and front turret.

55. **Weighing anchor**

Two bowmen should be detailed; one to tend the anchor and one to work the anchor-winch:

(i) The winchman should wind in the anchor cable until the cable clamp is adjacent to the fairlead, and should then apply the brake.

(ii) The bowman should remove the cable clamp, unshackle it from the mooring bridle and stow the bridle and clamp.

(iii) The winchman should then continue to wind in the anchor cable until the cable is "up and down".

(iv) The bowman should inform the Captain that the cable is "up and down".

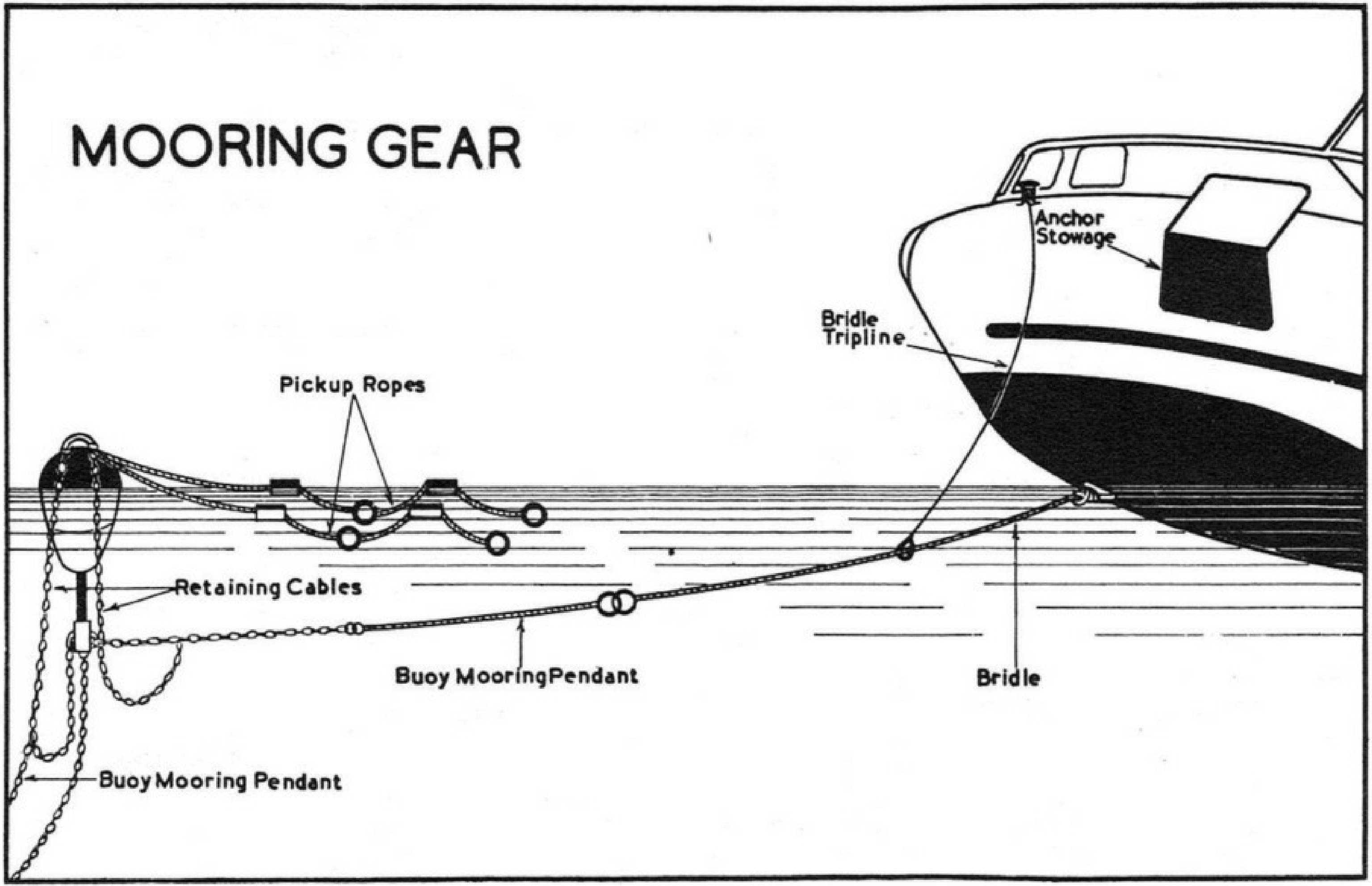
(v) An attempt should be made to break the anchor out by winding on the winch. If this is not successful the Captain should start one engine and override the anchor, thus breaking it out.

(vi) The engine and/or engines should then be started and the aircraft kept under way as slowly as possible. The drogues should be streamed if necessary.

(vii) The winchman should continue to turn the winch until the anchor is clear of the water, when, at a signal from the bowman, the brake should be applied.

(viii) The bowman should then lift the anchor inboard, taking care not to damage the hull, and stow it.

(ix) *See* page 28.


MOORING GEAR
Anchor Stowage
Bridle Tripline
Pickup Ropes
Retaining Cables
Buoy MooringPendant
Bridle
Buoy Mooring Pendant

(ix) Close anchor box door and turret. Report to the Pilot "anchor stowed, stowaged locked".

NOTE.—Eyes are provided each side of the hull above the mooring platforms for attaching a safety belt when mooring or unmooring the aircraft.

Care must be exercised when breaking out the anchor, from a sticky clay bottom in particular, to avoid a too violent action in breaking out with a resulting twisting of the anchor shank or fluke arm.

If the anchor clamp begins to lose its holding power, it will probably be because the brass liner in the clamp is worn. A new liner can be installed.

56. **Warming up**

		PILOT	FLIGHT ENGINEER
(i)	(*a*)	Engine r.p.m. should be kept down to 1,000 if possible until the flight engineer reports oil temperature 40° C.	Inform pilot when oil temperature reaches 40° C. NOTE.—Do no close gills to accelerate warming up.
	(*b*)	Test vacuum changeover cock.	
	(*c*)	Check and bleed automatic pilot and check all controls by moving them to their extreme positions in each direction and holding them there for 15 to 30 seconds.	At 1,500 r.p.m. c Oil pressure .. .. .. 65/105 lb./sq.in. Fuel pressure .. .. 14/16 lb./sq.in.
	(*d*)	Test de-icer and check pressure	Report fuel and oil corr
(ii)	(*a*)	When flight engineer has reported fuel and oil correct open up to 2,000 r.p.m.	
	(*b*)	Check operation of constant speed propellers over the full range; if sluggish repeat.	
(iii)	(*a*)	Open throttles to take-off boost (48 ins. Hg.) and r.p.m. (2,700)	
	(*b*)	Throttle back to $31\frac{1}{2}$ ins. boost and test each magneto in turn. The drop should not exceed 100 r.p.m.	
(iv)		Tell wireless operator to switch on both generators to test charge—then off.	

57. **Taxying**

(i) Do not allow the engines to idle below about 1,000 r.p.m. for longer than is necessary, and after idling give each engine a burst of about 2,000 r.p.m. before take-off.

(ii) Keep control column right back, this improves control and reduces the amount of water coming over the cabin.

(iii) Turning out of wind is easy if a swing is started and kept up, but it is difficult to steady the aircraft on a cross wind or down wind course. In wind speeds above 15 knots it is impossible to keep the aircraft across wind even with the use of the windward engine, but it is possible to taxy with the wind on the quarter. In an emergency both drogues may be used on the down wind side.

(iv) When taxying down wind speed is required to make the rudder effective. To counteract swing use plenty of opposite engine.

(v) *Taxying on the step.*—This method is advantageous when wishing to taxy some distance. Open up as for take-off, with control column back, when on the step reduce boost so as to maintain a speed of 45 knots.

58. **Check list before take-off**

T—Trimming tabs	..	Elevator 1° nose up. Others neutral.
M—Mixture controls	..	Signal AUTO RICH on visual system.
P—Propeller controls	..	Fully forward—INC. R.P.M.
F—Fuel ..	..	Check with flight engineer.
F—Floats ..	..	Check FLOATS DOWN.
G—Gills ..	..	OPEN.
Generators ..	..	Both ON.
Automatic pilot	..	OFF.

59. **Take-off**

(i) Keep control column right back and open up to 48 ins. boost.

(ii) Keep control column well back then allow it to move forward to neutral. Do not push control column forward.

(iii) When I.A.S. reaches 60–65 knots ease control column back when aircraft should become airborne.

(iv) Safety speed is 80 knots.

(v) When airborne, ease control column forward and climb at 85 knots.

(vi) Reduce power to climbing boost and r.p.m.

(vii) Signal "RAISE FLOATS" as soon as safely airborne.—*See* (viii).

(viii) In event of engine failure during take-off a landing should be made straight ahead. Only if lightly loaded should an attempt be made to continue climbing. It is desirable on taking off to raise the floats so that they do not reach the fully raised position below a safe height, then if the engine failure occurs below that height they may be lowered immediately for a landing ahead.

NOTE.—At normal operational take-off weight with underwing loads, and full fuel, the C.G. comes near the aft limit. For take-off, therefore, all crew should preferably be disposed as far forward as possible.

60. **Climbing**

The speed for maximum rate of climb is 85 knots to 6,000 ft., then reduce speed by 2 knots per 1,000 ft.

61. **General flying**

(i) *Engine revolutions.*—The engine speed range of 2,450 to 2,650 r.p.m. should be avoided as it may produce a vibration in the structure of the aircraft.

NOTE.—Handling and performance deteriorate considerably if the C.G. is at or near the aft limit; at the commencement of operational sorties, carrying underwing loads and full fuel, all crew should keep as far forward as operational conditions permit.

(ii) If large side-slip or skidding is produced by nearly full use of rudder at speeds of 110 knots or lower, the rudder may lock over. The nose will rise and the wing drop sharply, even against full opposite aileron. Control can be recovered by putting the nose down and increasing speed to 120 knots; the engines should be throttled back and the rudder then forced back. Much opposite aileron should not be used until the rudder centralises as it increases side-slip.

62. **Stalling**

A good margin of speed should be kept on turns; and steep turns at low altitudes avoided, especially when heavily loaded. At 34,000 lb. the approach to the stall is at about 70 knots. Rudder control becomes uncertain at 3 to 5 knots before elevator and aileron control are lost. The aircraft sinks rapidly, but without dropping the nose, or a wing, at the following speeds.

At 26,000 lb.	At 34,000 lb.
58–60 knots I.A.S.	66–70 knots I.A.S.

63. **Diving**

(i) The propeller control lever should be left in the cruising position.

(ii) The boost rises rapidly with loss of height, and care is necessary to avoid over-boosting.

64. Check list before landing

		PILOT	FLIGHT ENGINEER
(i)	(*a*)	M—Mixture, Signal AUTO RICH	Set mixture AUTO RICH.
	(*b*)	P—Propellers. Set to 2,300 r.p.m. NOTE.—For landings at, or emergency landings in excess of, normal maximum permissible landing weight set fully forward INC. R.P.M.	
(ii)	(*a*)	Reduce speed to 100 knots I.A.S.	
	(*b*)	F—Floats. Signal LOWER—Check by closing both throttles (red lights out); then open up to 15 ins. boost.	Check with W.O. by interphone FLOAT CONTROL —ON (when fitted) Lower floats, switch off "RAISE FLOATS" on indicator when down.
(iii)		Warn and detail crew to close all hatches and to take up landing positions NOTE.—For landing the C.G. should preferably be between 27.5% and 28.5% M.A.C.	Take up landing station.

65. **Approach and landing**

(i) *The speed recommended* for preliminary approach is 85–90 knots I.A.S.

(ii) *Engine assisted landings*.—This method of landing should always be used when circumstances permit.
(*a*) At 200 ft. reduce speed to 75 knots I.A.S. and set throttles to maintain a rate of descent of 200 ft. per minute.
(*b*) Trim aircraft in this attitude.
(*c*) On touching down ease throttles back smoothly and centralize the control column.

(iii) *Fully stalled landings*.—(Used in rough seas, wind speeds of 25 knots or over and in conditions of swell.) *It is inadvisable to use this method of landing with fuel in excess of* 1,000 *gallons*. Make an engine assisted approach as detailed above and commence to level off at approximately 30 ft. As the aircraft sinks, ease back the control column so that at the point of stall it is in the fully backward position, and kept in this position after touch-down until the aircraft has lost forward speed.

(iv) *Night landings*.—Proceed as for (ii) *Engine assisted landings*, but note:—
During preliminary approach from 1,000 ft. down to 200 ft. maintain 12 to 15 inches boost and 80 knots I.A.S. From 200 ft. until touch-down a fixed speed of 70–75 knots. I.A.S. must be maintained.
NOTE.—On touching the water when landing, except for fully stalled landings, the control column should be held in the neutral position until the aircraft settles on the water, and may then be eased back to reduce the amount of water coming over the cabin and engines.

66. **Mislanding**

Should a baulked landing necessitate the use of take-off boost, the propeller controls, if previously set to 2,300 r.p.m., should be set fully forward—INC. R.P.M. immediately to prevent detonation.

67. **After landing**

(i) Wireless operator to switch off both generators immediately.

68. **Approach to moorings** (*see* page 27)

(i) Taxy well to leeward of desired buoy, or down tide if no wind.

(ii) Give warning signal on horn, crew to stand by for mooring up, rigger and assistant in bows and one man on each drogue with intercom. on.

(iii) Do not stop engine until the mooring is secured. Flight engineer should start A.P.U. and energise both engine starters; they will then run for three to four minutes, when, should either engine stop, it can be restarted without loss of time.

(iv) Approach buoy as slowly as possible—drogues should always be used. It is possible to remain stationary or drift back with engines ticking over. Main ON–OFF switch may be "blipped" in light winds to reduce speed of approach.

(v) When bowman has picked up buoy-pickup rope and secured with slip line, and signalled to that effect:

(*a*) If wind is light, signal flight engineer to stop engines by using IDLE CUT-OFF.

(*b*) If wind is strong, keep one or both engines running as necessary until bowman has shackled main bridle to buoy pendant.

69. **Mooring.** *See* A.P. 1098, Chapters III and IV, and A.P.464/F-3

(i) One man should proceed to the port chine rail, secure himself with a safety belt, prepare the bollard and short slip for use, and open the door of the anchor box. A second man should be stationed in the front turret with a boathook. As soon as the aircraft approaches the buoy proceed as follows.

(ii) Pick up the pick-up rope with the boathook and pass the slip line through the eye near the middle of the rope; make the slip fast, close up to the bollard.

(iii) Signal "aircraft secure" to the pilot.

(iv) Pick up one of the mooring pendants and place the grommet over the bollard.

(v) Remove the mooring bridle from its stowage and shackle the free end to the mooring pendant. Mouse the shackle.

(vi) Remove the grommet from the bollard and drop the mooring bridle and pendant.

(vii) Cast off the short slip.

(viii) Close anchor box door and front turret. Report "aircraft moored" to the pilot.

70. **Dropping anchor**

Before dropping anchor charts should be consulted and a suitable area chosen. The aircraft should then be manœuvred to the down-wind end of the area and drogues should be streamed. Three men should be detailed; one to work the anchor-winch, one to be stationed on the port chine rail to prepare the anchor, and a third to be stationed on the starboard chine rail to heave the lead. Procedure should then be as follows:—

(i) The man stationed on the starboard chine rail should continually take soundings, calling out the depth of the water to the pilot.

(ii) The A.P.U. should be started in order that the engines can be re-started at short notice if necessary.

(iii) The man stationed on the port chine rail should remove the anchor from its stowage and prepare for anchoring.

(iv) The anchor cable should be led through the fairleads.

(v) The man stationed at the anchor-winch should have the handle ready for use, but not engaged, and should keep the brake in the "on" position.

(vi) When a suitable position has been reached the pilot should order the winchman to release the brake and should give the port bowman instructions to drop the anchor.

(vii) When the anchor has touched the bottom and sufficient cable has been run out the engine should be stopped and the brake applied to the anchor-winch. The aircraft should then be allowed to drift back until the anchor cable takes the strain. (In strong winds one engine only should be stopped.)

(viii) The bowman should feel the anchor cable to see if the anchor is holding fast. If the aircraft is dragging more cable should be paid out.

(ix) When the aircraft is safely at anchor the cable clamp should be clamped to the anchor cable and shackled to the mooring bridle. The anchor cable should then be paid out until the mooring bridle takes the strain.

(x) The A.P.U. may then be stopped.

(xi) Close anchor box and front turret. Report "aircraft anchored" to the pilot.

71. **Stopping engines**

PILOT	FLIGHT ENGINEER
(i) Signal STOP ENGINES on visual system.	(i) Stop engines by setting mixture to IDLE CUT-OFF.
(ii) When engines have stopped switch off ignition.	(ii) Switch off all switches on distribution panel and shut off main fuel cocks.

72. **Oil dilution.**—*See* A.P. 2095 and A.P. 1464A, Vol. I, part 5. Section 2, Ch. 6, for full instructions and note:—

(i) The dilution period for this engine is two to three minutes only.

(ii) When the dilution valve is opened a sudden drop in fuel pressure will result. If this does not build up to normal on closing valve, stop engine and check valve for leakage.

If, on operating switches, fuel pressure does not fall, suspect shut-off cocks not open or solenoid valves not operating.

NOTE.—If oil dilution is carried out while taxying to moorings, the operation should be timed so that the dilution period will be completed just before securing to the buoy. The full benefit of dilution will, however, not be obtained unless the engines are allowed to cool down before diluting.—*See* A.P. 2095.

PART III

OPERATING DATA

73. **Engine limitations**:—Twin Wasp R1830-82 and -92 (SIC3-G) Engines.

(i) *Fuel.*—100 octane.

(ii) *Oil.*—*See* A.P. 1464/C./37.

(iii) *Principal engine limitations*:

	R.p.m.	Boost ins. Hg. abs.	Cyl.	Temp. °C. Oil Max.	Oil Desired
TAKE-OFF TO 1,000 FT.	2,700	48	260		
CLIMBING 1 HR. LIMIT	2,450	40½	260	95	50/70
MAX. RICH CONTINUOUS	2,250	32½	230	70/85*	50/70
MAX. WEAK CONTINUOUS	2,250	30	230	70/85*	50/70
COMBAT 5 MINS. LIMIT	2,700	45	260	95	

OIL PRESSURE:—

MAX.	105 lb./sq.in.
NORMAL	75/95 lb./sq.in.
MINM. IN FLIGHT	60 lb./sq.in.
MINM. IDLING	15 lb./sq.in.

TEMPERATURE FOR TAKE-OFF:—

OIL—MINM.	40° C.
CYLINDER—MINM.	120° C.
MAX.	205° C.

FUEL PRESSURE:—

MAX.	17 lb./sq.in.	DESIRED	15 lb./sq.in.
MINM.	14 lb./sq.in.	IDLING	7 lb./sq.in.

*The upper limit of 85° is for use in tropical conditions only.

(iv) *The following limitations must also be observed*

Stopping engine.—Maximum cylinder temp. 205° C.

R.p.m. range restriction.—On account of vibration avoid the range 2,450 to 2,650 r.p.m. except as necessary when increasing or decreasing r.p.m. through it.

74. Position error corrections

From To	70 90	90 100	Knots I.A.S.
Add	6	8	Knots

With A.S.Is. connected to static vents the P.E.C. can be neglected.—*See* Note at head of Part II.

75. Flying limitations

(i) The aircraft is designed for duty as a general reconnaissance flying boat and intentional spinning and aerobatics are not permitted. *See* A.P. 2095.

(ii) *Maximum speeds*

At 23,000 lb. total weight .. 207 knots I.A.S.
At 28,000 lb. total weight .. 175 knots I.A.S.
At 34,000 lb. total weight .. 143 knots I.A.S.

In extremely rough air, as in cumulus cloud, 110 knots I.A.S. should not be exceeded.

76. Maximum range and endurance (*see* page 41)

(i) *Climbing*

Fly at about 85 knots I.A.S., using maximum permitted climbing boost and r.p.m. This gives maximum economy as well as optimum rate of climb.

(ii) *Cruising*

(*a*) At normal cruising altitudes the speed recommended is 90 to 92 knots I.A.S.

(*b*) Fly in AUTO WEAK using maximum permitted weak mixture boost and adjusting r.p.m. to maintain the recommended speed. As weight is lost r.p.m. may be reduced as low as 1,400 to 1,500 r.p.m. provided unduly rough running is not experienced.

(iii) *For maximum endurance* speed may be reduced to the lowest speed at which the aircraft can be comfortably flown; at light load this will be about 80 knots I.A.S.

(iv) *Use of warm intake.—See* A.P. 2095 and note ALTERNATE air should be used whenever there is a likelihood of icing conditions being met. Range, at normal cruising altitudes, is, in certain conditions, slightly increased so that ALTERNATE air may be used without disadvantage at all times provided that engine temperatures remain normal.

NOTE: (i) Underwing bomb-racks and loads considerably impair performance, range and endurance; when underwing loads are not to be carried the racks should preferably be removed and stowed inboard, as far forward as possible.

(ii) For maximum range and endurance; the crew should be disposed as far forward as operational conditions permit.

77. **Fuel capacity and consumptions**

	Galls. U.S.	Galls. Imp.
Port Tank	875	725
*Starboard Tank	875	725
Total	1,750	1,450
With one self-sealing Tank ..	1,500	1,246

*Less about 18 gallons reserve for A.P.U., which cannot be used for main engine.

The following are the approximate fuel consumptions in U.S. gallons per hour for the aircraft at 1,000 feet.

	Boost	R.p.m.					
	Ins.Hg	2,700	2,450	2,250	2,100	1,900	1,800
RICH	46½	300					
	40			240			
WEAK	30				93	83	77
	28					76	72
	27					73	70
	26					71	67
	25						64

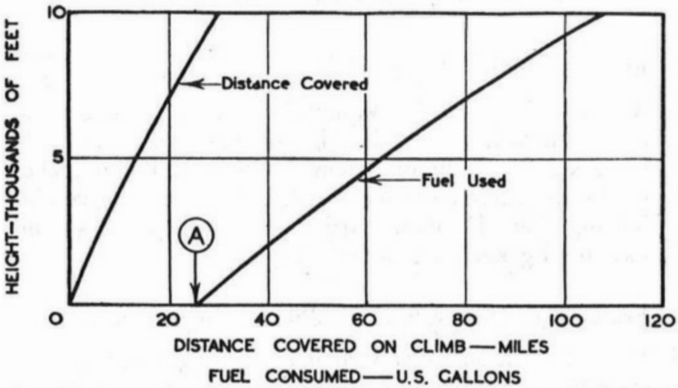
78. **Oil capacity and consumption**

There are two oil tanks each containing 54 gallons. Consumption is approximately one-third of a gallon per hour per engine.

CONSUMPTION CURVES

CLIMB

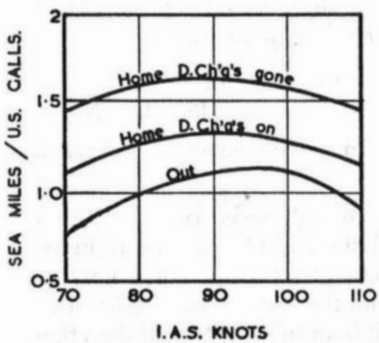
DISTANCE COVERED —— FUEL CONSUMED



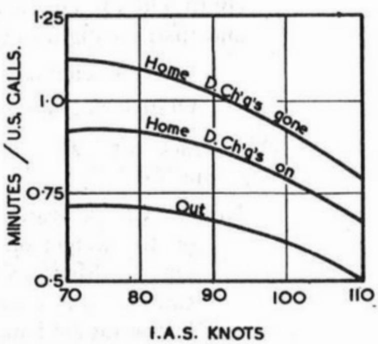
(A) Fuel allowance for warming up and taxying.

CRUISING

RANGE



ENDURANCE



PART IV

EMERGENCIES

79. **Engine failure in flight**

At 30,000 lb., with A.S.V. and depth charges, height can be maintained, at low altitudes, on one engine at 80/85 knots I.A.S. at climbing power, provided the propeller of the dead engine is feathered. *See* advice on rudder locking, Part II, para. 61(ii). Flight Engineer should switch off generator of a failed engine.

80. **Feathering**—(*See* A.P. 2095—Pilot's Notes General).

(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 signal flight engineer to set mixture of failed engine to IDLE CUT-OFF, Gills closed.

(iii) When engine has stopped, if single-engine flying is to be continued for any length of time, switch ignition OFF and instruct flight engineer to set fuel cocks—

Of dead engine .. .. .. OFF.
Of live engine .. .. .. BOTH ON.

(iv) Instruct wireless operator to switch generator of failed engine OFF.

NOTE.—Check feathering should never be carried out on the water; on land the A.P.U. must be running. On the Mark IV practice feathering should only be carried out in the air with the A.P.U. running, or check feathering on land with both the A.P.U. and the other engine running at not less than 1,500 r.p.m.

81. **Unfeathering**

(i) Instruct flight engineer—fuel—ON.

(ii) Set throttle as for starting, propeller control DEC. R.P.M. (fully back) and ignition BOTH ON.

(iii) Press button until r.p.m. reach 1,000 to 1,300. Signal flight engineer—mixture AUTO-RICH. Slight opening of the throttle may be needed before the propeller will resume constant speeding.

(iv) Instruct wireless operator—generator—ON.

(v) Instruct engineer—Gills—Set as necessary.

82. **Emergency float operation**

See Part I, para. 16. On Mark IB. and Mark IV; flight engineer should check with wireless operator that Float CONTROL switch is OFF before fitting hand crank. If the electrical system is known to be inoperative, pilot should check with wireless operator before signalling LOWER to flight engineer.

83. **Fuel Jettisoning** (On Mark IV aircraft)

(i) The port (or on some aircraft the starboard) only, tank contents can be jettisoned. The valve control (labelled DUMP) is a lever with a red knob fitted on the same side as the jettisonable tank above the flight engineer's head. To jettison fuel this lever is pulled down until it is engaged by a spring catch. To stop jettisoning at any time reset the lever to the normal position.

NOTE.—If it is desired to empty the one tank completely, the aircraft should be put into a climbing attitude, and should be flown slightly wing low to the side from which the fuel is being jettisoned.

(ii) A purging valve, which releases CO_2 into the empty tank to prevent fire due to petrol vapour, is fitted. The control is a blue and yellow "T" handle, behind the engineer's right shoulder; it is pulled forward to operate. The purging system should be used only after the tank has been completely emptied and the jettison valve closed.

84. **Bomb Jettisoning**

(i) On early aircraft the bomb jettisoning controls consist of two brown tabs which project through the port side of the bomb-selector switch box and are normally tected by a spring-loaded hinged flap (36). To set for jettison, flick the flap back and push both tabs in (to the left) as far as they will go, this releases all bombs. On some aircraft the hinged flap has an additional plated guard, which must be pulled off and down before the flap can be flicked back.

Mk. IV

(ii) On Mark IV aircraft the jettison controls are red pull-handles fitted to port and starboard below the instrument panel. Each handle is pulled fully out to jettison all the bombs on the same side.

85. **Fire-extinguishers**

Mk. I, IB & II only

(i) There is a non-automatic CO_2 pressure system serving both engine nacelles. The cylinder and main control valve are located in the flight engineer's compartment on the port side. There is also a selector valve (39) for selecting either engine nacelle and a remote control operating handle mounted below the flight engineer's instrument panel. (This is not fitted on Mark IV aircraft, which have no engine fire-extinguisher system.)

(ii) A portable liquid-type extinguisher is stowed on the forward face of No. 4 bulkhead on the port side.

(iii) Three hand extinguishers are also carried: the location of these varies, but on most aircraft they are stowed—

(*a*) On the forward face of bulkhead No. 2

(*b*) On the forward face of bulkhead No. 5

(*c*) On the after face of bulkhead No. 6.

(iv) For actions in the event of fire in the air—*see* Pilot's Notes General A.P. 2095.

Mk. IV only

(v) A.P.U. Fire-extinguisher. The A.P.U. extinguisher is both manually and automatically operated. A discharge indicator is provided on the bottle and takes the form of a black plunger which normally extends ¼ in. in the undischarged position.

86. **Parachute stowages and emergency exits**

See figure 8 and Note:

(i) *Parachute stowages* vary to some extent, but on most aircraft are as shown in figure 8.

(ii) *Parachute exits.*—The two gun blisters should be used by all members of the crew.

(iii) *Emergency exits.*—For use on the water only when engines are not running.—In addition to the gun blisters, the following exits can be used:

(*a*) For the Pilots—through the sliding panels each side of the cockpit roof.

(*b*) For the radio operator and navigator—through a hatch in the roof on the port side above the navigator's table.

87. Dinghies

See figure 8 and Note:—

(i) Two H type dinghies are carried. These are stowed with the emergency packs below the bunks on each side between bulkheads Nos. 5 and 6. Oars are stowed on the starboard side of the walkway just aft of bulkhead No. 5.

(ii) K type dinghies are provided for all members of the crew.

88. Other emergency equipment

(i) *Emergency ration kits.*—Two are stowed, one on each side on the forward face of bulkhead No. 6.

(ii) *Marine distress signals.*—These are stowed on the aft face of bulkhead No. 7 on both sides. On later aircraft these are stowed on the forward face of bulkhead No. 2, and on the aft face of bulkhead No. 6.

(iii) *Flame floats.*—Stowages for these are provided on the aft face of bulkhead No. 7 near the port flare chute.

89. Destruction equipment

(i) *The IFF destruction* push buttons and switch unit (22) are on the starboard side of the cockpit below the ventilator control knob. On Mark IV aircraft shielded switches replace the push buttons.

(ii) *Destruction of aircraft.*—Two incendiary bombs for this purpose can be stowed in clips—

(*a*) behind the second pilot's seat

(*b*) on the forward face of bulkhead No. 6

These bombs are fired by placing them on a solid foundation and striking the top with a heavy object.

PART V

DATA FOR FLIGHT ENGINEERS

90. Oil system

(i) One tank is fitted for each engine, situated in the engine nacelles.
The capacity of each tank is 76 U.S. = 63 IMP. galls. approx.
Maximum filling capacity is 54 IMP. galls.

(ii) (*a*) Each oil tank has a hot-pot (hopper), a dip stick and drain valve being fitted, the latter at the bottom forward end of the sump.

(*b*) An oil cooler with a thermostatic valve controlled by-pass is fitted in each nacelle at the firewall. When cold the return oil flow from the engine is by-passed directly into the bottom of the hot-pot near the suction outlet to the delivery pump. The temperature at which the by-pass valve closes, diverting the return oil flow through the cooler, can be regulated by an adjustment on the side of the valve. A check valve is incorporated.

(*c*) A liquidometer oil quantity gauge is installed for each tank, the remote reading indicator (52) being on the engineer's panel.

(*d*) On Mark I, IB and II aircraft a propane stove is provided for pre-heating the oil in cold weather. On Mark IV aircraft the engines are heated by hot air—*see* para. 32.

91. Electrical system

(i) Power supply

(*a*) A 24-volt D.C. system provides the main electrical power as well as the D.C. radio supply.

(*b*) A 120-volt A.C. system provides the radio A.C. power supply.

(ii) Generators and inverter

(*a*) A 24-volt generator is driven by each engine, and a third by the A.P.U. Each of these generators also supplies 120-volt A.C.

(*b*) On later aircraft only an S–666 inverter supplies 110-volt A.C. for fluorescent instrument panel lighting. This is controlled by a switch on the pilot's switch panel.

(iii) Batteries

Two S–34 batteries connected in series in the wing centre section furnish D.C. to the main system. Two S–17 batteries connected in series in the radio compartment furnish D.C. to the radio system. The batteries may be charged in the normal manner from any of the three generators by means of the control switches on the main distribution panel on bulkhead 4.

(iv) Controls

(*a*) The main controls for the electrical system are on the main distribution panel. The D.C. switch controlling the D.C. supply to the radio is on the radio power junction box.

(*b*) An A.C. receptacle (plug socket) for the radio is on a panel immediately outboard of the main distribution panel. The hotplate plug socket is also on this panel.

(*c*) Fuses for all main circuits are fitted behind the main switch panel which hinges forward.

(v) The following equipment is electrically operated:

(*a*) Main engine starters
(*b*) Retractable float mechanism
(*c*) Lights
(*d*) Radio equipment
(*e*) Cooking stove
(*f*) Visual intercommunication system
(*g*) Bomb sight
(*h*) Bomb release
(*i*) Camera control
(*j*) Pressure-head heaters
(*k*) Propeller feathering motors.
(*l*) Oil dilution valve solenoids valve
(*m*) Oil contents gauge
(*n*) Stewart-Warner heating system (except on Mark IV)
(*o*) Windscreen wipers (Mark IV only).

92. **Auxiliary power unit**

(i) To start:—(*Early aircraft*)

(*a*) Turn drum anti-clockwise to wind on the cord.

(*b*) To prime, press magneto cut-out button and pull engine over several revolutions.

(*c*) Release cut-out button and pull over smartly.

(*d*) Warm up until running smoothly (no gauges are fitted) before switching generators on.

(ii) To start:—(*Mark IV*)

(*a*) Depress the lever, fitted below the starter drum, and rotate drum anti-clockwise until it engages with engine crankshaft nut.

(*b*) Turn on fuel and with ignition OFF rotate drum several revolutions to prime.

(*c*) Switch ON ignition, pull engine over smartly.

(*d*) Warming up.—When temperature is below 70° F. the engine will run at about 1,800 r.p.m. after starting. The engine speed will gradually increase to about 2,400 r.p.m. and when it has reached this speed generator load may be applied. Normal oil inlet temperature is 140° F, it should not be permitted to reach 190° F.

NOTE.—If an oil heater is fitted do not use this before starting, switch on as soon as A.P.U. starts.

Mk. I, IB & II (iii) On Mark I, IB and II aircraft this engine can be clutched to drive the bilge pump.

93. **Bilge and refuelling pumps**

Mk. IV (i) On Mark IV aircraft the bilge and refuelling pumps are driven by a vapour proof ½-H.P. electric motor. A vapour proof switch for the motor as well as a clutch lever to engage either pump are fitted. When the lever is pulled out and to the left the refuelling pump is on. Lever central both pumps are off. Lever out and to right bilge pump on. A non-collapsible one-inch rubber-lined hose, long enough to reach all water-tight compartments, is stowed with the unit together with the fuel pipes. For use, for either fuel transfer or pumping bilges, the pump unit is placed on the platform on the top auxiliary tank.

Mk. I, IB & II (ii) On Mark I, IB and II aircraft the bilge pump is driven by the A.P.U., the refuelling pump being independent (*see* paras. 1 (ii) and 5.

PART VI

ILLUSTRATIONS

FIG 1

A GYRO PILOT OIL VALVE
B VACUUM PUMP SELECTOR VALVE
C BLIND LANDING INDICATOR
D AIR SPEED INDICATOR
E ALTIMETER
F STEERING INDICATOR
G TURN AND BANK INDICATOR
H DIRECTIONAL GYRO
J CLOCK
K RATE OF CLIMB INDICATOR
L GYRO HORIZON INDICATOR
M AILERON TAB CONTROL
N TACHOMETER
P DIRECTIONAL GYRO CONTROL UNIT.
Q SYNCHRONIZER
R BANK AND CLIMB CONTROL UNIT.
S MANIFOLD PRESSURE GAUGE
T GYRO PILOT SUCTION GAUGE
U GYRO OIL PRESSURE GAUGE
V DE-ICER PRESSURE GAUGE
W FLOAT WARNING LIGHT.

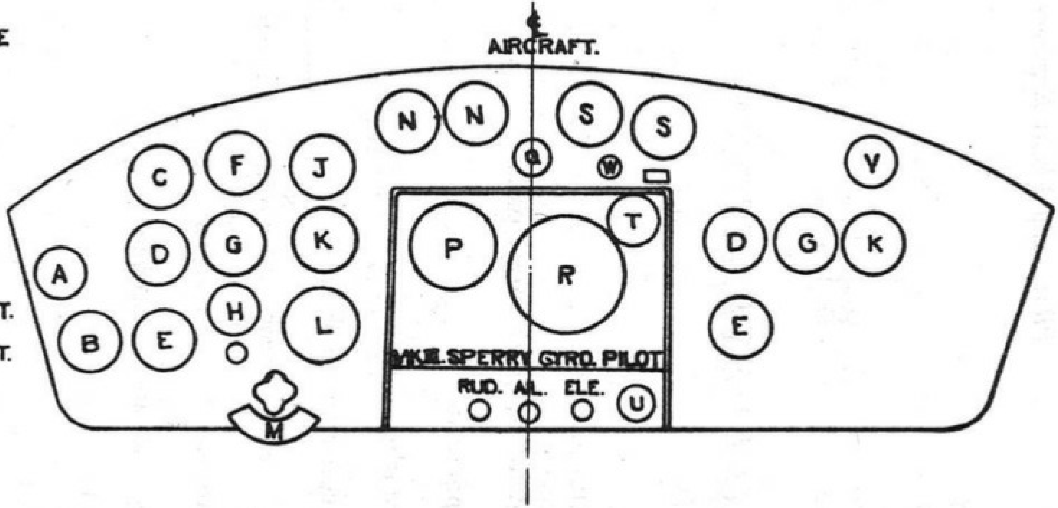


FIG 1

PILOTS INSTRUMENT PANEL

(CATALINA IB & IV ONLY)

KEY TO *Fig. 2*

PILOT'S CONTROLS AND INSTRUMENT PANEL

1. Ventilator controls.
2. Vacuum changeover cock.
3. Automatic controls—oil valve.
4. Engine revolution indicators.
5. Engine synchroscope.
6. Float warning light.
7. Windscreen de-icing pump and cock.
8. Pilot to flight engineer signalling switch box.
9. Propeller de-icing flow control.
10. Navigation light switch.
11. Morsing key.
12. Signalling selector switches unit.
13. Master ignition switch.
14. Engine ignition switches.
15. Aileron tab control.
16. Bomb release firing button.

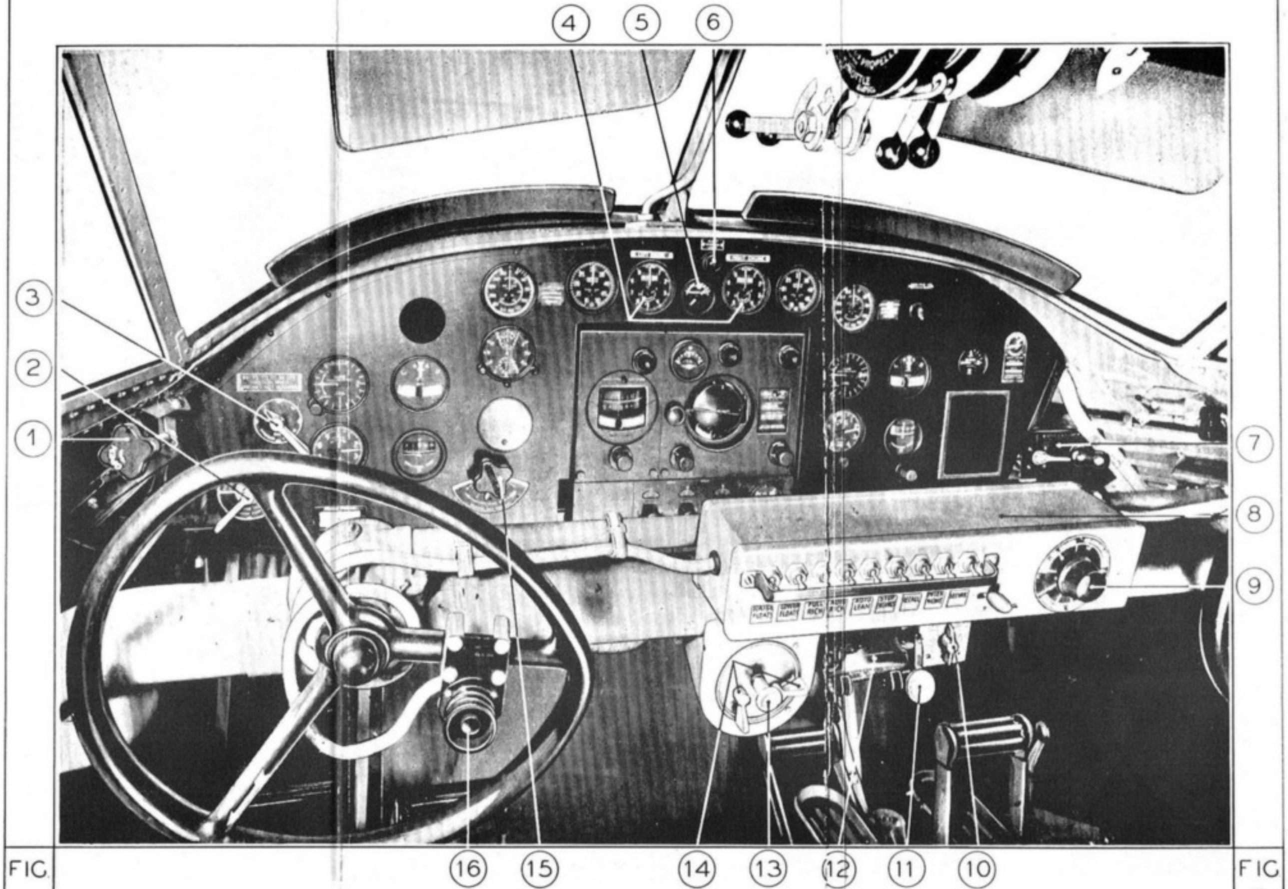


FIG. 2 PILOT'S CONTROLS & INSTRUMENT PANEL FIG. 2

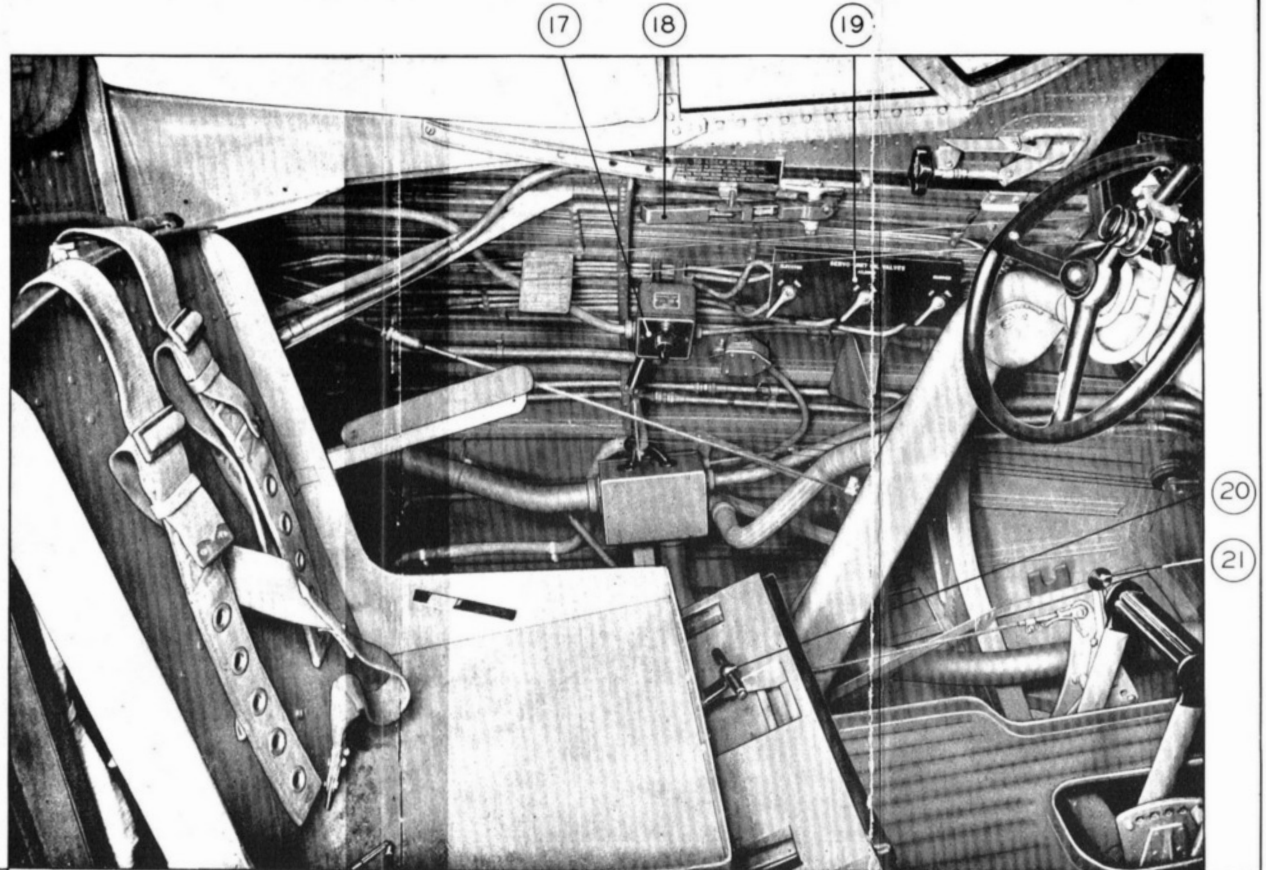


FIG. 3

COCKPIT-PORT SIDE

FIG. 3

KEY TO *Fig. 3*

COCKPIT—PORT SIDE

17. Pilot's intercommunication box.
18. Rudder control locking lever.
19. Servo-unit oil valves.
20. Pilot's seat lock control.
21. Rudder pedal adjustment control.

KEY TO *Fig. 4*

COCKPIT—
STARBOARD SIDE

1. Ventilator control.
22. IFF destruction switches.
23. Second pilot's intercommunication box.
24. Second pilot's seat lock control.

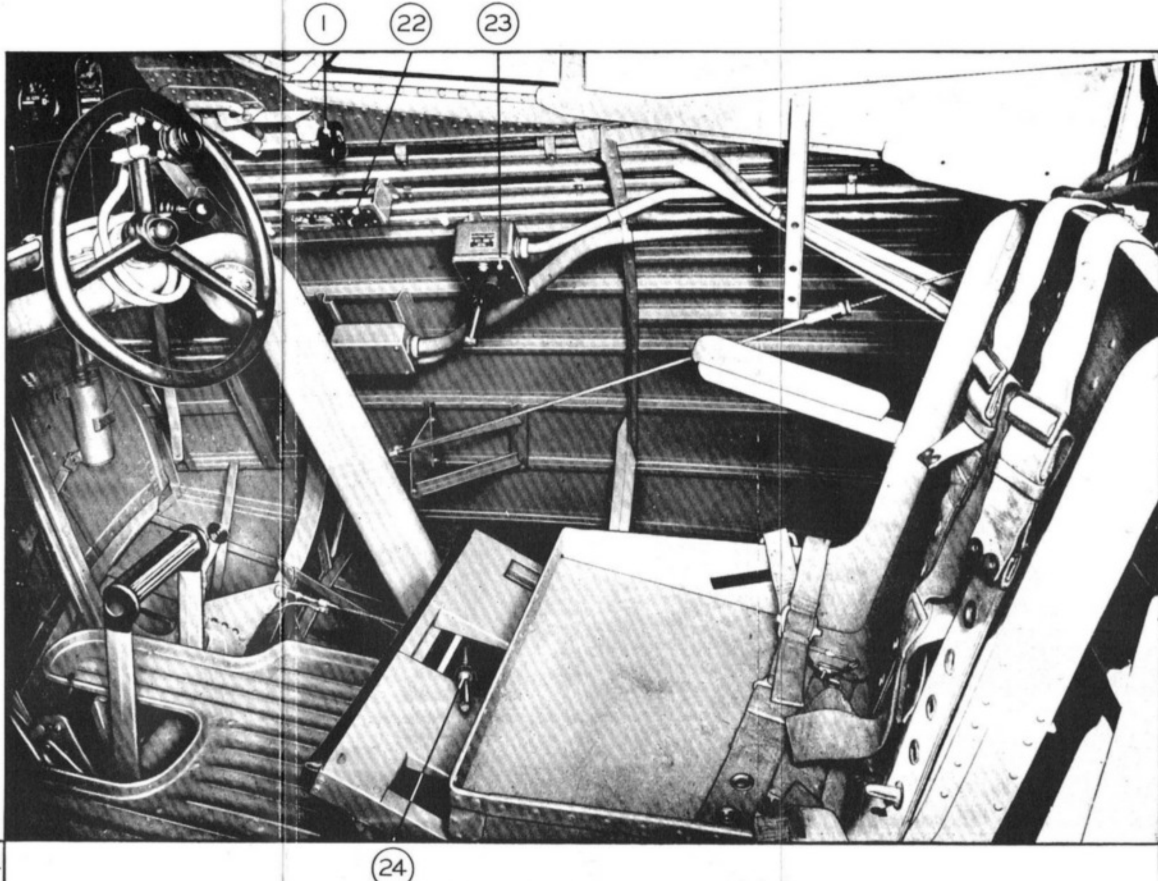


FIG. 4 COCKPIT-STARBOARD SIDE FIG. 4

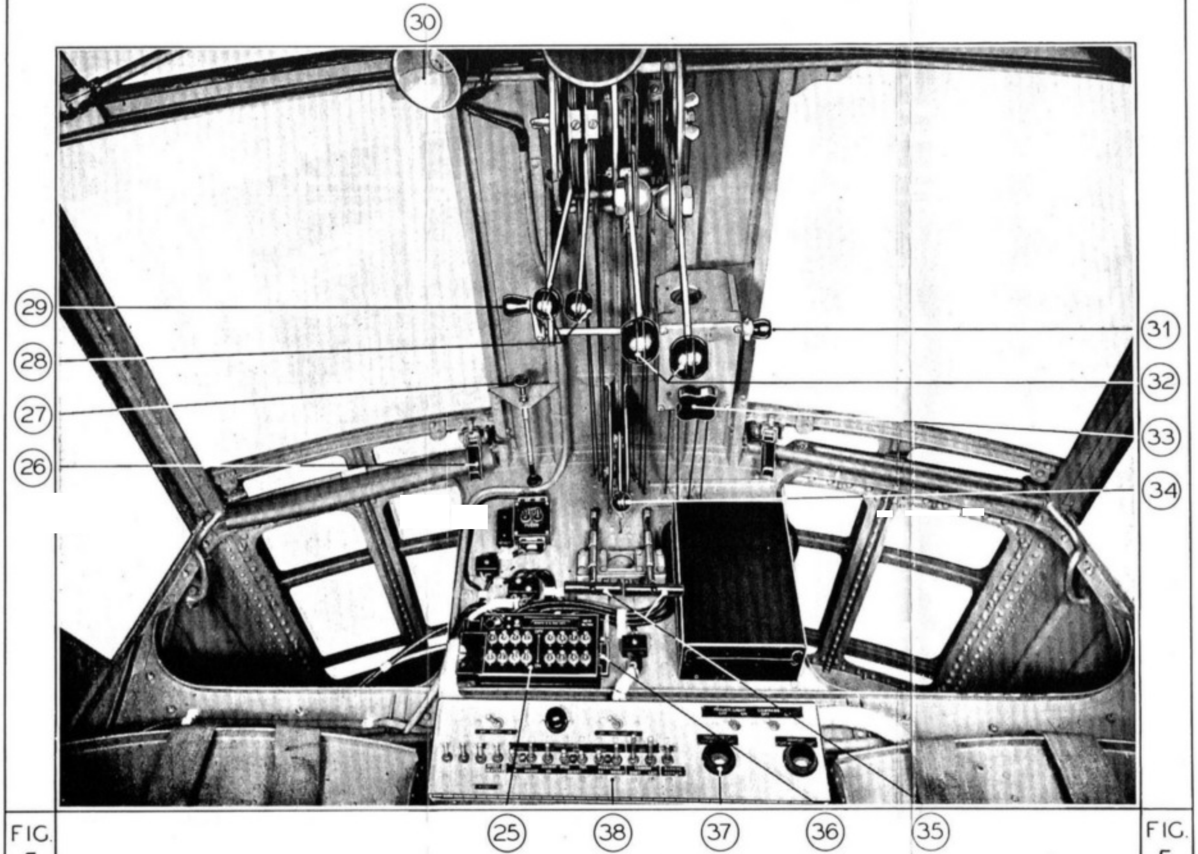


FIG. 5

PILOTS COCKPIT ROOF—LOOKING AFT

FIG. 5

KEY TO *Figs. 5 and 6*

PILOT'S COCKPIT ROOF—LOOKING AFT

25. Bomb selector switch panel.
26. Sliding hatch latch catch.
27. Wing de-icing control.
28. Propeller speed control levers.
29. Elevator trim control crank.
30. Cockpit light projector.
31 Elevator trim control crank.
32. Throttle levers.
33. Rudder trim control.
34. Gyro-pilot engaging lever.
35. Flare release control.
36. Bomb jettison switch cover flap.
37. Projector switch.
38. Pilot's electrical service switch panel.
39. Engine fire-extinguisher controls.
40. Engine revolution and boost indicators.
41. Fuel balance cock.
42. Float operating lever.
43. Main fuel tank cocks.
44. Fuel system diagram.
45. Fuel hand-pumps.
46. Fuel flowmeters.
47. Fuel contents gauges.
48. Contents gauge correction chart.
49. Mixture levers.
50. Pilot to flight engineer signalling switch box.
51. Carburettor air intake controls.
52 Oil tank contents indicator.
53. Oil temperature, pressure and fuel pressure gauges.
54. Engine cowling gilis controls.
55. Float operating crank sockets.

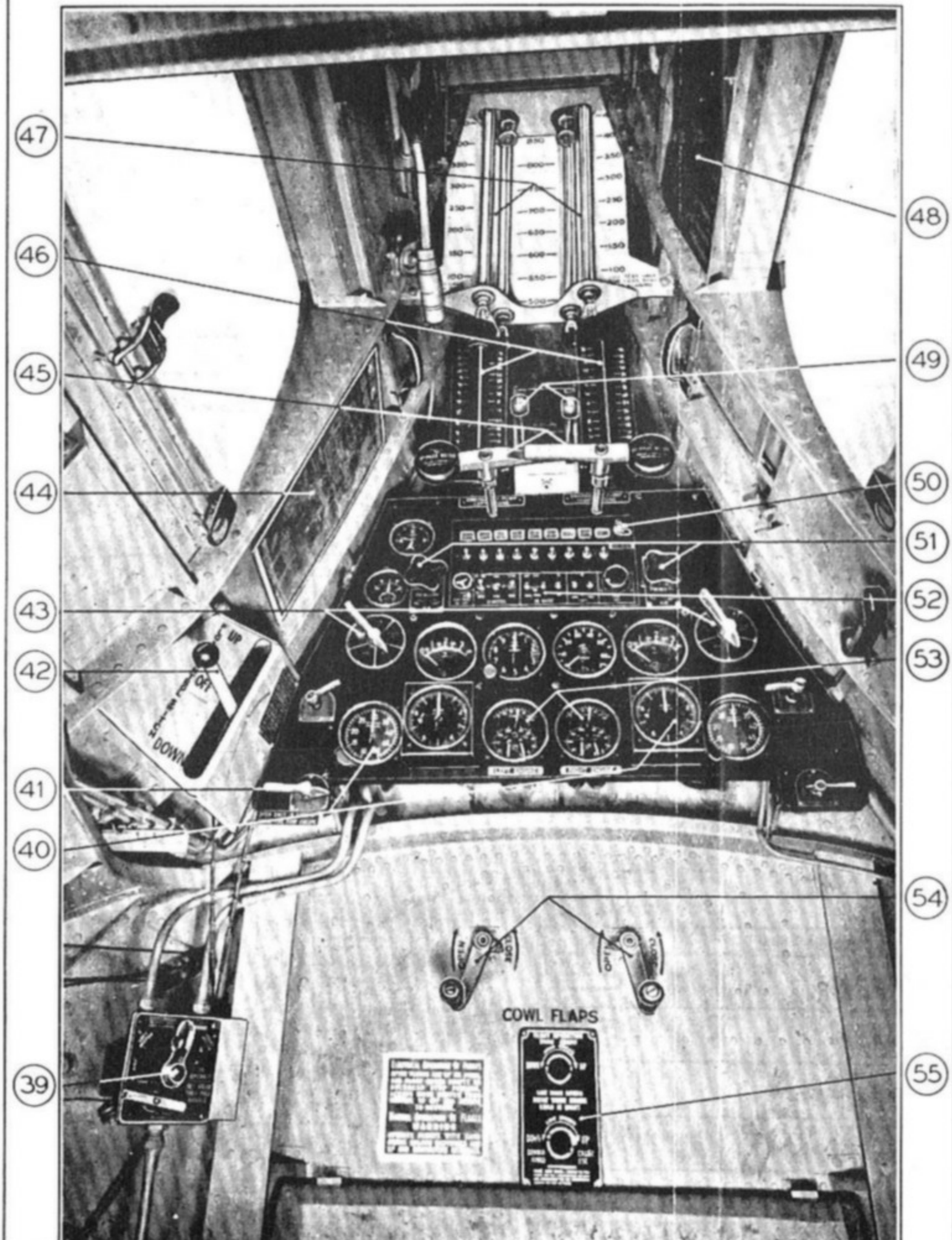


FIG. 6 FLIGHT ENGINEER'S CONTROLS & INSTRUMENT PANEL FIG. 6

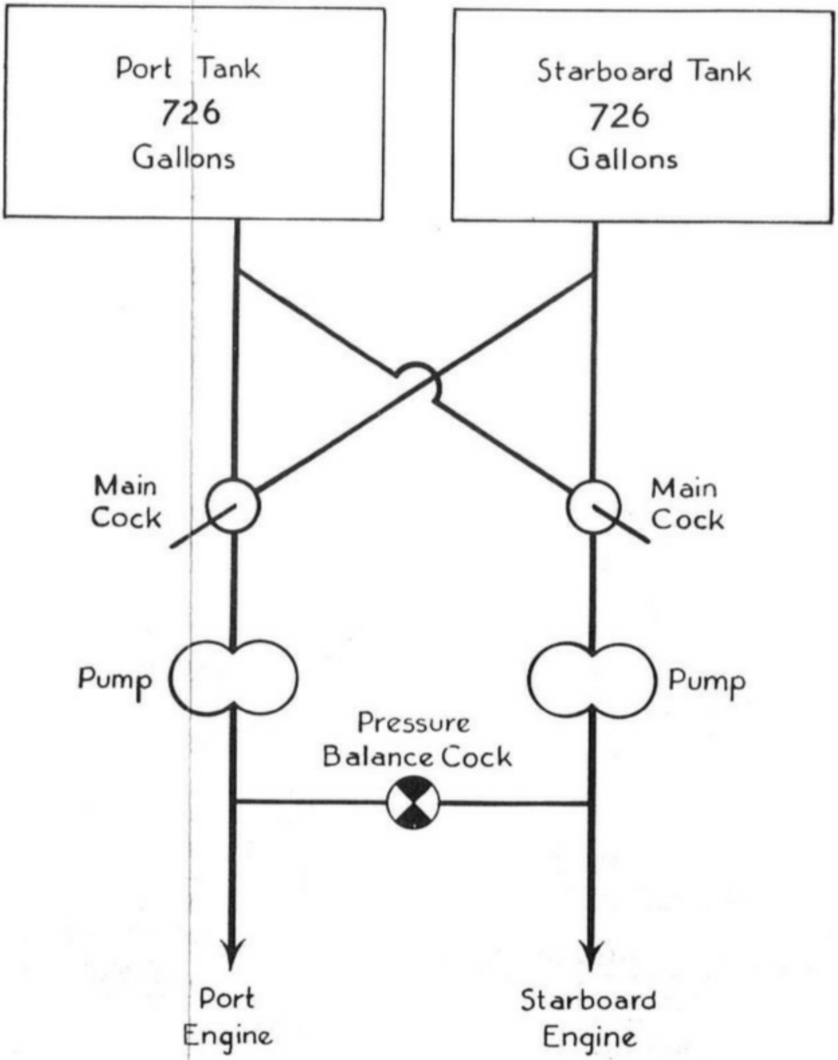
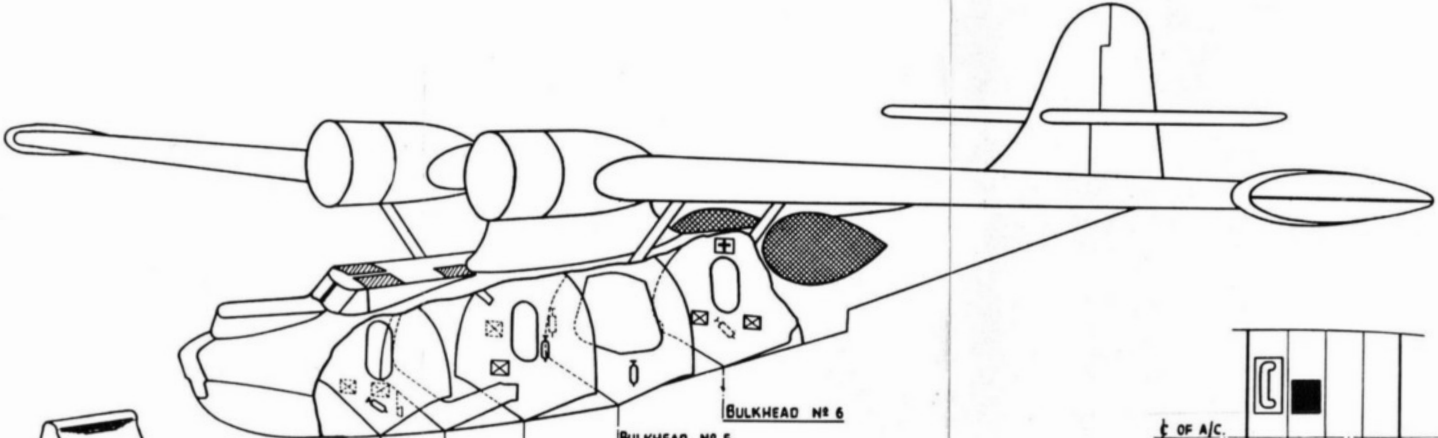
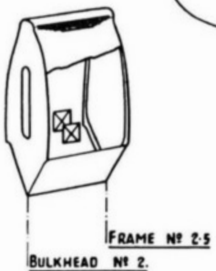


FIG. 7 FUEL SYSTEM-SIMPLIFIED DIAGRAM FIG. 7.

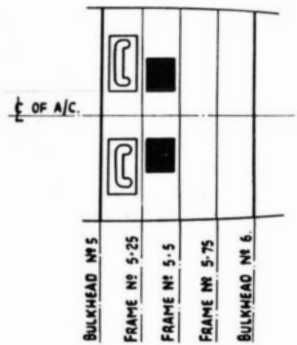




LOCATION OF PARACHUTES IN GANGWAY.
SCRAP VIEW.

NOTE:- PARTS SHOWN DOTTED ARE ON AFT SIDE OF BULKHEAD.

ITEM.	KEY	ITEM.	KEY
PARACHUTE EXITS.	(stippled leaf shape)	FIRE EXTINGUISHERS.	(extinguisher symbol)
CRASH EXITS. USE ON THE WATER, WITH ENGINES STOPPED, ONLY.	(hatched square)	PARACHUTES.	(crossed square)
		FIRST AID KIT.	(square with cross)
DINGHIES.	(dinghy symbol)	EMERGENCY. PACKS.	(solid black square)
		AXE.	(axe symbol)



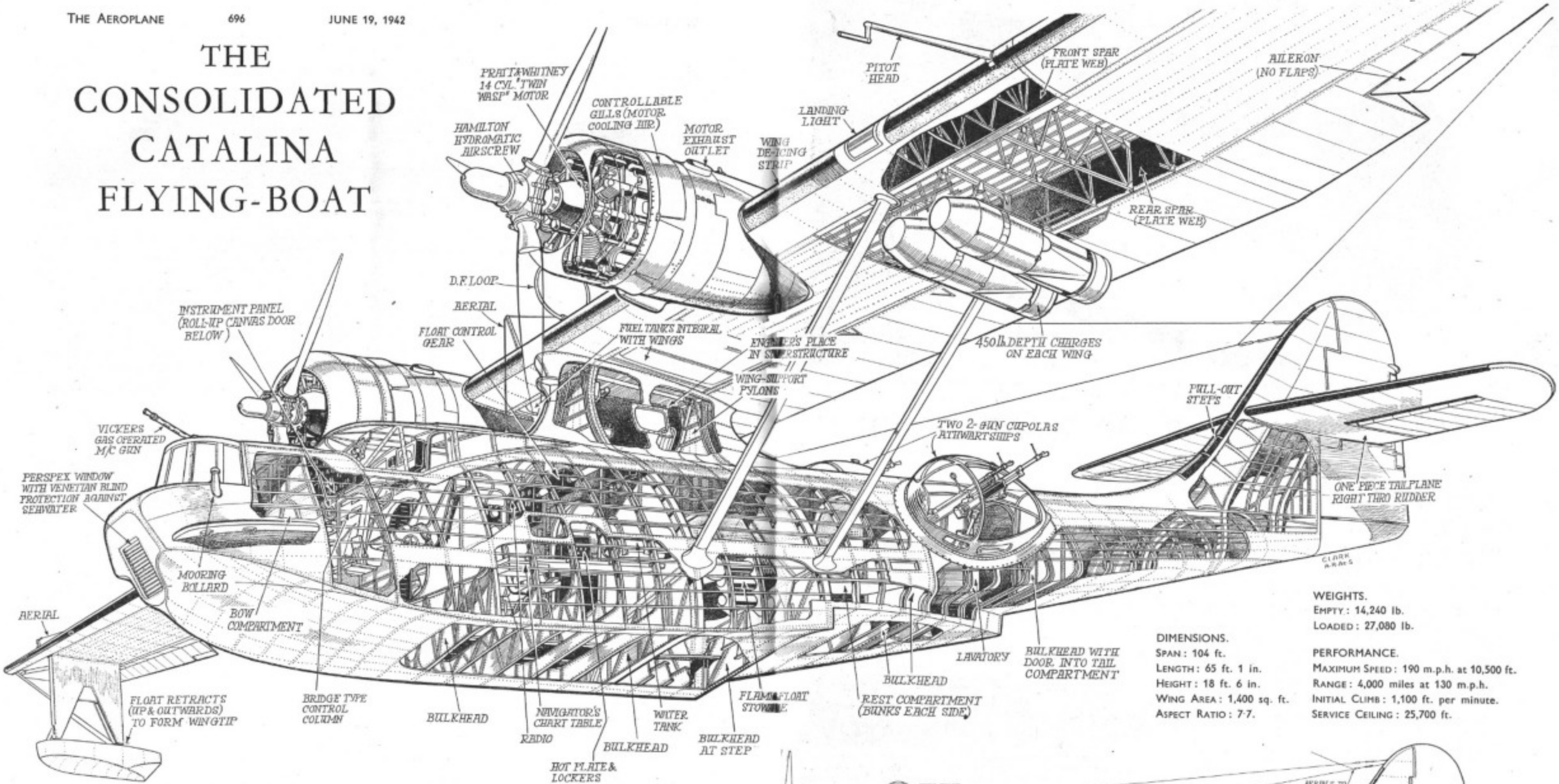
LOCATION OF DINGHIES & EMERGENCY PACKS.
SCRAP PLAN VIEW.

FIG. 8

EMERGENCY EXITS & EQUIPMENT.

FIG. 8

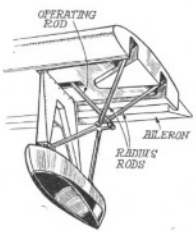
THE CONSOLIDATED CATALINA FLYING-BOAT

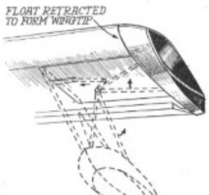


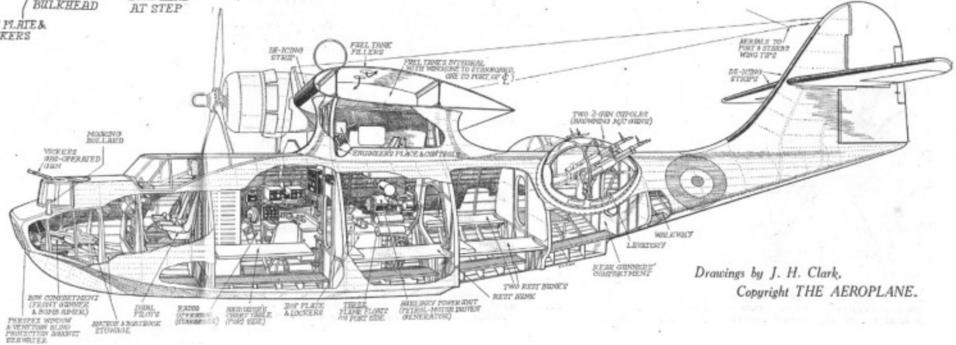
DIMENSIONS.
Span: 104 ft.
Length: 65 ft. 1 in.
Height: 18 ft. 6 in.
Wing Area: 1,400 sq. ft.
Aspect Ratio: 7·7.

WEIGHTS.
Empty: 14,240 lb.
Loaded: 27,080 lb.

PERFORMANCE.
Maximum Speed: 190 m.p.h. at 10,500 ft.
Range: 4,000 miles at 130 m.p.h.
Initial Climb: 1,100 ft. per minute.
Service Ceiling: 25,700 ft.



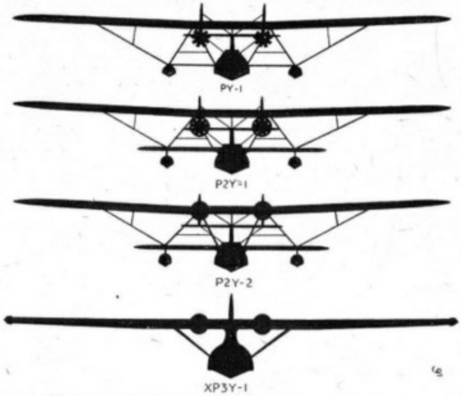




Drawings by J. H. Clark,

The Consolidated Catalina

THE comparatively small but nevertheless important part an R.A.F. Catalina played in the tracking down and destruction of the *Bismarck* has directed attention away from the magnificent work that this type and its long line of distinguished American forebears have accomplished in the taming of oceans and the development of oversea navigation and transport.



THE CATALINA'S FORBEARS:—Stages in the development of a famous flying boat described in the accompanying article.

In December, 1928, the Consolidated Aircraft Corpn., of San Diego, Cal., delivered an experimental twin-engined flying-boat to the U.S. Navy. This boat, known as the PY–1, passed all tests to win a small contract open to the American Industry for a naval patrol flying-boat.

The PY–1 was a high-wing monoplane, the well-triangulated bracing of which supported the two 425 h.p. Pratt & Whitney Wasp engines and the fixed stabilising floats. The braced tailplane had twin fins and rudders. The semi-circular hull with forward transverse and after vertical steps was basically similar to that of the present-day Catalina.

The PY–1 was designed so that with slight modifications it could be produced as a 30-passenger civil flying-boat with two 550 h.p. Pratt & Whitney Hornet engines, and fourteen of this type, named the "Commodore," were ordered by the New York, Rio and Buenos Aires Airline, Inc. (NYRBA) to operate between Miami and Buenos Aires. Before all these boats could be delivered the NYRBA line was absorbed by Pan American Airways and several "Commodores" after long service in South America are still being used by Pan American on short-haul routes in the Caribbean.

In 1932 the P2Y–1 appeared and was ordered in a small quantity by the U.S. Navy. This differed from the PY–1 in having two small lower wings to make the type a sesquiplane instead of a high-wing braced monoplane. It was fitted with two 575 h.p. Hornet engines and had enclosed accommodation for the crew. In September, 1933, six P2Y–1's flew from Norfolk, Va., to Coco Solo, C.Z., a distance of 2,039 miles, in 25 hours non-stop to exceed by 86 miles the then World's Seaplane Record for Distance covered in a straight line.

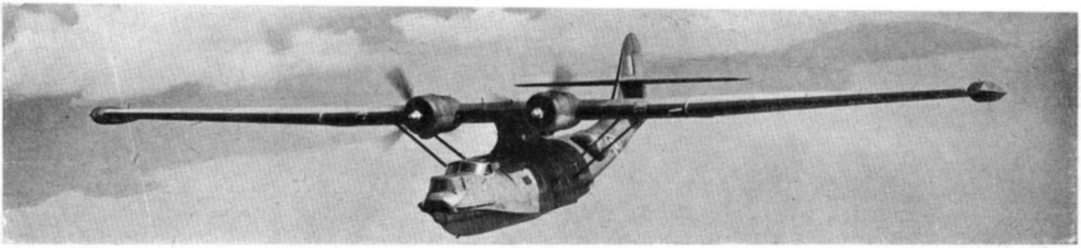
The P2Y–1 was followed by the P2Y–2 and P2Y–3, both of which had 700 h.p. Wright Cyclone engines in nacelles on the leading-edge of the centre-section. In January, 1934, six P2Y–2's flying in formation made the first non-stop trans-Pacific flight from San Francisco to Honolulu, now very much of a routine accomplishment but at that time a fine performance. Several of the P2Y Series are still in use as advanced trainers in the U.S. Navy to-day. Six P2Y–3A's were supplied to the Argentine Navy in 1934.

In 1935 a further development, the XP3Y–1, was ordered by the U.S. Navy. This model had all the characteristics of the present-day Catalina, with the centre-section supported by a faired-in structure, engines in the leading-edge of the centre-section, single fin and rudder and retractable wing-tip floats. Its performance was such that the U.S. Navy broadened its specification from that of a Patrol to a Patrol-Bomber flying-boat by stipulating a bomb load of 2,000 lb., and thus was evolved the PBY Series.

The prototype XPBY–1 was tested in the Spring of 1935 and after completing all its tests flew non-stop from Norfolk, Va., to San Diego, Cal., via Coco Solo, a distance of 3,443 miles, to set up a new International Distance Record. Contracts were placed in the two following years for a total of 176 PBY's—60 PBY–1, 50 PBY–2 and 66 PBY–3—by the U.S. Navy. Almost as quickly as they were delivered these boats established new massed flight records, most of them flying direct from the manufacturers to their naval bases at Hawaii (2,553 miles) or Coco Solo (3,087 miles) in groups of from 12 to 48, these delivery flights alone representing an aggregate of 422,300 miles.

There have been only three unarmed civil examples of the PBY, known as the Model 28, but two of these boats made names for themselves in the field of exploration

The Consolidated Catalina III Amphibian. This view shows the retractable wing-tip floats in the lowered position.



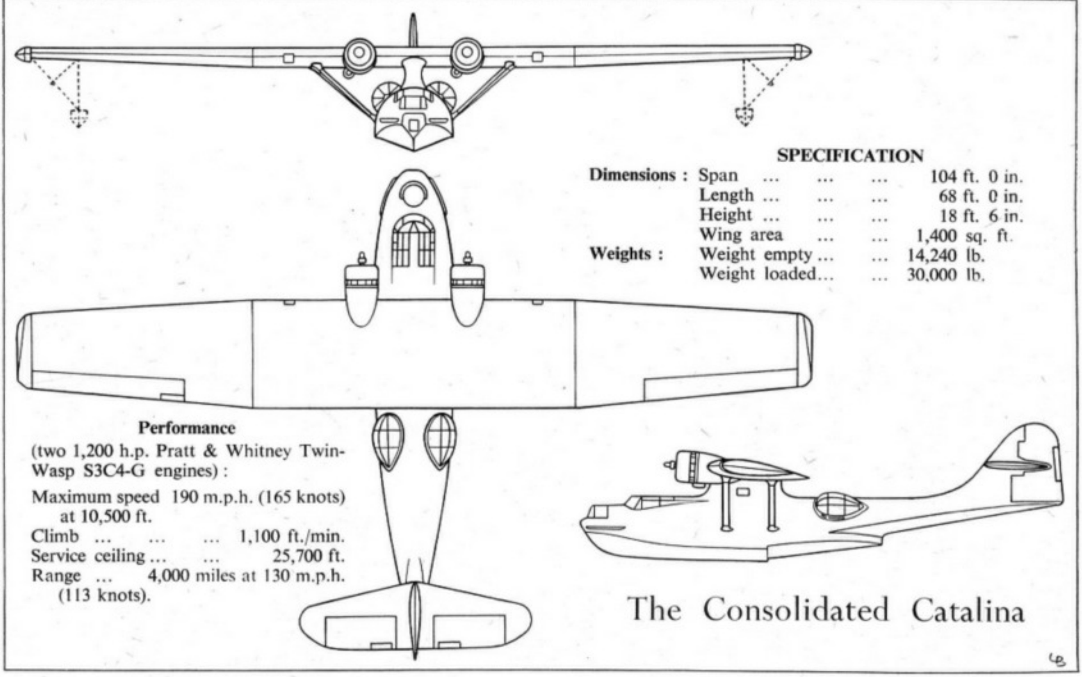
The Consolidated Catalina I long-range reconnaissance flying boat.

and survey. One, belonging to Mr. Richard Archbold of the American Museum of Natural History and named "Guba," flew round the World at its greatest diameter in the course of getting to and from Dutch New Guinea. It flew across the Pacific to New Guinea where, for nearly a year, it served the Archbold Scientific Expedition as a general transport. It returned to the United States via Australia, the Indian Ocean, Central Africa and the Atlantic. The "Guba" was sold to the British Government after the outbreak of war and has been in service with British Airways. The second Model 28 was used by American Export Airlines for trans-Atlantic survey. The third was bought by the British Government in July, 1939, for service experiment and test.

In 1938 the next development in the PBY Series—the PBY–4—appeared. Longer and heavier than the three earlier models, the PBY–4 was fitted with two 1,200 h.p. Twin-Wasp engines and was the first model to have the big gun blisters aft of the wings. This was followed in 1939–40 by the identical PBY–5. It was this model which, as the result of satisfactory tests with the unarmed Model 28 mentioned above, was adopted by the R.A.F., named the Catalina and ordered in large quantities. Maintaining the family reputation, all the R.A.F. Catalinas have been delivered by air across the Atlantic. In 1941 the U.S. Navy adopted a naming scheme for its operational aircraft and the PBY Series was given the American type name of Catalina.

In 1938 an amphibian version of the Model 28 was developed and in 1940 this type was adopted by the U.S. Navy as the PBY–5A for northern operation where bays and lakes are often frozen. It is used also by the U.S. Army under the designation OA–10. The landing-gear is of the tricycle type with the main wheels retracting into wells in the sides of the hull and the nose wheel into a compartment in the bow. The amphibian is now being built in Canada by Canadian Vickers, Ltd., and Boeing Aircraft of Canada, Ltd. It is known in Canada as the Canso and in the R.A.F. as the Catalina III.

For many years the PBY or Catalina has formed the backbone of the Patrol Wing organisation of the U.S. Navy and it is now in widespread use by the R.A.F., the Royal Australian Air Force and the Royal Canadian Air Force. It is in service over virtually all the oceans and seas of the World and is piling up an incredible record of mileage flown on United Nations' business.



SPECIFICATION

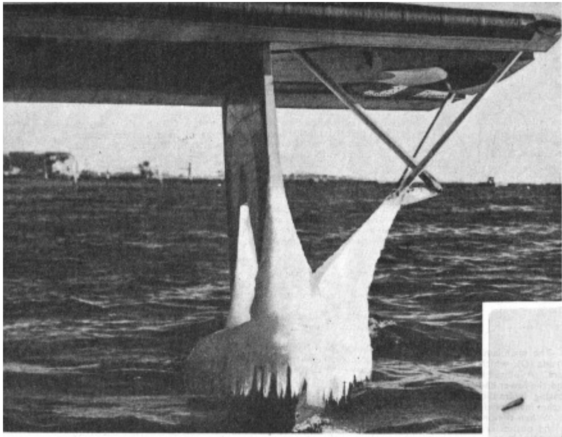
Dimensions :	Span	104 ft. 0 in.
	Length	68 ft. 0 in.
	Height	18 ft. 6 in.
	Wing area	1,400 sq. ft.
Weights :	Weight empty	14,240 lb.
	Weight loaded... ...	30,000 lb.

Performance

(two 1,200 h.p. Pratt & Whitney Twin-Wasp S3C4-G engines) :

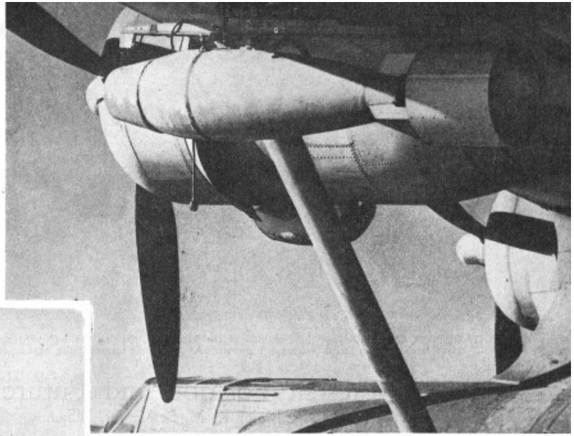
Maximum speed 190 m.p.h. (165 knots) at 10,500 ft.
Climb ... ... 1,100 ft./min.
Service ceiling ... ... 25,700 ft.
Range ... 4,000 miles at 130 m.p.h. (113 knots).

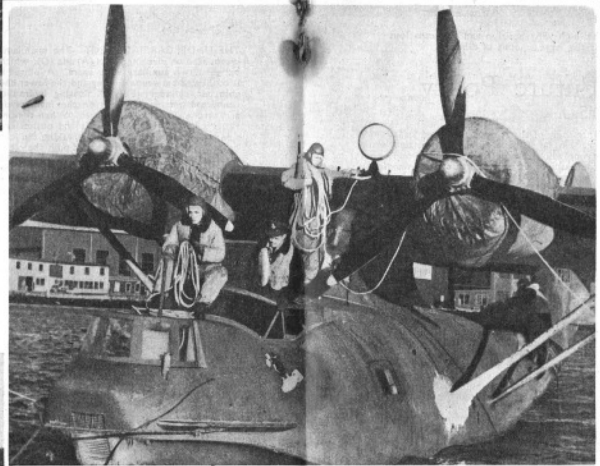
The Consolidated Catalina



ATLANTIC COASTAL COMMAND

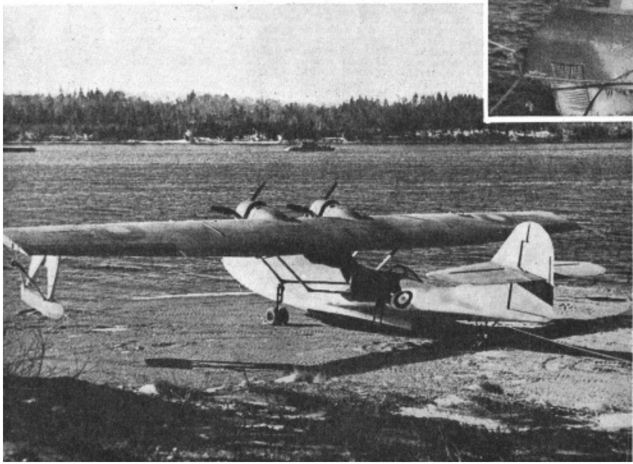
Sea Patrol off the Coast of Canada

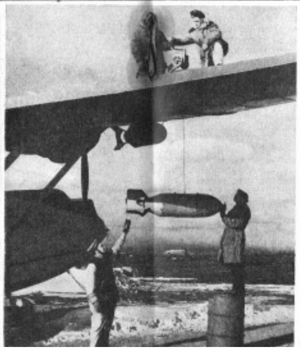




Operating from the East Coast of Canada, Bomber Reconnaissance Squadrons of the Atlantic Coastal Command of the Royal Air Force make offensive patrols in search of enemy submarines and surface raiders. Above, ice on the wing-tip float of a Consolidated Catalina at anchor gives an indication of the weather against which the patrols have to contend. The de-icers on the leading edge of the wing are worthy of note. Below, a Catalina beached at a seaplane base.

Above, a British-type bomb with armour-piercing nose, attached to the wing of a Catalina outboard of the port Pratt and Whitney Double Wasp motor. Left, a Catalina, with its motors covered for protection against weather and spray, is moored to a buoy. Below, an air gunner in the starboard side blister of a Catalina adjusts his twin Browning .303 machine-guns. Below, left, 500 lb. bombs are hoisted into position under the wings. Notice the difference between the fins on these bombs and that in the picture above.





The top picture shows a Catalina fitted with wing-tip floats, which made such a good impression on the U.S. Navy. In the middle is one of the earliest of the PY series of flying-boats, the P2Y-3 with a parasol wing. At the bottom a Catalina moored in the shadow of the "Rock" being fuelled and prepared for a Mediterranean patrol.

The Catalina

by David Vine

LIKE all successful aircraft, the Catalina flying-boat is the result of gradual modification and development from an original basic design. It began fifteen years ago with the first flying-boat of the series, known as the PYI. This boat began a long succession of sucessful naval flying-boats, culminating in what is probably the most remarkable of them all, the Catalina. No other aeroplane has a better claim to be classed as one of the outstanding operational aircraft of this war than the flying-boat which shadowed the *Bismarck* and indirectly brought about its destruction. The work of the "Cat" in anti-submarine patrol and convoy defence is outstanding. It has also the greatest mileage of any operational type still in regular use. The full story of the famous Catalina, when told, will make fascinating reading.

Development

The Catalina in many ways resembles the first of the series, the PYI of 1928. It has the same parasol high monoplane wing of thick section and wide chord, and twin radial engines. The hull with its two steps has always had excellent hydrodynamic qualities. For a flying-boat must not only be easy to fly, but it must be without vices on the water, especially on choppy surfaces. Floats were fitted to all the earlier types, but fixed by complicated triangular bracings to the hull and wings. For extra lift, two intermediate types in the series, the P2Y 1 and 2, were fitted with a small wing about a third of the main wing span. This wing was attached to the hull between the wing and the fixed floats. So for a short time the PY series became a sesquiplane. This was in 1932, and was the first radical modification to the PYI. In 1933 a formation of these flying-boats made a non-stop flight of 2,040 miles in 25 hours, a remarkable performance for ten years ago. This set up a new record for seaplanes. The small wings, however, did not stay long.

But it was not until 1935 that the PY series really began to look like the Catalina of to-day. The earlier twin fins and rudders were now replaced by a single fin and rudder. The wing was supported by the faired-in structure which now houses the flight engineer. The present wing-tip floats were also fitted to this 1935 model, called the XP3Y-1. This new series made such remarkable long-distance flights that the U.S. Navy ordered a further batch with a wider specification, chiefly with a greater range and a war load of 2,000 lb.

THE CONSOLIDATED CATALINA

Power plant: Two 1,200-h.p. Pratt & Whitney "Twin-Wasp" R-1830-S3C4-G radial air-cooled engines driving Curtiss electrically-operated constant-speed reversible-pitch airscrews.

Dimensions: Span 104ft., length 65ft. 1in., height 18ft. 6ins.

Weights and Loadings: Weight empty 17,561 lbs., weight loaded 26,651 lbs., wing loading 19.11 lbs./sq.ft., power loading 12.7 lbs./h.p.

Performance: Max. speed at 10,500 ft., 190 m.p.h.; stalling speed at sea-level, 70 m.p.h. Climb to 5,000 ft., 4.5 mins.; climb to 15,000 ft., 16 mins. Service ceiling 21,900 ft. Max. range (1,750 U.S. gallons of fuel) at critical altitude 4,000 miles.

Figures from *Jane's All the World's Aircraft*, 1942.

Thus began the famous series known as the PBY series. A formation of XPBYI flying-boats of 1935 flew, non-stop, a distance of 3,443 miles, setting up a new seaplane record as well as an international distance record for all types.

Civil Version

A civil version of the PBY series, called the Guba, acted as aerial transport for the Archbold Scientific Expedition to New Guinea. After a year of survey and oceanographic work the Guba flew back to the U.S.A. via Australia, India, Africa and the South Atlantic. A glance at an Atlas will show the magnitude of this flight. The 1938 XPBY 3 and 4 flying-boats had the new 1,200 Pratt & Whitney twin-row Wasp engines and the familiar gun-blisters. In the film "Wings over the Navy" XPBY boats were used almost exclusively. Then, as a result of the British Government purchase and tests of an earlier PBY boat, the same model as the Guba, the Model 28, an order was placed in 1939 for a large number of XPBY5s for the R.A.F. This boat was later called the "Catalina," or just the "Cat." Later, the U.S. Navy also called their XPBY5s Catalinas.

Accommodation

Constructionally, the "Cat" is interesting. The long, graceful, tapering hull weds exceptional hydrodynamic with aerodynamic qualities, as can be expected from such a gradual evolution. Forward of the gun compartment, where the blisters are, is a rest-room fitted with two bunks. The 4,000-miles range of the Catalina makes these bunks essential. Forward of the rest-room is the cook's galley. Here also is a rest-bunk fitted on the port side. On the starboard side is an electric hot-plate for cooking and lockers for food and crockery. Immediately above the galley is the flight-engineer's compartment, which is inside the faired wing-support pylon. Above this compartment, in the long, wide-chord, high-lift wing of 104 feet span, are the petrol tanks, which give the Catalina its extreme range. These tanks form part of the inner cellular structure of the wing, and are called integral tanks. They are situated between the engines in the wide untapered centre section. Just ahead of the galley, and separated, as are all the other compartments, by a bulkhead, is the navigator's compartment. A large navigator's chart table is fitted, with plenty of elbow room, a necessary item on long ocean flights, which are very trying if the navigator is cramped for table space. Ahead, and a little below the cockpit, and separated from it by a roll-up canvas door, is the front-gunner/bomb-aimer's compartment. Here all the sea gear is stowed away as neatly as on a private yacht. There is also a bomb-aimer's window, shuttered to prevent damage by salt-water.

An even later version of the series is the amphibian Catalina, with a nose-wheel and main landing-wheels retracting into the hull. So now the series is fifteen years old, with almost unbelievably vast mileages to its credit, and a reputation unsurpassed on every ocean from the Arctic to the Antarctic. The debt we in Britain owe to the "Cat" will never be fully realised, but it is so vast we should never forget it.