

HANDBOOK

OF

OPERATION AND FLIGHT INSTRUCTIONS

FOR THE

MODEL A-20A ATTACK BOMBER AIRPLANE

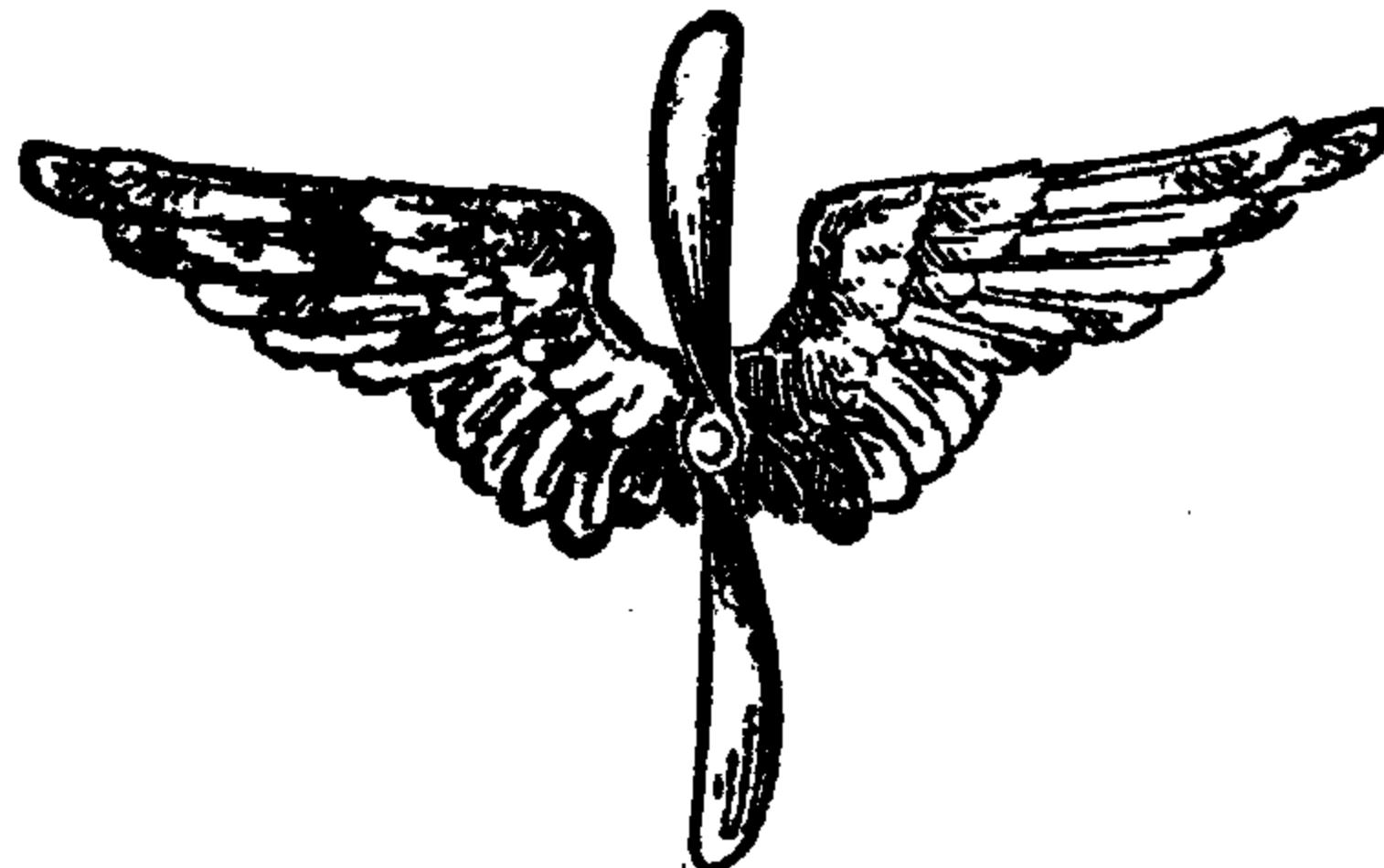
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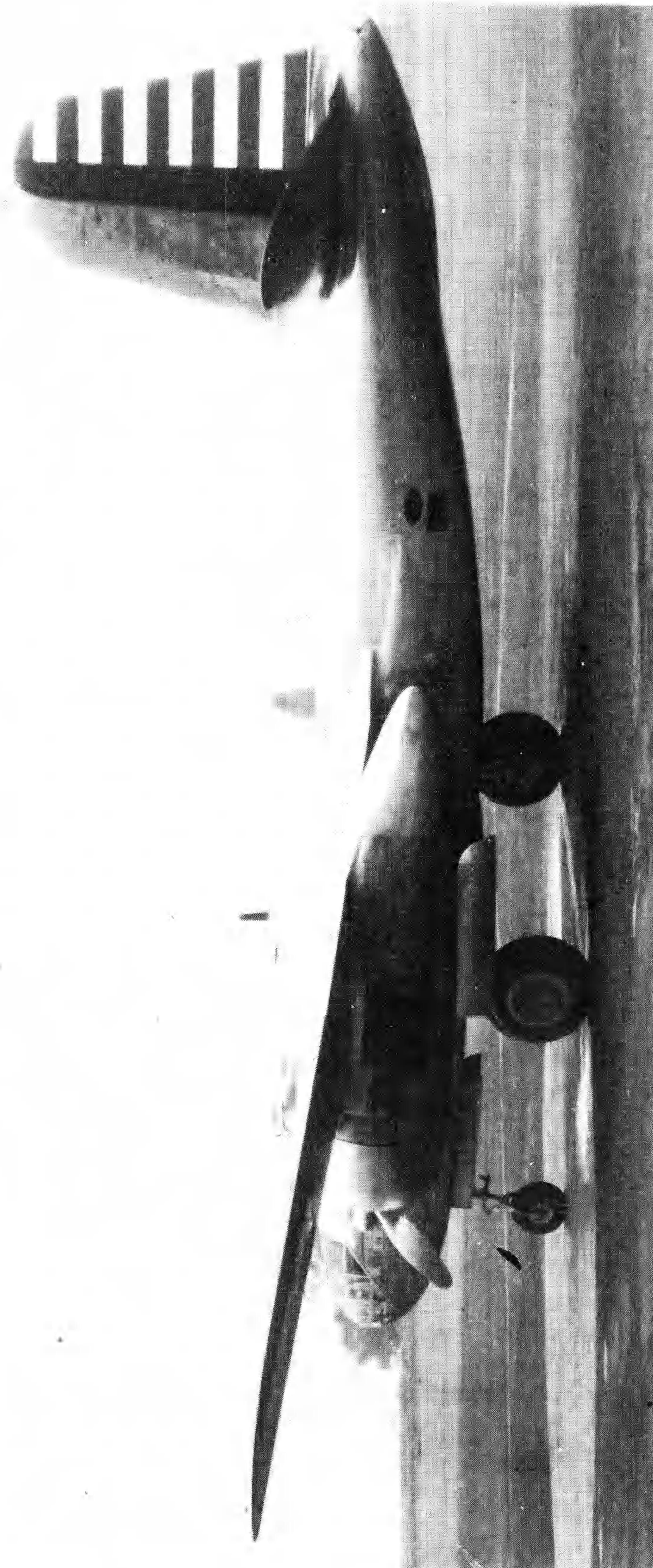


FIG. I - LEFT REAR VIEW OF COMPLETE AIRPLANE

SECTION IINTRODUCTION AND REFERENCES

1. This Technical Order is the Operation and Flight Instructions for the Model A-20A Attack Bomber Airplane. Pilots and other personnel who are required to understand the operation of this airplane will read and be familiar with the information contained herein.

2. Reference has been made in this Handbook to the following Technical Orders which contain applicable data and instructions.

T. O. No.	00-25-5	Procedure to be Followed in Case of Fires During Flight
	01-1-17	Flying Multi-Engined Airplanes with One or More Engines Useless
	01-1-60	Use of Flaps
	02-1-29	Ground Operation Instructions for Aircraft Engines
\$	02-35HA-1	Operation & Flight Instructions - R-2600-3 and -11 engines.
	03-20CA-1	Operation & Flight Instructions, Constant Speed Propeller Governor (Hamilton)
	03-20CC-1	Operation & Flight Instructions - Hamilton Hydromatic Controllable Propeller

SECTION IIDESCRIPTION1. Airplane.

a. General. - The A-20A Attack Bomber Airplane is a three place, twin engined, midwing monoplane incorporating a tricycle landing gear. 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 bombardier, pilot and a gunner.

b. Wing. - The wing is a full cantilever, single spar structure of semi-monocoque construction. The wing is made up of the left and right inboard panels and the left and right outboard panels. Each inner panel incorporates an engine nacelle and wing flaps. Each outer panel incorporates an aileron and a detachable wing tip. The wing flaps are hydraulically operated, two piece, trailing edge type with one section installed on each side of the nacelle. A wing flap position transmitter is linked to the flap mechanism and electrically operates a position indicator mounted on the pilot's instrument panel. The ailerons are of metal frame fabric covered construction and are balanced by means of lead weights in the leading edge. Each aileron has a trim tab controllable by the pilot.

c. Empennage. - The horizontal stabilizer is a two piece full cantilever structure with one panel attached in fixed alignment to each side of the fuselage. Ten degrees dihedral is provided to raise the tips above the wake of the engine nacelles. Each horizontal stabilizer panel incorporates an elevator of metal frame fabric covered construction balanced by lead weights in the leading edge. Each elevator is provided with a trim tab adjustable in flight by the pilot. The vertical stabilizer is a full cantilever structure attached in fixed alignment to the fuselage. It incorporates a rudder of metal frame fabric covered construction balanced by lead weights in the leading edge. The rudder is provided with a trim tab adjustable by the pilot.

d. Fuselage. - The fuselage is of semi-monocoque construction divided into four compartments as follows: bombardier's compartment, pilot's compartment, bomb bay, and gunner's compartment. The bombardier's compartment is located in the window paneled nose section. The pilot's compartment is located aft of the bombardier's compartment. The pilot's compartment is equipped with gun charging cables and a firing switch for operating .30 caliber fixed machine guns mounted in each side of the nose section. The bomb bay is located aft of the pilot's compartment and is divided into a fore and aft section. The bomb bay is equipped to carry fragmentation, chemical

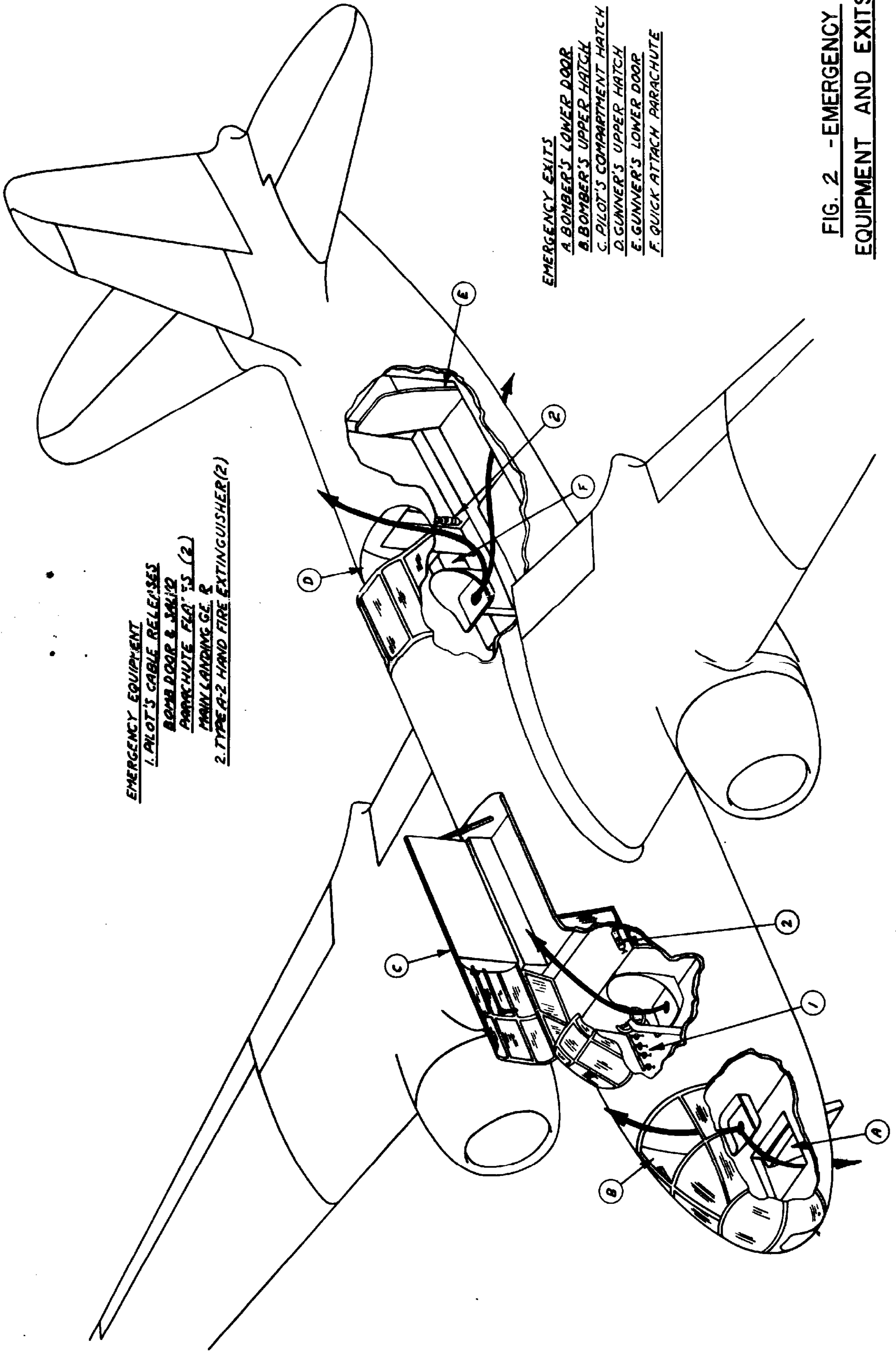


FIG. 2 - EMERGENCY EQUIPMENT AND EXITS

or demolition bombs or a combination of the bombs. The gunner's compartment is located aft of the bomb bay and is equipped with two .30 caliber flexible machine guns. The gunner's compartment is also provided with the flight and engine controls necessary for emergency operation of the airplane. Emergency equipment and exits are illustrated in Figure 2.

e. Landing Gear. - (1) Main Landing Gear: The main landing gear consists of two hydraulically operated units that are retractable into the nacelles. Doors, operated by linkage to the landing gear mechanism, completely enclose the gear when retracted. An automatic safety latch, operated by the initial movement of the actuating strut, is provided to lock the landing gear in full up or full down position. A manual release for the safety latch is provided in the event of hydraulic system failure. Each main landing gear wheel is equipped with hydraulically operated disc type brakes and a $\frac{1}{4}$ inch smooth contour tire.

(2) Nose Wheel Gear: The nose wheel gear is a hydraulically operated unit that is retractable into a well provided in the fuselage below the pilot's compartment. The nose wheel gear is retracted or extended simultaneously with the main landing gear. Doors, actuated by the nose wheel gear, completely enclose the gear when retracted. A latch is provided to lock the gear in retracted position. The latch is released by a cable mechanism operated from the landing gear four-way valve control handle when the handle is moved to "DOWN" position. A snubber is provided which in normal operation limits wheel castor to 30 degrees on each side of center. A release for the wheel snubber is provided to allow 360 degree wheel castor when towing the airplane. The nose wheel is equipped with a 26 inch smooth contour tire.

(3) Position Indicator: A position indicator, electrically operated by a transmitter linked to each landing gear unit, is mounted on the pilot's instrument panel to show the position of each wheel at all times.

(4) Warning Signal: A warning horn, energized by a system of switches installed at the throttle levers will sound if the throttle levers are closed to less than one-quarter segment when any landing gear is not latched in landing position. A switch is provided on the pilot's lower electrical panel to silence the horn if both throttles are closed with the gear not latched in landing position. A switch is provided on the pilot's lower electrical panel to silence the horn if both throttles are closed with the gear not latched in landing position. If only one throttle is closed and the landing gear is not latched in landing position, the silencing switch will quiet the horn only for an instant. To silence the horn, the throttle must be opened beyond one-quarter segment.

2. Power Plant.

a. Engines. - This airplane is equipped with two Wright Double Row Cyclone engines, Model R-2600-11. The engines have a compression ratio of 6.85:1 and are equipped with a two-speed controllable type supercharger. The low blower gear ratio is 7.14:1 and the high blower gear ratio is 10:1. The propeller drive reduction gears have a ratio of 16:9. The propeller shaft rotates clockwise when viewed from the rear of the engine. See T. O. No. 02-35HA-1 for further description and ratings. φ

b. Propellers. - The propellers are Hamilton Standard Hydromatic Quick Feathering type with a diameter of 11 feet 3 inches. Each engine oil system tank provides a one gallon reserve for operating the propeller feathering system.

c. Oil System. - Each engine is provided with an independent oil system. The oil supply for each system is carried in the inboard wing panels. In the airplanes containing integral tanks the oil tank is built into the wing structure and in the airplanes incorporating self-sealing tanks a self-sealing oil container is supplied for each system. Each tank has a capacity of 23 gallons and is provided with a dip stick to measure the oil quantity. The oil tank outlet flange is so constructed as to permit a one gallon reserve for the propeller feathering system. The dip stick is marked to indicate this reserve quantity. An oil temperature regulator is provided for each system. Air flow through the oil temperature regulator is controlled by a flap that is cable operated from the cowl flap mechanism and is adjusted simultaneously with the lower cowl flaps. Oil dilution equipment is provided for cold weather starting. The operating switches are installed on the pilot's lower electrical panel. Two oil pressure and temperature gages are mounted on the pilot's instrument panel.

d. Fuel System. - Each engine has an individual fuel system with the left fuel tanks supplying the left engine and the right fuel tanks supplying the right engine. However, if necessary, any tank may be used to supply either or both engines by means of a pressure cross-feed or suction cross-feed system. The tank capacities and fuel system diagram for those airplanes having integral fuel tanks are shown in Figure 3. For tank capacities and diagram pertaining to the airplanes having the self-sealing tanks refer to Figure 3A. The fuel quantity of each tank is measured by Liquidometer gage. The normal operating pressure of the fuel system, approximately 14 pounds per square inch, is obtained by a fuel pump mounted on each engine. Two fuel pressure warning lights are mounted on the pilot's instrument panel and are designed to eliminate should the pressure drop below 12 (+0, -1) pounds per square inch. Until further instructions are issued, the fuel pressure warning lights are inoperative. Two wobble pumps are provided to furnish pressure φ

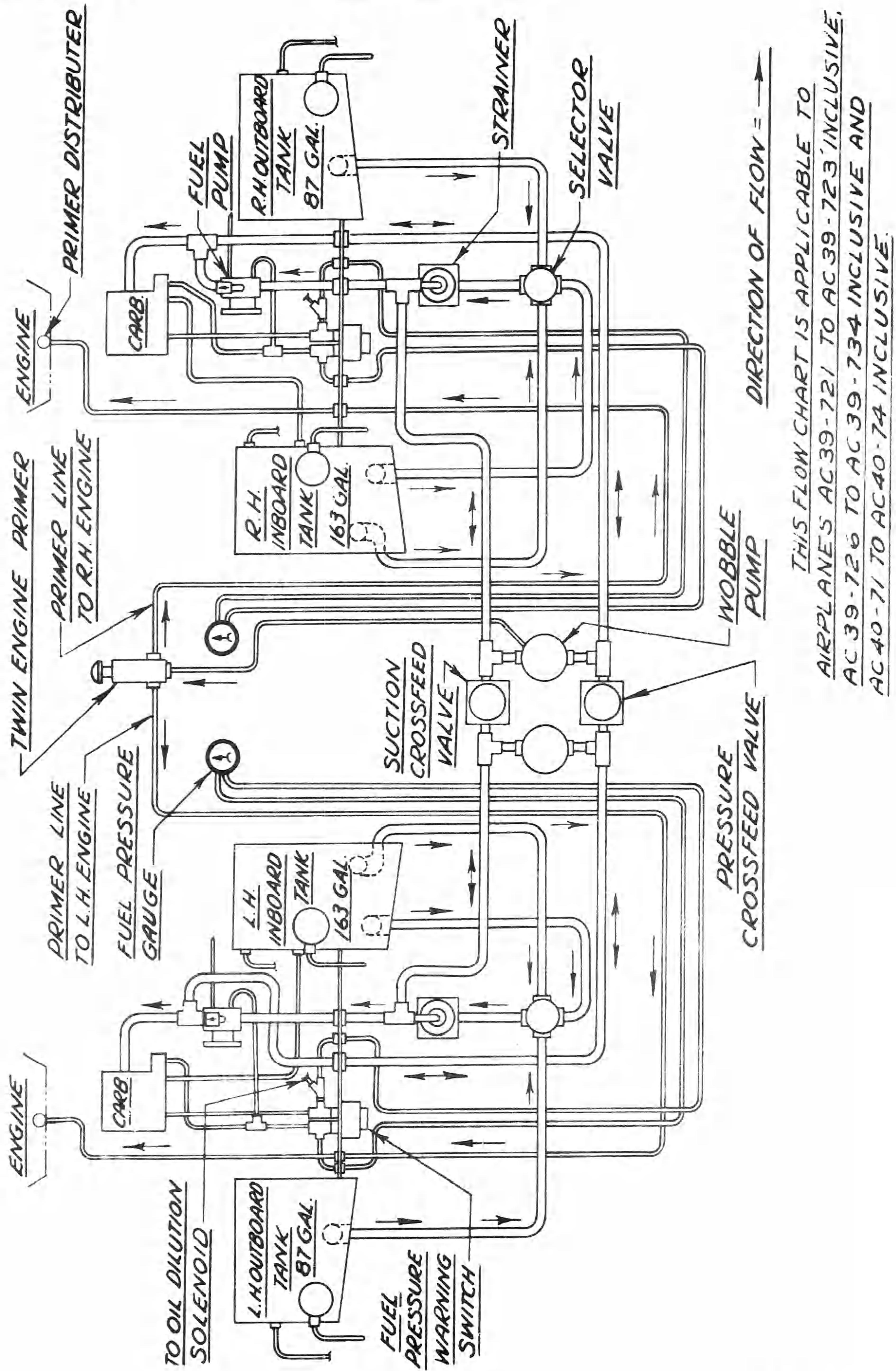


FIG. 3 - FUEL SYSTEM DIAGRAM - INTEGRAL TANKS

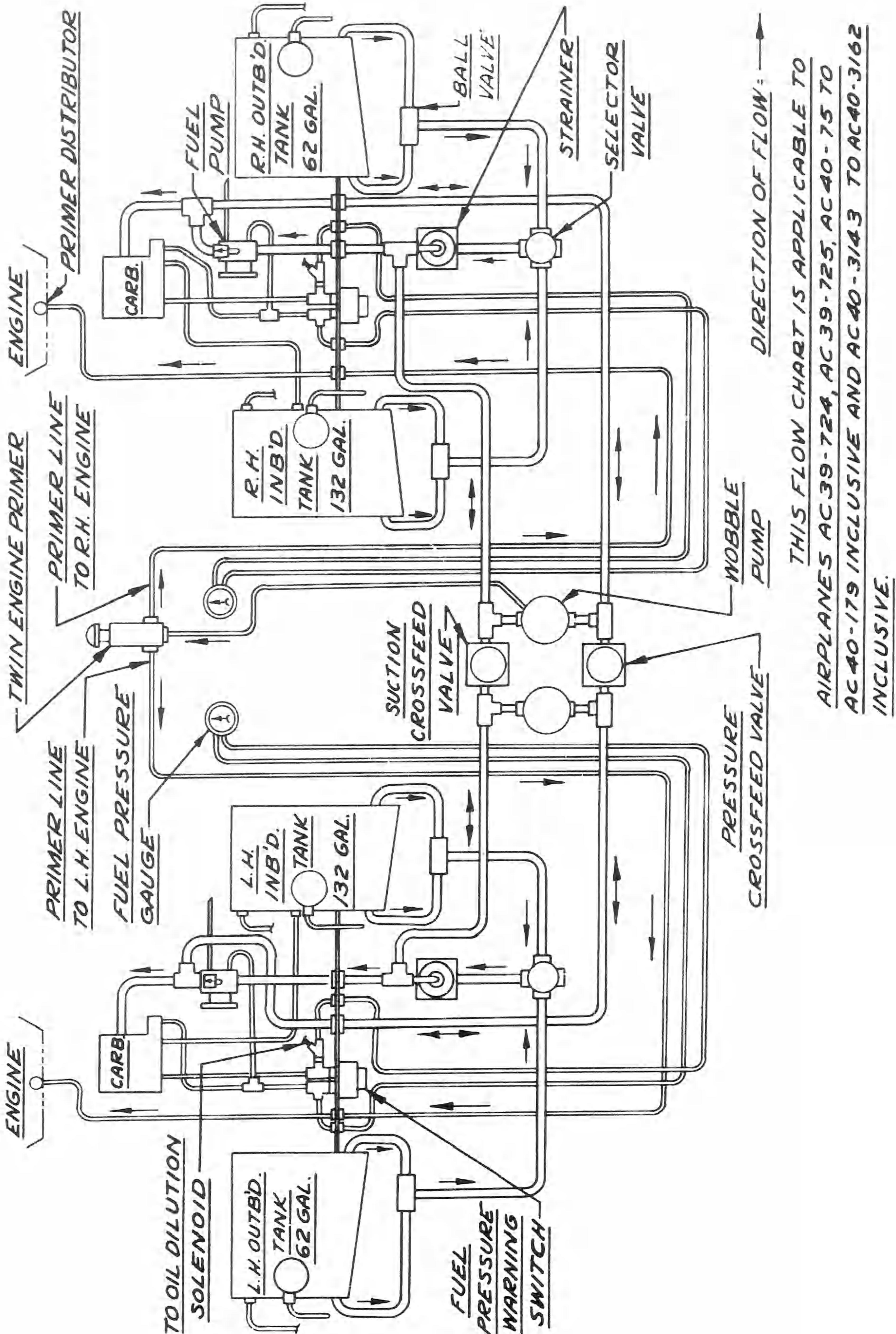


FIG. 3A - FUEL SYSTEM DIAGRAM - SELF SEALING TANKS

when the engine driven pumps are not operating. Both wobble pumps are operated simultaneously by a handle in either the pilot's or gunner's compartment.

3. Equipment.

a. Flight Controls. - Wheel-column-pedal flight controls are provided for the pilot and for the gunner. The gunner's column may be stowed on the left wall of the gunner's compartment. A lock mechanism is provided to secure the flight controls while parking.

b. Hydraulic System. - Hydraulic fluid under pressure is used to operate the landing gear, brakes, wing flaps, bomb doors and cowl flaps. An engine driven pump mounted on each engine supplies pressure to the system through a pressure accumulator. A normal operating pressure of 825 to 875 pounds per square inch is maintained in the accumulator by a pressure regulator valve. The accumulator smooths out the fluid surges and provides sufficient and immediate pressure to operate any of the hydraulic units. A hand pump is provided to either furnish pressure for operating any of the units or to build up hydraulic pressure in the accumulator when the engine pumps are not operating.

c. Ignition and Electrical System. - (1) General: The electrical system is a single wire 12 volt grounded system. A wiring diagram is located aft of the gunner's compartment on the left side of the fuselage above the ammunition containers. Miscellaneous electrical switches on the instrument panels are clearly marked. The gunner's switch panel incorporates two ammeters, a voltmeter, two generator on-off switches and a voltmeter selector switch for checking the generators.

(2) Landing Lights: A retractable landing light is incorporated in the lower surface of each inboard wing panel. Extension or retraction of the landing lights is controlled by switches on the pilot's upper electrical panel. A switch is incorporated in each light unit that will automatically close the lamp circuit, lighting the bulb, when the unit is lowered approximately 10 degrees and automatically opens the circuit when retracted above that position.

(3) Formation Lights: Formation lights are installed in the upper surface of the fuselage and the horizontal stabilizer. The lights are controlled by a rheostat mounted on the pilot's upper electrical panel.

(4) Passing Light: A passing light is mounted in the nose compartment and is controlled by a switch on the pilot's upper electrical panel.

(5) Fuse Boxes: A main fuse box is located on the left side of the fuselage and is accessible through the nose wheel well. A fuse panel for the bombing circuits is located on the right

side of the bombardier's compartment. The main dynamotor fuse box is located on the right side of the pilot's compartment and is accessible to the pilot while in flight.

d. Fuselage Equipment. - (1) Seats: The pilot's seat is adjustable in height. The bombardier's seat is a bucket type mounted on hinge fittings and held in down position by a cable and pin mechanism. The seat may be stowed in a vertical position up against the nose compartment bulkhead where it is retained by a shock cord bungee. The gunner's seat is of a swivel type and may be locked in a fore or aft position. It is also adjustable for height. Each seat is equipped with a Type B-11 safety belt.

(2) Relief Tubes: Each crew member is provided with a relief tube. The bombardier's tube is stowed under a panel in the floor of his compartment. The pilot's and gunner's tubes are stowed on the right side of their respective compartments.

(3) Gunner's Parachute: Stowage brackets for a quick-attachable parachute are installed on the right side of the gunner's compartment.

(4) Life Preserver Cushion: A Type A-1 life preserver cushion is provided for the gunner's seat.

(5) Miscellaneous: A combination navigation case and map case is installed in the pilot's compartment. A check list holder is mounted on the right side of the bulkhead behind the pilot's seat. An airplane data case is installed on the left side of the gunner's compartment. A bomb sight stowage box is installed in the upper aft end of the gunner's compartment and is provided with a key lock.

(6) Bombardier's Compartment: Entry into the bombardier's compartment is made through a door in the floor. The door is unlatched from the outside by a handle located in the right forward corner of the door. The handle also contains a key lock which permits the door to be locked from the outside. From inside, the door is unlatched by a handle located on the centerline of the door near the forward edge. It is also provided with an emergency release located just aft of the unlatching handle. When the emergency release is operated, it pulls the latching pins and a pin attaching the shock cord bungee to the door and allows the door to swing full open. The bombardier's compartment is provided with an emergency hatch (See Figure 2) located in the top of the compartment. The hatch may be opened by a cable release mechanism accessible through a hand hole. To open the hatch, pull cable release and push door out of the opening. Entrance to the bombardier's compartment may be gained from the outside of the airplane by breaking the fabric patch over the cable release hand hole and pulling the cable.

The left hand locking pin is provided with a latch preventing operation of the cable release. It is recommended that the cable release be left unlocked unless it is desired to lock the compartment, preventing entrance from the outside.

(7) Pilot's Compartment: Entry into the pilot's compartment is made through an enclosure installed over the compartment and the deck behind the pilot's seat. The enclosure is hinged on the right side and swings upward and to the right when opened. The enclosure is unlatched from the outside by a handle located at the left rear corner of the enclosure. A key lock installed in the handle also permits the enclosure to be locked from the outside. From inside, the enclosure is unlatched by a handle located on the left side of the enclosure between the forward and aft transparent panels. When opened, the enclosure is held in open position by a brace installed at the aft end of the enclosure. When closing the enclosure, the knee joint of the brace must be broken by operating the handle, located on the centerline of the enclosure between the fore and aft transparent panels. An emergency release handle is provided and is located at the aft transparent panel. When the release handle is operated, it unlatches the enclosure and at the same time pulls the pins from the hinges and the brace. A push on the enclosure allows the airstream to carry the enclosure away. Refer to Figure 2.

(8) Gunner's Compartment: Entry into the gunner's compartment is made through a door installed in the floor of the compartment. The door is made up of a fore and aft section hinged together and is hinged at its aft end to the fuselage structure. When the door is opened, the aft section raises approximately 15 degrees to provide increased clearance for the lower gun in firing position and the forward section swings upward and aft about the hinges attaching it to the rear section. To open the door from outside, operate the latch handle located in the center of the forward section and push upward on the door. From inside, the door may be opened by operating a crank mechanism installed on the right side of the compartment or by operating the latch handle in the center of the forward section and lifting up on the door. A spring bungee is provided to hold the door open when fully raised. The latch handle in the center of the forward section is provided with a key lock should it be desired to lock the gunner's compartment while the airplane is parked. The aft portion of the gunner's enclosure may be opened by moving the aft section of the enclosure forward and stowing it under the fixed section. In the closed position, the aft section is retained by two latches located at the upper aft end of the fixed section. The upper right latch is provided to lock the enclosure while the airplane is parked and it is recommended that the latch be kept in the unlatched position at all times, except when it is desired to lock the gunner's compartment while the airplane is parked. To open the enclosure, unlatch the upper left latch and the upper right latch if it has not been released previously; allow the forward end of the aft section of the enclosure

to drop down and then slide the section forward under the fixed section as far as it will go. A latch is provided to hold the section in the forward position. To close the aft section, release the latch holding it in the forward position by means of the handle located on the right side of the deck; pull the section aft and raise the forward end until held by the upper left latch. If necessary the enclosure may be opened from outside by tearing open a fabric patch provided over an access hole above the upper left latch; however, it is required that the upper right latch be in unlatched position.

e. Heating and Ventilating Equipment. - The heating system is of the steam heated air type. The right engine exhaust collector ring incorporates a boiler where water is converted into steam by the heat of the exhaust gases. The steam passes into a radiator where it heats air brought in from the outside. The heated air is then circulated through ducts to outlets in each crew member's compartment. Any desired interior temperature can be obtained by regulating the mixture of heated air and the air at outside temperature. If desired, air at outside temperature may be circulated through the system in variable amounts.

f. Fire Extinguishing Equipment. - Two Type A-2 fire extinguishers are provided. One is located on the left side of the fuselage deck behind the pilot's seat and the other is located on the right side of the gunner's compartment above the lower entrance door. Refer to T. O. 00-25-5.

g. Oxygen Equipment. - Provision is made to supply oxygen to each member of the crew from Type F-1 oxygen cylinders. Each crew member's compartment is provided with a Type A-9 oxygen regulator.

h. Communications Equipment. - The radio installation consists of a Type SCR-240- Command Set and a Type RC-15A Multiplace Interphone. The transmitter is located on the fuselage deck forward of the heating and ventilating system radiator. The receiver is located on the fuselage deck aft of the heating and ventilating system radiator. Interphone jack boxes are located at each crew member's station. A retractable loop antenna is installed in the floor at the forward end of the gunner's compartment. The loop retracting motor is controlled by a switch on the pilot's lower electrical panel. A fixed antenna is installed between masts on the top of the fuselage and the top of the vertical stabilizer. Remote radio controls are provided on the right side of the pilot's compartment. Provisions are made for the use of a Type T-20-B throat microphone by the pilot. The extension cord is stowed on the top of the radio fuse box located on the right side of the pilot's compartment. The control button is mounted on the inboard throttle

lever. The throat microphone amplifier is mounted forward of the instrument panel. The variable transmitter control is accessible from the bombardier's compartment.

i. Bombing Equipment. - (1) Bomb Bay and Bomb Racks: The bomb bay is located between the pilot's compartment and the gunner's compartment and is divided into a fore and aft section. Each section is provided with two chemical or fragmentation bomb racks and two demolition bomb racks that are carried in the airplane at all times. Each chemical or fragmentation bomb rack can carry 20 bombs and each demolition bomb rack incorporates four stations with supports for Type B-7 bomb shackles. When chemical or fragmentation bombs are carried, chutes and guard plates are installed to protect the demolition bomb racks and rails. No demolition bombs may be carried in the section carrying chemical or fragmentation bombs. The entire bomb load may consist of chemical or fragmentation or demolition bombs or a combination of the various bombs. The normal gross weight provides for the following bomb load:

40 - 17 pound to 30 pound fragmentation bombs,
or 38 - 30 pound chemical bombs,
or 10 - 100 pound demolition bombs,
or 4 - 300 pound demolition bombs,
or 2 - 600 pound demolition bombs,
or 1 - 1100 pound demolition bomb.

Alternate gross weight provides for the following bomb load:

80 - 30 pound chemical bombs,
or 80 - 17 pound to 30 pound fragmentation bombs,
or 16 - 100 pound demolition bombs.

(2) Bomb Controls: Normal release of the bombs may be made by electrical contacts automatically closed within the bomb sight, a momentary contact switch (firing key) on the bombardier's electrical panel, or a Type A-1 Interval control unit. Emergency salvo release of the bombs may be made by the bombardier's "Lock & Salvo" handle or the pilot's "Emergency Release" handle. A bomb "Arm & Safe" handle is provided adjacent to the bombardier's "Lock & Salvo" handle. The bomb bay doors are hydraulically operated and are controlled by the bombardier's "Lock & Salvo" handle or the pilot's "Emergency Salvo" handle. In the event of hydraulic system failure, the bomb doors may be opened and closed by a manually operated handle installed in the bombardier's compartment. The bomb door mechanism is wired in series to the electrical bomb release system and the bombs cannot be electrically released until the bomb doors are open, closing the circuit to the electrical bomb release system. A mechanical safety locking device is incorporated in the bomb door mechanism to prevent release of the bombs by the bombardier's or pilot's salvo handles until the bomb doors are open.

(3) Bomb Release Indicator Lights: Bomb release indicator lights are provided on the bombardier's electrical panel to indicate the active bomb rack stations. When a bomb is released, the indicator light corresponding to the released station will go out. The pilot is provided with a bomb release indicator light mounted on his upper electrical panel. The light flashes on and off as any bomb release switch is closed and opened. A bomb release formation signal light (red) is provided in the tail cone of the airplane. The light flashes on as any bomb release switch is closed and is provided with a five-second time delay to prevent it from going off immediately with the opening of the bomb release switch. The intensity of illumination of the signal can be varied by a rheostat mounted on the bombardier's electrical panel.

(4) Bomb Door Open Indicator Lights: A bomb door open indicator light is provided on the bombardier's electrical panel and the pilot's lower electrical panel. A bomb door open formation signal light (white) is also provided in the tail cone of the airplane. The lights go on when the bomb doors are opened. The intensity of illumination of the tail cone signal can be varied by a rheostat mounted on the bombardier's electrical panel.

j. Gunnery Equipment. - (1) General: The design useful load provides for 4 Model M-2, .30 caliber fixed guns, one Model M-2, .30 caliber flexible gun and one upper rear twin flexible gun which consists of two .30 caliber Model M-2 machine guns mounted side by side in a Bell Adapter. An alternate load condition provides for four additional Model M-2, .30 caliber fixed guns.

(2) Fixed Guns: Each fixed gun is mounted in a compartment in each side of the fuselage below the bombardier's compartment. When the alternate guns are carried, they are mounted outboard of the normally installed guns and are covered by fairings. The fixed guns are controlled electrically through a gun selector switch on the pilot's upper electrical panel and a firing switch mounted on the wheel of the pilot's control column. The selector switch permits firing of the two inboard guns, the two outboard guns or all four guns simultaneously. One pair of manually operated gun charging controls are installed on each side of the pilot's compartment below the instrument panel. The lower charging control of each pair attaches to the inboard gun and the upper control attaches to the outboard gun. A Type N-2A gun sight projector is installed on the floor of the pilot's compartment and the gun sight reflector is mounted on the cowl above the instrument panel. A rheostat for varying the intensity of the projected image on the reflector is mounted on the pilot's upper electrical panel. Ammunition containers for carrying 500 rounds of ammunition for each fixed gun are installed behind the bombardier's seat in the nose compartment.

(3) Flexible Guns: The upper flexible gun consists of two Model M-2, .30 caliber machine guns mounted side by side in a Bell Adapter. This adapter is mounted in a standard GIA Truck which may be moved from one side of the fuselage to the other on a semi-circular track. The Bell Adapter is of the pneumatic type and most of the recoil load is absorbed directly in the mount. The mount has a single trigger which controls both guns as well as a fire and safe control. A total of ten ammunition boxes are supplied, 5 for each gun, making a total of 1000 rounds of ammunition at this point. The guns stow on the centerline of the airplane -- pointing aft, the barrels sliding in stainless steel troughs. When moving the guns from firing position, it is necessary to open the gun tunnel doors which are controlled by means of a foot operated crank. A bungee is incorporated in the design to assist in bringing the guns into the firing position. The lower flexible gun is mounted on a support arm pivotable about a point near the floor on the left side of the gunner's compartment. The arm when lowered and latched in firing position permits the gun to be fired downward and rearward through a door installed in the floor. When the gun is stowed, the arm swings upward and is latched on the left side of the compartment. Ammunition box holders are installed on the left side of the compartment for carrying 500 rounds of ammunition.

(4) Nacelle Guns: Two Model M-2, .30 caliber fixed nacelle guns are mounted, one in each nacelle, firing directly aft. The rear post mounting bracket is made fairly flexible which is necessary in order to gain a large fire pattern. The rear gunner controls these guns and fires them by means of a foot switch located on the floor of the rear gunner's compartment. Charging is done with the control valve located on the L.H. side of the gunner's compartment. Both guns are fired and charged simultaneously. As these are so called splatter guns -- no sighting provisions are included. An ammunition box holding 1000 rounds of ammunition is located in each nacelle directly beneath each gun.

k. Pyrotechnic Installation. - Two parachute flare racks for carrying Type M-8 flares are installed in the aft end of the nose wheel well, with release handles located to the right of the pilot's seat near the floor.

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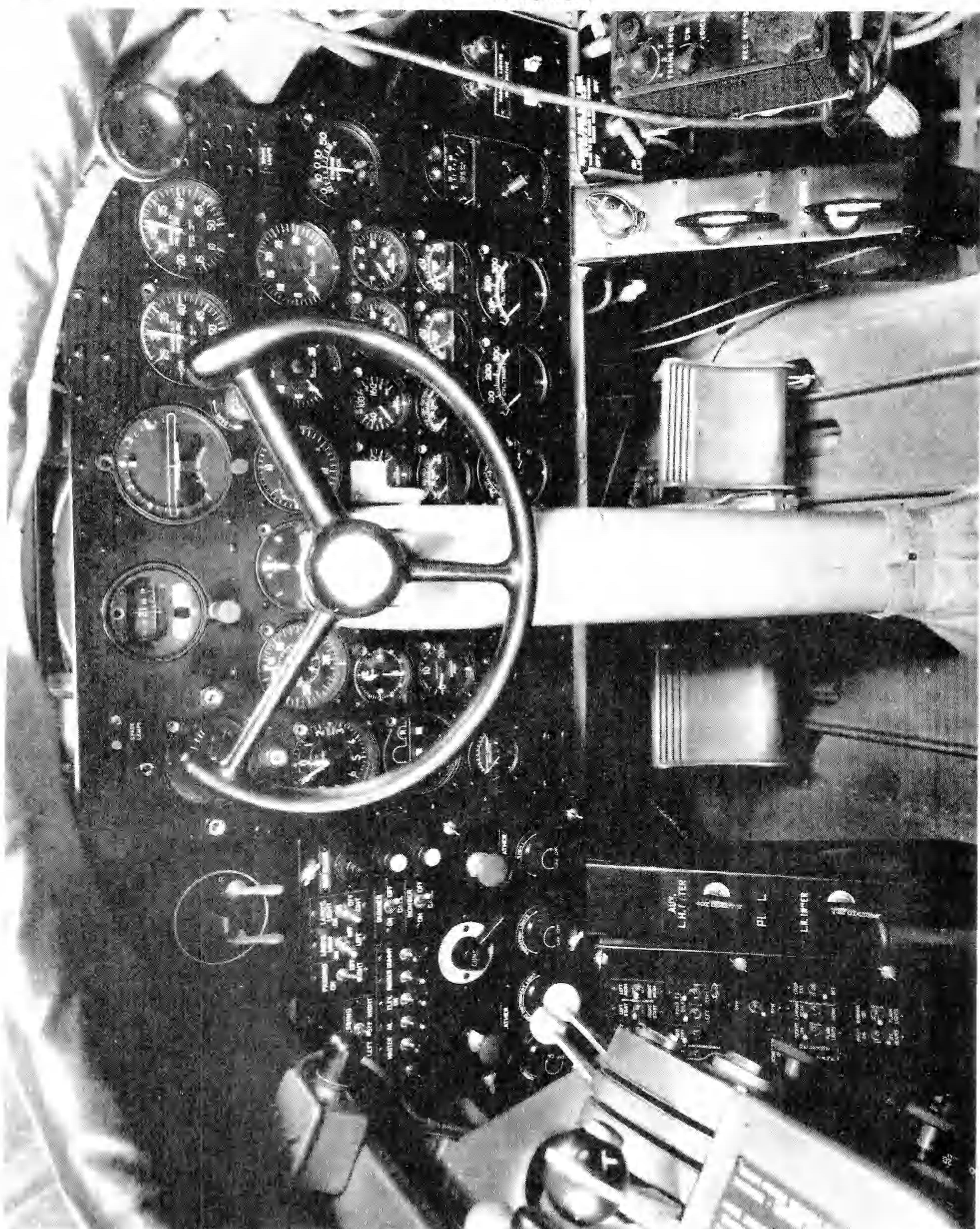


FIG. 4 - PILOT'S INSTRUMENT AND ELECTRICAL PANELS

SECTION IIIGENERAL INSTRUCTIONS

1. Location of Controls. - See Figures 4 to 10 Inclusive.

a. Flight Controls. - (1) Rudder Pedal Adjustment: On inner side of each rudder pedal.

(2) Aileron, Elevator and Rudder Tabs: On tab control box located on the right side of the pilot's compartment.

(3) Flaps: Hydraulic control on panel at left side of pilot's seat.

b. Landing Gear Controls. - (1) Hydraulic Control: On panel at left side of pilot's seat.

(2) Emergency Control: Near floor at right of pilot's seat.

c. Power Plant Controls. - (1) Carburetor Air Temperature: At forward end of fuel valve control panel on left side of pilot's compartment.

(2) Upper Cowl Flaps: Hydraulic control on panel at right side of pilot's seat.

(3) Lower Cowl Flaps and Oil Cooler Flaps: Hydraulic control on panel at right side of pilot's seat.

(4) Cross-Feeds: Engine (pressure) cross-feed and tank (suction) cross-feed controls are on fuel valve control panel on left side of pilot's compartment.

(5) Fuel Tank Selectors: Left fuel tank and right fuel tank selectors are on fuel valve control panel on left side of pilot's compartment.

(6) Ignition Switch: To left of instrument panel and above the upper electrical panel.

(7) Liquidometer Gage Selector Switch: On pilot's instrument panel.

(8) Mixture: On control unit on left side of pilot's compartment.

(9) Oil Dilution Switches: On pilot's lower electrical panel.

(10) Primer: Near lower right corner of pilot's instrument panel.

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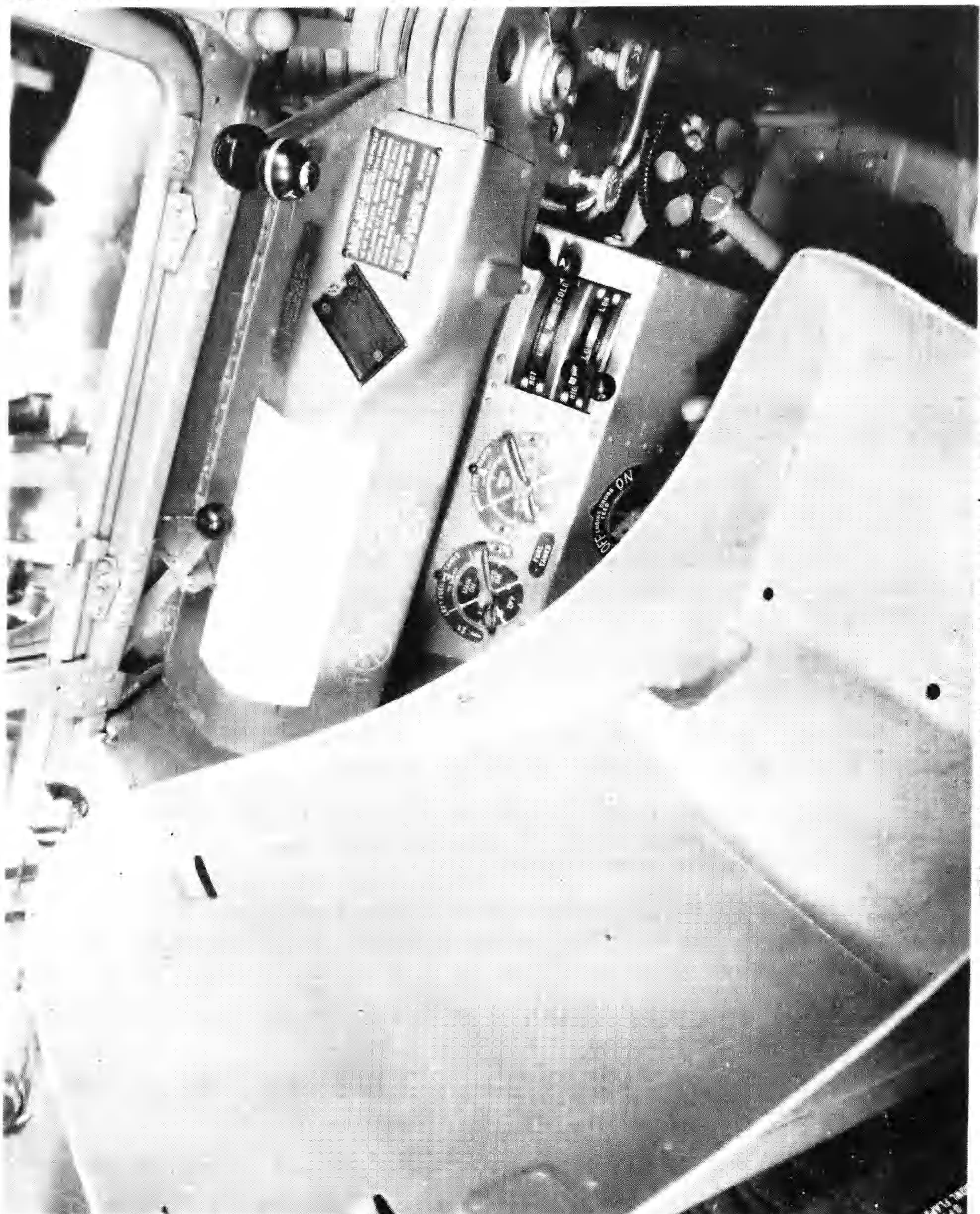


FIG. 5 - CONTROLS - LEFT SIDE PILOT'S COMPARTMENT

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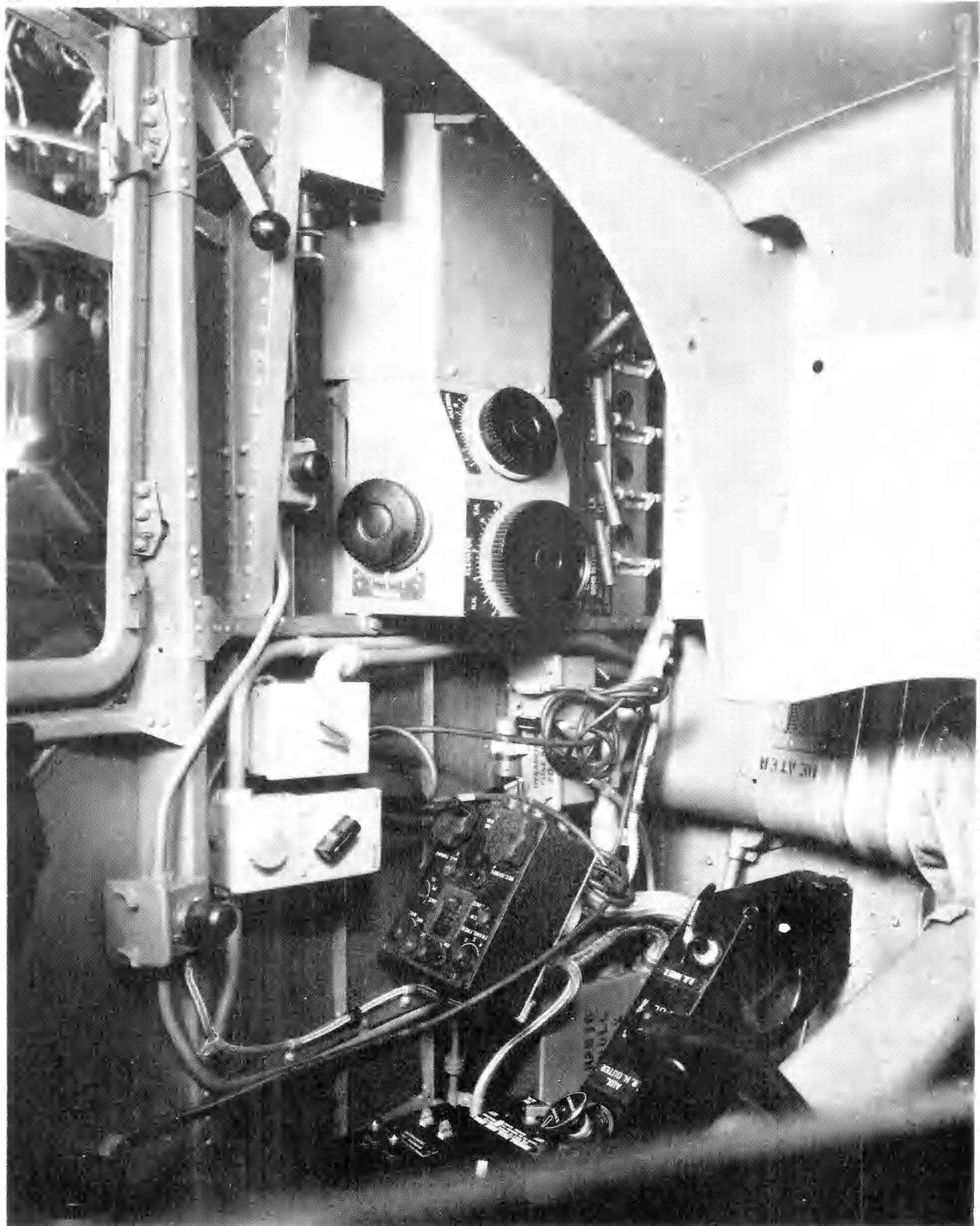


FIG. 6 - CONTROLS - RIGHT SIDE PILOT'S COMPARTMENT

(11) Propeller Feathering Switches: On pilot's upper electrical panel located at left of instrument panel.

(12) Propeller Pitch Controls: On control unit on left side of pilot's compartment.

(13) Starter Switches: On pilot's lower electrical panel.

(14) Supercharger Controls: Adjacent to carburetor air temperature controls at forward end of the fuel valve control panel on left side of pilot's compartment.

(15) Wobble Pump: Red handle adjacent to left forward corner of pilot's seat.

(16) Gunner's Wobble Pump: Red handle below mixture and throttle control unit in left forward corner of gunner's compartment.

d. Other Controls. - (1) Emergency Bomb-Salvo Release: Near floor at right side of pilot's seat.

(2) Fixed Gun Firing Switch: On pilot's control column wheel.

(3) Fixed Gun Selector Switch: On pilot's upper electrical panel.

(4) Flare Release Controls: Near floor on right side of pilot's seat.

(5) Gun Sight Light Rheostat: On pilot's upper electrical panel.

(6) Bomb Arm-Safe Lever: On panel at left side of bombardier's compartment.

(7) Electrical Panel: Installed on right side of bombardier's compartment and contains the following controls:

Bomb Door Open Formation Light Rheostat.
Bomb Firing Switch.
Bomb Indicator Lights Rheostat.
Bomb Release Formation Signal Rheostat.
Bomb Rack Selector Switch.
Chemical Release Switches.
Chemical Tanks Release Switches.
Interval Control Switch.

(8) Emergency Bomb Door Control: On inboard side of bomb control panel installed on left side of bombardier's compartment. Removable handle is stowed on shelf beneath the oxygen cylinders.

(9) Lock-Salvo Control: On panel at left side of bombardier's compartment.

(10) Brakes: Toe pressure on rudder pedals and parking brake control on pilot's instrument panel.

(11) Pilot's Upper Electrical Panel: Located at the left of the instrument panel and contains the following miscellaneous controls:

A.F.C.E. Gang Switch
Bombardier Call Switch
Engine Instrument Lights Rheostat
Flight Instrument Lights Rheostat
Formation Lights Rheostat
Gunner Call Switch
Landing Light Switches
Passing Light Switch
Precessing Switch

(12) Pilot's Lower Electrical Panel: Located below the upper panel on the left side of the compartment and contains the following miscellaneous controls:

Battery Main Line Switches
Cockpit Light Switch
Fuel Pressure Test Switches
Landing Gear Warning Horn Silencing Switch
Pitot Heater Switch
Radio Loop Extending Switch
Running Lights Switch
Synchroscope - Tachometer Switch

(13) Bombardier's Electrical Panel: Located on right side of bombardier's compartment and contains the following miscellaneous controls:

A.F.C.E. Control Switch
A.F.C.E. Bank-Center Switch
Dome Light Switch
Instrument Lights Rheostat
Pilot Call Switch

(14) Gunner's Electrical Panel: Located on the right side of the gunner's compartment and contains the following controls:

Cockpit Light Switch
Generator On-Off Switches
Pilot Call Switch
Voltmeter Selector Switch

(15) Heating and Ventilating System Controls: On panel in upper right corner of the fuselage deck aft of the pilot's seat.

(16) Hydraulic Hand Pump: Near floor at left side of pilot's seat.

(17) Radio Remote Controls: Below instrument panel on right side of pilot's compartment.

(18) Pilot's Seat Adjustment: Vertical adjustment on right side of seat.

(19) Gunner's Seat Adjustment: Vertical adjustment is on the left side of the mounting post and swivel adjustment is just below right side of seat.

2. Operation of Controls.

a. Flight Controls. - (1) General: Operation of the pilot's control column and rudder pedals is conventional. Operation of the gunner's control column and rudder pedals is conventional when the stowable column is in place. To install column remove from brackets on left side of gunner's compartment and insert in socket in center of torque tube. The column is secured in the socket by a spring loaded pawl.

(2) Control Surface Lock: The lock incorporates a hook in the approximate center of the pilot's instrument panel and a hook mechanism on the control column. When the control column is moved full forward and the panel hook is pulled out and engaged in the control column hook, the locking mechanism is engaged. The hook on the panel locks the rudders by means of a plunger which enters a hole in the side of each pedal and the control column hook locks the ailerons by means of a fork engaging the sprocket in the control column head.

(3) Rudder Pedal Adjustment: Rotate lever down to release plunger adjust pedal to desired position and release lever. Insure that plunger is properly seated.

(4) Aileron Tabs: Rotate control to left (counter-clockwise), to raise left wing.

(5) Elevator Tabs: Rotate control to right (clockwise) to raise the nose.

(6) Rudder Tab: Rotate control to right (clockwise) to obtain right yaw.

(7) Flaps: To lower the flaps, move the control to "DOWN" position. When flaps have lowered to desired position as shown by indicator on the instrument panel, return control to "NEUTRAL" position. To raise flaps, move control to "UP" position. When flaps are raised, return control to "NEUTRAL" position. Do not attempt to lower the wing flaps if indicated airspeed is greater than 175 M.P.H. When coming in for a landing and an emergency arises making it necessary to "go around again", do not raise wing flaps until sufficient altitude has been gained to clear any obstacle. For information on use of flaps, refer to T. O. 01-1-60. Refer also to Section IV, Paragraph 1. b.

b. Landing Gear Controls - (1) Landing Gear Hydraulic Control: To retract the landing gear, move control to "UP" position. When gear is fully up and latched as shown by the position indicator on the pilot's instrument panel, return the control to "NEUTRAL" position. To extend the gear, move control to "DOWN" position; and leave in that position. ♂

(2) Pilot's Emergency Control: This control is provided to allow the landing gear to be lowered in the event of hydraulic system failure. To operate, set hydraulic control in "DOWN" position and pull emergency control. The emergency control releases the latches, allowing the landing gear to drop down into landing position. If gear fails to extend when the emergency release is pulled, nose plane down sharply from a low airspeed to throw gear down.

(3) Brakes: (a) Toe pressure on the rudder pedals operates the brakes. A pull type control is provided to set the brakes for parking. To set brakes, apply toe pressure to the brake pedals until fully depressed and pull out control knob; release pedals before releasing knob. To release brakes, depress pedals; knob will return to off position. The hydraulic pressure gage should show 500 pounds per square inch minimum pressure for satisfactory operation.

(b) The brakes may be operated after hydraulic system failure by using the hand pump simultaneously with brake application. Test brakes before landing by depressing the toe pedals and operating hand pump. Toe pedal load should build up if hand pump is operated. Apply brakes steadily on landing. Do not pump brakes as loss of pressure will result, and excessive hand pumping will be necessary.

c. Power Plant Controls. - (1) Cold Engine Starting: Engine operating instructions are contained in T. O. No. 02-35HA-1. The following is the starting procedure when the engine is cold:

(a) Pull propellers through by hand.

(b) Set right fuel tank selector control at "4-RES. ON" when starting right engine and left fuel tank selector at "3-RES. ON" when starting left engine.

NOTE: Keep fuel tank selector at "OFF" for engine not being started to avoid overpriming while starting first engine if engines are warm and priming is done with the wobble pump.

(c) Set both cross-feed controls at "OFF".

(d) Set supercharger controls (B) in "LOW" position.

(e) Place carburetor air temperature controls (a (A) in "COLD" position.

(f) Place upper cowl flaps control and lower cowl flaps - oil cooler flap controls in "OPEN" position. Operate hydraulic hand pump until flaps are open, then return controls to "NEUTRAL" position.

NOTE: Use hydraulic hand pump to actuate the flaps until engines are running and supplying hydraulic pressure. Insure that all other hydraulic controls are in "NEUTRAL" position before operating the hydraulic hand pump.

(g) Place propeller controls (P) in high R.P.M. (low pitch) position.

(h) Set throttles (T) for 1000-1100 R.P.M.

(i) Place mixture controls (M) in "IDLE CUT-OFF" position.

(j) Set battery main line switches "ON".

(k) Move ignition battery switch to "ON" and switch for engine being started to "BOTH".

(l) Pump external hand primer approximately five (5) strokes.

(m) Raise fuel pressure slowly to 10 or 11 pounds per square inch with wobble pump. Move mixture control from "IDLE CUT-OFF" to "EMERGENCY RICH" while actuating the wobble pump until a good stream of gas runs out the supercharger drain. Then move the mixture control back to "IDLE CUT-OFF" and engage the starter, and as soon as the engine fires, move the mixture control to "EMERGENCY RICH".

(n) Energize and engage starter.

(o) When engine fires, move mixture control to "EMERGENCY" (manual full rich) position.

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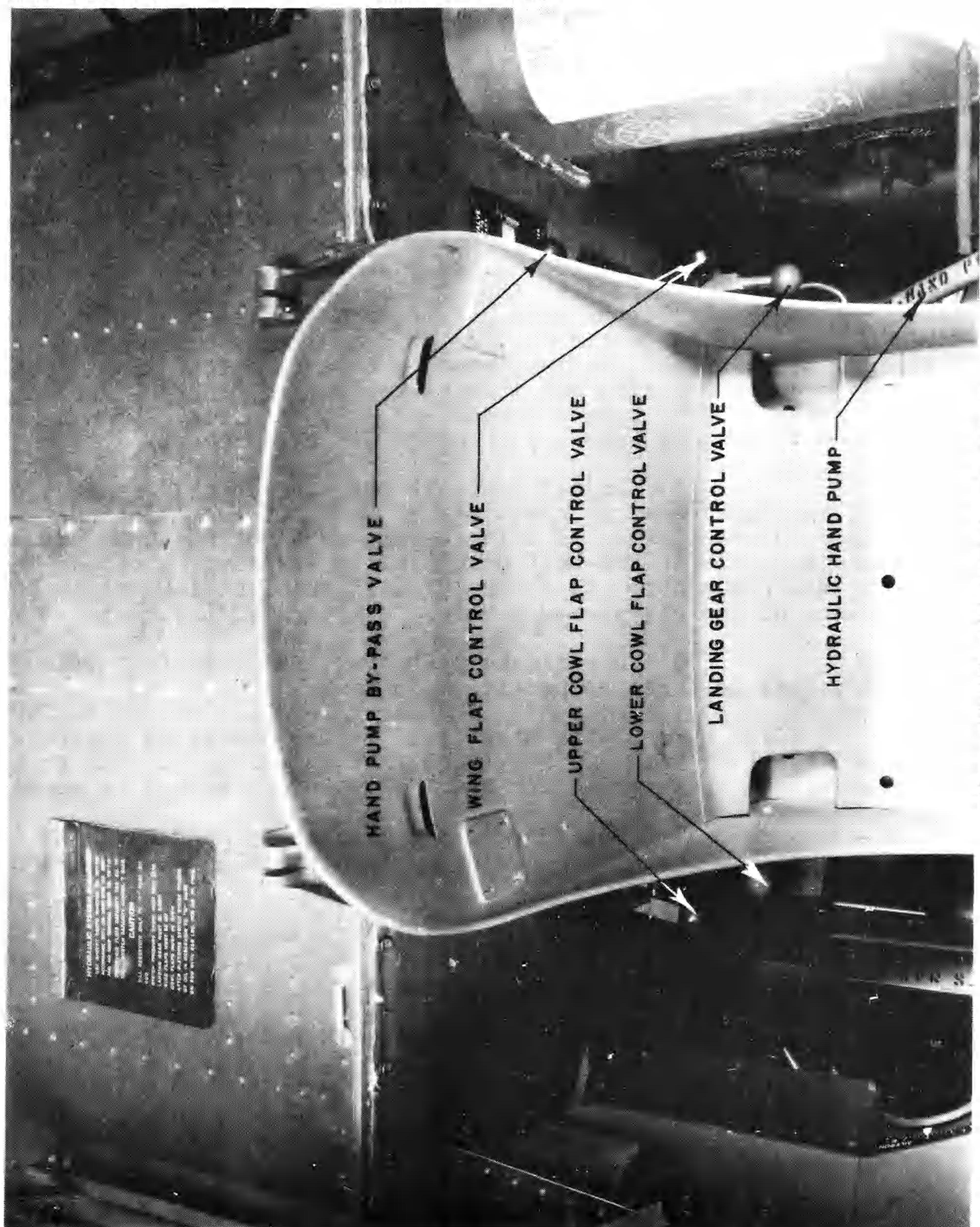


FIG. 7 -PILOT'S HYDRAULIC CONTROLS

NOTE: In extremely cold weather when ship has been outside for several hours or more, it would be necessary, in addition to the above procedure, to operate the primers before and after the engine had started. The wobble pump should not be used during the starting operation after mixture control has been moved out of "IDLE CUT-OFF" position unless the fuel pressure is not obtained with the engine-driven fuel pump. In case it is necessary to use the wobble pump, extreme caution should be used because of the danger of flooding the engine and causing a fire. If engine fails to start, the pumping will be discontinued the moment the engine ceases to turn. Further attempt at starting should not be made while any fuel drips from the supercharger drain. If engine is overprimed, as indicated by excessive fuel flowing out of the supercharger drain, set mixture control at "IDLE CUT-OFF", ignition switch "OFF", open throttle and pull propeller through several revolutions by hand until engine has cleared out.

(p) Adjust controls for warm-up and ground test after oil pressure shows on gage. Refer to T. O. Nos. 02-35HA-1 and 02-1-29 for instructions. If oil pressure does not reach 40 pounds per square inch within one-half minute after starting, stop engine by moving mixture control to "IDLE CUT-OFF" and ignition switch "OFF". Locate cause of low oil pressure before starting engine again.

(q) For flight operation, set both fuel tank selector valves to their respective main tanks.

(2) Warm Engine Starting: Engine operating instructions are contained in T. O. Nos. 02-35HA-1 and 02-1-29. The following procedure is recommended for starting when the engine is warm:

(a) Pull propellers through by hand at least three revolutions if engines have been standing idle for more than two hours.

(b) Set right fuel tank selector control at "4-RES. ON" when starting right engine and left fuel tank selector at "3-RES. ON" when starting left engine.

NOTE: Keep fuel tank selector at "OFF" for engine not being started to avoid overpriming while starting first engine if engines are warm and priming is done with the wobble pump.

(c) Set both cross-feed controls at "OFF".

(d) Set supercharger controls (B) in "LOW" position.

(e) Place carburetor air temperature controls (A) in "COLD" position.

(f) Place upper cowl flaps control and lower cowl flaps - oil cooler flap controls in "OPEN" position. Operate hydraulic hand pump until flaps are open, then return controls to "NEUTRAL" position.

NOTE: Use hydraulic hand pump to actuate the flaps until engines are running and supplying hydraulic pressure. Insure that all other hydraulic controls are in "NEUTRAL" position before operating the hydraulic hand pump.

(g) Place propeller controls (P) in high R.P.M. (low pitch) position.

(h) Set throttles (T) for 1000-1100 R.P.M.

NOTE: To provide the correct fuel-air mixture ratio, it may be necessary to open the throttle slightly beyond this position.

(i) Place mixture controls (M) in "IDLE CUT-OFF" position.

(j) Set battery main line switches "ON".

(k) Move ignition battery switch to "ON" and switch for engine being started to "BOTH".

(l) Raise fuel pressure slowly to 10 or 11 pounds per square inch with wobble pump.

(m) Energize and engage starter.

(n) When engine fires, move mixture control to "EMERGENCY" (manual full rich) position.

NOTE: The wobble pump should not be used during the starting operation after mixture control has been moved out of "IDLE CUT-OFF" position unless the fuel pressure is not obtained with the engine-driven fuel pump. In case it is necessary to use the wobble pump, extreme caution should be used because of the danger of flooding the engine and causing a fire. If engine fails to start, the pumping will be discontinued the moment the engine ceases to turn. Further attempt at starting should not be made while any fuel drips from the supercharger drain. If engine is overprimed, as indicated by excessive fuel flowing out of the supercharger drain, set mixture control at "IDLE CUT-OFF", ignition switch "OFF", open throttle and pull propeller through several revolutions by hand until engine has cleared out.

(o) Adjust controls for warm-up and ground test after oil pressure shows on gage. Refer to T. O. Nos. 02-35HA-1 and 02-1-29 for instructions. If oil pressure does not reach 40 pounds

per square inch within one-half minute after starting, stop engine by moving mixture control to "IDLE CUT-OFF" and ignition switch "OFF". Locate cause of low oil pressure before starting engine again.

(p) For flight operation, set both fuel tank selector valves to their respective main tanks.

ø (3) Stopping Engine: Refer to T. O. Nos. 02-35HA-1 and ø 02-1-29 for stopping, ground operation and oil dilution instructions. Stopping procedure is as follows:

(a) Leave propeller control in high R.P.M. (low pitch) position. Idle engine for approximately 5 minutes to allow the crankcase to be properly scavenged of oil and cylinder head temperatures to lower to less than 150° C. (302° F.).

(b) Move mixture control to "IDLE CUT-OFF" and at the same time open throttle. This will give a clean cut-off without after-firing.

(c) When propeller stops rotating, turn ignition "OFF".

(d) Set fuel tank selector control to "OFF" position. Do not stop engine by shutting off fuel with tank selector control. This allows vapor to be pumped into the regulator unit of the Bendix-Stromberg Injection Carburetor.

CAUTION: Do not move propeller until engine has thoroughly cooled.

ø (4) Fuel System: (a) Fuel Cross-Feed Controls: Two fuel cross-feed controls are provided. The "ENGINE CROSS-FEED" control operates the pressure cross-feed system and the "TANK CROSS-FEED" control operates the suction cross-feed system. (See Fig. 3 and 3A). For operation of the cross-feed valves, refer to T. O. No. 02-35HA-1. ø

(b) Fuel Tank Selector Controls: Two fuel tank selectors are provided to select the tanks that are to supply fuel to the engines. In normal operation, each engine has an individual fuel system whereby the left fuel tanks supply the left engine and the right tanks supply the right engine. If the need arises, any tank may be used to supply either or both engines by operating the fuel tank selectors in conjunction with the cross-feed controls. The normal selector control positions are as follows with the cross-feed controls "OFF":

OFF - No fuel supplied to engines.

AUX. ON - No. 1, left outboard tank, and
No. 2, right outboard tank, supplying
the left and right engines
respectively. See Fig. 3 and 3A. ♂

MAIN ON - No. 3, left inboard tank, and No. 4
right inboard tank, supplying the
left and right engines respectively.
Only airplanes having integral
tanks have a reserve supply.
Approximately 54 gal. reserve is
available from each of the 163 gal.
tanks.

(c) Liquidometer Selector Switch: The selector switch for the Liquidometer gage has the following positions:

Number 1 - Left auxiliary (outboard) tank.
Number 2 - Right auxiliary (outboard) tank.
Number 3 - Left main (inboard) tank.
Number 4 - Right main (inboard) tank.

NOTE: Positions number 3 and 4 give total tank capacity which includes the reserve supply.

(d) Mixture Controls: Four positions are provided as follows: "EMERGENCY", "AUTOMATIC RICH", "AUTOMATIC LEAN" and "IDLE CUT-OFF". When control is set at "AUTOMATIC RICH" or "AUTOMATIC LEAN", automatic mixture control is provided. Refer to the engine operation instructions, T. O. No. 02-35HA-1 for settings of mixture controls in conjunction with engine operation. ♂

In normal operation, gunner's control is kept in aft position. Forward movement of control to "RICH" position gives full rich mixture condition corresponding to setting of pilot's control at "EMERGENCY" position. Gunner may return control aft from "RICH" position; however, the carburetor setting will not be changed. Operation of the pilot's control does not affect the gunner's control except when gunner's control is at "RICH" position and pilot's control is moved aft from "EMERGENCY".

(e) Primer: Push in on handle and turn to "ON" position for engine to be primed. Pull out handle full length and push in for priming stroke. To lock handle, push in completely and turn to "OFF" position.

(f) Supercharger: Forward movement of controls to "LOW" position gives 7.14:1 blower ratio; aft movement to "HIGH" position gives 10:1 ratio. Refer to the engine operation instructions, T. O. No. 02-35HA-1 for blower control positions in conjunction with engine operation. To change blower speed, set mixture control to full rich, throttle control to one-quarter open; then shift blower control and reset throttle and mixture controls as desired.

CAUTION: Do not change to high blower below 9,000 feet altitude. Do not change blower ratios at intervals of less than 5 minutes. Do not leave blower control in an intermediate position; must be in either the full forward or full aft position.

(g) Wobble Pump: The wobble pump handle should be operated slowly and smoothly. Under all conditions when fuel pressure failure occurs, use wobble pump immediately and then attempt to locate the trouble.

(h) Operation in Event of Fuel Pump Failure:

1. Left-Hand System: If fuel pressure drops for left-hand system, operate the wobble pump. If pressure comes up with use of wobble pump, fuel pump failure is indicated. In this event, if no fuel is desired from a left-hand tank, set engine (pressure) cross-feed "ON" and left fuel tank selector "OFF". Leave tank (suction) cross-feed "OFF". Fuel will be supplied to both engines from the right tank for which right fuel tank selector is set. If fuel is desired from a left tank, set left fuel tank selector to tank desired, right fuel tank selector "OFF", tank (suction) cross-feed "ON" and engine (pressure) cross-feed "ON". Fuel will be supplied to both engines from the left tank for which the left fuel selector is set.

2. Right-Hand System: If fuel pressure drops for right-hand system operate the wobble pump. If pressure comes up with use of wobble pump, fuel pump failure is indicated. In this event, if no fuel is desired from a right tank, set engine

(pressure) cross-feed "ON" and right fuel tank selector "OFF". Leave tank (suction) cross-feed "OFF". Fuel will be supplied to both engines from the left tank for which the left tank selector is set. If fuel is desired from a right tank, set right fuel tank selector to tank desired, left fuel tank selector "OFF", tank (suction) cross-feed "ON" and engine (pressure) cross-feed "ON". Fuel will be supplied to both engines from the right tank for which the right fuel tank selector is set.

(i) Operation in Event of Relief Valve, or Fuel Line Failure:

1. Left Hand System: If fuel pressure drops for left hand system, operate the wobble pump. If pressure fails to come up with use of wobble pump, fuel pump relief valve or fuel line failure is indicated. In this event, leave both cross-feed controls at "OFF" and set left fuel tank selector to "OFF". This necessitates single engine operation; refer to T. O. No. 01-1-17.

CAUTION: Do not attempt to use fuel from a left hand tank if failure is due to a broken line.

2. Right Hand System: If fuel pressure drops for right hand system, operate the wobble pump. If pressure fails to come up with use of the wobble pump, fuel pump relief valve or fuel line failure is indicated. In this event, leave both cross-feed controls at "OFF" and set right fuel tank selector to "OFF". This necessitates single engine operation; refer to T. O. No. 01-1-17.

CAUTION: Do not attempt to use fuel from a right hand tank if failure is due to a broken line.

(5) Propeller: (a) General: For instructions pertaining to the operation of the propeller and governor refer to T. O. 03-20CC-1 and T. O. 03-20CA-1, respectively.

(b) Propeller Feathering Switches: Push in switch for propeller to be feathered. Switch will automatically release when propeller is feathered. To unfeather propeller push in switch and hold until propeller is unfeathered and then release switch.

(c) Emergency Feathering: 1. Push in propeller feathering switch.

2. Close throttle.

NOTE: Landing gear warning horn will sound when throttle is closed. After propeller is completely feathered open throttle to more than one-quarter segment to silence horn.

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3. Set propeller pitch control in minimum R.P.M. (high pitch) position.
4. Close cowl flaps.
5. Move mixture control to "IDLE CUT-OFF" position.
6. Set fuel tank selector control in "OFF" position.
7. Turn off ignition when propeller stops rotating.
8. Operate airplane in accordance with T. O. No. 01-1-17.

(d) Unfeathering: 1. Set fuel tank selector to tank desired.

2. Place mixture control in "EMERGENCY" (Manual full rich) position.

3. With throttle closed and propeller pitch control in minimum R.P.M. (high pitch) position, turn on ignition.

4. Push in feathering switch and hold until 800 R.P.M. is obtained and then release switch.

5. Allow engine to operate at this R.P.M. until the required head temperature, oil temperature, fuel pressure and oil pressure are obtained. Then open throttle gradually causing engine to speed up to minimum R.P.M. or speed for which governor is set.

6. Adjust mixture throttle and propeller pitch to desired power and engine R.P.M. and synchronize with other engine.

(e) Propeller Pitch Controls: Forward movement of levers to "INCREASE" (low pitch) position increases engine R.P.M. aft movement to "DECREASE" (high pitch) position reduces engine R.P.M. Refer to engine operation instructions, T. O. No. 02-35HA-1 for settings in conjunction with engine operation.

d. Other Controls. - (1) Pilot's Bomb and Gun Controls:

(a) Emergency Bomb Salvo Release: This control opens the bomb doors and releases the bombs in salvo in two stages of operation. The initial pull on the control opens the bomb doors.

When doors are open as indicated by the bomb door light, additional pull on the handle releases all bombs in salvo.

(b) Fixed Gun Firing Switch: Conventional operation.

(c) Fixed Gun Selector Switch: This switch has four positions noted as follows: "OFF", "INNER", "OUTER", and "SALVO". When switch is set at "INNER" position, the left and right inboard guns are fired simultaneously by the firing switch. When the left and right outboard guns are installed and the switch is set at "OUTER" position, the two outboard guns are fired simultaneously by the firing switch. In "SALVO" position, all four guns are fired in unison by the firing switch.

(d) Gun Sight Light Rheostat: This rheostat varies the intensity of the projected image on the gun sight reflector.

(2) Bombardier's Controls: (a) Bomb Arm-Safe Lever: When lever is in the aft or "SAFE" position, the bombs may be dropped unarmed. To arm bombs, the lever must be moved forward to "ARM" position.

(b) Emergency Bomb Door Control: This control is provided to open or close the bomb doors in the event of hydraulic system failure. The control has a removable handle stowed on the shelf in the left rear corner of the compartment. The control is manually operated and is connected by cables to a ratchet type mechanism engaging a rack on the bomb door actuating strut piston rod. To open the bomb doors, place the "LOCK-SALVO" lever in "LOCK-DOORS OPEN" position and install the removable handle. Work the handle forward from vertical position through a 90 degree arc and back up to vertical until doors are open as indicated by the bomb door light. To close the bomb doors, place the "LOCK-SALVO" lever in "LOCK-DOORS CLOSED" position and work the handle aft from vertical position through a 90 degree arc and back up to vertical until doors are closed as indicated by the bomb door light going off. When operating the handle to open or close the doors, do not move handle past the vertical position. Movement beyond the vertical position results in opposite movement of the doors.

(c) Lock-Salvo Lever: This lever controls the bomb doors and bomb racks and may be used to release all bombs in salvo. In the aft position, "LOCK-DOORS CLOSED", the bomb racks are locked and the bomb doors are closed. To open the bomb doors, raise safety stop and move lever to "LOCK-DOORS OPEN" position. When doors are open, the indicator light will flash on. The bomb racks are still inoperative when lever is in this position. To unlock bomb racks, move lever to "UNLOCK" position. When lever is in this position, the bombs may be released individually. To release all

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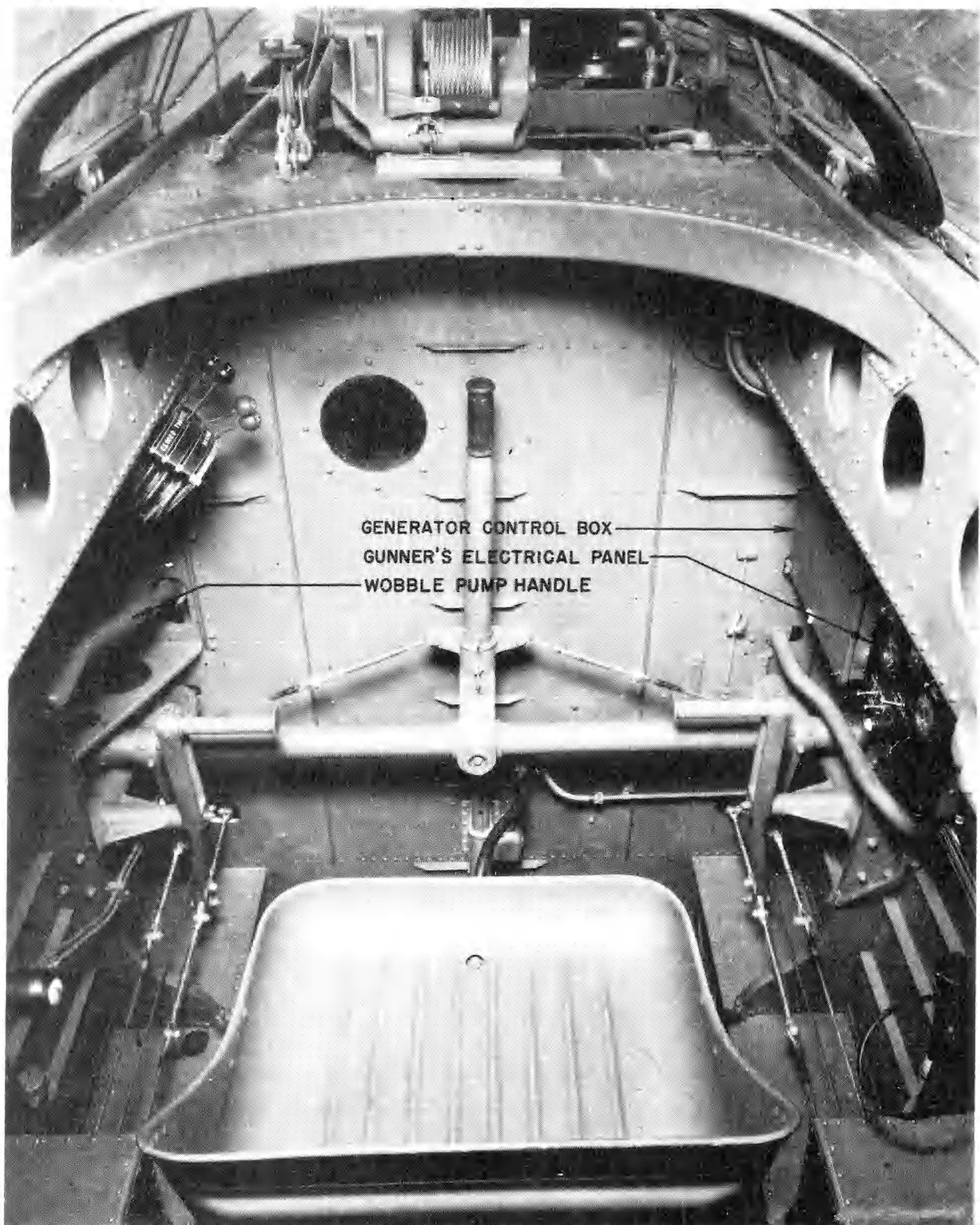


FIG. 8 - GUNNER'S EMERGENCY CONTROLS

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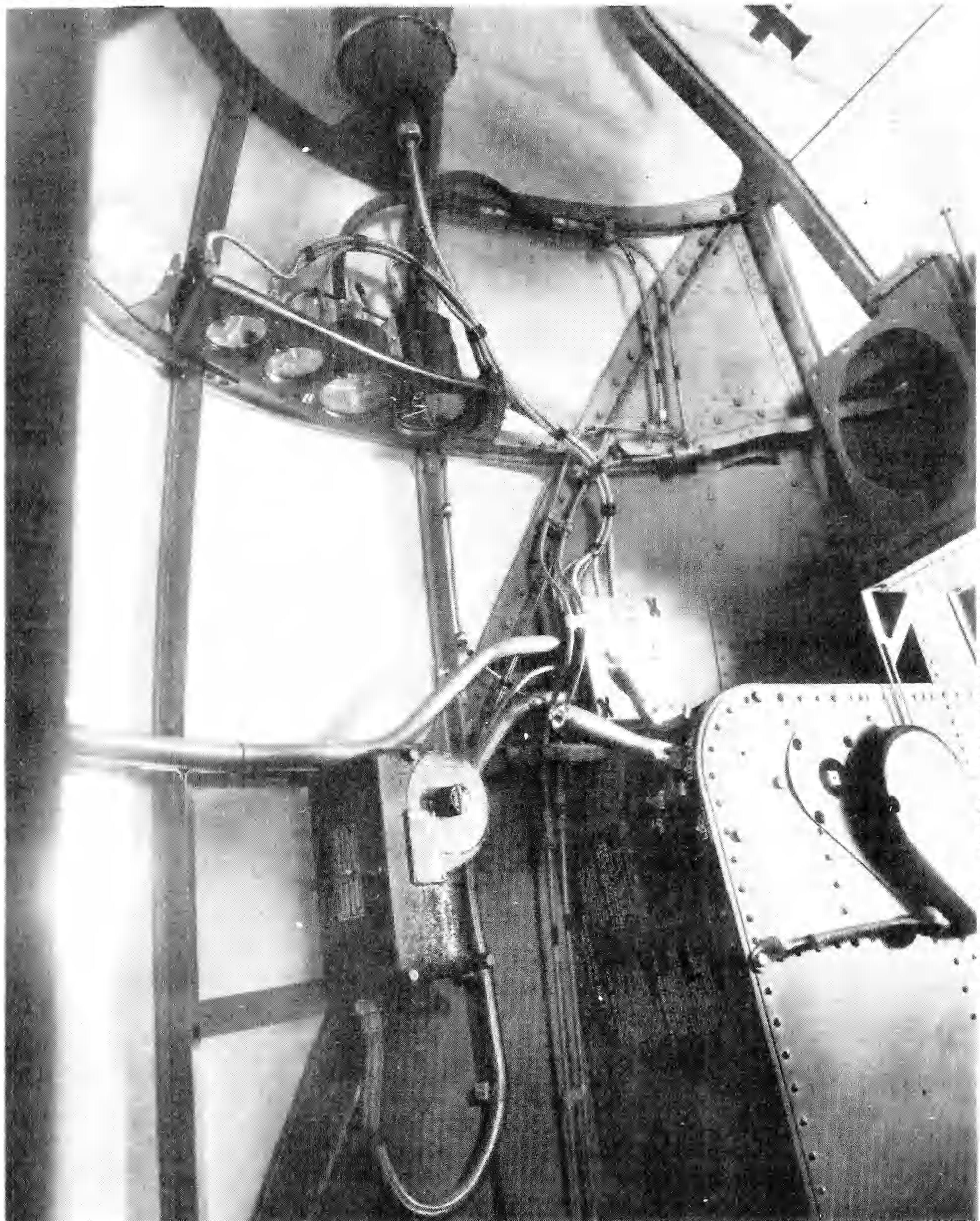


FIG 9 -BOMBARDIER'S INSTRUMENT PANEL AND BOMB CONTROL

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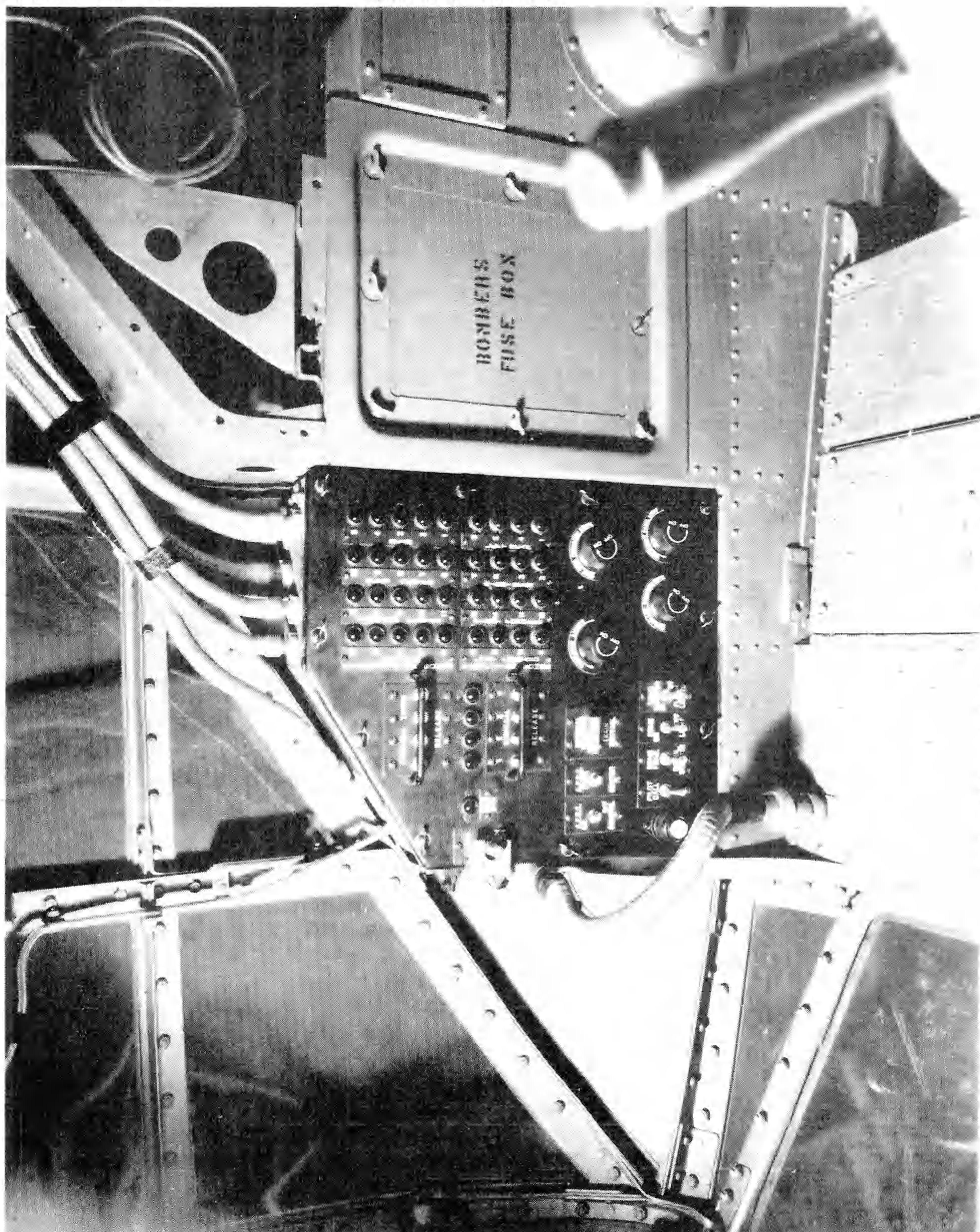


FIG.10-BOMBARDIER'S ELECTRICAL PANEL

bombs in salvo, raise safety stop and move lever to "SALVO" position. To close bomb doors, return lever to "LOCK-DOORS CLOSED" position. The "Lock-Salvo" lever is also used to re-engage the bomb release controls after the pilot's "Emergency Salvo Release" control has been operated. This is accomplished by moving the lever to "SALVO" position and then returning it to "LOCK-DOOR CLOSED" position.

(3) Heating and Ventilating System Controls: (a) Air Control: This push-pull handle regulates the volume of air drawn from outside into the radiator. The control is pulled out to close off the airscoop and pushed in to open the scoop. It may be set to any position between full open and full closed.

(b) Heat Control: This push-pull handle controls the amounts of cold air and heated air that are mixed to produce the desired temperature. The control is pulled out to lower the temperature and pushed in to raise the temperature. It may be set to any position between full hot and full cold. The positions at which the air control and the heat control must be set to produce the desired temperature will be determined by use in service.

(c) Heat-Water Control: This control is provided to shut off the water supply to the boiler. In "ON" position water is permitted to flow from the supply tank into the boiler. In "OFF" position, no water is permitted to flow into the boiler and the system does not function.

(4) Seat Adjustment: (a) Pilot's Seat: To raise seat, pull back on adjustment handle to release plunger; ease body weight off seat allowing bungee to raise seat. Release handle at desired height and see that the plungers are again properly seated. To lower seat, pull back on handle and allow body weight to move seat down. At desired position, release handle and insure that plungers are properly seated.

(b) Gunner's Seat: To lower seat, move vertical adjustment lever down to release plunger; allow body weight to lower seat. At desired height, release the lever and insure than plunger is seated properly in hole in mounting post. To raise seat, move lever down to release plunger; ease body weight off seat allowing spring to raise seat. At desired height, release plunger and check for proper seating of plunger. To rotate seat, pull out on swivel release knob, turn seat to fore or aft position and release knob.

(5) Vacuum System: The instruments operated by suction pressure are furnished the motivating force by a vacuum pump mounted on each engine. A throttle valve is located on the pilot's instrument panel to regulate the suction pressure for the turn and bank indicator.

(6) Flare Release Handles: Two flare release handles are provided. To release a flare, pull up on handle.

(7) Hydraulic System: (a) Control Handles: All control handles must be kept in "NEUTRAL" position while in flight.

(b) Hydraulic System Failure: Hydraulic system failure is indicated when any unit will not operate or when the pressure gage shows a loss of pressure. Failure may be caused by both engines stopping or by pump or line failure.

1. Engine Failure. - Operate control valves in the usual manner and hand pump units to required position. Return control valves to "NEUTRAL" after unit is positioned.

2. Pressure Failure. - Pressure failure is evidenced by failure of a hydraulic unit to function or by zero reading on the pressure gage. In this event the landing gear and bomb doors must be operated with emergency controls. Test and operate brakes as indicated in Par. 2. b. (3) preceding. Other units should not be operated as reserve fluid may be lost resulting in a landing without brakes. The capacity of the hand pump reserve in the reservoir is sufficient for 75 cycles (one up stroke and one down stroke) of the hand pump. Minimum use of brakes after landing requires approximately 20 cycles of the hand pump.

(c) Hydraulic Hand Pump: The hydraulic hand pump will supply pressure to actuate any of the hydraulic units when the engine driven pumps are not operating. It should be used principally to actuate the units when the plane is on the ground, and should be used sparingly in the air, after failure of hydraulic system, to avoid loss of reserve fluid. Do not use hand pump to extend landing gear unless maneuvering including nosing down from low speed, fails to extend and lock the gear in place. To operate, set the control of the unit to be actuated to the desired position; then work the hand pump with slow smooth strokes until unit is in the selected position. Return the unit control to "NEUTRAL" position. The hand pump may be used to charge the pressure accumulator by setting the hand pump bypass valve, located on the panel at the left side of the pilot's seat, to "HAND PUMP TO PRESSURE TANK" position and operating the hand pump.

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SECTION IV

SPECIAL INSTRUCTIONS

1. Flight Restrictions.

a. Maneuvers Prohibited:

Loop

Spin

Roll

Immelmann

Vertical Bank

Stall

Inverted Flight

b. Other Restrictions:

(1) Do not exceed 412 M.P.H. indicated airspeed.

(2) Do not lower wing flaps at an indicated airspeed in excess of 175 M.P.H.

(3) Do not lower landing gear at an indicated airspeed in excess of 198 M.P.H.

(4) Do not exceed a diving engine speed of 2760 R.P.M.

(5) To provide sufficient margin of safety against stalls, the speed of glide with flaps down must be established at not less than 15 M.P.H. above the stalling speed corresponding to the gross weight of the airplane. See T. O. No. 01-1-60. The stalling speeds noted below are given for arbitrary gross weights based on estimates. For stalling speeds corresponding to intermediate gross weights, refer to the stalling speed chart, Fig. 11.

<u>Condition</u>	<u>Gross Weight</u>	<u>Flaps Down</u>	<u>Flaps Up</u>
Crew (1)	17,112 lbs.	88.3 m.p.h.	103.3 m.p.h.
Fuel - 350 gals.			
Oil - 40 gals.			
Pyrotechnics			
Oxygen Equipment			
Crew (3)	19,331 lbs.	93.7 m.p.h.	109.7 m.p.h.
Fuel - 400 gals.			
Oil - 40 gals.			

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<u>Condition</u>	<u>Gross Weight</u>	<u>Flaps Down</u>	<u>Flaps Up</u>
Armament			
Fixed Guns (2)			
Flex. Guns (2)			
Bombs - 600 lbs. (2)			
Pyrotechnics			
Oxygen Equipment			
Maximum Load for Safe Flight	19,750 lbs.	94.7 m.p.h.	111 m.p.h.

¶ (6) Restriction on single engine operation is contained
in T. O. No. 01-1-17.

¶ (7) See T. O. No. 01-40A-3 before loading fragmentation
bombs.

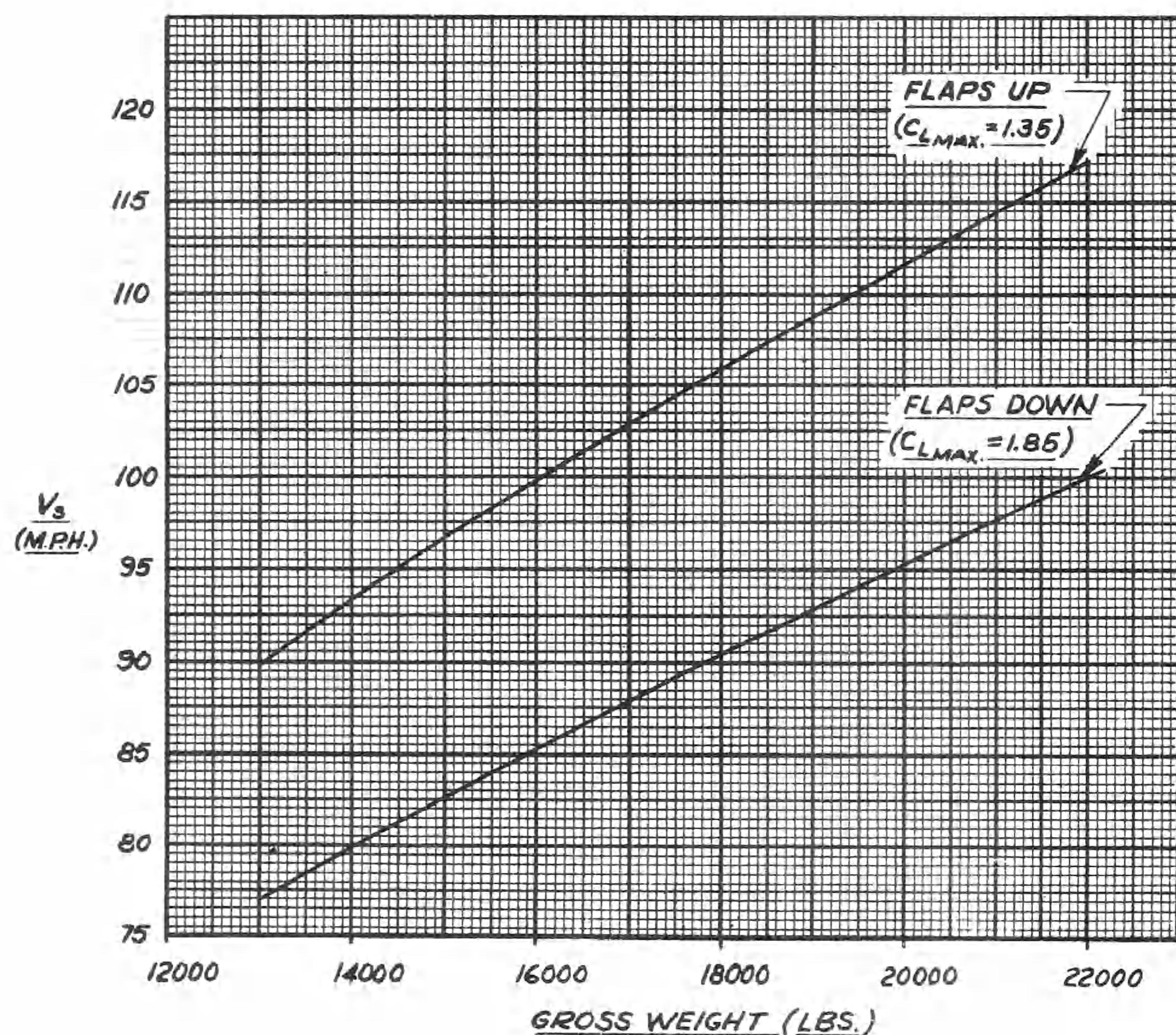


FIG. 11 -STALLING SPEED CHART

SECTION VIFLYING CHARACTERISTICS

- Actual
1. Level Flight Speeds at Design Altitude of 5,000 ft. with Design ~~Gross~~ Weight of 19,195 lb.

Maximum Speed.....	331	m. p. h. at.....	2400	r. p. m. with.....	3200	b. hp. (.....% rated)
High Speed.....	310	m. p. h. at.....	2300	r. p. m. with.....	2700	b. hp. (.....% rated)
Operating Speed.....	278	m. p. h. at.....	2050	r. p. m. with.....	2021	b. hp. (.....% rated)
Cruising Speed.....	183	m. p. h. at.....	1300	r. p. m. with.....	919	b. hp. (.....% rated)
 2. Optimum Range and Endurance with 400 gal fuel and 1200 lb. bombs.

At High Speed.....	425	miles at.....	1.06	mi./gal. or.....	1.37	hrs. at.....	292	gal./hr. (s. f. c.65....)
At Operating Speed.....	559	miles at.....	1.14	mi./gal. or.....	2.01	hrs. at.....	199	gal./hr. (s. f. c.59....)
At Cruising Speed.....	1000	miles at.....	2.5	mi./gal. or.....	5.5	hrs. at.....	72.8	gal./hr. (s. f. c.48....)
 3. Practical Range and Endurance with 400 gal. fuel and 1200 lb. bombs.

At Operating Speed.....	445	miles at.....	1.11	mi./gal. or.....	1.6	hrs. at.....	250	gal./hr. (s. f. c.74....)
At Cruising Speed.....	805	miles at.....	2.01	mi./gal. or.....	4.4	hrs. at.....	91	gal./hr. (s. f. c.60....)
 4. Climb Data with Gross Weight of 19,214 lb. above 15,000 ft.

Standard Altitude	ft. 15,000	20,000	25,000	29,300	30,600
* Climbing Speed m. p. h.	113	138	133	129	128
Engine Speed r. p. m.	2,300	2,300	2,300	2,300	2,300
Total Power b. hp.	2,200	1,840	1,440	1,120	1,000
Maximum Rate f. p. m.	1,315	880	460	100	0
Minimum Time min.

* Calibrated
 5. Ceiling: Normal Engine Operation: Service Ceiling..... 29,300 ft. Absolute Ceiling..... 30,600 ft.
 6. Take-off and Landing Distances—To Clear 50 ft. Obstacle at Sea Level (no wind).

Take-off.....	2060	ft. at.....	0	deg. flap. Gr. Wt. 19,214 lb. Ground run.....	1505	ft.
Land.....	1840	ft. at.....	88	m. p. h. full xxx Xflap. Gr. Wt. * lb. Ground run.....	1215	ft. down

* 19,214# less gas to circle field.
 7. References and Remarks: This airplane may be expected to give approximately the above performance with given load under standard atmospheric conditions. Figures given may vary slightly from figures listed elsewhere in this Technical Order and other technical publications for this model of airplane.
 This information taken from Memo Reports Serial Nos. PHQ-M-19-1237-A and PHQ-M-19-1272-A. Climb data not available for present A-20A. However, this airplane may be expected to give approximately same values under the same atmospheric and loading conditions.

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Typical Weight Conditions For Airplanes Equipped With Integral Fuel Tank.

	Normal Weight Design Load	Gross Weight With Useful Fuel Load	Alternate Weight with Max. Bomb & Fuel Load	Alternate Weight with 16-100# Dem. Bomb Load	Alternate Weight with One 1100# Dem. Bomb	Alternate Weight with Fixed Guns
Crew (3 with Chutes)	600	600	600	600	600	600
Fuel 400 Gals.	2400	2400	2400	2400	2400	2400
Fuel 500 Gals.		3000				
Oil 37 Gals.	277.5		277.5	277.5	277.5	
Oil 46 Gals.		345				
Bombs						
600# Dem.	(2)					
30# Frag.	(80)					
100# Dem.	(16)					
1100# Dem.	(1)					
Guns						
.30 Cal. Fwd. Fixed	(2)	1253.4	1253.4	12544.9	1253.4	1253.4
.30 Cal. Upper Flex	(1)		125.7		125.7	125.7
.30 Cal. Lower Flex	(1)		70.1		70.1	70.1
Pyrotechnics			70.4		70.4	70.4
Alternate Fixed Gun	(2)		32.5		32.5	32.5
Total Useful Load (AVR.) Basic Weight	4830 14376	6789 14376	5256 14376	4706 14376	4953 14376	19329
Gross Weight Wing Loading lbs./sq. ft. (465 sq. ft. Area)	19206	22165	19632	19082	19329	
Power Loading lbs./H.P. (1350 H.P. Per Engine)	41.3	45.5	41.0	41.0	41.6	
	7.11	8.21	7.27	7.07	7.16	

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Typical Weight Conditions for Airplanes Equipped With Self-Sealing Fuel Tanks.

	Normal Weight	Gross Weight	Alternate Weight	With Twin Upper Flex. Gun, Nac. Guns, Armor Plate & Prov. for Tow Target
Design Load	With Useful Max. Bomb Load	With Twin Upper Flex. Guns and Armor Plate	With Twin Upper Flex. Gun, Nac. Guns, Armor Plate & Prov. for Tow Target	With Twin Upper Flex. Gun, Nac. Guns, Armor Plate & Prov. for Tow Target

		T. O. NO. 01-40AB-1			
		WEIGHT DATA A-20A			
		1253.4	1253.4	125.7	125.7
Crew (3 with Chutes)	600	600	600	600	600
Fuel 400 Gals.	2400	2400	2400	2400	2400
Oil 37 Gals.	277.5	277.5	277.5	277.5	277.5
Bombs					
600# Dem.	(2)	1253.4	1253.4	125.7	125.7
30# Frag.	(80)	2544.9	2544.9	70.1	70.1
Guns					
•30 Cal. Fixed	(2)	125.7	125.7	70.4	70.4
•30 Cal. Upper Flex	(1)	70.1	70.1	147.5	147.5
•30 Cal. Lower Flex	(1)	70.4	70.4	185.5	185.5
Twin Flex Gun					
•30 Cal. Nacelle	(2)	32.5	32.5	32.5	32.5
Pyrotechnics					
Gun Armor					
Tow Target				41.3	41.3
				195.7	195.7
Total Useful Load	4830	5844	4948	3506	5134
AVR. Basic Weight	14897	14897	15083*	15031	15228**

Gross Weight	19727	20741	20031	18537	20362
Wing Loading (Area 465 sq. ft.)	42.4	44.6	43.1	39.9	43.8
Power Loading 1bs./H.P. (1350 H.P. Per Engine)	7.31	7.68	7.42	6.87	7.54

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NOTE: (1) 181.1 lbs. of crew armor is included in Weight Empty, marked thus: *.

(2) The weight of the guns includes 500 rounds of ammunition for each of the fuselage guns and 1000 rounds for each nacelle gun at 65 lbs. per 1000 rounds.

(3) The Weight Empty provisions for a tow target, 15 lbs., are included in this Weight Empty, marked thus: **.

(4) The weight of oil is figured at 7.5 lbs. per gallon and fuel at 6 lbs. per gallon.

(5) Weight data for airplanes with integral fuel tanks will apply to AC39-721, AC39-722, AC-39-726 to -73 $\frac{1}{4}$ inclusive and AC40-71 to -74 inclusive.

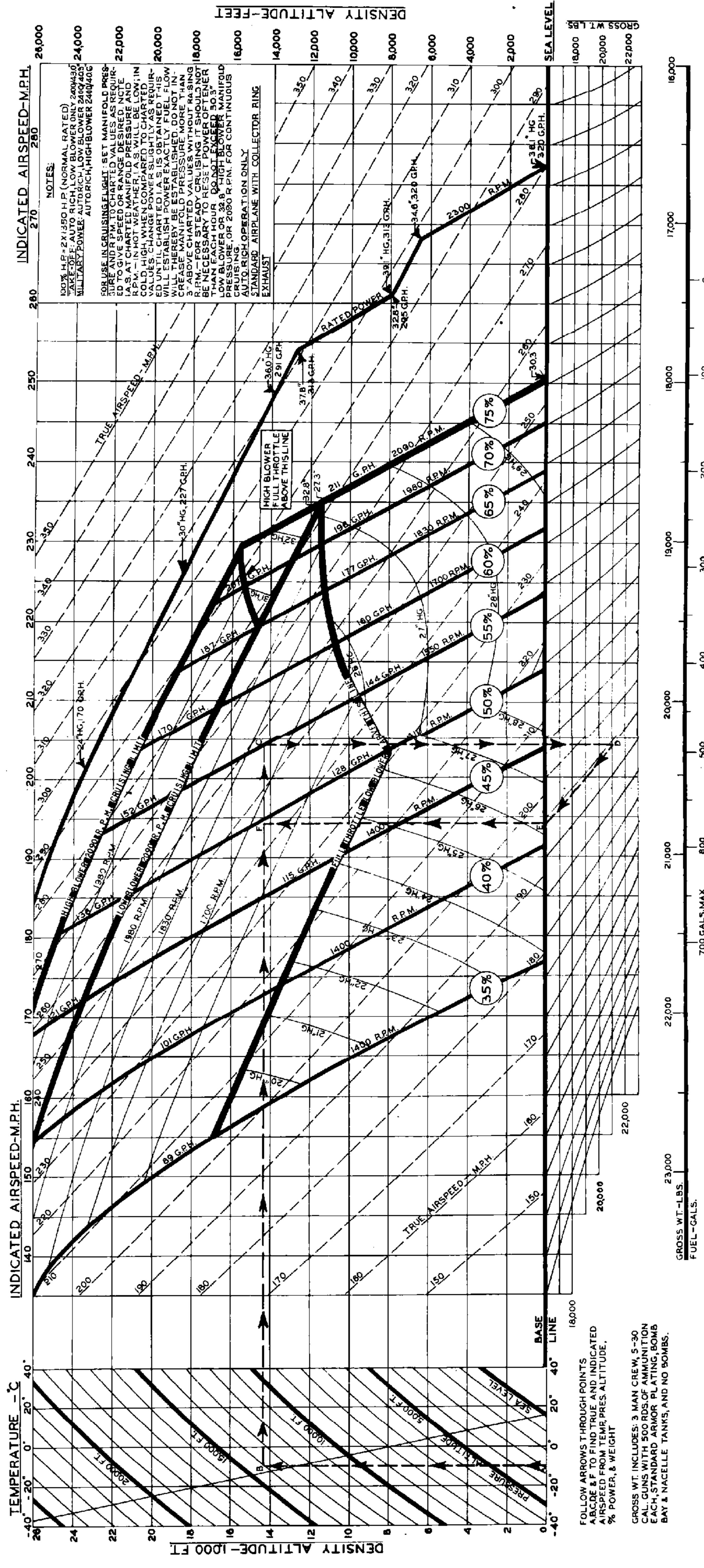
Weight data for airplanes with self-sealing fuel tanks will apply to AC39-72 $\frac{1}{4}$, AC40-75 to AC40-179 inclusive.

(6) Four chemical tanks may be carried in place of any bomb load, totaling 1657 lbs.

(7) Basic weight is Weight Empty plus 80.5 lbs. for the rear frag. rack which is carried at all times.

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SECTION VII**

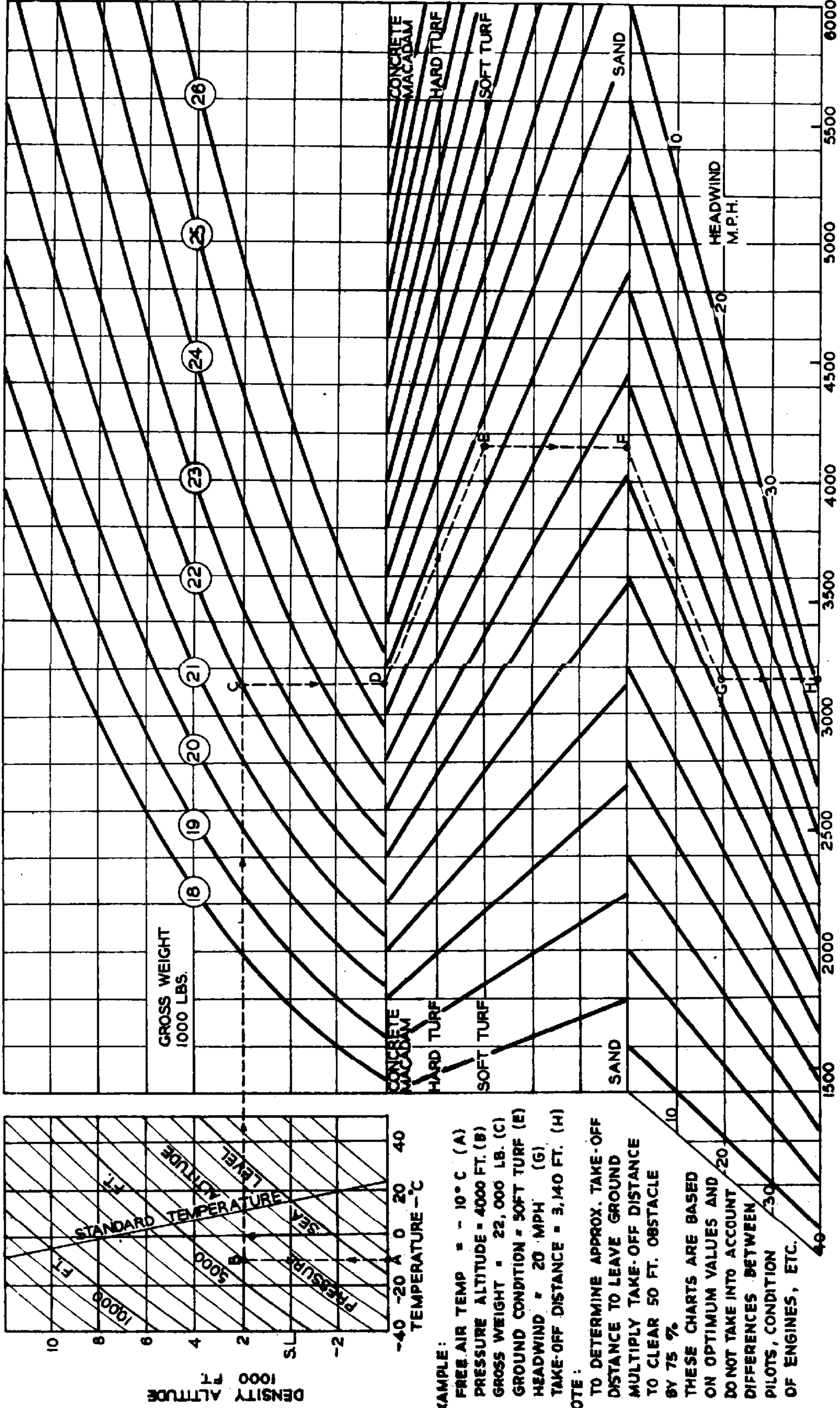


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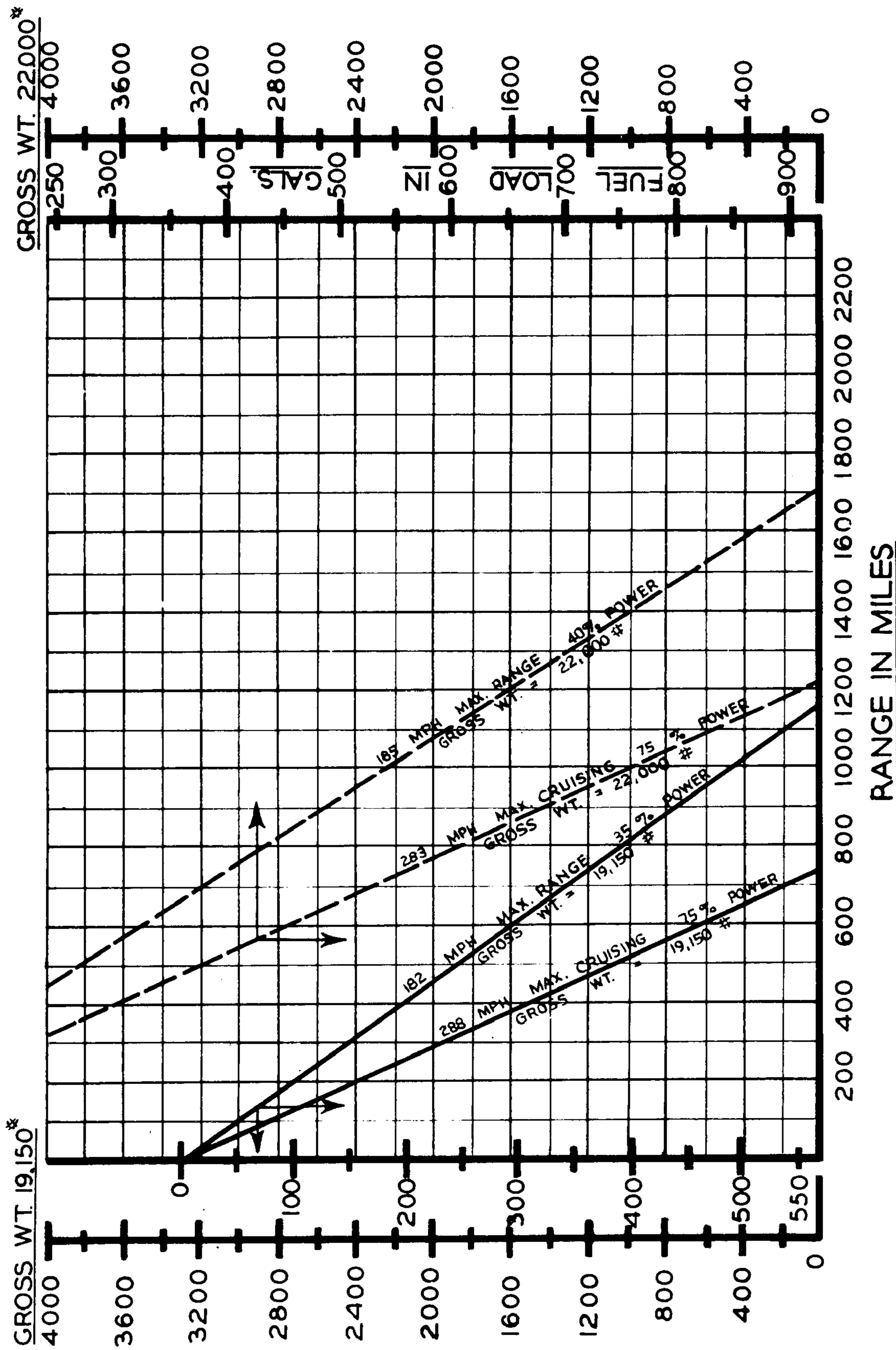
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A - 20A
TAKE-OFF DISTANCE TO CLEAR 50 FOOT OBSTACLE
FLAPS UP

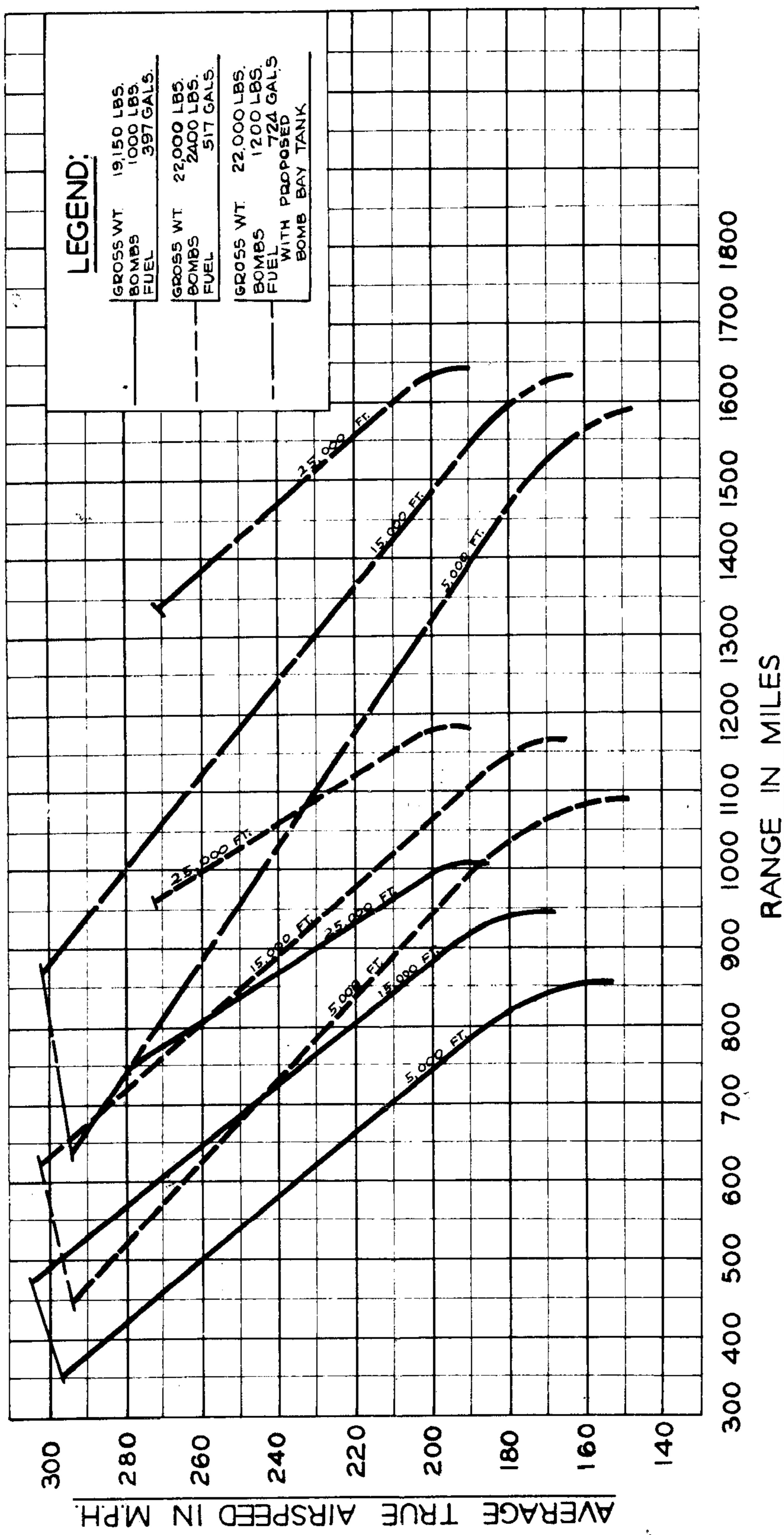


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T. O. NO. 01-40AB-1



LOAD RANGE CHART
MODEL A-20A
15,000 FT.



THESE CURVES ARE COMPUTED FROM INSTANTANEOUS CONDITIONS OF ALTITUDE, POWER, AND FUEL FLOW AT STANDARD CONDITIONS. REFER TO CRUISING CONTROL CHART. NO CONSIDERATION IS MADE FOR HEAD WINDS, WARM UP, TAKEOFF, CLIMB, OR DESCENT. BOMB LOAD IS CONSIDERED TO BE CARRIED HALF THE DISTANCE OF THE FLIGHT.

SPEED RANGE CHART
MODEL A-20A