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

PILOT'S FLIGHT OPERATING INSTRUCTIONS

FOR

ARMY MODEL
A-20B

NAVY MODEL
BD-2

This publication contains specific instructions for pilots and should be available for Transition Flying Training as contemplated in AAF Reg. 50-16.

This publication shall not be carried in aircraft on combat missions or when there is a reasonable chance of its falling into the hands of the enemy.

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These instructions permit the issue of restricted publications to civilian contract and other accredited schools engaged in training personnel for Government work, to civilian concerns contracting for overhaul and repair of aircraft or aircraft accessories, and to similar commercial organizations

LIST OF REVISED PAGES ISSUED

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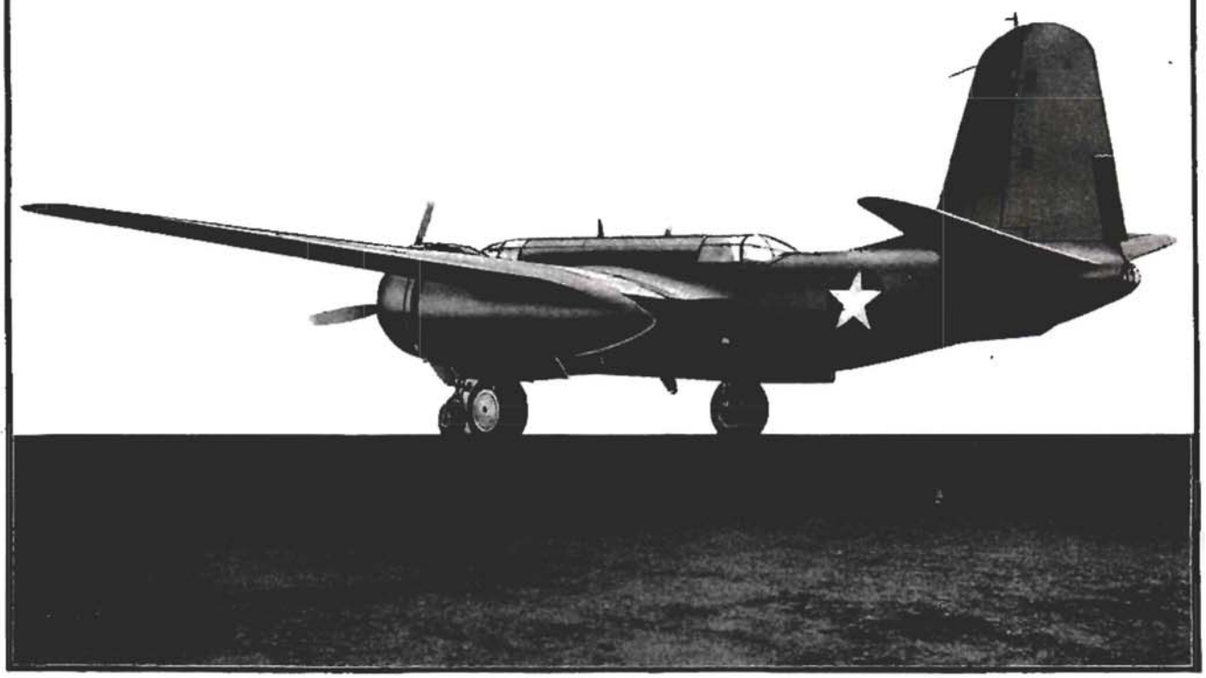
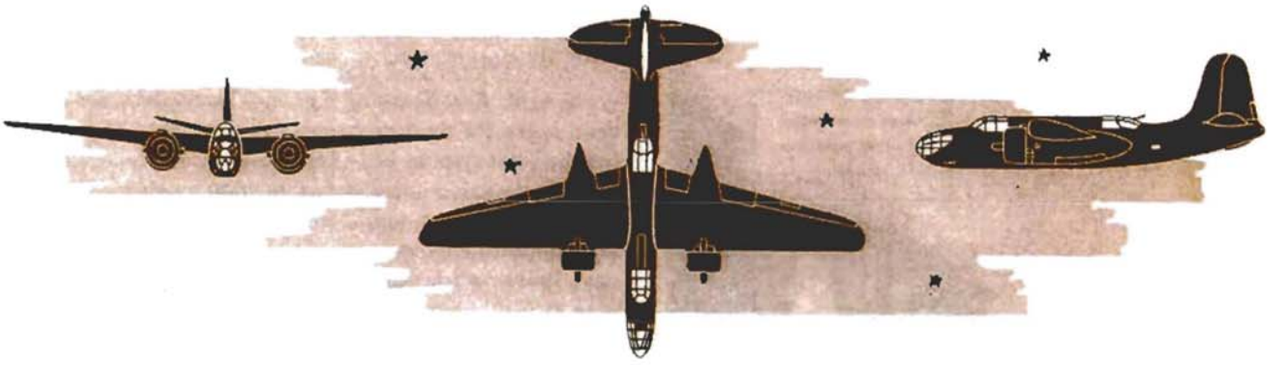
Figure 1
Three-quarter rear view of the A-20 B





SECTION I
DESCRIPTION

1. *AIRPLANE.*

a. General.—The A-20B attack bomber is a midwing, land monoplane manufactured by Douglas Aircraft Corp. and powered by two Model R-2600-11 Wright Double Row Cyclone engines. Hydraulically operated landing gear, wing flaps, and brakes are provided. The crew of three are: bombardier, pilot, and gunner. Overall dimensions are as follows:

Span	61 ft 4 in.
Length	48 ft
Height, at rest	16 ft 1½ in.

b. Fuselage Compartments.

Bombardier's	in the window-paneled nose section
Pilot's	aft of bombardier's compartment
Bomb Bay	aft of the pilot's compartment
Fuselage Deck	above the bomb bay

(1) *Access to Pilot's Compartment.*—Steps and hand holds are provided on the left side of the plane. The canopy is unlatched and lifted by a lever over the fuselage deck.

c. Armament.—Armament consists mainly of two type M-2 .50 caliber machine guns in the nose section, one type M-2 .30 caliber machine gun in each nacelle (for rearward fire), one .50 caliber, and one .30 caliber type M-2 flexible machine gun in the gunner's compartment. Fixed guns are charged manually on the ground, although hydraulic chargers remain on earlier models.

d. Armor Protection.—Armor plating is installed affording protection for the pilot from the angles illustrated. For protection for the bombardier and gunner, see those sections.

2. *POWER PLANT.*

The two R-2600-11 engines are of the air cooled radial type, developing 1600 hp each for take-off, and drive three-bladed Hamilton Standard Hydromatic, quick feathering propellers. Each engine has a two-speed controllable supercharger with a low blower ratio of 7.14:1, and a high blower ratio of 10:1.

Fuel: Specification	AN-VV-F-781
Octane	100
Oil: Specification	AN-VV-O-446
Viscosity	1120

3. *PILOT'S CONTROLS AND OPERATIONAL* EQUIPMENT.

a. Airplane Controls.

(1) *General.*

(a) Pilot's Seat.—Accommodates the seat parachute and back type life-preserver cushion. It is adjustable for height by a lever on the right side of the seat. After adjustment, "jiggle" the seat slightly to be sure it is locked.

(b) Hand Hydraulic Pump.—For use when the engines are not operating or for emergency. Located near floor at left side of pilot's seat (Figure 16-10) and may be used directly in the hydraulic system, or by setting hydraulic by-pass valve (Figure 10) to "HAND PUMP TO PRESSURE TANK" position, may be used to charge the accumulator.

(c) Cowling and Oil Cooler Flaps.—These are hydraulically operated by controls on panel (Figure 5-4, 5) at right side of seat.

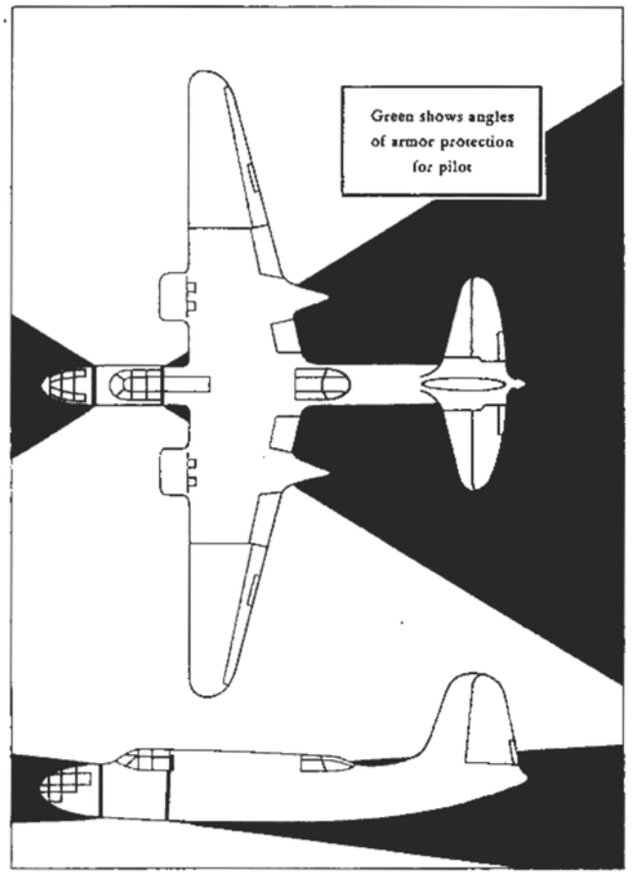


Figure 2—Pilot's Armor Diagram

1. Upper Flaps.—Both operated by a single lever. To open, pull control lever UP. To close, push DOWN. After opening or closing flaps, place lever in NEUTRAL. Upper flaps provide additional engine cooling on the ground.

★ *WARNING:* The upper cowling flaps are designed to be opened only during ground operations.

2. Lower Flaps.—Operated individually by two control levers located below upper cowling flap control lever. To open, push control lever DOWN. To close, pull control lever UP. Controls may be operated together, if desired. Oil cooler flaps are operated simultaneously by the same control lever.

(d) Fuel Supply Controls.—Fuel transfer selector valve and shut-off valves are on fuel control panel on left side of pilot's compartment, (Figure 16-1, 7) aft of supercharger quadrant. Each engine is supplied by an individual system.

1. Fuel transfer selector valve is conventional. Turning valve to desired position opens valve and automatically engages electric transfer pump.

2. Fuel Shut-Off Valves.—Two valves, the left-hand valve for the left system and the right-hand valve for the right system. In MAIN position, the corresponding nacelle valve opens. After turning valve to MAIN, turn booster pump toggle switch ON and keep in that position until engine-driven fuel pump is supplying pressure. Leave switch ON until after take-off in case of engine driven pump failure.

★ *NOTE:* Some airplanes also have a rheostat control on booster pump. In case of such installation, use booster pump only when engine pump does not maintain pressure and during all take-offs.

3. Fuel Level Gauge. (Figure 3).—Electrical. Registers quantity of fuel in each tank separately by using a three-position selector switch.

4. Primers.—Electric primers (Figure 15-4) on switch box. Earlier ships have primers in nacelles.

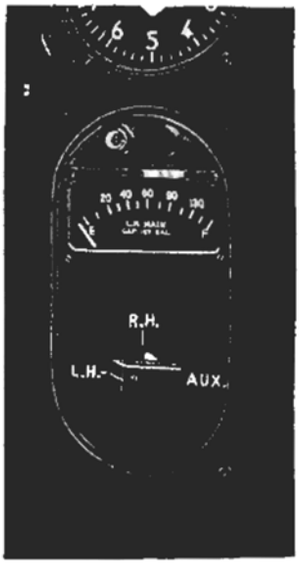


Figure 3—Fuel Level Gauge

5. Fuel Pressure.—Max. 16 lb/sq in.; Min. 12 lb/sq in.

> *CAUTION:* Adjust booster pump as the fuel pressure gage may indicate. Be sure not to turn pump above 14-15 lb/sq in. or too rich a mixture will result.

(e) Landing Light.—Single light in left wing. After turning switch ON, the light will not glow until

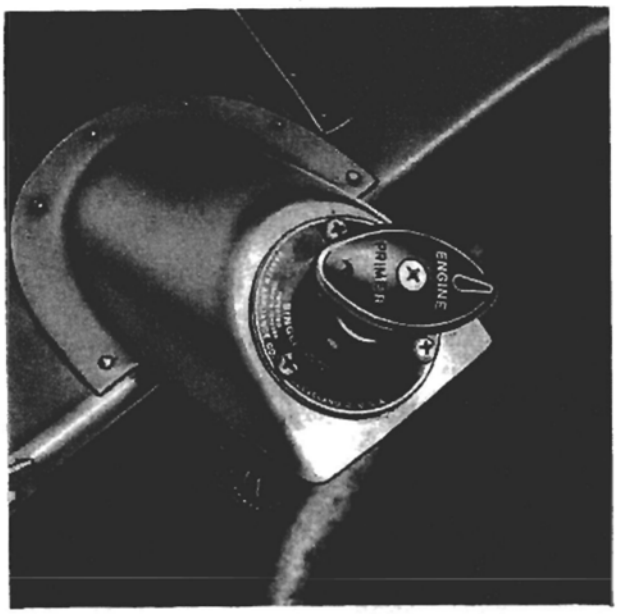


Figure 4—Engine Primer

the mechanism has extended the lamp to its operating position. Do not lower the landing light at speeds in excess of 175 mph (152 knots).

(f) Electrically-Heated Flying Suit.—Connection for pilot's suit (Figure 5-1) is located on the bulkhead on right rear of pilot's seat.

(g) Ice Eliminating Equipment.—None except for carburetor heat. For detailed instructions see Para. 3, b, (8).

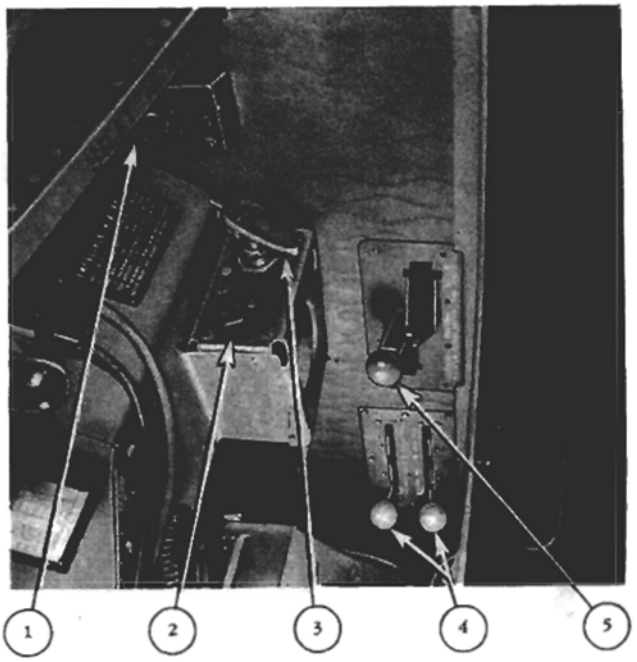
(h) Emergency Air Brake.—Control is on right-hand side of the pilot (Figure 5-3) mounted against the rear wall. Use this valve when hydraulic brakes are not operating. Degree of pressure is controlled by degree of valve movement. Do not use the brake until after contact with the ground. Gage must show 400 lb/sq in. before take-off. Bottle must be refilled after each use.

(i) Booster Pump Switches.—These are located on the lower switch panel (Figure 15-19). Rheostats, if such are provided, will be on the same panel.

(j) Beginning with ship no. AC-41-2870, generator control panel is mounted in the pilot's compartment (Figure 6) behind the pilot's head. It contains the following: panel light, panel light switch, generator "OFF-ON" switches (2), ammeters (2), voltmeter, and voltmeter selector switch.

(2) *Flight Controls.*

(a) Aileron, Elevator, and Rudder.—Conventional control column for aileron and elevator. Conventional



1. Suit heat receptacle
2. Air pressure gage
3. Emergency air brake control
4. Lower cowling flap control
5. Upper cowling flap control

Figure 5—Emergency Air Brake

rudder pedals are adjustable for length by pressing inboard on the adjustment levers. Always adjust pedals to the same length. Individual wheel brakes are operated by toe pressure on the rudder pedals. Surface controls are locked by external fasteners only.

(b) Trim Tab Controls. (Figure 7.)

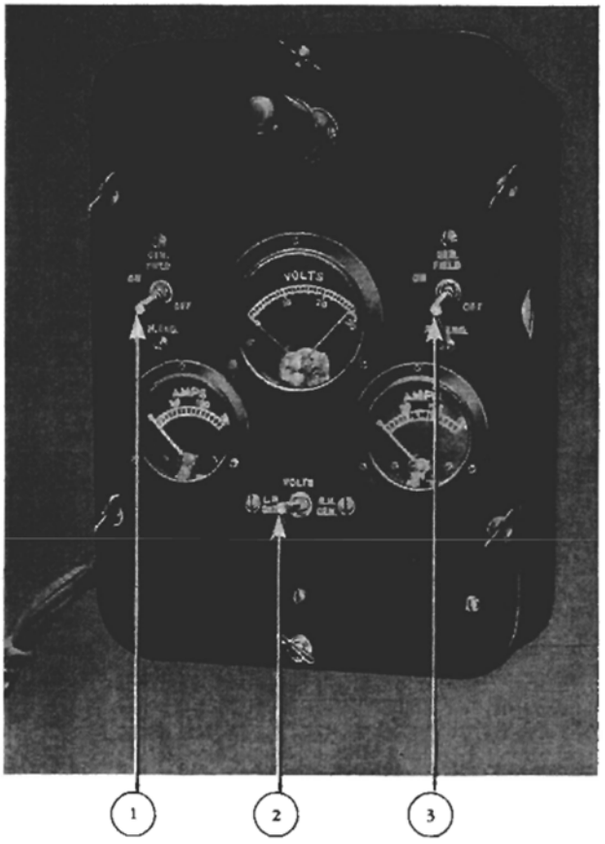
1. Elevator.—Knurled knob on right side of pilot's seat and marked "Elevator." Turning knob to the RIGHT brings the nose UP.

2. Rudder.—Knurled knob on top of control box on right side of pilot's seat and marked "Rudder." Turning knob to the RIGHT turns plane to the RIGHT.

3. Aileron.—Knurled knob on right side of pilot's seat and marked "Aileron." Turning knob to the RIGHT puts the right wing DOWN.

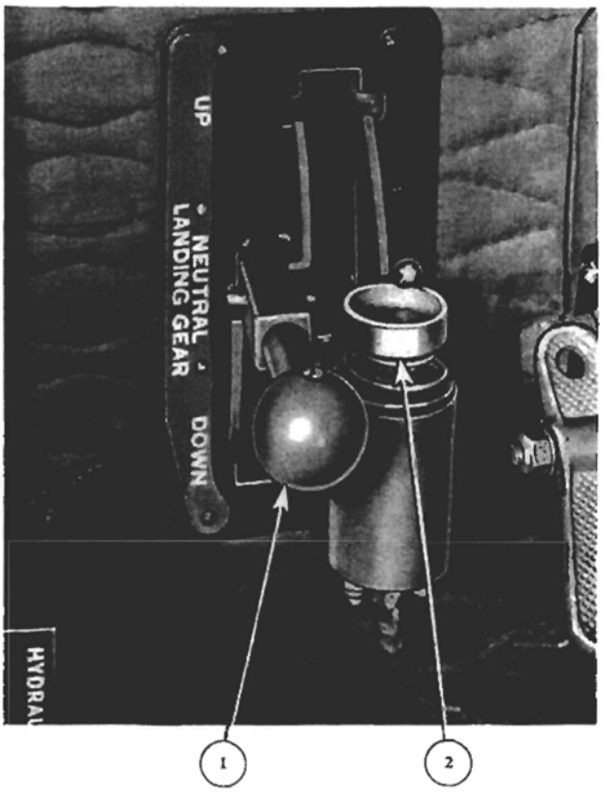
(c) Landing Gear Controls.—Landing gear is hydraulically operated by a control (Figure 8) to the rear and left of the pilot's seat. A lock is provided so the selector cannot be moved to the UP position while the weight of the airplane rests on the landing gear.

1. Gear Down.—Do not lower above 170 mph. When gear is locked in landing position, a green light, located on the upper left electrical panel, illuminates.



1. Generator "OFF-ON" switch
2. Voltmeter selector switch
3. Generator "OFF-ON" switch

Figure 6—Pilot's Generator Panel



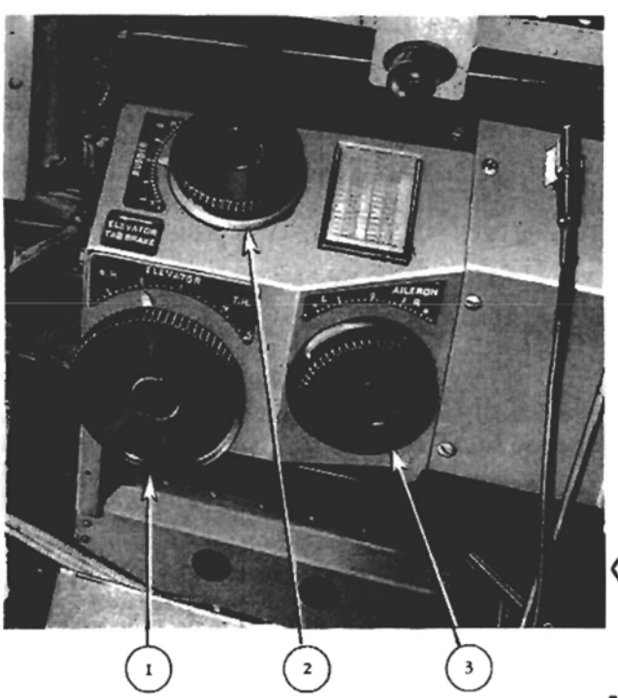
1. Landing gear control
2. Landing gear selector valve lock

Figure 8—Landing Gear Control

When gear is NOT locked in landing position and either throttle is less than one-quarter open, a warning horn will sound. A switch on the lower electrical panel will silence the horn, but if one throttle remains open the horn may only be silenced by moving the other throttle one-quarter open. Approximately 8 seconds are required to extend the gear, 10 seconds for complete retraction. After retraction or extension, return control to NEUTRAL.

2. *Gear Up.*—Retract at any air speed. Move the control lever to UP position. When the gear is fully retracted, return the control lever to NEUTRAL.

3. *Emergency Control.*—If the engine driven pump has failed, operate the hand pump to supply pressure. If the hydraulic system has failed, pull the manual release near the floor at right of the pilot's seat releasing the safety latch. Gear will drop down. To aid in latching,



1. Elevator tabs control
2. Rudder tab control
3. Aileron tabs control

Figure 7—Trim Tab Controls

it may be necessary to depress the nose of the airplane. IAS should not exceed 150 mph.

(d) Flap Controls.—Wing flaps are hydraulically operated by control near the floor on the left forward side of the pilot's compartment. (Figure 16-12.)

1. Flaps Down. — Place control lever in DOWN position. When fully extended, return control lever to NEUTRAL position.

2. Flaps Up.—Place control lever in UP position. When fully retracted, return control lever to NEUTRAL position. Do not lower wing flaps at speeds in excess of 170 mph.

★ *WARNING:* Intermediate positions should not be used unless ship is equipped with hydraulic equalizers.

> *CAUTION:* Do not raise wing flaps until enough altitude has been gained to clear any obstacle.

3. Emergency Control.—If the engine driven pump has failed, operate the hand pump until flaps have reached desired position. Then return control lever to NEUTRAL.

(e) Flight Instruments.—These are conventional. No automatic pilot is provided.

b. Engine Controls. (Figure 9.)

(1) *Throttle.*—Conventional.

(2) *Mixture.*—On left side of throttle quadrant has four positions: Emergency Rich, Automatic Rich, Automatic Lean, and Idle Cut-Off.

(3) *Supercharger Controls.*—Below and behind throttle quadrant. For ground operation see Section II 6., *a.*, (1). For flight operation see Section II, 11., *c.*

(4) *Propeller Controls.*—These are conventional, the automatic control located on throttle quadrant.

(a) To Feather.

1. Retard throttle fully.
2. Propeller control DECREASE rpm.
3. Move mixture to IDLE CUT-OFF.
4. Press feathering switch.
5. Ignition switch OFF.

★ *EXTREME EMERGENCY:* Press feathering switch first.

(b) To Un-feather.

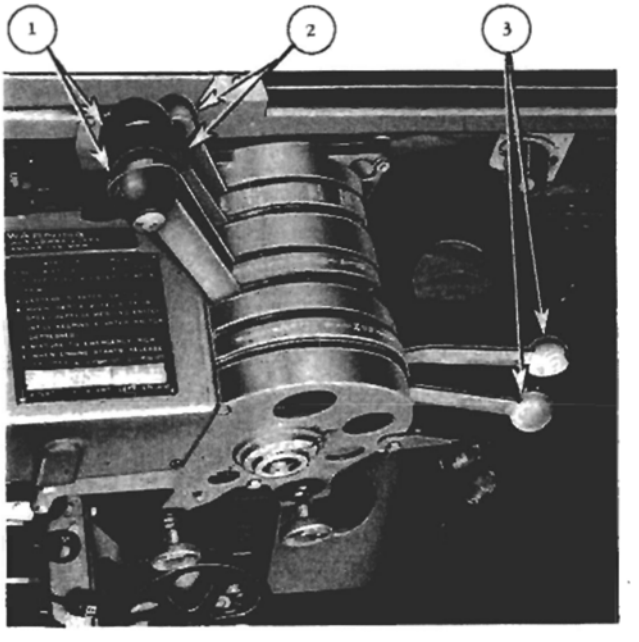
1. Ignition switch ON.
2. Press feathering switch (Figure 15-2, 17) until rpm reaches 800 to 1000.
3. Mixture control AUTO-RICH.
4. Reset propeller control.
5. Reset throttle.
6. Reset mixture.

Except in emergency, do not leave propeller feathered over 15 minutes or restarting may result in serious damage to the engine.

(5) *Oil Dilution.*—Switches are located on the main switch box (Figure 15-20). When temperatures are —7 degrees C (+20 degrees F) or lower, the oil system should be diluted before stopping the engines. Operate the engines at 800 to 1000 rpm and leave the oil dilution switches ON for about four minutes. Stop engines by setting mixture control in "IDLE CUT-OFF." There is very little danger of over dilution as long as the oil pressure gage remains up and steady.

(6) *Oil Pressure.*—Two pressure gages (Figure 17-10) are mounted on the pilot's control panel. Maximum oil pressure is 90 lb/sq in., minimum 80 lb/sq in., idling 40 lb/sq in. Desired pressure 85 lb/sq in.

(7) *Oil Temperature.*—Two oil temperature gages (Figure 17-23) are mounted on the pilot's instrument panel. Maximum temperature is 85° C (185° F), minimum oil temperature 40° C (104° F) desired, 50° to 70° C (122° to 158° F.)



1. Throttle controls
2. Mixture controls
3. Propeller pitch controls

Figure 9—Pilot's Throttle Quadrant

(8) *Carburetor Air.*—Carburetor air temperature control lever (Figure 16-2) is located below and behind throttle quadrant. Set the control in HOT position when flying under conditions of high humidity with outside temperatures of – 1° to +20° C (30° to 70° F). Heat may also be used to remove ice already formed. A permanent carburetor air filter is installed. It can be removed and cleaned with gasoline.

> *CAUTION:* Use no more heat than is absolutely necessary and turn heat off as soon as practicable. Never use heat during take-off.

Figure 10—By-Pass Valve

c. Other Controls.

(1) *Blind Flying Hood.*—When not in use this hood is stowed in a roll under and around the cockpit cowl, and thus forms the crash pad (Figure 17-8). A canvas flap, comprising a part of the hood, is located above the cockpit cowl, and is secured by means of three dot type fasteners. The flap may be opened quickly to afford a full view over the front of, and to the left and right of, the nose section. The emergency release handle of the compartment enclosure may be reached when the hook is in the extended position.

(2) *Generator Controls* (Figure 6).—Behind pilot's head. Generator "ON-OFF" switches, ammeters, voltmeter, and voltmeter selector switch.

(3) *Battery Cart Receptacle.*—On left wall of the nose wheel tunnel.

(4) *Emergency Bomb-Salvo Release* (Figure 15-27).—Located left of the left rudder pedal. First pull opens the bomb bay doors. When the bomb bay doors are open, as shown by the bomb bay door light, additional pull on the handle releases all the bombs in salvo unarmed.

(5) *Pilot's Nose Guns.*—Two .50 caliber fixed guns. Later models beginning with Ship AC41-3370 contain provisions for installation of a special gun nose.

(6) *Nose Gun Firing Switch.*—On control wheel and operated by pressure of right index finger. First place master nose gun switch on upper electrical panel in FIRE position.

(7) *Gun Sight.*—Type N-3 electric gun sight. To operate, open cover on gun sight lens, turn on master battery switch (Figure 15-24), and adjust rheostat (Figure 15-29) until the sight lines can be seen by looking through the small reflection glass behind the windshield and in line with the pilot's eyes.

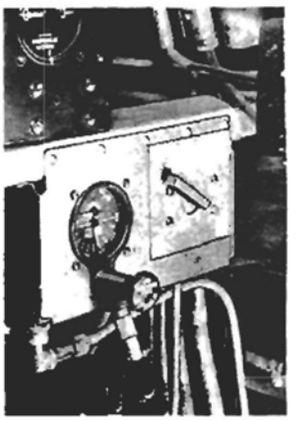


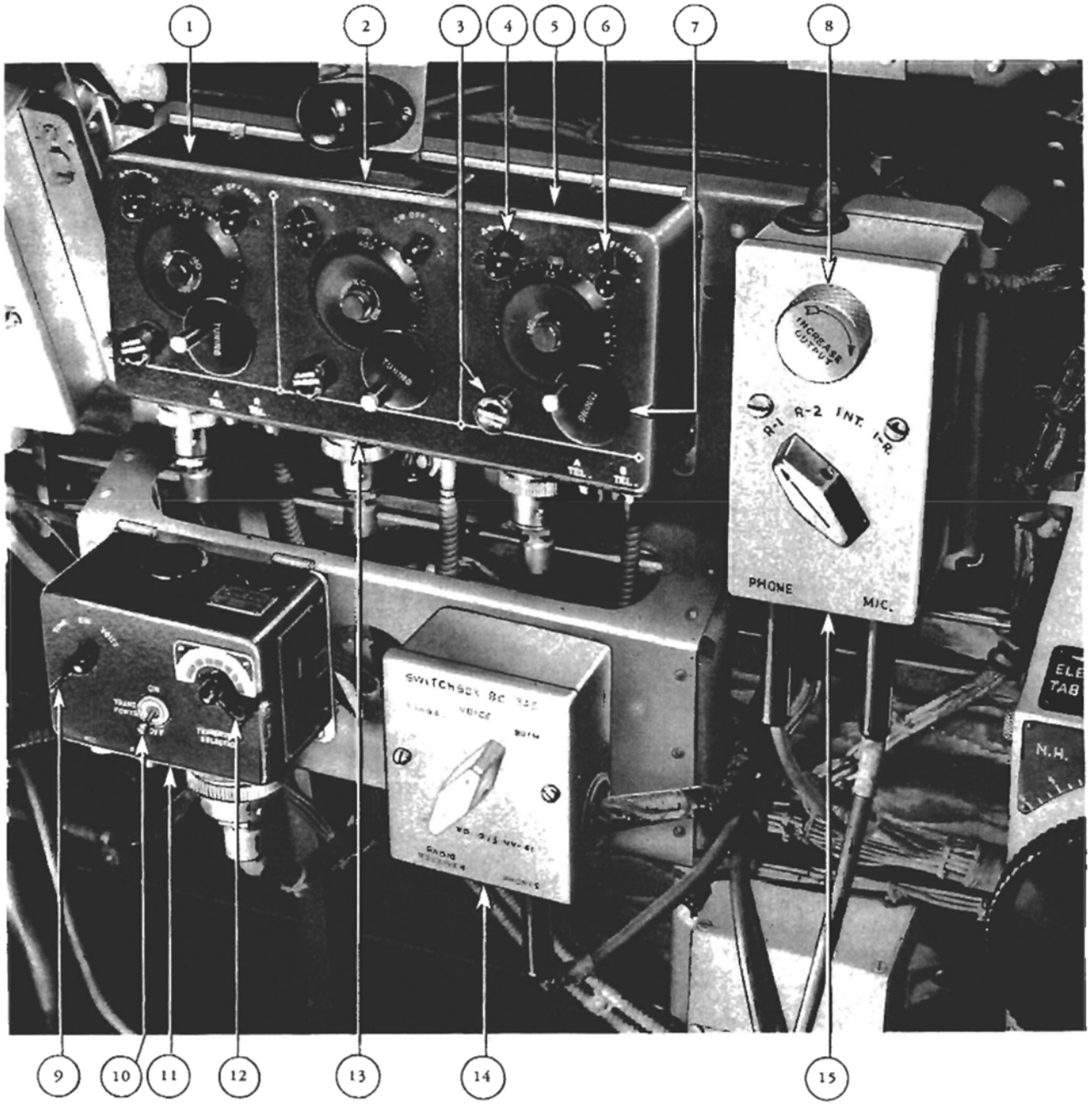
Figure 11—Pilot's Oxygen Regulator

(8) *Oxygen.*—Connection and gage (Figure 11) located on lower right-hand corner of instrument panel.

(9) *Ventilation.*—Knurled knob on either side window.

(10) *Upper Electrical Panel (Figure 15).*—Mounts the following:

Bombardier call switch
Bombardier call light
Formation lights rheostat
Landing light switch
Landing gear safe light



1. Receiver remote control
2. Receiver remote control
3. Increase output switch
4. "A-B" switch
5. Receiver remote control
6. "CW-MCW" switch
7. Receiver tuning control
8. Increase output switch
9. "Tone-CW-Voice" switch
10. Transmitter "OFF-ON" switch
11. Transmitter control box
12. Transmitter selection switch
13. Receiver control box
14. Interphone switch box
15. Interphone jack box

Figure 12—Communications Equipment in Cockpit

Landing gear safe light dimming switch
Landing gear warning horn silencing switch
Bomb release light
Camera exposure light
Bomb door open light
Gun sight light rheostat
Master nose gun switch
Compass light rheostat
Instrument panel lights switch
Propeller feathering switches (2).

(11) *Lower Electrical Panel* (Figure 15).—Mounts the following:

Primer switches (2)
Battery main line switches (2)
Panel and radio light rheostat
Pitot heater switch
Running lights switch
Oil dilution switches (2)
Starter switches (2)
Fuel booster pumps switches (2)
Fuel booster pump rheostats (2, if installed)
Pilot compartment light switch
Instrument panel heat receptacle
Suit heat receptacle.

4. *COMMUNICATIONS EQUIPMENT.*

a. General.

(1) Not all of the installations described herein will be found on every airplane. Most of the communications equipment may be operated from the pilot's compartment. Insofar as the transmitter is concerned, the equipment must be tuned prior to flight as they are installed beneath the canopy above the aft bomb bay.

CAUTION: For normal operation of all communications equipment, the crystal filter selector switch (Figure 12-14) should be set at "BOTH."

(2) To receive the radio ranges without possibility of voice interference, set the crystal filter selector switch (Figure 12-14) at "RANGE."

(3) To receive voice without range interference, set crystal filter selector switch to "VOICE." It is impossible to receive voice when this switch is set on "RANGE."

★ *NOTE:* The headset extension cord should be plugged into the crystal filter selector switch box and not into the interphone jack box or receiver control box.

★ *IMPORTANT:* When the throat microphone is being used, it must be adjusted so that its two circular elements are held snugly against each side of the throat just above the "Adam's apple." SPEAK SLOWLY, DISTINCTLY, AND IN A NORMAL TONE OF VOICE. Shouting will seriously distort the voice signal.

(4) Communications equipment controls (Figure 12) are provided on the right-hand side of the pilot's cockpit. The interphone jack box and command set controls are located above and forward of the trim tab controls.

b. Interphone Equipment RC-51.

The interphone jack box (Figure 12-15) has four positions marked on the face:

R-1—This position allows the pilot to transmit or receive over the command equipment.

R-2—The second position allows the pilot to receive over the compass equipment (if so equipped).

INT—This position allows the pilot to communicate with any other crew member who also has his interphone jack box selector switch in the "INT" position.

IR—The position marked "IR" allows any crew member to call other members of the crew regardless of the position of their interphone jack box selector switches.

c. Command Set SCR-274-N.

(1) *General.*—The command set is primarily designed for short range communication with nearby aircraft for tactical purposes and with ground stations for navigational and traffic control purposes.

(2) *Receiving.*

(a) Place interphone jack box selector switch (Figure 12-15) in "R-1" position.

(b) The receiver control box (Figure 12-13) is divided into three identical sections each of which controls one of three receivers to which it is electrically and mechanically connected. Reception of a signal of a specific frequency, as indicated on the dial, is accomplished by the use of the section of the receiver control box which controls the particular receiver involved.

★ *NOTE:* In case the airplane is equipped with a single receiver control box in the pilot's cockpit and a control box for two receivers in the observer's compartment, it is possible for the three receivers to be controlled by two different crew members. Access to the receiver channels by either pilot or observer can be had by placing the interphone jack box selector switch in the R-1 position.

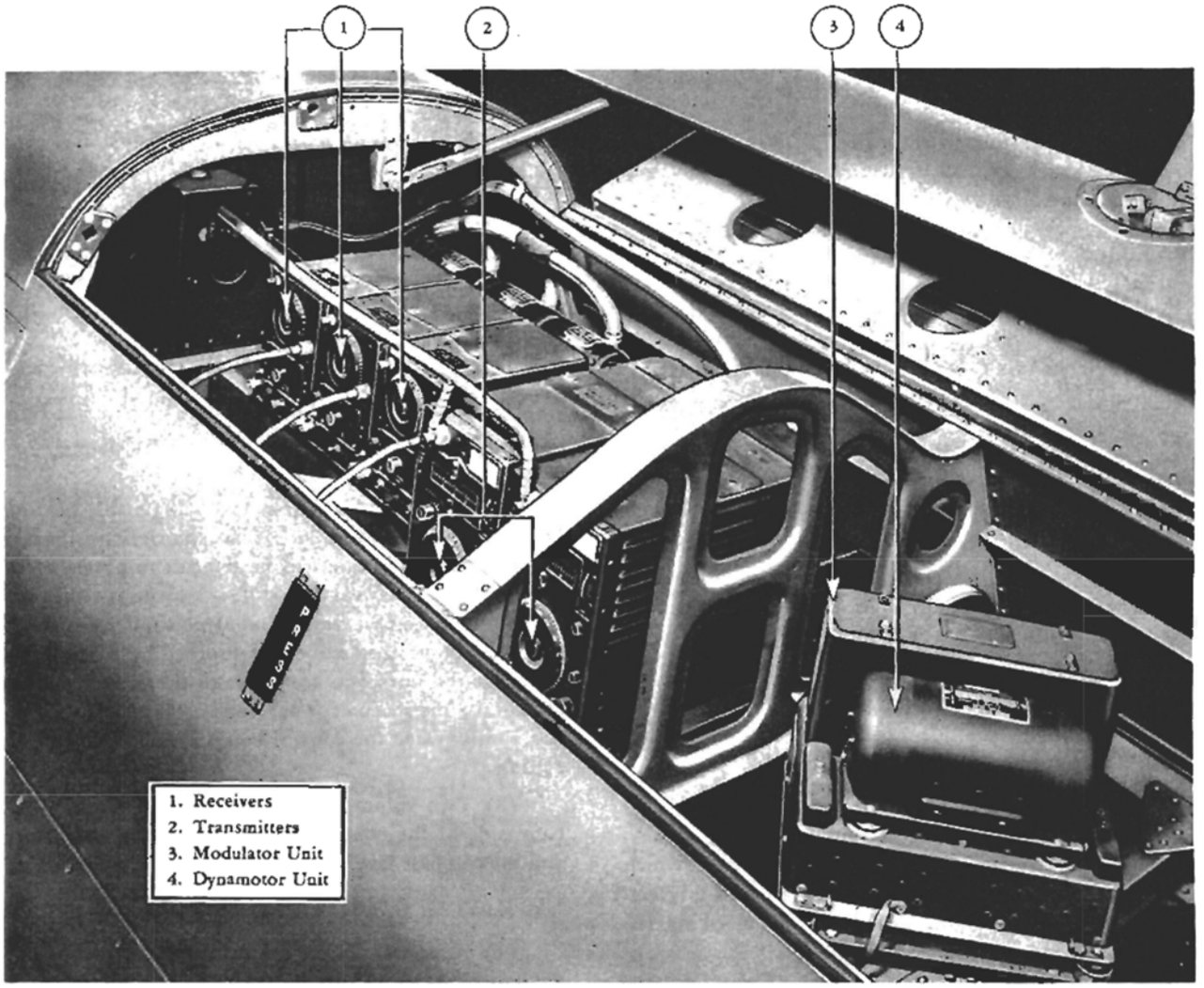


Figure 13—Communications Equipment in Fuselage

(c) Turn on desired receiver by placing switch (Figure 12-6) in either the "CW" or "MCW" position. These two positions, "CW" and "MCW," are "ON" positions and they indicate the type of signal which is to be received.

(d) Leave the "A-B" switch (Figure 12-4) in the "A" position at all times. It need not be turned off when the receivers are turned off.

★ *NOTE:* When tuning a receiver for a definite frequency, always turn the dial a little to each side of the frequency calibration mark to find the point where the signal is the strongest.

(3) *Transmitting (Bombardment type Airplanes).*

(a) Before transmitting, adjust radio receiver to the same frequency as the station with which you desire to talk, and listen in to be sure that the operator is not talking to someone else. If the station is transmitting, take advantage of the opportunity to more accurately set the receiver on the assigned frequency, and when the other operator is finished, proceed with your transmission.

(b) Place transmitter master switch (Figure 12-10) in "ON" position.

(c) Select type of transmission desired with switch marked "TONE-CW-VOICE" (Figure 12-9).

1. With the switch in the "VOICE" position, voice will be transmitted when the push-to-talk button is pressed.

2. With the switch in the "CW" position, a continuous wave, or unmodulated signal, may be transmitted, and the microphone is inoperative.

3. With the switch in the "TONE" position, a modulated tone signal may be transmitted and the microphone is inoperative.

★ *NOTE:* Greatest effective range can be obtained on "CW." Range is most limited when operating on "VOICE." Transmitting in both the "CW" and "TONE" positions is done by a key located on the top of the transmitter control box.

4. To reduce battery drain and to increase dynamotor life, the "TONE-CW-VOICE" switch (Figure 12-9) should be left on "VOICE" unless continued use on "CW" or "TONE" is expected.

(4) *Transmitting (Observation type airplanes).*—In airplanes which have been converted for observation use, the operation of the SCR-274-N set is the same as set forth above in paragraph 4, *c.*, (3) except that the transmitter control box (Figure 12-11) is located in the observer's compartment and is controlled manually by the observer. The pilot has control of this transmitter control unit by means of shafting which is accessible to the right of the pilot's instrument panel. An electrical switch is provided so that the pilot can turn the transmitting equipment on or off and the control shafts which extend to the observer's compartment are used for selecting the type of emission desired and for selecting the transmitter of the desired frequency.

d. Radio Compass MN-26C.

(1) The radio compass is designed to perform the following functions:

(a) Aural reception from the fixed antenna or from the rotatable loop. For signal reception during interference caused by precipitation, static, or proximity of signal, the loop will prove more satisfactory.

(b) Aural-null directional indication of an incoming signal with the loop only in use.

(c) Visual left-right indication of an incoming signal.

(2) If this airplane has a radio compass installed, and if aural reception is desired, set interphone jack box selector switch to "R-2" position.

(3) Turn on receiver by placing switch in the lower right-hand corner of the control unit in the "ON" position.

(4) Select desired frequency band in moving the dial by means of the tuning crank.

(5) Select type of reception desired by means of switch. Three types of reception are possible:

"COMP"—This position places both the rotatable knob and the fixed antenna in operation.

"REC. ANT."—When the switch is placed in this position, only the fixed antenna is in use.

"REC. LOOP"—This position provides reception with only the loop antenna.

(6) The loop azimuth control is connected to the loop by means of a tachometer shaft and is used for rotating the loop so that a bearing on the station may be obtained.

(7) Select a radio station providing stable bearing. Tune equipment carefully. If an interfering signal is heard in the headset, it will be difficult to obtain a correct bearing. To check, tune a few kilocycles either side of the resonance (greatest volume) point. If interference exists, select another station or proceed by other means of navigation until you are closer to the desired station. Do not use the station for bearing unless it can be identified aurally when the control box is set on "COMP" operation.

(8) Two volume controls are located on the right-hand side of the control box to control the audio level and the compass level.

c. Radio Set SCR-535 (IFF).

(1) A remote "OFF-ON" master switch for the equipment is located to the right of the pilot beneath the sliding window. Operation of the set is automatic and the pilot has only to place the master switch in the "ON" position to place the equipment in operation.

(2) Two destroyer pushbutton switches are provided beside the master switch. The purpose of these switches is to destroy the IFF equipment should it be necessary to abandon the airplane over unfriendly territory. When *both* pushbuttons are pressed simultaneously, a detonator is set off in the receiver which is located on the fuselage deck. The explosion of the detonator will destroy the receiver internally. No damage should occur to the airplane or personnel at the time of detonation, but bodily contact with the receiver should be avoided.

★ *NOTE:* Regeneration adjustment of the IFF set must be made on the ground prior to take-off in order to insure correct operation of the equipment.

d. Radio Set SCR-522-A (UHF).

(1) *General.*

(a) This equipment is an ultra high frequency command set designed for voice communication.

(b) The radio waves from this equipment travel in straight lines, like beams of light, and do not follow the curvature of the earth. Due to this fact, in order to receive signals from a ground station, it is necessary that the airplane be above a certain altitude, the altitude being determined by the distance of the airplane from the ground station.

1. If the airplane is between 35 and 50 miles away from the ground station, it must be above 1000 feet altitude before reception is possible.

2. If the airplane is between 80 and 100 miles away from the station, it must be above 5000 feet before reception is possible.

3. If the airplane is between 120 and 160 miles away from the station, it must be above 10,000 feet before reception is possible.

★ *NOTE:* If the range differs from any of the above-mentioned figures, the altitude will change proportionately.

(c) Excessive operation of this equipment on the ground must be avoided unless a battery cart is used to prevent running down the airplane's battery.

(2) *Operation.*

(a) Press the proper channel button on the cockpit control box (Figure 12-11) on which you are to transmit and receive.

★ *NOTE:* Transmission and reception take place on the same frequency.

(b) The green pilot light adjacent to the channel button pressed lights up whenever the set is in operation.

(c) The white pilot light adjacent to the toggle switch should light up indicating that the set is on "receive."

★ *NOTE:* Toggle switch should be in the "REM" position for throttle-button or control wheel button operation. "REM" (Remote) was marked "V.O." on early control boxes.

(d) To transmit, press microphone button, press the throttle (Figure 17-13) or wheel microphone push-to-talk button, and speak in a loud voice with the microphone against your lips. The white pilot light goes out indicating that set is on "transmit."

(e) It is also possible to transmit by moving the control box toggle switch to the "T" position, instead of pressing the throttle or wheel push-to-talk button, but it must be returned to either the "R" or "REM" position immediately after transmission is completed.

5. *FLYING CHARACTERISTICS.*

a. Take-off.—For normal take-offs, keep control column neutral, avoid heavy loads on the nose wheel. On soft ground, control column should be kept back during complete take-off in order to prevent nose wheel digging into the ground. When a speed of approximately 100-110 mph IAS has been reached, ease the control column back. After the airplane breaks ground, fly level until attaining 135 mph, IAS, to insure satisfactory rudder control in overcoming yaw if one engine fails. The take-off run will be approximately 1900 ft minimum over a 50 ft obstacle. Take-off distance may be improved by holding the airplane against the brakes until 30" Hg boost has been reached and then opening the throttles as the brakes are released.

b. Climb.—See Take-off, Climb, and Landing Chart (Figure 24).

c. Level Flight.—Remain in low blower until drop of 5" below desired M.P. at full throttle. If desired to climb further, shift to high blower; otherwise remain in low blower. At extreme aft limits of C.G. loading, slight instability will be noticed. Avoid steep turns or high speed dives. If upper cowl flaps are opened during flight, buffeting and nose heavy conditions will result.

Emergency maximum power (5 minutes only)

Cylinder head temperature	232°C (450°F)
Oil temperature	104°C (219°F)

For maximum range, fly at 13,000 ft at approximately 1700 rpm maintaining approximately 175 mph, IAS, by adjusting throttle.

d. Dives.—Maximum engine diving rpm, 2760, maximum speed 400 mph.

(1) Throttles should be at least one-third open and propeller pitch adjusted to prevent the engines exceeding the maximum permissible rpm.

(2) Wing flaps up and cowl flaps closed.

(3) Aircraft may be trimmed during a dive.

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

(5) Elevator trim tab control should NOT be used to assist maneuvering or recovery.

e. Bombing.—Bomb bay doors must not be opened at speeds above 345 mph. Bomb clearance angles are:

10° on each side

30° on forward end

15° on aft end

Bombs should not be dropped while the airplane is at an angle of dive in excess of 20°.

f. Failure of One Engine.—This airplane will maintain altitude on one engine provided the gross load does not exceed 27,800 lb at 4000 ft. Single engine characteristics are good. Normal approach and landing may be made.

g. Stalling.—With power off, the stall is straight forward and controllable and is preceded by a shuddering of the airplane followed by dropping of the nose. With power on, the airplane will tend to roll and spin if extreme stall conditions are allowed to develop. Stalling speeds:

Wing flaps and landing gear UP: 115 mph, IAS

Wing flaps and gear DOWN: 100 mph, IAS

Wing flaps DOWN and gear UP: 100 mph, IAS

h. Spinning.—Intentional spinning prohibited. In case of an accidental spin, standard methods of recovery should be used. If these fail, or if the airplane is spinning at or below 5,000 ft, abandon the aircraft. Before pulling cockpit emergency release, feather left engine propeller.

i. Approach.—At 20,000 pounds gross load, approach at 115 to 120 mph with power off or 110 to 115 mph with power on. These speeds should be sufficient to give a reasonable hold-off during the landing.

j. Landing.

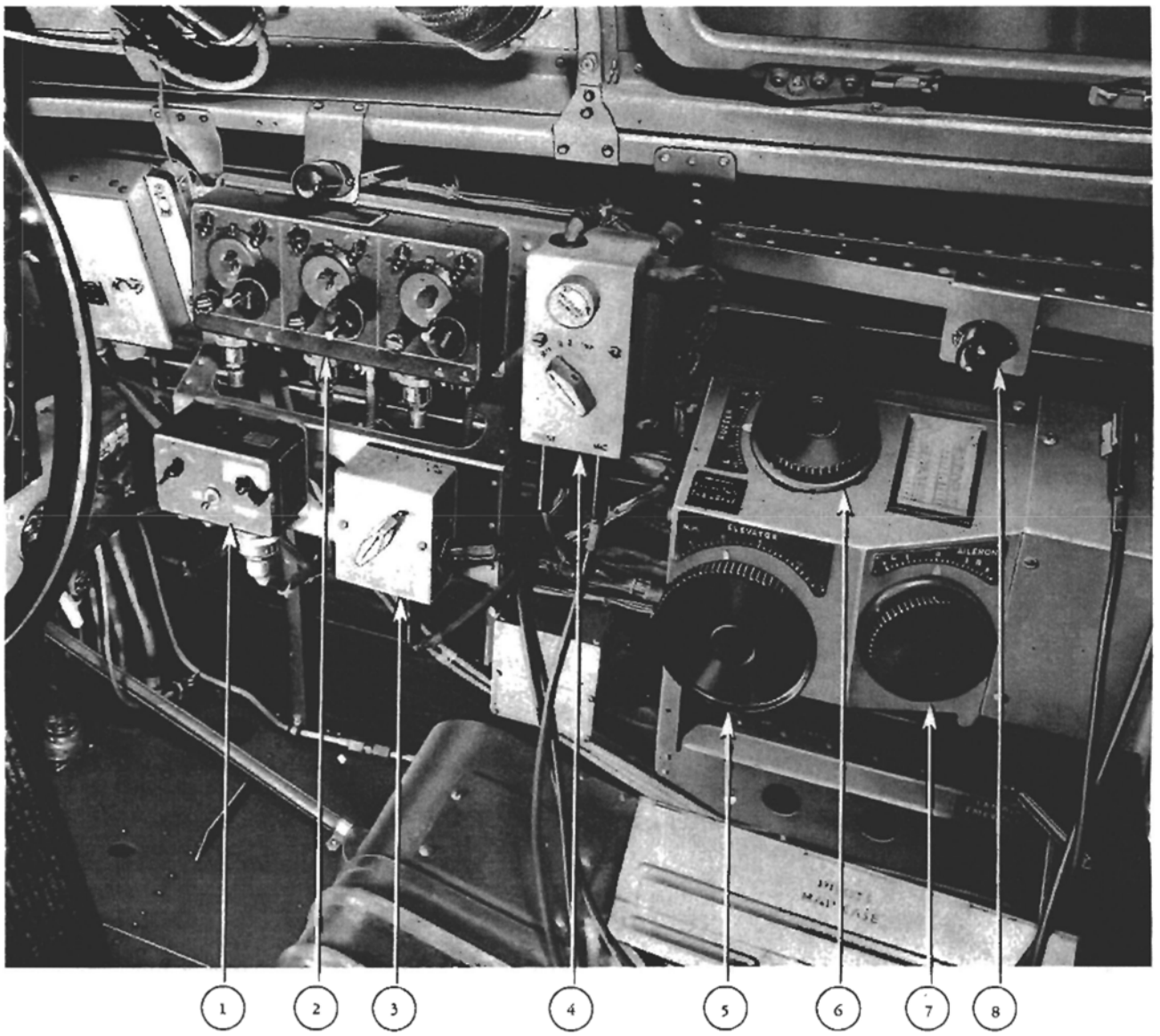
(1) In landing, the airplane should be flown close to the ground in a slight tail down attitude. This should not be so great as to risk striking the tail on the ground, but should be sufficient to give a higher angle of attack, and thereby reduce the landing speed. As the main wheels touch on the ground, the nose should be held up until the airplane pitches forward onto the nose wheel, then, 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 control column back. This concentrates the weight on the main wheels and improves braking characteristics.

(2) 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 control column back, or the landing run cannot be completed in the space available, the machine should be taken off and a new landing made.

(3) Landing can be made with the brakes on but, since the forward pitch onto the nose wheel is severe, this is not recommended.

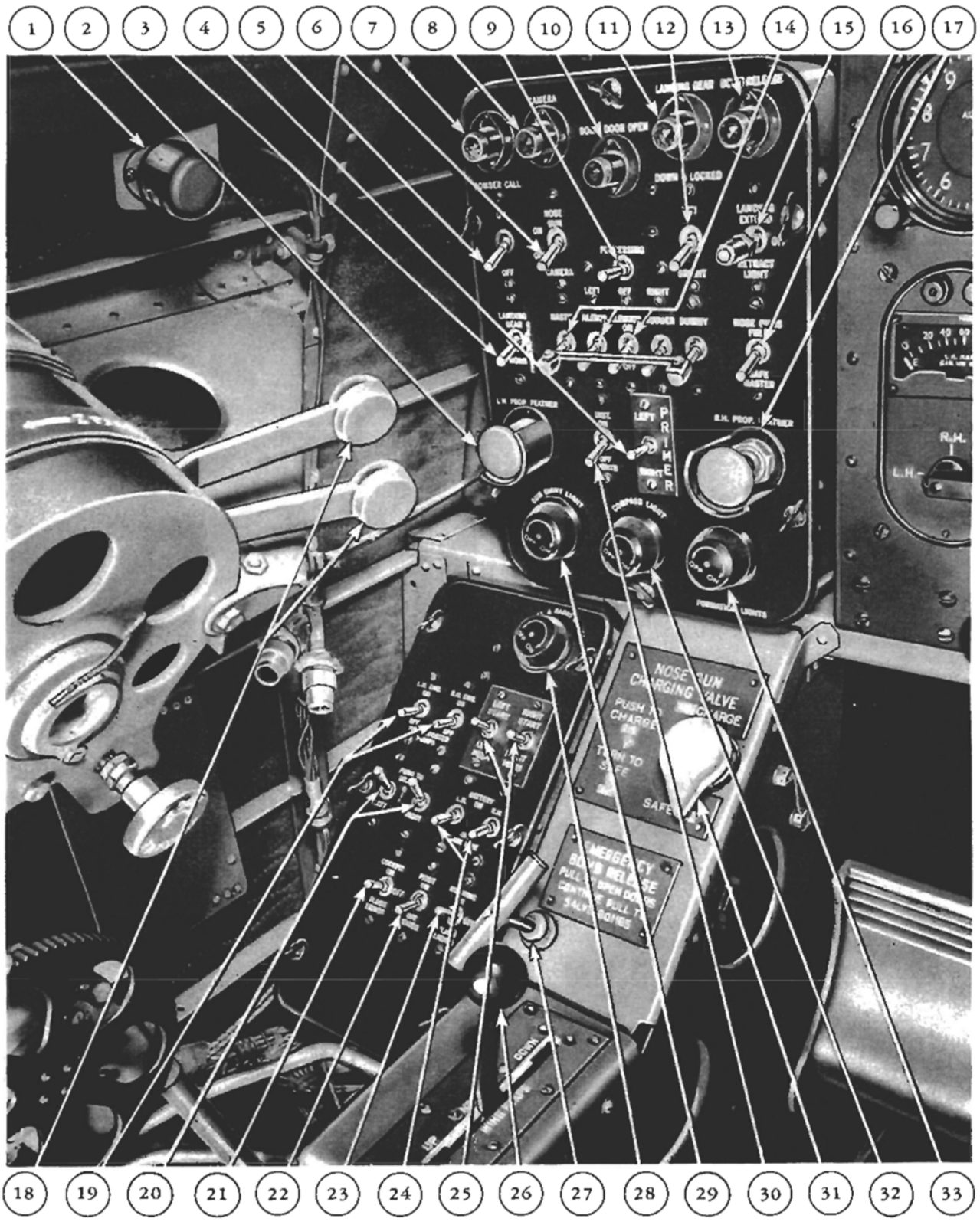
(4) Air brakes may be used after landing by holding brake pedals depressed and opening valve. The normal way is to open the control valve fully, allowing all available air pressure to be supplied.

(5) If brake lines are broken or punctured and no brakes are available, this airplane will require an extremely long landing run. If the pilot has any reason to believe that both the hydraulic and emergency air brake systems have failed, he should not lower landing gear by the mechanical means, but a belly landing should be made. 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 airplane.



1. Transmitter control box
2. Receiver control box
3. Interphone switch box
4. Interphone jack box
5. Elevator tabs control
6. Rudder tab control
7. Aileron tabs control
8. Light

Figure 14—Right Side View of Pilot's Cockpit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CAMERA
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LANDING GEAR
DOWN LOCKED
BOMBER CALL
NOSE CAMERA
LANDING GEAR EXTR.
RETRACT LIMIT
LANDING GEAR
LEFT PRIMER RIGHT
AIR SHUT LIGHT
COMPASS LIGHT
FORMATION LIGHTS
R.H.
L.H.
NOSE GUN CHARGING VALVE
PUSH TO CHARGE
TURN TO SAFE
SAFE
EMERGENCY BOMB RELEASE
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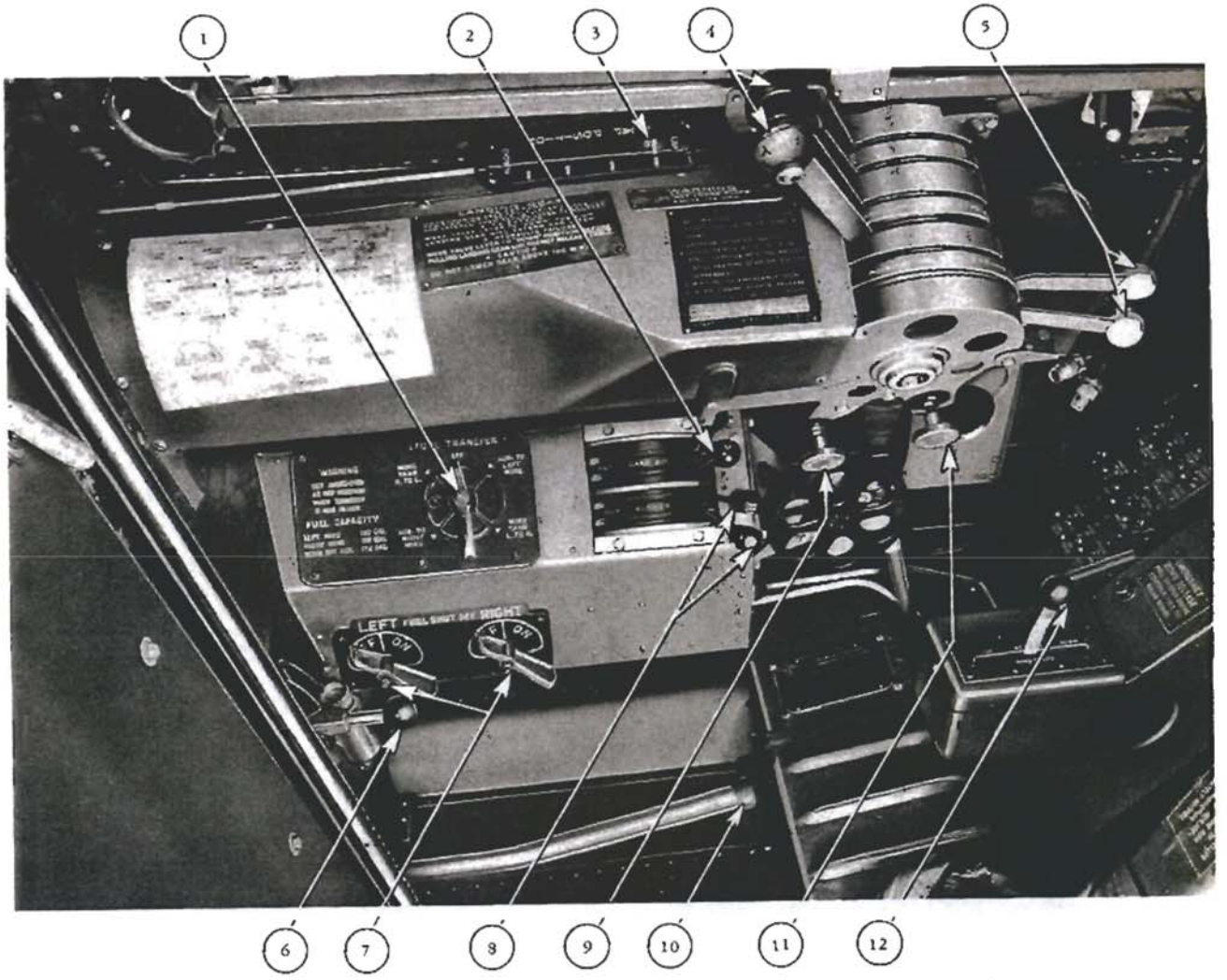
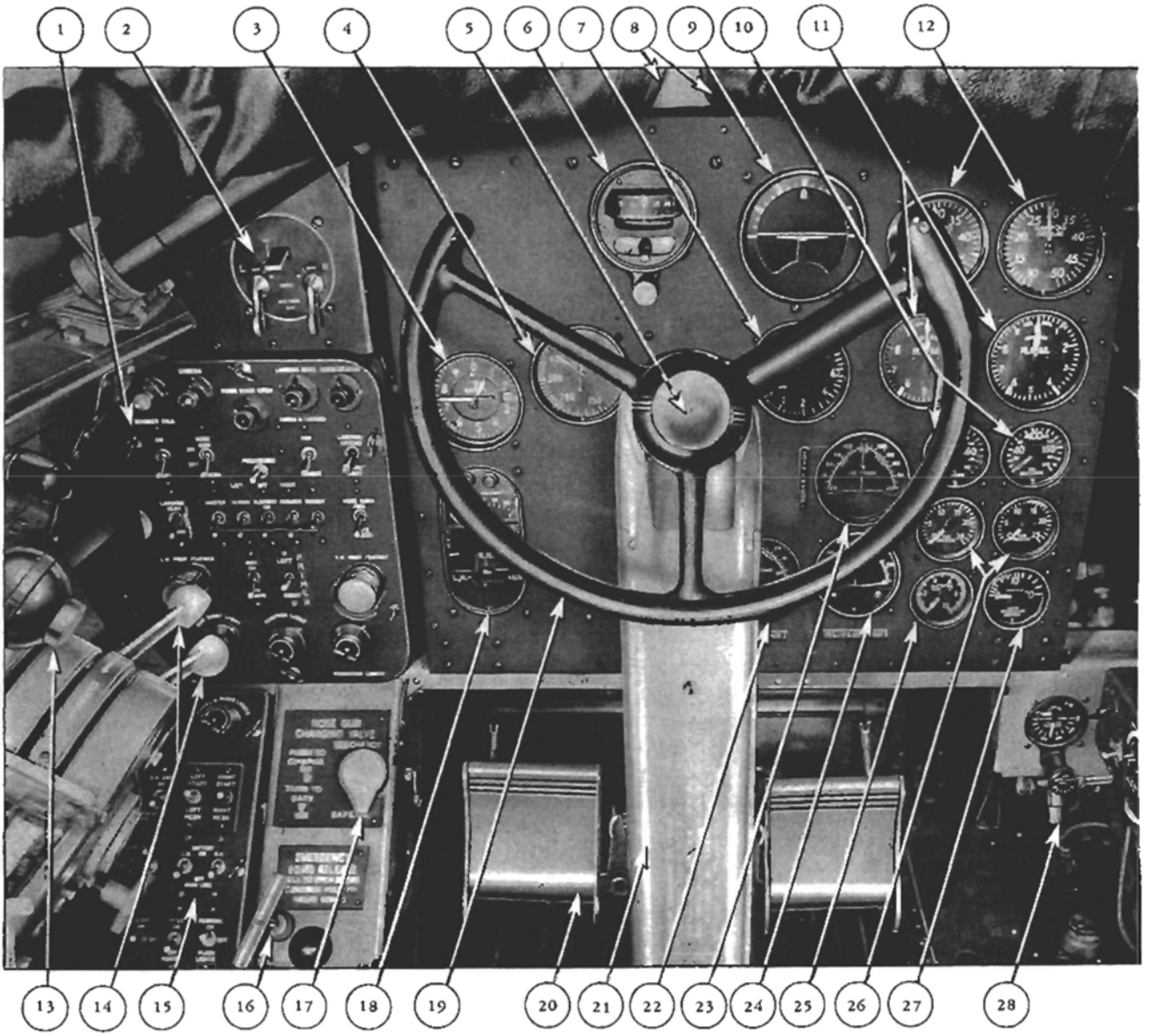


1. Fuel transfer selector valve
2. Carburetor air temperature control
3. Wing flaps position indicator
4. Throttle controls
5. Propeller pitch controls
6. Landing gear control
7. Fuel shut-off valves
8. Supercharger controls
9. Propeller lock
10. Hand hydraulic pump handle
11. Throttle lock
12. Wing flaps hydraulic control

Figure 16—Left Side View of Pilot's Cockpit

1. Light
2. Propeller feathering switches
3. Landing gear warning horn silencing switch
4. Primer switch
5. Bombardier call light switch
6. Nose gun camera light switch
7. Bombardier call light
8. Camera exposure light
9. Precessing switch
10. Bomb door open indicator light
11. Landing gear safe light
12. Landing gear safe light dimming switch
13. Bomb release indicator light
14. A. F. C. E. gang switch
15. Landing light switch
16. Master nose gun switch
17. Propeller feathering switches
18. Propeller pitch control
19. Fuel booster pumps switches
20. Oil dilution switches
21. Pilot compartment light switch
22. Pilot heater switch
23. Running lights switch
24. Battery main line switches
25. Starting and meshing switches
26. Wing flaps hydraulic control
27. Emergency bomb-salvo release control
28. Panel and radio lights rheostat
29. Gun sight light rheostat
30. Instrument panel light switches
31. Nose gun charging valve
32. Compass light rheostat
33. Formation lights rheostat

Figure 15—Pilot's Switch Panel



1. Upper electrical panel
2. Master ignition switch assembly
3. Altimeter
4. Airspeed indicator
5. Turn and bank indicator
6. Turn indicator
7. Rate of climb indicator
8. Crash pad
9. Artificial horizon
10. Oil pressure gages (2)
11. Tachometers (2)
12. Manifold pressure gages (2)
13. Microphone control button
14. Propeller pitch controls
15. Lower electrical panel
16. Emergency bomb-salvo release control
17. Nose gun charging valve
18. Fuel quantity gage
19. Wheel
20. Rudder pedal
21. Control column
22. Carburetor air temperature gage
23. Oil temperature gage
24. Cylinder head temperature gage
25. Suction gage
26. Fuel pressure gages (2)
27. Hydraulic pressure gage
28. Oxygen regulator

Figure 17—Pilot's Instrument Panel

SECTION II

PILOT'S OPERATING INSTRUCTIONS

1. *BEFORE ENTERING THE PILOT'S COMPARTMENT.*

a. Airplane Loading.—Check and sign Form F, the Weight and Balance Clearance prepared by ground loading personnel. This may be accurately accomplished by using a load adjuster (view A). The following instructions and *sample* loading problem are published as condensed instructions for the information and guidance of all personnel using a load adjuster to determine change in balance from the basic airplane to the loaded airplane as flown, and to insure that the weight distribution of all items loaded above and beyond the basic airplane weight and balance will not produce a weight and balance condition beyond permissible limits.

b. Application of Load Adjuster.—A load adjuster and carrying case for the model A-20B airplane will be found located on a mounting hook adjacent to the data case. Pick up the instrument and ascertain that the serial number for the airplane being loaded is identical with the serial number inscribed on the carrying case identification card (view A).

> *CAUTION:* The airplane model designation stamped on each load adjuster indicates that the instrument may be used for balance calculations on any AAF airplane of that particular model. However, the *index* figure entered on the carrying case identification card is correct only for the specific airplane serial number printed directly above, and represents the balance moment of *only that one individual basic airplane.*

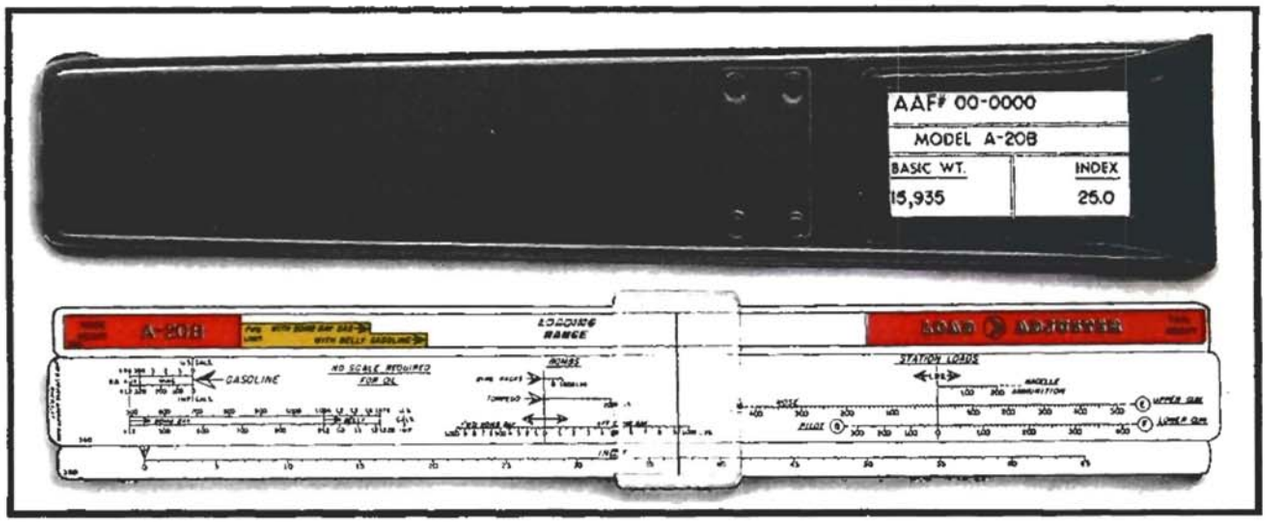


Figure 18—Load Adjuster
(View A)

c. Operating Instructions.

(1) The following sample loading problem is itemized in detail, and complete instructions with supporting illustrations are published to furnish the Service complete instructions on loading aircraft with the aid of a load adjuster. All items loaded in the airplane above and beyond the basic airplane (including personal items and all items commonly referred to as "expendable" items) are to be taken into consideration for each and every loading problem, and their balance moment must be added with the load adjuster on the compartment scale where they are to be located.

(a) Given:

ITEM	SUB-TOTAL	TOTAL
Basic Airplane		15,935
Gasoline: 394 U.S. gal (328 Imp. gal)		2,364
Oil: 44 U.S. gal (36.6 Imp. gal)		330
Bombs:		
Wing Racks (2 ea 500 lb)		1,600
Forward Bay		900
Rear Bomb Bay		900
Nose Compartment:		
Bombardier	200	
Ammunition (1,000 rds .30 cal)	65	
Special Equipment	50	315
Pilot's Compartment:		
Pilot	200	
Handbook Data	25	
Special Equipment	50	275
Nacelle Ammunition (2,000 rds .30 cal)		130
Upper Gun Compartment:		
Gunner	200	
Special Equipment	200	
Ammunition (1,000 rds .30 cal)	65	465
Lower Gun Station:		
Special Equipment	200	
Ammunition (500 rds .30 cal)	33	233
GROSS WEIGHT		23,447

(b) To Find: If the load distribution brings the airplane balance within permissible cg limits as indicated on the load adjuster "Loading Range" scale.

Adding the weights of all items loaded (refer to paragraphs 1. *c. (1)* (*a*) of this section) shows the gross load of the airplane well within allowable limits. Furthermore, the hairline of the transparent indicator is located well in the center of the loading range. Therefore, the airplane loading condition is satisfactory and the airplane may be flown.

> *CAUTION:* DO NOT SHIFT OR DISPOSE of any load without first predetermining (by use of the load adjuster) that the balance of the airplane will remain within limits *after* the change is made.

(12) As the index of 32.8 places the transparent indicator hairline well within fore and aft loading limits as indicated on the loading range scale at the top of the load adjuster, the airplane is satisfactory for flight. If the loaded airplane had balanced anywhere within the tail-heavy red colored section, or on the nose-heavy red colored section, or on the nose-heavy side of the aft limit of the yellow section labeled "F'W'D LIMIT" it would have been mandatory to readjust the load or carry sufficient ballast to bring the indicator hairline within the "LOADING RANGE" limits. It is permissible to shift miscellaneous cargo, baggage, or other items within the airplane to make the final balance fall within approved limits. The load adjusting instrument is exceedingly simple to operate, equally accurate, and the airplane should be loaded as it indicates.

2. *ON ENTERING PILOT'S COMPARTMENT.*

a. Check for All Flights.

(1) Check all flight controls for freedom of movement.

(2) Check oxygen mask fitting to regulator (Figure 11).

(3) Ignition switch OFF (Figure 17-2).

(4) Landing gear control handle in NEUTRAL (Figure 8-1).

(5) Flap control handle in NEUTRAL (Figure 16-12).

(6) Nose gun master switch SAFE (Figure 15-16).

(7) Parking brake ON.

(8) Emergency air brake OFF (Figure 5-3).

Pressure gage must show 400 lb/sq in. or more.

(9) Trim tab controls NEUTRAL (Figure 7).

(10) Turn battery main line switches ON (Figure 15-24).

(11) Turn fuel shut-off valve ON (Figure 16-7).

★ *WARNING:* Keep switches for engine not being started OFF.

(12) Fuel transfer valve OFF (Figure 16-1).

(13) All cowling flaps OPEN (Figure 5-4, 5). Use hand hydraulic pump.

> *CAUTION:* Be sure all other hydraulic controls are in neutral before operating hydraulic hand pump.

(14) Carburetor air heat in full COLD (Figure 16-2).

(15) Generator switches ON (Figure 6-1, 3, behind pilot's head or Figure 45-1, 6, in gunner's compartment).

b. Check for Night Flying.

(1) Turn master battery switch ON (Figure 15-24).

(2) Turn cockpit lights ON (Figure 15-21).

(3) Test operate bombardier call light (Figure 15-7).

(4) Test operate formation light rheostat (Figure 15-33).

(5) Test operate landing lights (Figure 15-15).

(6) Test operate gun sight light rheostat (Figure 15-29).

(7) Test operate compass light rheostat (Figure 15-32).

(8) Test operate panel and radio light rheostat (Figure 15-28).

(9) Test operate running lights (Figure 15-23).

3. *STARTING ENGINES.*

a. Start Right Engine First.

(1) With cold engine, ignition switches off, pull propeller through four to eight revolutions.

(2) Propeller controls in INCREASE RPM (Figure 9-3).

(3) Set throttle control (Figure 9-1) nearly closed for 800 to 1000 rpm.

(4) Mixture control IDLE CUT-OFF (Figure 9-2).

(5) Supercharger controls in LOW BLOWER (Figure 16-8).

(6) Turn ignition switch (Figure 17-2) on BOTH for the engine being started.

(7) Energize and engage starter (Figure 15-25).

(8) As starter is engaged prime engine five strokes or operate primer switch (Figure 15-4) until engine fires.

(9) When engine fires, set mixture control (Figure 9-2) to AUTOMATIC RICH.

(10) Set throttle for 800 to 1000 rpm.

(11) If oil pressure does not reach 40 lb/sq in. within 30 seconds stop the engine.

(12) Operate wing flaps down, then up. Note hydraulic pressure recovery showing right engine hydraulic pump O.K.

b. Repeat for Other Engine.

4. *ENGINE WARM-UP.*

Warm up engines between 800 and 1000 rpm until the oil maintains at least 50 lb/sq in. pressure, and the temperature increases to at least 38° C (100° F).

(1) Check engine instruments for consistency with the stage of warm-up.

(2) Set carburetor heat control (Figure 16-2) as required.

> *CAUTION:* Do not attempt take-off with the carburetor heat control ON.

(3) Adjust cowling and oil cooler flaps (Figure 5-4, 5) as necessary to obtain desired temperatures.

> *CAUTION:* Do not attempt take-off with upper cowling flaps open.

5. *EMERGENCY TAKE-OFF.*

a. Dilute Oil, if Necessary, to Acquire Steady Pressure.

(1) 2,400 rpm.

(2) 43" Hg manifold pressure.

(3) Set all other controls as usual and TAKE OFF.

6. *GROUND TESTS.*

a. Engine and Accessories.

(1) With throttle closed shift supercharger to high blower. Open throttle to not over 30" Hg. Make a quick, full shift to low blower. Manifold pressure gage (Figure 17-12) should show a sudden decrease in pressure.

(2) With propeller controls set at INCREASE RPM advance throttle to obtain 2050 rpm.

(3) Test ignition on each magneto, both engines. Drop should not exceed 75 rpm.

★ *WARNING:* This test should never exceed 30 seconds on any single magneto.

(4) Test operate propeller automatic control (Figure 9-3) at 2050 rpm.

(5) Test both generators (Figure 6-1, 3, behind pilot's head or Figure 45-1, 6, in gunner's compartment).

(6) Check fuel and oil pressures.

a. Fuel—12 to 16 lb/sq in.
b. Oil—80 to 90 lb/sq in.

(7) Check oil and cylinder head temperatures.

a. Oil—50° to 70° C (122°-158° F)

b. Cylinder—Desired 205° C (401° F)
—Normal 232° C (450° F)
—Maximum 260° C (490° F)

7. *TAXYING INSTRUCTIONS.*

a. Assure that all landing gear safety pins are removed.

b. The view ahead and down at each side is unobstructed.

c. Avoid taxying through mud holes and tall grass as the propellers can easily be damaged by small stones, mud clots, or hidden pieces of foreign materials.

d. Do not taxi with flaps extended.

8. *TAKE-OFF.*

(1) Roll airplane straight forward to straighten out nose wheel.

(2) Check cylinder head temperatures. Do not attempt take-off with temperatures below 120° C (248° F) or above 205° C (401° F).

(3) Trim tabs set for take-off. Aileron and rudder NEUTRAL. Elevator forward 1½ divisions.

(4) Mixture control (Figure 9-2) AUTO-RICH.

(5) Propeller pitch (Figure 9-3) at INCREASE RPM.

(6) Carburetor air heat (Figure 16-2) at FULL COLD.

(7) Superchargers (Figure 16-8) in LOW BLOWER.

(8) Oil cooler flaps OPEN.

(9) Upper cowling flaps (Figure 5-5) CLOSED. Lower cowling flaps (Figure 5-4) OPEN as necessary. All controls NEUTRAL.

(10) Open throttle to 43" Hg manifold pressure, 2,400 rpm and take-off.

(11) Raise landing gear as soon as practicable after leaving the ground.

9. *ENGINE FAILURE.*

a. During Take-off.

(1) Reduce power of live engine for directional control.

(2) Close the throttles and stop if there is room to do so.

(3) If off the ground and without room to land:

(a) Press feathering switch (Figure 15-2, 17) on useless engine.

(b) Retract landing gear.

(c) Carefully build up flying speed and altitude.

(d) Close cowl flaps and shutters on useless engine.

(e) Mixture IDLE CUT-OFF, propeller control DECREASE RPM, shut off fuel, and ignition on useless engine.

b. During Flight.—If one engine fails during flight and it is imperative that the propeller be feathered as quickly as possible, proceed as noted in Paragraph 9*a*. Otherwise, proceed as follows:

(1) Propeller feathering:

(a) Mixture—IDLE CUT-OFF.

(b) Propeller—DECREASE RPM.

(c) Throttle—CLOSED.

(d) Push feathering switch button. (Release button after feathering action starts.) When the blades are fully feathered, the button will "kick-out" automatically.

(e) Dead engine ignition—OFF.

(f) Cowl flaps—CLOSED.

(g) Fuel tank shut-off valve—OFF.

(2) Operate fuel transfer pump selector valves and fuel shut-off valves, depending on circumstances and causes of failure, as shown in FUEL TRANSFER CHART on this page.

(3) Regulate the cylinder head temperature of the operative engine by the lower cowl flaps. Head temperatures, which are sensitive to mixture, should not exceed 205° C (400° F).

(4) Adjust the rudder tab to suit speed and horsepower conditions.

(5) Final single engine approach and landing should be made as noted in Paragraph 9*a*.

(6) If it is necessary to stop an engine during flight and then restart, adhere to the following procedure:

(a) Fuel—ON.

(b) Engine switch—ON.

(c) Press feathering button.

(d) Mixture—AUTO RICH.

(e) Propeller—DECREASE (High Pitch).

(f) Allow engine revolutions to increase to approximately 1200 rpm, when the propeller governor will take control.

(g) Warm up engine and increase power as required.

(h) Adjust temperature.

> *CAUTION:* The engine must not run on full power until oil pressure and oil temperature are normal.

FUEL TRANSFER CHART

(Refer to Paragraph 9 of This Section)

Condition	*Remarks*	*Transfer Pump Selector Valve*	*Fuel Shut-off Valve*
Left hand engine failure.	Left hand tank supplies. Right hand engine	Is in OFF position (except while transferring fuel from left to right tanks).	Left hand engine shut-off valve in OFF position.
Right hand engine failure.	Right hand tank supplies. Left hand engine	Is in OFF position (except while transferring fuel from right to left tanks).	Right hand engine shut-off valve in OFF position.

When the auxiliary fuel tank is installed and desired to be used, set the transfer pump selector valve to either AUX. TO LEFT WING or AUX. TO RIGHT WING, depending on inoperative engine.

10. *CLIMB.*

The most efficient climbing speed is 140 mph.

11. *FLIGHT OPERATION.*

a. See that all hydraulic controls are in NEUTRAL.

b. Refer to Section III for performance data.

c. How to Shift Supercharger Blower. — (Refer to Flight Operation Instruction Chart for correct blower.)

(1) Mixture control AUTO-RICH.

(2) Throttle one-quarter open.

(3) Rpm under 1800.

(4) Quickly and fully shift blower control.

(5) Reset throttle and mixture controls.

CAUTION: Do not pause during blower shift.

★ *NOTE:* Allow 5 minutes between shifts in order to dissipate heat.

12. *EMERGENCY OPERATION.*

a. Engine Failure During Flight.

(1) Reduce power of live engine for directional control.

(2) Retard throttle (Figure 9-1) fully on useless engine.

(3) Propeller control (Figure 9-3) DECREASE RPM.

(4) Move mixture (Figure 9-2) to IDLE CUT-OFF.

(5) Press feathering switch (Figure 15-2, 17).

(6) Ignition switch (Figure 17-2) OFF.

★ *EXTREME EMERGENCY:* Press feathering switch first.

(7) Live engine mixture AUTO-RICH.

(8) If for any reason the speed falls below the minimum for control, regain the speed by losing altitude at reduced power and not by applying additional power.

(9) Avoid violent maneuvers.

★ *WARNING:* NEVER make steep turns with the inoperative engine down.

Practice of single engine operation should not exceed 15 minutes at a time. All practice operations must be above 5000 feet.

b. Restarting Engine.

(1) Fuel shut-off valve (Figure 16-7) ON.

(2) Ignition on BOTH.

(3) Push in feathering switch (Figure 15-2, 17) and hold until 800 to 1000 rpm is attained, then release.

(4) Mixture control (Figure 9-2) AUTO-RICH.

(5) Reset propeller control (Figure 9-3).

(6) Reset throttle (Figure 9-1).

(7) Reset mixture (Figure 9-2).

NOTE: When engine speed reaches 800 to 1000 rpm propeller control must be moved to INCREASE RPM or propeller will automatically re-feather itself.

(8) Run at reduced rpm and power until oil and cylinder temperatures indicate safe operation.

c. Emergency Operation of Landing Gear and Flaps.

(1) *Landing Gear.*—If the hydraulic system has failed the landing gear may be lowered by pulling the emergency release control. It may be necessary to drop the nose of the airplane momentarily to lock the gear down.

(2) *Wing Flaps.*—Must be lowered hydraulically. Power may be supplied by operating the hand hydraulic pump.

13. *LANDING*

a. Normal.—Do not lower landing gear or wing flaps above 170 mph.

(1) Check fuel quantity. Transfer fuel between wing tanks as required. Then fuel pumps (Figure 15-19) OFF.

(2) Nose gun master switch (Figure 15-16) SAFE.

(3) Master heater switch "OFF."

(4) Reduce speed to 170 mph.

(5) Lower cowl flaps (Figure 5-4) OPEN.

(6) Mixture control (Figure 9-2) AUTO-RICH.

(7) Supercharger controls (Figure 16-8) LOW BLOWER.

(8) Carburetor heat (Figure 16-2) COLD.

(9) Propeller control (Figure 9-3) INCREASE RPM.

(10) Check brake pressure by depressing pedals.

CAUTION: If air brakes are used keep pedals depressed or all air pressure will be lost.

b. Single Engine Landing.

(1) If the dead engine can be used (such as when stopped for low oil pressure) restart and operate at reduced power.

(2) Make the approach at least 1000 ft above the field.

(3) Maintain comfortably safe speed and altitude.

(4) Full flaps should be used as soon as there is no danger of undershooting.

(5) If landing is missed raise wheels at once. Apply power gradually; reset trim. Raise flaps as soon as safe flaps-up speed is reached.

c. Cross-wind Landing.—Observe usual precautions.

d. Emergency Take-off if Landing Not Completed.

(1) Open throttles to 2400 rpm, 43" Hg.

(2) Retract landing gear at once.

(3) Do not retract flaps until above 500 ft alt.

14. *STOPPING ENGINES.*

a. Stopping Right Engine.

(1) Apply toe brakes and set parking brake.

> *CAUTION:* Do not use parking brake when brakes are hot.

(2) Landing gear (Figure 8-1) and wing flaps (Figure 16-12) controls NEUTRAL.

(3) Leave propeller in INCREASE RPM (Figure 9-3) and allow engine to idle for approximately 5 minutes.

(4) Advance throttle (Figure 9-1) to 1200 rpm and operate for 1 minute more.

(5) Set mixture control (Figure 9-2) at IDLE CUT-OFF and advance throttle.

(6) When propeller stops rotating turn ignition switch (Figure 17-2) OFF.

(7) Operate wing flaps down, then up. Note hydraulic pressure recovery showing left engine hydraulic pump O.K.

(8) Set fuel shut-off (Figure 16-7) to OFF.

b. Stopping Left Engine.

(1) Repeat for left engine.

(2) Turn battery main line switches (Figure 15-24) OFF.

(3) Generator switches "OFF" (Figure 6-1, 3, behind pilot's head or Figure 45-1, 6), in gunner's compartment).

15. *BEFORE LEAVING PILOT'S COMPARTMENT.* Make out Form 1.

16. *MANEUVERS PROHIBITED.*

(1) Loops

(2) Spins

(3) Rolls

(4) Immelmanns

(5) Dives in excess of 400 mph, IAS

(6) Vertical banks

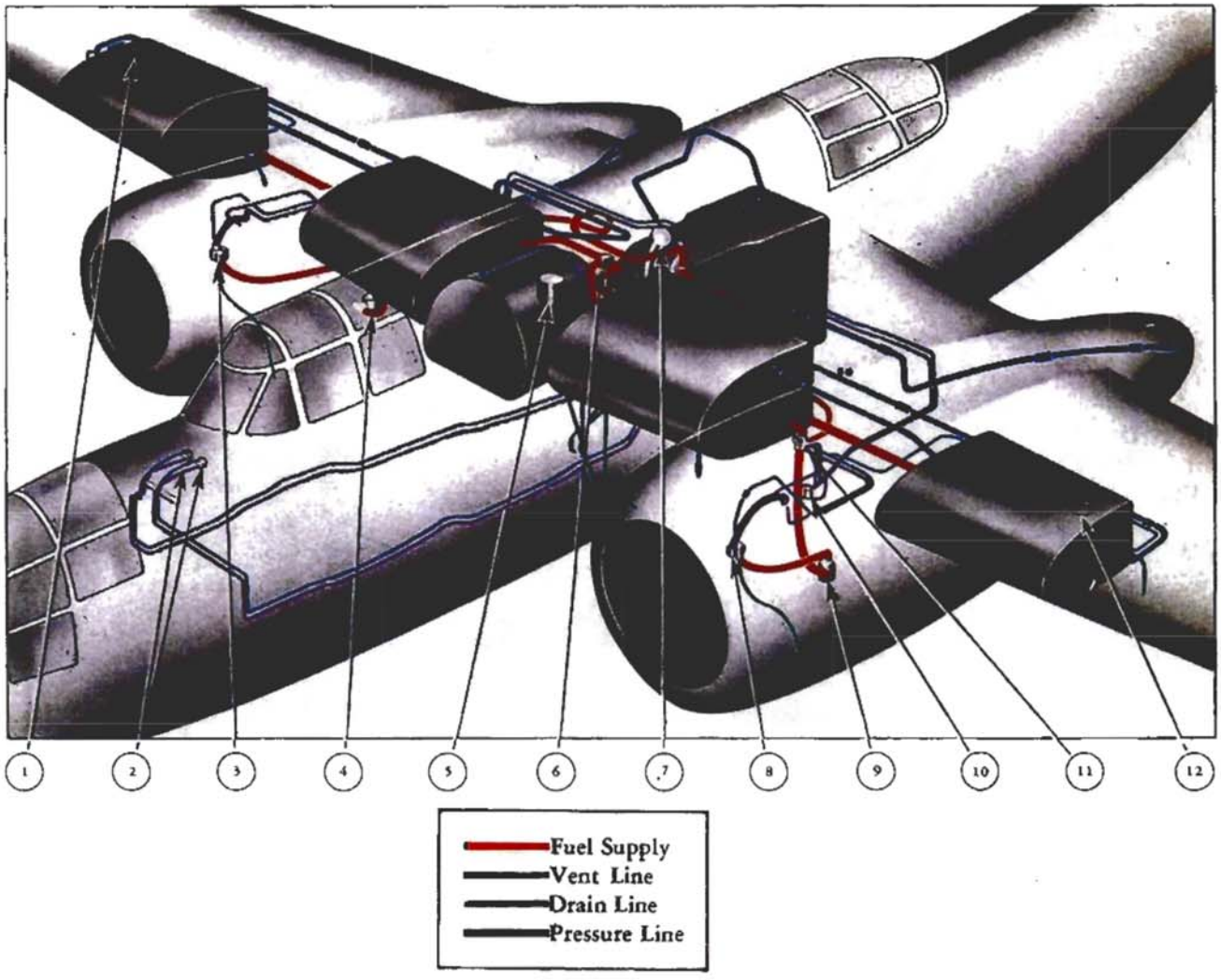
(7) Stalls

(8) Inverted flight.

17. *OTHER RESTRICTIONS.*

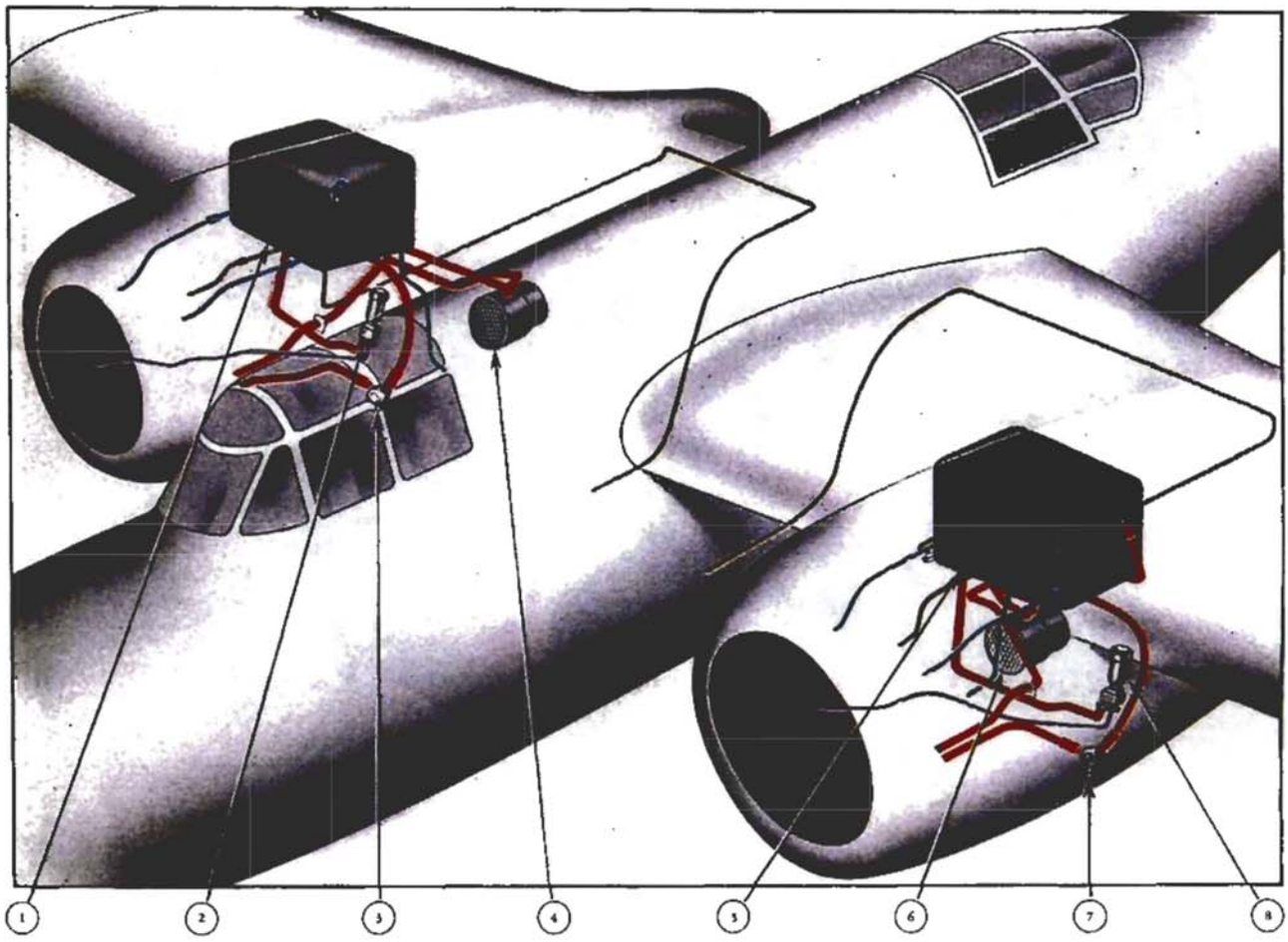
(1) Maximum engine diving rpm 2760.

(2) Glide with wing flaps down must be at least 15 mph above stalling speed. See chart of stalling speeds.



1. Right wing tank filler
2. Fuel pressure gages
3. Fuel pump
4. Fuel strainer
5. Fuselage tank filler
6. Fuel transfer selector valve
7. Auxiliary tank filler
8. Fuel pump
9. Fuel strainer
10. Electric primer
11. Fuel shut-off valve
12. Left wing tank filler

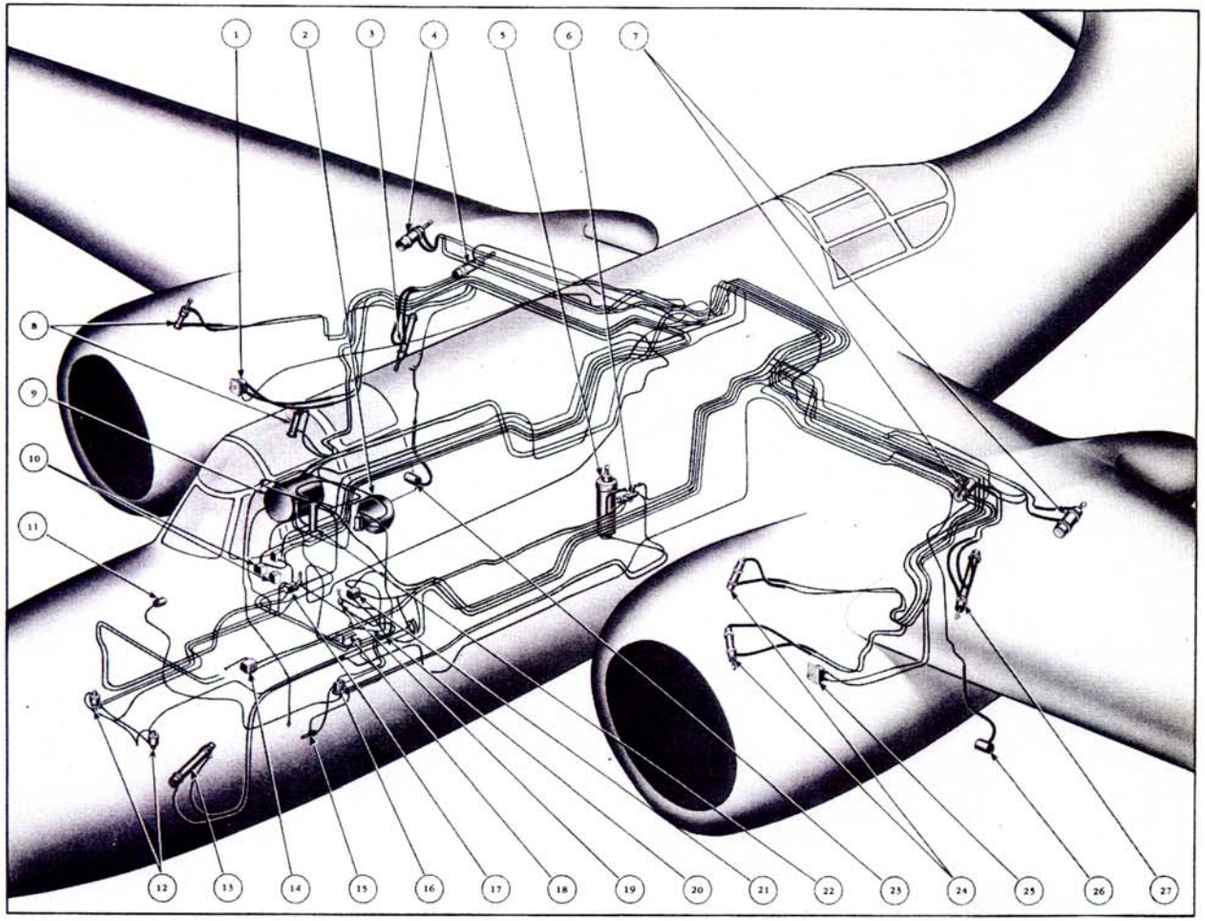
Figure 19—Fuel System Diagram

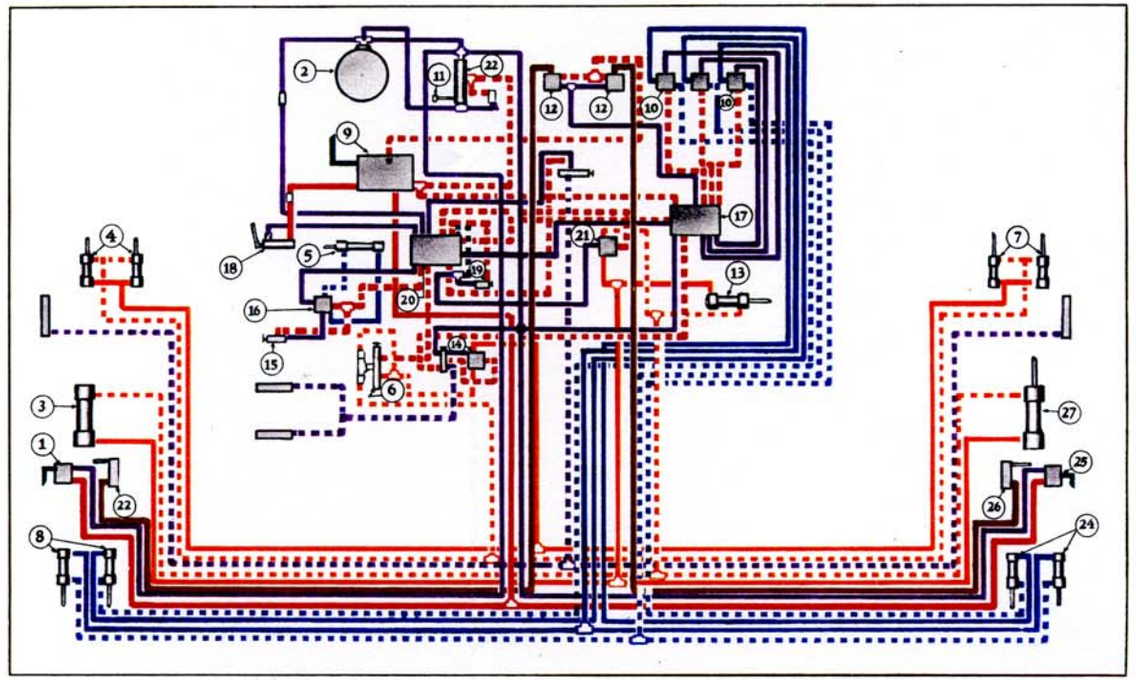


To Pressure Gage
Drain Line
Pressure Line
(Propeller Feathering)
Oil Lines
Vent Lines

1. Oil tank
2. Hydromatic pump
3. "Y" drain cock
4. Oil cooler
5. Oil tank
6. Oil cooler
7. "Y" drain cock
8. Hydromatic pump

Figure 20—Oil System Diagram





1. Engine driven hydraulic pump
2. Fluid pressure accumulator
3. Landing gear actuating cylinder
4. Wing flap actuating cylinder
5. Bomb door actuating cylinder
6. Wing flap relief valve
7. Wing flap actuating cylinder
8. Cowling flap actuating cylinder
9. Oil reservoir
10. Lower cowling flap four-way valve
11. Pressure gage
12. Brake control valve
13. Nose wheel actuating cylinder
14. Wing flap four-way valve
15. Bomb door adjustable relief valve
16. Bomb door four-way valve
17. R. H. manifold block
18. Hand hydraulic pump
19. Landing gear relief valve
20. L. H. manifold block
21. Landing gear four-way valve
22. Pressure regulator
23. Brake debooster
24. Cowling flap actuating cylinder
25. Engine driven hydraulic pump
26. Brake debooster
27. Landing gear actuating cylinder

Figure 21—Hydraulic System Diagram

SECTION III
FLIGHT OPERATION DATA

1. *DETERMINING GROSS WEIGHT AND BALANCE.*

Refer to Clearance Form F in the "Handbook of Weight and Balance Data" in the airplane. Determine from A-20B charts or load adjuster that loading is within safe balance limits.

2. *FLIGHT PLANNING.*

The following outline is a guide to using the FLIGHT OPERATION INSTRUCTION CHART (Figure 25-30) for flight planning.

NOTE: The flight operation instruction charts show practical ranges which can be obtained by service pilots with service equipment under the conditions set forth. Each range given is approximately 75% of the theoretical maximum range.

a. If the flight plan calls for a continuous flight where the desired cruising power and airspeed are reasonably constant after take-off and climb to 5000 feet, the fuel required and flight time may be computed as a "single section flight."

b. Greater speed means less range, and greater range means less speed. Determine speed by balancing range desired against urgency of the flight.

(1) Determine gross weight at take-off. Select the FLIGHT OPERATION INSTRUCTION CHART for this weight. Find the largest figure under GPH (gallons per hour, Column I, lower half of chart). Multiply this figure by the hours desired for reserve fuel. Add the resulting figure to the number of gallons set forth in footnote No. 3 and subtract the total from the amount of fuel in the airplane before starting engine. This figure represents the amount of fuel available for flight planning.

(2) Select a figure in the fuel column equal to, or less than, the amount of fuel available for flight planning (par. 2.b. (1)). Move horizontally to the right or left and select a figure equal to, or greater than, the air miles (with no wind) to be flown. This column represents the highest cruising speed possible at the range desired; however, any column of greater range may be used with the result of greater fuel economy but lower speed.

(3) Drop to the lower part of the same column (par. 2.b., (2)), and determine IAS at sea level. To allow for wind, use the above IAS as ground speed and calculate a new corrected ground speed with the aid of a flight calculator or by a navigator's triangle of velocities. Divide air miles to be flown by corrected ground speed to give hours of flight duration.

(4) Select cruising altitude in the lower half of chart under Operating Data and find beside this figure in the range column selected (par. 2.b., (1)), the desired RPM, IAS, MP, and GPH. To check, multiply GPH by hours of flight duration. The total should be equal to, or less than, the total amount of fuel available for flight planning. If greater, pilot should use next longer range column.

c. The flight plan may be readily changed at any time enroute, and the chart will show the balance of range at various cruising powers by following the Instructions for Using Chart printed on each page.

d. Usually the flight plan will call for a change during flight in power, speed, gross load, or external load. In such case, break the total flight into a series of individual short flights, each computed as outlined in par. b, in its entirety, then add them together to make up the total flight and its requirements.

CAUTION: Ranges listed in Column I (Max. Cont. Power) are correct only at the altitude given in footnote 1. Engine and airplane operating data will give constant miles per gallon only if operation is according to values set opposite the listed altitudes.

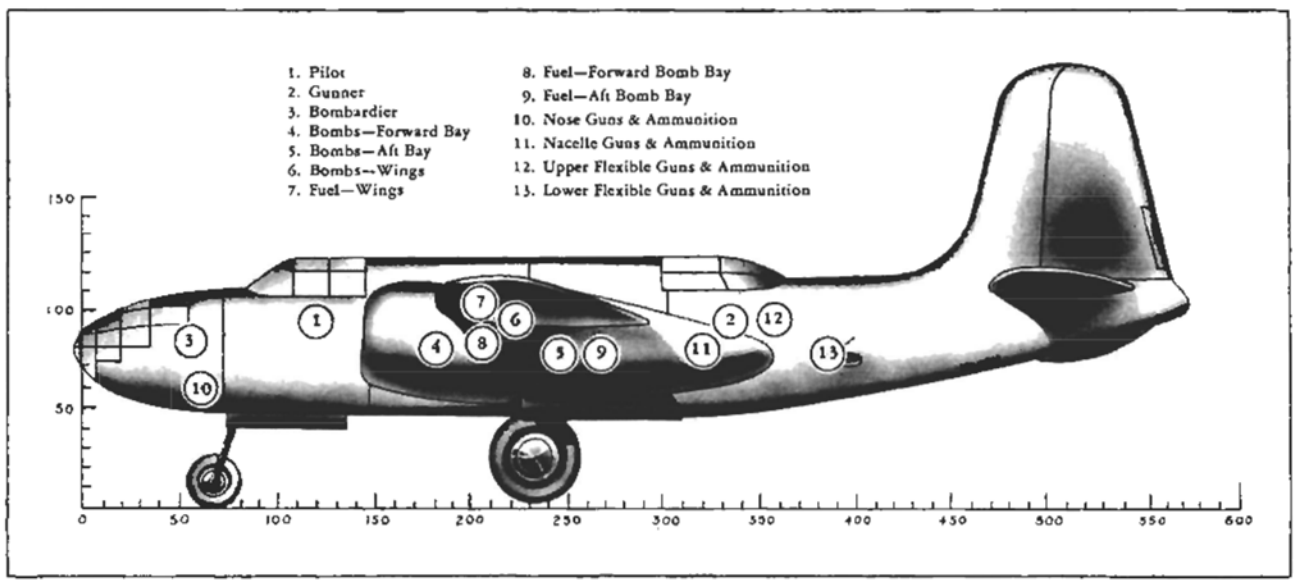


Figure 22—Stations Diagram

SECTION IV
BOMBARDIER'S COMPARTMENT

1. *GENERAL DESCRIPTION.*

a. Access to Bombardier's Compartment.

(1) *Normal.*—Through the floor of the Bombardier's compartment, in the nose section. Door may be opened by turning the handle in the forward corner.

(2) *Emergency Access.* — Through upper auxiliary door. May be opened by breaking the fabric patch over the cable release hand hole and pulling the release cable.

(3) *Emergency Exit Lower Door.*—Pull emergency release in lower door. This removes the latching pins and

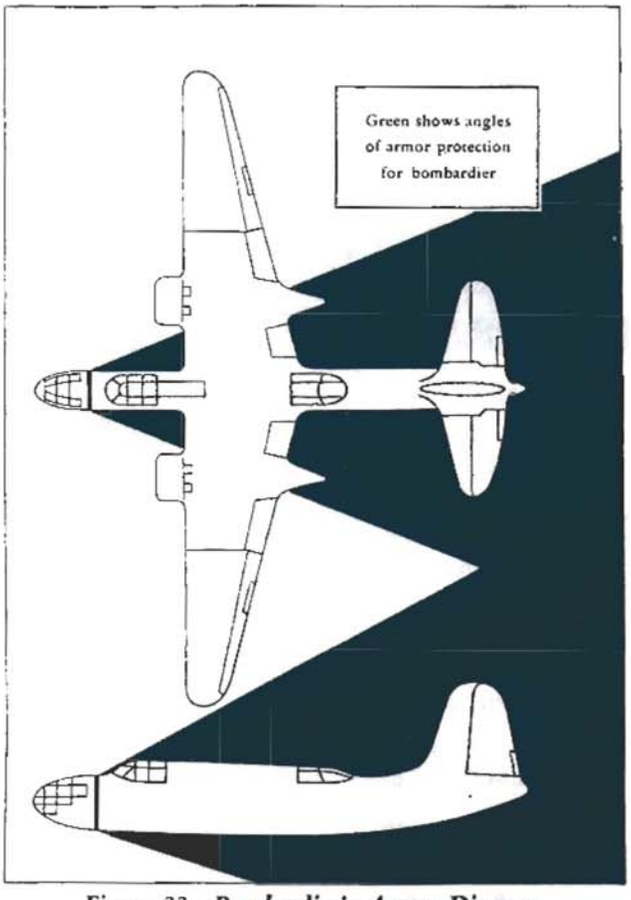


Figure 33—Bombardier's Armor Diagram

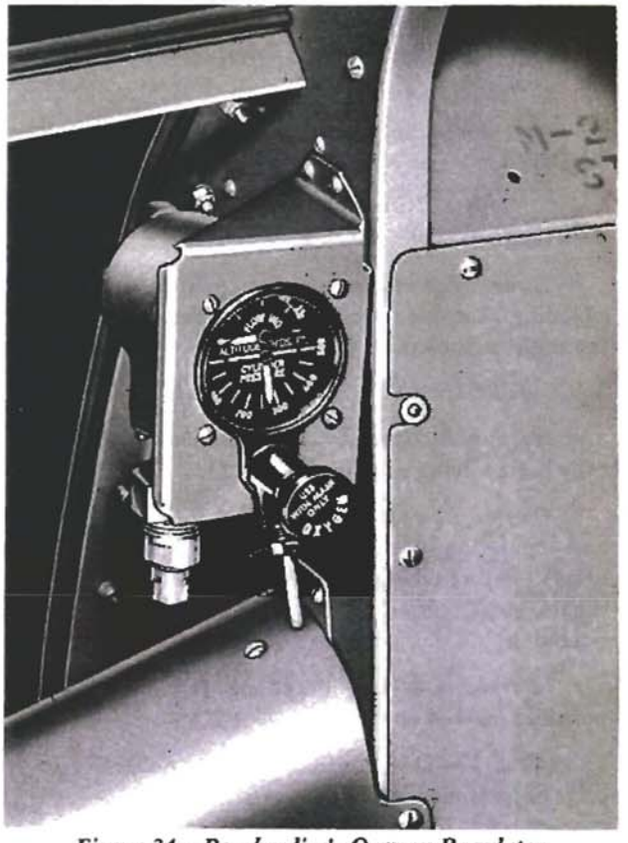


Figure 34—Bombardier's Oxygen Regulator

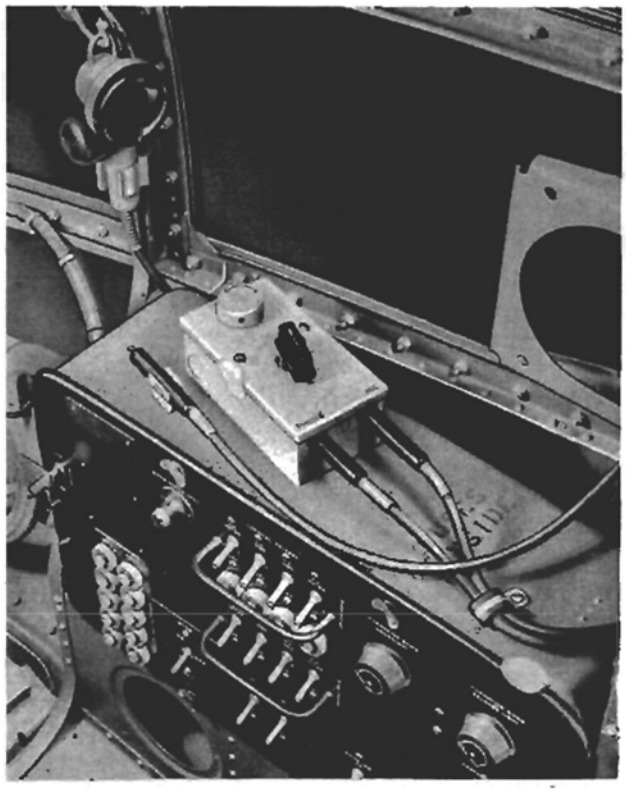


Figure 35—Bombardier's Interphone Jack Box

the shock cord connection, permitting the door to leave airplane.

Upper Panel.—Pull upper release cable and push door out of the opening.

b. Armor Protection.—Armor plating is installed, affording protection for the bombardier from fire from the angles as illustrated (Figure 33).

2. *CONTROLS AND OPERATIONAL EQUIPMENT.*

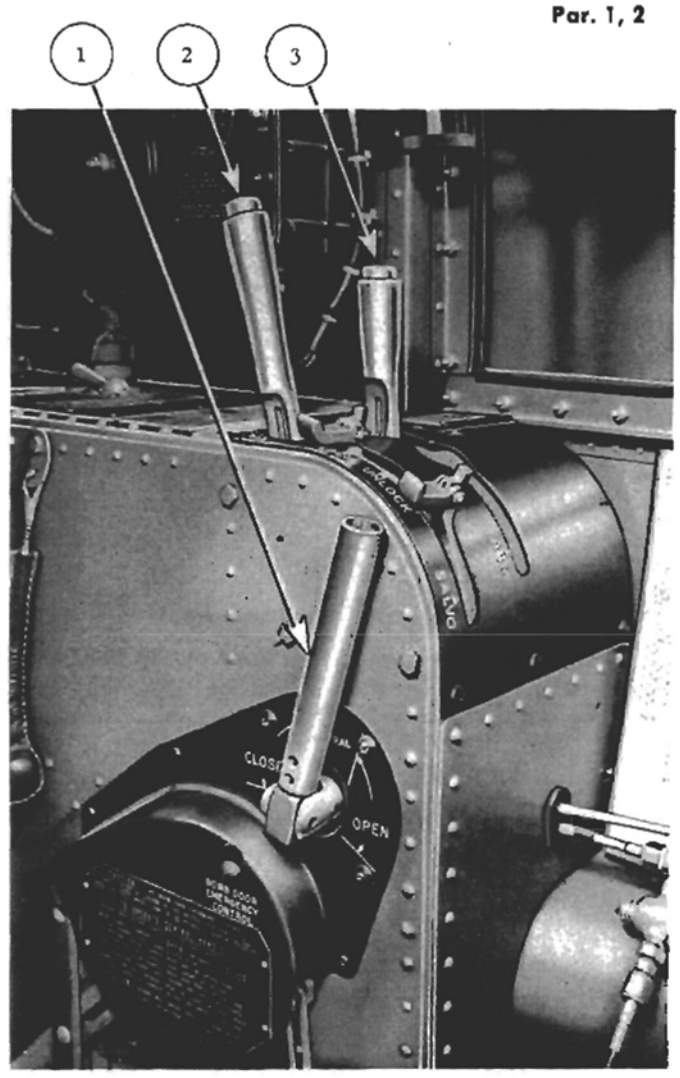
a. Heating Equipment.—Plug connection for electrically heated flying suit (Figure 37-17).

b. Oxygen Equipment.—A type A-9 oxygen regulator and connection supply oxygen for the bombardier (Figure 3). Before taking off on any flight, the oxygen mask should be test fitted to the regulator to insure proper operation.

c. Interphone.—The interphone jack box has four positions marked on its face:

(1) *R-1.*—This position allows bombardier to receive or transmit over the command set.

(2) *R-2.*—This position allows bombardier to receive over the compass equipment (if so equipped).



1. Emergency bomb door control
2. Lock and salvo lever
3. Bomb arm-safe lever

Figure 36—Bombardier's Bomb Release

(3) *INT.*—This position allows bombardier to communicate with any other crew member who is also set to INT.

(4) *IR.*—Bombardier may call any other crew member regardless of position of their interphone jack box selector switches.

d. Panel Door.—Secured by latch for ventilation. When open, provides access for cleaning windshields.

e. Data Case.—Directly back of seat.

f. Pyrotechnic Equipment.

(1) *Pistol.*—Stowed in a socket on the slanting shelf to right and rear of seat.

(2) *Signal Container.*—On left and rear of seat. Provides stowage space for 15 each Type M-10 and M-11 signals.

(3) *Flares.*—Clips on the shelf directly back of the bombardier's seat hold 5 Type M-9 flares.

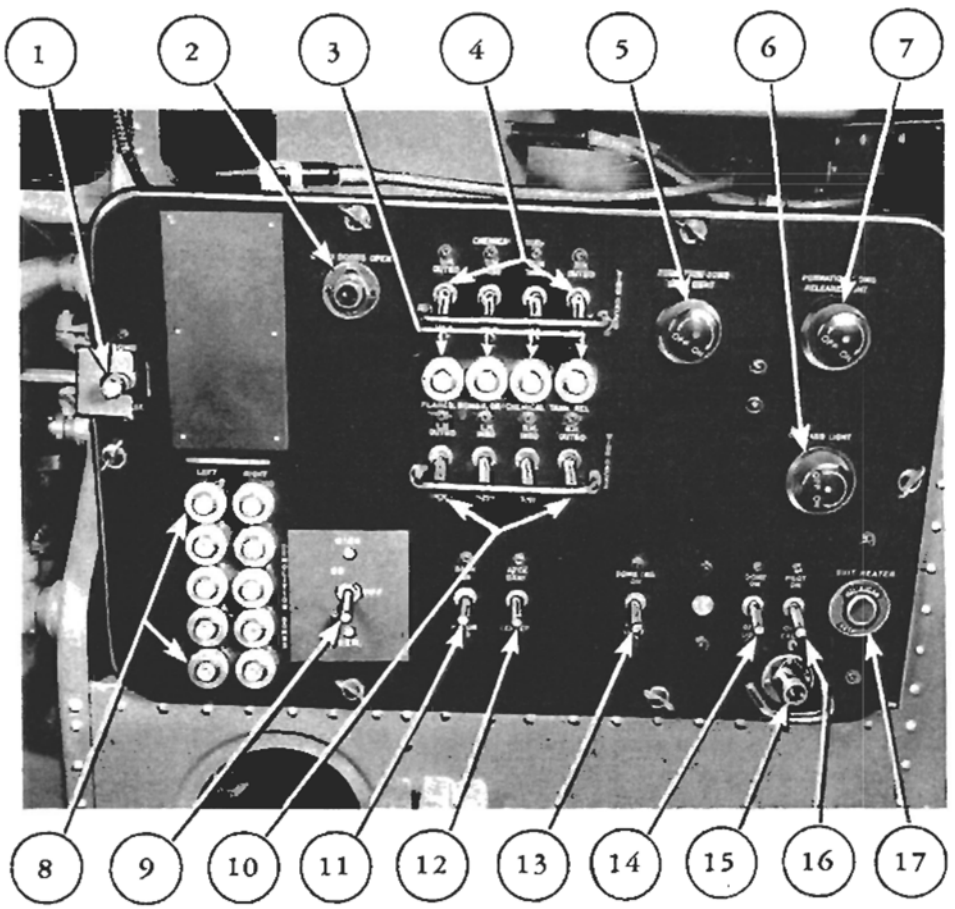
3. *BOMB RELEASE EQUIPMENT.*

Beginning with plane No. AC41-3370, bombing controls are in the pilot's compartment.

a. Bomb Arm and Safe Control (Figure 36-3).—When control is in "SAFE" position, bombs may be dropped unarmed. To arm bombs, lever must be moved forward to "ARM" position.

b. Lock and Salvo Control (Figure 36-2).—Bomb doors and bomb racks are controlled by this lever. May also be used to release all bombs in "SALVO." When in aft position, "LOCK-DOORS CLOSED," the bomb racks are locked and the bomb doors closed. To open doors, raise safety stop and move the lever to "LOCK-DOORS OPEN." When bomb doors are open, the bomb door indicator light will flash on. The bomb racks are still inoperative until lever is moved to "UNLOCK" position, then bombs may be released individually by selection. To release all bombs in "SALVO," raise safety stop and move lever to "SALVO" position. To close bomb doors move lever to "LOCK-DOORS CLOSED" position.

★ *WARNING:* Do not drop bombs in salvo with arm and safe control lever in "ARM" Position.



1. Bomb firing switch
2. Bomb door open light
3. Wing rack indicator lights
4. Chemical release switches
5. Formation bomb door light rheostat
6. Compass light rheostat
7. Formation bomb release light rheostat
8. Demolition indicator lights
9. Bomb selector switch
10. Wing rack switches
11. A. F. C. E. control switch
12. A. F. C. E. bank-center switch
13. Bomb indicator light switch
14. Dome light switch
15. Pilot call light
16. Pilot call switch
17. Suit heat receptacle

Figure 37—Bombardier's Switch Panel

c. Emergency Bomb Door Control (Figure 36-1).—For use in event of hydraulic system failure. The control is manually operated. To open bomb doors, place lock and salvo lever in "LOCK-DOORS OPEN." Unhook and extend control handle to its full length. Move handle forward from vertical position, through a 90 degree arc, and back to vertical until doors are open as shown by bomb door indicator light. To close bomb doors, place lock and salvo lever in "LOCK-DOORS CLOSED" position and operate emergency handle aft from vertical through a 90 degree arc and back to vertical until doors are closed as indicated by the extinguishing of the bomb door indicator light.

> *CAUTION:* When operating the emergency bomb door control to open or close the doors, do not move handle beyond the "VERTICAL" position, as this will result in opposite action of the doors. Doors will swing freely if handle is placed in NEUTRAL.

d. Bomb Release Indicator Lights (Figure 37-8).—Mounted on switch panel and indicate loaded racks. When a bomb is released, the corresponding indicator light will go out.

★ NOTE: When fragmentation racks are used one light will go out for each four bombs released.

The pilot has a bomb release indicator light (Figure 15-13), mounted on his upper electrical panel. The light flashes on or off when the bomb release switch is either closed or opened. At the same time a red lamp in the tail cone flashes on and remains on 5 seconds after switch is released.

e. Bomb Bay Door Indicator Lights.—A bomb bay door "Open Position" indicator light is provided on the bombardier's electrical panel (Figure 37-2), and on the pilot's upper electrical panel (Figure 15-10). A bomb door "Open Formation" signal light (white) is also provided in the tail cone. These lights go on when the bomb bay doors have been opened. The intensity of illumination of the tail cone signal light can be varied by a rheostat which is mounted on the bombardier's electrical panel (Figure 37-5).

4. *OPERATION.*

a. Before Entering Bombardier's Compartment:

(1) Have the pilot check for proper operation of the bomb door emergency control.

(2) Make thorough check of bomb racks.

(3) Check bomb loading.

b. On Entering Bombardier's Compartment:

(1) Test operate all light switches.

(a) Check bomb loading lights. If any fail to light, operate test switch. If lamp then lights, that bomb is improperly loaded. If the lamp does not then light, have lamp replaced.

(b) Bomb door open light (Figure 37-2).

(c) Pilot call light (Figure 37-15).

(d) Dome light (Figure 37-14).

(e) Wing rack indicator lights (Figure 37-3).

(f) Formation bomb door light (Figure 37-5).

(g) Compass light (Figure 37-6).

(h) Formation bomb release light (Figure 37-7).

(2) Check pyrotechnic pistol.

(3) Check signals in container.

(4) Check flares.

(5) Check oxygen mask fitting on regulator (Figure 34).

(6) Bomb door emergency control (Figure 36-1) in "NEUTRAL."

(7) Lock and salvo lever (Figure 36-2) "LOCK-DOORS CLOSED."

(8) Bomb arm and safe control (Figure 36-3) in "NEUTRAL."

(9) Camera switch (Figure 38-2) "OFF."

c. Before Leaving Bombardier's Compartment:

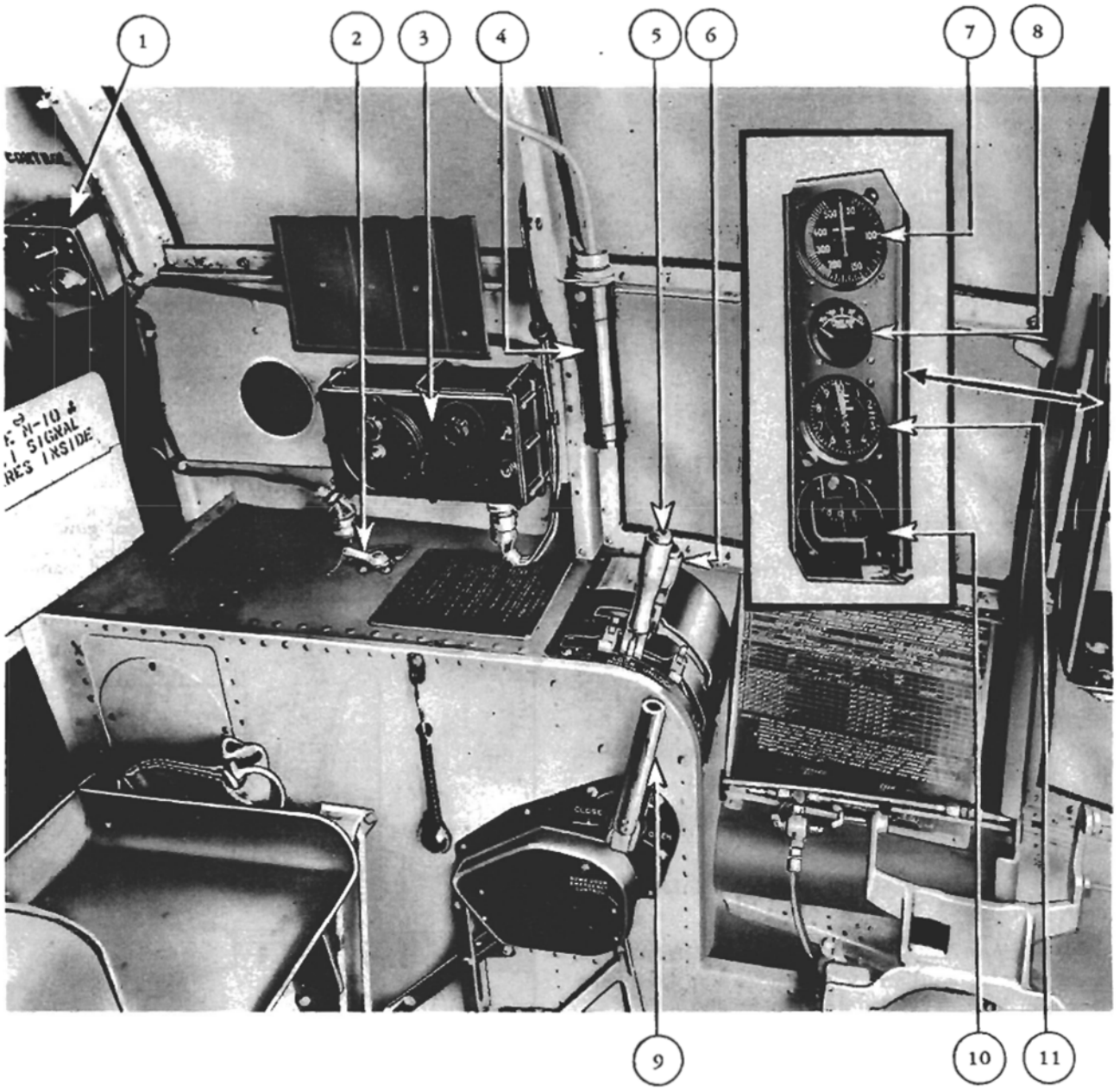
(1) All light switches "OFF."

(2) Camera switch (Figure 38-2) "OFF."

(3) Bomb door emergency control (Figure 36-1) in "NEUTRAL."

(4) Lock and salvo lever (Figure 36-2) in "LOCK-DOORS CLOSED."

(5) Bomb arm and safe control (Figure 36-3) in "NEUTRAL."



1. Camera control box
2. Vacuum camera switch
3. Intervalometer
4. Fluorescent lamp
5. Lock and salvo lever
6. Bomb arm-safe lever
7. Airspeed indicator
8. Free air temperature indicator
9. Emergency bomb door control
10. Magnetic compass
11. Altimeter

Figure 38—Bombardier's Instrument Panel

SECTION V
REAR GUNNER'S COMPARTMENT

1. *GENERAL DESCRIPTION.*

a. Access to Gunner's Compartment.—Through door in the floor of the compartment. Turn latch handle and push upward.

b. Emergency Access from Outside.—Tear open a fabric patch over the access door of the upper enclosure. Unlatch, allow enclosure to drop down, then push forward. The right upper latch must never be locked unless it is desired to lock the entire compartment.

c. Emergency Exit.—May be through the lower door or upper enclosure.

(1) *Lower Door.*—Turn latch handle. Lift up on door.

(2) *Upper Enclosure.*—Unlatch upper left latch and upper right latch. Allow forward end to drop down, then slide door forward as far as it will go.

d. Armor Protection.—Armor plating is installed, affording protection for the gunner from fire from the angles as illustrated (Figure 39).

2. *ARMAMENT.*

a. Description.

(1) *Nacelle Guns.*

(a) General.—Two fixed adjustable type M-2 .30 caliber machine guns are mounted, one in each nacelle, for rearward fire. They are adjustable from one degree (1°) below the level flight path to two degrees (2°) above it, and from parallel to convergence 100 yards of the tail.

(b) Ammunition.—1,000 rounds per gun.

(c) Gun Charging.—Guns are charged manually on the ground before flight.

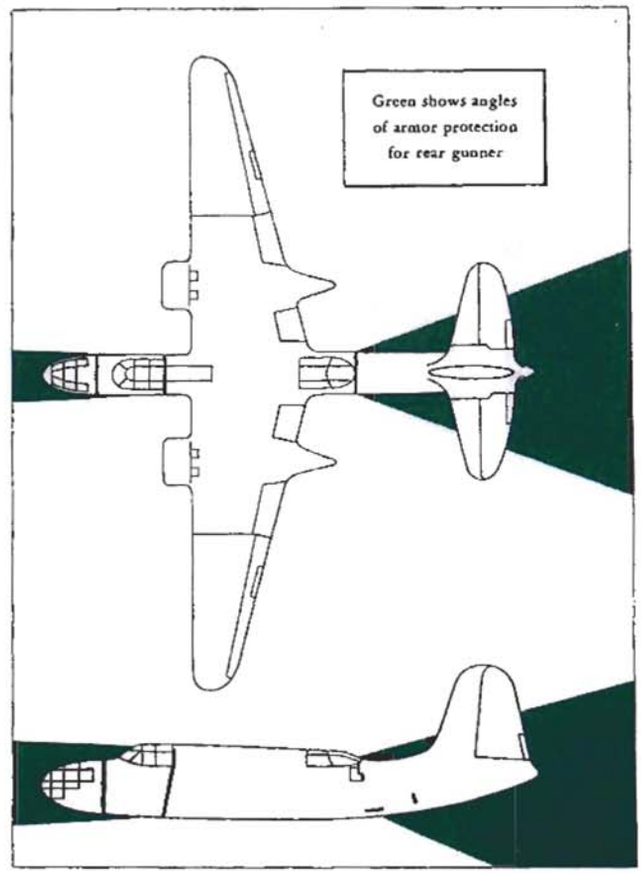


Figure 39—Rear Gunner's Armor Diagram

(d) Firing Controls.—The foot control (Figure 40) is used when the gunner is in the upper firing position. The hand control is used when the gunner is in the lower firing position.

(e) Safety Switch.—Located next to the hydraulic gun charger.

(2) *Upper Flexible Gun.*

(a) General.—Flexible type M-2 .50 caliber machine gun, mounted on an adapter for protection of the upper rear sector. The assembly operates on a straight track, around the upper aft rim of the gunner's compartment (Figure 41).

(b) Firing control is conventional.

(c) Ammunition.—Ammunition box holders are provided on both sides of the compartment for carrying 200 rounds as overload.

(d) Stowage.—The gun is stowed in a fore and aft position, in a trough along the centerline of the airplane (Figure 41). The gun stowage doors are operated by a crank (Figure 40) on the left side and attached to the gunner's step. This crank is operated by the gunner's right foot when facing aft.

(3) *Lower Flexible Gun.*

(a) General.—Type M-2 .30 caliber flexible machine gun mounted on a support arm, pivotable about a point near the floor, on the left side of the compartment. This arm, when lowered and latched, permits the gun to be fired through the gunner's access door, downward and rearward (Figure 42).

(b) Firing control is conventional.

(c) Ammunition.—Box holders are installed in the left side of the compartment for carrying 500 rounds.

Figure 40—Foot Firing Control

(d) Stowage.—To stow the gun, swing support arm upward and latch to left side of compartment.

(4) *Gun Cameras.*

(a) Upper Gun Camera.—The G.S.A.P. type N-1 gun camera is mounted to a bracket which mounts on the top side of the flexible gun and operates by controls in conjunction with the gun.

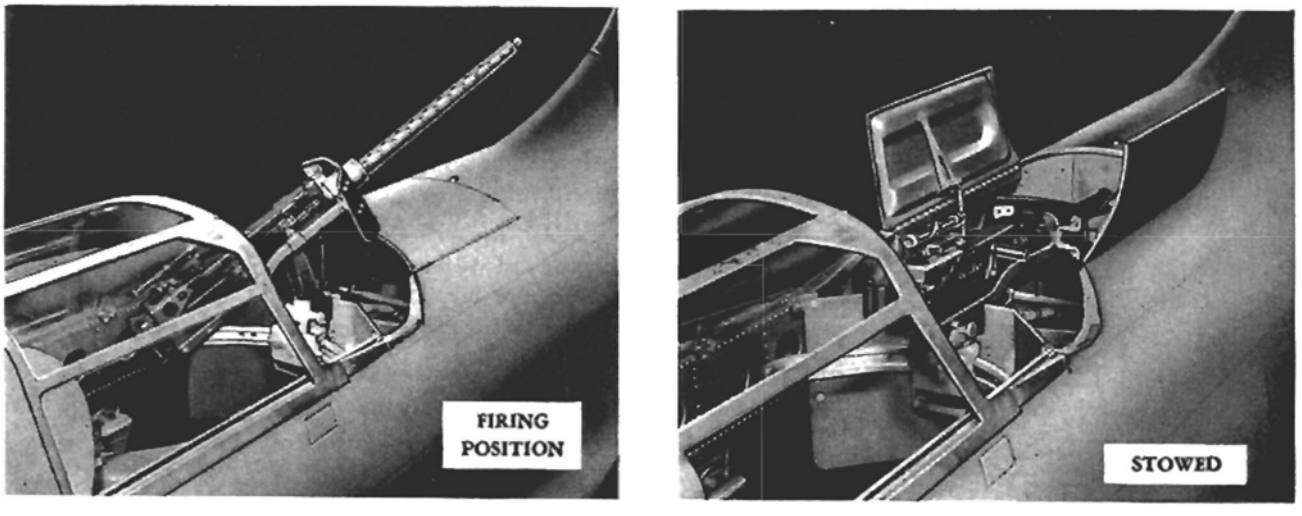


Figure 41—Upper Flexible Gun in Firing and Stowed Positions

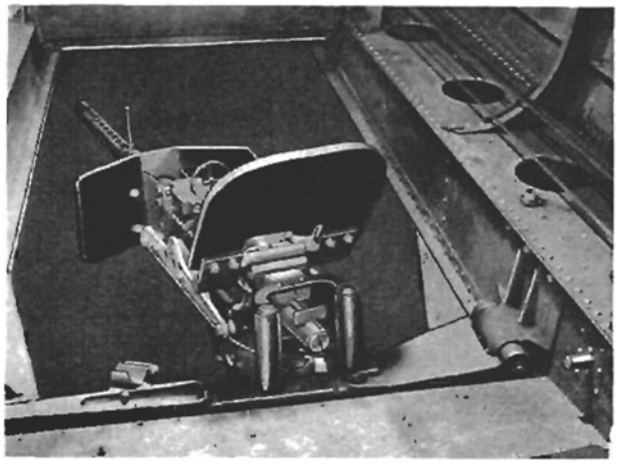


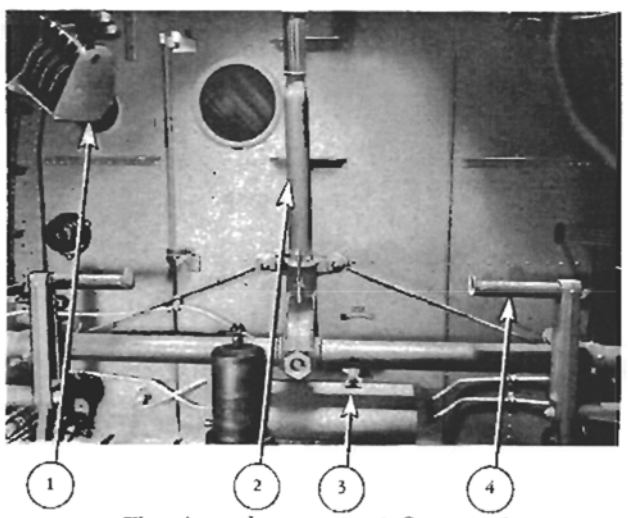
Figure 42—Lower Rear Gun in Firing Position

(b) Lower Gun Camera.—This G.S.A.P. type N-1 gun camera is clamped around the jacket of the lower flexible gun and operates by controls in conjunction with the gun.

3. *CONTROLS AND OPERATIONAL EQUIPMENT.*

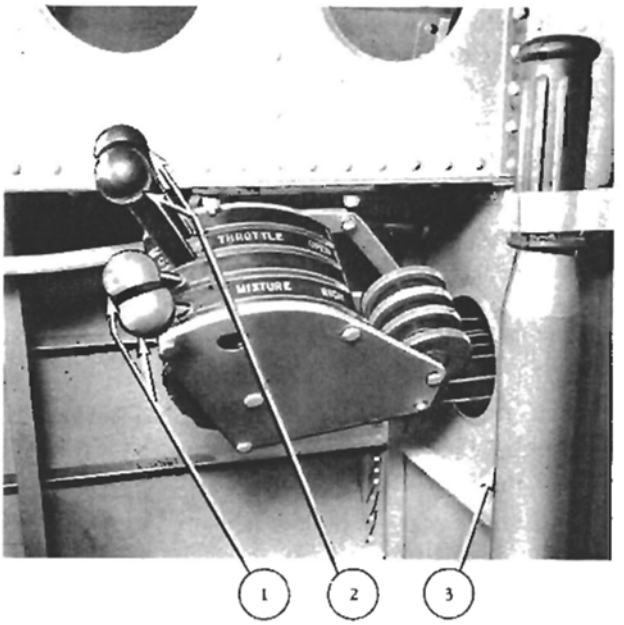
a. Flight Controls (Figure 43).—These are for emergency use and comprise a standard stick and rudder group, the stick remaining in a stowed position except when in use. Throttle and mixture controls also are provided for the gunners.

★ *NOTE:* Mixture control will place mixture in Auto-Rich (full forward) but will not return control to any leaner mixture.



1. Throttle quadrant
2. Control stick
3. Oxygen valve
4. Rudder pedal

Figure 43—Rear Gunner's Flight Controls



1. Mixture control 2. Throttle control 3. Control stick

Figure 44—Rear Gunner's Throttle Quadrant

b. Seat.—Has a vertical adjustment on left side of mounting post; swivel adjustment just below the right side of seat. Seat is provided with a life preserver cushion.

c. Suit Heat Receptacle.—Provision for electric suit heat (Figure 45-12).

d. Lights.—Panel light and dome light switches are located on the electrical panel (Figure 45).

e. Warning Bell.—Left-hand side of forward wall.

f. Oxygen.

(1) *Airplane.*—Three type F-1 low pressure oxygen cylinders are installed in gunner's compartment. Flow of oxygen to each crew member's station is controlled by a valve (Figure 43-3) which is to be turned on by gunner before flight is begun, and turned off when flight is completed.

(2) *Gunner's Compartment.*—The gunner's station is provided with a type A-9 low pressure oxygen regulator (Figure 46). The gunner shall check for proper connection of his oxygen mask before flight is made.

g. Tow Target.—Basic mounting provisions have been made for the installation of one Type C-5 tow target reel at approximately Sta. 265. An electric motor is installed on the left side of the reel for operation of the tow target reel. The clutch operates through a solenoid from a switch in the gunner's compartment. The reel capacity is

3000 feet of cable. The tow target is released through the gunner's access door.

b. Interphone.—On right side of compartment. The interphone jack box has four positions marked on its face:

(1) *R-1.*—This position allows gunner to receive or transmit over the command set.

(2) *R-2.*—This position allows gunner to receive over the compass equipment (if so equipped).

(3) *INT.*—This position allows gunner to communicate with any other crew member who is also set to INT.

(4) *IR.*—Gunner may call any other crew member regardless of position of their interphone jack box selector switches.

i. Command Set SCR-274-N.—Modified A-20B's use a single receiver control box in the pilot's cockpit and a control box for two receivers in the observer's compartment, making the three receivers controlled by two different crew members. The command set is designed for short range operation and is used for communicating with nearby aircraft for tactical purposes and with ground stations for navigational and traffic control purposes. Access to the receiver channels by either pilot or observer can be had by placing the interphone jack box switch in the R-1 position.

(1) *Receiving.*

(a) Place interphone jack box selector switch (Figure 45-7) in "R-1" position.

(b) Reception of a signal of a specific frequency, as indicated on the dial, is accomplished by the use of the section of the receiver control box which controls the particular receiver involved.

(c) Turn on desired receiver by placing switch (Figure 12-6) in the "CW" or "MCW" position. These

1. Generator "OFF-ON" switches (2)
2. Panel light
3. Voltmeter
4. Upper gun camera switch
5. Lower gun camera switch
6. Generator "OFF-ON" switches (2)
7. Interphone jack box
8. Ammeters (2)
9. Panel light switch
10. Relief tube
11. Voltmeter selector switch
12. Suit heat receptacle
13. Ammeters (2)

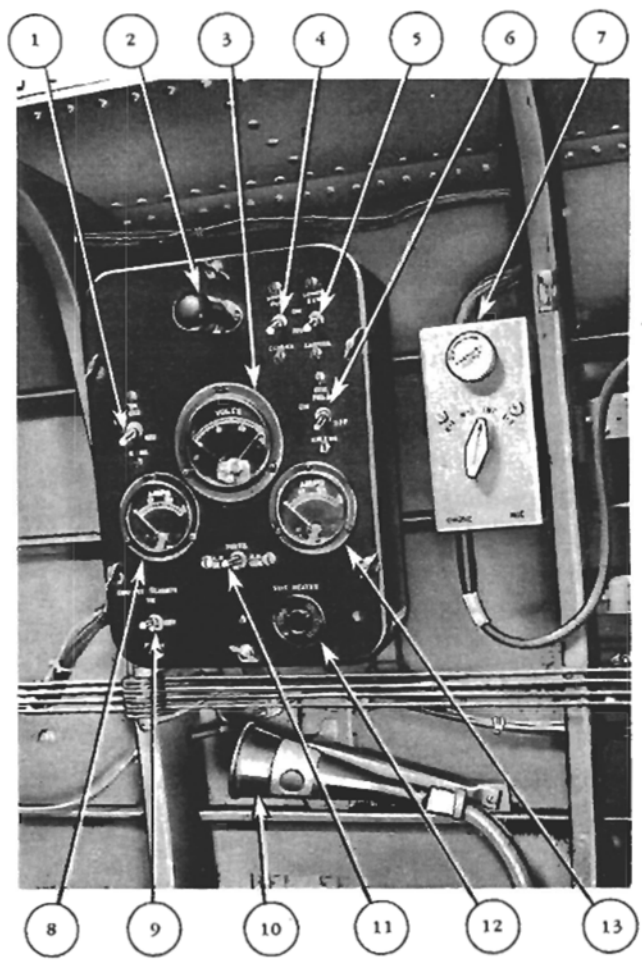


Figure 45—Rear Gunner's Switch Panel

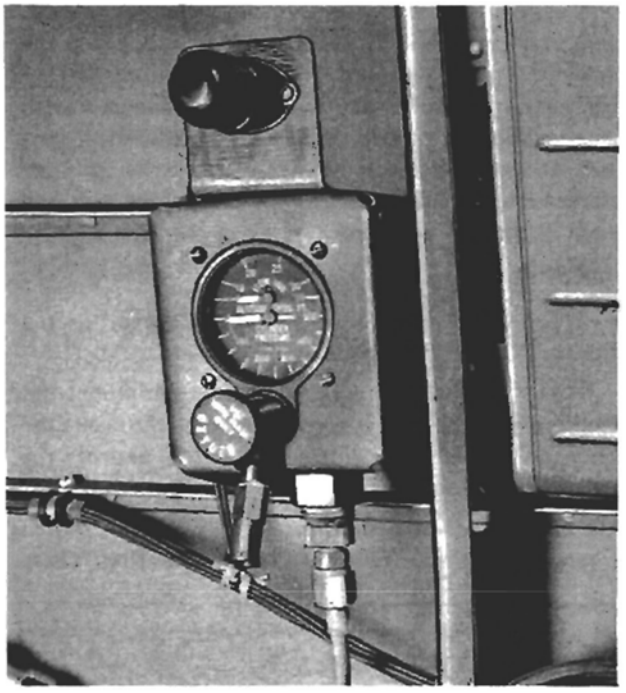


Figure 46—Rear Gunner's Oxygen Regulator

two positions are "ON" positions and indicate the type of signal which is to be received.

(d) Leave the "A-B" switch (Figure 12-4) in the "A" position at all times. It need not be turned off when the receivers are turned off.

★ *NOTE:* When tuning a receiver for a definite frequency, always turn the dial a little to each side of the frequency calibration mark to find the point where the signal is the strongest.

(2) *Transmitting.*

(a) Before transmitting, adjust receiver to the same frequency as the station with which you desire to talk and listen in to be sure that the operator is not talking to someone else. If the station is transmitting, take advantage of the opportunity to accurately set the receiver on the assigned frequency and, when the other operator is finished, proceed with your transmission.

(b) Place transmitter master switch in "ON" position.

(c) Select type of transmission desired with switch marked "TONE-CW-VOICE" (Figure 12-9).

1. With the switch in the "VOICE" position, voice will be transmitted when the push-to-talk button is pressed.

2. With the switch in the "CW" position, a continuous wave, or unmodulated signal, may be transmitted, and the microphone is inoperative.

3. With the switch in the "TONE" position, a modulated tone signal may be transmitted and the microphone is inoperative.

★ *NOTE:* Greatest effective range can be obtained on "CW." Range is most limited when operating on "VOICE." Transmitting in both the "CW" and tone positions is done by a key located on the top of the transmitter control box.

j. Generator Controls.—On earlier models the generator control panel is on the right wall of the gunner's compartment.

4. *OPERATION.*

a. On Entering Gunner's Compartment.

(1) Check ammunition stowage.

(2) Control stick stowed (Figure 43-2).

(3) Oxygen cylinder valve (Figure 43-3) "ON."

(4) Check oxygen mask fittings on regulator (Figure 46).

(5) Check panel light (Figure 45-9).

(6) Generator switches "ON" (Figure 6-1, 3, behind pilot's head or Figure 45-1, 6, in gunner's compartment).

(7) Test both generators (Figure 6-1, 3), behind pilot's head or Figure 45-1, 6), in gunner's compartment).

b. On Leaving Gunner's Compartment.

(1) Generator switches "OFF" (Figure 6-1, 3, behind pilot's head or Figure 45-1, 6, in gunner's compartment).

(2) Flexible guns stowed.

(3) Oxygen cylinder valve (Figure 43-3) "OFF."

(4) All lights off.

SECTION VI
BOMB BAY COMPARTMENT

1. *GENERAL.*

The bomb bay is located aft of the pilot's compartment, extending to the rear gunner's compartment, and is divided into a fore and an aft section.

2. *ACCESS TO BOMB BAY.*

May be through the bomb bay doors or through the top by removing the three screws from cover over locking handle and opening upper doors.

3. *BOMB INSTALLATION.*

The bomb installation is so arranged that the load may consist of a combination of the various type bombs. Refer to Section III for specific data pertinent to bomb loading.

a. The Design Useful Load As a Horizontal Bomber Provides for the Following Bomb Load:

10—100 lb demolition bombs, or

3—300 lb demolition bombs, or

1—500 lb demolition bomb, M type, or

1—1000 lb demolition bomb, M type.

Additional bombs as alternate loads can be carried as follows:

4—100 lb on wing racks, or

4—300 lb on wing racks, or

2—500 lb on wing racks.

b. The Design Useful Load As a Glide Bomber Provides for the Following Bomb Load:

6—100 lb demolition bombs, or

3—300 lb demolition bombs, and

1—500 lb demolition bomb, M type, or

1—1000 lb demolition bomb, M type.

Additional bombs as alertnate loads can be carried as follows:

4—300 lb on wing racks, or

2—500 lb on wing racks.

The fore section is equipped for installation of the glide rack, which carries demolition bombs. The aft section provides bomb rail assemblies to which B-7 shackles may be attached for carrying demolition bombs horizontally. No bombs can be released electrically or manually unless bomb bay doors are open.

4. *ALTERNATE INSTALLATIONS.*

a. Auxiliary Fuel Tank.—Provisions are made to mount an auxiliary fuel tank of approximately 140 U.S. gallons (116.6 Imp.) capacity in the rear bomb bay.

5. *BATTERIES.*

The airplane batteries are installed in the forward bomb bay, above the wheel well section.

APPENDIX I

U.S.A.-BRITISH GLOSSARY OF NOMENCLATURE

AMERICAN	BRITISH
Accumulator (hydraulic)	Should not be confused with electrical accumulator or battery.
Antifriction bearings	Ball and roller bearings
Battery (electrical)	Electrical accumulator
Cap screw	Setscrew or screw
Center of inboard wing panel	Center section
Check valve (hydraulic)	None-return valve
Clevis	Fork joint or knuckle joint
Compression ring (piston)	Gas ring
Cotter pin	Split pin
Cylinder (hydraulic)	Jack
Dump valve	Jettison valve
Fillister head screw	Cheese head screw
Flathead screw	Countersunk head screw
Flight indicator	Artificial horizon
Gall	To fret or score
Gasoline (gas)	Petrol
Green run	Endurance test
Gross weight	All up weight
Gyro pilot	Automatic pilot
Kerosene	Paraffin
Knuckle pin (used on radial engines)	Wrist pin or anchor pin
Landing gear	Alighting gear
Lock washer	Spring washer
Manifold pressure	Boost
Oil pan	Sump
Outboard panel	Outer plane
Palnut	Type of lock washer
Piston pin	Gudgeon pin
Reticule (gun sight, etc.)	Graticule
Round head screw	Cup head screw
Set screw	Grub screw
Slushing compound	Corrosion inhibiter
Socket wrench	Box spanner
Spanner	C-Spanner
Spanner wrench	Ring spanner
Stabilizer	Tail plane
Horizontal	Fin
Vertical	
Stack	Manifold
Sylphon	Aneroid
Tachometer	Engine speed indicator
Tube (radio)	Valve
Turn indicator	Direction indicator
Valve (fuel or oil)	Cock
Weight empty	Tare

APPENDIX II
EMERGENCY EQUIPMENT AND PROCEDURES

1. *EXITS.*

> *CAUTION:* It is very difficult to avoid striking vertical fin when leaving by upper hatches during flight. Bombardier and gunner should use lower exits. It is recommended that pilot use following procedure to abandon aircraft if controls operate satisfactorily:

(1) Release safety belt.

(2) Turn ship on its back.

(3) Push control column forward and fall clear.

a. Pilot's Compartment.

(1) Pull emergency lever at upper left transparent panel.

(2) Push upward on enclosure door; the force of the airstream will carry it away.

b. Gunner's Compartment.

(1) *Lower Door.*—Opened by latch handle in center of forward section. Lift up on door.

(2) *Upper Enclosure.*—Unlatch upper left latch and upper right latch. Allow forward end to drop down, then slide door forward as far as it will go.

c. Bombardier's Compartment.

(1) *Upper Panel.*—Pull upper release cable and push door out of the opening.

(2) *Lower Door.*—Pull emergency release in lower door. This removes the latching pins and the shock cord connection, permitting the door to fall free.

2. *GUNNER'S EMERGENCY FLIGHT CONTROLS.*

a. Conventional Aileron, Elevator, and Rudder Controls are Provided.—Control stick is stowable.

b. Mixture and Throttle Controls are Also Provided.—Mixture control may be placed in auto-rich full forward but control will not then return mixture to any leaner mixture.

3. *HYDRAULIC CONTROLS.*

a. Hydraulic Power.—In case of failure of the engine driven hydraulic pump, the emergency hand pump (Figure 16-10) should be used. Using this pump, operate controls in the normal manner. In case of failure of the entire hydraulic system, certain units may be operated mechanically.

b. Landing Gear.

(1) Set hydraulic control lever (Figure 8) at DOWN position.

(2) Pull emergency control near the floor at right of pilot's seat, releasing the hydraulic safety latch.

★ *NOTE:* It may be necessary to drop the nose of the airplane to aid in latching the gear in extended position.

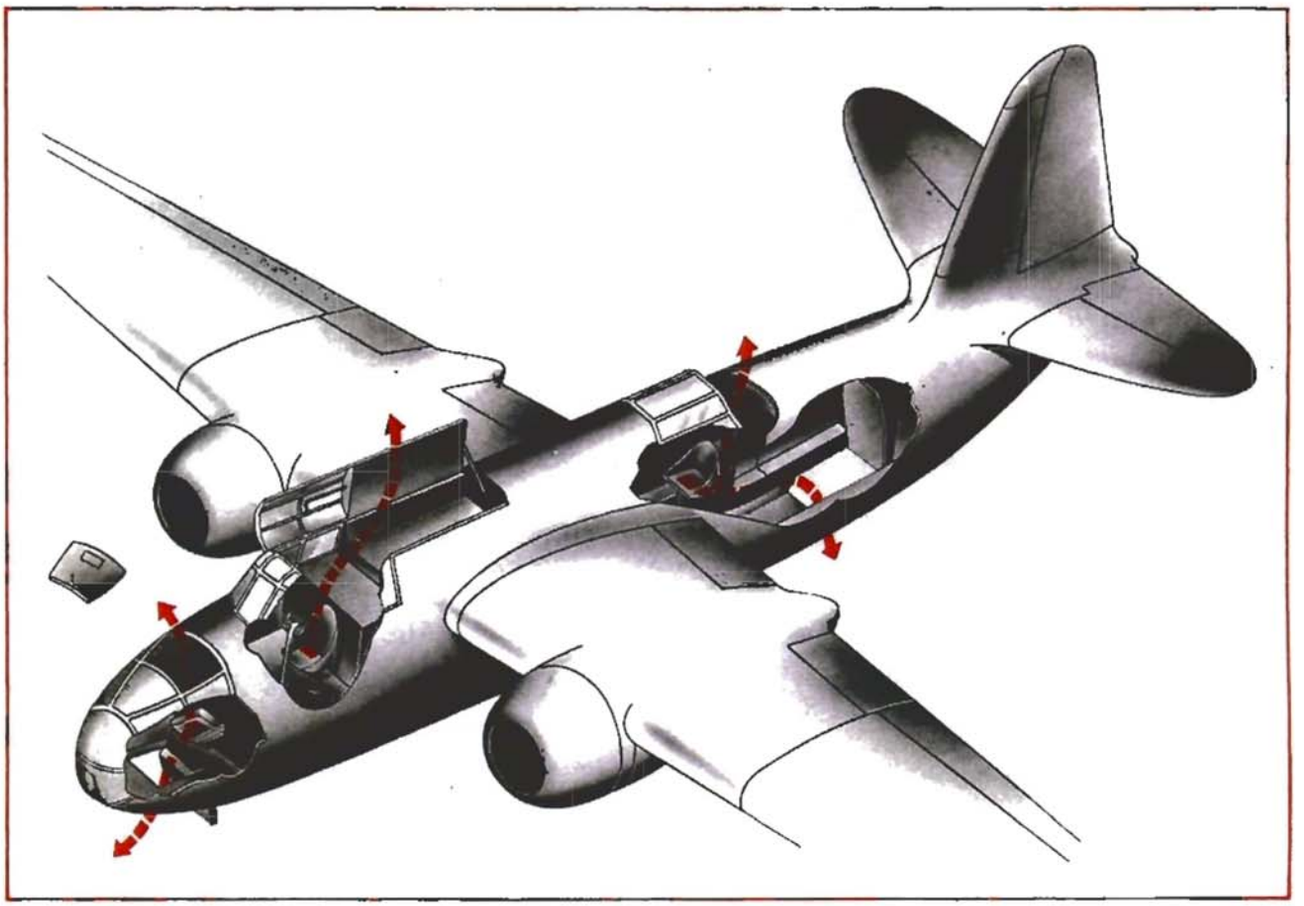


Figure 47—Emergency Exits Diagram

★ *WARNING:* For emergency operation, the indicated air speed must not be in excess of 150 mph (130 knots).

c. Bomb Doors.

(1) OPEN by placing lock and salvo lever (Figure 36-2) in "LOCK-DOORS OPEN" position. Unhook and extend control handle full length. Move handle forward and back to vertical until doors are full open.

(2) CLOSE by placing lock and salvo lever (Figure 36-2) in "LOCK-DOORS CLOSED" position. Operate control handle aft and back to vertical until doors are closed.

★ *NOTE:* This pump controls the direction of the doors by action forward or backward from the vertical.

4. AIR BRAKE.

Control valve and pressure gage (Figure 5-2, 3) are located on the right rear of the pilot's compartment. AFTER WHEELS ARE ON THE GROUND press handle on top of the valve and rotate. If brakes lock, rotate the handle in the opposite direction. Pressure is variable.

★ *NOTE:* Each time the emergency air brake is used, the bottle must be recharged.

CAUTION: If air brakes are used, keep pedals depressed or all pressure will be lost.

5. *FUEL SYSTEM FAILURE.*

In case fuel pressure drops below 12 lb/sq in. use booster pump to bring up pressure.

6. *PROPELLER FEATHERING.*

a. To Feather.

(1) Retard throttle (Figure 9-1) fully.

(2) Propeller control (Figure 9-3) DECREASE RPM.

(3) Move mixture (Figure 9-2) to IDLE CUT-OFF.

(4) Press feathering switch (Figure 15-2, 17).

(5) Ignition switch (Figure 17-2) OFF.

★ *EXTREME EMERGENCY:* Press feathering switch first.

b. To Un-feather.

(1) Ignition switch (Figure 17-2) ON.

(2) Press feathering switch (Figure 15-2, 17) until rpm reaches 800 to 1000.

(3) Mixture control (Figure 9-2) AUTO-RICH.

(4) RESET propeller control (Figure 9-3).

(5) Reset throttle (Figure 9-1).

(6) Reset mixture (Figure 9-2).

7. *BOMB SALVO RELEASE.*

a. Pilot's Control.

(1) Pull handle out to open bomb door.

(2) When bomb doors are open, continue pull on handle to salvo bombs.

b. Bombardier's Control.

(1) Lock and salvo lever (Figure 36-2) at "LOCK-DOORS OPEN."

(2) Operate emergency bomb door control (Figure 36-1).

(3) Arm and safe lever (Figure 36-3) at "SAFE."

(4) Move lock and salvo lever (Figure 36-2) to "SALVO."

CAUTION: Never salvo bombs with arming lever at "ARM."

8. *FIRES IN FLIGHT.*

a. General.—Warn all crew members immediately. The pilot must decide whether to attempt to land or to abandon ship.

b. Wing Fire.

(1) Turn all switches controlling landing or navigation lights OFF.

(2) Open emergency exits.

(3) Attempt to extinguish the fire by side-slipping.

c. Engine, Fuel Tank, or Hull Fires.

(1) Shut off fuel and open throttles.

(2) Open emergency exits.

d. Cabin Fires.

(1) Close all windows and ventilators.

(2) If electrical fire, turn main switches (Figure 15-24) OFF. If a leaking fuel or oil line, shut off valves.

e. Flare Fires.—Release the flares.

f. Extinguishing Equipment.—Carbon dioxide and carbon tetrachloride extinguishers are installed. They are adequate for fighting fires in their earliest stages only, and should be put into use immediately, if available.

(1) *Carbon Dioxide (CO_2).*—Most effective for extinguishing fires originating from fuel, oil, or similar combustible liquids. The fumes from these extinguishers are harmless. Avoid contact with this chemical as the "dry ice" formed may cause severe burns.

(2) *Carbon Tetrachloride (CCL_4).*—More effective for extinguishing fires originating from non-combustible sources.

★ *WARNING:* When sprayed on a fire, carbon tetrachloride forms phosgene, one of the poisonous gases used during World War I. DO NOT BREATHE fumes as results might prove fatal. When using, hold breath, stand as far as possible from fire, open all exits, then resume breathing. If an extinguisher is found to be leaking, repair it, or if it can't be repaired, empty it.

9. *DITCHING (FORCED DESCENT OF LAND-PLANES AT SEA).*

a. Prevention of Ditching.

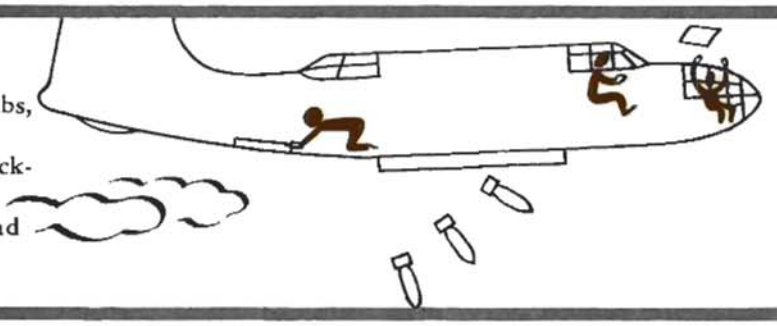
(1) Many ditchings could have been avoided if proper use of boost, rpm, and airspeed had been made. Operations and limitations of the fuel system should be thoroughly understood.

(2) Practice flying the airplane at different weights at heights above 5000 ft with one engine out of action.

ESCAPE PROCEDURE IN CASE OF FORCED LANDING AT SEA

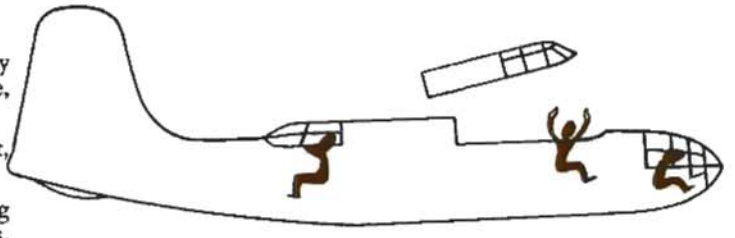
I. *PREPARATION FOR DITCHING*

1. Pilot radios for aid, dumps bombs, closes bomb bay doors.
2. Bombardier dumps top hatch, pockets Verey pistol.
3. Gunner secures lower exit and opens top hatch.



II. *DITCHING*

1. Pilot dumps top hatch, insures safety belt and parachute harness is secure, warns crew "Ditching".
2. Bombardier braces against impact, head covered with arms.
3. Gunner braces against impact facing aft, holding neck with both hands.



III. *AFTER DITCHING*

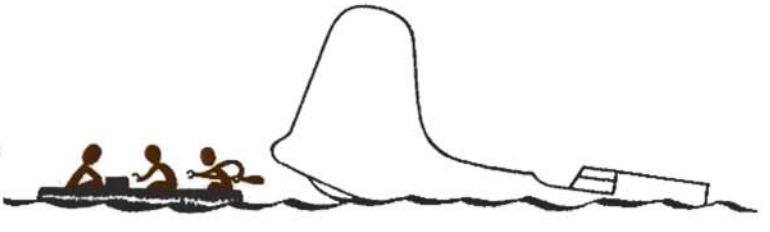
1. Pilot leaves compartment and helps bombardier from nose.
2. Gunner removes liferaft (and radio, if one is aboard) and leaves compartment.

IV. *BOARDING LIFERAFT*

1. Pilot assists bombardier aft to liferaft.
2. Gunner holds liferaft in position and assists pilot and bombardier aboard.

V. *ABOARD LIFERAFT*

1. Pilot casts off line.
2. Bombardier paddles away.
3. Gunner searches for leaks and tops up liferaft.



Find out the best speed and altitude for maintaining flight at reduced power in all circumstances. As an aid, charts are provided for single engine operation.

(3) If height cannot be maintained above a reasonable altitude because of failure of one engine or because of icing up or other defect, lighten the load of the airplane by dumping the bomb load.

b. Preparation for Ditching.

(1) If doubt exists in the pilot's mind whether he can reach the coast, preparation for ditching MUST begin, particularly the radio procedure.

(2) Give the SOS or "May Day," and time and position of the signal. It is better to make a distress call than to remain silent. A distress call can always be cancelled when no longer applicable and, of course, this must be done.

(3) The pilot must insure that the bomb doors are opened, the bombs and containers dumped *and the doors closed again.* It takes approximately 30 seconds to open and close doors and, if there is any doubt that there is time to do this, it is better to keep the doors closed; in this case it is essential for the pilot to check that the bombs are SAFE.

(4) All lower hatches must be checked for security and all upper ones dumped. If left closed hatches may jam upon impact and it is important that the crew leave the ship without a moment's delay.

(5) All bright internal lights should be put out in order to accustom the eyes to darkness. After ditching, all lights should be left on to facilitate search, in the event the airplane should float.

c. The Approach.—Wind speed and direction and surface conditions are important.

(1) *Calm Sea.*—There may be little or no wind, so that it is essential to ditch with the lowest IAS possible. Such a sea is deceptive with regard to judgment of height, particularly if the surface is "glassy." Surface ripples make judgment of height easier.

(2) *Waves.*—These always move with the wind except when close inshore and in fast flowing currents. Waves are the direct result of the wind which creates them and maintains them.

(3) *Swell.*—An undulating movement of the surface caused by past or distant disturbances by action of the wind. It does not necessarily move with the wind and it has no breaking crests. When the wind is across the swell the pilot must land along the swell and as near into the wind as possible.

(4) *Fixed Marks Smoke Blowing.*—These are good

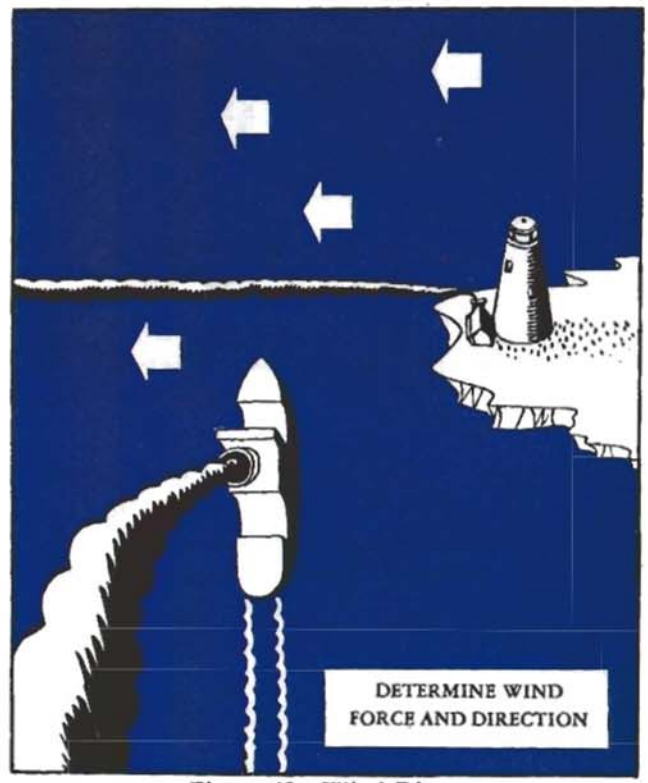


Figure 48—Wind Diagram

indications of wind speed and direction. Remember that a ship also has forward speed and that the wind lies somewhere between the forward path of the ship and the smoke trail. The pilot should practice judging wind velocity and direction.

d. Ditching Characteristics.

(1) If the airplane alights tail down as it should, there will be a primary slight impact as the rear of the airplane strikes. This will be followed by a severe impact with quick stop in most cases. If the alighting has been made too fast, a bounce will occur, providing the underbody is sufficiently strong. As the airplane comes to rest the nose will bury, but if the alighting has been carried out correctly, the effect of the nose burying will be minimized and the structure may not collapse.

★ *WARNING:* The open sea always appears from the air to be much more calm than it actually is.

(2) In a crosswind approach along a swell, the ship should be ditched on the upslope of the swell.

(3) In a steep swell, the pilot should ditch along the top of the swell unless there is a very strong crosswind. In ditching across the swell, the airplane should be put down on an upslope toward the top.

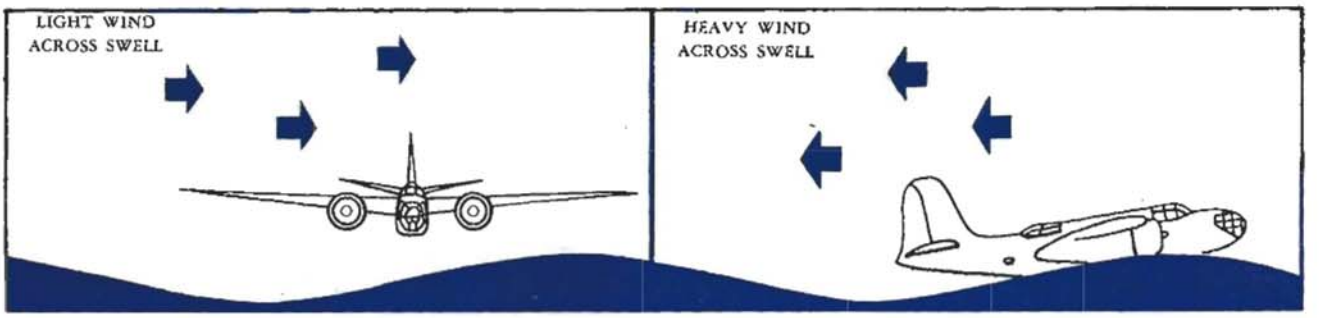


Figure 49—Method of Landing on Swells

(4) *Use of Power.*—Use of power is advisable, as even one engine will aid in flattening out the approach. Care must be taken to keep ample rudder control at all times during descent. The value of power in ditching is so great that the pilot should always ditch before fuel is quite exhausted, if it is certain that land cannot be reached.

e. Boarding the Liferaft (Providing liferaft is carried the following procedure should apply).

(1) After ditching, each member of the crew should carry out his alloted duties. The gunner should throw out the liferaft and see that it is in proper order. If the ditching has been made into the wind, the liferaft should float toward the tail plane and boarding should not be difficult. Be sure to hold on to the liferaft until it is inflated, but do not inflate until it has been removed from the inside of the airplane and is definitely outside.

(2) Do not jump into the liferaft; by so doing, it may become damaged and the whole crew endangered.

(3) Do not get any wetter than absolutely necessary. Wet clothing must NOT be taken off; it is far warmer with wet clothes on than off. In hot weather this may not apply but the body should be protected from the sun.

f. Aboard the Liferaft.—Each man should proceed to his appointed duty. Upon order, the bombardier should paddle away from the aircraft as the pilot casts off. If the ship floats, keep nearby to increase the chance of being spotted. But do not remain made fast to the airplane when there is any chance of the liferaft being punctured or in rough conditions where the liferaft is likely to be damaged by the rise and fall of the ship.

g. Use of the Emergency Radio (if carried).

(1) *Description.*—A complete self-contained portable emergency transmitter, Type SCR-578-A, is provided for operation anywhere away from the airplane. It is primarily designed for use in a small boat or liferaft, but may be placed in operation anywhere a kite can be flown, or where water may be found. It is equipped with a small parachute to permit dropping from the airplane in event of an emergency. No receiver is provided. There is no danger of damage to radio by water before unpacking as it is packed in a waterproof rubber bag.

(2) *Removal from Airplane.*

(a) If the airplane has made an emergency landing on water, the emergency set should be removed at the same time that the liferaft is removed. The set is waterproof and will float and, therefore, it is not necessary to take any precautions in keeping the equipment out of the water. Be sure that it does not float out of reach.

(3) *Operation.*—Complete operating instructions are packed in same rubber bag with radio. Complete instructions for the use of transmitter are also located on the transmitter itself. When operated, the transmitter emits an MCW signal and is tuned to the international distress frequency of 500 kc. Automatic transmission of a predetermined signal is provided. Any searching party can "home" on the signal with the aid of a radio compass. If desired, the manual sending key may be used.

h. Assisting Rescue.

(1) Don yellow skull caps immediately, before ditching if possible.

(2) When craft are in a position to see signals, fire the liferaft pistol or any available pyrotechnics, but conserve them as much as possible.

(3) Marine distress signals should be kept dry and handled with care.

(4) Very cartridges should be kept dry.

i. Awaiting Rescue.—If the proper distress signals were made, there is every chance of an early rescue. The

crew must be prepared to remain at sea for at least six days, although this seldom happens. This is only achieved by severe discipline and comes under three main headings:

(1) *Rationing of Food and Water.*—This is the duty of the pilot.

(a) Water.—For the preservation of life, water is more valuable than food. It is of the greatest importance that the drinking water available reaches the liferaft and that care is taken to avoid any loss. Water must be rationed.

(b) Solid Foods.—The pilot will take stock of available rations in the liferaft and make provision for rationing on a basis of three meals a day for at least six days. The number of days over six for which the pilot makes provision will depend on the distance from shore and the success of airplane W.T. signals.

(c) Energy Tablets.—Use of these tablets must conform strictly to instructions marked on the container.

(d) Rum or other alcoholic drinks used by those who are exposed to severe cold and wet conditions increases the dangers of such exposure. It should not be carried for use in liferafts.

(2) *Exercises to Promote Warmth.*—These require a minimum muscular effort:

(a) Exercise should afford relief from strain, and improve circulation when the body would otherwise be suffering from fatigue and cold through remaining for long periods in cramped conditions.

(b) Specified breathing exercises are not recommended because they may cause undue strain and increase hunger and thirst.

(c) Exercises should be performed slowly, one contraction and subsequent relaxation taking approximately 6 seconds.

(d) Frequently the performance of hands and feet working at the same time will produce greater warmth in a shorter time. The joints on the extremities of the body should be exercised first and then the joints such as shoulders and hips.

(e) The pilot should insure that exercises begin before intense cold or stiffness has set in. It is as well to take a little exercise at frequent periods.

(f) Where a crew are together in a liferaft, the exercises should develop into a periodic drill timed to a popular tune. Quality rather than quantity of exercises will prove more beneficial; the main desire is that movement shall occur at frequent intervals.

(3) *Morale.*

(a) If the crew are continually exercising and taking rations at regular intervals and at the same time, keeping a good watch, morale should look after itself. After a few days, nerves may begin to fray and it is then that the good example of each man will aid the behavior of his fellow. The need for more food and drink will increase and it will require greater effort to restrain the desire.

(b) The effect of continually having something to do is most favorable, and it is the pilot's duty to see that this is so. The crew should remember that others have been rescued from the sea after fourteen days, one crew from the Mediterranean after eleven days, while a U. S. Navy crew survived after thirty-four days.

j. Rescue.

(1) When the rescue craft comes alongside, do not assume that you will be able to get aboard easily. Remember that if you have been at sea for several days, you will be very weak.

(2) Insure that the information of rescue will be transmitted to the proper authorities to stop further search.

k. Abandoning Airplane by Parachute.

(1) The pilot will determine when this is advisable.

(2) When descending into water, the life jacket must be fully inflated once the descent is under control. As the surface is approached, straighten the body with the feet together. When the feet touch the water, release the harness with one hand and pinch the nostrils together with the other, keeping the elbows close to the sides. Land with the back toward the direction of travel.

CAUTION: Gunner and bombardier should use lower exits in flight to avoid striking the tail.

APPENDIX III
COLD WEATHER OPERATION

1. *STARTING.*

Cold weather starting will be accomplished the same as during warm weather except:

a. Before engaging starter, move mixture control (Figure 9-2) from IDLE CUT-OFF to EMERGENCY RICH until approximately one-half pint of fuel runs out the overflow.

b. Then move mixture control back to IDLE CUT-OFF and engage starter (Figure 15-25).

c. It may also be necessary to operate the primer (Figure 4), *after* the engine has started in extremely cold weather.

★ *NOTE:* If the engine doesn't start in three or four tries, moisture may have accumulated on the plugs. Remove one plug from each cylinder and heat plugs until they are comfortably warm in the hand.

2. *WARM UP.*

Do not gun engine to more than 900 rpm until oil has reached a temperature of 40° C (104° F).

3. *TAKE-OFF.*

a. Do not take off with frost or snow on the wings. Remove any accumulation by melting a small area of the ice-covered surface at a time using hot water, then flush this area with denatured alcohol before the hot water freezes. Pay particular attention to the hinges and controls. Alcohol is used for cleaning frost off windows and windshields.

b. Under severe conditions of frosting, it may be necessary to taxi to the take-off position before removing protective covers from airplane.

c. Don't take off on soft snow. Taxi along the runway a few times to pack down the snow.

4. *DURING FLIGHT.*

a. Following take-off from snow or slush covered fields, operate landing gear, flaps and bomb bay doors through a complete cycle two or three times to preclude freezing in the UP position.

b. Increase propeller speed by about 200 rpm every half-hour, to assure continued governing. Return propeller at once to the desired cruising rpm.

c. Stay on prearranged flight course so searchers will be able to find you if you are forced down. Except in extreme emergency, it is better to land or crash-land than bail out.

d. Ice formation can cause engine stoppage by clogging engine filters. Under icing conditions or before long flights and flights over water, air filters should be removed, even though take-off must be made from a dusty field.

e. Icing conditions occur when flying through rain or clouds when the air temperature is approximately freezing or colder. At very cold temperatures, -29° C (-20° F) or colder and/or high altitudes (above 20,000 feet) icing conditions are rarely encountered. If icing conditions have been encountered during the flight, and there are residual ice formations clinging to the wing and tail, the approach and landing should be made at a somewhat greater speed than normal in order to insure adequate lift and control.

f. While letting down for a landing, watch engine temperatures closely. Temperature inversions are likely in winter and the ground air may be 15 to 30° C (59-86° F) colder than at altitude.

5. *AFTER LANDING.*

a. Oil Dilution.

(1) *Description.*—This system provides a method of diluting or thinning the engine oil with gasoline at the end of each engine run in order to facilitate starting the

engine in cold weather. The engine oil should be diluted prior to stopping the engines when there is a possibility of the engine oil temperature dropping below approximately 5° C (41° F).

(2) *Operation.*—Maintain an engine speed of 800 rpm, oil temperature of 50° C (122° F) or below. Desired temperature is 40° C (104° F).

★ *NOTE:* It is impossible to dilute the engine oil unless engine is running.

Hold oil dilution switches (Figure 15-20) ON for four minutes. Move mixture control (Figure 9-2) to IDLE CUT-OFF. When engines stop rotating, release oil dilution switches. AVOID exceeding 50° C (122° F), as fuel vapor blown from the breather outlets will create a fire hazard. If temperature rises too high, fuel will vaporize so that no oil dilution will be obtained. In such a case, stop engines until the oil cools to approximately 35° C (95° F). Restart and proceed with dilution.

★ *NOTE:* If especially effective dilution is desired, stop the engine after first dilution; cool to 35° C (95° F). Restart and redilute.

(3) *Propeller Oil Dilution.*

(a) Description.—Hydromatic propellers require filling of the dome with diluted oil to prevent sluggish response of propeller when starting engine.

(b) Operation.—During dilution process, move automatic control (Figure 9-3) from INCREASE RPM to DECREASE RPM several times.

b. Portable Ground Heaters.—When operating under freezing conditions and, if available, use type D-1 portable heater or heaters as the weather conditions may require, to preheat the engines and compartments prior to first flight. Description and operation will be found under an appendix on Arctic Operation.

> *CAUTION:* Extreme care must be taken to prevent accidental ignition of the gas fumes from the engine breathers due to vaporization of the gasoline in the oil.

c. Batteries.—Energizers or battery carts are generally used for cold weather starting, as this is more practicable than heating the batteries. Batteries should be maintained at not less than —12.2° C (+10° F). Lower voltage at extremely low temperatures causes malfunctioning of all electrical equipment.

★ *NOTE:* To safeguard batteries, when airplane is not on the alert, remove them from the airplane and store them in a heated location.

d. Protective Covers.—The entire airplane should be covered with tarpaulins to prevent snow, ice, and frost accumulation.

e. Tires.—Put some insulating material under the wheels to prevent freezing tires to the surface.

f. Brakes.—Parking brakes should be OFF to prevent locking by ice formed through condensation.

g. Frosting.—When not heated, keep a hatch or panel open to prevent windshield and window frosting due to lack of ventilation.

APPENDIX IV
LONG RANGE OPERATION

1. *EQUIPMENT.*

a. Fuel System (Figure 19).

Wing tanks (4)	394 U.S. gal (328 Imp.)
Fuselage tank	100 U.S. gal (83.3 Imp.)
External belly tank	380 U.S. gal (316.4 Imp.)
Large bomb bay tanks	600 U.S. gal (500 Imp.)
Total capacity	1474 U.S. gal (1227.4 Imp.)

b. Oil System.—Overload capacity of the two individual tanks is 22 U.S. gal (18.3 Imp.).

c. Ammunition.—The following ammunition loads must be carried in order to secure proper weight and balance distribution:

Rear Lower Flexible Gun	50 rounds
Rear Upper Flexible Gun	50 rounds
Nacelle Guns (2)	50 rounds each gun
Front Fixed Guns (2)	200 rounds each gun

★ *IMPORTANT:* Full supply of 400 rounds total must be carried for the front fixed guns in order to secure proper balance.

A loose equipment shipping box is secured to the seat in the bombardier's compartment. It is necessary to remove this box in order to install the front fixed guns ammunition containers. After removing this box, be sure that it is *replaced and tied securely.*

d. Safety Equipment.

(1) *Life Raft.*

(2) *Emergency Rations.*

(3) *Portable Emergency Radio.*—This is a transmitter only, designed to be used in the lifecraft anywhere a kite can be flown. There is no receiver. The set is stowed in the gunner's compartment and is equipped with a small parachute.

2. *PRE-FLIGHT INSTRUCTIONS AND PROCEDURES.*

a. Loading Fuel.—Fill wing tanks to within 50 gallons tank capacity; all other tanks full. After warm-up, testing of fuel transfer system, and engine operation on all tank combinations, stop the engines and refill ALL tanks to capacity.

b. Loading Ammunition.—Follow exact schedule given under "Equipment" in this section.

c. Stowing Luggage.—The crew's luggage must be stored beside the loose equipment shipping box on the seat in the bombardier's compartment in order to secure proper weight and balance distribution.

d. Ground Operation.—During preliminary ground operation of the airplane, all engine starting, radio checking, and fuel transfer should be made with an external source of electrical power, preferably a battery cart. Tires should be inflated as follows:

Main wheel tires	48 lb/sq in.
Nose wheel tire	53 lb/sq in.

The nose wheel, under the heavy loading condition imposed by the long range tank installation, has a decided tendency to remain in a turned position.

> *CAUTION:* With long range tanks filled to capacity, avoid TURNS OF MINIMUM RADIUS, EXCESS BRAKE APPLICATIONS, and TOWING BY MEANS OF THE NOSE WHEEL.

e. Operational Check of the Long Range Fuel Tank System.—Fill all tanks to capacity, except wing tanks which should be filled to within 50 gallons of capacity. Check fuel transfer from each wing tank to the other. Check fuel transfer from the 100 gallon fuselage tank. Test operate the engines on all tank combinations. On completion of satisfactory check, stop the engines and refill all tanks to capacity.

f. Wing Flap Position for Take-Off.

(1) Flaps in "HALF-DOWN" position.

NOTE: All take-offs with the long range fuel tanks installed must be made with the wing flaps in the "HALF-DOWN" position.

(2) When no equalizers are installed, flaps may be set manually by lining the four flaps up to the half-way mark. Then place flap control in NEUTRAL.

3. *FLIGHT INSTRUCTIONS AND PROCEDURES.*

a. Pre-Flight.

(1) *Load and Ballast.*

27,200 lb maximum gross weight. Ferry condition.
No ballast required.
Observer in rear cockpit.
120 lb luggage—on bombardier's seat.

(2) *Fuel Load.*

Fill all tanks to capacity:
Bomb Bay .....(2)—600 U.S. gal (500 Imp.)
Fuselage .....(1)—100 U.S. gal. (83.3 Imp.)
External Belly.....(1)—380 U.S. gal (316.4 Imp.)
Wing Tanks.....(2)—Fill to within 50 gallons of capacity for checking. Refill to full capacity before take-off.

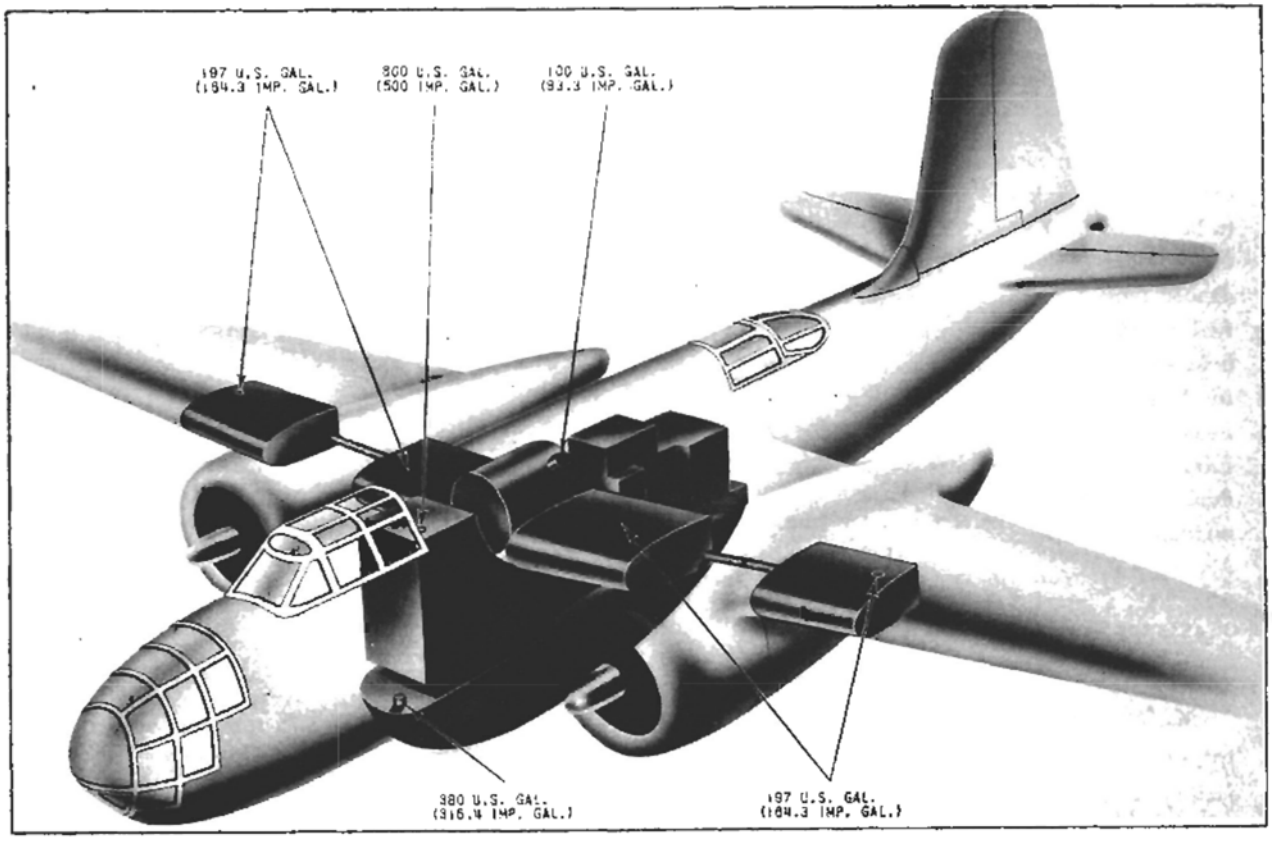


Figure 50—Long Range Fuel System Diagram

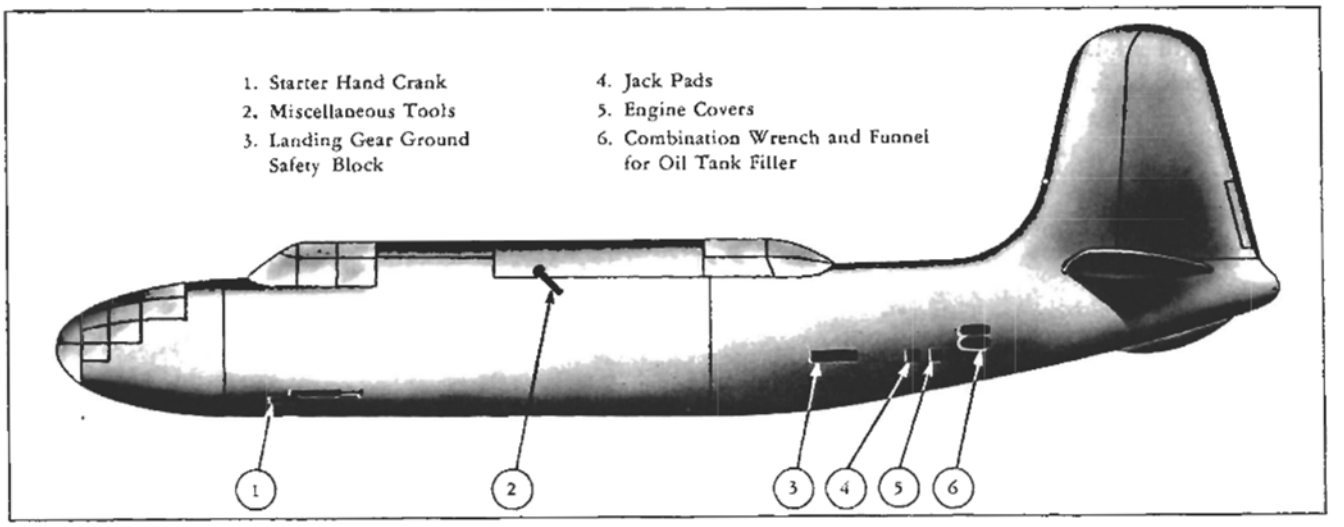


Figure 51—Fuselage Contents Diagram

(3) *Booster Pumps.*

"L.H. MAIN".....Left-hand wing tanks
"FUSELAGE AFT BAY"... Bomb bay tanks
"R.H. MAIN".....Right-hand wing tanks
(Panel aft of carburetor control quadrant)
"BELLY BOOSTER FUEL PUMP SWITCH".....External belly tank

NOTE: Booster pumps (Figure 15-19) for the external belly tank and the bomb bay tanks are to be placed in the ON position before the selector valve (Figure 16-1) is turned on—and should remain in the ON position as long as fuel is being drawn from these tanks. Wing tank booster pumps are operated to obtain 15 lb/sq in. fuel pressure for take-off, but should be turned off when the airplane is clear of the ground. If the fuel pressure drops below 15 lb during operation, use the booster pumps to maintain pressure.

(4) *Fuel Selector Valves* (Figure 16-1).—Operate the engines for 5 minutes on EACH combination.

"FUS".....Bomb bay tanks
"ALT".....External belly tank
"MAIN".....Wing tanks and fuselage tank.

IMPORTANT: Stop the engines after satisfactory functioning and after the preceding operations—FILL ALL TANKS TO CAPACITY.

(5) *Main Electric Line Switch* (Figure 15-24).—"ON"—If a battery cart is used, the switch must be in an "OFF" position until the cart has been disconnected.

(6) *Carburetor Fuel Mixture Controls* (Figure 9-2).—"AUTO-RICH."

(7) *Engine Supercharger Controls* (Figure 16-8).—"LOW BLOWER."

(8) *Engine Cowl Flaps Control* (Figure 5-4, 5),—"OPEN"—Both upper and lower flaps for ground operation.

(9) *Flight Controls.*—Check for free movement.

(10) *Trim Tab Controls* (Figure 7).—"NEUTRAL" position.

(11) *Hydraulic Brake Pressure.*—Check hydraulic system pressure gage (Figure 17-27) for 600-850 lb/sq in. pressure.

(12) *Flight Instruments.*—Check suction —4.2" Hg. Set altimeter to correct altitude.

(13) *Carburetor Heat Control* (Figure 16-2).—Full COLD position.

(14) *Engine Run-up.*

Manifold Pressure.....30" Hg
Oil Pressure.....85 lb/sq in.
Fuel Pressure.....15 lb/sq in.
Magneto Check.....75 rpm maximum drop.

(15) *Propeller Pitch Controls* (Figure 9-3).—Full "INCREASE RPM" position.

(16) *Wing Flaps.*—"HALF-DOWN"—Valve (Figure 16-12) in "NEUTRAL" position.

(17) *Main and Nose Gear Locks.*—Remove when hydraulic pressure gage indicates 500 lb/sq in. minimum.

(18) *Pilot's Enclosure.*—LOCK SECURELY.

b. Before Take-Off.

(1) *Fuel Selector Valves* (Figure 16-1).—"MAIN" position.

(2) *Wing Fuel Tanks Booster Pumps.*—15 lb/sq in.

(3) *Fuel Transfer Valve* (Figure 16-1).—"OFF" position.

(4) *Wing Flaps.*—"HALF-DOWN" position.

(5) *Upper Cowl Flaps.*—"CLOSED" position.

(6) *Engine Supercharger Control* (Figure 16-8).—"LOW BLOWER" position.

(7) *Engine Limitations for Take-Off.*
2400 rpm, 43" Hg
260° C (500° F) Head Temperature (5 minutes).

c. During Flight.

(1) *Landing Gear.*—Retract immediately after take-off.

(2) *Wing Flaps.*—Raise when IAS reaches 160 mph and 500 ft alt.

(3) *Allowable Engine Operation.*

Oil Pressure: 85 lb/sq in.—Desired
90 lb/sq in.—Maximum
80 lb/sq in.—Minimum

Oil Temperature: 50° to 70° C (122° to 158° F) Desired

Fuel Pressure: 12 lb/sq in.—Minimum
16 lb/sq in.—Maximum

(4) *Fuel Booster Pumps.*—Turn off the wing fuel tanks booster pumps when the airplane is clear of the ground. Do not turn the wing booster pumps on again until ready to land, unless it is necessary to do so, due to high altitude, or because of engine pump failure.

(5) *Cowl Flaps.*—Upper flaps "CLOSED," lower flaps adjusted for proper cooling.

(6) Climb to required altitude.

d. Before Landing.

(1) *Supercharger* (Figure 16-8).—"LOW BLOWER" position.

(2) Check fuel in wing tanks.

(3) *Wing Tank Fuel Booster Pumps* (Figure 15-19).—Both "ON."

(4) *Fuel Selector Valve* (Figure 16-1).—"MAIN" position.

(5) *Fuel Transfer Valve Controls* (Figure 16-1).—"OFF" position.

(6) *Carburetor Fuel Mixture Controls* (Figure 9-2).—"AUTO-RICH" position.

(7) *Propeller Pitch Controls* (Figure 9-3).—Set for maximum cruise rpm position.

(8) *Landing Gear* (Figure 8-1).—"DOWN" position.

(9) *Engine Cowl Flaps* (Figure 5-4, 5).—Upper flaps "CLOSED," lower flaps "CLOSED" (return valve to "NEUTRAL").

(10) *Wing Flaps.*—"DOWN." Place control (Figure 16-12) in the "NEUTRAL" position. Do not lower above 170 mph IAS.

(11) *Hydraulic Brake Pressure.*—Check hydraulic system pressure gage for 600-850 lb/sq in. If pressure falls below minimum, use Emergency Air Brakes *after ground contact is made.*