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AIR PUBLICATION 2023C

Pilot's Notes

PILOT'S NOTES
THE BOSTON IIIA AEROPLANE
TWO CYCLONE GR-2600-A5B-O ENGINES

AIR MINISTRY

BAC/12.41/DAC

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Incorporation of an amendment list in this publication should be certified by inserting the amendment list number, initialling in the appropriate column and inserting the date of incorporation.

Holders of the Pilot's Notes will receive only those amendment lists applicable to the preliminary matter, introduction and Section 1 and 2.

Amendt. List No.	1	2	3	4	5	6	7	8	9	10
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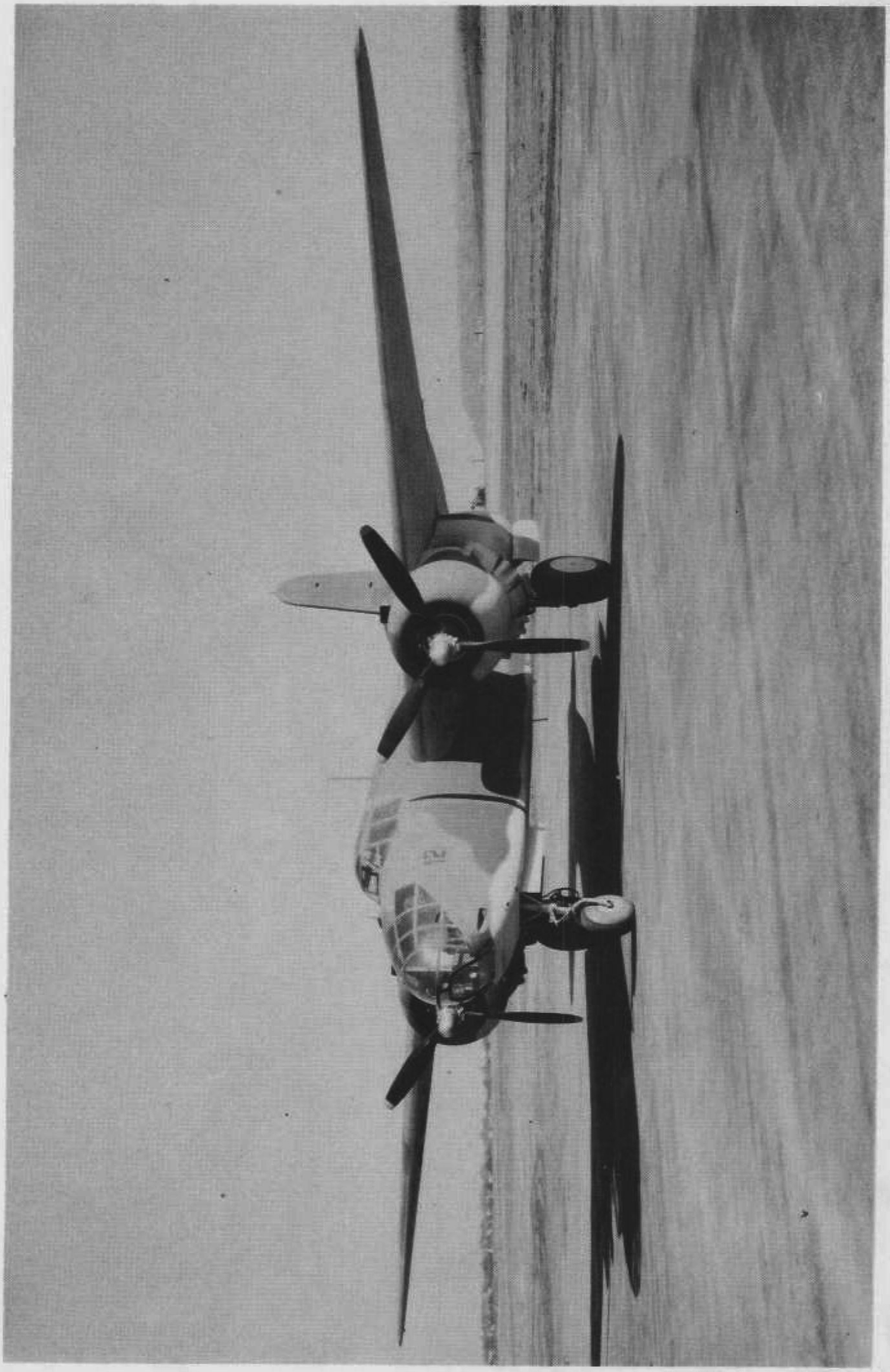


LIST OF SECTIONS

(A detailed List of Contents is given at the beginning of each Section.)

I N T R O D U C T I O N

1. The A-20C is a twin engined, midwing monoplane incorporating tricycle landing gear. It is powered with two Cyclone GR-2600-A5B-0 engines equipped with 3 bladed Hamilton Standard Hydromatic propellers. The airplane is of all metal construction with an overall span of 61 feet 4 inches, an overall length of 47 feet 4 inches and an overall height at rest of 16 feet 1 1/2 inches. Crew provisions are for a pilot, bomb aimer and two gunners.

2. The fuselage is of semi-monocoque construction and is divided in five compartments as follows: bomb-aimer's compartment, pilot's cockpit, bomb bay, gunners' compartment and the tail compartment. The nose of the airplane is paneled with windows providing full vision for the bomb-aimer. The bomb-aimer's compartment is provided with a door installed in the floor of the compartment for normal entry and exit. The top of the pilot's cockpit is formed by a window paneled enclosure door that is hinged on the right hand side. Entry and exit is made through this enclosure from the left side of the airplane. The bomb bay is divided into a fore and aft section with each section equipped to carry two bombs. The bomb bay is provided with two hydraulically operated bomb doors that extend the full length of the bay and form the lower contour of the fuselage when they are closed. The gunners' compartment is provided with a door in the floor which is used for normal entry and exit and also when operating the lower flexible machine gun. The compartment is also provided with a sliding enclosure formed of transparent panels.

3. The wing is a full cantilever, single spar structure of semi-monocoque construction. The complete wing is made up of four panels; namely, the left hand inboard and outboard panels and the right hand inboard and outboard panels. Each inner wing panel incorporates an engine nacelle and wing flaps. The wing flaps are of the hydraulically operated, trailing edge type with one section installed on each side of the nacelles. Each outer wing panel incorporates an aileron of metal frame fabric covered construction which is statically and dynamically balanced by means of lead weights in the leading edge. Each aileron is provided with a trim tab controllable from the pilot's cockpit.

4. The empennage is made up of a tail plane, elevators, fin and rudder. The fixed tail plane is a full cantilever structure and each side is provided with 10 degree dihedral to raise the tip above the wake of the engine nacelle. The fin is also a full cantilever structure. The elevators and rudder are of metal frame fabric covered construction, and are dynamically balanced. Each elevator and the rudder incorporate trim tabs controllable from the pilot's cockpit.

5. The ailerons, elevators and the rudder are conventionally operated by means of a control column and wheel and rudder pedals in the pilot's cockpit. A set of controls is provided at the forward end of the gunners' compartment for flying the airplane in an emergency.

6. The landing gear is of the hydraulically operated tricycle type incorporating two main units and a nose wheel unit. The main landing gear units retract into the nacelles and are completely enclosed when retracted. Each main wheel is equipped with hydraulically operated disc type brakes. A compressed air system is provided to operate the brakes in the event of hydraulic system failure. Air is supplied from a pressure bottle in the nose wheel well, to an on-off valve in the pilot's compartment and then to the brakes. The nose wheel unit retracts into a well in the fuselage below the pilot's cockpit and is completely enclosed when retracted. The nose wheel unit incorporates a snubber which in normal operation limits the wheel castor to 30 degrees on each side of center. A release is provided to allow 360 degree castor for towing or handling operation.

7. The fuel system incorporates four self-sealing fuel tanks installed in the inner wing panels and main fuel lines which are also of the self-sealing type. One fuel tank is located on each side of the nacelle between the wing leading edge and the main spar. A total fuel load of approximately 332 imperial gallons may be carried. The selector type quantity indicator on the pilot's instrument panel incorporates a warning light which goes on when the selected tank contains less than 10% of its capacity.

8. Each engine is provided with an independent oil system incorporating a self-sealing oil tank located forward of the main spar between the inboard and outboard fuel tanks in each inner wing panel. An oil cooler is provided for each oil system and is installed on the inboard side of each nacelle. Air flow through the radiator of the oil cooler is governed by thermostatically controlled shutters on the cooler and by flaps that are cable operated from the lower cowl flap mechanism. Oil dilution equipment is also provided for cold weather engine starting.

9. A hydraulic system is provided for actuating the landing gear, brakes, wing flaps, bomb doors and engine cowl flaps. A pump mounted on each engine supplies pressure for the hydraulic system through a pressure accumulator. A normal operating pressure of 850 $\pm$ 25 pounds per square inch is maintained in the accumulator by a pressure regulator valve. The accumulator smooths out the fluid surges and provides immediate and sufficient pressure to operate any of the hydraulic units. A manually operated handpump is provided to furnish pressure to the hydraulic system when the engine-driven pumps are inoperative.

10. The armament consists of four Browning .303 caliber fixed guns, twin Browning .303 caliber flexible guns and one Vickers Model K flexible gun. Two fixed guns may be mounted in each of the compartments provided on each side of the fuselage nose. The fixed guns are electrically controlled by the pilot. The twin flexible guns are mounted on a semi-circular track installed around the aft rim of the upper gunner's enclosure. The Vickers gun is mounted on a pivotable arm that allows the gun to be fired through the door in the floor of the compartment.

11. The bombing equipment incorporates a mounting for a bomb sight and a bomb firing switch in the bomb-aimer's compartment and bomb selector switches, fuzing switches and release switches in the pilot's cockpit. The design useful load provides for carrying two 500-pound bombs or four 250-pound bombs. Four 500-pound bombs may be carried as a maximum overload.

12. The electrical system incorporates a 30 volt, 1500 watt generator driven by the right hand engine. Two storage batteries are provided and are installed on the shelf at the forward end of the bomb bay. The generator circuit includes a voltage regulator, an ammeter, a voltmeter and a control switch located in the gunners' compartment. The electrical system provides for lighting and general services including a retractable landing light in the lower surface of each inner wing panel, formation lights, navigation lights, recognition lights, landing gear and wing flap position indicators, oil dilution system, engine section fire extinguisher system, propeller anti-icer, fixed gun installation, bombing equipment, pitot head heater and camera equipment.

13. Radio equipment includes a transmitter, receiver and power units mounted on two shelves at the aft end of the rear bomb bay. A microphone switch and plug-in is provided at each crew member's station and the pilot and the upper gunner are also provided with telegraph keys. The equipment includes a fixed antenna extending from a mast on the fuselage upper enclosure to the fin and a manually operated trailing antenna in the gunners' compartment. A remote control and a transmitter-interphone control are mounted on the fuselage deck at the forward end of the gunners' compartment.

14. Other equipment includes an F-24 camera installation, heating and ventilating system, oxygen system, reconnaissance flares and emergency equipment.

SECTION I

PILOT'S CONTROLS AND EQUIPMENT

AND

GENERAL EMERGENCY EQUIPMENT AND EXITS

CONTENTS

LIST OF ILLUSTRATIONS

PILOT'S CONTROLS AND EQUIPMENT AND GENERAL EMERGENCY EQUIPMENT AND EXITS

Introduction

1. This airplane is designed to be flown from the pilot's cockpit. However, primary flight and engine controls have been provided in the gunners' compartment and in emergency, the airplane may be flown from this position. The location and operation of the pilot's controls are described in the following paragraphs with the item numbers in parenthesis corresponding to the item numbers noted on Figures I to 4 at the end of this Section.

Fuel and Oil

2. The fuel and oil to be used with the Cyclone GR-2600-A5B-0 engines are as follows:

Fuel - Not less than 90 Octane

Oil - Specification D.T.D. 109

FLIGHT CONTROLS

Control Column and Wheel (16)

3. A control column is provided for operating the elevators with conventional fore and aft movement providing longitudinal control of the airplane. A control wheel for operating the ailerons is mounted at the top of the column. Conventional movement of the wheel provides lateral control of the airplane. The controls can be locked when the airplane is parked.

Rudder Pedals (39)

4. Pedals are provided for operating the rudder with conventional movement of the pedals providing directional control of the airplane. An adjustment lever (40) is incorporated on the inboard side of each pedal whereby the pedal may be set at a position most suitable to the pilot. To adjust a pedal, rotate the adjustment lever downward to disengage the plunger, slide the pedal forward or aft to the desired position and release the lever. Insure that the plunger is again properly engaged. Toe pressure applied at the top of the rudder pedals operates the main wheel brakes. The pedals can be locked when the airplane is parked.

Trim Tab Controls

5. The aileron, elevator and rudder trim tab controls are mounted on a tab control unit installed on the right side of the pilot's cockpit. The aileron tab control (33) is located on the aft end of the control unit and is provided to adjust the lateral trim of the airplane. To correct a low left wing flight condition, rotate the aileron tab control knob clockwise (toward R position) as required. To correct a low right wing flight condition, rotate the aileron tab control knob counter-clockwise (toward L position) as required. The elevator tab control (32) is located on the inboard face of the control unit and is provided to adjust the longitudinal trim of the airplane. To correct a nose-heavy flight condition, rotate the elevator tab control knob clockwise (toward T.H. position) as required. To correct a tail-heavy flight condition, rotate the elevator tab control counter-clockwise (toward N.H. position) as required. The elevator tab control is provided with an adjustable friction brake to prevent creeping. The rudder tab control (31) is located on the upper surface of the control unit and is provided to adjust the directional trim of the airplane. To correct a nose-left yaw condition, rotate the rudder tab control knob clockwise (toward R position) as required. To correct a nose-right yaw condition, rotate the rudder tab control knob counter-clockwise (toward L position) as required. Adjustable friction type brakes are incorporated on the rudder and elevator control knobs and are used to prevent "creeping" of the controls after a tab setting has been made.

Wing Flap Control (56)

6. The wing flaps are actuated by hydraulic pressure. The control is located on the panel at the left side of the pilot's seat. To lower the wing flaps, move the control to DOWN position; when the flaps have moved to the down position as shown by the position indicator on the pilot's instrument panel, return the control to NEUTRAL. To raise the flaps, move the control to the UP position; when the flaps have moved to UP position, return the control to NEUTRAL. When the airplane is standing idle, the wing flap control should be left in the UP position.

NOTE: Do not attempt to lower the wing flaps if the indicated airspeed is greater than 180 m.p.h.

POWER PLANT CONTROLS

Carburetor Air Temperature Controls (4)

7. A carburetor air temperature control is provided for each engine. The controls are located on the forward

end of the fuel valve control panel installed on the left side of the pilot's cockpit. Movement of the controls is forward for COLD and aft for HOT.

Supercharger Controls (5)

8. Each engine incorporates a two-speed supercharger. The supercharger controls are located adjacent to the carburetor air temperature controls on the forward end of the fuel valve control panel installed on the left side of the pilot's cockpit. Forward movement of the supercharger controls to LOW position gives 7.14:1 blower gear ratio. Aft movement of the controls to HIGH position gives 10:1 blower gear ratio. When changing from one blower ratio to the other, the engine should be partly throttled and the supercharger control moved without pausing to avoid rough operation during the clutch engagement. The control must be moved to the extremity of its travel in either gear ratio to prevent clutch slippage and to insure that rated power is always available. Normally the supercharger gear ratios should not be changed at intervals of less than five minutes to provide opportunity for dissipation of heat generated during clutch engagements. During a change in gear ratio, a slight hesitation of the engine may be observed. This is normal for a two-speed engine and has no detrimental effect.

Mixture Controls (9)

9. The carburetor mixture controls are located on the forward engine control unit installed on the left side of the pilot's cockpit. The controls have four settings from the forward to aft position as follows: IDLE CUT-OFF, AUTO. LEAN, AUTO. RICH and EMERGENCY. When the controls are in the IDLE CUT-OFF position, the automatic mixture control units of the carburetors are inoperative and the fuel flow is insufficient to run the engines. This position is used in the engine starting and stopping procedure. The mixture controls should be left in the IDLE CUT-OFF position when engines are not running. When the mixture controls are set in the AUTO. LEAN or AUTO. RICH position, the fuel mixture control unit of each carburetor automatically maintains the correct fuel-air ratio through changes of altitude and temperature. The desired mixture ratio is not disturbed by change of throttle position or propeller pitch. The AUTO. LEAN position should be used only during level cruising conditions at powers at and below maximum cruising power. It should not be used for cruising climb. The AUTO. RICH position is the normal position for all operations including take-offs. The EMERGENCY position provides full rich fuel-air mixture ratio with the automatic mixture control units of the carburetors inoperative. This setting may be used when full rich mixture is required for emergency operation.

Throttle Controls (10)

10. The throttle controls are mounted on the forward engine control unit installed on the left side of the pilot's cockpit. The controls are provided with a friction adjuster (8).

NOTE: If the throttles are closed to less than approximately one-quarter segment with the landing gear not latched in landing position, a warning horn will sound. See paragraphs 40 and 41 of this Section for additional information pertaining to the landing gear warning system.

Propeller Controls (11)

11. The propeller controls are mounted on the forward engine control unit installed on the left side of the pilot's cockpit. Forward movement of the controls toward INCREASE (fine) pitch position increases engine r.p.m. Aft movement toward DECREASE (coarse) pitch position reduces engine r.p.m. The controls are provided with a friction adjuster (7).

Engine Cowl and Oil Cooler Flap Controls

12. The engine cowl flaps are actuated by hydraulic pressure and are controlled by handles located on the panel at the right side of the pilot's seat. The upper cowl flaps for each engine are controlled in unison by a single handle (48) and the lower cowl flaps for each engine are controlled by individual handles (50). The oil cooler flaps are connected by cables to the lower cowl flap mechanism and operate simultaneously with the lower cowl flaps. To open the cowl flaps, move the respective control to OPEN position; when the flaps are open as desired, return the control to NEUTRAL position. To close the cowl flaps, move the control to CLOSED position; when the flaps are closed or partially closed as desired, return the control to NEUTRAL position. To avoid buffeting, the upper cowl flaps should be closed at all times in flight and opened only while the engines are running on the ground.

FUEL SYSTEM CONTROLS

Cross-Feed Controls

13. Two cross-feed controls are located on the fuel valve control panel installed on the left side of the pilot's

cockpit. The ENGINE CROSS-FEED control (2) operates the pressure cross-feed system and the TANK CROSS-FEED (1) operates the suction cross-feed system (see Fig. 5). In normal operation the cross-feed controls are set in the OFF position. For other conditions refer to the following page.

Fuel Tank Selector Controls (3)

14. Two fuel tank selector controls are located on the fuel valve control panel installed on the left side of the pilot's cockpit. In normal operation, each engine has an individual fuel system whereby the left fuel tanks supply the left engine and the right fuel tanks supply the right engine as shown in Fig. 5. However, if the need arises, any tank may be used to supply either or both engines by using the fuel tank selectors in conjunction with the cross-feed controls as noted on the following page. The normal positions of the fuel tank selector controls with the cross-feed controls in OFF position are as follows:

OFF - No fuel is supplied to the engines.

AUX. - No. 1, left-hand outboard tank and No. 2, right-hand outboard tank, supply fuel to the left and right engines respectively. Approximately 53 Imp. gallons are available from each tank when full.

MAIN - No. 3, left-hand inboard tank and No. 4, right-hand inboard tank, supply fuel toethe left and right engines respectively. Approximately 113 Imp. gallons are available from each tank when full.

Wobble Pump Control (41)

15. The wobble pump is a manually operated auxiliary fuel pump. The wobble pump control handle extends up from the floor at the left side of the pilot's control column.

NOTE: Under all conditions when fuel pressure drops, operate the wobble pump immediately and then attempt to determine the cause. If the fuel pressure drops for either the left-hand or right-hand system, operate the wobble pump. If the pressure comes up, failure of the respective engine-driven pump is indicated. In this event, both engines may be supplied fuel through the

operative engine-driven fuel pump. If the pressure fails to come up with the use of the wobble pump, fuel line failure is indicated. This failure necessitates single-engine operation. No attempt should be made to use fuel from a tank in the system wherein the failure occurred.

Primer Pump Control (19)

16. The primer pump is located at the upper end of the fixed gun charging control panel on the right side of the pilot's cockpit.

Fuel Quantity Gauge Selector Switch (86)

17. A Liquidometer fuel quantity gauge with selector switch is mounted on the pilot's instrument panel. The selector switch points are as follows:

No. 1 - Left auxiliary (outboard) tank
No. 2 - Right auxiliary (outboard) tank
No. 3 - Left main (inboard) tank
No. 4 - Right main (inboard) tank

Fuel Dump Valve Control (44)

18. A fuel dump valve control is located on the right side of the cockpit below the trim tab control unit. The fuel dump system is provided for emergency destruction of the airplane. To operate, pull up on the control which will cause fuel to be dumped from each inboard fuel tank to outside the airplane where it may be ignited.

LANDING GEAR CONTROLS

Hydraulic Control (57)

19. The landing gear is actuated hydraulically and controlled by a handle on the panel at the left side of the pilot's seat. To retract the landing gear, move the control to UP position. When the landing gear is fully retracted as shown by the position indicator on the pilot's instrument panel, return the control to NEUTRAL position. To extend the landing gear, move the control to DOWN position. When the landing gear is down completely as shown by the position indicator, return the control to NEUTRAL. The control incorporates a latch to prevent inadvertent movement of the control to UP position.

CONDITION	FUEL TANK SELECTOR CONTROLS	CROSS-FEED CONTROLS		REMARKS
		Engine (Pressure)	Tank (Suction)	
Take-Off	L.H. on 3 - MAIN R.H. on 4 - MAIN	OFF	OFF	Each inboard tank supplies own engine
Normal — a.	L.H. on 3 - MAIN R.H. on 4 - MAIN	OFF	OFF	Each inboard tank supplies own engine
Normal — b.	L.H. on 1 - AUX. R.H. on 2 - AUX.	OFF	OFF	Each outboard tank supplies own engine
To Use One Tank	Respective control on tank desired Other control OFF	OFF	ON	Selected tank supplies both engines
Fuel Pump Failure — L.H. — a.	L.H. on OFF R.H. on tank desired	ON	OFF	R.H. tank supplies both engines
Fuel Pump Failure — L.H. — b.	L.H. on tank desired R.H. on OFF	ON	ON	L.H. tank supplies both engines
Fuel Pump Failure — R.H. — a.	R.H. on OFF L.H. on tank desired	ON	OFF	L.H. tank supplies both engines
Fuel Pump Failure — R.H. — b.	R.H. on tank desired L.H. on OFF	ON	ON	R.H. tank supplies both engines
One Engine Failure — L.H. — a.	L.H. on OFF R.H. on tank desired	OFF	OFF	R.H. tank supplies R.H. engine L.H. engine inoperative
One Engine Failure — L.H. — b.	L.H. on tank desired R.H. on OFF	OFF	ON	L.H. tank supplies R.H. engine L.H. engine inoperative
One Engine Failure — R.H. — a.	R.H. on OFF L.H. on tank desired	OFF	OFF	L.H. tank supplies L.H. engine R.H. engine inoperative
One Engine Failure — R.H. — b.	R.H. on tank desired L.H. on OFF	OFF	ON	R.H. tank supplies L.H. engine R.H. engine inoperative
*Fuel Line Failure — L.H. System	L.H. on OFF	OFF	OFF	L.H. engine inoperative
*Fuel Line Failure — R.H. System	R.H. on OFF	OFF	OFF	R.H. engine inoperative

*Fuel line failure necessitates single engine operation. Do not attempt to use fuel from a tank in the system wherein the failure occurred.

FUEL VALVE CONTROL SETTINGS

NOTE: (i) The landing gear is provided with a warning system incorporating a warning horn and red and green signal lights. Should the throttles be closed to less than approximately one-quarter segment with the landing gear not latched in landing position, the warning horn will sound and the red light will flash on. With the landing gear latched in position, the green light is on, the red light is off and the warning horn is silent regardless of the throttle position.

(ii) If the engine-driven hydraulic pumps fail, the hydraulic handpump can be used to supply pressure as noted in paragraph 23.

Emergency Control (45)

20. An emergency landing gear control is provided to lower the landing gear in the event of complete hydraulic system failure. The control is located near the floor on the right side of the pilot's cockpit. To operate, set the hydraulic control to DOWN position and then pull up on the emergency control. The emergency control releases the latches holding the main landing gear in up position, allowing the main landing gear to swing down into landing position. The latch on the nose wheel gear is operated by a cable to the hydraulic control handle and is released when the hydraulic control is moved to DOWN position.

HYDRAULIC CONTROLS

Brakes (39)

21. Hydraulic (Normal) - The main landing gear wheels incorporate brakes actuated by hydraulic pressure. The brakes are operated by toe pressure applied to the foot rest of the pilot's rudder pedals. Each brake may be independently operated.

22. Air (Emergency) - An emergency air brake system is provided for use in the case of hydraulic system failure. It consists of an 18 cubic inch bottle in the nose wheel well, inflated to 400 pounds air pressure and connected to the brakes through an ON-OFF valve in the pilot's cockpit. Both brakes will operate simultaneously.

Hydraulic Handpump (58)

23. The hydraulic handpump is a manually operated auxiliary pump used to furnish hydraulic pressure when the engine-driven pumps are inoperative. The handpump handle extends from the panel at the left side of the pilot's seat. Any hydraulically controlled unit may be operated by the use of the handpump. To operate, set the control of the unit to be actuated in the desired position. and then work the handpump handle until the unit is in the selected position. Return the unit control to NEUTRAL when the operation is completed. The handpump may be used to charge the pressure accumulator by setting the handpump by-pass valve control (55), located on the panel at the left of the pilot's seat, to HANDPUMP TO PRESSURE TANK position and then operating the handpump until the normal system operating pressure of 850 ± 25 pounds per square inch is indicated on the hydraulic pressure gauge. The by-pass valve control must be returned to HANDPUMP TO SYSTEM position when the operation is completed.

Other Hydraulic Controls

24. Other hydraulic controls are noted in their respective paragraphs of this section as follows:

(i) Wing Flap Control (56) - paragraph 6.

(ii) Engine Cowl Flap Controls (48) (50) - paragraph 12.

(iii) Landing Gear Control (57) - paragraph 19.

(iv) Bomb Door Control (43) - paragraph 25.

BOMB CONTROLS

Bomb Door Control (43)

25. The bomb doors are actuated by hydraulic pressure and are controlled by a handle mounted on the floor adjacent to the left side of the pilot's seat. To open the bomb doors, press down the thumb button and move the control forward to OPEN position. To close the bomb doors, press down the thumb button and move the control aft to CLOSED position. The handle should be returned to NEUTRAL position after each operation. The bomb release circuit incorporates a switch operated by the bomb doors and bombs cannot be released until the bomb doors are open. Indicator lights, provided for the pilot and bomb-aimer, illuminate when the bomb doors are open and go off when the doors are closed.

Bomb Control Panel (35)

26. The pilot's bomb control panel is located just forward of the compass on the right side of the cockpit. The panel contains the following switches:

27. Master Bomb Control Switch - This switch controls the circuit to all bomb control switches. The switch is conventionally operated and must be on before any of the bomb control switches are operative. The other bomb control switches have no OFF position and are made inoperative by placing the master switch in OFF position.

NOTE: In addition to the master switch being on, the bomb doors must be open before any bombs can be released.

28. Bomb Selector Switches - Four switches are provided to select the bombs that are to be released. When any one of the four switches is moved to the UP position, the bomb selected may be released by either the bomb-aimer's or the pilot's individual bomb release switch. When an individual release switch is to be operated, only one bomb rack should be selected at a time to avoid overloading the individual release switch. When any one, or all, or a combination of the selector switches is moved to the DOWN position, the quadrant release switch will drop the bombs selected as it is moved to the corresponding bomb rack numbers.

29. Individual Bomb Release Switch - This switch is of the push-button type and is conventionally operated to release bombs individually as selected by the selector switches when they are placed in the up position. The switch should not be used to release more than one bomb at a time to avoid overloading and possible damage of the switch.

30. Quadrant Release Switch - This switch provides train release of more than one bomb as selected by the selector switches when they are placed in the down position. As the switch is moved over the markings 1 to 4, the bomb on the corresponding rack will be dropped if selected by the respective selector switch. See paragraph 28 preceding.

31. Fuzing Selector Switches - Two conventionally operated switches are provided for fuzing the nose and tail of the bombs.

32. Bomb Jettison Switch - This switch is conventionally operated and is provided for the jettison release of all bombs.

33. Small Bomb Containers Jettison Switch - This conventionally operated switch is provided for the jettison release of the small bomb containers.

FIXED GUN CONTROLS

Firing Switch (18)

34. The trigger type fixed gun firing switch is mounted on the right-hand side of the pilot's control wheel and incorporates a safety pin which must be removed before the switch can be operated.

Charging Controls

35. Two fixed gun charging handles (38) and (42) are mounted on brackets just below the instrument panel on each side of the cockpit. The lower handles of each pair charge the inboard guns and the upper handles of each pair charge the outboard guns.

ELECTRICAL CONTROLS

Ignition Switch (15)

36. The ignition switch is located in the upper left corner of the pilot's instrument panel. The ignition switch unit incorporates a master ignition switch and two individual engine switches as follows:

37. Master Ignition Switch - The master ignition switch has two positions controlling circuits as follows:

OFF - All magneto circuits are closed (grounded) and the circuits to all electrically controlled units in the airplane are open (magnetos and all electrically controlled units are inoperative).

ON - All magneto circuits are open (ungrounded) and the circuits to all electrically controlled units are closed (magnetos and all electrically controlled units are operative).

38. Individual Engine Switches - Each individual engine switch controls the ignition of one engine and has four positions controlling circuits as follows:

OFF - Both magneto circuits are closed (both magnetos inoperative) with the master switch ON or OFF.

L - The left magneto circuit is open (left magneto operative) and the right magneto circuit is closed (right magneto inoperative) with the master switch ON.

R - The right magneto circuit is open (right magneto operative) and the left magneto circuit is closed (left magneto inoperative) with the master switch ON.

BOTH - Both magneto circuits are open (both magnetos operative) with the master switch ON.

Pilot's Upper Electrical Panel (14)

39. The upper electrical panel is located at the left side of the pilot's instrument panel and contains the following electrical controls:

40. Warning Horn Release Switch - The warning horn release switch is provided to silence the horn if it is desired to close the throttles when the landing gear is not latched in landing position. The horn circuit is automatically re-set after operation of the release switch by opening the throttles and if the throttles are again closed, the horn will sound until the horn release switch is operated.

NOTE: If only one throttle is closed with the landing gear not latched in landing position, the warning horn release switch will silence the horn for only an instant. To quiet the horn, the throttle must be opened beyond the horn operating position.

41. Landing Gear Warning Lights Switch - A red signal light is provided on the pilot's upper electrical panel to indicate when the landing gear is not latched in landing position. A green light is provided to indicate that the gear is latched in landing position. These lights may be made dim or bright by the operation of the warning lights switch.

42. Gunner Call Light Switch - Conventional operation of the gunner call light switch will illuminate the call light on the gunner's electrical panel.

43. Bomb-Aimer Call Light Switch - Conventional operation of the bomb-aimer call light switch will illuminate the call light on the bomb-aimer's electrical panel.

44. Heating System Switch - Conventional operation of this switch will energize the fuel ignition plug of the Heat and Vent System heating unit.

45. Propeller Feathering Switches - A switch is provided for each propeller and is operated by pushing the respective switch for the propeller to be feathered. The switch will automatically release when the propeller blades reach the full feathered position. To unfeather the propeller, push in the switch and hold until the engine windmills at 600 to 800 r.p.m. then release the switch.

46. Propeller Anti-Icer Rheostat - Operating this rheostat turns on and regulates the anti-icer fluid pump so that fluid may be supplied to each propeller. A supply of 2 to 4 Imperial quarts per hour is considered satisfactory for normal operation under icing conditions.

47. Instrument Lighting Controls - The upper panel also incorporates the following instrument lighting controls:

(i) Compass Light Switch & Rheostat

(ii) Engine Instrument Lights Rheostat

(iii) Flight Instrument Lights Rheostat

Pilot's Lower Electrical Panel (12)

48. The pilot's lower electrical panel is installed at the left side of the cockpit just below the upper electrical panel and contains the following controls:

49. Main Battery Switch - Conventional operation of the switch controls the circuit from the airplane's batteries. If the airplane's batteries are used as the source of power supply, both the main battery switch and the master ignition switch must be on before any electrically controlled units in the airplane can be operated (see para. 37).

NOTE: An external source of power supply may be used while the airplane is on the ground and may be plugged into the socket located on the left side of the nose wheel well. If an external source of power supply is being used, all electrically controlled units in the airplane may be operated with the main battery switch and the master ignition switch off. To start the engines on the external power supply, the master ignition switch must be on. When changing over from the external power supply to the airplane's batteries with the engines running, the main battery switch must be on before the external power supply plug is disconnected.

50. Landing Light Switches - These switches are provided to control the extension and retraction of the landing lights installed in the lower surface of the inner wing panels. To extend a light, hold the respective switch in the EXTEND position until the light is fully lowered (approximately 12 seconds time is required). A cut-off switch incorporated in the operating mechanism will automatically stop the actuating motor when the light reaches its fully extended position. When the light has lowered approximately 10 degrees from its flush (up) position, a switch incorporated in the lamp unit will automatically turn on the light. To retract the light, hold the switch in the RETRACT position until the light is fully retracted. The cut-off switch will automatically stop the actuating motor when the light reaches its fully retracted position. The switch incorporated in the lamp unit will automatically turn off the light when it has raised within approximately 10 degrees of its retracted position. The retraction or extension of the landing lights may be stopped at any position between full up or full down by releasing the operating switches.

51. Oil Dilution Switches - An individual switch is provided to operate the oil dilution system of each engine. The switches are normally operated during the engine stopping procedure when a subsequent cold weather start is anticipated. Refer to Section 2 for operating procedure.

52. Engine Starter Switches - Two switches are provided for engine starting. The starter is energized by the START switch and engaged by the MESH switch. In starting the right engine, depress the START switch and when the inertia wheel is up to speed, depress the MESH switch, still keeping the START switch depressed. In starting the left engine, lift up the switches while proceeding in a similar manner as when starting the right engine.

53. Fire Extinguisher Release Switches - An individual release switch is provided for each engine section fire extinguisher system. The switches incorporate a safety guard which must be raised before the switches can be operated. In addition to the manually operated switches, the fire extinguisher system incorporates automatic flame actuators on the firewall of each engine section and an impact actuator located in the forward end of the nose wheel well.

54. Fire Extinguisher Test Light Switch - This switch is provided to check the electrical release circuit of the fire extinguisher system. When the switch is in the ON position, the light adjacent to the switch should be on, indicating that the circuit is continuous and the extinguisher release system is operative. If the lamp does not light with the switch in ON position, the circuit fuse should be checked. The fuse is located in the battery junction box installed at the forward end of the bomb bay.

55. Miscellaneous Switches - The lower panel also incorporates switches for the following:

(i) Cockpit Lights

(ii) Formation Keeping Lights

(iii) Navigation Lights

(iv) Pitot Heater

Recognition Light Switches (22) (25)

56. The recognition lights are controlled by a Morse key switch (22) and a color selecting switch (25) located just aft of the instrument panel on the right side of the pilot's cockpit. A master switch is provided for controlling the circuit to the recognition lights system. Three indicator lights are also provided adjacent to the controlling switches and illuminate simultaneously with the external lights.

Pilot's Extension Light (30)

57. A conventionally operated switch is incorporated on the extension light box which is installed in the right rear corner of the pilot's cockpit.

Other Electrical Controls

58. Other electrical controls are noted in their respective paragraphs as follows:

Fuel Quantity Gauge Selector Switch (85) - Paragraph 17.

Bomb Control Panel (38) - Paragraph 26.

Fixed Gun Firing Switch (18) - Paragraph 34.

RADIO CONTROLS

Radio Control Box (27)

59. A Bendix radio control box is provided for the pilot and is located just aft of the recognition lights switches on the right side of the cockpit.

Telegraph Key (24)

60. A telegraph key is provided for the pilot and is located above the recognition lights switch box on the right side of the pilot's cockpit.

R-3003 Receiver Master Switch (26)

61. A master switch for the R-3003 Receiver is located below the window in the right rear corner of the pilot's cockpit. Conventional operation of this switch controls the power supply to the R-3003 Receiver.

HEATING AND VENTILATING SYSTEM CONTROLS

General

62. The heat and air volume controls (51) are located on a panel at the right side of the fuselage deck just aft of the pilot's seat. The switch for the fuel ignition plug is located on the pilot's upper electrical panel.

63. Air Volume Control - This is a push-pull control which opens and closes the air scoop, thus regulating the amount of air which passes through the heater unit. Each crew member has an individual control which is used to regulate the amount of air entering his compartment.

64. Heat Control - This control is connected to a throttle valve in the main feed line which regulates the amount of fuel entering the heating unit.

MISCELLANEOUS OPERATIONAL EQUIPMENT

Oxygen Regulator (36)

65. The regulator (36) is located on the right side of the pilot's cockpit just outboard of the bracket for the fixed gun charging controls. A socket outlet (23) is located on the right side of the cockpit above the pilot's radio box.

Bank and Turn Indicator Throttle Valve (59)

66. A throttle valve is provided on the pilot's instrument panel to regulate the suction pressure for the Bank and Turn Indicator. The normal operating pressure is 2 inches Hg; however, the pressure may be adjusted as desired to regulate the reaction of the indicator to the operation of the airplane.

Manifold Pressure Gauge Drain Cock (20)

67. A drain cock for the manifold pressure gauge is located on the right side of the pilot's cockpit just below the instrument panel. The drain cock should be opened for a few seconds during the engine warm-up period to drain the gauge line of liquids and vapors. For best results, the line should be vented while idling, since there is an inflow of air through the vent line at idling speeds. If the drain cock is opened with the engine operating at a manifold pressure of approximately 30 inches Hg., the gases and liquid will be forced from the vent line.

Surface Control Lock (17) (61)

68. A lock mechanism is provided to secure the ailerons, elevators and rudder while the airplane is standing idle. The lock consists of a hook (61) in the approximate center of the pilot's instrument panel and a hook mechanism (17) in the upper end of the control column. To lock the surfaces, set the rudder and ailerons in neutral position and move the control column full forward. Pull on the hook at the center of the instrument panel and engage it with the hook on the control column. When the hook on the panel is engaged, it causes pins to be inserted in the rudder pedal arms preventing movement of the rudder. The ailerons are locked in position by means of a lever which engages the chain sprocket in the control column head and since the column is retained in the full forward position, the elevators cannot move.

Parking Brake Control (60)

69. A pull type control is provided to set the brakes for parking, and is located centrally at the lower edge of the pilot's instrument panel. To set the brakes, apply toe pressure to the brake pedals until fully depressed and pull out the parking brake control. Release the pedals when the parking lugs snap into place and then release the parking brake control. To release the parking brakes, depress the brake pedals. The parking control should return to off position. If the control does not return to off position, the return spring may be broken and the control should be pushed in while the brake pedals are depressed. The hydraulic system pressure should be at least 500 pounds per square inch for satisfactory operation of the parking brakes.

SEATING, EXITS, ETC.

Seat Adjustment Control (47)

70. The pilot's seat is adjustable for height. To raise, pull back on the handle located on the right side of the seat to release the retaining pins; at the same time ease body weight upward, allowing the shock cord bungee to raise the seat. At the desired position, release the handle and insure that the retaining pins are properly engaged. To lower, pull back on the handle and allow body weight to move the seat down. At the desired position, release the handle and insure that the retaining pins are properly engaged.

Safety Harness Release Control (49)

71. To allow the pilot to lean forward without undoing his safety harness, a control (49) is provided on the right hand side of the seat to release the spring-loaded drum on which a cable attached to the shoulder straps is wound. A catch is provided to hold the control in the release position, while the pilot is adjusting the engine controls, fuel controls, etc. To allow the harness to engage, the harness control handle must be released from the catch.

Pilot's Enclosure Door Controls

72. Entry into the pilot's cockpit is made through an enclosure door installed over the cockpit and also the fuselage deck behind the pilot's seat. The enclosure door swings upward toward the right side when opened. It is unlatched from the outside by a handle installed flush with surface at the left rear corner of the door. From within, the door is unlatched by a handle located at the left side of the door between the forward and aft transparent panels. A brace is provided at the aft end of the door to hold it in the open position. When closing the door, the knee joint of the brace must be broken by turning a handle located on the centerline of the door between the forward and aft transparent panels.

Emergency Exit

73. The pilot's enclosure door is also provided with an emergency release handle to release the door for emergency exit. The emergency release handle is located at the aft transparent panel as shown in Fig. 6. When the handle is pulled, it unlatches the door and at the same time pulls the pins from the hinges and from the brace at the aft end. Pushing the door up slightly will allow the airstream to get under the door and carry it away.

Retractable Step Control

74. Steps and hand holes are provided in the left side of the fuselage aft of the wing trailing edge for access to the wing walkway and pilot's cockpit. The lower step is retractable. The step may be extended by pushing a button control located in the side of the fuselage just above the wing trailing edge. The step is retracted by pushing it back up into the fuselage from the outside of the airplane or by pulling it up from inside the gunners' compartment. A 12 foot fabric strap is provided in the airplane's equipment to assist the pilot up the steps. It should be tied to a substantial part of the structure and allowed to hang over the trailing edge of the wing.

Armor Plate Release (52)

75. A release is provided for lowering the pilot's head armor plate. The release is a pull type handle located on the deck above the right side of the pilot's seat.

MISCELLANEOUS EQUIPMENT

Vacuum Flask

76. The pilot's vacuum flask is located on the fuselage deck aft of the pilot's seat. The bomb-aimer's vacuum flask is located in the left rear corner of his compartment. A vacuum flask for the gunners is located on the right side of their compartment.

Relief Tube

77. A relief tube for the pilot is located near the floor adjacent to the bracket for right-hand fixed gun charging controls. The bomb-aimer's relief tube is located below a hinged cover on the entrance door installed in the floor of the compartment. A relief tube for the gunners is located on the right-hand side of the compartment opposite the seat.

Message Carrier

78. A message carrier is provided between the pilot's cockpit and the gunners' compartment.

Data Case

79. A combination navigation case, map and glove compartment is located on the left side of the pilot's cockpit. A map case for the bomb-aimer is located on the shelf at the left side of his compartment. A map case is provided on the left side of the gunners' compartment.

GENERAL EMERGENCY EQUIPMENT AND EXITS

General

80. The locations of emergency equipment and the methods of abandoning the airplane are shown in Fig. 6.

Emergency Exits

81. Emergency exits for each compartment are noted in the following paragraphs:

82. Pilot's Cockpit - Emergency exit is made through the cockpit enclosure. The enclosure is released as noted in paragraph 73 preceding.

83. Bomb-Aimer's Compartment - Emergency exit may be made through the lower door or through a hatch installed in the top of the compartment. The upper hatch must be used only in the case of a "gear up" landing and not in flight. The lower door is provided with an emergency release located just aft of the normal latch handle. When the emergency release is pulled up, it unlatches the door and at the same time pulls a pin attaching the brace and shock cord bungee to the door, allowing the door to swing fully open. The upper hatch is opened by pulling on a cable release accessible through an opening in the lower surface of the door and pushing the door out of the opening. The cable release is also accessible from the exterior by tearing open a fabric patch covering the release access opening.

NOTE: A locking device is incorporated in the latching pin located on the left side of the upper hatch. It is provided to prevent the cable release from being operated from the exterior when it is desired to lock the compartment while the airplane is standing idle. It is recommended that the lock be disengaged at all times other than when the compartment is to be locked.

84. Gunners' Compartment - Emergency exit may be made through the lower door or through the upper enclosure. The lower door may be opened by means of a latching handle located in the approximate center of the door or by operating the crank mechanism installed on the right side of the compartment. The upper enclosure is opened by releasing the two latches at the upper forward end of the sliding section, allowing the forward end to drop down and thensliding it forward under the fixed section as far as it will go. A latch is provided to retain the section in its full forward position. The enclosure may be opened from the exterior by tearing open a fabric patch covering the upper left latch access opening and releasing the latch.

NOTE: The upper right latch is to prevent the enclosure being opened from the exterior when it is desired to lock the compartment while the airplane is standing idle. It is recommended that the latch be disengaged at all times other than when the compartment is to be locked. The enclosure cannot be opened from the exterior if the right hand latch is engaged.

First-Aid Outfit

85. The pilot's first-aid kit is strapped to the compartment hatch. A first-aid kit for the bomb-aimer is located on the right side of the compartment. A first-aid kit is also provided on the left side of the gunners' compartment.

Parachute Stowage

86. The pilot's seat, bomb-aimer's seat and the seat in the gunner's compartment are constructed to accommodate seat type parachutes. Two quick-attach type parachutes may be stowed in the gunners' compartment, one on the right side of the compartment and the other on the brace rods of the upper gunners' seat.

Fire Extinguishers

87. In addition to the CO_2 type engine section fire extinguisher system, two hand type fire extinguishers are provided. One is stowed at each crew member's station as shown on Fig. 6.

Fireman's Axe

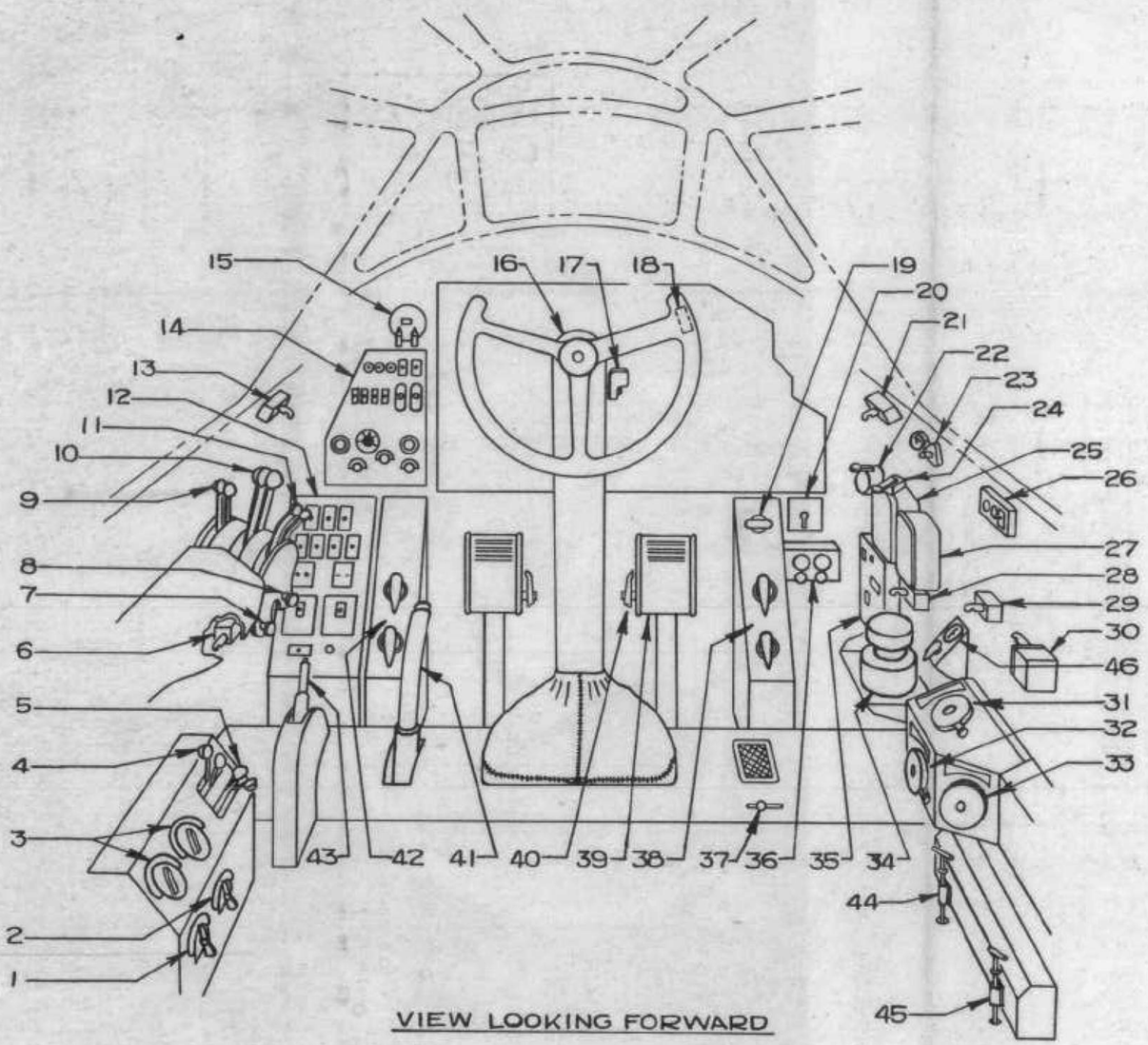
88. Three fireman's axes are provided for cutting a way out of the airplane in an emergency. One is located on the fuselage deck aft of the pilot's seat, another is mounted on the forward bulkhead of the gunners' compartment, and the third is mounted in the right rear corner of the bomb-aimer's compartment.

Desert Equipment

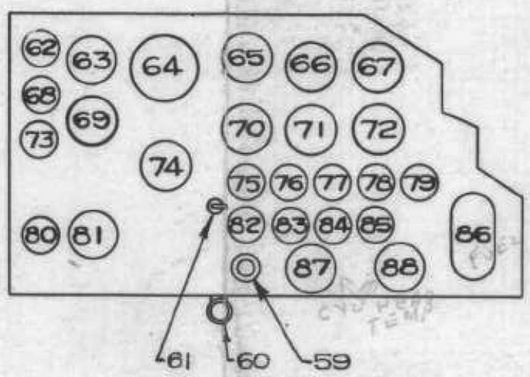
89. The pilot's food ration kit and water bottle are attached to the cockpit hatch. The bomb-aimer's food ration kit is located on the shelf below the first-aid kit on the right side of his compartment. His water bottle is located in the right rear corner of the compartment. The upper gunner's food ration kit is located on the forward bulkhead of the compartment and his water bottle is located in the left forward corner of the compartment. The lower gunner's food ration kit is located on the left side of the compartment above the lower entrance door and his water bottle is located on the left side of the compartment in the first bay forward of the lower entrance door. Four additional water containers are located in the upper rear corner of the forward bomb bay. Each crew member's water bottle contains one-quarter Imperial gallon and each container in the bomb bay contains 1 1/2 Imperial gallons.

1. Tank (Suction) Cross-Feed Control
2. Engine (Pressure) Cross-Feed Control
3. L.H. and R.H. Fuel Tank Selector Controls
4. Carburetor Air Temperature Controls
5. Blower Controls
6. Fuel Valve Panel Light
7. Propeller Control Friction Adjuster
8. Throttle Control Friction Adjuster
9. Mixture Controls
10. Throttle Controls
11. Propeller Controls
12. Lower Electrical Panel
13. Engine Controls Light
14. Upper Electrical Panel
15. Ignition Switch
16. Control Column and Wheel
17. Surface Control Lock Release
18. Fixed Gun Firing Switch
19. Engine Primer Pump
20. Manifold Pressure Gauge Drain Cock
21. Radio Controls Light
22. Recognition Lights Tapping Key
23. Oxygen Outlet
24. Telegraph Tapping Key
25. Recognition Lights Switch Panel
26. R-3003 Receiver Master Switch
27. Radio Control Panel
28. Compass Light
29. Trim Tab Controls Light
30. Cockpit Extension Light
31. Rudder Trim Tab Control
32. Elevator Trim Tab Control
33. Aileron Trim Tab Control
34. Compass
35. Bomb Control Panel
36. Oxygen Regulator
37. Heat and Vent Outlet Control
38. Fixed Gun Charging Controls - R.H.
39. Rudder and Brake Pedals
40. Pedal Adjustment Lever
41. Wobble Pump (Manual Fuel Pump)
42. Fixed Gun Charging Controls - L.H.
43. Bomb Door Control
44. Fuel Dump Valve Control
45. Landing Gear Emergency Release
46. Emergency Air Brake Control
47. Seat Adjustment Lever
48. Lower Engine Cowl and Oil Cooler Flap Controls
49. Safety Harness Release Lever
50. Upper Engine Cowl Flap Control
51. Heating and Ventilating System Controls
52. Armor Plate Release
53. Thermos Bottle
54. Hand Fire Extinguisher
55. Hand Pump By-Pass Valve
56. Wing Flap Control
57. Landing Gear Hydraulic Control
58. Hydraulic Hand Pump
59. Bank and Turn Indicator Throttle Valve
60. Parking Brake Control
61. Surface Control Lock
62. Free-Air Thermometer
63. Airspeed Indicator
64. Flight Indicator (Gyro-Horizon)
65. Rate of Climb Indicator
66. L.H. Manifold Pressure Gauge
67. R.H. Manifold Pressure Gauge
68. Clock
69. Altimeter
70. Bank and Turn Indicator
71. L.H. Tachometer
72. R.H. Tachometer
73. Suction Gauge
74. Turn Indicator (Directional-Gyro)
75. L.H. Oil Pressure Gauge
76. R.H. Oil Pressure Gauge
77. L.H. Fuel Pressure Gauge
78. R.H. Fuel Pressure Gauge
79. Hydraulic Pressure Gauge
80. Steering Indicator
81. Landing Gear and Wing Flaps Position Indicator
82. L.H. Oil Temperature Gauge
83. R.H. Oil Temperature Gauge
84. L.H. Carburetor Air Temperature Gauge
85. R.H. Carburetor Air Temperature Gauge
86. Fuel Quantity Gauge
87. L.H. Cylinder Head Temperature Gauge
88. R.H. Cylinder Head Temperature Gauge

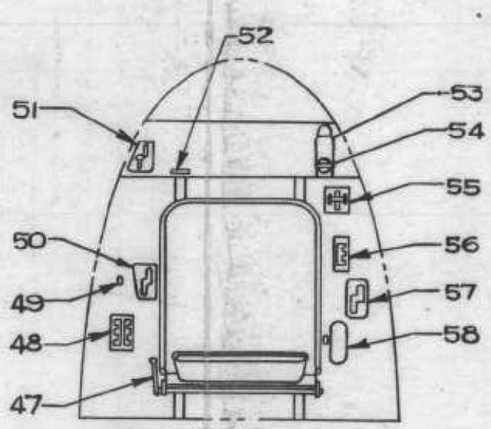
KEY - ILLUSTRATION ITEM NUMBERS



VIEW LOOKING FORWARD



INSTRUMENT PANEL



VIEW LOOKING AFT

FIG. I PILOT'S COCKPIT ARRANGEMENT

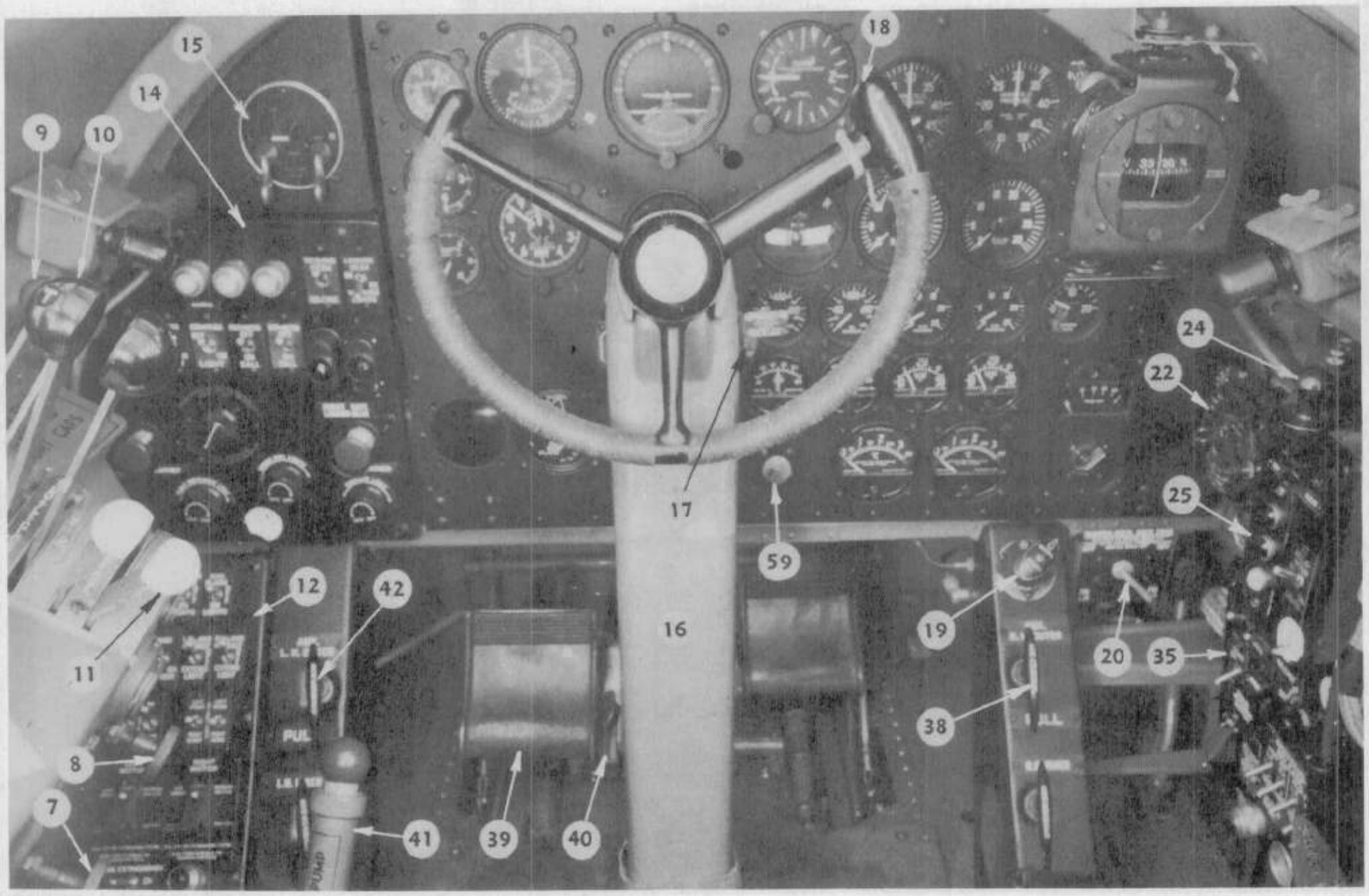


FIG. 2 PILOTS INSTRUMENT PANEL

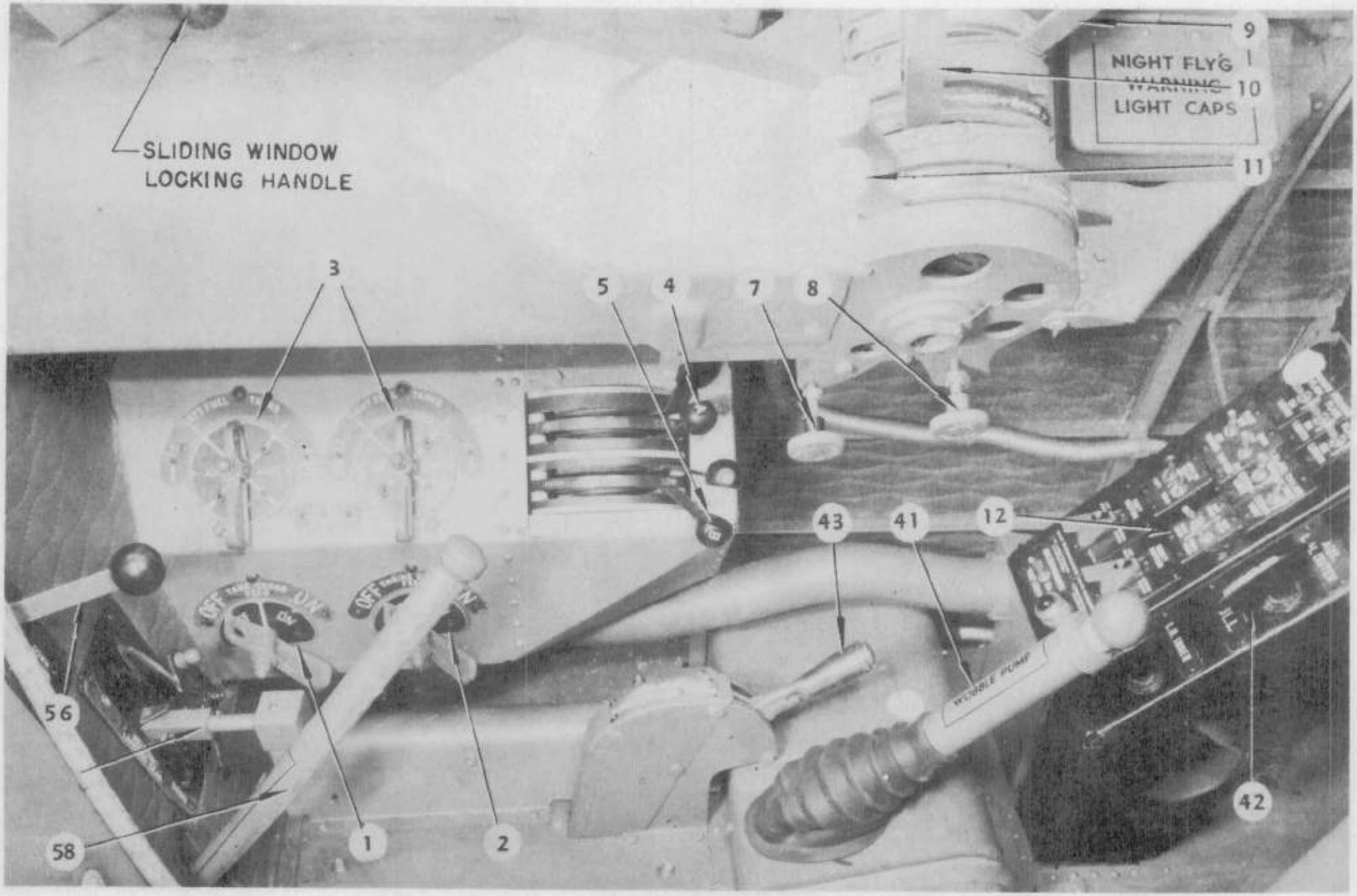


FIG. 3 PILOTS COCKPIT - L.H. SIDE

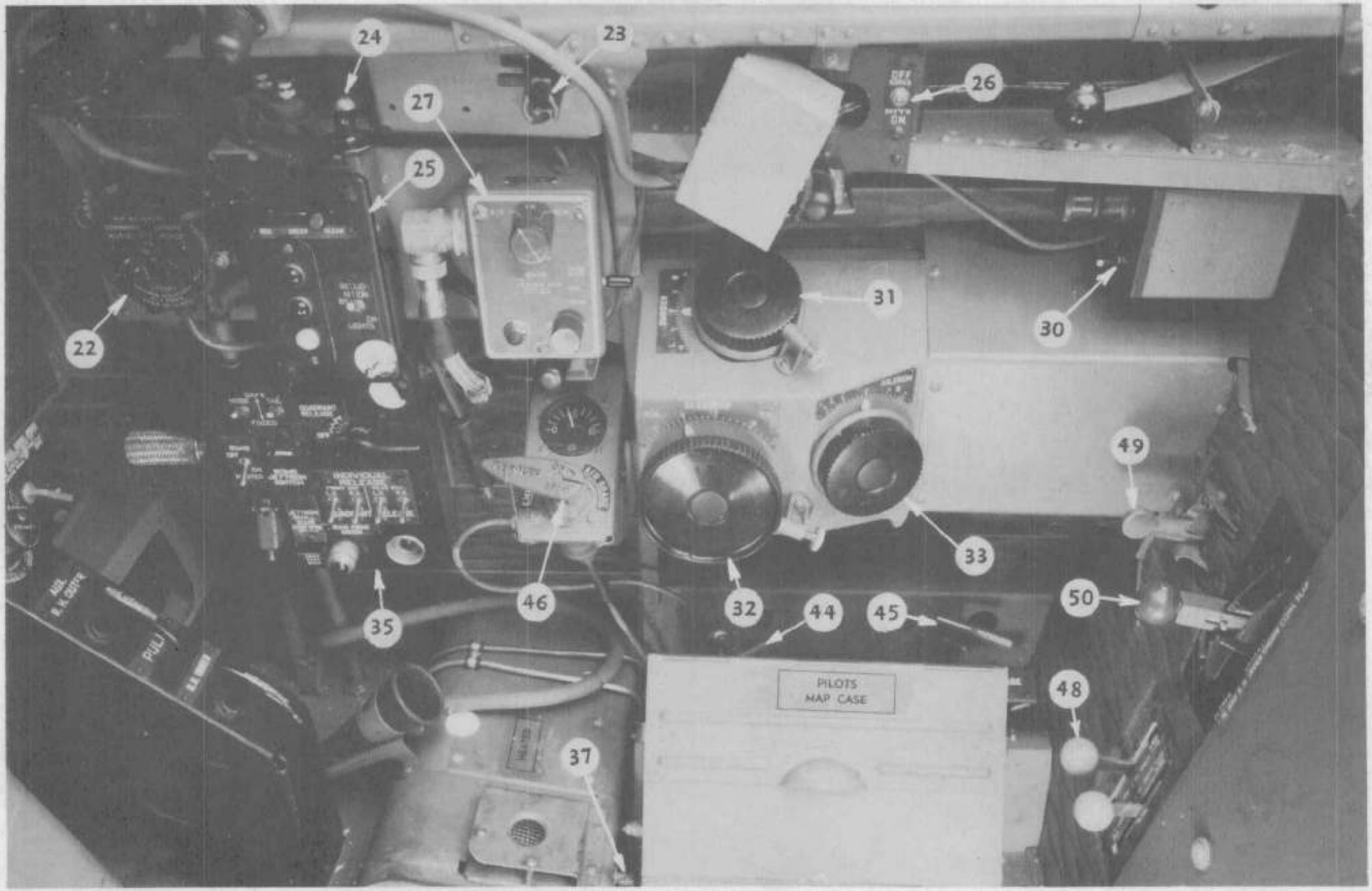


FIG. 4 PILOTS COCKPIT - R.H. SIDE

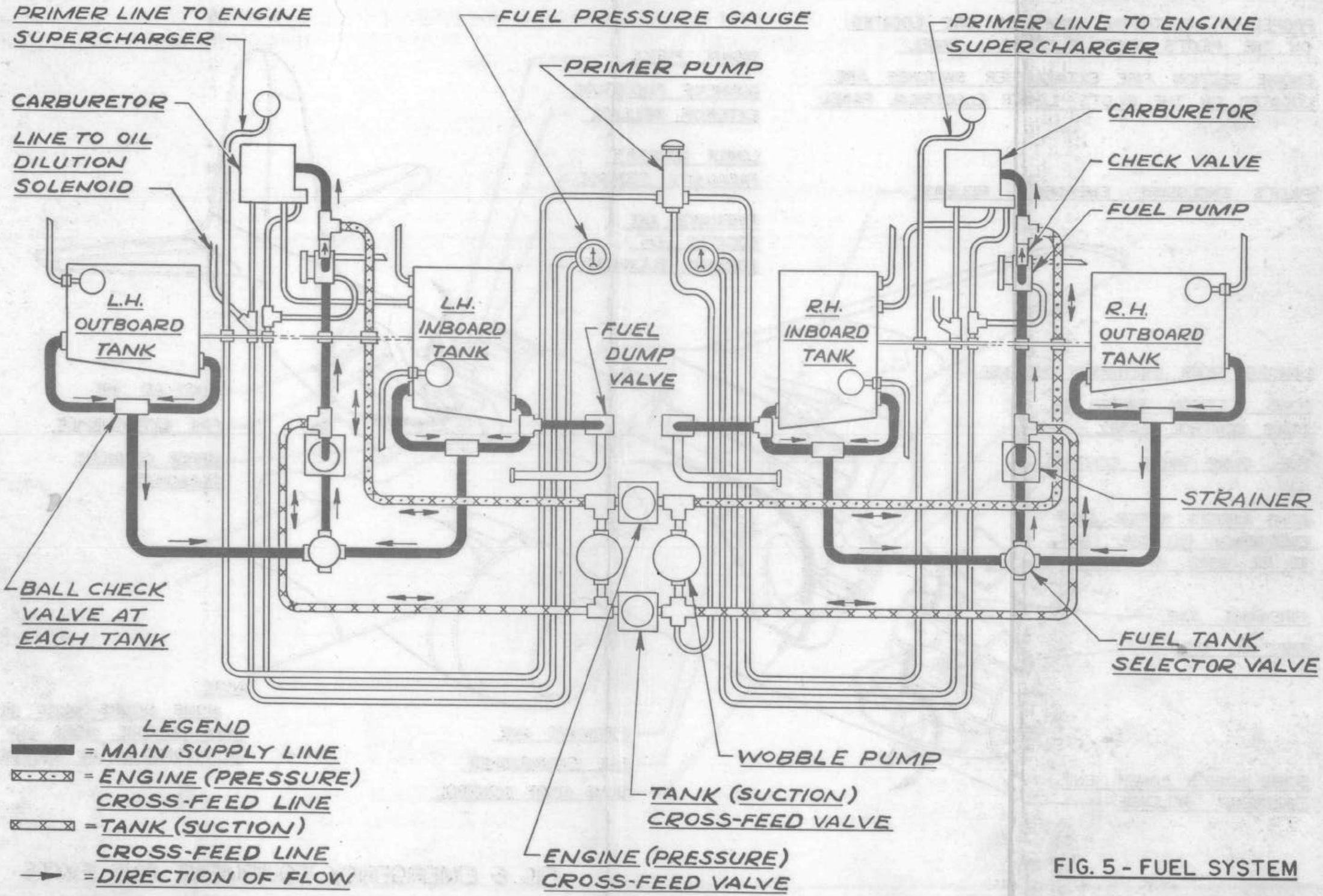


FIG. 5 - FUEL SYSTEM

PROPELLER FEATHERING SWITCHES ARE LOCATED ON THE PILOT'S UPPER ELECTRICAL PANEL

ENGINE SECTION FIRE EXTINGUISHER SWITCHES ARE LOCATED ON THE PILOT'S LOWER ELECTRICAL PANEL

PILOT'S ENCLOSURE EMERGENCY RELEASE

LANDING GEAR EMERGENCY RELEASE

BOMB JETTISON SWITCH ON BOMB CONTROL PANEL

FUEL DUMP VALVE CONTROL

BOMB AIMER'S UPPER EXIT EMERGENCY RELEASE (NOT TO BE USED IN FLIGHT)

FIREMAN'S AXE

FIRST-AID KIT

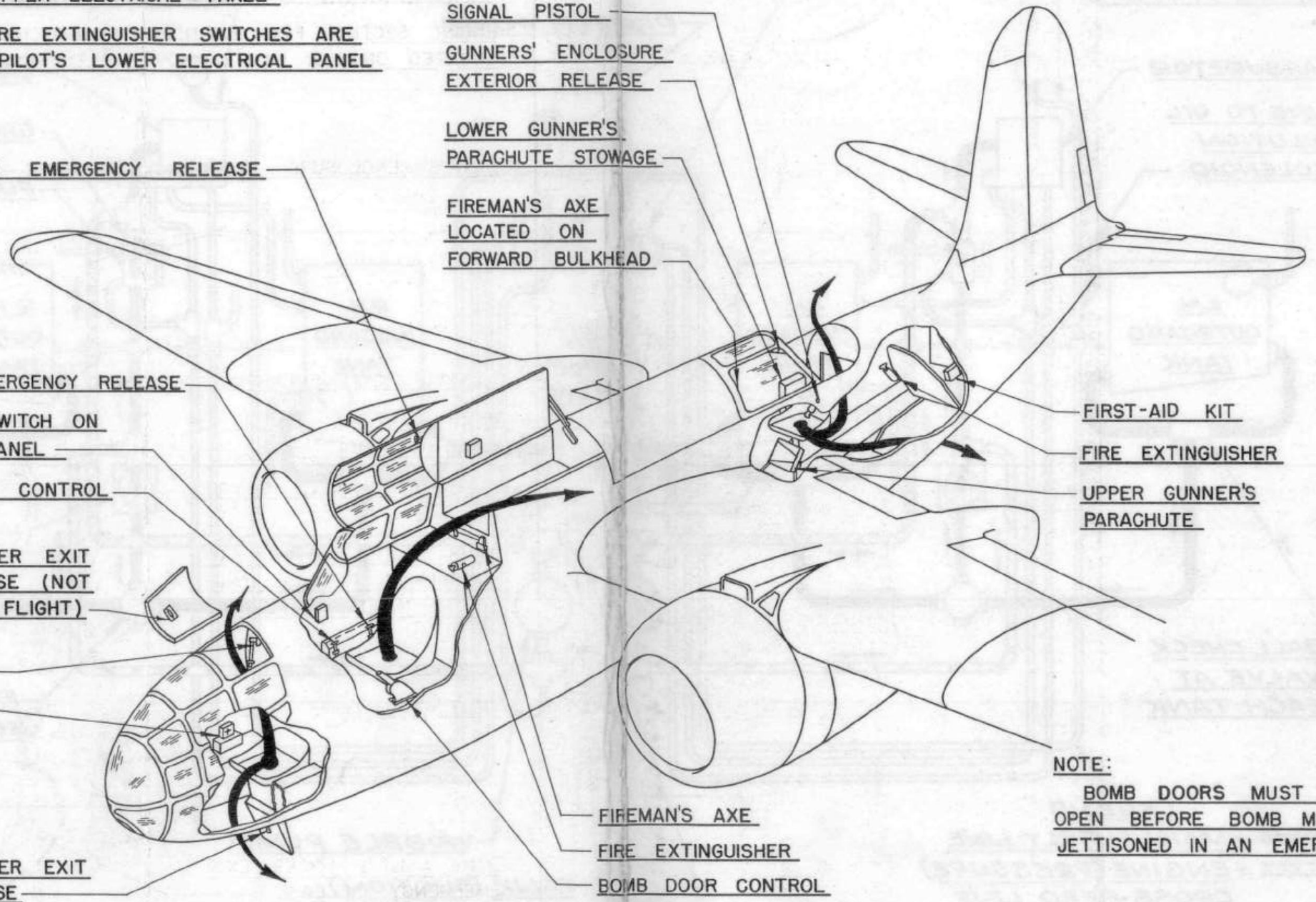
BOMB AIMER'S LOWER EXIT EMERGENCY RELEASE

SIGNAL PISTOL

GUNNERS' ENCLOSURE EXTERIOR RELEASE

LOWER GUNNER'S PARACHUTE STOWAGE

FIREMAN'S AXE LOCATED ON FORWARD BULKHEAD



FIRST-AID KIT

FIRE EXTINGUISHER

UPPER GUNNER'S PARACHUTE

FIREMAN'S AXE

FIRE EXTINGUISHER

BOMB DOOR CONTROL

NOTE:
BOMB DOORS MUST BE OPEN BEFORE BOMB MAY BE JETTISONED IN AN EMERGENCY

FIG. 6 EMERGENCY EQUIPMENT AND EXITS

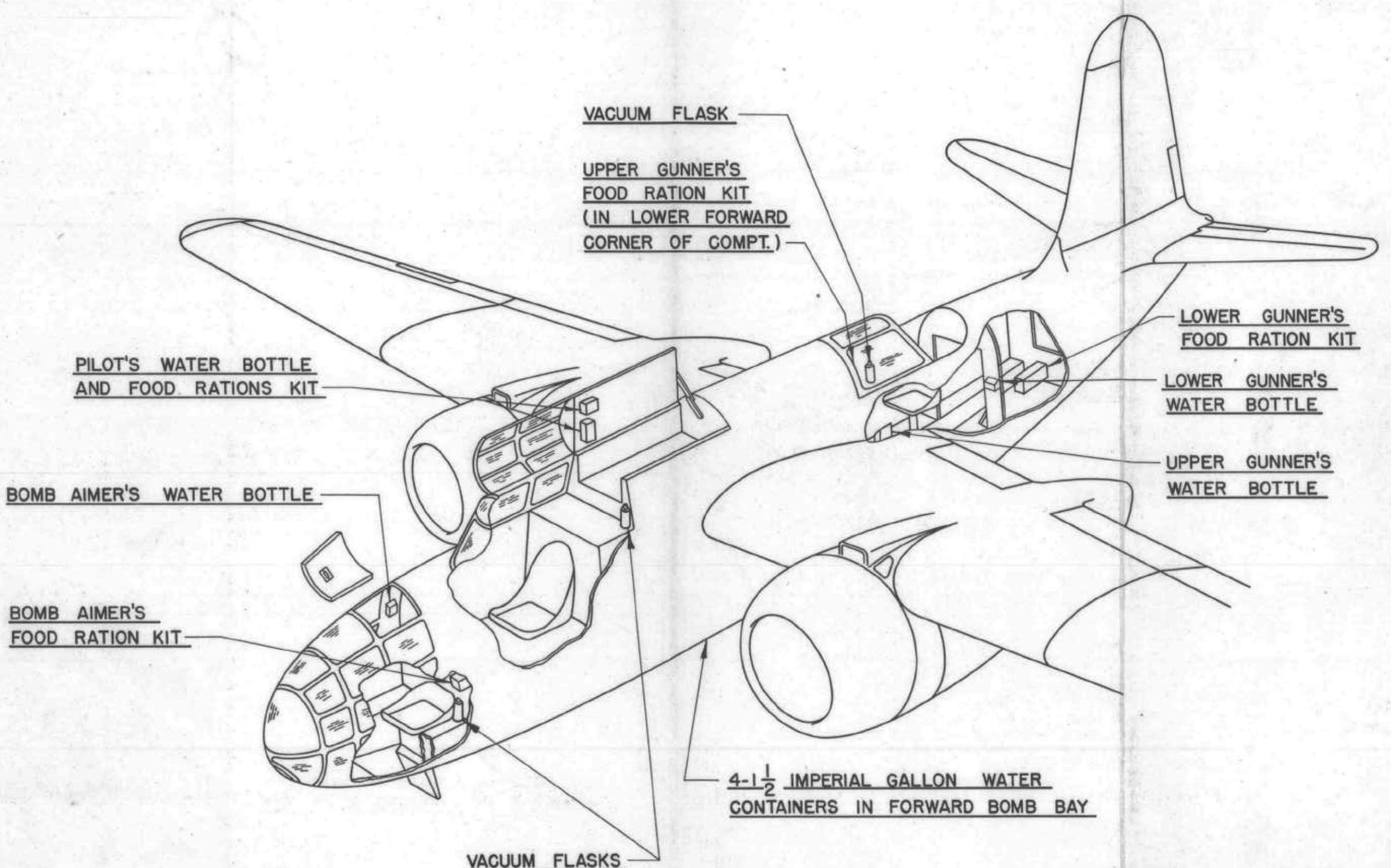


FIG. 7
DESERT EQUIPMENT

SECTION 2

HANDLING AND FLYING NOTES FOR PILOT

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

SECTION 2

HANDLING AND FLYING NOTES FOR PILOT

INTRODUCTORY NOTES

1. Full details of the equipment of the aircraft are given in Section 1. Pilots should be acquainted with these before flying the aircraft.

FITNESS OF AIRCRAFT FOR FLIGHT

2. Note the following and insure that all items are satisfactory before starting a flight:

(i) Insure that the total weight and disposition of the load are in accordance with the Weight Sheet Summary given in Section 4, Chap. I. The maximum permissible C.G. positions for this aircraft should not be exceeded, and in the event of the C.G. being in the most aft position, care should be exercised when subjecting the airplane to any high acceleration loadings, either on a turn or during recovery from a dive.

(ii) See that the nose wheel gear snubbing pin is engaged.

PRELIMINARIES

3. On entering the cockpit -

(i) Release control locks.

(ii) Switch on main battery, master ignition switch and also generator switch in gunners' compartment.

(iii) Check landing gear hydraulic control for DOWN and that green light is ON, indicating that landing gear is latched in position. If green light is ON, remove the main landing gear safety pins and nose wheel gear safety clamp, if they have not already been removed.

(iv) Engage parking brake.

(v) Check controls for free movement.

(vi) Insure that wing flaps are UP.

(vii) Check contents of fuel tanks.

(viii) Test engine section fire extinguisher release circuit by placing test switch to ON position. The indicator lamp adjacent to the switch should flash ON. (If lamp does not light, inspect fuse).

4. STARTING ENGINES AND WARMING UP

NOTE: Since the generator and the heating and ventilating system are dependent on the right engine, it is suggested that this engine be started first.

(i) Turn engine over by hand at least three revolutions.

(ii) Set right fuel tank selector to 4- MAIN position. (Set left fuel tank selector to 3-MAIN when starting left engine.)

NOTE: The fuel tank selector for engine not to be started first should be kept in OFF position to avoid overpriming while starting the first engine.

(iii) See that both cross-feed controls are OFF.

(iv) Supercharger controls in LOW

(v) Carburetor air temperature controls in COLD. The engine should never be started with the control in HOT position since serious damage and fire could result from a backfire. During icing conditions, the start should be made in the COLD position and then immediately after starting, the control may be moved to the HOT position.

(vi) Set upper and lower cowl flap controls to OPEN and operate hydraulic hand pump until cowl flaps are open. When open, return control levers to NEUTRAL.

NOTE: Before operating the hand pump, insure that all other hydraulic controls are in NEUTRAL position. Oil cooler flaps will open with lower cowl flaps.

(vii) Propeller pitch controls to INCREASE (fine pitch).

(viii) Set throttle controls for 1000 to 1250 r.p.m. (approximately one-quarter open).

(ix) Mixture controls in IDLE CUT-OFF.

(x) Individual ignition switch for engine being started to BOTH position.

(xi) Raise fuel pressure with wobble pump to 10 or 12 pounds per square inch. If engine is cold, pump primer 3 to 5 strokes and lock primer OFF. (If engine is warm, priming is not required.)

(xii) Work wobble pump slowly to maintain 10 to 12 pounds per square inch pressure.

(xiii) Energize and engage starter.

(xiv) When engine fires, move mixture control to AUTO RICH.

NOTE: Wobble pump should not be used after mixture control has been moved out of IDLE CUT-OFF position unless fuel pressure is not obtained with the engine-driven pump. Should it be necessary to use the wobble pump, exercise extreme caution because of danger of flooding engines and causing fire.

If engine fails to start, the wobble pumping should be discontinued the moment the engine ceases to turn. Further attempt at starting should not be made if any fuel is dripping from the supercharger drain

If engine is overprimed (excessive fuel flowing out of supercharger drain) move mixture control to IDLE CUT-OFF position, ignition switch OFF and open the throttle wide. Pull propeller through by hand or starter until the engine is cleared out. When engine has cleared repeat starting procedure.

(xv) After engine is started, idle at 600 r.p.m. If oil pressure does not come up to at least 40 pounds per square inch within one-half minute after starting, stop engine and investigate.

(xvi) If the oil pressure is satisfactory after first half-minute, run the engine at 1000 to 1200 r.p.m.

NOTE: Continued idling below 800 r.p.m. may result in fouled spark plugs.

(xvii) Note hydraulic pressure, then lower and raise wing flaps, return lever to NEUTRAL. After operation, the hydraulic pressure should recover to 850 ± 25 pounds per square inch indicating that the starboard engine hydraulic pump is operating properly. (The port engine pump may be checked on stopping by switching off the starboard engine first.)

(xviii) Repeat similar starting procedure for port engine.

5. After Starting:

(i) Run engines at 1000 to 1200 r.p.m. until oil temperature is at least 40°C. (104°F.) or, in colder weather, a temperature rise of 10°C. is noted.

(ii) Open throttle to 30" Hg. manifold pressure, check oil pressure and temperature.

Pressure - 75 to 90 pounds per square inch.
Temperature - 71° to 93°C. (160°-200°F.)

(If oil pressure drops as throttle is opened, further warming up is required.)

(iii) Check magnetos. In switching from both magnetos to one, the normal drop-off is 50 to 75 r.p.m. and does not usually exceed 100 r.p.m. Do not run engine on one magneto for more than 30 seconds.

WARNING: Do not run at high manifold pressures longer than is necessary. Cooling of cylinder heads and barrels and ignition harness is usually insufficient for prolonged running on the ground above 1400 r.p.m. and should be avoided. Do not exceed 232°C. (450°F.) cylinder head temperature during ground operation.

(iv) Check the supercharger operation as follows: With the propeller controls in INCREASE (fine pitch) position, close the throttle completely, move the supercharger control to HIGH position and then reopen the throttle to obtain not over 30 inches Hg. manifold pressure. When the engine speed has stabilized, observe the manifold pressure and shift the supercharger control to LOW position without moving the throttle. A sudden decrease in manifold pressure is an indication that the two-speed supercharger drive is operating properly. When changing the supercharger ratios, the control should be moved quickly without pausing between one extreme of the control position to the other.

(v) Check functioning of propeller pitch controls by moving back until a drop in r.p.m. is shown, return to INCREASE (fine pitch) position.

(vi) Check the fuel pressure. This should be 12 to 15 pounds per square inch.

(vii) Switch pitot head heater ON if icing conditions prevail.

(viii) Check cockpit hood and enclosures to see that they are securely fastened and locked.

TAXIING OUT

6. Before taxiing out, insure that the nose wheel safety clamp together with main landing gear safety pins have been removed and insure that the snubbing pin on the nose wheel is engaged. As soon as the pressure on the brakes themselves is released, the aircraft will move slowly forward, although the engines may only be ticking over.

(i) Always taxi slowly to avoid excessive wear on the brakes. It will be found that the machine is easily steerable by means of the brakes, although it will be found that once the nose wheel is castored to one side or the other it will tend to remain in that position until straightened up by firm application of opposite brake or until the engines are opened up evenly to give a direct and even forward thrust. This latter method of straightening the aircraft up on the ground is preferable, provided there is sufficient room, as it is difficult to stop the nose wheel over-castoring when correcting direction by means of the brakes. The control column should be held in NEUTRAL.

ACTIONS PRIOR TO TAKE-OFF

7. Check following vital actions:

(i) Trimming Tabs:

Aileron	- NEUTRAL
Rudder	- NEUTRAL
Elevator	- FORWARD by 1 1/2 Divisions

(ii) Mixture - AUTO RICH

(iii) Propeller - INCREASE (fine pitch)

(iv) Wing Flaps - UP
Control - NEUTRAL

(v) Cowling flaps: -
Upper - CLOSED
Lower - OPEN (As necessary)
Controls - NEUTRAL

(vi) Blower Ratio - LOW

(vii) Carburetor Air Temperature - COLD

(viii) Cross-feed Valves - OFF

(ix) Fuel Tank Selectors - MAIN

NOTE: (a) Upper cowl flaps MUST be closed prior to take-off. If they are left open, take-off run will be increased and severe buffeting will be experienced.

(b) Always clear engines by running up against the brakes.

(c) Do not exceed 232°C. (450°F.) cylinder head temperatures during ground operation. If cylinder head temperatures become excessive, idle engines to cool heads before turning into the wind for take-off.

TAKE-OFF

8. It is important to allow the aircraft to roll straight forward into wind to ensure that the nose wheel is straight prior to take-off. The aircraft will automatically hold itself straight as speed increases. For normal take-offs, keep the control column neutral and avoid excessive loads on the nose wheel, but on soft ground the stick should be kept back during the complete take-off in order to prevent the nose wheel digging into the ground. When a speed of approximately 100 to 110 m.p.h. I.A.S. has been reached, ease the stick back and pull the aircraft off the ground and immediately ease the stick forward again in order to allow the aircraft to accelerate before commencing to climb. This will assure control in the event of one engine failure, as a speed of at least 135 m.p.h. I.A.S. will be necessary to obtain satisfactory rudder control and overcome yaw if engine fails.

Take-off distance may be improved by holding the aircraft against the brakes until 30" Hg. boost has been reached and then opening the throttles as the brakes are released.

Take-off boost should not exceed 45" Hg.

Take-off r.p.m. should not exceed 2400.

ACTIONS AFTER TAKE-OFF

9. As soon as the aircraft has left the ground and ample flying speed is assured:

(i) Raise landing gear. When up, return control lever to NEUTRAL.

NOTE: As landing gear comes up, the aircraft becomes tail heavy and needs retrimming to approximately 2 1/2 divisions forward.

(ii) Reduce boost to power desired for climb.

(iii) Reduce r.p.m. to climbing requirements.

Subsequent actions

(iv) Check all engine instruments.

(v) If prolonged climbs are not being undertaken, or in cold weather, lower cowling flaps may be closed.

(vi) See that all hydraulic control levers are in NEUTRAL.

ONE-ENGINE FAILURE DURING TAKE-OFF

10. In the event of engine failure after take-off, proceed as follows:

(i) Ease nose down to ensure sufficient speed.

(ii) Apply sufficient rudder tab to hold aircraft straight.

(iii) Ensure that landing gear is up or coming up.

(iv) Feather propeller of failing engine by pushing in the respective feathering control button. (This will feather propeller in approximately six seconds.)

(v) See that propeller controls of good engine are in INCREASE (fine pitch) position.

(vi) Close cowl flaps of failed engine.

(vii) Adjust throttle setting of good engine.

NOTE: It will be found that at normal loads this aircraft will climb satisfactorily at 36-38 inches Hg. manifold pressure at approximately 165 m.p.h. I.A.S. at 2400 r.p.m. Approximately 5 to 6 rudder tab divisions will be required at this speed.

(viii) Circle landing field, preferably on a circuit against the good engine, at 160 m.p.h. I.A.S. and carry out an engine assisted approach at approximately 130 m.p.h. I.A.S.

(ix) Reduce rudder bias as speed decreases during final approach in order to avoid excessive tab load.

(x) A normal final approach and landing may be made with assistance from good engine. The three-wheeled landing gear enables the machine to be flown onto the ground at a higher speed than would be the case with the standard two-wheeled landing gear, so that an excess of speed may be maintained during final approach.

WARNING:

(xi) Do not lower landing gear until machine is facing the landing field.

(xii) Do not lower wing flaps until it is certain that the landing field can be reached.

(xiii) Do not undershoot, and maintain ample speed. (See (x) above.)

NOTE: Should an engine fail, either during take-off or in flight, due to a loss of fuel pressure, operate the wobble pump. If the wobble pump fails to bring the pressure up, a broken fuel line is indicated. In this event, the crossfeed controls should be in the OFF position and the respective fuel tank selector should be turned OFF to avoid a loss of fuel. No attempt should be made to use fuel from the system wherein the failure occurred and single engine operation is required.

If the use of the wobble pump brings the pressure up, however, engine-driven fuel pump failure is indicated. Fuel may be

supplied to the failing engine by turning ON the (engine pressure) cross-feed control. At take-off power, with throttles full open, however, the capacity of the single operating pump may be insufficient to supply both engines; therefore, when the cross-feed is used in these conditions, the r.p.m. should be held at 2400 (to maintain maximum fuel pump operation), but the throttles should be closed as far as circumstances will allow, or until the fuel pressure rises to a minimum of 11 pounds per sq. in.

FAILURE OF ONE ENGINE DURING CRUISING FLIGHT

11. This aircraft will maintain height on one engine at all normal military loads, and it will be found that the single engine operation characteristics are good. In the event of engine failure in flight, the actions are as described in para. 10. Where extensive operation is necessary:

(i) See that dead engine throttle is shut and mixture control is in IDLE CUT-OFF, and propeller is fully feathered.

(ii) Operate fuel tank selectors and cross-feed, depending on circumstance and cause of failure, in accordance with instructions given in Section 1, paragraphs 13 and 14, and Note following item (xiii) in para. 10, Section 2.

(iii) Regulate cylinder head temperature of good engine by means of lower cowling flaps; head temperatures should not exceed 232°C. Head temperatures are sensitive to mixture and a richening up of the mixture will often reduce the head temperatures.

(iv) Mixture control of good engine to AUTO. RICH or to EMERGENCY RICH if cylinder head temperature is too high as noted in paragraph (iii) above.

(v) When approaching to land after flying on full power, it will be necessary to reduce amount of rudder bias. Rudder bias should be adjusted to suit speed and horsepower output conditions prevailing during any one particular period of approach.

(vi) Final single engine approach and landing should be done as described in para. 10.

NOTE: In the event of it being necessary to stop an engine in flight and then to re-start, the following procedure should be followed:

(i) See that throttle is SHUT.

(ii) Mixture in IDLE CUT-OFF.

(iii) Pitch control in COARSE PITCH.

(iv) Engine switch ON.

(v) Fuel ON.

(vi) Push feathering button and hold until engine windmills at 800 r.p.m. Do not exceed this until oil pressure shows at least 40 lbs.

(vii) Switch on and when engine fires, set mixture to AUTO. RICH, allow revs to increase to approximately 1100 r.p.m. when propeller governor will take control.

(viii) Warm up engine and then pick up revs as required.

WARNING: The engine must not be run at full power until oil pressure and oil temperature are once more normal.

CLIMBING

12. This aircraft has a high rate of climb at full power but it should be noted that the fuel economy under this condition is decreased and the effective range is reduced.

(i) For the best climbing speeds, see Fig. 1.

(ii) Maximum permissible cylinder head temperature 218°C. Maximum permissible oil temperature 93°C.

(iii) The best climbing conditions for full power climb are as follows:

Maximum permissible r.p.m. 2300.
Maximum permissible Boost (Low ratio 36½" Hg.)
(High ratio 41½" Hg.)

(iv) Maximum engine performance will be obtained by remaining in the low blower until critical altitude has been exceeded and manifold pressure has dropped by 3 or 4 inches Hg. When this stage is reached, throttles should be partially closed to reduce manifold pressure 3 or 4 inches Hg. and supercharger controls shifted rapidly, without pausing, to the limit of travel to HIGH position. High blower should not be used at altitudes at which cruising power is available in low blower as fuel economy is inferior to that obtained in the low blower and tendency to detonate is greater.

CRUISING AND GENERAL FLYING

13. When flying this aircraft at extreme aft conditions of C.G. loading loading, slight instability may be apparent. Care should be exercised not to subject the aircraft to high acceleration loading during steep turns or on recovery from dive at high speeds.

The following should be noted:

(i) Tab controls must NOT be used to assist maneuvering or recovery from dive.

(ii) Bomb doors must not be opened at an indicated airspeed in excess of 345 m.p.h. I.A.S.

(iii) Bomb clearance angles are as follows:

10^{0} on each side
30^{0} on forward end
15^{0} on aft end

Bombs should not be dropped while the aircraft is at an angle of dive in excess of 20^{0}.

(iv) The aircraft may be flown feet-off at all times.

(v) The raising of landing gear causes tail heaviness and vice versa. Wheels must not be lowered at speeds in excess of 180 m.p.h. I.A.S.

(vi) The lowering of wing flaps does not produce any appreciable change in trim. Flaps must not be lowered at speeds in excess of 180 m.p.h. I.A.S.

(vii) The closing of lower engine cowl flaps causes aircraft to become nose heavy and vice versa.

(viii) Upper cowl flaps must not be open during take-off or in flight. If they are opened in flight, buffeting will occur and the machine becomes nose heavy.

(ix) When in flight, it is recommended that fuel be used from outboard tanks in order to reserve main or inboard tanks for final operation and landing. Cross-feed controls should normally be kept in OFF position. Should any tank run dry and tank (suction) cross-feed control be turned ON, it is advisable to immediately use the wobble pump in order to displace any air that may have entered the system. Use of wobble pump eliminates the possibility of considerable time interval before normal engine operation is resumed.

(x) The cylinder head and oil temperatures should not exceed the maximum permissible. For continuous cruising level flight, maximum temperatures are as follows:

Cylinder heat temperature - 205°C.
Oil Temperature - - - - - - 71°C.

Emergency maximum for 5 minutes only:

Cylinder head temperature - 232°C.
Oil Temperature - - - - - - 104°C.

(xi) For maximum range, fly at 13,000 feet at approximately 179 m.p.h. I.A.S. in low blower at 22" Hg. boost. (See paragraphs 27 and 28.)

INSTRUMENT FLYING

14. Instrument flying on this aircraft is normal, and it is recommended that feet be removed from the rudder bar when flying on instruments.

STALLING

15. The stalling characteristics of this aircraft are good and with power off, the stall is straightforward and controllable and is preceded by a shuddering of the aircraft followed by the dropping of the nose. With power on, the aircraft will tend to roll and spin if extreme stall conditions are allowed to develop. The following stalling speeds at operational loadings should be noted:

(i) Wing flaps and landing gear up 115 m.p.h. I.A.S.

(ii) Wing flaps and landing gear down 100 m.p.h. I.A.S.

(iii) Wing flaps down and landing gear up 100 m.p.h. I.A.S.

NOTE: For stalling speeds at variable gross weights with power off and wing flaps up or down, see the stalling speed chart. (See Fig. 2.)

SPINNING

16. Intentional spinning is prohibited. In the event of an accidental spin, standard methods of recovery should be used. If these fail, or if the aircraft is spinning at or below 5000 feet, abandon the aircraft.

On abandoning the aircraft, the left engine propeller should be feathered prior to pulling the emergency release of the cockpit enclosure door. If the door is opened prior to pulling the emergency release, there is a possibility that the door will remain in the open position without being pulled clear of the aircraft. See Fig. 6, Section I, for details of emergency exits.

GLIDING

17. With wing flaps and landing gear up and power off, gliding turns should not be made at less than 135 m.p.h. I.A.S. With flaps and landing gear down and power off, gliding turns should not be made at less than 125 m.p.h. I.A.S. It will be found that the aircraft is stable on a glide and that the view is good. The application of the wing flaps does not appreciably alter the trim of the aircraft but the gliding angle is steepened. The following limitations should be noted:

(i) Wing flaps should not be lowered at an indicated airspeed in excess of 180 m.p.h.

(ii) Landing gear should not be lowered at an indicated airspeed in excess of 180 m.p.h.

DIVING

18. The maximum permissible engine revolutions during a dive are 2760 r.p.m. and the limiting diving speed is 390 m.p.h. I.A.S.

(i) During a dive, throttles should be at least 1/3 open and propeller pitch adjusted to prevent over-revving.

(ii) Wing flaps must be up and engine cowl flaps closed.

(iii) Machine may be trimmed during dive.

(iv) Supercharger controls should be shifted to LOW before starting a dive.

AEROBATICS

19. Aerobatics on this aircraft are prohibited.

PRELIMINARY APPROACH

20. The approach to land may be made with or without power but should always be made with the wing flaps fully down. The preliminary circuit of the landing field should be made at approximately 150 m.p.h. I.A.S. and the following actions should be carried out in good time during the first half of the circuit:

(i) Fuel tank selectors set for MAIN tanks or tanks with greater quantity of fuel.

(ii) Cross-feed controls OFF unless cross-feed system is being used.

(iii) Carburetor air temperature COLD.

(iv) Supercharger LOW.

(v) Mixture AUTO. RICH.

(vi) Cowling flaps - SHUT (Return controls to NEUTRAL).

Then on last half of circuit:

(vii) Lower landing gear and check for green light. Return control to NEUTRAL. (For emergency instructions see para. 20, Sect. 1.)

(viii) Propellers to INCREASE (fine pitch).

(ix) Wing flaps DOWN. (Return control to NEUTRAL.)

(x) Check the brake pressures by depressing the rudder pedals.

NOTE: If there is resistance on the pedals, hydraulic pressure is available in the brake system. If hydraulic pressure has failed, carry out the instructions given in para. 23.

FINAL APPROACH

21. The final straight approach when loaded to approximately 20,000 lbs. should be carried out at a speed of 120 to 115 m.p.h. I.A.S. with the power off, or 115 to 110 m.p.h. I.A.S. with power on. These speeds should be sufficient to give a reasonable hold-off during the landing.

22. In landing, the aircraft should be held off just above the ground in a slight tail down attitude. This should not be so great as to risk striking the tail on the ground but should be sufficient to give a higher angle of attack and thereby reduce the landing speed. As the main wheels touch on the ground, the aircraft will pitch forward onto the nose wheel and the brakes may be applied as required to reduce the landing run. The load on the nose wheel should be lightened as much as possible by holding the stick back. This concentrates the weight on the main wheels and improves braking.

In the event of nose wheel shimmy, do not apply the brakes since this will increase the load and shimmy. If the shimmy cannot be relieved by holding the stick back or consequently the landing run cannot be completed in the space available, the machine should be taken off and a new landing made.

The aircraft can be landed with the brakes on, but the forward pitch onto the nose wheel is severe and this is not a recommended practice.

After completion of the landing run, taxi clear of the runway and carry out the following:

(i) Raise wing flaps. (Return control to NEUTRAL.)

(ii) Open all cowling flaps. (Return control to NEUTRAL.)

EMERGENCY OPERATION OF FLAPS LANDING GEAR AND BRAKES

23.

(i) In the event of hydraulic pump failure, the landing gear and wing flaps may be lowered by use of the emergency hydraulic hand pump. If the landing gear and/or flap, pipe lines are damaged, or trouble occurs on the hydraulic circuit to these controls, the landing gear may be lowered by means of the emergency release. When operating this release, speed should be reduced to 140 m.p.h. I.A.S. and the gear assisted into place by a sharp depression of the nose.

(ii) In the event of hydraulic power failing completely as a result of pump failure, it will be necessary to operate the brakes after the landing by means of the emergency air-braking system. The air control valve is located on the right side of the pilot's cockpit just forward of the trim tab control unit. The normal procedure for applying the emergency brakes is to open the control valve fully, thus allowing all of the available air pressure to be applied. If the brake pedals are released while the air pressure is being applied, all pressure is lost.

(iii) In the event the air and hydraulic lines themselves are punctured or damaged, obviously no brake pressure would be available, and it is doubtful if the aircraft can be stopped once it is on the ground unless considerable landing run is available. Any attempt to swing the machine by means of the engines to avoid obstacles results in a considerable increase in speed and is not recommended unless ample room is available.

In view of this, if the pilot has any reason to believe that the hydraulic power has failed, both for the brakes as well as the landing gear and flaps, it is most unwise to lower the landing gear by the mechanical means, and a belly landing should be attempted. Once the landing gear has been lowered mechanically, the lack of hydraulic power will prevent it being retracted on the ground, in order to stop the aircraft.

STOPPING ENGINES

24. The following procedure is recommended for stopping the engines. It is suggested that the right engine be stopped first to permit checking of the hydraulic pump on the left engine. After the right engine has been stopped and while the left engine is still running, note the hydraulic pressure and operate the wing flaps. After operation, the hydraulic pressure should recover to 850 - 25 pounds per square inch. (The right engine hydraulic pump should be checked during the starting procedure. This should ensure that both hydraulic pumps are operative for each flight.)

(i) With propeller pitch controls in INCREASE (fine pitch), idle the engines at 800 to 1000 r.p.m. for approximately 5 minutes to allow crankcase to be properly scavenged of oil and cylinder head temperatures to drop to 150°C. (303°F.). If a cold weather start is anticipated, operate oil dilution switches as noted in para. 25.

(ii) Move mixture controls to IDLE CUT-OFF, and at the same time, open throttles.

(iii) When engines have stopped, switch ignition OFF.

(iv) Fuel tanks selectors OFF.

(v) Main battery and other switches OFF.

(vi) All cowling flaps SHUT.

(vii) All hydraulic controls in NEUTRAL.

OIL DILUTION OPERATION

25. When a cold weather start is anticipated, the engines should be stopped in the normal manner (see preceding paragraph) with the exception that while the engines are idling at 800 r.p.m., the oil dilution switches should be held ON for approximately four minutes, and then released when the ignition switches are moved to OFF and after the engines have stopped turning.

PROCEDURE IN EVENT OF ENGINE SECTION FIRE

26. In the event of a fire in an engine section, cut off fuel supply to the engine and immediately feather propeller to prevent fuel and oil being fed to the blaze.

Immediately upon noticing a fire in an engine section, proceed as follows:

(i) Fuel tank selector for engine afire OFF.

(ii) Cross-feed controls OFF.

(iii) Lift fire extinguisher switch guard and depress switch to release the CO_2 gas.

(iv) Mixture control IDLE CUT-OFF.

(v) Propeller FEATHERED.

(vi) Individual engine ignition switch OFF.

(vii) Engine cowling flaps SHUT.

NOTE: The fire extinguisher system incorporates flame actuators in each engine section for automatic release of the CO_2; however, if a fire is promptly noticed, the manually operated switch should be used to avoid any delay that may result in the automatic operation of the flame actuators.

NOTES CONCERNING THE CYCLONE GR-2600-A5B-0 ENGINES

27. Refer to the following for data pertaining to the GR-2600-A5B-0 engines:

(i) Limiting operational conditions

Take-off (3 minutes limit)	Maximum r.p.m. at maximum manifold pressure	2,400 45 inches
Climbing	Maximum r.p.m. at maximum manifold pressure	
	(Low Ratio)	$36\frac{1}{2}$ inches
	(High Ratio)	$41\frac{1}{2}$ inches
Maximum continuous cruising (AUTO RICH) (Low or High ratio)	Maximum r.p.m. at maximum manifold pressure	1,900 30 inches
Maximum continuous cruising (weak mixture) (Low or High Ratio)	Maximum r.p.m. at maximum manifold pressure	1,850 27 inches
Maximum level (5 minutes limit)	Maximum r.p.m. at maximum manifold pressure	2,400
	(Low ratio)	43 inches
	(High ratio)	$44\frac{1}{2}$ inches
Dive	Momentary maximum r.p.m. (throttle not less than one-third open)	2,760

(ii) Oil pressures

Normal range	75 to 90 lb./sq.in.

(iii) Oil inlet temperatures

Minimum for opening up	10°C. steady increase
Maximum for continuous cruising	71°C. approx.
Maximum for climbing	93°C.
Emergency Maximum (5 minutes limit)	104°C.

(iv) Cylinder head temperatures

Maximum for climbing	218°C.
Maximum for cruising	205°C.
Emergency maximum (5 minutes limit)	232°C.

FUEL AND OIL CAPACITY AND CONSUMPTION

28. The following should be noted:

(i) Oil Capacity

Each tank	19 Imp. Gals.
Total (two tanks)	38 Imp. Gals.

(ii) Fuel Capacity

Each main (inboard) tank, approx.	113.0 Imp. Gals.
Each auxiliary (outboard) tank, approximately	53.0 Imp. Gals.
Total (four tanks) approx.	332.0 Imp. Gals.

(iii) Fuel consumptions: The following figures are based on consumption tests, but are subject to carburetor variation of 5%.

Maximum consumptions per engine.

Climbing (1350 H.P.)	Low ratio	141 Imp.Gals/hr.
Climbing (1600 H.P.)	Low ratio	167 Imp.Gals/hr.
Maximum cruising (AUTO. RICH) (900 H.P.)	Low ratio	70 Imp.Gals/hr.
Maximum cruising (AUTO.LEAN) (900 H.P.)	Low ratio	58 Imp.Gals/hr.

Maximum level (1600 H.P.) Low ratio 167 gallons/hr.

NOTE: It is more economical to cruise with the two-speed supercharger in low ratio up to any height provided that the desired A.S.I. can be obtained in this gear.

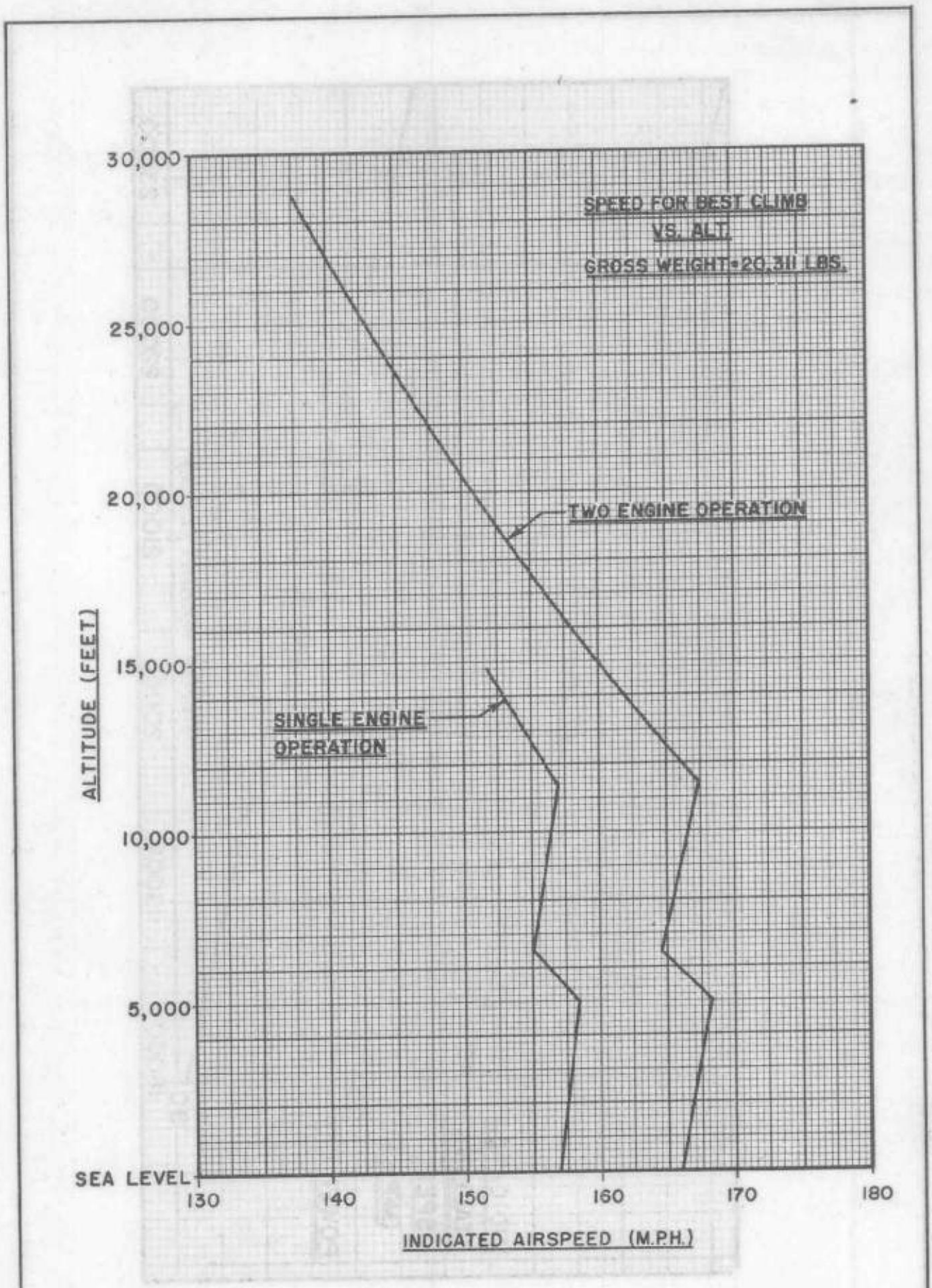


FIG. I BEST CLIMBING AIRSPEED CHART

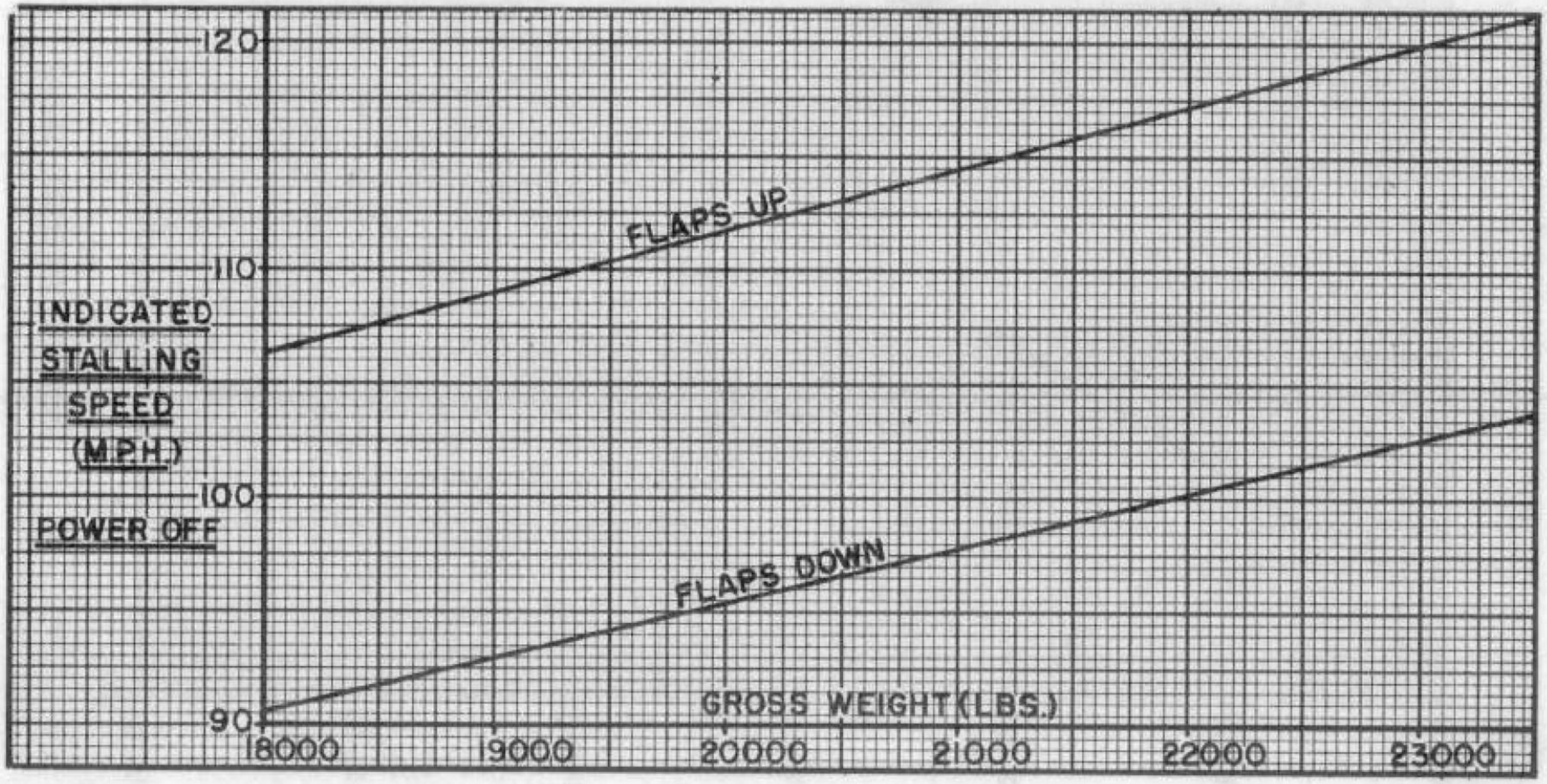


FIG. 2 STALLING SPEED CHART

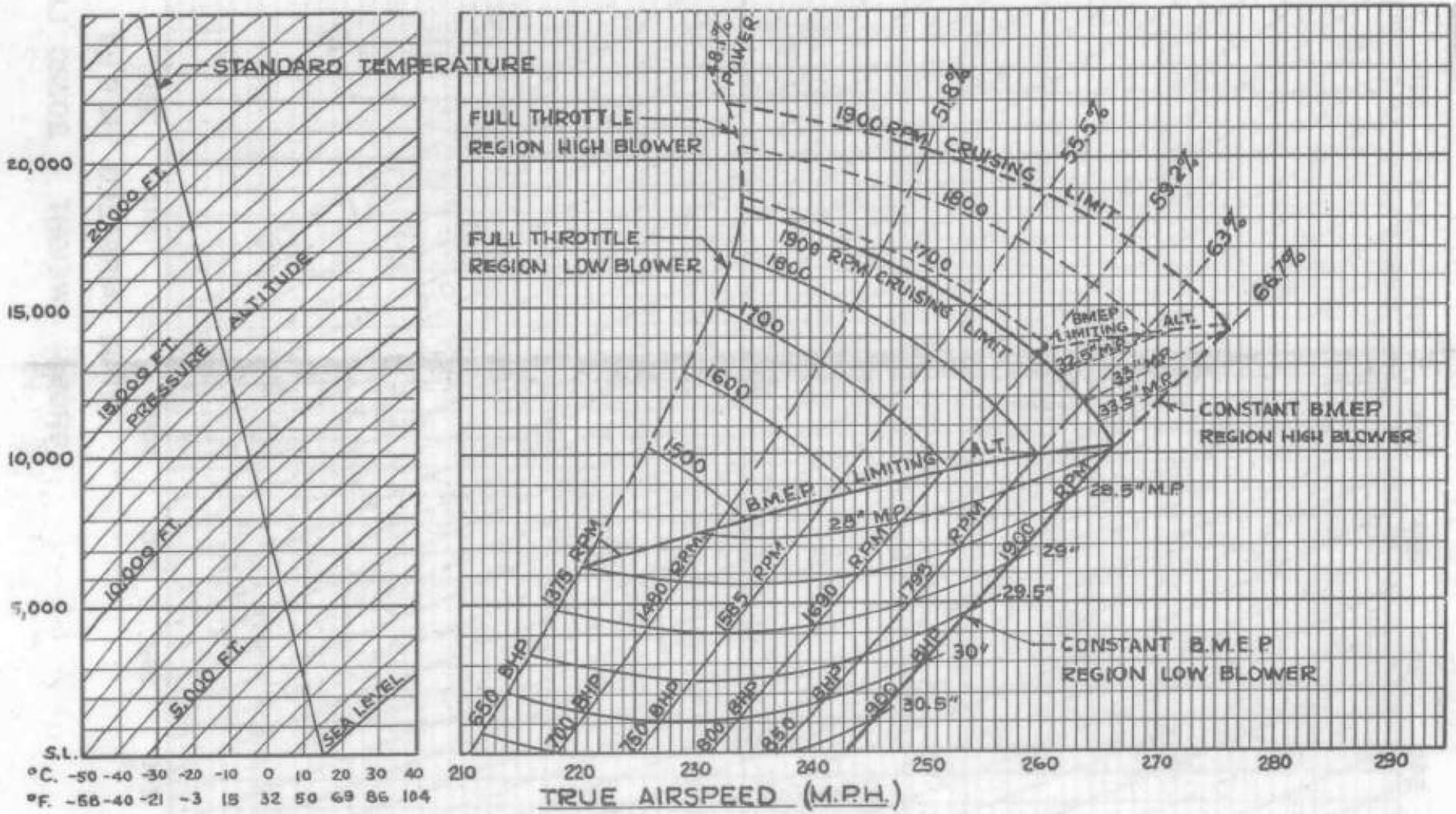


FIG. 3 CRUISING CHART

WEIGHT 20,300 LBS.

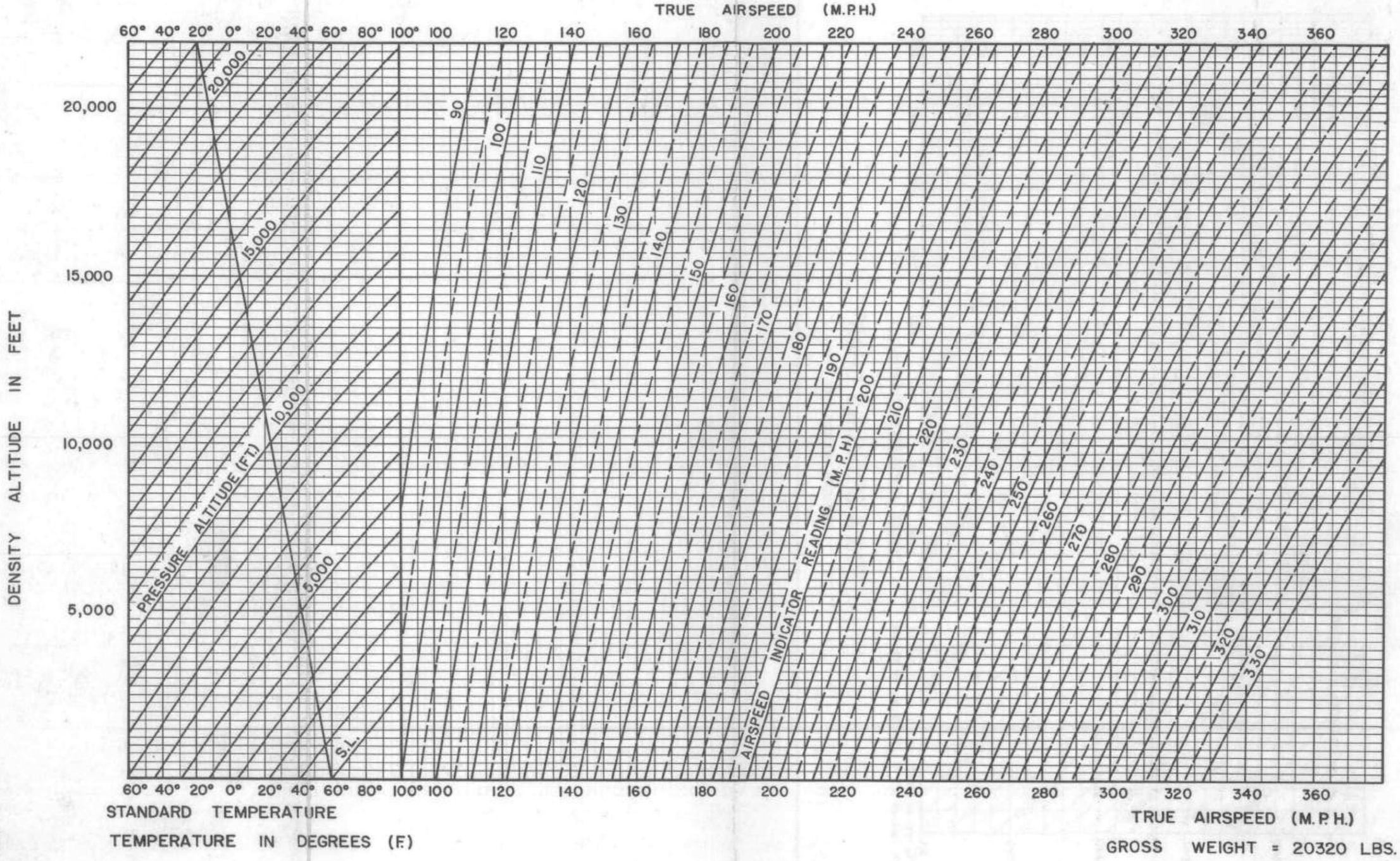
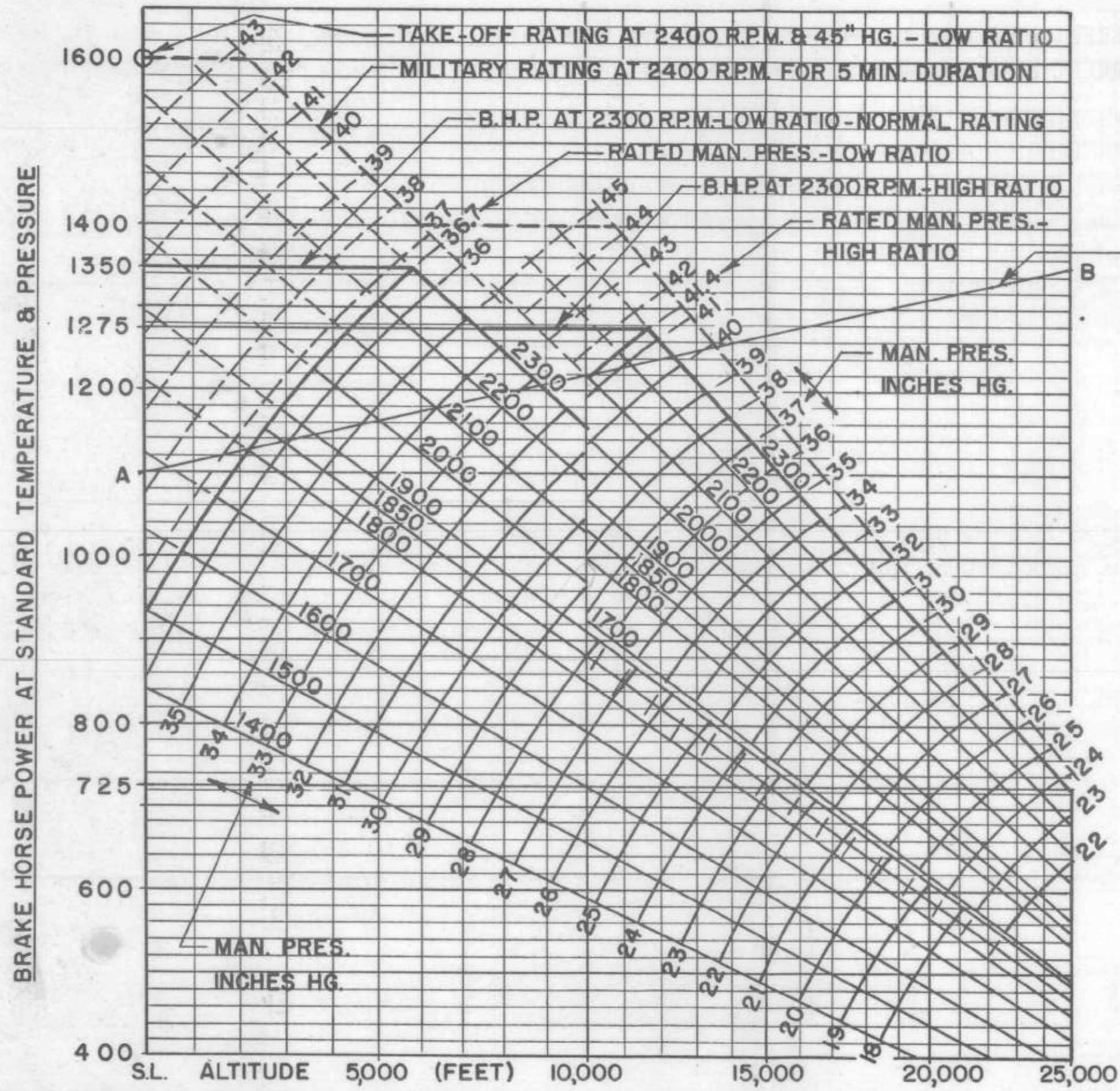


FIG. 4 AIRSPEED CORRECTION CHART



MODEL - GR-2600-A5B
PROP. GEAR RATIO - 16:9
COMP. RATIO - 6.30:1
BLOWER RATIO - 7.14:1 & 10:1
IMPELLER DIAM. - 11 INCHES
FUEL - 90 OCTANE C.F.R.

STANDARD ALTITUDE TEMP.					
ALT.	°C.	°F.	ALT.	°C.	°F.
S.L.	15	59	11000	-7	20
1000	13	55	12000	-9	16
2000	11	52	13000	-11	13
3000	9	48	14000	-13	9
4000	7	45	15000	-15	6
5000	5	41	16000	-17	2
6000	3	38	17000	-19	-2
7000	1	34	18000	-21	-5
8000	-1	30	19000	-23	-9
9000	-3	27	20000	-25	-12
10000	-5	23			

NOTE: ADD APPROXIMATELY .3 IN. HG. FOR EACH 5.5°C. (10°F.) ABOVE STD. AIR TEMP. OR SUBTRACT IF BELOW.

FIG. 5 ENGINE POWER CHART