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Ditching Station - If seat not available, seated on floor, back braced against main cabin forward bulkhead.

After Ditching.

Pass out the emergency equipment bag and leave through the main cargo door.

STEWARD OR FLIGHT MECHANIC.

First Actions.

1. Assist and brief passengers.
2. Loosen tie, and don antiexposure suit and life vest.
3. Stow essential emergency equipment in emergency bag, and stow the bag in the lavatory.

When Ditching Is Imminent (10 Minutes Left).

1. Assist pilot as directed.
2. Make certain the passengers are prepared.
3. Jettison main cargo door.

Ditching Station - If seat is not available, seated on floor of main cabin, back braced against main cabin forward bulkhead.

After Ditching.

Pass out the emergency equipment bag and leave through the main cargo door.

RADIO OPERATOR.

First Actions.

1. On pilot's orders, send an emergency signal (SOS), followed as soon as possible by an emergency message giving position, flight time, nature of the emergency, and any other information available.
2. Obtain Direction Finding Service, bearing, etc, on normal air ground frequency if possible.
3. Loosen tie, don antiexposure suit and life vest, and fasten shoulder harness and safety belt.
4. Continue the outlined emergency procedure every 10 minutes.

When Ditching Is Imminent (10 Minutes Left).

1. Send final distress signal (SOS), position, altitude, course, speed, and intention of pilot as to ditching.
2. Screw the emergency key down.

Ditching Station - If seat is not available, seated on floor of main cabin, back braced against main cabin forward bulkhead.

After Ditching.

- a. Launches life raft through main cargo door.
- b. Leaves through main cargo door.

LOADMASTER.

First Actions.

1. Monitor interphone.
2. Acknowledge pilot's verbal order.
3. Passengers - prepared for ditching; loosen ties, don anti-exposure suits, life vests, and fasten seat belts.
4. Cargo jettisoned if time permits; remaining cargo tied down.
5. Emergency/survival equipment in place and tied down.
6. Hatches and doors - close doors that may take in water, open all others.

When Ditching Is Imminent (10 Minutes Left).

1. Monitor interphone.
2. Passengers/crew - assume ditching positions and fasten seat belts; flash lights on life vests turned on.
3. Pilot notified on interphone - cabin prepared for ditching.

Ditching Station - If seat is not available, seated on floor, back braced against main cargo compartment forward bulkhead.

AFTER DITCHING.

1. Life rafts launched and inflated through main cargo door.
2. Passengers evacuated.
3. Emergency/survival equipment aboard rafts.
4. Board raft.
5. Disconnect raft from aircraft as soon as all possible crew and passengers are aboard rafts.
6. Secure all emergency/survival equipment to raft.

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MALFUNCTIONS OF MULTI-GENERATOR D-C ELECTRICAL SYSTEM

FAILED GENERATOR AMMETER	FAILED GENERATOR WARNING LIGHT	OTHER GENERATOR AMMETER	OTHER GENERATOR WARNING LIGHT	RESULTS AND CAUSES OF D-C ELECTRICAL SYSTEM FAILURE
1. ZERO	ON	ABOVE NORMAL	OFF	GENERATOR MECHANICAL FAILURE, ARMATURE OPEN, BROKEN BRUSH, REVERSE CURRENT RELAY NOT CLOSING, ONE POLE OF GENERATOR SWITCH OPEN.
2. ZERO	OFF	ABOVE NORMAL	OFF	MAIN BUS OPEN TO REVERSE CURRENT RELAY, GENERATOR FAILURE WITH WARNING LIGHT FAILURE, OPEN GENERATOR SWITCH, REVERSE CURRENT RELAY MAIN COIL NOT CLOSING.
3. ZERO	OFF	NORMAL	OFF	AMMETER CIRCUIT OPEN.
4. LOW	OFF	ABOVE NORMAL	OFF	IMPROPER PARALLELING, EQUALIZER COIL IN REGULATOR NOT WORKING, REGULATOR SET LOW OR STICKING.
5. ABOVE NORMAL	OFF	LOW - OR ZERO	OFF	EQUALIZER COIL NOT WORKING, REGULATOR MALFUNCTION.
6. OFF SCALE HIGH	OFF	OFF SCALE HIGH OR ABOVE NORMAL	OFF	MAIN BUS GROUNDED.
7. OFF SCALE HIGH	OFF	LOW - OR ZERO	OFF	REGULATOR MALFUNCTION.
8. OFF SCALE HIGH	OFF	ZERO	ON	OVERVOLTAGE DUE TO REGULATOR MALFUNCTION OR FIELD TO ARMATURE LEAD SHORTED.
9. NORMAL	ON	NORMAL	OFF	FAILURE OF WARNING LIGHT RELAY CIRCUIT.
10. REVERSED AND PEGGED	OFF	OFF SCALE HIGH OR ABOVE NORMAL	OFF	REVERSE CURRENT RELAY WELDED WITH GENERATOR LEAD GROUNDED, FAILED REVERSE CURRENT RELAY COIL.
11. OFF SCALE HIGH TO GENERATOR FAILURE THEN TO ZERO.	OFF THEN ON	HIGH UNTIL FAILURE OF OTHER GENERATOR, THEN ABOVE NORMAL. MAY NOT GO AS HIGH AS FAILED GENERATOR. MAY GO LOW AFTER OTHER GENERATOR FAILURE DUE TO BURNED-OUT LOADS.	OFF	OVERVOLTAGE.
12. OFF SCALE LOW AND PEGGED THEN TO ZERO.	ON	OFF SCALE HIGH THEN BACK TO ABOVE NORMAL.	OFF	GENERATOR FEEDER GROUNDED.

NOTES:

1. GENERATOR SWITCH CONTROLS: REVERSE CURRENT RELAY, VOLTAGE REGULATOR EQUALIZING WINDING CROSS CONNECTION, WARNING LIGHT POWER CONNECTION.
2. ALL AIRCRAFT HAVE ONE WARNING LIGHT PER GENERATOR, OPERATED BY A LIGHT RELAY. THE LIGHT COMES ON WHEN THE GENERATOR SWITCH IS POSITIONED TO ON AND GENERATOR REVERSE CURRENT RELAY IS NOT CLOSED. THE LIGHT GOES OFF WHEN THE GENERATOR REVERSE CURRENT RELAY PILOT COIL IS ENERGIZED AND OPERATES THE LIGHT RELAY.
- 3a. DO NOT REMOVE VOLTAGE REGULATOR EXCEPT IN AN EMERGENCY.

- b. MAKE CERTAIN THE ELECTRICAL SYSTEM (REGULATOR, GENERATOR, REVERSE CURRENT RELAY, AND WARNING LIGHT CIRCUIT) IS FUNCTIONAL AFTER ANY INSPECTION OR OVERHAUL WHICH MAY AFFECT THE ELECTRICAL SYSTEM.
- c. WHEN CHECKING THE ELECTRICAL SYSTEM, TURN OFF ALL ELECTRICAL EQUIPMENT (BATTERY, RADIO, RADAR LIGHTS, ETC) WHICH WOULD BE AFFECTED BY OVERVOLTAGE. EVERY EFFORT SHOULD BE MADE TO KEEP VOLTAGE BELOW 35 VOLTS.
- d. IN EVENT AN ELECTRICAL SYSTEM MALFUNCTION TRIPS ONE OR BOTH GENERATORS OF BUS, TURN OFF.

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MALFUNCTIONS OF MULTI-GENERATOR D-C ELECTRICAL SYSTEM

IMMEDIATE ACTION

CORRECTIVE ACTION

PLACE FAILED GENERATOR SWITCH IN OFF POSITION. (SEE NOTE 3f.)

1. PLACE GENERATOR SWITCH TO ON POSITION AND SEE IF GENERATOR PICKS UP LOAD. IF AMMETER DOES NOT SHOW LOAD, PLACE GENERATOR SWITCH TO THE OFF POSITION.

PLACE GENERATOR SWITCH TO OFF THEN ON. IF GENERATOR DOES NOT SHOW LOAD, PLACE SWITCH IN THE OFF POSITION. (SEE NOTE 3f.)

2. NONE

TURN GENERATOR SWITCH OFF. (SEE NOTE 3f.)

3. NONE

SEE NOTE 3g.

4. CHECK VOLTAGE REGULATOR FOR OPEN OR SHORTED CONTACTS ON REGULATOR BASE.

OPERATE GENERATOR SWITCHES INDIVIDUALLY TO OFF THEN ON. IF SYSTEM DOES NOT OPERATE CORRECTLY PROCEED PER NOTE 3g.

5. SAME AS 4.

ACT FAST. TURN OFF BATTERY SWITCH. TURN OFF GENERATOR SWITCHES. OPERATE ON EMERGENCY POWER IF AVAILABLE.

6. NONE

PLACE THE GENERATOR MAIN LINE SWITCH TO OFF. (SEE NOTE 3f.)

7. SAME AS 4.

SWITCH OFF AFFECTED GENERATOR; BE PREPARED FOR POSSIBLE GENERATOR FIRE. (SEE NOTE 3f.) REMOVE VOLTAGE REGULATOR IF POSSIBLE. (SEE NOTE 3a.)

8. SAME AS 4.

REPLACE BURNED OUT LIGHTS. (SEE NOTE 3g.)

9. PRESS FIXTURE TO TEST LAMP. OPERATE GENERATOR SWITCH OFF AND ON TO CLEAR POSSIBLE OPEN SWITCH CONTACT. REPLACE LAMP AND RECHECK BY PRESSING FIXTURE.

ACT FAST. TURN OFF BATTERY SWITCH. TURN OFF GENERATOR SWITCHES. OPERATE ON EMERGENCY POWER IF AVAILABLE.

10. NONE

ACT FAST. SWITCH OFF BATTERY. SWITCH OFF GENERATORS. SWITCH BATTERY ON. SWITCH LOW GENERATOR ON. MONITOR LOAD FOR NORMAL OPERATION. MOST LIGHTING AND RADIO CIRCUITS WILL PROBABLY BURN OUT. REPLACE BURNED-OUT LAMPS.

11. REMOVE REGULATOR. SAME AS 4. (SEE NOTE 3a.)

REMOVE VOLTAGE REGULATOR IF POSSIBLE. PLACE GENERATOR SWITCH TO OFF. (SEE NOTES 3f AND 3a.)

12. NONE

BATTERY SWITCH IMMEDIATELY. TURN ON EMERGENCY POWER SYSTEM IF AVAILABLE. DO NOT PLACE BATTERY ON LINE PRIOR TO CLEARING ELECTRICAL SYSTEM MALFUNCTION.

e. WITH BATTERY SWITCH OFF AND BATTERY RELAY OPEN, POWER IS SUPPLIED TO THREE ITEMS.

1. BAIL-OUT BELL.
2. MAIN JUNCTION BOX INTERNAL LIGHT.
3. CB FIRE EXTINGUISHING SYSTEM.

f. IF GENERATOR FAILURE OCCURS, THE AMMETER OF THE REMAINING GENERATOR SHOULD BE IMMEDIATELY CHECKED FOR OVERLOAD AND NON-ESSENTIAL ELECTRICAL EQUIPMENT TURNED OFF. IF NECESSARY, MONITOR REMAINING GENERATOR AMMETER TO PREVENT OVERLOADS.

g. IF TWO-GENERATOR POWER CAPACITY IS REQUIRED, MONITOR BOTH AMMETERS FOR POSSIBLE OVERLOAD. TURN OFF ALL NON-ESSENTIAL ELECTRICAL EQUIPMENT. IT IS PREFERRED THAT THE DEFECTIVE GENERATOR BE TURNED OFF.

Figure 3-10 (Sheet 2 of 2)

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ABANDONING THE AIRCRAFT.

Leave the aircraft as quickly as possible. Do not overlook necessary equipment or assigned duties. Hold ditching position until the aircraft comes to rest, then proceed as follows:

- a. Crew members detailed to life raft removal will launch life rafts through the main cargo door and inflate.
- b. Crew members and other personnel will leave through assigned escape exit and, upon emerging, inflate life jackets.

BAIL-OUT.

BAIL-OUT ALARM BELL

The following are the standard alarm signals for bail-out:

Three short rings Prepare to bail out

One long ring Bail out

BAIL-OUT PROCEDURE.

When the decision has been made to abandon the aircraft in flight, the pilot will give a warning signal to "Prepare for bail-out." This signal will be three short rings on the alarm system, a verbal signal over the interphone/PA system. When all the crew members (and passengers, if carried) are ready, the pilot will be notified. When the pilot desires to have all on board abandon the aircraft, he will give a warning signal to "Bail out," which will be one long sustained ring, or a verbal signal over the interphone/PA system. In addition to the alarm signals, the pilot will give verbal warnings over the interphone. If passengers are carried, a crew member will brief them. Primary exit from the aircraft will be through the main cargo door, which can be jettisoned from the aircraft.

Pilot.

The pilot will:

- a. Notify crew and receive acknowledgement. Ring alarm bell three short rings, or give verbal signal over interphone for crew members to perform all preparatory duties for bail-out. IFF/SIF - EMERGENCY.
- b. Reduce the airspeed, if possible, to approximately 100 knots (115 mph) IAS.
- c. Put aircraft on autopilot control.

- d. Don an antiexposure suit and life vest if over water, adjust parachute.
- e. Place alarm bell on continuous signal, give signal for "bail-out" over interphone/PA system.
- f. After receipt of "All clear" signal from the co-pilot, the pilot will order him to bail out and will follow him out.

Co-Pilot.

The co-pilot will:

- a. Acknowledge the pilot's bail-out instructions and adjust his parachute. Don an antiexposure suit and life vest if over water. Adjust parachute.
- b. Transmit emergency voice signals.
- c. Turn on landing lights (night only).
- d. Assist pilot until bail-out signal is given.
- e. Evacuate aircraft on the final bail-out signal.

Navigator (C-47 and R4D Series Aircraft).

The navigator will:

- a. Acknowledge pilot's bail-out instructions, adjust his parachute, and don an antiexposure suit and life vest if over water.
- b. Give final aircraft position report to the pilot, co-pilot, and radio operator.
- c. Evacuate aircraft on final bail-out signal.

Radio Operator.

The radio operator will:

- a. Acknowledge pilot's bail-out instructions.
- b. Transmit distress signal and position report, and continue to do so until the final bail-out signal.
- c. Don an antiexposure suit and life vest if over water, adjust parachute.
- d. Screw down the transmitter key.
- e. Evacuate the aircraft on final bail-out signal, taking code book and radio operator's flimsy (notebook).

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Flight Mechanic or Steward.

The flight mechanic or the steward will:

- a. Prepare passengers for bail-out.
- b. Don an antiexposure suit and life vest if over water, adjust parachute.
- c. Unlock door and kick down on the yellow emergency release latch at the main cargo door forward end and push the door from the aircraft.

WARNING

The person jettisoning cargo door will be secured to the interior of the aircraft fuselage.

NOTE

On some aircraft there is no provision for jettisoning the air stair door.

- d. Control movement of passengers to main cargo door.
- e. Bail out after all passengers have evacuated.

LOADMASTER.

The loadmaster will:

- a. Monitor interphone.
- b. Acknowledge pilot's order - verbal or 3 short rings on alarm bell.
- c. Prepare passengers for bail-out.
- d. Jump-door-pulled and secured on pilot's order.
- e. Notify pilot - cabin prepared for bail-out.
- f. Bail-out on signal after all passengers have evacuated.

OVERWATER RECOMMENDATIONS.

Bail-out is not recommended unless visual contact is made with adequate surface help. If no rescue vessels are in the vicinity, bail-out should be used only as a last resort because of the extreme difficulty of getting the crew together in the water. The life rafts offer survival and signaling equipment. In any but the warmest seas, a man will survive only a few hours if kept afloat by means of a life vest alone. Wearing an anti-exposure suit will increase this time, but this still cannot compare with

the length of time survival is possible in a life raft. If bail-out is required or decided upon, the following procedure is recommended:

- a. If surface help is available, it is much easier for rescue crews to find and rescue 2 or 3 men at a time in a small area than to rescue 10 or more men strung out in a long line in the water. Always head the aircraft in a direction to allow the crew to drift into the course and just ahead of rescue vessel.
- b. If surface help is not available, it is still important to keep the crew as close together as possible in the water. Individual members can aid each other, especially if some of them are injured. Most important of all, a group of life rafts is much easier to find than a single individual. This is true whether the search is from a surface vessel or from an aircraft. Therefore, inflated rafts should be jettisoned if possible. Then the aircraft should be flown in as tight a circle as conditions will permit, bailing out three or four men at a time, and then come around in relation to the other men or the surface vessel, before bailing out the other members. This will place the members as close as possible to the other men or the surface vessel.
- c. As in ditching, try to plan the bail-out before the last minute. The pilot must warn the crew as soon as bail-out is decided upon. Give three short rings on the alarm bell, or warn the crew on the interphone and receive acknowledgements.
- d. When the bail-out warning is given, crew members should check each other's equipment to insure that all straps and packs are properly secured and adjusted. Upon receiving the bail-out signal, crew and passengers will leave with the least possible delay, through the main cabin door, in accordance with the above procedure, or as prescribed by the pilot to cope with the particular emergency.

FUEL SYSTEM FAILURE.

VAPOR LOCK.

Vapor lock can cause malfunction of the fuel system when the fuel boils or when the fuel is supersaturated with air. The usual indications start with regular and rapid engine surging at high frequency, usually followed by an irregular surge of greater magnitude with extreme fuel pressure fluctuation. Vapor lock can be corrected by retarding the throttle and placing the fuel booster pump ON.

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ELECTRICAL POWER SYSTEM FAILURE.

GENERATORS.

(See figure 3-10, Malfunctions of Multi-Generator D-C Electrical Systems.)

If there is no indication on one ammeter, but the other indicates a normal reading, make the following check.

If the switch for the malfunctioning generator is ON, turn it OFF and see whether the reading of the other ammeter increases. If it does, the trouble may be attributed to the instrument and the generator may be turned on again.

On aircraft with the priority bus system installed, if the bus priority relay disconnects the No. 2 bus system for any reason, the remaining generator will automatically supply power to the failed bus.

HYDRAULIC POWER SYSTEM FAILURE.

Failure of the normal hydraulic system will usually be indicated by the loss of both system pressure and of fluid in the sight gage on the hydraulic control panel.

NOTE

During flight when hydraulic units are being operated, the movement of fluid within the reservoir may draw the fluid from the level sight gage; however, when no hydraulic units are being operated, the fluid level in the sight gage will rise.

In the event of system failure place the controls of all hydraulically operated units in the OFF positions.

NOTE

The hydraulic fluid reserve of 3 quarts does not show on the sight gage.

WING FLAP EMERGENCY OPERATION.

If a loss of hydraulic pressure occurs and it is necessary to operate the wing flaps, move the wing flap lever to the desired position, actuate the hydraulic hand pump, then return flap lever to neutral.

LANDING GEAR SYSTEM FAILURE.

LANDING GEAR EMERGENCY EXTENSION.

1. Star valve - OFF - CP.
2. Landing gear lever - DOWN - CP.
3. Handpump - Operate the pump until the gear is down - CP.
4. Landing gear lever - NEUTRAL - CP.
5. Warning lights - check green ON red OFF - CP.
6. Visual check - CHECKED - P, CP.
7. Landing gear latch lever - POSITIVE LOCK - CP.

CAUTION

Place latch lever in POSITIVE LOCK position only after the gear is down and normal pressure is indicated, since the spring lock action catch is locked closed in the POSITIVE LOCK position.

8. Warning horn - CHECKED (retard throttle) - P.

LANDING GEAR HYDRAULIC LINE FAILURE.

In the event of a complete line failure, the gear can be snapped down so that the latches will engage. Return the landing gear lever to NEUTRAL as soon as it is certain that the safety latches have engaged, so as to conserve all the fluid and pressure possible for wing flap and brake operation. If the above condition exists, the green landing gear warning light will go on when the lever is returned to NEUTRAL, but the pressure shown on the landing gear system pressure gage may fall rapidly to zero.

LANDING GEAR SAFETY LATCH FAILURE.

The aircraft may be safely landed whether or not the landing gear safety latches are engaged, providing the landing gear is fully down, the hydraulic system pressure is within limits and the landing gear lever is in the DOWN position. Pressure in the landing gear actuating struts is indicated on the landing gear pressure gage. The horn will continue to sound and the red light will stay on, since the switches are connected to the safety latch and landing gear lever. When landing under these conditions, the gear is held in the extended position by the pressure of the hydraulic fluid against the retracting strut pistons.

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When the brakes are applied, the resulting rotative force will have a tendency to cause the gear to retract, moving the pistons up in the struts and resulting in an increased pressure in the landing gear downlines. To eliminate the possibility of a line failure due to the excessive rise in pressure caused by the piston moving up in the strut, the brakes should be used only if absolutely necessary. If the length of the runway necessitates the use of the brakes, apply them as lightly as possible and, in any event, limit the pressure applied to the brakes so that the pressure indicated on the landing gear pressure gage does not exceed 1500 psi.

LANDING WITHOUT HYDRAULIC SYSTEM PRESSURE.

A landing without fluid pressure would be necessary only in case of failure in the lines from the hand pump to the retracting struts. In this case, the landing gear down position latches will hold the gear in place, and a safe landing can be made. Move the landing gear lever to the DOWN position to allow as much fluid as possible to get into the actuating strut, and then zoom the aircraft as required to snap down the gear and engage the latches. Return the control handle to NEUTRAL. If the warning light is green, it indicates that the latches have engaged and a normal landing can be made.

BRAKE SYSTEM FAILURE.

If the pressure gage reads below 600 psi and the hydraulic system is connected to the operating engine, or if both engines are operating and the pressure gage reads below 600 psi, carry out the hydraulic braking operation with the aid of the hydraulic hand pump, leaving the star valve in the OFF position. The co-pilot should operate the hydraulic hand pump to supply pressure to the brakes. The pump handle will move each time the brakes are applied. About 50 pounds pull should be exerted on the pump handle continuously until the brakes are no longer required. When the brakes are hand-operated in this manner, no pressure will show on the gage. Apply the brakes with one steady application.

1. Star Valve - OFF.
2. Hydraulic Handpump - OPERATE.
3. Brake Pedals - STEADY APPLICATION.

LANDING GEAR FIRE.

Head aircraft into the wind and park. Maintain at least 2000 RPM on engine ahead of the affected landing gear. If fire causes the tire to explode, continue to maintain at least 2000 RPM. Explosion will not extinguish the fire. Shut down engines when fire equipment is in position to fight the fire. Evacuate the aircraft. First Officer: call tower for assistance. Wing flaps full down. On order from the Captain deplane with passengers on side of fuselage opposite from fire to a safe distance from the aircraft.

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SECTION IV
DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT

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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 thermostats, the necessary insulated ducting, air scoops, 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 air scoops 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 air scoop 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 air scoop 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 defrost-

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ing. 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, 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).

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.

HEATING AND VENTILATING SYSTEM - TYPICAL

C47 AND R4D SERIES AIRCRAFT

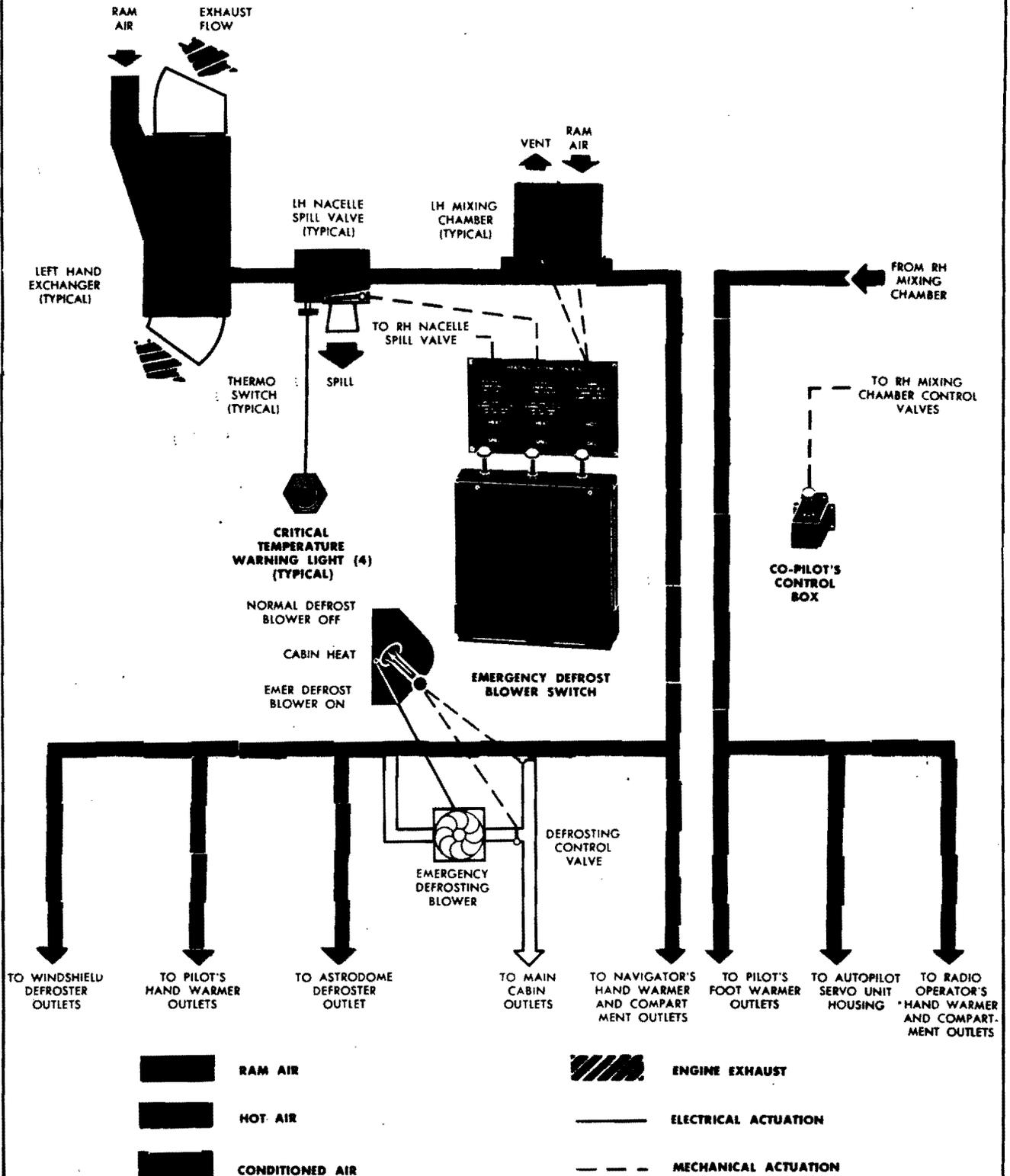


Figure 4-1

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**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 DE-FROST-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.

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, 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 1/2 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.

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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.

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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

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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 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 air-stream 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, and 26, figure 1-12) indicates system operating pressure.

WING AND EMPENNAGE DEICING SYSTEM OPERATION.

NOTE

For best results, wait until at least $\frac{1}{4}$ 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.

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WING AND EMPENNAGE DE-ICING SYSTEM

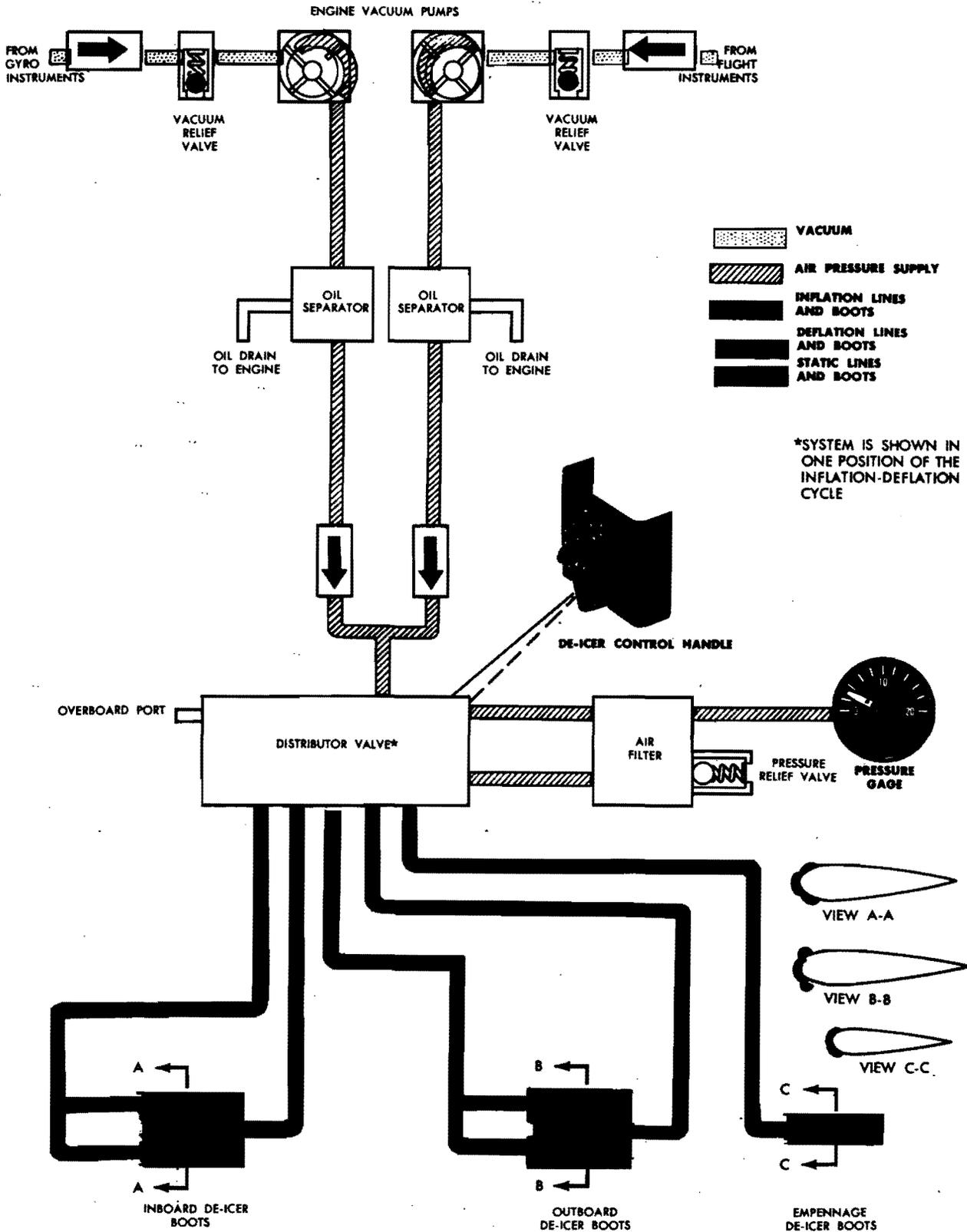


Figure 4-3

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**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 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 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.

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COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT

The following list is typical for all C-47, C-117, and E-40 series aircraft. Each aircraft must be checked to determine the exact radio equipment installed.

FUNCTION	EQUIPMENT	DESCRIPTION	PRIMARY OPERATOR	RANGE	LOCATION
VHF COMMAND	AN/ARC-3 WILCOX 807	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	LONG-RANGE, TWO-WAY VOICE AND CODE COMMUNICATION	RADIO OPERATOR	200 TO 2500 MILES	RADIO OPERATOR'S STATION
OMNI-RANGE AND INSTRUMENT APPROACH	AN/ARN-14 AND AN/ARN-18	OMNI-RANGE LOCALIZER AND GLIDE PATH INDICATION	PILOT AND CO-PILOT	LINE OF SIGHT TERMINAL AREA	PILOTS' RADIO CONTROL PANEL
LOCALIZER AND GLIDE PATH	AN/ARN-18	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 AN/AIC-10	INTERCREW COMMUNICATION	ALL CREW MEMBERS	WITHIN THE AIRCRAFT	CONTROL PANEL IN EACH CREW MEMBER'S STATION
AUTOMATIC RADIO COMPASS	AN/ARN-6 (DUAL) AN/ARN-7	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-22	10,000 FT. OVERLAND, 20,000 FT. OVER WATER	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 SIP	AN/APX-25 AN/APX-6	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	SCR718	50,000 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
"LORAN" NAVIGATION	AN/APN-9	"LORAN" NAVIGATIONAL EQUIPMENT	NAVIGATOR		PILOT'S OVERHEAD RADIO CONTROL PANEL

Figure 4-4

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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.

RADAR ALTIMETER (SCR 718) (HIGH RANGE)

Radar set SCR 718 is a high-altitude altimeter that operates in the UHF band on a frequency of 440 megacycles. The altimeter is a pulse type, and is capable of indicating accurate terrain clearance up to 50,000 feet. The altitude reading displayed on the indicator is accurate to within 50 feet on the 5,000-foot scale, and to within 500 feet on the 50,000-foot scale. Basically, the equipment transmits pulses of radar energy earthward from the aircraft, and then receives the same signal as it is reflected from the earth. The length of time required for the signal to follow its path is measured, and presented as a lobe on the circle on the face of the indicator tube. The circle is calibrated to read directly in feet. When the toggle switch on the indicator is in the TIMES ONE position, the altimeter reads up to 5,000 feet; when the toggle switch is in the TIMES TEN position, the altimeter reads up to 50,000 feet.

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

CAUTION

The SCR-718 radio altimeter operating in the band 420/460 mc/s is a source of interference to the radio astronomy receivers and other authorized electronic radiation equipment operating in 406/450 mc/s. To prevent interference, SCR-718 radio altimeter equipment will be used only over broad ocean area starting not less than than 50 miles offshore.

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.

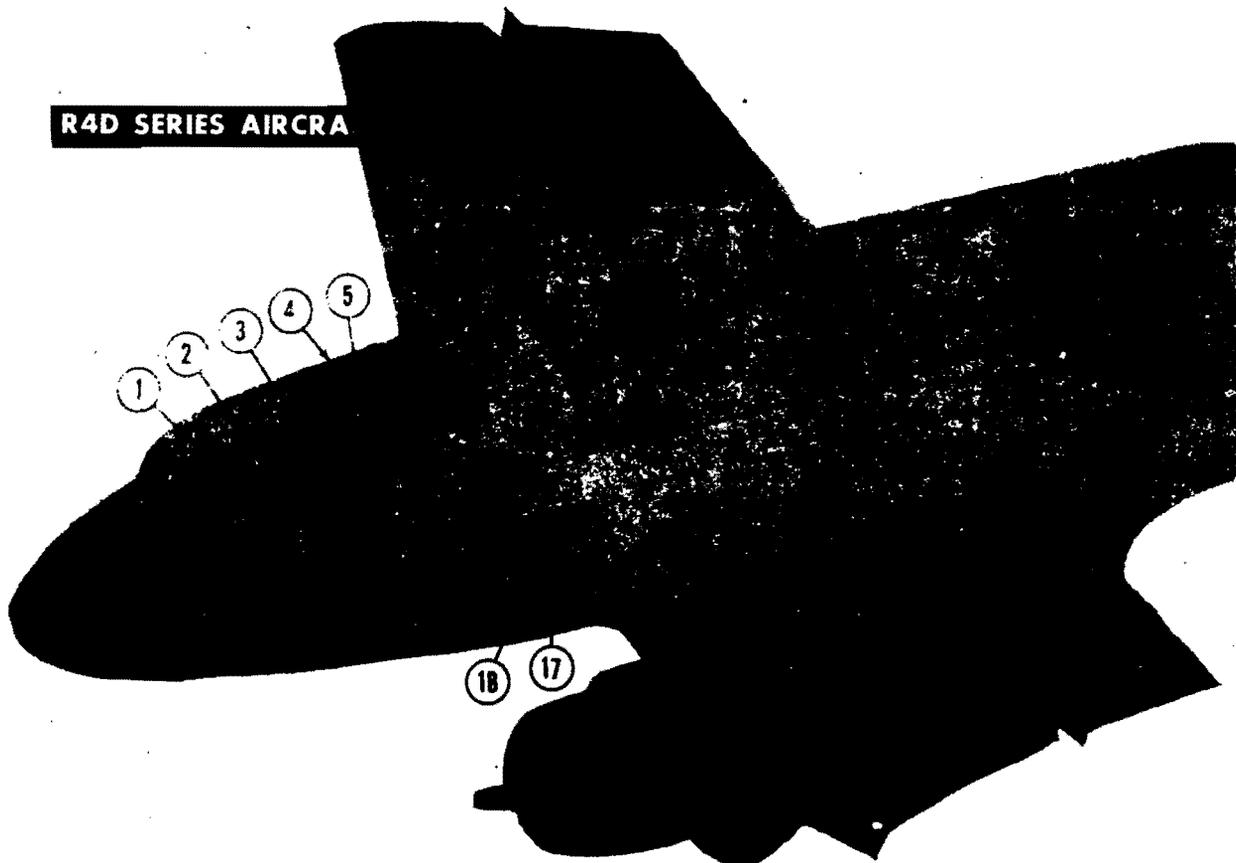
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COMMUNICATION AND ASSOCIATED ELECTRONIC

R4D SERIES AIRCRA



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

Figure 4-5 (Sheet 1 of 2)

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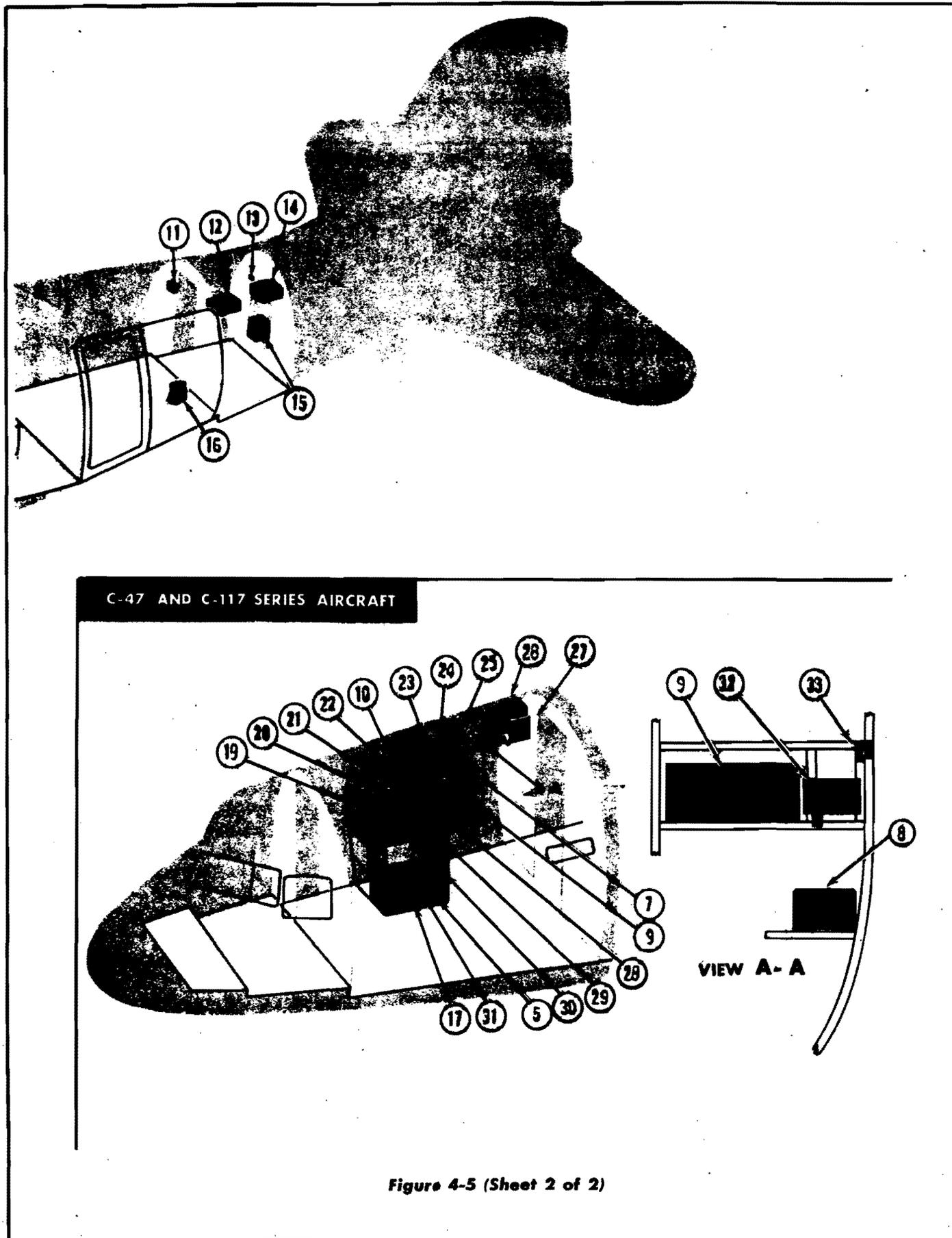


Figure 4-5 (Sheet 2 of 2)

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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.

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.

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.

INTERPHONE CONTROL PANEL—TYPICAL

C47 AND C117 SERIES AIRCRAFT

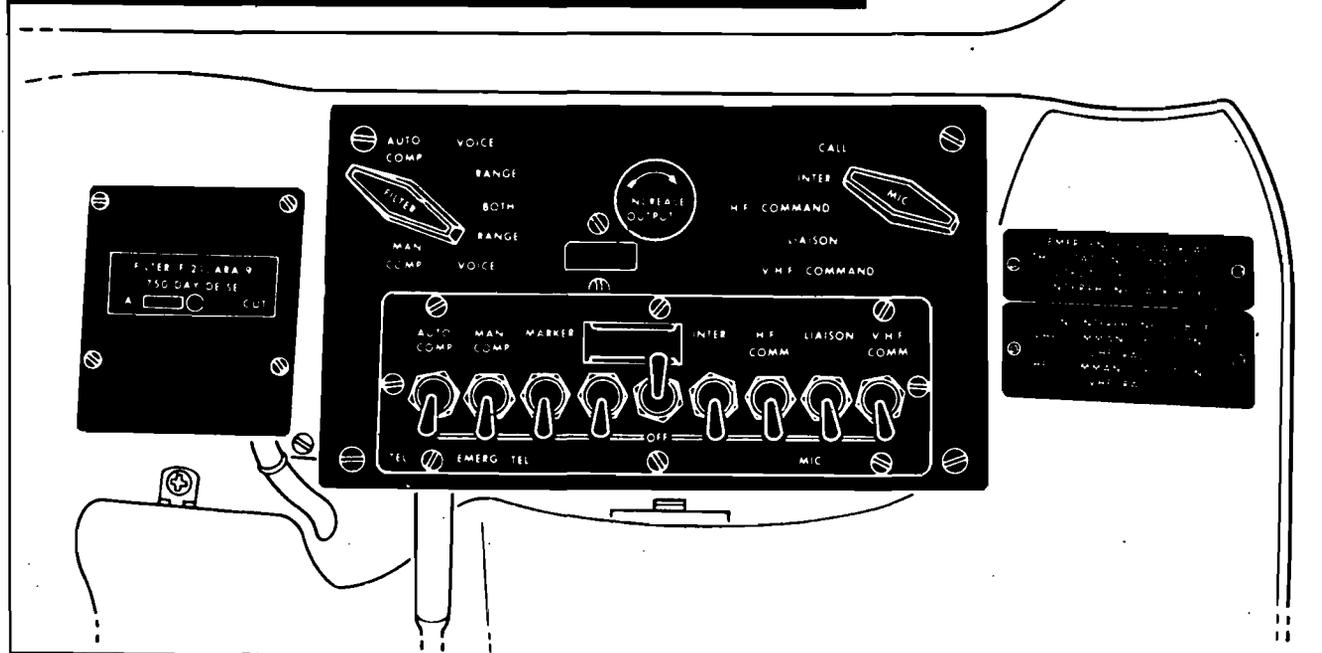


Figure 4-6

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LOCALIZER RECEIVER AND GLIDE PATH RECEIVER (RC/101 and AN/ARN-18).

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-18).

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 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.

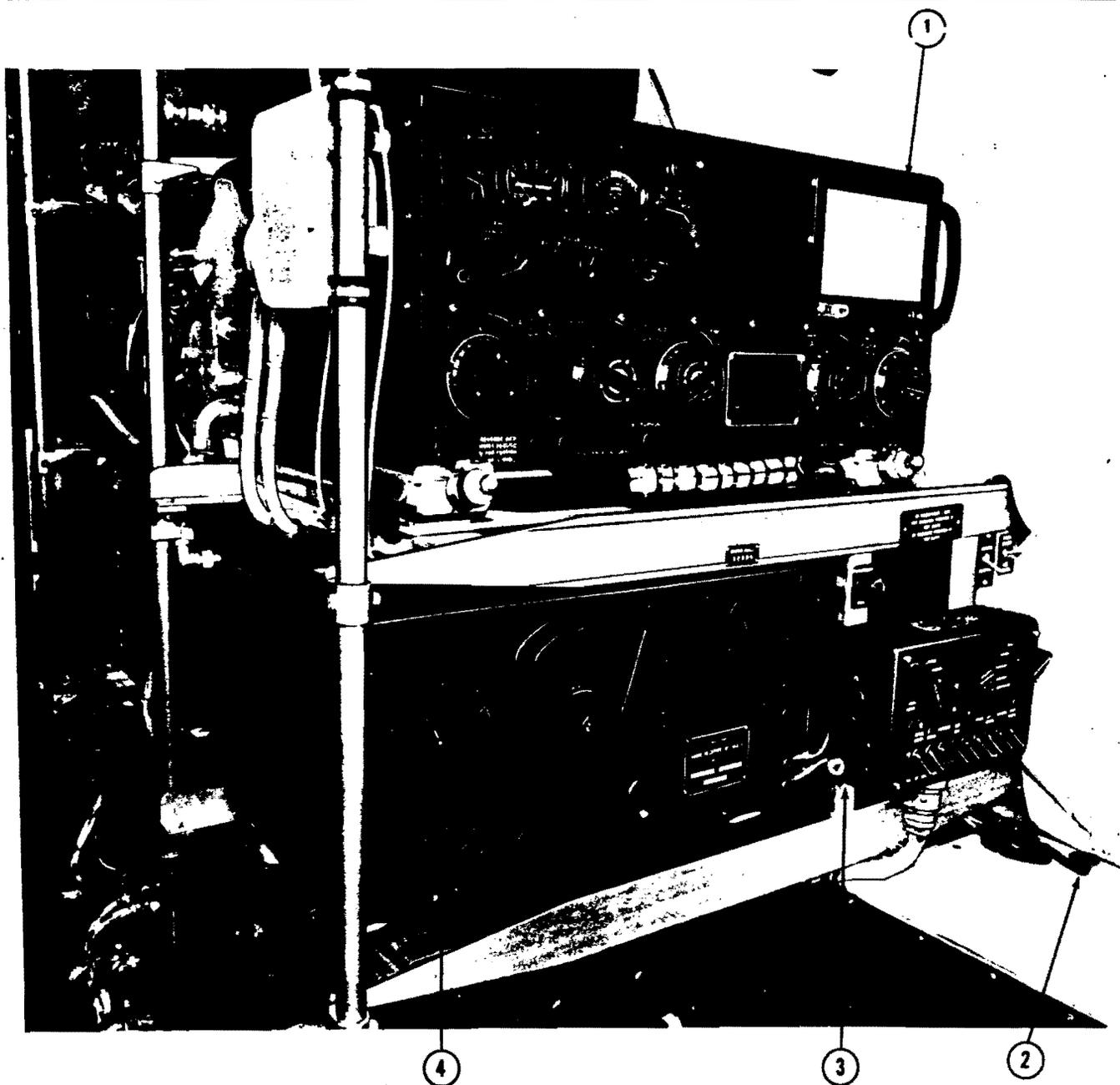
TACAN RADIO (AN/ARN-21/45).

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.

RADIO OPERATOR'S STATION
TYPICAL



1. HF LIAISON TRANSMITTER

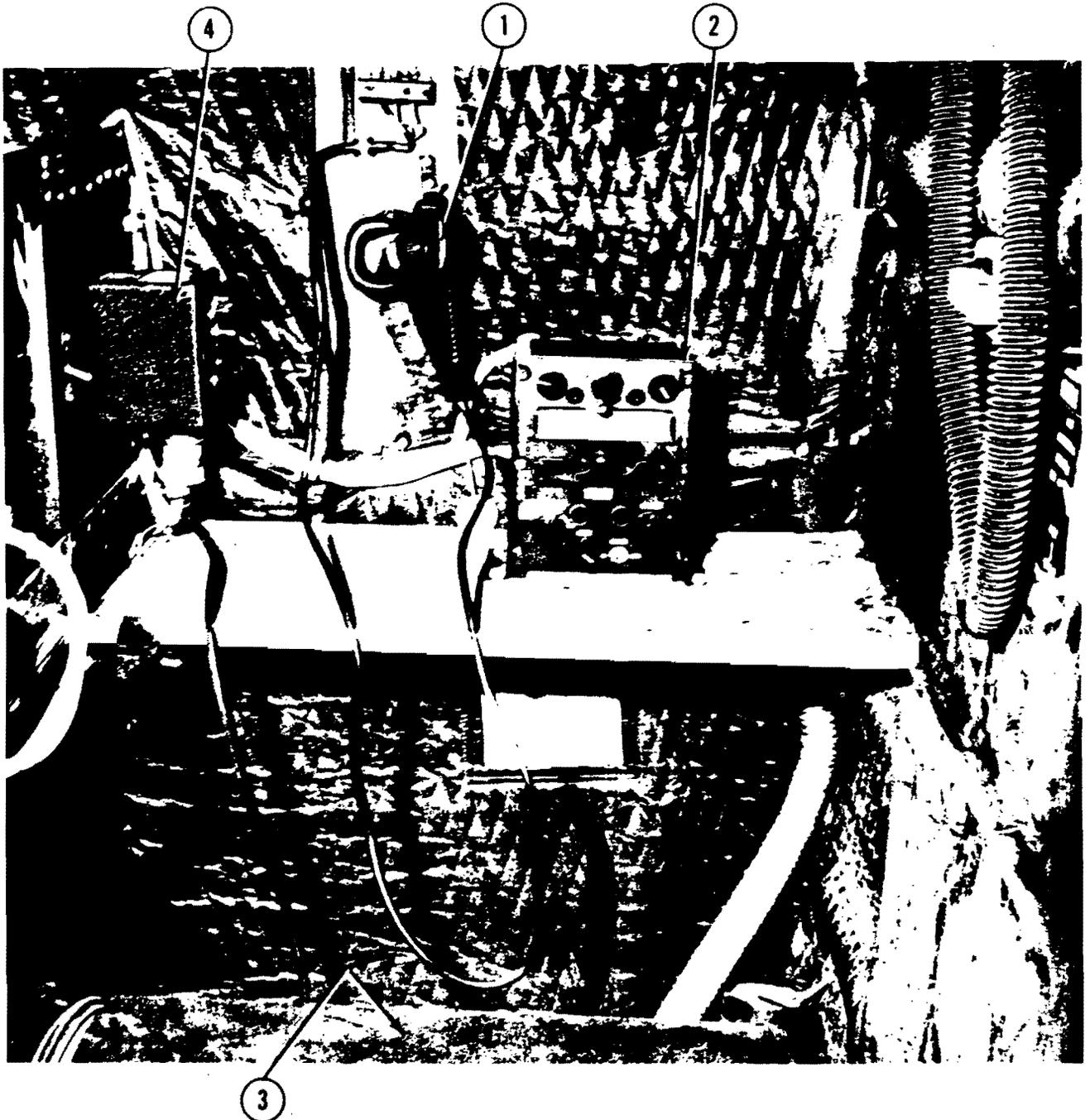
2. KEYER

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)

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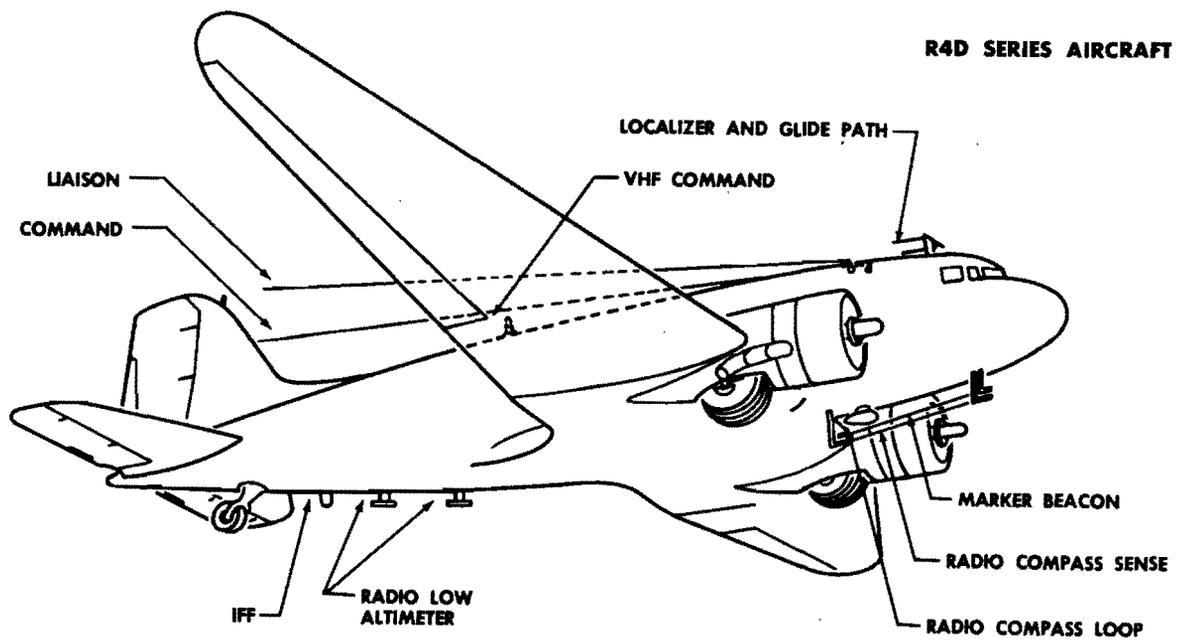
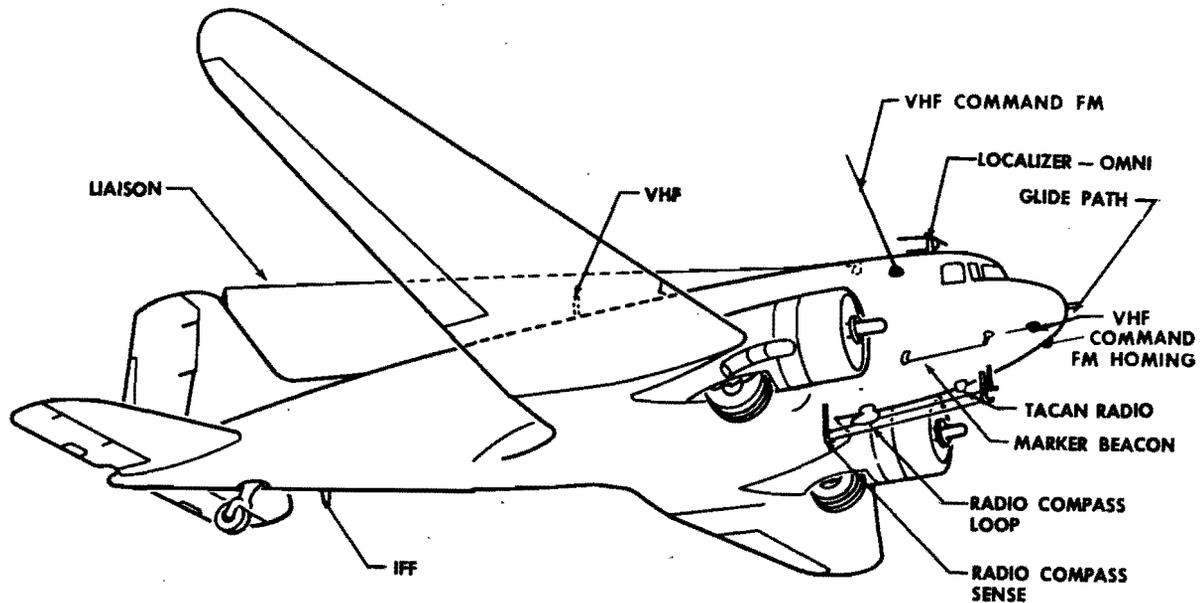


Figure 4-8

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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 1-20).

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.

TACAN FALSE LOCK-ON.

Occasionally TACAN equipment will "lock-on" to a false bearing which will be 40° or a multiple of 40° in error. These errors can be on either side of the correct bearing. When the TACAN "locks-on" a false bearing, switching to another channel and then back to the desired channel, or turning the set off and then back on will recycle the search mode. This will most probably result in a correct "lock-on."

NOTE

This deficiency does not affect the DME display provided by the TACAN equipment.

- a. When using TACAN, cross check for false "lock-on" with ground radar, airborne radar, VOR, dead reckoning or other available means. These cross checks are especially important when switching channels or when turning set on.
- b. If a false "lock-on" is suspected, switch to another channel, check it for correct bearing and then switch back to the desired channel.
- c. Check for correct "lock-on".
- d. If false "lock-on" is still suspected, turn set off and then ON.
- e. Recheck for correct "lock-on."
- f. If false "lock-on" persists, utilize the other equipment or aids available.

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NOTE

If, during an emergency the size and direction of error can be determined, TACAN can be utilized if compensation is made for the error in TACAN bearing.

"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.

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.

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.

Anticollision Light and Switch

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.

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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 anticollision light during these conditions since it could not be observed by pilots of other aircraft.

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.

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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.

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 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.

AUTOPILOT CONTROL PANEL - TYPICAL



Figure 4-10

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.

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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. Autopilot oil pressure gage - Within limits.
7. Uncage the bank-climb gyro unit.
8. Set the gyro turn unit to desired heading and uncage.
9. Flight controls - Neutral.
10. 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.
11. 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.
12. Autopilot control valve handle - ON.
13. Check autopilot operation by turning each trimmer control knob.
14. 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.

15. Auto - pilot emergency shutoff handle - OFF.

During Flight.

To operate the autopilot during flight, proceed as follows:

1. Trim the aircraft to fly "hands off."
2. Auto-pilot emergency shutoff handle - ON.
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 and the autopilot emergency shutoff handle - OFF.

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 upper face of the instrument shows the magnetic heading uncorrected for variation. 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.

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.

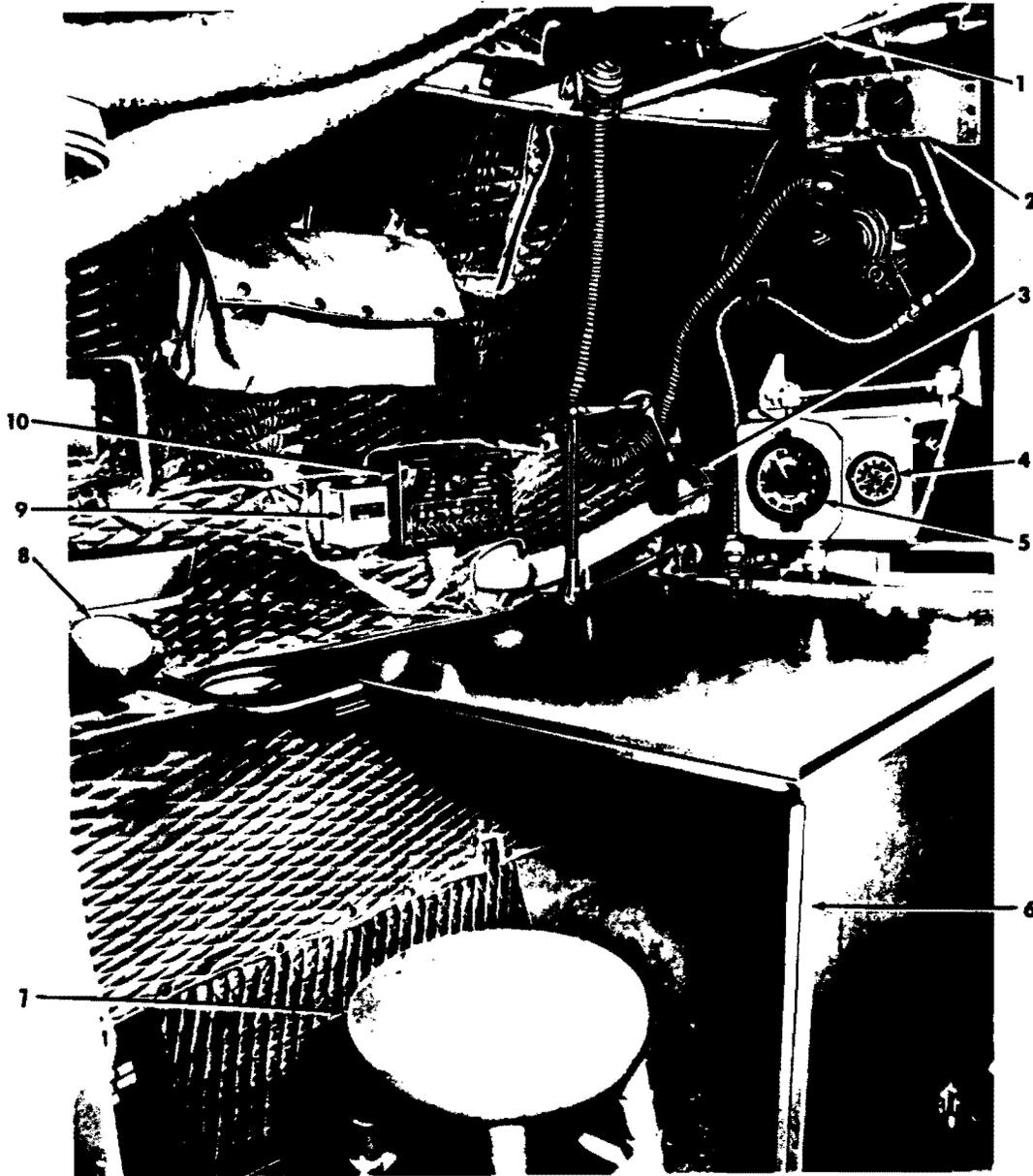
Holes for the attachment of loading ramps are provided in the sill of the main cargo loading doors.

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NAVIGATOR'S STATION—TYPICAL
C-47 SERIES AIRCRAFT



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

Figure 4-11

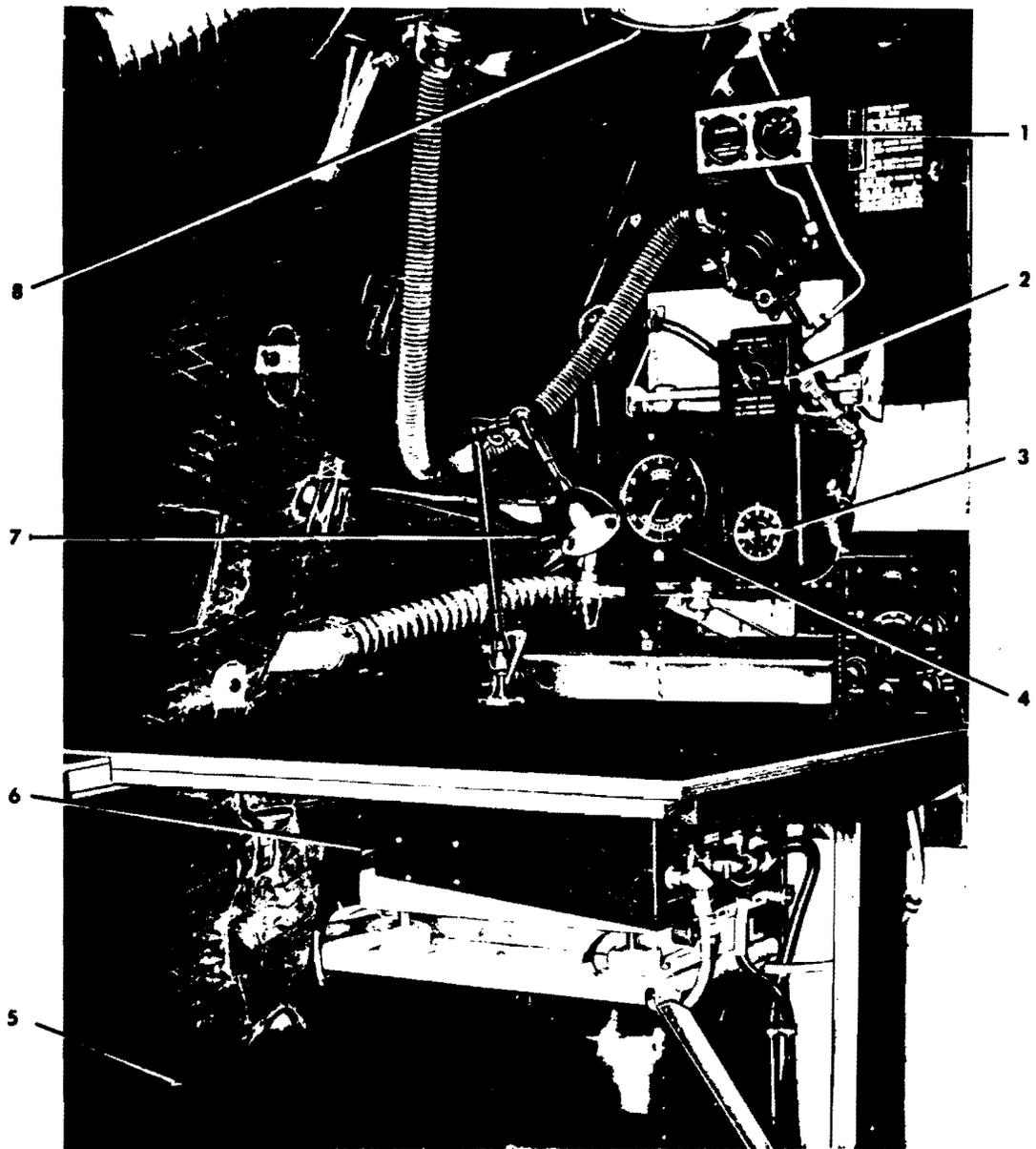
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NAVIGATOR'S STATION - TYPICAL

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



1. OXYGEN FLOW PANEL

5. NAVIGATOR'S STOOL

2. RADIO COMPASS SWITCH

6. R-101/ARN-6 COMPASS RECEIVER

3. RADIO MAGNETIC INDICATOR

7. TABLE WORK LAMP

4. FLUX GATE COMPASS MASTER INDICATOR

8. DOME LIGHT

Figure 4-12

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**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 lifting 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.

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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.