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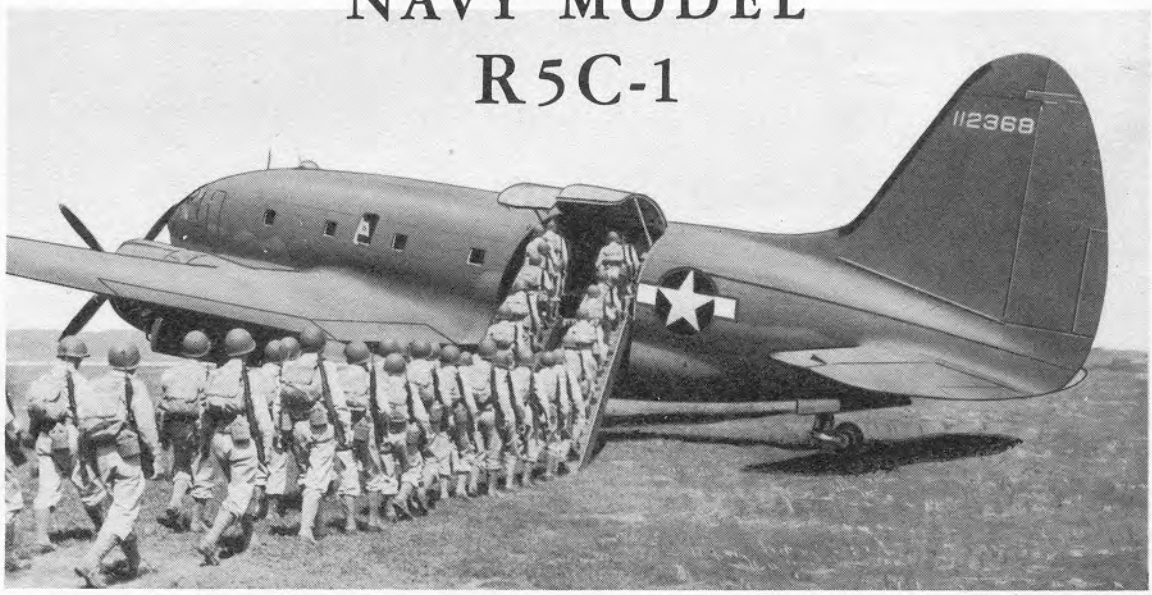
PILOT'S FLIGHT OPERATING INSTRUCTIONS

For ARMY MODELS
C-46 and C-46A
NAVY MODEL
R5C-1



NOTE: This Handbook replaces T. O. No. 01-25LA-1 dated June 1, 1942.

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Keller-Crescent Co., Evansville, Ind.—8-3-43—18M

JULY 20, 1943

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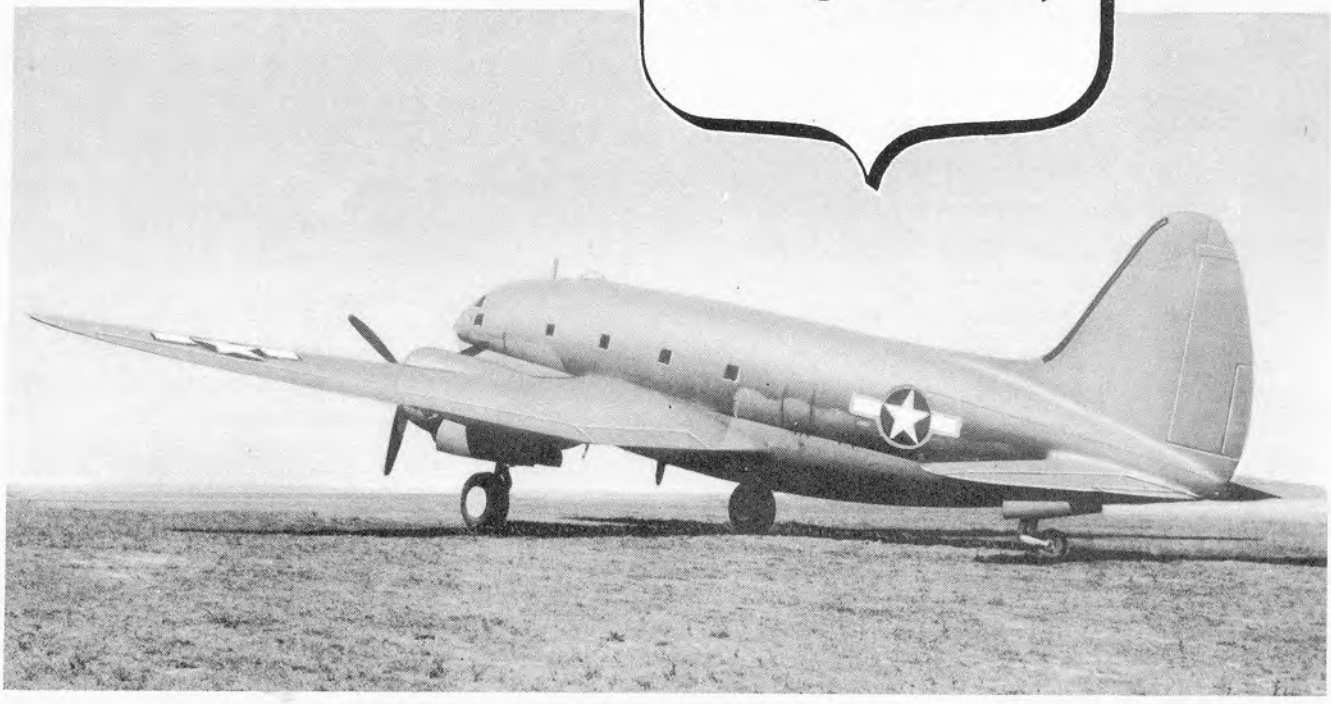
C-46
C-46A
(Navy R5C-1)



Section I
DESCRIPTION

1. AIRPLANE.

a. GENERAL.—The C-46 and C-46A (Navy R5C-1) are transport and cargo airplanes. Their primary use is to transport troops, military equipment, and supplies. They can also be used as ambulance or glider tow airplanes.

These airplanes, manufactured by Curtiss Wright Corporation, are land monoplanes. The approximate over-all dimensions of the C-46 airplanes are: length, 76 feet, 4 inches; height at rest, 21 feet, 9 inches; and span, 108 feet, and a normal gross weight of 40,000 pounds.

The approximate over-all dimensions of the C-46A (Navy R5C-1) airplanes are approximately the same except that these airplanes are designed for a higher gross weight. Their weight empty is 28,000 pounds, useful load 17,000 pounds, and normal gross load 45,000 pounds. Their normal wing and power loadings are (33.09) pounds per square foot and 14.06 pounds per horsepower. The overload gross weight is 50,000 pounds.

b. ACCESS TO AIRPLANE.—Access to the airplane is normally made through the troop door in the left side of the fuselage.

c. FUSELAGE.—The fuselage above the floor is divided into the pilots' compartment which includes the radio operator's station and the main cargo compartment. The navigator's station is in the main cargo compartment immediately aft of the pilots' compartment. Curtains are provided to partition off the navigator's section when desired. Below the floor there are two lower cargo compartments, the forward one being generally used to carry the airplane's accessories, the aft one for cargo. The forward lower compartment is accessible from the pilots' compartment through a trap door in the floor while the airplane is in flight. Access to lower fore-and-aft compartments while the airplane is on the ground is through two doors on the lower right side of the fuselage. A ground service door is also located in the belly of the fuselage between the two lower cargo compartment doors. See figure 16.

2. POWER PLANT.

a. ENGINE.—These airplanes are powered with two Pratt & Whitney Model R-2800-51 double row, radial air-cooled engines developing 2000 HP each for take-off. A two-speed supercharger is built integrally into each engine with speed ratios of 7.60:1 and 9.89:1. The propeller reduction gear ratio is 2:1. A Stromberg injection carburetor (type PT-13G1) is installed on each engine.

Fuel: Specification	AN-VV-F-781
Octane	100
Oil: Specification	AN-VV-O-446
Viscosity: Summer	1120
Winter	1100A

b. PROPELLERS. — On airplanes AF41-5159 to AF41-5204 and AF41-12280 to AF41-12333, Hamilton hydromatic controllable, three-bladed propellers are installed. On airplanes AF41-12334 and subsequent, Curtiss electric controllable, four-bladed propellers are used. Both types of propellers feature constant speed, full-feathering controls.

3. CONTROLS DESCRIPTION.

a. SURFACE CONTROLS AND TRIM TABS.

(1) GENERAL.—Dual surface controls are of the conventional wheel, column, and rudder pedal type. The surface control system is of the cable type, with hydraulic boosters.

NOTE

On airplanes AF41-5159 to AF41-5204 and AF41-12280 to AF41-12333, a gust lock valve is incorporated in each hydraulic booster unit. On airplanes AF41-12334 and subsequent, tie-down harnesses are slipped over the control columns for locking the controls.

(2) OPERATIONAL CHECK.—Check all surface controls for freedom of movement and ease of operation. The presence of air in the hydraulic booster system is easily detected by the rough, erratic operation of the booster cylinders. If such a condition exists, the boosters should be operated vigorously for several minutes through their full range of travel in each direction by means of the controls until the air has been worked out of the pressure system into the return lines. As soon as all air is out of the pressure system, the boosters will work with a smooth action.

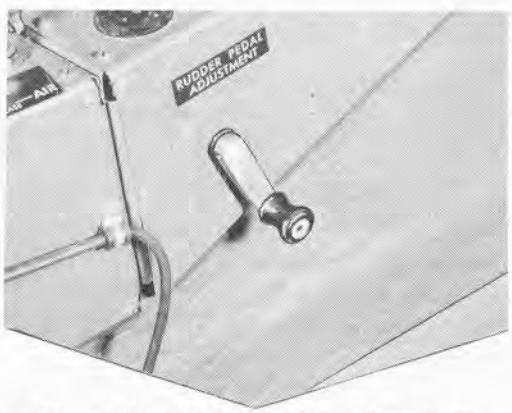


Figure 3—Rudder Pedal Adjustment

(3) RUDDER.—The rudder is operated by stirrup pedals which are adjusted by turning the crank located outboard of the seat for each pilot. Test the rudder pedal positions for maximum travel.

(4) ELEVATORS AND AILERONS.—Operation of elevators and ailerons is by two conventional control columns and wheels.

(5) TRIM TABS.—The trim tab controls are located on the engine control pedestal. The tab controls are lettered to indicate position. Rudder and aileron tabs are of the combination trim and balance type, while the elevator tab is for trimming only.

WARNING

ALL TRIM TAB CONTROLS MUST BE AT "O" AT TAKE-OFF, OTHERWISE EXCESSIVE TAB LOADS WILL DEVELOP WHICH WILL MAKE THE AIRPLANE UNCONTROLLABLE.

b. ENGINE CONTROLS.

(1) IGNITION.—The ignition master switches and individual engine magneto switches are installed on the overhead panel in the pilots' compartment.

(2) STARTERS.

(a) SWITCHES.—The electric inertia engine starter switches are installed in the overhead panel.

(b) OPERATION.—Place the starter switch in the "ENERGIZE" position and hold for 15 to 18 seconds (18 seconds maximum) to energize the inertia element. After energizing, place the starter switch in the "ENGAGE" position and hold until the engine has turned approximately one revolution before turning the corresponding ignition switch to the "BOTH" position.

IMPORTANT

On airplanes AF41-12284 and subsequent, a separate switch is installed for the "ENERGIZE" and "ENGAGE" positions. Since there are two starter switches for each engine in place of the one switch installed on airplanes AF41-15159 through AF41-12283, it will be necessary to check the overhead panel carefully to be certain which switch installation is employed, and govern the starting procedure accordingly. Some time in service, airplanes AF41-15159 through AF41-12283 will be changed to agree with the new installation.

CAUTION

If the engine does not "take," allow the starter switch to return to the "OFF" position. Energizing the booster coil longer than 15 seconds may burn out the coil windings.

(3) THROTTLES.—Conventional, located on engine control pedestal. The throttles may be locked in any desired position by turning the friction adjusting handle on the upper control pedestal. (See figure 4.)

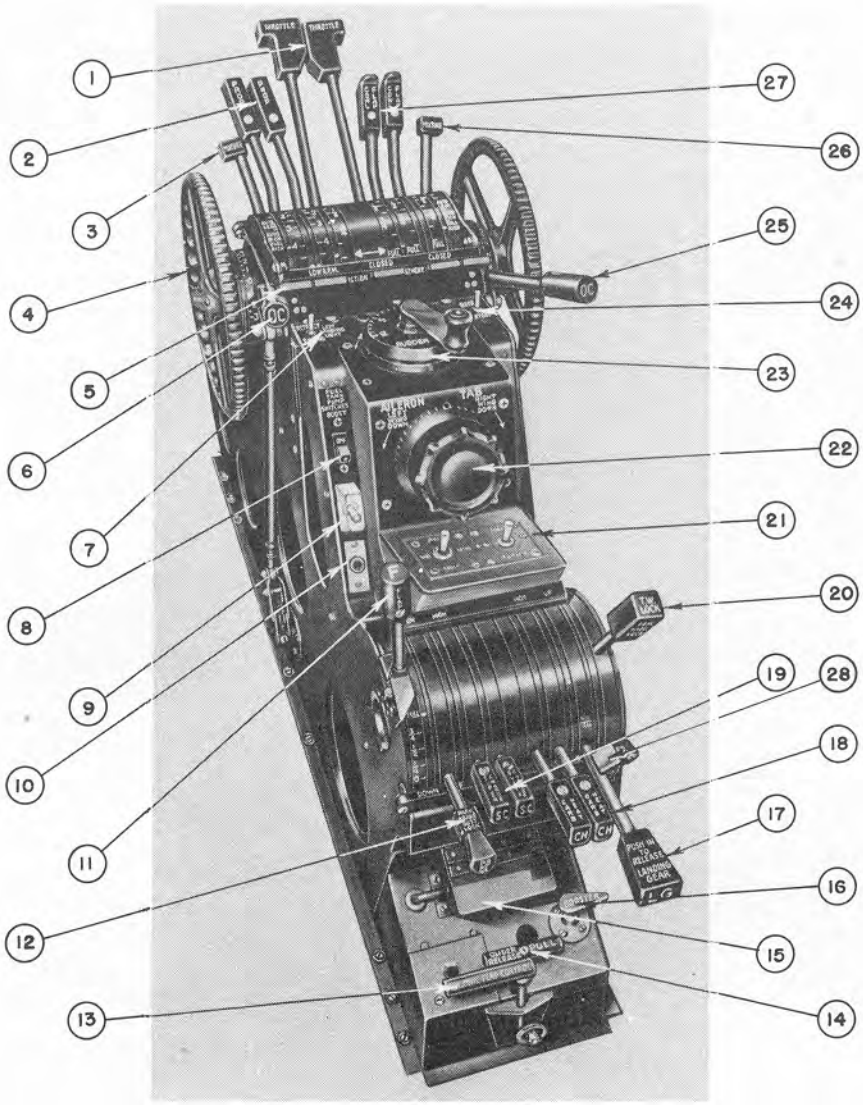


Figure 4—Control Pedestal

LEGEND FOR FIGURE 4

1—Left Throttle
2—Propeller Governor Controls
3—Left Mixture Control
4—Elevator Tab Control
5—Friction Adjustment
6—Left Oil Cooler Flap Control
7—Left Landing Light Switch
8—Booster Pump Switches
9—Feather Switch for Left Propeller (Curtiss)
10—Circuit Breaker for Left Propeller (Curtiss)
11—Wing Flap Control
12—Parking Brake and Gust Lock
13—Auxiliary Cowl Flap or Filtered Air
14—Glider Release
15—Detonator Buttons
16—Control Booster Shut-Off Valve
17—Landing Gear Release
18—Carburetor Heat
19—Supercharger Controls
20—Tail Wheel Lock
21—Propeller Selector Switches (Curtiss)
22—Aileron Tab Control
23—Rudder Tab Control
24—Right Landing Light Switch
25—Right Oil Cooler Flap Control
26—Right Mixture Control
27—Cowl Flap Controls
28—Landing Gear Control Lock

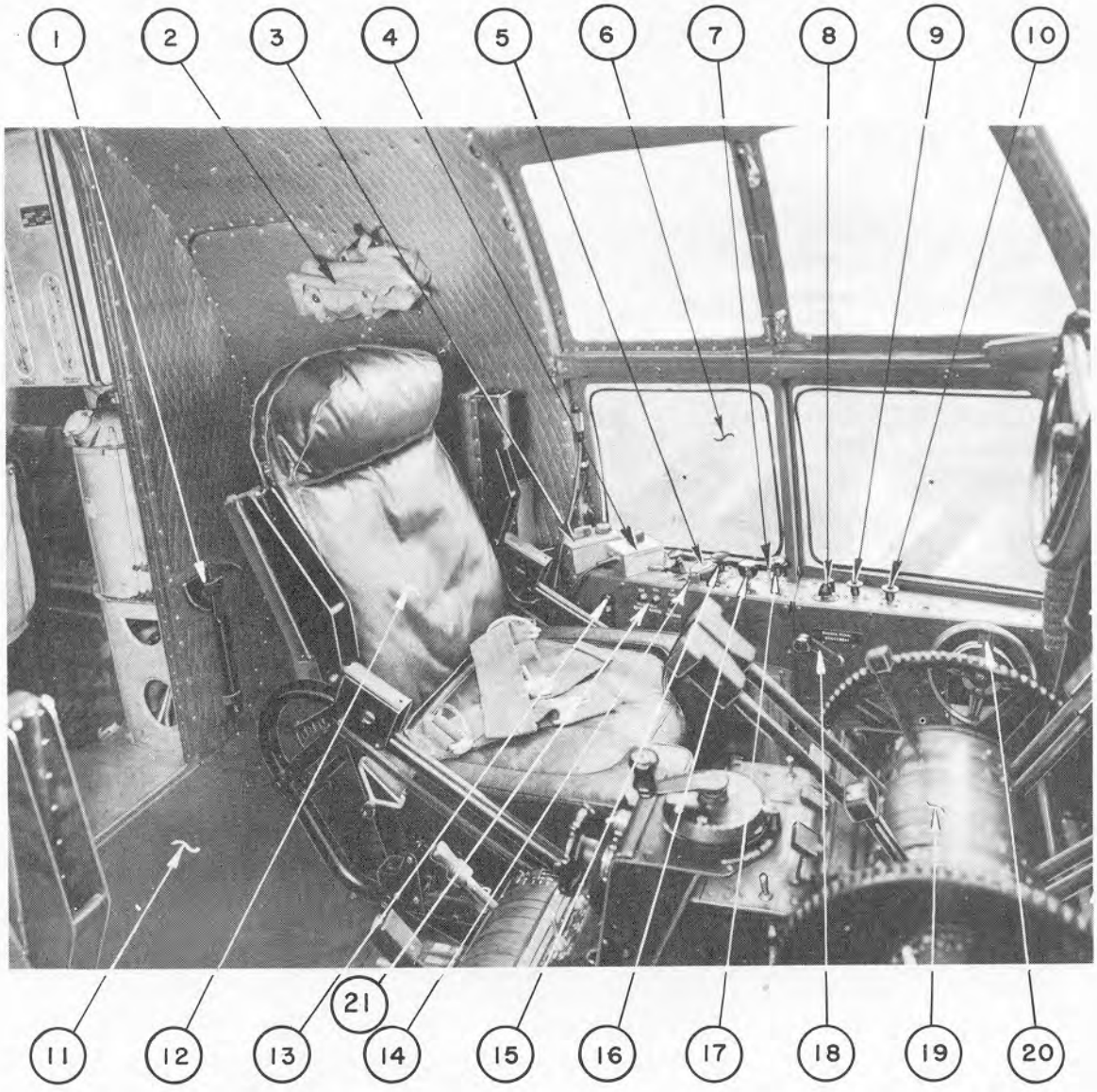


Figure 5—Pilots' Compartment—Left Side

LEGEND FOR FIGURE 5

1—Hand Axe
2—Pyrotechnic Signal Container and Flares
3—Jack Box
4—Switch Box
5—Oxygen Regulator
6—Defroster Panel
7—Heater Blower Starter Switch
8—Rheostat for Ultra-Violet Light
9—Anti-Icer Valve for Windshield
10—Windshield Wiper
11—Access Hatch Door
12—Pilot's Seat
13—Heater Selector
14—Heater Stop
15—Throttle for Heater
16—Heater Fuel Shut-off Valve
17—Butterfly Control for Heater Air Scoop
18—Pilot's Rudder Pedal Adjustment
19—Control Pedestal
20—Fuel Selector Valve Control
21—Heater Indicating Lights

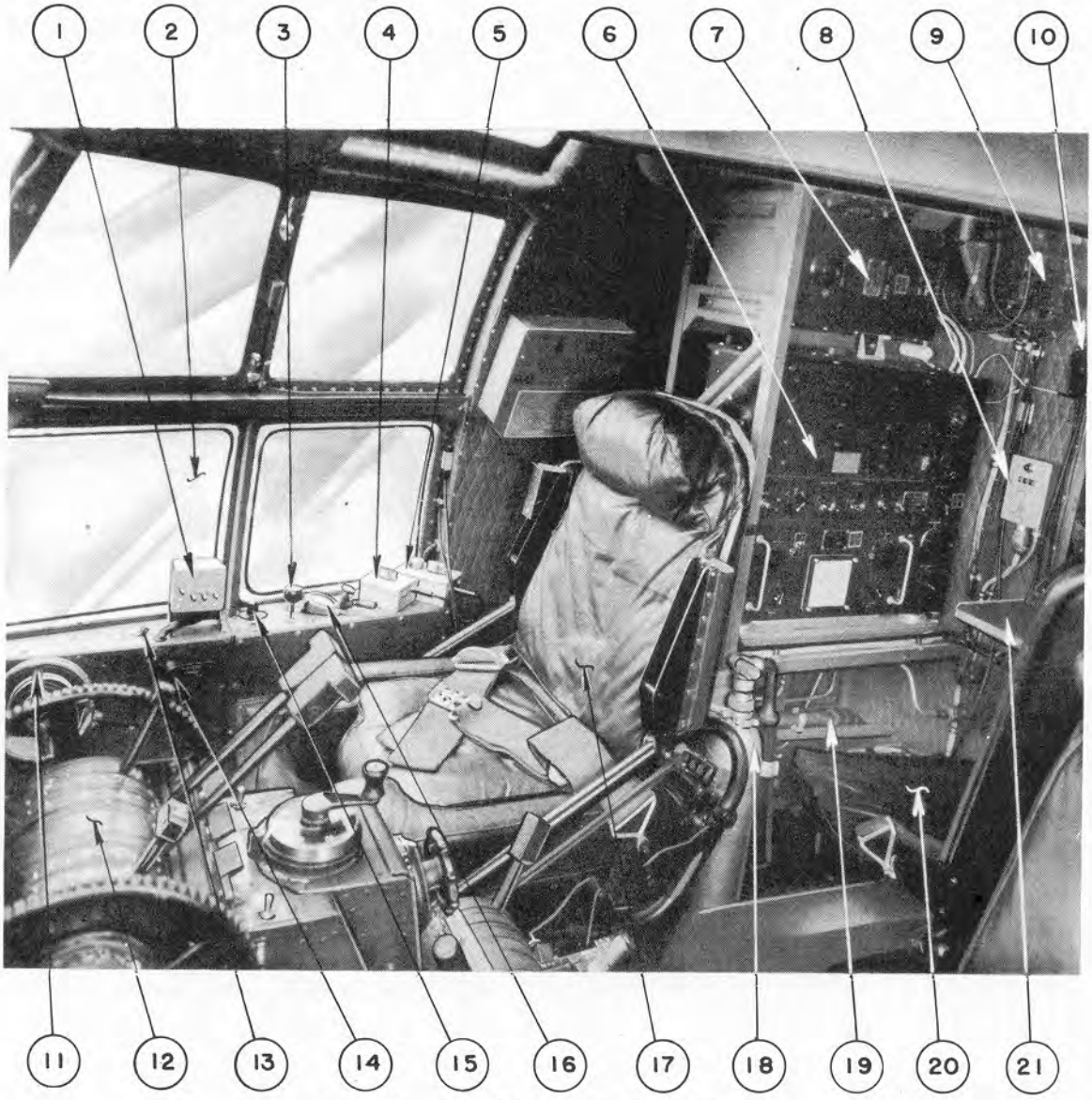


Figure 6—Pilots' Compartment—Right Side

LEGEND FOR FIGURE 6

1—Recognition Light Switch
2—Defroster Panel
3—Main Accumulator "ON"—"OFF"
4—Switch Box
5—Jack Box
6—Liaison Transmitter Unit
7—Antenna Tuning Unit
8—Reel Control Box
9—Identification Radio Control Box
10—Throat Microphone Switch
11—Fuel Selector Valve Control
12—Control Pedestal
13—Booster Heater Control
14—Copilot's Rudder Pedal Adjustment
15—Rheostat for Ultra-Violet Light
16—Oxygen Regulator
17—Copilot's Seat
18—Fire Extinguisher
19—Handle for Hydraulic Pump
20—Radio Operator's Seat
21—Radio Operator's Shelf

(4) SUPERCHARGERS.

(a) CONTROLS.—The controls for the two-speed blowers are located on the lower section of the engine control pedestal. To lock these controls, turn the friction adjusting handles on the control pedestal.

(b) OPERATION.

1. Close throttles as much as the flight conditions will permit.

2. Set mixture control to "AUTO-RICH."

3. Change blower control to desired position.

4. Readjust throttle, propeller rpm, and mixture controls as required.

NOTE

Shift directly to full "HIGH" or "LOW" blower positions without any hesitation between stops, to avoid slippage of the blower clutches. Blower ratio changes should not be made at intervals of less than five minutes to avoid overheating the clutches. Always use "LOW" blower below 9,600 feet except for other operating conditions as specified on the Specific Engine Flight Chart. For other altitudes, consult the Specific Engine Flight Chart.

(5) MIXTURE CONTROLS.

(a) The mixture controls have four positions—"FULL RICH," "AUTOMATIC RICH," "AUTOMATIC LEAN," and "IDLE CUT-OFF."

(b) "FULL RICH" is used only for emergency operation in the event of failure of the automatic device.

(c) "AUTOMATIC RICH" should be used for all ground running, take-off, climb, and single engine operation.

(d) "AUTOMATIC LEAN" should be used to provide fuel economy.

(e) "IDLE CUT-OFF" is used for stopping, and when the engines are stopped.

(6) CARBURETOR CONTROLS.

(a) CARBURETOR ANTI-ICER AND PREHEAT.

1. Carburetor heat is operated by adjustable controls located on the control pedestal. The carburetor anti-icer switch is located on the overhead panel in the pilots' compartment. The tank which supplies anti-icing fluid for the carburetors, windshields, and propellers has a capacity of 20 U. S. gallons (16.7 Imperial gallons).

NOTE

On airplanes prior to AF41-12334 a tank with a capacity of 10 U. S. gallons (8.3 Imperial gallons) supplies anti-icing fluid for carburetors and windshields.

CAUTION

Fill anti-icing tank with fluid, AAF Specification No. 14082-A only. Drain all anti-icing fluid before going into combat areas.

2. Keep the heat and anti-icers on continuously during icing conditions rather than attempt to melt the ice periodically. Applying the heat periodically causes uneven engine operation, loss of power, and excessive consumption of fuel. If icing conditions are not extreme, the carburetor heat control can be set at any desired intermediate position. When icing conditions do not exist, keep the carburetor heat controls in "COLD" and the carburetor anti-icer switch in the "OFF" position.

WARNING

The carburetor heat control should be in the "COLD" position when starting the engines, so as to prevent damage to the induction system in case of an engine backfiring.

(b) CARBURETOR ICE FORMATION.

1. Ice may form in the air induction system when the outside air temperatures are 35°F (2°C) to 65°F (18°C) and the humidity is high, or from impact conditions when flying through snow or cold rain.

2. Indications of carburetor ice are:

a. Ice formation on the wings and other surfaces.

b. Steady loss in engine power with the throttles placed in any position.

c. A slow and steady falling off of manifold pressure.

NOTE

Carburetors are most susceptible to icing near the closed throttle position. When conditions arise that necessitate flying at a reduced air speed and a relatively high humidity, this reduction should be accomplished by lowering the landing gear or by other means than closing the throttles.

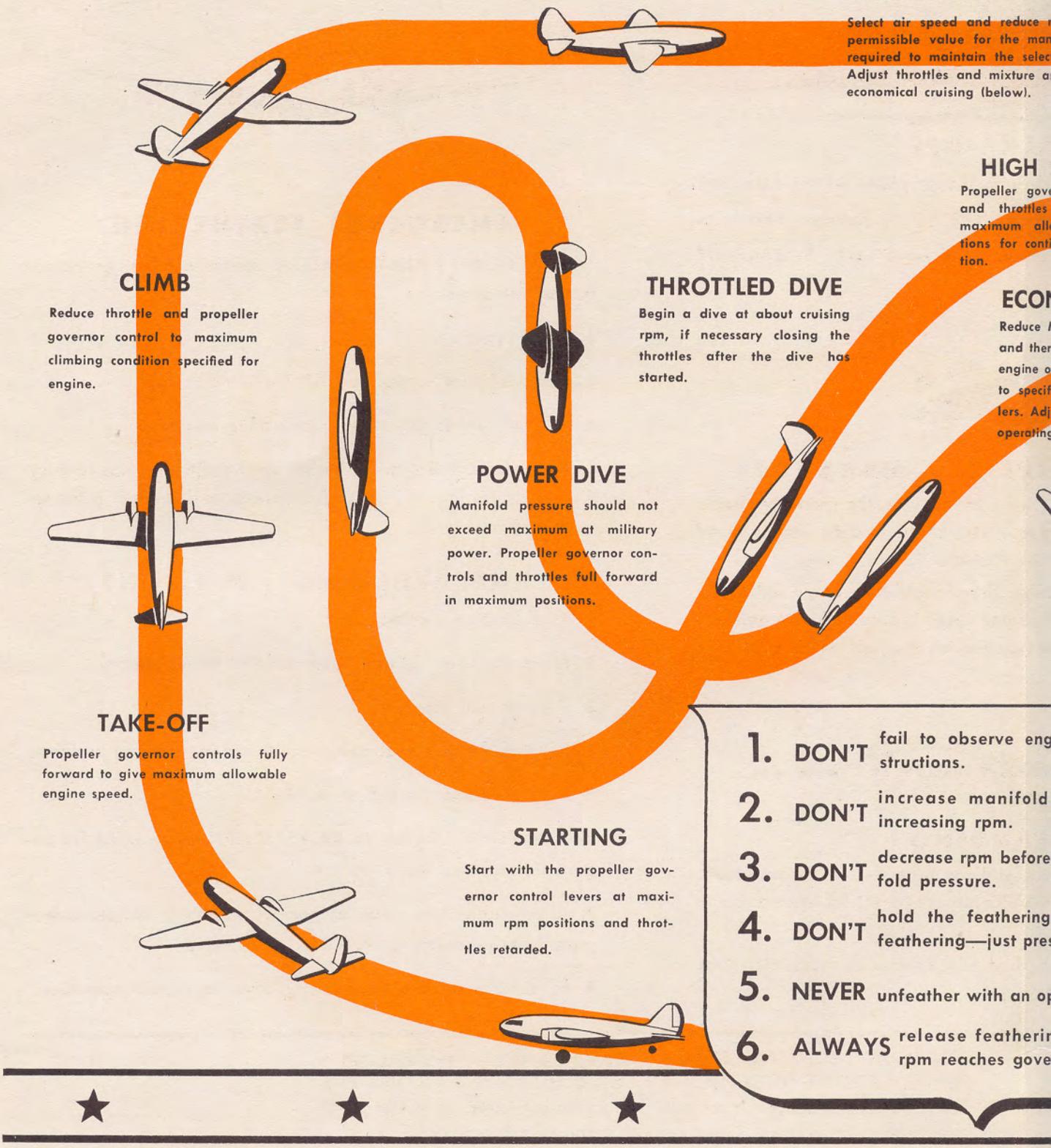


Figure 7—Operation of Hamilton Standard Propellers

MAXIMUM ENDURANCE

Select air speed and reduce rpm to lowest permissible value for the manifold pressure required to maintain the selected air speed. Adjust throttles and mixture as described in economical cruising (below).

HIGH SPEED

Propeller governor controls and throttles forward in maximum allowable positions for continuous operation.

POWER DESCENT

Set propeller governor controls and throttles to the desired conditions, usually about maximum cruising.

ECONOMICAL CRUISING

Reduce M.P. to approximate cruising value and then reduce rpm to value specified by engine operating instructions. Readjust M.P. to specified limits and synchronize propellers. Adjust mixture as required by engine operating instructions.

ENGINE FAILURE

Depress the feathering button. Close the throttle. Switch off ignition and turn off fuel supply. However, if there is danger of fire, the mixture control should be placed in idle cut-off position immediately after depressing feathering button.

SINGLE ENGINE FLIGHT

Increase propeller governor and throttle settings of operating engine to maintain level flight but not exceeding the maximum continuous rating of the engine.

UNFEATHERING

Set propeller governor control of dead engine to minimum rpm position and retard throttle to position used for starting. Switch on ignition, turn on fuel, press feathering button, and hold down until engine speed reaches approximately 1000 rpm, then release.

Always release feathering switch before rpm reaches minimum governing rpm.

APPROACH AND GLIDE

Set propeller governor controls to approximately maximum cruising position, and mixture control to automatic rich position, and control power by the throttle as required.

STOPPING ENGINES

Move the propeller governor controls to the maximum rpm position to prepare for next take-off. Follow engine operating instructions.

N'T fail to observe engine operating instructions.

N'T increase manifold pressure before increasing rpm.

N'T decrease rpm before decreasing manifold pressure.

N'T hold the feathering button in when feathering—just press and release.

VER unfeather with an open throttle.

WAYS release feathering button before rpm reaches governing range.

NOTE: Propeller operation identical on one, two, or four-engine airplanes, except elimination of feathering on single engine airplanes.

PRE-FLIGHT OPERATING CHECK—

1. Make certain the propeller circuit breaker is in the "ON" position.

2. Place Selector Switch in AUTOMATIC and Propeller Control Lever in the TAKE-OFF position.

3. Start and warm up the engine.

4. Turn generator "ON" and make sure it is operating.

• • •

When the engine has reached proper operating temperature . . . with the Selector Switch in AUTOMATIC and the Propeller Control Lever in the TAKE-OFF position . . . open throttle until engine turns approximately 70% of its take-off RPM . . . and

1. Pull Propeller Control Lever back until a reduction of not more than 200 RPM is noted.

The propeller should now hold the engine at a steady speed without surges or other irregularities.

2. Return Propeller Control Lever to the TAKE-OFF position and see that the original RPM is resumed. If it is — the propeller is operating normally, and is ready for flight.

In the case of a multi-engine installation — the same check should be made on each propeller.

Pilots should always make the above operating check just prior to take-offs, as this will eliminate the possibility of taking-off with an inoperative propeller, which may be caused by an incorrect switch setting or possible mechanical difficulty.

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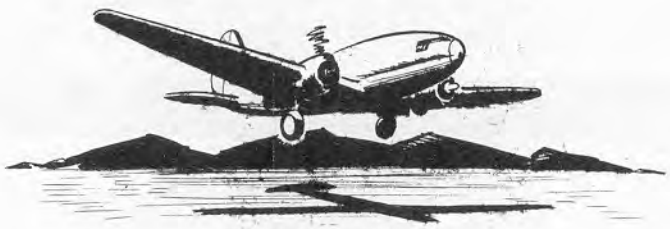
The Curtiss Electric Propeller needs electricity to operate. • The generator must be turned "ON" and operating. • The Circuit Breaker must be "ON" at all times. • The pre-flight propeller operating check should be made by the pilot prior to all take-offs.



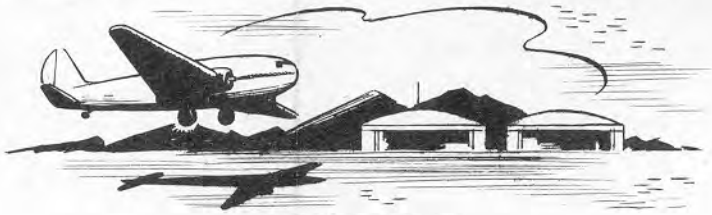
TAKE-OFF

Take-offs should be made with the propeller set for automatic operation — Circuit Breaker "ON" . . . Selector Switch in AUTOMATIC . . . and Propeller Control Lever in TAKE-OFF position.

CLIMB . . . CRUISE . . . MANEUVER

In climbs, cruising and during maneuvers, the propeller should continue to be operated in AUTOMATIC, and the engine speed regulated by adjusting the Propeller Control Lever.

During automatic operation, the correct blade angle setting for maintaining the selected engine speed is obtained automatically with no further attention required on the part of the pilot.



LANDING

Landings should be made with the propeller set for automatic operation, and the Propeller Control Lever set for the maximum cruising RPM.

With this setting, the propeller will operate satisfactorily in the event that landing is deferred.

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AUTOMATIC CONSTANT SPEED is the p ations. SELECTIVE FIXED PITCH is an au be used when fixed pitch propeller oper the automatic constant speed control b

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Figure 8—C

KE-OFF

with the propeller set for automatic
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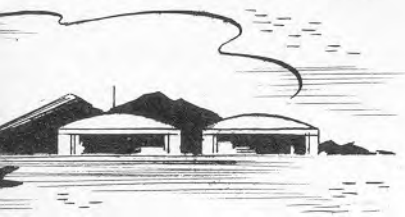

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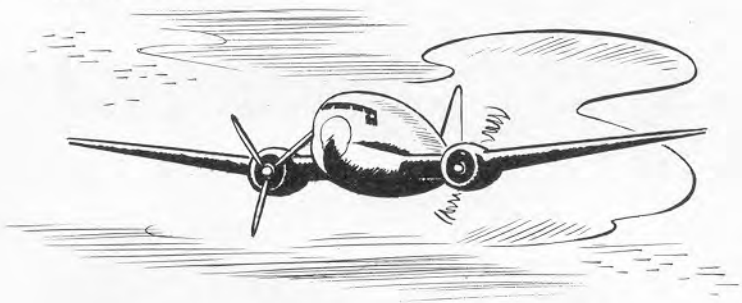


EMERGENCY FEATHERING

1. Place feather switch to FEATHER. Blades will feather without further attention.
2. Close throttle.
3. Move mixture control to IDLE CUT-OFF.
4. Shut off fuel supply to the inoperative engine only.
5. Turn off engine ignition switch after propeller stops turning. It is important that the above instructions be followed in the sequence given.

UNFEATHERING (IN FLIGHT)

1. Turn ignition switch "ON".
2. Move Propeller Control Lever to LOW RPM position.
3. Turn on fuel supply.
4. Set throttle and mixture control to normal starting positions.
5. Return Feather Switch to NORMAL.
6. Hold Selector Switch to INCREASE RPM as required for engine starting and warm up.
7. After engine has resumed normal operating temperature—place Selector Switch in AUTOMATIC . . . and
8. Set throttle and Propeller Control Lever for normal operation.

AUTOMATIC CONSTANT SPEED is the proper setting for all flying operations. SELECTIVE FIXED PITCH is an auxiliary form of control that may be used when fixed pitch propeller operation is desired, or in the event the automatic constant speed control becomes inoperative.

Figure 8—Operation of Curtiss Electric Propellers

3. TO TEST FOR ICING.—Apply full carburetor heat by placing the carburetor heat control to the full "HOT" position and, in addition, place the carburetor anti-icer switch, located on the overhead panel, in the "ON" position. Hold the carburetor heat control in the "HOT" position for 15 to 20 seconds, then place the control in the "COLD" position. If ice existed in the carburetor, and this procedure has removed it, the manifold pressure should increase toward its normal reading.

(c) CARBURETOR AIR FILTERS.—The carburetor air filters are operated by the same control lever as the auxiliary cowl flaps. This lever is located on the lower section of the control pedestal (see figure 4). (Refer to section VII, paragraph 2.)

(7) COWL FLAP CONTROL.—Since the engines are air-cooled, cowl flaps are provided for controlling the air flow through the engine section. The cowl flap controls are located on the upper control pedestal. (See figure 4.)

CAUTION

Do not close cowl flaps during engine warm-up, as this will cause burning of the ignition system insulation, particularly at spark plug elbows. In cold weather cowl flaps may be closed while starting the engines, but they should be opened as soon as the engines are running.

(8) AUXILIARY COWL FLAPS.—The auxiliary cowl flap control is located on the lower control pedestal. It should remain in the "DOWN" position for all normal operation.

c. PROPELLER CONTROLS.

(1) HAMILTON STANDARD HYDROMATIC PROPELLERS.

(a) GOVERNOR CONTROLS.—The propeller governor controls, located on the upper part of the control pedestal, are used to select the desired rpm. (See figure 7.)

(b) FEATHER SWITCH.—The feather switch is used to feather or unfeather the propellers when necessary.

(2) CURTISS ELECTRIC PROPELLERS.

NOTE

Curtiss electric propellers need electricity to operate. Generators must be turned "ON" and operating. The circuit breaker must be "ON" at all times.

(a) GOVERNOR CONTROLS.—The propeller governor controls, located on the upper part of the control pedestal, are used to select the desired rpm. (See figure 8.)

(b) CIRCUIT BREAKER.—A thermal circuit breaker is part of the Curtiss propeller circuit. If the push button (located near selector switches on control pedestal) opens due to an overload (indicated by a luminous red and white band appearing on the button), it may be reset by holding the button closed several seconds. (See figure 10.)

NOTE

In an emergency, this circuit breaker can be short-circuited to permit operation by holding the button full in, even though the overload continues to exist. Should a failure (due to overload) occur in the propeller circuit and an increase in blade angle is desired, hold the push button full in, place the selector switch to "DECREASE RPM" until the desired pitch is obtained, then release the selector switch and circuit breaker.

(c) SELECTOR SWITCHES.—The Curtiss propeller selector switches, located on the center part of the control pedestal, allow the propellers to operate in "FIXED PITCH" or "AUTOMATIC." (See figure 9.)

(d) FEATHER SWITCH.—The feather switches (one for each propeller) are used to feather or unfeather the propellers when necessary.

(e) SPECIAL GROUND TEST.—When airplanes are equipped with Curtiss propellers, the following test should be made as a supplement to the routine ground checks prior to all take-offs:

1. Check the constant speed operation by placing the selector switch on "AUTOMATIC" and the governor control in "TAKE-OFF" position.

2. Open throttle until engine turns approximately 70 percent of rated rpm, and pull the governor control lever back until a reduction in the engine rpm is noted.

3. Return control to "TAKE-OFF" position, noting that original rpm is resumed. Close throttle.

IMPORTANT

On airplanes equipped with Curtiss electric propellers, be sure the pitch control is the same for both propellers. Unequal thrust may

Figure 9—Curtiss Propeller Selector Switches

Figure 10—Feather Switch and Circuit Breaker, Left Propeller (Curtiss)

result when opening the throttles during take-offs and landings, if one of the propellers is set for fixed pitch and the other for automatic constant speed. AUTOMATIC CONSTANT SPEED is the proper setting for all flying operation, and selective fixed pitch is mainly an auxiliary form of control.

d. FUEL SYSTEM CONTROLS. *(See figure 17.)*

(1) FUEL SYSTEM.—A separate fuel system is provided for each engine with a cross feed between the two systems. The regular fuel supply is carried in six metal fuel tanks, three installed in each wing, having a total capacity of 1,400 U. S. gallons (1,166 Imperial gallons). The three tanks in each wing have the following capacities:

Forward tank (No. 1) 224 U. S. gal.—203.2 Imp. gal.
Center tank (No. 2) 285 U. S. gal.—237.4 Imp. gal.
Aft tank (No. 3) 171 U. S. gal.—142.4 Imp. gal.

(2) FUEL TANK SELECTOR VALVE.—Two fuel tank selector valves, one on each side of the pilots' compartment, permit the selection of fuel from any one tank in each wing.

CAUTION

Never allow a fuel tank to run dry in flight before switching to a full one, as detonation and engine failure may result. To change from one fuel tank to another, hold the airplane in a level flying position, throttle position unchanged, mixture control on "FULL RICH," and turn the fuel selector valve control to the desired tank position.

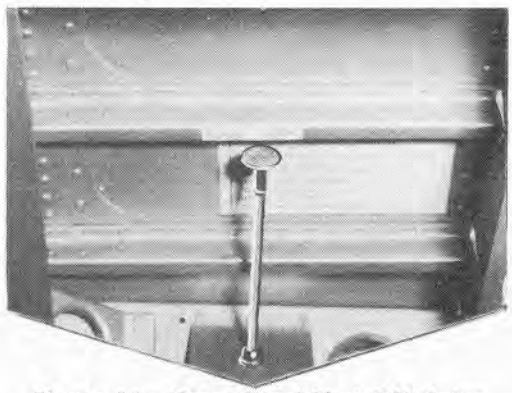


Figure 11—Cross-Feed Shut-Off Valve

(3) CROSS-FEED SHUT-OFF VALVE.—A cross-feed valve control located in the main cargo compartment ceiling is normally sealed, and should be opened only when it is desired to use the cross-feed line as a supply source. (See figure 11.)

(4) FUEL BOOSTER PUMPS.—Fuel booster pumps are controlled by switches on the control pedestal and supply fuel to the engines at an approximate pressure of 16 pounds per square inch.

(5) PRIMER SWITCHES.—Two primer switches are on the overhead panel (near the battery selector switches).

(6) FUEL QUANTITY GAGES.—Three dual gages located on the lower right of the instrument panel register the amount of fuel in the front, center, and rear wing tanks. (See figure 13.)

(7) FUEL PRESSURE GAGE.—A fuel pressure gage is located on the upper right of the instrument panel.

(8) FUEL PRESSURE WARNING LIGHT.—A fuel pressure warning light located on the instrument panel warns the pilots when the fuel pressure drops below the desired pressure (16 pounds per square inch).

(9) FUEL FLOW METER.—A fuel flow meter located on the lower right of the instrument panel registers the fuel flow.

e. OIL SYSTEM CONTROLS. *(See figure 18.)*

(1) OIL SYSTEM.—A separate and complete oil system is provided for each engine. Each system consists of a hopper type oil tank having a capacity of 39.8 U. S. gallons (33.1 Imperial gallons). Oil system instruments consist of one dual oil pressure gage, one dual oil temperature indicator, and two oil low level warning lights.

(2) OIL COOLER FLAPS.—The oil cooler flap controls on the engine pedestal regulate the flow of air through the oil coolers. The flaps may be closed to shorten the time of warm-up.

(3) OIL LOW LEVEL WARNING LIGHTS.—Two warning lights, one for each oil tank, are installed on the center of the instrument panel and are lighted when 10 gallons or less of oil are left in the tank.

(4) OIL PRESSURE GAGE.—A dual oil pressure gage is located on the top right of the instrument panel.

NOTE

When the engine first starts, the oil pressure may reach 300 pounds per square inch or more when cold. This, however, is normal, as the oil pressure relief valve is fitted with a temperature control that forces the oil, when cold, through the engine under high pressure. With the engine operating normally, the pressure will return to 60 to 80 pounds per square inch when an oil temperature of approximately 40°C (104°F) is attained.

WARNING

If oil pressure does not register on the gage within 30 seconds after starting, stop engine and investigate.

(5) OIL TEMPERATURE GAGE.—The oil temperature gage, located on the upper right of the instrument panel, indicates the engine oil temperature in degrees centigrade. The desired oil temperature is 60° to 75°C (140° to 167°F).

(6) OIL DILUTION.—Refer to section 6, paragraph 9.

f. HYDRAULIC CONTROLS. *(See figure 19.)*

(1) HYDRAULIC SYSTEM.—The main hydraulic system is of the accumulator type and operates the landing gear, brakes, cowl flaps, surface controls and flaps, and the automatic pilot. The normal operating pressure is 1,200 pounds per square inch. An emergency hand pump is provided for obtaining hydraulic pressure when either or both of the engine-driven hydraulic pumps fail. Refer to section 4, paragraph 6. The hydraulic fluid reservoir has a capacity of 7 U. S. gallons (5.8 Imperial gallons). Fill only with fluid, Specification No. AN-VV-O-366a.

(2) HYDRAULIC PRESSURE GAGE.—The hydraulic pressure gage is located on the lower right of the instrument panel.

(3) LANDING GEAR CONTROL.

(a) LANDING GEAR SYSTEM.—The landing gear consists of two main wheels and a tail wheel mounted on air-oil shock struts. All three units are extended and retracted by a control handle mounted on the lower section of the engine control pedestal.

CAUTION

Except in an emergency, do not reverse the landing gear movement by actuating the landing gear control until the gear has reached the fully "RETRACTED" or "EXTENDED" position.

(b) To raise the landing gear, push the thumb latch aside and push the control handle inward; then raise the handle fully up. After the landing gear is completely retracted and locked in the "UP" position, return the control handle to the "NEUTRAL" position to relieve the pressure in the landing gear hydraulic system. Be sure that the safety latch is re-engaged on the control rod.

(c) To lower the landing gear, place the control handle in the "DOWN" position and allow it to remain in this position until the landing gear warning horn ceases to blow. If the horn ceases to blow when the throttles are retarded below 15 inches to 18 inches Hg, this is a safe indication that the gear is locked in the "DOWN" position.

CAUTION

Do not lower the landing gear with an indicated air speed in excess of 150 mph.

(4) BRAKES.

(a) GENERAL.—The wheels of the main landing gear are equipped with hydraulic brakes. The brake systems for the two wheels are entirely independent of each other. Brakes are controlled by conventional treadle type rudder pedals and operate off the main hydraulic system.

NOTE

When making turns on the ground, extreme care should be taken to avoid pivoting on one tire, as this will cause excessive tire twisting and wear.

(b) PARKING BRAKES.—A parking brake and gust lock control is located on the lower part of the engine pedestal. To operate the parking brakes, depress the brake pedals, move the parking brake and gust lock control up, and release the brake pedals. The brakes and all surface controls are then locked. To release the brake and surface controls, depress the brake pedals, push in the "PARKING BRAKE-GUST LOCK" control handle and move to the "DOWN" position.

NOTE

On airplanes AF41-12234 and subsequent, and on all airplanes in service, the gust lock will be replaced with control column harnesses and surface locking frames.

(5) WING FLAP CONTROL.—This control is located on the lower part of the pedestal. Check the operation of the wing flaps by moving the flap control handle to the "DOWN" position. Check the flap indicator on the left side of the instrument panel and the flap control on the pedestal against the actual flap movement. Return the flap to the "UP" position.

(6) SURFACE CONTROLS BOOSTERS.—Refer to paragraph 3.*a.*, this section.

(7) AUTOMATIC PILOT.—Refer to section 2, paragraph 2.

(8) WINDSHIELD WIPERS. — A hydraulic restrictor valve on the pilot's window ledge controls the operation of the windshield wipers.

g. TAIL WHEEL LOCKING CONTROL.—The tail wheel may be locked in the straight position by operating the locking control lever on the lower part of the pedestal. The tail wheel should be unlocked for all normal taxying and should be locked for all take-offs and landings.

WARNING

Be sure that the tail wheel lock is in the "UNLOCKED" position before any turns are started on the ground. UNDER NO CIRCUMSTANCES should a turn be started with the tail wheel in the "LOCKED" position or DAMAGE will result to the tail wheel shear pin. If a turn should be inadvertently made with the wheel locked, it is dangerous to continue take-off as the tail wheel assembly might swing off-center causing serious damage to the tail wheel well when the landing gear is retracted.

b. ELECTRICAL CONTROLS.

(1) OVERHEAD PANEL.—The majority of electrical controls are located on the overhead panel in the pilots' compartment. (See figure 12.)

(2) INVERTER SWITCH. — An inverter switch, located on the overhead panel, controls all Autosyn instruments.

(3) GENERATOR SWITCHES.—The generator switches, located on the overhead panel, should not be turned "ON" until the engine rpm is at least 1,700. In conjunction with the generators, two ammeters, one for each engine, and one voltmeter, with corresponding voltmeter switch to select the generator desired, are installed forward of the generator switches.

NOTE

Check generators as follows: Turn on the left generator switch in the overhead panel, turn on the left generator voltmeter switch, and note a reading of approximately 26 volts. Likewise, note a charge on the ammeter. Follow the same procedure for the right generator. After the generator check, return the switches to the "OFF" position.

IMPORTANT

In cold weather, the generators will cut in as low as 1,200 rpm, but it is not advisable to turn the generator switches "ON" for test purposes until the engine is run up to at least 1,700 rpm.

CAUTION

On airplanes equipped with Curtiss electric propellers, the generator switches should be left "ON" for all take-offs and landings.

(4) A-C VOLTMETER.—The a-c voltmeter, located on the lower right instrument panel, indicates the voltage in the radio compass circuit. Desired voltage is 110.

(5) INTERIOR LIGHTING.

(a) MAIN CARGO COMPARTMENT LIGHTS.—The circuit breaker is located on the overhead panel.

(b) LOWER CARGO COMPARTMENT LIGHTS.—Switches are installed to the left of each lower cargo compartment door.

(c) OVERHEAD PANEL LIGHT.—Controlled by a rheostat located on the forward section of the lower panel.

(d) CARGO COMPARTMENT DOME LIGHT.—Controlled by a circuit breaker and switch installed on the overhead panel.

(e) NAVIGATOR'S LIGHTS.—Located on the navigation table.

(6) INSTRUMENT LIGHTING.

(a) NIGHT FLYING EQUIPMENT.—This airplane is equipped for night flying. The instrument calibrations, including the pointers, are painted with fluorescent material which is illuminated under the ultra-violet rays from the control column spotlights. The compass at the top of the automatic pilot instrument panel is individually lighted with an inverted screw-in lamp bulb. A spare lamp bulb is carried on the right side, in the instrument panel, adjacent to the compass. The compass ring light is controlled by a rheostat on the overhead panel.

(b) FLUORESCENT LIGHTS.—A fluorescent spotlight is mounted on each control column. To illuminate these lights, place the rheostat switches on the left and right window sills in the "ON" position and wait a few seconds until lights illuminate, then adjust the rheostats for the desired intensity of light. The type of light emitted is controlled by turning the knurled lens on the front of the fluorescent lights to obtain either ultra-violet or fluorescent lighting.

(c) SPOTLIGHTS. — Two spotlights, one on the radio rack and one on the overhead panel, are controlled by switches on the lights themselves.

(7) NAVIGATION LIGHTS.

(a) POSITION LIGHTS.—Controlled by a circuit breaker and two switches on the overhead panel.

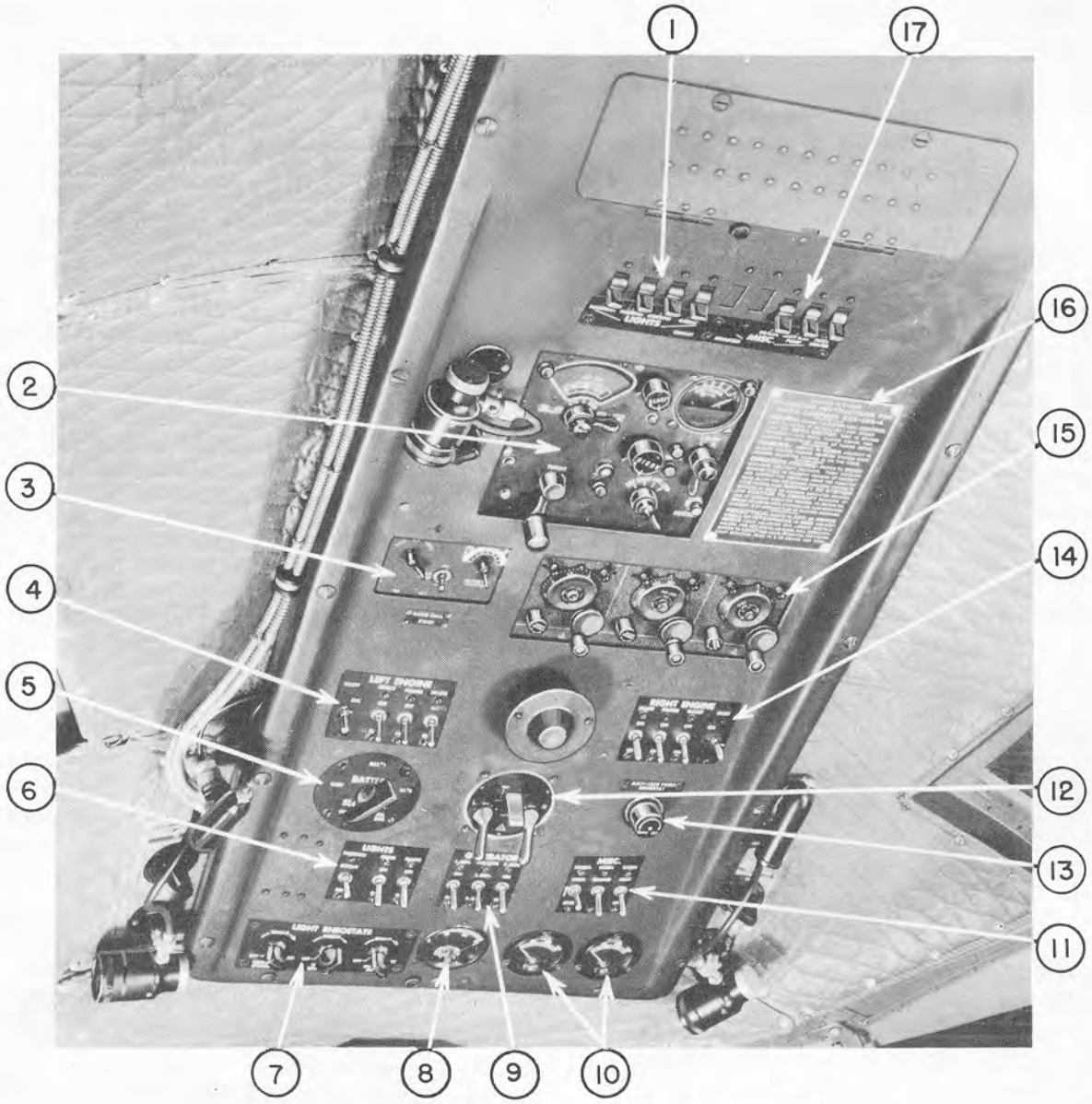


Figure 12—Overhead Panel in Pilots' Compartment

LEGEND FOR FIGURE 12

1—Circuit Breakers for Lights
2—Radio Compass Control Box, BC-434-A
3—Command Transmitter Control Box, BC-451- ( )
4—Left Engine Starting, Boost, Primer, and Oil Dilution Switches
5—Battery Selector Switch
6—Light Switches
7—Light Rheostats
8—Voltmeter
9—Generator Switches
10—Ammeters
11—Inverter, Horn Release, and Cabin Heat Switches
12—Master Ignition Switch
13—Anti-Icer Pump Rheostat
14—Right Engine Oil Dilution, Primer, Boost, and Starting Switches
15—Command Receiver Control Box BC-450-( )
16—Chart MC-208, Operation Instructions for Radio Compass
17—De-Icer, Anti-Icer, and Pitot Heater Switches

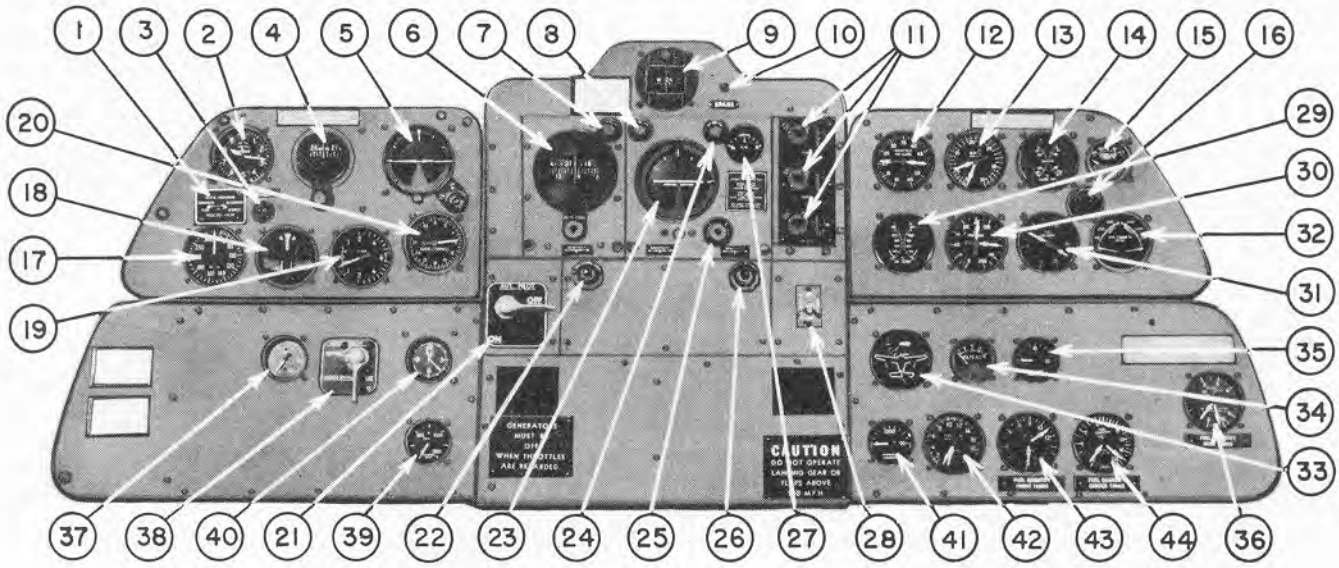


Figure 13—Instrument Panel

LEGEND FOR FIGURE 13

1—Static Pressure, Air-Speed, Selector Valve
2—Altimeter
3—Marker Beacon Light
4—Turn Indicator
5—Flight Indicator
6—Turn Gyro, Auto Pilot
7—Rudder Knob
8—Aileron Knob
9—Compass
10—Spare Bulb
11—Speed Valves—Auto Pilot
12—Engine Manifold Pressure
13—Tachometer
14—Carburetor Temperature
15—Free Air Temperature
16—Fuel Pressure Warning Light
17—Air-Speed Indicator
18—Turn and Bank Indicator
19—Climb Indicator
20—Radio Compass
21—Auto-Pilot, "ON" "OFF" Valve
22—Left Oil Low Level Warning Light
23—Bank-Climb Gyro, Auto Pilot
24—Elevator Knob
25—Caging Knob
26—Right Oil Low Level Warning Light
27—Vacuum Gage, Auto Pilot
28—Warning Bell Switch
29—Dual Oil Temperature Indicator
30—Dual Oil Pressure Indicator
31—Dual Fuel Pressure Indicator
32—Dual Cylinder Head Temperature Indicator
33—Landing Gear, Tail Wheel, Flap Indicator
34—Voltmeter
35—De-Icer Pressure Gage
36—Fuel Quantity Rear Tanks Indicator
37—Suction Gage
38—Automatic Pilot Servo Bypass Valve
39—Automatic Pilot Pressure Gage
40—Clock
41—Hydraulic Pressure Gage
42—Dual Fuel Flow Meter Gage
43—Fuel Quantity Front Tanks Indicator
44—Fuel Quantity Center Tanks Indicator

(b) PASSING LIGHT.—Located in the nose cone of the airplane and controlled by a circuit breaker on the overhead panel.

(c) RECOGNITION LIGHTS.—Three colored lights installed on the belly of the fuselage are operated by a control box mounted on the right window ledge in the pilots' compartment.

(d) TWO RETRACTABLE LANDING LIGHTS.—The landing light switches are located on the upper control pedestal. Test operate the landing lights for not over five seconds to guard against smoking the reflectors.

NOTE

Do not lower landing lights above 150 mph.

i. INSTRUMENT CONTROLS.

(1) AIR-SPEED INDICATOR.—A static selector valve on the upper left of the instrument panel provides an alternate source of static pressure in case of malfunctioning of the pitot tube static line.

j. HEATING AND VENTILATING CONTROLS. —Refer to section 6, paragraph 2.*l.*

k. ICE ELIMINATION EQUIPMENT CONTROLS. —Refer to section 6, paragraph 2.

l. ENGINE FIRE EXTINGUISHER SYSTEM CONTROLS.—Refer to section 4, paragraph 9.

m. PYROTECHNIC INSTALLATION.—A Very pistol and flares are stowed above the data case to the left of the pilot. The pistol is loaded, and inserted in an adapter located in the pilots' compartment ceiling. The adapter acts as a shock absorber when discharging the pistol.

n. PILOT'S AND COPILOT'S SEAT ADJUSTING CONTROLS.—Adjust the seats to the proper height by raising the right-hand lever. The seats are spring loaded and all adjustments should be made with the occupant in the seat so that the seat will not rapidly fly up when the lock is released. Adjust the seat for fore-and-aft position with the left-hand lever. The back of the seat can be adjusted fore and aft to change the angle of the back for greater comfort. To make the back adjustment, pull up the crank handles on the left aft seat frame, and adjust the back as desired. Allow the crank handle to drop back and the seat back will remain as adjusted.

4. CARGO PROVISIONS.

(Package Dimension Limits Chart. See figure 14.)

a. GENERAL.

(1) Loading access to the main cargo compartment is gained through a double doorway on the left side of the airplane.

(a) The limiting dimensions for the cargo door on C-46 airplanes are 81 inches wide and 68.5 inches high at the forward end. The dimensions for the cargo door on the C-46A (Navy R5C-1) airplanes are 95.5 inches wide and 79.5 inches high at the forward end.

(2) Two lower cargo compartments are provided, one forward and one aft of the main wing beam. Screens are installed in the lower compartments to prevent cargo from fouling the controls. A screen in which there is a passageway separates the two compartments.

b. NORMAL CARGO.—The normal load of 17,000 pounds, or an overload of 22,000 pounds, may be carried. Provisions have been made to carry two three-bladed or two four-bladed propellers on the fuselage belly.

c. TASK FORCE EQUIPMENT.

(1) PERSONNEL.—Benches for the transportation of 40 troops are installed along each side of the fuselage and a single row of seats is placed along the center line of the fuselage.

(2) EQUIPMENT.—Any combination of two of the following may be carried: Jeeps, prime movers, guns, or howitzers.

(3) AMBULANCE EQUIPMENT.—Provisions for hospital litters are provided for the transport of 33 patients.

5. PARACHUTE RACKS.

Parachute racks are installed in some C-46A (Navy R5C-1) airplanes.

6. GLIDER TOW.

A glider tow release mechanism, installed in the tail, is controlled by a release handle at the base of the engine control pedestal.

7. FIRST-AID KIT.

A first-aid kit is stowed back of the pilot's seat.

8. BLIND FLYING HOOD.

A blind flying hood is stowed back of the pilot's seat.

9. LIFE RAFTS.

Eleven life rafts are provided. Ten are stowed at the aft fuselage bulkhead, and one at the right of the radio rack in the main cargo compartment.

NOTE

When litter supports are installed, stow the life rafts in the lower forward cargo compartment.

10. ANTI-GLARE SHIELD.

A black cloth cover is used to shield the forward window from glare caused by the lights behind the instrument panel. Snap fasteners hold it to the lower window frames and behind the instrument panel.

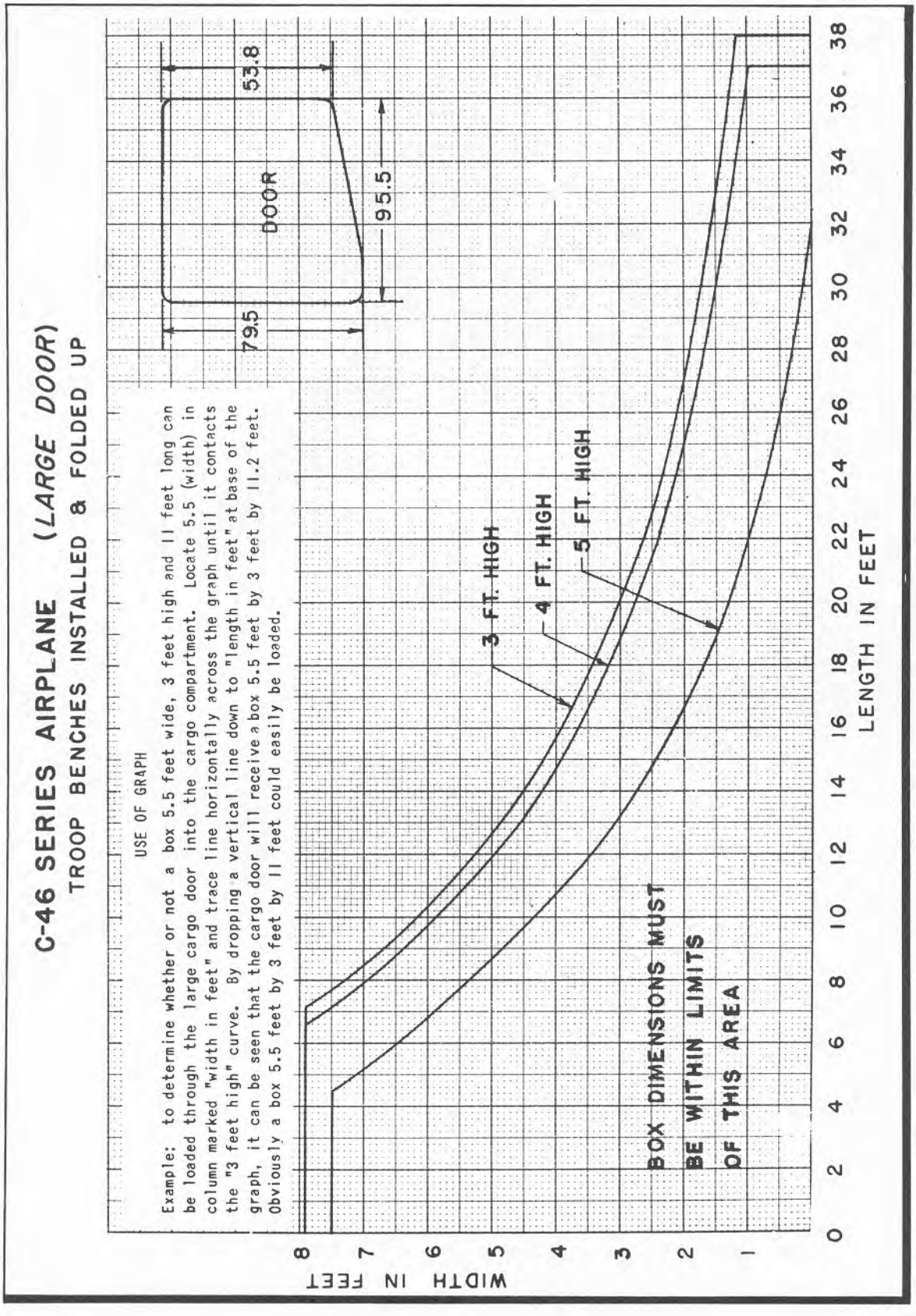
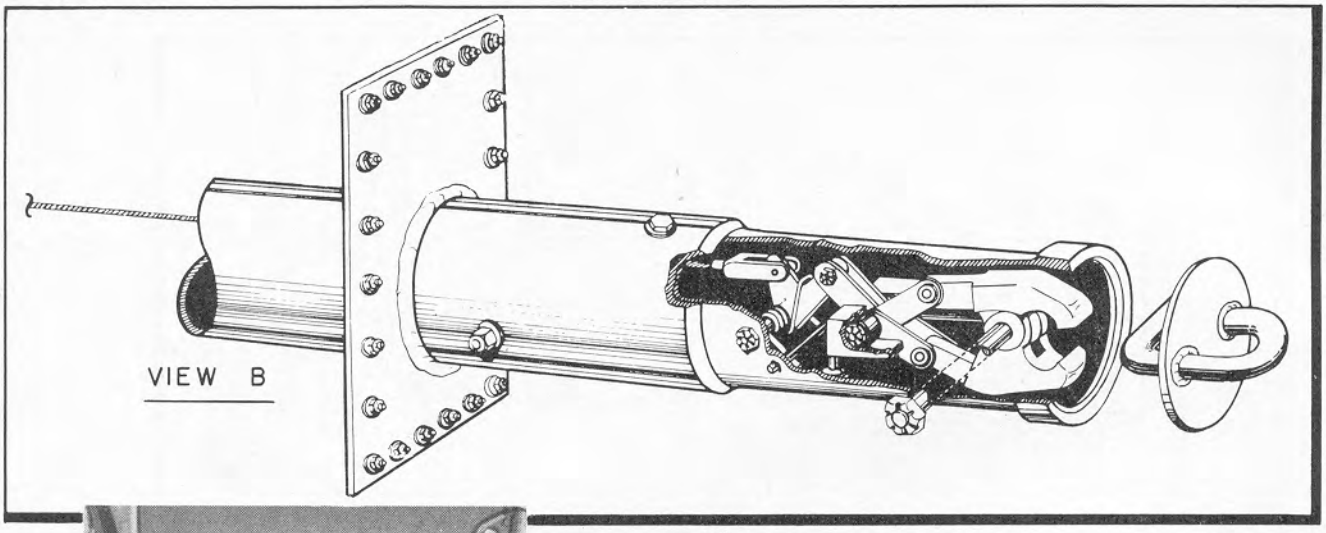


Figure 14—Package Dimension Limits Chart



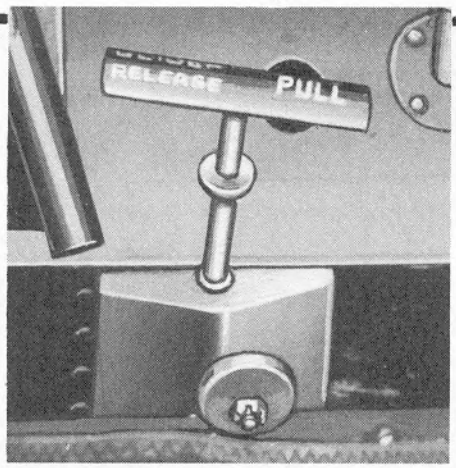


Figure 15—Glider Tow Release Handle and Mechanism

11. LOAD ADJUSTER.

A load adjuster for determining the correct distribution of weight in the airplane is placed on a hook adjacent to the data case.

CAUTION

The index number on the carrying case of the load adjuster is correct only for the airplane, the serial number of which appears on the load adjuster case.

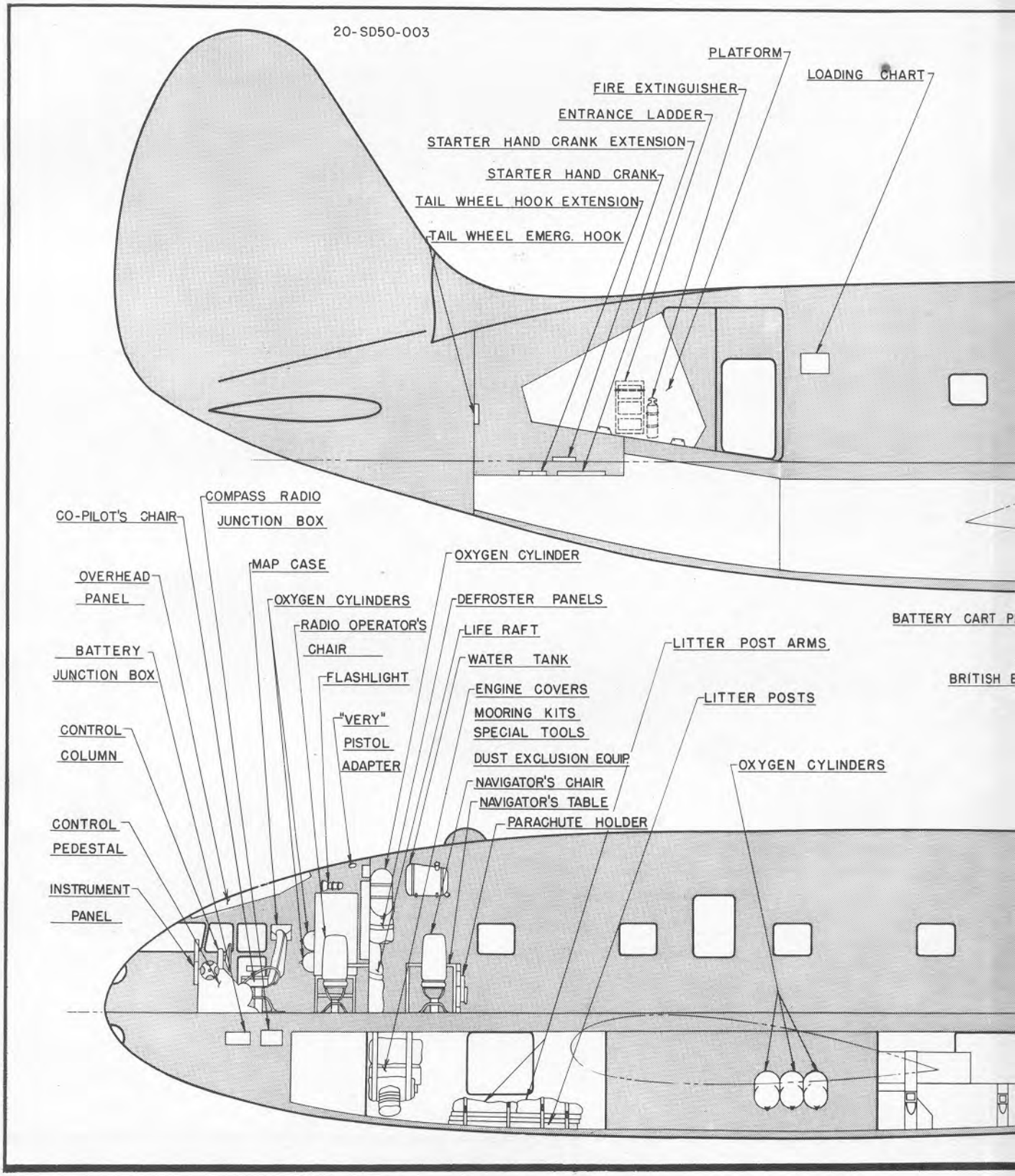
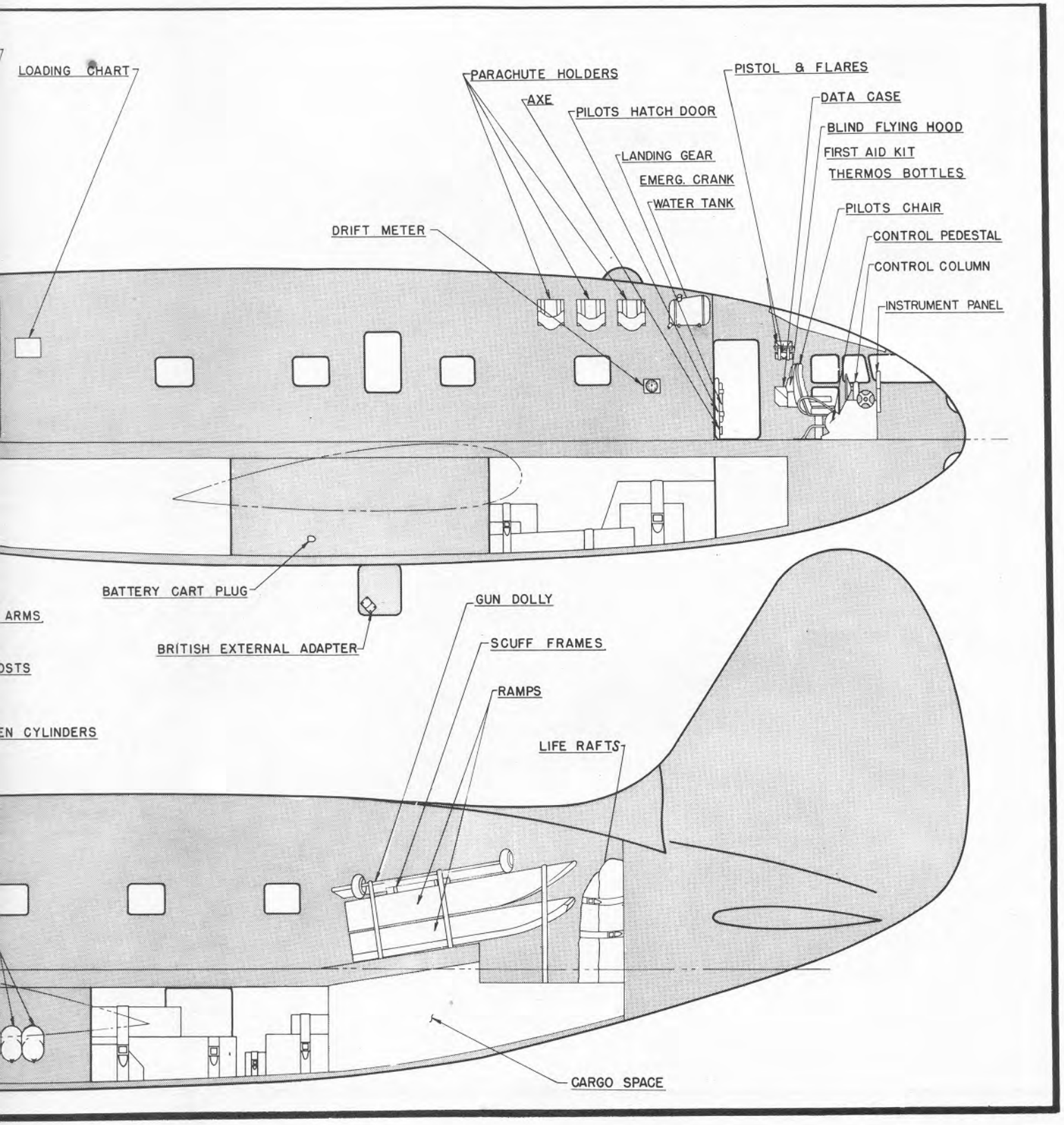


Figure 16—Airplane Contents Diagram


LOADING CHART
PARACHUTE HOLDERS
AXE
PILOTS HATCH DOOR
PISTOL & FLARES
DATA CASE
BLIND FLYING HOOD
FIRST AID KIT
THERMOS BOTTLES
LANDING GEAR
EMERG. CRANK
WATER TANK
PILOTS CHAIR
CONTROL PEDESTAL
CONTROL COLUMN
INSTRUMENT PANEL
DRIFT METER
BATTERY CART PLUG
BRITISH EXTERNAL ADAPTER
GUN DOLLY
SCUFF FRAMES
RAMPS
LIFE RAFTS
CARGO SPACE

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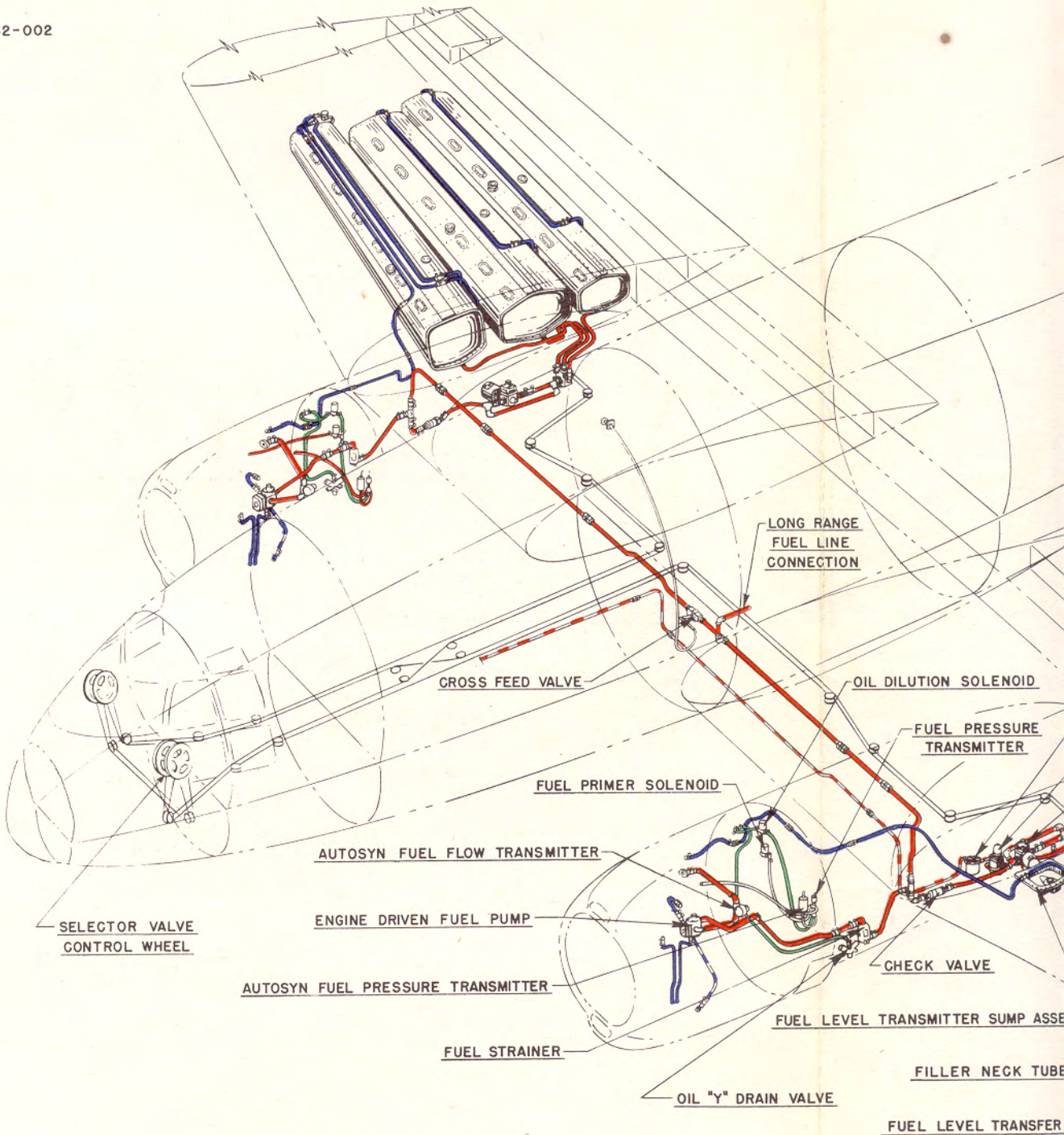
LONG RANGE FUEL LINE CONNECTION
CROSS FEED VALVE
OIL DILUTION SOLENOID
FUEL PRESSURE TRANSMITTER
FUEL PRIMER SOLENOID
AUTOSYN FUEL FLOW TRANSMITTER
SELECTOR VALVE CONTROL WHEEL
ENGINE DRIVEN FUEL PUMP
CHECK VALVE
AUTOSYN FUEL PRESSURE TRANSMITTER
FUEL LEVEL TRANSMITTER SUMP ASSE
FUEL STRAINER
FILLER NECK TUBE
OIL "Y" DRAIN VALVE
FUEL LEVEL TRANSFER

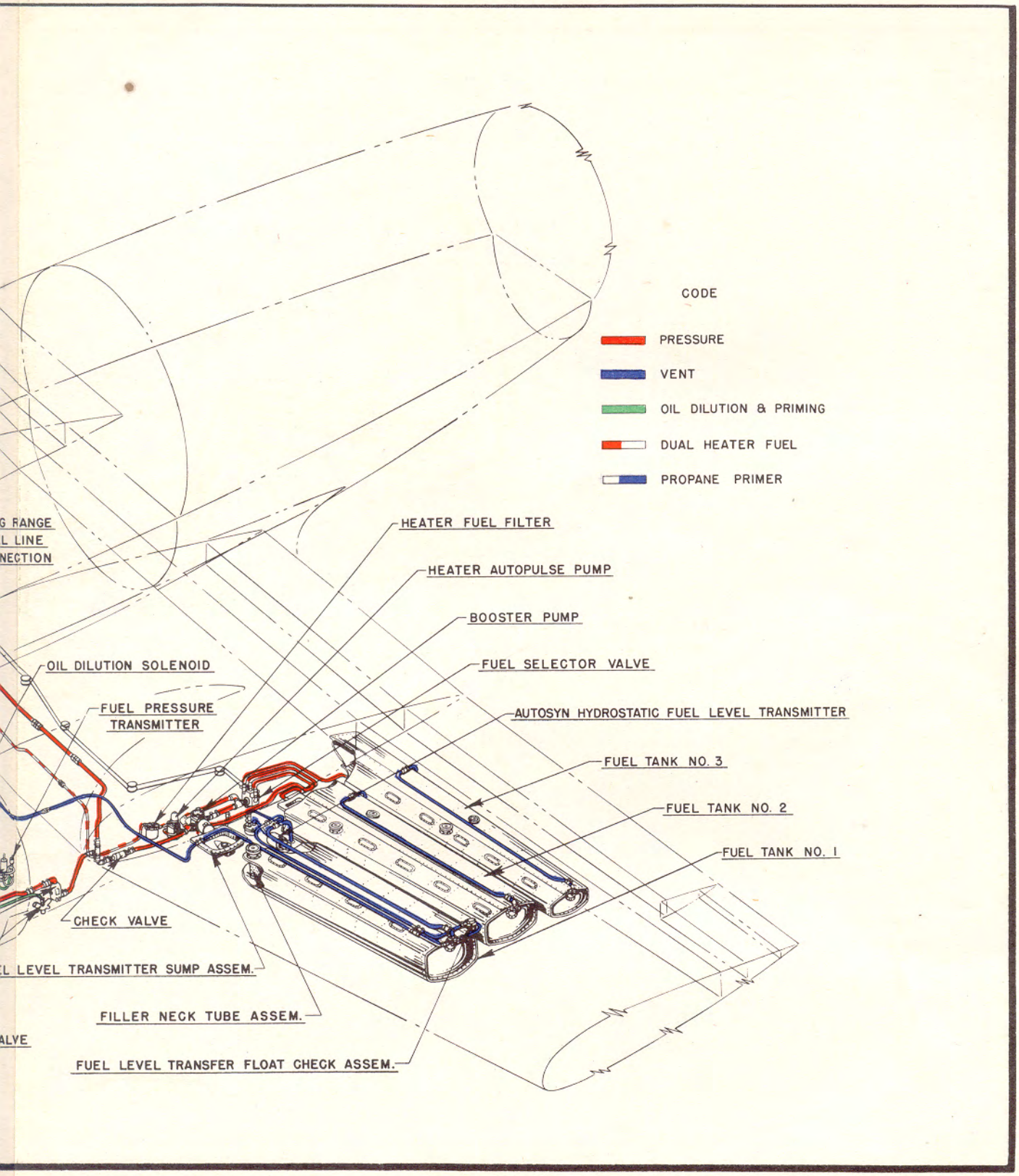

Figure 17—Fuel System

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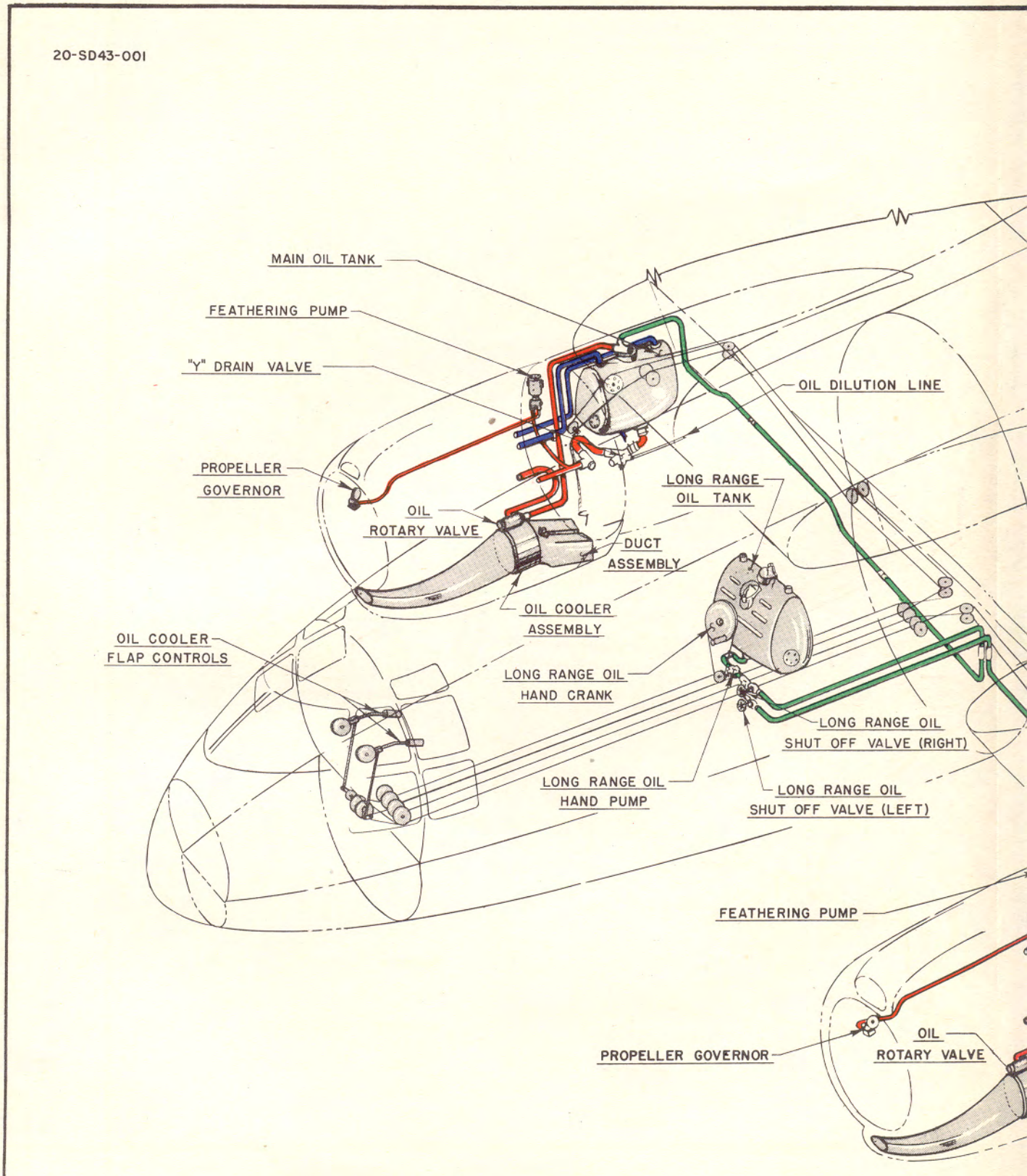
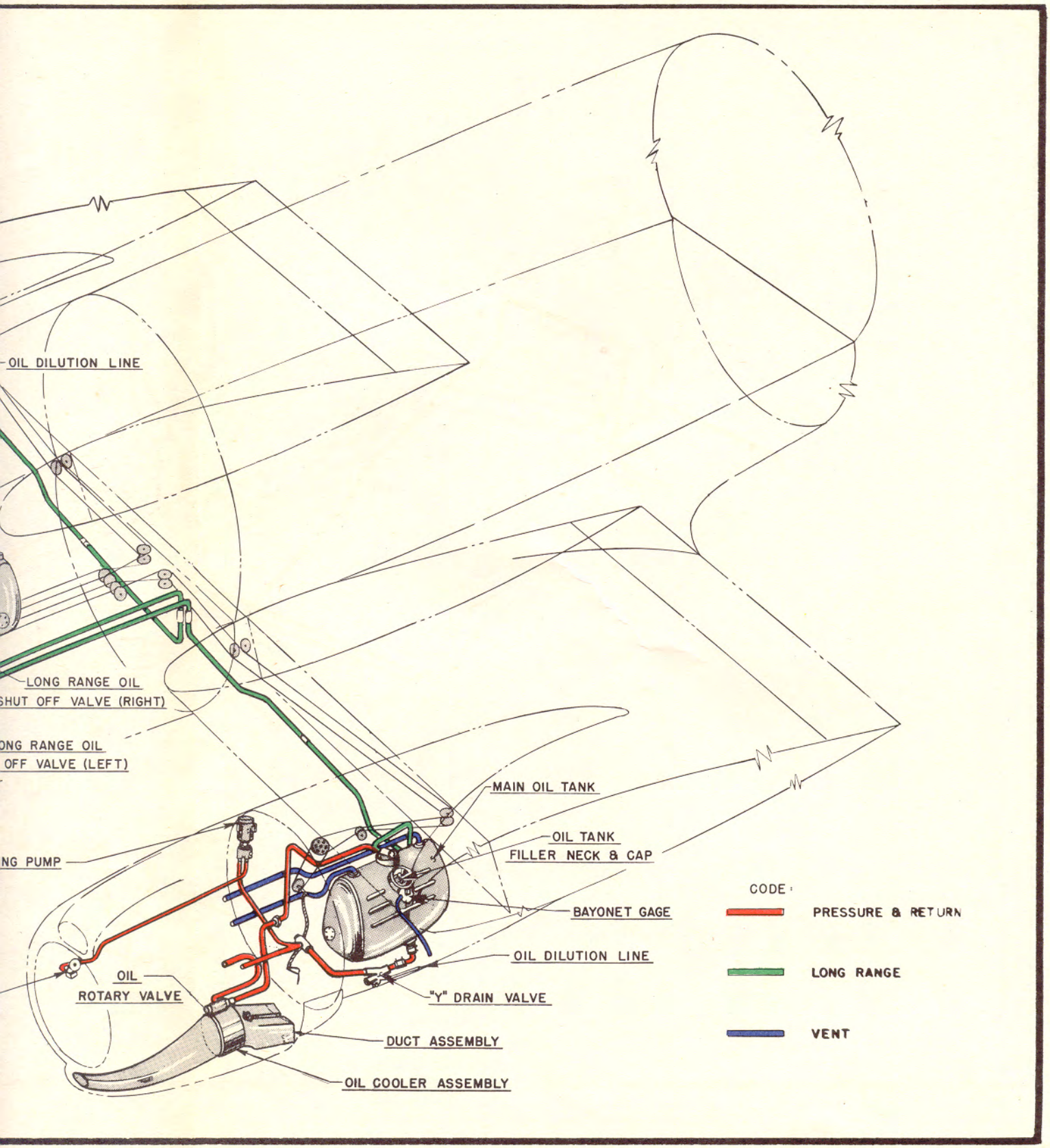
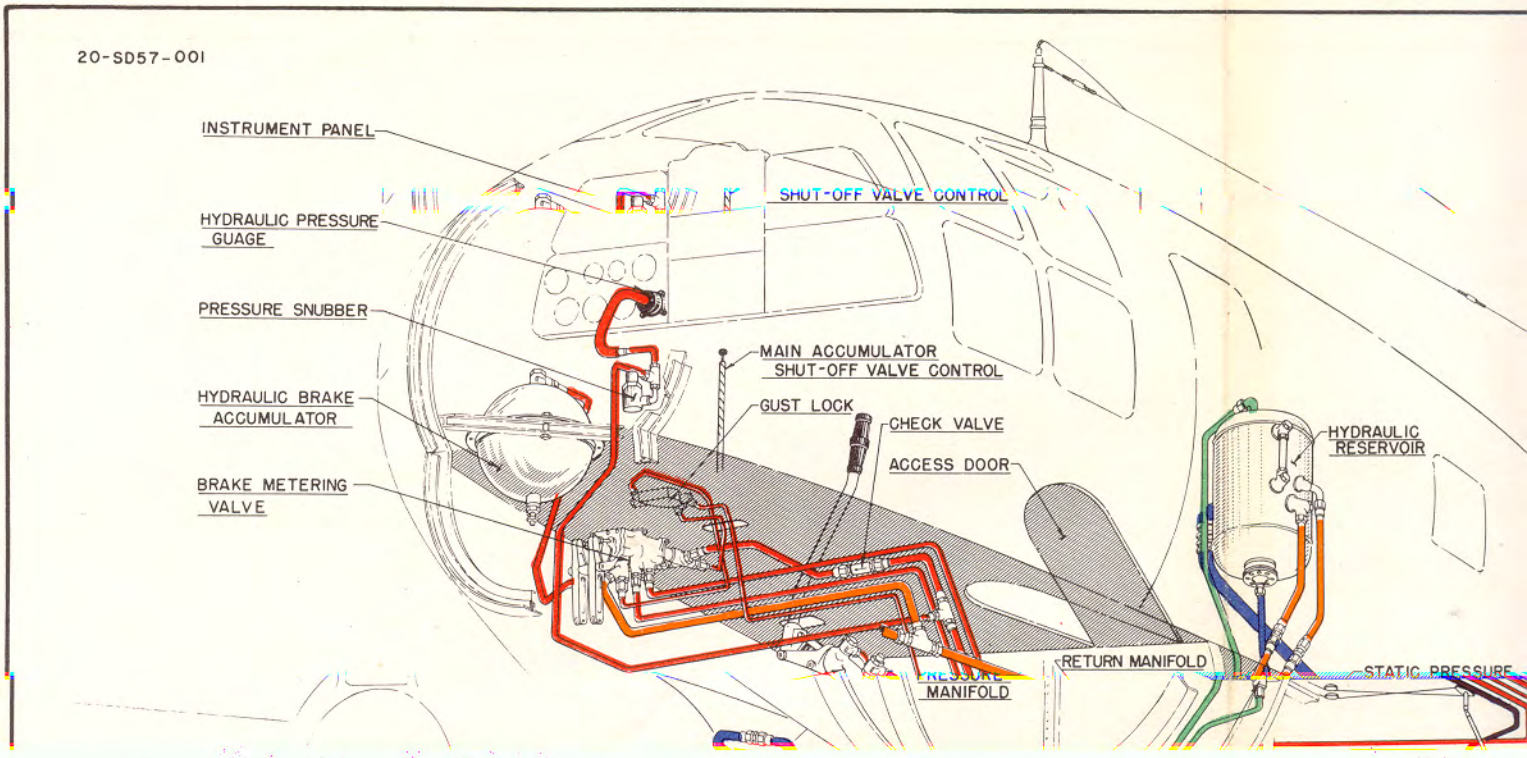


Figure 18—Oil System


OIL DILUTION LINE
LONG RANGE OIL
SHUT OFF VALVE (RIGHT)
ONG RANGE OIL
OFF VALVE (LEFT)
NG PUMP
MAIN OIL TANK
OIL TANK
FILLER NECK & CAP
BAYONET GAGE
OIL DILUTION LINE
"Y" DRAIN VALVE
OIL
ROTARY VALVE
DUCT ASSEMBLY
OIL COOLER ASSEMBLY
CODE:
PRESSURE & RETURN
LONG RANGE
VENT


20-SD57-001
INSTRUMENT PANEL
HYDRAULIC PRESSURE GUAGE
PRESSURE SNUBBER
HYDRAULIC BRAKE ACCUMULATOR
BRAKE METERING VALVE
SHUT-OFF VALVE CONTROL
MAIN ACCUMULATOR SHUT-OFF VALVE CONTROL
GUST LOCK
CHECK VALVE
ACCESS DOOR
HYDRAULIC RESERVOIR
RETURN MANIFOLD
STATIC PRESSURE

STATIC PRESSURE
CONNECTION

Section II

PILOT'S OPERATING INSTRUCTIONS

1. FLIGHT INSTRUCTIONS.

a. BEFORE ENTERING THE AIRPLANE.

(1) Check Form 1.

(2) Check and sign Form F, in the Handbook of Weight and Balance Data.

b. ON ENTERING THE PILOTS' COMPARTMENT.

(1) Adjust the seats to the proper position.

(2) Adjust rudder pedals to correct length.

(3) Check all surface controls for freedom of movement.

(4) SPECIAL CHECK FOR NIGHT FLIGHT.

(a) Turn battery switches "ON."

(b) Turn circuit breakers to "ON" position.

(c) Control column fluorescent lights.

(d) Overhead panel spotlight.

(e) Overhead panel dome light.

(f) Overhead panel light.

(g) Radio panel spotlight.

(h) Compass ring light.

(i) Main cargo compartment lights.

(j) Navigation table light.

(k) Lower cargo compartment lights.

(l) Position lights.

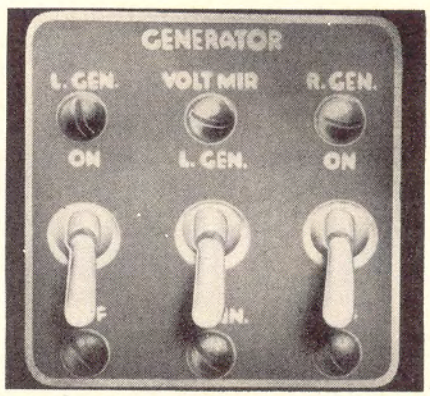
(m) Passing lights.

(n) Identification lights.

(o) Landing lights. (Test for not over 5 seconds.)

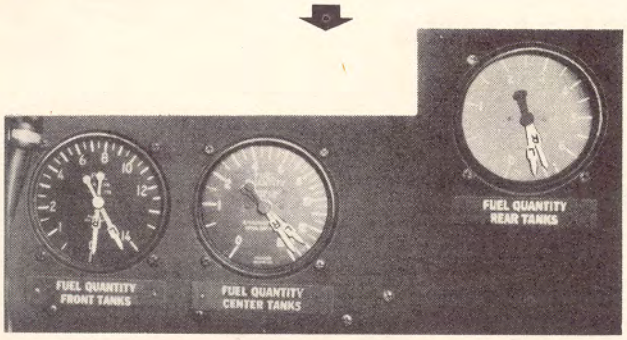
(5) CHECK FOR ALL FLIGHTS.

(a) Generator switches "OFF."

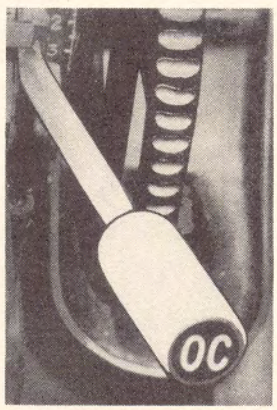


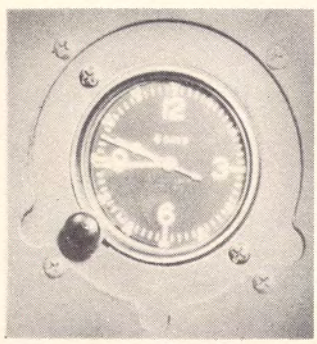
(b) Check fuel pressure and oil low level warning light.

(c) Check fuel quantity gages for desired fuel loading.



(d) Check operation of oil cooler flaps. Leave flaps closed.





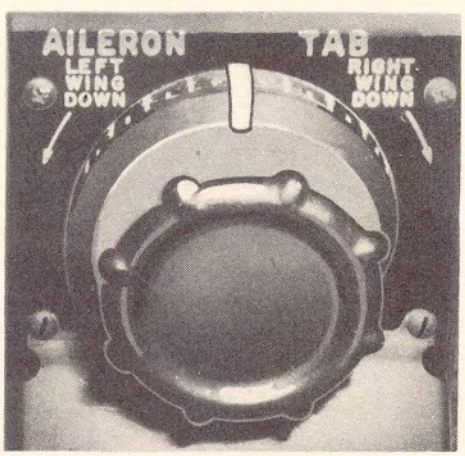
(e) Wind and set clock

(f) Cage directional gyro.

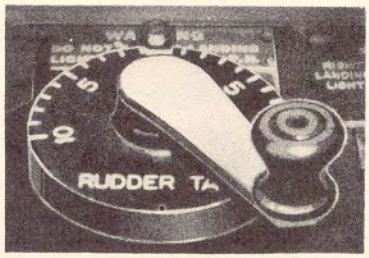
(g) Set altimeter.

IMPORTANT

(h) AILERON TAB "O."



(i) RUDDER TAB "O."

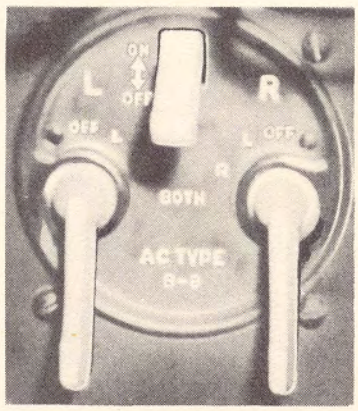


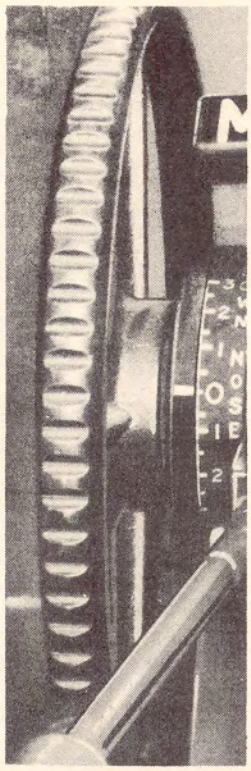
(j) ELEVATOR TAB "O."

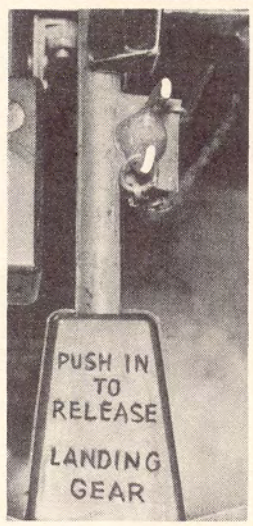
(k) Parking brake "ON."

(l) Master ignition switch "OFF."

(m) Left and right magneto switch "OFF."





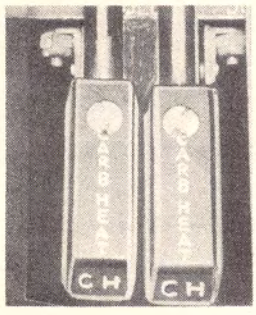


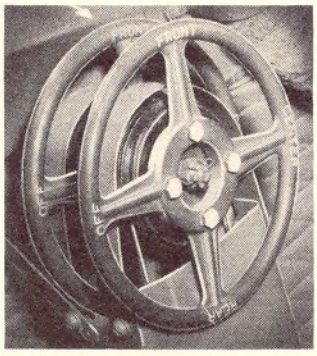
(n) Landing gear control "DOWN."

(o) Flap control "NEUTRAL."

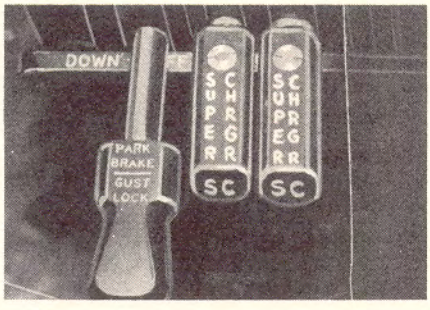
(p) Fuel tank selector valves "FRONT."

(q) Carburetor heat controls "COLD."





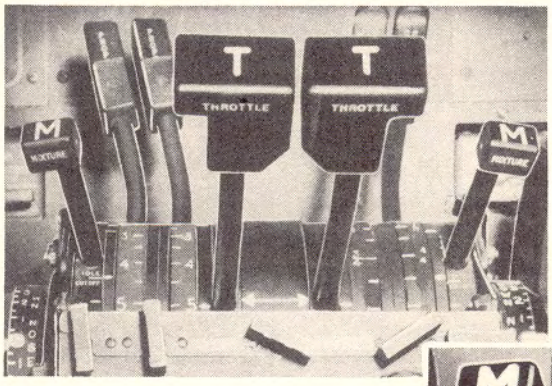
(r) Supercharger controls "LOW."

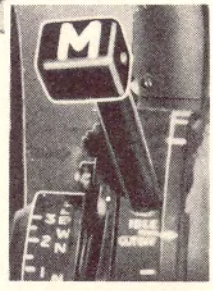


(s) Propeller pitch controls "LOW PITCH" (full forward).

(t) Throttles "CLOSED."

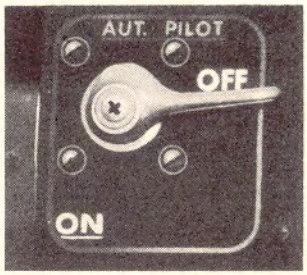
(u) Adjust friction on throttles.



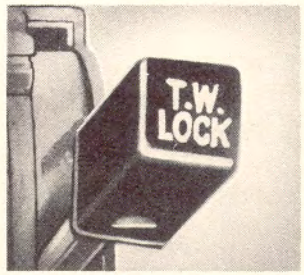


(v) Mixture controls "IDLE CUT-OFF."

(w) Auto pilot control "OFF."



(x) Tail wheel released.



(y) Check operation of radio equipment. Communication with control tower usually sufficient.

(z) Check oxygen supply and equipment.

c. FUEL SYSTEM MANAGEMENT.

(1) If all tanks are full, take off on front wing tanks and continue to use fuel from front tanks to allow space for fuel vented back from the carburetor.

(2) Fuel cross-feed valves should remain "OFF" for normal operation.

(3) Fuel booster pumps "ON" for all operations.

(4) Do not exhaust any tank completely before changing to another tank.

d. STARTING THE ENGINES.

NOTE

The instructions below follow in general the sequence of operating conditions shown on the "Pilot's Check List."

(1) Before starting the engines, be sure wheel chocks are in place.

(2) A battery cart (135 amp), if available, should be plugged in.

(3) Be sure the battery switches and the master ignition switch are in the "OFF" position.

(4) Place the fuel tank selector hand wheel controls to "FRONT" tank position. (Full tank.)

(5) Inverter switch "ON."

(6) Place the following controls in the positions noted:

Auxiliary Cowl Flaps	"OPEN"
Supercharger (Blower)	"LOW"
Carburetor Heat	"COLD"
Oil Cooler Flap	"OPEN" in hot weather "CLOSED" in cold weather

Carburetor Mixture	"IDLE CUT-OFF"
Throttle	1/10 to 1/4 "OPEN"
Cowl Flaps	"OPEN"
Propeller	"HIGH RPM" (low pitch, full forward)
Propeller Selector Switch (Curtiss)	"AUTO"
Propeller Circuit Breaker (Curtiss)	"ON"
Fuel Booster Pump Switch	"ON"
Battery Switches	"ON" (if not using a battery cart)
Master Ignition Switch	"ON"

(7) On airplanes AF41-12334 and subsequent, equipped with *Curtiss electric propellers,* be sure the propeller circuit breaker, located on the control pedestal, is "ON." *Turn generators "ON" for Curtiss propellers.*

(8) Energize (from 15 to a maximum of 18 seconds) and engage; prime as needed.

(9) As soon as the engine fires, place mixture control in "AUTO-RICH."

(10) Do not use electric booster pumps with mixture control out of "IDLE CUT-OFF" position when engine is not firing. Prime to keep from stalling; do not pump throttles. If overprimed, open throttles full.

CAUTION

If engine does not fire, return mixture control to "IDLE CUT-OFF" immediately.

(11) FIRE IN ENGINE NACELLE.—Do the following immediately:

(a) Mixture control in "IDLE CUT-OFF."

(b) Fuel selector cock "OFF."

(c) Booster pump "OFF."

(d) Throttle "WIDE OPEN."

(e) Select the engine on fire. Pull the corresponding release handle on the instrument panel to actuate the fire extinguisher equipment in the engine nacelle of the engine on fire. (Refer to section 4, paragraph 9.)

e. ENGINE WARM-UP.

(1) If oil pressure is obtained within 30 seconds, proceed with the engine warm-up.

(2) Be sure that the mixture control is in the "AUTOMATIC RICH" position.

(3) Be sure that the propeller control is in the "FULL FORWARD" or "TAKE-OFF" position.

(4) During warm-up, the cowl flaps and auxiliary cowl flaps must remain open.

CAUTION

Cooling of the cylinder heads and barrels, as well as the ignition harness insulation, is usually insufficient on the ground for continued running above 1,400 rpm to 1,500 rpm. Avoid prolonged running at high speeds. Do not exceed cylinder head temperatures of 232°C (450°F) during ground operations.

(5) When the engines are thoroughly warmed up, with the propeller control in the "FULL FORWARD" position and the mixture control in "AUTO-RICH" position, the throttles may be opened to approximately 30 inches Hg manifold pressure. Do not exceed 1,000 rpm until the oil temperatures have exceeded 40°C (104°F). In addition the cylinder head temperatures should have reached at least 120°C (248°F).

(6) Normal oil pressure should be 75 pounds per square inch with engine running at 2,000 rpm.

(7) Normal oil temperature, 60° to 75°C (140° to 167°F).

f. EMERGENCY TAKE-OFF.

(1) In an emergency, when an airplane must be flown before the engines are properly warmed up, place the oil dilution switches in the "ON" position to maintain oil pressure of 75 pounds per square inch (80 pounds maximum). The engines may be flown as soon as they will "take" the throttle.

(2) In cold temperatures, be sure that the control booster cylinder heat switch on the lower pedestal is placed in the "ON" position immediately upon entering the pilots' compartment to provide rapid response of the controls for take-off.

g. ENGINE AND ACCESSORY CHECK.

(1) Check generators at 1,700 rpm.

(2) Check propellers. (Refer to section 1, paragraph 3.*c.*)

(3) Check oil pressure and temperature. (Refer to Specific Engine Flight Chart, section 3.)

(4) Check fuel pressure. (Refer to Specific Engine Flight Chart, section 3.)

(5) MAGNETOS.—Set propeller controls to maximum rpm and adjust throttle to cruising speed or less. With Curtiss propellers, turn the selector switch to "NEUTRAL" position so that propellers are in "FIXED PITCH" position. Check the magnetos by turning the ignition switches momentarily from "BOTH" to "LEFT," then back to "BOTH," then to

"RIGHT," and back to "BOTH." Note the change in rpm. The normal drop is 50 to 75 rpm when switching from "BOTH" to "LEFT" or "RIGHT." This drop should never exceed 100 rpm. The difference between "LEFT" and "RIGHT" should not be above 30 to 40 rpm.

NOTE

Check magnetos as above in as short a time as possible, never exceeding 30 seconds' running on one magneto alone. To avoid detonation, do not exceed manifold pressure of 30 inches Hg (2,100 rpm).

(6) SUPERCHARGER.—Shift the blower control directly to the "HIGH" position for a short time, in order to clear the blower of sludge, noting the oil pressure changes. A momentary drop in oil pressure should accompany the shift from "LOW" to "HIGH" blower. To shift the blower control, push in on the handle and raise the control to the "HIGH" position.

CAUTION

All shifts of the blower control should be made directly to the full "HIGH" or "LOW" positions without hesitating between stops.

(7) Place blower control in the full "LOW" position after ground check has been completed.

b. TAXYING THE AIRPLANE.

(1) Release the parking brake and surface control locks.

(2) Be sure that the tail wheel lock is in the "UNLOCKED" position.

(3) Do not drag brakes while taxying. Use brakes as little and as lightly as possible when turning the airplane.

i. TAKE-OFF.

(1) BEFORE TAKE-OFF.—With the airplane in the take-off position, lock the tail wheel (straight ahead), apply the brakes by depressing the brake pedals, and perform the customary run-up of each engine prior to starting the take-off run.

DANGER

ALWAYS TAKE OFF WITH TABS IN "ZERO" POSITION. Failure to comply with this rule may develop excessive tab loads, making the airplane uncontrollable.

(2) FLAPS.—Place the flaps in the full "UP" position, unless it is definitely known that some other setting is more desirable for existing take-off conditions.

NOTE

Eight-degree to 10-degree flaps will shorten the take-off run. The first stop on the flap control indicates the correct handle position for the 10-degree flap setting.

(3) THROTTLES.—After clearing out the engines, open the throttles slowly and simultaneously to 52 inches Hg. Do not allow the manifold pressure of either engine to exceed 52 inches Hg or 2,700 rpm during take-off. Be sure the friction adjustment is sufficiently tightened to prevent throttle creeping.

IMPORTANT

If the pilot is not certain the airplane is fueled with 100 octane gasoline, the manifold pressure must not exceed 46 inches Hg.

(4) BRAKES.—Apply the brake pedals to stop the wheels from rotating after the wheels leave the ground.

(5) LANDING GEAR.—Raise the landing gear as soon as there is not enough field left to land the airplane.

(6) MANIFOLD PRESSURE.

(a) Hold to 52 inches Hg and 2,700 rpm (2,000 HP) until the field and all obstacles are cleared, then reduce the manifold pressure to 41.5 inches Hg and 2,400 rpm (1,600 HP).

(b) It is recommended that the manifold pressure be reduced to 32.3 inches Hg and 2,100 rpm (1,100 HP) within 2 or 3 minutes after take-off.

(7) GENERATOR SWITCHES.—Turn generator switches "ON."

j. ENGINE FAILURE AT TAKE-OFF.—Refer to section 4, paragraph 2.

k. CLIMB.

(1) POWER RATING AND SPEED. — Under normal conditions, power will be reduced to normal rating or less, as soon as the airplane is clear of the ground and obstructions. The best rate of climbing speed, unless otherwise indicated on the Take-Off, Climb, and Landing Chart (Appendix II) is 130 mph at 1,100 HP.

(2) MIXTURE CONTROLS.—Keep the mixture controls in the "AUTOMATIC RICH" position.

(3) SUPERCHARGER.—Use "LOW" blower up to 9,600 feet altitude.

(4) FUEL BOOSTER PUMPS.—Use the fuel booster pumps to maintain the normal fuel pressure of 16± 1 pounds.

(5) COWL FLAPS.—Set the cowl flaps to the full "OPEN" position. Do not exceed cylinder head temperatures of 260°C (500°F). It is recommended that the cylinder head temperatures be maintained below 232°C (450°F).

(6) OIL COOLER FLAPS.—Unless otherwise indicated, keep oil cooler flaps full "OPEN." Do not allow the oil temperatures to exceed 100°C (212°F) during operation under military power rating, or 85°C (185°F) thereafter. A tendency for the oil to overheat can be checked more quickly by reducing the rate of climb rather than by throttling alone.

NOTE

A material reduction in cylinder head and oil temperatures can be obtained by climbing at an indicated air speed of 10 to 20 percent higher than the best climbing speed, without much loss in rate of climb.

(7) ADJUSTING POWER. — Adjust power as follows to avoid excessive pressures and to afford a comparatively smooth transition:

(a) Bring the manifold pressure down to 40 inches Hg or less, the rpm down to 2,400, and adjust the manifold pressure to 41.5 inches Hg.

(b) If further reduction in power is desired, reduce the manifold pressure 2 inches to 4 inches Hg, then reduce the rpm approximately 200 in successive alternate steps until the desired engine speed is attained for climb or cruising conditions. Never reduce the rpm first.

l. GENERAL FLYING CHARACTERISTICS.

(1) Operate engines within limitations given in Specific Engine Flight Chart, section 3.

(2) Increase rpm with propeller controls before increasing manifold pressure.

(3) Decrease manifold pressure before decreasing rpm.

(4) The handling characteristics of this airplane are normal in all conventional flight altitudes.

(5) This airplane is very sensitive to the trim tab controls. ALWAYS TAKE OFF WITH TABS IN ZERO POSITION.

(6) The airplane is stable in all acceptable balance conditions outlined in the Handbook of Weight and Balance Data, T. O. No. 01-1-40, which is in the data case of the airplane.

m. MANEUVERS PROHIBITED. — Loops, rolls, spins, dives, inverted flight.

n. STALLS.

(1) Stalling characteristics are excellent in all conditions. Buffet stall warning is good with flaps down, and warning increases in power stalls.

(2) The following stall speeds under various flight conditions at 40,000 pounds gross loading have been recorded:

	Indicated Air Speeds
(a) Flaps up—Landing gear up—Power off	88.2 mph
(b) Flaps up—Landing gear up—Power on (2,100 rpm—975 HP—25 in. Hg)	80 mph
(c) Flaps down 35°—Landing gear down—Power on	67 mph
(d) Flaps down 35°—Landing gear down—Power off	76.5 mph
(e) Flaps down 45°—Landing gear down—Power off	75.6 mph
(f) Flaps down 45°—Landing gear down—Power on (2,100 rpm—1,050 HP—30.5 in. Hg)	64 mph

o. SPINS.—Every precaution should be exercised against spin entry with this airplane, since it is not designed to be spun, and a spin could result in structural failure. If the airplane should spin, push control column full forward, then turn rudder hard against spin. Pull out of ensuing dive gently.

p. ACROBATICS.—All acrobatics are strictly prohibited with this airplane since the wing structure is not designed to stand up under the severe shocks and stresses of acrobatic maneuvers.

q. DIVING.—Under no circumstances should a dive be attempted in this airplane. Never exceed a maximum glide speed of 300 mph.

r. NIGHT FLYING.—Refer to section 1, paragraphs 3.*b.*(6) and (7) for location of light switches and operation of lights.

s. APPROACH AND LANDING.

(1) LANDING GEAR.—Place the landing gear control in the "DOWN" position.

CAUTION

Do not lower the landing gear with an indicated air speed in excess of 150 mph.

(2) FLAP SETTING.—The flaps should be set to suit the pilot's desire. It has been found that a normal landing is best made with a 35-degree flap and a fixed stop has been provided for this setting. A minimum approach speed of 100 mph is recommended. The flap control lever has an intermediate stop set at 10 degrees for take-off. This stop may be released by thumb when the pilot desires more flap for landing.

IMPORTANT

The flaps may be lowered in an emergency with fluid in the system by closing the hydraulic accumulator shut-off valve, and setting the flap control handle on the pedestal to the desired flap angle; and then operating the hydraulic hand pump vigorously until the flap indicator shows the flaps to be in the desired position. DO NOT LOWER THE FLAPS ABOVE 135 MPH.

NOTE

Down to 85 mph, approaches can be made with experience in emergency small field landings.

(3) COWL FLAPS.—Insure that the cowl flaps are open. Do not attempt to lower the cowl flaps at air speeds in excess of 165 mph.

(4) SUPERCHARGER.—Be sure that the superchargers are in "LOW" blower.

(5) MIXTURE CONTROL.—Put mixture control in "AUTOMATIC RICH."

(6) PROPELLER CONTROLS.—Set the propeller controls for maximum cruising (2,400 rpm) just before starting the glide. An engine speed of 2,400 rpm is recommended. If 2,400 rpm is employed, the take-off can be made again with 41.5 inches Hg manifold pressure. Extreme caution should be used as this is only 1,600 HP, whereas 2,700 rpm and 52 inches Hg manifold pressure gives 2,000 HP.

IMPORTANT

On airplanes equipped with Curtiss propellers, generators must be "ON" during landing.

(7) Be sure the tail wheel lock is in the "LOCK" position.

(8) Use brakes as little and lightly as possible when stopping the airplane.

(9) CROSS-WIND LANDING.—When making a cross-wind landing retard the "DOWN WIND" throttle 2 or 3 inches less in manifold pressure, so that the additional thrust of the "UP WIND" propeller will assist in holding the airplane in line. The windward wing may also be slightly dropped to help maintain a straight landing course.

(10) TAKE-OFF IF LANDING NOT COMPLETED.—Refer to section 4, paragraph 12.

t. STOPPING THE ENGINES.

CAUTION

If the brakes have been used excessively during landing and taxying, do not apply the parking brakes immediately, as the heat generated by overuse of the brakes will be transmitted to the expander shoes, with resultant damage if the parking brake is applied before this heat has been dissipated.

(1) IDLING ENGINES.—If the cylinders are hot, due to hard taxying, permit the engines to idle a short time to allow the cylinder temperatures to cool below 205°C (400°F). When idling the engines, be sure the controls are in the following positions:

Mixture Controls	"AUTOMATIC RICH"
Auxiliary Cowl Flaps	"OPEN"
Cowl Flaps	"OPEN"
Blower Controls	"LOW"
Propeller Controls	"LOW PITCH" (full forward)

(2) PROPELLER CONTROLS. — Stop the engines with the propeller controls in the take-off or high rpm position (fully forward). With Curtiss propellers, leave the selector switch in "AUTOMATIC."

(3) SUPERCHARGERS.—Before shutting the engines off, it is mandatory to run the engines up to 1,500 rpm and shift from low blower to high blower for 15 seconds to clear out any sludge that may have accumulated in the high blower during flight. Return to low blower before shutting the engines "OFF."

NOTE

If the "IDLE CUT-OFF" should not stop the engine, close the throttle, cut the ignition switch, and slowly open the throttle wide. In-

sure that the "IDLE CUT-OFF" is adjusted properly as soon as possible.

(4) COWL FLAPS.—After the engines stop, leave the cowl flaps fully open to aid in the circulation of air over the engines.

CAUTION

Do not move the propellers until the engines have properly cooled, or the engines may kick over and start.

u. BEFORE LEAVING THE PILOTS' COMPARTMENT.

(1) Turn the fuel selector valve "OFF."

(2) Place all cockpit light switches, pitot head switch, etc., in the "OFF" position.

(3) Place the battery switch in the "OFF" position.

(4) If oxygen has been used during flight, make sure that the oxygen regulators are turned off to prevent leakage.

(5) Be sure that the parking brake is "ON" if brakes have cooled sufficiently. Check to see that the gust lock control is functioning properly to lock the control surfaces. If chocks are used instead of the parking brake, the gust lock can be operated independently of the brakes by moving the control handle to the first stop.

(6) Insure that the propeller feathering switch safety guards are down, so that no one will accidentally feather the propellers.

(7) Be certain that the mixture control is in the "IDLE CUT-OFF" position, and that the cowl flaps are open.

(8) IMPORTANT—PLACE ALL TAB CONTROLS AT ZERO.

(9) Be sure that the landing gear control lever safety latch is secure so that the landing gear control lever cannot be accidentally pulled up.

(10) Insure that the flaps are up.

(11) Two hand lifts are provided at the forward corners of the overhead panel to assist the pilot and copilot to pull themselves up from their respective seats.

(12) Close and lock all compartment windows as well as the door.

(13) On passing through the main fuselage compartment, make a quick visual inspection to insure that all component parts and equipment are in order.

(14) Fill out Flight Report, AAF Form No. 1.

v. MOORING THE AIRPLANE.

(1) When mooring the airplane in the open, if practicable, head the airplane into the wind before tying down.

(2) Tie down airplane by mooring rings on lower surface of each outer wing panel. Tie down tail wheel (see figure 20).

(3) If no fixed mooring anchorage is provided, use mooring kit furnished with airplane.

WARNING

The automatic pilot will not be used as a means for locking the surface controls when the airplane is parked, or during engine warm-up periods.

2. AUTOMATIC PILOT OPERATING INSTRUCTIONS.

a. PREFLIGHT CHECK. *(See figure 21.)*—With the engines running up to 1,000 rpm, check the automatic pilot (Jack & Heintz Type A-3A) as follows:

(1) Check the vacuum gage to indicate 4 to 4.25 inches Hg. The vacuum should not exceed 4.25 inches Hg at maximum ground rpm.

(2) Adjust the 3-speed valve settings (rudder, aileron, and elevator) to "3" position.

NOTE

With airplane on the ground, speed valve settings must be at zero and the gyros caged when not in use.

(3) Uncage the gyros. Align gyro and rudder, aileron, and elevator index pointers.

(4) Turn the servo bypass valve to vertical or "OFF" position.

(5) Turn the main auto pilot valve to "ON" position and check oil pressure rise. It should be 150 $\pm$ 10 pounds per square inch 15 seconds maximum at 1,500 rpm.

(6) Move the ailerons manually through the entire range six or eight times, then do the same for the rudder and elevator.

(7) Realign the gyro indices.

(8) Turn the servo bypass valve to horizontal or "ON" position.

(9) Using the index knobs, run the ailerons, elevators, and rudder through their full movement.

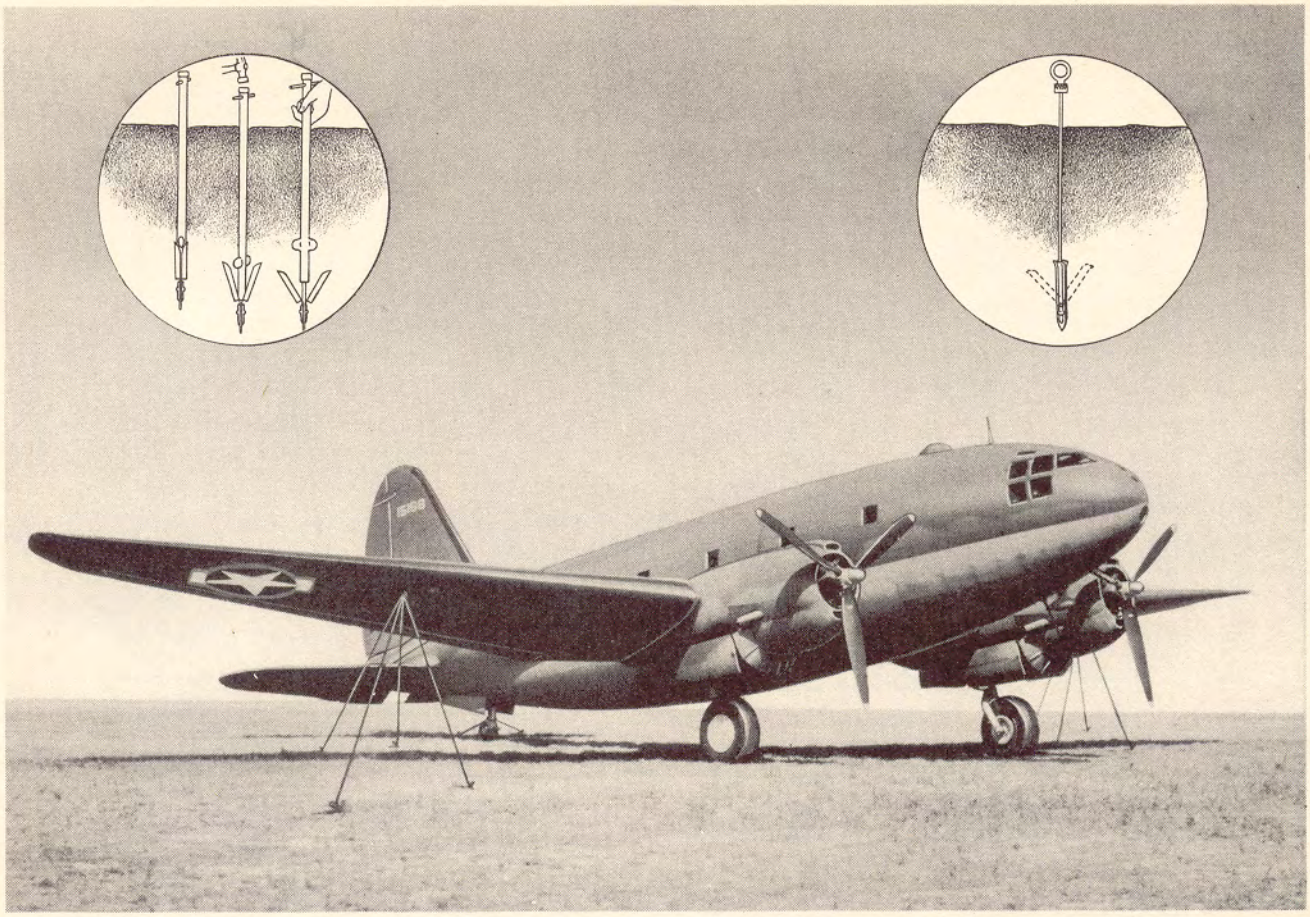


Figure 20—Mooring the Airplane

(10) Adjust the speed valve setting to "6."

(11) Using the index knobs, run the ailerons, elevators, and rudder through their full movement, and check for speed increase from "3" to "6."

(12) Attempt to overpower the auto pilot. Overpowering must be possible at a speed valve setting of "6."

(13) Return all the indices to neutral.

(14) Set the speed valves to zero.

(15) Turn the main auto pilot valve to the "OFF" position.

(16) Check the controls (manually) for freedom of movement.

(17) Cage the gyros. It is important that this operation be done slowly.

b. CAGING AND UNCAGING PROCEDURE.

(1) To cage the directional (turn) gyro, firmly push the caging knob in as far as it will go. To uncage, pull the knob *straight* out so as to avoid turning the gyro card away from the desired heading.

(2) To cage the horizontal (bank and climb) gyro, turn the caging knob clockwise as far as it will go, until caging knob pointer is on white line above the word "CAGE." To uncage, turn caging knob counterclockwise until the pointer is on the white line above the word "UNCAGE."

c. OPERATING AUTOMATIC PILOT IN FLIGHT.

(1) RESTRICTED USE OF THE AUTOMATIC PILOT.

(a) Do not engage the automatic pilot at any speed or altitude until it has been determined by manual control that the existing flight conditions permit safe control by the automatic pilot. Under no circumstances will the automatic pilot be engaged when the airplane is flying at less than an indicated air speed of 40 mph above the stalling speed.

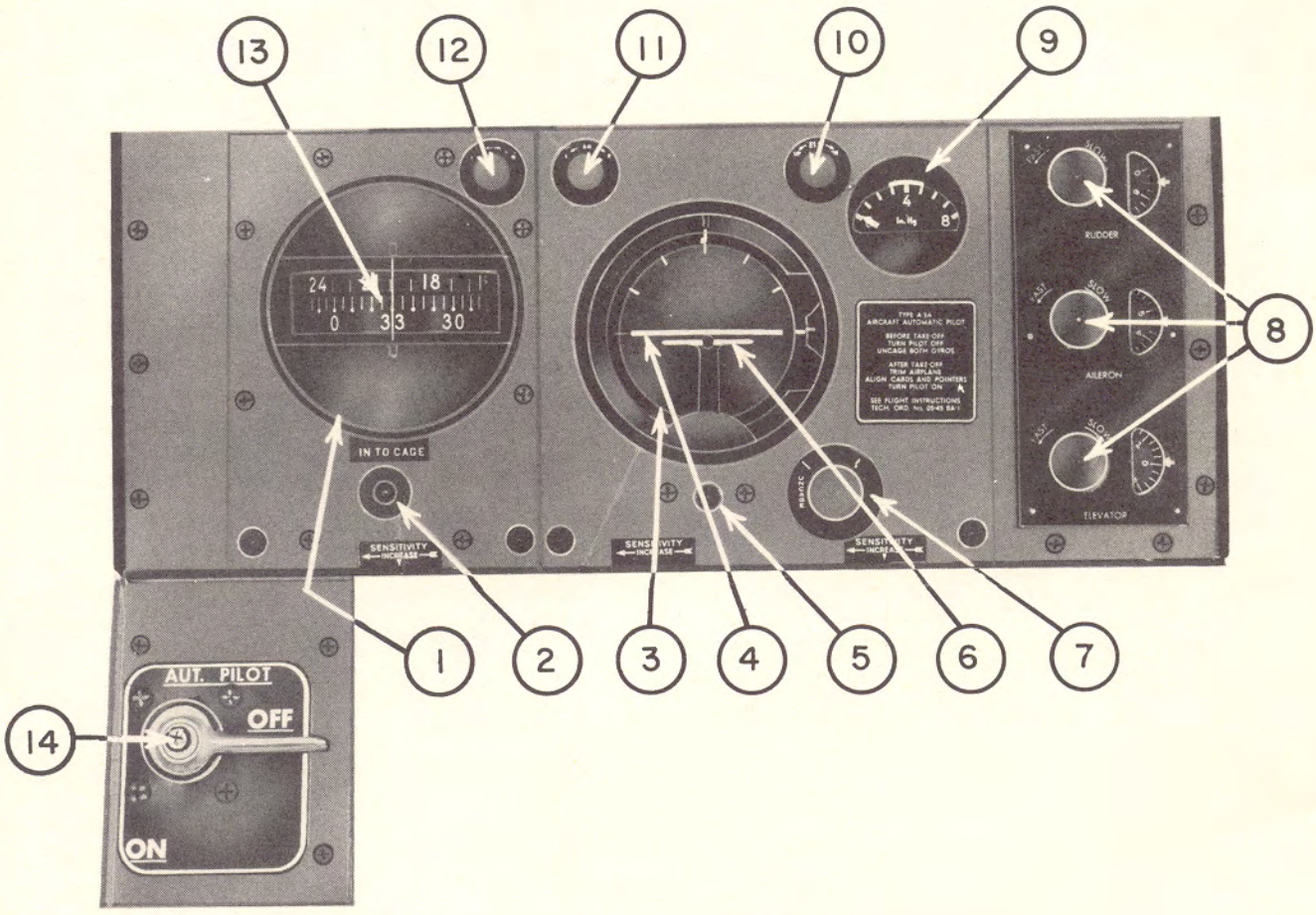


Figure 21—Automatic Pilot

LEGEND FOR FIGURE 21

1—Directional Gyro
2—Caging Knob
3—Bank and Climb Gyro
4—Horizon Bar
5—Miniature Airplane Adjusting Knob
6—Miniature Airplane
7—Caging Knob
8—Speed Valves
9—Vacuum Gage
10—Elevator Knob
11—Aileron Knob
12—Rudder Knob
13—Directional Gyro Card
14—Switch

NOTE

Do not operate the automatic pilot in extremely turbulent air, when surface de-icers are operating, or when one engine is not delivering normal rated power.

(b) Never use the automatic pilot unless one rated pilot remains "on watch" and maintains a close check on the airplane and its instruments.

(c) The operating limit (from the vertical) for the horizontal gyro is 50 degrees, and for the directional gyro it is 55 degrees.

CAUTION

During maneuvers which would exceed the operating limits, or when the engines are not running, the gyros should be caged. At all other times the gyros should be uncaged.

(2) BEFORE ENGAGING THE AUTOMATIC PILOT IN FLIGHT.

(a) Pilot the airplane manually to 2,000 feet or more above ground level, observing whether the bank and climb and directional gyros are indicating properly as flight instruments.

(b) Set the airplane to the desired compass heading.

(c) Using the trim tab controls, trim the airplane "HANDS OFF."

(d) Align the indices.

1. Using the rudder index caging knob, align the bottom card on the directional gyro with the airplane's compass. Match the upper and lower cards of the directional gyro control unit, using the rudder control knob at the upper right of the directional gyro.

2. Align the aileron follow-up index with the bank index, using the aileron control knob at the upper left of the horizontal gyro.

CAUTION

Do not align elevator follow-up index with horizon bar, since the relative movement between the elevator alignment index and the horizon bar is in opposite directions.

(3) ENGAGING THE AUTOMATIC PILOT.

(a) Place the automatic pilot control valve in the "ON" position.

(b) Open the 3-speed valves to the desired setting.

(c) Insure that the bypass valve is in the "ON" position (vertical).

(4) FLYING WITH THE AUTOMATIC PILOT.

IMPORTANT

The following instructions will be strictly adhered to when flying with the automatic pilot.

(a) Do not allow the airplane to get too far out of trim.

(b) Do not engage the automatic pilot when the follow-up indices are not lined up.

(c) Do not make course or altitude changes with rapid control movements. Turn the controls SLOWLY and SMOOTHLY.

(d) Do not forget that the automatic pilot can be overpowered.

(5) MANEUVERS WITH AUTOMATIC PILOT.

(a) Outside of straight flight, which may be level, climbing, or descending, the only maneuvers that should be performed with the automatic pilot are turns and spirals.

(b) Course changes of a few degrees may be made as flat turns, in which case it is only necessary to rotate the rudder control knob slowly until the airplane reaches the new heading.

(c) For normal turns, place the airplane in a 15- to 20-degree bank by turning the aileron control knob in the desired direction. The banking reference marks at the top of the bank and climb gyro dial are graduated in 10-degree steps up to 50 degrees on each side of the vertical. Immediately rotate the rudder control knob at such a rate that the ball in the ball bank indicator remains centered.

(d) If the airplane tends to nose up or down slightly, this can be corrected with the elevator tab control. As the desired zero heading is approached, rotation of the rudder control knob should be stopped and the airplane leveled out by means of the aileron control knob.

(e) Spirals may be executed in the same manner as turns, the airplane being nosed up or down as required by means of the elevator control knob. A convenient method of making spirals is to cage the directional gyro and offset the upper card a few degrees, depending upon the rate of turn desired (10-degree maximum turn), by turning the control knob in the direction desired. Then center the ball by means of the aileron control knob and control the rate of ascent by means of the elevator control knob. In employing this method, no indication of the amount of turn is given, as the gyro is caged. To resume normal flight, uncage the directional gyro and level the airplane by turning the aileron and elevator control knobs.

CAUTION

When flying with the automatic pilot, the trim tab controls should not be used to change the course since, when the tabs are used for this purpose, the automatic pilot will be fighting constantly against the tab force, creating a very dangerous condition. Use of the trim tabs for this purpose will have a tendency to throw the airplane into a snap roll if the automatic pilot is suddenly disengaged.

(6) USE OF AIRPLANE TRIM CONTROLS.—Changes in flight attitude, power, altitude, and load

shifts will affect the fore-and-aft trim of the airplane and cause the automatic pilot to hold the elevator against the out-of-trim condition and retain the airplane in the set-in attitude. This may result in an oscillation of the elevator control. The trim of the airplane can be checked by disengaging the automatic pilot for a few seconds and noting whether the airplane tends to nose up or down. A trim correction should then be made with the elevator trim tab control.

(7) MANUAL CONTROL.—When it is desired to resume manual control, it is only necessary to move the engaging lever to the "OFF" position and take over the controls. As an added safety measure servo overpower valves are provided so that the pilot can overpower the automatic pilot by applying about twice the normal force on the controls.

3. PILOTS' OPERATING INSTRUCTIONS FOR COMMUNICATIONS EQUIPMENT.

a. RADIO NAVIGATION VARIABLES.

(1) When using radio equipment for navigational purposes, although the equipment may be operating satisfactorily, erroneous indications may be obtained as a result of the following conditions:

(a) Night effect, or reflection of the radio wave from the sky, is always present. It may be recognized by a fluctuation in bearings or by signal fading. The remedy is:

1. Increase altitude, thereby increasing the strength of the direct wave.

2. Take an average of the fluctuations or select a lower frequency station. Night effect is more prevalent at sunrise and sunset. Night effect may be present on stations at 1,750 kcs at distances greater than 20 miles; as the frequency decreases, the distance increases, until at 200 kcs the distance will be about 200 miles. Satisfactory bearings will often be obtained at greater distances than stated above, and unsatisfactory bearings may be obtained at shorter distances.

(b) The presence of mountain ranges, rivers, etc., will cause the patterns of the transmitter to be uneven and somewhat scalloped. This will produce erroneous or fluctuating bearings or multiple on-course signals, which will sound exactly like the true on-course signal except that they will usually be bounded by identical quadrant letters. In some cases the multiple will be like the true course or even with reversed signals.

(c) The presence of a bend in a radio range quadrant leg is due to the same topographical irregularities which cause multiples.

(d) When a radio wave travels through a cold front, erroneous and fluctuating bearings may result to a limited extent.

(e) Station interference between stations on the same frequency may result in erroneous indications. Clear channel stations are preferable. If clear channel stations cannot be used as a reference, a stable station, widely separated by distance from other stations on the same frequency, is desirable.

(f) Where a radio range signal crosses an irregularity in terrain, such as a deep canyon, there may exist a false cone of silence. As the radio waves pass over such an irregularity, some of the waves will be reflected back from the far wall. The reflected waves serve to cancel the direct waves when over the canyon and cause the signal to disappear momentarily. False cones may change in character at different times of day. Additional Heaviside reflection may obscure the false cone at night. A true cone of silence produces a definite increase in volume just before entering and just after leaving the cone. The quadrant signal to the right after emerging from a true cone of silence is not the same as that received before entering the cone.

(g) For the best definition of A-N radio range quadrant signals, the interphone jack box "INCREASE OUTPUT" control must be in a fully clockwise position, and the head-set volume level should then be adjusted by means of the control box volume control in accordance with the following:

1. At low volume levels which are just above the threshold of audibility, the ear can not easily distinguish differences in the volume of the "A" and "N" signals. When flying on the edge of the on-course it is desirable to detect small differences between the "A" and "N" signals. Consequently, the volume level should be set high enough to give a loud but not unpleasant signal.

2. Radio set SCR-274-N and radio compass SCR-269 have delayed automatic gain control provisions. This feature provides for a fixed output level effective only after a predetermined high level has been reached through clockwise adjustment of the control box volume control. When the AVC feature is active, true representation of "A" and "N" signal input is not possible, and errors may be introduced into radio range navigation.

3. In view of the above conditions, the head-set volume should be adjusted to a minimum usable level. This can be determined by listening to a signal which is slightly off the "on-course" zone and adjusting the head-set volume to give the best audible ratio between signals.

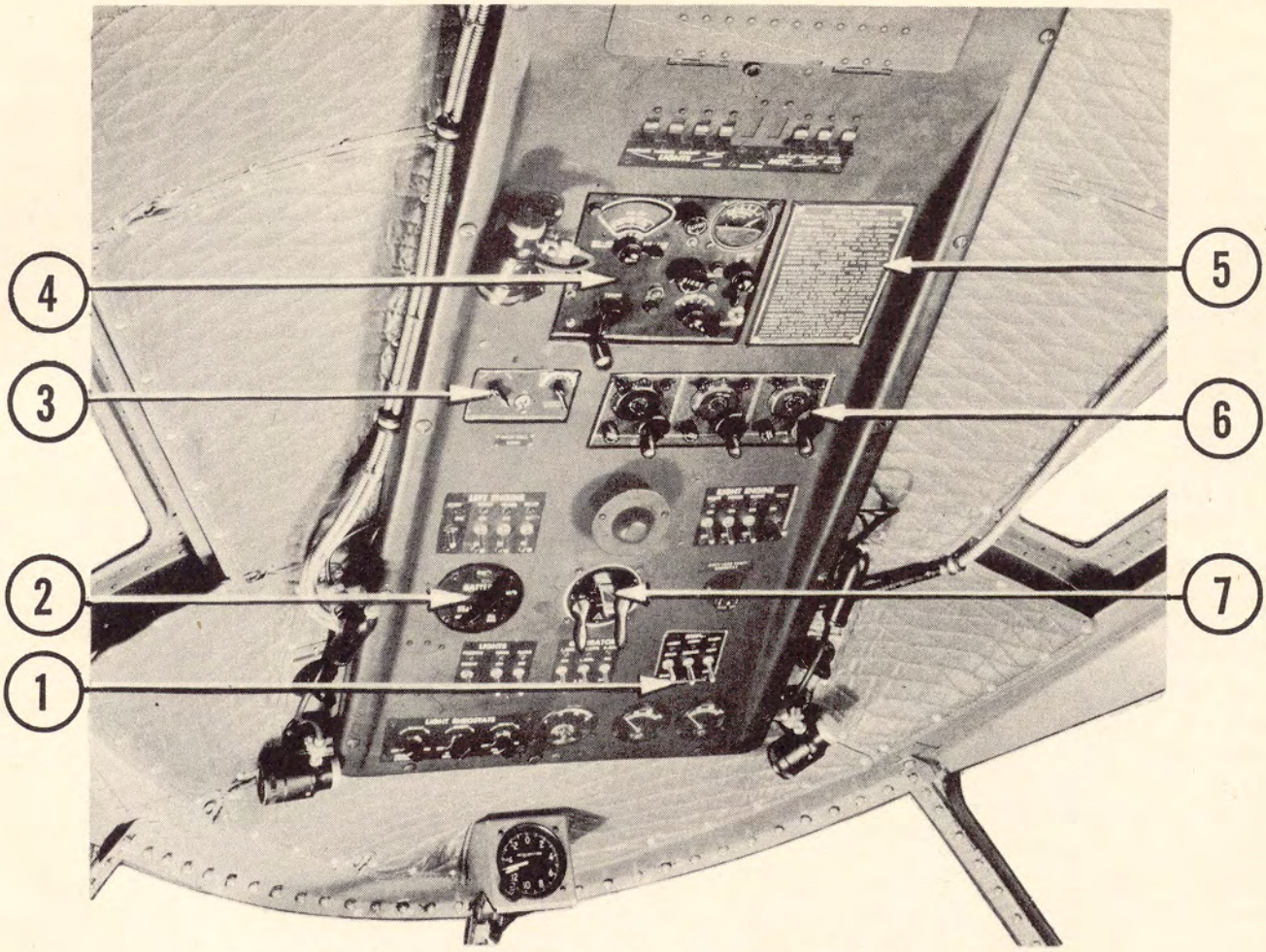


Figure 22—View of Pilots' Ceiling Showing Location of Radio Controls

LEGEND FOR FIGURE 22

1—A-C Inverter Switch
2—Battery Selector Switch
3—Command Transmitter Control Box, BC-451-( )
4—Compass Control Box, BC-434-A
5—Chart MC-208, Operation Instructions for Radio Compass
6—Command Receiver Control Box, BC-450-( )
7—Master Ignition Switch

4. It can be seen from the above that the question of accuracy of radio navigational equipment indications should, if possible, be checked against navigation data obtained by other means.

b. GENERAL OPERATING INSTRUCTIONS.

(1) PLUG HEAD SET into head-set disconnector cord jack. (Cord must be plugged into filter switch box (figure 25) PHONES jack.) PLUG THE THROAT MICROPHONE (or hand microphone, if installed) into the microphone disconnector cord jack. (Cord must be plugged into the interphone jack boxes "MIC" jack.) (Figure 26.)

(2) Set the interphone jack box selector switch on the applicable position and turn the "INCREASE OUTPUT" knob fully clockwise.

(3) Set filter switch box selector switch on "BOTH." If rejection of radio range quadrant signals is desired, set on "VOICE." If reception of radio range quadrant signals with rejection of voice modulation is desired, set on "RANGE."

(4) If the airplane is on the ground, turn the battery selector switch (figure 22-2) clockwise from "OFF" to "ON" and turn master ignition switch "ON" (figure 22-7.) When operation of the communications equipment is completed, turn off these switches.

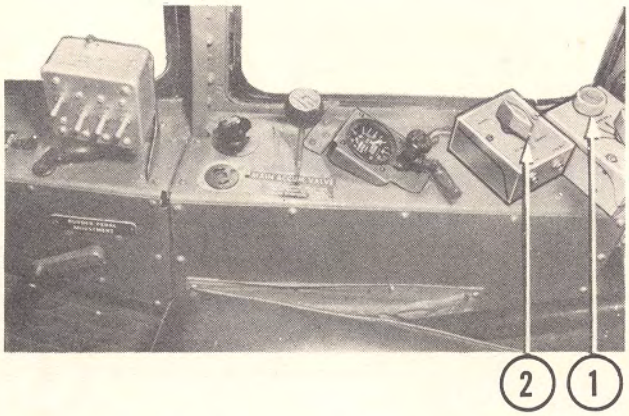


Figure 23—1. Interphone Jack Box. 2. Filter Switch Box on Ledge to Right of Copilot's Position

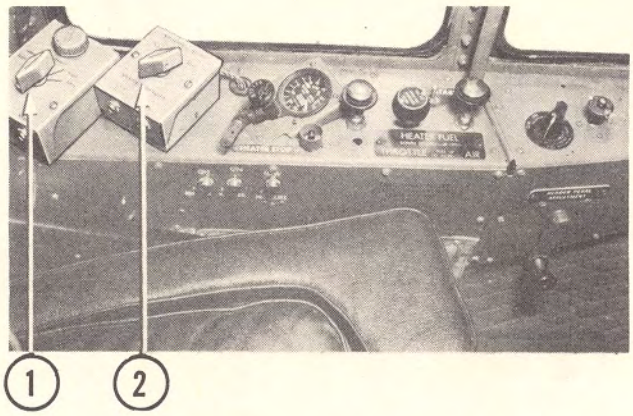


Figure 24—1. Interphone Jack Box. 2. Filter Switch Box on Ledge Left of Pilot's Position

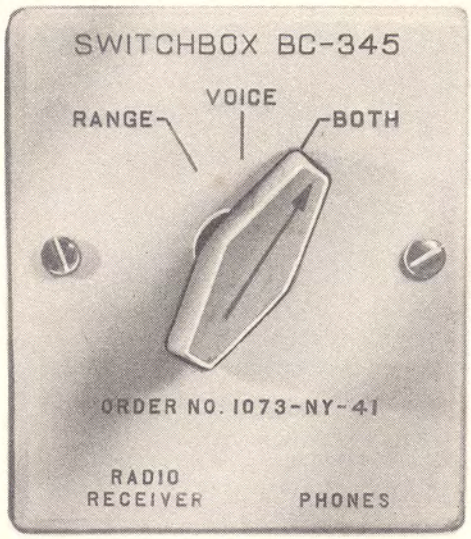


Figure 25—Filter Switch Box, BC-345

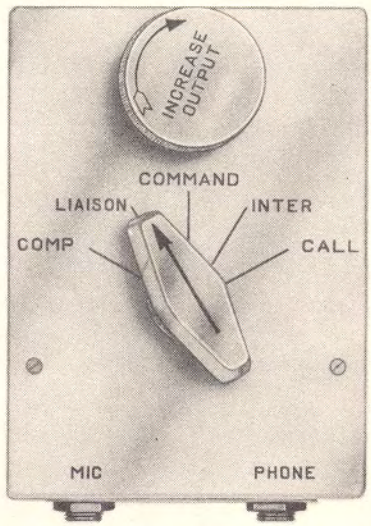


Figure 26—Interphone Jack Box, BC-366

NOTE

It is important to use either a battery cart or a portable generator as an external source of power when operating the communications equipment while the engines are not running, to prevent the ship's batteries from becoming discharged.

When using an external source of power, turn the battery selector switch to "CART" and put the master ignition switch to the "ON" position. When operation of the radio compass set is desired, turn on the a-c inverter switch (figure 22-11) to furnish the a-c power necessary for the operation of the loop-drive components of this equipment.

c. TO OPERATE INTERPHONE.

(1) Complete necessary operations included in 3.*b.* The command set transmitter power switch (figure 22-3) must be turned "ON" in order to energize the interphone amplifier. (Audio output of the command receivers, compass receiver, and liaison receiver can be heard over the interphone system without the interphone amplifier being operative but no output over the interphone system when on either "INTER" or "CALL" will be heard, unless the interphone amplifier is energized.)

(2) Hold the interphone jack box selector switch (figure 26) in "CALL" position, call desired crew member, and release selector switch, allowing it to return to "INTER."

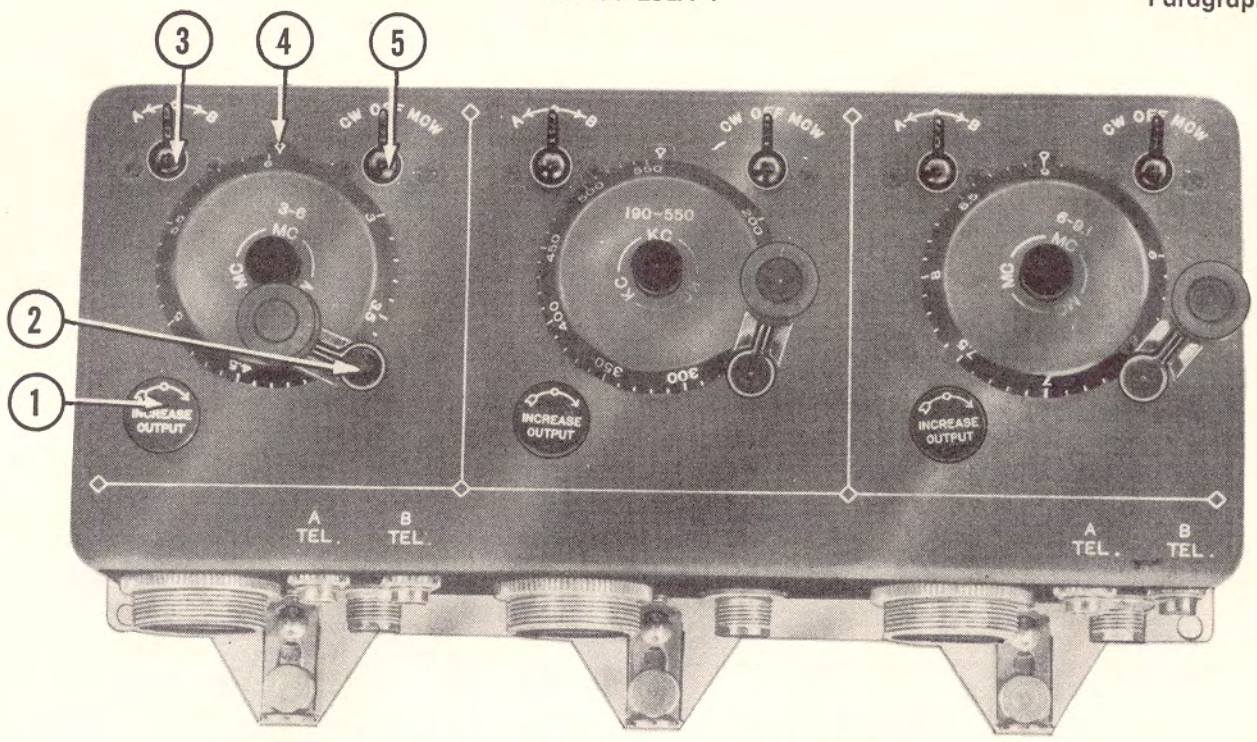


Figure 27—Command Receiver Control Box, BC-450-A

LEGEND FOR FIGURE 27

1—Volume (gain) Control
2—Tuning Crank
3—"A-B" Telephone Switches
4—Frequency Band Tuning Dial
5—"CW-OFF-MCW" Power Switch

(3) When the crew member answers, intercommunication may be carried on with the selector switch on "INTER."

(4) To turn off interphone, turn command transmitter "TRANS POWER" switch "OFF."

(5) In the event of interphone equipment failure, the audio frequency section of the command transmitter may be substituted for the regular interphone amplifier. To make this connection, the pilot should place his command transmitter control box channel selector switch in either "No. 3" or "No. 4" position. (See figures 22-3 and 28-4.) Set interphone jack box selector switches on "COMMAND" to place interphone equipment in operation.

NOTE

In this position, it is impossible to communicate with ground stations or other aircraft.

NOTE

To resume normal command set operation, place channel selector switch back in either "No. 1" or "No. 2" position.

d. ADJUSTMENT OF THROAT MICROPHONE (TYPE T-30).

(1) The throat microphone neck band length should be adjusted to allow the microphone elements to bear firmly but not tightly against the throat. For best results, the microphone elements should be equally spaced about the "Adams apple." Do not allow clothing to get between the microphone elements and the skin of the wearer. Speak in a normal tone of voice.

e. TO OPERATE COMMAND RADIO SET—SCR-274-N.

(1) RECEIVING COMPONENTS.

(a) Set the three "A-B" switches on the receiver control box (figure 27-3) to "A." These switches have no function in this installation on "B" position.

(b) Select section of the receiver control box covering the desired frequency band.

(c) Turn the "CW-OFF-MCW" switch (figure 27-5) to the type of reception desired.

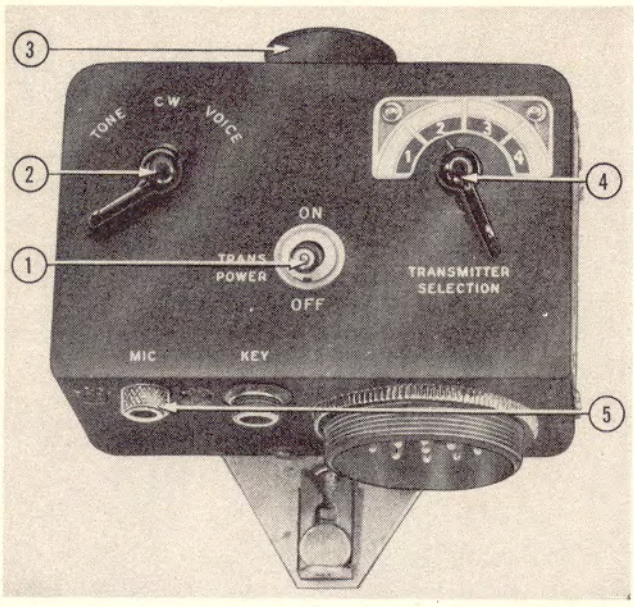


Figure 28—Command Transmitter Control Box, BC-451

LEGEND FOR FIGURE 28

1—Transmitter Power Switch
2—"Tone-CW-Voice" Selector Switch
3—"Built-In" Transmitting Key
4—Band Selector Switch
5—"Mic" Jack Knurled Nut

(d) Turn tuning crank (figure 27-2) to desired station frequency.

(e) Set head-set volume to desired level by adjusting the "INCREASE OUTPUT" knob (figure 27-1).

NOTE

Two or more frequencies, each peculiar to one receiver, may be monitored at one time by appropriate adjustment of head-set volume levels.

(f) To turn off receiver, throw "CW-OFF-MCW" switch to "OFF."

(2) TRANSMITTING COMPONENTS.

(a) Monitor the frequency of desired answering station before transmission is effected.

(b) Turn "TRANS POWER" switch "ON" (figure 28-1).

(c) Set frequency selector switch (figure 28-4) to the desired frequency as indicated on placard above switch.

(d) Set the "TONE-CW-VOICE" switch (figure 28-2) to the type of emission desired.

(e) If "TONE" or "CW" emission is selected, transmit with "PUSH-TO-TALK" switch on the control wheels.

(f) If "VOICE" transmission is desired and the throat type (T-30) microphone (if available) is selected for use, press the "PUSH-TO-TALK" switch on the control column and speak slowly and distinctly in a normal tone of voice.

(g) If the hand microphone (type T-17) is being used, press the microphone "PUSH-TO-TALK" button, and speak into the microphone. Make sure that protruding knurled nut at "MIC" jack (figure 28-5) is turned fully counterclockwise and left in that position at all times. (Only the hand microphone can be used in airplanes not equipped with the "PUSH-TO-TALK" switch on the control wheel.)

(h) During flight the "TRANS POWER" switch on the transmitter control box is usually kept "ON" to keep the transmitter tube filaments warm and ready for use and to keep the interphone dynamotor operating. The emission selector switch should always be kept on "VOICE" position except when it is desired to transmit code. In the "CW" and "TONE" positions the dynamotor is running continuously, resulting in possible equipment failures. In "VOICE" position the dynamotor runs only when the "PRESS-TO-TALK" switch is closed.

(i) To turn off transmitter, throw "TRANS POWER" switch to "OFF."

f. TO OPERATE RADIO COMPASS SCR-269.

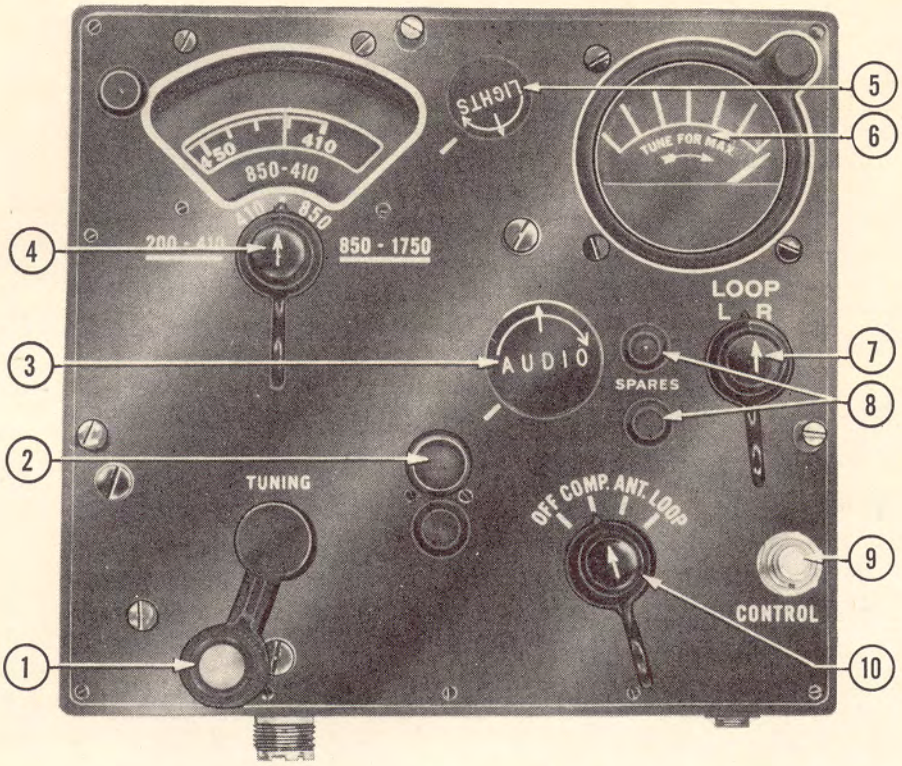
(1) GENERAL.

(a) This equipment provides for:

1. Aural reception of modulated or unmodulated radio frequency energy, using a nondirectional antenna, when operating on the "ANT." position of the selector switch.

2. Aural reception (at a net gain of snow static reduction and a loss of signal strength as compared to operation on "ANT.") of modulated or unmodulated radio frequency energy, using a shielded loop antenna, when operating on the "LOOP" position of the selector switch.

3. Aural null directional *indications* of the arrival of modulated or unmodulated radio frequency energy, using a loop antenna, when operating on the "LOOP" position of the selector switch.



LEGEND FOR FIGURE 29

1—Tuning Crank
2—Control Indicator Light
3—Audio Output Control
4—Frequency Band Selector Switch
5—Dial Lights Control
6—Tuning Meter
7—Loop Drive Control
8—Spare Lamps
9—Control Switch (Not used in this installation)
10—Function Selector Switch

Figure 29—Radio Compass Control Box, BC-434-A

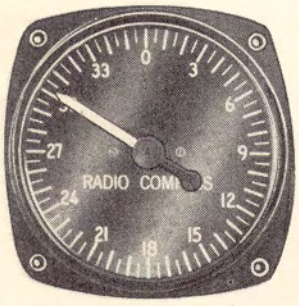


Figure 30—Radio Compass Indicator, I-81-A

Figure 31—Radio Compass Receiver, BC-433—( ). 1. "CW-VOICE" Switch

4. Automatic bearing indication, with regard to the longitudinal axis of the airplane, of the direction of arrival of radio frequency energy and simultaneous aural reception of modulated or unmodulated radio frequency energy, when operating on the "COMP" position of the selector switch.

(b) When using the radio compass as a homing device the indications are such that the aircraft will ultimately arrive over the radio station antenna regardless of probable drift due to cross wind. The flight path will be a curved line and coordination with ground fixes or landing fields along the route will be difficult or impossible. Consequently, it is often expedient to fly a straight-line course by off-setting the aircraft's heading to compensate for wind drift. To do this, determine the wind drift, either with a drift sight or by noting the change in magnetic compass reading over a period of time, while homing with the radio compass.

(c) Complete the necessary operations included in paragraph 3.*b*.

(d) Dial lamps may be turned on and their brilliance controlled by means of the "LIGHTS" control on the compass control box. (See figure 29-5.)

(e) Head-set volume may be regulated by means of the "AUDIO" control. (See figure 29-3.)

(f) Select station frequency with band selector switch (figure 29-4) and tuning crank (figure 29-1). Move tuning crank to a position producing greatest clockwise indication of tuning meter. (See figure 29-6.) This tuning meter should not be construed to be a distance indicator.

(g) Provision is made for aural reception of "CW" signals. Control of this feature is provided by the "CW-VOICE" switch (figure 31-1) on the panel of the radio compass receiver located on shelf, right forward side of bulkhead at fuselage station 128 in belly of airplane. With the "CW-VOICE" switch in "VOICE" position the compass and homing components of this equipment will function properly while receiving "CW" signals, but aural identification of such signals will be impossible, unless the "CW-VOICE" switch is set on "CW."

(2) *To operate as a receiver only, using the non-directional fixed sense antenna:*

(a) Set the selector switch on "ANT." (See figure 29-10.)

(b) Set band selector switch to desired band and tune in desired station by means of tuning crank, making final adjustment by referring to tuning meter.

(c) Regulate the head-set volume by adjusting the "AUDIO" control. (See figure 29-3.)

NOTE

If reception on "ANT" is noisy due to precipitation static, commonly known as rain or snow static, operate on shielded loop antenna. Precipitation static existing in air mass fronts at different temperatures can sometimes be avoided by crossing the front at right angles, and then proceeding on the desired course, instead of flying along the air mass front.

(d) To turn off radio compass, turn selector switch on compass control box to "OFF."

(3) *To operate as a receiver only, utilizing the shielding provision of the loop antenna to reduce precipitation static noises:*

(a) Set the selector switch on "LOOP."

(b) Tune in desired station.

(c) Depress "LOOP L-R" knob (figure 29-7) and turn it to "L" or "R," rotating loop to obtain maximum signal strength as indicated by head-set volume. *Release* "LOOP L-R" knob and make final adjustment of loop position at slow speed by turning the knob to "L" or "R." Changing course will affect signal strength, and necessitate readjustment of loop position.

(d) Regulate head-set volume with "AUDIO" knob.

NOTE

If the loop is in null (minimum signal) position when flying on a radio range course, the signal may fade in and out, and possibly be mistaken for a cone of silence. When operating on "LOOP," cone of silence indications from radio range stations employing loop type radiators (shown on radio facility chart) are not reliable. The signal may increase in volume to a strong surge when directly over the station instead of indicating a silent zone.

(e) To turn off radio compass, turn the selector switch on compass control box to "OFF."

(4) *To operate as an aural null homing device,* utilizing the directional characteristics of the loop antenna:

(a) Set the selector switch on "LOOP."

(b) Tune in desired (preferable clear channel) station.

(c) If loop indicator pointer is not at zero, *depress* the "LOOP L-R" knob and turn it to "L" or "R" position until the pointer rests on zero. Final adjustment of loop position can be made at slow speed by *releasing* "LOOP L-R" knob and turning it to the "L" or "R."

(d) Turn the "AUDIO" control fully clockwise and head airplane in proper direction, based upon the null (point where a sharp minimum or loss of signal is found) indicated in the head set. (The broadness of the null depends on the strength of the signal. Strong signals produce very sharp nulls, sometimes as small as one tenth of a degree.) Vary "AUDIO" control until the null is of satisfactory width. The tuning meter may be used as a visual null indicator.

NOTE

When determining direction of flight by this method it must be remembered that a 180-degree ambiguity exists, in that the airplane may be flying either directly *toward* or directly *away from* the station. If the direction of flight with regard to this ambiguity is not known and the radio compass is inoperative on the "COMP" position, a standard orientation procedure will have to be executed before flying any great distance along the null.

(e) To turn off radio compass, turn selector switch on compass control box to "OFF."

(5) *To operate as a homing compass*, utilizing the unidirectional characteristics of the radio compass when operating with both the sense and loop antennae:

(a) Set the selector switch on "COMP."

(b) Tune in desired station.

(c) Apply the rudder in direction shown by the radio compass indicator (figure 30), until the pointer centers on zero. This indication is unidirectional; as long as pointer rests on zero, the airplane is headed *towards* the transmitting antenna of the radio station.

(d) Regulate head-set volume by adjusting "AUDIO" control.

(e) Since a pronounced AVC action may be present when operating the radio compass on "COMP," aural indications received on this position should *not* be used when homing on a radio range station.

(f) To turn off radio compass, turn selector switch on the compass control box to "OFF."

(6) *To operate as a direction finder,* for the purpose of establishing a fix:

(a) GENERAL.

1. The usual method of establishing a fix is by triangular plotting of three bearings obtained on three radio stations. Prior to making fix determinations, the stations to be used should be located on the map, tuned in, identified, and the dial reading logged. This avoids delay and error at the time of obtaining the fix.

2. For best accuracy, several bearings should be taken in rapid succession thereby eliminating error caused by the distance traveled between bearing observations. Bearings cannot be accurate unless the aircraft is held on a steady heading.

3. When close to a station, accurate bearings cannot be taken with the aircraft in a steep bank. This is especially applicable to reception of signals from instrument landing trucks.

4. Only head-on bearings are entirely dependable. If side bearings are taken, keep the wings horizontal.

5. Do not depend on two stations for a fix of location; at least three station bearings should be used. In general, a set of stations with bearings spaced at approximately equal intervals throughout 360 degrees will give best accuracy.

6. In compensating for magnetic variation (declination), it must be remembered that the variation indicated on the geographic compass rose (printed on the map) of the radio station on which the bearing is being taken is the figure normally used. The magnetic variation of the locality over which the airplane is flying at the time the bearing is taken is not generally known. However, if this figure is used, the station compass rose variation figure should be excluded. In obtaining bearings for plotting on radio direction finding maps, (D.F. maps) the variation should be excluded from the computation, as the compass roses on these charts are offset to compensate for magnetic variation.

(b) AUTOMATIC VISUAL DIRECTION FINDING.

1. With the radio compass selector switch set on "COMP," tune the first station, previously logged and identified and record the reciprocal reading of the radio compass indicator pointer which is the station-to-airplane bearing.

2. Rapidly repeat operation *1.* to obtain two additional station-to-airplane bearings.

3. To the station-to-airplane bearing obtained in *1., add* the magnetic compass heading of the airplane

(referring to the compass correction card attached to the magnetic compass in order to obtain a true magnetic heading).

4. Refer to the air navigation chart and obtain the magnetic variation (declination) for the locality of the radio station involved in operation *1.*

5. If the magnetic variation for the locality is shown as Easterly, *add* the indicated amount of variation to the result of operation 3. If the variation is shown as Westerly, *subtract* the indicated amount of variation from the result of operation 3.

NOTE

When using Direction Finding (D.F.) maps, omit operations *4.* and *5.* as the compass roses surrounding the geographical locations of the radio stations are offset to compensate for magnetic variation.

6. If the resultant sum of operation *5.* is larger than 360 degrees, subtract 360 degrees from the result of operation *5.* to obtain the correct station-to-airplane bearing. Plot this result on the map as illustrated in figure 33.

7. With each of the two additional station-to-airplane bearings obtained in *2.*, repeat operations *3.*, *4.*, *5.*, and *6.* using the bearings obtained in operation *2.* in each case.

8. When the three bearings are plotted on a map at the proper angle, indicated by the compass roses, the lines should intersect. This point of intersection is the approximate location of the airplane at time of observation, as illustrated by figure 33.

(c) AURAL NULL DIRECTION FINDING.

1. Set the selector switch on "LOOP."

2. Tune in desired (preferable clear channel) station.

3. Turn "AUDIO" control fully clockwise, *depress* "LOOP L-R" knob, and turn it to "L" or "R," rotating loop in proper direction to null position, indicated by minimum head-set signal volume or tuning meter dip. Release "LOOP L-R" knob and make final adjustment of loop position at slow speed by turning knob to "L" or "R."

4. Record the station-to-airplane bearing, indicated by reciprocal reading of radio compass indicator pointer.

5. Rapidly repeat operations *2.*, *3.*, and *4.* in order to obtain two additional station-to-airplane bearings.

6. To the station-to-airplane bearing obtained in operation *4.*, *add* the magnetic compass heading of the airplane (referring to the compass correction card attached to the magnetic compass, in order to obtain a true magnetic heading).

7. Refer to the air navigation chart and obtain magnetic variation (declination) for locality of radio station involved in operation *4.*

8. If magnetic variation for locality is shown as Easterly, *add* indicated amount of variation to result of operation *6.* If variation is shown as Westerly, *subtract* indicated amount of variation from result of operation *6.*

NOTE

When using Direction Finding (D.F.) maps, omit operations *7.* and *8.* as compass roses surrounding the geographical locations of radio stations are offset to compensate for magnetic variation.

9. If resultant sum of operation *8.* is larger than 360 degrees, subtract 360 degrees from result of operation *8.* to obtain correct station-to-airplane bearing. Plot this result on map.

10. With each of two additional station-to-airplane bearings obtained in operation *5.*, repeat operations *6.*, *7.*, *8.*, and *9.*, using bearings obtained in operation *5.*, in each case.

11. When the three bearings are plotted on a map at the proper angle, indicated by compass roses, lines should intersect. This point of intersection is approximate location of airplane at time of observation, as illustrated by figure 33.

12. Bearings obtained by aural-null method are subject to 180 degrees ambiguity. Where 180 degrees ambiguity exists, the bearing lines plotted on the map will indicate an airplane-to-station (rather than a station-to-airplane) bearing and they will fail to intersect. When it is clearly evident that 180 degrees ambiguity exists, the reciprocal bearing may be plotted. In other cases of doubtful correctness the bearing may be retaken.

13. To turn off radio compass, turn selector switch on the compass control box to "OFF."

g. TO OPERATE MARKER BEACON RECEIVER RC-43.

(1) Turn on radio compass, which furnishes power for marker beacon receiver.

(2) When flying over an airway's fan marker or Z (cone of silence) marker (indicated on radio facility chart) or an instrument landing marker, the indicator lamp (figure 13-3) will light.

(3) The interval during which the marker beacon indicator lamp will be lit varies from a few seconds to as long as several minutes, depending upon the type of marker, as well as the altitude and speed of the airplane. Cone of silence markers utilize non-directional antenna arrays which cause equal indications for any direction of flight. Indications over cone of silence markers last about one minute at 10,000 feet altitude, when the speed of the airplane is 150 miles per hour.

(4) When passing over a marker the indication should be steady or flash regularly, following the keying of the transmitter. Cone of silence markers and Army instrument landing markers are not keyed. Fan type markers and C.A.A. instrument landing markers are identified by keying. The radio receiver may not follow the keying of the 100-watt fan marker transmitters when the airplane is passing through the strongest part of the beam at low altitudes.

(5) To turn marker beacon receiver off, turn off radio compass.

h. TO OPERATE LIAISON RADIO SET SCR-287-A.

(1) GENERAL.

(a) The liaison radio set may be operated from the pilot and copilot positions only after operating adjustments have been accomplished at the radio operator's position.

(2) RECEIVING AND TRANSMITTING COMPONENTS.

(a) Instruct radio operator to make operating adjustments of liaison receiver and transmitter.

(b) Set the interphone jack box on the "LIAISON" and receive and transmit by conventional use of head set, "INCREASE OUTPUT" control (on interphone jack box), and the hand type or throat microphone.

(c) When communication is finished, instruct radio operator to turn off equipment and, if necessary, to reel in trailing antenna.

i. OPERATION OF IFF RADIO SET SCR-595.

(1) OPERATING COMPONENTS. — Refer to paragraph 1.*g.*(1), section 5.

(2) DESTRUCTOR COMPONENTS.

(a) If necessary to destroy the IFF radio set, raise the hinged cover on the destructor switch (figure 32) and simultaneously press two switch buttons on the destructor switch.

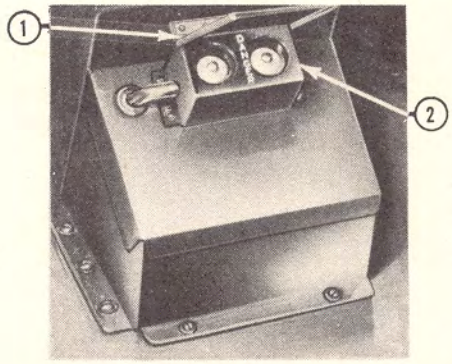


Figure 32—IFF Destructor Switch Mounted on Control Pedestal Between Pilot and Copilot

1—Hinged Cover over Switch Box
2—Switch Box BC-765

NOTE

The above switch is paralleled by an automatic inertia type switch, which is mechanically energized by a crash landing.

OPERATIONS NECESSARY TO PLOT A BEARING.

I. Tune in previously logged and identified station.

II. Add compass deviation (B) to or subtract from compass heading (A). (Add E deviation, subtract W deviation.) To A $\pm$ B, add Compass Indicator Pointer reading.

III. The result ($35° + 1° + 55° = 91°$) is the airplane to station bearing and can be plotted on the (D.F.) map as illustrated, using the outer ring of figures on the compass rose.

IV. When using maps (other than the D.F. maps) which do not have the offset compass roses, the formula A $\pm$ B $\pm$ C (add Easterly Variation, subtract Westerly Variation) + D would be used to determine the airplane to station bearing, then the reciprocal (station to airplane) bearing (E) would be plotted on the map.

OPERATIONS NECESSARY TO ESTABLISH A FIX.

The plotted bearing for only one station (station XYZ) is shown for purposes of simplicity of explanation. To complete an actual observation, two additional bearings (preferably located at equal intervals throughout 360 degrees for best accuracy) should be rapidly obtained and plotted on the same map, following the procedure outlined above. The three plotted bearings should then intersect and form a triangle around point (F) indicating the approximate position of the airplane at the time of observation.

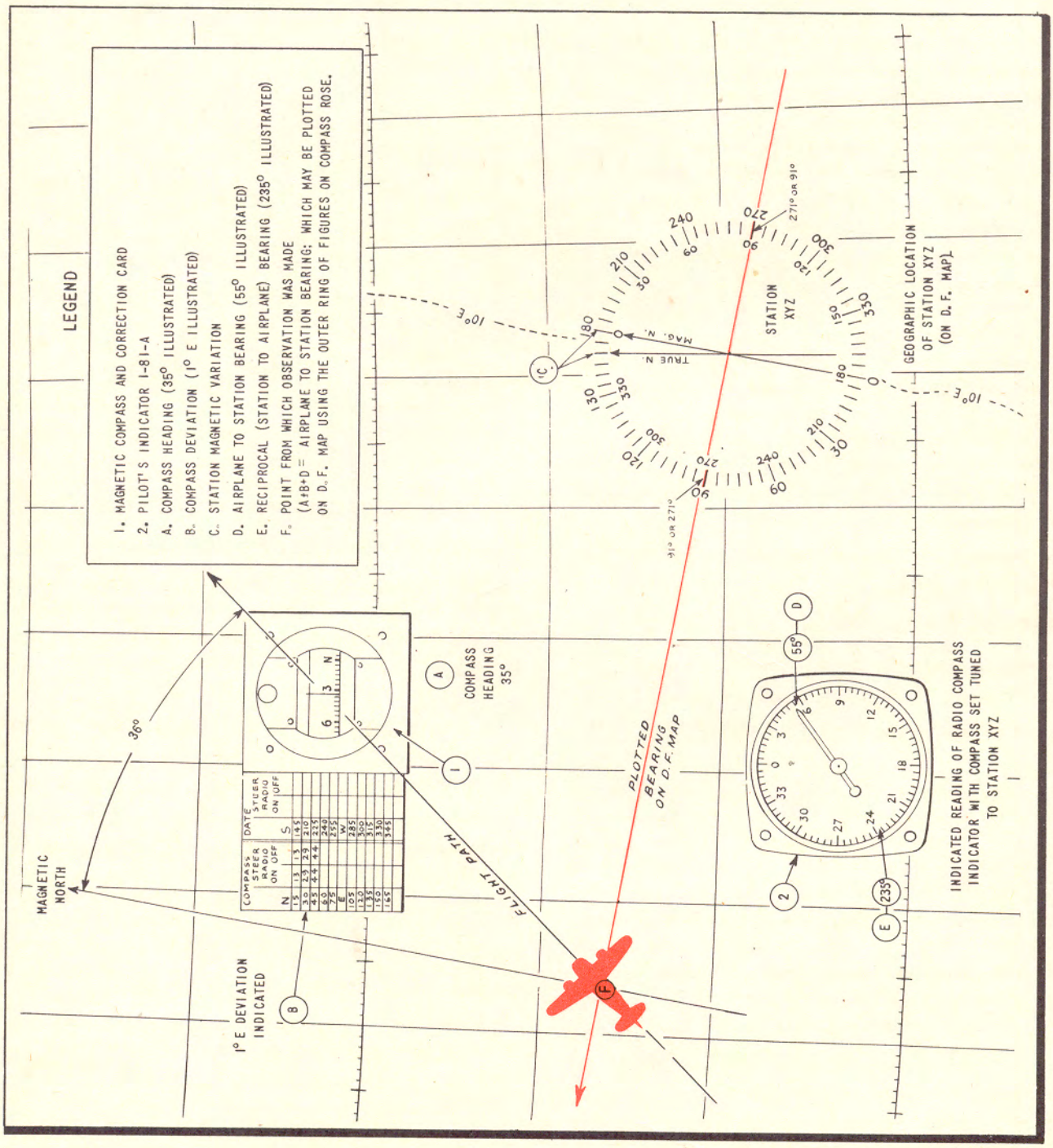


Figure 33—Plotting a Geographic Bearing with the SCR-269-G Radio Compass Set

Section III
FLIGHT OPERATING DATA

1. AIR-SPEED LIMITATIONS.

a. Do not exceed 300 mph IAS.

b. Do not lower the landing gear above 150 mph IAS.

c. Do not lower wing flaps above 135 mph IAS.

d. Do not open cowl flaps above 165 mph IAS.

e. Do not operate landing lights above 150 mph IAS.

f. Do not fly below 100 mph IAS in normal flight.

2. AIR-SPEED CORRECTION CHART.

a. The air-speed correction chart (figure 34) gives a quick method for converting air-speed indicator readings at any altitude to true air-speed figures.

b. The following example will show the use of the air-speed correction chart:

(1) Given an air temperature of 20°C, pressure altitude of 6,000 feet, and indicated air speed of 140 mph, find the true air speed.

(2) Method: Start with air temperature (20°C) at either top or bottom of chart. Move vertically up or down to pressure altitude curve (6,000 feet). From this point move horizontally to the right across the chart until the air-speed indicator reading curve is reached (140 mph). Then move vertically up or down to the true air-speed table. The answer in this case is 160 mph true air speed.

3. SPECIFIC ENGINE FLIGHT CHART.

a. Operating limitations and characteristics of the R-2800-51 engine, with which this airplane is powered, are summarized for ready reference on the Specific Engine Flight Chart. Flight operating personnel will be familiar with and observe this information.

b. Engine power ratings shown on the chart are defined as follows:

(1) TAKE-OFF.—Maximum recommended for take-off under the specified time limit of five minutes.

(2) MILITARY.—Maximum recommended for operation for periods not exceeding 15 minutes in duration.

(3) MAXIMUM CONTINUOUS.—Maximum recommended for operation with rich mixture in climb and level flight, for periods not exceeding 60 minutes in duration.

(4) MAXIMUM CRUISE. — Maximum recommended for operation with lean mixture.

(5) MINIMUM SPECIFIC CONSUMPTION.—The power at which greatest range can be obtained.

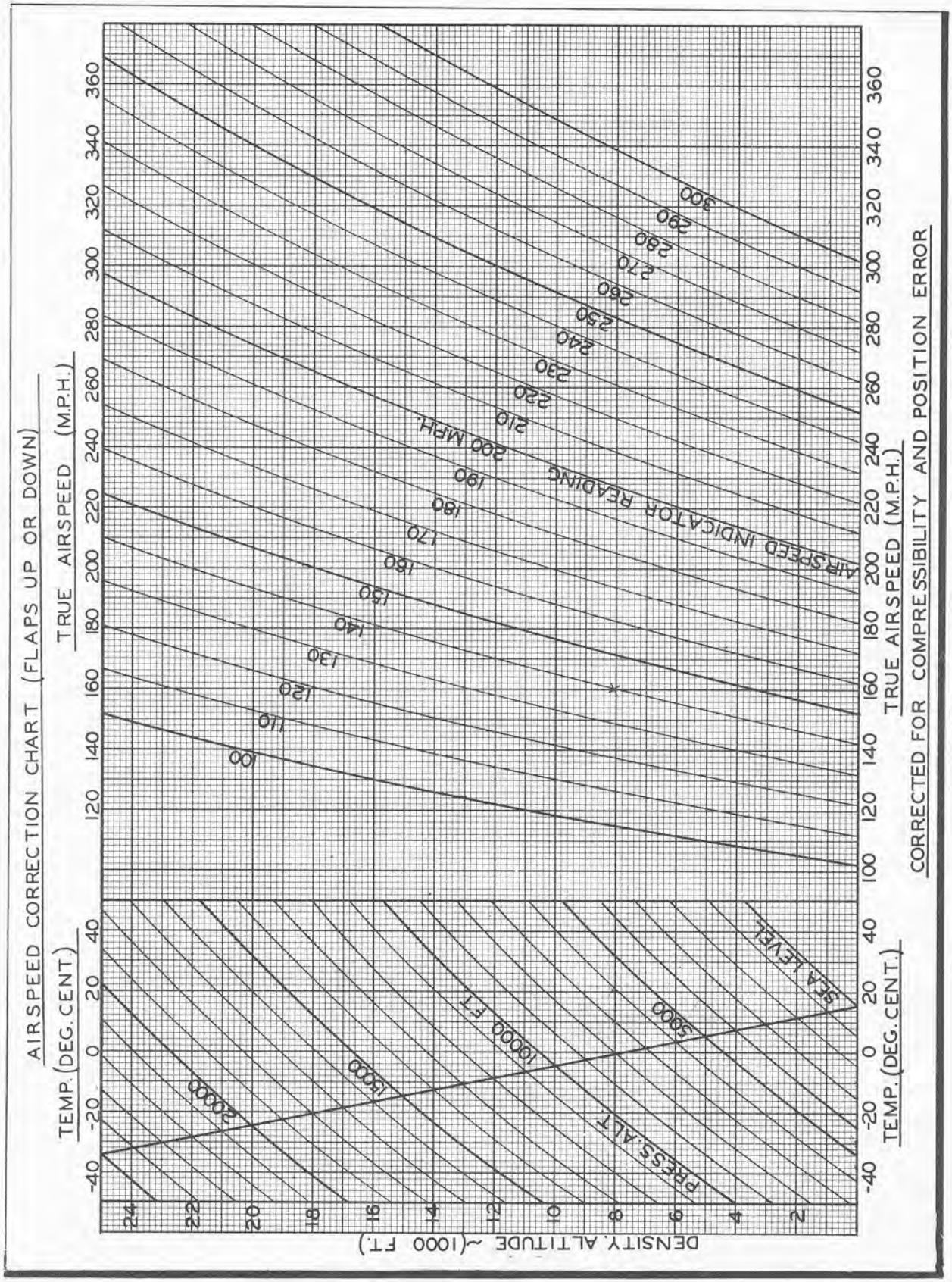


Figure 34—Air-Speed Correction Chart

SPEC. AN-H-8
DEC. 18, 1942

FORM ASC-512

AIRPLANE MODELS
C-46 SERIES

SPECIFIC ENGINE FLIGHT CHART

ENGINE MODELS
R-2800-51

CONDITION	FUEL PRESSURE (LB/SQ. IN.)	OIL PRESSURE (LB/SQ. IN.)	OIL TEMP. °C	OIL TEMP. °F	COOLANT TEMP. °C	COOLANT TEMP. °F
DESIRED	16	75	60-75			
MAXIMUM	17	80	100		AIR COOLED	
MINIMUM	15	75	40			
IDLING	7	25				

MAX. PERMISSIBLE DIVING RPM: 2800

CONDITION	ALLOWABLE OIL CONSUMPTION
MAX. CONT.	30 U.S.QT/HR 50 IMP.PT/HR
MAX. CRUISE	20 U.S.QT/HR 33 IMP.PT/HR
MIN. SPECIFIC	10 U.S.QT/HR 17 IMP.PT/HR

OIL GRADE: (S) 1120 (W) 1100A

SUPERCHARGER TYPE: GEARED TWO-SPEED, SINGLE STAGE

FUEL GRADE: 100 OCTANE

OPERATING CONDITION	RPM	MANIFOLD PRESSURE (BOOST)	HORSE-POWER	CRITICAL ALTITUDE WITH RAM	CRITICAL ALTITUDE NO RAM	BLOWER	USE LOW BLOWER BELOW:	MIXTURE CONTROL POSITION	FUEL FLOW (GAL/HR/ENG.) U.S.	FUEL FLOW (GAL/HR/ENG.) IMP.	MAXIMUM CYL. TEMP. °C	MAXIMUM CYL. TEMP. °F	MAXIMUM DURATION (MINUTES)
TAKE-OFF	2700	52	2000	1,500		L	9,600	A.R.	274	238	260	500	5
WAR EMERGENCY													
MILITARY	2700	50.8 43.5	2000 1600	1,500 13,500		L H	9,600	A.R.	274 213	238 177	260	500	15
MAXIMUM CONTINUOUS	2400	41.5 40	1600 1450	5,300 14,000		L H	8,700	A.R.	174 170	145 142	260	500	60
MAXIMUM CRUISE	2100	32.3 30.0	1100 975	10,000 20,000		L H	13,300	A.L.	88 56	73 47	232	450	
MINIMUM SPECIFIC CONSUMPTION	1600 1600	34.5 33.2	850 790	3,200 9,700		L H	5,800 5,800	A.L.	60 56	50 47	232 232	450 450	

REMARKS: Generator limitations restrict operation below 1600 rpm.
Allow 10% margin on fuel flow values.

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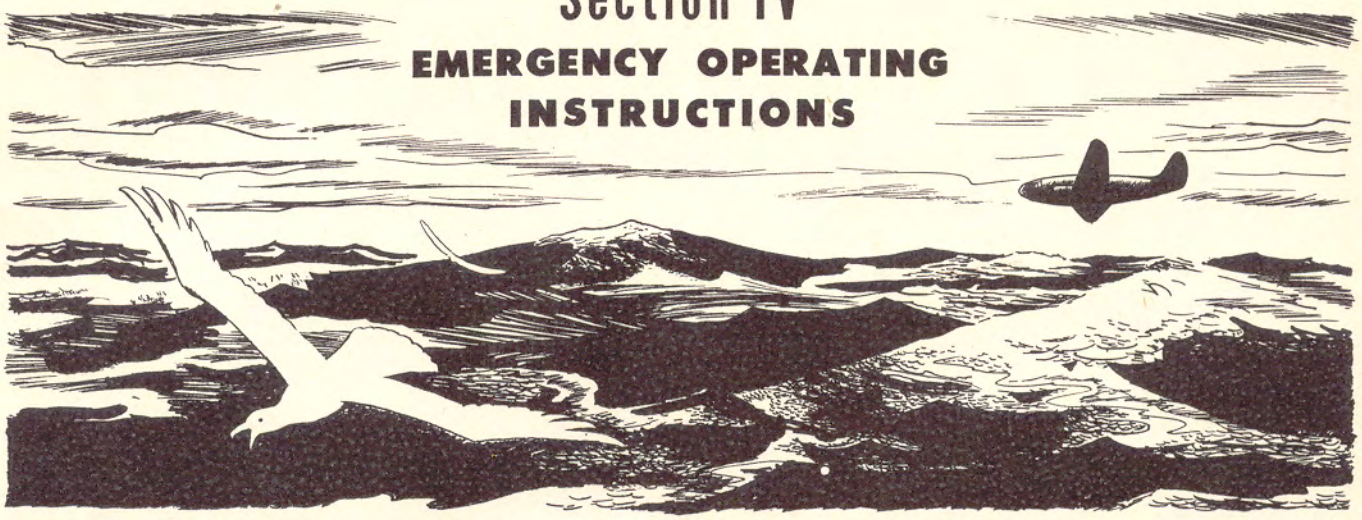
Section IV
EMERGENCY OPERATING INSTRUCTIONS



1. EMERGENCY EXITS.

a. Emergency exits are provided as illustrated on figure 35 and should be used as follows:

(1) TROOP DOOR.—The troop door is located in the forward section of the main cargo door on the left side of the fuselage. There is an outside and an inside latch handle on the lower center of the door. The door swings inward and upward and is held in its extreme open position by a snap and strap assembly. Pull type hinge pins are installed so this door can be used as an emergency exit, in the event cargo is being carried, that makes swinging the door inward and upward impossible. This door should generally be used by all personnel for entering and leaving the airplane.

(2) EMERGENCY DOORS. — There are three emergency doors in the main fuselage, which can be opened inward and downward by pulling inward on the two handles at the top of each door.

(3) PILOTS' UTILITY DOOR.—The utility door, on the left side of the pilots' compartment, opens into the slip stream and should never be used in a flight emergency unless the propeller on the left engine is feathered and has completely stopped rotating.

NOTE

The pilots' utility door normally should be used only when the airplane is on the ground or after a crash landing.

WARNING

The MAIN CARGO DOOR MUST BE KEPT LOCKED IN FLIGHT. This door swings outward and upward and when caught by the slip stream would probably be torn away.

2. ENGINE FAILURE AT TAKE-OFF.

a. The most serious emergency which can arise during take-off is failure of one or both engines. The action possible in this event is limited. *Every precaution should be taken against fire by cutting the battery switch.*

b. FAILURE OF ONE ENGINE DURING TAKE-OFF.—If one engine fails during the take-off run before the airplane leaves the ground, the airplane will swerve sharply. The operating engine should be stopped immediately and the brakes used to regain control of the airplane. It is impossible, even with a light load, to take off with one engine.

c. FAILURE OF ONE ENGINE BEFORE SAFE SPEED IS REACHED.—Sudden failure of one engine immediately after leaving the ground, and before reaching minimum safe flying speed for single engine operation, will cause the airplane to become uncontrollable. Throttle down and land straight ahead WITH LANDING GEAR UP.

d. SINGLE ENGINE FAILURE AFTER FLYING SPEED IS ATTAINED.

IMPORTANT

The minimum safe speed for single engine operation with a normal gross weight, and the

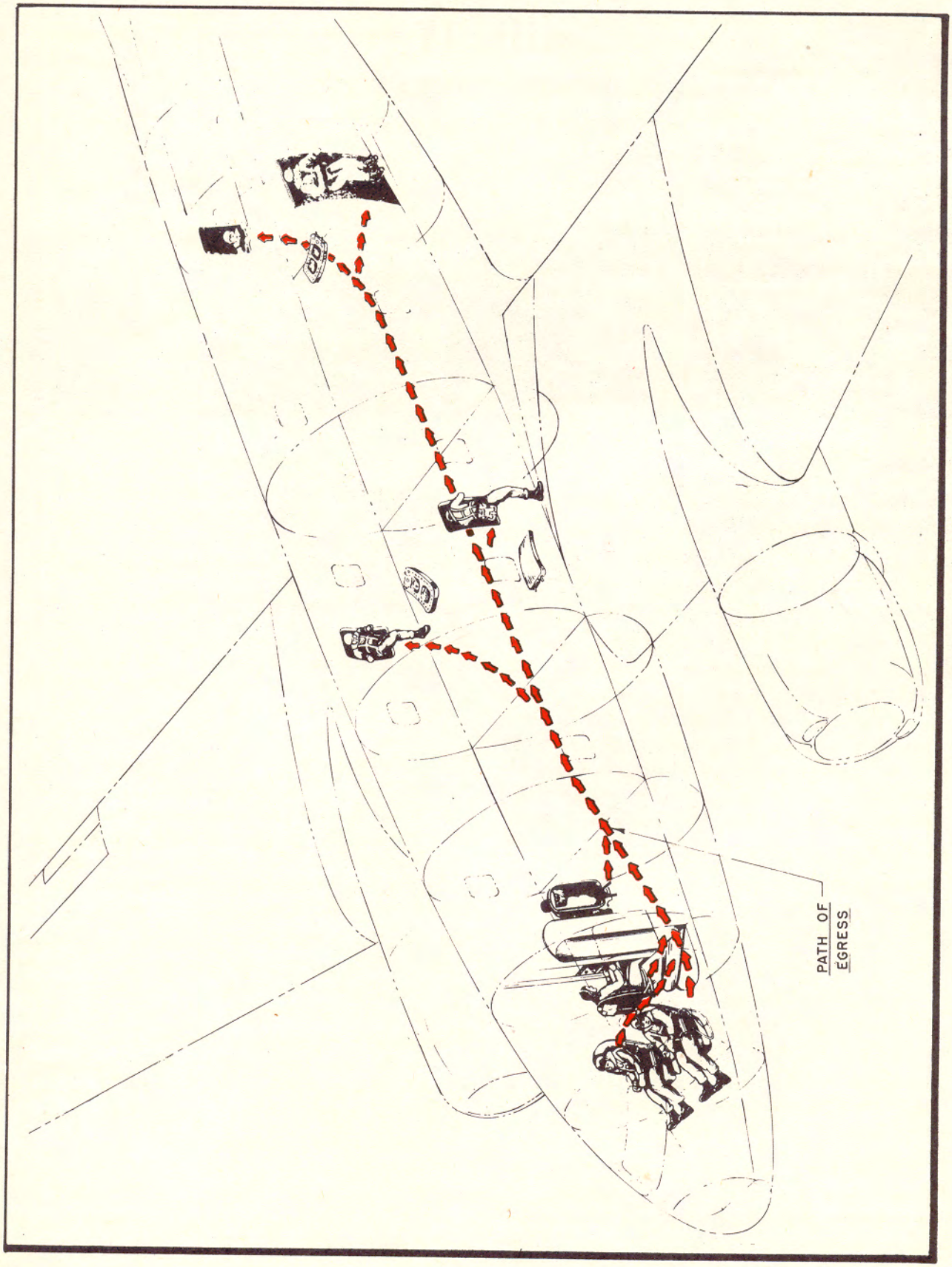


Figure 35—Emergency Exits

landing gear in the process of retracting, at the time of engine failure, is not less than 95 to 100 mph. The indicated air speed should not be allowed to drop below 100 mph at any time during flight on a single engine.

NOTE

The turn indicator will point to the faulty engine.

(1) Apply opposite rudder immediately, and at the same time bank the airplane with the running engine down until a reasonably straight course can be maintained. Use rudder trim tab to reduce heavy rudder forces.

(2) *Feather propeller* on dead engine as follows:

(a) Pull up the safety guard on the correct feather switch.

(b) On *Hamilton propellers,* depress the feathering button and release.

(c) On *Curtiss propellers,* place the feather switch to "feather position."

(d) Propeller will stop automatically when the feathering angle is reached.

(3) Carefully build up flying speed and altitude until a safe landing can be made.

CAUTION

Increase the power of the running engine to the fullest extent, but do not greatly exceed the rated take-off manifold pressure (52 inches Hg) as this will lead to detonation with a consequent loss of power. Do not exceed rated manifold pressure if it is not necessary.

(4) Set *dead engine controls* as follows:

(a) Close throttle.

(b) Move mixture control to "IDLE CUT-OFF" position.

(c) Turn fuel selector valve to "OFF" position.

(d) After dead propeller stops rotating, turn ignition switch "OFF."

(e) Close cowl flaps.

(f) Shut off fuel booster pump.

(5) If wing flaps are used for take-off, raise the flaps as soon as possible to reduce drag.

3. ENGINE FAILURE DURING FLIGHT.

a. If an engine fails while cruising, immediately increase the live engine to 2,400 rpm and 41.5 inches Hg manifold pressure.

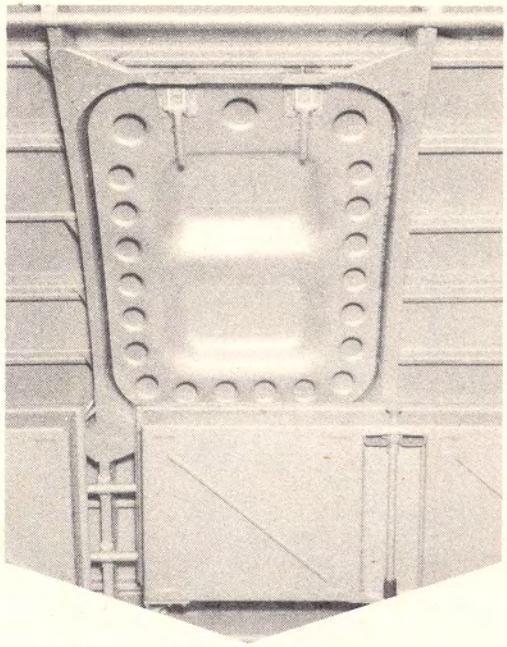


Figure 36—Emergency Door

b. Place dead engine propeller in high pitch.

c. If impossible to start the dead engine, or if additional performance is imperative, move mixture control to "IDLE CUT-OFF."

d. Feather propeller of dead engine as in paragraph 2.*d.*(2) above.

e. Turn fuel selector valve to "OFF" position, cut ignition switch, close cowl flaps, and shut off fuel booster pump of dead engine.

f. Reduce rudder forces, which will be heavy, by using rudder trim tab, thereby permitting flight on a straight course with the wings nearly horizontal. Do not allow the running engine to rise above the dead engine while flying at low speed.

g. One hundred and twenty mph is the minimum safe speed at which a turn can be made. Make all turns with the dead engine on the inside of the turn. Never make steep turns with the dead engine down.

h. Avoid rapid changes in speed or power. If the speed falls below the minimum for control, regain speed by losing altitude at reduced power instead of applying additional power.

i. Avoid violent maneuvers.

j. The airplane will fly well on one engine and by adjusting the aileron and rudder tabs, will fly "hands off." However, the flight should be terminated at the first available landing field.

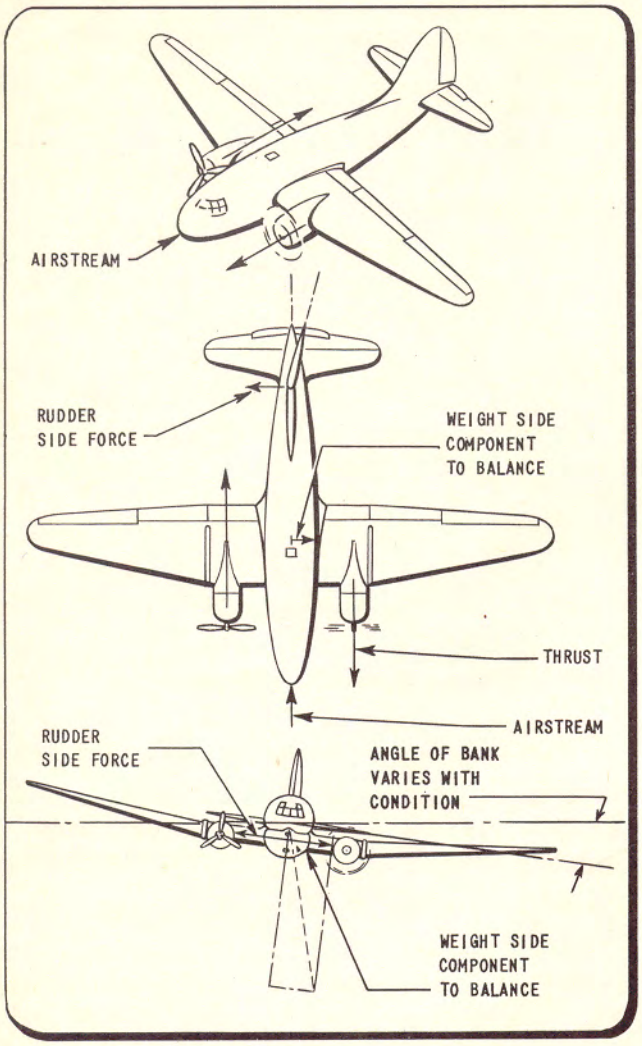


Figure 37—Use of Rudder in Single Engine Flight

NOTE

For flight planning, refer to "Single Engine Flight Operation Instruction Charts," Appendix II.

k. RESTARTING ENGINE.—If, while flying at sufficient altitude (not less than 2,000 feet) and speed, it is desired to attempt to start the dead engine, the following procedure should be carried out:

(1) Turn the ignition switch "ON" with the throttle closed.

(2) Set the propeller control to the minimum rpm (full back) position.

(3) Turn the fuel selector valve control on a full tank.

(4) Move the mixture control to the "AUTO-RICH" position.

(5) *Unfeather the propeller* as follows:

(a) Raise the safety guard. On the *Hamilton propeller,* push the feathering button full inward and hold until the tachometer reading reaches 800 rpm.

(b) On the *Curtiss propeller,* return the feather switch to "NORMAL" position and hold the selector switch to "INCREASE RPM" until the tachometer reading reaches 800 rpm.

(6) If the engine "takes" and starts to run, operate it at 800 rpm until the required engine temperature is obtained. Then open the throttle gradually, causing the engine to speed up to the minimum rpm or the speed for which the governor is set. Adjust mixture, throttle, and governor setting to the desired power and engine rpm and synchronize.

NOTE

With the Curtiss propeller, after the engine has resumed normal operating temperature, place the selector switch in "AUTOMATIC" position and set throttle and propeller control lever for normal operation.

(7) Open engine cowl flap.

(8) If the engine does not start, feather the propeller again, shut off controls, and continue on one engine to the nearest landing field.

l. PRECAUTIONS FOR UNFEATHERING PROPELLER.

(1) In flight, the propeller begins to windmill and crank the engine as soon as it starts to unfeather. The engine speed increases rapidly as power is applied and unfeathering proceeds.

(2) It is imperative when unfeathering a propeller, after the engine has cooled, to idle the engine until it is thoroughly warmed up before bringing it up to speed; otherwise damage may result due to improper lubrication. The windmilling action of unfeathering is a powerful cranking force and will easily overspeed the engine beyond a safe idling speed, unless care is exercised to stop unfeathering while the propeller is still at a very high angle.

(3) After unfeathering to about 800 rpm at an air speed of approximately 125 mph, the engine may be permitted to warm up as long as desired without a tendency to speed up.

(a) With *Hamilton propellers*, it is only necessary to open the throttle to cause the propeller to shift to a lower angle when the governor takes charge.

(b) On *Curtiss propeller* installations, it will be necessary to place the selector switch in "AUTOMATIC," or to hold the toggle in "INCREASE RPM," before the engine speed will increase.

CAUTION

If practicing feathering with a Hamilton Standard propeller while flying, the period of time the propeller can be left in the feathered position must not exceed 15 minutes. Otherwise, damage to the engine may occur when restarting. This restriction does not apply to airplanes equipped with Curtiss propellers. All practice operations must be above 5,000 feet.

4. PROPELLER GOVERNOR FAILURE AT TAKE-OFF.

a. On take-offs, where throttles are opened up too suddenly to the allowable rated power of 52 inches Hg, one or both engines may over-rev momentarily causing a howling sound. This is normal and the governors usually restore the rpm to 2,700. If, however, acceleration of the airplane increases, and the rpm goes above the allowable limits without immediately coming back, the following remedies should be applied:

(1) Cut the throttles and discontinue the take-off. On most fields this can be accomplished without danger even after reaching take-off speeds of from 75 to 85 mph.

(2) GROUND CHECK.—With *Curtiss propellers* installed, check to see that the circuit breaker is "ON" and that the selector switch is in "AUTOMATIC." If the propeller controls are in the proper settings, take-off should not be attempted until the propeller has been checked.

b. If shortly after the take-off a propeller governor fails, allowing the rpm to increase rapidly, a "run-away" propeller will result. The seriousness of the emergency depends mainly on the air speed, rpm, and power at the time of governor failure.

NOTE

The following instructions apply to the Curtiss propeller only.

(1) If both the automatic and manual control circuits of the propeller fail (as with a dead battery) at 120 mph, 52 inches Hg manifold pressure, and 2,700 rpm, with landing gear retracting or fully retracted, and air speed is increased, the rpm will increase rapidly. If the air speed is held at 120 mph, the rpm should remain nearly constant at 2,700. It is safer, however, to obtain an air speed of 150 mph. The rpm will then probably increase to 3,000 or more.

NOTE

Remember that Curtiss electric propellers need electricity to operate. Generators must be turned "ON" and operating. The circuit breaker must be "ON" at all times.

(2) If the manual control circuit is operative, correction may be made by allowing the air speed to increase as desired, and reducing the rpm to safe limits by placing the selector switch to "DECREASE RPM."

(3) If the engine overspeeds on take-off, the following procedure must be accomplished very rapidly:

(a) Check to see that the selector switch is in "AUTOMATIC" position and that the circuit breaker is "ON."

(b) Let the good engine alone, but be prepared for yaw toward the "run-away" engine.

(c) Pull back the propeller governor control handle and if the rpm does not decrease immediately, hold the selector switch to "DECREASE RPM." If this does not reduce rpm at once, release the selector switch from the "DECREASE RPM" position and allow the propeller to remain in fixed pitch.

(d) Reduce the manifold pressure on the "run-away" engine to hold the rpm at a maximum of 3,000.

(e) WATCH FOR YAW.—Fly with caution until a safe air speed and altitude are reached. It may be necessary to reduce the power and rpm on the good engine to keep the airplane under control. Use the trim tabs to obtain the best flying conditions and hold the air speed to 150 mph in level flight. If the nose is dropped, power must be reduced to keep from increasing the air speed, which will cause the fixed propeller to increase in rpm. With the good engine slightly down and acting as a pivot, make all turns gently.

(f) Return to the landing field as quickly as possible.

(g) It should be possible by experimenting to find the best setting for the "run-away" engine. Reduce the manifold pressure to reduce the rpm as low as possible, holding the air speed constant. Do not reduce the manifold pressure below 15 inches Hg until ready to land.

(b) Exercise caution in making the approach for a landing in order not to undershoot the field. The airplane can normally be brought to a stop in a very short distance.

5. PROPELLER GOVERNOR FAILURE DURING FLIGHT.

a. HAMILTON STANDARD HYDROMATIC PROPELLERS.—If one governor fails, the corresponding propeller will be feathered in accordance with paragraph 2.*d.*(2) above, this section, and single engine operation conducted.

b. CURTISS ELECTRIC PROPELLERS.

(1) If one or both governors fail on airplanes equipped with Curtiss propellers, the rpm may be controlled manually by use of the selector switch, and the engines continued in use.

(2) In the event of such a failure, the propeller should be set to rated cruising rpm by means of the selector switch, and the manifold pressure reduced to hold the air speed constant. Do not reduce manifold pressure below 15 inches Hg until ready to land.

NOTE

With Curtiss propellers, the engine rpm may be controlled by holding the selector switch in either "INCREASE RPM" or "DECREASE RPM."

(3) Approach for a landing cautiously and do not undershoot the field.

6. EMERGENCY OPERATION OF THE HYDRAULIC SYSTEM.

a. Hydraulic system failures will be indicated in several ways, such as failure of the landing gear to retract fully after take-off, pressure gage reading below normal (1,200 pounds per square inch), etc.

b. ENGINE-DRIVEN HYDRAULIC PUMP FAILURE.—In the event of failure of either engine-driven hydraulic pump or of the lines to and from the pumps, proceed as follows:

(1) Turn the main hydraulic accumulator valve "OFF" so that the pressure is sufficient only to overcome friction of flow in the lines. (See figure 6-3.) Leakage of fluid will then be held to a minimum. To close the main accumulator valve, pull "UP" on the control knob located on the copilot's right, on the window ledge.

(2) If the fluid level in the pumps falls below the suction level, the hydraulic pumps will run dry and may be permanently damaged if operated in this manner for any length of time. If less than ten minutes out from a landing field where repairs can be made, return to the field, operating the engines at the lowest practicable speed.

c. LANDING GEAR HYDRAULIC FAILURE.—If normal hydraulic pressure exists before take-off and the landing gear fails to retract after take-off, the cause may be an air lock around the hydraulic pumps. The failure may be of a more serious nature and if possible, the following procedure should be followed:

(1) Return the landing gear handle to the "DOWN" position.

(2) Shut "OFF" the main accumulator control valve by pulling the control knob up.

(3) Pump the landing gear "DOWN" and lock with the hydraulic hand pump.

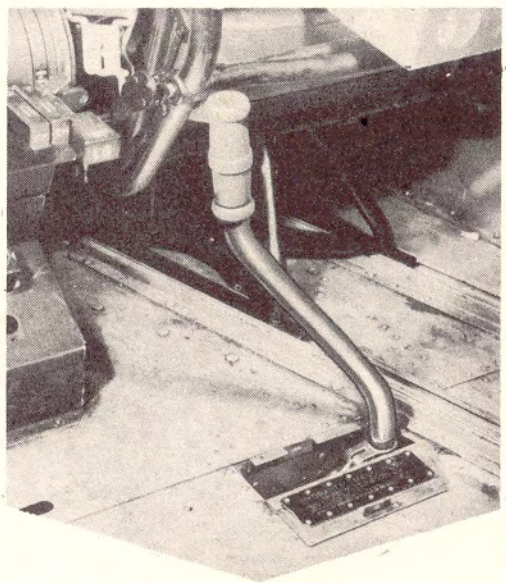


Figure 38—Hydraulic Hand Pump Handle in Position

(4) To operate the HYDRAULIC HAND PUMP, remove the pump handle from its stowage clips below the liaison radio. Lift up the hatch in the pilots' compartment floor to expose the pump assembly. Insert the pump handle into the socket on the pump assembly, push down on the handle, and turn the handle in the socket until it is locked in place. Pump the handle vigorously to produce the required pressure. (See figure 38.)

(5) Pump the flaps down as required by placing the flap control at the desired setting.

(6) Check the flap and wheel indicator to insure that the gear is down and locked. If the gear is not locked "DOWN," the warning horn will sound when the engines are throttled below 15 to 18 inches Hg of manifold pressure with the propellers in the "INCREASE RPM" or low pitch position.

(7) Make a normal landing. Brake pressure will be supplied by the hydraulic brake accumulator.

(8) Have the hydraulic system checked for malfunctioning.

d. EMERGENCY MANUAL OPERATION OF THE LANDING GEAR.—In the event of the failure of the complete hydraulic system, the landing gear can be lowered manually and locked in the "DOWN" position as follows:

(1) If both the main hydraulic system and the hydraulic hand pump fail to lower and lock the landing gear, place the landing gear warning horn switch in the "OFF" position.

(2) Place the landing gear control in the "DOWN" position and pull the emergency "UP" latch release handle as far as it will go. The emergency release also actuates a dump valve in each nacelle and one in the tail wheel compartment, which vent the fluid in the retracting struts overboard, thus relieving back pressure in the struts and system. This emergency release handle is below the liaison radio shelf on the compartment floor and is painted red for quick identification. The emergency release has a ratchet assembly to retain it in the "UP" position.

(3) Open the hatch in the pilots' compartment floor, just aft of the pilot's seat. Just below the sill on the outboard side are two chain and sprocket assemblies encased in a fairing. The hand crank is stowed in clips on the under side of the hatch.

(4) Remove the crank from the stowage clips on the hatch and insert the crank in the forward hole in the fairing below the hatch sill. (See figure 39.) Crank slowly counterclockwise with a steady force sufficient to displace the hydraulic fluid in the retracting strut until the strut locks. Remove the crank and insert it in the aft hole and repeat the cranking procedure. Place the warning horn switch on the overhead panel in the "ON" position, and when both landing gear assemblies are locked in the "DOWN" position, the warning horn will cease to blow.

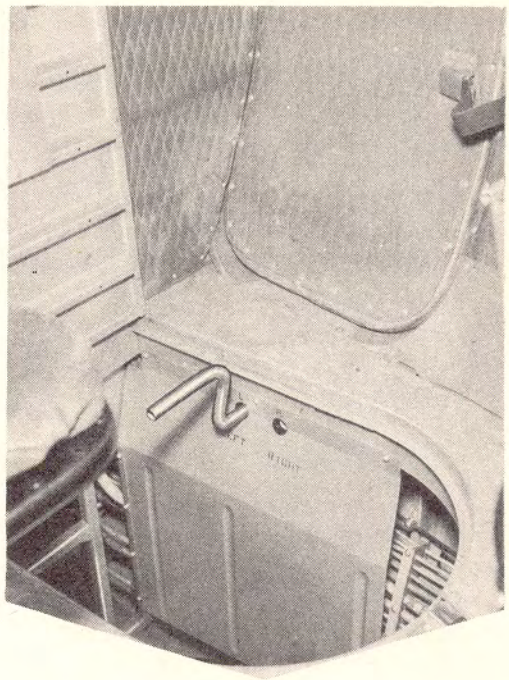


Figure 39—Hydraulic Emergency Release Handle in Position

(5) A bungee assembly on the tail gear will positively lock the tail gear in the "DOWN" position when the "UP" latch is released by the emergency release handle, stowed on the main cargo compartment aft bulkhead wall.

7. FUEL SYSTEM FAILURE.

a. FUEL PUMP FAILURE.—In the event of a fuel pump failure, the booster pump on the side of the fuel pump should maintain a fuel pressure sufficient for normal engine operation.

b. BROKEN FUEL LINE.—If a break occurs in a fuel line, warning will be given by loss of pressure on the fuel pressure gage. If this condition arises, the fuel supply to the affected engine should be turned off by turning the fuel selector wheel valve to the "OFF" position. This will isolate the failing engine. Feather the propeller on the failing engine and when the propeller has stopped rotating, cut the ignition switch. Land as soon as possible and repair the damage.

c. POWER RECOVERY AFTER FUEL RUN-OUT.—Power recovery after a fuel tank has run dry is considerably delayed by air and vapor passing through the vapor separator into the regulator body of the carburetor. It has been found that power recovery is fastest when the fuel control is in the "FULL RICH" position.

(1) If a tank has been allowed to run dry to the extent that the engine slows down, the throttle on the affected engine should be closed, the mixture control moved to the "FULL RICH" position, and the fuel selector wheel valve turned to another fuel tank.

(2) The throttle should then be opened and the mixture control should be returned to its previous setting after the engine has assumed its normal operation.

d. FUEL SYSTEM CROSS FEED.

(1) In the event of the failure of both the engine-driven fuel pump and the booster pump on either engine, the cross feed valve should be opened. The operating pump combined with the booster pump of the opposite engine can then be used to feed both engines.

(2) If one engine should fail and greater power is desired for the operating engine, necessitating the use of the fuel supply of the failed engine, the cross-feed valve should be opened so that all fuel is available to the operating engine.

(3) The cross-feed valve is located approximately half way between the pilots' compartment door and the main cargo door on the ceiling of the main cargo compartment. The cross-feed valve is normally sealed in the "OFF" position, so it will be necessary to break the seal before pulling the valve control knob up to open the valve.

CAUTION

With a fuel system failure, watch for evidence of fire. At the first sign of fire breaking out in an engine nacelle, operate the engine fire extinguisher equipment.

8. OIL SYSTEM FAILURE DURING FLIGHT.

a. The following procedure should be followed for single engine oil system failure.

b. Turn the fuel booster pump "OFF" and place the fuel selector valve control in the "OFF" position.

c. Feather the propeller on the affected engine. (Refer to instructions in paragraph 2.*d.*(2), this section.)

d. Place the throttle control in the "IDLE CUT-OFF" position, and as soon as the propeller stops rotating, cut the ignition switch on the engine affected.

CAUTION

Be sure to operate the correct controls so that the good engine is not cut-out.

e. Fly the airplane on the single engine as outlined in paragraph 3., this section, and land as soon as possible. Watch for evidence of fire.

9. FIRES.

NOTE

Notify crew members to attach their parachutes, and to stand by for further instructions. If flying low and conditions permit, gain as much altitude as possible. Put fire extinguishers in operation as soon as fire starts.

a. ENGINE FIRES.

(1) Shut off gasoline supply and open throttle.

(2) Open all emergency exits.

(3) When fire is extinguished, land as soon as possible to determine and correct cause of fire before continuing flight.

b. FIRE IN ONE NACELLE.—A fuel or oil system failure in flight may cause fire to break out in one of the engine nacelles.

(1) Pull the fire extinguisher release handle (Red) on the instrument panel corresponding to the engine on fire.

(2) Make certain the correct release handle is pulled or carbon dioxide gas will be discharged on the wrong engine.

c. FIRE IN BOTH NACELLES.—If fire breaks out in both nacelles, the same procedure should be used as for a fire in a single nacelle, except that *both* engine fire-extinguisher release handles (Red) must be pulled at once.

NOTE

Once either one of the RED handles of the engine fire extinguisher system is tripped, complete emptying of that engine's system cannot be prevented.

d. WING FIRES.

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

(2) Open all emergency exits.

(3) Attempt to extinguish fire by side slipping.

e. FIRE IN FUSELAGE.—In the event of fire in the fuselage, there is one hand fire extinguisher located in the pilots' compartment, and two hand fire extinguishers located in the main cargo compartment—one just aft of the main cargo door, and one just aft of the pilots' compartment door above the hydraulic reservoir.

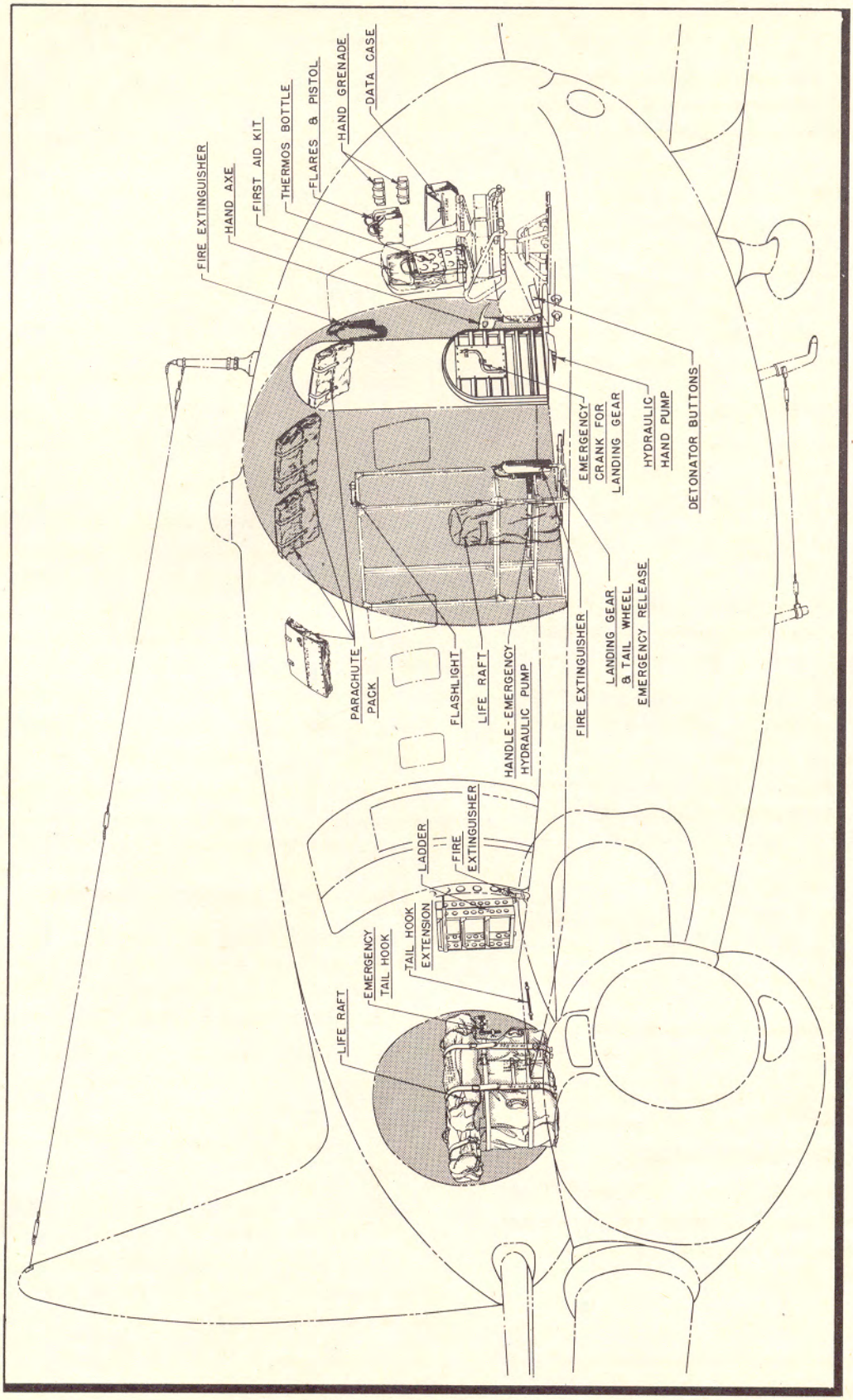


Figure 40—Emergency Equipment

(1) CARBON DIOXIDE HAND FIRE EXTINGUISHERS.

(a) To release the portable carbon dioxide fire extinguishers from their brackets, pull out on the retainer strap handle and lift the extinguisher from the bracket.

(b) To operate the carbon dioxide fire extinguishers, swing the horn up and discharge close to the base of the fire. Control the discharge with the trigger valve at the top of the cylinder.

(c) To shut off flow of gas, return horn to clip on side of cylinder. Extinguisher must be recharged after each use.

WARNING

White discharge from carbon dioxide hand fire extinguishers is "dry ice." Handle horn on cylinder carefully to avoid frostbite.

(2) CARBON TETRACHLORIDE HAND FIRE EXTINGUISHER.

(a) To release the carbon tetrachloride fire extinguisher, pull out on the retainer strap handle and remove the cylinder from its bracket.

(b) Stand as far as possible from the fire when using a carbon tetrachloride extinguisher; effective range is 20 to 30 feet.

(c) To operate, turn handle and pump plunger. Keep stream full and steady. To shut off, push handle in and turn until sealing plunger is depressed.

WARNING

When sprayed on a fire, carbon tetrachloride produces phosgene, an extremely poisonous gas, which can be harmful, even in small amounts, and if inhaled in sufficient quantities may prove fatal. Do not use in a confined area and do not stand near fire. OPEN WINDOWS AND VENTILATORS immediately after fire is extinguished.

10. ELECTRICAL SYSTEM FAILURE.

a. BATTERIES COMPLETELY DISCHARGED.—If both generators have ceased to function and this has not been noted in time to save the remaining energy in the batteries, proceed as follows:

NOTE

Usually there will be an indication of the coming failure by oscillation of the landing gear and flap indicators, or oscillation of the Autosyn instruments. A check of the overhead panel voltmeter and ammeters will also indicate if there is a failure in the electrical system.

(1) Immediately turn off both generator switches and all electrical equipment.

(2) Immediately turn off both battery switches.

(3) Leave ignition switches "ON." Engine will operate on magnetos.

NOTE

Without electric current, Curtiss electric propellers will operate as fixed pitch propellers.

(4) After 15 to 30 minutes, the batteries should rebuild sufficient energy to allow approximately five minutes' use of electrical equipment (estimate only).

b. BATTERIES PARTIALLY DISCHARGED.—If both generators have failed, but the batteries are not completely discharged, follow the same procedure outlined above.

(1) With a known reserve of electrical energy in the batteries, it is possible to turn on the battery switches every 10 to 15 minutes to check engine instruments, etc.

(2) Reserve enough battery energy to make a normal landing at the nearest landing field.

c. Should one generator fail, indicated by a low or zero voltmeter and ammeter reading, the generator and battery switches should be turned "OFF."

11. EMERGENCY LANDINGS ON LAND.

a. Emergency landings on unprepared fields, on questionable terrain, and wherever there is a probability of overrunning the available landing area, should be made with LANDING GEAR RETRACTED.

(1) As much weight as possible should be dropped so the airplane can be landed at as slow a speed as practicable with the shortest possible ground run.

(2) Lower flaps manually to provide normal drag and lift.

b. Safety belts should be secured and personnel prepared to leave the airplane immediately upon landing.

c. Throw battery switches to the "OFF" position just before contacting the ground. Precautions against fire must be taken upon landing.

d. A first-aid kit is stowed on the back of the pilot's seat.

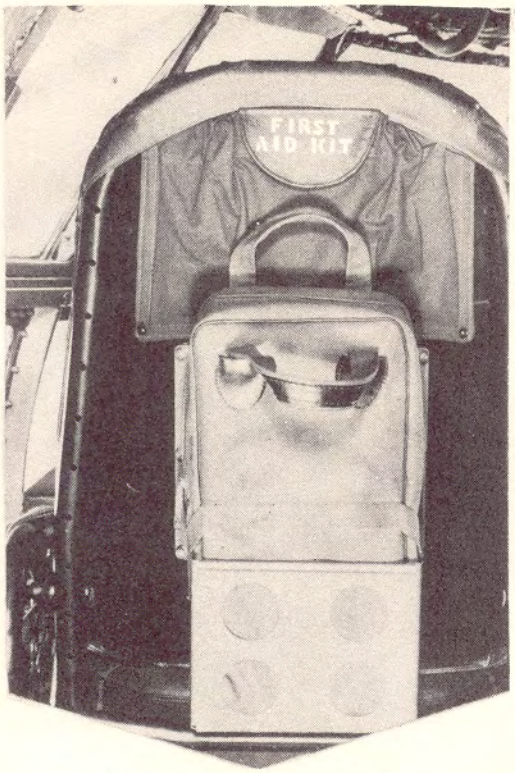


Figure 41—First-Aid Kit

CAUTION

In landing, the elevator tab must be quickly employed as trim changes very rapidly with the changes in speed. Elevator forces increase with the stick angle, and both operations are practically simultaneous.

12. SINGLE ENGINE LANDING.

a. Make the approach for landing at least 1,000 feet above the field if possible.

b. Maintain constant power and speed (not less than 120 mph indicated air speed) until successful landing is reasonably assured.

c. Partially reduce rudder trim tab before landing to prevent excessive rudder forces.

d. Full flaps should be used as soon as there is no danger of undershooting.

e. Lower landing gear. This should not be done too soon, since the airplane cannot maintain altitude on one engine with landing gear extended.

f. If the dead engine can be used (such as when it has been stopped for low oil pressure), restart and operate at reduced power to make a normal landing with both engines running.

g. If an attempt to land is unsuccessful, raise wheels at once. Apply power gradually. Raise flaps as soon as safe flaps-up speed is reached and go around again.

13. EMERGENCY TAKE-OFF IF LANDING IS NOT COMPLETED.

a. If 2,400 rpm and 41.5 inches Hg manifold pressure are being used for landing, a take-off can normally be made in case of failure to complete the landing, if there are no obstacles and the loading is normal. Extreme caution should be used, however, since with the controls set as above, the engines are only developing 1,600 HP.

(1) If any doubt exists as to the advisability of attempting a take-off at these control settings, gradually increase the rpm to 2,700 and the manifold pressure to 52 inches Hg to give the maximum of 2,000 HP for take-off.

b. If a take-off is made during an attempted landing, retract the landing gear as soon as possible and proceed with the take-off in the normal manner.

14. EMERGENCY LANDING ON WATER (DITCHING).

a. PREPARATION FOR DITCHING.

(1) In the event of a forced landing on water, every precaution must be taken to keep the airplane under control by not allowing the airplane's speed to go below 100 mph. At this speed there is little danger of the airplane stalling, and the pilot should be able to execute a belly landing without difficulty.

(2) If existing orders permit, pilot radios on command transmitter to contact other airplanes, surface craft, or nearby shore stations.

(3) Copilot helps pilot with controls.

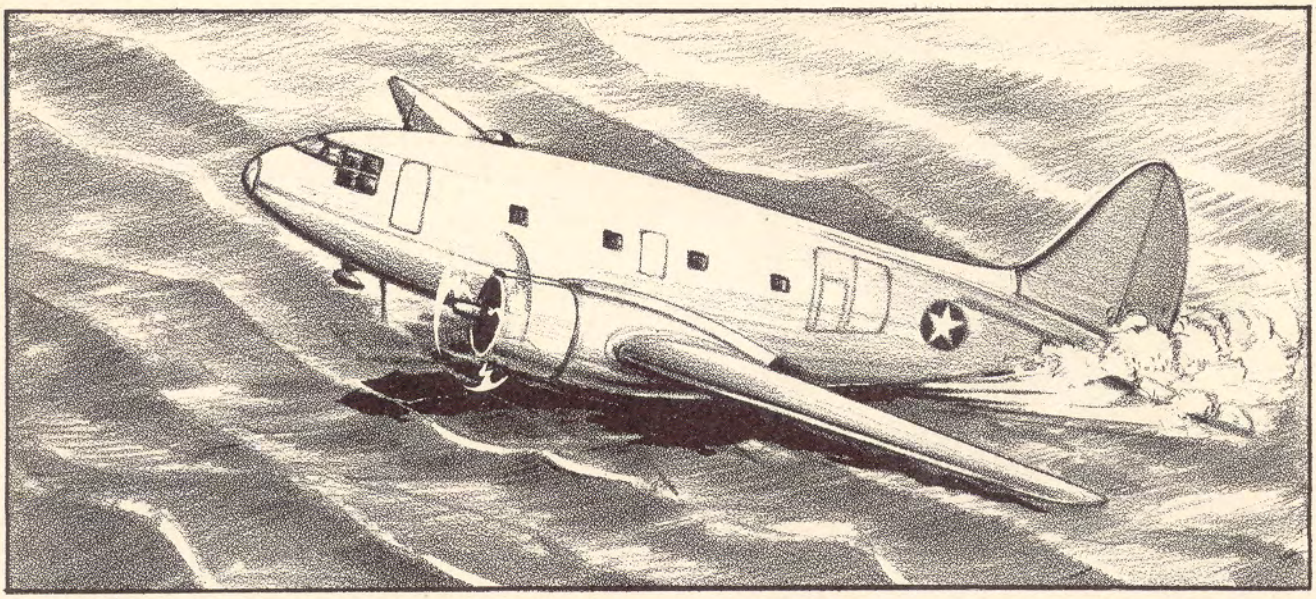
(4) If orders permit, the radio operator radios on liaison transmitter to contact more distant stations (ship and shore), sending distress signals on designated frequency, including time and position signals. He also transmits course, altitude, ground speed, and estimated position of landing. The radio operator's "ditching station" should be as near as possible to his flight position.

(5) Crew members jettison all possible equipment and cargo.

(6) Navigator releases EMERGENCY EXITS. (See figure 35.)

IMPORTANT

Emergency exits must be opened prior to landing, as the impact on striking the water may jam them if they are closed.



(7) Pilot, copilot, navigator, and radio operator and any other personnel make sure safety belts and parachute harnesses are secure.

(8) The pilot should operate the warning bell switch on the center instrument panel before landing, to give any personnel in the main cabin a chance to make necessary preparations.

(9) Pilot warns crew of "ditching," using interphone set at "CALL," or some other prearranged signal.

c. PREPARATION FOR DITCHING AT NIGHT.

(1) Same procedure as for day except:

(2) Turn on all lights. They may assist in landing, or in attracting searching parties, and they will assist in abandoning the airplane.

(3) Judgment of height over water at night is difficult. One way of telling how high the airplane is above the water is to lower the trailing antenna. Instruct the radio operator to clamp the transmission key down and to watch the ammeter. The current will drop as soon as the antenna touches the water. The radio operator should inform the pilot as soon as this happens.

IMPORTANT

Do not throw the emergency radio transmitter (SCR-578-A) overboard before landing at night. Have the radio operator or some other crew member take it along when leaving the airplane.

d. CONDITION OF SEA.—At least an elementary understanding of sea conditions is important in making a water landing.

(1) With a calm sea and little or no wind, it will be possible to land the plane with the lowest safe indicated air speed. Such a sea is deceptive with regard to judgment of height, particularly if the surface is glassy. If there are ripples on the surface, judgment of height is improved.

(2) Waves always move with the wind except close inshore and in fast flowing estuaries. Waves are the direct result of the wind, which creates and maintains them.

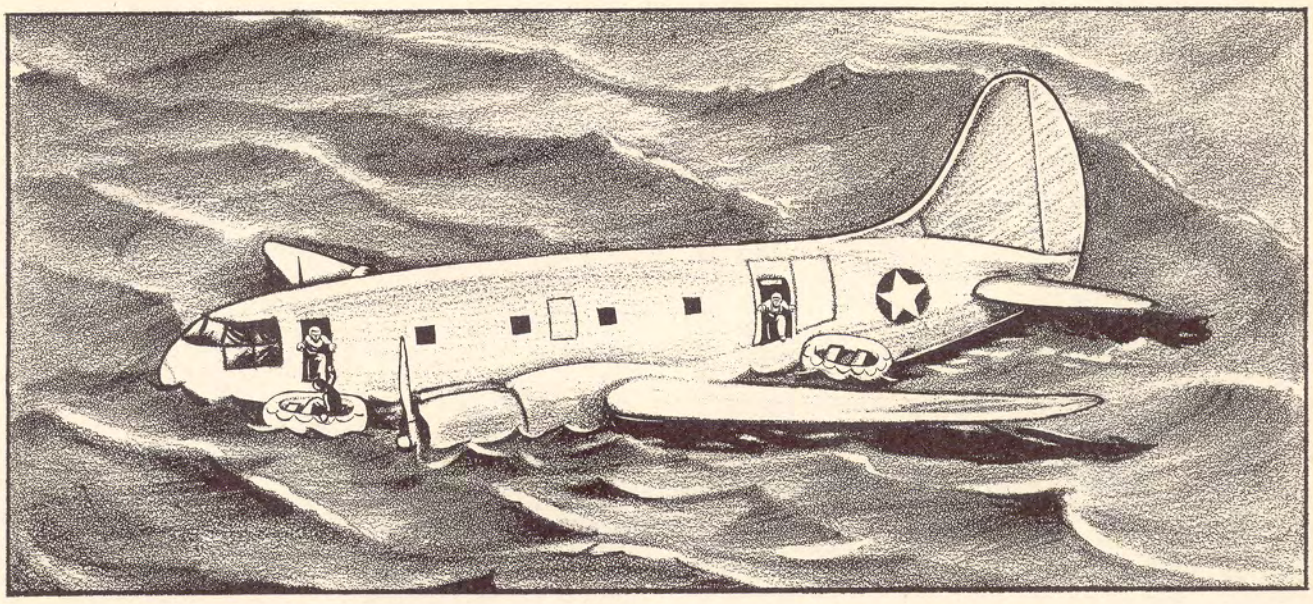
(3) A swell is an undulating movement of the surface caused by a past or distant disturbance of the sea. It does not necessarily move with the wind and has no breaking crests.

e. WIND SPEED AND DIRECTION.—To determine wind speed and direction in the absence of any fixed mark (such as land or a ship), the pilot can only judge motion relative to the motion of the waves.

(1) Waves, as distinct from swells, move down wind and the line of the wind can be taken to be at right angles to the lines of the wave crests, but doubt may exist as to which way the wind blows along the line.

(2) If there is sufficient wind, waves break down wind. This can be easily observed from a low height, and if the airplane is flown at right angles to the breaking waves the direction of drift will be apparent.

(3) If there is enough wind to blow the spray off the wave crests, the direction in which the spray is blown is a reliable indication of wind direction.



(4) Smoke from a ship is a useful guide as smoke drifts with the wind and if this drift can be determined, the wind direction will be indicated. Do not make the mistake of supposing that the wind direction is along the trail of the smoke.

(a) The smoke trail is the result of wind speed and direction, and also of the ship's forward motion. The wind direction is between the forward path of the ship and the smoke trail.

(b) Only when the wind is blowing in a similar direction to the forward path of the ship will the smoke be a reliable indication of direction. The wind in this case will be from astern.

(5) Where the water's surface is not broken up, it is possible to watch gusts rippling the surface in great sweeps, which will indicate the wind direction.

f. USE OF POWER.

(1) If only one engine is available, a little power should be used to flatten the approach, but the engine should not be used to such an extent that the airplane cannot be turned against it right down to the stall with a margin of rudder power in hand. Under no circumstances should the engine be opened up during the final stage of landing.

(2) The value of power in water landing is so great that the pilot should always land before the fuel is completely exhausted when it is certain that shore cannot be reached.

g. APPROACH AND LANDING ON WATER.

(1) Landing gear must be retracted.—*Important.*

(2) If the wind is blowing across the swell, a cross sea is created with the waves (which are moving down wind) running on the swell. Under these conditions the pilot must choose the direction along the swell which will make the approach as near into the wind as possible.

(3) A normal glide approach speed should be used, since this will insure control and some margin of speed after flattening out to allow the pilot to choose the best point for landing on a swell. The pilot should hold off until he loses all excess speed above the stall, and strike the sea with a normal, three-point landing attitude.

(4) Before the actual landing, the flaps should be lowered to reduce the speed at which the airplane can approach and touch down. It is better to use a medium setting rather than the full down setting, since little, if any, further reduction of speed is obtained, while the rate of descent is increased and the airplane approaches more nose down. A steep nose down descent is dangerous if the sea is met sooner than expected, and also more altitude is required to flatten out from such a position.

(5) If the airplane alights tail down in a three-point attitude (as it should) there will be a slight primary impact as the rear of the airplane strikes. This will be followed by a severe impact with violent deceleration.

(6) If a landing is made too fast, a bounce will occur providing the fuselage does not fail. As the airplane comes to rest the nose will bury, but if the landing has been carried out correctly, the effect of the nose burying will be minimized.

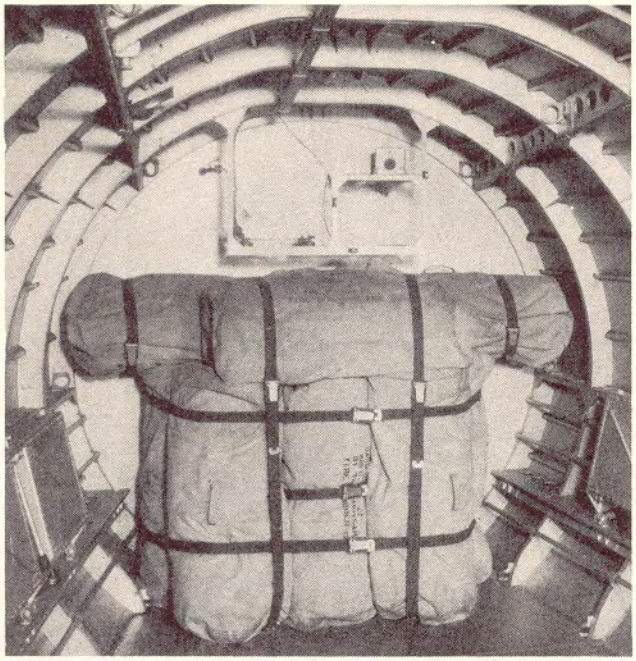


Figure 42—Life Rafts Stowed

(7) If the airplane bounces, the control column should be held back. In the average sea the tail should first touch the crest of a wave, and the nose should be kept up. This should allow the fore body of the fuselage to touch down approximately under the center of gravity on the next wave.

(8) The best point for landing is toward an oncoming swell top. In a steep swell the pilot should land along the top of the swell, or upwind in a long swell. If landing along a swell involves landing in a strong cross-wind, the airplane should be landed into the wind. In landing across a swell, the airplane should be put down on an upslope towards the top.

NOTE

On any emergency landing on water, all disposable load should be jettisoned, if time is available, to lighten the airplane so it can be bellied into the water at as slow a speed as possible. The slower the landing speed the less violent the breaking force of the water will be. When possible, shift the center of gravity aft by moving personnel, etc., aft.

b. LIFE RAFTS.

(1) The airplane is equipped with 11 life rafts, 10 of which are stowed against the aft fuselage bulkhead. The eleventh life raft is stowed at the right of the radio rack in the main cargo compartment.

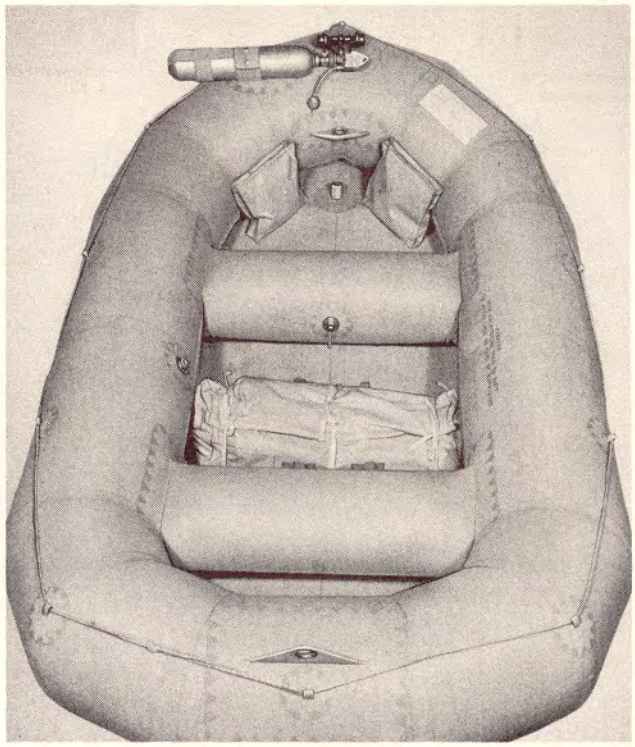


Figure 43—Type A-3 Life Raft

(2) The life rafts are stowed in canvas containers which are closed with snap fasteners. The rafts are held in their stowed position by straps and may be quickly released by pulling out on the locking dogs on the straps.

i. AFTER DITCHING.

(1) Navigator and radio operator release life rafts and drop emergency transmitter (SCR-578-A) overboard.

(2) Pilot and copilot escape via emergency exit and assist navigator and radio operator.

(3) With a successful landing it should be possible to launch the life rafts from the troop door before the airplane settles deep in the water. If not, use other emergency exits to launch them.

(4) If landing has been made into the wind, the life rafts should float toward the tail of the airplane so that boarding the rafts should not be difficult.

j. BOARDING LIFE RAFTS.

(1) Do not jump into life rafts or they may be damaged and the whole crew endangered.

(2) First crew member in each raft shall steady the raft alongside the airplane and each crew member shall assist the next one aboard.

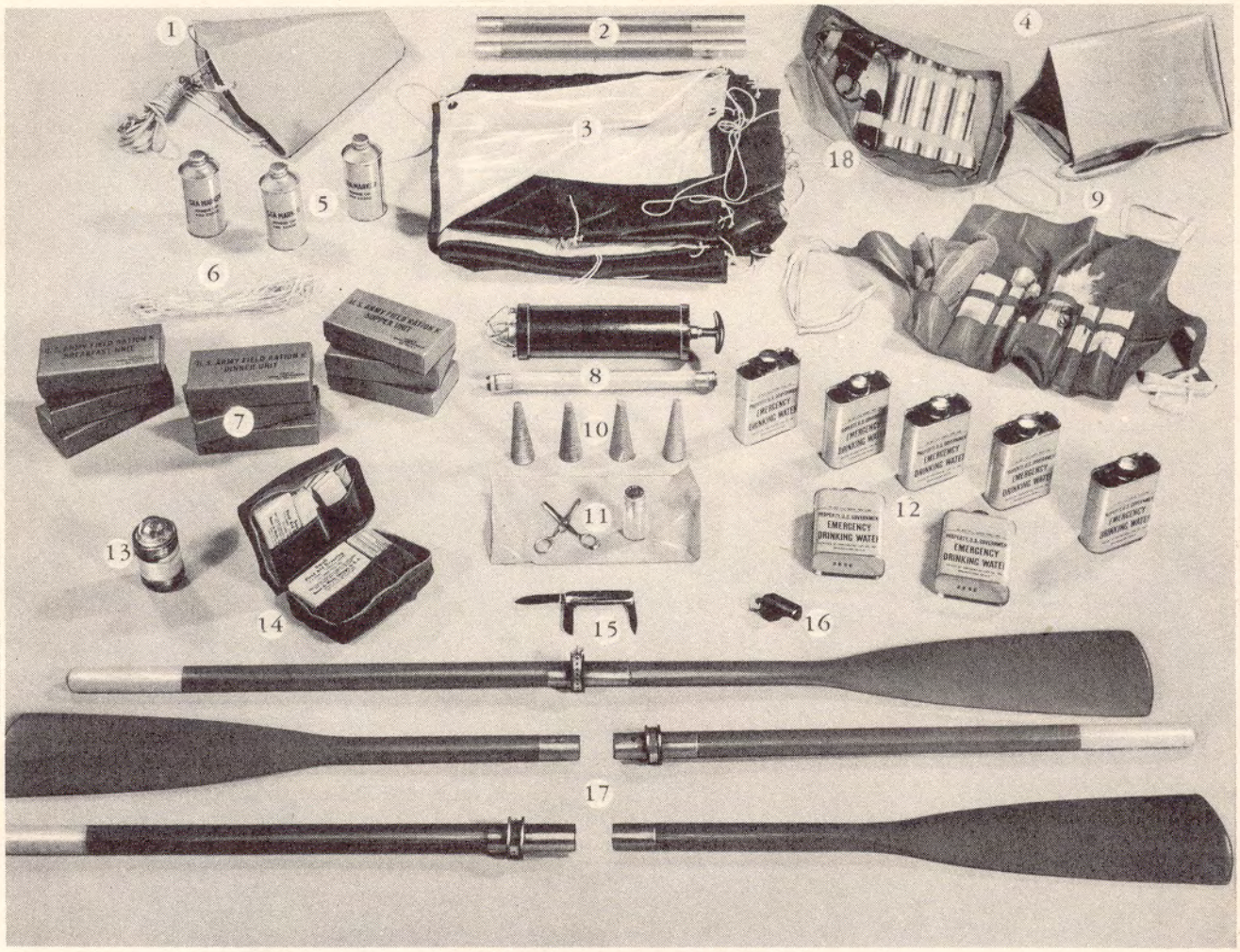


Figure 44—Life Raft Kit (Open)

1—Sea Anchor
2—Mast
3—Sail (Also Camouflage and Signal Cloth)
4—Bailing Bucket
5—Signal Slick
6—Line
7—Ration K
8—Inflating Pump
9—Fishing Tackle
10—Puncture Plugs
11—Repair Patch Kit
12—Emergency Drinking Water
13—Flashlight
14—First-Aid Kit
15—Jackknife
16—Whistle
17—Oars
18—Very Pistol

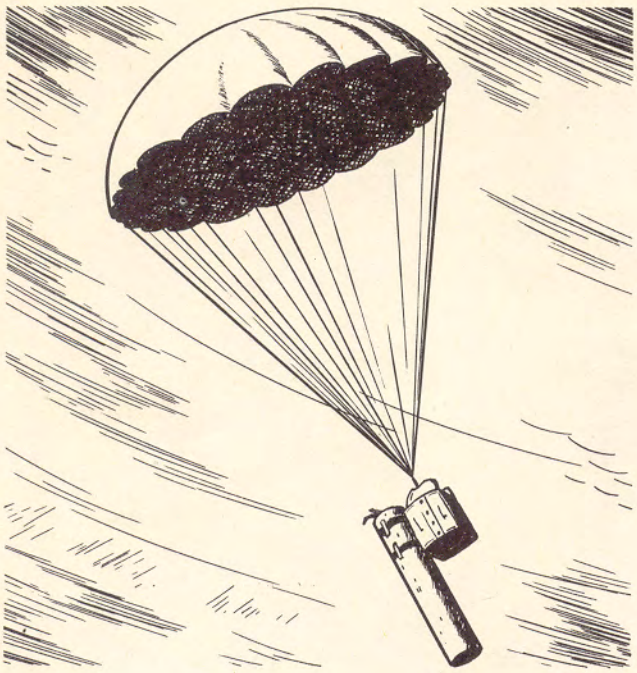
k. ABOARD LIFE RAFTS.

(1) Cast off and recover radio transmitter.

(2) Check for leaks and repair them.

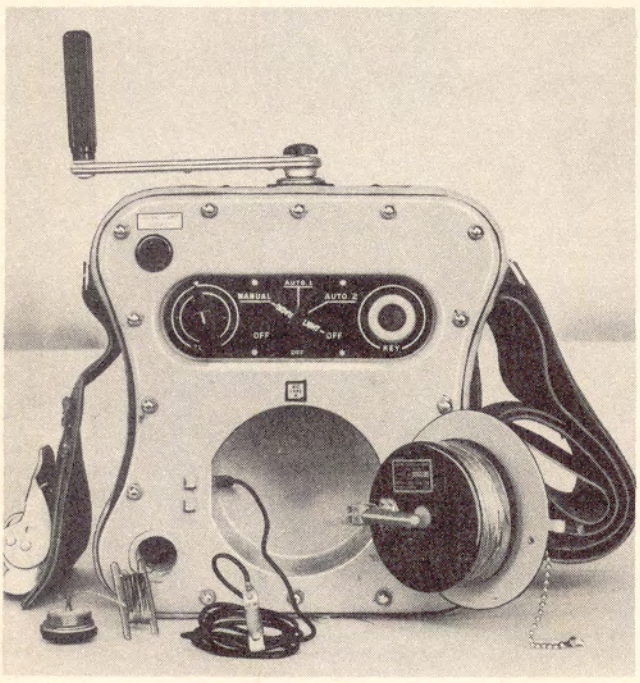
(3) If the airplane floats, keep close by to increase the chance of being spotted. But do not remain tied up to the airplane when there is any chance of life rafts being damaged by the rise and fall of the airplane or the airplane sinking.

(4) Do not get wetter than absolutely necessary. Wet clothing should not be taken off. It is warmer with wet clothes on than off. In hot weather this may not apply, but then the body should be protected from the sun.

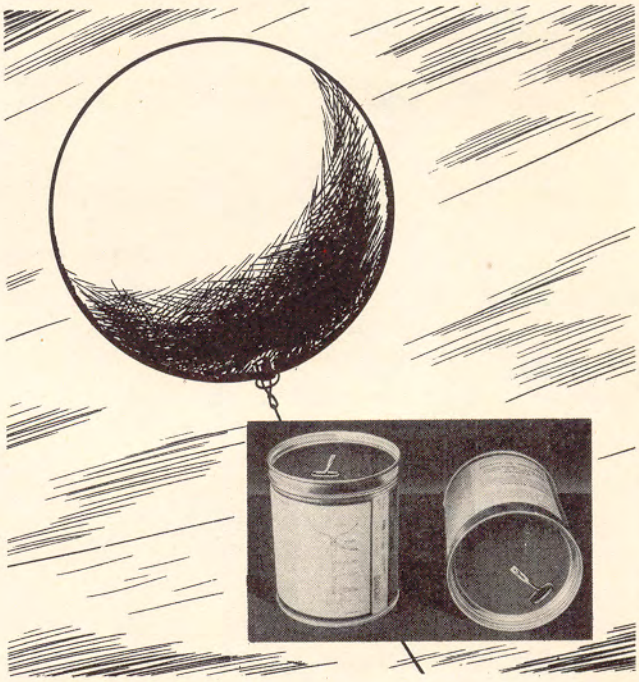


Dropping Emergency Radio Set from Airplane

Parachute M-276-A Packed with BG-110A and Accessory Bag BG-109-A

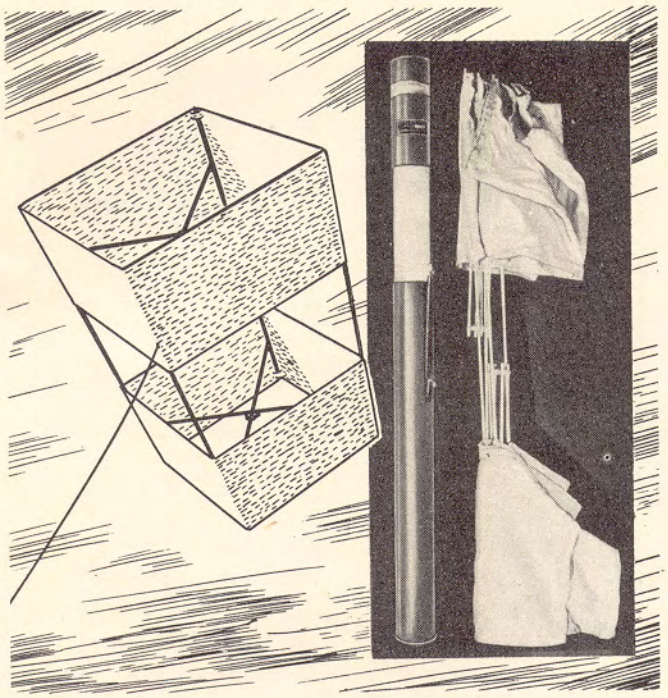


Radio Transmitter BC-778-A



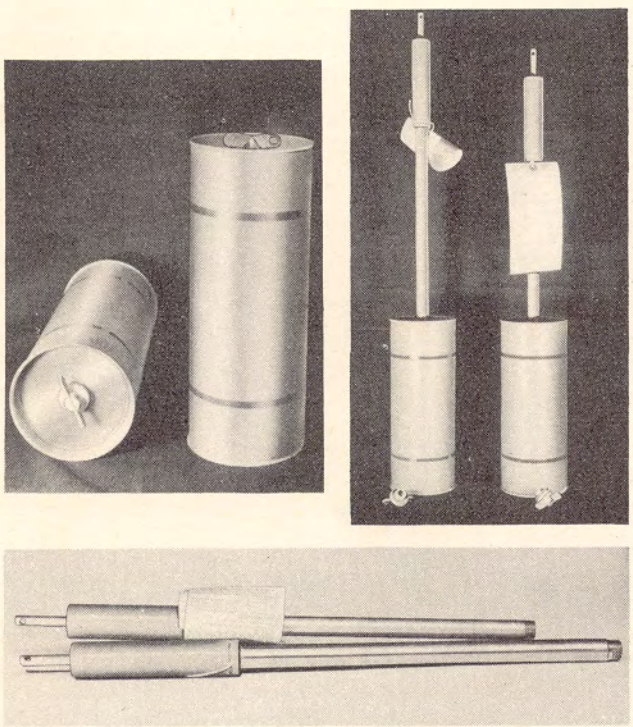
Balloon M-278-A Inflated with Antenna Attached. Balloon Containers Also Shown

Figure 45—(Page 1 of 2 Pages) Emergency Radio Set SCR-578-A

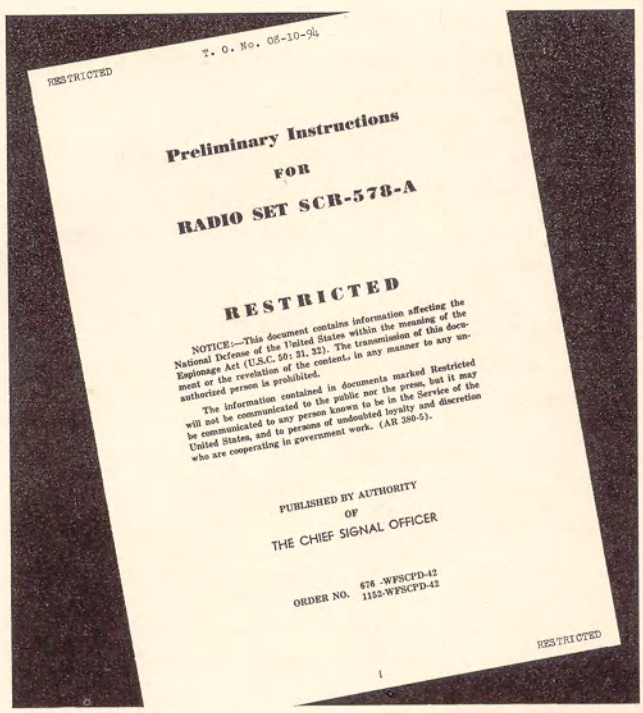


Kite M-277-A Unassembled and Assembled with Antenna Attached

Signal Lamp M-308-A and Spare Roll of Antenna Wire W-148



Generators M-315-A Hydrogen and Inflating Tubes Unassembled and Assembled



RESTRICTED

T. O. No. 08-10-94

Preliminary Instructions

FOR

RADIO SET SCR-578-A

RESTRICTED

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OF
THE CHIEF SIGNAL OFFICER

ORDER NO. 676 -WFSCPD-42
1152-WFSCPD-42

RESTRICTED

1

Instructions for Operating Radio Set

Figure 45—(Page 2 of 2 Pages) Emergency Radio Set SCR-578-A

l. OPERATION OF PORTABLE EMERGENCY RADIO, TYPE SCR-578-A.

(1) GENERAL.

(a) A complete, self-contained portable emergency transmitter is provided for operation anywhere away from the airplane. (See figure 45.) Primarily designed for use in a small boat or life raft, it may be placed in operation anywhere. The unit is equipped with a small parachute to permit dropping from airplane in event of an emergency.

(b) When operated, the transmitter emits an MCW signal and is pretuned 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.

(c) No receiver is provided.

(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 life raft 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.

(b) The emergency set may be dropped from the airplane by use of the parachute attached. The altitude of the airplane when dropping the equipment should be between 300 and 500 feet. To drop the equipment, the following steps should be observed:

(c) Tie the loose end of the parachute static line to any solid metal structure of the airplane.

CAUTION

Be sure the static line is in clear and will not foul.

(d) Throw the emergency set out through a convenient opening in airplane. Parachute will be opened by static line.

CAUTION

Do NOT attach static line to any part of one's body when throwing the equipment through the opening.

(3) OPERATION.—Complete operating instructions are contained in one of the bags which contain the equipment. Complete instructions for the use of transmitter are also located on the transmitter.

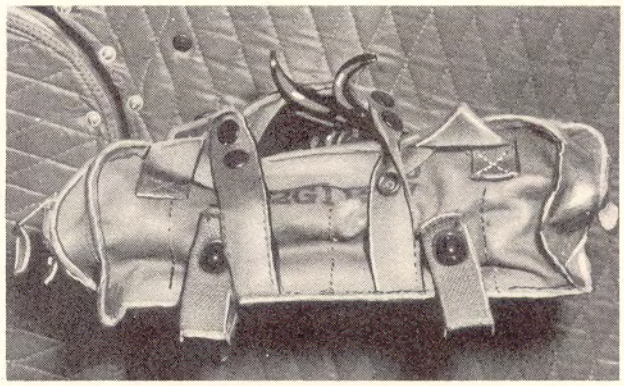


Figure 46—Very Pistol Stowed

m. PYROTECHNICS.—When craft are in a position to see signals, fire life raft pistol or any available pyrotechnics. A Very pistol is stowed in a case support on the left of the pilots' compartment just above the data case, and should be taken along when leaving airplane, if possible.

n. ABANDONING AIRPLANE BY PARACHUTE.

(1) The pilot will determine when this is advisable, and will warn personnel, using the interphone set at "CALL" or some other prearranged signal and will operate the warning bells.

(2) If existing orders permit, pilot and radio operator will follow same procedure as given in paragraphs 14.*a.*(2) and (4), this section.

(3) Personnel will make sure parachute harnesses are secure.

(4) All emergency exits will be opened.

(5) If over water, all life rafts will be removed from stowage, inflated outside the airplane, and released overboard.

(6) The emergency transmitter (SCR-578-A) will have its parachute removed from its stowage pocket, prepared, and the set thrown overboard.

(7) Personnel will leave the airplane as instructed by the pilot.

(8) 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.

Figure 47—Emergency Sustenance Kit, Type E-5, AAF Specification No. 40444

15. EMERGENCY SUSTENANCE KITS.

There are numerous emergency sustenance kits provided for specific operations and these should be considered when an airplane has been assigned to perform a definite mission other than routine.

LIFE SAVERS

a. Frequently inspect your life rafts and their equipment.

b. Learn the location of all life rafts, how to release and inflate them, and the purpose of every piece of equipment. (Read and know the instructions on each piece of equipment.)

c. Learn where everything in the airplane is located and be able to reach for it without hesitation even in the dark.

d. Decide what extras you will need, stow them, and know where they are.

WISDOM

The only place where something you may vitally need will do you any good is aboard the life rafts and it isn't going to be there, unless you put it there!

e. Drill, drill as a team—in getting the life rafts away complete with all equipment and all of the crew. Drill so that if some one is injured, the others can do his job in addition to their own and get him away with them.

f. Practice in the daylight, practice in the dark, practice until you do the right thing instinctively.

g. If it's lack of fuel that is causing the forced landing, don't wait until the engines "sputter," but land while you have power available to assist in reducing speed and assist you in selecting your landing spot.

Figure 48—Emergency Ration Kit, Type E-2, AAF Specification No. 40422

b. Immediately upon deciding to make a forced landing, inform the crew. Preparation should start at once, particularly radio procedure. If existing orders permit, send distress signals at once.

i. Land with the LANDING GEAR RETRACTED, emergency exits opened, other doors sealed, and the airplane FULLY STALLED.

j. Leave all life rafts and equipment in the stowed position until the airplane has come to rest on the water (loose equipment may be damaged by impact).

k. Never throw a life raft overboard before landing.

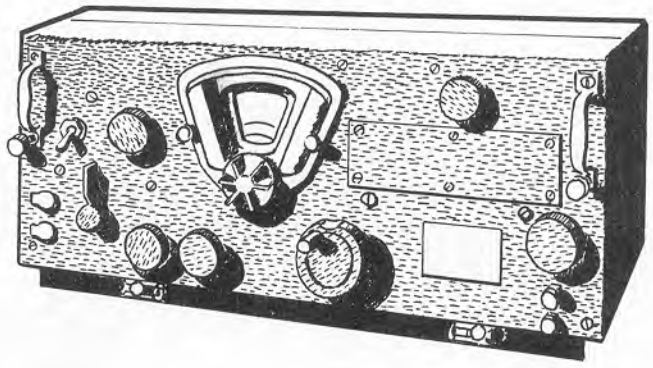
l. Never inflate life rafts inside the airplane.

m. Never release a life raft in the water unless it is tied to the airplane or a crew member.

n. Keep the pockets in the raft buttoned, except when actually removing an article.

o. Once in the life raft, LASH OR TIE DOWN ALL EQUIPMENT! "Loose equipment is as good as lost."

Section V
OPERATIONAL EQUIPMENT



1. COMMUNICATIONS EQUIPMENT AT RADIO OPERATOR'S POSITION.

a. GENERAL OPERATING INSTRUCTIONS.

(1) *Plug head set* into head-set disconnector cord (figure 50-4). (Cord must be plugged into the interphone jack box (figure 50-1) "PHONES" jack.) *Plug throat microphone* (or hand microphone, if installed) into microphone disconnector cord jack (cord must be plugged into the interphone jack box "MIC" jack). (See figure 50-1.)

(2) Set the interphone jack box selector switch on applicable position and turn "INCREASE OUTPUT KNOB" (figure 50-1) fully clockwise. If listening to radio sets having operating controls at other positions, head-set volume may be regulated with "INCREASE OUTPUT" knob. Cutting in on radio range quadrant signals being used by pilot personnel is not recommended, as this will affect head-set volume at those positions.

(3) If airplane is not in flight, turn battery selector switch (figure 22-2) clockwise from "OFF" to "ON" and turn on master ignition switch (figure 22-7). When operation of the communications equipment is completed, turn off these switches (if the plane is not in flight).

NOTE

It is important to use either a battery cart or a portable generator as an external source of power when operating the communications equipment while the engines are not running, to prevent the ship's batteries from becoming discharged. When using an external source of power, turn the battery selector switch (figure 22-2) to "CART" and put the master ignition switch (figure 22-7) to the "ON" position (aft).

b. TO OPERATE INTERPHONE JACK BOX.

(1) Complete necessary operations included in 1.*a.*, preceding.

(2) Hold selector switch on the interphone jack box in the "CALL" position, call desired crew member, and release selector switch, allowing it to return to "INTER."

(3) When the crew member answers, intercommunication may be carried on with selector switch on "INTER."

c. TO OPERATE COMMAND RADIO SET—SCR-274-N.

(1) This radio set may be operated from this position only after operating adjustments have been made by pilot personnel.

(2) Set the interphone jack box selector switch on the "COMMAND" position and receive and transmit by conventional use of the head set and the microphone.

d. TO OPERATE RADIO COMPASS—SCR-269-G.

(1) The radio compass may be operated only from the pilot's and copilot's positions.

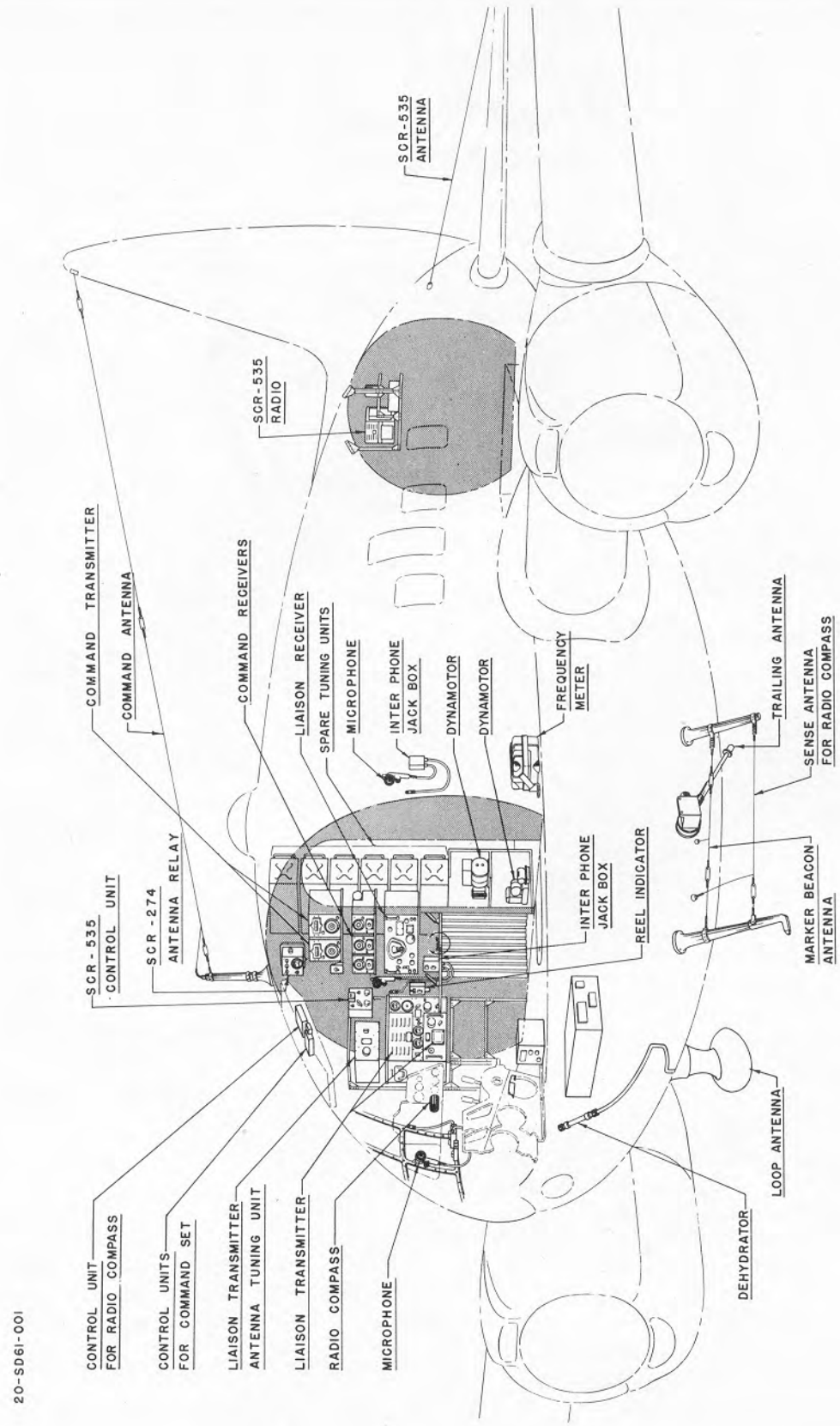


Figure 49—Communications Equipment

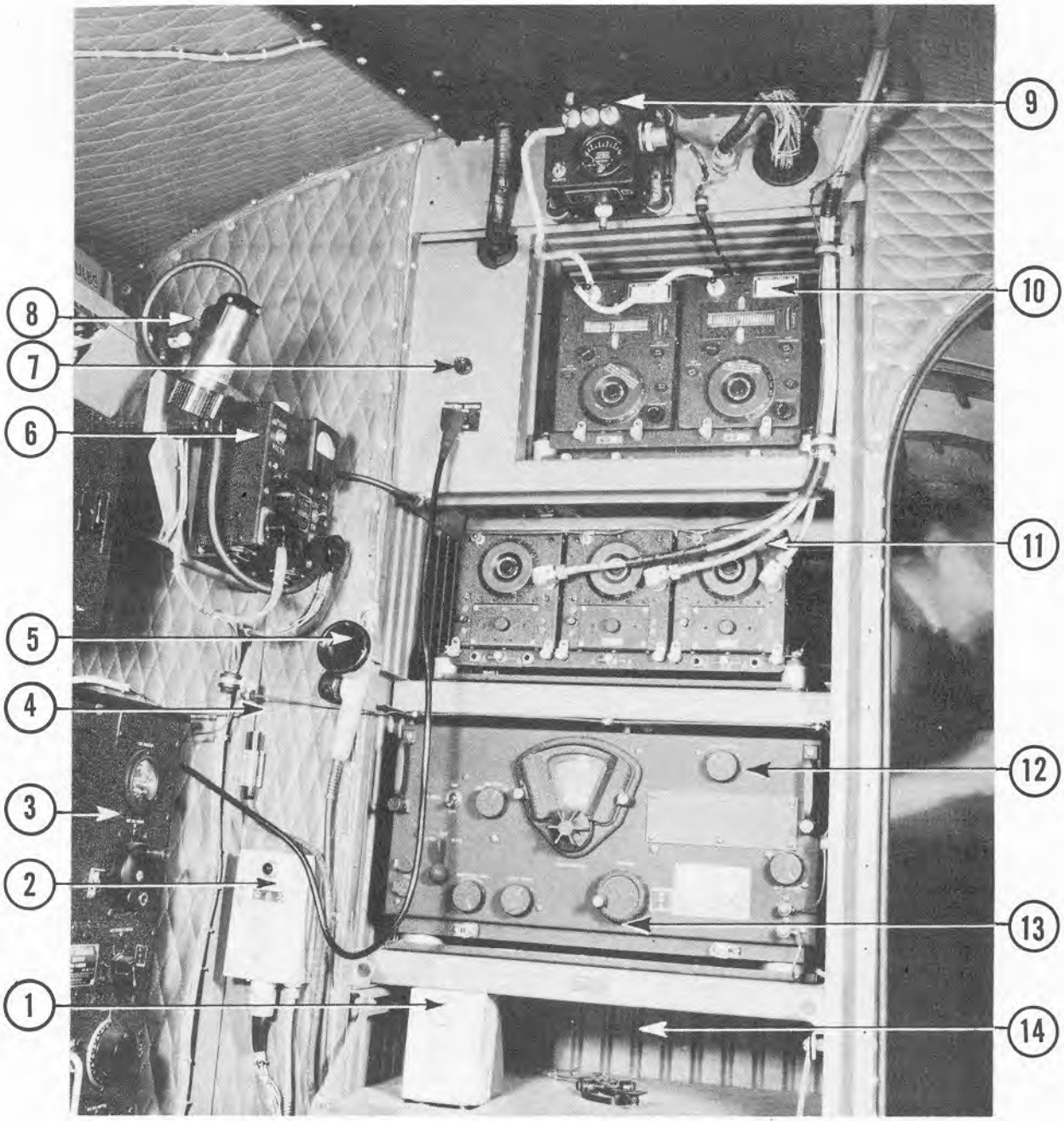


Figure 50—Equipment Rack Above Radio Operation Table

1—Interphone Jack Box, Type BC-366
2—Reel Control Box, Type BC-461 for Trailing Wire Antenna
3—Liaison Transmitter, Type BC-375-D
4—Disconnector Cord for Radio Operator's Head Set
5—Microphone, Type T-17
6—Control Box, Type BC-648-A for SCR-535-A; Control Box for SCR-595 May Be Installed at This Position
7—Liaison Monitor Switch
8—Signal Lamp
9—Antenna Relay for SCR-274-N Command Set
10—Transmitters for Command Set SCR-274-N
11—Receivers for Command Set SCR-274-N
12—Liaison Receiver, Type BC-348-H
13—"Radio Call" Plate
14—"CW" Key for Liaison Transmitter, BC-375-D

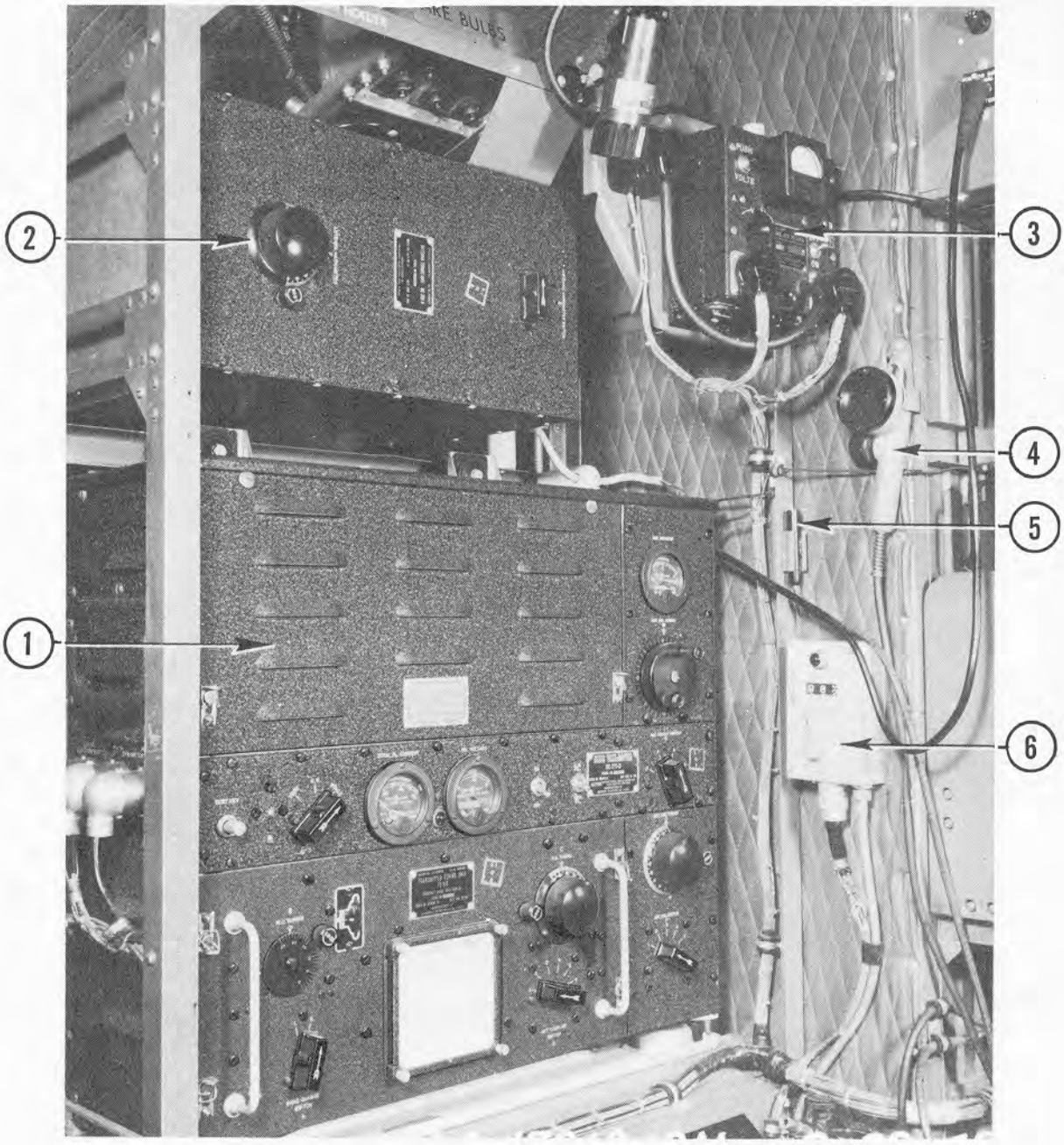


Figure 51—Equipment Rack (To the Left of Radio Operator's Position)

1—Liaison Transmitter, Type BC-375-D
2—Antenna Tuning Unit, Type BC-306-A
3—Control Box, Type BC-648-A for Radio Set SCR-535-A
4—Microphone, Type T-17
5—Disconnector Cord for Radio Operator's Head Set
6—Reel Control Box, Type BC-461 for Trailing Antenna

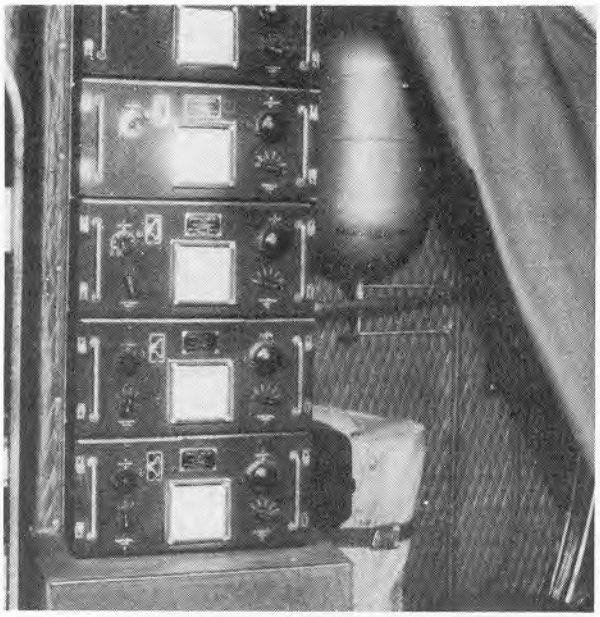


Figure 52—Tuning Unit Rack

1—"Tel" Phone Jacks
2—Crystal Filter Switch
3—"CW Oscillator" Switch
4—Dial Lights Control
5—Antenna Alignment Knob
6—Antenna Post
7—Ground Post
8—Tuning Crank
9—Band Selector Switch
10—Best Frequency Adjustment
11—Volume Control
12—Power "OFF-AVC-MVC" Switch

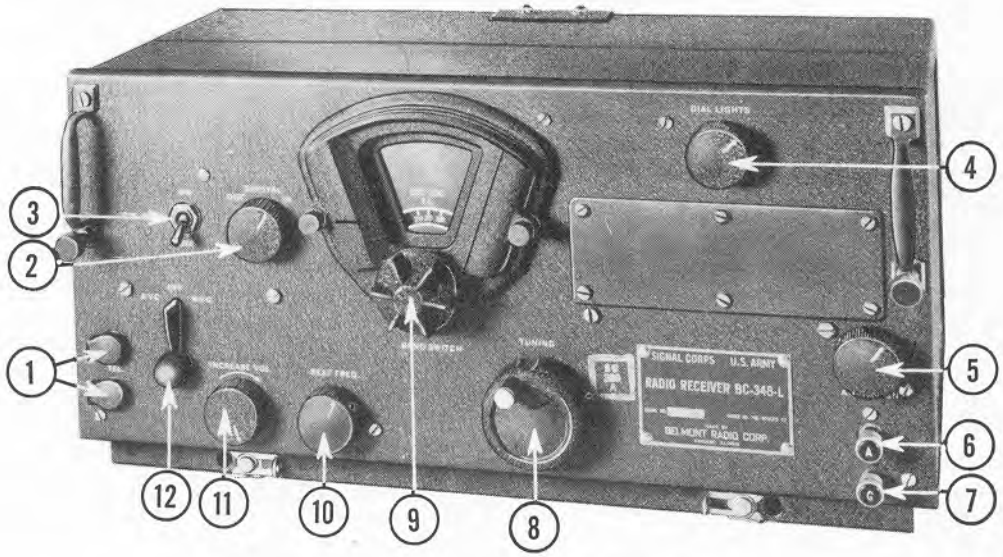


Figure 53—Liaison Receiver BC-348-( )

(2) The radio compass audio output only is available on the "COMP" position of the interphone jack box, after the operating adjustments have been made by pilot personnel.

e. TO OPERATE LIAISON RADIO SET—SCR-287-A.

(1) GENERAL.

(a) Only those instructions necessary to enable crew members, other than the radio operator, to operate this set in case of non-availability of abbreviated instructions, referred to in the following paragraph, have been included herein. It is assumed that considerably more efficient operation, based upon a more extensive knowledge of use of the equipment, can be attained by the radio operator.

(b) It is recommended that these instructions be supplemented by abbreviated instructions and a chart showing all transmitter and antenna loading unit dial and switch settings for each frequency normally used. Dial and switch settings listed should be applicable to a

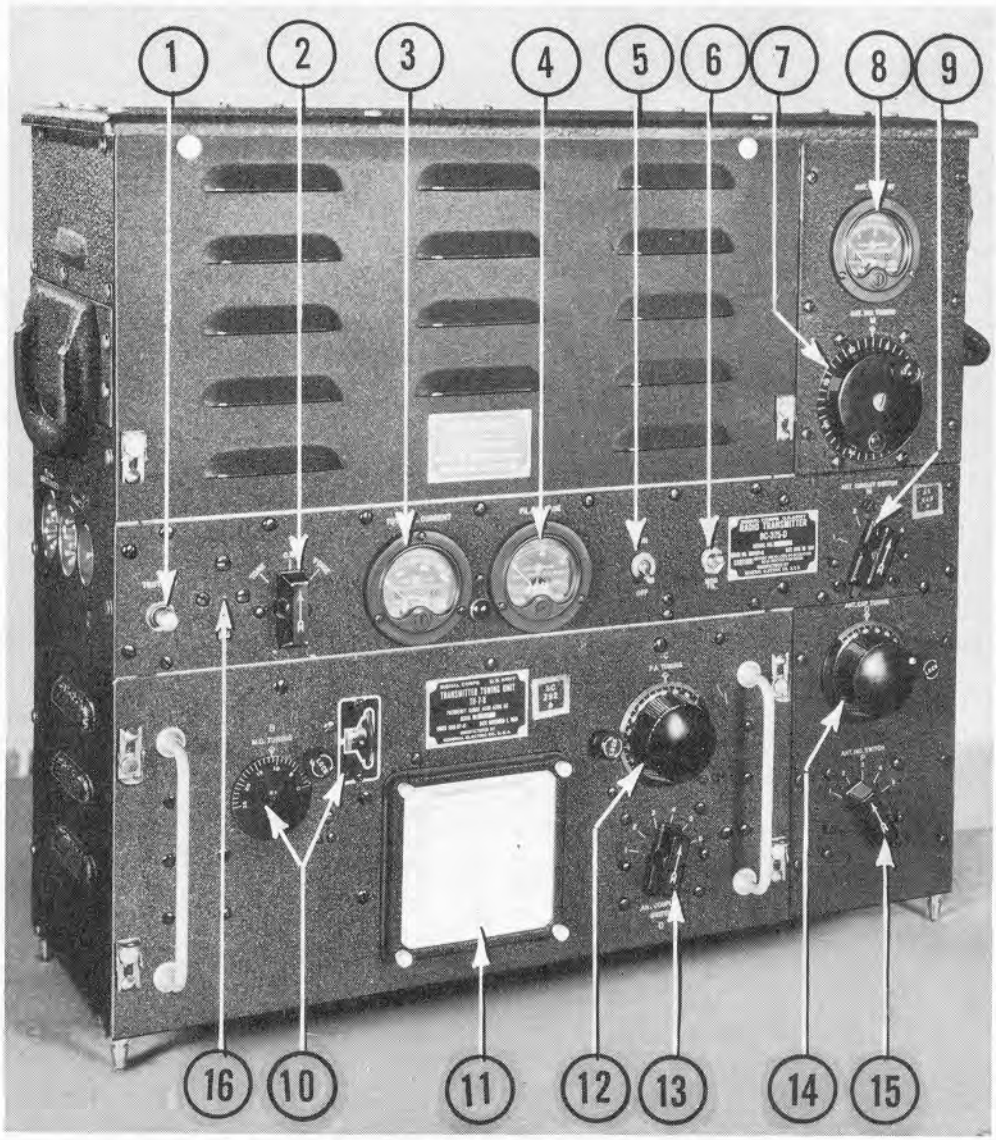


Figure 54—Liaison Transmitter BC-375-( )

1—Test Key
2—Signal Selector Switch
3—"TOTAL PLATE CURRENT" Meter
4—"FILAMENT VOLTAGE" Meter
5—Transmitter Power Switch
6—"CW FILAMENT-MOD. FILAMENT" Switch
7—"ANTENNA CURRENT" Meter
8—"ANTENNA INDUCTANCE TUNING" Control "M"
9—"ANTENNA CIRCUIT" Switch "N"
10—"M.O. TUNING" Control "B"
11—Calibration Chart
12—"P.A. TUNING" Control "C"
13—"ANTENNA COUPLING" Switch "D"
14—"ANTENNA CAPACITANCE TUNING" Control "O"
15—ANTENNA INDUCTANCE" Switch "P"
16—"CALIBRATION RESET PORT"

given installation in a given airplane and should be based upon flight operating tests. These abbreviated instructions should be available to crew members who may be required to operate the equipment.

(2) RECEIVING COMPONENTS.

(a) RADIO RECEIVER, BC-348.

1. Complete the necessary operations included in paragraph 3.*a.* above.

2. Turn "OFF-AVC-MVC" switch on the liaison receiver (figure 53-12) to the "MVC" position.

3. Turn the "CW-OSC" "ON-OFF" switch (figure 53-3) to "ON."

4. Turn "BEAT FREQ" control (figure 53-10) so arrow on knob is pointing upward.

5. Turn "CRYSTAL" "OUT-IN" switch (figure 53-2) to "OUT."

6. Turn "DIAL LIGHTS" control (figure 53-4) clockwise.

7. Turn "INCREASE VOL" control (figure 53-11) clockwise until a sufficiently strong background is heard.

8. Turn "BAND SWITCH" (figure 53-9) to band covering 500 kilocycles, indicated on the frequency dial above the switch.

9. Tune receiver to signal nearest to 500 kilocycles by means of the tuning crank (figure 53-8).

10. Tune the "ANT ALIGN" control (figure 53-5) for maximum signal, indicated by head-set volume.

11. To receive a modulated signal turn "CW OSC" switch to "OFF."

12. Tune in desired signal by means of band change switch, tuning crank, and volume control.

13. If a CW signal is being received, signal pitch may be adjusted by "BEAT FREQ" control (figure 53-10).

14. Automatic volume control may be employed after signal is tuned in by turning the "AVC-OFF-MVC" switch to "AVC."

15. If noise and interfering signal reduction is desired, turn the "CRYSTAL OUT-IN" switch to the "IN" position and make any tuning adjustments necessary.

16. Auxiliary head-set jacks, marked "TEL" are provided on the face of the receiver.

17. To turn off the receiver, turn the "AVC-OFF-MVC" switch to the "OFF" position.

(3) TRANSMITTING COMPONENTS.

(a) GENERAL.

1. The transmitter may be expected to give satisfactory service on CW at all altitudes up to 27,000 feet. On "TONE" and "VOICE," however, insulation breakdown may be experienced with transmitter tuning unit TU-8-( ) (6,200-7,700 kc) above 25,000 feet, and with tuning unit TU-9-( ) (7,700-10,000 kc) above 19,000 feet. These altitude limitations may be exceeded slightly by care in tuning and by carefully guarding against accumulation of dust and other foreign matter in the equipment. Complete assurance of effective operation between 6,200 and 10,000 kc at altitudes between 19,000 and 27,000 feet may be had on CW alone. Transmitter tuning unit TU-26-( ) may be expected to give satisfactory service at all altitudes up to 15,000 feet.

2. Inasmuch as operation of the liaison transmitter on frequencies below 800 kc involves tuning instructions for the antenna tuning unit (figure 51-2), the tuning instructions for the transmitter are given under two sections, viz., for frequencies above 800 kc and for frequencies below 800 kc.

(b) TO OPERATE LIAISON TRANSMITTER ON FREQUENCIES ABOVE 800 KC.

1. Monitor the desired frequency on the receiver before effecting transmission.

2. Insert the transmitter tuning unit covering the desired frequency in the transmitter. (See figure 54.) The tuning units (figure 55) are stacked on a rack (figure 52) against bulkhead wall immediately aft of the radio operator's position.

3. Set the "BAND CHANGE SWITCH" "A" (figure 55-3) on the position indicated on the "Calibration Chart" on the face of the tuning unit installed.

4. Set the "M. O. TUNING" control "B" (figure 54-10) on the dial calibration (last two figures indicated on the vernier) corresponding to the desired frequency and the calibration chart. If the frequency falls between listed frequencies on calibration chart, refer to paragraph 1.*e.*(3)*(f)* for interpolation instructions.

5. Set the "P. A. TUNING" control "C" (figure 54-12) on the dial calibration corresponding to the desired frequency and the calibration chart.

6. Set the "ANT. COUPLING SWITCH" "D" (figure 54-13) on position "2."

7. Set the "ANT. IND TUNING" control "M" (figure 54-8) on zero.

8. Set the "ANT. CIRCUIT SWITCH" "N" (figure 54-9) on "2."

9. Set the "ANT. CAP. TUNING" control "O" (figure 54-14) on "50."

10. Set the "ANT. IND SWITCH" "P" (figure 54-15) on "1."

11. Set the selector switch "E" on the antenna tuning unit (figure 51-2) on position "1."

12. Disconnect the trailing antenna from the transmitter by pressing the binding post marked "Ant." on the right side of the transmitter and removing the antenna lead-in from the binding post.

13. Set the "TONE-CW-VOICE" switch (figure 54-2) on the "CW" position.

14. Set the "CW FIL-MOD FIL" switch (figure 54-6) on the "CW FIL" position.

15. If the airplane is in flight, request pilot's permission to reel out the antenna.

NOTE

The trailing antenna must be in before landing, when flying in formation or when not in use. If it is desired to use the trailing antenna under icing conditions, the weight should be released from the fair-lead 2 or 3 inches before icing begins, to prevent it from being frozen to the fair-lead.

16. If the trailing wire antenna control box (figure 50-2) indicator does not read "000" with the antenna in, set the indicator at "000' by means of the reset.

NOTE

Paragraphs 17., 19., and 20. to 23., inclusive, pertaining to proper loading of transmitter antenna, cannot be performed, on ground, due to the lack of a fixed antenna. The airplane must be in flight with its trailing antenna out for these operations.

17. Turn the "OFF-IN-OUT" switch to the "OUT" position and reel out an appropriate number of turns, based upon the following table. One turn, indicated on the meter, equals approximately one foot.

Recommended antenna lengths:

KC	*1/4 Wave Lengths (feet)*	*3/4 Wave Lengths (feet)*
2,000	123	
3,000	82	
4,000	62	
5,000	49	147
6,000	41	123
7,000	35	105
8,000	31	93
9,000	27	81
10,000	24	73

For frequencies below 800 kc, use full length of trailing antenna.

18. Turn the "ON-OFF" switch (figure 54-5) to the "ON" position. Note the filament voltage indicated on the "FIL VOLTAGE" meter (figure 54-4). The pointer should fall on the red line. If not, remove the tube shield (upper front panel) and make sure the "24-28.5 VOLT" switch is in the appropriate position (if operating equipment from a battery cart as an external source of power, use the "24 VOLT" position; if the engines are running and delivering rated generator voltage output, use the "28.5 VOLT" position, which is the normal terminal voltage of a battery under charge). Check to see that the "AC-DC" switch is in the "DC" position.

NOTE

Do not change tubes or make adjustments inside the transmitter with the test key, the microphone switch, or the hand key depressed. Do not operate any equipment with the tube shield removed.

19. Press the "TEST KEY" (figure 54-1) and tune the "P.A. TUNING" control "C" to obtain the minimum value of plate current, indicated on the "TOTAL PL CURRENT" meter (figure 54-3).

NOTE

If the minimum total plate current exceeds 100 milliamperes with the antenna circuit open, the transmitter should not be operated until the defect is corrected by maintenance personnel. Always release the "TEST KEY" while changing switch positions. When tuning, avoid pressing the test key any more than necessary.

20. Reconnect the antenna lead to the "Ant." binding post on the transmitter.

21. Rotate "ANT. IND TUNING" control "M" to obtain the maximum value of total plate current.

NOTE

Resonance will also be indicated in a secondary sense by the maximum value of antenna current, indicated on the "ANT. CURRENT" meter (figure 54-7). If no deflection of the plate current meter pointer is indicated or if the maximum plate current is less than 210-220 milliamperes, increase the "ANT. COUPLING SWITCH" "D" and repeat this tuning operation if necessary.

22. It may be necessary to change the position of the "ANT. CAP. TUNING" control "O" or the length of the antenna and repeat operation *21.* before a satisfactory plate loading of 210-220 milliamperes is obtained.

23. The final tuning operation is to move "P. A. TUNING" control "C" to determine if a decrease in plate current, indicated on the total plate current meter, can be produced. If the movement of control "C," which produces the lowest value of plate current, exceeds 2 to 3 dial divisions or if the decrease in plate current exceeds 5 to 10 milliamperes, antenna coupling or antenna tuning adjustments are in error and operations *19.* to *23.* inclusive should be repeated.

NOTE

For more comprehensive instruction, refer to Technical Order No. 08-10-66.

24. Transmit with the hand key (figure 50-14).

25. To transmit tone or voice modulated signals, turn the signal selector switch (figure 54-2) to the applicable position and transmit with the hand key or microphone.

26. Each time the frequency is changed the transmitter must be retuned accordingly, as outlined above.

(c) TO OPERATE LIAISON TRANSMITTER ON FREQUENCIES BELOW 800 KC.

1. Complete operations *1.* to *21.* inclusive and *23.* included in the preceding operating instructions for the liaison transmitter, except that in operations *6.* and *8.*, position "4" should be substituted for position "2."

2. If it is impossible to resonate the antenna, set the "ANT. IND SWITCH" "P" on positions "2," "3," "4," and "5" successively, attempting to resonate the antenna on each position by use of the "ANT. IND TUNING" control "M."

3. If operation *2.* preceding does not permit resonating the antenna, set the "ANT. IND TUNING" control "M" and the "ANT. IND SWITCH" "P" on their maximum positions, set the antenna tuning unit selector switch "E" on positions "2," "3," "4," and "5" successively, and attempt to resonate the antenna by tuning the "ANT. VARIOMETER" switch "F" (figure 51-2) on each position.

4. Make sure in the preceding operations *1.* to *3.* inclusive that sufficient antenna coupling is used and that the plate loading does not exceed 220 milliamperes.

5. Transmission on CW may be effected by use of the hand key, or transmission of tone or voice modulated signals may be accomplished as heretofore noted.

6. To turn off the transmitter, turn the "ON-OFF" switch to the "OFF" position.

NOTE

The maximum specified continuous running time for the transmitter dynamotor is 30 minutes. Always reel in the trailing antenna when communications are completed.

(d) OPERATION OF LIAISON TRANSMITTER MONITOR SWITCH.—The liaison monitor switch is located at the radio operator's position (figure 50-7). This switch is used to enable the operator to quickly tune the transmitter to coincide with the frequency of any desired answering station.

1. Roughly tune the transmitter to the desired frequency.

2. Put the monitor switch in the "MONITOR" position.

3. Listen to the desired frequency on the liaison receiver and adjust the transmitter to "M.O. TUNING" control (figure 54-10) until the transmitter sidetone beats against the desired station signal. The resulting "beat note" will indicate arrival at the proper setting of the transmitter "M.O. TUNING" control.

4. Put the monitor switch in the "NORMAL" position for regular operation of the liaison transmitter.

(e) It is *important* that the radio operator be able to tune to a given frequency quickly. Therefore the calibration chart on the front of the transmitter should be accurate. If a check with the frequency meter

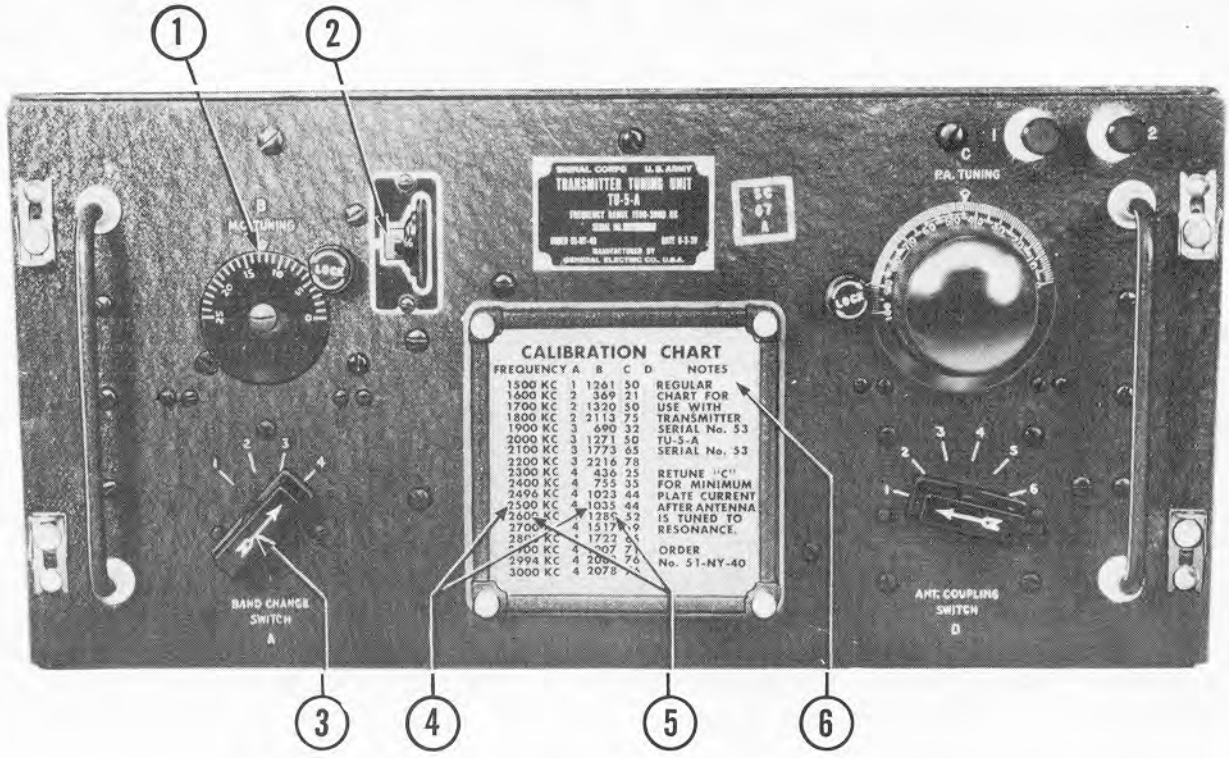


Figure 55—Transmitter Tuning Unit, TU-5-( )

1—M.O. TUNING "Hundreds Scale"

2—M.O. TUNING "Units Scale"

3—"BAND CHANGE" switch "A"

4—Nearest Listed Lower Frequency and "M.O." Dial Setting "B"

5—Nearest Listed Higher Frequency and "M.O." Dial Setting "B"

6—Calibration Chart

shows that the M.O. setting does not coincide with that of the calibration chart, check the calibration accuracy, observing the following steps:

NOTE

Refer to paragraph 1.*f.* for operation of frequency meter.

1. Set transmitter tuning controls to positions appropriate for CW operation on 11,800 kc.

CAUTION

M.O. control "B" must be set in accordance with the calibration chart and locked.

2. Disconnect transmitter antenna.

3. Place filament voltage switch in tube compartment in appropriate position.

4. Place frequency meter in proximity of transmitter. (The frequency meter is located at forward end of main cargo compartment, on left side, lashed to the floor in a horizontal position. The unit is easily removed for use, by unbuckling a single strap (figure 56).)

5. Place frequency meter in operation and turn on transmitter by throwing "OFF-ON" switch to "ON" position. (Do not apply transmitter plate voltage.)

6. Tune transmitter with transmitter antenna disconnected.

7. Set frequency meter on 11,800 kc in accordance with the operating instructions and calibration chart furnished with the frequency meter.

8. Open the calibration reset port, located on the front panel (figure 54-16) between the TEST KEY and TONE-CW-VOICE switch, insert a screw driver, and rotate the calibration screw until the transmitter frequency coincides with that of the frequency meter.

Figure 56—Frequency Meter Set, SCR-211-( )

Obtain minimum "PLATE CURRENT" and adjust calibration if necessary until transmitter frequency is set with that of the frequency meter while the "PLATE CURRENT" meter reading is at minimum value.

9. Close the calibration reset port. The transmitter is now properly calibrated for any of its tuning units.

10. Tune transmitter as instructed herein.

(f) To obtain dial settings for frequencies falling within the limits of those shown on the calibration chart, but not specifically shown thereon, interpolation of dial settings is necessary, i.e.: (See figure 55.)

1. Desired operating frequency is 2589 kc.

2. Dial setting "B" for nearest listed higher frequency 2600 kc is 1289

3. Dial setting "B" for nearest listed lower frequency 2500 kc is 1035

4. Frequency and dial setting variation 100 254

5. Dial variation per kilocycle 2.54

6. Interpolation multiplier ..... 2589 — 2500 = 89

7. Interpolation product (dial units) ..... 2.54 x 89 = 226.06

8. Interpolated dial setting .....1035 + 226 = 1261

9. Set "B" to 2589 kc by rotating units dial (figure 55-2) until a reading of 12 is obtained on the hundreds scale (figure 55-1) and a reading of 61 is obtained on units scale (figure 55-2).

f. OPERATION OF FREQUENCY METER SET SCR-211-( ).

(1) GENERAL.

NOTE

All references made to figure. Inexperienced personnel should not attempt checking frequency of BC-375-( ) transmitter.

(a) Secure an antenna, preferably a rigid wire not over 2 to 3 feet long, to the antenna terminal on top of the frequency meter cabinet. (Flexible insulated wire may be used.)

(b) Plug head set in the "PHONES" jack (figure 57-2) and turn the POWER switch (figure 57-3) to "CHECK." (Head set must be plugged in to complete d-c power circuit to vacuum tubes.) Allow vacuum tube filaments to warm for at least ten minutes or longer, if necessary, as indicated by the drifting of the beat note.

NOTE

Some frequency meters of BC-221-( ) series have a power "OFF-ON" switch and a "CRYSTAL" "OFF-ON" switch. On this type both switches should be turned to "ON."

(c) From HIGH or LOW frequency indices on front and rear covers of calibration book (figure 57-1), determine in which band desired frequency is located and set "FREQ BAND" selector switch (figure 57-9) to correspond.

(d) Locate, in the calibration book, the heterodyne oscillator calibration for frequency desired (figure 57-10). At bottom of the page will be found the CRYSTAL CHECK POINT (in red) (figure 57-12), together with the heterodyne tuning dial setting (figure 57-13).

(e) To set heterodyne tuning control to any desired crystal check point, rotate tuning control until the following readings are observed, using 2070.5 kc as an example.

1. The "DIAL HUNDREDS" scale (figure 57-5) should read "20."

2. The "DIAL UNITS" scale (figure 57-7) should read "70."

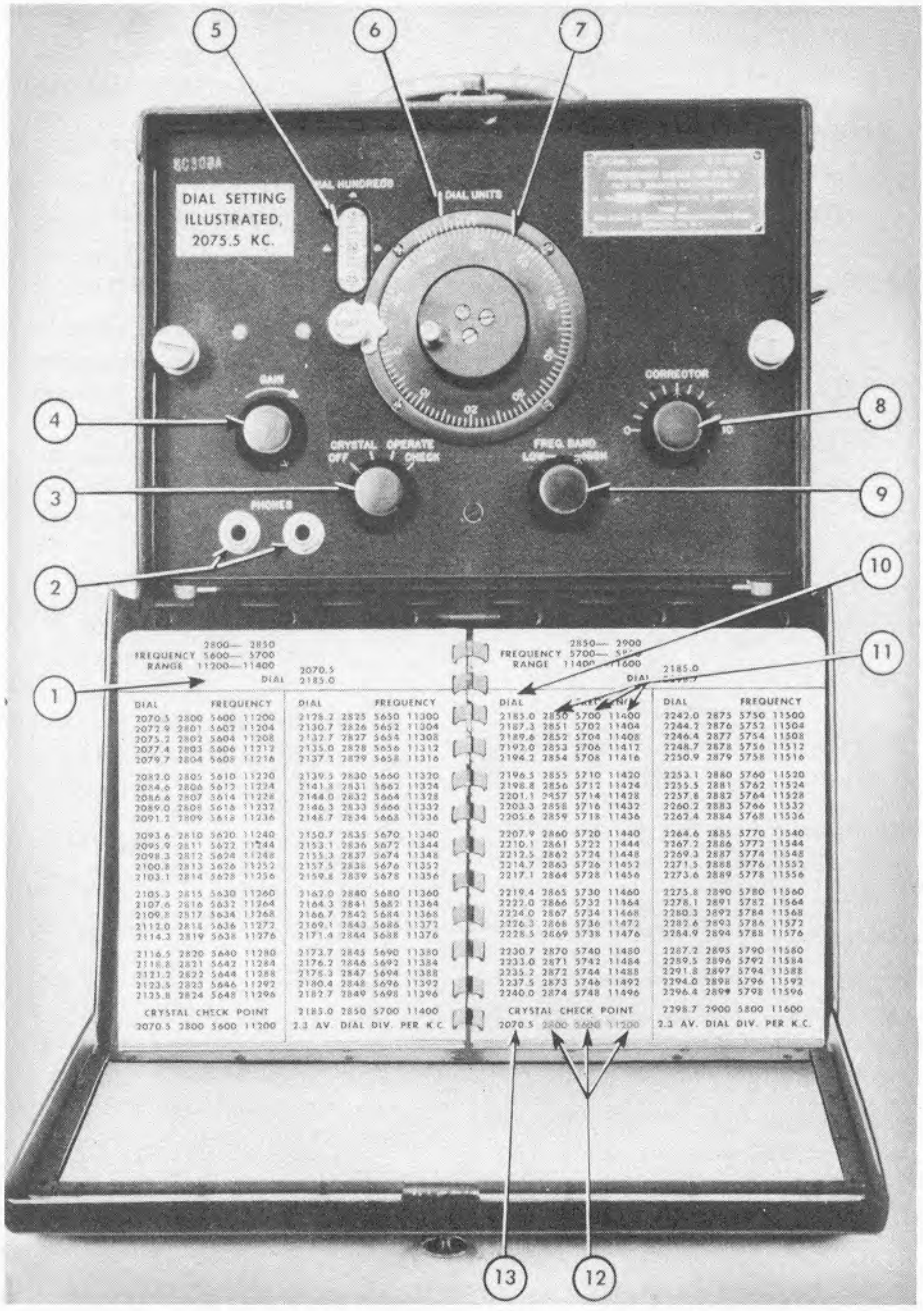


Figure 57—Frequency Meter BC-211-( )

1—Frequency Calibration Chart
2—"PHONE" Jacks
3—Operation Knob (Power Switch)
4—"GAIN" Control
5—Dial Setting Indication "Hundreds" Scale
6—Dial Setting "Tenths" Scale, Outer Vernier Markings
7—Dial Setting "Units" Scale, Inner Markings
8—"CORRECTOR" Control
9—"BAND SELECTOR" Switch
10—Heterodyne Oscillator "DIAL SETTINGS" Column
11—Listed Frequencies
12—Crystal Check Points for Associated Page
13—DIAL SETTING for Crystal Check Points

3. The fraction ".5" will be indicated when the fifth outer vernier marking (counterclockwise from the heterodyne control arrow) coincides with any mark on the rotating inner scale (figure 57-7). (There are ten vernier markings, each representing one tenth of a unit.) When the above readings are accomplished, lock the tuning dial.

NOTE

To obtain dial setting for a frequency falling between two listed frequencies, interpolate as directed in paragraph 1.*e.*(3)*(f)*.

(f) A beat note will probably be heard, as complete absence of beat note can result from only three possible causes; i.e., when heterodyne oscillator is exactly on calibration; when it is so far off calibration that beat frequency is above audibility; and when equipment is defective. First two conditions may be determined by rotating "CORRECTOR" dial (figure 57-8) to where beats become audible. If third condition is the cause, check battery voltages under load. (Filament voltage: 5.4 to 6.0; plate voltage 121.5 to 135.) Adjust heterodyne oscillator frequency by rotation of "CORRECTOR" dial until a zero beat is reached.

(2) TRANSMITTER ADJUSTMENTS.

(a) The method of adjusting transmitter BC-375 to a frequency consists of zero-beating the transmitter frequency with the proper heterodyne oscillator frequency, effecting the comparison by means of a head set plugged into the "PHONES" jack on the front panel of the frequency meter. The "CRYSTAL" switch should be in the "OPERATE" position during the process. (On frequency meters of the BC-221-( ) series having "CRYSTAL ON-OFF" switch, set "CRYSTAL ON-OFF" switch to "OFF."

(b) Specifically, the procedure for adjusting the BC-375 transmitter to a desired frequency is as follows:

1. Correct the frequency meter heterodyne oscillator to calibration at the crystal check point nearest the desired frequency, as explained under paragraph 1.*f.*(1)*(e)*, preceding.

2. Turn the "CRYSTAL" switch to "OPERATE." (On frequency meters of the BC-221-( ) series having "CRYSTAL ON-OFF" switch, set "CRYSTAL ON-OFF" switch to "OFF."

3. Turn the frequency meter tuning control to the dial setting of the desired frequency, as given in the calibration book attached to the meter. Do not disturb the "CORRECTOR" control adjustment obtained in paragraph 1.*f.*(1)*(f)*, above.

4. Disconnect the transmitter antenna.

5. Obtain minimum reading on "TOTAL PLATE" current meter.

6. Press "TEST KEY" on transmitter and vary M.O. control "B" until a zero beat is heard in the frequency meter head set. Simultaneously obtain minimum dip on "TOTAL PLATE CURRENT" meter and zero-beat note on frequency meter. Lock M.O. control "B."

7. Turn off frequency meter and remove head set cord from plug jack.

8. Connect transmitter antenna and resonate the antenna quickly to avoid unnecessary station interference.

(3) RECEIVER ADJUSTMENTS.

(a) The method of adjusting a receiver to a desired frequency consists of tuning the receiver to the proper heterodyne oscillator output frequency, and effecting the comparison by means of a pair of headphones connected to the receiver output circuit.

1. Correct the heterodyne oscillator to calibration at the crystal check point nearest the desired frequency as expained under Operation.

2. Turn the operating knob (57-3) to "OPERATE" and change over to another head set connected to the receiver output jack. (On frequency meters of BC-221-( ) series having "CRYSTAL ON-OFF" switch, set "CRYSTAL ON-OFF" switch to "OFF."

NOTE

If CD-196 or CD-307 extension cord is used in frequency meter, the head set may be disconnected and used in receiver position since the plug operates the power switch, the head set not being required.

3. Turn the frequency meter tuning control to the dial setting of the desired frequency, as given in the calibration book and lock the dial. Do not disturb the CORRECTOR adjustment as made in paragraph *1.*

4. Adjust the receiver for "CW" reception as outlined in preceding operating instructions for the particular receiver to be checked.

5. With the frequency meter antenna loosely coupled to the receiver antenna lead, vary the receiver tuning control in the vicinity of the desired frequency, listening for the output of the frequency meter. (Signal source may be positively identified by tapping frequency meter antenna with finger and listening for resulting interruption.)

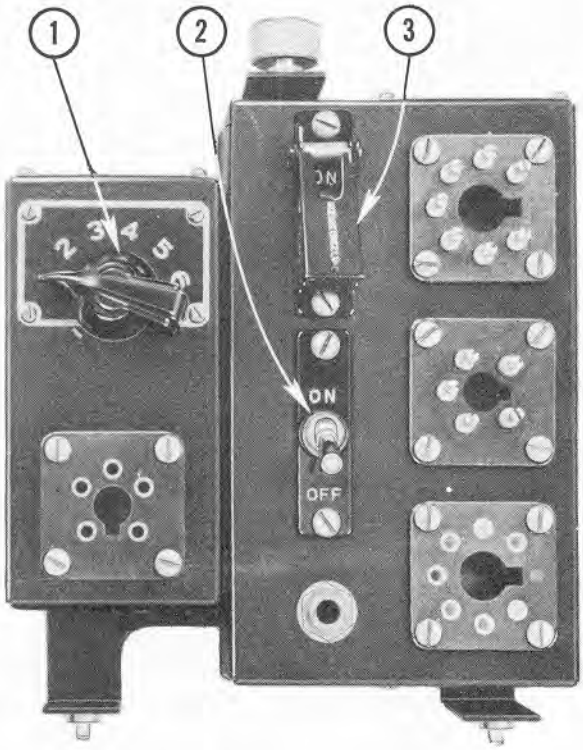


Figure 58—Control Box for SCR-595 (IFF)

1—Selector Switch
2—"EMERGENCY" Switch
3—IFF Power Switch

6. Turn off frequency meter and remove head set from "PHONE" jack.

g. OPERATION OF IFF RADIO SET SCR-595.

(1) OPERATING COMPONENTS.

(a) Turn on the local "ON-OFF" switch (figure 58-3).

(b) Set the selector switch (figure 58-1) to the numbered position designated by tactical orders.

(c) If "EMERGENCY" operation is desired, place the "EMERGENCY" switch (figure 58-2) "ON."

(d) To turn off the radio set, turn local "ON-OFF" switch to "OFF."

(2) DESTRUCTOR COMPONENTS.

(a) The switch controlling the destructor (detonator) unit installed in the IFF chassis is located at the pilot's and copilot's position (figure 32).

(b) To destroy the IFF radio set, if it becomes necessary to do so, raise the hinged cover of the destructor switch and simultaneously press the two switch buttons on the destructor switch.

2. COMMUNICATIONS EQUIPMENT AT NAVIGATOR'S POSITION.

a. GENERAL.—The navigator's position at the extreme front end of the main cargo compartment will not be found in some C-46 airplanes. The interphone jack box for use by the navigator will be installed on the right side wall at the extreme front end of the main cargo compartment in all C-46 airplanes, whether the navigator's plotting table is installed or not.

b. TO OPERATE INTERPHONE JACK BOX.

(1) Complete the necessary operation included in paragraph 1.*a.*, preceding.

(2) Hold the selector switch (figure 26) on the interphone jack box in the "CALL" position, call the desired crew member, and release the selector switch, allowing it to return to the "INTER" position.

(3) When the crew member answers, intercommunication may be carried on with the selector switch on the "INTER" position.

3. NAVIGATIONAL EQUIPMENT.

Navigational equipment includes navigator's seat, desk, adjustable desk lamp, astrodome, drift meter, magnetic compass, and other instruments. The drift meter support is mounted on the left side of the fuselage opposite the navigator's desk. Racks and containers are provided for maps and charts.

4. CONSTANT FLOW OXYGEN SYSTEM.

(See figure 59.)

a. GENERAL.—A constant flow oxygen system, consisting of six type G-1 cylinders and a type A-9A regulator mounted at each of the four crew stations, is provided.

b. REGULATOR.

(1) The oxygen regulator automatically controls the amount of oxygen delivered from the cylinders to the mouthpiece for a manually set altitude indication. This flow is graduated in accordance with the oxygen required at various altitudes and is so measured on the face of the regulator.

(2) The other indicator on the face of the regulator shows the oxygen supply pressure. Supply limits are 400 pounds per square inch (fully charged) down to 50 pounds per square inch (empty).

(3) To obtain proper oxygen flow, set indicator on gage to point to the altitude at which the airplane is flying. (See figure 61.)

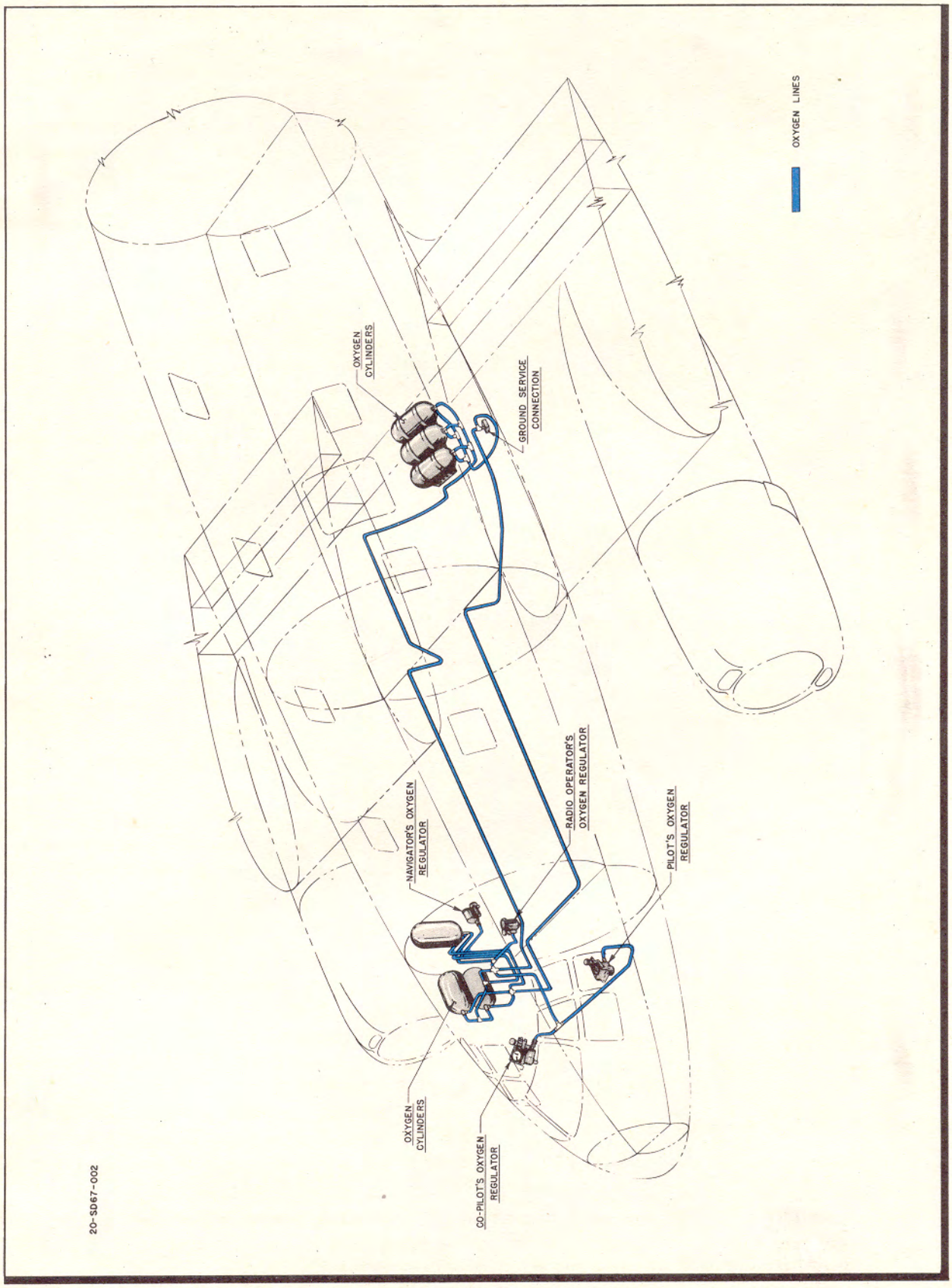


Figure 59—Oxygen System

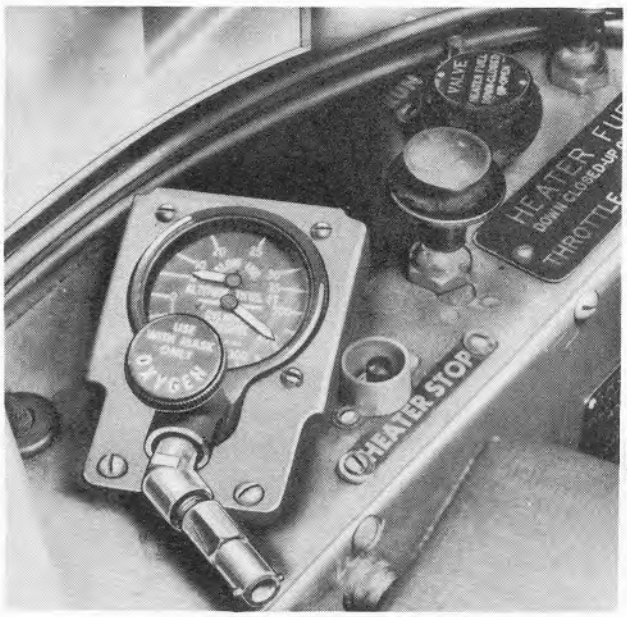


Figure 60—Oxygen Regulator

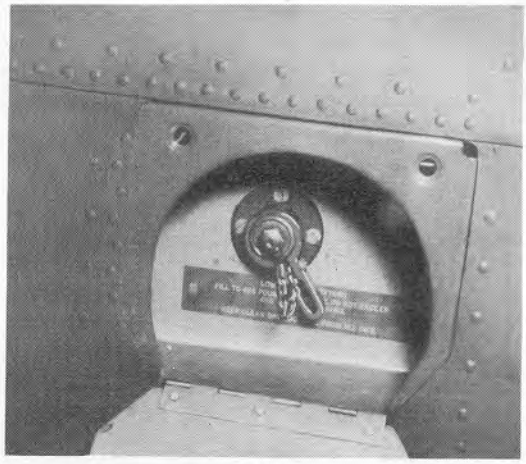


Figure 61—Oxygen Filler Valve

(4) On landing, make sure the regulator is shut off.

MAN-HOUR OXYGEN CONSUMPTION TABLE

System—Low Pressure Regulators—Type A-9A	*6 Cylinders—Type G-1*
Altitude (Thousands of feet)	*Crew of 4 Duration in Hours Fully Charged*
10	12.75
15	10.8
20	9.38
25	7.95
30	6.6

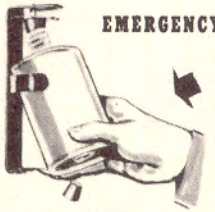
c. FILLING CYLINDERS.—The filler valve for the oxygen system is located inside an access door on the lower left fuselage skin.

USE OXYGEN INTELLIGENTLY

DO	DON'T
Use oxygen above 10,000 feet on all flights.	Don't fail to check all oxygen equipment before take-off.
Use oxygen from the ground up, at night or on rapid ascents to high altitude.	Don't fail to insure full cylinder pressure and an adequate supply of oxygen for your mission.
Breathe normally.	Don't fail to use your own fitted mask and necessary connecting tubing.
Adjust your mask carefully and eliminate leaks before take-off.	Don't leave your walk-around bail-out oxygen bottles in your locker. You may need them.
Be familiar with your oxygen equipment and its use.	Don't waste your oxygen supply by excessive and needlessly high flows.
Report faulty function of oxygen equipment promptly and insure correction.	Don't take liberties at high altitude by walking about the aircraft without portable oxygen bottles, or by not turning on the oxygen supply in time.
Check your oxygen equipment frequently during flight.	

CAUTION: Extreme caution must be exercised to insure that oxygen equipment does not become contaminated with oil or grease. Fire or explosion may result when even slight traces of oil and grease come in contact with oxygen under pressure.

EMERGENCY GAS ABSORBING CANISTER



Gas canisters are furnished for all flying personnel to provide for protection against gas attacks while in flight or when landing on gassed terrain. Grasp canister near bottom and pull loose. This will automatically release both seals, making it ready for immediate use.

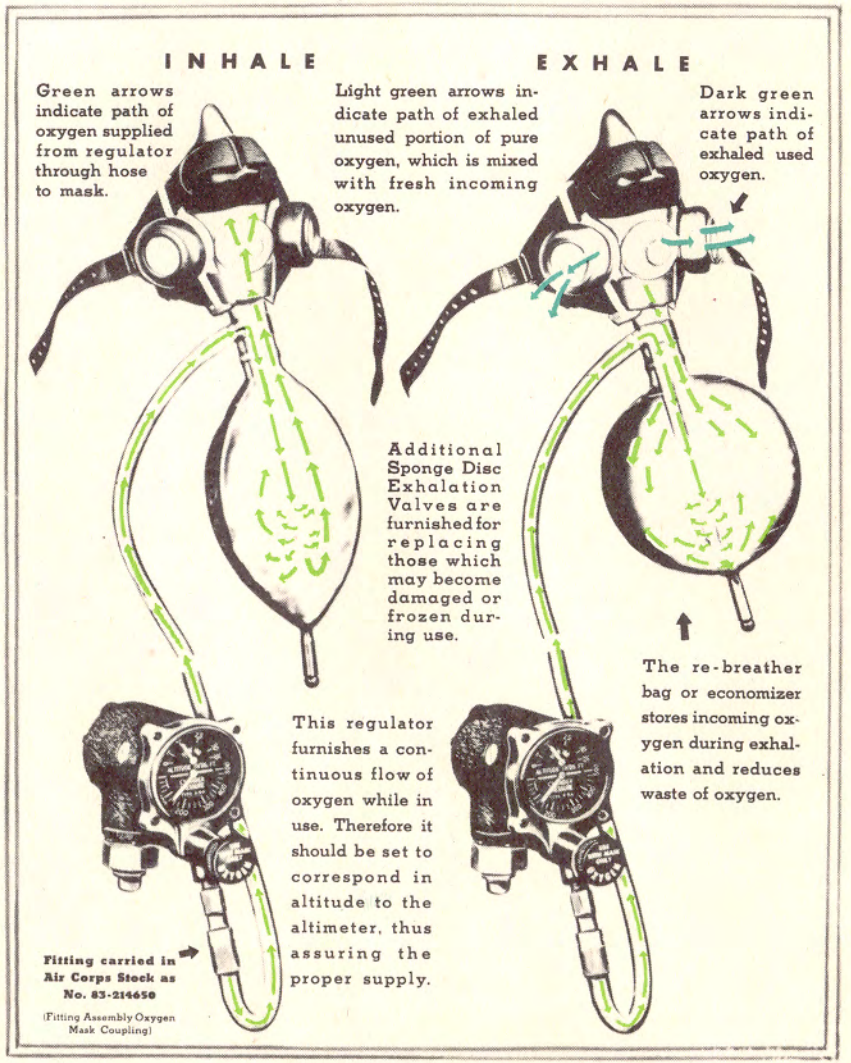
Before detaching oxygen mask hose from regulator connecting hose, take a deep breath. Then, before attaching the mask hose to the gas canister, exhale sufficiently, to clear the mask and hose itself of any possible gas accumulation. Immediately thereafter, attach gas canister to mask hose, by inserting connection end into top of canister. Fasten canister to clothing by means of clip affixed to it.

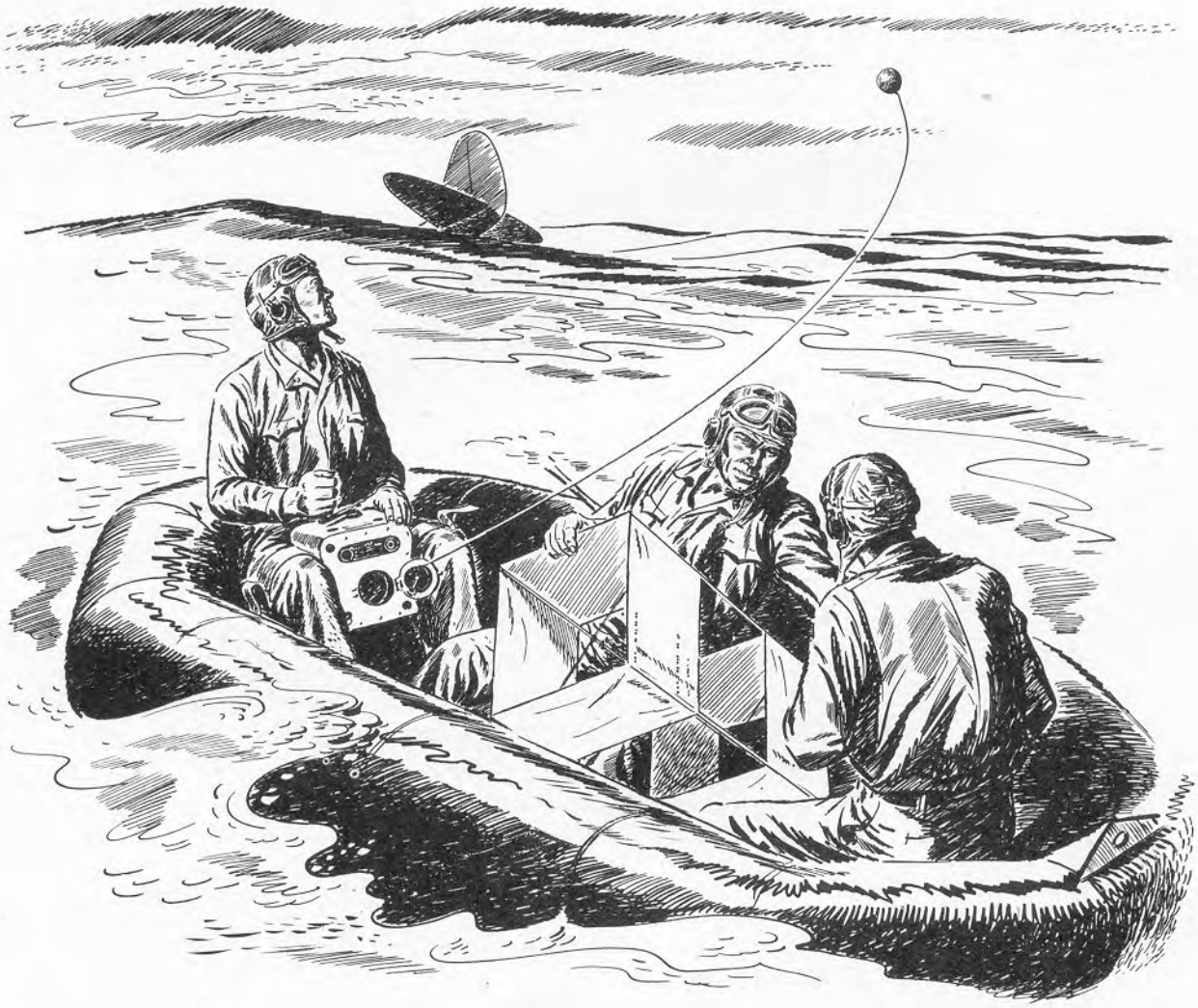
To use the regular chemical warfare service training canister, attach a small section of rubber tubing to it, replacing the cork stopper to end of tube. This should be done before ascent. In attaching it to the oxygen mask remove the corks, top and bottom, and thus proceed in the same manner as with the aircraft gas canister.

To get oxygen . . . attach coupling on end of hose to the regulator and open the manually operated valve until indicator hand points to altitude at which airplane is flying. If valve vibrates off setting, tighten gland packing nut.

To insure a proper supply of oxygen at any altitude, make sure the indicator hand is set at the same altitude as shown on altimeter.

Figure 62—Operation of Oxygen Mask and A-9-A Continuous Flow Regulator





Section VI
COLD WEATHER OPERATION

1. GENERAL.

These instructions supplement the regular instructions for cold weather operation of the airplane, and describe the procedure for using the winterization equipment installed in accordance with Army Air Forces requirements.

NOTE

Check Technical Order No. 01-1-46 "Winterization Check List Data Book" located in the data case in this airplane, for information applicable to the airplane when operating in cold climates.

2. COLD WEATHER EQUIPMENT.

a. OIL IMMERSION HEATERS.—A plug on the outboard longeron of each nacelle, at the aft end, provides a fitting to which an external source of power can be attached to supply current for immersion heaters in each engine oil tank and a heater for the blower oil tank of the airplane heating system. The plugs are encased in a small box and the cover of the box must be unbuttoned to gain access to the plug connection.

b. SELF-THAWING ENGINE OIL COOLING SYSTEM.—A self-thawing engine oil cooling system is installed.

c. OIL COOLER FLAPS.—The oil cooler flaps operated from the upper control pedestal should be kept as nearly "CLOSED" as possible while maintaining oil temperatures between 60°C to 70°C (140°F to 158°F). If the flaps are kept too far open during low power operation in extremely cold weather, it is possible that the oil may congeal.

d. OIL DILUTION SYSTEM.—The oil dilution system is controlled by switches on the overhead panel. (Refer to paragraph 9., this section, for method of using.)

e. CARBURETOR ANTI-ICER SYSTEM.—A fluid spray system to each carburetor is controlled by switches on the overhead panel. (Refer to section 1, paragraph 3.*b.*(6) for operation instructions.)

f. WINDSHIELD ANTI-ICER SYSTEM.—To operate the windshield anti-icer system, turn the circuit breaker located on the overhead panel to "ON" position and control the fluid low by the valve on the left window ledge. The tank which supplies fluid for both windshield and carburetor anti-icing has a capacity of 10 U. S. gallons (8.3 Imperial gallons).

g. PROPELLER ANTI-ICER SYSTEM.—Anti-icing fluid is supplied through slinger rings to each propeller and is controlled by a circuit breaker and rheostat on the overhead panel. The fluid supply tank has a capacity of 4 U. S. gallons (3.3 Imperial gallons).

NOTE

On airplanes AF41-12334 and subsequent, one tank with a capacity of 20 U. S. gallons (16.7 Imperial gallons) and divided into three compartments, supplies all anti-icing fluid for carburetors, windshields, and propellers.

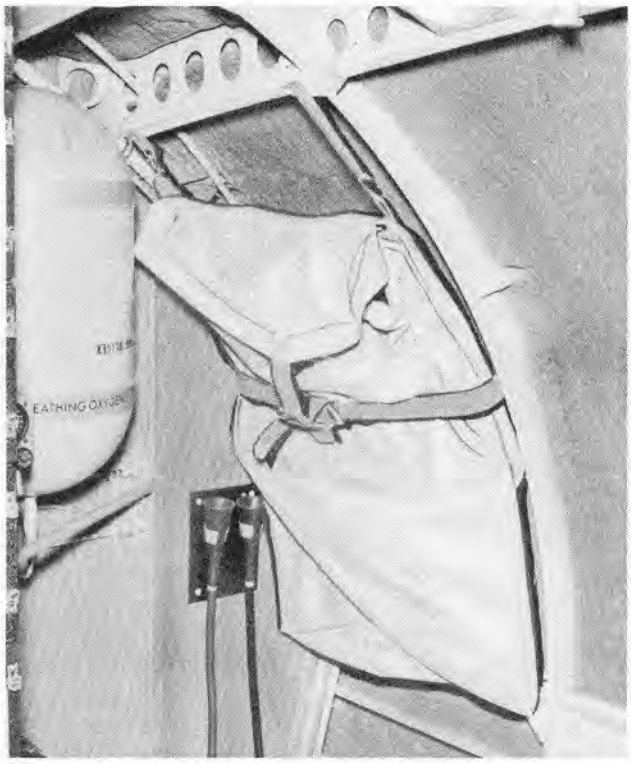


Figure 63—Windshield Defrosters Stowed

CAUTION

Use only fluid, AAF Specification No. 14082-A, in carburetor, windshield, and propeller anti-icer systems. Drain all fluid from anti-icer tanks before going into combat areas.

h. WINDSHIELD DEFROSTERS.—Defroster panes are stowed in the right side above the toilet in the main cargo compartment. These are slid into channels and locked in place, providing a double windshield with an air space between the panels into which heat is directed. The heat control is located on the left of the control pedestal.

i. DE-ICER SYSTEM.—De-icer shoes are installed on the leading edge of the wings, stabilizer, and fin. To operate the de-icer system, place the de-icer circuit breaker on the overhead panel in the "ON" position and place the electrical control switch in the "ON" position.

j. ENGINE COVERS.—Engine covers are provided for covering the cowl back to the fire wall and are stowed in the lower forward compartment. Outlets are provided in the covers for ground heating.

k. OIL COOLER RINGS.—Plywood discs five inches in diameter are provided for installation on the fore-and-aft face of the oil coolers.

NOTE

Use oil cooler rings with caution. Remove them promptly if there is any likelihood of encountering warm air temperatures. Remember there should always be sufficient oil cooling capacity for single engine emergency operation, and that there is danger of overheating the oil when flying from cold to warmer temperatures.

l. AIRPLANE HEATING SYSTEM.

(1) GENERAL.—The heating system of the airplane includes two heating units of the hot air combustion type. Fuel for the operation of the heater is taken from the main fuel system. Air for heating and ventilation enters through the nose cone air duct, passes down over the heater coils, then branches off to the pilots' compartment and main compartment ducts. (Figure 64.)

(2) HEATER BLOWER OIL TANK.—Oil for cooling and lubricating the heater blower mechanism is supplied from a tank with a capacity of 5 U. S. quarts (4.2 Imperial quarts). Prior to each flight, check and fill the tank, if necessary, with oil, Specification No. AN-VV-O-366a.

(3) CONTROLS.—The control for the air intake and all controls for operating the heater are located on the left window ledge in the pilots' compartment. (See figure 65.)

(4) OPERATION OF HEATING SYSTEM.

(a) Place the air intake valve control in the "OPEN" position, by pulling the control up as far as possible.

(b) Place the heater switch on the overhead panel in the "ON" position.

(c) Place the heater selector control in either full forward or full aft position for single heater operation. Place control in "BOTH" position for operation of both heating units.

(d) Open the heater fuel shut-off valve.

(e) Pull the heater throttle control knob up approximately half the distance of its full travel.

(f) Place the start-and-run toggle switch in the "START" position to start the blower motor. Hold in this position for 3 to 5 seconds to allow the motor to gain speed before full voltage is applied.

(g) Throw the start-and-run toggle switch to the "RUN" position. Hold in this position until amber low-oil-pressure indicating light goes out. Then allow toggle to return to neutral position.

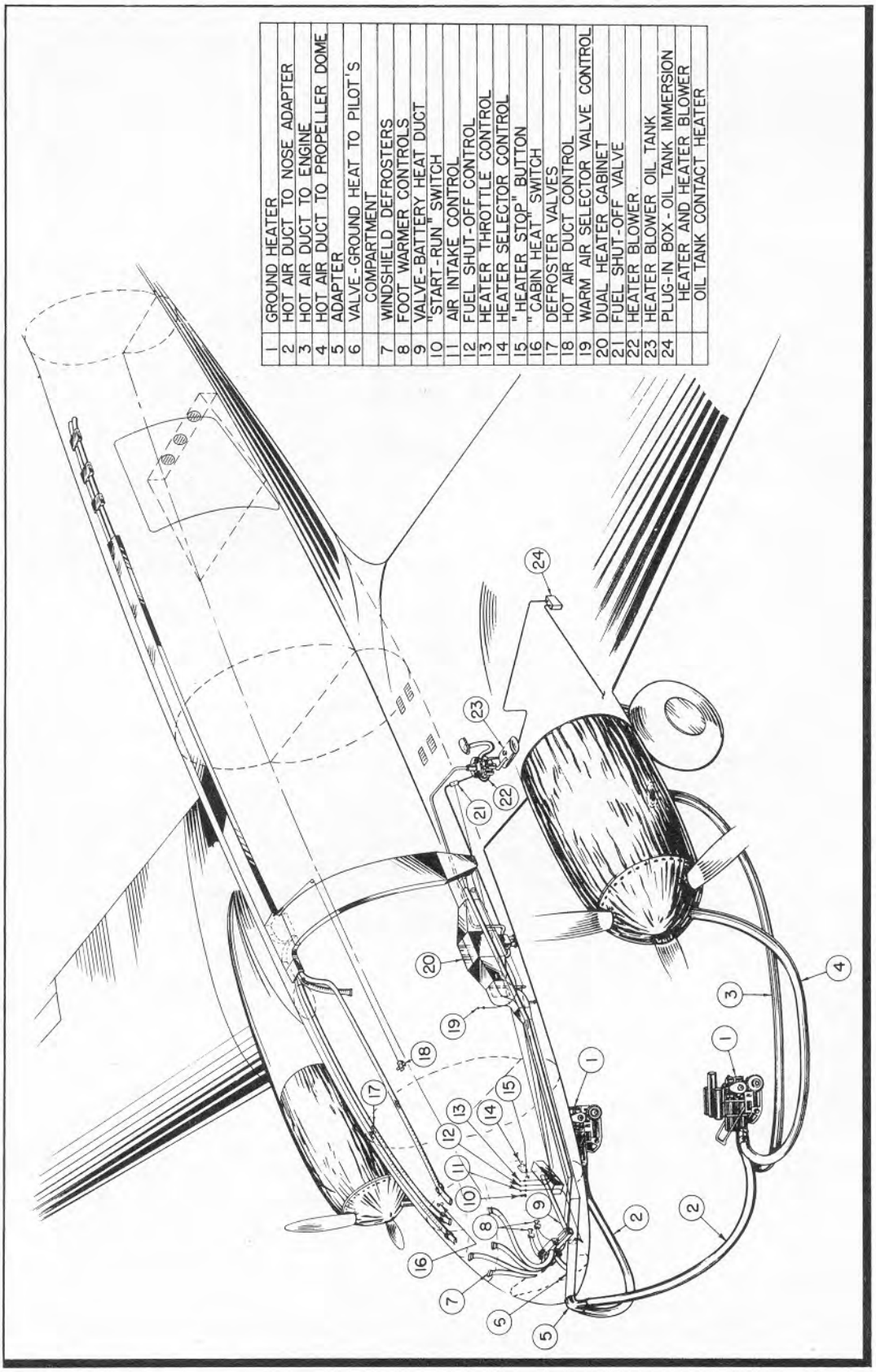


Figure 64—Airplane Heating System and Ground Heating Equipment

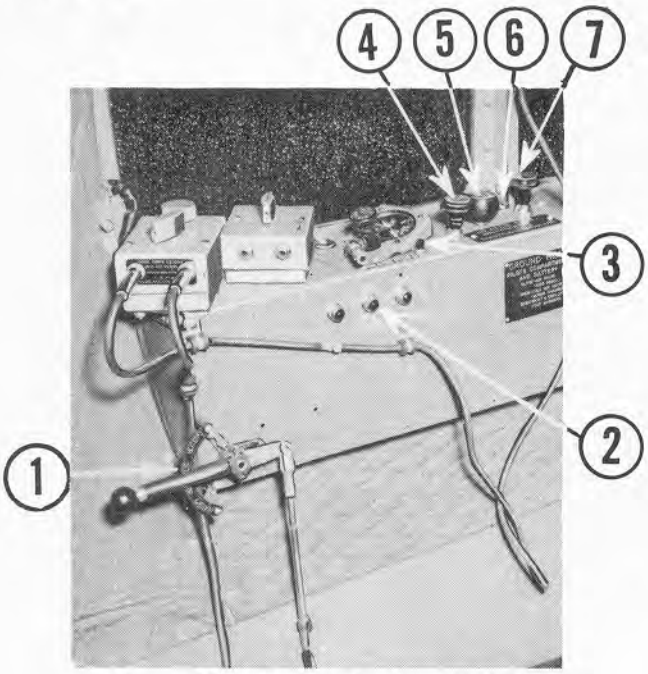


Figure 65—Heating System Controls

1—Heater Selector
2—Heater Indicating Lights
3—Heater Stop
4—Heater Throttle
5—Heater Fuel Shut-off Valve
6—Heater Blower Starter Switch
7—Air Intake Valve Control

(b) When the heater has started, set the heater throttle control knob for the desired amount of heat. Pull the control "UP" to increase the heat, and push it "DOWN" to decrease the heat. If there is evidence of surging or uneven running, open throttle far enough to allow blower motor to run smoothly.

(5) HEATER INDICATING LIGHTS. — Two green lights indicate that the heating system is operating. One light is on for single heater operation and two lights are on for dual heater operation. The low-oil-pressure amber light remains off during normal operation. These three indicating lights are located under the window ledge to the left of the pilot's seat.

(6) HEAT DIVERSION.

(a) Warm air is supplied from the heating system through both air ducts to the pilots' and the main cargo compartments. Heat may be directed through only one of the ducts by operating a control located near the left-hand wall of the navigator's compartment just aft of the door to the pilots' compartment. This control is marked for three positions: "PILOTS' COMPARTMENT HEAT ONLY" (fully up), "PILOTS' COMPARTMENT AND MAIN CARGO COMPARTMENT HEAT" (half-way down), and "MAIN CARGO COMPARTMENT HEAT ONLY" (fully down).

Figure 66—Main Cargo Compartment Heat Control

(b) From the forward end of the main cargo compartment warm air duct, four small ducts with flexible tube ends and individual shut-off valves convey warm air for the individual use of flight operating personnel. One of these tubes is in easy reach of each pilot, the radio operator, and the navigator. They may be used for personal comfort, heating instruments, and auxiliary defrosting.

(c) If the navigator's curtain is installed between the navigator's and cargo compartments, the supply of warm air aft of the navigator's compartment may be shut off by closing a valve in the air duct. This control is located near the ceiling to the left of the radio rack.

(d) Controls for the pilot's foot warmer and for windshield defroster heat are located on the left of the control pedestal. The control for the copilot's foot warmer is on the right of the control pedestal.

(7) TO STOP HEATING SYSTEM.

(a) Place the heater throttle control in the "FULL DOWN" position.

(b) Push down on the "HEATER STOP" button just aft of the heater throttle control.

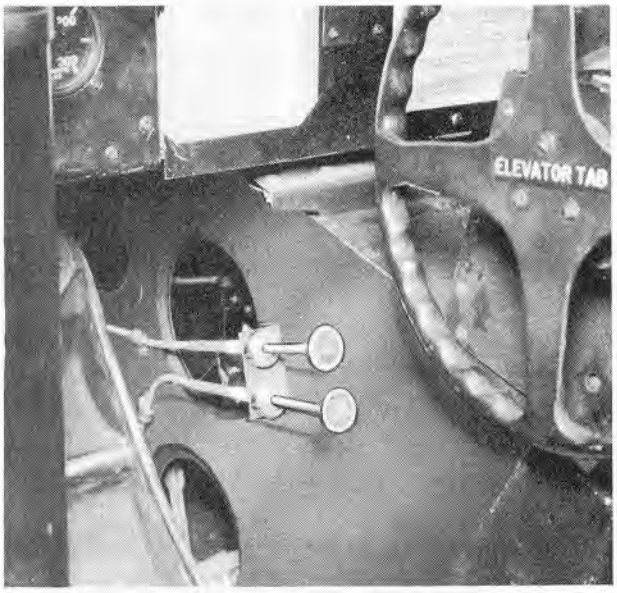


Figure 67—Foot Warmer and Windshield Defroster Controls

WARNING

Do not operate the airplane heating system while the airplane is on the ground, unless a suitable blower or fan is used in the air intake duct to pass air over the heating unit—*and then operate only one heating unit.* The spark plug leads will burn off without this cooling action.

3. PROCEDURE PRIOR TO FLIGHT.

a. Preparations before flight are largely dependent on the extent of the cold weather steps which were taken at the last landing, and on outside air temperatures. In very cold weather the engine and accessory sections and pilots' compartment should be preheated before starting the engines. (Refer to paragraph 11., below, for ground heating procedure.)

b. Operate ailerons, elevators, rudder, and all trim tabs through their complete travels 3 or 4 times, noting the forces required. If forces are excessive, check system for cause.

WARNING

If ice, frost, or snow is present on the airplane wing or flight surfaces, it must be removed by brushing, flushing, or heat prior to take-off.

c. When it is necessary to remove frost or ice from areas of the airplane, use hot water on a small area at a time, then flush with denatured alcohol before the water freezes, or use heat from a portable ground heater. Pay particular attention to exposed hinges, openings between fixed and movable surfaces, landing gear, and brakes.

4. STARTING ENGINES.

a. The procedure for starting an engine is the same as during warm weather, with the exception of the amount of prime, oil dilution, and cowl flap adjustment. If one engine is consistently easier to start than the other, start it first.

b. Before starting, take the following precautions:

(1) To prevent plugs fouling and oil congealing in extreme cold, do not start the engines until the airplane is loaded and ready for immediate departure.

(2) Do not attempt to start the engines until the propellers are checked. Hydromatic propellers should turn normally as in warm weather, if oil dilution and ground heat have been effective.

(3) Insure that the batteries are well charged, as a half charged battery will freeze at approximately −20°F (−29°C) and a fully charged battery freezes at approximately −85°F (−65°C).

c. Place cowl flaps, auxiliary cowl flaps, and oil cooler flaps in "CLOSED" position before starting engines.

d. Except in an emergency, connect a battery cart of ample capacity (135 amperes) to the socket on the lower right side of the fuselage skin. This cart plug-in is quickly identified by the decalcomania "BATTERY PLUG-IN" above the opening.

NOTE

In an emergency, the engines may be started without the external battery cart, by placing the battery switch "ON."

e. With the battery and ignition switches "OFF," turn the engines over 4 or 5 revolutions by pulling the propeller through by hand in the direction of rotation, if the engines have not been running for two hours or more.

f. PRIMING.

(1) The lower the temperature, the greater the amount of priming which will be required. Experience will dictate how much priming is necessary to obtain good starting in various temperatures.

(2) When the starter switch is placed in the "ENGAGE" position, simultaneously place the primer switch in the "ON" position and prime while the engine is turning over.

(3) Overpriming is indicated by raw gasoline in the exhaust, collector ring, or on spark plugs. It creates a fire hazard and washes oil from the cylinder walls, which may cause scored pistons and cylinders. If engine is overprimed, open throttle wide and clear out engine by pulling through several times by hand with battery and ignition switches "OFF." Be sure battery cart is not plugged in when clearing out engine.

NOTE

In cold weather, fuel may be discharged through the blower drain pipe and still leave the engine underprimed.

g. MIXTURE CONTROL.

(1) If starting difficulty is encountered in sub-zero weather, move mixture control out of "IDLE CUT-OFF" to "AUTOMATIC RICH" at the same time the starter is engaged.

(2) If the engine does not start almost immediately (three seconds), return mixture control to "IDLE CUT-OFF" position.

(3) If the engine does not start within the next five seconds with mixture control in the "IDLE CUT-OFF" position, continue to turn the engine with the starter and repeat the procedure. One to three repetitions of this procedure will usually start the engine.

NOTE

With the mixture control in the "IDLE CUT-OFF" position, set the fuel booster pumps in the "ON" position to maintain a pressure of 16 $\pm$ 1 pound per square inch.

(4) As soon as the engine starts, move the mixture control to "AUTO-RICH" and observe the engine instruments for normal operation. Do not GUN the throttle.

(5) If the engine does not "take," return the mixture control to the "IDLE CUT-OFF" position immediately to avoid flooding the supercharger. Allow the starter switch to return to the "OFF" position. Energizing the booster coil longer than 15 seconds may burn out the coil winding.

5. ENGINE WARM-UP.

a. Keep cowl flaps and auxiliary cowl flaps closed until the engines are actually running, then open them.

b. Close the surface control booster shut-off valve located at the base of the control pedestal.

c. Place the control booster heater switch located on the control pedestal to "ON" position.

NOTE

On airplanes AF41-12334 and subsequent, this switch is installed on the right window ledge of the pilots' compartment.

6. TAKE-OFF.

a. Open the surface control booster shut-off valve.

b. Do not take off on soft snow. Taxi along the runway a few times to pack it down.

c. Regardless of the degree of cold weather encountered, take-off should be made with the cowl flaps open. The hazard of taking off with partially closed cowl flaps is too great to risk, and the engines will not cool off excessively during the take-off and rated power climb.

CAUTION

When taking off on muddy or snow-covered fields, there is danger of the landing gear recesses or mechanism being clogged with mud or wet snow, and then becoming inoperative after retraction because of freezing. If this is likely to occur, do not retract the landing gear.

7. DURING FLIGHT.

If icing conditions exist:

a. Turn on wing and empennage de-icer system. Check de-icer system operation by the pressure gage on the lower right instrument panel.

b. Turn on carburetor, windshield, and propeller anti-icing fluid.

c. Place the carburetor heat control on "HOT."

d. Install the defroster windshield panels.

8. LANDING AND TAXYING.

a. AVOID EXCESSIVE COOLING.—Temperature inversions are common in winter and the ground air may be much colder than at altitude. To avoid excessive cooling when letting down, use considerable power and regulate cowl flaps to keep engine temperatures up.

b. CARBURETOR.—Make approach and landing with carburetor heat on, if there is a tendency toward carburetor icing during the approach. Turn on carburetor anti-icer if necessary.

c. COWL FLAPS.—If cowl flaps are closed to maintain satisfactory cylinder head temperatures, remember to open them if power is to be used for an extended period of time.

d. ENGINES.—In approach for landing in cold weather, do not idle engines at low speed. Check engines frequently for ability to accelerate.

e. LANDING WITH ORDINARY TIRES.—When landing with ordinary tires in temperatures between 0°F (−18°C) and −32°F (−35°C), allow the airplane to roll to a stop, if practical, rather than apply the brakes, as application of the brakes builds up friction between the wheel and the snow. The ice and snow melt, freeze into a glaze, and skidding results. At temperatures below −32°F (−35°C), ice and snow act almost like gravel and landing conditions are generally good.

9. PROCEDURE AFTER FLIGHT.

a. OIL DILUTION.

(1) During cold weather, to make the next start easier and reduce starting wear, dilute the engine oil before stopping the engines.

NOTE

It is impossible to dilute the oil unless the engines are running.

(2) Run engines at 800 rpm.

(3) Maintain oil temperature below 50°C (122°F), never over 70°C (158°F).

(4) Hold oil dilution switches "ON" for four minutes, then shut off engines in normal manner, holding dilution switches "ON" until engines stop.

(5) If ground temperature is below 20°F (−7°C), repeat operation after a 15-minute wait. For temperatures below −20°F (−30°C), dilute a third time after another 15-minute period.

(6) When the airplane has not been flown after dilution, the oil will not be diluted again until after the engines have been operated for 20 minutes or unless the oil temperature has reached 70°C (158°F) or above for five minutes or more.

(7) If the airplane is equipped with Hamilton propellers, slowly move the propeller controls from "FULL INCREASE RPM" to "FULL DECREASE RPM" several times during the dilution period to allow diluted engine oil to fill the propeller domes.

(8) Overdilution will not normally occur if the engines are warm, and will have no serious effect on engine bearings as long as oil pressure remains normal.

CAUTION

Do not dilute when oil temperature is 70°C (158°F) or more, since fumes from engine breathers may create a serious fire hazard, and dilution will be useless. Stop engines and when the oil has cooled to 40° to 50°C (104° to 122°F), restart and proceed with dilution.

(9) When engines are started after oil dilution, start them in the normal manner. If oil pressure is too high, or fluctuates or falls back when rpm is increased, indicating heavy viscosity, the oil may be diluted to correct this condition. Use this method *only* if time and extreme temperature do not permit normal warm-up, since overdilution may result. If dilution is used during warm-up, watch oil pressure closely during both warm-up and take-off. Overdilution can cause low oil pressure.

b. OIL IMMERSION HEATERS.—Connect the immersion heaters after stopping engines before the oil is allowed to cool, and operate during the entire time the airplane is inactive. The heaters should not be relied on to thaw congealed oil as the oil has no chance to circulate and will carbonize around the heaters. If the oil has been allowed to congeal, the heaters may be turned "ON" for two minutes and "OFF" for one minute, then "ON" for another two minutes, etc., until the oil around the heater units is circulating.

WARNING

Under no circumstances should the oil tank heaters be connected to the airplane batteries. Use an outside source of power.

c. FUEL TANKS.—Insure that fuel tanks are filled at the termination of each flight, before the airplane is parked or moored to stand any length of time, to minimize condensation.

10. GROUND HANDLING OF AIRPLANE.

a. COLD-WEATHER MOORING.

(1) When parking in the open, if practicable, head the airplane into the wind before tying down. Close the cowl flaps to keep dirt, snow, etc., out of the power plant.

(2) If no fixed anchorage is available and the ground is frozen too solidly to use the mooring equipment in the airplane, dig holes in the ground eight inches deep and eight inches square. Coil as much manila rope (⅜-inch diameter) in each hole as possible, or tie stakes crosswise to mooring ropes and place cornerwise in holes. Fill the holes with water, and after the water has frozen, attach the free ends of the ropes to the mooring points on the airplane.

NOTE

If conditions permit, fires may be built to thaw the ground so mooring pins can be driven in.

(3) When mooring on ice, two holes may be dug one foot apart and a mooring line passed through a hole drilled under the intervening solid ice crosspiece.

b. PARKING ON SNOW OR ICE.—Put a layer of fabric, grass, straw, green boughs, or other insulating material under the wheels to prevent freezing into the surface. Lack of such precautions frequently results in tearing off large chunks of rubber from the tires when the airplane is again moved.

c. BRAKES "OFF."—Leave brakes "OFF" when the airplane is parked to prevent locking by ice formed through condensation.

d. OVERNIGHT PARKING.—When the airplane is parked for the night, leave a door or window partly open, to permit circulation of air inside the airplane, and to prevent the frosting up of windows.

e. COVERING OR BLANKETING. — Protective covers, if available, consisting of paulins with ropes to secure the paulins to the airplane, will be used on the wings, tail surfaces, and fuselage to prevent frost accumulation.

f. BATTERIES.—At freezing temperatures or below, remove airplane batteries, when practicable, and store in a heated room, or in some suitable place where the temperature remains above freezing. Portable generators may be used, if available, to build up the batteries and assist in starting.

CAUTION

Do not operate electrical devices on the ground except for test purposes, unless a portable generator is kept in operation, since early depletion of the batteries will result.

11. USE OF PORTABLE GROUND HEATERS.

a. Use two Stewart-Warner type D-1 ground heating units, AAF Specification No. 40390, or equivalent, if available, to heat the airplane and engines while moored, or before the first flight of the day. Put engine covers on before applying heat.

b. Hand-operated Stewart-Warner portable ground heaters, if available, may be used for preheating the engine sections, melting snow and ice from control hinges and cables, and at other points where spot-heating is required.

c. ATTACHING GROUND HEAT CONNECTIONS. *(See figure 64.)*—A "Y" connection is provided to be inserted in the air duct of the airplane's nose cone to accommodate two hose adapters, one from each ground heater unit. Before attaching ground heat adapters, use a ladder or other means of elevation and reach into the mouth of the nose cone air duct to open the battery heat valve and the pilots' compartment heat valve. These valves must be opened before the ground heat connection is installed, since they have no remote control.

(1) In the pilots' compartment, place the air intake control valve in the closed "DOWN" position, pull control knobs out to open the foot warmer and defroster valves located on either side of the lower pedestal, and insure that the pilots' compartment door is closed after adjusting all controls.

(2) Attach the center duct of each ground heater to the ground heat connection in the airplane nose.

(3) Open the ground heat access in each bottom engine cowl and attach a ground heater tube to the opening, through the sleeve in the engine cover.

(4) If the airplane is equipped with Hamilton propellers, attach a heater duct to the adapter in each propeller dome cover.

CAUTION

Do not permit excessively hot air to blast against ignition harness, flexible hose, or other rubberized or fabric materials. The blast will be too hot, unless the hand can be comfortably held for one minute in the same position as the part in question.

WARNING

After heat has been applied and the ground heat connection removed from the nose section, be sure that the battery heat valve and pilots' compartment heat valve are closed by reaching into the nose duct. These valves cannot be closed when the airplane is in flight, since they have no remote controls.

12. EMERGENCY COLD WEATHER OPERATION.

a. In extremely cold weather, when an external source of current is not available for oil immersion heaters, immediately following a single dilution, drain all oil into clean containers and store the oil where the temperatures will not be lower than freezing. Or heat the oil on a stove or other heat source, and pour back into the oil tanks immediately before starting the engines.

CAUTION

Be sure that all open flames (fire pots, etc.) are at a safe distance, when the oil is being drained, especially if the oil has been diluted.

b. Where containers and heating facilities are not available, drain all oil out on the ground before trying to start engines. This is essential if oil cannot be kept warm, since it is easier to bring in fresh oil and heating facilities for removing it from shipping containers, than it is to warm up the oil system of the airplane sufficiently to permit the flow of congealed oil.

c. When heating facilities are inadequate to assure engine starting, it may be necessary to keep engines running throughout the lay-over period. This can be done only when sufficient fuel is available for the necessary time of ground running at about 1,000 rpm, and for flight to the next fuel supply. Keep a crew member constantly on watch for any troubles which may develop. Run up engines to 1,500 rpm occasionally to clear them. Maintain oil pressure at normal, even though it is necessary to dilute the oil periodically to reduce pressure.

d. When containers and heating facilities are not available for draining and warming oil, the following procedure may sometimes be successfully used if the minimum temperature does not fall below —22°F (—30°C):

(1) Use normal oil dilution procedure before shutting down engines.

(2) After shutdown, drain sufficient oil from the system to bring oil level to two-thirds of its total capacity.

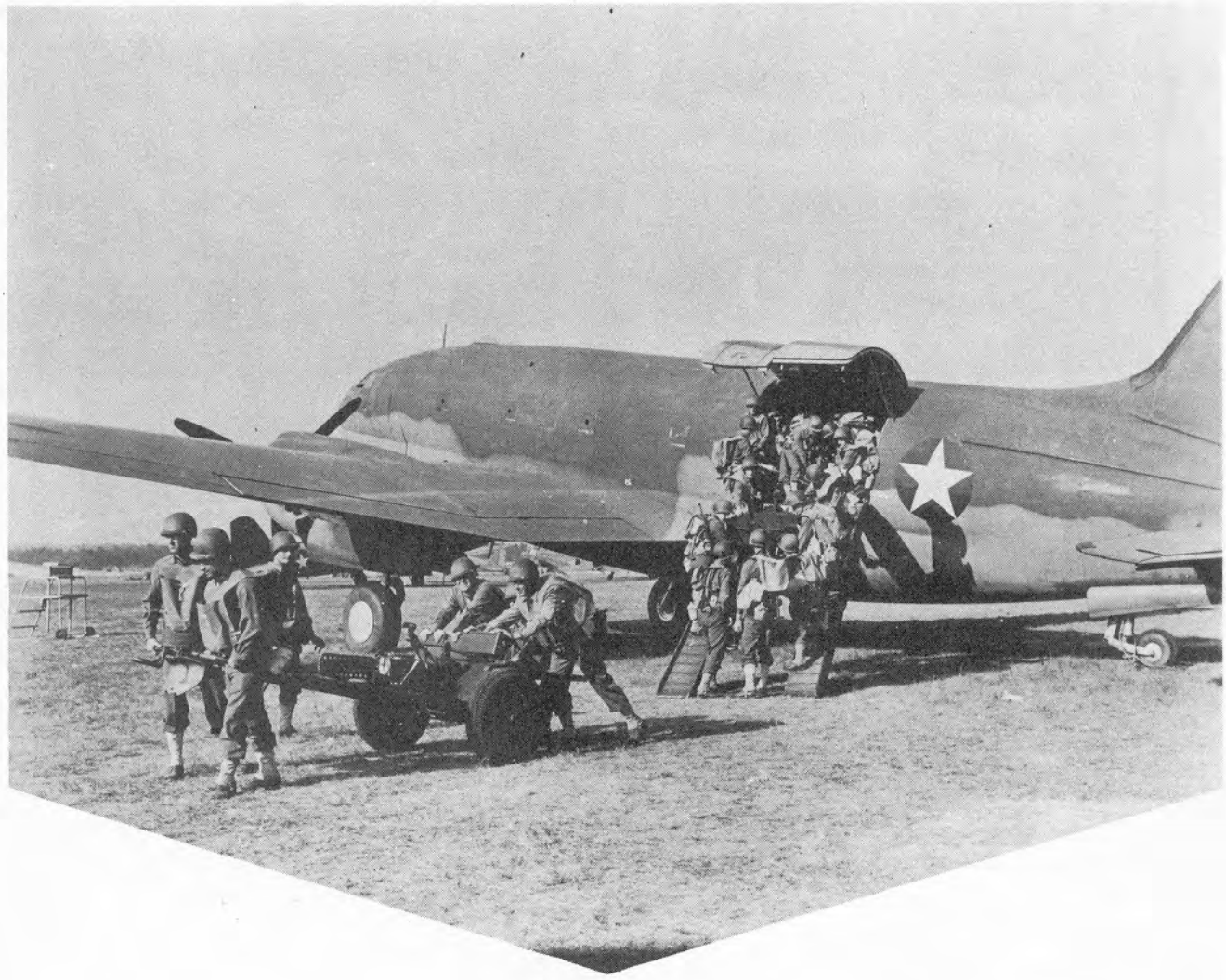
(3) Restart engines and run with covers over oil coolers if necessary until oil temperature shows 50°C to 60°C (122°F to 140°F).

(4) With engines still running at 800 to 1,000 rpm, slowly add enough gasoline at the oil filler neck to fill the system. This gives a 2 to 1 ratio of oil to fuel and will produce some dilution of the oil adjacent to the tank hopper.

(5) Restart after 20 to 30 minutes and give a second dilution, using only the normal dilution procedure, followed by a final shutdown.

CAUTION

This is strictly an emergency procedure to be followed only when equipment is lacking for heating or draining oil. When the gasoline evaporates, only two-thirds of the total oil capacity remains in the system and it must be sufficient for flight to a new oil supply.



Section VII
DESERT OPERATION

1. DESERT EQUIPMENT.

a. PROTECTION AGAINST DUST. — Boots and covers have been furnished to protect all exposed portions of the airplane, such as in the landing gear and tail wheel wells, where the infiltration of dust may hinder operation of the airplane.

b. PLUGS AND COVERS.—Following is a list of plugs and covers which are installed at all times when the airplane is to remain on the ground for an extended period of time in dusty or desert areas. All plugs are equipped with pull cords for easy removal prior to starting engines.

(1) Nose cone air intake plug

(2) Battery drain plug

(3) Pitot tube boot assembly

(4) Hydraulic drain plug

(5) Nacelle carburetor air scoop plug

(6) Heater carburetor inlet plug

(7) Exhaust pipe and breather plug

(8) De-icer and oil separator exhaust plug

(9) Fuselage louvers cover

(10) Center wing panel heater exhaust cover

(11) Outer wing panel fuel vent plugs

(12) Landing gear well covers

(13) Landing gear brake covers

(14) Long range fuel tank vent plug

WARNING

All dust plugs and covers must be removed before starting the engines.

c. STOWAGE OF EQUIPMENT.—The desert equipment should be stowed in the dust equipment stowage bag when not installed on the airplane. The stowage bag is secured to the cargo rings (four places) in the forward cargo compartment between station 128 and station 150.75 on the right side.

2. CARBURETOR AIR FILTERS.

a. Filters are installed in the air induction ducts leading from the nacelles, to rid the air of sand and other foreign materials.

b. The filters are operated by the same control handle as the auxiliary cowl flaps. This control is located at the base of the control pedestal.

c. Pulling on the control handle opens a butterfly valve just above the carburetor, which will close the

top cowl air scoop and open the air induction ducts from the nacelles. Lock control in slot provided.

d. The pilot should personally check to see that during desert operation the cables are connected to the filter control.

3. REDUCED FLYING RANGE.

In hot climates range may be reduced as much as 10 percent on account of the gasoline being hot at take-off. Allowance should be made accordingly in using the Flight Operation Instruction Charts (Appendix II) for flight planning.

4. VENTILATION OF AIRPLANE.

While the airplane is parked, keep doors and windows open so that air can circulate through the airplane. If it is necessary to keep the airplane locked, it should be opened at intervals for ventilation. Otherwise, excessive temperatures may cause damage to instruments, gyro equipment, some parts of the automatic pilot system, and radio equipment.

Section VIII
LONG RANGE FUEL AND OIL SYSTEMS

1. LONG RANGE FUEL SYSTEM.

a. GENERAL.—The long range fuel system consists of individual removable 100 U. S. gallon (83 Imperial gallon) fuel tanks mounted by pairs on cradles in the main cargo compartment, in any combination of from 2 to 16 tanks, and a permanently installed long range fuel booster pump, strainer, and lines. (See figure 68.)

b. CONTROLS FOR LONG RANGE FUEL SYSTEM.

(1) Normally, an eight tank installation on the left side is used. At the bottom aft end of each tank, a fuel line leads from the tank to a shut-off valve. In large installations, this shut-off valve at the rear of each tier serves as the shut-off for all tanks in that tier. It is possible, therefore, to supply fuel from either the upper or lower or both tiers of tanks.

(2) The long range fuel booster pump is a permanently installed electric pump controlled by a switch on the pilot's overhead panel. The cross-feed valve on the main fuel cross-feed line is operated by a push-pull control located in the cargo compartment above the tanks at station 276. For normal wing tank operation, the cross-feed valve is closed. The long range master shut-off valve is hand operated.

c. FILLING FUEL TANKS.

(1) Each tank has an independent filler neck at the top of the tank near the aft end.

(2) Before fuel tanks are filled, check all long range fuel shut-off valves for "OFF" or closed position.

(3) Fill the aft tanks first and work forward. Make sure filler caps are hand-tight after filling tanks. Since the tanks are filled while the plane is in the three-point position, the front tier tanks will not hold their full capacity of 100 U. S. gallons (83 Imperial gallons), but approximately 95 U. S. gallons (79 Imperial gallons) each. Check amount of fuel put into the tanks with the gage on the fueling truck.

NOTE

After filling, the caps of the tanks aft of the forward tank of each tier cannot be opened while the airplane is in the three-point position without spilling fuel.

d. OPERATION OF THE LONG RANGE FUEL SYSTEM.

CAUTION

Do not use the long range tanks for take-off or landing. Use 100 U. S. gallons (83 Imperial gallons) from front wing tanks of main fuel system first, then use long range fuel to depletion.

(1) The engines should be run on the long range fuel system *on the ground* before take-off, to eliminate air or vapor locks in the system.

(2) Before using the long range tanks, see that all the following valves in the system are in the "OFF" position: Cross-feed shut-off, long range master shut-off, and both tank shut-off valves.

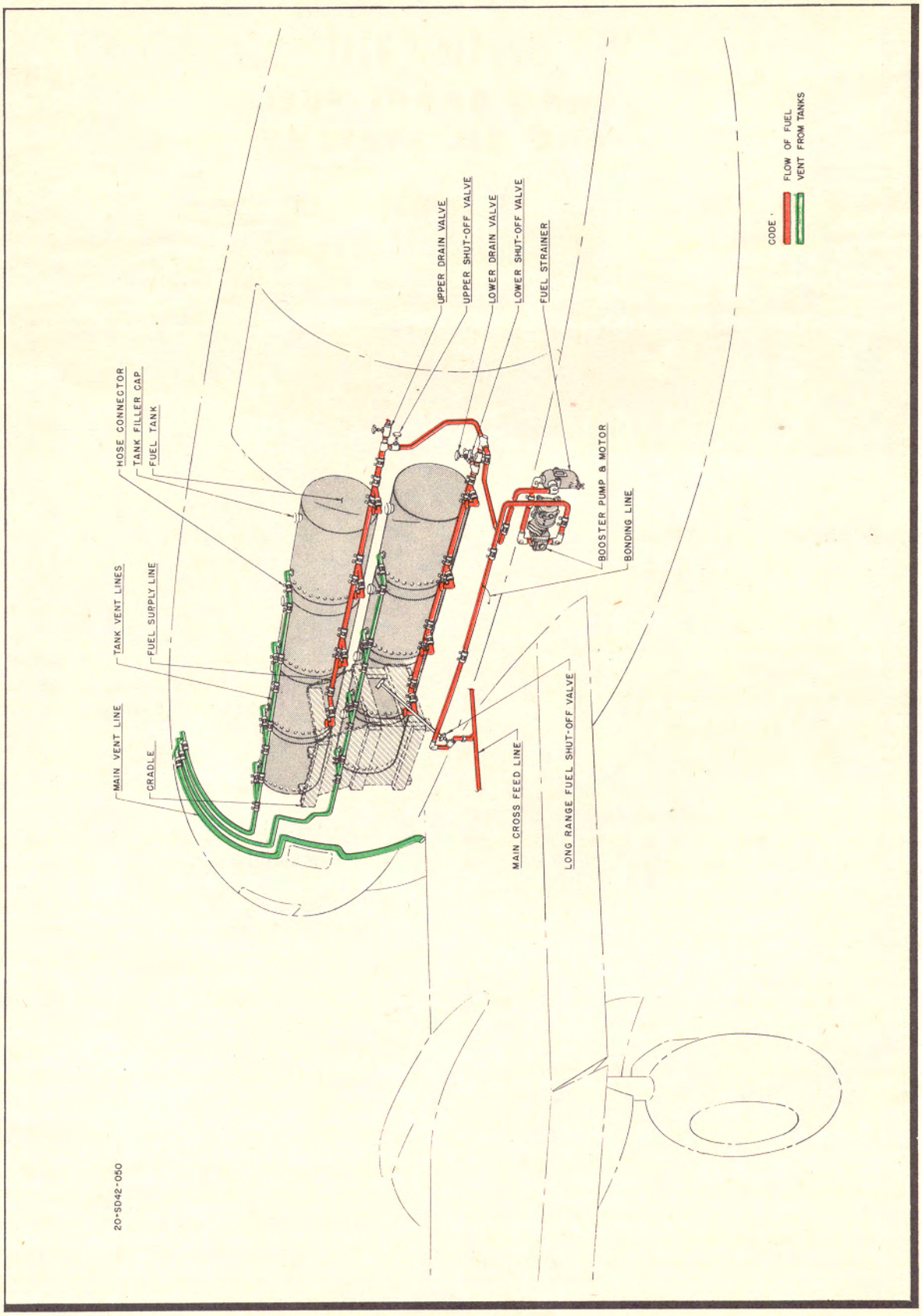


Figure 68—Long Range Fuel System

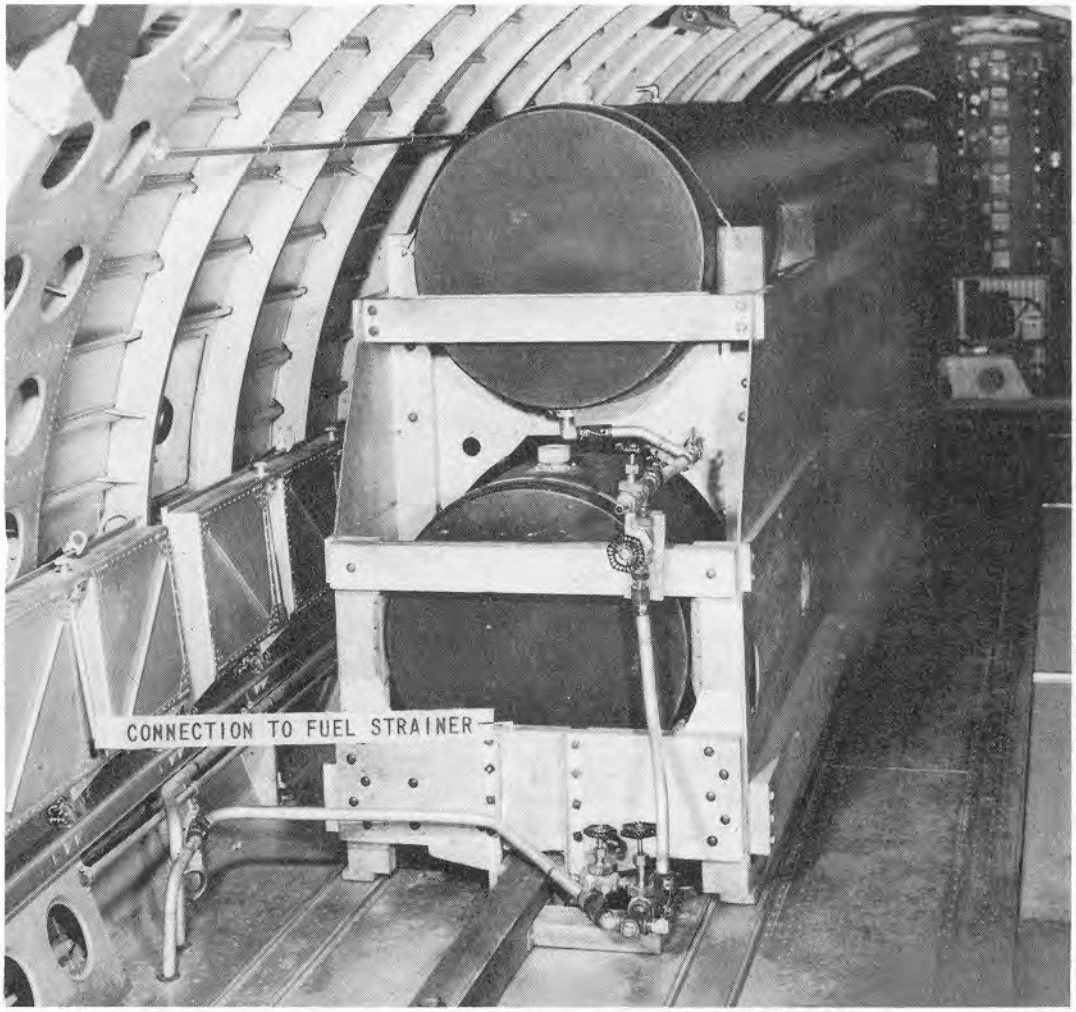


Figure 69—Long Range Fuel Tanks

(3) TO USE THE LONG RANGE SYSTEM, PROCEED AS FOLLOWS:

(a) Open the shut-off valve for the top tanks.

(b) Open the cross-feed valve in the main fuel system by pulling out on the push-pull control located above the long range tanks. If cross-feed valve is closed, long range fuel will flow to left engine only.

(c) Check to see that main fuel system booster pumps are "OFF." (Switches are located on the control pedestal in the pilots' compartment.)

CAUTION

Do *not* turn off main fuel system. Leave selectors on a usable tank on each side.

(d) Turn on the long range booster pump by operating the switch on the overhead panel in the pilots' compartment.

(e) Open the long range master valve at station 277, on the left side of the cargo compartment just aft of and outboard of the tanks.

(f) Check the fuel pressure gage on the co-pilot's instrument panel for 16 pounds' pressure.

(g) After operating the long range tanks for about five minutes, turn off the long range booster pump and use gravity feed to the engine driven pumps.

(h) Check the fuel level in the tanks frequently during use. Turn on the shut-off valve to cut in the lower tanks before the upper tanks run dry.

(4) TO RETURN TO WING TANK (MAIN) FUEL OPERATION, PROCEED AS FOLLOWS:

(a) Turn on main booster pumps by operating switches on the pedestal in the pilots' compartment.

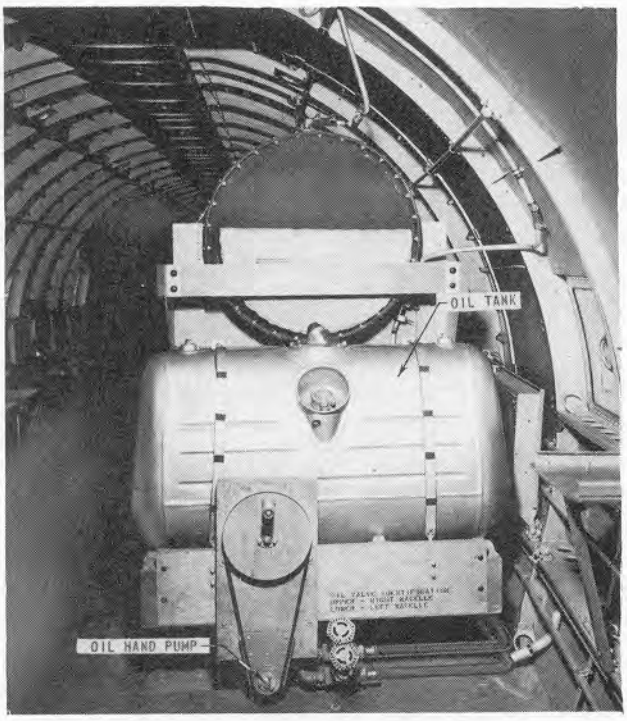


Figure 70—Long Range Oil Tanks

(b) Turn "OFF" the long range booster pump (if still operating).

(c) Turn "OFF" the long range master valve located aft of and outboard of the tanks, on the left side of the main cargo compartment.

(d) Close the cross-feed valve in the main fuel system.

(e) Close the shut-off valve at the long range tank last in use.

2. LONG RANGE OIL SYSTEM.

a. GENERAL.

(1) The long range oil system consists of a removable 40 U. S. gallon (33.3 Imperial gallon) oil tank, an oil hand pump at the tank, two shut-off valves, and two permanently installed oil lines, one leading to each nacelle oil tank.

(2) The long range oil tank is mounted in a wooden cradle support at the forward end of the left bank of long range fuel tanks. A hand-operated pump is installed in the oil supply line leading from the bottom of the tank to the lines running to the nacelles. The pump operating gear is mounted on the forward side of the tank support. A shut-off valve is installed in each line, to the nacelles, outboard of the pump operating gear.

b. OPERATION OF THE LONG RANGE OIL SYSTEM.

(1) Oil is pumped to either or both nacelle oil tanks as required, by opening the appropriate shut-off valve or valves and operating the hand pump.

(2) The nacelle oil tank low level warning lights go on when the quantity of oil in the nacelle tanks drops to one-quarter full (10 U. S. gallons or 8.3 Imperial gallons). Oil should then be pumped from the long range oil tank to the nacelle oil tanks.

(3) Pump 15 U. S. gallons (12.5 Imperial gallons) of oil to a nacelle tank when the low level warning light first comes on.

(4) Pump to only one nacelle tank at a time; otherwise it will be impossible to determine how much oil is pumped to each tank.

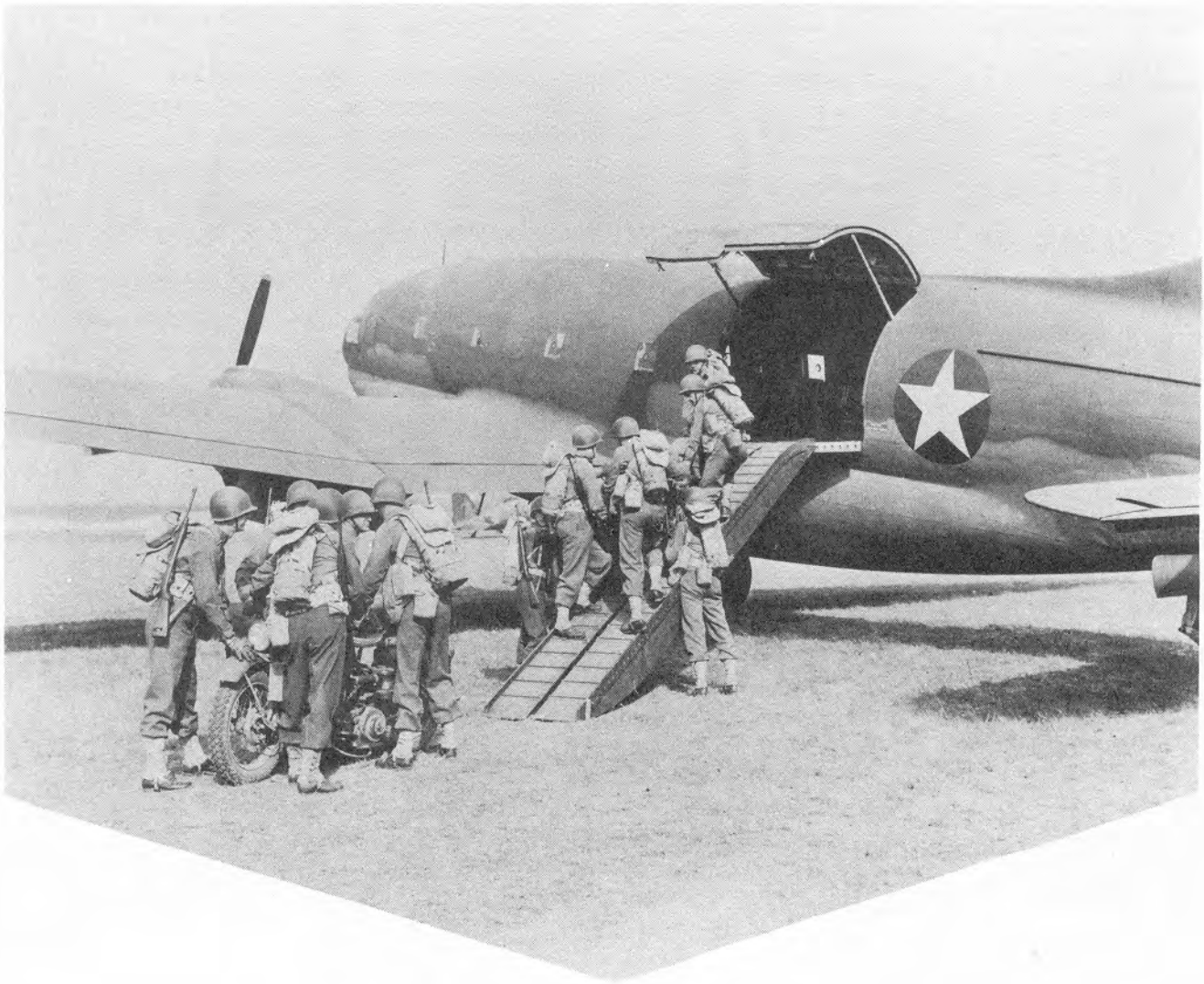
(5) The amount of oil pumped to the nacelle tanks is determined by the difference in the oil level readings on the bayonet gage located just forward of the filler cap on the long range tank.

(6) After 15 U. S. gallons (12.5 Imperial gallons) of oil have been pumped to both nacelle tanks, there will be a reserve supply of 10 U. S. gallons (8.3 Imperial gallons) in the long range tank.

APPENDIX I

U. S. A.-BRITISH GLOSSARY OF NOMENCLATURE

U. S. A.	*British*
Accumulator (hydraulic)	Pressure reservoir
Air filter	Air cleaner
Airfoil	Aerofoil
Antenna	Aerial
Battery (electrical)	Electrical accumulator
Bombardier	Bomb aimer
Ceiling	Cloud height
Check valve	Non-return valve
Command set (radio)	Pilot controller set
Copilot	Second pilot
Course (direction with respect to true north)	Track angle
Critical speed	Stalling speed
Cylinder (hydraulic)	Jack (hydraulic)
Dead load	Tare weight
Drift	Drift-angle
Dump valve	Jettison valve
Empennage	Tail unit
Flare (signal)	Signal star, signal projectile
Flight indicator	Artificial horizon
Frequency meter	Wavemeter
Gage (fuel)	Fuel-contents gauge
Gasoline (gas, fuel)	Petrol or fuel
Generator	Dynamo
Ground (electrical)	Earth
Gyro horizon	Artificial horizon
Gyro pilot	Automatic pilot
Heading	Course
Indicated air speed (IAS)	Air-speed-indicator reading
Interphone	Inter-communication
Landing beam	Approach beam
Landing gear	Alighting gear
Lean mixture	Weak mixture
Left	Port
Level off	Flatten out
Liaison set (radio)	General purpose set
Life raft	Dinghy
Manifold pressure	Boost pressure
Mooring line	Mooring guy
Mooring rings	Picketing rings
Oil pan	Crankcase sump
Panel (center wing)	Centre section plane
Panel (outboard)	Outer plane
Radio mast	Rod aerial
Radio operator	Wireless operator
Radio range beacon	Radio track beacon
Right	Starboard
Screen (oil)	Filter
Stabilizer (horizontal)	Tail plane
Stabilizer (vertical)	Fin
Tachometer	Engine speed indicator, revolution counter
Take-off distance	Take-off run
Tube (radio)	Valve
Valve (fuel or oil)	Cock
Weight (empty)	Tare
Weight (gross)	All-up weight
Windshield	Windscreen
Wing	Main plane



APPENDIX II
FLIGHT OPERATION CHARTS AND CURVES

1. GENERAL.

This section presents charts and curves giving a summary of specific characteristics of the engines and airplane, and containing restrictions and instructions to be observed in the flight operation of this airplane.

2. TAKE-OFF, CLIMB, AND LANDING CHART.

This chart is three tables in one. It gives in a compact form important information to be followed in take-off, climb, and landing. Note the temperature correction under each table.

3. FLIGHT OPERATION INSTRUCTION CHARTS.

Two sets of four charts each are provided. One set of four charts applies to flights under various loading conditions with both engines operating normally, while the other group supplies data for flights with only one engine operating. The gross weight limits, for which each chart has been computed, are stated at the head of the chart.

4. DETERMINING GROSS WEIGHT AND BALANCE.

Refer to form F in the "Handbook of Weight and Balance Data" in the airplane. Determine from the charts in this handbook or by means of the load adjuster that loading is within safe balance limits.

5. FLIGHT PLANNING.

a. On each Flight Operation Instruction Chart, note the two reference columns which show gallons of fuel in the upper half of the table and altitudes in the lower half. Other columns are in sets with practical ranges (statute and equivalent nautical air miles) listed in the upper half, and corresponding operating instructions in the lower half. Progressing from left to right, these columns are arranged to show increases in range at sacrifice in speed, with maximum cruising speeds at the extreme left and maximum range at the extreme right.

b. In planning a flight, first 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 or fractions of hours desired for reserve fuel. Add the resulting figure to the number of gallons set forth in footnote No. 2 and subtract the total from the amount of fuel in the airplane before starting engines. This figure represents the amount of fuel available for flight planning.

c. Select a figure in the fuel column equal to, or less than, the amount of fuel available for flight planning as calculated above. 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.

d. Drop to the lower part of the same column selected above, and determine IAS at sea level. To allow for wind, use this 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.

e. Select cruising altitude in the lower half of chart under Operating Data and find beside this figure in the range column selected, 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.

CAUTION

Ranges listed in Column I (Max Cont Power) are correct only at an altitude of 6,000 feet. Engine and airplane operating data will give constant miles per gallon only if operation is according to values set opposite the listed altitudes, in the lower half of the column under "Operating Data."

f. If the flight plan calls for a continuous flight where the desired cruising power and air speed are reasonably constant after take-off and climb to 5,000 feet, the fuel required and flight time may be computed as a "single section flight."

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

b. 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 above, then add them together to make up the total flight and its requirements.

6. ENGINE FLIGHT CALIBRATION CURVES.

Two curves are provided; one for low blower ratio, the other for high blower ratio. They present in graphic form necessary data for operating the engines in this airplane, within recommended limits.

SPEC. AN-H-8 Dec. 18, 1942 FORM ASC-510

AIRPLANE MODELS
C-46 SERIES

TAKE-OFF, CLIMB & LANDING CHART

ENGINE MODELS
R-2800-51

TAKE-OFF DISTANCE (IN FEET)

GROSS WEIGHT (IN LBS.)	HEAD WIND		HARD SURFACE RUNWAY						SOD-TURF RUNWAY						SOFT SURFACE RUNWAY					
			AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.		AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.		AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.	
	MPH	KNOTS	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.
34,000	0	0	900	1550	1100	1800	1400	2300	950	1600	1150	1850	1450	2350	1000	1650	1200	1900	1550	2450
	20	17	550	1050	700	1250	900	1600	550	1050	700	1250	900	1600	600	1100	750	1300	1000	1700
	40	35	250	600	350	800	500	1050	250	600	350	800	500	1050	300	650	400	850	550	1100
45,000	0	0	1950	3250	2400	4050	3150	5450	2000	3300	2450	4100	3300	5600	2150	3450	2700	4350	3650	5950
	20	17	1250	2350	1600	2950	2150	4000	1300	2400	1600	2950	2200	4050	1400	2500	1800	3150	2450	4300
	40	35	700	1500	900	2000	1300	2750	700	1500	950	2050	1350	2800	800	1600	1050	2150	1450	2900
52,000	0	0	2900	5000	3650	6300	4950	8750	3000	5100	3800	6450	5200	9000	3300	5400	4250	6900	5900	9700
	20	17	1950	3650	2500	4800	3450	6650	2000	3700	2600	4900	3600	6800	2200	3900	2900	5200	4100	7300
	40	35	1150	2500	1550	3400	2200	4750	1200	2550	1600	3450	2300	4850	1300	2650	1750	3600	2600	5150

NOTE: INCREASE DISTANCE 10 % FOR EACH 10°C ABOVE 0°C (10 % FOR EACH 20°F ABOVE 32°F)

ENGINE LIMITS FOR TAKE-OFF 2700 RPM & 52 IN. HG

CLIMB DATA

COMBAT MISSIONS USE 2400 RPM & * IN. HG

FERRY MISSIONS USE 2100 RPM & * IN. HG

GROSS WEIGHT IN LBS.	TYPE OF CLIMB	S. L. TO 3,000 FT. ALT.				5,000 FT. ALT.						10,000 FT. ALT.						15,000 FT. ALT.						20,000 FT. ALT.						BLOWER CHANGE
		BEST I.A.S.		FT/MIN	TIME FROM S. L.	BEST I.A.S.		FT/MIN	TIME FROM S. L.	FUEL FROM S.L.		BEST I.A.S.		FT/MIN	TIME FROM S. L.	FUEL FROM S.L.		BEST I.A.S.		FT/MIN	TIME FROM S. L.	FUEL FROM S.L.		BEST I.A.S.		FT/MIN	TIME FROM S. L.	FUEL FROM S.L.		
		MPH	KNOTS			MPH	KNOTS			U. S.	IMP.	MPH	KNOTS			U. S.	IMP.	MPH	KNOTS			U.S.	IMP.	MPH	KNOTS			U.S.	IMP.	
34,000	COMBAT	128	111	1400	2.2	127	111	1400	3.6	86	72	122	106	1250	7.4	111	93	117	102	1100	11.6	140	117	112	97	800	16.7	170	142	9,000
	FERRY	134	117	800	3.7	134	117	800	6.2	80	67	134	117	750	12.6	100	83	134	117	550	20.3	124	104							
45,000	COMBAT	128	111	900	3.3	127	110	900	5.5	101	84	122	106	750	11.6	142	118	117	102	650	18.6	189	158	112	97	400	28.4	249	208	9,000
	FERRY	134	117	450	6.2	134	117	450	10.7	94	78	134	117	400	22.4	132	110	134	117	200	38.1	182	152							
52,000	COMBAT	128	111	700	4.3	127	110	700	7.2	114	99	122	106	550	15.7	170	142	117	102	400	26.1	241	201	112	97	200	42.8	355	296	9,000
	FERRY	134	117	300	9.5	134	117	300	16.2	112	93	134	117	250	35.0	174	145	134	117	100	66.8	298	248							

NOTE: INCREASED ELAPSED CLIMBING TIME 10 % FOR EACH 10°C ABOVE 0°C FREE AIR TEMPERATURE (10 % FOR EACH 20°F ABOVE 32°F) FUEL INCLUDES WARM-UP AND TAKE-OFF ALLOWANCE

LANDING DISTANCE (IN FEET)

GROSS WEIGHT IN LBS.	BEST I. A. S. APPROACH		HARD DRY SURFACE						FIRM DRY SOD						WET OR SLIPPERY					
			AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.		AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.		AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.	
	MPH	KNOTS	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL
34,000	80	70	1750	1050	1800	1150	1950	1250	1850	1150	1950	1300	2100	1400	3250	2550	3450	2800	3800	3100
39,000	90	78	1900	1200	2000	1300	2150	1450	2050	1350	2150	1450	2300	1600	3650	2950	3950	3250	4250	3550
45,000	95	83	2100	1400	2250	1500	2400	1650	2250	1550	2450	1700	2600	1850	4100	3400	4450	3700	4800	4050

NOTE: FOR GROUND TEMPERATURES ABOVE 35°C (95°F) INCREASE APPROACH I.A.S. 10% AND ALLOW 20% INCREASE IN GROUND ROLL.

REMARKS *Refer to Engine Flight Calibration Curves

LEGEND
I.A.S.: Indicated Air Speed
M.P.H.: Miles Per Hour
S.L.: Sea Level
U.S.: U. S. Gallons
IMP.: Imperial Gallons
NOTE: All Distances are Average
RED FIGURES HAVE NOT BEEN FLIGHT CHECKED

SPEC. AN-M-8 DEC. 18, 1942 — FORM ASC-511

MODEL (S) C-46 SERIES

FLIGHT OPERATION INSTRUCTION CHART

SHEET 1 OF 4 SHEETS

GR. WT. 52,000 TO 45,000 POUNDS

EXTERNAL LOAD ITEMS: NONE

CONDITION	R.P.M.	M.P. (IN. HG)	BLOWER POSITION	MIXTURE POSITION	DURATION IN MIN.	U.S. G.P.H.	IMP. G.P.H.
TAKE-OFF	2700	52.0	LOW	A.R.	5	547	455
MILITARY POWER	2700	51.0 43.5	LOW HIGH	A.R.	15	547 426	455 354
ENGINE (S)	R-2800-51						

INSTRUCTIONS FOR USING CHART: Select figure in fuel column equal to or less than total amount of fuel in airplane. Move horizontally to the right or left and select a figure equal to or greater than the air miles to be flown. Vertically below and opposite desired cruising altitude read optimum cruising conditions. *NOTES:* (A) Avoid continuous cruising in Column I except in emergency. (B) Columns (II, III, IV & V) toward the right progressively give increase in range at sacrifice in speed. (C) Manifold Pressure (M.P.), Gallons Per Hour (G.P.H.), are approximate maximum values for reference. (D) For quick reference, take-off and military power data are listed in the upper left corner of chart.

(NO WIND) **ALTERNATE CRUISING CONDITIONS** (NO RESERVE FUEL ALLOWANCE)

I (MAX. CONT. POWER) RANGE IN AIR MILES				FUEL U.S. GALS. (2)	II RANGE IN AIR MILES		III RANGE IN AIR MILES		IV RANGE IN AIR MILES		FUEL IMP. GALS. (2)	V (MAX. RANGE) RANGE IN AIR MILES	
STATUTE		NAUTICAL			STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL		STATUTE	NAUTICAL
AT S.L.	AT 6,000	AT S.L.	AT 6,000	1270	170 U.S. (140 IMP.) GALLONS NOT AVAILABLE IN FLIGHT						1055		
	615		535	1100	825	725	1100	955	1375	1195	915	1450	1265
	560		485	1000	750	650	1000	870	1250	1085	830	1320	1150
	500		435	900	675	585	900	780	1125	990	750	1190	1030
	445		390	800	600	520	800	695	1000	870	665	1058	920
	390		340	700	525	450	700	610	875	760	580	925	805
	335		290	600	450	390	600	520	750	650	500	795	690
	280		240	500	375	325	500	435	625	545	415	660	575
	225		195	400	300	260	400	345	500	435	330	530	460
	170		145	300	225	195	300	260	375	325	250	395	345
	110		97	200	150	130	200	175	250	215	165	265	229
	55		50	100	75	65	100	85	125	110	85	130	115

OPERATING DATA

R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	(1) DENSITY ALT. IN FEET
						30000
						25000
2400	188	163	F.T.	337	280	20000
2400	208	181	F.T.	420	349	15000
2400	216	188	40.8	395	328	12000
2400	220	191	F.T.	357	297	9000
2400	234	203	F.T.	453	377	6000
2400	236	205	42.3	432	358	3000
2400	240	208	42.7	427	354	S.L.

OPERATING DATA

R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.
2250	200	174	F.T.	335	278
2100	206	182	F.T.	328	272
2350	216	188	F.T.	331	275
2200	220	191	F.T.	321	267
2050	224	195	F.T.	313	260
2050	226	196	41.5	302	251

OPERATING DATA

R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.
2250	169	147	F.T.	230	191
2300	183	159	F.T.	229	190
2150	190	165	F.T.	227	188
2050	196	170	F.T.	223	185
1900	200	174	F.T.	218	181
1850	204	177	F.T.	212	176
1800	208	181	F.T.	207	172

OPERATING DATA

R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	(1) DENSITY ALT. IN FEET
						30000
						25000
						20000
1950	168	146	32.5	169	140	15000
2000	172	149	F.T.	165	137	12000
1950	181	157	F.T.	163	135	9000
1850	186	161	34.0	163	135	6000
1800	188	163	34.9	156	130	3000
1750	190	165	36.0	153	127	S.L.

OPERATING DATA

R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.
1850	156	135	F.T.	149	124
1800	165	143	33.2	150	125
1850	170	148	F.T.	147	122
1750	176	153	F.T.	145	120
1650	178	155	39.5	140	116
1600	180	156	36.3	136	113

LEGEND

(1) INDICATED ALTITUDE CORRECTED FOR FREE AIR TEMPERATURE.

(2) ALLOW 170 U. S. GALS., 140 IMP. GALS. FOR WARM UP.

TAKE-OFF AND CLIMB TO 10,000 FEET ALTITUDE

RETURN FUEL FLOWS TO TANK

USE FUEL FROM TANKS IN THE FOLLOWING ORDER

REFER TO "SPECIFIC ENGINE FLIGHT CHART" FOR ADDITIONAL ENGINE OPERATION DATA.

BOLD NUMBERS: Use Auto-Rich

LIGHT NUMBERS: Use Auto-Lean

WITH TWO SPEED BLOWER: Use high blower above heavy line only

I.A.S.: Indicated Air Speed
M.P.: Manifold Pressure (In. Hg)
U.S.G.P.H.: U. S. Gallons Per Hour
IMP.G.P.H.: Imperial Gallons Per Hour
F.T.: Full Throttle
S.L.: Sea Level

RED FIGURES ARE PRELIMINARY: SUBJECT TO REVISION AFTER FLIGHT CHECK

SPEC. AN-H-8 DEC. 18, 1942 — FORM ASC-511

MODEL (S) C-46 SERIES

FLIGHT OPERATION INSTRUCTION CHART

SHEET 2 OF 4 SHEETS

GR. WT. 45,000 TO 39,000 POUNDS

EXTERNAL LOAD ITEMS
NONE

CONDITION	R.P.M.	M.P. (IN. HG.)	BLOWER POSITION	MIXTURE POSITION	DURATION IN MIN.	U.S. G.P.H.	IMP. G.P.H.
TAKE-OFF	2700	52.0	LOW	A.R.	5	547	455
MILITARY POWER	2700	51.0 43.5	LOW HIGH	A.R.	15	547 426	455 354
ENGINE (S)	R-2800-51						

INSTRUCTIONS FOR USING CHART: Select figure in fuel column equal to or less than total amount of fuel in airplane. Move horizontally to the right or left and select a figure equal to or greater than the air miles to be flown. Vertically below and opposite desired cruising altitude read optimum cruising conditions. *NOTES:* (A) Avoid continuous cruising in Column I except in emergency. (B) Columns (II, III, IV & V) toward the right progressively give increase in range at sacrifice in speed. (C) Manifold Pressure (M.P.), Gallons Per Hour (G.P.H.), are approximate maximum values for reference. (D) For quick reference, take-off and military power data are listed in the upper left corner of chart.

ALTERNATE CRUISING CONDITIONS

(NO WIND) — (NO RESERVE FUEL ALLOWANCE)

I (MAX. CONT. POWER) RANGE IN AIR MILES STATUTE AT S.L.	I (MAX. CONT. POWER) RANGE IN AIR MILES STATUTE AT 6,000	I (MAX. CONT. POWER) RANGE IN AIR MILES NAUTICAL AT S.L.	I (MAX. CONT. POWER) RANGE IN AIR MILES NAUTICAL AT 6,000	FUEL U.S. GALS. (2)	II RANGE IN AIR MILES STATUTE	II RANGE IN AIR MILES NAUTICAL	III RANGE IN AIR MILES STATUTE	III RANGE IN AIR MILES NAUTICAL	IV RANGE IN AIR MILES STATUTE	IV RANGE IN AIR MILES NAUTICAL	FUEL IMP. GALS. (2)	V (MAX. RANGE) RANGE IN AIR MILES STATUTE	V (MAX. RANGE) RANGE IN AIR MILES NAUTICAL
				1140	140 U.S. (116 IMP.) GALLONS NOT AVAILABLE IN FLIGHT						945		
	560		485	1000	750	650	1000	870	1250	1085	830	1500	1300
	505		440	900	675	585	900	780	1125	975	750	1350	1170
	450		390	800	600	520	800	695	1000	870	665	1200	1040
	395		340	700	525	455	700	610	875	760	580	1050	910
	335		290	600	450	390	600	520	750	650	500	900	780
	280		245	500	375	325	500	435	625	545	415	750	650
	225		195	400	300	200	400	345	500	435	330	600	520
	170		145	300	225	195	300	260	375	325	250	450	390
	110		95	200	150	130	200	175	250	215	165	300	260
	55		50	100	75	65	100	85	125	110	85	150	130

OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	(1) DENSITY ALT. IN FEET	OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	(1) DENSITY ALT. IN FEET	OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.
						30000																			30000						
						25000																			25000						
2400	194	168	F.T.	337	280	20000							2300	184	160	F.T.	252	210							20000						
2400	211	183	F.T.	420	349	15000	2250	206	179	F.T.	345	287	2300	194	168	F.T.	243	202							15000	1800	162	141	F.T.	136	113
2400	218	189	40.8	395	328	12000	2150	211	183	F.T.	340	283	2200	199	173	F.T.	239	199	2100	188	163	F.T.	181	151	12000	1700	168	146	F.T.	135	112
2400	222	193	F.T.	356	297	9000	2350	220	191	F.T.	336	280	2050	203	176	F.T.	232	193	2000	194	168	F.T.	177	147	9000	1750	170	148	F.T.	130	108
2400	235	204	F.T.	453	377	6000	2200	223	194	F.T.	326	272	1950	206	179	F.T.	226	188	1900	196	170	34.0	172	143	6000	1600	172	149	F.T.	126	105
2400	238	206	42.3	432	358	3000	2100	227	197	F.T.	316	263	1850	208	181	F.T.	219	182	1900	198	172	34.9	166	138	3000	1600	171	148	31.8	119	99
2400	242	210	42.7	427	354	S.L.	2050	229	199	41.5	306	255	1800	212	184	F.T.	212	176	1850	200	174	35.8	161	134	S.L.	1600	162	141	30.7	108	90

LEGEND

(1) INDICATED ALTITUDE CORRECTED FOR FREE AIR TEMPERATURE.

(2) ALLOW 140 U. S. GALS. 116 IMP. GALS. FOR WARM UP.
TAKE-OFF AND CLIMB TO 10,000 FEET ALTITUDE
RETURN FUEL FLOWS TO TANK
USE FUEL FROM TANKS IN THE FOLLOWING ORDER

BOLD NUMBERS: Use Auto-Rich
LIGHT NUMBERS: Use Auto-Lean
WITH TWO SPEED BLOWER: Use high blower above heavy line only

I.A.S.: Indicated Air Speed
M.P.: Manifold Pressure (In. Hg)
U.S.G.P.H.: U. S. Gallons Per Hour
IMP.G.P.H.: Imperial Gallons Per Hour
F.T.: Full Throttle
S.L.: Sea Level

REFER TO "SPECIFIC ENGINE FLIGHT CHART" FOR ADDITIONAL ENGINE OPERATION DATA.

RED FIGURES ARE PRELIMINARY: SUBJECT TO REVISION AFTER FLIGHT CHECK

SPEC. AN-H-8 DEC. 18, 1942 — FORM ASC-511

MODEL (S) C-46 SERIES

FLIGHT OPERATION INSTRUCTION CHART

SHEET 3 OF 4 SHEETS

GR. WT. 39,000 TO 34,000 POUNDS

EXTERNAL LOAD ITEMS: NONE

CONDITION	R.P.M.	M.P. (IN. HG)	BLOWER POSITION	MIXTURE POSITION	DURATION IN MIN.	U.S. G.P.H.	IMP. G.P.H.
TAKE-OFF	2700	52.0	LOW	A.R.	5	547	455
MILITARY POWER	2700	51.0 43.5	LOW HIGH	A.R.	15	547 426	455 354
ENGINE (S)	R-2800-51						

INSTRUCTIONS FOR USING CHART: Select figure in fuel column equal to or less than total amount of fuel in airplane. Move horizontally to the right or left and select a figure equal to or greater than the air miles to be flown. Vertically below and opposite desired cruising altitude read optimum cruising conditions. ***NOTES:*** (A) Avoid continuous cruising in Column I except in emergency. (B) Columns (II, III, IV & V) toward the right progressively give increase in range at sacrifice in speed. (C) Manifold Pressure (M.P.), Gallons Per Hour (G.P.H.), are approximate maximum values for reference. (D) For quick reference, take-off and military power data are listed in the upper left corner of chart.

ALTERNATE CRUISING CONDITIONS

(NO WIND) — (NO RESERVE FUEL ALLOWANCE)

I (MAX. CONT. POWER) RANGE IN AIR MILES				FUEL U.S. GALS. (2)	II RANGE IN AIR MILES		III RANGE IN AIR MILES		IV RANGE IN AIR MILES		FUEL IMP. GALS. (2)	V (MAX. RANGE) RANGE IN AIR MILES	
STATUTE		NAUTICAL			STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL		STATUTE	NAUTICAL
AT S.L.	AT 6,000	AT S.L.	AT 6,000										
				920	120 U.S. (100 IMP.) GALLONS NOT AVAILABLE IN FLIGHT						765		
	450		390	800	600	520	800	695	1200	1045	665	1245	1080
	395		345	700	525	455	700	610	1050	910	580	1090	945
	340		295	600	450	390	600	520	900	780	500	935	810
	280		245	500	375	325	500	435	750	650	415	780	675
	225		195	400	300	260	400	345	600	520	330	625	540
	170		145	300	225	195	300	260	450	390	250	465	405
	110		95	200	150	130	200	175	300	260	165	310	270
	55		50	100	75	65	100	85	150	130	85	155	135

OPERATING DATA						(1) DENSITY ALT. IN FEET	OPERATING DATA						OPERATING DATA						OPERATING DATA						(1) DENSITY ALT. IN FEET	OPERATING DATA					
R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.		R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.		R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.
						30000																			30000					
						25000																			25000					
2400	199	173	F.T.	337	280	20000							2350	192	167	F.T.	264	219	2000	175	152	F.T.	160	133	20000	1900	158	137	F.T.	135	112
2400	214	186	F.T.	420	349	15000	2300	210	182	F.T.	351	292	2350	200	173	F.T.	254	211	2000	182	158	F.T.	154	128	15000	1800	170	147	F.T.	135	112
2400	220	191	40.8	395	328	12000	2150	214	186	F.T.	342	284	2200	204	177	F.T.	246	204	1800	185	161	33.2	149	124	12000	1700	174	151	F.T.	132	110
2400	224	194	F.T.	856	297	9000	2350	222	192	F.T.	338	281	2100	208	181	F.T.	239	199	1800	187	162	F.T.	143	119	9000	1700	175	152	F.T.	125	104
2400	236	205	F.T.	453	377	6000	2200	226	196	F.T.	329	273	1950	210	182	F.T.	231	192	1700	189	164	F.T.	138	115	6000	1600	176	153	31.0	121	101
2400	240	208	42.3	432	358	3000	2100	230	200	F.T.	318	264	1850	212	184	F.T.	223	185	1600	190	165	34.2	132	110	3000	1600	174	151	30.7	114	95
2400	243	211	42.7	427	354	S.L.	2100	230	200	41.5	308	256	1800	215	186	F.T.	215	179	1600	190	165	34.8	127	106	S.L.	1600	160	139	28.7	101	92

LEGEND

(1) INDICATED ALTITUDE CORRECTED FOR FREE AIR TEMPERATURE.

(2) ALLOW 120 U. S. GALS., 100 IMP. GALS. FOR WARM UP.
TAKE-OFF AND CLIMB TO 10,000 FEET ALTITUDE
RETURN FUEL FLOWS TO TANK
USE FUEL FROM TANKS IN THE FOLLOWING ORDER

REFER TO "SPECIFIC ENGINE FLIGHT CHART" FOR ADDITIONAL ENGINE OPERATION DATA.

BOLD NUMBERS: Use Auto-Rich
LIGHT NUMBERS: Use Auto-Lean
WITH TWO SPEED BLOWER: Use high blower above heavy line only

I.A.S.: Indicated Air Speed
M.P.: Manifold Pressure (In. Hg)
U.S.G.P.H.: U. S. Gallons Per Hour
IMP.G.P.H.: Imperial Gallons Per Hour
F.T.: Full Throttle
S.L.: Sea Level

RED FIGURES ARE PRELIMINARY: SUBJECT TO REVISION AFTER FLIGHT CHECK

SPEC. AN-H-8 DEC. 18, 1942 — FORM ASC-511

MODEL (S) C-46 SERIES

FLIGHT OPERATION INSTRUCTION CHART

SHEET 4 OF 4 SHEETS

GR. WT. 34,000 TO 29,000 POUNDS

EXTERNAL LOAD ITEMS: NONE

CONDITION	R.P.M.	M.P. (IN. HG)	BLOWER POSITION	MIXTURE POSITION	DURATION IN MIN.	U.S. G.P.H.	IMP. G.P.H.
TAKE-OFF	2700	52.0	LOW	A.R.	5	547	455
MILITARY POWER	2700	51.0 43.5	LOW HIGH	A.R.	15	547 426	455 354
ENGINE (S)	R-2800-51						

INSTRUCTIONS FOR USING CHART: Select figure in fuel column equal to or less than total amount of fuel in airplane. Move horizontally to the right or left and select a figure equal to or greater than the air miles to be flown. Vertically below and opposite desired cruising altitude read optimum cruising conditions. *NOTES:* (A) Avoid continuous cruising in Column I except in emergency. (B) Columns (II, III, IV & V) toward the right progressively give increase in range at sacrifice in speed. (C) Manifold Pressure (M.P.), Gallons Per Hour (G.P.H.), are approximate maximum values for reference. (D) For quick reference, take-off and military power data are listed in the upper left corner of chart.

ALTERNATE CRUISING CONDITIONS

(NO WIND) (NO RESERVE FUEL ALLOWANCE)

I (MAX. CONT. POWER) RANGE IN AIR MILES STATUTE AT S.L.	I (MAX. CONT. POWER) RANGE IN AIR MILES STATUTE AT 6,000	I (MAX. CONT. POWER) RANGE IN AIR MILES NAUTICAL AT S.L.	I (MAX. CONT. POWER) RANGE IN AIR MILES NAUTICAL AT 6,000	FUEL U.S. GALS. (2)	II RANGE IN AIR MILES STATUTE	II RANGE IN AIR MILES NAUTICAL	III RANGE IN AIR MILES STATUTE	III RANGE IN AIR MILES NAUTICAL	IV RANGE IN AIR MILES STATUTE	IV RANGE IN AIR MILES NAUTICAL	FUEL IMP. GALS. (2)	V (MAX. RANGE) RANGE IN AIR MILES STATUTE	V (MAX. RANGE) RANGE IN AIR MILES NAUTICAL
				900		100 U.S. (85 IMP.) GALLONS NOT AVAILABLE IN FLIGHT					750		
	455		395	800	600	520	800	695	1200	1045	665	1345	1170
	395		345	700	525	455	700	610	1050	910	580	1180	1025
	340		295	600	450	390	600	520	900	780	500	1010	875
	285		245	500	375	325	500	435	750	650	415	840	730
	225		195	400	300	260	400	345	600	520	330	675	585
	170		145	300	225	195	300	260	450	390	250	505	440
	115		100	200	150	130	200	175	300	260	165	335	295
	55		50	100	75	65	100	85	150	130	85	170	145

OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	(1) DENSITY ALT. IN FEET	OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	(1) DENSITY ALT. IN FEET	OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.
						30000																			30000						
						25000																			25000						
2400	199	174	F.T.	337	280	20000							2350	192	187	F.T.	264	219	2000	175	152	F.T.	160	133	20000	1900	163	142	F.T.	133	111
2400	214	186	F.T.	420	348	15000	2300	210	182	F.T.	351	292	2350	200	174	F.T.	254	211	2000	182	158	F.T.	154	128	15000	1750	172	149	F.T.	130	108
2400	220	191	40.8	395	328	12000	2150	214	186	F.T.	342	284	2200	204	177	F.T.	246	204	1800	185	161	33.2	149	124	12000	1650	175	152	F.T.	126	105
2400	224	195	F.T.	356	297	9000	2350	222	192	F.T.	338	281	2100	208	181	F.T.	239	199	1800	187	162	F.T.	143	118	9000	1650	174	151	F.T.	119	99
2400	236	205	F.T.	453	377	6000	2200	226	196	F.T.	329	273	1950	210	182	F.T.	231	192	1700	189	164	F.T.	138	115	6000	1600	174	151	29.2	114	95
2400	240	208	42.3	432	358	3000	2100	230	200	F.T.	318	264	1950	212	184	F.T.	223	185	1600	190	165	34.2	132	110	3000	1600	170	147	28.7	106	88
2400	243	211	42.7	427	354	S.L.	2100	230	200	41.5	308	256	1950	215	187	41.4	215	179	1600	190	165	34.8	127	105	S.L.	1600	152	132	25.9	90	75

LEGEND

(1) INDICATED ALTITUDE CORRECTED FOR FREE AIR TEMPERATURE.

(2) ALLOW 100 U. S. GALS. 85 IMP. GALS. FOR WARM UP, TAKE-OFF AND CLIMB TO 10,000 FEET ALTITUDE

RETURN FUEL FLOWS TO TANK _____

USE FUEL FROM TANKS IN THE FOLLOWING ORDER _____

REFER TO "SPECIFIC ENGINE FLIGHT CHART" FOR ADDITIONAL ENGINE OPERATION DATA.

BOLD NUMBERS: Use Auto-Rich

LIGHT NUMBERS: Use Auto-Lean

WITH TWO SPEED BLOWER: Use high blower above heavy line only

I.A.S.: Indicated Air Speed
M.P.: Manifold Pressure (In. Hg)
U.S.G.P.H.: U. S. Gallons Per Hour
IMP.G.P.H.: Imperial Gallons Per Hour
F.T.: Full Throttle
S.L.: Sea Level

RED FIGURES ARE PRELIMINARY: SUBJECT TO REVISION AFTER FLIGHT CHECK

RESTRICTED

RESTRICTED AN 01-25LA-1

SPEC. AN-H-8 DEC. 18, 1942 — FORM ASC-511

MODEL (S) C-46 SERIES

SINGLE ENGINE OPERATION

FLIGHT OPERATION INSTRUCTION CHART

SHEET 1 OF 4 SHEETS

GR. WT. 52,000 TO 45,000 POUNDS

EXTERNAL LOAD ITEMS

(1) PROPELLER FEATHERED

CONDITION	R.P.M.	M.P. (IN. HG)	BLOWER POSITION	MIXTURE POSITION	DURATION IN MIN.	U.S. G.P.H.	IMP. G.P.H.
TAKE-OFF			DO NOT ATTEMPT				
MILITARY POWER *	2700	51.0 43.5	LOW HIGH	A.R.	15	273 213	227 177
ENGINE (S)	R-2800-51						

INSTRUCTIONS FOR USING CHART: Select figure in fuel column equal to or less than total amount of fuel in airplane. Move horizontally to the right or left and select a figure equal to or greater than the air miles to be flown. Vertically below and opposite desired cruising altitude read optimum cruising conditions. *NOTES:* (A) Avoid continuous cruising in Column I except in emergency. (B) Columns (II, III, IV & V) toward the right progressively give increase in range at sacrifice in speed. (C) Manifold Pressure (M.P.), Gallons Per Hour (G.P.H.), are approximate maximum values for reference. (D) For quick reference, take-off and military power data are listed in the upper left corner of chart.

(NO WIND) **ALTERNATE CRUISING CONDITIONS** (NO RESERVE FUEL ALLOWANCE)

I (MAX. CONT. POWER) RANGE IN AIR MILES				FUEL U.S. GALS. (2)	II RANGE IN AIR MILES		III RANGE IN AIR MILES		IV RANGE IN AIR MILES		FUEL IMP. GALS. (2)	V (MAX. RANGE) RANGE IN AIR MILES	
STATUTE		NAUTICAL			STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL		STATUTE	NAUTICAL
AT S.L.	AT 6,000	AT S.L.	AT 6,000										
	685		790	1100							915		
	625		720	1000							830		
	560		485	900							750		
	500		430	800							665		
	435		380	700			SINGLE ENGINE OPERATION				580		
	375		325	600							500		
	310		270	500							415		
	250		215	400							330		
	185		160	300							250		
	125		110	200							165		
	80		55	100							85		

OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	(1) DENSITY ALT. IN FEET	OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	(1) DENSITY ALT. IN FEET	OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.
						30000																			30000						
						25000																			25000						
						20000																			20000						
						15000																			15000						
						12000																			12000						
						9000																			9000						
2400	129	112	F.T.	227	189	6000																			6000						
2400	139	121	42.3	216	180	3000																			3000						
2400	148	128	42.7	213	177	S.L.																			S.L.						

LEGEND

(1) INDICATED ALTITUDE CORRECTED FOR FREE AIR TEMPERATURE.

(2) ALLOW_____U. S. GALS._____IMP. GALS. FOR WARM UP.
TAKE-OFF AND CLIMB TO_____FEET ALTITUDE
RETURN FUEL FLOWS TO TANK_____
USE FUEL FROM TANKS IN THE FOLLOWING ORDER_____

BOLD NUMBERS: Use Auto-Rich
LIGHT NUMBERS: Use Auto-Lean
WITH TWO SPEED BLOWER: Use high blower above heavy line only

I.A.S.: Indicated Air Speed
M.P.: Manifold Pressure (In. Hg)
U.S.G.P.H.: U. S. Gallons Per Hour
IMP.G.P.H.: Imperial Gallons Per Hour
F.T.: Full Throttle
S.L.: Sea Level

REFER TO "SPECIFIC ENGINE FLIGHT CHART" FOR ADDITIONAL ENGINE OPERATION DATA.

* One engine.

RED FIGURES ARE PRELIMINARY: SUBJECT TO REVISION AFTER FLIGHT CHECK

RESTRICTED

RESTRICTED
AN 01-25LA-1

SPEC. AN-H-8 DEC. 16, 1942 — FORM ASC-511

MODEL (S) C-46 SERIES

SINGLE ENGINE OPERATION

FLIGHT OPERATION INSTRUCTION CHART

SHEET 2 OF 4 SHEETS

GR. WT. 45,000 TO 39,000 POUNDS

EXTERNAL LOAD ITEMS

(1) PROPELLER FEATHERED

CONDITION	R.P.M.	M.P. (IN. HG)	BLOWER POSITION	MIXTURE POSITION	DURATION IN MIN.	U.S. G.P.H.	IMP. G.P.H.
TAKE-OFF			DO NOT ATTEMPT				
MILITARY POWER *	2700	51	LOW	A.R.		273	227
		43.5	HIGH	A.R.	15	213	177
ENGINE (S)	R-2800-51						

INSTRUCTIONS FOR USING CHART: Select figure in fuel column equal to or less than total amount of fuel in airplane. Move horizontally to the right or left and select a figure equal to or greater than the air miles to be flown. Vertically below and opposite desired cruising altitude read optimum cruising conditions. *NOTES:* (A) Avoid continuous cruising in Column I except in emergency. (B) Columns (II, III, IV & V) toward the right progressively give increase in range at sacrifice in speed. (C) Manifold Pressure (M.P.), Gallons Per Hour (G.P.H.), are approximate maximum values for reference. (D) For quick reference, take-off and military power data are listed in the upper left corner of chart.

ALTERNATE CRUISING CONDITIONS

(NO WIND) — (NO RESERVE FUEL ALLOWANCE)

I (MAX. CONT. POWER) RANGE IN AIR MILES				FUEL U.S. GALS. (2)	II RANGE IN AIR MILES		III RANGE IN AIR MILES		IV RANGE IN AIR MILES		FUEL IMP. GALS. (2)	V (MAX. RANGE) RANGE IN AIR MILES	
STATUTE		NAUTICAL			STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL		STATUTE	NAUTICAL
AT S.L.	AT 6,000	AT S.L.	AT 6,000										
	745		645	1000							830	930	805
	670		580	900							750	835	725
	595		515	800							665	745	645
	520		450	700							580	650	565
	445		395	600			SINGLE ENGINE OPERATION				500	555	485
	370		320	500							415	465	405
	300		260	400							330	370	325
	225		195	300							250	280	250
	150		130	200							165	185	160
	70		65	100							85	95	80

OPERATING DATA						(1) DENSITY ALT. IN FEET	OPERATING DATA						OPERATING DATA						OPERATING DATA						(1) DENSITY ALT. IN FEET	OPERATING DATA					
R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.		R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.		R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.
						30000																			30000					
						25000																			25000					
						20000																			20000					
						15000																			15000					
						12000																			12000					
2400	133	115	F.T.	179	149	9000																			9000					
2400	156	135	F.T.	227	189	6000																			6000	2150	133	115	F.T.	157	131
2400	159	138	42.3	216	180	3000																			3000	2100	146	127	F.T.	167	139
2400	164	142	42.7	213	177	S.L.																			S.L.	2150	155	131	41.5	163	135

LEGEND

(1) INDICATED ALTITUDE CORRECTED FOR FREE AIR TEMPERATURE.

(2) ALLOW 450 U. S. GALS. 375 IMP. GALS. FOR WARM UP, TAKE-OFF AND CLIMB TO 10,000 FEET ALTITUDE **

RETURN FUEL FLOWS TO TANK _____

USE FUEL FROM TANKS IN THE FOLLOWING ORDER _____

BOLD NUMBERS: Use Auto-Rich
LIGHT NUMBERS: Use Auto-Lean
WITH TWO SPEED BLOWER: Use high blower above heavy line only

I.A.S.: Indicated Air Speed
M.P.: Manifold Pressure (In. Hg)
U.S.G.P.H.: U. S. Gallons Per Hour
IMP.G.P.H.: Imperial Gallons Per Hour
F.T.: Full Throttle
S.L.: Sea Level

REFER TO "SPECIFIC ENGINE FLIGHT CHART" FOR ADDITIONAL ENGINE OPERATION DATA. *One Engine. **2 Engine take off; 1 engine climb.

RED FIGURES ARE PRELIMINARY: SUBJECT TO REVISION AFTER FLIGHT CHECK

SPEC. AN-H-8 DEC. 18, 1942 — FORM ASC-511

MODEL (S) C-46 SERIES
SINGLE ENGINE OPERATION

FLIGHT OPERATION INSTRUCTION CHART

SHEET 3 OF 4 SHEETS

GR. WT. 39,000 TO 34,000 POUNDS

EXTERNAL LOAD ITEMS
(1) PROPELLER FEATHERED

CONDITION	R.P.M.	M.P. (IN. HG)	BLOWER POSITION	MIXTURE POSITION	DURATION IN MIN.	U.S. G.P.H.	IMP. G.P.H.
TAKE-OFF	DO NOT ATTEMPT WITH 1 ENGINE.						
MILITARY* POWER	2700	51 43.5	LOW HIGH	A.R. A.R.	15	273 213	227 177
ENGINE (S)	R-2800-51						

INSTRUCTIONS FOR USING CHART: Select figure in fuel column equal to or less than total amount of fuel in airplane. Move horizontally to the right or left and select a figure equal to or greater than the air miles to be flown. Vertically below and opposite desired cruising altitude read optimum cruising conditions. *NOTES:* (A) Avoid continuous cruising in Column I except in emergency. (B) Columns (II, III, IV & V) toward the right progressively give increase in range at sacrifice in speed. (C) Manifold Pressure (M.P.), Gallons Per Hour (G.P.H.), are approximate maximum values for reference. (D) For quick reference, take-off and military power data are listed in the upper left corner of chart.

(NO WIND) **ALTERNATE CRUISING CONDITIONS** (NO RESERVE FUEL ALLOWANCE)

I (MAX. CONT. POWER) RANGE IN AIR MILES STATUTE AT S.L.	I STATUTE AT 6,000	I NAUTICAL AT S.L.	I NAUTICAL AT 6,000	FUEL U.S. GALS. (2)	II STATUTE	II NAUTICAL	III STATUTE	III NAUTICAL	IV STATUTE	IV NAUTICAL	FUEL IMP. GALS. (2)	V (MAX. RANGE) STATUTE	V NAUTICAL
	705		610	800							865	935	810
	615		535	700							580	820	710
	530		460	600							500	700	610
	440		380	500			SINGLE ENGINE OPERATION				415	585	510
	350		305	400							330	470	405
	265		230	300							250	350	305
	175		155	200							165	235	200
	80		70	100							85	115	100

OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	(1) DENSITY ALT. IN FEET	II OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	III OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	IV OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	(1) DENSITY ALT. IN FEET	V OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.
						30000																			30000						
						25000																			25000						
						20000																			20000						
						15000																			15000						
2400	135	117	F.T.	131	109	12000																			12000						
2400	150	130	F.T.	179	149	9000																			9000	2100	130	113	F.T.	128	106
2400	165	143	F.T.	227	189	6000																			6000	2050	138	120	F.T.	130	108
2400	169	147	42.3	216	180	3000																			3000	1950	143	124	F.T.	129	107
2400	173	150	42.7	213	177	S.L.																			S.L.	1900	148	128	41.5	127	105

LEGEND

(1) INDICATED ALTITUDE CORRECTED FOR FREE AIR TEMPERATURE.

(2) ALLOW 300 U. S. GALS. 250 IMP. GALS. FOR WARM UP.

TAKE-OFF AND CLIMB TO 10,000 FEET ALTITUDE **

RETURN FUEL FLOWS TO TANK _____

USE FUEL FROM TANKS IN THE FOLLOWING ORDER _____

BOLD NUMBERS: Use Auto-Rich
LIGHT NUMBERS: Use Auto-Lean
WITH TWO SPEED BLOWER: Use high blower above heavy line only

I.A.S.: Indicated Air Speed
M.P.: Manifold Pressure (In. Hg)
U.S.G.P.H.: U. S. Gallons Per Hour
IMP.G.P.H.: Imperial Gallons Per Hour
F.T.: Full Throttle
S.L.: Sea Level

REFER TO "SPECIFIC ENGINE FLIGHT CHART" FOR ADDITIONAL ENGINE OPERATION DATA. *One engine. **2 engine take off; 1 engine climb.

RED FIGURES ARE PRELIMINARY: SUBJECT TO REVISION AFTER FLIGHT CHECK

SPEC. AN-H-8 DEC. 18, 1942 — FORM ASC-511

MODEL (S) C-46 SERIES

FLIGHT OPERATION INSTRUCTION CHART

SHEET 4 OF 4 SHEETS

GR. WT. 34,000 TO 29,000 POUNDS

EXTERNAL LOAD ITEMS
(1) PROPELLER FEATHERED

CONDITION	R.P.M.	M.P. (IN. HG)	BLOWER POSITION	MIXTURE POSITION	DURATION IN MIN.	U.S. G.P.H.	IMP. G.P.H.
TAKE-OFF	DO NOT ATTEMPT WITH 1 ENGINE.						
MILITARY POWER *	2700	51 43.5	LOW HIGH	A.R. A.R.	15	273 213	227 177
ENGINE (S)	R-2800-51						

INSTRUCTIONS FOR USING CHART: Select figure in fuel column equal to or less than total amount of fuel in airplane. Move horizontally to the right or left and select a figure equal to or greater than the air miles to be flown. Vertically below and opposite desired cruising altitude read optimum cruising conditions. *NOTES:* (A) Avoid continuous cruising in Column I except in emergency. (B) Columns (II, III, IV & V) toward the right progressively give increase in range at sacrifice in speed. (C) Manifold Pressure (M.P.), Gallons Per Hour (G.P.H.), are approximate maximum values for reference. (D) For quick reference, take-off and military power data are listed in the upper left corner of chart.

(NO WIND) **ALTERNATE CRUISING CONDITIONS** (NO RESERVE FUEL ALLOWANCE)

I (MAX. CONT. POWER) RANGE IN AIR MILES STATUTE AT S.L.	I STATUTE AT 6,000	I NAUTICAL AT S.L.	I NAUTICAL AT 6,000	FUEL U.S. GALS. (2)	II STATUTE	II NAUTICAL	III STATUTE	III NAUTICAL	IV STATUTE	IV NAUTICAL	FUEL IMP. GALS. (2)	V (MAX. RANGE) STATUTE	V NAUTICAL
	665		570	800							665	1265	1100
	575		500	700							580	1105	960
	495		425	600							500	945	820
	410		355	500			SINGLE ENGINE OPERATION				415	790	685
	330		285	400							330	630	550
	245		215	300							250	475	410
	165		140	200							165	315	275
	80		70	100							85	160	135

OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G. P. H.	IMP. G. P. H.	(1) DENSITY ALT. IN FEET	II OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G. P. H.	IMP. G. P. H.	III OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G. P. H.	IMP. G. P. H.	IV OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G. P. H.	IMP. G. P. H.	(1) DENSITY ALT. IN FEET	V OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G. P. H.	IMP. G. P. H.
						30000																			30000						
						25000																			25000						
						20000																			20000						
2400	132	115	F.T.	132	110	15000																			15000						
2400	147	128	F.T.	131	109	12000																			12000	2050	110	96	F.T.	83	69
2400	158	137	F.T.	179	149	9000																			9000	2100	133	115	F.T.	97	81
2400	171	148	F.T.	227	189	6000																			6000	2050	137	119	33.8	96	80
2400	174	151	42.3	216	180	3000																			3000	2000	141	122	34.7	93	77
2400	177	154	42.7	213	177	S. L.																			S. L.	1950	143	124	35.6	90	75

LEGEND

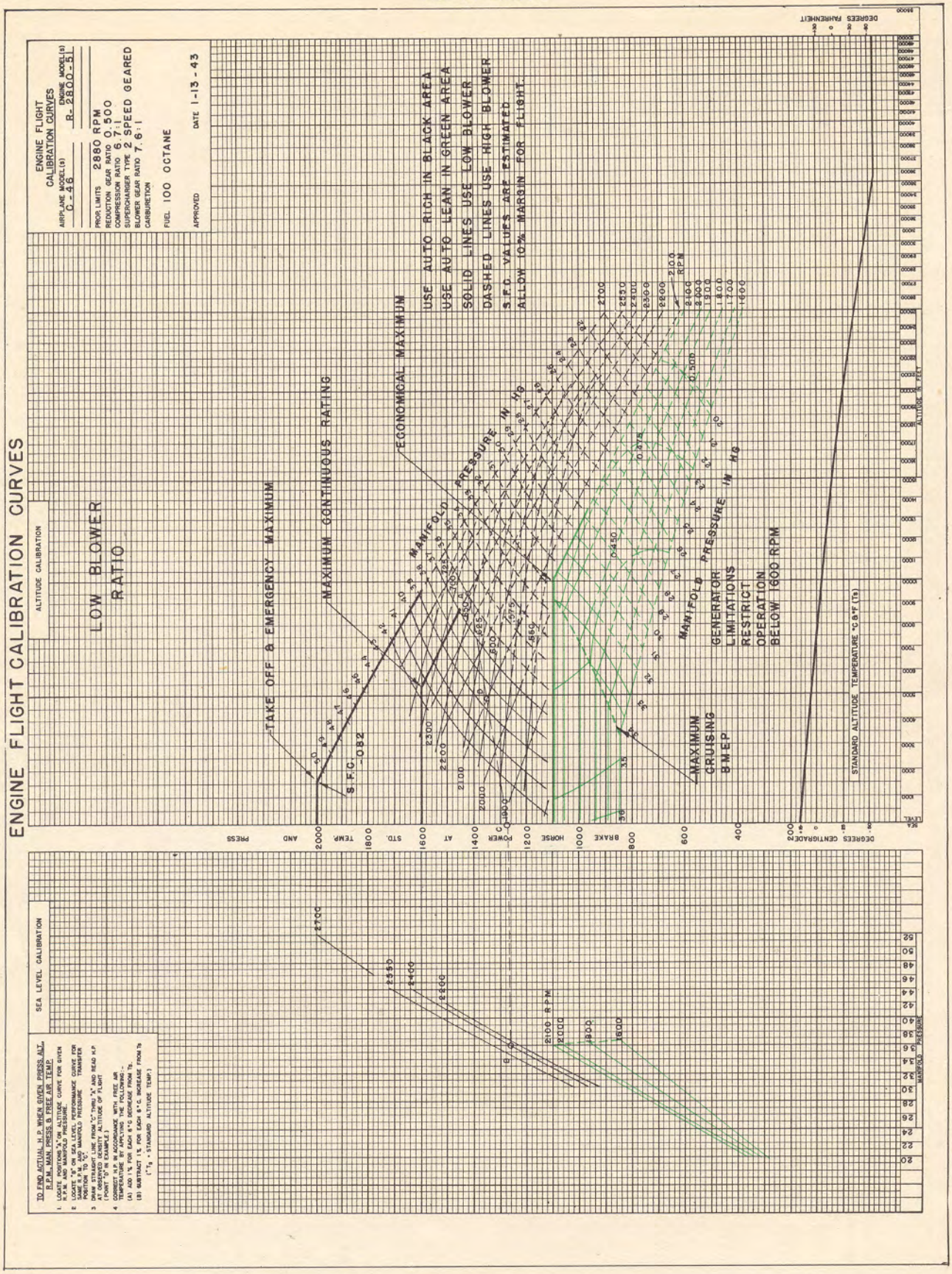
(1) INDICATED ALTITUDE CORRECTED FOR FREE AIR TEMPERATURE.
(2) ALLOW 200 U. S. GALS., 165 IMP. GALS. FOR WARM UP, TAKE-OFF AND CLIMB TO 10,000 FEET ALTITUDE **
RETURN FUEL FLOWS TO TANK
USE FUEL FROM TANKS IN THE FOLLOWING ORDER

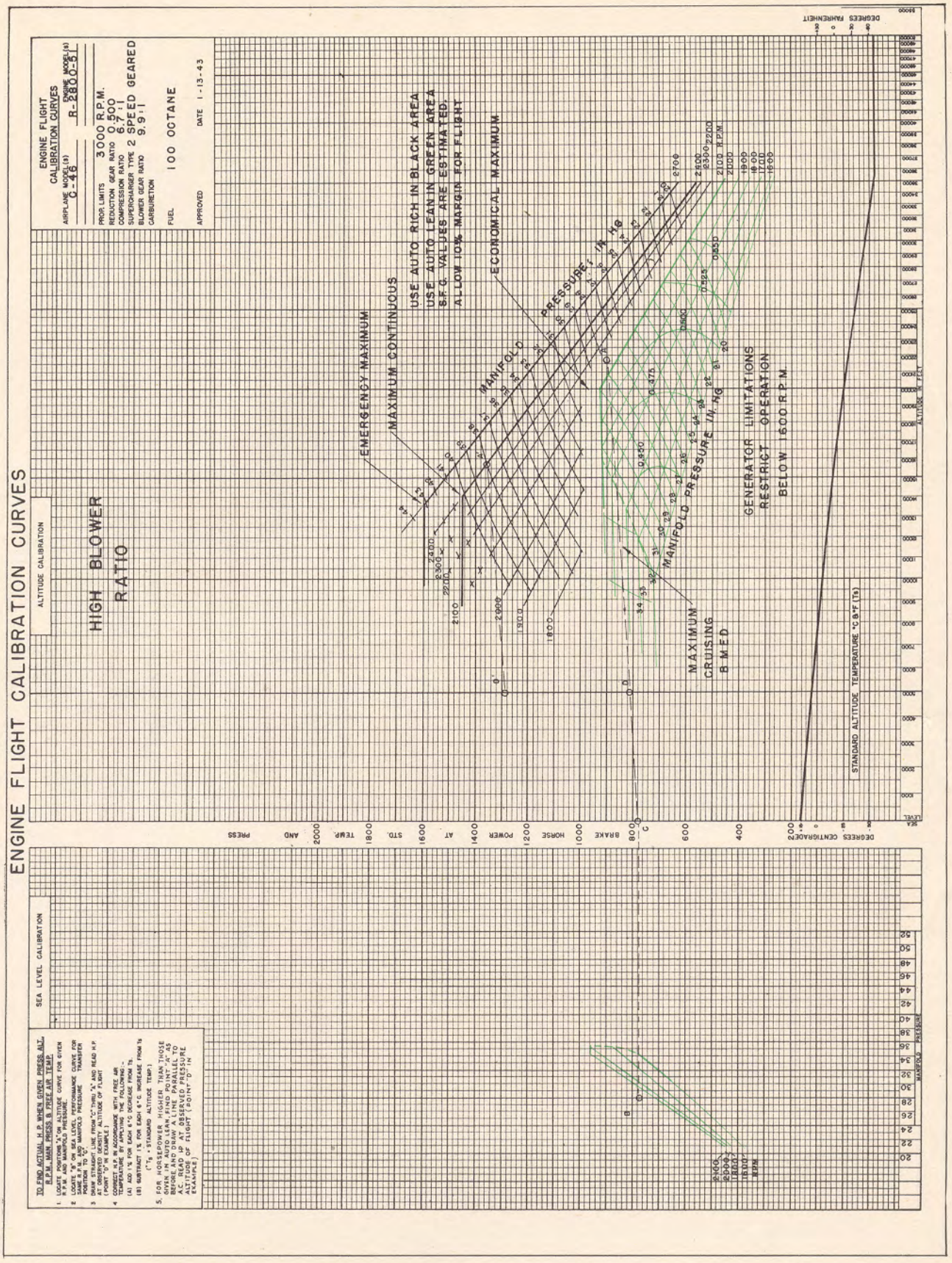
BOLD NUMBERS: Use Auto-Rich
LIGHT NUMBERS: Use Auto-Lean
WITH TWO SPEED BLOWER: Use high blower above heavy line only

I.A.S.: Indicated Air Speed
M.P.: Manifold Pressure (In. Hg)
U.S.G.P.H.: U. S. Gallons Per Hour
IMP.G.P.H.: Imperial Gallons Per Hour
F.T.: Full Throttle
S.L.: Sea Level

REFER TO "SPECIFIC ENGINE FLIGHT CHART" FOR ADDITIONAL ENGINE OPERATION DATA. *One engine. **2 engine take off; 1 engine climb.

RED FIGURES ARE PRELIMINARY: SUBJECT TO REVISION AFTER FLIGHT CHECK


ENGINE FLIGHT CALIBRATION CURVES
ENGINE FLIGHT CALIBRATION CURVES
AIRPLANE MODEL(S) C-46
ENGINE MODEL(S) R-2800-51
PROP LIMITS 2880 RPM
REDUCTION GEAR RATIO 0.500
COMPRESSION RATIO 6.7:1
SUPERCHARGER TYPE 2 SPEED GEARED
BLOWER GEAR RATIO 7.6:1
CARBURETION
FUEL 100 OCTANE
APPROVED
DATE 1-13-43
ALTITUDE CALIBRATION
LOW BLOWER RATIO
TAKE OFF & EMERGENCY MAXIMUM
MAXIMUM CONTINUOUS RATING
ECONOMICAL MAXIMUM
MANIFOLD PRESSURE IN HG
S.F.C. .082
USE AUTO RICH IN BLACK AREA
USE AUTO LEAN IN GREEN AREA
SOLID LINES USE LOW BLOWER
DASHED LINES USE HIGH BLOWER
S.F.C. VALUES ARE ESTIMATED
ALLOW 10% MARGIN FOR FLIGHT
MAXIMUM CRUISING BMEP
GENERATOR LIMITATIONS
RESTRICT OPERATION BELOW 1600 RPM
MANIFOLD PRESSURE IN HG
STANDARD ALTITUDE TEMPERATURE °C & °F (Ts)
DEGREES CENTIGRADE
DEGREES FAHRENHEIT
ALTITUDE FEET
BRAKE HORSE POWER AT STD. TEMP. AND PRESS
SEA LEVEL CALIBRATION
TO FIND ACTUAL H.P. WHEN GIVEN PRESS. ALT., R.P.M., MAN. PRESS. & FREE AIR TEMP.
1. LOCATE POSITION "A" ON ALTITUDE CURVE FOR GIVEN R.P.M. AND MANIFOLD PRESSURE.
2. LOCATE POSITION "B" ON SEA LEVEL PERFORMANCE CURVE FOR SAME R.P.M. AND MANIFOLD PRESSURE
3. POWER TRANSFER POINT: LINK FROM "A" THRU "X" AND READ H.P. AT OBSERVED DENSITY ALTITUDE OF FLIGHT (POINT "D" IN EXAMPLE)
4. CORRECT H.P. FOR DEVIATION FROM STD. TEMPERATURE BY APPLYING THE FOLLOWING:-
(A) ADD 1% FOR EACH 6°C DECREASE FROM Ts.
(B) SUBTRACT 1% FOR EACH 6°C. INCREASE FROM Ts
(°Ts = STANDARD ALTITUDE TEMP.)


ENGINE FLIGHT CALIBRATION CURVES
ENGINE FLIGHT CALIBRATION CURVES
AIRPLANE MODEL(S) G-46
ENGINE MODEL(S) R-2800-51
PROP. LIMITS 3000 R.P.M.
REDUCTION GEAR RATIO 0.500
COMPRESSION RATIO 6.7:1
SUPERCHARGER TYPE 2 SPEED GEARED
BLOWER GEAR RATIO 9.9:1
CARBURETION
FUEL 100 OCTANE
APPROVED
DATE 1-13-43
SEA LEVEL CALIBRATION
ALTITUDE CALIBRATION
HIGH BLOWER
RATIO
EMERGENCY MAXIMUM
MAXIMUM CONTINUOUS
USE AUTO RICH IN BLACK AREA
USE AUTO LEAN IN GREEN AREA
S.F.C. VALUES ARE ESTIMATED.
ALLOW 10% MARGIN FOR FLIGHT
ECONOMICAL MAXIMUM
MANIFOLD PRESSURE IN. HG
MAXIMUM CRUISING B.M.E.P.
MANIFOLD PRESSURE IN. HG
GENERATOR LIMITATIONS
RESTRICT OPERATION
BELOW 1600 R.P.M.
STANDARD ALTITUDE TEMPERATURE °C & °F (Ts)
DEGREES CENTIGRADE
DEGREES FAHRENHEIT
ALTITUDE IN FEET
BRAKE HORSE POWER
MANIFOLD PRESSURE
R.P.M.
TO FIND ACTUAL H.P. WHEN GIVEN PRESS. ALT., R.P.M., MAN. PRESS & FREE AIR TEMP
1. LOCATE POINTON ALTITUDE CURVE FOR GIVEN R.P.M. & MANIFOLD PRESSURE
2. LOCATE "B" ON SEA LEVEL PERFORMANCE CURVE FOR SAME R.P.M. & MAN. PRESSURE
3. DRAW STRAIGHT LINE FROM "C" THRU "A" AND READ H.P. AT POINT OF INTERSECTION OF LINE WITH "D" (EXAMPLE)
4. CORRECT H.P. IN ACCORDANCE WITH FREE AIR TEMPERATURE BY APPLYING THE FOLLOWING:-
(A) LOSE 1% FOR EACH 2°C OR 4°F INCREASE IN (B) ABSTRACT 1% FOR EACH 4°C OR 8°F DECREASE FROM Ts ("Ts" = STANDARD ALTITUDE TEMP.)
5. FOR HORSEPOWER HIGHER THAN THOSE GIVEN IN AUTO LEAN, FIND POINT "A" AS BEFORE AND DRAW A LINE PARALLEL TO A-C FROM POINT OF INTERSECTION OF ALTITUDE OF FLIGHT (POINT "D" IN EXAMPLE)