SECTION IV
DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT

TABLE OF CONTENTS

HEATING AND VENTILATING SYSTEM

This heating and ventilating system *(figure 4-1)* is the exhaust-heated type and consists of two heat exchangers, one mounted on each engine exhaust tailpipe, two mixing chambers, two nacelle spill valves, a 28-volt d-c emergency defrosting blower for windshield and astrodome defrosting, four 28-volt d-c critical temperature warning lights, two critical temperature thermoswitches, the necessary insulated ducting, airscoops, outlet valves, and controls. Ram air entering the heat exchanger is heated by the exhaust tailpipe, then routed through the nacelle spill valve to the mixing chamber. Here the heated air is mixed with ram air from a scoop in the proportions necessary for regulating the temperature, and routed to the various outlets. The left heat exchanger supplies heated air to the main cabin outlets, the windshield and astrodome defroster outlets, the pilots' handwarmer outlets, and the navigator's station outlets. The right heat exchanger supplies heated air to the radio operator's station outlets, the pilots' footwarmer outlets, and the autopilot servo unit housing. The hot air flow from the heat exchangers is continuously supplied to the heating system when the engines are operating. Heating system operation is discontinued by positioning the nacelle spill valve controls to spill the hot air flow, from the left and/or right heat exchanger, overboard. Ventilation for hot weather operation is obtained by spilling the heated air overboard and permitting only the ram air flow from the mixing chamber airscoops to be routed through the system. In addition, each outlet location is provided with a control valve to regulate the flow of heated or ventilated air, as desired. Two control boxes, one located in the cockpit and one located at the radio operator's station, contain the necessary controls for regulating the temperature in the fuselage compartments. The two spill valves, one in each nacelle, are controlled from the radio operator's control box. A defrosting control valve at the navigator's station controls the flow of air to the main cabin and defrosting outlets, and turns on the emergency defrosting blower.

MIXING CHAMBER CONTROL KNOBS

Two push-pull mixing chamber control knobs placarded HOT-COLD, one located on the control box (*figure 4-1*) at the radio operator's station, and the other located on the control box (*figure 4-1*) behind the co-pilot's seat, are used to mechanically position the butterfly valves in the left and right mixing chambers respectively. When the knob on the co-pilot's control box is in the HOT position, the valves in the right mixing chamber are positioned to shut off the ram air flow from the airscoop and open the hot air flow from the right heat exchanger to supply the respective outlets with heated air. When the knob is in the COLD position, the valves are positioned to shut off the hot air flow from the right heat exchanger and open the ram air flow from the airscoop to supply the respective outlets with ventilating air. Any intermediate position of the control knob will provide a mixture of ram and heated air in proportion to the control knob setting. The left mixing chamber control knob at the radio operator's station controls the ram and hot air flow from the left mixing chamber, and functions in the same manner as the right mixing chamber control knob at the co-pilot's station.

NACELLE SPILL VALVE CONTROL KNOBS

Two nacelle spill valve control knobs, placarded HEAT-SPILL, are located on the control box (*figure 4-1*) at the radio operator's station. These push-pull knobs are used to spill the heated air overboard when heating system operation is not desired, or during hot weather operation when cold air flow is desired or when a critical temperature warning light illuminates. When either control knob is in the SPILL position, the corresponding spill valve is opened mechanically to exhaust the heated air overboard. When the knob is in the HEAT position, the spill valve is closed, and the heated air is routed to the mixing chamber and distribution ducts. No intermediate positions are provided for the spill valves.

DEFROSTING CONTROL VALVE HANDLE

A mechanically operated defrosting control valve handle (*figure 4-1*), located at the navigator's station, controls the flow of heated air from the left heat exchanger to the windshield, astrodome, and the main cabin compartment, and also turns ON the emergency defroster blower. The control handle has the following placarded positions: NORMAL DEFROST-BLOWER OFF, CABIN HEAT, and EMER DEFROST-BLOWER ON. When the control handle is placed in NORMAL DEFROST-BLOWER OFF position, the control valve is positioned to shut off the heated air flow to the main cabin and route heated air to the pilots' handwarmer outlets and to the windshields and astrodome for defrosting. When the handle is positioned to CABIN HEAT, the control valve shuts off the heated air flow to the defroster outlets and routes heated air to the main cabin compartment. When the control handle is moved to the EMER DEFROST-BLOWER ON position, the emergency defrosting control valve shuts off the cabin heat, routes the heated air flow to the emergency defrosting blower, and automatically positions a 28-volt d-c spring-loaded switch to turn ON the emergency defrosting blower motor to supply an increased quantity of heated air to the pilots' handwarmer outlets and to the windshields and astrodome for defrosting. When the control is moved from this position, the switch automatically returns to OFF position, shutting off the blower motor.

AIR OUTLET CONTROL HANDLES

The air outlet control handles, one located at each air outlet at the crew stations, mechanically control the amount of air released through the outlets.

CRITICAL TEMPERATURE WARNING LIGHTS

Four 28-volt d-c critical temperature warning lights are provided, two on the main instrument panel (17, figure 1-11, 17, and 19, figure 1-12), and two above the control box at the radio operator's station. The two warning lights at each station, one for the RIGHT spill valve and one for the LEFT spill valve, are illuminated by thermoswitches located on the right and left spill valve assemblies (figure 4-1) when temperatures exceed approximately 232°C (450°F). The respective warning light or lights will go out when the temperature falls below these limits.

DEFROSTER FANS AND SWITCHES

Two 28-volt d-c defrosting fans are installed, one above and aft of the pilot's seat, and the other above and aft of the co-pilot's seat. A defroster fan switch is located on top of each fan. When the switch is positioned ON, a 28-volt d-c circuit is closed to start the fan motor. When the switch is positioned OFF, the fan circuit is opened.

HEATING AND VENTILATING SYSTEM OPERATION

Heating (Flight or Ground).

1. Individual air outlet control handles — Open (as required).
2. Mixing chamber control knobs — HOT (or as required for desired temperature).
3. Nacelle spill valve control knobs — HEAT.
4. Defrosting control valve handle — CABIN HEAT (if required).

HEATING AND VENTILATING SYSTEM - TYPICAL

C47 AND R4D SERIES AIRCRAFT

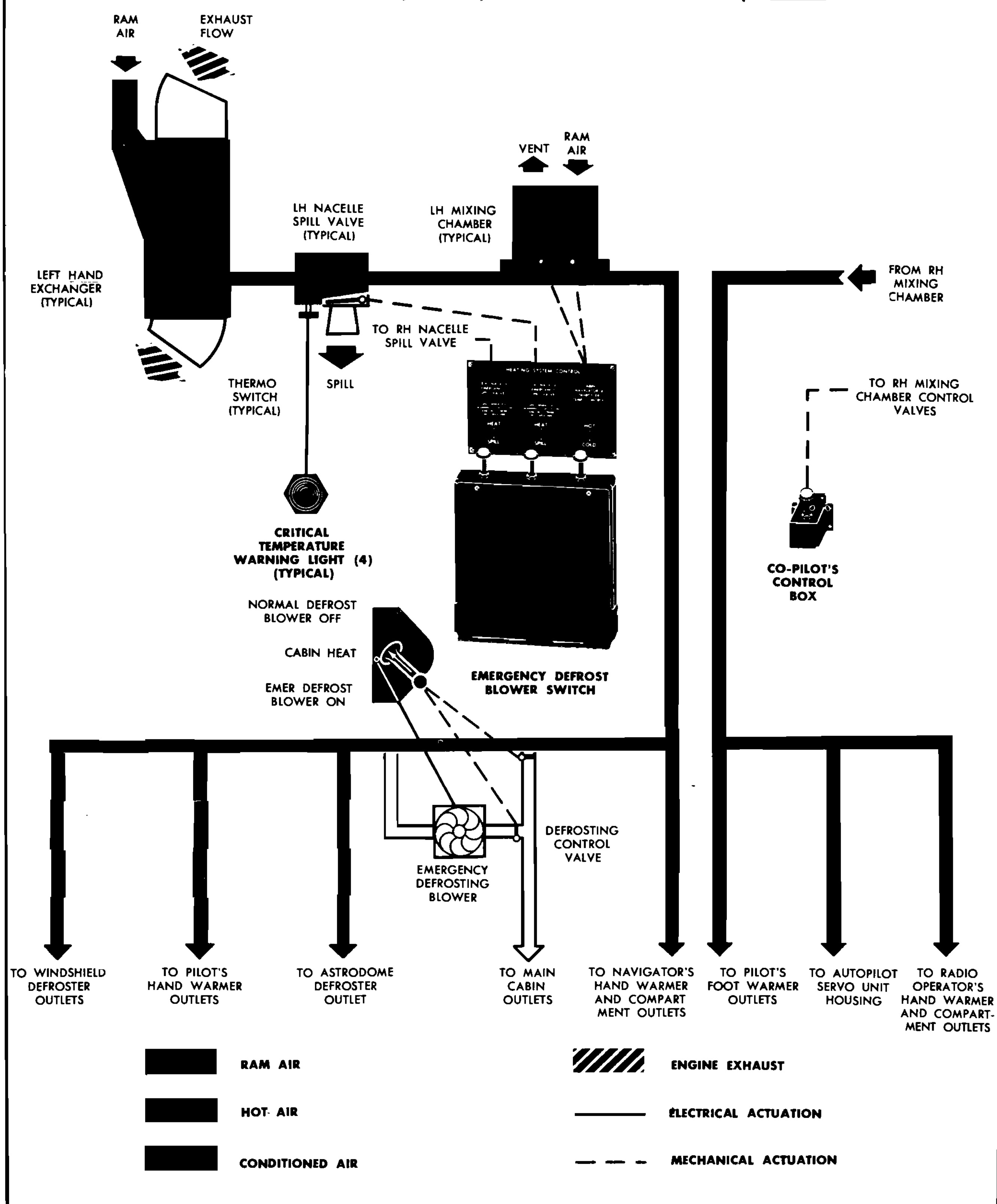


Figure 4-1

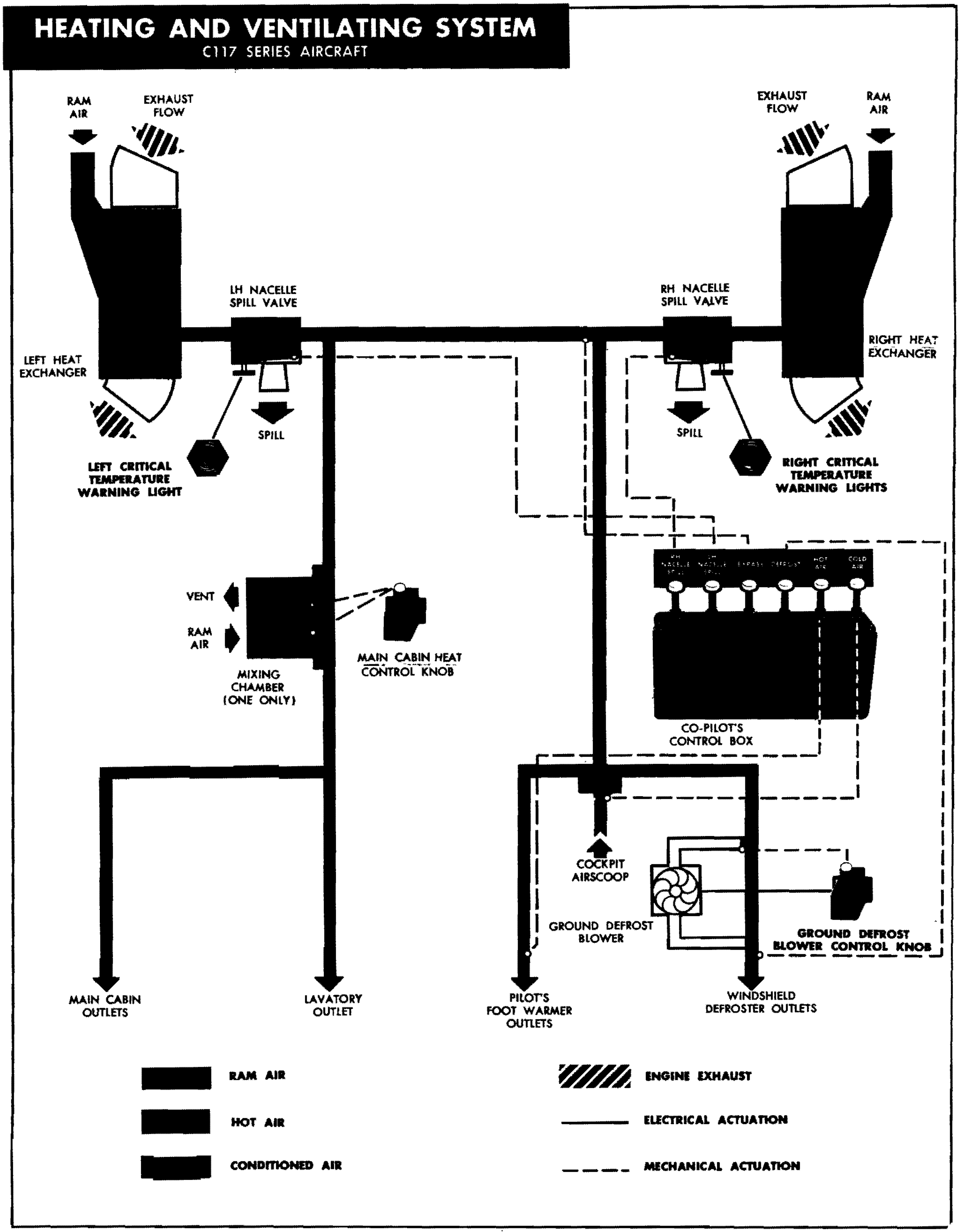

HEATING AND VENTILATING SYSTEM
C117 SERIES AIRCRAFT
RAM AIR
EXHAUST FLOW
EXHAUST FLOW
RAM AIR
LH NACELLE SPILL VALVE
RH NACELLE SPILL VALVE
LEFT HEAT EXCHANGER
RIGHT HEAT EXCHANGER
SPILL
SPILL
LEFT CRITICAL TEMPERATURE WARNING LIGHT
RIGHT CRITICAL TEMPERATURE WARNING LIGHTS
VENT
RAM AIR
MIXING CHAMBER (ONE ONLY)
MAIN CABIN HEAT CONTROL KNOB
CO-PILOT'S CONTROL BOX
COCKPIT AIRSCOOP
GROUND DEFROST BLOWER
GROUND DEFROST BLOWER CONTROL KNOB
MAIN CABIN OUTLETS
LAVATORY OUTLET
PILOT'S FOOT WARMER OUTLETS
WINDSHIELD DEFROSTER OUTLETS
RAM AIR
HOT AIR
CONDITIONED AIR
ENGINE EXHAUST
ELECTRICAL ACTUATION
MECHANICAL ACTUATION

Figure 4-2

CAUTION

If a critical temperature warning light illuminates, it is imperative that the respective nacelle spill valve be opened immediately to spill the heated air overboard. When the light goes out, the spill valve may be closed again.

If an engine is feathered, the respective spill valve should be opened to spill the air overboard, and the respective mixing chamber control knob should be placed in HOT position, to eliminate air flow through the system.

Ventilating.

1. Individual air outlet controls — OPEN (as required).
2. Nacelle spill valve control knobs — SPILL.
3. Mixing chamber control knobs — COLD (or as required for desired ventilation).
4. Defrosting control valve handle — CABIN HEAT (if main cabin ventilation is required).

Windshield and Astrodome Defrosting (Normal Operation).

1. Navigator's station heat outlet — CLOSED.
2. Mixing chamber control knob at radio operator's station — HOT.
3. Left nacelle spill valve control knob — HEAT.
4. Defrosting control valve handle — NORMAL DEFROST-BLOWER OFF.

Note

Cabin heat is not available during defrosting operation. The mixing chamber control knob at the co-pilot's station may be positioned to HOT to furnish heat to the cockpit and the radio operator's station, as desired, during defrosting operation.

Windshield and Astrodome Defrosting (Emergency Operation).

1. Navigator's station heat outlet — CLOSED.
2. Mixing chamber control knob at radio operator's station — HOT.
3. Left nacelle spill valve control knob — HEAT.
4. Defrosting control valve handle — EMER DEFROST-BLOWER ON.

CARGO SPACE HEATER.

A gasoline heater, with a rated output of 200,000 BTU per hour is installed in the aft end of the cargo compartment. It is a fuel injection type heater. For operation the heater requires gasoline, from the regular fuel system, under pressure, electric current for ignition, and a flow of combustion and ventilating air. A control panel is mounted on the heater.

HEATER OPERATION:

1. Turn on inverter at the power systems junction box.
2. Put manual heater valve in the OPEN position.
3. Turn the heater switch ON.
4. Use manual heat control to obtain the required cabin temperature.

HEATER OPERATION FOR VENTILATION:

1. Turn heater switch OFF.
2. Put manual heater valve in OPEN position.
3. Maximum ventilation is obtained when the manual heat control is in the OPEN position.

NOTE

To shut off all airflow put the manual heater valve in the CLOSED position and the manual heat control in the HOT position.

HEATING AND VENTILATING SYSTEM (C-117 SERIES AIRCRAFT).

The heating and ventilating system *(figure 4-2)* is the exhaust-heated type and consists of two heat exchangers, one mounted on each engine exhaust tailpipe, one mixing chamber, two nacelle spill valves, a 28-volt d-c ground defroster blower for windshield defrosting, two 28-volt d-c critical temperature warning lights, two critical temperature thermoswitches, the necessary insulated ducting, airscoops, outlet valves and controls. Ram air entering the heat exchangers is heated by the exhaust tailpipe, then routed through the nacelle spill valves to the mixing chamber. Here the heated air is mixed with ram air from a scoop in the proportions necessary for regulating the temperature in the main cabin and lavatory. A bypass duct is connected to the ducting from the right heat exchanger to route the heated air through a bypass valve to the cockpit for the pilots' footwarmer outlets, and the windshield defroster outlets. When the bypass control valve is positioned to route the maximum quantity of heated air to the cockpit outlets, 80 per cent of the heated air from the right heat exchanger will bypass the mixing chamber and be routed to the cockpit outlets. The heated air from the left heat exchanger and a portion of the heated air from the right heat exchanger (depending on the position of the bypass valve control) is routed to the mixing chamber for distribution to the main cabin and lavatory outlets *(figure 4-2).* Ventilation for hot weather operation is obtained by spilling the heated air overboard and permitting only the cold air flow through the system. The two spill valves, one in each nacelle, are controlled from the cockpit. During flight, ventilation for the main cabin is supplied by two ram air ducts extending along either side of the main cabin ceiling, with outlets at the passenger seat locations and in the lavatory. The supply of ventilating air to the main cabin is regulated by controls on the main cabin forward bulkhead. A ground air conditioning inlet, located on the right side of the aircraft adjacent to the lavatory, provides for ventilation of the main cabin from an external source. Two control boxes, one located in the cockpit and one located on the right forward side of the main cabin bulkhead, contain the necessary controls for regulating the temperature in the cockpit and the main cabin areas. An airscoop, mounted on the fuselage below the cockpit, is provided to admit ram air through the ducting to the pilots' footwarmer outlets for ventilation, or for mixture with the heated air flow during heating system operation. A control is provided in the cockpit to regulate the air flow from the scoop. The ground defroster blower is energized by a control in the cockpit. A carbon monoxide warning system is provided to indicate the presence of carbon monoxide in the heating system by illuminating a warning light in the cockpit.

MAIN CABIN HEAT CONTROL KNOB (C-117 SERIES AIRCRAFT).

A main cabin heat control knob *(figure 4-2)*, located on the right forward side of the main cabin bulkhead, is used to mechanically position the butterfly valves in the mixing chamber. The control knob has COLD and HOT positions. When the knob is moved to the COLD position, the valves in the mixing chamber are positioned to shut off the hot air flow and open the ram air flow. When the control knob is moved to the HOT position, the valves are positioned to shut off the ram air flow and open the hot air flow. Intermediate positions of the control knob will provide a mixture of ram and hot air in proportion to the control knob setting.

NACELLE SPILL VALVE CONTROL KNOBS (C-117 SERIES AIRCRAFT).

Two nacelle spill valve control knobs, one for the right nacelle spill valve and one for the left nacelle spill valve, are located on the control box *(figure 4-2)* behind the co-pilot's seat. These push-pull control knobs placarded HEAT-DUMP are used to spill the heated air overboard when heating system operation is not desired, or during hot weather operation when a cold air flow is desired, or when a critical temperature warning light illuminates. When either control knob is moved to the DUMP position, the spill valve is mechanically opened to exhaust the heated air overboard. When the knob is moved to the HEAT position, the spill valve is closed, and the heated air is routed to the mixing chamber and distribution ducts. No intermediate positions are provided for the spill valves.

BYPASS CONTROL KNOB (C-117 SERIES AIRCRAFT).

A bypass control knob, located on the control box *(figure 4-2)* behind the co-pilot's seat, mechanically regulates the bypass valve to control the proportion of hot air desired in the cockpit. When the control knob is moved to the PILOT position, the bypass valve is positioned to deliver a maximum quantity of heated air to the cockpit. When the knob is moved to the MIXING CHAMBER position, the bypass valve is positioned to deliver a maximum quantity of heated air to the mixing chamber. Intermediate positions of the control knob will provide a flow of hot air in proportion to the control knob setting.

COLD AIR CONTROL KNOB (C-117 SERIES AIRCRAFT).

A cold air control knob, located on the control box *(figure 4-2)* behind the co-pilot's seat, is used to regulate the valve in the inlet of the cockpit airscoop. When the control knob is in the COLD position, the valve is mechanically positioned to admit ram air through the ducting to the pilots' footwarmer outlets and windshield defroster outlets. When the knob is in the OFF position, the valve is positioned to shut off the ram air supply. Intermediate positions of the control knob will provide a flow of ram air in proportion to the control knob setting.

DEFROSTER HEAT CONTROL KNOB (C-117 SERIES AIRCRAFT).

A defroster heat control knob, located on the control box *(figure 4-2)* behind the co-pilot's seat, controls the flow of hot air to the windshield for defrosting by positioning a valve in the outlet ducting. When the control knob is moved to the ON position, the valve is opened to route hot air to the windshield for defrosting. When the knob is moved to the OFF position, the valve is closed, shutting off the hot air flow to the windshield. Intermediate positions of the control knob provide heated air flow in proportion to the control knob setting.

HOT AIR CONTROL KNOB (C-117 SERIES AIRCRAFT).

A hot air control knob, located on the control box *(figure 4-2)* behind the co-pilot's seat, is placarded MAX. DEFROST and COCKPIT and is used to position a valve in the pilots' footwarmer outlets. When the control knob is moved to the MAX. DEFROST position, the valve is mechanically closed and a greater quantity of heated air is routed to the defroster outlets. When the knob is moved to the COCKPIT position, the valve is opened to supply hot air to the pilots' footwarmers. Intermediate positions provide a hot air flow to the footwarmers in proportion to the control knob setting.

GROUND DEFROSTER BLOWER CONTROL KNOB (C-117 SERIES AIRCRAFT).

A ground defroster blower control knob *(figure 4-2)*, located above and to the rear of the co-pilot's seat, has the placarded positions GROUND BLOWER and FLIGHT. When the knob is moved to the GROUND BLOWER position, a valve in the blower duct is opened and a spring-loaded switch is automatically positioned to close a 28-volt d-c circuit in order to turn ON the ground defroster blower to supply air to the windshields for defrosting during ground operation. When the control knob is moved to the FLIGHT position, the blower switch automatically returns to the OFF position, shutting off the blower motor, and the valve is closed. During flight, the ground defroster blower control should be in the FLIGHT position; however, during emergency defrosting conditions, the GROUND BLOWER position may be used to supply an increased quantity of heated air to the windshields.

CRITICAL TEMPERATURE WARNING LIGHTS (C-117 SERIES AIRCRAFT).

The two 28-volt d-c critical temperature warning lights, placarded RIGHT and LEFT, are located on the main instrument panel (17, figure 1-11). The warning lights are illuminated by thermoswitches located in the right and left spill valve assemblies *(figure 4-2)* when temperatures exceed approximately 232°C (450°F). The respective warning light or lights will go out when the temperature falls below these limits.

CARBON MONOXIDE WARNING LIGHT AND RESET BUTTON (C-117 SERIES AIRCRAFT).

A 28-volt d-c carbon monoxide warning light, installed on the main instrument panel (30, figure 1-11), is controlled by a 28-volt d-c carbon monoxide control box and signal assembly mounted on the left forward side of the main cabin bulkhead. This assembly samples the air from the heat exchangers, and, if concentrations of more than 0.005 to 0.007 per cent of carbon monoxide are detected, a bimetal element switch is activated and in turn illuminates the carbon monoxide warning light. The 28-volt d-c reset button, located immediately left of the carbon monoxide warning light (31, figure 1-11), is used to check the warning light circuit.

DEFROSTER FANS AND SWITCHES (C-117 SERIES AIRCRAFT).

Two 28-volt d-c defrosting fans are installed, one above and aft of the pilot's seat, and the other above and aft of the co-pilot's seat. A 28-volt d-c ON-OFF switch is located on top of each fan. When the switch is positioned to ON, a 28-volt d-c circuit is closed to start the fan motor. When the switch is positioned to OFF, the fan circuit is opened.

CABIN COLD AIR VENTILATION SYSTEM (C-117 SERIES AIRCRAFT).

Additional ventilation for the main cabin is supplied by two ram airscoops, one located on either side of the fuselage. The ram air from the scoops is ducted along either side of the main cabin interior to the adjustable swivel-type outlets at each passenger seat location and in the lavatory. Controls for regulating the ram air flow through the system are located on the main cabin forward bulkhead.

Cabin Cold Air Control Knobs.

Two cabin cold air control knobs, with OPENED and CLOSED positions, are located on the main cabin forward bulkhead, one on either side. When the control knobs are in the OPENED position, the inlet valve in each cabin cold air duct is mechanically opened to admit ram air to the main cabin. When the control knobs are in the CLOSED position, the inlet valves are closed to shut off the cold air supply.

HEATING AND VENTILATING SYSTEM OPERATION (C-117 SERIES AIRCRAFT).

Heating (Flight or Ground).

1. Nacelle spill valve control knobs — HEAT.
2. Mixing chamber control knob — HOT.
3. Cold air control knob — OFF.
4. Bypass control knob — PILOT (or as desired).
5. Hot air control knob — COCKPIT.

6. Defroster heat control knob — OFF.

CAUTION

If a critical temperature warning light illuminates, it is imperative that the respective nacelle spill valve be opened immediately to spill the heated air overboard. When the light goes out, the spill valve may be closed again. If an engine is feathered, the respective nacelle spill valve should be opened to spill the air overboard, and the mixing chamber control knob should be placed in the HOT position, to eliminate air flow through the system.

Ventilating.

1. Nacelle spill valve control knobs — DUMP.
2. Cold air control knob — ON.
3. Main cabin heat control knob — COLD.
4. Bypass control knob — MIXING CHAMBER.
5. Hot air control knob — COCKPIT.
6. Cabin cold air control knobs — OPENED.
7. Main cabin individual cold air outlets — As desired.

Windshield Defrosting (Normal Operation).

1. RH nacelle spill valve control knob — HEAT.
2. Cold air control knob — OFF.
3. Bypass control knob — PILOT.
4. Defroster heat control knob — ON.
5. Hot air control knob — MAX. DEFROST (if required).
6. Ground defroster blower control knob — FLIGHT.

Windshield Defrosting (Emergency Operation).

1. RH nacelle spill valve control knob — HEAT.
2. Cold air control knob — OFF.
3. Bypass control knob — PILOT.
4. Defroster heat control knob — ON.
5. Hot air control knob — MAX. DEFROST.
6. Ground defroster blower control knob — GROUND BLOWER.

CARBON MONOXIDE INDICATION (C-117 SERIES AIRCRAFT).

If the carbon monoxide warning light illuminates, check for presence of carbon monoxide as follows:

1. Flight crew — Don oxygen masks and place diluter lever at 100% OXYGEN.
2. Press the carbon monoxide reset button for a minimum of 3 seconds.
3. Place the right nacelle spill valve control knob in the HEAT position.
4. Place the left nacelle spill valve control knob in the DUMP position.
5. Wait a few seconds for the signal assembly to indicate. If the red light illuminates, carbon monoxide is in the right heat exchanger.
6. Reverse the positions of the nacelle spill valve control knobs and test the left heat exchanger in the same manner.
7. Place the nacelle spill valve control knob for the faulty heat exchanger in the DUMP position.
8. Place the main cabin heat control knob in the COLD position to ventilate.

ANTI-ICING AND DEICING SYSTEMS.

PROPELLER DEICING SYSTEM.

The propeller deicing system utilizes isopropyl alcohol supplied from a 4 US gallon supply tank located behind the pilot's seat. The system includes a pump mounted on a 28-volt d-c motor, a filter, a shutoff valve, a slinger ring on each propeller hub, and the necessary piping. A switch and rheostat is located in the cockpit to energize the pump motor circuit and control the speed of the pump motor. The fluid is pumped from the supply tank through the shutoff valve and filter into the slinger rings. Distributor lines from the rings supply each blade. For fluid specification and filler point location, see figure 1-30.

Propeller Deicer Switch.

An ON-OFF propeller deicer switch is mounted on the electrical control panel (12, figure 1-13, 10, and 5, figure 1-14). When the propeller deicer switch is in the ON position, a 28-volt d-c circuit is completed to the propeller deicer rheostat. The OFF position opens the circuit to the rheostat.

Propeller Deicer Rheostat.

A propeller deicer rheostat, located to the right of and behind the pilot's seat (13, *figure* 1-6 *and* 14, *figure* 1-8), completes a 28-volt d-c circuit to the pump motor and controls the speed of the motor. When the rheostat is in the ON position, the pump motor is energized, provided the propeller deicer switch is in the ON position. When the rheostat is in the full clockwise position, fluid will flow at the minimum rate (approximately ½ gallon per hour). When the rheostat is turned COUNTERCLOCKWISE from the full clockwise position, the fluid flow gradually increases until a maximum flow (approximately 3 gallons per hour) is reached when the rheostat is in the fully counter-clockwise position. If the rheostat is turned counter-clockwise beyond the maximum flow position, the pump motor will be turned OFF.

NOTE

On some aircraft the rheostat is reversed.

Propeller Deicer Valve Handle.

A propeller de-icer valve handle, located behind the pilot's seat and below the deicing fluid supply tank, mechanically positions the shutoff valve that controls deicing fluid flow to the propellers. The handle has unmarked OPEN and CLOSE positions. When the deicer valve is moved to the OPEN position (aligned with supply line), the shutoff valve is mechanically opened to supply deicing fluid to the propellers. Moving the deicer valve handle to the CLOSE position (at right angle to the supply line), closes the shutoff valve, stopping fluid flow through the system.

Propeller Deicer System Operation

1. To start, propeller deicer valve handle—OPEN (aligned with supply line).
2. Propeller deicer switch—ON.
3. Propeller deicer rheostat—ON (regulate as required).
4. To stop, propeller deicer rheostat—OFF.
5. Propeller deicer, switch—OFF.
6. Propeller deicer valve handle—CLOSE (right angle with supply line).

CARBURETOR DEICING SYSTEM

The carburetor deicing system furnishes alcohol to the carburetor air intake throat for the removal of ice. The carburetor deicing system and the windshield de-icing system utilize a common supply tank with a capacity of 11.5 US gallons. The supply tank is located under the right wing fillet, with the filler neck extending through the fillet. On some aircraft, a filler neck is also located behind the co-pilot's seat to replenish the carburetor and windshield alcohol supply during flight, if required. The system includes a pump mounted on a 28-volt d-c motor, a filter, and a relief valve to allow excess fluid to flow back into the tank in the event of excessive pressure. Operation of the pump motor is controlled by a switch located in the cockpit. A control valve is also provided in the cockpit to shut off the alcohol supply when carburetor de-icing is not required. With continuous operation, the fluid output of the pump is approximately 8 gallons per hour. For fluid specification and filler points, see figure 1-30.

Carburetor and Windshield Deicer Switch

The carburetor deicer switch, located on the electrical control panel (13, figure 1-13 and 8, figure 1-14), has ON and OFF positions. When the switch is placed ON, a 28-volt d-c circuit is closed to energize the pump motor to supply alcohol to the carburetors under pressure for continuous operation, provided the control valve handle is ON. In the OFF position, the circuit is opened to discontinue system operation. On some aircraft a 3-position 28-volt d-c windshield deicing switch (13, figure 1-13 and 23, figure 1-14) is located on the electrical control panel. When the switch is placed ON, the circuit is closed to energize the pump motor to supply alcohol to the windshield under pressure for continuous operation, provided the control valve handle is turned ON. When the switch is placed in the MOM (spring-loaded) position, momentary operation of the system is provided for occasions when it is desired to operate the system only during short intervals. In the OFF position, the circuit is opened to discontinue system operation.

Carburetor Deicing Control Valve Handle

The carburetor deicing control valve handle, located to the right of and above the co-pilot's seat *(6, figure* 1-7), controls the supply of alcohol from the supply tank to the carburetors. The handle is turned ON to supply alcohol for operation of the carburetor deicing system, provided the carburetor deicer switch is ON. The handle is turned OFF to shut off the fluid supply to the carburetors.

CARBURETOR DEICER SYSTEM (R4D SERIES AIRCRAFT).

The carburetor deicing system utilizes a 28-volt d-c pump motor to supply alcohol to the carburetor air intake throat for the removal of ice. The 11 US. gallon supply tank is located in the right forward baggage compartment. A shutoff valve is located immediately below the supply tank. Operation of the pump motor is controlled by a switch located in the cockpit. The fluid output of the pump for continuous operation is approximately 8 gallons per hour. For fluid specification and filler points, see figure 1-30.

Carburetor Deicer Switch (R4D Series Aircraft).

The carburetor deicer switch, located on the electrical control panel *(8, figure* 1-14), has ON, MOM, and OFF positions. When the switch is placed ON, a 28-volt d-c circuit is closed to energize the pump motor and supply alcohol to the carburetors under pressure for continuous operation, provided the shutoff valve below the supply tank is opened. When the switch is placed in the MOM (spring-loaded) position, momentary operation for short intervals is provided. In the OFF position, the circuit is opened to shut off the pump motor.

WINDSHIELD DEICING SYSTEM

The windshield deicing system is designed to furnish alcohol to the outside of the windshields to remove ice. The system utilizes the same supply tank and pump motor as the carburetor deicing system (see the paragraph on Carburetor Deicing System, this section). The alcohol sprayed on the front windshields can be used in conjunction with the windshield wipers. The pump is controlled by a switch in the cockpit, and the rate of alcohol flow to the windshields is controlled by a needle valve control located in the cockpit. A control valve is also provided to shut off the fluid supply when system operation is not necessary. For fluid specification and filler point location, see figure 1-30.

Windshield Deicing Control Valve Handles

Two windshield deicing control valve handles, one located to the left of the pilot's seat and one located to the right of the co-pilot's seat (10, *figure* 1-6 *and* 12, *figure* 1-7), control the supply of alcohol from the supply tank to the windshields. The handle is turned ON to supply alcohol for operation of the windshield deicing system, provided the windshield deicer switch is ON. The handle is turned OFF to shut off the fluid supply to the windshields.

Windshield Alcohol Speed Control Knob

The windshield alcohol speed control knob, located in the vee of the windshield above the main instrument panel, controls the quantity of fluid flow to the windshields. When the knob is turned counterclockwise, the opening becomes wider for the passage of more fluid in proportion to the knob setting and, when the knob is turned clockwise, the opening becomes smaller to reduce the fluid flow.

Windshield Deicing Hand Pump Handle (Some Aircraft).

A windshield deicing hand pump handle is located forward and to the right of the co-pilot's station. Operation of the pump handle forces alcohol through the perforated tubing that outlines the frames on the side windshields and the sliding window panels.

WINDSHIELD DEICING SYSTEM (R4D SERIES AIRCRAFT).

The windshield deicing system furnishes alcohol to the outside of the windshields from a 6.5 US. gallon supply tank, located in the right forward baggage compartment (11, *figure* 1-30). This system contains two units with the same source of supply. The first unit sprays alcohol by means of a hand pump onto the right and left windshields and both sliding window panels; the second unit sprays alcohol by means of a 28-volt d-c motor driven pump onto the front windshields, and can be used in conjunction with the windshield wipers. The pump motor is controlled by a switch, and the alcohol rate of flow is controlled by a needle valve, both located in the cockpit. A control valve is also provided to shut off the fluid when system operation is not necessary. For fluid specification and filler point location, see figure 1-30.

Windshield Deicing Hand Pump Handle (R4D Series Aircraft).

The windshield deicing hand pump handle is located forward and to the right of the co-pilot's station *(29, figure* 1-9). Operation of the pump handle forces alcohol through the perforated tubing that outlines the frames on the side windshields and the sliding window panels.

Windshield Deicing Switch (R4D Series Aircraft).

The 3-position, 28-volt d-c windshield deicing switch is located on the electrical control panel *(23, figure* 1-14). When the switch is placed ON, the circuit is closed to energize the 28-volt d-c pump motor and spray alcohol on the front windshields. When the switch is placed in the MOM (spring-loaded) position, momentary operation of the system for short intervals is provided. In the OFF position, the circuit is opened to discontinue system operation.

Windshield Deicing Control Valve Handles (R4D Series Aircraft).

Two windshield deicing control valve handles, one located to the left of the pilot's seat and one located to the right of the co-pilot's seat *(15, figure* 1-8 *and 22, figure* 1-9), control the supply of alcohol from the hand pump to the right and left windshields and both sliding window panels. When the handle is turned on, the supply line is opened; when the handle is turned OFF, the supply to the side windshields is shut off.

Windshield Alcohol Speed Control Knob (R4D Series Aircraft).

The windshield alcohol speed control knob, located in the vee of the windshield above the main instrument panel, controls the quantity of fluid flow to the front windshields. When the knob is turned clockwise, the opening becomes wider for the passage of more fluid in proportion to the knob setting, and, when the knob is turned counterclockwise, the opening becomes smaller to reduce the fluid flow.

WING AND EMPENNAGE DEICING SYSTEM.

A wing and empennage deicing system is installed on the aircraft for the purpose of removing ice after it

WING AND EMPENNAGE DE-ICING SYSTEM

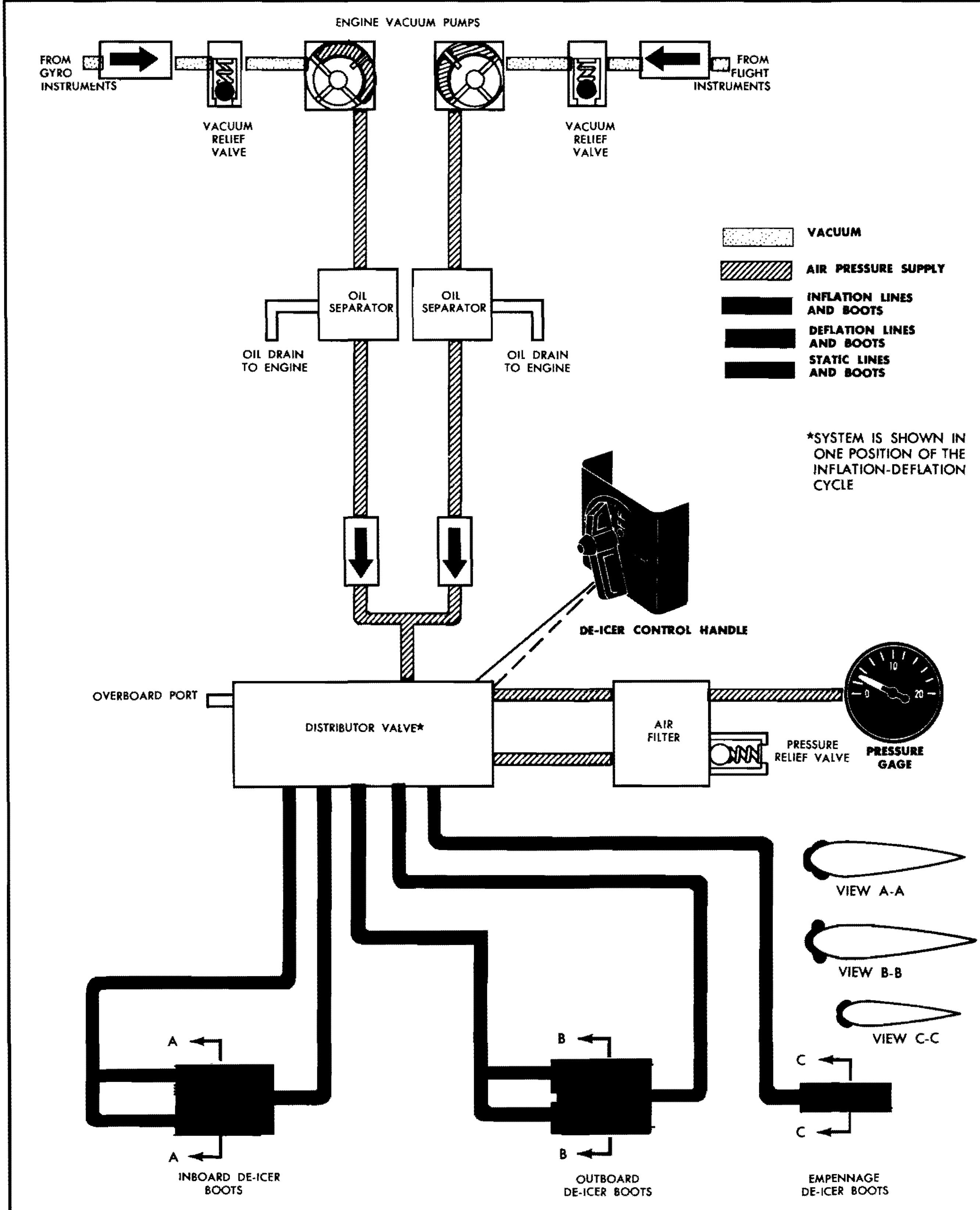


Figure 4-3

has formed. Rubber deicing boots are installed on the leading edge of each wing, each horizontal stabilizer, and on the vertical stabilizer. Air pressure, supplied from the pressure ports of the two engine-driven vacuum pumps (one on each engine), flows through two oil separators (to separate the oil from the air), two check valves, an air filter, and through a distributor valve to alternately expand and contract the tubes in the de-icing boots *(figure 4-3)*. One complete de-icing cycle is completed every 40 seconds. Each cycle consists of five 8-second pressurizing periods. The first period: air inflates the center tubes on the right and left outboard de-icer boots. Second period: the upper and lower tubes on the right and left outboard boots are inflated. Third period: the center tubes in the right and left inboard boots are inflated. Fourth period: the upper and lower tubes in the right and left inboard boots are inflated. Fifth period: both tubes in each of the three stabilizer boots are inflated. This pulsing action cracks ice formations on the boots, and the airstream blows the ice off. The distributor valve is controlled by a 28-volt d-c motor which opens or closes the port in the distributor valve unit. Operation of the electric motor is controlled from the cockpit. A pressure relief valve in the air filter regulates the pressure in the system. A gage located in the cockpit is connected to a line from the air filter and indicates the system air pressure.

Wing and Empennage Deicing System Control Handle

A wing and empennage deicing system control handle *(17, figure 1-9)*, located on the bulkhead aft of the co-pilot's station, has ON and OFF placarded positions. The control handle mechanically turns an arm, connected at either end to a cable, to start or stop the distributor valve motor, and positions the overboard ports in the distributor valve as required.

Wing and Empennage Deicing System Pressure Gage.

A direct-reading wing and empennage deicing system pressure gage mounted on the main instrument panel (23, figure 1-11, 27, and 26, figure 1-12) indicates system operating pressure.

WING AND EMPENNAGE DEICING SYSTEM OPERATION.

NOTE

For best results, wait until at least ¼ inch of ice has formed before starting the deicing system. If ice is too thin, it will crack in small patterns and will not have enough weight and body to be blown off by the slipstream.

Start the system by turning the deicing control handle to the ON position.

1. Observe the pulsation of the deicer boots for proper operation.
2. Deicer system pressure – Check.

NOTE

When the system is operating, the gage will not give a constant recording of 8 psi because of the fluctuation of air pressure; however, it should reach 8 psi at the peak of each inflation in order to properly inflate the individual tubes in each boot.

PITOT STATIC TUBE HEATERS.

The two pitot static tubes (21, figure 1-1) are each equipped with a 28-volt d-c integral heater which prevents ice from forming on the tubes. The heaters are operated by means of switches located in the cockpit.

Pitot Heater Switches.

The pitot heater units are controlled by two switches, located on the electrical control panel, one for the FWD. pitot tube and one for the AFT pitot tube (10, 11, figure 1-13, and 21, 22, figure 1-14). When either switch is positioned ON, the 28-volt d-c circuit is closed to operate the electrical heaters in the pitot tubes. In the OFF position, the circuit is opened to discontinue heater operation.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT.

(See figure 4-4.)

The following equipment is typical for all C-47, C-117 and R4D series aircraft. Each aircraft must be checked to determine the exact radio equipment installed.

RADIO SELECTOR SWITCH.

A radio power selector switch (2, figure 1-7), is mounted on the pilot's radio control panel, and selects the VHF, the UHF, or the HF liaison transmitter. Only one transmitter operates at a time.

VHF COMMAND TRANSMITTER RECEIVER (AN/ARC-3).

The VHF transmitter-receiver is controlled from the pilot's control panel and receives its power from the 28-volt d-c Radio Junction Box Bus No. 1. The

COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT

The following list is typical for all C-47, C-117, and R-4D series aircraft. Each aircraft must be checked to determine the exact radio equipment installed.

TYPE	DESIGNATION	FUNCTION	PRIMARY OPERATOR	RANGE	LOCATION OF CONTROLS
VHF COMMAND	AN/ARC-3	SHORT-RANGE, TWO-WAY VOICE AND CODE COMMUNICATION	PILOT AND CO-PILOT	LINE OF SIGHT	PILOT'S RADIO CONTROL PANEL
UHF COMMAND	AN/ARC-27	SHORT-RANGE, TWO-WAY VOICE COMMUNICATION	PILOT, CO-PILOT AND RADIO OPERATOR	LINE OF SIGHT	PILOTS' RADIO CONTROL PANEL AND RADIO OPERATOR'S CONTROL PANEL
HF LIAISON	AN/ARC-8 OR SCR-287	LONG-RANGE, TWO-WAY VOICE AND CODE COMMUNICATION	RADIO OPERATOR	200 TO 2500 MILES	RADIO OPERATOR'S STATION
LF RECEIVER	BC-453	LOW-FREQUENCY RADIO RANGE RECEIVER	PILOT	200 MILES	PILOT'S STATION
OMNI-RANGE AND INSTRUMENT APPROACH	AN/ARN-14 AND AN/ARN-5B	OMNI-RANGE LOCALIZER AND GLIDE PATH INDICATION	PILOT AND CO-PILOT	LINE OF SIGHT TERMINAL AREA	PILOTS' RADIO CONTROL PANEL
LOCALIZER AND GLIDE PATH	RC/103 AND AN/ARN-5D	INDICATES GLIDE ANGLE FOR LANDING AND LATERAL ALIGNMENT WITH RUNWAY	PILOT AND CO-PILOT	TERMINAL AREA	ABOVE THE LEFT ELECTRIC CONTROL PANEL
INTERPHONE	AN/AIC-3 OR RC-36B	INTERCREW COMMUNICATION	ALL CREW MEMBERS	WITHIN THE AIRCRAFT	CONTROL PANEL IN EACH CREW MEMBER'S STATION
AUTOMATIC RADIO COMPASS MANUAL RADIO COMPASS	AN/ARN-6 (DUAL) AN/ARN-7 AN/ARN-11	RECEPTION OF VOICE OR CODE COMMUNICATION: POSITION FINDING, HOMING	PILOT, CO-PILOT, NAVIGATOR	20 TO 200 MILES	PILOT'S RADIO CONTROL PANEL AND NAVIGATOR'S STATION
RADIO LOW ALTIMETER	AN/APN-1	ABSOLUTE ALTITUDE 0 TO 4000 FEET	PILOT	AIRCRAFT TO TERRAIN OR WATER	MAIN INSTRUMENT PANEL
MARKER BEACON	RC-193A OR BC-1333-B	RECEIVES LOCATION MARKER SIGNAL ON NAVIGATIONAL BEAM	PILOT AND CO-PILOT	OVER STATION	INDICATOR LIGHT IN COCKPIT VISIBLE TO PILOT AND CO-PILOT
TACAN	AN/ARN-21	AID TO NAVIGATION	PILOT AND CO-PILOT	LINE OF SIGHT 195 MILES MAXIMUM	PILOT'S RADIO CONTROL PANEL
IFF OR SIF	AN/APX-25 AN/APX-6 SCR/695B	PROVISIONS ONLY IDENTIFICATION	PILOT OR CO-PILOT	LINE OF SIGHT	PILOT'S RADIO CONTROL PANEL
EMERGENCY TRANSMITTER	AN/CRT-3	EMERGENCY SEA RESCUE		LINE OF SIGHT	STRAPPED ON AFT MAIN CABIN DOOR OR NAVIGATOR'S STATION
RADAR ALTIMETER	AN/APN-22	ABSOLUTE ALTITUDE 0 TO 20000 FT.	PILOT	AIRCRAFT TO TERRAIN OR WATER	MAIN INSTRUMENT PANEL
DIRECTION FINDER	AN/ARA-25	UHF DIRECTION FINDER	PILOT CO-PILOT		RADIO OPERATOR'S STATION
HOMING ADAPTOR	AN/ARA-8	VHF HOMING DEVICE	PILOT CO-PILOT	LINE OF SIGHT	PILOT'S OVERHEAD RADIO CONTROL PANEL
"LORAN" NAVIGATION	AN/APN-9	"LORAN" NAVIGATIONAL EQUIPMENT	NAVIGATOR		PILOT'S OVERHEAD RADIO CONTROL PANEL
	AN/ARC-65		RADIO OPERATOR NAVIGATOR		
VHF COMMAND FM	AN/ARC-44	SHORT RANGE, TWO WAY VOICE COMMUNICATION, HOMING	PILOT, CO-PILOT NAVIGATOR	LINE OF SIGHT 50 MILES	PILOT'S OVERHEAD RADIO CONTROL PANEL, NAVIGATOR'S STATION

Figure 4-4

equipment is line-of-sight VHF and is used for 2-way voice communication, air-to-air or air-to-ground. The set is turned on by placing the VHF 2-position ON-OFF switch in the ON position. To turn the equipment off, place the switch in the OFF position.

UHF COMMAND TRANSMITTER-RECEIVER (AN/ARC-27).

The UHF transmitter-receiver is controlled from the pilot's radio panel, and receives its power from the 28-volt d-c Radio Junction Box Bus No. 2. The transmitter-receiver has been designed to provide radio telephone communication in the frequency range of 225.0 to 399.9 megacycles between aircraft and ground or between aircraft. The transmitter may be tone modulated (A2) at 1020 cycles per second for emergency or direction-finding purposes. The transmitter-receiver provides 1750 frequency channels in this range and provision has been made for the pilot's remote selection of any of the 18 or 20 preset frequencies or operation of a guard frequency. On some installations, a quick manual tuner is installed on the radio panel. On these airplanes, the pilot is able to select any one of the available 1750 frequency channels which include 18 or 20 preset ones and guard. Transmission and reception are line-of-sight on the same frequency and antenna. To turn the equipment on, rotate the function switch clockwise from the off position. To turn the equipment OFF, rotate the function switch counterclockwise to OFF.

CAUTION

- To preclude damage to the equipment, allow at least one minute for the set to warm up before operating.
- Do not rotate the channel selector while the tuning cycle is in progress.

HF LIAISON TRANSMITTER AND RECEIVER. (AN/ARC-8 or SCR-287).

The HF liaison transmitter and receiver are controlled from the radio operator's station (1, and 5, figure 4-7) and are operated by power from the 28-volt d-c Radio Junction Box Bus No. 1. The HF liaison set provides long-range 2-way code and voice communication. A key for the operation of CW (3, figure 4-7) is mounted on the radio operator's table. To turn on the transmitter, place the radio power selector switch in the LIAISON position and rotate the emission selector switch clockwise to VOICE, CW, or MCW as required. To turn off the transmitter, place the emission selector switch in the OFF position. To turn on the receiver, place the radio power selector switch in the LIAISON position and move the function selector switch either to MVC or AVC, as desired. To turn off the receiver, place the function selector switch in the OFF position.

INTERPHONE SYSTEM.

Multiple interphone control panels are located in the flight compartment, adjacent to each crew member's station; headsets and hand microphones are also provided. These are operated from the interphone control panels (figure 4-6) at each crew member's station The interphone equipment provides communication facilities between all crew members and enables the the flight compartment crew members to use the VHF command set, VHF navigation set, the liaison set, the automatic radio compass, and the marker beacon. The power source is the 28-volt d-c Radio Junction Box Bus No. 2. To turn on the interphone equipment, turn on the aircraft power supply and see that the radio power circuit breaker in the main junction box and the three circuit breakers on the radio circuit breaker panel (figure 1-20) are in the ON position. To turn off the interphone equipment on the ground, turn off the aircraft power supply. In an emergency, to turn off the interphone in flight, open the circuit breakers.

INTERPHONE SYSTEM (SOME AIRCRAFT).

The interphone system provides a means of communication between crew members and also permit crew participation in radio operations. Five interphone control panels are provided, one for each crew member and one at the rear of the main cabin compartment. The pilot and co-pilot are each provided with a mixer control box and a filter control, which make it possible to monitor all radio sets, or isolate as desired. Selection at the navigator's station interphone control panel and radio operator's station interphone panel differs in that the radio operator cannot select the VHF navigation radio and the navigator cannot select the liaison radio. Selection at the rear cabin compartment interphone control panel is the same as at the radio operator's station with the exception that, in the LIAISON position, only reception is possible.

The MIXED SIGNALS COMM position, on the pilot's and co-pilot's interphone control panels, permits HF, VHF, or UHF transmission and reception, depending on the position of the microphone selector switch and the audio switches on the interphone control panel.

The radio power switch must be set to correspond. The power source is the 28-volt d-c Radio Junction Box Bus No. 2. To turn on the interphone equipment, turn on the aircraft power supply and see that the radio power circuit breaker in the main junction box and the three circuit breakers on the radio circuit breaker panel (figure 1-20) are in the ON position. To turn off the interphone equipment on the ground, turn off the aircraft power supply. In an emergency, to turn off the interphone equipment in flight, pull the circuit breakers.

RADIO LOW ALTIMETER (AN/APN-1).

This equipment is controlled from the pilots' compartment. Power for operation is supplied from the 28-volt d-c bus. The function of the equipment is to provide a positive altitude reading of the aircraft above the existing terrain or the surface of the water. The equipment's range is from 0 to 4000 feet. An altitude limit switch located below the ignition switches in the vee of the windshield, presets the desired altitude to be maintained. A radio altimeter (35, figure 1-12) provides positive measurement of altitude. Three indicator lights (36, figure 1-12) function as follows:

RED – Indicates flight below the preset altitude.

AMBER – Indicates flight at the preset altitude.

GREEN – Indicates flight above the preset altitude.

To turn on the equipment, rotate the switch, incorporated on the radio altitude indicator, clockwise to ON. To turn the equipment off, rotate the switch on the radio altitude indicator to the OFF position.

WARNING

Do not rely on your SCR-718, AN/APN-21, or AN/APN-22 equipment to provide terrain clearance when flying over areas covered by a large depth of snow and ice.

RADAR ALTIMETER SYSTEM (LOW-RANGE, AN/APN-22).

The AN/APN-22 radar altimeter system is a microwave altimeter, and receives power from the 28-volt DC No. 1 radio bus and 115 volt AC power from No. 1 radio bus. The system measures the terrain clearance of the aircraft through a transmitted and received frequency – modulated microwave carrier. The system is reliable from 0 to 10,000 feet over land and from 0 to 20,000 feet over water. The indication accuracy is ± 2 feet from 0 to 40 feet, and ± 5 percent of the indicated altitude from 40 to 20,000 feet. The system ON-LIMIT control switch is located on the height indicator. ON turns on the power for the system. LIMIT sets the bug pointer at the desired. altitude. Indication that the aircraft is above the set altitude is obtained by comparing the indicator pointer with the bug pointer, or by observing illumination of a red light on the face of the indicator. The indicator pointer will go behind a mask on the indicator if the system is inoperative or a dropout altitude is reached. The dropout altitude is the altitude when the return signal is too weak to operate the system. The signal will be too weak above 10,000 feet over land and above 20,000 feet over water, or in banks of 60 degrees or more, and climbs and dives of 70 degrees or more.

WARNING

Do not rely on your AN/APN-22 equipment to provide terrain clearance when flying over areas covered by a large depth of snow and ice.

IFF/SIF EQUIPMENT.

Power for the identification radio equipment is provided by the 28-volt d-c Radio Bus No. 2 and the 115 volt a-c Radio Bus No. 1. Refer to appropriate manual for operating instructions.

MARKER BEACON RECEIVER (RC-193A or BC-1333-B).

The 28-volt d-c marker beacon receiver has no controls, but comes on automatically when power is supplied to the No. 2 Radio d-c bus. The marker beacon indicator light is mounted on the main instrument panel. When the aircraft is within the radiation pattern of a 75 megacycle marker beacon transmitter, the indicator light illuminates and the aural signal is received.

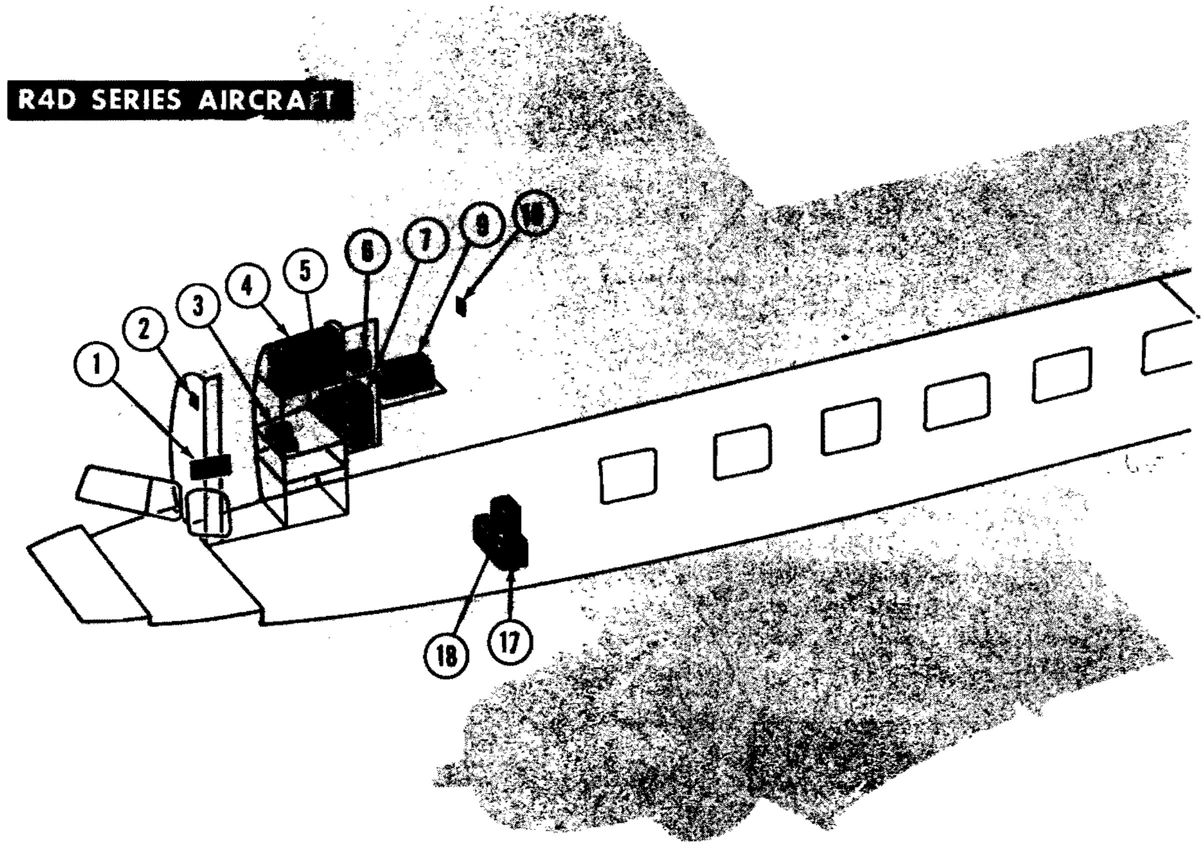
LF RECEIVER (BC-453).

The LF receiver is operated by power from the 28-volt d-c bus, and is controlled from the LF radio control panel (24, figure 1-8) located above the pilot's side window. This receiver is used to monitor low-frequency radio range signals. To turn on the receiver, place the function selector switch on either CW or MCW, as desired. To turn off the receiver, place the function selector in the OFF position.

AUTOMATIC RADIO COMPASS (AN/ARN-6).

The radio compass, AN/ARN-6, is used for the reception of radio voice or code communication, and for navigation and homing. It has a frequency range from 100 to 1750 kilocycles. Power is supplied to the equipment from the 28-volt No. 1 Radio d-c bus and 115V a-c No. 2 Radio Bus.

COMMUNICATION AND ASSOCIATED ELECTRONIC



1. LF CONTROL PANEL
2. VHF COMMAND RADIO CONTROL PANEL
3. LOCALIZER AND GLIDE PATH RECEIVER
4. LIAISON TRANSMITTER SPARE TUNING UNITS
5. MARKER BEACON RECEIVER
6. LF RECEIVER
7. LIAISON RADIO TRANSMITTER
8. VHF COMMAND FM
9. LIAISON RADIO RECEIVER
10. INTERPHONE AMPLIFIER
11. CARGO COMPARTMENT INTERPHONE CONTROL PANEL
12. RADIO LOW ALTIMETER TRANSMITTER-RECEIVER
13. MICROPHONE JACK BOX
14. VHF COMMAND RADIO TRANSMITTER-RECEIVER
15. IFF RADIO TRANSMITTER-RECEIVER
16. EMERGENCY TRANSMITTER (GIBSON GIRL)—MOUNTED ON INSIDE OF CARGO DOOR
17. AUTOMATIC RADIO COMPASS RECEIVER
18. FREQUENCY METER
19. VHF RADIO RECEIVER
20. RADIO CIRCUIT BREAKER PANEL
21. VHF RADIO TRANSMITTER
22. OMNI BEARING INDICATOR
23. COMPASS REPEATER AMPLIFIER
24. FLUXGATE COMPASS AMPLIFIER
25. GLIDE PATH RECEIVER
26. RADIO BEARING INDICATOR
27. TACAN RADIO TRANSMITTER – RECEIVER
28. OMNI LOCALIZER RECEIVER
29. LIAISON RADIO DYNAMOTOR
30. OMNI LOCALIZER RECEIVER DYNAMOTOR
31. UHF TRANSMITTER-RECEIVER
32. INTERPHONE CONTROL PANEL
33. LIAISON MONITOR SWITCH

Figure 4-5 (Sheet 1 of 2)

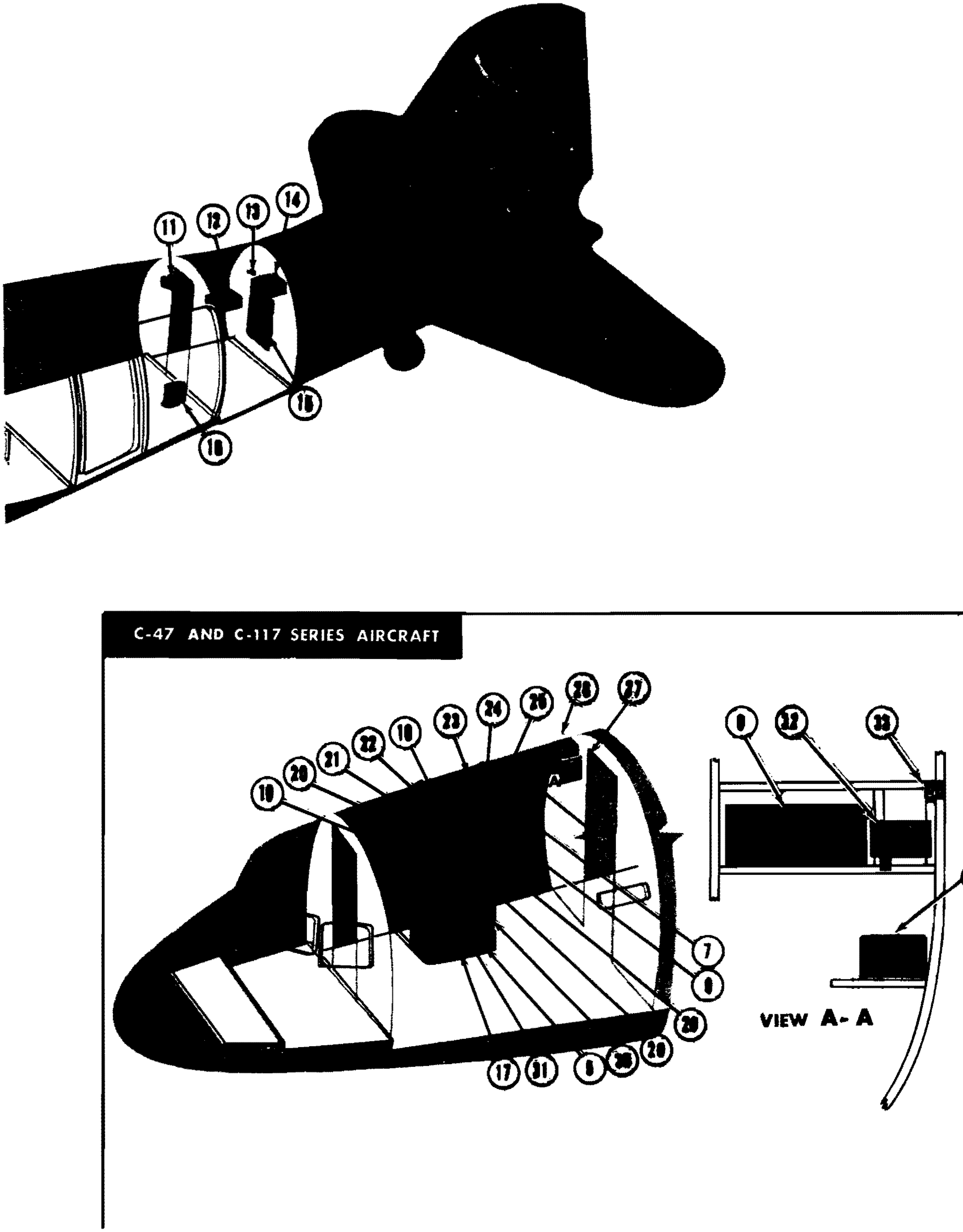


Figure 4-5 (Sheet 2 of 2)

INTERPHONE CONTROL PANEL—TYPICAL

C47 AND C117 SERIES AIRCRAFT

Figure 4-6

The equipment consists of the following units: one radio compass unit, R-101/ARN; one loop antenna, AS-313/ARN-6; two control boxes C-1514/A; two tuning meters installed as auxiliary equipment, one at each control location; three bearing indicators, ID-250/ARN; a lighting plate located at each indicator, ID-250/ARN; a wire sense antenna; and a coupling unit, CU-65/ARN-6.

The AN/ARN-6 is operated from the pilot's and co-pilot's overhead radio control panel and from the navigator's compass control panel (figure 4-12). To turn ON the automatic compass, place the function selector switch on the direction finder control, C-1514/A, to COMP, ANT, or LOOP position, as desired. To turn the equipment OFF, place the function selector switch in the OFF position.

AUTOMATIC RADIO COMPASS (AN/ARN-7).

The radio compass is operated from the radio control panel (2, figure 1-7) in the pilots' compartment. Power is supplied to the equipment from the 28-volt d-c bus and from the 115-volt inverter system. The automatic compass system is used for the reception of radio voice or code communications and for navigation and homing. To turn on the radio compass, place the function selector switch on the automatic compass tuning control panel at COMP, ANT, or LOOP, as desired. To turn the equipment off, place the function selector switch in the OFF position.

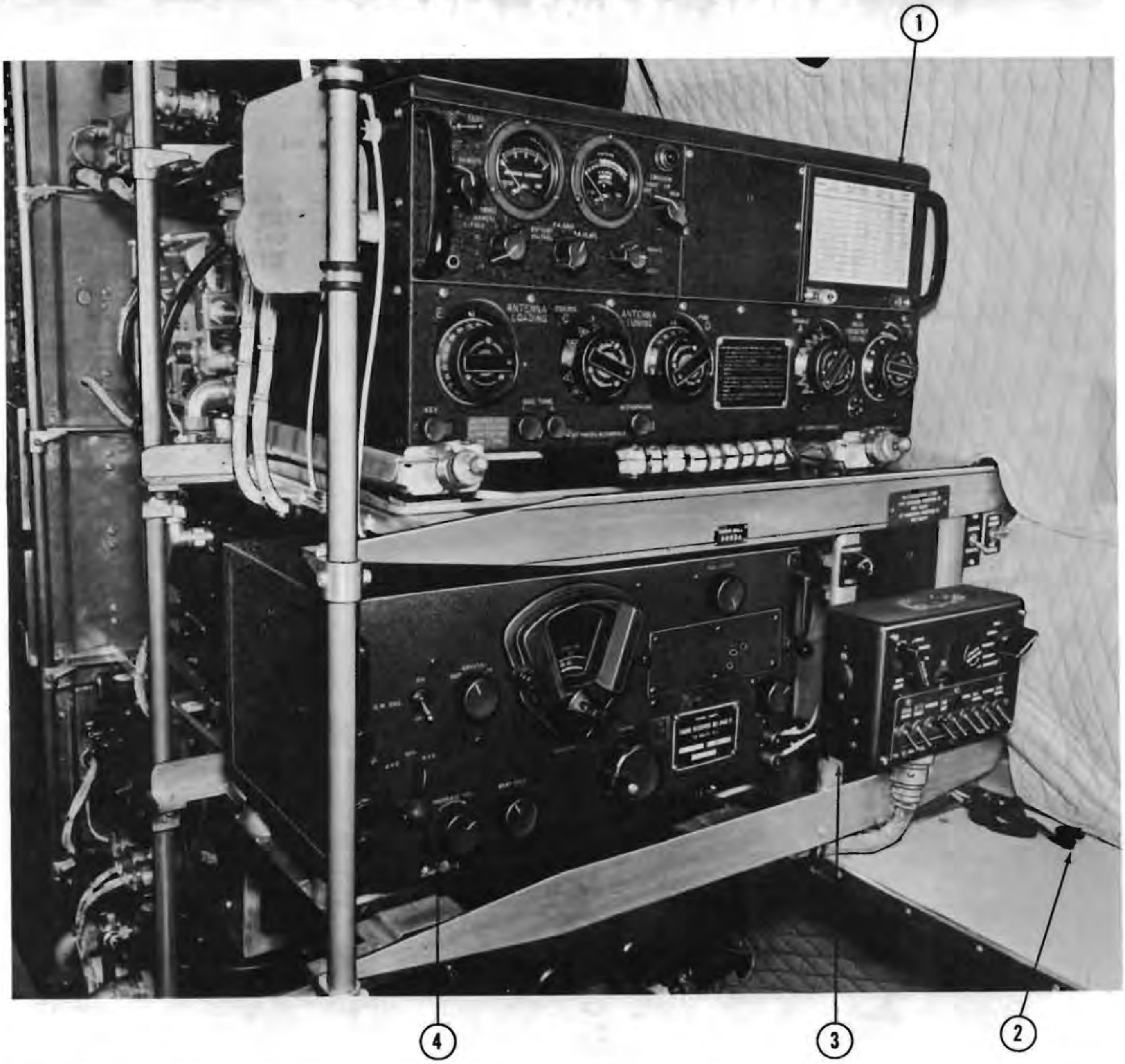
LOCALIZER RECEIVER AND GLIDE PATH RECEIVER (RC/101 and AN/ARN-5).

This equipment is controlled from the LOCALIZER control panel located above the electrical control panel in the pilots' compartment. Its power sources are the 28-volt d-c bus localizer and the 115-volt a-c bus glide slope. Instrument landing approach system localizer channels are selected on the control panel. Channels U, V, W, X, Y, and Z may be selected by placing the selector switch handle in the position required. Glide path frequencies are automatically paired with their respective localizer channels. Localizer and glide path course deflection is indicated on the glide path indicator installed on the pilot's instrument panel. To turn on the receivers, place the ON-OFF toggle switch on the localizer control panel in the ON position. To turn the equipment off, place the ON-OFF toggle switch in the OFF position.

OMNI-RANGE AND LOCALIZER RECEIVER AND GLIDE PATH RECEIVER (AN/ARN-14 and AN/ARN-5B).

This equipment is controlled from the VHF NAV radio control panel in the pilot's compartment (2, figure 1-7). Its power sources are the 28-volt d-c No. 1 Radio Bus for the course indicator (ID 249) except the heading pointer. 115V AC power from the No. 2 a-c radio bus is required for the heading pointer, and the radio magnetic indicator (ID 250). Omni-range

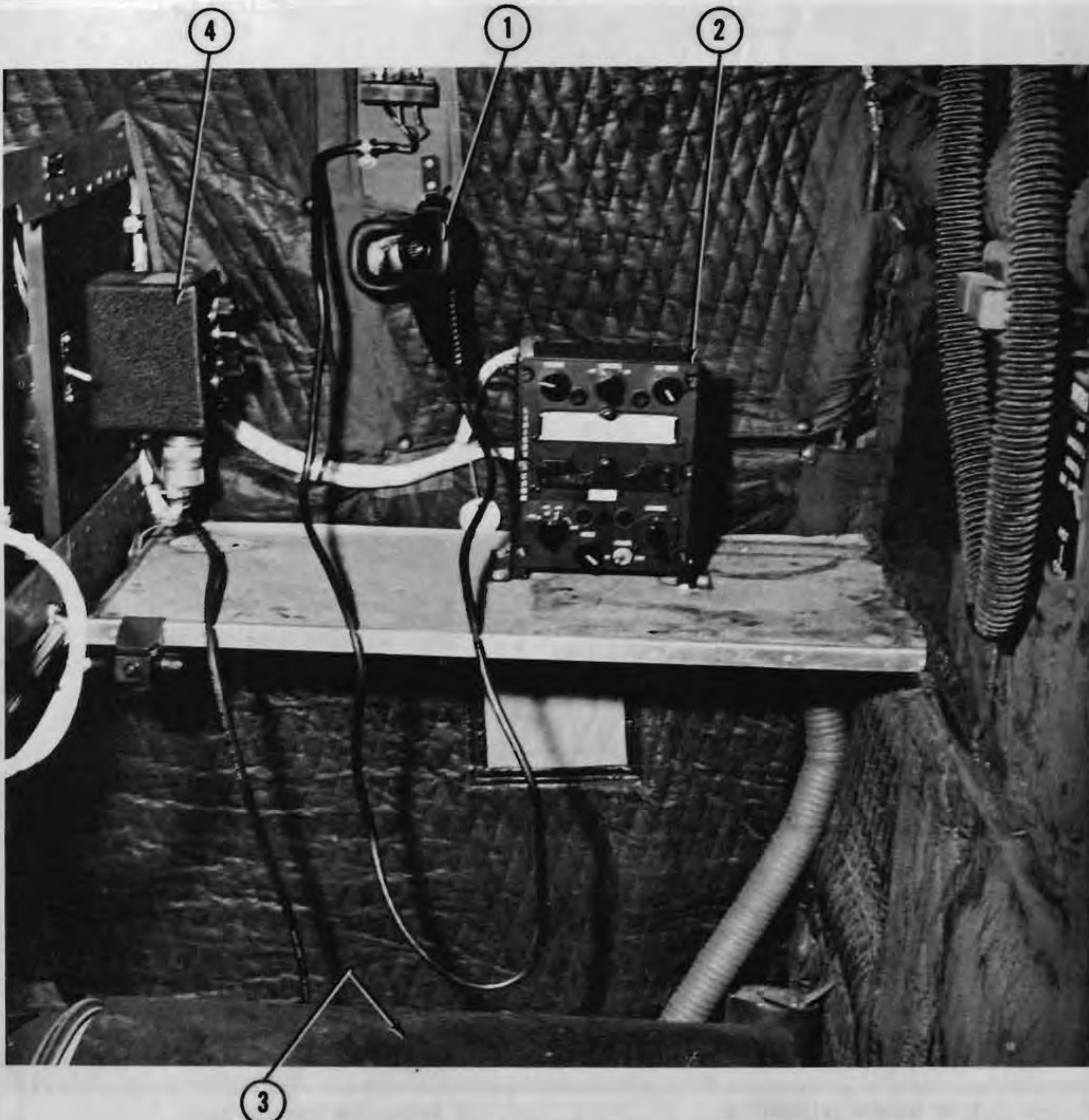
RADIO OPERATOR'S STATION
TYPICAL



1. HF LIAISON TRANSMITTER
2. KEYER
3. INTERPHONE CONTROL PANEL
4. HF LIAISON RECEIVER

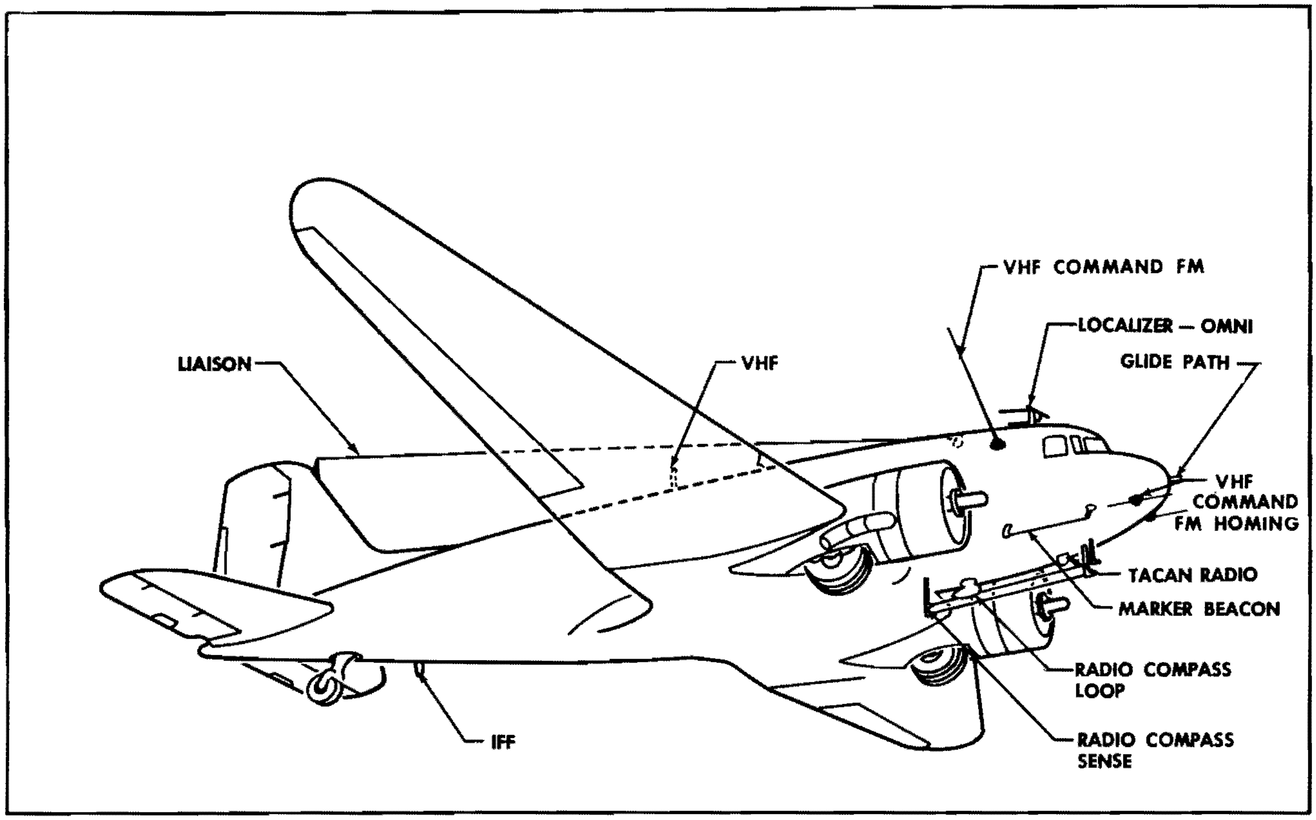
Figure 4-7 (Sheet 1 of 2)

RADIO OPERATOR'S STATION SOME SC-47 AIRCRAFT



1. MICROPHONE
2. CONTROL BOX
3. HF LIAISON TRANSMITTER-RECEIVER
4. SPEAKER CONTROL BOX

Figure 4-7 (Sheet 2 of 2)


VHF COMMAND FM
LOCALIZER — OMNI
GLIDE PATH
LIAISON
VHF
VHF COMMAND FM HOMING
TACAN RADIO
MARKER BEACON
RADIO COMPASS LOOP
RADIO COMPASS SENSE
IFF

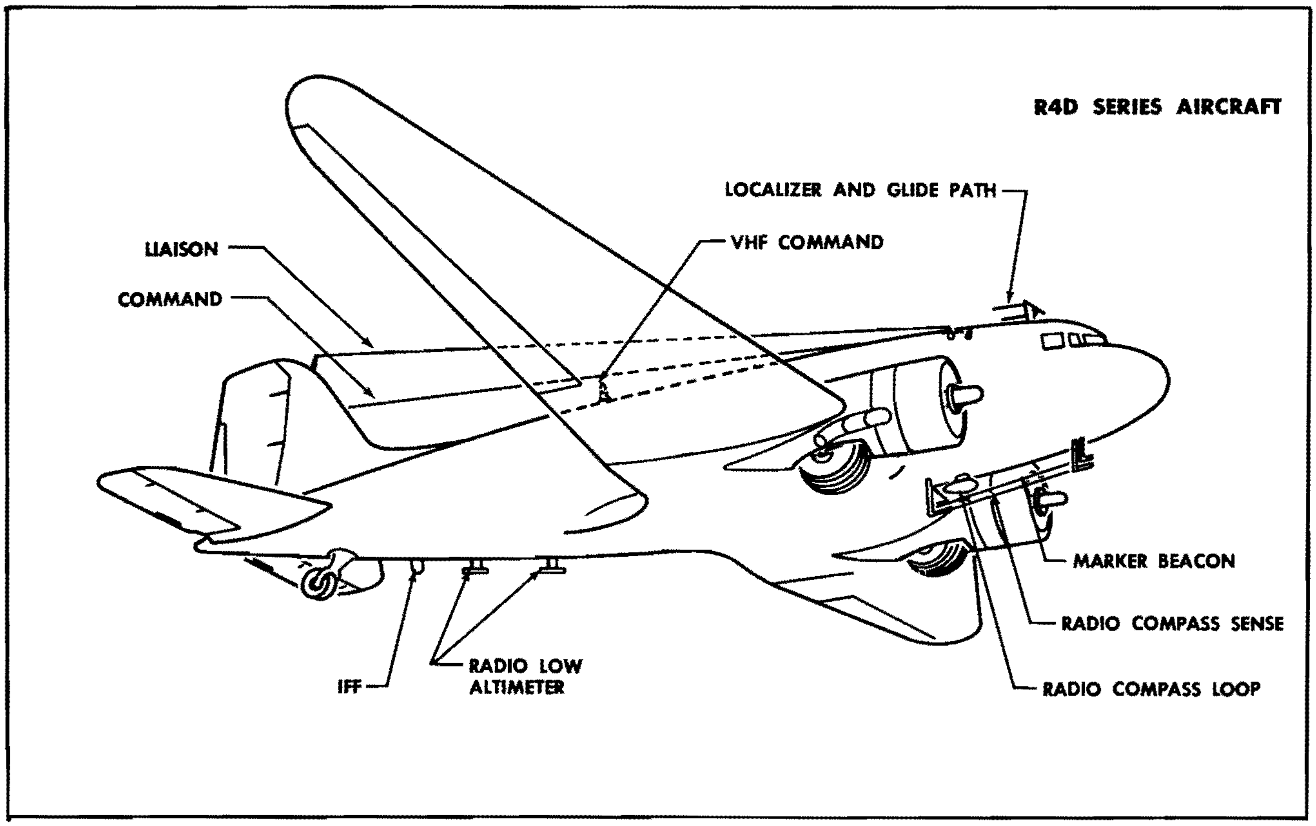

R4D SERIES AIRCRAFT
LOCALIZER AND GLIDE PATH
VHF COMMAND
LIAISON
COMMAND
MARKER BEACON
RADIO COMPASS SENSE
RADIO COMPASS LOOP
IFF
RADIO LOW ALTIMETER

Figure 4-8

and instrument landing system approach localizer frequencies are selected on the frequency control unit. Glide path frequencies are automatically paired with their respective localizer frequencies. Omni-range courses are selected with reference to the head or tail of the (VOR No. 2) bearing indicator and set in the course selector window located on the main instrument panel. The function of the equipment is radio navigation and instrument landing. To turn on the equipment, place the VHF NAV POWER switch in the ON position. To turn off the equipment, turn the VHF NAV POWER switch OFF.

WARNING

- Power source for glide indication will vary from aircraft to aircraft. Determine power source prior to flight.
- During a VOR instrument approach, turn the Tacan set off at the Tacan control panel. This will prevent an automatic switchover to Tacan in the event of a VOR power failure during a VOR approach.

NOTE

In case of complete inverter failure power is still available to operate the CDI of the ID 249 when used with the ARN-14.

TACAN RADIO (AN/ARN-21/45).

Tacan is designed to operate in the UHF frequency band in conjunction with a radio navigation system called TACAN (Tactical Air Navigation). The system enables an equipped aircraft to obtain continuous indications of its distance and bearing from any selected tacan surface (station beacon) located within a line-of-sight distance of approximately 195 nautical miles. Tacan consists essentially of a receiver-transmitter, radio bearing indicator (ID 307) located at the radio equipment rack and a DME. The AN/ARN-21/45 components available to the pilot in flight are the radio magnetic indicator (ID 250), the course indicator (ID 249), the Tacan Range indicator DME (ID 310), Tacan Control Panel, and a Navigation instrument selector switch. There are 126 frequency channels any one of which may be selected by setting the proper controls on the control panel. Tacan is powered by both 28-volt d-c Radio Junction Box Bus No. 2 and 115-volt a-c Radio Bus No. 1.

TACAN CONTROL PANEL.

The Tacan control panel located on the pilot's radio control panel, has a power switch with OFF, REC and T/R positions, two channel selector knobs, a channel window, and a volume-control knob. With the power switch in the REC position, the distance function of the set is disabled, and only bearing information is available. With the power switch in the T/R position, both bearing and distance information is displayed on the indicators. The left or outside on the concentric channel selector knob selects the first two figures of the Tacan beacon channel number, and the right or inside channel selector knob selects the third number. The volume control knob is used to adjust the volume of aural identification signals received from the Tacan surface beacon.

Navigation Instrument Selector Switch.

A navigation instrument selector switch with TACAN and VOR positions, is located on the pilots' radio control panel. When the switch is positioned to VOR, the omni-range receiver controls the course indicator and the No. 2 needle of the radio magnetic indicator (RMI). When the switch is positioned to TACAN, the Tacan radio controls the course indicator and the No. 2 needle of the radio magnetic indicator. The switch receives power from the 28-volt d-c system through a circuit breaker on the radio circuit breaker panel (figure 1-23).

COURSE INDICATOR (ID 249/ARN).

The course indicator ID 249 (8, figure 1-12) is used in conjunction with both the VOR and Tacan. Signals received from either radio are relayed to the course deviation indicator of the course indicator. Deviation of the aircraft course either left or right of the selected course will be indicated by displacement of the course deviation indicator, regardless of position of aircraft in relation to the station.

RADIO MAGNETIC INDICATOR ID 250.

The radio magnetic indicator (1, figure 1-12) is also used with AN/ARN-21 (Tacan) as well as with the AN/Radio Compass. It consists of a rotating compass card, actuated by the directional indicator (slaved) system, and two bearing indicators. The bearing indicators are connected to function as a single unit and are actuated by the receiver portion of the AN/ARN-21 when Tacan is selected. Azimuth signals from the Tacan surface beacon are then received by the AN/ARN-21 and relayed to the radio magnetic indicator, causing the bearing indicators to indicate the magnetic bearing of the Tacan surface beacon. With the control switch in the REC position bearing information may be received even though the transmitter portion of the set is not energized.

TACAN RANGE INDICATOR.

A Tacan range indicator is installed on the pilot's instrument panel. The indicator displays the slant range distance in nautical miles between the airplane and the Tacan surface beacon. The numerals in the window are controlled by the range circuits of the AN/ARN-21 Tacan. While the indicator is "searching" for the correct range or when the switch is in the REC position, the rotating numbers are partially covered by a red flag, which warns the pilot against reading incorrect distance indications.

TACAN RADIO OPERATION.

1. Navigation instrument selector switch – TACAN.
2. Function switch – T/R or REC.
3. Channel selector knobs – Desired Channel.
4. Volume control knobs – As Required.
5. Bearing selector knob (course indicator) – Desired Bearing.
6. To Stop, function switch – OFF.

WARNING

The course indicator (localizer and glide path needles) is unreliable for instrument approaches (ILS) when the navigation instrument selector switch is in the TACAN position.

"LORAN" NAVIGATIONAL EQUIPMENT (AN/APN-9).

The "Loran" navigational equipment is located at the navigator's station and receives, amplifies, and detects "Loran" signals and provides a method of navigation. The equipment is controlled by switches located on the receiver.

UHF DIRECTION FINDER (AN/ARA-25).

A UHF direction finder device is installed in the aircraft to indicate the relative bearing of and to home on radio signal sources in the 225.0 to 400 megacycle range. The relative bearing of the signal source is indicated on the course indicators located on the main instrument panel and navigator's station. To turn on the equipment, turn the selector switch on UHF control unit to the ADF position. To turn equipment off, turn the selector switch on the UHF control unit to the OFF position.

VHF HOMING ADAPTER (AN/ARA-8).

The AN/ARA-8 homing adapter receives 28-volt d-c power through the number 2 radio bus, is used with the VHF command set, and will provide the pilot with means to home on any radio signal course within the frequency range at 120 to 140 megacycles. To turn the equipment on, position the switch on the pilot's overhead radio control to the HOMING position.

LIAISON RADIO (AN/ARC-65).

The AN/ARC-65 (Figure 4-7) provides long-range voice communication from aircraft to aircraft, or aircraft to ground in a frequency range from 2 to 23.9995 megacycles in 500-cycle steps, giving a total of 44,000 available frequencies. Any 20 of the 44,000 frequencies can be set at Radio Set Control C-451A/ARC-21 and then switch-selected as desired during use.

Tune-up of the receiver on a newly selected channel is automatically completed in a few seconds. Transmitter tune-up is completed the first time the key or push-to-talk button is pressed after changing channels. Presetting the 20 channels requires only the use of a small tool located inside the top cover of the channel setting drums. No conversion charts or codes are required for presetting the channels since the markings for the frequency determining button indicates frequencies directly.

RADIO SET CONTROL C-451A/ARC-21

This unit, located at the Radio Operator's station (figure 4-7), provides facilities for presetting 20 of the 44,000 available frequencies, and for permitting complete control and operation of the equipment. The settings on the switch that selects the mode of operation are: Amplitude Modulation Equivalent (AME), Single Sideband (SSB), Continuous Wave (CW) and Frequency Shift Keying (FSK). The number of the channel in use is visible through an illuminated window, together with the numbers of the preceding and succeeding channels. In the center of the panel are two covers, held closed by thumb screws, which enclose the drums on which the desired frequencies are preset. A matte-surfaced plastic sheet for recording the preset channels is mounted on the top cover. Illumination is provided by installing four panel lights through a brilliance control.

There are no provisions for manual tuning. CW operation is possible when a keying adapter is available. Audio input or output for the equipment is obtained through the interphone system, utilizing the same headphones and microphone for reception and transmission as used for intercommunication in the aircraft.

SPEAKER SYSTEM (SOME SC-47 AIRCRAFT).

GENERAL.

The speaker system consists of 4 booster amplifiers, 4 loud speakers, 1 preamplifier and 3 microphones. The system is controlled by an ON-OFF switch located in the aft side of the radio rack (figure 4-7), receives 115-volt 400 cycle a-c power from the auxiliary inverter and is protected by a circuit breaker on the radio circuit breaker panel. The system is designed to provide airborne communication with ground personnel.

AUXILIARY INVERTER.

The auxiliary inverter is located on the floor under the navigator's table and provides power for operation of the speaker system and the ARC-65 radio. The inverter is controlled by an ON-OFF switch located on the main electrical junction box control panel. The auxiliary inverter reset button is located on the side of the main electrical junction box control panel.

A three position selector switch, placarded OFF, ARC-65 and SPEAKER SYSTEM, located on the main electrical junction box control panel, is provided to supply power to either the speaker system or ARC-65 in the event of auxiliary inverter failure. When the switch is placed in either the ARC-65 or SPEAKER SYSTEM position, the unit selected receives power from the number 1-AC bus, and the heater ignition, test receptacle, APN-9 receiver indicator, and the APN-22 control amplifier are automatically disconnected from the number 1-AC bus.

BOOSTER AMPLIFIERS.

The 4 booster amplifiers are located in the forward left side of the lavatory compartment and are protected by a 1 Amp and 3 Amp slow blow fuse on the face of each amplifier. An ON-OFF switch is located on the rear side of each amplifier and must be in the On (up) position at all times.

NOTE

The booster amplifiers are wired so that if one or more of the top 3 amplifiers fail or the switch on the rear side of the amplifier is OFF (Down), the remaining amplifiers will operate. However, if the bottom amplifier fails or is turned off, the complete system will be inoperative. In this event, the bottom amplifier may be removed and replaced with one of the other amplifiers or the wiring from the bottom amplifier may be moved up to the next amplifier. The speaker switch must be OFF while replacing amplifiers or wiring.

LOUDSPEAKERS.

The 4 loud speakers are mounted externally on the underside of the fuselage between the center wing section and the main cargo doors and are provided with covers for use during extended storage.

CAUTION

The speaker covers must be removed prior to ground or flight operation of system.

PREAMPLIFIER.

The preamplifier is located on the aft side of the radio rack and is controlled by the volume control knob located on the face of the preamplifier.

MICROPHONES.

The 3 microphones are located, one on the upper left side of the bulkhead behind the co-pilot's seat, one on the right side of the navigator's compartment (1, figure 4-7) aft of the radio rack and one on the right side of the cargo compartment aft bulkhead. Switches are incorporated in each microphone assembly and are ON when the switch is pressed in.

SPEAKER SYSTEM OPERATION.

1. Auxiliary inverter switch – ON.
2. Speaker switch – ON.

Allow 3 to 5 minutes for system to warm up prior to transmitting.

3. Volume control – as required.

The operator will hold the microphone firmly against his mouth before pressing the microphone switch to eliminate engine noise and prevent possible damage to the system. With the aircraft on the ground and the APU on the line, turn the volume up as high as possible for maximum readibility, then increase the volume until words are slightly garbled. This volume setting will provide the best in-flight results. The operator should pronounce each syllable in a normal voice leaving a space between each word. The final word should be spoken with the same emphasis as all other words. To turn system off, turn speaker switch to OFF.

NOTE

To prevent possible damage to system, the speaker switch should be in the OFF position when system is not in use.

Chart of approximate altitude, speed and time of usable signals.

Altitude	Speed KTS	Post Target Delay Seconds	Range Time Seconds
100	130	2-4	40
400	130	2-4	40
600	130	2-4	35
1500	130	5-8	30
3000	130	5-8	30

NOTE

Composition of message should be such that it can be repeated twice during the range time indicated.

RADIO SET AN/ARC-44 (SOME SC-47 AIRCRAFT).

The AN/ARC-44 radio set is a frequency modulated (FM) radio receiver transmitter (rt) set operating in a frequency range of 24.0 to 51.9 megacycles (mc). It provides two-way air to air or air to ground communication and may also be used to "home" on any signal within its frequency range. The effective operating range is limited by line-of-sight considerations to approximately 50 miles. The system may be controlled from the pilot's, co-pilot's or navigator's position and is operated through the existing aircraft interphone system.

The radio set consists of the following components: dynamotor, radio receiver-transmitter, two control panels, two radio signal distribution panels, two separate antenna systems (communication and homing), and a switch assembly. Power for operation is supplied from the number 2, 28 volt dc radio bus and is protected by a 10 amp circuit breaker located on the number 2, dc radio circuit breaker panel.

Dynamotor.

The dynamotor, mounted on the radio operator's table, supplies high voltage dc power and 400 cycle per second ac power for operation of the radio set. Two 0.5 amp output circuit fuses are accessible at the front of the chassis, below the dynamotor assembly.

Radio Receiver-Transmitter (RT)

This unit is mounted on the radio operator's table. The unit tuning drive mechanism, which is remotely controlled by the control panel, automatically tunes the receiver stages and transmitter stages to the frequency selected at the control panel. Included with the receiver circuits are the homing circuits for detection of the signals which are coded in the homing antenna group. An external switch is used to energize the homing circuits. A test switch and test jack is located behind the front cover. The SQUELCH and HOMING controls are located above the handle on the left side of the front panel, behind the sliding panel.

Control Panel.

Two control panels containing the receiver transmitter unit frequency selectors, the power switch, and the receiver volume control are mounted, one on the pilot's radio control panel and one above the navigator's interphone control panel. Each unit provides a choice of remote or local operation. The frequency selectors are mounted on concentric shafts which also mount the corresponding "whole" and 1/10 megacycle re-entrant switch sections. The selected frequency appears in the window above the 1/10 megacycle lever.

Radio Signal Distribution Panel.

Two radio signal distribution panels are located, one on the left side of fuselage at the navigator's station and one at the pilot's radio control panel.

Antenna.

The communication (whip) antenna is mounted on top of the fuselage above the baggage compartment.

Antenna Group.

The antenna group consists of a keyer, two impedance matching networks, and four antenna elements. Two antenna elements and one impedance matching network make up a homing antenna. There are two homing antennas, one mounted on each side of the fuselage below and forward of the pilot's compartment.

Switch Assembly.

The switch assembly is located forward of the pilot's oxygen pressure gage and flow indicator. The unit has five switches, only two of which are part of the radio set, the other three are spares. The switch functions are as indicated on the panel.

OPERATING PROCEDURES.

Preliminary Starting Procedures.

1. Control Panel.

   a. Turn the ON-OFF Switch to OFF. (Pilot's and navigator's panel.)

   b. Rotate the VOL control to the full counter-clockwise position. (Pilot's and navigator's panel.)

   c. Turn the REM-LOCAL selector on the pilot's panel to the LOCAL position.

   NOTE

   When the ON-OFF switch is turned to the ON position, the control box not selected for LOCAL operation will automatically switch to REM.

2. Radio Signal Distribution Panel.

   a. Place the RECEIVERS "1" switch to the up position. (Pilot's and navigator's panel.)

   b. Place the RECEIVERS 2, 3, MB, and NAV switches to the down position (pilot's and navigator's panel).

   c. Rotate the TRANS selector lever so that INT shows in the indicator window (pilot's and navigator's panel).

   d. Rotate the headset amplifier VOL control to the full counterclockwise position.

3. Switch Assembly. Place all toggle switches to the down position.

FM Reception.

Turn the aircraft circuit breaker for the AN/ARC-44 on and perform the following:

1. Radio Signal Distrubution Panel.

   a. Rotate the headset amplifier VOL control on the pilot's and navigator's panel clockwise until either a slight amount of noise or an intercommunications signal is heard in the headset. (Operator's own sidetone should be audible during intercommunications.)

   b. Rotate the TRANS selector lever so that "1" appears in the indicator window.

2. Control Panel.

   a. Turn the ON-OFF switch ON at either the pilot's or navigator's station. Allow a minimum of one minute for the set to warm up.

   NOTE

   Cycling (gear rotating), indicated by a continuous 400 cycle tone in the headset, should not continue longer than approximately 6 seconds.

   b. Rotate the "whole" 1/10 mc selectors to the desired frequency (indicated on the pilot's control panel).

   c. Rotate both the pilot's and navigator's receiver radio VOL control approximately 1/2 turn clockwise.

   NOTE

   The receiver-transmitter unit will not operate properly if the REM-LOCAL selector is manually turned to the REM position. Should this occur, return the selector to its LOCAL position and repeat step 1. (a). above.

The system will now operate as an FM communications receiver and the receiver signal can be heard at both the pilot's and navigator's stations.

3. Switch Assembly.

   If the received signals are too weak to unsquelch the receiver, place the FM SQUEL switch on the switch assembly in the up position. This will disable the squelch circuit and allow reception of weak signals.

FM TRANSMISSION.

The pilot, co-pilot or navigator may transmit by using their respective existing microphones.

HOMING RECEPTION

To operate the equipment as a homing receiver, place the FM HOME switch on the switch assembly to the up position and tune to the desired frequency. The coded D and U signals or steady 400 cps on-course tone should be audible.

The three types of signals that are heard during homing operation are described below.

SIGNALS	MEANING
1. A keyed 400 cps tone with the code character "D" dah-dit-dit predominant.	The transmitting station is left of course heading. Turn left until a steady 400 cps tone is heard.
2. A keyed 400 cps tone with the code character "U" dit-dit-dah predominant.	The transmitting station is right of course heading. Turn right until a steady 400 cps tone is heard.
3. A steady 400 cps tone.	On course.

NOTE

It is possible to receive a 400 cps tone when heading directly away from the transmitting station. This may be determined by turning either right or left. If a turn to the RIGHT produces a "U" or a turn to the LEFT produces a "D", the aircraft is headed away from the transmitting station. Correct this condition by continuing the right or left turn until a steady 400 cps tone only is audible.

To turn the unit off, place the ON-OFF switch on both the pilot's and navigator's control panels to the OFF position.

NOTE

For maintenance and test procedures, refer to T. O. 12R2-2ARC44-11.

EMERGENCY RADIO TRANSCEIVER.

Some aircraft are equipped with an emergency radio transceiver.

LIGHTING EQUIPMENT.

All lights are wired to the 28-volt d-c power supply system through their respective circuit breakers and switches, except that, on some aircraft, the fluorescent lights use 26-volts a-c, supplied through a transformer, for power (figure 1-19).

EXTERIOR LIGHTING.

Navigation (Position) Lights and Switches

Navigation (position) lights are installed on the aircraft as follows: a green light on the right wing tip, a red light on the left wing tip, and a clear lens on the tail cone. Two navigation light switches are mounted on the electrical control panel (1, figure 1-13 and 24, figure 1-14). These are 3-position toggle switches, one with BRIGHT and DIM positions, the other with STEADY and FLASH positions. The center position of the switches is the OFF position. When the STEADY FLASH switch is placed on FLASH, the wing tip lights and tail cone light flash on and off. When the switch is in the STEADY position, the lights remain illuminated continuously. The BRIGHT-DIM switch controls the intensity of the lights when the FLASH-STEADY switch is in either position.

Formation Lights and Switch (R4D Series Aircraft).

Nine formation lights are installed on R4D series aircraft, three on top of the center fuselage and three on the top of each wing. The lights are controlled by a rheostat located on the electrical panel (10, figure 1-14). The switch has OFF and ON positions. It is OFF when rotated to the left, and the intensity increases as the switch is rotated 180 degrees to the right to the full ON position.

Anticollison Light and Switch.

On aircraft modified in accordance with T. O. 1C-1-525, a red rotating beacon anticollision light is installed on top of the vertical stabilizer to minimize the possibility of inflight collision. The light is controlled by an ON-OFF switch located on the pilot's electrical control panel.

NOTE

The rotating anticollision light should be turned OFF during flight through conditions of reduced visibility where the pilot could experience vertigo as a result of the rotating reflections of the light against the clouds. In addition, the light would be ineffective as an anticollison light during these conditions since it could not be observed by pilots of other aircraft.

Recognition Lights and Switches (R4D Series Aircraft).

Three downward recognition lights are installed on the underside of the fuselage below the main cargo door. Looking forward, the lenses are amber, green, and red, respectively. One upward recognition light with a clear lens protrudes from the top of the fuselage, above the radio operator's compartment. The lights are controlled by three toggle switches and a keying switch, located on the electrical control panel (14, figure 1-14). Each of the three switches has KEY, OFF, and STEADY positions. When the switch or switches are in the KEY position, the lights may be operated intermittently for code signalling by means of the pushbutton keying switch. When the switches are in the STEADY position, the lights are on and the keying switch is inoperative.

Landing Lights and Switches.

One landing light is permanently installed in the leading edge of each outer wing panel. Two ON-OFF landing light switches (27, figure 1-13 and 25, 1-14) are installed on the electrical control panel for individual operation of the lights. The left landing light is adjusted to project a beam of approximately 430 feet, and the right landing light to project one of about 380 feet, when the aircraft is in 3-point ground position.

NOTE

There is no restriction on the use of the landing lights.

Aldis Lamp (Some Aircraft).

On some aircraft, an aldis lamp is provided in a holder located on the bulkhead behind the co-pilot's seat. The lamp may be plugged into the receptacle at the co-pilot's station when the light is required. The aldis lamp may be used to advantage during taxiing at night and during night flying to check for wing icing.

INTERIOR LIGHTING.

Instrument Lights and Switches.

The instrument lights consist of three dashlights controlled by the ON-OFF cockpit lights switch located on the electrical control panel (21, figure 1-13 and 6, figure 1-14). On some aircraft, Grimes instrument lights are installed. Illumination of the electrical control panels is controlled by the light rheostat (4, figure 1-13 and 4, figure 1-14) on the left electrical control panel. The compass light is controlled by the compass light rheostat (2, figures 1-13, and 1-14) located on the electrical control panel left of the instrument lights rheostat.

INSTRUMENT LIGHTS AND SWITCHES (Some Aircraft).

On some aircraft, a Grimes red lighting system is installed on the main instrument panel. The panel lights in the main instrument panel are controlled by three rheostats, one for the pilot's instrument panel, one for the center instrument panel and one for the co-pilot's instrument panel. The lights on the overhead radio panel are controlled by a rheostat on the command selector box and the lights in the electrical panel are controlled by a rheostat on the pilots overhead panel. The compass light is controlled by a rheostat in the electrical panel.

Fluorescent Lights and Switches.

On some aircraft, four fluorescent ultraviolet lights are installed, one on each side of the pilots' compartment and two on the control pedestal (6, figure 1-6 and 17, figure 1-7), and are used for the illumination of the instrument panel. Four rheostat-type switches (one for each light) are located immediately above the main instrument panel, two on the pilot's side and two on the co-pilot's side, and are used to turn the lights ON and adjust the brilliancy. The rheostats are placarded OFF, DIM, ON, and START. The switch must be positioned to START in order to put the lights in operation. The ON position provides the brightest illumination and, as the knob is turned past DIM toward OFF, the brilliancy is decreased. The OFF position turns the light OFF.

EXTENSION LIGHT AND SWITCH.

An extension light is installed on the bulkhead behind the co-pilot's seat. The light is operated and adjusted by a red knurled rheostat at the bottom of the light and a red momentary switch button on top and at the end of the light.

Navigator's Table Light and Switch.

The navigator's table light (3, figure 4-11 and 7, figure 4-12) is controlled by a switch mounted on a wooden support plate directly over the table. The switch is a toggle-type placarded WORK LIGHT.

Dome Lights and Switches.

Nine dome lights are installed in the following locations; one in the forward passageway, one in the radio operator's compartment, one in the navigator's compartment, four in the main cabin, one in the lavatory, one in the tail compartment, and, on C-117 series aircraft, one at the steward's station. Except for the main cabin lights, each light is controlled by a switch mounted beside it. On C-47 and R4D series aircraft, the main cabin compartment dome lights are controlled by either of two switches located at each end of the main cabin compartment ceiling. On C-117 series aircraft, the main cabin dome lights are controlled by a switch at the steward's station. The navigator's dome light is controlled by a switch mounted on the navigator's dome light panel (1, figure 4-11 and 8, figure 4-12).

Passenger Warning Sign and Switches (Some Aircraft).

A passenger warning sign, located on the upper center of the main cabin forward bulkhead, when illuminated will read NO SMOKING – FASTEN SAFETY BELT. The control switches for operation of the warning sign are located on the electrical control panel in the cockpit.

OXYGEN SYSTEM.

NOTE

As an aircraft ascends to high altitudes where the temperature is normally quite low, the oxygen cylinders become chilled. As the cylinders grow colder, the oxygen gage pressure is reduced, sometimes rather rapidly. With a 37.8°C (100°F) decrease in temperature in the cylinders, the gage pressure can be expected to drop 20 per cent. This rapid fall in pressure is occasionally a cause for unnecessary alarm. All the oxygen is still there, and as the aircraft descends to warmer altitudes, the pressure will tend to rise again, so that the rate of oxygen usage may appear to be slower than normal. A rapid fall in oxygen pressure while the aircraft is in level flight, or while it is descending, is not ordinarily due to falling temperature. When this happens, leakage or loss of oxygen must be suspected.

A gaseous oxygen system is installed which incorporates diluter-demand regulators for the crew and automatic continuous-flow regulators for the passengers and, on C-117 series aircraft, for the steward. The complete oxygen system is filled through a filler valve located in an access door forward of the main cabin door (1, figure 1-30). It is not possible to supplement the passengers' constant-flow system from the supply for the demand system because of check valves installed in the line, but the crew's oxygen system may be supplemented from the supply of the constant-flow system by opening the line valve.

CREW OXYGEN SUPPLY.

On C-47 and R4D series aircraft, the crew members are supplied by five to ten oxygen cylinders. On C-117 series aircraft, the crew members are supplied by three type G-1 cylinders. For combat safety, check valves are installed between the pilots' oxygen supply and the other crew members' oxygen supply. A diluter-demand oxygen regulator is installed at each flight crew's station (14, figure 1-6 and 9, figure 1-7). Type A-1 diluter-demand portable units and portable recharger assemblies are installed, in C-47 and R4D series aircraft, at the pilot's, copilot's, and navigator's stations. When oxygen is needed, the tube on the regulator is connected to the hose on the user's mask. Inhaling opens the valve in the regulator, which automatically supplies a proper mixture of air and oxygen at all times. A line shutoff valve, located just forward of the main cabin door, is provided in the filler line between the crew's and passenger sections of the oxygen system. The line valve may be opened to charge the complete oxygen system, and closed when it is desired to charge only the crew's section of the oxygen system. The approximate duration of the crew's oxygen system is given in figure 4-9.

Oxygen Regulator Diluter Lever.

A diluter lever is provided on each regulator to select NORMAL OXYGEN for all normal usage or to select 100% OXYGEN for emergency use. When the lever is placed in the NORMAL OXYGEN position, the air inlet valve is opened so that the regulator automatically supplies a proper mixture of air and oxygen to the mask at all altitudes. When the lever is placed in the 100% OXYGEN position, the air inlet valve is closed and the regulator supplies 100 per cent oxygen to the mask.

Oxygen Regulator Emergency Valve.

The emergency valve of the oxygen regulator is for use in case the demand oxygen regulator becomes inoperative. The valve should be opened only in an emergency to provide a means of manually supplying oxygen pressure to the mask in the event of regulator failure.

Oxygen Pressure Gages.

A direct-reading oxygen pressure gage that indicates system pressure is installed at the pilot's and co-pilot's stations and, on C-47 and R4D series aircraft, at the navigator's station (2, *figure* 1-6, 5, *figure* 1-7, 2, *figure 4-11, and 1, figure 4-12)*. An oxygen pressure gage is also installed at the rear of the main cabin for the passenger's oxygen system.

Oxygen Flow Indicators.

An oxygen flow indicator is installed at each flight crew station.

OXYGEN SYSTEM NORMAL OPERATION.

Note

Each flight crew member should check his gage and oxygen regulator with the diluter valve first at the NORMAL OXYGEN position and then at the 100% OXYGEN position as follows: Remove the mask and blow gently into the end of the oxygen regulator hose as during normal exhalation. If there is a resistance to blowing, the system is satisfactory. Little or no resistance to blowing indicates a faulty demand diaphragm or diluter air valve, or a leak in the mask-to-regulator tubing.

Use only a demand oxygen mask. Set the regulator diluter lever at the NORMAL OXYGEN position.

OXYGEN SYSTEM EMERGENCY OPERATION.

With the first symptoms of hypoxia, accomplish the following:

1. Break safety wire and open oxygen regulator emergency valve by turning the red knob counterclockwise.
2. After determining that a sufficient amount of oxygen is being received, turn the regulator diluter lever to the 100% OXYGEN position, and close regulator emergency valve.
3. If 100% oxygen is adequate, check equipment to determine if the NORMAL OXYGEN position may again be used. If conditions permit, turn regulator diluter lever to the NORMAL OXYGEN position.

If smoke or fumes should enter the cabin, accomplish the following:

1. Turn regulator diluter lever to the 100% OXYGEN position.
2. After the emergency condition has been corrected, turn regulator diluter lever to the NORMAL OXYGEN position.

CAUTION

Use of 100% oxygen or opening the regulator emergency valve exhausts the oxygen supply very rapidly. After the emergency condition has been corrected, close the regulator emergency valve and return the regulator diluter lever to the NORMAL OXYGEN position. If for any reason the emergency valve must be left open or the diluter lever in the 100% OXYGEN position, the pilot will be notified so that he may descend to a lower altitude. During all oxygen system emergency operations, oxygen pressure will be monitored closely.

OXYGEN SYSTEM FOR PASSENGERS, TROOPS, OR LITTER PATIENTS.

The passengers, troops, or litter patients are supplied by one type J-1 cylinder. The approximate man-hour duration of the passengers' system is given in figure 4-9. There are no controls for this system. Oxygen will automatically be supplied to the mask when the mask bayonet is inserted into the outlet coupling. Flow is automatically cut off when the bayonet is removed.

Note

Only a continuous-flow oxygen mask must be used.

A continuous-flow portable unit is installed on the main cabin aft bulkhead. Portable recharger assemblies are located on the main cabin forward and aft bulkheads.

NORMAL OPERATION.

The regulators and a pressure gage for the passengers' system are installed at the rear of the main cabin. The passengers' system regulators are automatic and supply the proper oxygen for the altitude of the aircraft. Oxygen outlet couplings are provided at each passenger's station. The coupling automatically opens to supply a proper oxygen flow when the oxygen mask bayonet is attached to the coupling. The coupling automaticaly closes when the mask bayonet is disconnected.

EMERGENCY OPERATION.

If the passengers' oxygen regulator should become inoperative, descend to an altitude where oxygen is not required.

AUTOPILOT.

The type A-3 or A-3A-1 autopilot is a gyroscopically controlled, hydraulically actuated system which automatically operates the flight control cable systems to maintain a desired magnetic heading and a normal stabilized attitude. An autopilot control panel *(figure 4-10)*, installed in the center of the main instrument panel, contains controls necessary for actuation of the

OXYGEN CONSUMPTION TABLES

OXYGEN DURATION, HOURS

BASED ON ONE TYPE G-1 CYLINDER PER CREW MEMBER

CABIN ALTITUDE (FEET)	GAGE PRESSURE (PSI) 400	350	300	250	200	150	100	Below 100
30,000	4.3	3.7	3.1	2.5	1.8	1.2	0.6	EMERGENCY Descend to altitude not requiring oxygen
	4.4	3.8	3.1	2.5	1.9	1.3	0.6	
25,000	3.3	2.8	2.4	1.9	1.4	0.9	0.5	
	4.2	3.6	3.0	2.4	1.8	1.2	0.6	
20,000	2.5	2.2	1.8	1.4	1.1	0.7	0.4	
	4.7	4.0	3.4	2.7	2.0	1.4	0.7	
15,000	2.0	1.7	1.4	1.2	0.9	0.6	0.3	
	5.7	4.9	4.1	3.3	2.5	1.6	0.8	
10,000	1.6	1.4	1.2	0.9	0.7	0.5	0.2	
	7.6	6.5	5.4	4.3	3.3	2.2	1.1	

BLACK FIGURES INDICATE DILUTER LEVER AT NORMAL
RED FIGURES INDICATE DILUTER LEVER AT 100%

Note: For hours duration multiply figure by number of bottles and divide by number of crew members.

OXYGEN DURATION, MAN HOURS

PASSENGER
ONE TYPE J-1 CYLINDER

CABIN ALTITUDE (FEET)	GAGE PRESSURE (PSI) 400	350	300	250	200	150	100	Below 100
30,000	48.8	41.9	35.0	28.0	21.0	14.0	7.0	EMERGENCY Descend to altitude not requiring oxygen
25,000	53.1	45.5	38.0	30.4	22.8	15.2	7.6	
20,000	58.5	50.1	41.7	33.4	25.9	16.7	8.4	
15,000	65.0	55.6	46.3	37.0	27.8	18.6	9.3	
10,000	73.0	62.5	52.0	41.6	31.3	20.8	10.4	

FIGURES INDICATE CONSTANT FLOW

Figure 4-9

20,170

AUTOPILOT CONTROL PANEL - TYPICAL

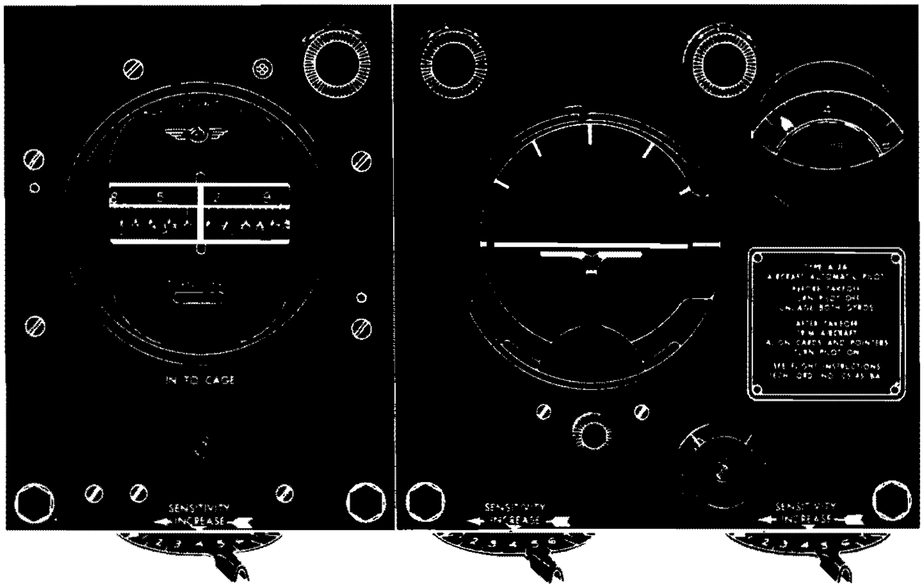


Figure 4-10

autopilot in maneuvering and trimming the aircraft. Bypass valves in the servo units are operated by the autopilot control valve handle on the control pedestal. Relief valves in each servo unit permit overpowering of the autopilot control in the event of an emergency by limiting the oil pressure in each servo cylinder.

CAUTION

The autopilot shall be engaged or disengaged with the flight control systems only when the aircraft is in a level flight attitude.

AUTOPILOT CONTROL VALVE HANDLE.

A manually operated autopilot control valve handle (10, *figure* 1-10), mounted on the aft lower face of the control pedestal, has ON and OFF positions. When the handle is placed in the ON position, a bypass valve in each servo unit is mechanically closed, and hydraulic fluid pressure enters the servo cylinders to actuate the autopilot system. Placing the handle in the OFF position opens the bypass valve in the servo unit and permits the hydraulic fluid to bypass the servo cylinders and return to the hydraulic reservoir.

CAUTION

Trimming the aircraft shall not be accomplished with the autopilot engaged since undue loads will be imposed on the autopilot system.

AUTOPILOT EMERGENCY SHUTOFF VALVE HANDLE.

A manually operated autopilot emergency shutoff valve handle (*5, figure* 1-24) mounted on the hydraulic control panel has ON and OFF positions. The handle is safetywired in the ON position for normal autopilot operation. When the handle is placed in the OFF position, a shutoff valve installed in the hydraulic fluid pressure line is mechanically closed to divert the flow of oil from the autopilot system in case of damage to the oil lines resulting in fluid loss.

ELEVATOR CONTROL KNOB.

The elevator control knob, located on the autopilot control panel *(figure 4-10)*, controls the aircraft in pitch attitude. Rotating the knob counterclockwise results in a nose-up attitude; rotating the knob clockwise produces a nose-down attitude.

RUDDER CONTROL KNOB.

The rudder control knob, located on the autopilot control panel *(figure 4-10)*, controls the aircraft about the vertical axis. Rotating the knob clockwise produces a right turn; rotating the knob counterclockwise results in a left turn.

AILERON CONTROL KNOB.

The aileron control knob, located on the autopilot control panel *(figure 4-10)*, controls the aircraft about the roll axis. Turning the control knob toward the high wing will bring the aircraft to a level attitude.

AUTOPILOT INDICATORS.

A vacuum-operated gyro turn indicator and gyro bank-climb indicator is incorporated in the autopilot control panel *(figure 4-10)* to provide visual indication of the autopilot signal in each axis. If the needles diverge more than one pointer width from the respective index, an excessive out-of-trim condition exists and should be corrected.

Vacuum Gage.

A direct-pressure-operated vacuum gage, installed on the autopilot control panel *(figure 4-10)*, indicates the vacuum pressure of the vacuum system in inches of Hg. Vacuum pressure indication is taken directly from the vacuum manifold.

Autopilot Oil Pressure Gage.

A direct-pressure-operated autopilot oil pressure gage mounted on the right side of the main instrument panel *(22, figure* 1-11 *and 24, figure* 1-12), indicates the autopilot system oil pressure.

Caging Knobs.

Caging knobs for the autopilot gyro instruments are installed on the autopilot control panel *(figure 4-10)*. The limit of the gyro turn unit is 55° from vertical in bank, glide, or climb. The limit of the bank-climb gyro unit is 50° from vertical in bank, climb, or glide. Any maneuver that exceeds these limits will result in gyro spill or tumble causing the instruments to give incorrect indications. Pushing the gyro turn caging knob to the IN position, and turning the bank-climb caging knob clockwise to the CAGE position will mechanically set the gyro gimbal rings of each unit in their proper positions. After resetting the gyro units for proper heading and indication, the gyro turn caging knob may be pulled to full OUT, and the bank-climb caging knob may be turned counterclockwise to the UNCAGE position for gyro operation of both units.

Note

Instruments should be uncaged at all times, except during maneuvers that exceed their operational limits.

Sensitivity Dials.

On aircraft with the A-3A-1 autopilot installed, three manually operated sensitivity dials, one for each flight control, are installed on the autopilot control panel *(figure 4-10)*. Each dial has seven settings: 0 through 6. Moving the dials toward higher numbers stimulates quicker flight control response. The sensitivity dials mechanically control the amount of air flow through an air relay valve diaphragm chamber connected to a balanced oil valve that controls the flow of oil in each servo unit.

Speed Control Valve Knobs.

On aircraft with the A-3 autopilot installed, three manually operated speed control valve knobs *(32, figure* 1-12), one for each flight control, are installed on the main instrument panel directly in front of the pilot's station. Each control knob has an indicator dial with seven settings: 0 through 6. Rotating the dials toward higher numbers stimulates quicker flight control response. The speed control valve knobs mechanically control the flow of oil from the servo cylinders to the hydraulic reservoir.

AUTOPILOT OPERATION.

Preflight Ground Test.

To perform an autopilot preflight ground test, proceed as follows:

1. Autopilot emergency shutoff valve handle – Safetied ON.
2. Fluid level in hydraulic reservoir – Check sight gage.
3. Autopilot control valve handle – OFF.
4. Operate engines at approximately 1000 rpm.
5. Autopilot vacuum gage – Within limits.
6. Check selector right engine – Forward Position (Modified aircraft).
7. Autopilot oil pressure gage – Within limits.
8. Uncage the bank-climb gyro unit.
9. Set the gyro turn unit to desired heading and uncage.
10. Flight controls – Neutral.
11. Set the rudder followup card to match the gyro turn card, set the aileron followup index to match the bank index, and set the elevator followup index to match the elevator alignment index.
12. On the type A-3A-1 autopilot, set each sensitivity dial to position 3. On the type A-3 autopilot, open each speed control valve knob to position 6.
13. Autopilot control valve handle – ON.
14. Check autopilot operation by turning each trimmer control knob.
15. Check the manual override by operating the flight controls against the autopilot.

Note

If the flight controls are moved too far from the automatic control position when overpowering the A-3A-1 autopilot, they will not return automatically when released, because the indexes of the autopilot gyro instruments will be moved out of alignment, and the signal response from the flight control surfaces to the autopilot followup cable system will be disrupted. Disengage the autopilot, align the indexes, and reengage the autopilot.

16. Turn off the autopilot by placing the autopilot control valve handle in the OFF position. Leave the instruments uncaged.
17. Hydraulic Selector – Both (Modified aircraft).

During Flight.

To operate the autopilot during flight, proceed as follows:

1. Trim the aircraft to fly "hands off."
2. Hydraulic Pump Selector – Right engine (Modified aircraft).
3. Select the desired aircraft heading and align the followup cards and indexes on the control panel.
4. Sensitivity dials or speed control valve knobs – Set (as desired).
5. Autopilot control valve handle – ON.
6. Trim the aircraft in the axis indicated by the gyro indexes with the autopilot in operation.

To turn off the autopilot, place the autopilot control valve handle in the OFF position.

NAVIGATION EQUIPMENT.

For instrument approach equipment, see Communication and Associated Electronic Equipment, this section.

For instrument approach procedures, see Section IX.

DRIFTMETER.

A type B-5 driftmeter (8, figure 4-11), installed on a wooden shelf located aft of the navigator's table, is used by the navigator to measure the angle of drift while in flight. On some aircraft, a type B-3 driftmeter is located aft of the navigator's table.

ASTROCOMPASS.

Some aircraft, facilities for mounting an astrocompass are located directly under the astrodome.

FLUX GATE COMPASS.

The flux gate compass system consists of a flux gate transmitter and gyro caging motor, both installed in the right outer wing panel, a flux gate compass master indicator installed at the navigator's station (5, figure 4-11 and 4, figure 4-12), a repeater indicator in the main instrument panel (1, figure 1-11), and a C-1 compass signal amplifier installed in the radio rack. The compass system receives its a-c power from the a-c inverter that is installed on the floor at the radio operator's station. The master indicator provides compensated compass readings by means of a direct-reading, 360-degree dial. The dial shows the four cardinal headings as well as intermediary headings which are marked every 5 degrees and numbered every 30 degrees. The small window on the lower face of the instrument will show a reciprocal reading. The master indicator actuates the repeater indicator on the main instrument panel.

CARGO LOADING EQUIPMENT (C-47 AND R4D SERIES AIRCRAFT).

The aircraft is equipped to handle diversified types of cargo in the main cabin *(figure 4-14)*. Fittings are provided for carrying external load items. Loading of the aircraft is accomplished through the double cargo loading doors, with a snatch block and idler pulley, a small and large platform, and a set of loading ramps.

WARNING

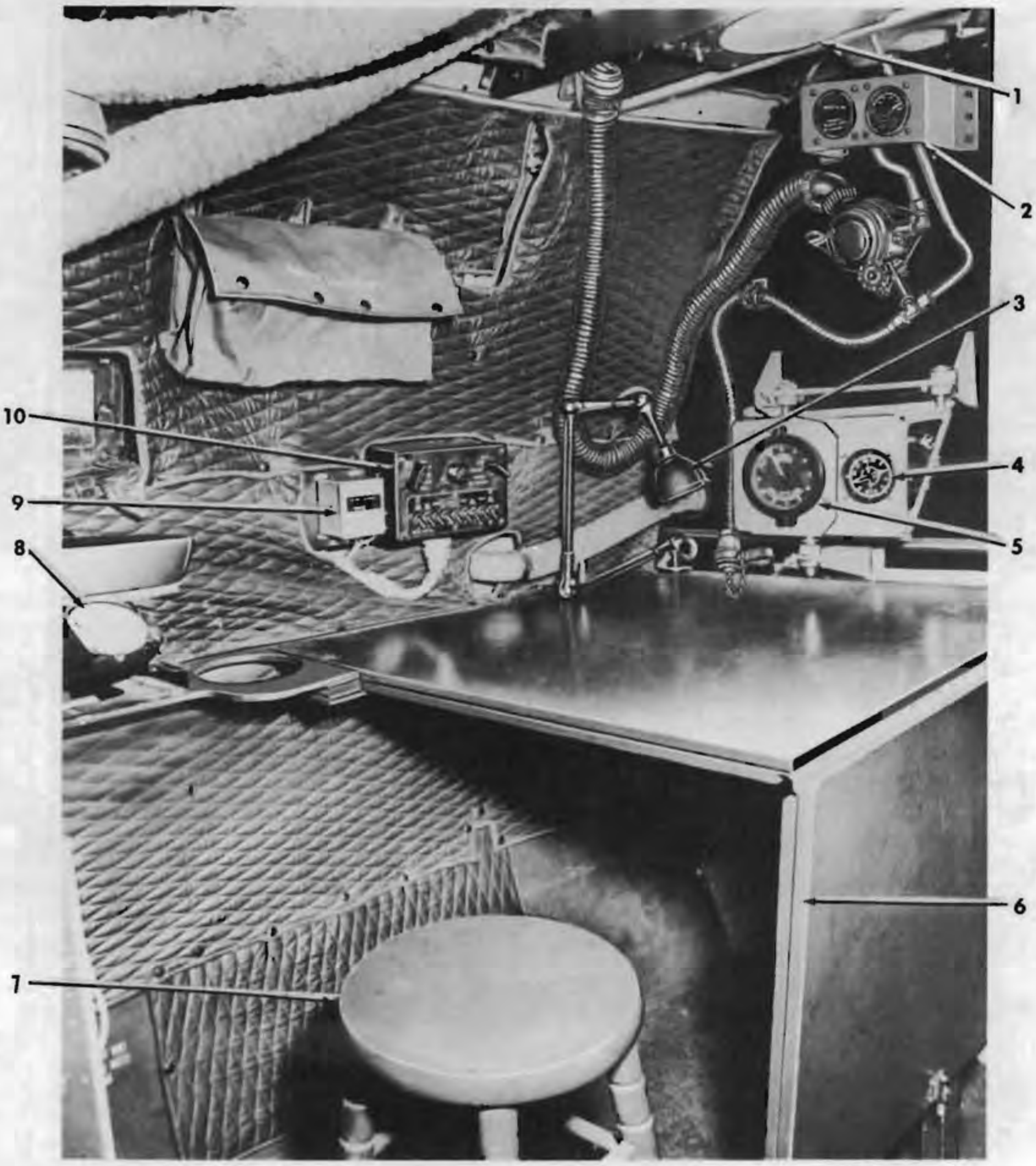
If possible, all personnel carried in the main cabin shall be located aft of the cargo.

For detailed information concerning cargo loading and dimensional limitations, refer to the applicable handbook of maintenance instructions.

TIE-DOWN FITTINGS AND RINGS.

Tie-down rings, installed along the sides of the main cabin compartment, are used for securing cargo, with fittings stowed in the miscellaneous stowage bag (8, *figure* 1-1) on the main cabin compartment aft bulkhead.

NAVIGATOR'S STATION—TYPICAL
C-47 SERIES AIRCRAFT

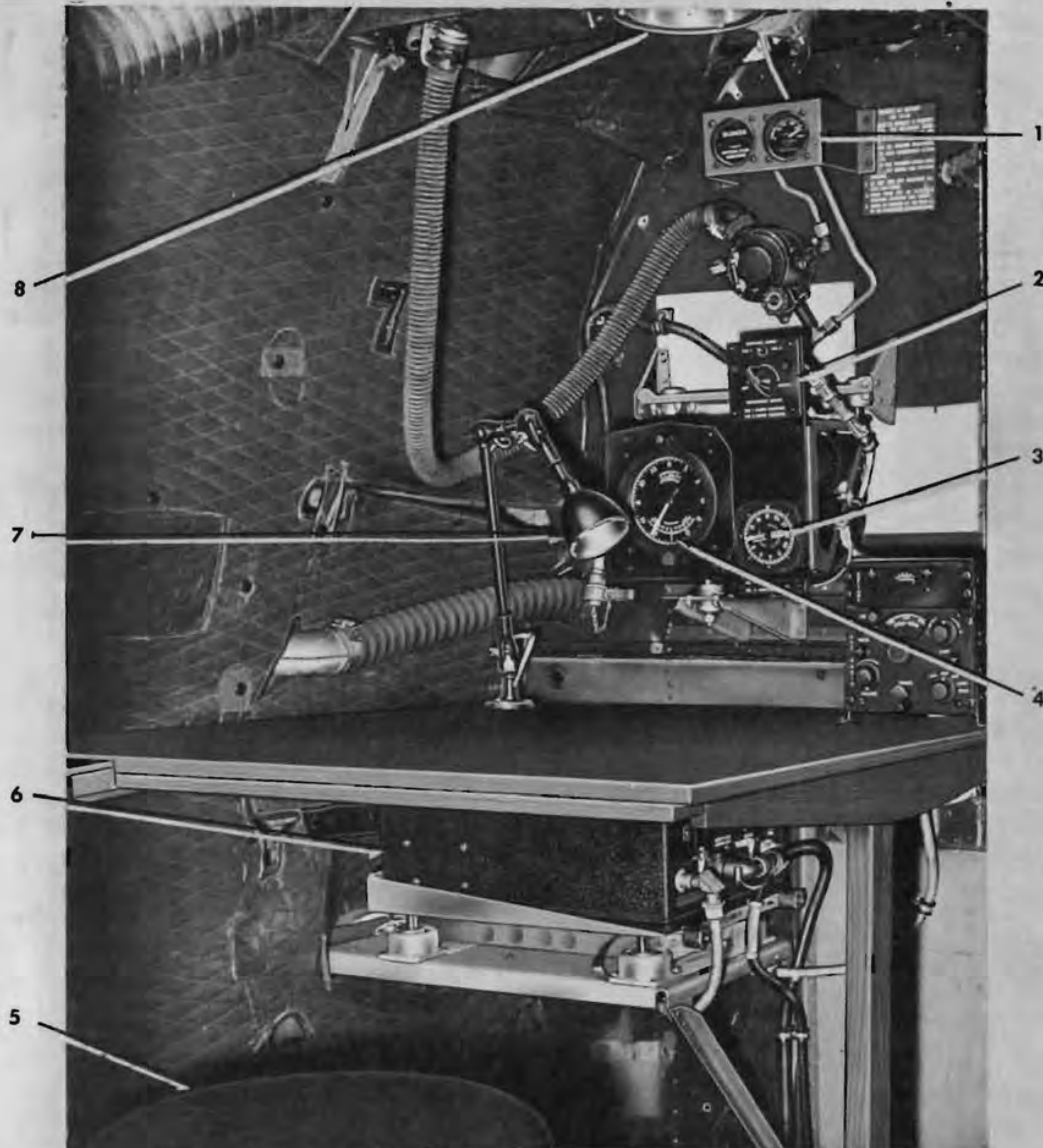


1. DOME LIGHT
2. OXYGEN FLOW PANEL
3. TABLE WORK LAMP
4. RADIO MAGNETIC INDICATOR
5. FLUX GATE COMPASS MASTER INDICATOR
6. DROP LEAF TABLE
7. NAVIGATOR'S STOOL
8. DRIFTMETER
9. RADIO FILTER
10. INTERPHONE CONTROL PANEL

Figure 4-11

NAVIGATOR'S STATION - TYPICAL

C-47 SERIES AIRCRAFT WITH AN/ARN-6 INSTALLED



1. OXYGEN FLOW PANEL
2. RADIO COMPASS SWITCH
3. RADIO MAGNETIC INDICATOR
4. FLUX GATE COMPASS MASTER INDICATOR
5. NAVIGATOR'S STOOL
6. R-101/ARN-6 COMPASS RECEIVER
7. TABLE WORK LAMP
8. DOME LIGHT

Figure 4-12

INTERIOR ARRANGEMENT—TYPICAL
C117 SERIES AIRCRAFT

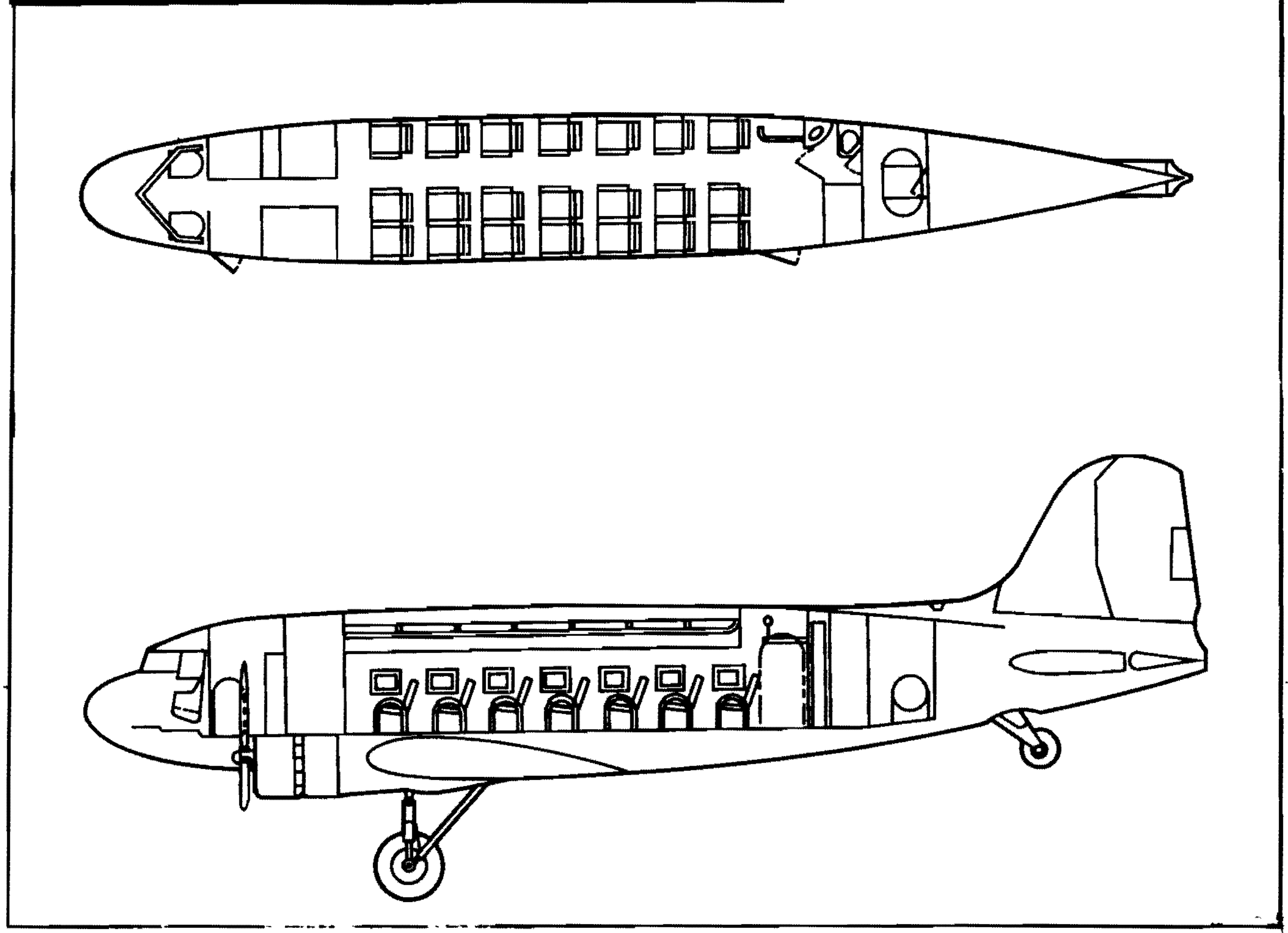


Figure 4-13

CARGO DOORS.

Double cargo doors, divided in the center, are mounted on hinges that swing outward. The doors may be secured against the side of the fuselage, in the open position, to permit unobstructed cargo loading operations. The main cargo door incorporates a smaller door that is used as a paratroop exit in flight, and for personnel entrance and exit when the aircraft is on the ground. The cargo door is also equipped with an emergency release mechanism that pulls the hinge pins if it becomes necessary to jettison the door while the aircraft is in flight. The two cargo doors may be removed from their hinges, if necessary, when loading heavy equipment. On some aircraft, the rear cargo door hinges have been redesigned to permit the door to swing farther aft and make removal for cargo loading unnecessary.

Main Cargo Door Latch Handles.

Two external and two internal door handles are located at the aft end of the forward cargo door. The lower handle controls the upper and lower latches of the forward cargo door, and the upper handle controls the center latching mechanism between the forward and aft cargo doors.

Main Cargo Door Emergency Release Handle.

The main cargo door is equipped with an internal emergency release handle should it become necessary to remove the door. The emergency release handle, located just above the lower hinge of the forward door and attached to the forward door jamb, is painted yellow and must be pushed down to remove the door. The handle operates as a direct lever in pulling the hinge pins.

Main Cargo Door Paratroop Door Handles.

The main cargo door incorporates a paratroop exit door which may be opened for the exit of paratroops by turning the two handles located near the top of the forward cargo door and pulling inboard.

Aft Cargo Door Latch Handles.

The aft cargo door can be opened only from the interior of the aircraft by means of two latch handles, one located on top and one located on the lower forward end of the aft cargo door.

LOADING RAMPS.

Holes for the attachment of loading ramps are provided in the sill of the main cargo loading doors.

CARGO CARRYING EQUIPMENT — EXTERIOR (C-47 AND R4D SERIES AIRCRAFT).

Fittings are installed on the underside of the fuselage for carrying two propellers.

PARA PACK PROVISIONS — EXTERIOR (C-47 AND R4D SERIES AIRCRAFT).

Provisions are made for carrying six para pack racks on the underside of the fuselage. The racks are attached to fittings that are installed flush with the fuselage skin. Standard bomb shackles in the para pack racks contain the carrying and releasing mechanism for the para packs, when para packs are carried. A para pack electrical control panel, installed on the para pack control junction box (13, *figure* 1-1) on the left fuselage wall forward of the main cargo doors, contains the necessary switches and indicator lights for operation of the release mechanisms.

Para Pack Master Switch and Circuit Breaker Switch.

A para pack master switch mounted on the para pack electrical control panel has ON and OFF positions. When the master switch is in the OFF position, a red warning light on the control panel is illuminated to indicate that the para packs cannot be released until the master switch is placed in the ON position to energize the 28-volt d-c para pack circuit. The red warning light is placarded WARNING—RED LIGHT MUST BE OFF TO RELEASE PACKS. An ON-OFF toggle circuit breaker switch, mounted on the para pack electrical control panel, protects the para pack circuit.

Para Pack Selective Control Switches.

Six para pack selective control switches are installed on the para pack electrical control panel for releasing the para packs. Each ON-OFF toggle switch, when placed in the ON position, completes a 28-volt d-c circuit to electrically energize a solenoid that actuates the electrical release mechanism on the respective para pack rack. Any para pack or combination of para packs may be released by actuating the selected toggle switch.

Para Pack Series Release Switch.

A para pack button-type release switch is connected to the para pack electrical control panel by a 2-foot length of flexible cable. Each time the switch button is depressed, a 28-volt d-c circuit is closed and the para pack release mechanisms are electrically actuated through individual solenoids to drop the para packs in the following sequence: (1) right aft, (2) left aft, (3) right center, (4) left center, (5) right forward, and (6) left forward.

Indicator Lights.

Six green 28-volt d-c indicator lights, installed above the selective control switches on the para pack electrical control panel, indicate that the para pack electrical circuit is armed. As each para pack is released, its respective indicator light will automatically go out.

Para Pack Salvo Switch.

A para pack salvo switch (23, *figure* 1-13 *and 29, figure* 1-14), located on the electrical control panel, has ON and OFF positions. When the switch is placed in the ON position, a 28-volt d-c circuit is closed and the six para pack electrical solenoids are simultaneously energized, allowing the electrical release mechanisms to drop all six para packs in the event of an emergency.

Para Pack Manual Salvo Release Handle.

A manually operated para pack salvo release handle is installed directly below the para pack electrical control panel. The handle is placarded PULL UP FOR PARACHUTE PACK SALVO RELEASE. When the handle is pulled to the full out position, a manual release mechanism is mechanically actuated, permitting the six para packs to be released simultaneously in the event of electrical failure.

TROOP CARRYING EQUIPMENT (C-47 AND R4D SERIES AIRCRAFT).

Folding bench-type seats are provided in the main cabin for the seating of 27 or 28 troops *(figure 4-14)*. Each seat is fitted with a safety belt.

PARACHUTE RIP CORD CABLE (STATIC LINE).

A parachute rip cord anchorage cable is installed along the top of the main cabin interior to the left of the centerline. When not in use, the cable may be stowed by snapping it into four spring clips, located directly above it, which are provided for that purpose.

PARACHUTE TROOP EXIT PANEL.

On some aircraft, the inside panel of the forward half of the main cargo door is removable inward by turning the handles near the top of the door and lift-

INTERIOR ARRANGEMENT—TYPICAL
C-47 AND R5D AIRCRAFT

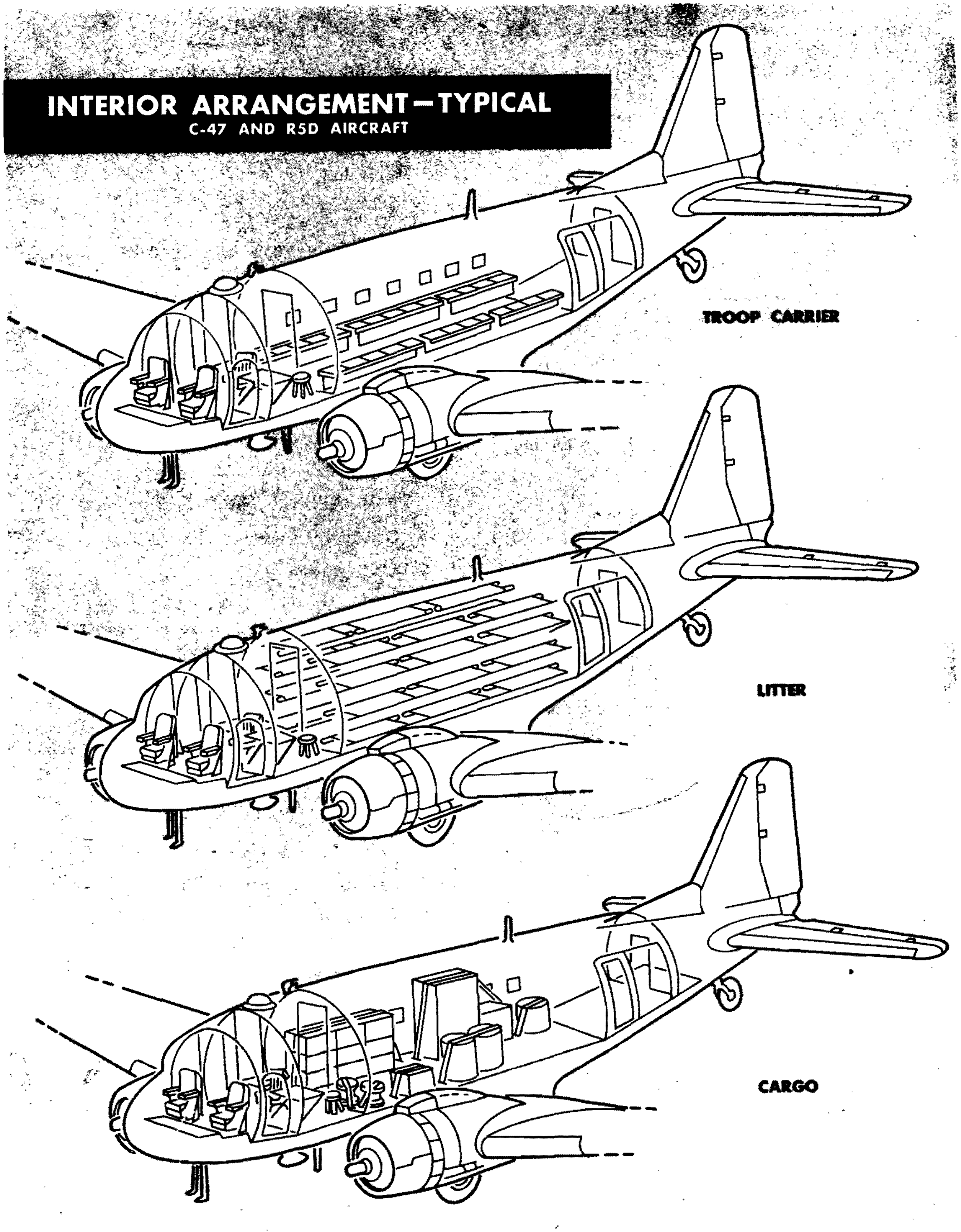


Figure 4-14

20,175

ing it out. This is used as the exit for parachute troops. Four hooks and bungee rings, installed on the right side of the fuselage opposite the main cargo loading door, are provided for stowing the panel while using the exit. The door is stowed by holding it against the side of the fuselage and hooking the bungees over it to secure it to the side.

CASUALTY CARRYING EQUIPMENT (C-47 AND R4D SERIES AIRCRAFT).

On some aircraft, 18 sets of metal supports are carried for setting up litter accommodations *(figure 4-14)*. The supports are stowed in red fiber boxes beneath the aft end of the main cabin compartment floor, and are accessible by removing the screws from the center floor panel and raising the floor. In use, the supports attach to built-in fittings in the floor. On other aircraft, leather strap supports are provided, making possible the installation of 24 litters. Canvas bags, marked LITTER STRAP STOWAGE, are snapped to the longerons in the main cabin compartment.

PASSENGER CARRYING EQUIPMENT (C-117 SERIES AIRCRAFT).

Adjustable upholstered seats are provided in the main cabin for the seating of 21 passengers *(figure 4-13)*. A lever is located at the side and front of each seat to make adjustments for the various settings. Each seat is fitted with a detachable safety belt and ash tray. A reading light and switch are located above each outboard seat. A cabin attendant's call button is also located on each reading light panel. Hat racks extend along either side of the main cabin ceiling. Adjustable cold air outlets are provided above each outboard seat. A passenger oxygen outlet door is provided below each main cabin window.

AUXILIARY POWER PLANT (APP).

The auxiliary power plant (APP), is located in the aft section of the main cargo compartment *(figure 1-1)*. The APP is used to supply 28-volt d-c power to the aircraft for emergency purposes or to ground check electrical equipment on the aircraft. The unit consists essentially of a two-cylinder gasoline engine and generator with a normal rated capacity of 0 to 175 amperes, and an emergency capacity of 175 to 200 amperes. The gasoline engine is supplied fuel from the main fuel system. Oil is supplied the engine by a self-contained oil tank with a capacity of 3 quarts. The APP is preheated by means of a combustion heater and an enclosure. The APP receives 28-volt d-c power through circuit breakers on the auxiliary power plant control panel *(figure 4-15)*.

CAUTION

- Do not operate the APP at emergency capacity (175 to 200 amperes) for a duration of more than 5 minutes, since damage to the APP may result.
- To preclude the possibility of a fire, do not operate the APP at any time long-range fuel tanks are installed.

APP OIL TEMPERATURE AND CYLINDER HEAD TEMPERATURE INDICATOR.

A combination oil temperature and cylinder head temperature indicator is mounted above the auxiliary power plant control panel *(figure 4-15)*.

STARTING APP.

1. Battery switch and APP fuel valve — ON.
2. For cold weather starts, preheat switch — ON.
3. When APP is warm, preheat switch — OFF.
4. Generator control switch — OFF.
5. APP ignition — ON.
6. Start control switch — START, hold in START position, operating choke as necessary. Allow 2- to 3-minute period for warmup.
7. APP throttle and start control switch — RUN, after APP has warmed up.
8. Generator control switch — RESET, THEN ON after 5-minutes of operation.

TO STOP.

1. Generator control switch — OFF.
2. APP throttle — IDLE.
3. Start control switch — OFF.
4. APP fuel valve — OFF, after 5-minutes of operation.
5. APP ignition — OFF.

PREHEATER.

A heater is installed on the forward end of the enclosure surrounding the APP. The heater system is intended to be used in temperatures below −6.6°C (20°F) to bring engine oil temperature up to −6.6°C (20°F). The oil temperature gage located on the auxiliary power plant control panel will indicate when this temperature is reached. Fuel is supplied to the heater from the main fuel system. Power for the igniter system is supplied from the 28-volt d-c bus. The heater has a rated output of 200 BTU and consumes approximately 0.4 of a gallon of fuel per hour. The heater is controlled by a preheater switch located on the auxiliary power plant control panel.

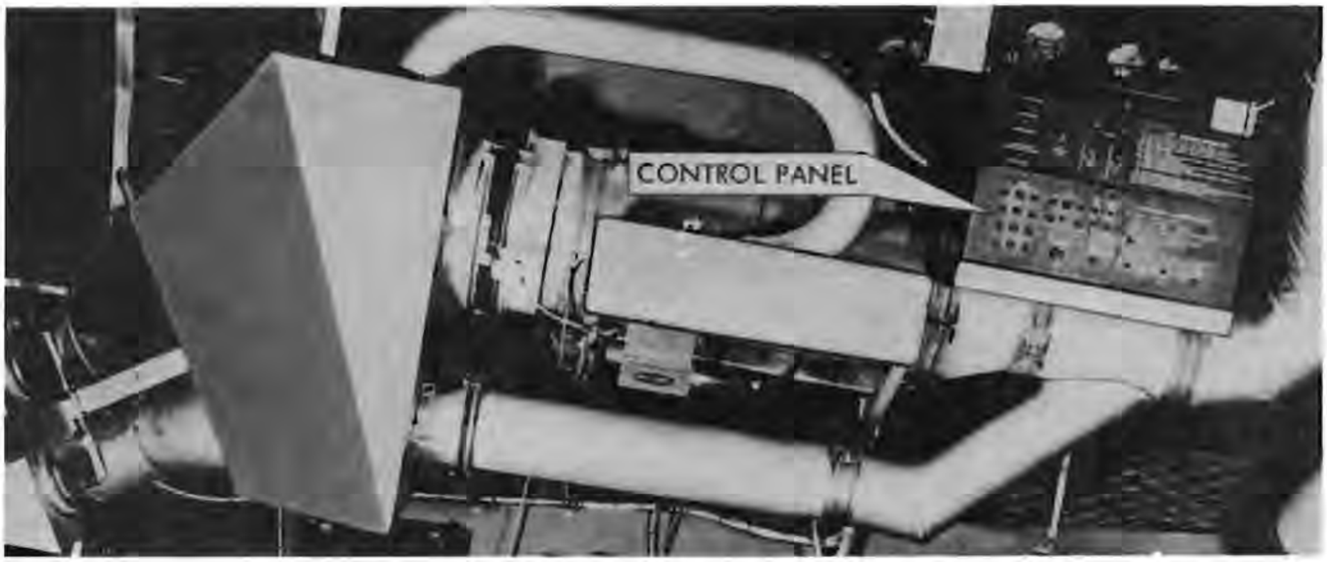


Figure 4-15

MISCELLANEOUS EQUIPMENT.

STEWARD'S SEAT (C-117 SERIES AIRCRAFT).

The steward's folding seat is installed on the left side of the main cabin just aft of the main passenger entrance door. The seat is fitted with a quick-detachable safety belt.

RADIO OPERATOR'S CHAIR.

A light metal swivel-type chair secured to the floor is provided for the radio operator. The chair swivels through a 180-degree angle and may be locked at any of four points through this angle by a locking pin beneath the seat. The seat is equipped with a quick-detachable safety belt.

NAVIGATOR'S STOOL/CHAIR (C-47 AND R4D SERIES AIRCRAFT).

NAVIGATOR'S SEAT/STOOL.

A bucket type adjustable seat is installed at the navigator's position. The seat may be adjusted vertically and laterally by means of the levers located below the seat. The seat is fitted with cushions and a safety belt and shoulder harness. On some aircraft, a wooden stool is provided at the navigator's station. The stool is secured near the bulkhead which serves as a backrest. No safety belt is provided for the navigator's stool.

WINDSHIELD WIPERS.

A windshield wiper system is provided for the two forward windshields. The windshield wipers are hydraulically operated and controlled by two needle-type control valve knobs, one for each windshield *(1, figure* 1-7), located in the vee of the windshield above the main instrument panel. To operate either wiper, slowly open the control valve until the desired speed of the wiper blade is obtained. During heavy rain, or if ice forms on the windshield, the windshield wipers may be operated in conjunction with the windshield de-icing system. See the paragraph on Windshield De-icing System, this section.

CAUTION

Do not operate the windshield wipers on dry windshields.

ACCESSORY OUTLET RHEOSTATS (C-47 AND R4D SERIES AIRCRAFT).

On some aircraft, five accessory outlet rheostats are installed, one at each crew member's station, and one in the forward passageway.

DATA CASES.

Two data cases are installed, one at the pilot's station and one at the co-pilot's station.

CABIN ENTRANCE LADDER.

A dural cabin entrance step ladder is stowed either on the bulkhead in front of the lavatory or within the lavatory.

WINDSHIELD DEFROSTER PANELS.

On some aircraft, windshield defroster panels are stowed in the left forward baggage compartment and may be attached to the front windshields to provide a space between the windshield and the defroster panel for entry of hot air from the heating system. Each defroster panel has an outlet for connection to the flexible windshield ducts of the heating system.

RELIEF TUBES.

Two relief tubes are installed, one beneath the pilot's seat, and one beneath the co-pilot's seat.

LAVATORY.

The lavatory compartment is located aft of the main cabin and includes a toilet, a wash basin, a water tank, and a relief tube.

SECTION V
OPERATING LIMITATIONS

TABLE OF CONTENTS

INTRODUCTION.

This section includes the engine and aircraft limitations that must be observed during normal operation. The instrument markings (*figure 5-1*), which form a part of these limitations, must be referred to, as they are not necessarily repeated in the text.

MINIMUM CREW REQUIREMENT.

The minimum crew for a flight is a pilot and a copilot. Additional crew members, as required, will be added at the discretion of the commander.

INSTRUMENT LIMIT MARKINGS.

The limits marked on the aircraft instruments are shown in figure 5-1.

Note

The limitations marked on the instruments apply to flight conditions and are not intended to indicate ground operating limits.

ENGINE LIMITATIONS.

Refer to figure 5-1 for normal engine operating limits. Overspeed limitations on the engine are 3100 to 3300 ✓ rpm for complete inspection and above 3300 rpm for ✓ replacement. Note all conditions of overspeed on Form 781.

ENGINE POWER TIME LIMITATIONS.

The engines are approved for 5 minutes of operation at maximum power during takeoff and climb at takeoff speed. There is no limitation in the use of METO power.

ENGINE (OVERBOOST OR) EXCESSIVE MANIFOLD PRESSURE.

Use of manifold pressures in excess of those specified under normal and alternate fuel grade operating limits, this section, is not permitted. If excessive manifold pressure is experienced, the following limits apply:

1. At or above METO power an excessive manifold pressure over 15 seconds duration requires engine removal.

2. At any power setting 10 or more inches Hg excessive manifold pressure required engine removal.

3. Below METO power 5 to 10 inches Hg excessive manifold pressure from 5 to 15 seconds duration required engine inspection.

ALTERNATE FUEL GRADE (91/96) OPERATING LIMITS.

Take-Off	2700 rpm 46 in. Hg at SL auto-rich mixture
Max Continuous	2550 rpm 41 in. Hg at SL auto-rich mixture
Max Auto-Lean	2250 rpm 34 in. Hg at SL

When 115/145 fuel grade is used, the limits for fuel grade 100/130 apply.

AIRSPEED LIMITATIONS.

Item	26,000 Lb Gross Wt	29,000 Lb Gross Wt	31,000 Lb Gross Wt	33,000 Lb Gross Wt
Max level flight (indicated)	177 Knots (204 mph)	169 Knots (195 mph)	148 Knots (171 mph)	129 Knots (149 mph)
Max allowable	221 Knots (255 mph)	202 Knots (233 mph)	170 Knots (196 mph)	140 Knots (160 mph)
Max for extending landing gear (indicated)	140 Knots *(160 mph)			
Max for extending full wing flaps (indicated)	97 Knots *(112 mph)			
Max for extending ½ wing flaps (indicated)	100 Knots *(115 mph)			
Max for extending ¼ wing flaps (indicated)	104 Knots *(120 mph)			

*Not Affected By Gross Wt.

PROHIBITED MANEUVERS.

All acrobatic flight maneuvers are prohibited.

CENTER OF GRAVITY LIMITATIONS.

Gear down	Forward 11% MAC	Aft 28% MAC
Gear up	Forward 11% MAC	Aft 28% MAC

For additional information, refer to *Basic Weight Check List and Loading Data, T.O. 1C-47-5.*

OPERATIONAL WEIGHT LIMITATIONS.

Weight, more than any other single factor, will determine the capability and performance of your aircraft. In designing an aircraft, weight has always been a primary restrictive factor as it has a direct effect on aircraft configuration, power, and range. Aircraft are designed with sufficient strength to accomplish a certain basic mission without undue allowance for overloading or improper weight distribution. Every effort is made to eliminate unnecessary weight; however, the weight penalty for making an aircraft foolproof is prohibitive. Weight limitations, therefore, are necessarily involved in the operation of the aircraft. If these limitations are exceeded, a loss in the performance of the aircraft is inevitable and structural failure is quite probable. When an aircraft is loaded beyond the established limits, ceiling and range are decreased, control forces and stalling speeds become higher, and the rate of climb falls off rapidly as the maximum gross weight is exceeded. The take-off and landing rolls increase appreciably with an increase in gross weight. Likewise, the braking power is insufficient for checking the forward momentum of the aircraft and the wings are more vulnerable to airloads during maneuvers or flight through turbulent air. These effects can reach serious proportions when the weight limitations of a specific aircraft are disregarded. In cargo aircraft, particular attention must be paid to the weight problem. In order that cargo of various sizes may be accommodated, the cargo compartment is of such proportions that space is not usually a restrictive factor; consequently, overloading is entirely possible and weight limitations must be complied with if the aircraft is to be operated efficiently, economically, and safely. A consideration of the weight factors involved, particularly as they apply to this aircraft, appears in the succeeding paragraphs.

WEIGHT AND LOADS.

Due to the effect of gravity on the mass of your aircraft, the aircraft possesses weight. More exactly, this weight is a force which gravity exerts on the material used in the fabrication of the aircraft and which pulls the aircraft toward the earth. In any condition of static equilibrium during straight and level flight or at rest on the ground, the aircraft is subjected to this pull of gravity, the strength of which is spoken of as 1G. As fuel, cargo, passengers, crew members, and additional equipment are added in order that the aircraft may accomplish a specific mission, the additional weight constitutes a force acting on the aircraft structure. The weight of the aircraft, or the force that gravity imposes on the aircraft, may also be considered as a load. On the ground, this load must be sustained by the landing gear; in flight, by the wings. There is a limit to the load which the landing gear is capable of supporting during taxi, take-off, and landing operations; there is likewise a limit to the load which the wings can sustain in flight. During maneuvering and flight through turbulent air, additional loads are imposed on the aircraft. These loads, caused by the acceleration of the aircraft, are the result of forces which, in addition to that of gravity, act upon the total mass of the loaded aircraft. Both types of force tend to produce undesirable and potentially dangerous loads on the aircraft structure and its members. This is particularly true of the wings, which must sustain the aircraft in flight. When the weight of the aircraft is increased, the wings become more and more vulnerable to the loads imposed by sudden changes in air currents or manipulation of the controls. The ultimate strength of the aircraft structure is eventually exceeded by the combined forces of weight and airloads. When this condition occurs, structural failure results. Since the maximum weight which the aircraft can safely carry is dependent upon distribution of the weight throughout the aircraft and its capacity to sustain airloads in accelerated flight, an understanding of weight limitations is required to accomplish a mission successfully.

LOAD FACTORS.

A load factor is the ratio of the load imposed on the aircraft when accelerated in any direction, as compared with the load imposed on the aircraft by gravity in any condition of static equilibrium. The load factor denotes the strength of the forces acting on the aircraft as a result of sudden changes in air currents and manipulation of the controls, and is expressed by the term G, which is the gravitational force. By definition, then, all aircraft at rest on the ground or in straight and level flight possess a load factor of 1G because the force acting upon the aircraft under either of these conditions is merely that of gravity. When the aircraft enters a region of turbulent air or the pilot elects to maneuver the aircraft, additional forces are imposed on the structure. The additional load on the wings resulting from these forces is expressed in relation to the gravitational force and is referred to as 0.5G, 2.0G, 3.0G, etc, which mean that the forces exerted on the wing structure and its members are .5, 2, or 3 times the force exerted by gravity. For example, if the normal weight of the aircraft is 25,000 pounds and the load factor at some given moment of accelerated flight is 3.0G, the total force which the wings must sustain is 75,000 pounds, or three times the normal weight of the aircraft in straight and level flight.

MARGIN OF SAFETY.

The margin of safety is the range of forces which exist between the load factor the aircraft is sustaining at any given moment and the load factor at which structural damage will occur. If, for example, the aircraft is incapable of sustaining a load factor greater than 3.0G, and during flight through turbulent air is subjected to a force of 1.5G, the margin of safety at this particular moment is 1.5G. When fuel and cargo loads are increased, the margin of safety decreases. This increase in weight actually becomes a component of the forces acting on the aircraft, and, as such, lessens the capacity of the aircraft to sustain further loads due to accelerated flight. For this reason, it is advisable in loading an aircraft to maintain a margin of safety that will never be exceeded during any period of flight.

WARNING

If the combined weight of cargo and fuel is such that the aircraft is incapable of sustaining a force of 3.0G, turns and pull-outs should be made with caution to minimize the resulting airloads.

EXPLANATION OF CHART.

The weight limitations chart *(figure 5-2)* is intended to present graphically the weight-carrying capabilities of the aircraft as defined by the various criteria which provide limits for safe and efficient operation. The chart will help the flight planner to recognize the weight limitations that will restrict operation in a specific mission and to determine what margin of safety may be established.

Note

Although the chart indicates the limitations involved in the loading of the aircraft, the authority for operating the aircraft at a given gross weight remains the responsibility of the local authority.

GROSS WEIGHTS.

The data in this chart is based on an initial operating weight of the aircraft exclusive of fuel and cargo. The zero point of the chart at the junction of the fuel and cargo load axes represents an operating weight of 20,000 pounds. Because individual operating weights may vary, it will be necessary to adjust the chart for the specific aircraft involved. The operating weight plus the fuel and cargo required in a mission can be shown by gross weight lines that slope at a 45-degree angle to the axis of the chart. These diagonal lines also indicate various structural and performance limitations. However, any gross weight line may be plotted to obtain a graphic representation of the limitations involved in the fuel-weight combination that a mission may require.

Note

The gross weight of the aircraft should never exceed that required for the mission, since unnecessary risk and wear of the equipment will otherwise result. Take-off gross weights must also be considered in the light of available runways, surrounding terrain, altitude, atmospheric conditions, and the requirements and urgency of the mission.

INSTRUMENT MARKINGS

OIL TEMPERATURE

- 40°C Minimum
- 60°C To 80°C Normal
- 100°C Maximum

OIL PRESSURE

- 65 Psi Minimum For Flight
- 65 To 110 Psi Normal
- 110 Psi Maximum

FUEL GRADE 100/130
or 115/145

MANIFOLD PRESSURE

- 28-30.5 In. Hg — A.L. Permitted
- 30.5-42.5 In. Hg — A.R. Reqd
- Above 42.5 In. Hg — 5 Min Limit A.R. Reqd
- 42.5 In. Hg—Meto Power
- 48 In. Hg — Maximum

TACHOMETER

- 1300 To 1700 Rpm — Dangerous Empennage Vibration
- 1700 To 2050 Rpm — A.L. Permitted
- 2050 To 2550Rpm — A.R. Reqd
- Above 2550 Rpm — 5 Min Limit A.R. Reqd
- 2550-Meto Power
- 2700 Rpm — Maximum

CARB AIR TEMPERATURE

- —10°C To 15°C — Possible Icing
- 15°C To 38°C — Normal
- 50°C — Detonation

CYL—HEAD TEMPERATURE

- 150°C — 232°C — A.L. Permitted
- 232°C To 260°C — A.R. Reqd
- 260°C — Maximum

Figure 5-1 (Sheet 1 of 2)

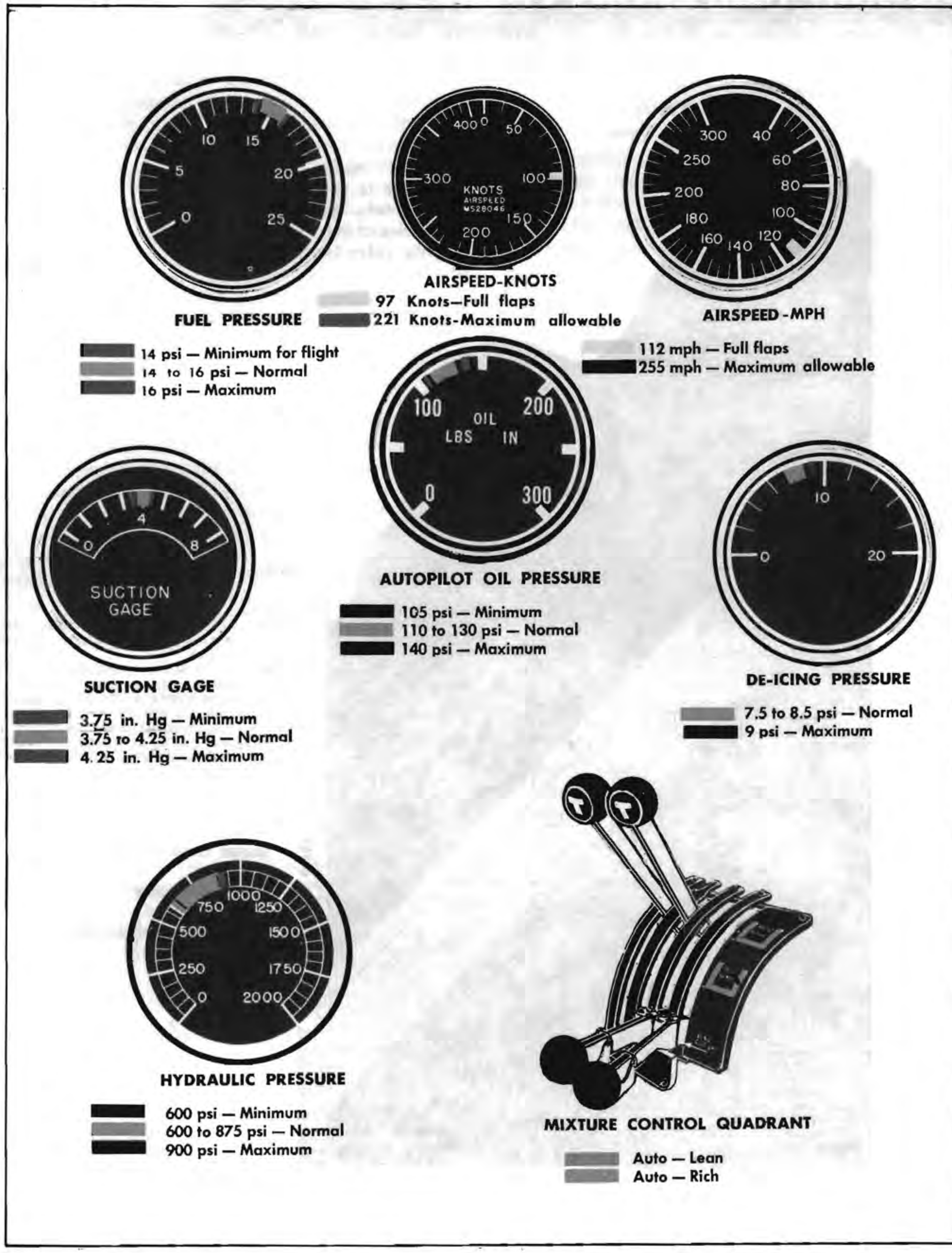
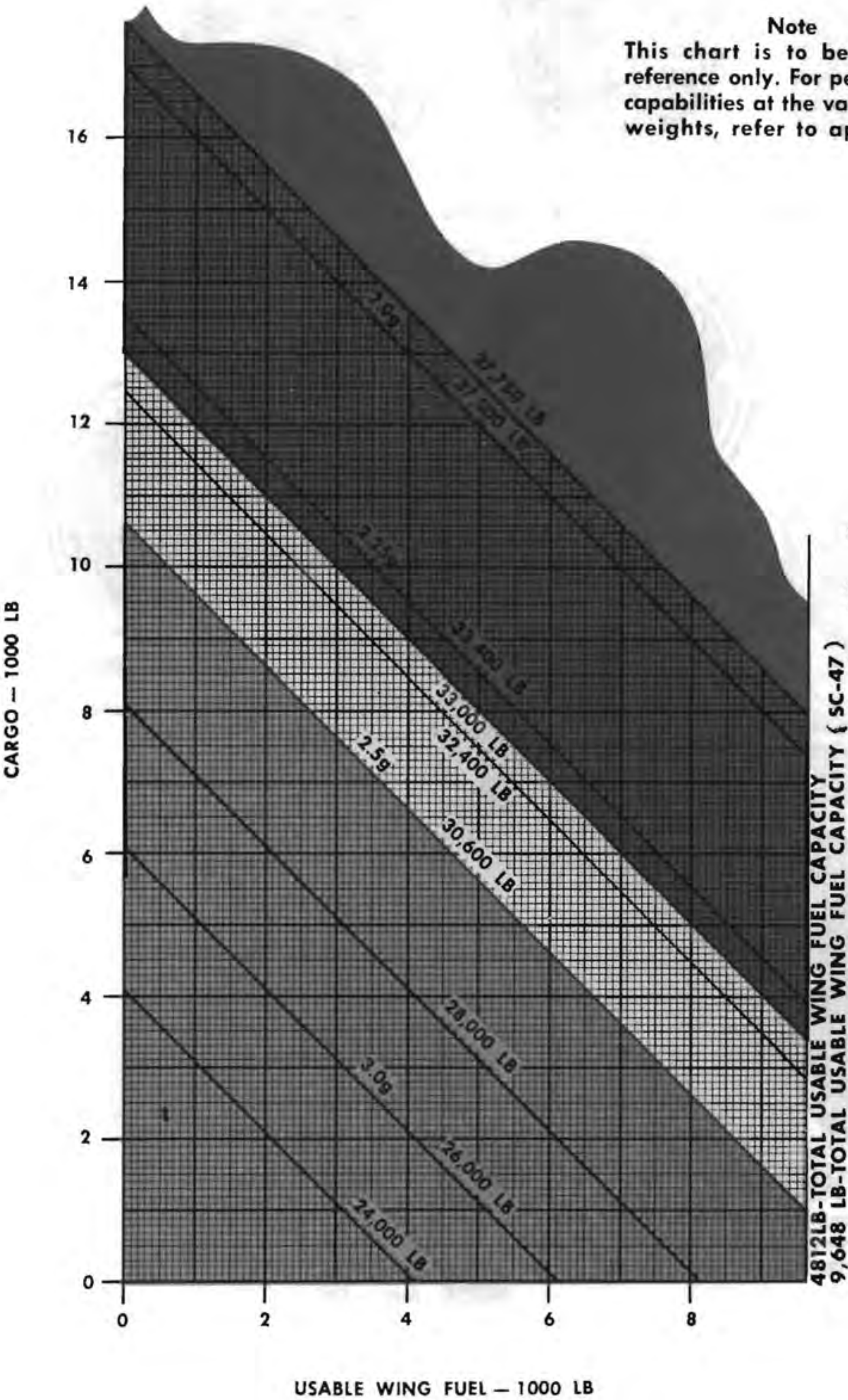


Figure 5-1 (Sheet 2 of 2)

WEIGHT LIMITATIONS CHART - TYPICAL

BASIC OPERATING WEIGHT OF 20,000 LB

Note
This chart is to be used for reference only. For performance capabilities at the various gross weights, refer to appendix I.



26,000 — DESIGN GROSS WEIGHT AT 3.0g WING LOAD FACTOR. NORMAL LANDING WEIGHT.
30,600 — 2.5g WING LOAD FACTOR.
32,400 — 100 FPM, SL, HOT DAY, SINGLE ENGINE CLEAN CONFIGURATION, MAXIMUM POWER.
33,000 — 100 FPM, SL, STANDARD DAY, SINGLE ENGINE, CLEAN CONFIGURATION, MAXIMUM POWER, MAXIMUM RECOMMENDED LANDING WEIGHT.
37,000 — 2.0g WING LOAD FACTOR.
37,750 — 500 FPM, SL, STANDARD DAY BOTH ENGINES OPERATING, CLEAN CONFIGURATION, METO POWER.

RECOMMENDED
CAUTIONARY
NOT RECOMMENDED

Figure 5-2

WING FUEL LOAD.

At the base of the chart along the horizontal axis, the weight of the fuel normally carried in the wing tanks is indicated in thousands of pounds.

LONG-RANGE FUEL LOAD.

When long-range fuel tanks are installed in the main cabin to increase the range of the aircraft or to transport fuel, the total weight of this fuel and the tanks should be computed as cargo load. By computing the fuel in the long-range tanks as cargo load, detailed chart work is eliminated, as are the individual calculations involved in adding the weight of the long-range fuel to the fuel load and the weight of the long-range tanks to the cargo load. Whenever long-range fuel is carried, a reduction in the cargo load is necessary to compensate for the weight of the long-range fuel and tanks.

CARGO LOAD.

In any mission, range and fuel consumption directly determine the fuel that must be carried, and indirectly the cargo that can be transported. With the necessary fuel for the mission established, cargo loading is variable within the limits established by the strength and performance of the aircraft. The payload, as carried in the cargo compartment, appears in thousands of pounds along the vertical axis of the chart. When long-range fuel is utilized to increase the range of the aircraft, the combined weight of the fuel and tanks should be computed as cargo load.

WING LOAD FACTORS.

The loads which the wing will sustain under different weight conditions are represented by the wing load factor lines on the chart. Under most loading conditions, which are normally limited by single-engine performance, the margin of safety provided by the wing load factors is very small. However, when flight through turbulent air is anticipated, the highest practical wing load factor is desirable.

SPEED.

The loads on the wing increase as the gross weight increases. This effect may be largely nullified by a reduction in speed. Refer to the paragraph on Airspeed Limitations, this section, for recommended speeds at various gross weights.

LANDING GEAR LIMITATIONS.

The landing gear structure is designed for landing during routine operation at a gross weight of 26,000 pounds at a maximum contact sinking speed of 9 fps limit. This is the maximum recommended landing weight for normal operation. The maximum recommended landing weight under emergency conditions is 33,000 pounds. This weight is based on the fact that the landing gear fittings become critical at this weight when landing in the tail down attitude. Therefore, when landing at weights in excess of 26,000 pounds, the tail down attitude should be avoided if at all possible. At a landing weight of 33,000 pounds, the brakes are good for 100 stops. The main wheels and tail wheel and tire become critical for strength at 33,000 pounds gross weight.

SKI LIMITATIONS.

The main skis are designed for a gross weight capacity of 15,000 lbs. each. The tail ski is designed for a gross weight capacity of 4000 lbs.

PERFORMANCE LIMITATIONS.

In the case of 2-engine aircraft, it is generally inherent that performance rather than structural limitations restricts the weight which the aircraft can carry. Obviously, the gross weight must necessarily be limited by the ability of the aircraft to take off within available runway length and clear any obstacles. But the primary consideration is the ability of the aircraft to fly with partial power. Single-engine performance, then, is the major restrictive factor in the loading of the aircraft. Note the gross weight lines on the chart, particularly those which separate the loading areas. Each of these lines defines a specific limitation and several of the lines are wholly performance limitations. These performance limitations are based on the gross weight at which an adequate rate of climb can be maintained under various conditions of power, temperature, and configuration.

POWER LOSS AND PERFORMANCE.

On this aircraft, the effect of an engine failure on performance is immediate. The loss of half the total thrust normally developed by both power plants and the asymmetric power condition that results produce a marked decrease in the rate of climb. The significance of gross weight and configuration immediately becomes apparent, for the aircraft with partial power is unable to maintain an adequate rate of climb at gross weights above 33,000 pounds, or in a configuration where the landing gear and wing flaps are extended. Power losses due to temperature, humidity, and engine deficiency exert a considerable influence on the rate of climb, even when both engines are operating. It is not difficult to visualize the effect which engine failure will produce on the rate of climb, but it is interesting to note the remarkable difference in aircraft performance resulting from a rise in temperature and a corresponding fall in air density. As the weight limitations chart illustrates, the difference between a standard day and a hot day requires a cargo adjustment of approximately 600 pounds. For purposes of standardization, the temperature of a standard day is 15°C (59°F) and that of a hot day, 38°C (100.4°F) at sea level. Naturally, variations of temperature and altitude within this range will give similarly graduated values in brake horsepower and rate of climb. The effect of humidity and engine deficiency on brake horsepower and, ultimately, on the gross weight at which the aircraft may be operated, has not been included in the weight limitations chart because there are so many variable conditions involved.

CONFIGURATION AND PERFORMANCE.

The configuration of the aircraft also imposes a penalty on performance. In other than clean configurations, the increase in drag produces a decrease in the rate-of-climb and requires a readjustment of the gross weight at which the aircraft may be operated. As with power losses, this condition is most critical at take-off when, of necessity, the landing gear is extended and the cowl flaps and oil cooler flaps are open. The drag created by a windmilling propeller and the extended landing gear during the take-off roll is such that no attempt to take off should be made unless the safe single-engine airspeed for the aircraft gross weight has been achieved.

RECOMMENDED LOADING AREA.

The green area on the chart represents the loading conditions that present no particular problem in regard to the strength or performance of the aircraft. Operation of the aircraft at weights outside this recommended loading area should be avoided unless the dictates of the mission require it. The green area is bounded by the 2.5G wing load factor line.

CAUTIONARY LOADING AREA.

The yellow area on the chart represents loadings of progressively increasing risk as the red area is approached. Caution must be exercised because single-engine performance at these gross weights is marginal, depending upon configuration, altitude, and ambient air temperature. This area is defined by the gross weight diagonal which indicates a rate of climb of 100 feet per minute at sea level on a standard day with one propeller feathered, gear and flaps up, and maximum power on the operative engine.

LOADING NOT RECOMMENDED.

Note

Whenever flights are conducted at weights shown i- the red area of the chart, entry of this fact in Form 781 is required.

The red area represents loadings which are not recommended because the margin of safety, from the standpoint of both performance and structural limitations, is something less than the most desirable or practical. Under conditions of extreme emergency when safety of flight is of secondary importance, the commander will determine whether the degree of risk warrants operation of the aircraft at gross weights appearing in the red zone.

USE OF CHART.

A sample problem is presented to illustrate the application of the chart.

1. Assume that a C-47 aircraft calls for a 10,500-pound payload and 3000 pounds of fuel. Starting with the operating weight of 20,000 pounds at "0," proceed along the vertical axis to 10,500 pounds; this increases the gross weight to 30,500 pounds. Next proceed along the horizontal axis to 3000 pounds and project a line vertically to intersect the horizontal projection of the 10,500 pound line. By interpolation, the intersection will indicate a gross weight of 33,500 pounds. This value is above the maximum recommended gross weight, and in order to keep within the cautionary envelope, the cargo or fuel must be reduced by 500 pounds.

2. Another example to demonstrate a problem where the operating weight of the aircraft is greater than that shown on the chart: assume an operating weight of 22,000 pounds instead of 20,000 pounds, or a difference of 2000 pounds. Using the same requirements as in the previous example and proceeding as before, the gross weight will be found to be 33,500 pounds by interpolation; but, to this value, 2000 pounds must be added to the cargo scale to correct the chart for the heavier aircraft. This increases the total gross weight to 35,500 pounds. This value is above the maximum recommended gross weight, and in order to keep within the cautionary envelope, the cargo or fuel must be reduced by 2500 pounds.