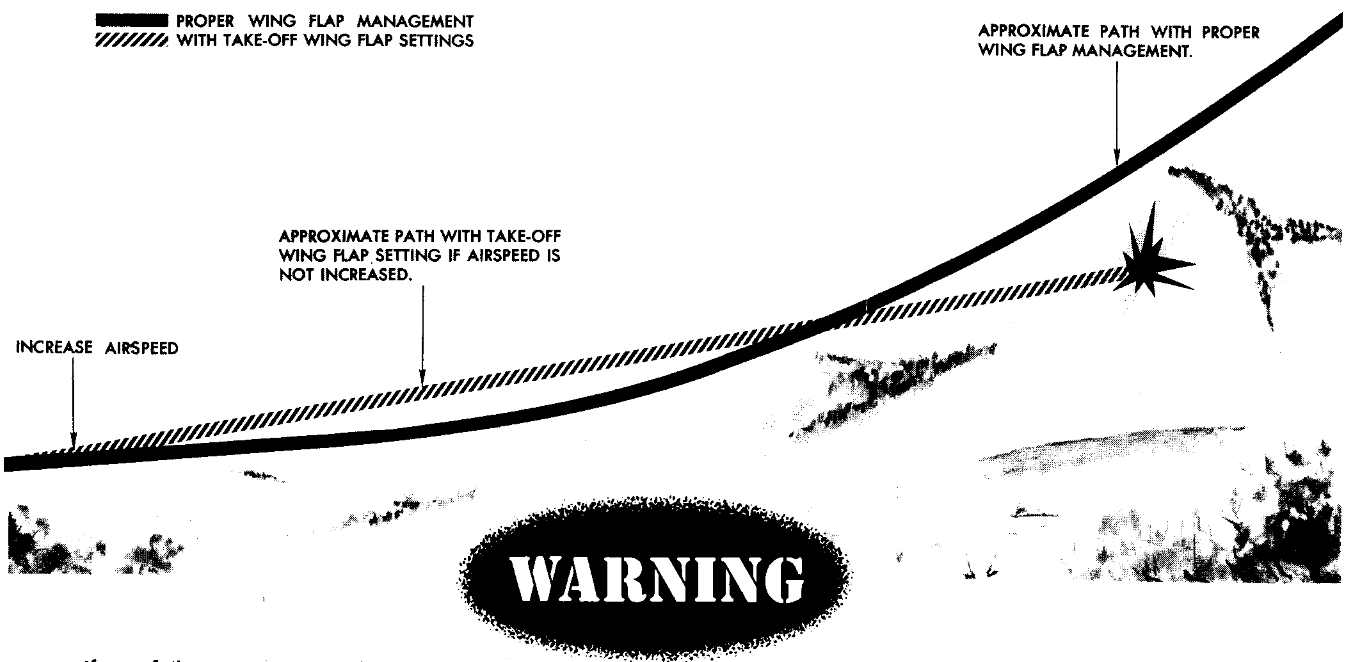
CLIMB-OUT PROCEDURE (TYPICAL)



If you fail to reduce rate of climb in order to increase airspeed, you will lose altitude when you retract the wing flaps.

Retract the wing flaps approximately 1° per knot increase in airspeed as acceleration permits.

C-45257-2

Note

While propeller is feathering, accomplish power, gear, and flap changes as necessary. Complete the following engine shutdown actions accurately and promptly.

2. MIXTURE — OFF. (CP)

3. FLUID HANDLE — PULL OUT. (CP)

Note

If the handle cannot be pulled out, it may be turned to free the fire extinguisher switch and guard.

4. FUEL VALVE — OFF. (FE)

5. FUEL BOOST PUMP — OFF. (FE)

6. NACELLE FLAPS (SHUTDOWN ENGINE) — CLOSED. (FE)

WARNING

If flame or smoke is observed at a nacelle flap opening, close the flaps completely prior to fire extinguisher discharge. If no flame or smoke is evident at the nacelle flaps but is observed elsewhere, discharge the fire extinguisher as soon as the engine stops or obviously will not slow down further.

7. MANUAL HEAT ANTI-ICE (SHUTDOWN ENGINE) — OFF. (FE)

WARNING

During practice this action may be simulated, however this procedure is extremely critical during icing conditions; refer to Single-Engine Anti-Icing Operation, this Section.

1.1 MINIMUM CONTROL SPEEDS

DENSITY ALTITUDE (FEET)	S.L.	5000	10000
IAS (KNOTS)	102 A B 103 C D	99 A B 101 C D	96 A B 98 C D

C-45260

Figure 3-2

8. FIRE EXTINGUISHER — ON (IF FIRE EXISTS). (CP)

Note A

If either the MAIN or RESERVE supply has been discharged, placing the selector switch to the remaining supply and holding the fire extinguisher switch to the ON position will discharge the remaining extinguisher agent.

Clean Up Airplane

1. Generator (shutdown engine) — Off. (FE)
(2.) Electrical Load — Minimum. (FE)
(3.) Load Monitor — As required. (FE)
4. Alternator (shutdown engine) — Off. (FE)
(5.) Alternator Selector — As required. (FE)
6. Nacelle Flaps — As required. (FE)
(7.) Ignition (shutdown engine) — Off. (FE)
8. Throttle (shutdown engine) — Closed. (CP)
9. Cabin Pressure — As required. (CP) B C D

Note B C D

- If the left engine has failed, the cabin pressurization switch may be turned to ALT AIR FLOW to reduce the load on the right engine. Alert crew to use oxygen as required.

B C D

- If the right engine has failed, the cabin pressurization switch should be turned to ALT AIR FLOW position to allow adequate circulation of air into the cabin.

- If it is necessary to continue flight on a single engine, maintain balanced fuel weight in the wings within 600 pounds by operating the engine alternately from both tanks. Refer to FUEL CROSSFEED OPERATION, Section VII, and the Appendix.

ENGINE FIRE

Safety of personnel and the airplane required the use of optimum fire control procedures in combating an inflight engine fire. Elapsed time from engine fire detection to initiation of fire control actions must be kept to a minimum. Tests have demonstrated that the effectiveness of fire extinguishing agents are maximum when the engine fluid pumps are not actuating as a result of propeller feathering. Accordingly, initiation of feathering action cannot be delayed upon detection of an engine fire. The procedure presented below is designed for maximum fire control effectiveness.

Engine Shutdown

Identify malfunctioning engine by fire warning lights and visual observation.

Note

All ENGINE FIRE, Engine Shutdown procedures, Steps 1 thru 8, are identical to INFLIGHT ENGINE FAILURE SHUTDOWN procedures. All Notes and Warnings apply.

Clean Up Airplane

Note

All Clean Up Airplane procedures, Steps 1 thru 9, are identical to those for INFLIGHT ENGINE FAILURE. All Notes apply.

FUEL PRESSURE DROP

The fuel pressure-low warning light serves both engines. If the light comes on, check the fuel pressure gages to determine which engine is affected. If the fuel pressure drops below the operating limits during flight, but the engine continues to operate normally, the cause may be one or more of the following: primer leakage, oil dilution solenoid leakage, engine-driven fuel pump bypass valve leakage, clogged pressure line, instrument failure, or line leakage. Whenever fuel pressure drops and the engine continues operating normally, the first concern of the crew must be to guard against the outbreak of an engine fire. The greatest danger lies in the fact that the crew develops a false sense of security because no fire exists at the time the fuel pressure drop is noticed or after several hours of flight. However, when the throttle is retarded (as in preparation for a landing), an engine fire develops and the results are usually disastrous. What has happened is that a fuel leak existed, but the cooling and dispersing effect of the airflow through the engine nacelle at cruising speed has prevented the start of a fire. When the throttle was retarded, the airspeed dropped and the airflow was reduced sufficiently to permit ignition of the leaking fuel. Any change in the airflow pattern, such as feathering the propeller or entering a climb, can start a fire if a fuel leak exists. Increasing the power is less likely to start a fire since airspeed will be increased, but even here there is a possibility of fire since the exhaust heat and flame pattern may change sufficiently to outweigh the increase in cooling airflow. Accordingly, it must be the objective of the crew to eliminate the fuel before any change is made to the airflow or exhaust pattern. The most efficient way of accomplishing this is by moving the mixture control to IDLE CUT OFF before any throttle reduction, propeller feathering, or any other engine shutdown procedure is initiated. An additional advantage of moving the mixture control to IDLE CUT OFF is that it provides the most rapid means of eliminating exhaust stack flames and reducing exhaust heat. Possible courses of action, depending on the cause of the pressure drop, are listed below:

SHUT DOWN THE ENGINE

Do this if the power is not necessary to sustain flight or to reach a safe destination.

Engine Shutdown

1. Mixture — Off. (CP)

WARNING

Do not change airspeed or airplane attitude prior to mixture control cutoff.

2. Propeller — Feather. (CP)

Note

While the propeller is feathering, accomplish power, gear, and flap changes as necessary. Complete the following engine shutdown actions accurately and promptly.

3. Fluid Handle — Pull Out. (CP)

Note

If the handle cannot be pulled out, it may be turned to free the fire extinguisher switch and guard.

4. Fuel Valve — Off. (FE)

5. Fuel Boost Pump — Off. (FE)

5A. Oil Coolers — Off. (FE)

6. Nacelle Flaps (Shutdown Engine) — Closed. (FE)

WARNING

If flame or smoke is observed at a nacelle flap opening, close the flaps completely prior to fire extinguisher discharge. If no flame or smoke is evident at the nacelle flaps but is observed elsewhere, discharge the fire extinguisher as soon as the engine stops or obviously will not slow down further.

7. Manual Heat Anti-ice (Shutdown Engine) — Off. (FE)

WARNING

During practice this action may be simulated, however this procedure is extremely critical during icing conditions; refer to Single Engine Anti-Icing Operation, this Section.

8. Fire Extinguisher — On (If Fire Exists). (CP)

Note Ⓐ

If either the MAIN or RESERVE supply has been discharged, placing the selector switch to the remaining supply and holding the fire extinguisher switch to the ON position will discharge the remaining extinguishing agent.

Clean Up Airplane

Note

All Clean Up Airplane procedures, Steps 1 thru 9, are identical to those for INFLIGHT ENGINE FAILURE. All Notes apply.

KEEP THE AFFECTED ENGINE IN OPERATION AT OR ABOVE CRUISING SPEED WHILE MAINTAINING WATCH FOR FIRE

Do this if it cannot be determined whether or not an actual leak exists and the engine is needed to either sustain flight or to maintain the required altitude for arrival at a safe destination. However, prior to power reduction for entry into the landing pattern, shut down the affected engine completely (by means of the mixture control, not by retarding the throttle) unless power from both engines is absolutely essential to effect a safe landing.

CONTINUE OPERATING THE ENGINE NORMALLY

This may be done if it can be unquestionably determined that the indicated fuel pressure drop has not resulted from a fuel leak.

Note

All other factors being equal, shutting down the engine immediately is generally the best course. However, action to be taken depends entirely upon the circumstances existing at the time. Such factors as the known condition of the airplane and the remaining engine, stage and requirements of the mission, and power requirements of the airplane should all be considered.

RESTARTING ENGINE

CAUTION

Do not attempt to restart engine unless it can be determined that it is safe to do so. It is safer to make a single-engine landing than to take a chance on starting an engine fire in flight.

1. Airspeed — 130 KIAS Maximum. (P)
   To prevent overspeeding in event of propeller malfunctioning, the recommended airspeed for unfeathering is 130 KIAS.
2. Mixture — Off. (CP)
3. Throttle — Close. (CP)
4. Propeller — Low Lights. (CP)
   Hold the propeller speed control lever for the shutdown engine in the DEC RPM position until the governor limit light illuminates. Setting the governor in its decrease rpm limit (high pitch) will prevent engine overspeed in the event of a power surge when the engine is restarted.
5. Fluid Handle — In. (CP)
6. Fuel Valve — On. (FE)

6A. Starter — As required. (P-CP)
If an engine has been shut down from five minutes to an hour, use starter to crank propeller through six blades prior to unfeathering for hydraulic lock check. If an engine has been shut down for an hour or more, crank through 15 blades to ensure adequate engine pre-oiling.

(7.) Feather Button — Pull Out. (P-CP)

WARNING

- Watch the propeller during unfeathering and release the button when rotation begins. With this procedure the governor can control the propeller and pitch hunting or inadvertent reversal can be avoided if the propeller electrical system is faulty.
- Do not use the tachometer for determining when to return the button to NORMAL. The tachometer indication is too slow and holding the manual feather button to OUT longer than necessary when unfeathering may cause inadvertent pitch reversal if the circuit is defective.

CAUTION

If three attempts to unfeather a propeller are not successful, the pitch changing mechanism may be considered to be defective and further attempts to unfeather may ultimately lead to more serious trouble. Leave the propeller feathered and land as soon as practicable.

8. RPM — 1200 (stabilized). (P-CP)
9. Oil Pressure — Checked. (FE)
10. Ignition — Both. (FE)
11. Mixture — Auto Rich. (CP)

Note

- Warmup after unfeathering should be accomplished in a manner as similar to ground warmup as possible. RPM should not exceed 1200, until oil temperature starts to rise. Complete engine warmup may then be accomplished at 1500 RPM and 20 in. Hg.
- When climatic conditions are favorable to carburetor icing and the engine will not start with the mixture control placed in the AUTO RICH position, carburetor icing may be suspected. Place the carburetor heat control lever in the HOT position and hold the prime switch to the ON position. The engine should start and generate enough heat to warm the carburetor and clear it of ice.

12. Engine Instruments — Checked. (FE)
13. Nacelle Flaps — As required. (FE)
14. Generator — On. (FE)
15. Alternator — On. (FE)
16. Manual Heat Anti-ice — On. (FE)
17. Load Monitor — Normal. (FE)
18. Electrical Equipment — As required. (P-CP)
19. Restarting Engine Checklist — Completed. (FE)

PROPELLER FAILURES

Inadvertent Propeller Reversal

Results of controlled flight tests with one propeller in reverse pitch indicate that control of the airplane can be maintained if corrective action is taken immediately. It cannot be accurately predicted, however, what effects would be encountered should a propeller suddenly and unexpectedly go into reverse pitch at cruising speeds and power settings. Controllability of the airplane is expected to be most critical at low airspeed and high power settings. The propeller noise resulting from overspeed as the blade angle passes through flat pitch is unmistakable. The higher the airspeed, the higher the noise level.

ENGINE SMOKE AND FLAME IDENTIFICATION

NOTE
Whenever flame or smoke trails from the augmentor tubes and augmentor position indicators indicate CLOSED, place vane switches in TRAIL position.

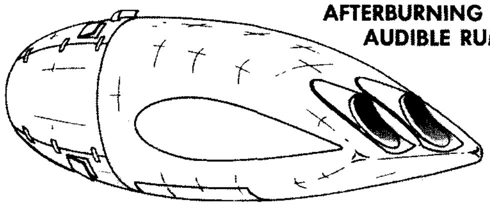
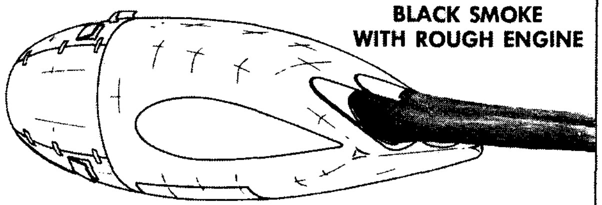
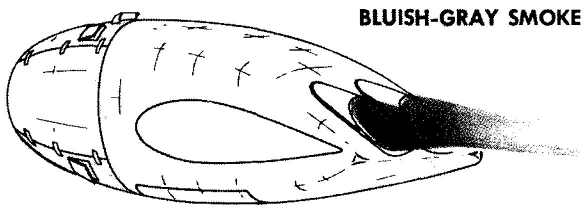
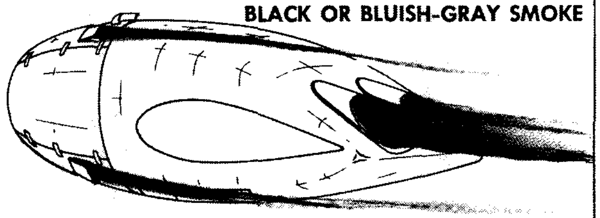
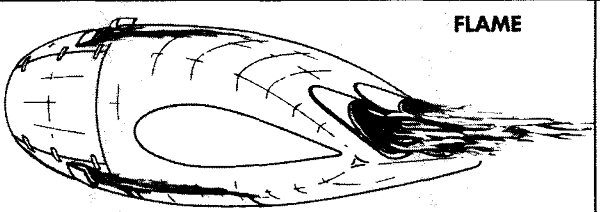
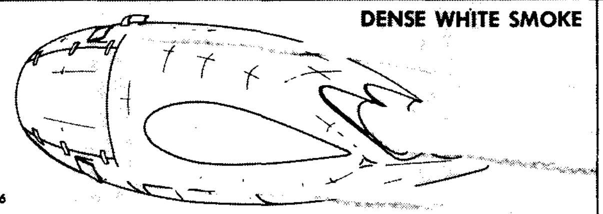
CONDITION	CAUSE	ACTION
AFTERBURNING AND/OR AUDIBLE RUMBLE 	Augmentor vanes closed. Augmentor vanes jammed. Excessively rich mixture.	Trail augmentor vanes. Reduce power or feather. Reduce power. Close nacelle flaps. Lean mixture.
BLACK SMOKE WITH ROUGH ENGINE 	Detonation, afterfire or backfire fr[illegible]h mixture.	Reduce power.
BLACK SMOKE (SAME ILLUSTRATION AS ABOVE)	Possible oil leak.	Monitor oil pressure. If pressure drops below minimum—feather.
BLUISH-GRAY SMOKE 	Damaged or worn piston rings, permitting cylinder to pump oil.	No inflight action possible. Record on DD form 781 and monitor condition.
BLACK OR BLUISH-GRAY SMOKE 	Oil fire.	Use fire and feather procedure.
FLAME 	Gasoline fire.	Use fire and feather procedure.
DENSE WHITE SMOKE  25,666	Fire in induction system. Magnesium engine case has probably ignited.	Action should have been taken to extinguish fire before it reaches this stage. Use fire and feather procedure. Alert crew for bail-out as fire can cause major structural damage.

Figure 3-3

Deceleration of the airplane and possibly yaw, buffeting, or bucking effect would be pronounced at higher airspeeds. Closing the throttle of the affected engine will cause the engine to stall out and the propeller to start windmilling backward. This will be indicated by a zero indication on the tachometer. The amount of control then required will be approximately the same as that required for a normal windmilling propeller condition. If a suspected propeller reversal occurs, the following procedure must be used:

1. THROTTLE — CLOSE. (P)

Note

If altitude permits, close both throttles to reduce airspeed and minimize yaw. Restore power to the engine which continues to indicate rpm.

2. PROP. REVERSE CIRCUIT BREAKERS — PULL OUT. (FE)

Note

It is quicker to have the flight engineer pull both circuit breakers than attempt to tell him which one to pull.

3. PROPELLER — FEATHER (CP)

WARNING

Under no circumstances should the engine be restarted. Do not reset the propeller reverse circuit breaker after a propeller reversal in flight, as reversal may recur.

Note

If propeller will not feather out of reverse pitch, continued windmilling backwards will cause oil starvation and probable engine seizure.

Runaway Propeller

If the propeller allows the engine to exceed 2825 rpm and cannot be controlled by the propeller speed control lever, it is considered to be a runaway propeller. If a runaway propeller occurs, proceed as follows:

1. THROTTLE — RETARDED. (P)
2. MAINTAIN BEST CLIMB SPEED FOR CONFIGURATION. (P)
3. PROPELLER — FEATHER. (CP)

Note

If single-engine climb performance is not sufficient to clear obstacles or terrain, some power may be obtained by repeated use of the feathering button to hold engine rpm within limits.

If this condition exists, proceed as follows:

a. Push the manual feathering button to IN; then pull it to the NORMAL (half out) position as rpm drops within limits. (CP)

WARNING

Holding the feathering button all the way out may cause inadvertent propeller reversal, if the blade switch is defective or inoperative.

(b.) After reaching a safe altitude, retard the throttle to a point which will give 2800 rpm. Unless essential for continued flight, close the throttle and feather the engine. (CP)

CAUTION

If propeller is not feathered, maintain watch on oil quantity. If oil quantity decreases rapidly, feather the propeller.

c. Land as soon as possible.

Overspeeding Propeller

An overspeeding propeller is one which has allowed the engine to exceed 2825 rpm, but is controllable by the propeller speed control lever.

Failure to Feather

a. If the manual feathering button will not remain in, hold it in until feathering is completed. (CP)

b. If the circuit breaker pops out, hold the circuit breaker in until feathering is completed. The feathering pump control circuit breaker is a non-trip-free breaker that may be held in the reset position in the event of an emergency. (FE)

c. If the propeller still fails to feather, place the mixture control in the IDLE CUT OFF position; move the throttle to full open position; the autofeather switch to on; and manually depress feather button. (CP-FE)

d. If the propeller still fails to feather, use the propeller speed control lever to place the propeller in full DEC RPM (low light). At this setting, windmilling drag will be at a minimum although considerably greater than when feathered.

WARNING

Operating the engine fluid-off handle shuts off the supply of fuel, oil, and hydraulic fluid to the affected engine. If the propeller fails to feather and it can be definitely determined that a fire or fire hazard does not exist, leave the fluid-off handle in. This may prevent damage to the engine which could result from windmilling without lubrication.

Power Loss or Oscillation

Note

Propeller oscillation may occur at high power settings at altitudes above 20, 000 feet due to oil foaming and poor oil scavenging.

CAUTION

If engine overspeed occurs, land at the nearest base. Note all conditions of overspeeding on Form 781.

Serious damage to the engine may result from overspeeding if power is restored suddenly while the propeller is in low pitch. If a momentary power loss or n appreciable oscillation occurs, proceed as .ollows:

a. Close the throttle of the affected engine and reduce airspeed to approximately 130 KIAS. (P-CP)

b. Mixture control level — AUTO RICH. (CP)

c. Propeller speed control lever — LOW LIGHT (decrease rpm). (CP)

d. If oscillation has resulted from fuel exhaustion, reestablish fuel pressure by proper setting of the fuel system controls. Refer to FUEL SYSTEM OPERATION, Section VII. (FE)

e. Check for normal operation at reduced power. Apply power slowly, noting whether the condition recurs. (CP)

CAUTION

If power oscillation cannot be controlled by this procedure, shut down the engine.

Propeller Pitch Hunting

On Takeoff— If rpm oscillation is encountered during takeoff, return to the field immediately and determine the cause.

During Cruise — If rpm cannot be stabilized and the engine is running smoothly, the propeller pitch oscillation may be due to a malfunction of the propeller governor. To overcome this condition, exercise the propeller speed controls from high rpm to low rpm several times. If this procedure does not correct the condition, land the airplane at the first opportunity and investigate the cause.

Propeller Blade Failure

During flight, the damage or loss of a propeller blade would make immediate identification extremely difficult due to severe vibration. If the affected engine cannot be identified by visual observation, immediate power reduction on both engines (throttles to the CLOSE position and propeller speed control levers in the DEC RPM position until the low lights illuminate) may dampen vibration sufficiently to enable identification so the engine can be feathered.

WARNING

Corrective action must be taken immediately to prevent engine separation.

ELECTRICAL FIRES (UNDETERMINED SOURCE)

Specific circumstances will, in most cases, dictate what action will be taken when the source and location of an electrical fire is known. The primary objective is to isolate the source of the fire. If an electrical fire occurs, check all circuit breakers for indications as to which circuit or circuits have caused the trouble. If the system which caused the trouble can be determined, turn off the system and isolate the circuit by pulling the proper circuit breaker(s). If the cause of the fire cannot be determined and the fire is not under control:

1. ALERT CREW/PASSENGERS: ORDER USE OF OXYGEN (100%): DESIGNATE CREW MEMBER TO DIRECT FIRE FIGHTING. (P)
2. (2) Cabin Pressure — Dump and Alternate Air Flow. (CP) B C D
3. RPM — METO Set. (CP)
4. Battery — Off. (CP)
5. Generators — OFF. (CP)
6. Alternators — Off. (CP)

WARNING

When Steps 1 thru 6 are completed, there are no flight instruments in operation. Exercise extreme caution during IFR and/or icing conditions.

7. Blowers — Low. (CP)
8. (8) Circuit Breakers — As required. (FE) If the source of fire has been determined, it

is necessary only to pull the circuit breakers that will isolate the system before restoring electrical power. If the source of fire has not been determined, pull all circuit breakers before proceeding.

CAUTION

Do not turn on any electrical equipment except in case of extreme emergency, unless the source of trouble has been definitely located and the circuit isolated.

Note

Monitor the loadmeter for abnormal indications while restoring electrical power.

9. Battery — On. (FE)

10. Generators — On. (FE)

11. Alternators — On. (FE)

(12.) Necessary Circuit Breakers — On, one at a time. (FE)

FUSELAGE FIRE

WARNING

Fire in the fuselage must be fought with portable fire extinguishers. These extinguishers are filled with bromochloromethane pressurized with nitrogen to 150 psi. Prolonged exposure (five minutes or more) to high concentrations of bromochloromethane (CB) or its decomposition products can cause pronounced eye and nose irritation and should be avoided. CB is an anesthetic agent of moderate intensity. It is safer to use than previous fire extinguishing agents (carbon tetrachloride, methylbromide); however, adequate respiratory and eye protection from excessive exposure, including the use of oxygen when available, should be sought as soon as the primary fire emergency will permit.

1. ALERT CREW/PASSENGERS: ORDER USE OF OXYGEN (100%): DESIGNATE CREW MEMBER TO DIRECT FIRE FIGHTING. (P)

Note

The users of the portable fire extinguishers will wear the portable oxygen units if a fixed oxygen regulator is not within reach.

WARNING

Some portable oxygen bottles have no provision for 100% oxygen flow in the diluter valve. For these type bottles, a 100% oxygen flow can be obtained by holding the hand over the diluter valve. This will not increase the rate of flow of oxygen, but will merely restrict air from mixing with the oxygen.

(2.) Cabin Pressure — Dump and Alternate Air Flow. (CP) B C D

3. Load Monitor — OFF. (FE)

4. Heat and Vent — Shutoff. (CP)

5. Reserve Oil Heat — Off. (CP)

Note

If the fire is below the floor, restrict the CB discharge to the below-floor area. An access door is provided in the floor opposite the rear service door for fighting fire in the area of the reserve oil tank. For areas forward of that point, on A, B, and C airplanes, use the vent grills just above the floor along each side of the cabin to get access to discharge the CB. Kick out a section of grill if necessary. On D airplanes, it will be necessary to remove floor panels or chop holes with the crash axe. Try to discharge the CB just forward of the fire as circulation will carry the vapor aft.

WARNING

If the fire threatens to get beyond control, be prepared to bail out or make an immediate emergency landing.

After the fire is definitely extinguished, ventilate the airplane. Refer to SMOKE AND FUMES ELIMINATION, this Section.

SMOKE AND FUMES ELIMINATION

Cabin Pressurized B C D

To remove smoke and fumes from the fuselage when the cabin is pressurized, allow the cabin pressurization system to remain in operation. Smoke and fumes will be eliminated in approximately five minutes.

Cabin Not Pressurized

If the cabin is not pressurized, open one of the direct-vision windows in the flight compartment, open all curtains between compartments, and remove one of the emergency exit hatches over the wing.

ACCESS TO RESERVE OIL TANK

Figure 3-4

CAUTION

Do not open the extreme aft emergency exit. Fumes and smoke will be forced towards the cockpit.

WING FIRE

1. Alert Crew and Order Use Of Oxygen (if necessary). (P)
2. Electrical Equipment To Wing — Off. (CP-FE)
3. Manual Heat Anti-ice Handle — Off. (FE)
4. If Fire Is In Right Wing:
   a. Alternator-Generator Hydraulic System — OFF. (CP)
   b. Pressurization Switch — Alternate Air Flow. (CP) Ⓑ Ⓒ Ⓓ

WARNING

If fire involves the fuel tank area of the wing, be prepared to bail out or make an immediate emergency landing should leaking fuel begin to feed the flame.

BAILOUT

If parachutes are available, the pilot must make the decision to bail out, crash land, ditch, or emergency descend and land depending upon the circumstances and type of emergency. The information and procedures given below are based on the assumption that the pilot has made the decision to bail out.

If over uninhabited territory, make bailouts in close order so that all personnel will land in the same vicinity. If over water, and surface vessels are below, head the airplane so that personnel will drift onto the course of a vessel. Make two or more bailout runs, if practicable, to place personnel close together. Make a particular crew member responsible for bailout of the passengers in the cabin. The procedure will vary according to conditions. If circumstances permit, descend to an altitude at which oxygen will not be required for bailout.

Preparation for Bailout

1. Alert Crew and Passengers. (P)
   Notify crew and cabin occupants by interphone and/or loudspeaker and receive acknowledgement. Ring alarm bell three short rings. This notification will be the signal for airplane occupants to put on parachute and to perform all preparatory duties for bailout.
2. Transmit Distress Signals — IFF/SIF Emergency. (CP)
   The copilot or radio operator will transmit course, altitude, ground speed, and estimated position. Turn IFF/SIF to emergency setting.
3. Cabin Pressure — Dump and Alternate Air Flow. (CP) Ⓑ Ⓒ Ⓓ
   Depressurize the cabin with the manual dump valve and turn the cabin pressurization switch to ALT AIR FLOW.
4. Airspeed — 120 KIAS. (P)
   Reduce airspeed to as near the recommended bailout speed of 120 KIAS as time will permit.
5. Wing Flaps — 24°. (CP)
6. Autopilot — ON; Altitude Control — OFF. (P)
   Time permitting, the autopilot will be engaged to assist in affording a more stable platform from which to bailout. With the autopilot engaged (altitude control OFF), the pilot will have a better chance of accomplishing a bailout without personal injury.
7. Rear Service Door — Unlock and Jettison. (Designated)
   See figure 3-5. Have a designated crew member or cabin occupant jettison the rear service door and perform jump master duties during exit of passengers. This designated jump master should be in interphone contact with the pilot and report his activities.

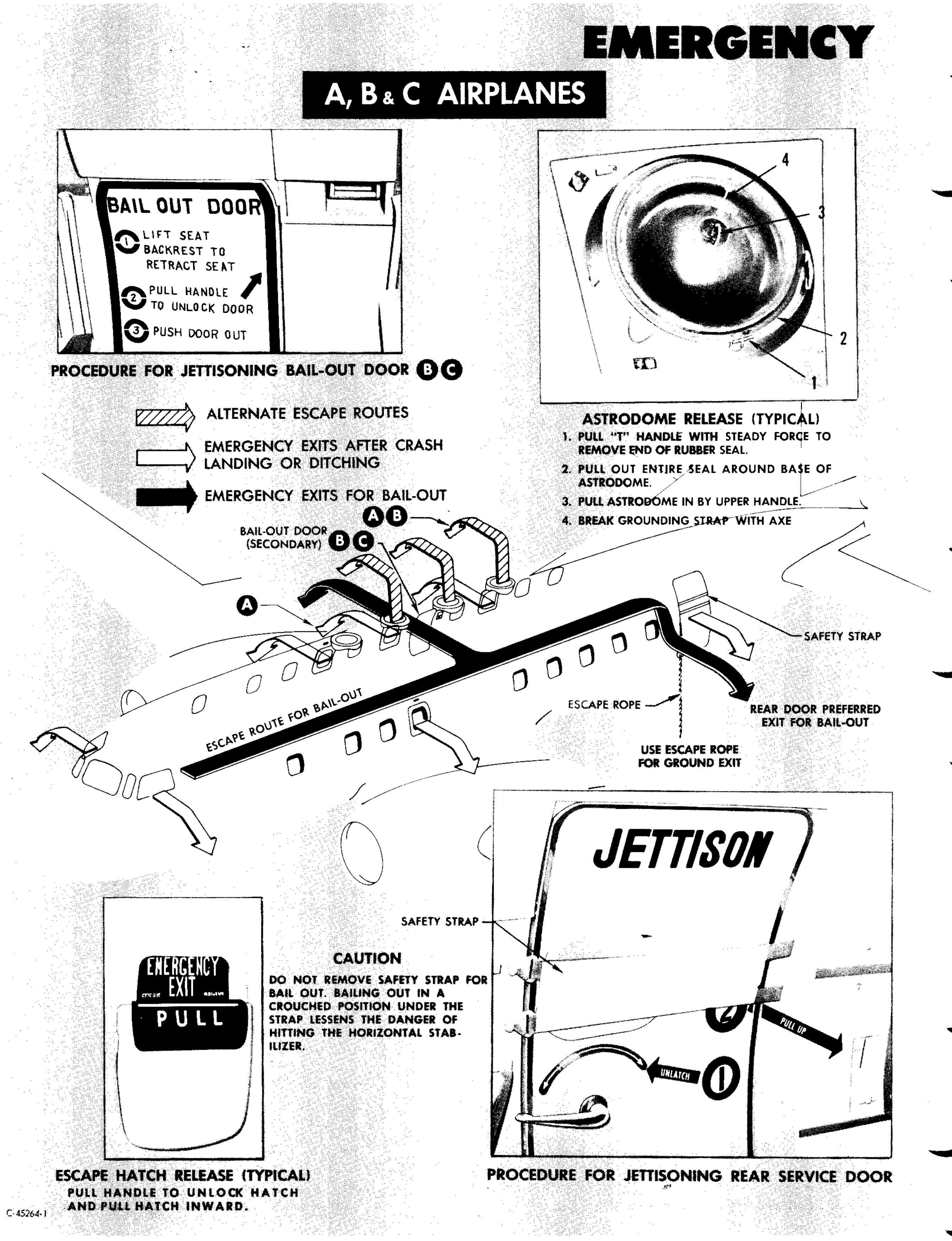
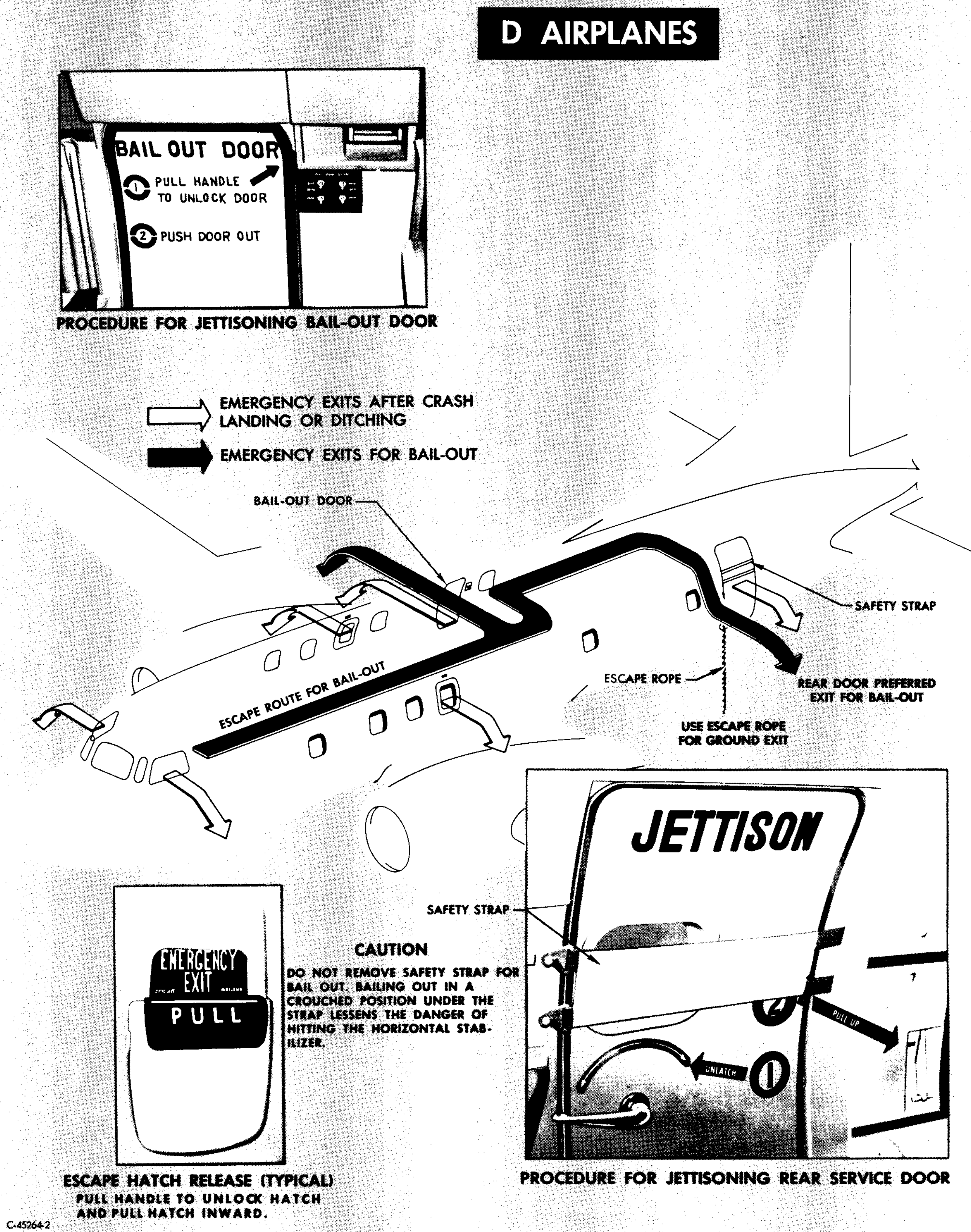

EMERGENCY
A, B & C AIRPLANES
BAIL OUT DOOR
1 LIFT SEAT BACKREST TO RETRACT SEAT
2 PULL HANDLE TO UNLOCK DOOR
3 PUSH DOOR OUT
PROCEDURE FOR JETTISONING BAIL-OUT DOOR B C
ASTRODOME RELEASE (TYPICAL)
1. PULL "T" HANDLE WITH STEADY FORCE TO REMOVE END OF RUBBER SEAL.
2. PULL OUT ENTIRE SEAL AROUND BASE OF ASTRODOME.
3. PULL ASTRODOME IN BY UPPER HANDLE.
4. BREAK GROUNDING STRAP WITH AXE
ALTERNATE ESCAPE ROUTES
EMERGENCY EXITS AFTER CRASH LANDING OR DITCHING
EMERGENCY EXITS FOR BAIL-OUT
A B
BAIL-OUT DOOR (SECONDARY) B C
A
SAFETY STRAP
ESCAPE ROUTE FOR BAIL-OUT
ESCAPE ROPE
REAR DOOR PREFERRED EXIT FOR BAIL-OUT
USE ESCAPE ROPE FOR GROUND EXIT
JETTISON
SAFETY STRAP
PULL UP
UNLATCH
CAUTION
DO NOT REMOVE SAFETY STRAP FOR BAIL OUT. BAILING OUT IN A CROUCHED POSITION UNDER THE STRAP LESSENS THE DANGER OF HITTING THE HORIZONTAL STABILIZER.
EMERGENCY EXIT
PULL
ESCAPE HATCH RELEASE (TYPICAL)
PULL HANDLE TO UNLOCK HATCH AND PULL HATCH INWARD.
PROCEDURE FOR JETTISONING REAR SERVICE DOOR
C-45264-1

Figure 3-5

ESCAPE ROUTES *(TYPICAL)*



MAXIMUM GLIDE

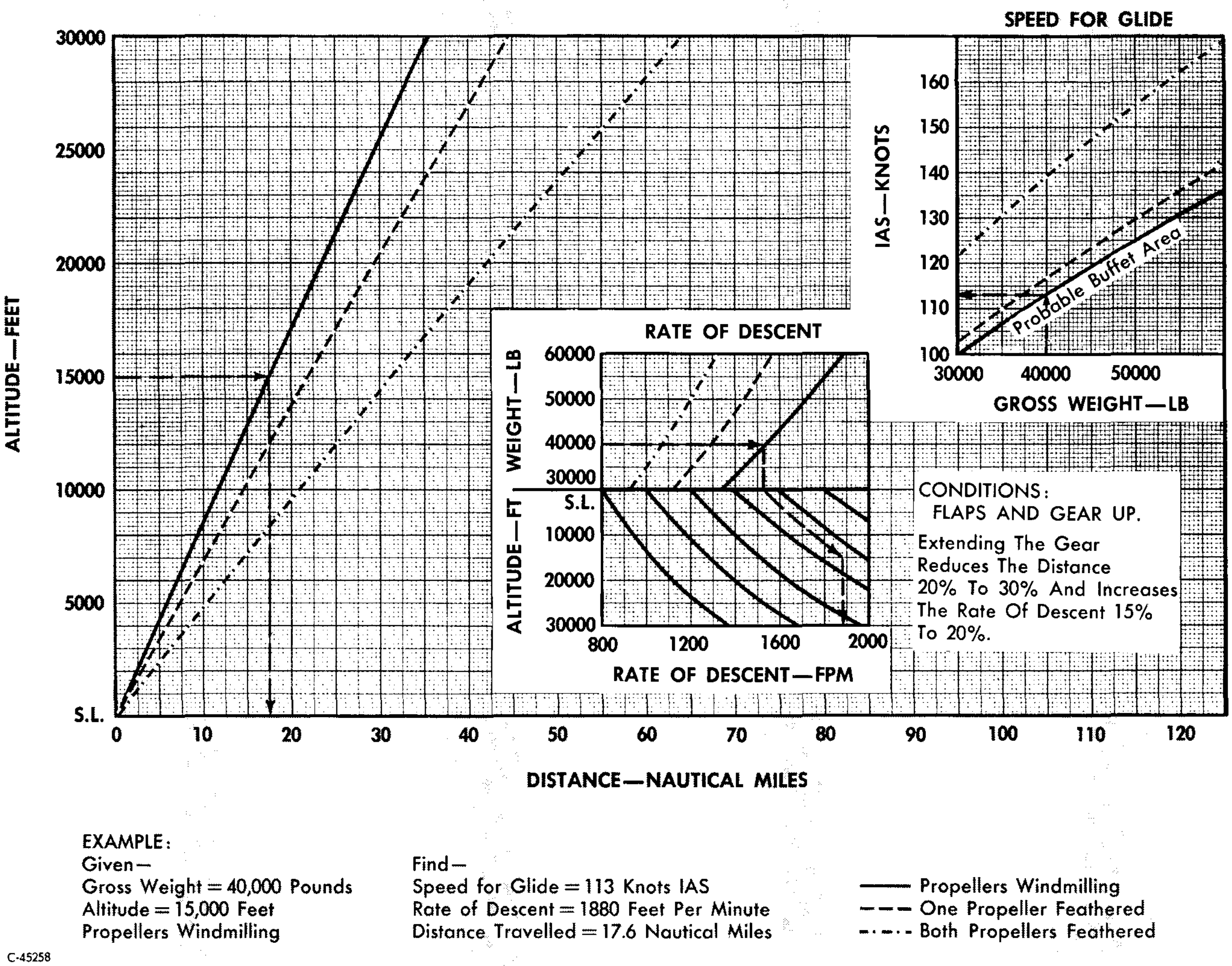


Figure 3-6

Note

- Be sure that the airplane is depressurized before opening any exits.
- The only safe exits in flight are the rear service door and the secondary bailout door (if installed). However, due to the size of the secondary bailout door, the rear service door should be used as the primary exit for bailout. The only exception to this would be if the rear service door would not jettison or if there were a fire on the left side of the fuselage.

WARNING

- Do not attempt to open the main entrance door in flight under any circumstances; it is not structurally designed for opening in flight.
- When the rear service door is jettisoned during certain flight attitudes, there is a possibility of the door striking the horizontal stabilizer and even remaining embedded in the stabilizer; however, the low airspeed and angle of attack with flaps extended should minimize this possibility. If the door does become embedded in the stabilizer, do not use the exit for bailout purposes, as the clearance would be marginal.

8. Give Bailout Signal. (P)
   The bailout order will be given by loudspeaker, interphone, and/or one long ring on the alarm bell.

MAXIMUM GLIDE

See figure 3-6.

Note

If buffet occurs at glide speeds indicated in figure 3-6, an increase of 10 KIAS will decrease the buffet, provide better control of the airplane, and will not decrease the glide distance significantly.

DRIFT-DOWN

If an engine fails during flight at altitudes above single-engine ceiling, the airplane will drift down; i. e., lose altitude at a decreasing rate until stabilized flight is attained at the absolute ceiling for the power and instantaneous weight conditions. For best results, operate the remaining engine at METO power and fly the airplane at recommended drift-down speeds. In cases of emergency, the use of military power will reduce the altitude loss. Refer to DRIFT-DOWN in the Appendix.

EMERGENCY DESCENT

The two recommended methods for emergency descent are low airspeed maximum-drag, and high airspeed minimum-drag. The low airspeed maximum-drag condition is recommended when structural damage to the airplane is suspected, when operating in turbulent air, or in case of engine fire, when the fire is contained within the engine or accessory cowling. The high airspeed minimum-drag condition is recommended if pressurization fails at high altitude.

Note

If an engine fire should become uncontrolled, with flames sweeping past the nacelle, the landing gear and wing flaps should not be lowered until just before landing. Airspeed limits should be observed to avoid structural failure.

Low Airspeed—Maximum Drag

a. Mixture control levels — AUTO RICH. (CP)

b. Close throttles and reduce airspeed to maximum full flap speed. (P)

c. Propeller speed control levels — HIGH LIGHTS. (FE)

(d.) Lower landing gear and extend full flaps. (CP-FE)
The copilot will lower the landing gear and the flight engineer will extend the flaps.

e. Descend at airspeed not to exceed maximum full flaps airspeed. (P)

High Airspeed—Low Drag

a. Power — As required. (P)

(b.) Landing gear and flaps up. (CP-FE)
The copilot will raise the landing gear and the flight engineer will retract the flaps.

c. Airspeed — 266 KIAS maximum. Above 16, 500 feet, reduce maximum airspeed approximately five knots per 1000 feet. (P)

WARNING

When operating at high airspeed, take into account atmospheric conditions and need for maneuvering the airplane. In no case exceed maximum dive speed. Do not exceed limiting airspeed with propeller feathered.

CRASH LANDING

Before Approach

1. Alert the Crew/Passengers. (P)
Notify crew and cabin occupants by interphone and/or loudspeaker and receive acknowledgement. Ring alarm bell six short rings. This notification will be the signal for airplane occupants to perform all preparatory duties for crash landing. See figure 3-7 for individual crew duties.

Note

Although figure 3-7 is entitled "Ditching Chart" the duties listed are, with the obvious exception of duties concerning flotation gear, for all practical purposes, identical to Crash Landing duties. Therefore, figure 3-7 can be effectively utilized by disregarding references to flotation gear and substituting "Crash Landing" for "Ditching."

2. Transmit Distress Signals — IFF/SIF to Emergency. (CP)
The copilot or radio operator will transmit course, altitude, ground speed, and estimated position. Turn IFF/SIF to emergency setting.

3. Cabin Pressure — Dump and Alternate Air Flow. (CP) B C D
Depressurize the cabin with the manual dump valve and turn cabin pressurization switch to ALT AIR FLOW.

4. Escape Hatches — Open. (Designated)

5. Rear Service Door — Unlock. (Designated)

6. Loose Equipment — Secure or Jettisoned. (Designated)

7. Order Seat Belts Fastened, No Smoking. (P)
See figure 3-8 for Crash Landing positions.

A, B & C AIRPLANES DITCHING

PILOT'S DUTIES

1. Alert the crew and personnel with six (6) short rings on the alarm bell and give the order "Prepare for Ditching" over the loudspeaker and interphone.
2. Request the Navigator to obtain present position, time, altitude, course, ground speed, wind, and estimated position of ditching.
3. Instruct Radio Operator or Copilot to transmit emergency message containing above information.
4. Transmit "MAYDAY" and give position information on VHF (UHF) emergency channels.
5. Remove cords, tie, straps, and oxygen mask (below 12,000 feet); loosen collar and parachute harness; don exposure suit and life vest (do not inflate).
6. Move seat full forward and tighten seat belt securely.
7. Immediately before contact give one (1) long ring on alarm bell.

COPILOT'S DUTIES

1. Stand by for orders. Send emergency messages as required. Operate voice radio as required.
2. Depressurize cabin with manual control (some airplanes).
3. Secure all loose equipment in cockpit; check that sliding windows are closed.
4. Remove cords, tie, straps, and oxygen mask (below 12,000 feet); loosen collar and parachute harness; don exposure suit and life vest (do not inflate) and energize transceiver.
5. Move seat full forward and tighten seat belt securely.

FLIGHT ENGINEER'S DUTIES

1. Stand by for orders. Assist in carrying out ditching procedures; jettison escape hatches, astrodomes and secure or jettison all loose equipment.
2. Remove cords, tie, straps, and oxygen mask (below 12,000 feet); loosen collar and parachute harness; don exposure suit and life vest (do not inflate).
3. Strap first aid kit to arm.
4. Take ditching position in cabin seat before contact. Tighten seat belt securely.

AFTER DITCHING

All crew members and personnel will evacuate the airplane through one of the following exits listed in preferred order:
A. Rear service door.
B. Escape hatches over left wing.
C. Flight compartment left side window.
D. Forward escape hatch over right wing and bail-out door.
E. Flight compartment right side window.
F. Astrodomes and aft escape hatch over right wing.

Designated crew members will launch the life raft(s) and provide emergency radio transmitter.

Navigation Instructor will carry a complete navigation kit.

Personnel seated near first aid kits and flashlights will carry these items.

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RADIO OPERATOR'S DUTIES

1. Transmit international distress signal (SOS) and give position information. At 3000 feet descending, lock key for continuous signal.
2. Remove cords, tie, straps, and oxygen mask (below 12,000 feet); loosen collar and parachute harness; don exposure suit and life vest (do not inflate).
3. Take ditching position at radio operator's station or vacant student position with seat belt fastened, seat facing forward, and parachute on lap in crash landing position.

NAVIGATOR / NAVIGATION INSTRUCTOR'S DUTIES

1. Obtain present position, time, altitude, course, ground speed, wind, and estimated position and give to pilot and radio operator.
2. Supervise ditching procedures; removal and jettisoning of escape hatches, astrodomes, Loran sets, and all loose equipment. Unlock the rear service door.
   Note: Turn NAV-RADIO switch OFF (pilot will disconnect alternator BUS NO. 2) before removing electronic equipment to prevent short circuits.
3. Supervise seating and preparation of personnel in cabin. Notify pilot when all preparations are completed.
4. Remove cords, tie, straps, and oxygen mask (below 12,000 feet); loosen collar and parachute harness; don exposure suit and life vest (do not inflate) and energize transceiver.
5. Take ditching position with seat belt fastened, seat facing forward, and parachute on lap in crash landing position.

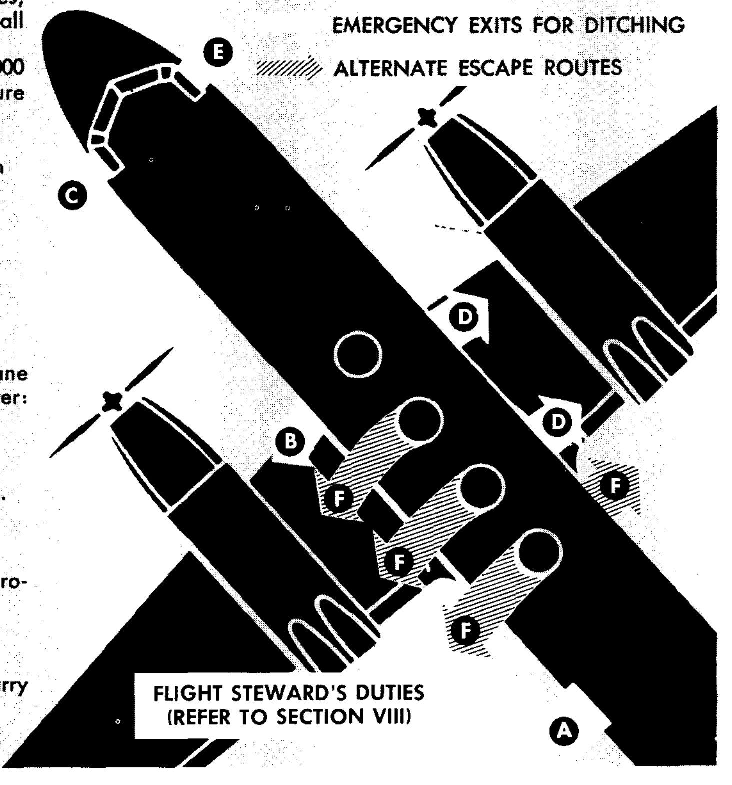

Figure 3-7

CHART (TYPICAL) D AIRPLANES

PILOT'S DUTIES

1. Alert the crew and personnel with six (6) short rings on the alarm bell and give the order "Prepare for Ditching" over the interphone.
2. Request the Navigator to obtain present position, time, altitude, course, ground speed, wind, and estimated position of ditching.
3. Instruct Copilot to transmit emergency message containing above information.
4. Transmit "MAYDAY" and give position information on VHF (UHF) emergency channels.
5. Remove cords, tie, straps, and oxygen mask (below 12,000 feet); loosen collar and parachute harness; don exposure suit and life vest (do not inflate).
6. Move seat full forward and tighten seat belt securely.
7. Immediately before contact give one (1) long ring on alarm bell.

COPILOT'S DUTIES

1. Stand by for orders. Send emergency messages as required. Operate voice radio as required.
2. Depressurize cabin with manual control.
3. Secure all loose equipment in cockpit; check that sliding windows are closed.
4. Remove cords, tie, straps, and oxygen mask (below 12,000 feet); loosen collar and parachute harness; don exposure suit and life vest (do not inflate).
5. Move seat full forward and tighten seat belt securely.

FLIGHT ENGINEER'S DUTIES

1. Stand by for orders. Assist in carrying out ditching procedures; jettison escape hatches and secure or jettison all loose equipment.
2. Remove cords, tie, straps, and oxygen mask (below 12,000 feet); loosen collar and parachute harness; don exposure suit and life vest (do not inflate).
3. Strap first aid kit to arm.
4. Take ditching position in cabin seat before contact. Tighten seat belt securely.

AFTER DITCHING

All crew members will evacuate the airplane through one of the following exits in preferred order:

A. Rear service door.
B. Escape hatch over left wing.
C. Flight compartment left side window.
D. Escape hatch over right wing and bail out door.
E. Flight compartment right side window.

Designated crew members will launch life raft(s) and provide emergency radio transmitter.

Navigation instructor will carry a complete navigation kit.

All personnel will carry their own flashlights

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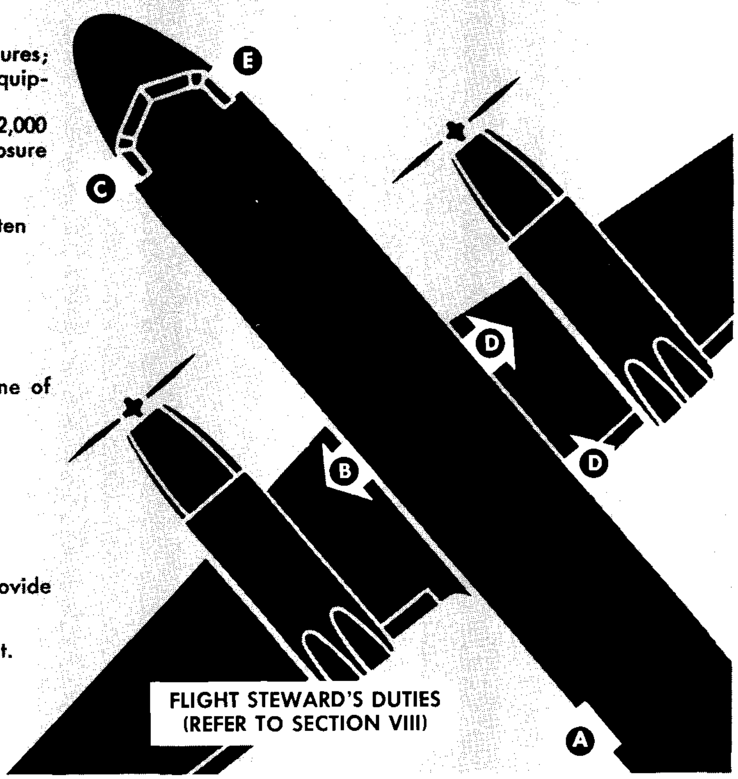
NAVIGATION INSTRUCTOR'S DUTIES

1. Obtain present position, time, altitude, course, ground speed, surface wind, estimated position of ditching and give information to copilot.
2. Supervise students at stations 4, 5, 6, and 7 for position, stowage of loose gear and turn off all radio and radar sets not essential for navigation.
3. Remove cords, tie, straps, and oxygen mask (below 12,000 feet); loosen collar and parachute harness; don exposure suit and life vest (do not inflate).
4. Strap first aid kit to arm.
5. Take ditching position at station 8. Tighten seat belt securely.

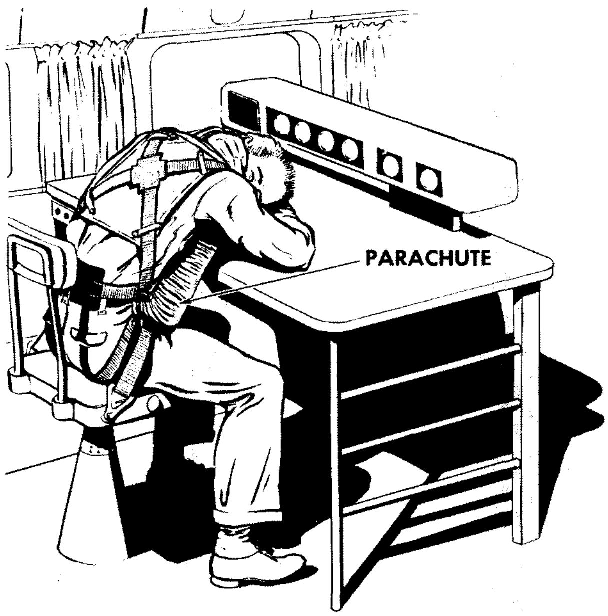
BOMBARDIER INSTRUCTOR'S DUTIES

1. Assist navigation instructor.
2. Make security check of all loose equipment at aft stations.
3. Distribute parachutes to student bombardiers.
4. Turn off all radio and radar equipment.
5. Unlock the rear service door.
6. Remove cords, tie, straps, and oxygen mask (below 12,000 feet); loosen collar and parachute harness; don exposure suit and life vest (do not inflate).
7. Strap first aid kit to arm.
8. Take ditching position at station 11, seat full down and feet braced against back of station 9 and 10 seats. Tighten seat belt securely.



FLIGHT STEWARD'S DUTIES (REFER TO SECTION VIII)

CRASH LANDING AND DITCHING PROCEDURES *(TYPICAL)*



CABIN OCCUPANTS AND FLIGHT ENGINEER POSITION—TYPICAL

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PILOT AND COPILOT POSITION—TYPICAL

Figure 3-8

WARNING

The flight engineer's seat is not designed to withstand expected crash landing forces. The flight engineer will secure himself in a cabin seat before contact.

8. Crossfeed – Off. (P)
   To avoid having fuel under pressure in the crossfeed line, have each tank feed its own engine, if possible.

Approach and Contact

(1.) Landing Gear – As required. (CP)

Note

Crash land with the landing gear extended if possible. If it is impossible to extend one of the main landing gears, land with the other gear extended. The extended gear, even on reasonably rough terrain, provides an absorption of the initial shock, resulting in less injury to personnel and damage to the airplane. If a foam-covered runway is available and it is impossible to extend one of the main landing gears, a gear-up landing is recommended.

(2.) Wing Flaps – As required. (CP)

(3.) Alert Crew/Passengers For Contact. (CP)
The alert for contact will be given by loud-speaker, interphone, and/or one long ring on the alarm bell.

4. Generators – Off. (CP)

(5.) Fluid Handle – Pull Out. (CP)
Immediately before contact.

6. Ignition – Off. (CP)

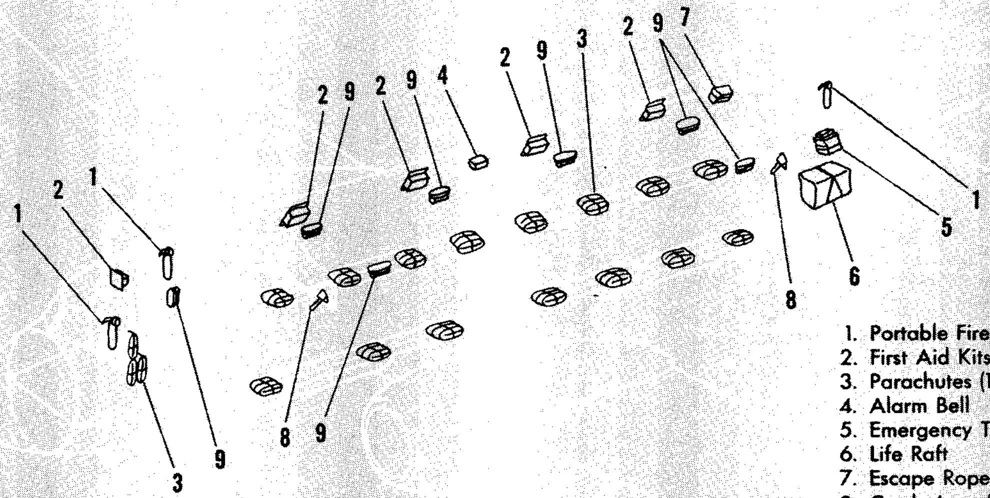
7. Battery – Off On Impact. (CP)

Note

In the event a fire was the reason for the emergency landing, try to turn the air-plane so that the wind blows the fire away from the exit(s) to be used.

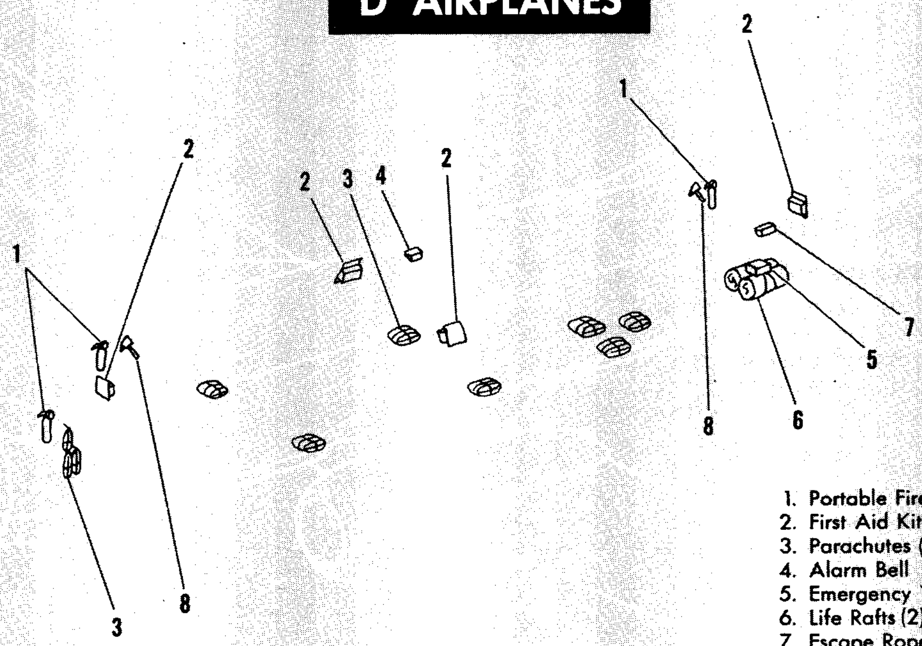
MISCELLANEOUS EMERGENCY EQUIPMENT *(TYPICAL)*

A, B & C AIRPLANES



1. Portable Fire Extinguishers (3)
2. First Aid Kits (5)
3. Parachutes (18)
4. Alarm Bell
5. Emergency Transmitter AN/CRT-3
6. Life Raft
7. Escape Rope
8. Crash Axes (2)
9. Flash Lights (6)

D AIRPLANES



1. Portable Fire Extinguishers (3)
2. First Aid Kits (4)
3. Parachutes (11)
4. Alarm Bell
5. Emergency Transmitter AN/CRT-3
6. Life Rafts (2)
7. Escape Rope
8. Crash Axes (2)

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Figure 3-9

After Crash Landing

Hold crash landing positions until the airplane comes to rest. Available emergency equipment, such as the crash axe, first aid kit, and portable fire extinguisher, should be carried from the airplane. Exit from the airplane should be made in an orderly manner according to the routes shown in figure 3-5.

DITCHING

Results of tests conducted with scale models and results of actual ditchings indicate that the airplane is equal or superior to the ditching safety potentials of other airplanes in the same general classification. The airplane has shown good static buoyancy qualities, floating slightly nose down with all openings and important equipment remaining above the load water line. It is essential that crew members and passengers become thoroughly familiar with all procedures and specific duties to ensure success in the event of an emergency ditching. Ditching drills should be performed by the flight crew at established intervals. Prior to all overwater flights, the passengers should be given a briefing on ditching procedures and use of applicable equipment.

Before Ditching

If time and conditions permit, observe the major swell movements. Determine the direction of the major swell system by observing the sea from 2000 feet or above. At this altitude, the relatively regular parallel pattern of the predominant system stands out in a clear relief. Note the compass heading from which the swell front approaches. Observe the surface conditions. Fly at an altitude under 1000 feet (preferably 200 or 300 feet) to observe surface conditions. Frequently the direction of the swell as observed from this lower altitude will vary considerably from the major system observed above 2000 feet.

Select Ditch Heading

Generally speaking, the best ditch heading is parallel to the major swell regardless of wind direction. Under 20 knots, disregard the wind except to avoid downwind components when possible. (A formidable secondary swell system may necessitate a heading down swell and partially down wind.) Study successive likely headings and note the one in which the sea appears most favorable for a landing. Normally the heading that looks the smoothest will be the best.

Select Touchdown Area

Look ahead for abnormally rough areas and try to avoid them. Look for a relatively smooth area when a minor swell fills in the trough of the major swell and flattens the resultant sea.

Before Approach

Use as much of the fuel supply as possible before ditching to lighten the load and make flotation aids out of the fuel tanks. Do not completely exhaust the fuel supply, as a power-on landing is desirable.

1. Alert Crew/Passengers To Prepare For Ditching. (P)
   Notify crew and cabin occupants by interphone and/or loudspeaker and receive acknowledgement. Ring alarm bell six short rings. This notification will be the signal for airplane occupants to perform all preparatory duties for ditching. See figure 3-7 for individual crew duties.
2. Transmit Distress Signal — IFF/SIF Emergency. (CP)
   The copilot or radio operator will transmit course, altitude, ground speed, and estimated position. Turn IFF/SIF to emergency setting.
3. Cabin Pressure — Dump. (CP) Ⓑ Ⓒ Ⓓ
   Depressurize the cabin with the manual dump valve.
4. Escape Hatches (over wing) — Open. (Designated)
5. Rear Service Door — Unlock. (Designated)
6. Loose Equipment — Secure or Jettisoned. (Designated)
7. Manual Dump Valve — Normal. (CP) Ⓑ Ⓒ Ⓓ
8. Order Seat Belts Fastened, No Smoking. (P)
   See figure 3-8 for ditching positions.

WARNING

The flight engineer's seat is not designed to withstand expected ditching forces. The flight engineer will secure himself in a cabin seat before contact.

9. Crossfeed — Off. (P)
   To avoid having fuel under pressure in the crossfeed line, have each tank feed its own engine, if possible.

Approach

Make a long low approach with nose-high attitude of approximately 9°. Head the airplane parallel to the major swells and aim the touchdown along the swell crest or just after the crest has passed, if the wind velocity is under 25 knots. If the wind exceeds 25 knots, select an intermediate heading by taking into consideration the wind and the major swell. The stronger the wind, the more the ditching heading should be into the wind. The higher the swell, the more the ditching heading should be parallel to the swell.

Before Contact

1. Landing Gear — Up. (CP)
2. (2) Wing Flaps — Full Down. (CP)
3. (3) Alert Crew and Passengers For Contact. (CP)

The alert for contact will be given by loudspeaker, interphone, and/or one long ring on the alarm bell.

Note

Be prepared for the following upon contact:

- Backlash of the control column.
- Nose-down attitude as airplane stops.
- Flooding of the forward portion of the cabin.

After Ditching

Hold ditching positions until the airplane comes to rest. Exit from the airplane in an orderly manner and as quickly as possible by the preferred or alternate exits shown in figures 3-5 and 3-7.

Evacuation

WARNING

Do not, in haste, overlook necessary emergency equipment or assigned duties.

a. Disperse passengers as evenly as possible. Try to keep them seated until they can be evacuated. Exercise caution when opening the rear exit door since passengers may rush to back of airplane, causing submerging of the door and premature flooding of the airplane.

b. Secure raft line to the airplane and do not inflate raft until outside the airplane.

WARNING

It may be impossible to force an inflated raft through the door. To preclude loss of raft, keep the safety lanyard attached to the airplane until raft is loaded and ready to be cut loose.

After Evacuation

a. Secure all liferafts together with raft lines. The longer the line, the better.

b. Distribute survivors among the liferafts, and check that all are accounted for. A crew member should be in charge of each raft.

c. Stay close to the airplane to facilitate rescue by search parties as the airplane will be easier to spot from the air than the liferafts. Keep the liferafts far enough away from the airplane to avoid contact with gas and oil on water as these will deteriorate the rubber rafts.

d. If airplane does not appear to be in imminent danger of sinking, a crew member may reboard to search for possible survivors or to obtain any items useful for survival such as blankets, food, and water.

LANDING

HYDRAULIC SYSTEM FAILURE

If a hydraulic system failure is encountered, the appropriate facility should be notified that the gear cannot be retracted for a go-around. Generally, it is better to fly a normal approach or traffic pattern. The following procedures shall be used for landing:

1. HYDRAULIC BYPASS – UP. (FE)

CAUTION

Keep the hydraulic pressure bypass handle in the UP position until after landing and the landing gear safety pins have been installed.

2. Emergency Hydraulic Pump – On (check pressure 2900 psi), Then Off. (FE) Build up accumulator pressure with the emergency hydraulic pump to 2900 psi. Then place the switch OFF and see if pressure remains up.

CAUTION

If accumulator pressure will not build up or if pressure does not remain at 2900 psi, a complete hydraulic failure is indicated. No attempt should be made to lower wing flaps. Whatever hydraulic pressure is available should be reserved for braking. During the early part of the landing roll, attempt to apply hydraulic brakes. While there is no assurance that hydraulic brakes will be available, even a slight amount of braking will greatly reduce tire wear and damage often associated with emergency air brake operation. (To conserve brake pressure, do not pump brakes.) If hydraulic braking is ineffective, the airplane may be stopped as described under EMERGENCY AIR BRAKE OPERATION, this Section.

3. Use Emergency Hydraulic Pump To Lower Approach Flaps, Then Turn Pump Off. (FE)

(4.) Landing Gear – Free Fall At 130 KIAS. (CP)

Note

If the main gear does not lock down, opening the oil cooler doors will direct air to the gear to assist locking.

5. Use Emergency Hydraulic Pump To Lower Landing Flaps – Leave Pump On. (FE) When on final approach and landing is assured, lower landing flaps and leave the emergency hydraulic pump ON for the completion of the landing.

WARNING

- The landing gear cannot be raised with the hydraulic pressure bypass handle in the UP position.
- Nose wheel steering will not be available. Reverse thrust should be used during the initial high speed ground roll while rudder control is still effective to aid in directional control. Loss of directional control could result in the event one propeller does not reverse.
- The airplane should be stopped straight ahead. Shut down engines and install gear pins before having airplane towed from the runway.

LANDING WITH ONE ENGINE INOPERATIVE

Single-engine landings are not much more difficult to perform than those with both engines operating and are accomplished in much the same manner. With the engine operating at METO power, it is desirable to conform as nearly as possible to the normal traffic pattern and speeds, to maintain familiar key points, thereby decreasing the possibility of a go-around by being too close to the runway on the downwind leg or too high or low on the final approach. A straight-in approach may be flown if necessary. Approach flaps should be used on the base leg, but landing gear extension may be delayed until the final approach is reached. Since the landing gear extends and locks down in less than 13 seconds, no special difficulty will normally arise during gear extension. Maintain a safe altitude on final approach until landing is assured, then lower the gear and extend the flaps as desired. (See figure 3-10 for typical procedure.)

LANDING WITH BOTH ENGINES INOPERATIVE

Make the landing in the same manner as described previously for landing with one engine inoperative except that the approach pattern must be varied in accordance with the steeper glide angle.

GO-AROUND WITH ONE ENGINE INOPERATIVE

Note

See figure 3-11 for typical single-engine go-around.

CAUTION

If making a go-around at extremely low altitude, do not retract the landing gear until positive that the airplane will not settle to the runway.

LANDING WITH LANDING GEAR RETRACTED—PREPARED SURFACE

If it is impossible to extend one of the main landing gears, land with the other gear extended unless a foam-covered runway is available. If a foam-covered runway is available, a gear-up landing is recommended. Follow procedures for CRASH LANDING, this Section.

LANDING WITH NOSE GEAR RETRACTED—MAIN GEARS EXTENDED—PREPARED SURFACE

If it is impossible to extend the nose gear but the main gears can be extended, extend the main gears and make a landing in such a way as to bring the nose down on the runway before elevator control is lost. The airplane is sufficiently nose heavy to cause extensive structural damage if the nose is allowed to come down suddenly. Proceed as follows:

a. Alert the selected airfield. (CP) Request specified section of runway be foamed.

Note

Better directional control may be maintained if the runway is foamed so that the main gear touchdown is in an unfoamed section and the nose touchdown is in the foamed section.

b. Warn the crew and passengers. (P)

c. Depressurize the cabin. (CP) B C D

d. Remove and stow the escape hatches in the lavatory compartment or jettison. (Designated crew member)

e. Jettison or secure all loose equipment. (Designated crew member)

f. Make a normal approach and flare-out. (P)

g. Cut both engines on contact by moving the mixture control levers to OFF. (CP)

h. Battery switch OFF on contact. (CP)

i. Use the elevators to lower the nose gradually, but force the nose to make contact with the runway before elevator control is lost. Keep the nose on the runway after it makes contact. Use the brakes lightly for steering and stopping. Heavy brake application will cause avoidable damage to the nose section and lessen the rudder steering effect. (P)

Note

The propeller blade tips will contact the runway when the nose is a little more than half lowered to the runway.

WARNING

When the propeller tips contact the runway, the load on the main gear will be reduced. Extreme caution should be exercised when applying brakes to prevent blowing out a tire.

LANDING WITH ONE ENGINE INOPERATIVE *(TYPICAL)*

WARNING

* SACRIFICE ALTITUDE FOR AIRSPEED ONLY WHEN 1.2 STALL SPEED (MIN) CANNOT BE MAINTAINED. CARE MUST BE EXERCISED TO AVOID PRE-STALL BUFFET WHILE TURNING. SHALLOW BANK TURNS ARE RECOMMENDED.

NOTES

- THIS IS A TYPICAL DIAGRAM WHICH IS NOT MEANT TO SHOW THE INTENDED FLIGHT PATH BUT DOES INDICATE A CHRONOLOGICAL ORDER FOR THE ITEMS TO BE PERFORMED. THESE ITEMS MAY BE PERFORMED BEFORE, BUT NORMALLY NOT LATER THAN THE POINT INDICATED ON THE DIAGRAM.
- REFER TO THE APPENDIX FOR APPROACH FLAP SETTINGS AND AIRSPEEDS AT VARIOUS GROSS WEIGHTS.

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Figure 3-10

SINGLE-ENGINE GO-AROUND

(TYPICAL)

Figure 3-11

LANDING WITH FLAT TIRE

Keep airplane headed in a straight landing roll by using nose wheel steering and reverse thrust. Use brakes as little as possible.

MISCELLANEOUS

OIL PRESSURE DROP (OIL INGESTION)

Oil ingestion can be detected when high oil temperature occurs with a subsequent drop in oil pressure and rapid decrease of engine oil quantity. If oil ingestion is experienced, the recommended action is to:

(a.) Immediately reduce power on the affected engine. (CP)

Note

Both manifold pressure and rpm should be reduced.

b. Open the oil cooler doors to the fully open position. (FE)

c. Increase speed to increase the airflow over the engine and through the cooling area. (P)

(d.) Retract or keep landing gear retracted unless preparing for landing. (CP)

In the event that oil ingestion cannot be controlled, the propeller should be feathered and a single-engine landing made.

SINGLE-ENGINE ANTI-ICING OPERATION

In the event of single-engine operation during icing conditions, cylinder head temperature must be increased to near maximum limits to provide adequate heat for wing and tail anti-icing.

WARNING

Because of the reduced capability of the anti-icing system during single-engine operation, there may not be sufficient heat in the wing and tail leading edges to evaporate the moisture or precipitation during icing conditions.

Proceed as follows:

a. Engine power — METO. (CP-FE)

b. Manual heat anti-ice handle (shutdown engine) — Off. (FE)

c. Augmentor vane switch — CLOSE. (FE)

Note

If the augmentor overheat warning bell rings and the vanes trail, reset vanes to a lesser degree.

d. Cylinder head temperature — Maintain 250° to 260°C. (FE)

e. Nacelle flaps — As required, but not exceeding MID-POSITION. (FE)

WARNING

Cylinder head temperatures must be monitored very closely. Every effort must be made to reach an ice-free flight level as soon as possible.

f. Reduce cabin heat requirements to an absolute minimum. (CP)

FUEL CROSSFEED OPERATION

For information regarding normal and emergency crossfeed operations, refer to FUEL CROSSFEED OPERATIONS, Section VII.

CAUTION

During all fuel system management operations, avoid creating fuel starvation in the system and then suddenly supplying fuel.

The design of the crossfeed system does not permit fuel to be transferred from one tank to the other. During normal two-engine operation, crossfeed valves must be closed. Operation with crossfeed valves open might result in partial feeding of fuel from one tank to the other, with resultant possible overflow of fuel through the tank vent outlets. In the event of fuel pressure fluctuation within operating limits at altitude when one fuel boost pump is inoperative, feed both engines from the tank with the operative boost pump. Shut off the main fuel valve with the inoperative boost pump. Return to normal operation as soon as practicable.

ELECTRICAL SYSTEM EMERGENCY OPERATION

Circuit Protection

The electrical system employs fuses and circuit breakers to open overloaded circuits automatically.

Generator Failure

WARNING

- If a generator failure occurs, the generator switch for the inoperative generator must be placed in the OFF position immediately. Generator equalizer coils are connected through the generator switches, and with the switch in the ON position, the voltage is reduced in the operating generator. In late **C** and **D** airplanes, the generator equalizer coils are automatically disconnected from the generator switch. The inoperative generator switch must still be turned off to prevent further damage.

WARNING

- Certain types of internal generator failure will create a serious fire hazard. If the generator is engine-driven, serious consideration should be given to feathering the propeller, if not essential for safe flight. In any case, maintain a watch for fire and make a landing at the nearest suitable airfield.

If either generator fails and the load monitor switch is in the NORMAL position, the load monitoring circuit will automatically disconnect nonessential electrical and electronic equipment. Nonessential equipment items that are automatically disconnected are described in the following table:

ITEM	NONOPERATING INDICATION
Antenna reel and reel light Ⓐ Ⓑ Ⓒ	Antenna will not reel. Light will go out or will not indicate, depending upon whether antenna is out or in.
Astrodome blowers Ⓐ Ⓑ Ⓒ	Will not function.
Automatic approach equipment	Approach ready light will go out. Airplane will not follow ILS beam.
Automatic pilot, spare inverter, RMI slaved compass #2 Ⓓ	Will not function.
Bomb scoring camera	Will not function.
Cabin dome lights Ⓐ Ⓑ Ⓒ	Will not function.
Cockpit heater Ⓑ Ⓒ Ⓓ	Will not operate.
Driftmeter inverters and indicator lights (late airplanes) Ⓒ	Will not function.
Instrument approach equipment (Omnirange)	Glide-scope and course deviation indicators will return to their nonoperating, centered position, and will not react to change in airplane position. Aural signals will not be heard and the alarm flag will appear.
Loran equipment Ⓐ Ⓑ Ⓒ	Receiver indicator will become inoperative.
Marker beacon receiver	Marker indicator lights will not glow. Aural signals will not be heard.
Periscopic sextant power Ⓐ Ⓑ Ⓒ	Sextant readings will not be illuminated.
Public address system	Loudspeakers will not be heard.
Radar interphone system Ⓐ Ⓑ	No communication.
Radar set and associated equipment	Traces will disappear from indicators. Phantom target, camera, and compressor will become inoperative.
Radar modulator (MD-78/APS-23) compressor	Transmitter output signal improperly controlled.
Radio altimeters	Pointer of the pilot's altitude indicator will move back to zero altitude. Pilot's three indicator lights will not function. The green traces will fade from the students' indicators.
Student compass repeaters	Indicator pointers will not follow heading, but will remain at the heading made good when power was cut.
Student table lights	Will not light.
Sight well light Ⓓ	Will not function.
Tacan	Course deviation indicators will return to their nonoperating, centered position, and will not react to change in airplane position. Aural signals will not be heard and warning OFF flag will appear.
Tail cone utility light Ⓓ	Will not function.

Failure of One Generator

Note

The generator failure warning light should illuminate when the generator switch is in the ON position and an overvoltage condition exists on Ⓐ aircraft and Ⓑ aircraft serial numbers 51-3739 thru 51-3816, or an overvoltage, undervoltage, or mechanical failure exists on all other Ⓑ , Ⓒ , and Ⓓ aircraft.

If generator failure occurs, proceed as follows:

a. Turn off defective generator. (FE)

b. Reduce electrical load. (P-CP-FE)

c. Load monitor switch - OVERRIDE. (FE)

Note

When operating in the OVERRIDE position, do not overload the remaining generator. Use only equipment necessary for safe operation. Use of the radar may overload the remaining generator.

d. Check voltage of defective generator. (FE) Select the failed generator with the voltmeter selector switch and check for the following conditions:

(1) Zero Voltage - probable mechanical failure (leave generator OFF).

(2) Undervoltage - indicated by less than 24 volts. Increase voltage to 28-28.5 volts and turn generator ON.

(3) Overvoltage - indicated by residual voltage of approximately plus 0.5 volts to 2 volts. Turn voltage control rheostat toward decrease. Attempt only one reset. If successful, adjust voltage to 28-28.5 volts and turn generator ON.

If generator power is restored:

e. Load monitor switch - NORMAL. (FE)

f. Radar - As required. (N)

If generator power is not restored, establish a fire watch and land at the nearest suitable airfield.

CAUTION

At any time an attempt is made to reset a failed generator, place the generator switch to the OFF position and check that generator voltage is within limits before placing the switch to the ON position. This procedure will prevent placing dangerously high voltages on the line when voltage control devices have failed.

g. Auxiliary power plant (if installed and modified for use in flight) — As required. (FE)

To provide an immediate source of dc power in the event the remaining generator fails, start the APP using normal starting procedures. Do not place the APP on the line unless the remaining generator fails.

Failure of Both Generators— If both generators fail, accomplish "Failure of One Generator" procedure on each generator. If generator power from either generator cannot be restored, proceed as follows:

a. METO RPM — Set. (CP)

WARNING

If both generators fail, land as soon as possible. Battery power will quickly be depleted, with consequent failure of all dc and regulated ac operated instruments, systems, and equipment.

CAUTION

- It is important that the battery switch be placed in the ON position and the propeller be set to METO rpm before battery power is depleted with a subsequent loss of propeller control.
- If the engines are operating in high blower ratio when the main bus is cut off, the blowers will automatically shift to low ratio. To prevent inadvertent return to high blower place the blower switches in the LOW position before restoring power to the main dc bus.

Inverter Failure Ⓐ Ⓑ Ⓒ

If the main inverter fails, the inverter failure warning light will illuminate. Place the inverter selector switch to SPARE and the warning light will go out if the spare inverter is operative. If the spare inverter is inoperative or subsequently fails, the inverter warning light will illuminate. Loss of both inverters will deprive the pilot of the E-4 compass system or N-1 compass system, as applicable, and all electrically powered flight and engine instruments except:

Turn-and-slip indicator

Course deviation indicator

Glide-slope indicator (some Ⓐ)

Temperature gages

RPM indicators

ADI quantity indicator

Flap indicator

Note

When the inverter failure warning light illuminates, the selected inverter circuit-breaker-tripped indicator light (on the main circuit breaker panel) should be checked. If the circuit-breaker-tripped indicator light is also illuminated, the inverter failure was caused by interruption of dc power to the inverter. In that event, holding the corresponding inverter circuit breaker switch to RESET position should restart the inverter, and the inverter failure warning light should go out.

Inverter Failure (D)

If the main inverter fails, the "main out" failure warning light will illuminate. Place the inverter selector switch to SPARE. The following equipment will then become inoperative:

Autopilot

N-1 compass system indicators

Course deviation indicator (CDI) in TACAN function

Number 2 bearing pointer

TO/FROM (ID 249) in TACAN function

Heading pointer

The loss of both inverters has the same effect as described under INVERTER FAILURE (A) (B) (C).

Alternator Failure

WARNING

Certain types of internal alternator failure will create a serious fire hazard. If alternator failure occurs, turn the alternator off. If the alternator is engine driven, serious consideration should be given to feathering the propeller, if not essential for safe flight. In any case, maintain a watch for fire and make an immediate landing at the nearest suitable airfield.

Note

The alternator switches should be on during flight as the alternator failure warning lights will normally provide the first indication of a malfunction.

If an alternator fails, the alternator selector switch, located on the pilots' pedestal, permits selection of function for the remaining alternator. When operating on one alternator, choice of function is limited to either Bus No. 1 or Bus No. 2 as selected by the alternator selector switch.

Bus No. 1 supplies power for;

a. Windshield anti-ice

b. Propeller de-icing

c. Alternator-generator scoop de-icing (B) (C) (D)

d. Reserve oil heating

e. Flight compartment heating (some (C) (D))

Bus No. 2 supplies power for:

a. Flight compartment heating (B) (C) (D)

b. IFF/SIF (some airplanes)

c. TACAN (some airplanes)

d. Radar equipment

e. Loran equipment

f. Student's radio altimeters

If only No. 1 alternator is operating: Alternator selector switch in NORMAL will furnish power for Bus No. 1 equipment; in 2 OFF — 1 ON BUS 2 will furnish power for Bus No. 2 equipment. If only No. 2 alternator is operating: Alternator selector switch in NORMAL will furnish power for Bus No. 2 equipment; in 1 OFF — 2 ON BUS 1 will furnish power for Bus No. 1 equipment.

Alternator-Generator Hydraulic System Failure (B) (C) (D)

Failure of the alternator-generator hydraulic system will be indicated by illumination of the system pressure-low warning light or pressure gage, or by an indication of excess temperature on the system temperature gage.

CAUTION

- To prevent damage to the system and to reduce the possibility of fire, the alternator-generator hydraulic system switch must be turned OFF if:

  a. The right generator or No. 2 alternator fails.

  b. Excessive temperature or pressure is indicated.

  c. Low pressure warning light illuminates.

- Once placed in the OFF position, the switch must not be turned ON again until the defect has been corrected on the ground.

Failure of Instrument Circuit

When a power failure occurs in the circuits of certain instruments, the indicators will freeze in the positions they were in when power was interrupted and may thus give a false indication. These instruments are:

Note

Vibrations may cause the indicators to move from frozen position.

Augmentor vane position indicators

Autopilot directional indicators

Cabin compressor hydraulic pressure gage Ⓑ Ⓒ Ⓓ

Engine and reserve oil tank quantity gages

Fuel flowmeters

Fuel pressure gages

Fuel quantity gages

Radio magnetic indicators

Hydraulic pressure gages (late Ⓐ, all Ⓑ Ⓒ Ⓓ)

Oil pressure gages

Radio compass indicators

Torquemeters

Water pressure gages

HYDRAULIC SYSTEM EMERGENCY OPERATION

If time permits, attempt to determine the nature and cause of any hydraulic emergency. Place the hydraulic pressure bypass handle in the UP position and check fluid level and pressures. Refill the hydraulic reservoir if necessary. Hydraulic emergencies may generally be categorized as follows:

a. One or both engine-driven hydraulic pumps inoperative. In this case, the remaining pump or emergency hydraulic pump may be used to operate the components of the hydraulic system.

CAUTION

Internal failure of any hydraulic pump may contaminate the hydraulic fluid and cause the loss of all hydraulic power.

b. A failure downstream (main hydraulic system) of the bypass valve. This will be indicated on the main hydraulic and brake pressure gages by a fluctuation or pressure drop in the system with the bypass handle in the DOWN position. Placing the bypass handle in the UP position will stop fluid loss. The brake pressure gage will return to normal.

c. A failure upstream (including brake system) of the bypass valve. This will be indicated on the brake pressure gage by a fluctuation or pressure drop when the bypass handle is in the UP position. All hydraulic fluid, except the emergency hydraulic pump supply, will probably be lost. Placing the bypass handle in the DOWN position will not prevent fluid loss. Hydraulic power will not be available.

Emergency Hydraulic Pump Operation

Any component of the hydraulic system can be operated by the emergency hydraulic pump. To operate the hydraulic system when the engine-driven pumps are not operating: Place the hydraulic pressure bypass handle DOWN and turn the emergency hydraulic pump switch to ON. Operate the desired hydraulic powered equipment normally, then return the hydraulic pump switch to OFF.

Note

Any interruption in the dc power supply system trips the emergency hydraulic pump circuit breaker. Therefore, if the pump fails to operate when its switch is turned on, check the pump circuit-breaker-tripped light (on main circuit breaker panel). If it is illuminated, press the circuit breaker switch below it to RESET position.

WARNING

Do not operate the emergency pump continuously for longer than five minutes. Allow the pump to cool for at least one-half hour after each five-minute period of continuous operation.

In the event of a main hydraulic system pressure line failure, operate the emergency pump to charge the accumulator and to operate the wing flaps and brakes. In this case, the hydraulic pressure bypass handle must be placed in the UP position. This emergency procedure is limited, however, by the amount of fluid in the reservoir. With the normal reserve of 1.3 gallons, the wing flaps can be lowered, the accumulator can be charged, and 12 to 15 brake applications can be made.

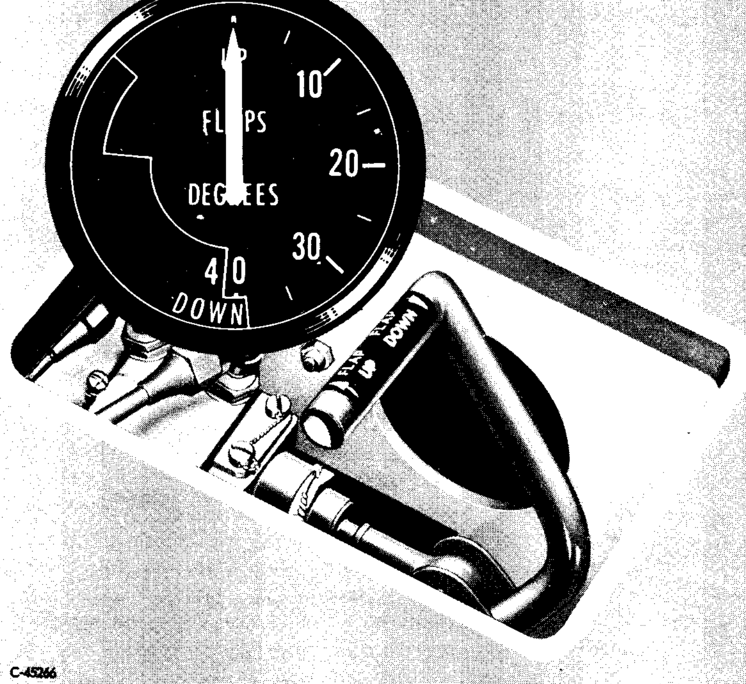
CAUTION

In case of complete hydraulic failure, the 1.3 gallons of reserve hydraulic fluid may not be available.

WING FLAPS EMERGENCY OPERATION

The wing flaps cannot be moved mechanically, hydraulic pressure is required. Normal pressure is supplied by the engine-driven pumps. Emergency pressure is supplied as follows:

a. If engine pumps are inoperative and the accumulator is charged, place the hydraulic



WARNING

Since there is no electrical limit control in effect when the wing-flap control circuit is de-energized, operation of the emergency wing-flap handle requires constant reference to the wing-flap position indicator to avoid overrunning the UP or DOWN limit stops at the wing flaps. Forcing the wing-flap drive motor to continue to turn after the limit has been reached will severely stress the wing-flap drive mechanism until the motor stalls. If the wing-flap drive components are defective, such excessive torque stress might damage the wing-flap torque tube and cable installations.

Figure 3-12

pressure bypass handle DOWN and control the wing flaps in the normal manner. Accumulator pressure will supply the flap motors for approximately one complete flap actuation cycle. (FE)

b. If engine pumps are inoperative and the hydraulic accumulator pressure is depleted, place the hydraulic pressure bypass handle in UP position and turn on the emergency hydraulic pump. Then control the wing flaps in the normal manner. (FE)

c. In the event the wing flap switch circuit fails, the wing flap selector can be operated manually by means of the emergency handle on the valve. Pull the handle for wing flaps down; push the handle for wing flaps up; hold the handle in either operating position until the desired wing flap setting is obtained.

Note

The valve (figure 3-12) is accessible through the hinged door located on the cabin floor at student position No. 11 on (A), (B), and (C) airplanes, or through a door located beneath the radar rack on the cabin floor on (D) airplanes.

CAUTION

When operating flaps with the emergency wing flap handle, maintain continuous visual reference with the flap position indicators to avoid overriding the flap limit switches. Return the emergency flap handle to the neutral position as soon as the flaps have reached the UP or DOWN limit of travel to prevent damage to the flap actuating mechanism. Since the wing flap limit switches are inoperative when the wing flap control circuit is inoperative, operation of the emergency wing flap handle must be coordinated with constant visual reference to the wing flap position indicator. Forcing the wing flap drive motors to continue to operate, after the wing flaps have reached the UP or DOWN limit stops, would impose undue torque stresses on the wing flap drive mechanism.

Split-Flap Configuration

If a split-flap configuration occurs during the normal or emergency extension or retraction of the flaps, perform the following procedures immediately:

a. Stop all flap operation immediately. (P)

b. If airplane yaw and roll are uncontrollable:

(1) Adjust throttle(s) to maintain directional control. This can usually be done by reducing power on the high-wing side and /or adding power to the low-wing side. (P)

(2) Retract (or extend) flaps by small increments in an attempt to equalize flaps. The operable flap should be operated to equalize its position with the inoperable flap. (FE)

c. When directional control can be maintained, land immediately. (P)

LANDING GEAR SYSTEM EMERGENCY OPERATION

In the event of failure of both engine-driven hydraulic pumps, the landing gear can be operated by use of the emergency hydraulic pump. Proceed as follows:

a. Hydraulic pressure bypass handle — DOWN. (FE)

b. Emergency hydraulic pump switch — ON. (FE)

(c.) Landing gear lever — As required. (CP)

WARNING

Do not use the emergency pump for landing gear operation if it is evident that the failure of the main system is due to a ruptured line. The landing gear operation would result in further loss of fluid. Reserve hydraulic fluid should be used for flap extension and brake application when landing. Refer to HYDRAULIC SYSTEM EMERGENCY OPERATION, this Section.

Landing Gear Emergency Release Operation

The landing gear can be extended by the free-fall method but can be retracted only by hydraulic pressure. The up-latches are provided with a mechanical linkage to the landing gear lever. Moving the lever in the DOWN position releases the up-latches for free-fall extension. Air loads on the extended gear will actuate the down-latches. Opening the oil cooler doors will direct air to the gear to assist locking. The best speed for landing gear free-fall operation is 130 KIAS. If the nose gear does not lock, increase airspeed to actuate the down-latch.

Note

Approximately 35 to 50 pounds pull must be exerted on the landing gear lever to release the up-latches if the hydraulic pressure bypass handle is in the UP position.

Emergency Landing Gear Up-Latch Release Operation

Should it prove impossible to release the landing gear up-latches mechanically, an emergency air system is available. If any of the gear indicate down or in-transit and at least one gear remains up and locked, proceed as follows:

(a.) Landing gear lever — DOWN. (CP)

b. Hydraulic pressure bypass handle — UP. (FE)

c. Break the safety wire on the emergency landing gear up-latch release knob, turn the knob to the RELEASE position momentarily then return to the OFF position. (P)

d. Hydraulic pressure bypass handle — DOWN. (FE)

e. Check the landing gear position indicators and warning horn. (P)

WARNING

If all three gear remain up and locked or if the gear retracts when the hydraulic pressure bypass handle is placed in the DOWN position, immediately place the hydraulic pressure bypass handle in the UP position as the landing gear selector valve or linkage has malfunctioned. Proceed as in Landing Gear Lever Jammed In Up Position.

Landing Gear Lever Emergency Operation

An emergency release button (figure 1-34), located on the copilot's side of the pedestal, is provided to allow emergency release of the landing gear lever from the DOWN position after takeoff in the event the gear-actuated safety switch fails. The lever may be moved out of the DOWN position by simultaneously pushing in on the emergency release button.

CAUTION

Do not continue flight unless it can be definitely determined that the lever lock solenoid is at fault. If the malfunction is in the landing gear safety relays, other systems will become inoperative.

This procedure can also be used to raise the landing gear before the weight of the airplane is off the gear. This may be desirable if the airplane cannot be stopped and ground conditions beyond the end of the runway would cause extensive damage to the airplane or personnel. If the locking shaft binds or fails, it can be unlocked by pulling out on the locking collar, located on the base of the lever, and simultaneously moving the lever to the desired position. Access to the locking collar is gained by removing the side panel which covers the lower portion of the control lever.

Landing Gear Lever Jammed In Up Position

If the landing gear lever becomes jammed in the UP position, the following procedure may be used to extend the landing gear.

a. Hydraulic pressure bypass handle — UP. (FE)

b. Break the safety wire on the emergency landing gear up-latch release knob and turn the knob to the RELEASE position momentarily then return the knob to the OFF position. (P)

Note

This procedure may be used if the landing gear lever can be moved to the DOWN position but the connection to the landing gear selector valve is broken.

WARNING

- Do not move the bypass handle to the DOWN position or the landing gear will retract.
- To prevent retraction of the gear by inadvertent movement of the bypass handle to the DOWN position, stop the aircraft on the runway and install gear lock safety pins before taxiing.

Unsafe Landing Gear Indications

It is not possible to establish procedures which cover all possible unsafe landing gear malfunctions. Technical assistance and guidance from qualified ground sources may permit the crew to more thoroughly analyze and solve gear problems. Some possible solutions are given below. If an unsafe gear indication occurs during a normal extension, the position of the gear must first be established.

1. If the landing gear appears to be completely extended, leave the gear lever down and try the following:

   a. Open oil cooler doors to direct air flow toward gear to assist locking.

   b. Reset gear position and warning circuit breakers.

   c. Actuate hydraulic bypass UP and DOWN.

   d. With the hydraulic bypass UP and the oil cooler doors open, increase airspeed to 176 KIAS, yaw aircraft, and exert positive and negative g forces.

   e. With the hydraulic bypass DOWN and oil cooler doors still open, try the speed increase, yaw, and g forces again. Continued hydraulic pressure for an extended period may cause a safe indication.

   f. If indicators still show unsafe, make a normal landing. The landing loads on the gear are applied toward the lock-down positions.

2. If the visual check indicates the gear is not fully extended, leave the landing gear lever in the DOWN position and try the following:

   a. Increase airspeed to 176 KIAS, yaw aircraft, and apply positive and negative forces. Continued hydraulic pressure for an extended period may cause a safe gear indication.

   b. Place the hydraulic bypass in the UP position and try the airspeed increase, the yaw, and g forces again.

   c. Place the landing gear lever in the UP position.

   d. Place the hydraulic bypass in the DOWN position and allow gear to fully retract.

   e. Place the landing gear lever in the DOWN position.

   f. If the gear cannot be fully extended, and it appears that loads applied during landing will not be applied toward the gear lock-down positions, proceed with LANDING WITH LANDING GEAR RETRACTED procedure.

EMERGENCY AIR BRAKE OPERATION

CAUTION

- When reverse thrust is available, it should be used during the initial high-speed ground roll since the use of air brakes at that time may cause wheel locking and tire damage. The emergency air brake system should be reserved for final slowing and stopping of the airplane.
- Extreme caution should be exercised in using reverse thrust on landing with loss of hydraulic brake pressure and/or hydraulic system pressure due to the loss of nose wheel steering. If only one propeller should reverse, close the engine throttles and allow the airplane to roll down the runway until the ground speed has reduced sufficiently to allow operation of the emergency air brakes without danger of a wheel locking and subsequent tire damage.

In case of hydraulic brake pressure failure, and if reverse propeller thrust is not available, use the emergency air brake knob on the pilot's console as follows:

CAUTION

- Break safety wire before actuating.
- The air valve control is very sensitive. Carefully meter the pressure with the control knob to prevent grabbing of the brakes and subsequent danger of tire blowout.
- Bleed the hydraulic system at the earliest opportunity after using the emergency air braking system. Air left in the system lines would cause actuating failure in subsequent hydraulic operation.

a. Operate the airbrake knob to the HOLD position. There should be no braking action at this point. (P)

CAUTION

Do not move the airbrake knob to the HOLD position until ready for braking action. Experience has shown that pressure may leak into the brake lines with the knob in the HOLD position.

b. For braking action, move the brake knob toward the ON position. (P)

Note

As soon as the knob is moved toward ON position, the available air system pressure will flow to the brake lines. At high speeds, the tires may be damaged unless the air brake knob is moved rapidly back to the OFF position. Several of these rapid applications may be necessary to obtain the desired braking effect.

c. After the airplane has been slowed down by this method, it can be brought to a stop by moving the knob toward the ON position and then back to the HOLD position after the desired braking action is felt. (P)

Note

With the air bottle fully charged, approximately eight brake applications can be made. If air pressure has been used to release the landing gear uplocks, fewer brake applications will be available.

EMERGENCY ENTRANCE

Emergency entrance may be gained by opening the entrance door. The door can be opened from outside even though it is mechanically and electrically locked

from the inside at the time. The bailout door, located in the right cabin wall over the wing trailing edge, can be opened from the outside by pulling out the emergency release handle located just aft of the door. Emergency entrance may also be gained through the rear service door by using the rear service door handles on the outside of the airplane. The escape hatches at each side of the cabin may be opened by pressing inward on a small plate located above each of the escape hatch windows. If these methods prove unsuccessful, the windows which have dotted yellow lines painted around them and the stenciling "CUT HERE FOR EMERGENCY RESCUE" may be cut out with an axe. (See figure 3-13.)

PRACTICE OPERATIONS WITH ONE ENGINE INOPERATIVE

Practice Maneuvers With One Engine Inoperative

To become thoroughly acquainted with the single-engine characteristics of the airplane, the following maneuvers should be practiced:

WARNING

Practice these maneuvers at sufficient altitude so that recovery can be made with an ample margin of safety.

a. Engine failure at takeoff speed.

b. Minimum control speed with one engine windmilling.

c. Best single-engine rate of climb for various flap settings.

d. Low-speed turns with single engine.

e. Single-engine go-around.

f. Approach to stalls.

CAUTION

Observe correct procedure for restarting an engine in flight.

Practice Ground Maneuvers

Practice bringing the airplane to a stop by using reverse pitch and brakes, when an engine failure is experienced before refusal speed is reached. During this maneuver, it is important that nose wheel steering be used to keep the airplane on the runway. To get maximum braking effect, retract the wing flaps.

CAUTION

After each accelerated stop, inspect tires and brakes for excessive wear and any condition that may cause brake or tire failure during the next stop.

Practice of Engine Failure at Takeoff Speed

It is recommended that a propeller not be feathered during single-engine takeoff and landing practice, but that zero thrust on one engine be obtained by running the "dead" engine propeller speed lever to HIGH LIGHT and applying power with the throttle to maintain engine rpm that corresponds with airspeed according to the following values:

	ENGINE RPM					
KIAS	S. L.	2000 FT	4000 FT	6000 FT	8000 FT	10,000 FT
100	1720	1770	1820	1880	1930	1980
110	1910	1955	2015	2075	2130	2190
120	2070	2140	2200	2270	2330	2400
130	2250	2320	2390	2460		
140	2420	2500				

Note

For prolonged operation (above traffic pattern altitude) under simulated single-engine conditions, maintain 1700 rpm and 17 inches Hg manifold pressure on the idle engine.

The effects of trying to take off before takeoff speed is attained should be demonstrated in flight at a safe altitude by showing the difference in rates of climb for speeds above the below takeoff speed with corresponding wing flap settings.

Practice of Minimum Control Speed with One Engine Windmilling

Minimum control speed can be demonstrated at any safe altitude. With one engine windmilling, the corresponding throttle closed, and the other engine operating at maximum power, the airplane should be slowed down gradually until it is no longer possible to maintain flight in a straight line. It is important to note that the airplane must be banked approximately 3° with the dead engine high. If this is not done full rudder will be required at a much higher minimum speed. Excess rudder causes a slip with excessive drag which materially affects rate of climb.

Practice of Best Rate of Climb for Various Flap Settings with Single Engine

It is extremely important that the pilot understand wing flap management. The best way to acquire this knowledge is by actually demonstrating the effect of speed on rate of climb with various wing flap settings. This can be done at any safe altitude with one engine feathered. First, practice rate of climb with the best speed corresponding to the wing flap setting being used and then note rate of climb above and below this optimum speed. Also note loss of altitude when wing flaps are retracted before reaching the next higher speed for the next reduced wing flap setting.

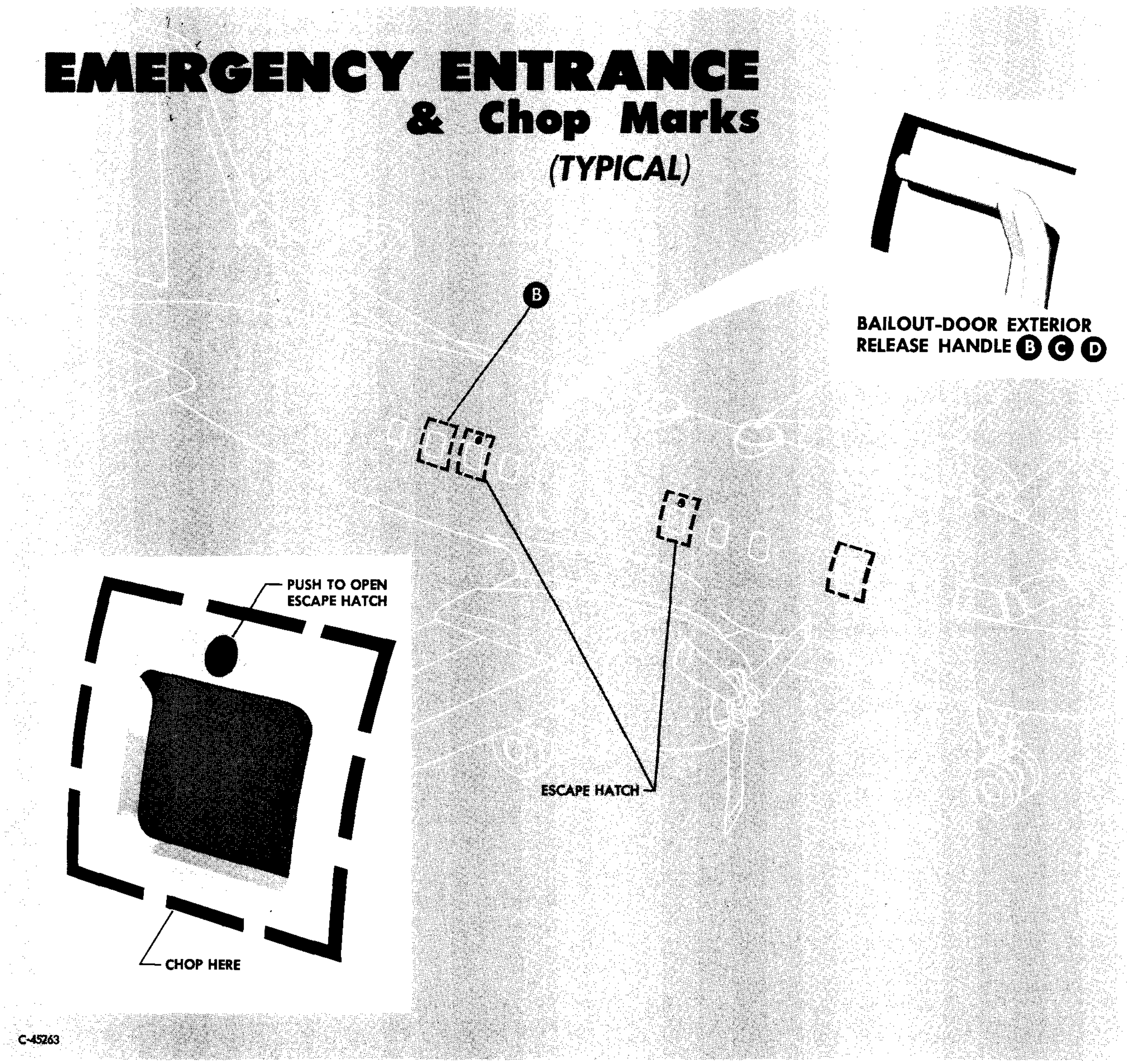


Figure 3-13

Practice of Low-Speed Turns with Single Engine

The airplane is completely controllable in turns in either direction with one engine out. Turns can be made up to 60° of bank with the dead engine on the down side, and with any selected power on the operative engine. While in a steep turn, with the dead engine on the down side, the airplane can be slowed down by climbing in the turn until the buffet warning occurs. The turn can be continued with perfect control even while this buffet continues.

Practice of Single-Engine Go-Around

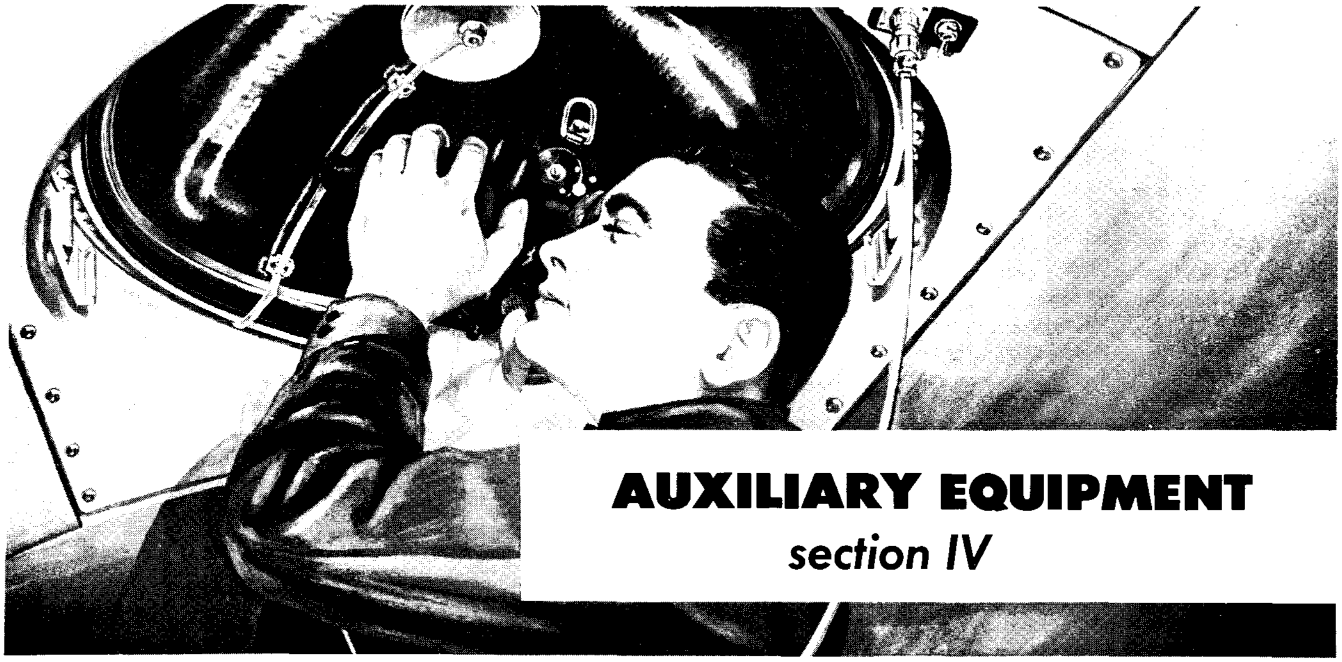
In practicing single-engine go-around, it is recommended that one engine be wind-milled to simulate a feathered engine and that power be applied to maintain engine rpm in accordance with the airspeed-rpm values given in PRACTICE OF ENGINE FAILURE AT TAKEOFF SPEED, this Section. For procedure, see figure 3-11.

Practice of Approach to Stalls on Single Engine

Stalls can be practiced at a safe altitude with one engine feathered and one engine operating at METO power. The stall should be approached with reduction in airspeed of approximately one knot per second. A buffet warning will be experienced in each case before the stall is encountered. This buffet warning will occur at about 13 knots above stall speed with the airplane clean, and 4 to 5 knots above stall speed with full flaps. It will be noted that, in some cases with the airplane light, a minimum control speed will be encountered before the actual stall. In this case, the airplane will start to turn and may roll during the stall. The roll will be controllable if the control column is brought forward and corrective action taken as soon as the roll starts. Do not hold back on the wheel after roll occurs. In most cases the airplane will normally stall and pitch straight ahead. See figure 6-1 for stall speeds.

Practice of Engine Shutdown While Airborne

When practicing actual engine shutdown while airborne, place the mixture in the OFF position prior to feathering the propeller. This places less stress on the engine and decreases the possibility of engine damage.



AUXILIARY EQUIPMENT
section IV

TABLE OF CONTENTS

AIR-CONDITIONING SYSTEM Ⓐ

The air-conditioning system (figures 4-1 and 4-2) provides air for heating and ventilating the cabin and the flight compartment when the airplane is in flight. Normally, the system is under automatic thermostatic control, but nonautomatic electrical controls are also provided.

VENTILATION AND HEATING

Outside ram air from a scoop in the right wing leading edge is used for ventilating the cabin and flight compartment. When heat is required, all or part of the ram air is directed through a heat exchanger. Heating air from the inboard heat source valves is routed through the heat exchanger, where it flows across the tubes through which the ram air flows. The ram air picks up heat, by transfer, from the heating air and is then ducted to outlets in the cabin and flight compartment; to enclosures surrounding the reserve oil system transfer pump, shutoff valve, and selector valve; and to the lavatory area. Temperature of heated air is controlled by a cooling air valve and a heating air valve. The cabin heating system uses the same heating air source that is used for tail anti-icing. When tail anti-icing is required, it is advisable to have the cabin temperature control at a low setting to insure sufficient heat for tail anti-icing. When the airplane is in motion, ram air enters a flush scoop in the right wing leading edge and is ducted to five outlets located along the right side of the cabin ceiling, to an outlet outboard of each pilot's seat, and to the lavatory area. After circulating through the fuselage, the air escapes through an exhaust air door on the bottom aft end of the fuselage. A dc powered temperature control unit is installed below the cabin floor, on the right side of the fuselage outboard of the heat anti-ice relay panel. The unit provides automatic control of cabin temperature by modulating the positions of the heating and cooling air valves.

AIR-CONDITIONING SYSTEM B C D

The air-conditioning system (figures 4-1 and 4-2) provides fuselage ventilation, pressurization, and temperature control automatically during flight. All or part of the system, however, may be operated on a selective nonautomatic basis, without pressurization, should such operation be required or preferred. Whenever the right engine is operating at 1400 rpm or more, forced draft ventilation is provided by an air compressor driven by a hydraulic motor. A separate hydraulic system is provided for this purpose. The cabin air compressor takes air from a scoop in the lower surface of the right wing and forces it through a heat exchanger and, if required by cooling demand, through a refrigeration unit and intercooler and thence to ventilation outlets in the fuselage. After circulating in all parts of the fuselage excepting the nose wheel well and the camera well, the air vents overboard through regulator valves. The valves restrict output flow to provide pressurization of the fuselage above 8000 feet. The rate of air flow is constant at 65 pounds per minute, which is sufficient to change the air in the fuselage every five minutes and provide a maximum pressure differential of 3.5 psi at 17,700 feet altitude. A cabin altimeter indicates the pressure altitude of the cabin. An automatic relief valve and a manual dump valve are provided to assure cabin pressure relief at 8000 feet during descent. Temperature control is effected automatically at any selected temperature within a range of 40° to 80°F, by modulating valves that allow varying amounts of cooling air and heating air to flow to the heat exchanger. Cooling air is obtained from a ram scoop in the right wing leading edge. Heating air is obtained under ram pressure from heat collector muffs installed around the inboard augmentors in the nacelles. A heat source valve at each muff opens and closes the duct from the muff to the heating air valve at the heat exchanger. (These same heat valves and ducts serve the tail leading edges during anti-icing.) The heating and cooling air mix before entering the heat exchanger; this air then vents overboard. A modulating refrigeration unit bypass valve allows more or less of the ventilating air to bypass the refrigeration unit and intercooler. The refrigeration unit is powered by the compression force of the ventilating air and incorporates an expansion turbine which can cool the ventilating air substantially below outside air temperature on demand. Positioning of all of the modulating valves is determined by direct current supplied by the main bus to the opening and closing sides of the valve actuators through the temperature control unit. The unit closes the various circuits electronically in response to regulated ac phase signals from one side or the other of balanced bridge resistance circuit. Two anticipator pickup thermistors and the cabin heat rheostat setting determine the balance or unbalance of the bridge circuit in response to temperature changes. During tail anti-icing, heated air is shared between cabin heating and the tail leading edges. When tail anti-icing is required it is advisable, therefore, to have the cabin temperature control at a low setting to insure sufficient heat for tail anti-icing. With the cabin heat rheostat set to full decrease, the heat generated in the ventilating air as it is compressed is the only heat available for cabin temperature control. This is usually sufficient to maintain comfortable temperature although not always up to selected temperature. Heating is not available during ground operation due to lack of ram pressure at the heat collector muffs in the nacelles. Should ventilation by alternate air flow be selected in flight, the air compressor stops, and all ventilating air is then obtained at the ram air scoops in the wing leading edges. The air from the right scoop then passes through the heat exchanger but bypasses the refrigeration unit and intercooler on its way to the ventilation outlets. The ram air from the left scoop goes directly to the cabin outlets, but if heating is demanded, this flow is restricted. The heat exchanger is furnished with heating and cooling air as before, but cooling below outside temperature is not possible in this method of operation because the air compressor, refrigeration unit, and intercooler are then inoperative.

CABIN COMPRESSOR HYDRAULIC SYSTEM B C D

The air compressor of the air-conditioning system is operated by an integral hydraulic system (figure 4-3) separate from the main hydraulic power supply system. Two hydraulic pumps driven by the right engine supply normal operating pressure whenever the right engine is operating at 1400 rpm or more and the cabin pressure switch is in AUTO position.

Note

> The small hydraulic pump has been removed from the cabin pressurization and air conditioning system on those aircraft modified by TCTO 1T-29-603. The removal of the small pump slightly reduces the air conditioning capability.

These pumps provide fluid under pressure to the compressor hydraulic motor. Part of the return fluid is diverted from the return line to the compressor sump, which serves as the fluid reservoir of the system. A fluid level sight gage is provided on the sump. Test and service connections are provided near the compressor in the right wing trailing edge. A sump pump, driven by the compressor, provides hydraulic fluid under low pressure to the return manifold and thence through a micronic filter to the two pumps. A throttling valve monitored by the weight of the air delivered by the compressor regulates the hydraulic fluid pressure flow to the motor, any excess being automatically drained off to the return manifold. When the cabin pressurization switch is placed in ALT AIR FLOW position, the bypass valve in the pressure line opens and allows the fluid to circulate freely from the pumps to the return manifold, thus leaving the air compressor inoperative. Operation of the cabin compressor hydraulic system is monitored by a temperature bulb installed in the return manifold, a pressure switch installed in the return line near the pumps, and a pressure transmitter installed in the pressure manifold. The corresponding indicators are located on the copilot's instrument panel skirt.

Cabin Compressor Hydraulic Fluid Specification B C D

See figure 1-42.

Cabin Compressor Hydraulic Temperature Gage B C D

A temperature gage (48, figure 1-9), located on the copilot's flight instrument panel shelf, is provided to indicate the temperature of hydraulic fluid in the return manifold of the cabin compressor hydraulic system. The gage is energized by dc from the main bus transmitted by a temperature bulb installed in the return manifold. If any essential operating component or valve in the cabin pressure hydraulic system fails to function in a safe and efficient manner, or if the cooling air scoop is blocked, temperature of the fluid will rise. If the temperature rises above the normal maximum limit, the system must be shut down until the defect can be repaired.

Cabin Compressor Hydraulic Pressure-Low Warning Light B C D

A pressure-low warning light (47, figure 1-9) located on the copilot's flight instrument panel shelf, will be on if the right engine is not running or in event of fluid loss or system malfunction when the right engine is running. If the light illuminates when the right engine is running, the cabin compressor hydraulic system must be shut down by placing the cabin pressurization switch to ALT AIR FLOW to prevent cavitation of the pumps or damage to system components. The light is powered by the dc main bus.

Cabin Compressor Hydraulic Pressure Gage B C D

This pressure gage (46, figure 1-9), on the copilot's flight instrument panel shelf, registers the hydraulic pressure at the air compressor motors. The gage is operated by 26-volt regulated ac.

Cabin Compressor Fluid Sight Gage B C D

A direct-reading glass tube hydraulic fluid sight gage is attached to the outboard side of the cabin pressure air compressor. A vent on top of the sight gage must be closed.

No. 2 Engine Fluid-Off Handle B C D

A cabin pressure hydraulic fluid shutoff valve is installed at the right nacelle fire wall in the return line to the two pumps. The valve is operated by No. 2 engine fluid-off handle on the fire control panel (figure 1-39). Refer to ENGINE FIRE EXTINGUISHER SYSTEM, Section I.

Cabin Altimeter B C D

A cabin altimeter (45, figure 1-9), located on the copilot's flight instrument panel, is provided to indicate the cabin altitude in feet. The cabin altimeter is used to check for cabin pressurization above 8000 feet altitude and for relief of cabin pressure during descent below 8000 feet.

CABIN PRESSURE AND TEMPERATURE CONTROLS

Cabin Pressurization Switch B C D

A guarded cabin pressurization switch, located on the copilot's console (figure 4-4), has AUTO and ALT AIR FLOW positions. In AUTO position, the switch closes a dc circuit to the closing side of the bypass valve actuator in the cabin pressure hydraulic system bypass line, thus forcing fluid to flow through the hydraulic motor that operates the air compressor. In ALT AIR FLOW position, the switch closes a dc circuit to the opening side of the bypass valve actuator which lets fluid flow directly from the pressure manifold to the return manifold, thus bypassing the compressor. Direct current from the main bus is also connected at this time to the opening side of the refrigeration unit bypass valve actuator, the alternate (ram) air shutoff valve actuator, and the cabin pressure relief valve. This allows ventilation to proceed under ram pressure from the alternate air scoops in the wing leading edges.

CAUTION

Do not move pressurization switch to AUTO position while the right engine is running. The resulting high-pressure surge could damage the system. Refer to VENTILATION FAILURE, this Section.

Cabin Pressure Manual Dump Control B C D

The manual dump valve, located on the copilot's console (figure 4-4), has NORMAL and DUMP positions. The valve is mechanically linked to the cabin pressure regulator system. In the NORMAL position, the regulator automatically provides pressurization of the fuselage above 8000 feet and a maximum pressure differential of 3.5 psi at 17,700 feet altitude. In the DUMP position, the valve is opened for emergency relief of cabin pressure or to relieve cabin pressure in the event pressure is not automatically relieved during descent.

Cabin Heat and Vent Switch

A guarded cabin heat and vent switch, located on the copilot's console (figure 4-4), is provided to afford a means of precluding flow of fuel and oil vapors to the fuselage area from the nacelles during engine starting. If the heat valves at the augmentors were to remain open at that time, vapors flowing to the heat exchanger would constitute a fire hazard in the fuselage area below the floor and in the wing and tail ducts. The cabin heat and vent switch has

AIR CONDITIONING
Air Flow
A AIRPLANES

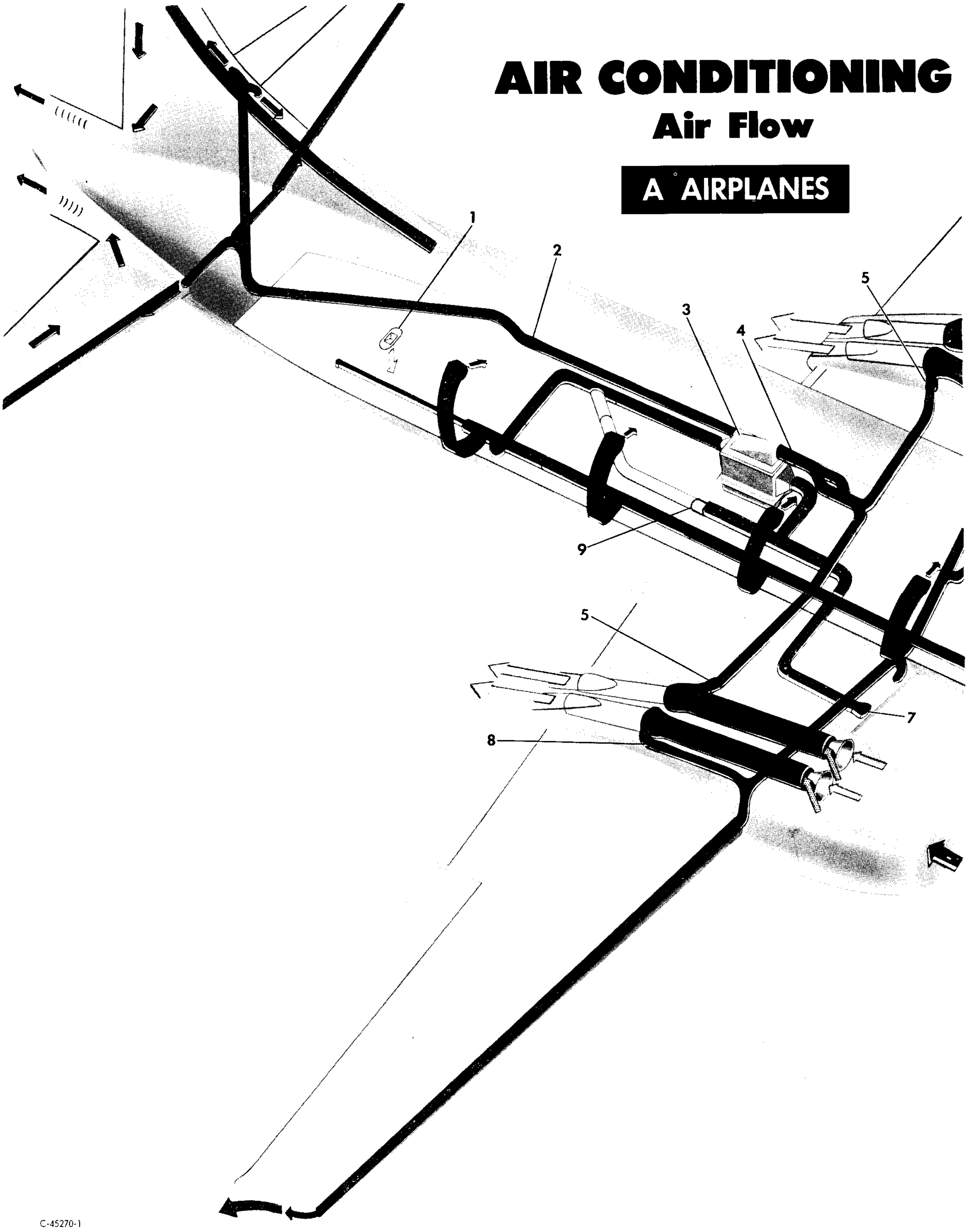
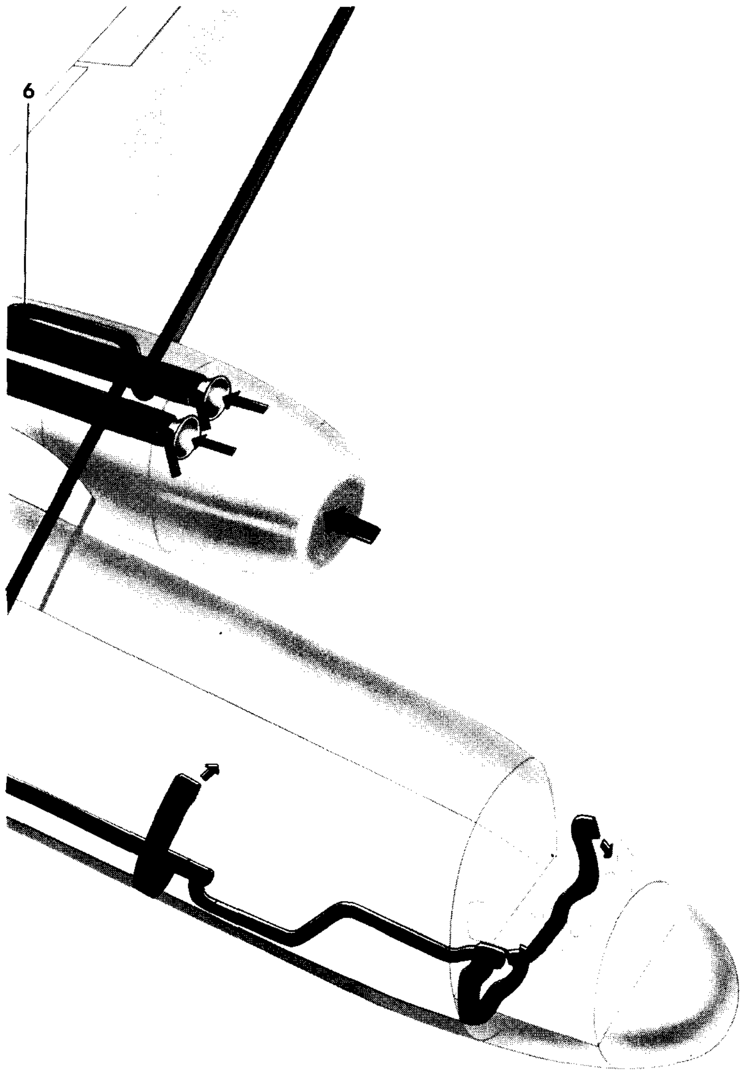
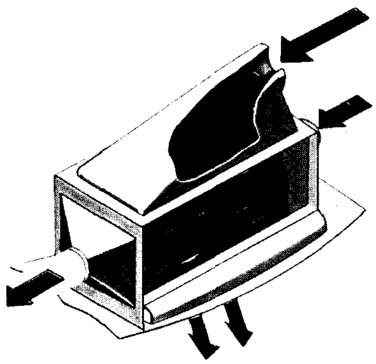


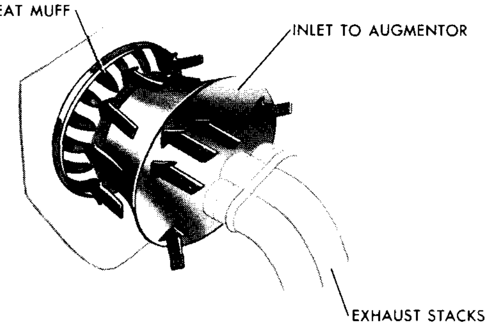
Figure 4-1 (Sheet 1 of 4)

AND ANTI-ICING *(TYPICAL)*





HEAT EXCHANGER AIR FLOW



AUGMENTOR AIR FLOW

CODE

- RAM (COOLING) AIR
- EXHAUST GASES
- ENGINE COOLING AIR
- HEATING AIR
- VENTILATING AIR
- STATIC AIR OR REDUCED FLOW

NOTE: For greater clarity all temperature conditions shown are maximums.

1. Air Exhaust Duct
2. Tail Anti-icing Shutoff Valve
3. Heat Exchanger
4. Heating Air Valve
5. Inboard Heat Source Valve
6. Left Wing Heat Source Valve
7. Ram Air Duct
8. Right Wing Heat Source Valve
9. Cooling Air Valve

C-45270-2

Figure 4-1 (Sheet 2 of 4)

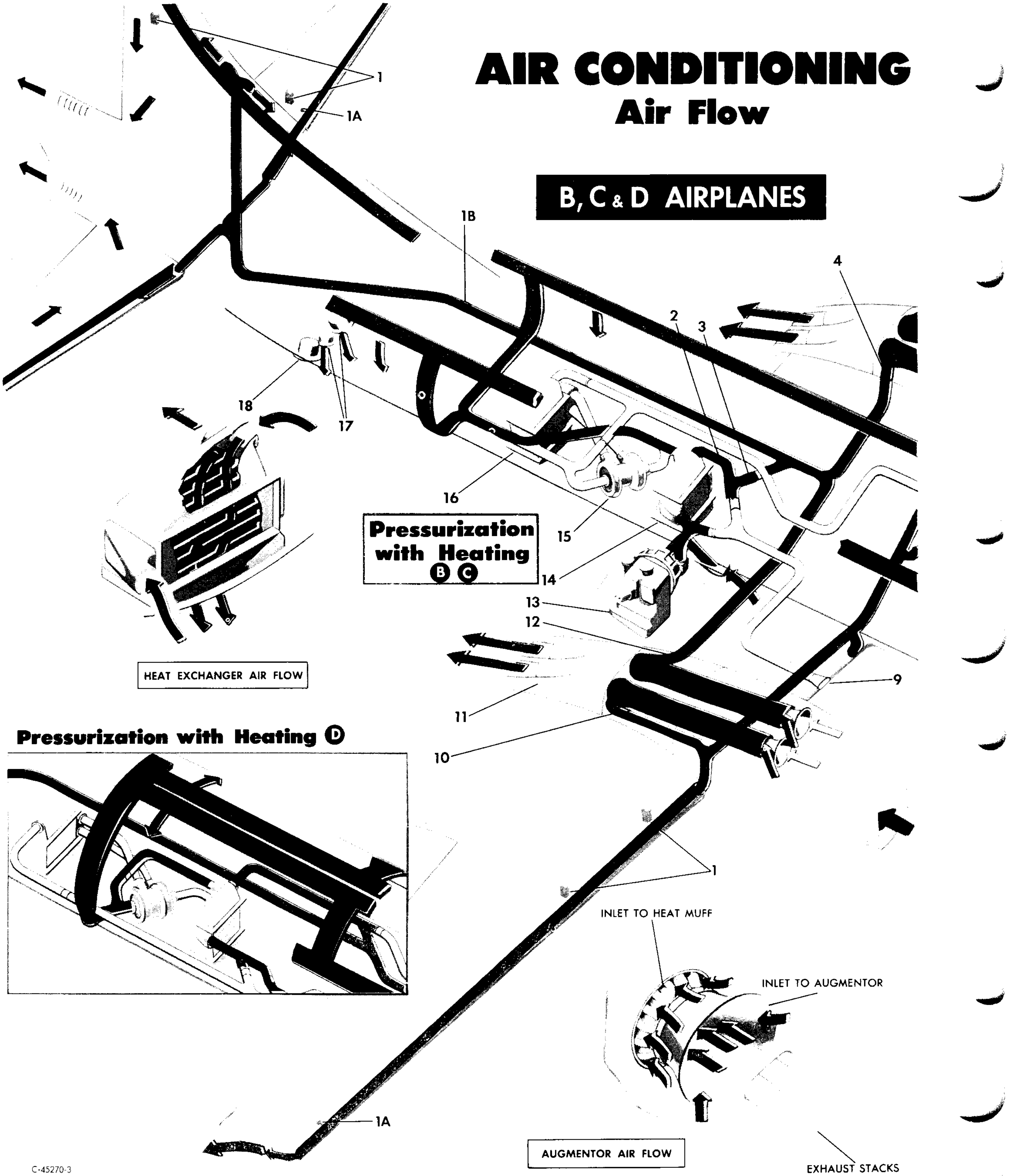
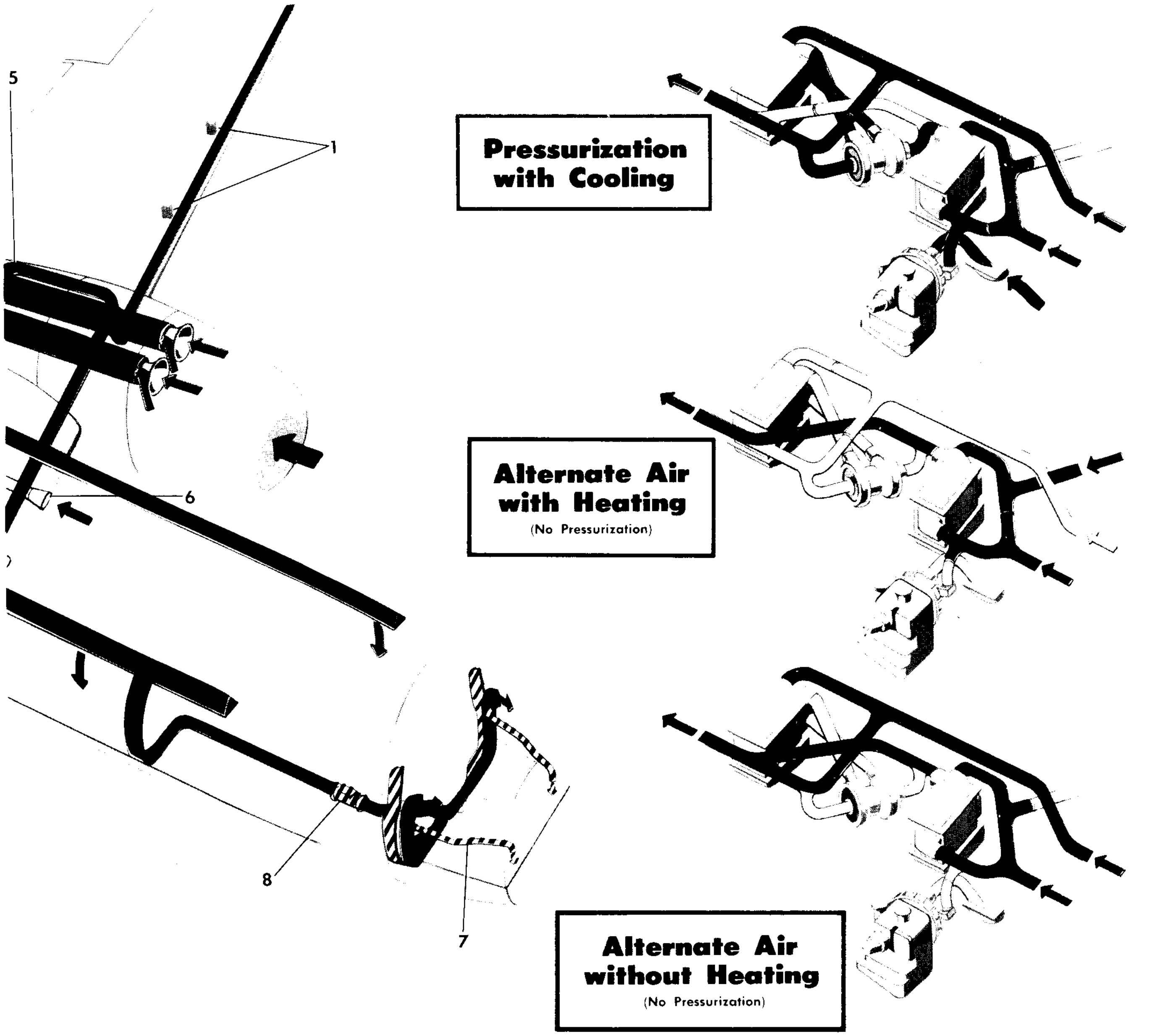


Figure 4-1 (Sheet 3 of 4)

AND ANTI-ICING *(TYPICAL)*



CODE

- RAM (COOLING) AIR
- EXHAUST GASES
- ENGINE COOLING AIR
- HEATING AIR
- PRESSURIZED (VENTILATING) AIR
- STATIC AIR OR REDUCED FLOW
- PRESSURIZED (VENTILATING) AIR LATER B ; ALL C ; D

NOTE: For greater clarity all temperature conditions shown are maximums.

1. Thermostatic Limit Switches
1A. Anti-icing Temperature Bulbs (left wing position not shown)
1B. Tail Anti-icing Shutoff Valve
2. Cooling Air Valve
3. Heating Air Valve
4. Left Wing Inboard Heat Source Valve
5. Left Wing Outboard Heat Source Valve
6. Ram Air Scoop, LH
7. Pilots' Foot Warmers and Cockpit Ventilation LATER B ; ALL C ; D
8. Cockpit Electric Heater LATER B ; ALL C ; D
9. Ram Air Scoop, RH
10. Right Wing Outboard Heat Source Valve
11. Augmentors
12. Right Wing Inboard Heat Source Valve
13. Compressor and Air Intake
14. Heat Exchanger
15. Refrigeration Unit
16. Intercooler
17. Pressure Regulator Valves
18. Pressure Relief and Dump Valve

C-45270-4

Figure 4-1 (Sheet 4 of 4)

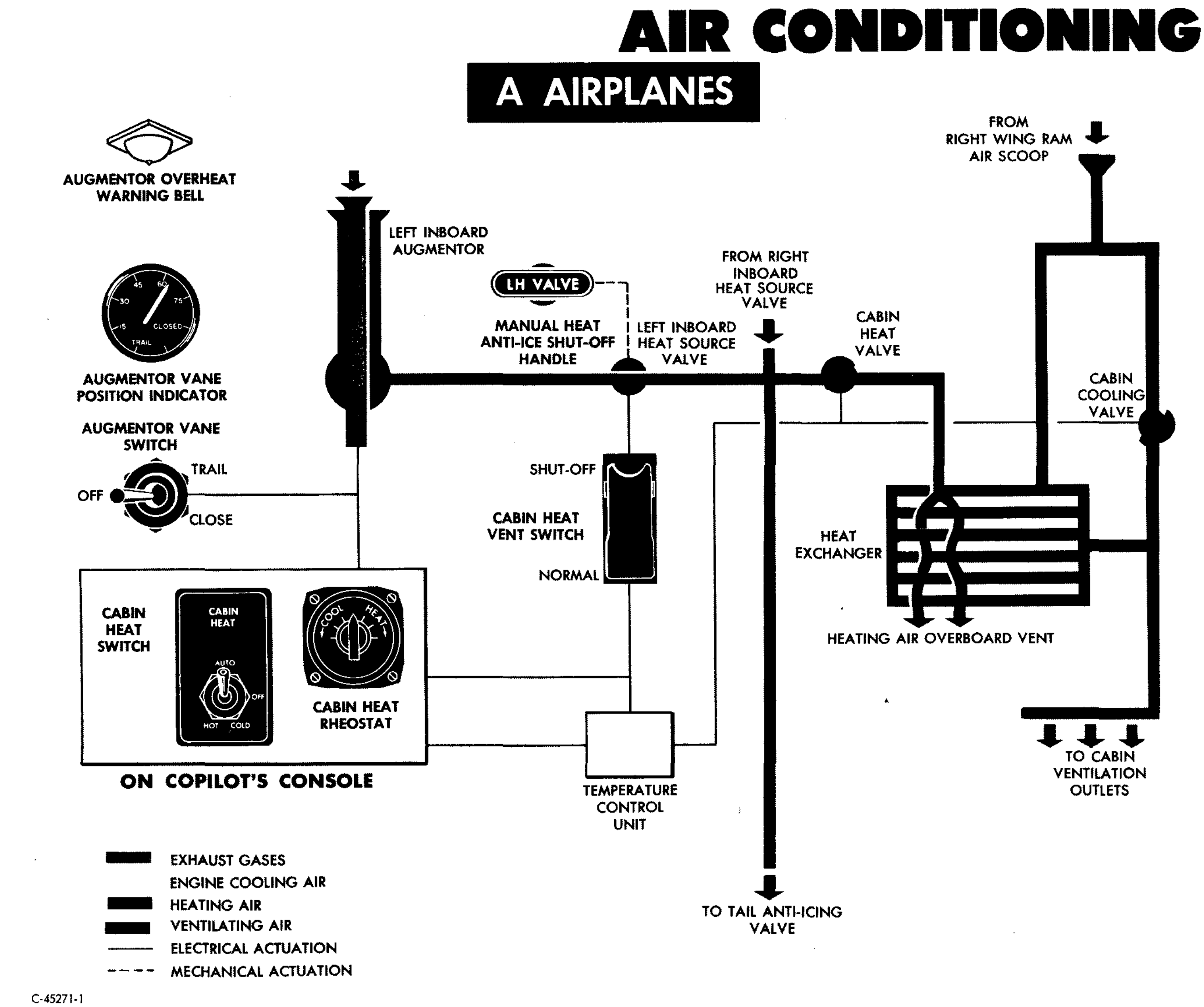


Figure 4-2 (Sheet 1 of 3)

NORMAL and SHUTOFF positions. In SHUTOFF position, the heat valves are turned to closed position by actuators powered by the dc main bus. When the switch is in NORMAL position, the actuating circuits for these valves are again restored to normal, and further operation will depend on the position of their normal control switches or the preliminary position demanded by normal automatic operation of the air-conditioning system.

Note

- On Ⓐ airplanes, the SHUTOFF position has no override effect on wing and tail anti-icing operation in flight. Wing and tail anti-icing cannot be started until the cabin heat and vent switch has been placed in the NORMAL position; however, once wing and tail anti-icing has been started, the SHUTOFF position will not shut it off.
- On Ⓑ, Ⓒ, and Ⓓ airplanes, the wing and tail anti-icing system is inoperative when the cabin heat and vent switch is in the SHUTOFF position unless the heat valves are opened by the manual heat anti-ice shutoff handles.

Cabin Heat Selector Switch

The cabin heat selector switch, located on the copilot's console (figure 4-4), has an AUTO position, two MANUAL positions (HOT and COLD), and on Ⓑ, Ⓒ, and Ⓓ airplanes, an unmarked OFF position. On Ⓐ airplanes, the off position is placarded OFF. In respect to the MANUAL positions,

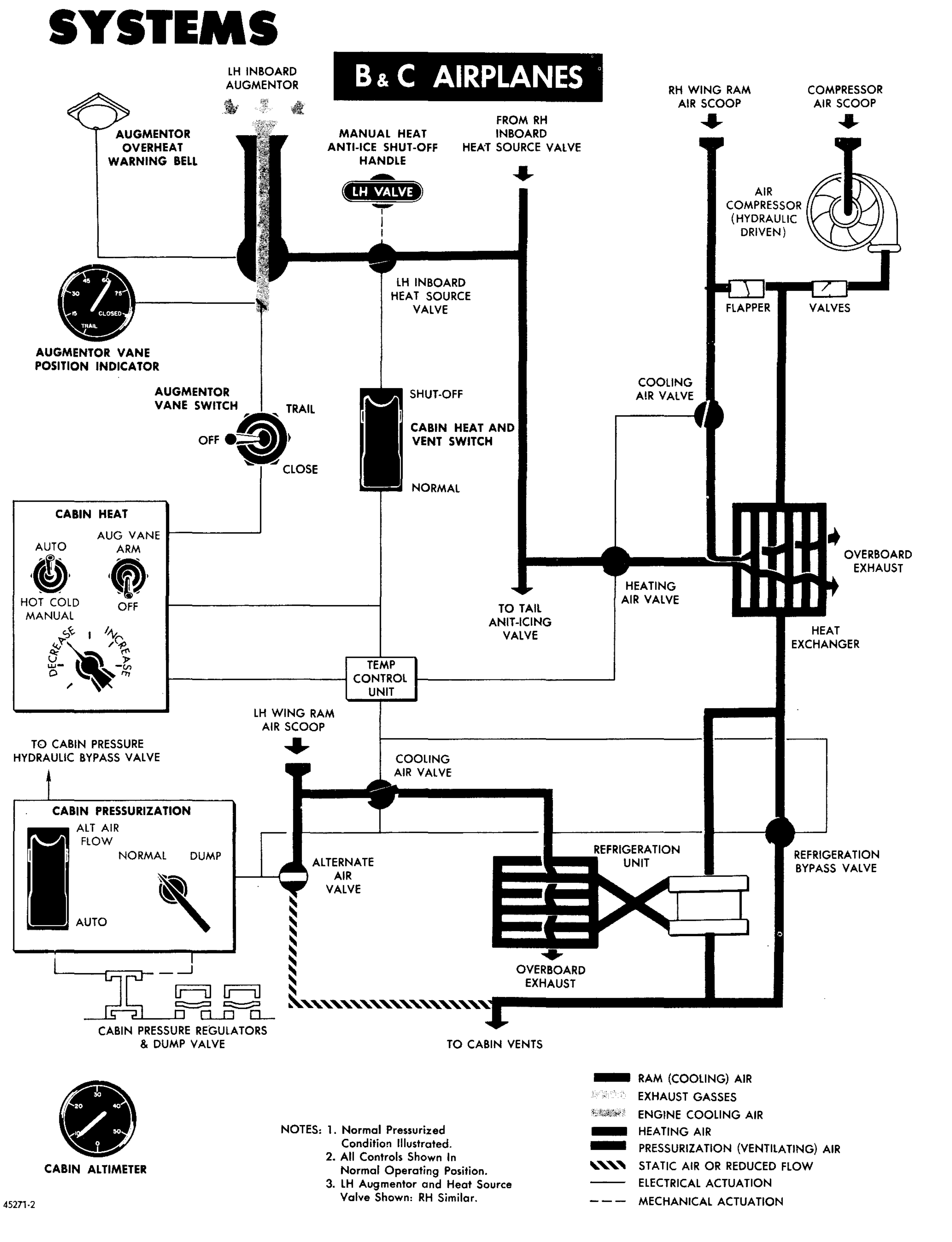


Figure 4-2 (Sheet 2 of 3)

AIR CONDITIONING SYSTEM

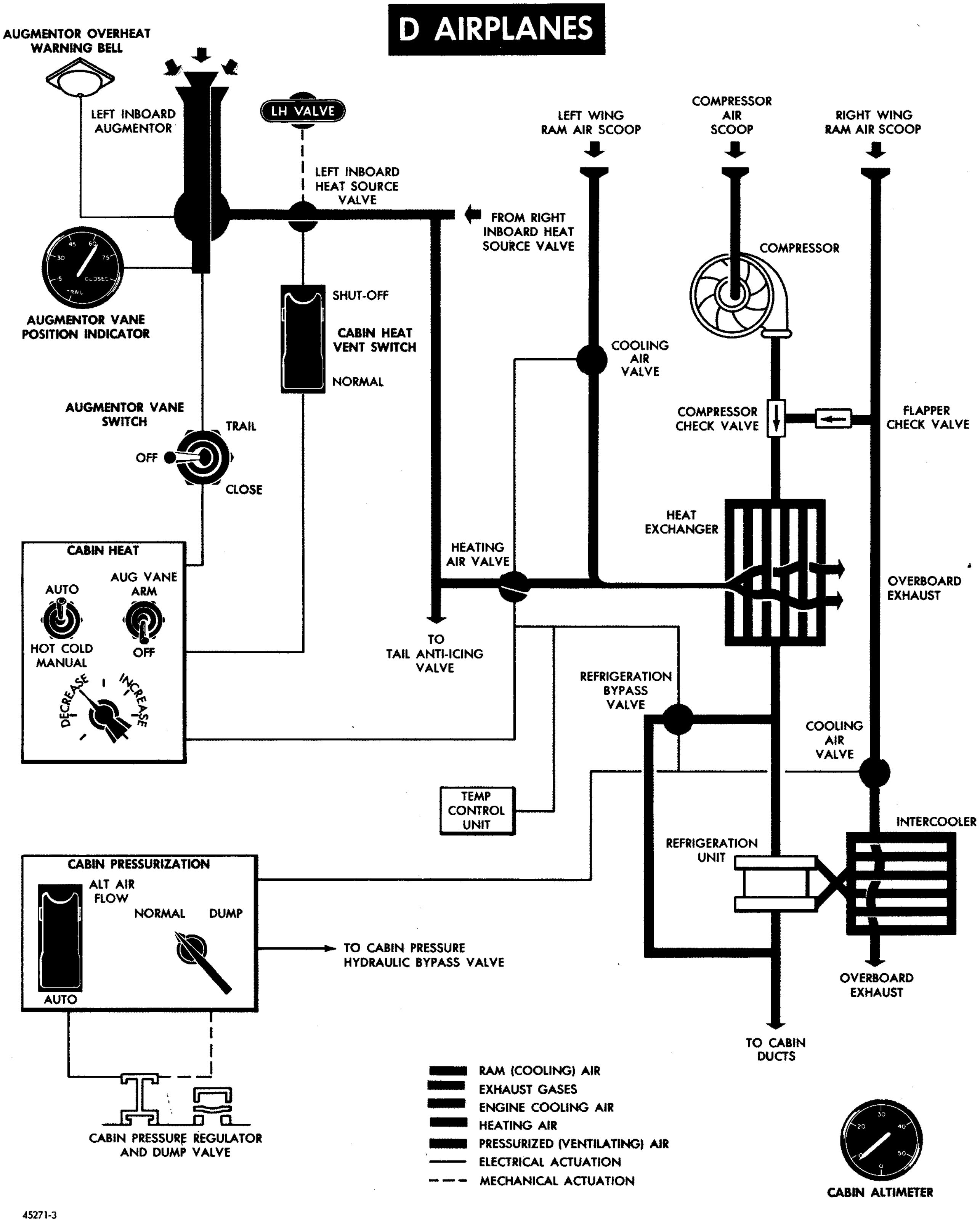


Figure 4-2 (Sheet 3 of 3)

CABIN COMPRESSOR HYDRAULIC SYSTEM

B, C & D AIRPLANES

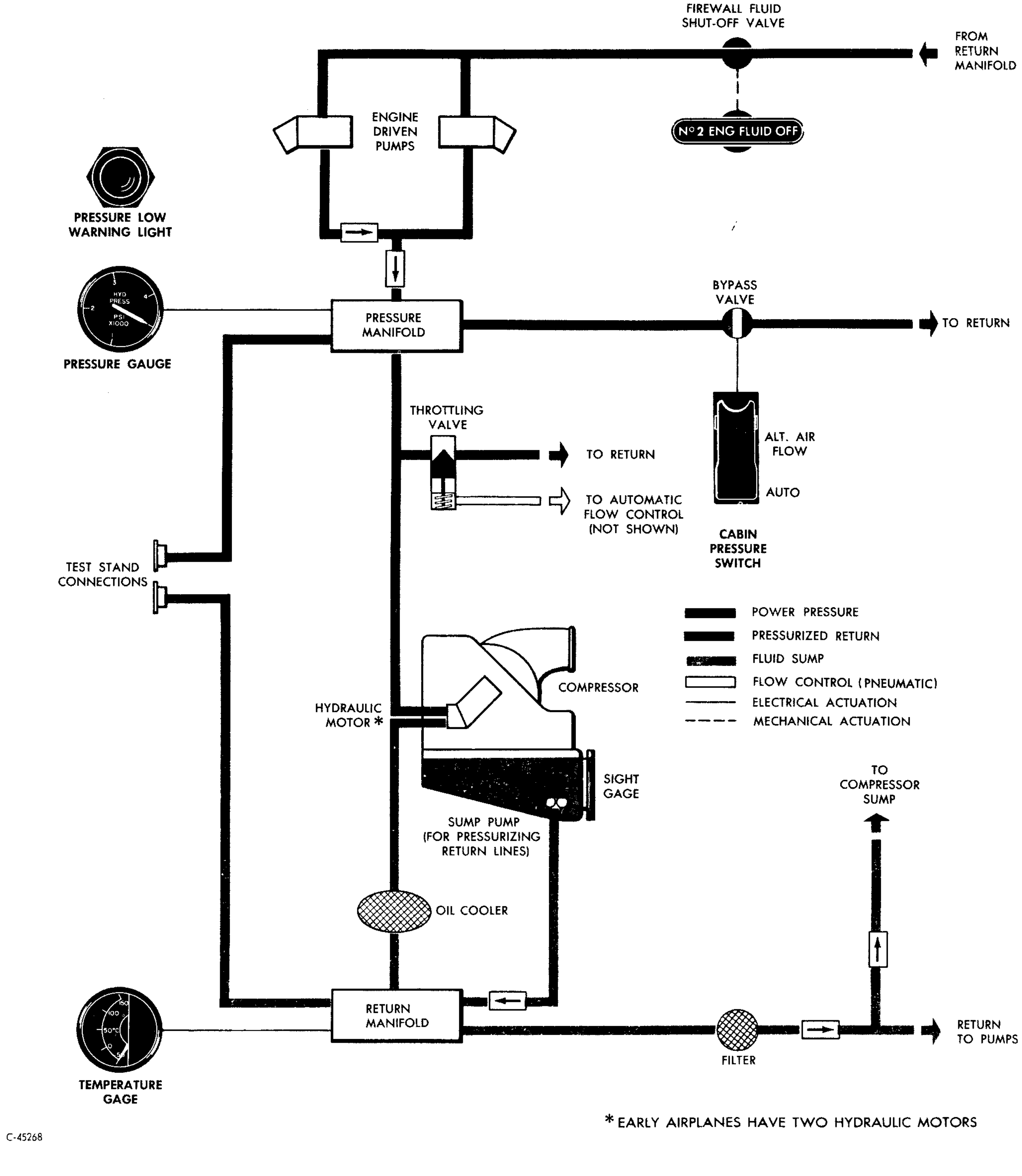


Figure 4-3

AUXILIARY EQUIPMENT

A AIRPLANES

C-45269-1

Figure 4-4

the switch is spring-loaded to OFF. When in AUTO position, the switch powers the automatic temperature control system by connecting direct current from the main bus to the valve actuating circuits of the temperature control unit. In HOT position the cabin heat switch bypasses the temperature control unit and originates a heat demand signal of its own. This causes sequential operation of all valves toward the maximum heat condition. Holding the cabin heat selector switch in COLD position also bypasses the temperature control unit and supplies a cold demand signal, causing sequential operation of all valves toward the maximum cold condition. The time required to complete the full cycle from full hot to full cold, or vice versa, is approximately one minute and thirty seconds. If the switch is left in the center OFF position, the temperature control system is inoperative, the control rheostat is ineffective, and the valves will retain the last assumed position. For manual operation, best results are obtained by holding the switch to either manual position momentarily, repeating as necessary to obtain the temperature desired.

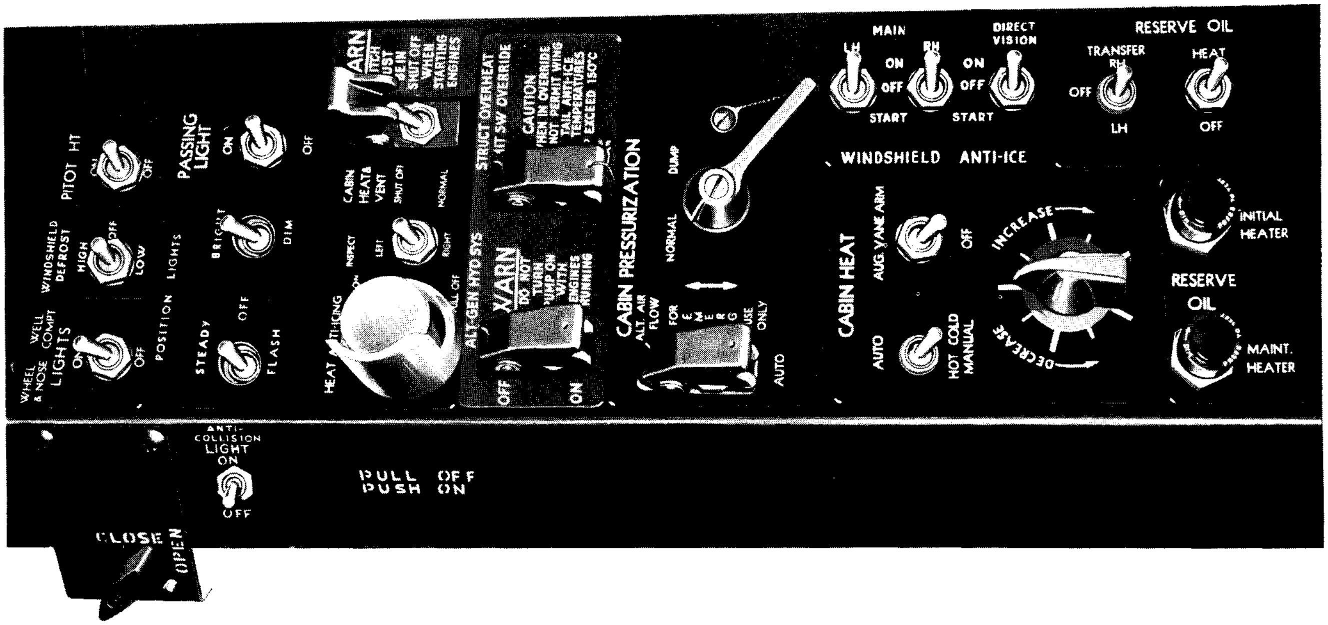
Cabin Heat Rheostat

The cabin heat rheostat, located on the copilot's console (figure 4-4), automatically maintains cabin temperature by action of the temperature control unit when the cabin heat selector switch is in the AUTO position. The rheostat has INCREASE and DECREASE positions. If the cabin heat switch is in OFF, or is held in HOT or COLD position and is then released to OFF, the cabin heat rheostat will have no effect and cabin temperature will not be controlled. Operating the rheostat alters resistance in the bridge circuit that senses cabin temperature and activates the temperature control unit. The total range controlled by the rheostat is 40° to 80°F. At any one setting, temperature will be maintained within a range of approximately 5°F. On Ⓐ airplanes, the rheostat will not be effective in obtaining a cabin temperature below outside air temperature because refrigeration facilities are not provided. On Ⓑ, Ⓒ, and Ⓓ airplanes, a cabin temperature below outside air temperature may be obtained if the cabin pressurization switch is in AUTO position or has been placed in the manual COLD position.

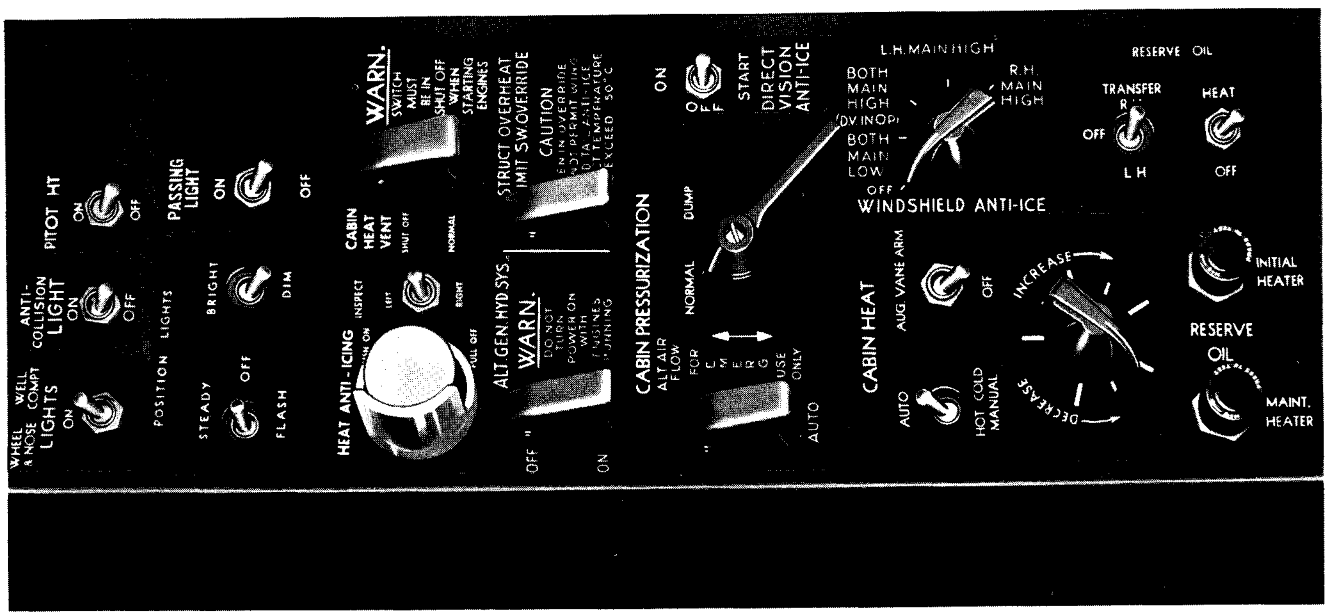
CONTROLS ON COPILOT'S CONSOLE (TYPICAL)

B, C & D AIRPLANES

B; EARLY C



LATE C; ALL D



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CABIN PRESSURE CHART

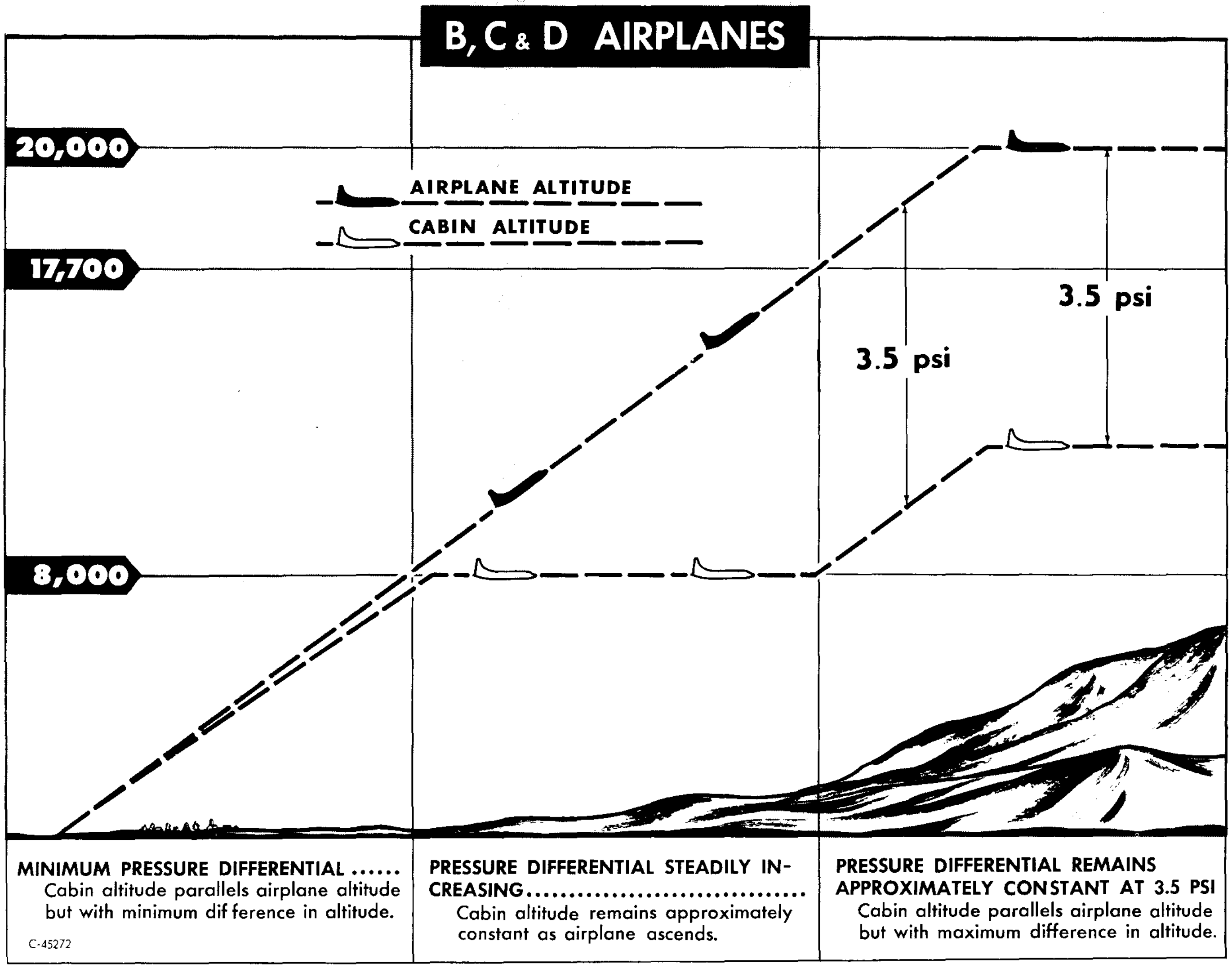

Figure 4-5

On Ⓐ airplanes, the bridge circuit is powered by the main dc bus. On Ⓑ , Ⓒ , and Ⓓ airplanes, the bridge circuit is powered by 115-volt regulated alternating current.

Heat Source Valve Indicator Lights Ⓐ

Two heat source valve indicator lights (figure 4-4) for the cabin air-conditioning system are provided in the heat valves indicator panel on the copilot's console. Both lights glow when the inboard augmentor heat source valves are operated. The valves are normally fully closed or fully open and both lights are out. If one or both of the indicator lights continues to glow for more than 15 seconds, the affected valve(s) failed to complete an operating cycle. The cycle must then be completed manually by operating the corresponding manual heat anti-ice shutoff handle(s). The same emergency operation is required if one or both of the lights fails to illuminate at the start of an operating cycle.

Cockpit Heat Ⓑ Ⓒ Ⓓ

The flight compartment side windshield defroster, pilots' foot warmers, and cockpit ventilating ducts are connected to the cabin heating and ventilating system (figure 4-6). An auxiliary electric heater provides additional heat for side windshield defrosting and cockpit heat. The heating elements operate on 115-volt unregulated alternating current from the No. 2 bus on Ⓑ and some Ⓒ airplanes, and from both No. 1 and No. 2 buses on other Ⓒ and all Ⓓ airplanes.

Cockpit Heater Control Switch Ⓑ Ⓒ Ⓓ

The cockpit heater control switch on the copilot's console has four positions: OFF, LOW, MED, and HIGH. The control uses nonessential direct current.

Pilots' Foot Warmers Ⓑ Ⓒ Ⓓ

On late Ⓑ and all Ⓒ and Ⓓ airplanes, heated air from the cabin heat and ventilating system can be directed to the floor area near the rudder pedals. The foot warmers are turned on or off manually by valve control knobs located aft of the discharge nozzles on each side of the flight compartment, below the consoles.

NORMAL OPERATION OF AIR-CONDITIONING SYSTEM (A)

1. Place cabin heat and vent switch to NORMAL.
2. Turn cabin heat selector switch to AUTO.
3. Position cabin heat rheostat pointer in either COOL or HEAT range to select desired temperature of ventilating air. The temperature control unit will position the heating and cooling air valves to obtain the required temperature and will maintain that temperature until the rheostat pointer is moved to a new setting.
4. If the desired temperature cannot be obtained by setting the rheostat, turn the cabin heat selector switch from AUTO to either HOT or COLD position momentarily, repeating as necessary until the desired air temperature is reached.
5. If the heating system does not respond to the electrical controls, the heat source valves can be opened or closed manually by the manual heat anti-ice shutoff handles.
6. During severe icing conditions, when heat is required for tail anti-icing, cabin heat may be reduced by turning the rheostat pointer to the COOL side. This normally insures the closing of the cabin heat valve (cabin cooling valve partially open), stopping flow of heated air to the heat exchanger, and thus allowing maximum heated air to be directed toward the tail anti-icing ducts. This neutral position of the modulating valves may also be attempted with the HOT and COLD manual positions by toggling the switch intermittently to the COLD position until cabin temperature is definitely on the cool side.
7. Before leaving the airplane, while electrical power is still on, turn the cabin heat and vent switch to SHUTOFF.

NORMAL OPERATION OF AIR-CONDITIONING SYSTEM (B) (C) (D)

Ground Tests

1. Cabin heat and vent switch — NORMAL.
2. Cabin compressor hydraulic pressure-low warning light (right engine idling) — Out.
3. Cabin compressor hydraulic pressure gage (right engine operating at 2000 rpm) — 1100-1250 psi.
4. Cabin compressor hydraulic temperature gage (right engine operating at 2000 rpm) — Within limits.

After Takeoff

1. Observe the cabin compressor hydraulic temperature gage occasionally for temperature within limits.
2. Check that cabin compressor hydraulic pressure-low warning light remains out.
3. Note that cabin temperature is maintained steadily within the selected range.
4. Above 8000 feet altitude observe cabin altimeter for pressure differential within limits and cabin altitude of 8000 feet up to airplane altitude of 17,700 feet.
5. Observe for cabin altitude rise in direct proportion to airplane altitude rise above 17,700 feet.
6. During descent between 17,700 feet and 8000 feet, observe cabin altimeter for a steady decrease in the difference between cabin altitude and airplane altitude.

EMERGENCY OPERATION OF AIR-CONDITIONING SYSTEM

Failure of Heat Source Valve Actuator (A)

If the actuator at one or both of the inboard augmentor heat source valves cannot be operated by electrical controls in response to cabin heat controls, the valve(s) may be operated manually by turning the corresponding manual heat anti-ice shutoff handle. This action will operate both heat source valves in the affected nacelle. If one of the inboard heat source valves is opened by the manual heat anti-ice shutoff handle, for example, the corresponding outboard heat source valve will also open and provide wing anti-icing heat to both wings. Once a manual heat anti-ice shutoff handle has been used, the affected heat source valves will no longer respond to electrical control.

Ventilation Failure (B) (C) (D)

A flapper-type alternate air valve (figure 4-2) will open automatically and admit ventilating air to the fuselage if the air compressor of the air-conditioning system ceases to operate or operates intermittently. The latter condition will be indicated by fluctuation of the cabin compressor hydraulic pressure. Further indication of malfunction of the air compressor may be illumination of the cabin compressor hydraulic pressure-low warning light, excessive temperature in the cabin compressor hydraulic system, or failure to pressurize above 8000 feet. Noticeable fluctuation of cabin temperature may also occur. Proceed as follows:

1. Cabin pressurization switch — ALT AIR FLOW.

2. If above 10,000 feet, use oxygen masks.

3. Descend to altitude not requiring oxygen.

CAUTION

To prevent pressure surge and possible damage to the system, do not return the cabin pressurization switch to AUTO position with the right engine operating.

Pressurization Failure Ⓑ Ⓒ Ⓓ

If the cabin altimeter indicates increasing altitude as the airplane rises above 8000 feet, and ventilation has been satisfactory up to that altitude, check cabin pressure manual dump valve handle for NORMAL position. Note ventilation efficiency and be prepared to turn cabin pressurization switch to ALT AIR FLOW if air compressor malfunction is indicated. Refer to VENTILATION FAILURE, this Section.

Temperature Control Failure Ⓑ Ⓒ Ⓓ

Note

Automatic cabin temperature control may be continued (cabin heat switch in AUTO position) with either engine inoperative, although cabin temperature may decrease below the desired level. It is not advisable to attempt to raise the heating air temperature by closing augmentor vanes under single-engine operations because cylinder head temperatures may rise above operating limits.

If cabin temperature control hunts widely, or fails, check manual heat and anti-ice shutoff handles for ON position, cabin heat and vent switch for NORMAL position, cabin heat switch for AUTO position, cabin heat rheostat for desired settings, and heat anti-icing button for PULL OFF position. Check inverter output for 115 volts; check dc supply.

Note

Heating air from the collector muffs at the inboard augmentors is routed to tail leading edges during wing and tail anti-icing operation (heat anti-icing button in PUSH ON position). Cabin temperature may therefore drop below the desired temperature during wing and tail anti-icing operation. This is not an indication of malfunction.

If all controls are correctly positioned as noted above and temperature control failure persists, hold the cabin heat switch to HOT or COLD position periodically, as required, to keep cabin temperature within comfortable limits. Leave the switch in OFF position between operations. If the temperature control failure takes the form of continued low temperature, and extremely low outside air temperature is indicated, there may be insufficient heat available at the heat collector muffs in the nacelles. To obtain greater heat in the heating air, turn the augmentor vane arm switch to ARM position and close the augmentor vanes as required. If cabin temperature does not rise to the desired range within five minutes, return the vanes to TRAIL position and turn the augmentor vane arm switch to OFF.

Note

Use of augmentor vanes to provide adequate heat for cabin heating should be necessary only in extremely cold weather, if at all. Refer to WING AND TAIL ANTI-ICING SYSTEM, this Section. Closing the augmentor vanes raises cylinder head temperatures and augmentor temperatures. The augmentor overheating warning bell will ring and the vanes will trail automatically if a dangerous overheat condition develops in the augmentors.

If attempts to increase cabin temperature by these means are not successful, the temperature control unit may be defective. Override the unit by operating the cabin heat switch to HOT and then leaving it in OFF as described above.

CABIN TEMPERATURE CONTROL DURING WING AND TAIL ANTI-ICING OPERATION Ⓑ Ⓒ Ⓓ

During wing and tail anti-icing, heated air from the inboard augmentor muff is shared between cabin heating and tail leading edges. The only other heat then available for cabin heating is the heat generated in the ventilating-pressurizing air as it is compressed by the air compressor. To obtain the maximum benefit from this heat, leave all air-conditioning controls set for normal automatic operation. Discontinue wing and tail anti-icing operation as soon as it is safe to do so.

DEFROSTING SYSTEMS

SIDE WINDOW DEFROSTING

On Ⓐ and early Ⓑ airplanes, an independent system of distribution ducts and two dc motor-driven blowers are provided to blow heated cabin air directly against the inner surfaces of the side windows. The air intake is located at the bottom of the flight compartment aft bulkhead. Cabin air is drawn into the intake and forced through nozzles at the aft ends of the side windows by two blowers installed in the ducts. On late Ⓑ airplanes and all Ⓒ and Ⓓ airplanes, the flow of air from the cabin heat and ventilating system is directed against the side windows. The defrosting air to either window can be turned ON or OFF by manual control handles located on the flight compartment floor, outboard of the pilot's and copilot's seats. Additional heat can be obtained with the cockpit heater control switch located on the copilot's console.

Side Window Defrost Switch (A) (B)

On (A) and early (B) airplanes, the side window defrost switch on the copilot's console has positions OFF, LOW, and HIGH. The operating position selected governs the speed of the side window defrosting blowers.

ASTRODOME AND PERISCOPIC SEXTANT WINDOW DEFROSTING SYSTEM (A) (B) (C)

A defrosting blower (figure 4-6) is attached to the base of each astrodome and periscopic sextant window. Each blower circulates cabin air against the inner surface of the dome or window. The blowers are individually controlled, and are powered by the dc nonessential bus. On some (A) airplanes, de-icing is accomplished by use of alcohol.

Defrost Blower Switches (A) (B) (C)

An ON-OFF defrost blower switch (figure 4-6) is installed adjacent to the blower at each astrodome and at the periscopic sextant window.

CAMERA WINDOW DEFROSTING SYSTEM (A) (B) (C)

The bomb scoring camera window, located below the floor in the aft end of the cabin, is defrosted by an electrically operated blower (figure 4-6) that draws heated air from the cabin and directs it through a duct and nozzle across the surface of the window. The camera window defrosting blower is turned on and off by the operation of a "Camera Master-Off" switch on the camera control panel (figure 4-6) at the master radar operator's station. The defroster operates whenever the bomb scoring camera system is turned on. The scoring system is powered by the dc nonessential equipment bus.

NORMAL OPERATION OF DEFROSTING SYSTEMS

1. Side window defrost switch — LOW or HIGH (A) (B)
2. Side window defrost handle — UP. (C) (D)
3. Defrost blower switches (four) — ON. (A) (B) (C)
4. Camera master switch — CAMERA MASTER. (A) (B) (C)

EMERGENCY OPERATION OF DEFROSTING SYSTEMS

There are no provisions for emergency operation of the defrosting systems.

ANTI-ICING AND DE-ICING SYSTEMS

Anti-icing or de-icing systems are provided for the following installations:

- Wing and tail leading edges
- Windshields and direct vision windshields
- Propellers
- Alternator-generator cooling air scoops (B) (C) (D)
- Pitot tubes

WING AND TAIL ANTI-ICING SYSTEM

The leading edges of the wing, dorsal fin, vertical stabilizer, and horizontal stabilizer can be heated to prevent the formation of ice. The leading edges are heated by routing hot air, from the engine augmentor muffs, through integral ducts in the leading edge structures. (See figure 4-7.) Each engine has an outboard augmentor and an inboard augmentor. To heat the leading edges, hot air from the outboard augmentor muff in each nacelle is directed into the anti-icing ducts in the wing leading edge. The leading edge ducts in the right wing and the left wing are interconnected by a crossover duct so that the leading edges of both wings can be heated during single-engine operation. Heated air from the inboard augmentor muffs in both nacelles enters a fore-and-aft duct which leads to the tail anti-icing ducts. (This duct also serves the heat exchanger of the cabin air-conditioning system.) The flow of heated air from the augmentor muffs into the heated air ducts is controlled by four heat source valves (figure 4-7), one at each augmentor muff. A tail anti-icing shutoff valve (figure 4-7), in the duct leading to the tail, operates in conjunction with the heat source valves to supply heated air to the tail leading edges. The temperature of the anti-icing air can be increased by varying the position of the augmentor vanes. Thermal switches at the augmentors automatically "trail" the augmentor vanes and ring a warning bell in the cockpit if an overheat condition occurs in the augmentors. Thermostatic limit switches in the wing and tail anti-icing ducts automatically close the heat source valves and the tail anti-icing valve if an overheat condition occurs in the ducts.

INTERRELATION OF WING AND TAIL ANTI-ICING SYSTEM AND AIR-CONDITIONING SYSTEM

The inboard heat source valves and the air-conditioning system heating air valve are controllable by either the cabin temperature control circuit of the air-conditioning system or the wing and tail anti-icing system control circuit. On (A) airplanes, the cabin temperature heat control unit and the wing and tail anti-icing control circuit operate on dc power from the main bus. On (B), (C), and (D) airplanes, the cabin temperature heat control unit operates on 115-volt regulated ac power and the wing and tail anti-icing system control operates on dc power from the main bus. The outboard heat source valves and the tail anti-icing shutoff valve are controllable by the wing and tail anti-icing system control circuit only. When the wing and tail anti-icing control circuit is not energized, the cabin temperature control circuit opens or closes the heating air valve and the inboard heat source valves together so that the required amount of heating air is supplied to the heat exchanger-intercooler of the air-conditioning system. In this condition, the outboard heat source valves and the tail anti-icing shutoff valve remain closed. During anti-icing operation,

DEFROSTING SYSTEM (TYPICAL)

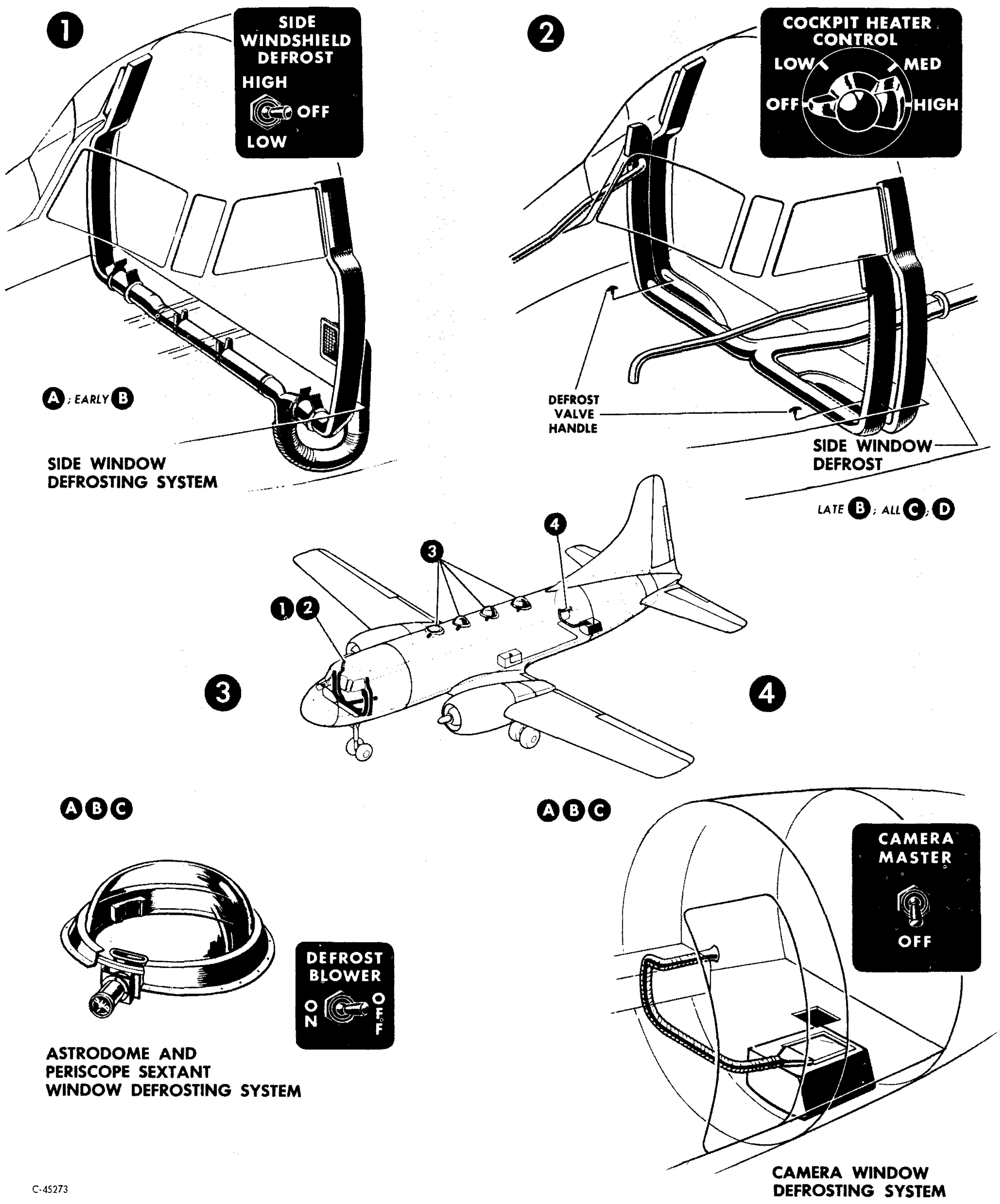

Figure 4-6

if an anti-icing duct becomes overheated, an automatic duct overheat circuit de-energizes the anti-icing control circuit. The outboard heat valves and the tail anti-icing shutoff valve close, and control of the inboard heat source valves and the heating air valve reverts to the cabin temperature control system. On Ⓐ airplanes, when the cabin heat and vent switch is in the SHUTOFF position, it overrides the cabin temperature control circuit but not the wing and tail anti-icing control circuit. Both the inboard and the outboard heat source valves are then closed unless the wing and tail anti-icing system is in operation.

Heat Anti-Icing Button

The heat anti-icing button (figure 4-4), on the copilot's console, controls the operation of the wing and tail anti-icing system. The button is placarded "Push On" and "Pull Off." On Ⓐ airplanes, when the button is in the PULL OFF (out) position, the outboard heat source valves are closed, the tail anti-icing shutoff valve is closed, the inboard heat source valves and the heating air valve are under control of the cabin temperature control system, and the augmentor vane control circuits are deenergized. On Ⓑ, Ⓒ, and Ⓓ airplanes, when the button is in the PULL OFF (out) position, the outboard heat source valves are closed, the tail anti-icing shutoff valve is closed, the inboard heat valves and the heating air valve are under control of the cabin temperature control system, and the augmentor vane circuits are under control of the augmentor vane switches and the augmentor vane arm switch. When the heat anti-icing button is pushed in, all four heat source valves and the tail anti-icing shutoff valve are opened, and the augmentor vane control circuits are automatically armed. The button is held in the PUSH ON position by a magnetic holding coil. Normally, the button is pulled out manually when anti-icing is no longer required. However, a safety circuit, controlled by thermostatic limit switches releases the button to PULL OFF position if an overheat condition develops. In that event, the valves and the augmentor vane circuits revert to the closed and deenergized conditions described above.

Structural Overheat Limit Override Switch

On some Ⓐ and Ⓑ airplanes and all Ⓒ and Ⓓ airplanes, a guarded override switch (figure 4-4) on the copilot's console permits continued operation of the wing and tail anti-icing system if, because of a malfunction or an open circuit in one or more of the thermal limit switches, the control circuit becomes de-energized even though temperatures are within limits. The override switch operates from the main dc bus. If the heat anti-ice button will not stay in the PUSH-ON position and the wing and tail anti-ice temperatures are within limits, operation of the heat anti-icing system can be continued by placing the override switch in the OVERRIDE position and the heat anti-ice button in the PUSH-ON position.

CAUTION

When wing and tail anti-icing is being accomplished through use of the override switch, the automatic overheat disconnect is inoperative. Duct temperatures should not be allowed to exceed the maximum limits.

Cabin Heat and Vent Switch

The cabin heat and vent switch (figure 4-4) controls the operation of the heat source valves. In the SHUTOFF position the valves are closed and heat is not available for anti-icing and cabin heat. When the switch is in the NORMAL position, the valves are controlled by the normal automatic or manual operation of the air-conditioning system or normal operation of the anti-ice system. The heat and vent switch is powered by the main dc bus.

Manual Heat Anti-Ice Shutoff Handles

Two handles (figure 4-8), mounted on a recessed overhead panel, are provided for manually closing or opening the heat source valves at the augmentors if the electrical control circuits for these valves fail. One handle is provided for the two heat source valves in each nacelle, and is connected to the valves by a cable system. A handle is pulled downward to engage its clutch mechanism and is then rotated 100° clockwise to close the heat source valves in the corresponding nacelle. When the handle has reached the OFF position, it should be pushed into a detent provided to hold the handle in the valves-closed position.

Note

Once the heat source valves have been operated manually, they cannot be operated electrically until the valve actuators have been reset by the ground crew.

If the heat source valves have been manually closed, they can be opened by pulling the handles down and rotating them counterclockwise to the open position. If the valves are in the closed position when electrical failure occurs, they can be opened by pulling the handles down, rotating them clockwise to the closed position, and then rotating them counterclockwise back to the normal position.

Heat Valve Indicator Lights Ⓐ

Five lights (figure 4-4), located on the copilot's console, illuminate while the four heat source valves and the tail anti-icing valve are in transit. The lights for the outboard heat source valves are related to wing anti-icing. The two lights for the inboard heat source valves are related to tail anti-icing and also to the cabin heat system. The fifth light indicates operation of the tail anti-icing valve. If one of the lights fails to light when the heat anti-icing button is positioned in PUSH ON or is returned to PULL OFF, the corresponding valve has failed to

WING AND TAIL ANTI-ICING SYSTEM
(TYPICAL)

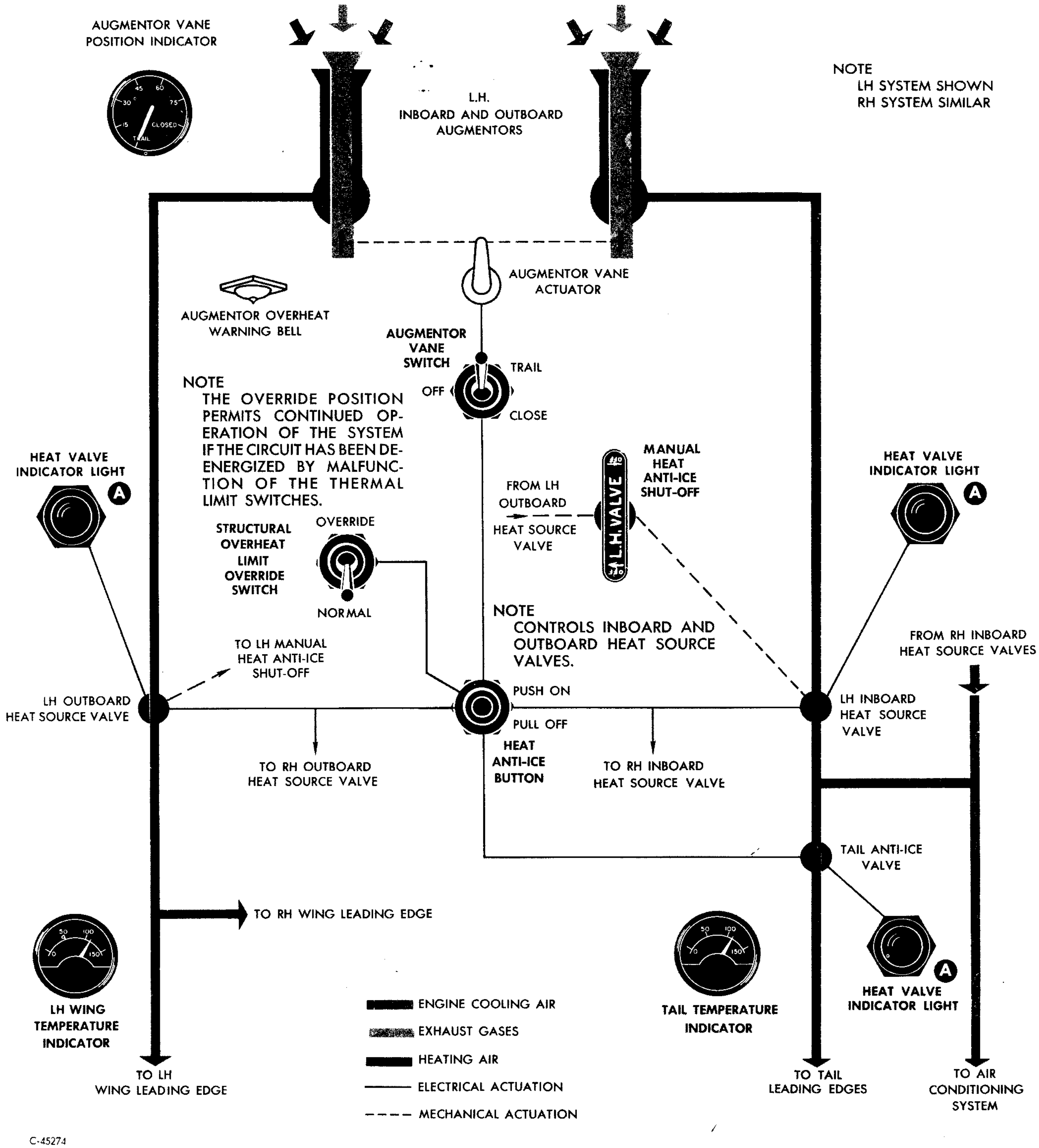

Figure 4-7

MANUAL HEAT ANTI-ICE SHUT-OFF HANDLES

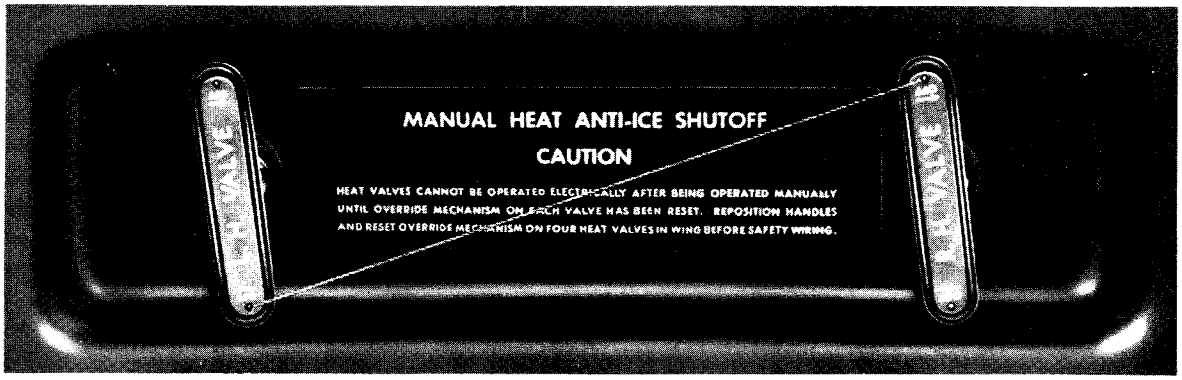

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Figure 4-8

operate. If one of the lights remains on for more than 15 seconds, the corresponding valve has failed to complete an opening or closing movement. The corresponding manual anti-ice shutoff handle may be used to operate a defective heat source valve. (This will automatically result in manual operation of the other heat source valve in the affected nacelle.) The lights operate on power from the main dc bus.

Augmentor Vane Arm Switch B C D

The augmentor vane arm switch (figure 4-4), on the copilot's console, has OFF and ARM positions. It is normally positioned in OFF. The augmentor vanes are normally controllable only when the wing and tail anti-icing system is in operation. The switch, when positioned to ARM, allows operation of the augmentor vanes without simultaneously operating the wing and tail anti-icing button. The switch is overridden and has no effect when the heat anti-ice button is in PUSH ON position. The augmentor vane control circuits are then armed regardless of the position of the augmentor vane arm switch. Refer to Section I for description of the augmentor vane system. The augmentor vane arm switch receives power from the main dc bus.

Augmentor Vane Switches

When the heat anti-icing control button is in the PUSH ON position, the temperature of the heated air delivered to the anti-icing ducts can be increased by operating the augmentor vane switches to close the augmentor vanes. The augmentor vane switches are powered by the main dc bus. Refer to Section I for a description of the augmentor vane system.

Augmentor Vane Position Indicators

Two augmentor vane position indicators (36, figure 1-9) are installed on the engine instrument panel. Each indicator shows the position of the two augmentor vanes in the corresponding nacelle. The position is indicated in degrees closed. The indicator circuits are controlled by the mechanism that links and actuates the two augmentor vanes. The indicators function at all times that 26-volt ac (transformer) power is available.

Augmentor Overheat Warning Bell

The augmentor overheat safety circuit "trails" the augmentor vanes and rings a warning bell on the flight compartment ceiling when an overheat condition exists in an augmentor. There is no cutoff switch for the warning bell, and it continues to ring as long as the overheat condition exists and power is supplied to the main dc bus.

WARNING

The circuit breaker that protects the augmentor overheat warning bell also protects the fire detection circuit. This circuit breaker must not be pulled to silence the warning bell. Such action would make the fire detection circuit inoperative.

Wing and Tail Anti-Icing Temperature Gages

Three temperature gages (13, 14 and 16, figure 1-9), on the pilot's flight instrument panel shelf, indicate the temperature of the anti-icing air in the leading edge ducts of the wing and tail. The gages are powered by the main dc bus through temperature bulbs installed in the wing and tail leading edges.

NORMAL OPERATION OF WING AND TAIL ANTI-ICING SYSTEM

1. Push the heat anti-icing button to PUSH ON position at least 30 minutes before leading edge icing conditions are anticipated. If icing conditions are anticipated during climb, actuate heat anti-icing button on the ground prior to takeoff.

2. When icing conditions are actually encountered, completely close the augmentor vanes and adjust nacelle flaps, not to exceed MID POSITION, to maintain cylinder head temperature below 232°C (between 220° and 232°C desired).

Note

- During a climb, an augmentor vane closure in excess of 70° on (A) and (B) airplanes or 60° on (C) and (D) airplanes may cause serious afterburning in augmentors. If afterburning occurs, reset the vanes to a lesser closure.
- Maximum wing and tail anti-icing will be provided by exceeding 150°C on the wing and tail heat gages. The thermal limit switches will provide overheat protection. If it is necessary to place the structural overheat limit override switch in the OVERRIDE position, do not allow the wing anti-icing air temperature to exceed 150°C.

3. If nacelle flap MID POSITION does not maintain desired cylinder head temperatures, readjust augmentor vanes to a lesser closure.

4. When leading edge anti-icing is no longer necessary, pull heat anti-icing button to PULL OFF position.

Note

On the ground there is not sufficient ram airflow into the augmentor muffs to provide wing and tail anti-icing.

EMERGENCY OPERATION OF WING AND TAIL ANTI-ICING SYSTEM

Malfunction of Heat Source Valve Electrical Control Circuits

1. To open the heat source valves, pull the manual heat anti-ice handles (located on a recessed overhead panel), rotate them clockwise to the off position, and then counterclockwise back to the normal position.

2. To close the heat source valves, pull the manual heat anti-ice handles and rotate them clockwise to the off position.

Note

Once the heat source valves have been operated manually, they cannot be operated electrically until the valve actuators have been reset by the ground crew.

Failure of Heat Anti-Icing Button to Remain In

1. Check the circuit breaker.

2. If the circuit breaker is set, place the structural overheat limit override switch in the OVERRIDE position and push in the anti-ice button. If failure of the anti-ice button to remain in was caused by malfunction of the anti-icing thermal limit circuit, the button should remain in and the system will function.

CAUTION

When using the override switch, the automatic overheat disconnect is inoperative. Duct temperatures should not be allowed to exceed 150° C.

WINDSHIELD ANTI-ICING SYSTEM

Icing of the main windshields and the two direct vision windshields is prevented by heating the glass electrically with a high voltage alternating current. The windshield anti-icing circuit is identified on the circuit breaker panels as the "Nesa Glass" circuit. Current for heating the glass is taken from the No. 1 alternator bus. To prevent damage to the glass from the thermal shock, 115-volt alternator output is used for warming the glass from a cold start. After about 10 minutes, the current is stepped up to 325 volts if the anti-ice switch is moved to the ON position. Direct current from the main bus is employed for operating three temperature control units (one for each main windshield and one for the direct vision windshield panels). Temperature-sensing elements of the wire grid type, embedded in the vinyl layer of the glass panels, operate to maintain the panels at a minimum temperature of about 29.4° (85°F). At approximately 32.2°C (90°F), power to the glass is automatically turned off to prevent damage by overheating. The system thus cycles between the temperature limits noted.

CAUTION

Unwarranted use of ON or HIGH positions can cause excessive stress and may result in failure of the glass. In practice, START or LOW positions provide sufficient heat to prevent icing when outside air temperature is as low as -34.4°C (-30°F). If conditions require higher heat, the system must be operated in the START or LOW positions at least 10 minutes before switching to the ON or HIGH positions.

Windshield Anti-Ice Switches

On (A), (B), and early (C) airplanes, three windshield anti-ice switches (figure 4-4) — placarded "LH," "RH," and "Direct Vision" — are located on the copilot's console. These switches control power to the Nesa glass in the windshields. Each switch has three positions: OFF, START and ON. The switches are placed in the START position for an initial warmup period of 10 minutes, after which full anti-icing heat is obtained by moving the switches to the ON position. On late (C) and all (D) airplanes, two windshield anti-ice switches (figure 4-9) are located on the copilot's console. A rotary switch controls the power to both the main windshields. The positions are OFF, D. V. ARM, BOTH MAIN LOW, BOTH MAIN HIGH (D. V. INOP), LH MAIN HIGH, and RH MAIN HIGH. The switch is turned to BOTH MAIN LOW position for an initial warmup period of 10 minutes, after which full anti-icing heat is obtained by turning the switch to the desired operating position. With the selector switch in the BOTH MAIN HIGH (D. V. INOP) position, the direct vision windshields cannot be heated. A toggle type switch with three positions, DIRECT VISION START, OFF, and ON, controls the power to the left and right direct vision windshields. The switch is placed in the LOW position for the initial warmup period of 10 minutes, and then to the HIGH position for full heat application.

NORMAL OPERATION OF WINDSHIELD ANTI-ICING SYSTEM

1. Alternator switches — ON.
2. Alternator selector switch — NORMAL (for ground operation, EXT PWR ON BUS 1).
3. AC voltmeter selector switch — Bus No. 1 (check voltage).
4. Windshield anti-ice switches — START (at least 30 minutes before icing conditions are anticipated).

Note

- If the No. 1 alternator fails, and windshield anti-icing is necessary, turn the alternator selector switch to the 1 OFF — 2 ON BUS 1 position to supply current from the No. 2 alternator to the windshield anti-icing circuit.
- When the alternator selector switch is placed in the 1 OFF — 2 ON BUS 1 position, the No. 2 alternator bus (figure 1-25) receives no current.

WINDSHIELD ANTI-ICE SWITCHES
(Late Airplanes)

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Figure 4-9

PROPELLER DE-ICING SYSTEM

Electrical heating elements, installed inside the leading edges of the propeller blades on (A) airplanes and on the external surface of the leading edges of the blades on (B), (C), and (D) airplanes, receive power through a de-icing timer. The timer directs current to the propellers in cycles so that they are alternately heated to loosen the ice and free it for removal by centrifugal force. Alternating current (115-volt) from No. 1 alternator bus is stepped down by transformer to 29.5-volt ac for operation of the propeller heating elements in the blades.

Propeller De-Ice Switch (B) (C) (D)

A propeller de-ice circuit breaker switch (figure 4-10) is located on the copilot's console. The switch has ON and OFF positions, and controls operation of the propeller de-icing system. This switch simultaneously controls the alternator-generator cooling scoops de-icing system. The switch also serves as a circuit breaker to protect the dc circuits to the de-ice timer and de-ice control relays. Refer to ALTERNATOR-GENERATOR COOLING SCOOPS DE-ICING SYSTEM, this Section.

Propeller De-Ice Circuit Breakers

Two trip-free propeller de-ice circuit breakers (figure 4-10), placarded LH and RH, are located on the copilot's console beside the propeller de-ice switch. These two circuit breakers are connected to relays that open if the heating elements in the propeller blades are subjected to excessive current. An overload in the de-icing circuit for one propeller

PROPELLER DE-ICE LOADMETER

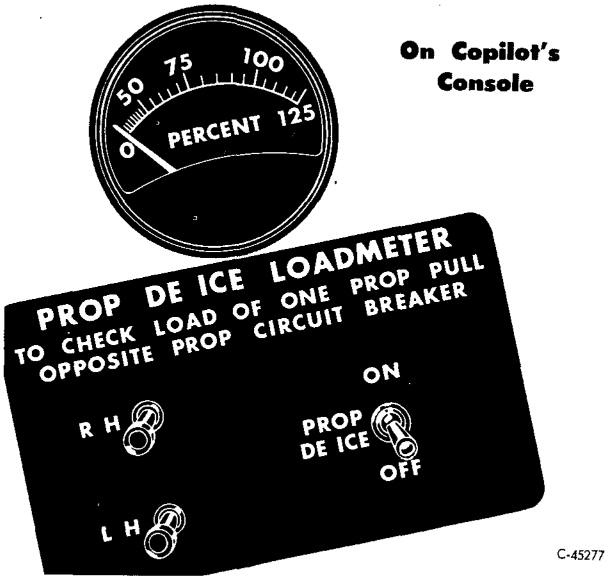

Figure 4-10

opens the corresponding relay and causes the related trip-free circuit breaker on the copilot's console to pop out, indicating the overloaded condition. The circuit breaker cannot be made to stay in the reset (in) position until the relay has cooled (approximately one minute). Additional protection is provided by the main propeller de-ice circuit breaker on the main circuit breaker panel.

Propeller De-Ice Loadmeter Ⓑ Ⓒ Ⓓ

A propeller de-ice loadmeter (figure 4-10) is installed on the copilot's console adjacent to the propeller de-ice switch. The dial of the loadmeter is calibrated in percentage of electrical load, from 0% to 125%. When the propeller de-ice system is operating, the needle of the loadmeter indicates alternately from 0% to approximately 90% each time the propeller de-ice timer directs current to a propeller, indicating normal operation. The loadmeter indicates when the three heating elements of a propeller are not drawing the normal amount of alternating current required to de-ice the blades uniformly.

NORMAL OPERATION OF PROPELLER DE-ICING SYSTEM

1. Alternator switches — ON.
2. Alternator selector switch — NORMAL or Bus No. 1.
3. Propeller de-ice circuit breakers — Check in.
4. Propeller de-ice switch — ON (when icing conditions are encountered).
5. AC voltmeter selector switch — Bus No. 1.
6. AC voltmeter — Periodic fluctation of pointer indicates operation of propeller de-ice timer.
7. On Ⓑ, Ⓒ, and Ⓓ airplanes, a periodic loadmeter indication of approximately 90% for 60 seconds duration and 0% for 60 seconds, indicates normal operation of both propeller de-icing systems.

EMERGENCY OPERATION OF PROPELLER DE-ICING SYSTEM

Abnormal operation of the propeller de-icing system is indicated by one or both of the circuit breakers on the copilot's console popping out to tripped position or by the propeller de-ice switch tripping to the OFF position. Failure of a circuit breaker to stay reset indicates that de-icing is impossible for the related propeller. On Ⓑ, Ⓒ, and Ⓓ airplanes a top reading of 60% or below on the propeller de-ice loadmeter indicates that the blades of one propeller are not being de-iced uniformly. Determine which propeller is affected by pulling out first one and then the other circuit breaker on the console while observing the loadmeter. Leave the circuit breaker for the affected propeller in OUT position.

WARNING

When uneven de-icing of the blades of a propeller is indicated, it is imperative that the de-icing circuit for that propeller be broken. Uneven de-icing of blades can result in propeller unbalance and engine failure.

Note

- If No. 1 alternator fails and propeller de-icing is necessary, turn alternator selector switch to 1 OFF — 2 ON BUS 1 position, and operate propeller de-icing system in normal manner.
- When the alternator selector switch is placed in the 1 OFF — 2 ON BUS 1 position, No. 2 alternator bus (figure 1-25) receives no current.

ALTERNATOR-GENERATOR COOLING SCOOPS DE-ICING SYSTEM Ⓑ Ⓒ Ⓓ

Electrical de-icing boots are installed on the leading edges of the alternator-generator cooling air scoop on the right nacelle, and the alternator-generator hydraulic fluid cooler air scoop in the right wing lower surface. Alternating current (115-volt) from No. 1 alternator bus is used for the boot heaters The circuits are manually controlled by operation of the propeller de-ice switch, but are also automatically armed or disarmed by the landing gear safety switch, so that the scoop de-icers cannot normally be operated on the ground.

Alternator-Generator Cooling Scoops De-Icing System Control B C D

When the weight of the airplane is off the landing gear, the scoop de-icing system is turned on and off with the propeller de-icing system by means of the propeller de-ice circuit breaker switch on the copilot's console. The scoop de-icing system has its own circuit breaker and is not controlled by any of the propeller de-icing system circuit breakers except the propeller de-ice switch.

NORMAL OPERATION OF ALTERNATOR-GENERATOR COOLING SCOOPS DE-ICING SYSTEM B C D

1. Alternator switches — ON.
2. Alternator selector switch — NORMAL.
3. Propeller de-ice switch — ON.

Note

- If the No. 1 alternator fails and de-icing is necessary, turn alternator selector switch to 1 OFF — 2 ON BUS 1 position, and operate propeller de-ice switch in a normal manner.
- When the alternator selector switch is placed in the 1 OFF — 2 ON BUS 1 position, the No. 2 alternator bus receives no current.

PITOT TUBES ANTI-ICING SYSTEM

Each of the three pitot tubes incorporates an anti-icing heating element that is energized by power from the main dc bus.

Pitot Heat Switch

An on-off pitot heat switch (figure 4-4), on the copilot's console, controls electrical power for heating the elements in all three pitot tubes. A pitot heat circuit breaker, on the main circuit breaker panel, safeguards the circuit.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

The communication and associated electronic equipment (figure 4-11) in this airplane falls into three categories: communication electronic equipment, electronic equipment used for flight operation purposes by the crew, and training electronic equipment used by the students and instructors. Circuit breakers for each piece of equipment are located on the radio junction box at the radio operator's station on A and B airplanes, on the aft side of the radio rack on C airplanes, and on the radio junction box at the flight engineer's station and at the master bombardier station on D airplanes. Static dischargers are located on the wing and empennage trailing edges. Electronic training and some communication equipment is nonessential to safe flight, and as such is subject to being disconnected automatically from the airplane power source by the load monitor system when a generator fails in flight. The disconnect may be overridden and the equipment reconnected by moving the load monitor switch to OVERRIDE if continued use of communication equipment is required by a flight emergency.

FLIGHT OPERATION COMMUNICATION EQUIPMENT

INTERPHONE AND PUBLIC ADDRESS SYSTEM AN/AIC A B

Each crew and student station is equipped with an interphone control panel (figure 4-13) and an outlet. Interphone panels and outlets are provided, for use by instructors, on the forward side of the master radar control panel installation at position seven and below the forward edge of the table at position eight. In addition to the normal interphone channel in use when interphone selector switches are in INTER position, to which all stations are connected, the system incorporates four specialized features. The first of these is a PVT INTER channel which is connected to all stations. Second is a RADAR INTER channel which is connected only to the interphone panels in the radar training section of the cabin, at the radio operator's station, and at the camera operator's station. The PVT INTER and RADAR INTER channels allow the isolation of desired combinations of training stations from other stations for particular training purposes. A CALL channel is connected to all stations so that any crew member or student can make contact with other stations regardless of which channels the other stations may be on. Third is a mixed signals facility which is provided for the pilots only. They may individually mix command radio, radio compass, interphone, marker beacon and omnidirectional range audio signals onto one output. The fourth feature is a public address system for use by the pilots or radio operator. Four loudspeakers for the system are installed in the cabin. A public address system control panel is mounted at the radio operator's station (figure 4-17). It has two volume controls and a selector switch with two positions: LOUDSPEAKER and NORMAL. The pilots have an ON-OFF public address loudspeaker switch located on the overhead radio remote control panel (figure 4-15). The mixed signals facility of the interphone system utilizes four toggle switches located on the pilot's and copilot's interphone control panels (figure 4-13). They are placarded "Inter," "Comp," "Marker," and "Localiz." The "Inter" switch is for the normal interphone channel; the "Comp" switch is for the radio compass; "Marker" is for marker beacon; and the "Localiz" switch is for the omnidirectional range radio and its localizer function.

TABLE OF COMMUNICATION AND

AIRPLANE USAGE	TYPE AND DESIGNATION	FUNCTION	PRIMARY OPERATOR	RANGE	LOCATION OF CONTROLS
COMMUNICATION EQUIPMENT					
A B	Interphone AN/AIC	Interplane communication and radio set transmission and reception	All	Within airplane	Control panel at each crew and student position
A B EARLY C	Public Address	Public Address	Radio operator and pilot	Within airplane	Radio operation station and radio remote control panel
C D	AN/AIC-10 Interphone	Interplane communication and radio set transmission and reception	All	Within airplane	Control panel at each crew and student position and landing wheel well
A B	VHF Command AN/ARC-3	Air-to-air and air-to-ground communications	Pilots	Line of sight	Radio remote control panel
A B C	VHF Communication Wilcox 807	Air-to-air and air-to-ground communications	Pilots	Line of sight	Radio remote control panel
A B C D	UHF Command AN/ARC-27	Air-to-air and air-to-ground communications	Pilots	Line of sight	Radio remote control panel
A B	Liaison AN/ARC-8	Long range code or voice communication	Pilots and radio operator	200-2500 miles, depending upon frequency and time used	Radio remote control panel and radio operator's station
A B C D	Emergency Radio Transmitter	Transmit emergency signals from life raft, from ground, or from airplane in flight	Radio operator	Variable depending on model	On transmitter
C	HF Communication Collins 18S4	Long range code or voice communication	Pilots	500 to 1500 miles	Radio remote control panel
FLIGHT OPERATION ELECTRONIC EQUIPMENT					
A B C D	Radio Compass AN/ARN-6	Reception of visual and aural signals for direction findings and homing	Pilots	20-200 miles	Radio remote control panel
A B C D	Omni Range Receiver AN/ARN-14	Reception of all VHF radio aids to navigation	Pilots	Line of sight	Radio remote control panel
A	Glide-Slope AN/ARN-5D	Reception of Glide-Slope Signals	Pilots	75 miles	Radio remote control panel

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Figure 4-11

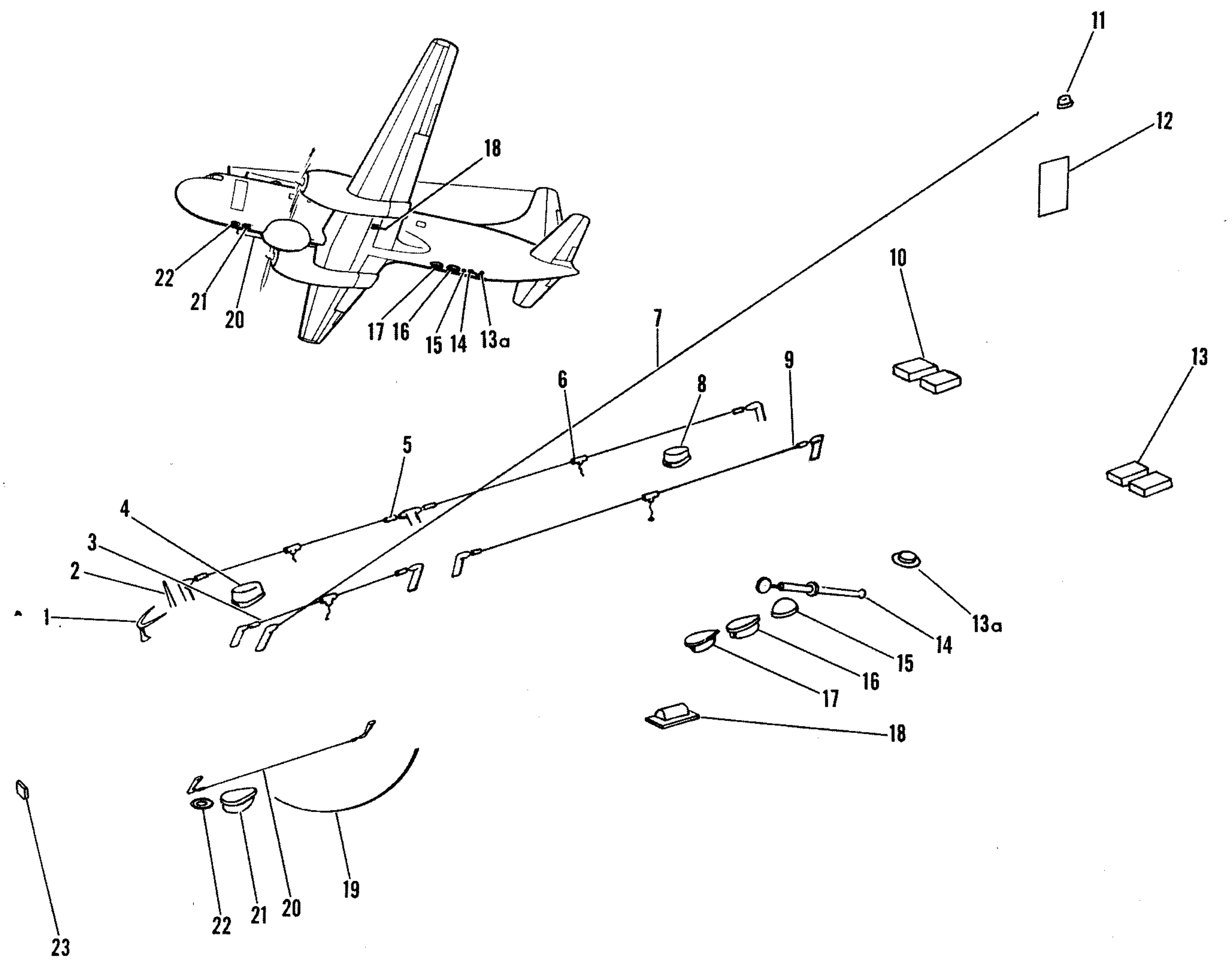
ASSOCIATED ELECTRONIC EQUIPMENT

AIRPLANE USAGE	TYPE AND DESIGNATION	FUNCTION	PRIMARY OPERATOR	RANGE	LOCATION OF CONTROLS
FLIGHT OPERATION ELECTRONIC EQUIPMENT (CONT)					
B C D	Glide-Slope AN/ARN-18	Reception of Glide-Slope Signals	Pilots	75 miles	Overhead switch panel
A B C D	IFF AN/APX-25	Automatic Airplane identification	Pilots	Line of sight	Radio remote control panel
LATE C and D	Direction Finder Group AN/ARA-25	Provides continuous visual indication of the relative direction of a radio station from the airplane	Pilots	Line of sight	Radio remote control panel
A	Marker Beacon RC-193A	Reception of marker signals	Pilots	Vertical distance to airplane from ground	Radio remote control panel
SOME A B C D	Marker Beacon AN/ARN-12	Reception of airways marker signals	Pilots	Vertical distance from airplane to ground	Radio remote control panel
A B C D	TACAN AN/ARN-21	Obtain distance and bearing from any selected TACAN beacon	Pilots	Line of sight	Radio remote control panel
TRAINING ELECTRONIC EQUIPMENT					
A B C D	Radar Altimeter SCR-718-C	Indicate absolute altitude	Students	0-50,000 feet	Student stations
A B C D	Radio Compass AN/ARN-6	Reception of visual and aural signals for direction finding and bombing	Students	20-200 miles	Student stations
A B EARLY C	Loran AN/APN-9	Long range navigation	Students	Day: 700 miles; night: 450-1400 miles	Student positions
LATE C and D	Loran AN/APN-70	Long range navigation	Students	450-1400 miles	Student stations
A B C	Radar AN/APQ-24T1	High altitude navigation and bombardier training	Students	200 miles plus sweep delay	Student positions
D	Bomb/Nav Computer A-1A	Computes solution to the bombing problem	Students		Student station 9
A B C D	Radar AN/APS-23	To supply slant range and altitude to the K-3A and AN/APQ-24T1 systems	Students	200 miles (30 miles in K-3A system)	Student station 9
D	I.C.E.	Interconnect A-1A and AN/APS-23			
A B C D	Repeater system AN/APA-82	Supply radar information to observers	Students		Student stations 4, 5, and 6 A B C Student stations 6, 7, and 10 D

C-45278-2

ANTENNA INSTALLATIONS *(TYPICAL)*

A, B & C AIRPLANES



1. Glide Slope and Localizer
2. VHF Command
3. No. 1 Radio Compass Sense Antenna (Pilot)
4. No. 3 Radio Compass Loop Antenna
5. No. 3 Radio Compass Sense Antenna
6. No. 4 Radio Compass Sense Antenna
7. Liaison Antenna
8. No. 4 Radio Compass Loop Antenna
9. No. 5 Radio Compass Sense Antenna
10. Radio Altimeter Transmitting Antenna
11. UHF Command Antenna
12. Omnidirectional Range Antenna
13. Radio Altimeter Recieving Antenna
13a. IFF/SIF Antenna
14. Loran Equipment Trailing Antenna
15. Directional Finding Group
16. No. 5 Radio Compass Loop Antenna
17. No. 4 Radio Compass Loop
18. Marker Beacon Antenna
19. Radar Antenna (Radome)
20. Pilots Radio Compass Sense
21. No. 1 Radio Compass Loop Antenna (Pilot)
22. Tacan Antenna
23. Glide Slope Antenna

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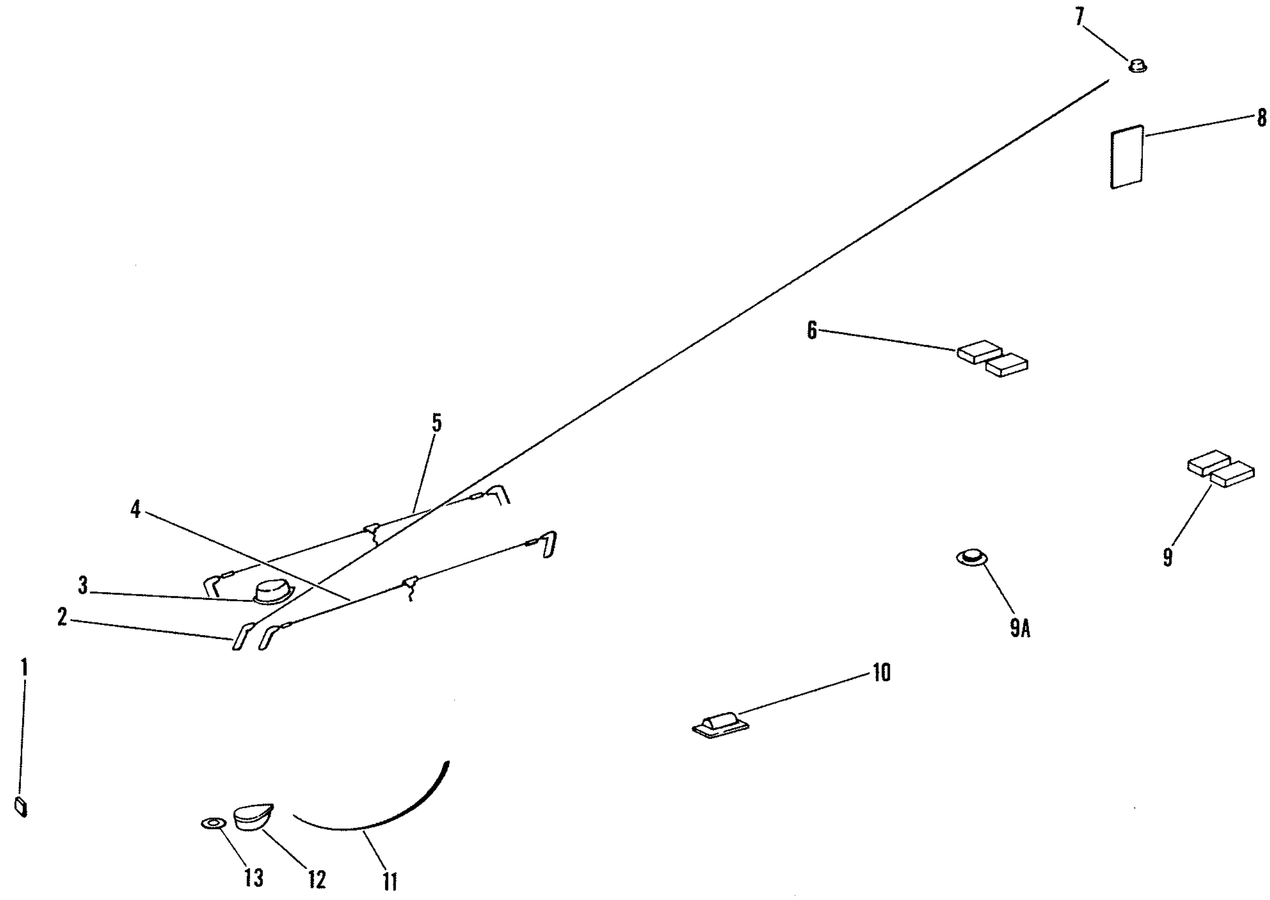
Figure 4-12

D AIRPLANES



1. Glide Slope Antenna
2. Loran Antenna
3. Radio Compass Loop Antenna (Students)
4. Radio Compass Sense Antenna (Pilot)
5. Radio Compass Sense Antenna (Students)
6. Radio Altimeter Transmitting Antenna
7. Command Antenna
8. Omnidirectional Range Antenna
9. Radio Altimeter Receiving Antenna

9A. IFF/SIF Antenna

10. Marker Beacon Antenna
11. Radar Antenna (Radome)
12. Radio Compass Loop Antenna
13. Tacan Antenna

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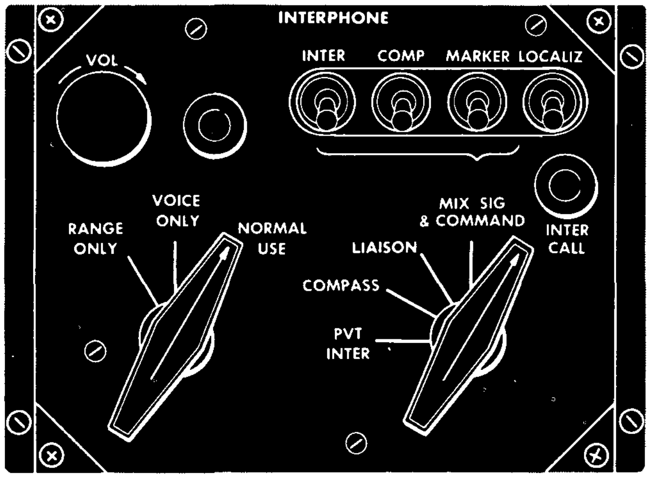
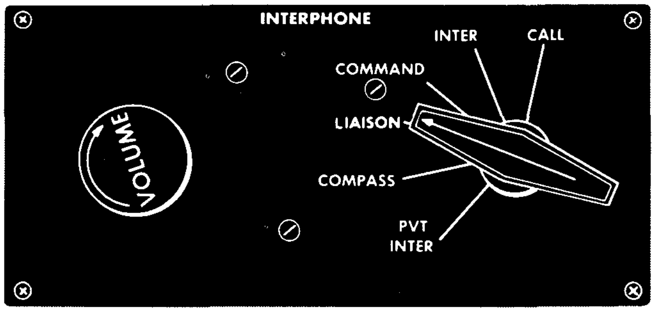
INTERPHONE

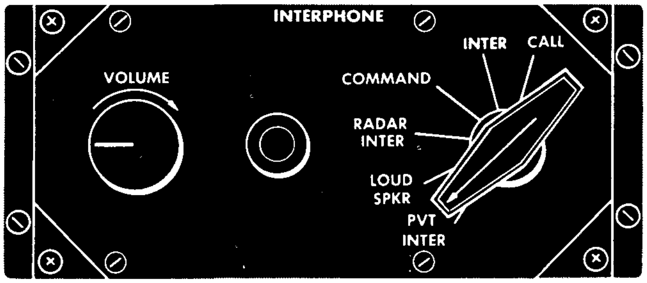
A & B AIRPLANES



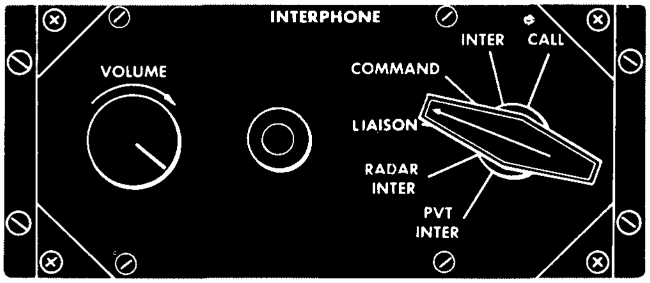
PILOT'S PANEL



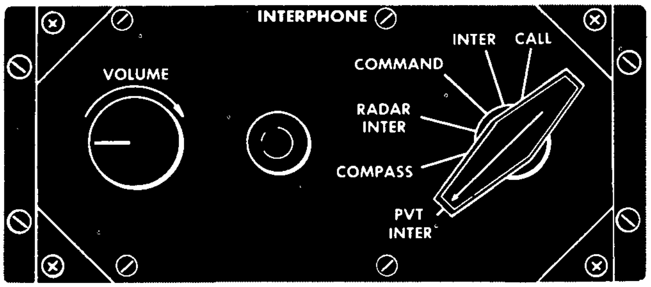
FLIGHT ENGINEER'S PANEL



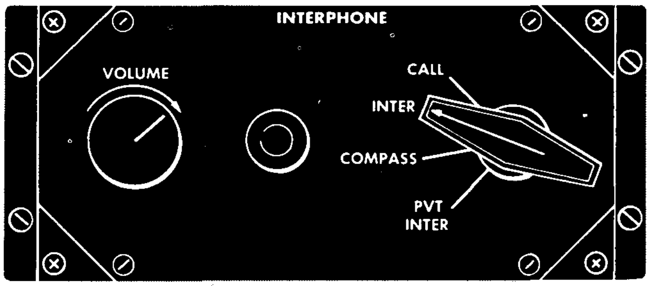
RADAR INSTRUCTOR'S PANEL



RADIO OPERATOR'S PANEL



RADAR STATION AND CAMERA OPERATOR'S PANEL



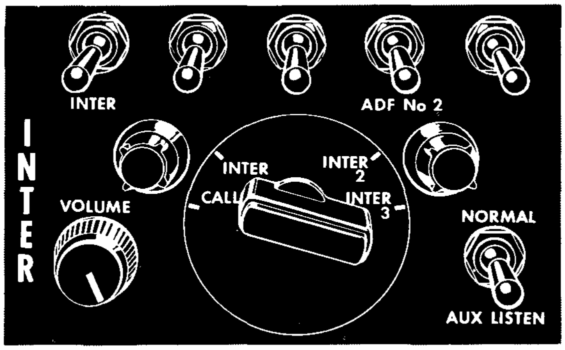
NAVIGATION STUDENT'S PANEL

C-45280-1

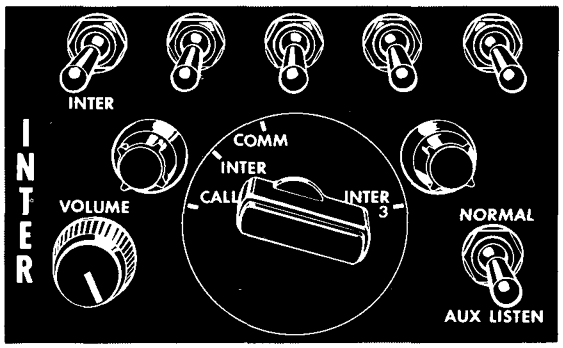
Figure 4-13

CONTROL PANELS *(TYPICAL)*

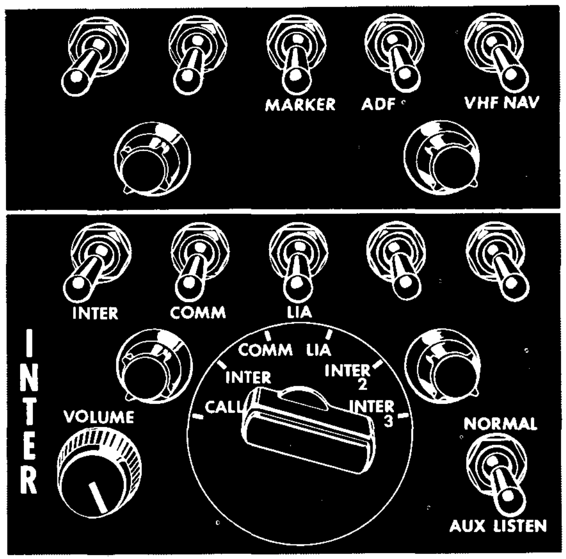
C & D AIRPLANES



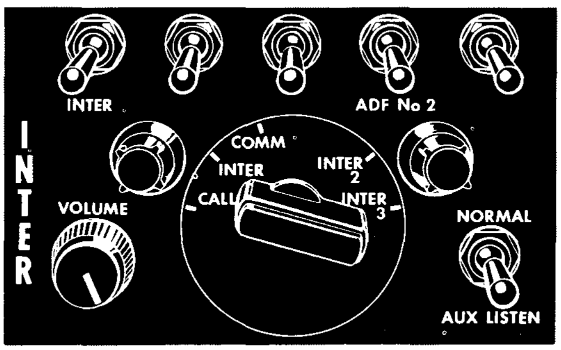
NAVIGATION STUDENT'S PANEL (C)
STATION 4-5-6-7-8 (D)



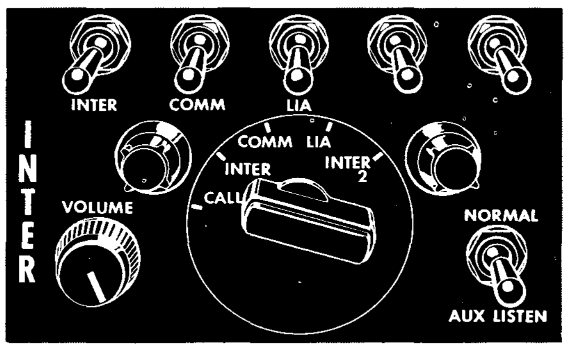
RADAR STATION AND CAMERA OPERATOR'S PANEL (C)
STATION 9-10 (D)



PILOT'S AND COPILOT'S PANEL



RADAR INSTRUCTOR'S PANEL (C)
STATION 11 (D)



FLIGHT ENGINEER'S PANEL

C-45280-2

Operation of Interphone AN/AIC Ⓐ Ⓑ

Note

The interphone is on whenever the airplane dc power supply system is energized.

Operate the interphone public address system as follows:

1. Place selector switch, at radio operator station, in NORMAL position.
2. To broadcast from pilots' stations, place interphone selector switch in INTER, hold loudspeaker switch ON, and speak into microphone. Release loudspeaker switch to OFF position to stop broadcast.
3. To broadcast from radio operator's station, place public address selector switch in LOUDSPEAKER position, place interphone selector switch in INTER, and speak into microphone.
4. Adjust loudspeaker volume by means of volume controls at radio operator's station.
5. Place public address selector switch at radio operator's station in NORMAL position.

Operate the interphone mixed signals facility as follows:

1. Place interphone selector switch in the MIX. SIG. AND COMMAND position. When the command set is turned on, command signals will then be heard.
2. Adjust volume of command reception so that the output level is the same as the interphone line level.
3. Place any one or all four of the toggle switches in the up (on) position. When otherwise operating, corresponding signals then will be heard along with those of the command set.
4. To turn off any or all of the signals, place the corresponding switch(es) in the down position.
5. To turn off the command set, move interphone selector switch from the MIX. SIG. AND COMMAND position to another position.

WARNING

Moving the interphone selector switch from the MIX. SIG. AND COMMAND position will interrupt the signals from INTER, COMP, MARKER, and LOCALIZ channels. If command signals are not desired, turn off command set at its individual remote control panel.

INTERPHONE AN/AIC-10 Ⓒ Ⓓ

Each crew and student station is equipped with an interphone control panel (figure 4-13) and an outlet. Interphone control panels and outlets are provided, for use by instructors, on the inboard side of the table at student position 5, and the forward side of the table at student position 8. In addition to the normal interphone channel (in use when the interphone selector switches are at INTER), to which all stations are connected, the system incorporates three specialized features. The first of these is the INTER 2 channel. On Ⓒ airplanes, the INTER 2 channel is connected to all stations. On Ⓓ airplanes, the INTER 2 channel is connected to all stations except the bombardier students station. The second feature is the INTER 3 channel. On Ⓒ airplanes, the INTER 3 channel is connected to the interphone panels at the radar student stations, the radio operator's station, the camera operator's station, and both pilot's stations. On Ⓓ airplanes, the INTER 3 channel is connected to all stations except the flight engineer's station. The INTER 2 and INTER 3 channels allow the isolation of desired combinations of training stations from other stations for particular training purposes. A CALL channel is connected to all stations so that any crew member or student can make contact with the other stations regardless of which channel the other stations have selected. The third feature is a mixed signal facility which is provided at all stations. Each station may individually mix the audio signals of all the interphone and radio facilities that are provided at that particular station. This facility utilizes toggle switches located on the interphone control panels. Each station is provided, in whole or in part, with the following placarded switches: "Inter" for the normal interphone channel; "Comm" for the command radio; "Lia" for the liaison radio; "Marker" for the marker beacon; "ADF" for the radio compass; "VHF-NAV" for the omnidirectional range radio and its localizer function; and "Normal-Aux Listen" for bypassing the interphone amplifier if it fails. On some airplanes, three loudspeakers are installed as part of the interphone system, two in the flight compartment, and one at the radio operator's station. Other airplanes have only the two speakers in the flight compartment for radio reception. Interphone foot switches are provided at the radar training station on Ⓒ airplanes and at the master bombardier station on Ⓓ airplanes.

Normal — Auxiliary Listen Switch Ⓒ Ⓓ

The normal — auxiliary listen switch is installed to provide emergency monitoring capability in case of interphone amplifier failure. When failure occurs the switch should be placed in the AUX LISTEN position. The station will then be able to monitor only one channel at a time and will be unable to transmit over the interphone system. The only signal heard is that of the farthest left bottom mixer switch that is in the ON position. If all mixer switches on the bottom row are OFF, priority passes to the top row (left to right).

Operation of the Interphone AN/AIC-10 Ⓒ Ⓓ

Normal operation of the interphone system is as follows:

The interphone system is on whenever the airplane dc system is energized.

1. Place all toggle switches on the control panels, except the "Normal-Aux Listen" switch, in the OFF (down) position.
2. Turn the selector switch to the INTER position and speak into the microphone. The voice signal will be heard at all stations on the interphone channel.
3. To originate a call, hold the selector switch to CALL and speak into the microphone. All other stations will receive the signal regardless of the position of the selector switches on the other control panels.

Note

Normally the best audio level will be below mid-position of the volume control. Volume control past the mid-position is used for radio reception during abnormal atmospheric conditions, interference, or weak signal strength.

Operation of the mixed signal facility is as follows:

1. Place the interphone selector switch on the control panel to any position except CALL.
2. Turn ON (up) the mixing toggle switches, one at a time. As each toggle switch is turned on, the audio signal from the facility associated with that toggle switch will be heard in the headset simultaneously with the previously selected signals.

In this manner it is possible to monitor six different signals simultaneously, except where duplication exists between the toggle switches and the selector switch positions. Mixing can be accomplished in any position of the selector switch except CALL.

COMMAND TRANSFER SWITCH (SOME AIRPLANES)

A transfer switch is located on the radio remote control panel (figure 4-15). The switch has UHF and VHF positions and selects the command radio signal to the interphone system.

VHF COMMAND TRANSCEIVER, TYPE WILCOX 807

The VHF transceiver is an airborne unit providing two-way air-to-air and air-to-ground voice communications. The set operates on a frequency range of 116.0 to 149.9 megacycles. A total of 1360 frequencies are available to transmit and receive. Frequency selection may be made on the VHF control panel on the radio control panel. The radio is turned on and off with the power switch on the VHF control panel. The radio power source is the aircraft 28-volt dc bus.

VHF Command Transceiver Controls Type Wilcox 807

Operating controls for the VHF command transceiver are located on the radio control panel. Included on the panel are: a VHF power switch with OFF and PWR positions for controlling radio power; two frequency selector knobs for selecting the desired frequency; and a volume control knob for adjusting the set to the desired audio level.

Operation of the VHF Command Transceiver Type Wilcox 807

1. Place VHF power switch in the PWR position and allow 30 to 40 seconds for set warmup. Transceiver is ready for operation when channelization tone is heard.
2. Slowly rotate frequency selector knobs to desired frequency.
3. Adjust volume control for desired volume.
4. Place power switch to OFF position when VHF communication is no longer desired.

VHF COMMAND RADIO AN/ARC-3 Ⓐ Ⓑ

The VHF command radio is installed on some Ⓐ and Ⓑ airplanes. The set is a very high frequency, multichannel receiver-transmitter pretuned to operate on any one of eight auto-tuning channels. An individual remote control panel for the set is located on the overhead radio control panel, and a command radio channel is provided on all interphone panels except those at navigation training stations. This set is also used to supply the tone scoring phase of the AN/APQ-24T-1 radar bomb scoring system. For this purpose, the microphone at the master radar operator's station is connected to the VHF command set to permit transmission from that station. When working in conjunction with the radar set, the pilot selects the proper channel at his remote control panel, turns the bomb scoring tone switch ON (figure 4-15), located on the radio remote control panel and then turns the command set over to the radar operator. When the tone scoring phase is deactivated by the radar operator, the command set is automatically returned to normal use. In an emergency, the pilot may disconnect the tone scoring phase from the command set at any time by placing the bomb scoring tone in OFF position. (Refer to RADAR SET AN/APQ-24T-1, this Section.)

Operation of VHF Command Radio AN/ARC-3

1. Place the interphone channel selector switch in MIX. SIG. AND COMMAND position.
2. Move the power control switch on the radio remote control panel to ON position.
3. Place command radio channel selector switch in position for desired channel.
4. Press the microphone switch to transmit: release the microphone switch to receive.
5. Adjust volume with volume knob.

6. Turn the equipment off by moving the power control switch on the radio remote control panel to OFF position.

CAUTION

Do not turn this equipment off while the channel selector is cycling. This action will cause arcing and consequent fouling of the relay contacts.

UHF COMMAND RADIO AN/ARC-27

The AN/ARC-27 command radio is installed on some Ⓐ and Ⓑ airplanes, and all Ⓒ and Ⓓ airplanes. The set provides voice communications in the UHF frequency range of 225.0 to 399.9 megacycles at line-of-sight distances. A quick manual tuner is installed on the radio remote control panel. The pilot is able to select any one of the available 1750 frequency channels, including setting of preset channels, from the radio remote control panel. This set is also used to supply the bomb scoring tone of the AN/APQ-24T-1 radar bombing system. For this purpose, the microphone at the master radar operator's station is connected to the UHF command set to permit transmission from that station. When working in conjunction with the radar set, the pilot selects the proper channel at his remote control panel, turns the bomb scoring tone switch, located on the overhead radio remote control panel to ON, and then turns the command set over to the radar operator. When the tone scoring phase is deactivated by the radar operator, the command set is automatically returned to normal use. In an emergency the pilot may disconnect the tone scoring phase from the command set at any time by placing bomb scoring tone switch in the OFF position. Refer to operation of tone scoring system, RADAR SET AN/APQ-24T-1, this Section. This equipment may also be used to transmit continuously a signal, tone modulated at 1020 cycles per second, as an aid to direction finders or for emergency purposes. On late Ⓒ and Ⓓ airplanes, the UHF command radio set may be connected to the AN/ARA-25 direction finder group to provide automatic direction finding information. This is accomplished automatically through an antenna relay when the ADF function is selected on the UHF control panel. The UHF transceiver is powered by the dc main bus.

Operation of UHF Command Radio AN/ARC-27

To turn the equipment on, rotate the function switch to the desired type of operation.

Note

- To preclude damage to the equipment, allow at least one minute for the set to warm up before operating.
- In rotating the channel selector, allow a few seconds at each channel setting to permit completion of the tuning cycle.

SWITCH POSITION	FUNCTION
OFF	Transmitter/Receiver and ADF off
T/R	Transmitter on in standby Main receiver on ADF in standby Guard receiver off
T/R & G REC	Transmitter on in standby Main receiver on Guard receiver on ADF in standby
ADF	Transmitter in standby Guard receiver in standby ADF and main receivers on

To turn the equipment off, rotate the function switch to OFF.

DIRECTION FINDER GROUP AN/ARA-25 Ⓒ Ⓓ

On late airplanes the direction finder group, AN/ARA-25 provides a continuous visual indication of the relative direction of a radio station from the airplane. This equipment is used with the UHF communication set and is operated entirely from the UHF control panel. The continuous indication is given on the No. 1 pointer of the pilot's radio magnetic indicators (1, figure 1-9). The direction finding group operates on power from the dc main bus.

Operation of Direction Finding Group AN/ARA-25 Ⓒ Ⓓ

When the UHF communication set AN/ARC-27 function switch is in the T/R or T/R & G REC position, the direction finding equipment is on in a standby condition. For complete operation, turn the UHF communication function switch to the ADF position. To turn the equipment entirely off, place the UHF communication function switch in the OFF position.

Note

When the UHF communication function switch is in the ADF position, the UHF communication set AN/ARC-27 has priority over the pilot's radio compass AN/ARN-6; the No. 1 radio magnetic indicator needle will indicate the direction of the station to which the UHF communication set is tuned.

HF COMMUNICATION RADIO 18S4 Ⓒ

This equipment consists of a Collins 18S4 transmitter-receiver which is remotely controlled through 20 preset channels in the frequency range of 2 mc to 18.5 mc. The control panel on the pilot's overhead radio panel provides the flight crew with all the operational functions necessary for voice communication.

Operation of HF Communication Radio 18S4 Ⓒ

1. Place power switch ON and allow time for units to warm up.

TRAINING EQUIPMENT AC POWER SUPPLY SYSTEM

D AIRPLANES

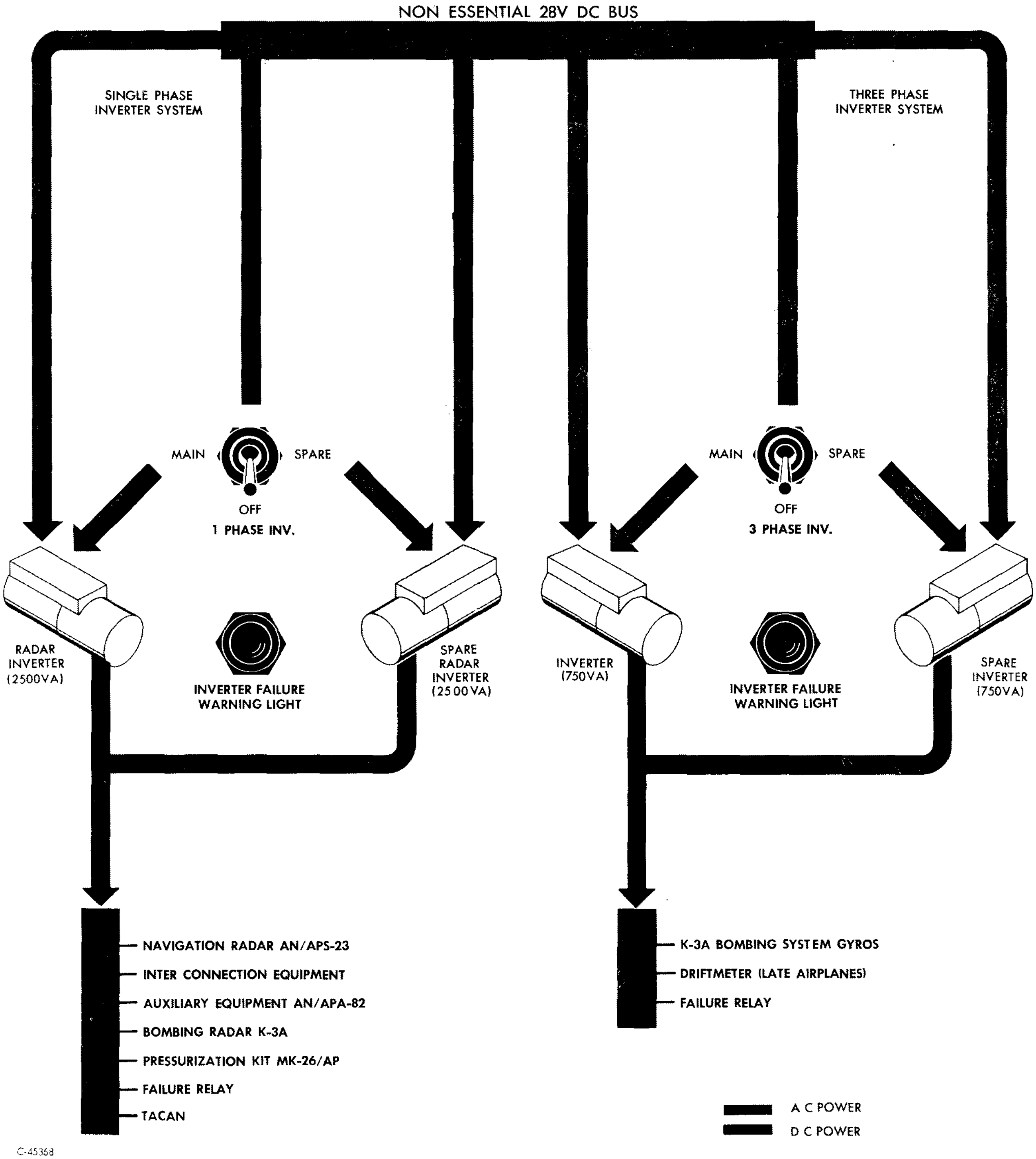
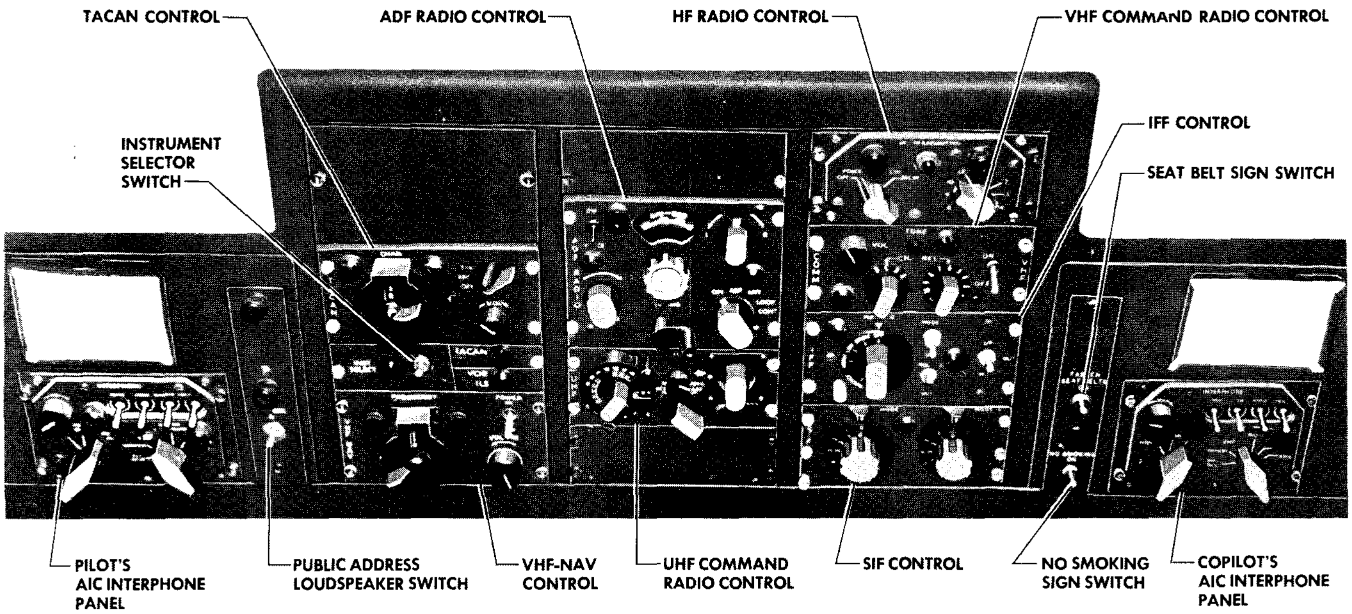


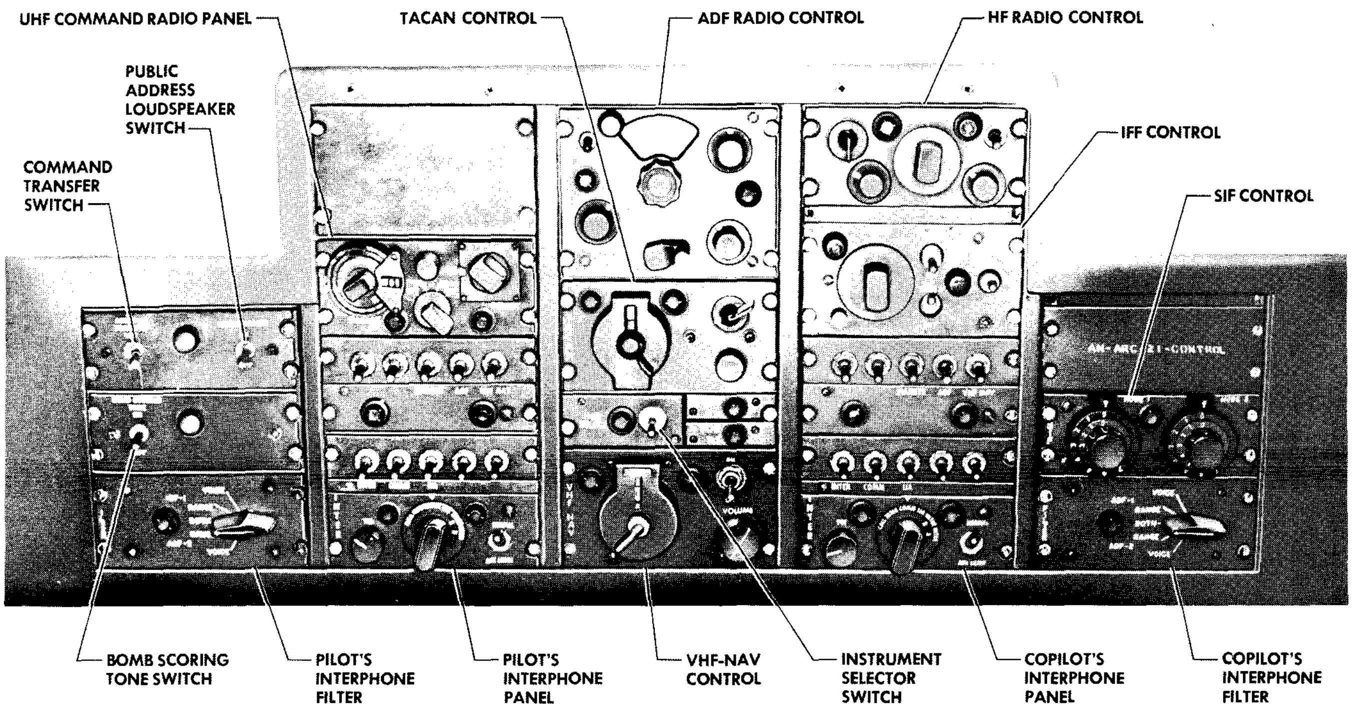
Figure 4-14

RADIO REMOTE

A & B AIRPLANES



EARLY C AND EARLY D AIRPLANES

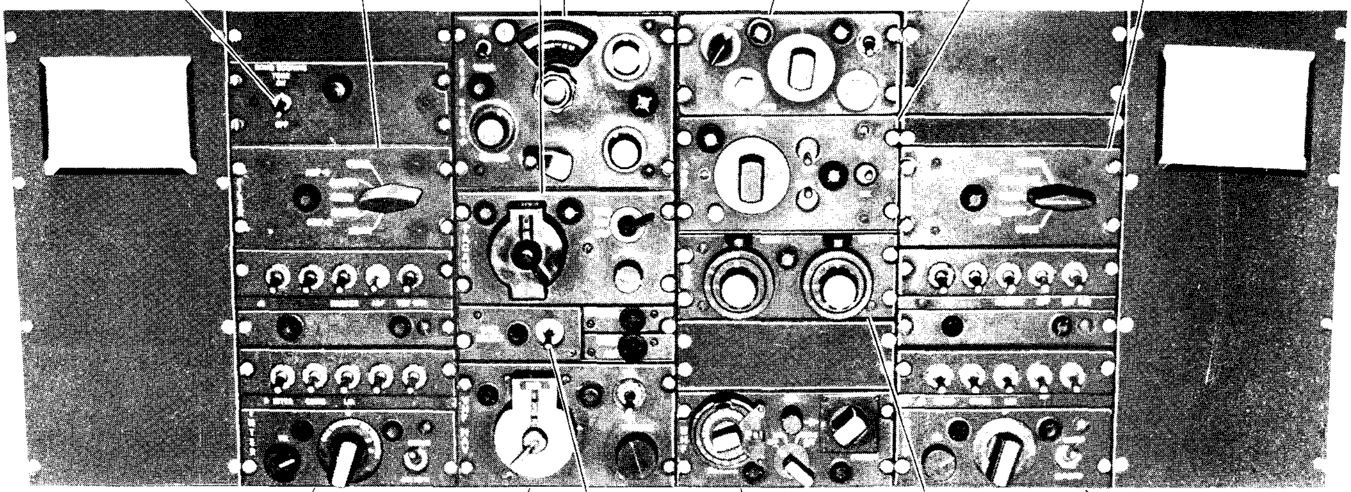


C-45281-1

Figure 4-15

CONTROL PANELS (TYPICAL)

LATE C AND LATE D AIRPLANES



C-45281-2

2. Turn function switch to PHONE position.

3. Turn channel selector switch to the desired frequency channel.

4. Push the microphone button to talk; release to listen.

5. To turn equipment off, place power switch to OFF.

LIAISON RADIO AN/ARC-8 Ⓐ Ⓑ

This equipment consists of an AN/ART-13A transmitter which can be remotely controlled through 11 preset frequencies by the pilots, and a BC-348R or BC-348Q receiver which is controllable only from the radio operator's station. A green light on the radio remote control panel (figure 4-15) illuminates to indicate that the radio operator has readied the transmitter for pilot control.

Note

The transmitter cannot be operated in the low frequency range (200 to 600 kilocycles). The low-frequency components of this set are not installed.

A monitor switch on the radio circuit breaker panel (8, figure 4-17), removes the transmitter side-tone from the interphone circuit to allow transmitter signals to be monitored through the receiver. The switch is controlled by the radio operator.

Operation of Liaison Radio AN/ARC-8 Ⓐ Ⓑ

The liaison transmitter is operated from the pilot's remote control panel as follows:

1. Request radio operator to place LOCAL-REMOTE switch on the transmitter in REMOTE position. Note that green light is on.

2. Place emission switch on remote control panel in VOICE position.

3. Turn channel selector switch on the remote control panel to the desired frequency.

Note

Approximately 25 seconds is required for the auto-tune to seek the proper position.

4. Move interphone selector switch to LIAISON position.

5. Turn transmitter off by placing emission switch in OFF position.

CAUTION

- Under no circumstances should the transmitter be keyed or voice modulated when the emission switch is being operated. Such operation may cause arcing and damage to the relay contacts.
- While transmitter is being channeled or light is out on liaison panel at pilot's station, do not key emission switch. Such operation may cause arcing and damage to the contacts.

The liaison receiver is operated from the radio operator's station as follows:

1. Turn set on by turning AVC-MVC switch to AVC (for voice) or MVC (for CW).
2. Turn CS-OSC switch to OFF for voice reception.
3. Place interphone selector switch in LIAISON position.

Note

Only the pilots', flight mechanic's and radio operator's interphone control panels are provided with liaison receiver selection.

4. Turn receiver off by moving AVC-MVC switch to OFF position.

TACAN—AN/ARN-21

TACAN (TACtical Air Navigation) equipment is designed to operate in conjunction with ground stations to provide bearing and range information and an aural identification signal. The system provides continuous indications of its distance and bearing from any selected TACAN station located within a line-of-sight distance of approximately 195 nautical miles (maximum). TACAN uses the radio magnetic indicator, a range indicator, the course deviation indicator of the course indicator (ID-249), a control panel, and an instrument selector panel.

TACAN Power Ⓐ Ⓑ Ⓒ *

TACAN receives dc power from the 28-volt dc non-essential bus. It receives ac power from the regulated ac bus and from the unregulated ac bus No. 2. The system is protected by two dc and two ac circuit breakers on the radio equipment circuit breaker panel.

*Applicable to Ⓒ airplanes except 52-1095, -1099, -1101, -1102, -1103, -1121, and -1123.
**Applicable to Ⓒ airplanes 52-1095, -1099, -1101, -1102, -1103, -1121, and -1123.

TACAN Power Ⓒ **

On these airplanes, TACAN receives dc power from the 28-volt dc non-essential bus. AC power is obtained from a TACAN inverter and from the airplane's regulated ac power supply system. The system is protected by two circuit breakers and an inverter circuit breaker reset switch.

TACAN Power Ⓓ

TACAN on these airplanes receives dc power from the 28-volt dc non-essential bus. Regulated ac power is obtained from the training equipment radar inverter and unregulated ac power is obtained from ac bus No. 2.

WARNING Ⓓ

If the spare inverter fails during TACAN operation, certain navigational aid components may become inoperative without being readily apparent to the pilot. The inverter light marked SPARE OUT will illuminate and, depending on differences in wiring on specific aircraft, one or more of the following events will occur: the CDI will center (without the OFF flag appearing), the ID-249 TO-FROM indicator will be blank, the heading pointer will be inoperative, the No. 2 bearing pointer (RMI) will become inoperative, the DME range indicator will continue operating and the TACAN audio signal will still be heard. This type of failure is particularly critical during TACAN approaches due to the pilot's being unaware that the ID-249 and ID-250 are inoperative. The above events will also occur if the spare inverter is used to power the main inverter bus.

TACAN Inverter Switch and Failure Warning Light Ⓒ **

The TACAN inverter switch and failure warning light (figure 1-22) are located on the auxiliary circuit breaker panel. The TACAN inverter switch has NORM and EMER positions and an unmarked OFF position. In the NORM position, the TACAN inverter is connected to the TACAN inverter bus and the AN/ARN-21 may be operated. The EMER position is used in the event of TACAN inverter failure. The TACAN inverter failure warning light will illuminate at any time the TACAN inverter output is interrupted or when the TACAN inverter is inoperative. The TACAN inverter failure warning light will also illuminate any time the inverter tripped light illuminates. When the TACAN failure warning light illuminates, placing the TACAN inverter switch in the EMER position will connect the TACAN circuit to the regulated 115-volt ac bus and the warning light will go out. The TACAN switch and failure warning light are powered by the 28-volt dc nonessential bus.

TACAN Inverter Reset Switch and Tripped Indicator Light Ⓒ **

The TACAN inverter reset switch and tripped indicator light (figure 1-22) are located on the auxiliary circuit breaker panel. The reset switch has OFF and RESET positions and an unmarked NEUTRAL position. The switch is spring-loaded from the RESET position to the NEUTRAL position. When the switch is held momentarily in the RESET position, the TACAN remote circuit breaker is set or reset and the TACAN inverter is energized but not connected to the TACAN inverter bus. When released, the switch will return to the unmarked NEUTRAL position. The OFF position is used to disconnect the inverter in the event of malfunction of the normal control. The inverter tripped indicator light is located above the reset switch and will illuminate when the TACAN inverter power remote circuit breaker is tripped. The TACAN inverter reset switch and indicator light are powered by the 28-volt dc nonessential bus.

Note

The TACAN inverter reset switch must be reset after the dc power supply is energized again, after having been even momentarily deenergized.

TACAN Control Panel

The TACAN control panel, located on the radio remote 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 volume control knob is used to adjust the volume of aural identification signals received from the TACAN station.

Note

The TACAN channels range from 00 to 129; however, the AN/ARN-21 is designed to operate only on channels 01 to 126.

Instrument Selector Panel

An instrument selector panel, containing a two-position switch is located on the radio remote control panel. The switch controls the double-barred bearing indicator on the RMI and the course indicator. With the switch in TACAN position, the course deviation indicator responds to AN/ARN-21 functions. With the switch in VOR/ILS position, the course deviation indicator responds to localizer signals used in conjunction with the AN/ARN-14. Edge lights on the instrument selector panel will illuminate the TACAN or VOR/ILS portions of the panel according to the position of the instrument selector switch.

WARNING

It is possible that improperly adjusted or malfunctioning ground or airborne TACAN equipment may "lock-on" a false bearing. The error will probably be plus or minus 40°, but can be of any value which is a multiple of 40° and can be either side of the correct bearing. The possibility of a wrong 40° "lock-on" is inherent in the TACAN system and can only be completely avoided by use of other navigation equipment in addition to TACAN.

Operation of the AN/ARN-21

1. TACAN inverter reset switch — RESET, then NEUTRAL. Ⓒ*
2. TACAN inverter switch — NORM. Ⓒ*
3. Power switch to REC or T/R.
4. Instrument selector switch — TACAN.
5. Allow approximately 90 seconds warmup time after power is applied. There is no delay when going from REC to T/R.
6. Select desired TACAN channel.
7. Adjust volume to desired level.
8. To turn equipment off, position power switch to OFF.

Note Ⓒ*

If the TACAN inverter failure warning light illuminates, place the TACAN switch in the EMER position and the TACAN inverter reset switch OFF.

False Lock-On Procedures

TACAN equipment will occasionally lock-on to a false bearing 40° or a multiple of 40° in error. These errors can be on either side of the correct bearing. To check for false lock-on or when it is suspected, proceed as follows:

1. 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 the set on.
2. If a false lock-on is suspected, switch to another channel, check it for correct bearing and then switch back to the desired channel.
3. Check for correct lock-on.
4. If false lock-on is still suspected, turn set OFF and then ON.
5. Recheck for correct lock-on.
6. If false lock-on persists, utilize the other equipment or aids available.

*Applicable to Ⓒ airplanes 52-1095, -1099, -1101, -1102, -1121, and -1123.

Note

TACAN can be utilized during an emergency if the magnitude and direction of error can be determined.

OMNIDIRECTIONAL RANGE RADIO AN/ARN-14

WARNING (D)

Depending on differences in wiring on specific aircraft, if the spare inverter fails or is used to power the main inverter bus, the ID-250 (except the ADF bearing pointer) and certain components of the ID-249 indicators, will be inoperative. These indicators receive power from the autopilot which derives its power from the spare inverter. This type of failure is critical during VOR approaches.

This radio receiving set equips the airplane for use of all very high frequency range radio aids to navigation. The receiver, dynamotor, and indicator-control are installed on a rack in the tail section of the fuselage. Access is obtained through a removable panel in the aft bulkhead of the lavatory compartment. The following table lists the types of service provided by the omnirange radio, with their frequency bands:

FREQUENCY BAND IN MEGACYCLES	TYPE OF SERVICE
Odd tenth megacycles from 108.1 thru 111.9	Runway localizer
Even tenth megacycles from 108.0 thru 112.0 plus all frequencies between 112.0 and 117.9	Range (omnidirectional)
108.3 to 110.3	VHF two-course range
118.0 to 121.9	Tower
122.0 to 135.9	General communication

The set is controlled by the pilots from the radio remote control panel (figure 4-15). Two selector knobs are provided for frequency selection: a whole-megacycle selector knob (the larger of the two) tunes in a whole frequency number, such as 108.0, 122.0, 130.0, etc.; a tenth-megacycle knob, smaller and mounted within the whole-megacycle selector knob, tunes in a tenths number of a megacycle frequency, such as 0.1, 0.5, etc. On the same control panel are the volume control, and the two-position ON-OFF switch. A pilot's course indicator (2, figure 1-9) is mounted on the pilot's flight instrument panel Two radio magnetic indicators (1, figure 1-9) are provided, one each on the pilot's and copilot's flight instrument panels. An omnidirectional range radio-indicator-control is provided near the dynamotor to control the radio magnetic indicator.

Instrument Selector Panel

On airplanes with TACAN installed, an instrument selector panel, containing a two-position instrument selector switch, is also installed on the radio remote control panel. The switch has VOR/ILS and TACAN positions. The switch controls the double-barred bearing indicator on the RMI and the course indicator. In the TACAN position, the course deviation indicator responds to AN/ARN-21 functions. In the VOR/ILS position, the course deviation indicator responds to localizer signals used in conjunction with the AN/ARN-14 during an instrument landing system approach. Edge lights on the instrument selector panel will illuminate the TACAN or VOR/ILS portions of the panel according to the position of the instrument selector switch.

Operation of Omnidirectional Range Radio AN/ARN-14

1. Place the on-off switch in the ON position.
2. Place the instrument selector switch in the VOR/ILS position (if installed).
3. Select frequency of desired range station with frequency selector knobs.
4. On (A) and (B) airplanes, place the interphone selector switch in the MIX SIG AND COMMAND position, and turn on interphone panel localizer switch. On (C) and (D) airplanes, place interphone selector switch in any position except CALL and turn ON interphone panel "Vhf Nav" switch.
5. Adjust omnirange radio volume to desired level.
6. Observe airplane heading and range station bearing on the radio magnetic indicators.
7. To turn the receiver off, place the on-off switch in the OFF position.

GLIDE-SLOPE RADIO AN/ARN-5D (A)

On other airplanes, a glide-slope radio AN/ARN-5D is installed and is used in conjunction with the localizer function of the omnidirectional range radio. Visual glide-slope indications are presented on the course indicator on the pilot's instrument panel. The glide-slope receiver is controlled from the omnirange radio remote control panel. Selection of an ILS localizer frequency on the omnirange radio control panel, automatically results in the corresponding glide-slope frequency being tuned in on the glide-slope receiver. The set is powered by 28-volt direct current through the AN/ARN-14.

Operation of Glide-Slope Radio AN/ARN-5D (A)

1. Place the on-off switch, on the omnirange radio remote control panel, in the ON position.

2. Place the instrument selector switch in the VOR/ILS position (if installed).

3. Select the localizer frequency to be used with the omnirange radio remote control panel frequency selector knobs.

4. Adjust omnirange radio volume control to desired level.

5. Observe glide-slope indications on the pilot's course indicator.

GLIDE-SLOPE RADIO AN/ARN-18 B C D

This set is used in conjunction with the localizer portion of the omnidirectional range radio. Visual glide-slope indications are presented on the pilot's course indicator (2, figure 1-9) by means of the glide-slope indicator of that instrument. When an ILS localizer frequency is selected on the omnirange radio control panel (figure 4-15), the glide-slope receiver is automatically tuned to the corresponding glide-slope frequency. This set is powered by the regulated ac power supply system.

Operation of Glide-Slope Radio AN/ARN-18

1. Place the on-off switch, on the omnirange radio remote control panel, in the ON position.

2. Place the instrument selector switch in the VOR/ILS position (if installed).

3. Select the localizer and glide-slope frequency to be used, with the omnirange radio remote control panel frequency selector knobs.

4. Adjust omnirange radio volume control to desired level.

5. Observe glide-slope deviation as indicated by the glide-slope indicator of the pilot's course indicator.

6. To turn set off, place omnirange on-off switch in OFF position.

MARKER BEACON RC-193A A

The marker beacon receiver is a continuous-operating, airborne radio navigation aid, which provides visual and aural signals to the pilots. Amber indicator lights located on the flight instrument panels, provide visual signals. The marker beacon indicator lights contain a press-to-test feature; when pressed, the lights will illuminate even when the marker beacon circuit breaker is pulled out. The receiver is powered by the dc nonessential radio equipment bus.

WARNING

It is possible to receive false indications on the RC-193A marker beacon system as it is susceptible to spurious responses to television and other signals using adjacent channels. During instrument conditions, the marker beacon shall not be used as a primary position indicator.

Operation of Marker Beacon RC-193A A

1. Turn the interphone channel selector switch to MIX SIG AND COMMAND.

2. Place the marker switch on the interphone-control panel to the ON (up) position.

3. Adjust audio level with the interphone volume control.

4. The marker beacon indicator lights will flash in synchronization with the transmitter keying of the instrument landing markers.

MARKER BEACON RADIO AN/ARN-12 B C D

The marker beacon radio provides visual and aural indication of the airplane's passage over any marker beacon transmitter. The receiver is permanently tuned to 75 megacycles and is in operation whenever power is available to the dc nonessential radio equipment bus. The pilot's marker beacon indicator light is located on the course indicator (2, figure 1-9); the copilot's indicator light (44, figure 1-9) is mounted separately on the right instrument panel. Both lights contain the press-to-test feature, and will illuminate whenever pressed even if the marker beacon circuit breaker is pulled out.

Reception of Marker Beacon Aural Tone

1. On B airplanes, place the interphone selector switch in the MIX SIG AND COMMAND position. On C and D airplanes, place the interphone selector switch in any position except CALL.

2. Turn the interphone panel "Marker" switch ON to receive aural tone.

3. To discontinue reception of aural signals, turn interphone panel marker switch OFF.

NO. 1 (PILOTS') RADIO COMPASS AN/ARN-6

The pilots' radio compass set is separate and distinct from the three student radio compass sets. The output of the pilots' radio compass is coupled to the pilot's and copilot's radio magnetic indicators (1, figure 1-9). These indicators are used to indicate station bearings as received by the pilots' radio compass as well as the omnirange radio. The pilots' radio compass remote control panel (figure 4-15) is mounted on the overhead radio remote control panel. The radio compass is powered by the dc main bus.

CAUTION

On late C and D airplanes, the single-barred indicator of the AN/ARN-6 radio compass is shared between the AN/ARN-6 and the AN/ARA-25 direction finding group. When the UHF communication set AN/ARC-27 function switch is in the ADF position, signals received by the AN/ARC-27 will override those received by AN/ARN-6, and the single-barred indicator will indicate the direction of the station to which AN/ARC-27 is tuned.

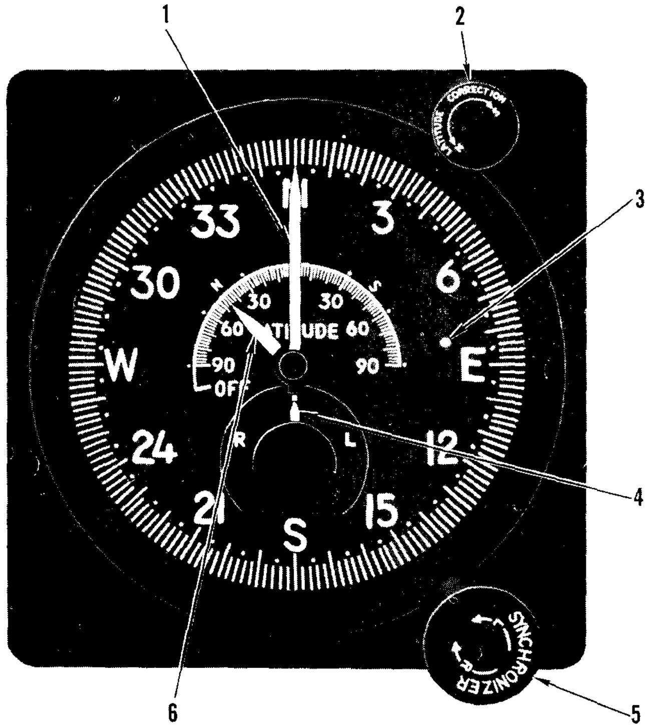
Operation of Pilot's Radio Compass AN/ARN-6

1. Turn equipment on by placing the function switch in the ANT position.
2. On A and B airplanes, place interphone selector switch in the MIX SIG AND COMMAND position. On C and D airplanes, place the interphone selector switch in any position except CALL.
3. On A and B airplanes, place the interphone "Comp" switch in the ON position. On C and D airplanes, place the interphone "ADF" switch ON.
4. Turn equipment off by placing the function switch in the OFF position.

Note

On some airplanes, the radio compass remote control panel does not have a tuning meter. On these airplanes, fine tuning for ADF must be accomplished with the function switch in the antenna position and the CW-voice switch in the CW position. Tune for minimum or zero modulated tone; return the CW-voice switch to VOICE position and the function switch to COMP.

N-1 COMPASS SYSTEM MASTER INDICATOR



1. Heading Pointer
2. Latitude Correction Knob
3. Correction Servo Indicator
4. Annunciator Pointer
5. Synchronizer Knob
6. Latitude Correction Pointer

45202

Figure 4-16

NAVIGATION, RADAR, AND BOMBARDIER TRAINING AND COMMUNICATION EQUIPMENT

TRAINING EQUIPMENT POWER SUPPLY AND CONTROLS (D)

Training Equipment Regulated AC Power Supply (D)

The operation of the electronic training equipment requires single-phase and three-phase regulated alternating current. Each phase is supplied by a pair of training equipment inverters (figure 4-14). The dc power source is the nonessential 28-volt bus in the right-hand power distribution panel. Only one of each pair of inverters can be used at one time. Manual selection between the main and spare inverters is accomplished by two inverter switches. The main inverters will normally be used and the spare inverter will be selected only in the event of main inverter failure.

Training Equipment Inverter Circuit Breakers and Fuses (D)

The training equipment inverters are protected by fuses on the right-hand power distribution panel. The inverter switches and inverter failure warning lights are protected by circuit breakers on the master bombardier station circuit breaker panel. The circuit breakers are placarded "1φ CONT" and "3φ CONT."

Training Equipment Inverter Switches (D)

Switches to control each pair of training equipment inverters are located on the master bombardier station circuit breaker panel. The switches are placarded "1 Phase Inv" and "3 Phase Inv" and have positions MAIN, OFF, and SPARE.

TRAINING EQUIPMENT PITOT-STATIC SYSTEM (D)

Pitot tubes (figure 1-38) mounted on the nose of the airplane, supply pitot pressure for all the training equipment airspeed indicators. The copilot and student stations 4 and 5 share a common pitot tube. A separate pitot tube supplies pressure for the true airspeed computer. The computer electrically transmits true airspeed to the master bombardier station and student stations 6 and 7. Static ports on each side of the fuselage are the normal source of static pressure. One pair of ports is connected to the copilot's instruments, student stations 4 and 5, and the B-6 amplifier. Student stations 6 and 7 share another pair of ports with the master bombardier station and the true airspeed computer. There is no alternate source of static pressure for the training equipment.

N-I COMPASS SYSTEM Ⓒ Ⓓ

The N-1 compass system is a remote-indicating, gyro-stabilized compass system designed for use in all latitudes. The system has two modes of operation: magnetic slaved and directional gyro. In the magnetic slaved mode, the directional gyro receives signals from the remotely located compass transmitter (flux valve) in the right wing. The magnetic slaved mode may be used in any locality except near the magnetic poles or in areas of severe magnetic disturbance. In directional gyro mode, the system is free of magnetic influence and operates as a directional gyro. Corrections are applied to the gyro to maintain accurate headings for the latitude selected. The corrections compensate for apparent directional gyro drift resulting from the earth's rotation. The directional gyro mode may be used in any latitude, but is especially useful where the magnetic field is weak or distorted, or for grid navigation in the polar regions. The N-1 compass system supplies directional reference to the automatic pilot system, the pilot's and copilot's heading indicators (slaved), radio magnetic indicators, and to repeater indicators located at all student stations except stations 4, 5, 6, and 7 on Ⓒ airplanes. A master indicator which incorporates the system controls is mounted on the radio equipment rack on Ⓒ airplanes and at the master bombardier station on Ⓓ airplanes. The system receives 28-volt dc power and 115-volt regulated ac power through the autopilot system.

Master Indicator Ⓒ Ⓓ

The master indicator (figure 4-16) is located on the radio rack on Ⓒ airplanes and at the master bombardier station on Ⓓ airplanes. The indicator has a latitude correction knob, a correction servo indicator, and a synchronizer control knob to provide control of the N-1 system operational modes. The heading pointer (1, figure 4-16) indicates the magnetic heading of the airplane when the system is in magnetic slaved mode, and the airplane heading reference to the preselected gyro heading when the system is in directional gyro mode.

Note

Erratic movement or oscillation of the heading pointer indicates a malfunction in the N-1 compass system, and that the master indicator cannot be relied upon.

Disengage the autopilot rudder control lever if the autopilot is to be used.

The latitude correction scale has an OFF position and is calibrated in two-degree increments clockwise from 90 degrees N, through 0 degrees, to 90 degrees S. When the latitude correction pointer (6, figure 4-16) indicates OFF, the system is operating as a magnetic slaved compass system. When the pointer is anywhere on the latitude scale, the system is operating in the directional gyro mode and corrections are applied to the gyro to maintain accurate headings for the latitude selected. An annunciator pointer indicates the direction in which to rotate the heading pointer to synchronize the system while in magnetic slaved mode.

Latitude Correction Knob Ⓒ Ⓓ

A latitude correction knob (2, figure 4-16) is located on the upper right side of the master indicator and allows selection of magnetic slaved or directional gyro modes. The knob is mechanically connected to the latitude correction pointer. Turning the knob positions the latitude correction pointer and latitude correction mechanism. In the magnetic mode, the latitude correction pointer is positioned to OFF. When operating in the gyro mode, the pointer is positioned to the local latitude to correct for apparent drift of the gyro due to rotation of the earth.

Synchronizer Knob Ⓒ Ⓓ

A synchronizer knob (5, figure 4-16) is located on the lower right side of the master indicator. Turning the knob manually synchronizes the master indicator heading pointer with the correct magnetic heading when the system is in magnetic slaved mode. An annunciator pointer (4, figure 4-16) is located below the latitude correction pointer and indicates the direction in which to rotate the heading pointer to accomplish synchronization. The heading is synchronized when the annunciator pointer is on the center index mark. The synchronizer knob also provides a means of setting the heading pointer on the desired heading reference when the system is in the directional gyro mode.

Correction Servo Indicator Ⓒ Ⓓ

The correction servo indicator (3, figure 4-16) is a small white dot which appears in a hole on the right side of the master indicator face. Rotation of the correction servo indicator indicates that the system is coordinating the electrical signals from either the remote compass transmitter or the latitude correction mechanism The rate of rotation indicates the rate of corrections being applied. During directional gyro operation, the white dot rotates clockwise in north latitudes and counterclockwise in south latitudes and the setting of the latitude correction pointer governs the rate of correction. When the latitude correction pointer is at 0, the white dot should not be rotating. In the magnetic slaved mode, the white dot rotates clockwise when the annunciator pointer is in the R area and counterclockwise when in the L area. When the annunciator pointer is at the top center index, the system is synchronized.

N-1 Compass Repeaters (C) (D)

N-1 compass repeaters are provided at all student stations except stations 4, 5, 6, and 7 on (C) airplanes. The repeater indicators are slaved to the master indicator and repeat the indications shown on the master indicator.

NORMAL OPERATION OF N-1 COMPASS SYSTEM (C) (D)

Preflight

When power is available for operation of the airplane inverters, proceed as follows:

Note

Allow ten minutes for system warmup.

a. Latitude correction pointer — OFF. Rotate the latitude correction knob until the latitude correction pointer is in the OFF position.

b. Synchronizer knob — Engage and rotate until the annunciator pointer is zeroed. Engage and rotate the synchronizer knob in the direction indicated by the annunciator pointer. The heading pointer should indicate the correct magnetic heading.

CAUTION

- If synchronization is accomplished in a direction opposite that indicated by the annunciator pointer, the heading pointer will be 180 degrees off the correct magnetic heading. This is an unstable condition which will correct itself at an approximate rate of three degrees per minute if left alone; however, correction should be accomplished with the synchronizer knob.
- Do not synchronize the heading pointer during or immediately after turns.

c. Synchronizer control knob — Engage and rotate the heading pointer scale in a clockwise direction. The heading pointer should follow clockwise.

d. Heading pointer — Set three to five degrees to the right of the magnetic heading. The annunciator pointer should move to the right of center (approximately 30 degrees) into the area marked L. With the annunciator pointer in the L area, the synchronizer knob and the heading pointer must be rotated to the left (counterclockwise) to synchronize the instrument.

e. Correction servo indicator — Rotating counterclockwise. The correction servo indicator (white dot) should rotate counterclockwise to indicate that the heading pointer is being returned to the correct magnetic heading. The heading pointer should return slowly to its original heading and the annunciator should approach the center position.

f. Synchronizer knob — Engage and rotate the heading pointer scale in a counterclockwise direction. The heading pointer should follow.

g. Heading pointer — Set three to five degrees to the left of the magnetic heading. The annunciator pointer should move to the left of center (approximately 30 degrees) into the area marked R. With the annunciator pointer in the R area, the synchronizer knob and the heading pointer must be rotated to the right (clockwise) to synchronize the instrument.

h. Correction servo indicator — Rotating clockwise. The correction servo indicator (white dot) should rotate clockwise to indicate that the heading pointer is being returned to the correct magnetic heading. The heading pointer should return slowly to its original heading and the annunciator pointer should approach the center position.

i. Latitude correction knob — Rotate the latitude correction pointer to 90 degrees N, then slowly to 0 and 90 degrees S. Observe that the correction servo indicator rotates clockwise and that its speed gradually diminishes and stops completely when the latitude correction pointer reaches 0. Observe that the correction servo indicator rotates counterclockwise with speed of rotation reaching a maximum at 90 degrees S.

j. Latitude correction knob — Set latitude correction pointer on local latitude.

k. Heading indicators — Check. Check pilot and copilot heading indicators and repeater indicators at the student stations by rotating the synchronizer knob on the master indicator 360 degrees, first clockwise, then counterclockwise. The pointers on the repeater indicators should the master indicator heading smoothly, without sticking or lagging.

Magnetic Slaved Mode

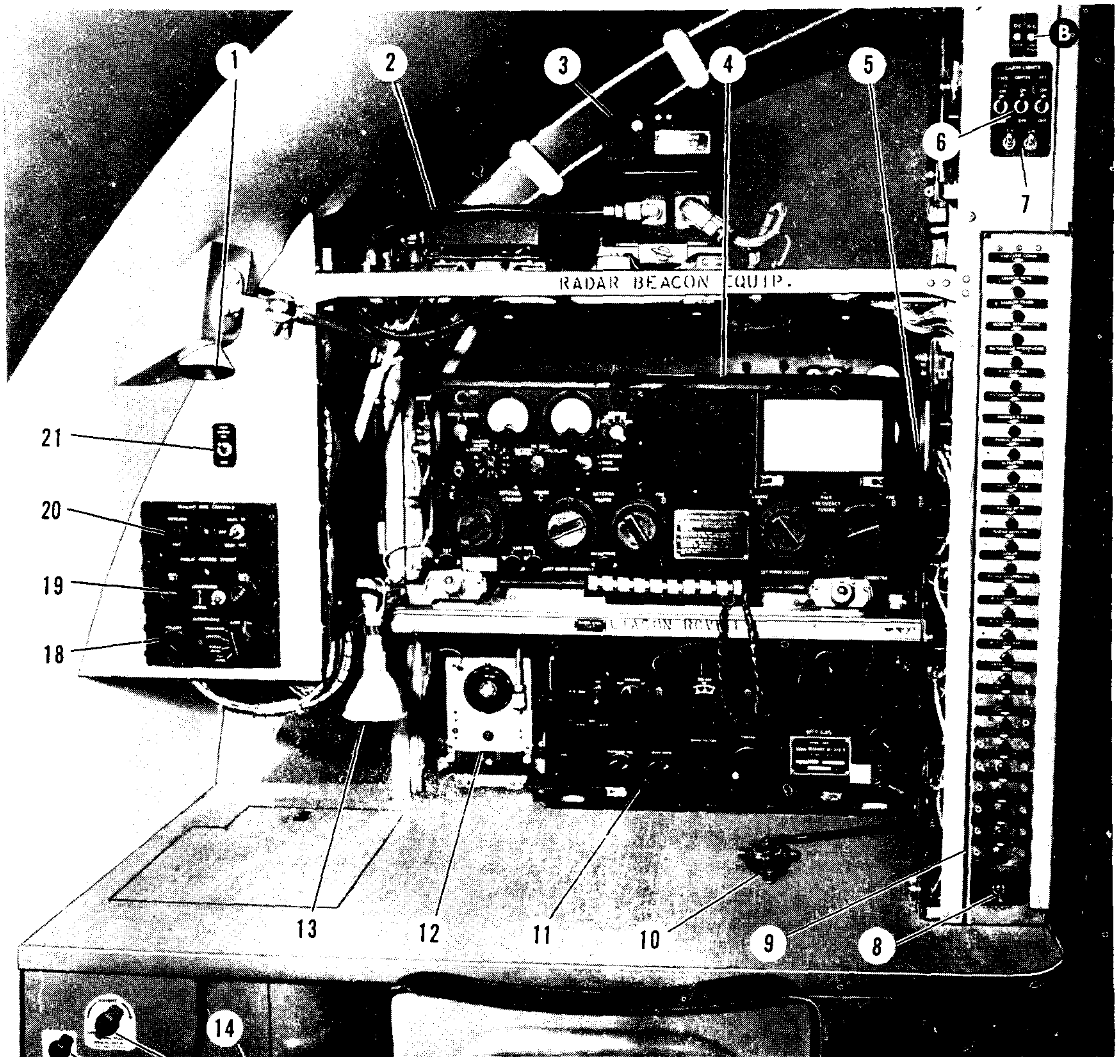
Note

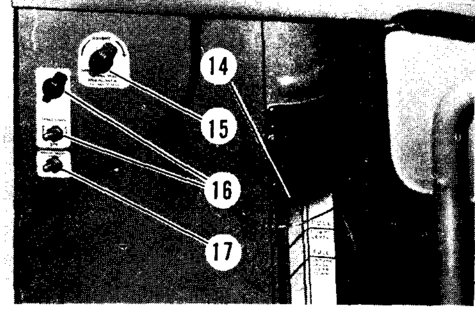
Allow ten minutes for system warmup.

1. Latitude correction knob — Rotate latitude correction pointer to OFF. Rotate the latitude correction knob until the latitude correction pointer is in the OFF position. This slaves the indicator to the remote compass transmitter.
2. Synchronizer knob — Engage and rotate until the annunciator pointer is at the

RADIO OPERATOR'S

A & B AIRPLANES



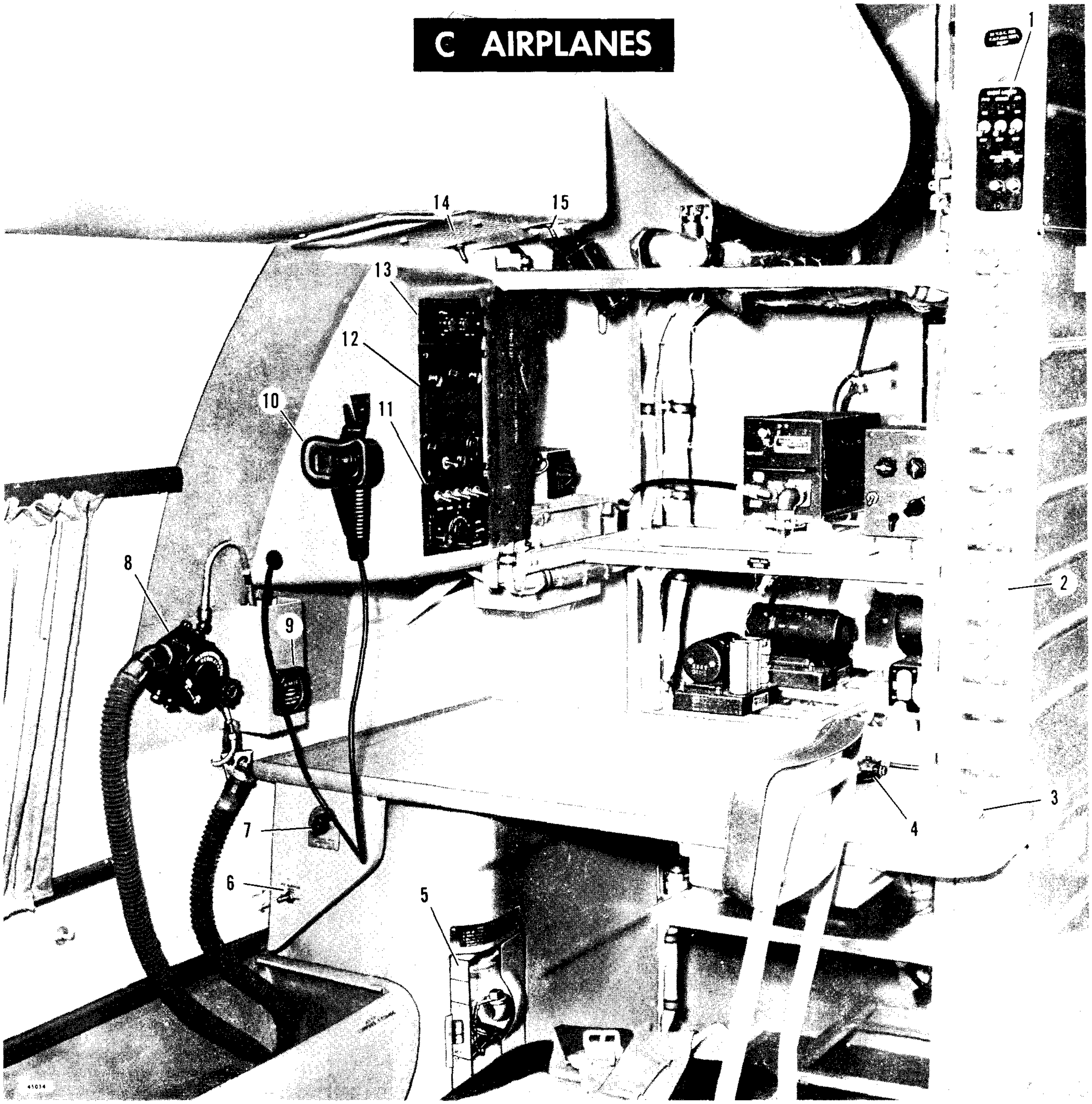


1. Fixed Table Light
2. Interphone Mixer Amplifiers
3. Marker Beacon Receiver
4. Liaison Transmitter
5. Fuse Block
6. Cabin Dome Lights Switches
7. Omni Circuit Breaker Switches
8. Liaison Radio Monitor Switch
9. Circuit Breaker Panel
10. Liaison Transmitter Code Key
11. Liaison Receiver
12. Range Receiver
13. Flexible Table Light
14. Hydraulic Reservoir Sight Gage
15. Trailing Antenna, Interphone, and Public Address Panel Lights Rheostat
16. Table Lights Switch and Rheostat
17. Hydraulic Reservoir Sight Gage Light Switch
18. Interphone Panel
19. Public Address Panel
20. Trailing Antenna Control Panel
21. Nav Radio Switch

C-45282-1

Figure 4-17

STATION (TYPICAL)

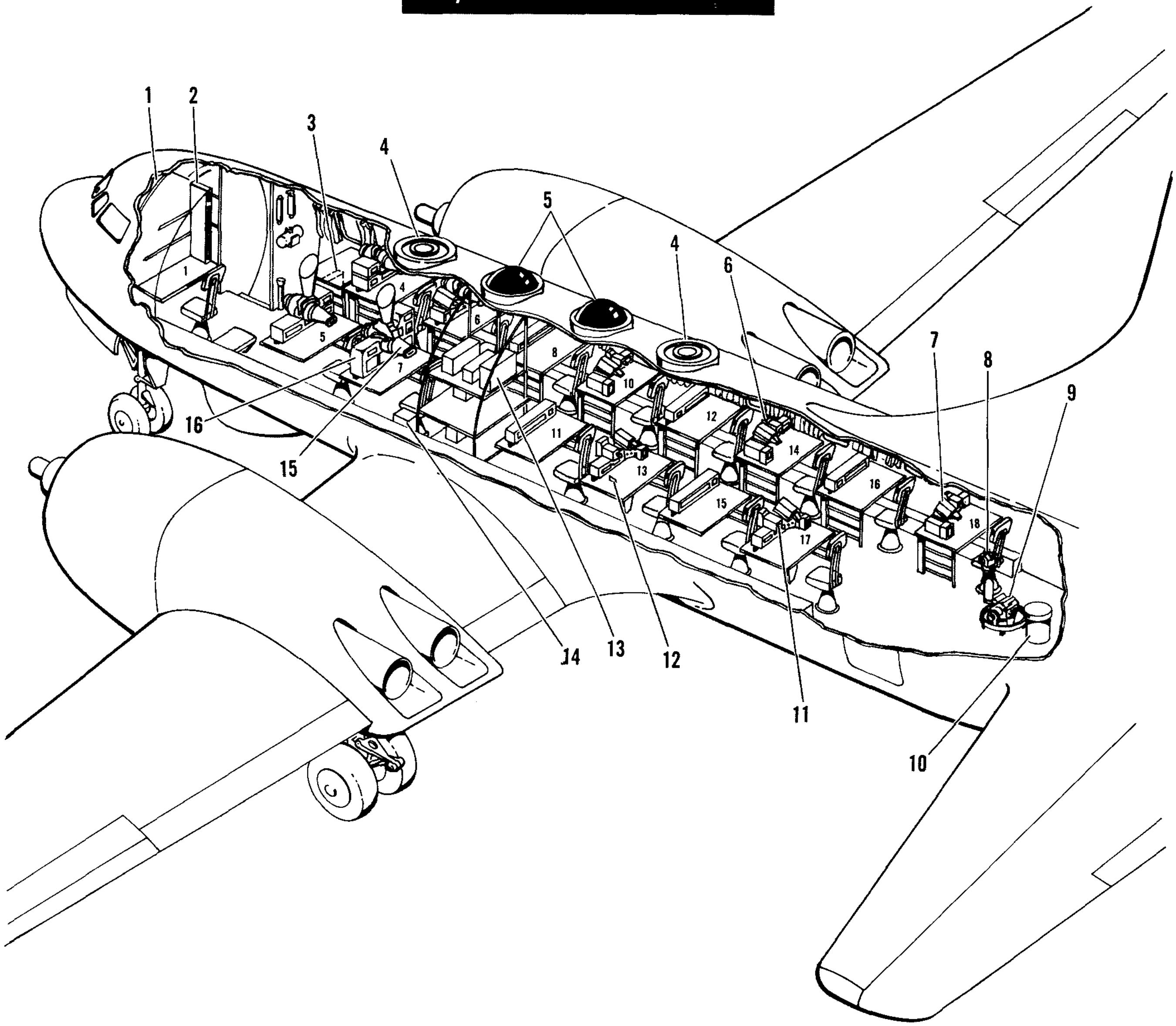


1. Cabin Dome Light Switches
2. Circuit Breaker panel
3. Liaison Monitor Switch
4. Liaison Transmitter Key
5. Hydraulic Reservoir Sight Gage
6. Hydraulic Reservoir Light Switch
7. Table and Panel Light Switches
8. Oxygen Regulator
9. Oxygen Flow Regulator
10. Michrophone
11. Radio Operator's Interphone panel
12. Liaison Radio Master Control Panel
13. Trailing Antenna Control Panel
14. Loudspeaker
15. Navigation Radio Switch

C-45282-2

TRAINING STATIONS GENERAL

A, B & C AIRPLANES



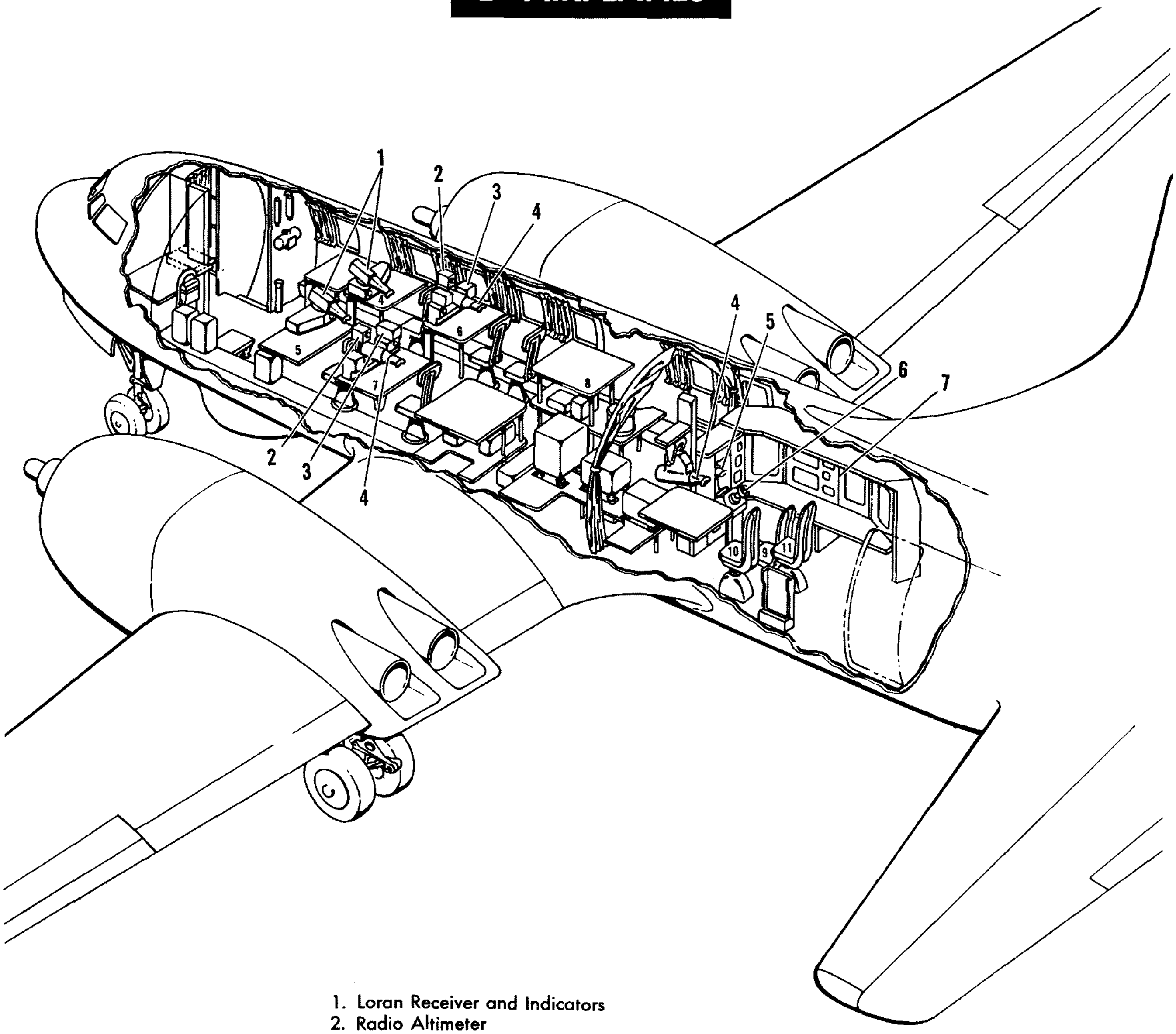
1. Radio Rack
2. Radio and Navigation Equipment Junction Box
3. Periscopic Sextant Stowage Case
4. Periscopic Sextant Window
5. Astrodome
6. Radio Compass Control Panel
7. Loran Control Unit
8. Driftmeter Installation
9. Camera
10. Camera Operater's Seat
11. Radio Altimeter Indicator
12. Thermometer Installation
13. Radar Equipment Rack
14. Bomb and Camera Control Panel
15. Master Radar Scope
16. Radar Master Control Panel

C-45283-1

Figure 4-18

ARRANGEMENT *(TYPICAL)*

D AIRPLANES



1. Loran Receiver and Indicators
2. Radio Altimeter
3. Radio Compass panel
4. Radar Repeater Scopes
5. Master Radar Indicator
6. Periscopic Bombsight
7. Master Bombardier Station Control Console

Note:
Station 4 and 5 Student Navigators
Station 6 and 7 Student Navigator Bombardiers
Station 8 Navigator Instructor
Station 11 Bombardier Instructor
Station 9 Master Bombardier
Station 10 Bombardier

C-45283-2

center index. Synchronize the heading pointer by rotating the synchronizer knob in the direction indicated by the annunciator pointer.

Note

- It is necessary to rotate the synchronizer knob until the annunciator pointer is approximately centered, then allow one or two minutes for the system to drive into synchronization.
- Check the indication of the heading pointer against a known heading of the magnetic compass to avoid an ambiguous heading.

CAUTION

- If synchronization is accomplished in a direction opposite that indicated by the annunciator pointer, the heading pointer will be 180 degrees off the correct magnetic heading. This is an unstable condition which will correct itself at an approximate rate of three degrees per minute if left alone. If the autopilot is engaged, the airplane will change heading at approximately three degrees per minute and assume the new heading.
- Do not synchronize the heading pointer during or immediately after turns, or when the autopilot is engaged.

3. Correction servo indicator — Check for rotation. Rotation of the correction servo indicator (white dot) indicates the system is operating properly.

DIRECTIONAL GYRO MODE

Directional gyro operation is to be used when the earth's magnetic field is too weak or distorted to be reliable, such as in regions near the earth's magnetic poles.

1. Latitude correction knob — Rotate to correct latitude. Rotate the latitude correction knob until the latitude correction pointer indicates the latitude of the airplane position. This isolates the remote compass transmitter from the system and switches to directional gyro mode.

Note

As the airplane changes position, the latitude correction pointer should be reset progressively to the new latitude. Setting the mid-latitude every two degrees will generally be sufficient for proper operation.

2. Synchronizer knob — Rotate to desired reference heading.
3. Correction servo indicator — Rotating. Observe that the correction servo indicator is rotating to indicate proper operation of the system (clockwise in north latitudes and counterclockwise for south latitudes).

STUDENTS' RADIO ALTIMETER SCR-718-C

Note

Except in emergency, the SCR-718 Radio Altimeter equipment will be used only over broad ocean areas starting not less than 50 miles offshore, unless restriction is specifically waivered by Headquarters, USAF.

The students' radio altimeter uses the same transmitting and receiving antennas as the pilots' radio altimeter. When the pilots' set is turned on, the antennas are automatically disconnected from the students' set; when the pilots' set is turned off, the students' set is reconnected automatically. Six radio altimeter indicators (4, figure 4-19) are installed at alternate navigation and radar training stations; the master indicator is at training station number 10, and the other five indicators are coupled by an indicator amplifier unit. The other end of the mounting installation, at all six stations, carries the student's radio compass control panel. The mountings are on turntables which can be locked into position for use at either one of the adjacent training stations. On **D** airplanes the radar altimeter indicators are installed at the two navigation training stations and rotate for use at the navigator-bombardier training station. The students' radio altimeter operates on unregulated alternating current from No. 2 bus.

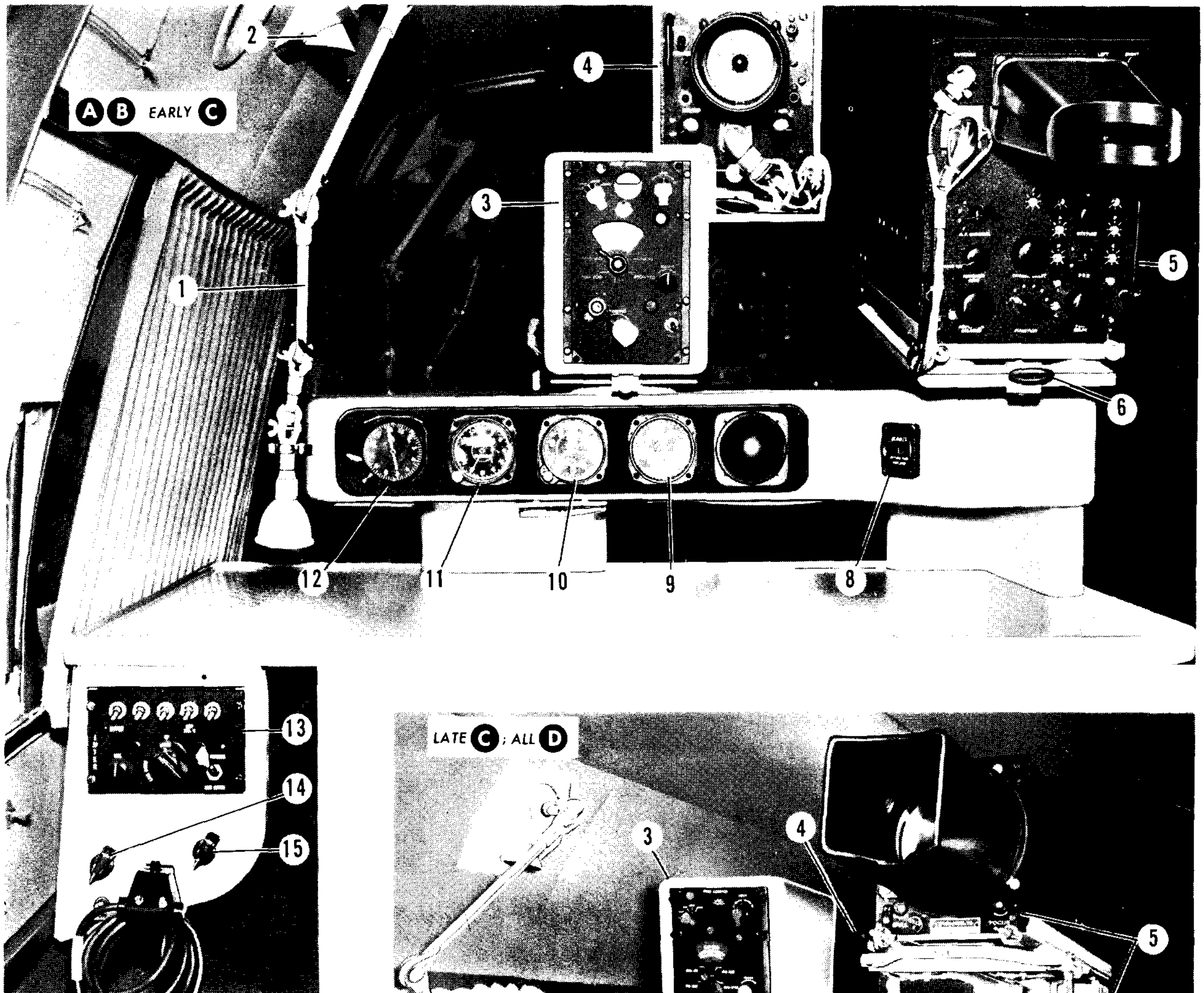
WARNING

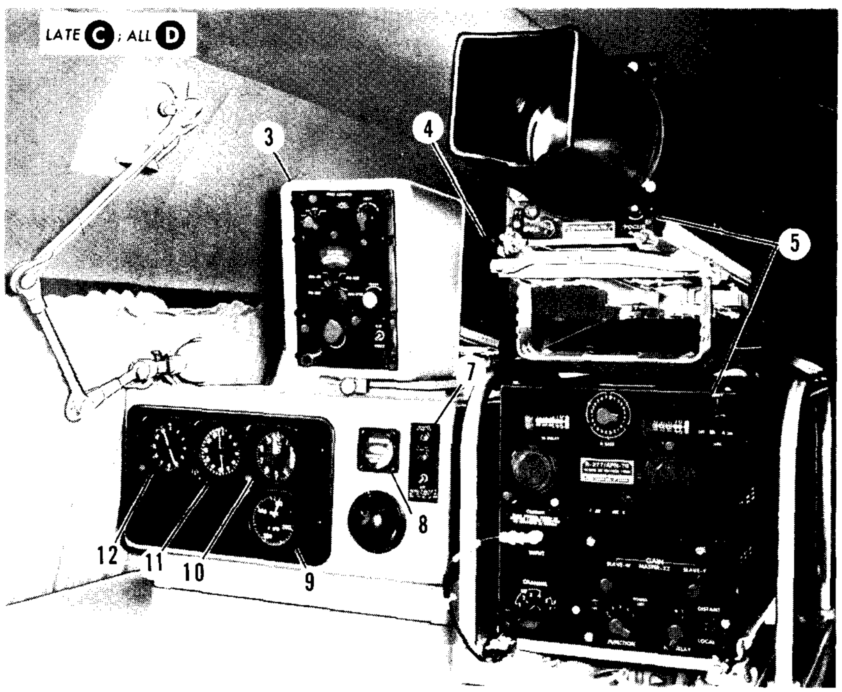
Radio altimeter measurements of terrain clearance are unreliable over areas (such as polar regions) which are covered by a large depth of snow and ice. Radio altimeter waves can penetrate the surface of snow and ice fields; therefore, they may indicate a greater terrain clearance than actually exists under these conditions. An apparent terrain clearance 1600 feet greater than actual clearance has been recorded.

NO.3, 4, AND 5 RADIO COMPASSES AN/ARN-6

On **A** , **B** , and **C** airplanes, all training stations except numbers 5 and 7 have radio compass indicators (9, figure 4-24) which are supplied signals from number 3, 4, or 5 radio compass receiver. Six control panels (3, figure 4-19), two for each set, are installed at alternate navigation and radar training stations. They are mounted on the same turntables as the students' radio altimeter indicators, the turntables permitting the radio compass control panels to be locked into position at either one of two

NAVIGATION TRAINING STATION *(TYPICAL)*





1. Flexible Table Light
2. Fixed Table Light
3. Radio Compass Panel A B C
4. Radio Altimeter Panel (Opposite Side of Radio Compass Panel)
5. Loran Receiver Indicator
6. Turntable Locking Handle
7. Driftmeter Inverter Switch
8. Oxygen Flow Indicator
9. True Airspeed Indicator
10. Altimeter
11. Radio Compass Indicator
12. Slaved Gyro Magnetic Compass Indicator
13. Interphone Panel
14. Table Lights Switch and Rheostat
15. Interphone and Radio Compass Panel Lights Rheostat

C-45284

Figure 4-19

adjacent training stations. Each of the three sets is independent of the other two, having its own receiver and antennas. No. 3, 4 and 5 radio compasses are powered by the dc nonessential radio equipment bus. D airplanes have similar radio compass mountings.

LORAN AN/APN-9

Note

Because of the hazards associated with the loss of the trailing wire antenna weight, use only over broad ocean or isolated land areas if operational requirements permit. A B C

On A, B, and early C airplanes, six long-range navigation receiver-indicators (5, figure 4-19) are installed at alternate navigation and radar training stations. They are independently operated from their respective control panels located on the front of the receiver-indicators. One trailing antenna (14, figure 4-12) is used by all six sets; it is reeled in and out by a reel motor controlled from the trailing-wire control panel (20, figure 4-17) at the radio operator's position. On late C airplanes, the control panel is located on the flight engineer's interphone panel. The control panel has an amber "Antenna Out" indicator light, and a REEL IN – OFF – REEL OUT switch which controls the motor. A spare trailingwire antenna, reel, and weight are stowed next to the installed trailing antenna, and are provided for the replacement of the installed antenna should the latter be lost during flight. Loran AN/APN-9 operates on unregulated alternating current from the No. 2 bus. The Loran reel switch, reel light switch, and trailing antenna couplers switch operate on power from the dc nonessential equipment bus.

CAUTION

- The trailing antenna should be reeled in only when the airplane is in level flight. Excessive oscillation that may accompany the reeling can be prevented by performing the operation intermittently. The antenna can be observed through one of the drift sights.
- When operating in or near thunderstorm activity, the trailing antenna should be retracted.

Operation of Loran AN/APN-9

The Loran set is turned on as follows:

1. Set the "Amplitude Balance" control at its center position of rotation.
2. Set the "Fine Delay" control at its center position of rotation.
3. Turn the "Receiver Gain" control clockwise until the "Station" rate identification (pilot light) illuminates.
4. Wait at least five minutes to allow the equipment to warm up.

The Loran set is turned off as follows:

1. Turn the "Receiver Gain" control to POWER OFF.
2. Check to see that the pilot light is not illuminated and that the pattern on the indicator screen has disappeared.

LORAN AN/APN-70 C D

The AN/APN-70 is a dual-indicating, direct reading Loran Navigation System installed on late C and some D airplanes. It provides facilities for receiving 100 KC and 180 KC channels in addition to the standard Loran frequencies. The equipment includes an indicator and a receiver. The focus and brilliance controls are located on the face of the indicator, and all other controls are located on the face of the receiver. On C aircraft the equipment utilizes a trailing wire antenna or the fixed wire liaison antenna. On D aircraft a trailing wire antenna is not provided, and the equipment utilizes the fixed wire antenna. The receiver and indicator operate on 115-volt unregulated ac power provided through bus No.2. The antenna couplers and antenna reel (if applicable) operate on 28-volt dc provided through the nonessential radio equipment bus. Circuit protection is provided by circuit breakers and fuses located on the radio rack circuit breaker panel and radio fuse blocks.

Sextant D-1 Periscopic

The periscopic sextant consists of two main assemblies: the mount, which is permanently affixed in the astrodome and the sextant which is stowed in a carrying case when not in use. The sextant provides an angle of observation from -10° to + 92° elevation. The optical system consists of a two-power telescope with a 15° field of vision. A timer averager in the sextant provides continuous averaging of celestial body elevations for 30 seconds to two minutes. A moveable, 360° compass rose is built into the mount for azimuth readings. Lighting only is provided by 28-volt dc power. The bubble chamber and azimuth scale lighting are controlled by a rheostat located on the face of the sextant. Additional lighting is provided for the azimuth counter, altitude counter and averager indices. Circuit protection is provided by a circuit breaker located behind the pilot and on the right front edge of the astrodome.

RADAR SET AN/APS-23

The AN/APS-23 is an airborne navigation radar. The set operates on a frequency of 9375 (±55) mc and provides search capability from ranges of 5 to 200 nautical miles. It utilizes a PPI scope which provides full 360° scan or adjustable 40° to 180° sector scan operation. Sweep delay is incorporated which allows magnification of a selected portion of the presentation. Fixed range markers of 5, 10, 20 and 50 NMS are supplied for range determination. A sensitivity time control has been added to provide better scope presentations at low altitudes. The radar equipment operates on dc power from the nonessential bus, 115-volt regulated ac from the inverters and 115-volt unregulated ac power from the alternators. Repeater indicators may be utilized with the radar set and are controlled either from the master radar position or at each indicator through the use of the C-676/APA-82 system. The Radar Control Unit (RCU, C-413) provides the main control switches for the APS-23 radar. The following operating controls are found on this unit:

1. POWER SWITCH – A five position switch with OFF, STBY (standby), SCAN OFF, SCAN SLOW and SCAN FAST positions. The STBY position applies power to filaments, gyroscope erection circuits, keep alive rectifier, time delay relay and antenna tilt control circuits.

2. RANGE KNOB – Determines operating range of radar set between 5 and 200 nautical miles.

3. SWP. DELAY – Push-pull and rotating switch permits selection of any distance from 5 to 200 nautical miles as starting point of sweep on the PPI. Pull out to energize the circuit.

4. CONTRAST SWITCH – Provides for discrimination of radar returns.

5. TUNING SWITCH – Permits selection of manual or automatic (AFC) tuning of radar or beacon local oscillator.

6. MAN TUNING – Permits manual tuning of local oscillator depending upon position of TUNING SWITCH.

7. DEG TILT – Controls tilt of antenna pillbox from +5° to -30°.

8. METER SWITCH – Provides capability of monitoring radar voltages.

9. ILLUM – Controls intensity of lights on the radar control unit.

10. ANTI-JAM – Emphasizes target contours at expense of target detail.

11. RECVR GAIN – Controls I-F amplification of radar energy.

Normally the APS-23 radar installation incorporates the A-1A or AN/APA-44 computer systems. When the computers are removed two additional control boxes are installed. The CN-135, which provides a Mag Var for manual magnetic variation adjustment and the C-412 which provides altitude delay, true or relative scope orientation, antenna stabilization and a depressed center, 120° sector scan.

WARNING

The equipment utilizes high voltages which are dangerous to life. Personnel must observe safety precautions at all times. No tubes should be changed nor adjustments made inside the equipment while the power supply is turned on. Under certain conditions, a dangerous high voltage potential may exist in some circuits, even if the power is turned off, because of charges retained by capacitors. To avoid casualties, always ground any circuit prior to handling.

A-1A COMPUTER (D)

The A-1A computer is one of four units required to make up a complete bombing navigation system. The other units are a radar, an optical sight, and interconnection equipment. The radar and/or the optical sight are used to pick up the target for bombing or navigational fix. Interconnection equipment provides circuits to permit the use of the A-1A and the radar in conjunction with each other. The A-1A computer system supplies data for the following uses:

Bombing

1. To position the radar and optical line of sight.

2. To control airplane flight during bombing run.

3. To simulate automatic bomb release.

Navigation

1. To continuously compute latitude and longitude of the airplane.

2. To compute velocity and direction of the wind. During a bombing run, the A-1A system supplies the pilot with "time to go" and heading correction to arrive at the proper point of release. On a bombing run, control of the airplane may be either automatic or manual. Prior to the bombing run the computer must be given the airplane altitude and ballistics information (time to fall and trail). During the bombing run, wind corrections must be made. With this system the airplane is also equipped for offset bombing and polar navigation. This equipment also has indicators to supply the navigator with true airspeed, airplane heading, and magnetic variation.

RADAR SET AN/APQ-24T-1 (A) (B) (C)

The APQ-24 Radar incorporates the AN/APS-23 radar set as previously described, with the AN/APA-44 computer system to provide navigation and a simulated bombing capability. The master units and controls for both pieces of equipment are located at Position No. 7 (Figure 4-21). Also incorporated with the APQ-24 system is an APA-82 to provide additional auxiliary indicators at Positions 4, 5 and 6 (Figure 4-24). A, B and early C model aircraft also incorporated a control unit C-676/APA-82 to permit the operator to transfer the primary control of the APS-23 radar to any selected auxiliary position. The auxiliary controls consist of receiver gain, contrast control, range switch and dial illumination (1, Figure 4-24). The auxiliary positions are numbered 2 through 4, proceeding clockwise from the master indicator.

The APA-44 computer system is controlled through the computer control unit C-949/APA-44 (14, Figure

4-21). located at the master radar position. When this system is energized by placing the switch in SEARCH. NAV or BOMB function, magnetic variation is coupled with the aircraft heading system to provide azimuth stabilization to the radar. The correct magnetic variation must be manually set at the computer control unit. The computer system can also be utilized for navigation purposes and will provide fix information up to 1, 000 miles north, south, east or west of a reference fix. The equipment also provides for simulated bombing and bomb scoring. When the computer control unit is placed in BOMB function, a ballistic computer provides correct heading and time to release information to correspond to the position of the cross hairs. Automatic steering and bomb release may be accomplished by transferring the auto-pilot control to the master radar position. Bomb scoring may be accomplished by a tone scoring system operating through the aircraft's command radio equipment or by radar scope photography provided by bomb scoring circuits incorporated with the 0-15 camera installation. This equipment operates on dc power from the nonessential bus, regulated ac from the aircraft inverters and unregulated ac power from the No. 2 alternator bus.

The following is a description of the APA-44 units and other associated equipment.

1. Computer Control Panel (14, Figure 4-21) controls power to the computers by selecting mode of operation. Tracking control lever, wind determination and a manual magnetic variation control are also located on this panel. A rheostat also controls panel illumination lights.

Note

Function switch must be in SEARCH position for azimuth stabilization to be supplied to the PPI.

2. Range Computer (15, Figure 4-21) provides distance in rectangular coordinates from position of crosshairs to aircraft (fix dials) and distance in rectangular coordinates up to 1,000 miles from a reference fix. The range computer also contains switches for arming, pilot's steering meter, interruption of wind determination, bombing offset and cross hair or range mark selector. A gyroscope not erect light is also included. The mileage dials drive at a groundspeed rate dependent upon the airspeed and wind information supplied the computers.

3. Ballistics Computer (8, Figure 4-21) provides control for setting ballistics information into the computer. Absolute altitude, trail, time of fall, offset values and wind controls are found on this computer.

4. Airspeed Indicator provides a visual indication of aircraft's true airspeed and electronically furnishes the airspeed to the computers. A three position switch labeled NORMAL, HOLD and OPERATE, located on the unit, enables the operator to check the system. In normal operation the current true airspeed is computed. When the switch is placed in the OPERATE position, the airspeed will increase until the limit of the unit is reached. Placing the switch in the HOLD position will cause the unit to maintain the preset value of true airspeed.

5. Monitor Voltmeter (3, Figure 4-21) indicates the computer voltage level.

6. Steering Meter (4, Figure 4-21) — A dual indicating instrument that provides the operator with time-to-go for bomb release from 0 to 6 minutes and the steering correction to the bomb run course provided by the computers. The center of the dial is zero with a range of 40° either side of center. An indicator light labeled REL illuminates at bomb release.

7. Camera Control Panel (16, Figure 4-21) provides control of the 0-15 camera. Power is 28-volt dc supplied through the bomb control circuit breaker panel.

WARNING

The equipment utilizes high voltages which are dangerous to life. Personnel must observe safety precautions at all times. No tubes should be changed nor adjustments made inside the equipment while the power supply is turned on. Under certain conditions, a dangerous high voltage potential may exist in some circuits, even if the power is turned off, because of charges retained by capacitors. To avoid casualties, always ground any circuit prior to handling.

CAUTION

Do not operate this equipment on the ground unless an external power supply is used with either a battery or a 100-mf capacitor connected across the feeders to provide filtering.

RADAR SYSTEM K-3A ⓓ

The K-3A radar system is a bombing and navigation radar system incorporating the APS-23 radar set and the A-1A computer. Other associated equipment include stabilization, optics and interconnect equipment. The APS-23 radar is the same as previously described.

Computer System

The computer system consists of three computers: a bombing, tracking (navigation) and a polar converter (sighting). The following is a brief description of the units:

1. TRACKING COMPUTER — Computes and furnishes information to the bombing computer and the polar converter. Computes the wind when a wind run is performed and furnishes the navigation control unit the aircraft's position.

2. POLAR CONVERTER — Solves the sighting problem by computing true bearing of line of sight, ground range and slant range to the crosshair position.

3. BOMBING COMPUTER — Solves for proper release heading and time-to-go to bomb release. Receives information from the Ballistic Control Unit and the Tracking Computer.

Turn on and control of the computers are accomplished through the primary control unit (14, Figure 4-20). The various switches and their functions are:

1. FUNCTION SWITCH — This five position switch (OFF, STAB, NAV, TRACK and BOMB) controls the functions of the computers, stabilization and optics and interconnect equipment.

2. RANGE MARK-CROSSHAIR SWITCH — Permits selection of crosshairs or fixed range marks and heading marker presentation on the indicators.

3. PPI-OB SWITCH — Orients the movement of the tracking control handle to TRUE NORTH or line of sight. With PPI selected, forward pressure on the handle causes crosshair movement to the north. OB position causes the tracking control to be oriented to line of sight for use with the optics and B-scope. In this position forward pressure on the tracking handle causes crosshair range to increase in the direction of line of sight.

4. RADAR ALTITUDE SWITCH AND LIGHT — Enables the operator to measure altitude. When the switch is ON, the light is illuminated.

5. ALTITUDE CORRECTION KNOB — Permits accurate measurement of altitude. A read out of the altitude is located on the ballistics control unit.

6. ERECTION CUT-OFF LIGHT — This light will illuminate when the gyros are not vertically aligned.

7. ERECTION RESET SWITCH — Permits overriding of the ECO circuit to correct the gyros in the stabilization unit to the vertical.

8. MEMORY POINT-DISPLACEMENT SWITCH — Permits integration of a new wind in the computers when in memory point.

9. MEMORY POINT LIGHT — A green light will illuminate 15 seconds after memory point switch is activated. The light will remain on for 4-3/4 minutes or until the operator discontinues memory point operation.

10. MEMORY POINT WARNING LIGHT — A red memory point warning light will illuminate 30 seconds prior to the system automatically discontinuing memory point operation.

11. BOMB-RELEASE LIGHT — This red light flashes when simulated bomb is released.

12. OFFSET SWITCH AND LIGHT — Permits use of offset bombing coordinates. A white light illuminates when the switch is ON.

13. AUXILIARY PPI or NAV TRACK SWITCH — Permits full 360° scan with crosshair tracking when in NAV, TRACK or BOMB function.

T. G. Indicator

The T. G. Indicator gives time in seconds (from 180 - 0) to bomb release.

True Airspeed Indicator

This instrument indicates true airspeed provided the tracking computer from the airspeed transmitter.

Ballistics Control Panel

The ballistics control panel (23, Figure 4-20) provides means of setting ATF and trail for use of the computers. The unit also has an RG limit light to indicate when the crosshairs are at maximum range. A forward sighting button provides for rapid placement of the crosshairs in front of the aircraft and permits "lock out" when the crosshairs are at maximum range and the button is depressed. Provisions for manually setting offset values are also provided by this unit.

Navigation Control Unit

The navigation control unit (22, figure 4-20) provides the following information:

1. Latitude and longitude of the aircraft or of the crosshairs, depending on the position of the INDICATOR POSITION SELECTOR SWITCH.

2. Displays the computed wind in rectangular coordinates on N-S and E-W dials.

3. Reflects distance (N-S and E-W) of the crosshairs from the aircraft.

4. Computes and displays magnetic variation and transmits information to the computers.

Manual controls are located on the unit to enable operator to correct LAT and LONG counters and variations.

Tracking Control Unit

A handle on the tracking control unit (13, figure 4-20), provides the operator a means of moving the crosshairs. The direction is true north oriented when the PPI-OB switch is in PPI position. A "deadman's switch" on the back of the handle must be depressed to energize the system. A button on the tip of the handle provides a slew rate (100 times the normal) to move the crosshairs.

Computer Amplifier Unit (CAU)
The CAU contains fuses and amplifiers for the computers.

Stabilization Unit
The stabilization unit provides vertical and directional reference to the bomb-navigation system. The unit receives magnetic heading information from a flux valve and variation information from the navigation control unit. The STAB unit is thus oriented to true north and a true heading read out is provided on the polar navigation unit.

Polar Navigation Unit
The polar navigation unit (30, figure 4-20) provides a capability for integrating the polar angle into the bomb-navigation system for grid operation. The following controls are located on the unit:

1. N-S POLE SWITCH — Orients the system to northern or southern hemisphere operation.

2. NAVIGATION METHOD SWITCH — This is a three position switch (NORMAL. POLAR and POST POLAR). In NORMAL position the system is disconnected from the bomb-navigation system. POLAR position permits integration of the polar angle selected. POST POLAR permits more rapid transition from polar to normal operation.

3. POLAR ANGLE DISC and SETTING CONTROL — Permits manual setting of grid convergence angle and indicates angle set.

Stabilization Amplifier Unit
The stabilization amplifier unit (28, figure 4-20) contains amplifiers and fuses for the stabilization unit and true heading units of the bomb-navigation system and optics.

Periscope
Some aircraft are equipped with a periscope which provides an optical view of the area around the crosshairs. Provisions are made for a Range Azimuth Indicator incorporated with the periscope. (Refer to Interconnect Equipment.)

Interconnect Equipment
These units integrate the computers with the radar set. The following units are associated with the equipment:

1. RANGE AZIMUTH INDICATOR — Provides an electronic magnification of the area around the crosshairs through a three inch cathode ray tube (B-Scope).

2. SYNCHRONIZER (SN-57) — Generates the crosshairs and sector scan. Fuses to protect the equipment and adjustments for intensity of the crosshairs and width of sector-scanned are located on the face of the unit.

3. POWER SUPPLIES — Provide the high and low voltage power required by the interconnect equipment.

WARNING

The equipment utilizes high voltages which are dangerous to life. Personnel must observe safety precautions at all times. No tubes should be changed nor adjustments made inside the equipment while the power supply is turned on. Under certain conditions, a dangerous high voltage potential may exist in some circuits, even if the power is turned off, because of charges retained by capacitors. To avoid casualties, always ground any circuit prior to handling.

OPERATION OF BOMB SCORING CAMERA SYSTEM

To use the simulated bombing and camera bomb scoring function of the radar set, proceed as follows:

1. Place camera master switch on camera control panel to CAMERA MASTER position.

2. Turn film in camera to new frame, if necessary.

3. Place master power switch on bomb control panel to ON position.

4. Place sel-train switch on bomb-release interval control panel to desired position.

5. On the bomb-release interval control panel, set INTERVAL-BETWEEN BOMBS-FT and BOMBS-TO-BE-RELEASED dials to desired positions.

6. Place bomb-bay doors switch on bomb control panel to OPEN position.

7. Place either one or both of bomb-group-selector switches (fwd and aft) on bomb control panel to desired position.

8. Place fuze-arming switch on bomb control panel to either NOSE & TAIL ARM or TAIL ARM position, as required.

9. Place any one or all, as required, of four rack selector switches on the bomb control panel to ON position.

10. Place camera door timer bypass switch in TIMER IN-DOOR AUTO position.

11. Place power switch on camera timer panel to ON position.

12. Set time-in-seconds knobs on camera timer panel to the required actual time to fall of bombs.

13. Uncage the vertical gyro stabilizer on the camera sight head when the camera door is open.

To turn the bombing and camera scoring system off, proceed as follows:

1. Hold camera door switch on camera control panel to CLOSED position until camera-door-closed indicator light comes on.

Note

This is the only method by which the camera doors can be closed, regardless of whether they have been opened manually or automatically.

2. Place camera master switch on camera control panel to OFF position.

3. Place master power switch on bomb control panel to OFF position.

4. Place all other controls in their normal or off positions.

To turn on the bombing tone-scoring function of the radar set, proceed as follows (refer to UHF COMMAND RADIO AN/ARC-27, this Section):

1. Place the bomb scoring tone switch on the pilots' overhead radio control panel in the ON position.

2. Place the bomb scoring tone switch, located next to the tracking control panel at the master radar station, in the ON position.

To turn off the bombing tone-scoring function of the radar set, place the master radar station bomb scoring tone switch in the OFF position.

Note

Turning OFF the pilot's bomb scoring tone switch also disconnects the tone scoring system, although this method should be used only in emergencies.

J-2 Compass Slaving Cutoff Switch (B) (C)

On late (B) and (C) airplanes, a two-position toggle switch (12, figure 4-21) at the master radar station is provided to permit deslaving of the radar remote gyro magnetic compass indicators. When the switch is in the SLAVED position, the compass indicators are slaved to the J-2 (radar) compass system. Placing the switch in the CUT-OFF position disconnects the remote compass transmitter and the indicator will operate as free gyros. Refer to PILOT'S J-2 INDICATOR SELECTOR SWITCH, this Section.

RADAR IDENTIFICATION IFF/SIF SET AN/APX-25

The AN/APX-25 radar set identifies the airplane automatically according to prearranged modes of operation when challenged by suitably equipped ground or airborne units. Interrogation signals are decoded and coded signals sent in return. The identification radar set also has a means for transmitting a special distress signal. The AN APX-25 identification radar can be set by ground technicians to decode challenges from either of two ground or airborne identification systems: the MARK X (APX-6) IFF, or the selective identification feature (SIF) systems. SIF provides a greater number of possible coded replies than does the Mark X (APX-6) system. When operating in SIF, in addition to the conventional IFF controls used with the Mark X (APX-6) IFF, it will be necessary to use the coder group control panel placarded "SIF". The equipment operates on 28-volt dc from the main bus and 115-volt regulated ac from the main or spare inverter.

IFF Control Panel

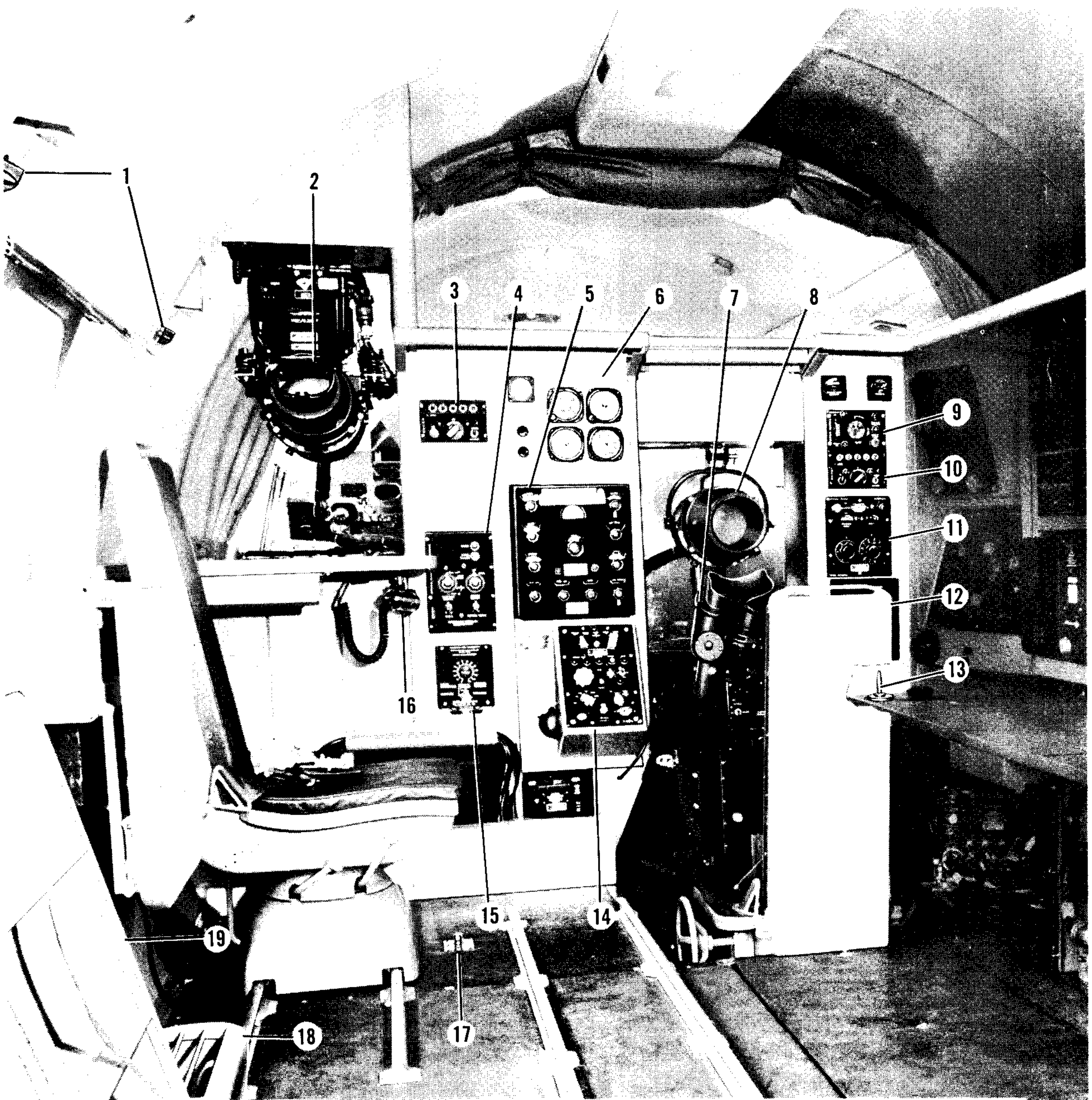
The IFF control panel (figure 4-15) is located on the radio remote control panel. The panel contains the IFF master control knob, a plunger button, and three toggle switches. The IFF master control knob is placarded "Master" and has positions EMERGENCY, NORM, LOW, STDBY, and OFF. Placing the IFF control knob to EMERGENCY selects the special distress signal. The OFF position deenergizes the identification radar. STDBY provides for set warmup with primary power on, but the receiver desensitized so that the set will not respond to interrogation signals. NORM position provides for normal set operation, while the LOW position provides a partial receiver sensitivity which allows the set to respond to only very strong interrogation signals. Selection is achieved by turning the IFF master control knob until the desired position appears below the selection arrow marker. To select EMERGENCY it is necessary to depress the plunger button in the lower left corner of the control panel while turning the control knob. This button prevents accidental selection of the emergency position. Normal operating selections are called modes (mode 1, mode 2, mode 3). Mode 1 is selected by placing the IFF master control knob in the NORM position. Selection of additional modes is accomplished by use of two mode selector toggle switches with positions MODE 2 OUT, and MODE 3 OUT.

Note

Combinations of mode selections available are: mode 1 and mode 2, mode 1 and mode 3 and modes 1, 2, and 3. Mode 1 is always used, alone or with any combination of modes.

The third toggle switch is provided to supply a special "identification of position feature". This toggle switch has three positions placarded I/P, OUT, and

MASTER BOMBARDIER



1. Table Red Light Dimming Controls
2. APS-23 Radar Scope
3. Station 10 Interphone Control Panel
4. 0-15 Camera Control Box
5. APS-23 Control Panel
6. Flight Instrument Panel
7. Periscope Bombsight
8. APA-82 Master Indicator
9. Radar Pressurization Control Panel
10. Station 9 Interphone Control Panel
11. Bombing Navigational Computer Line of Sight Control Panel
12. Bombardier's Compartment Lights Control Panel
13. Tracking Control
14. Primary Bombing Navigational Computer Control Panel
15. Variable Power Transformer Control Panel
16. Utility Spot Light
17. Interphone Control Switch
18. Data Stowage Rack
19. Parachute Stowage Rack

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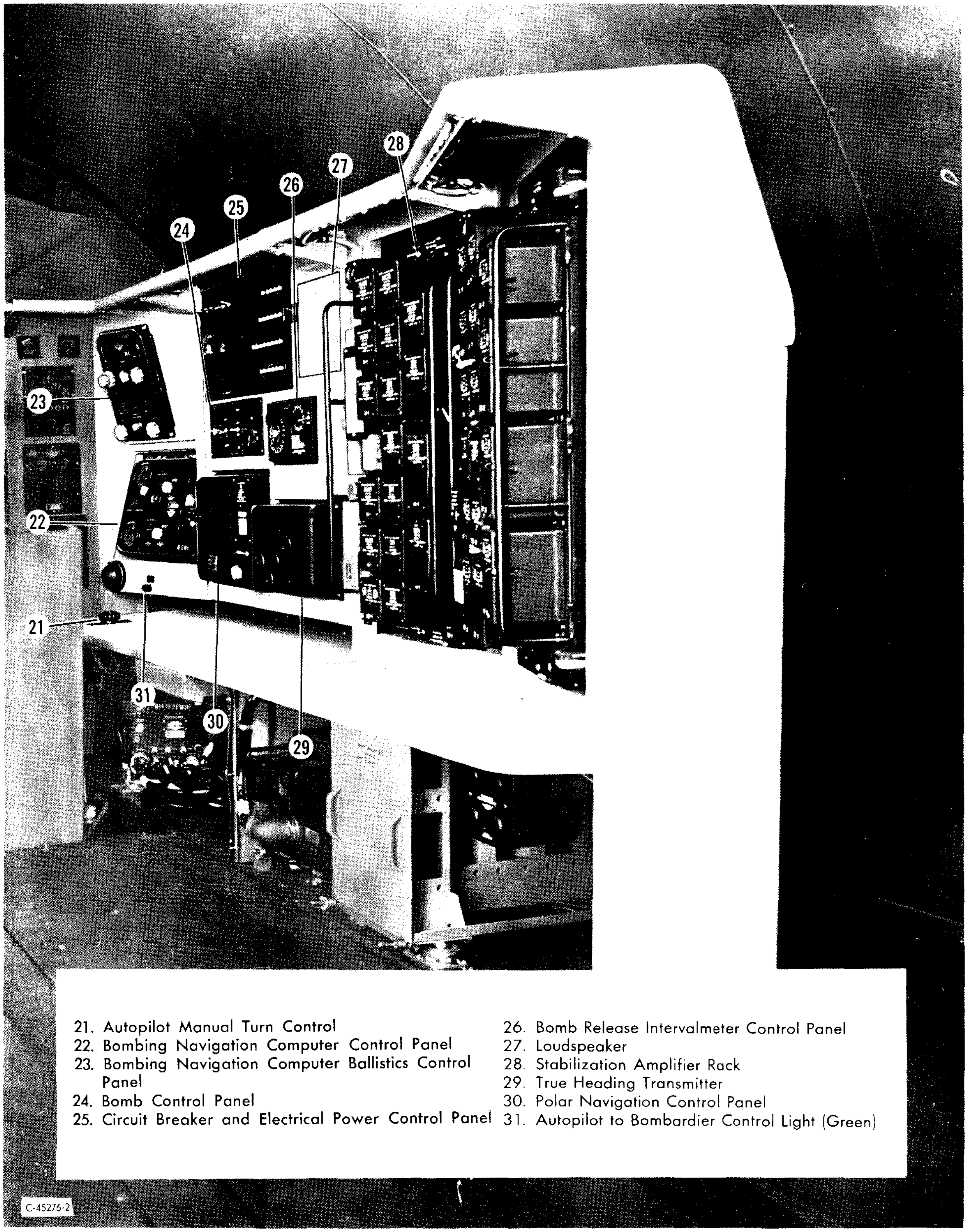
Figure 4-20

STATION *(TYPICAL)* D AIRPLANES



21. Autopilot Manual Turn Control
22. Bombing Navigation Computer Control Panel
23. Bombing Navigation Computer Ballistics Control Panel
24. Bomb Control Panel
25. Circuit Breaker and Electrical Power Control Panel
26. Bomb Release Intervalmeter Control Panel
27. Loudspeaker
28. Stabilization Amplifier Rack
29. True Heading Transmitter
30. Polar Navigation Control Panel
31. Autopilot to Bombardier Control Light (Green)

MASTER RADAR STATION (TYPICAL)

A, B & C AIRPLANES

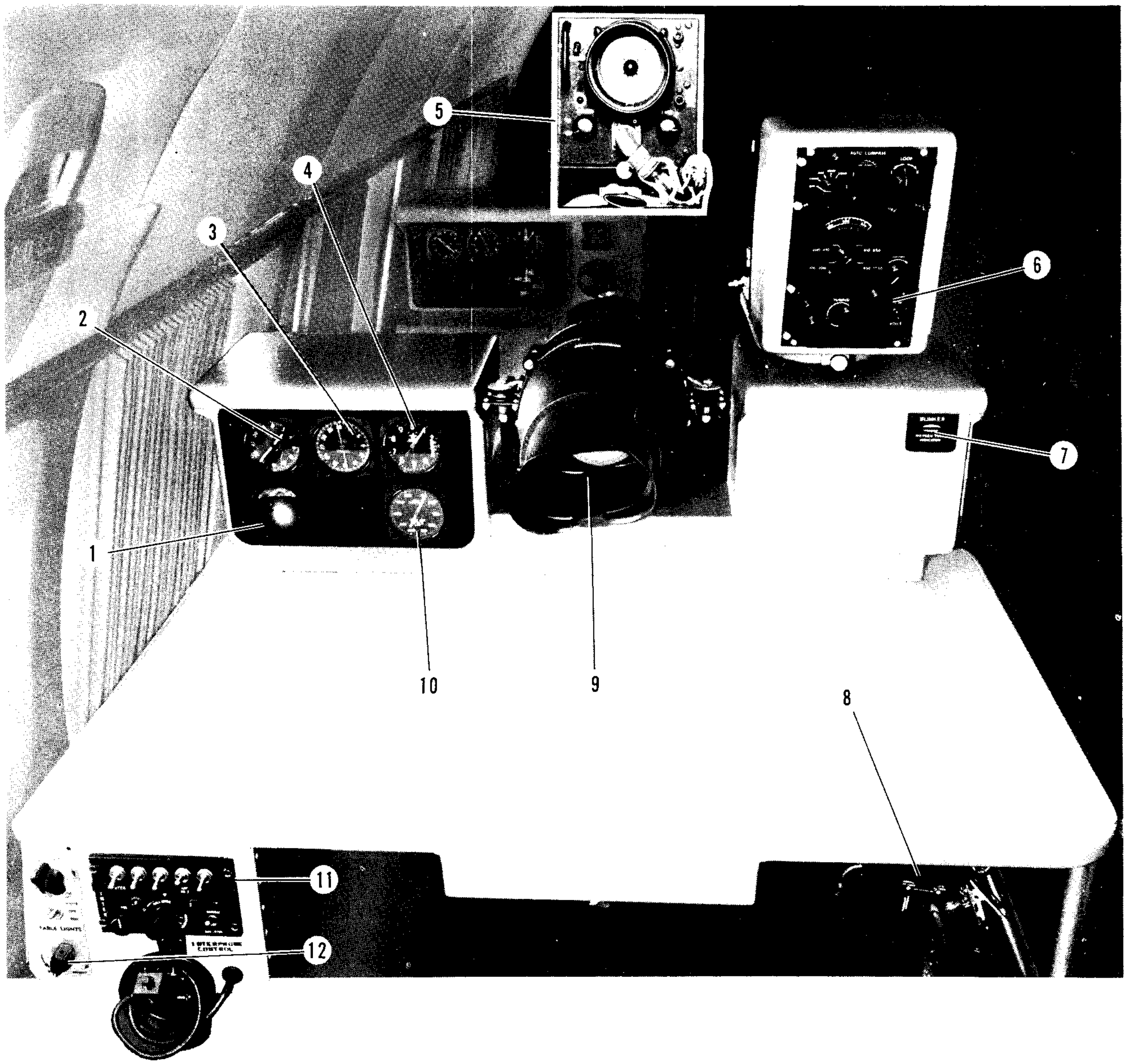
1. Master Radar Scope
2. Camera
3. Monitor Voltmeter
4. Steering Indicator (Radar)
5. True Airspeed Indicator
6. Altimeter
7. Slaved Directional Indicator
8. Ballistics Computer Control Panel
9. Autopilot-to-Bombardier Indicator Light
10. Oxygen Pressure Gage and Flow Indicator
11. Bomb Scoring Tone Switch and Light
12. J2 Compass Slaving Cut OFF Switch
13. Autopilot Turn Knob and Turn Control Selector Switch
14. Computer Control Panel
15. Range Computer Control Panel
16. Camera Controls
17. Radar Control Unit
18. Radar Pressurizing Control Panel
19. Auto Transformer

C-45285

Figure 4-21

NAVIGATOR-BOMBARDIER TRAINING STATION *(TYPICAL)*

D AIRPLANES



1. Ash Tray
2. Repeater Compass
3. Radio Compass
4. Altimeter
5. Radio Altimeter (Opposite Side of Radio Compass Panel
6. Radio Compass Panel
7. Oxygen Flow Indictor
8. Oxygen Regulator
9. Radar Repeater
10. True Airspeed Indicator
11. Interphone Control Panel
12. Light Control Panel

C-45292

Figure 4-22

MIC. It is spring-loaded to OUT from the I/P position. and must be held in the I/P position. When placed in the MIC position, the microphone button must also be depressed. The identification radar features provided by the incorporation of this switch have been supplied to aid ground and airborne air-controllers with special position identification problems and should be used only as directed.

SIF Coder Control Panel

The SIF coder control panel (figure 4-15) is located on the radio remote control panel, and is used in conjunction with the IFF control panel when the AN/APX-25 identification radar has been set to respond to SIF challenges. The selection of the mode of operation is done by positioning of the controls on the IFF control panel. The coder control panel is used to select the coded response to the selected mode 1, mode 3, or both. Coded SIF responses to a selected mode 2 are set on the ground and are provided automatically when mode 2 is selected on the IFF control panel if the AN/APX-25 has been set to respond to SIF interrogations. The coder control panel consists of two dual concentric selector knobs. The left knob controls mode 1 SIF responses coding, the right knob controls coded response to mode 3 SIF interrogations. Combinations of numbers on the inner and outer rings of each of the two selector knobs, aligned with the index markers, set the codes.

Operation of Identification Radar (IFF/SIF)

1. IFF master control knob — As desired.
2. Mode 2 and mode 3 selector switches — OUT, unless otherwise directed.

Note

> Set I/P/OUT/MIC switch to OUT unless directed otherwise for identification of position.

3. SIF coder group controls — Set for proper codes as directed.
4. If in distress — Press dial stop plunger button and rotate master switch to EMERGENCY position and select mode 3, code 77. Set will then automatically transmit distress signals when interrogated.

EMERGENCY RADIO TRANSMITTER

Note

> No transmission will be made on emergency (distress) frequency channels except for emergency purposes, in order to prevent transmission of messages that could be construed as actual emergency messages.

An AN/CRT-3 emergency radio transmitter (figure 3-9) is stowed in a strap sling aft of the rear service door. The transmitter can be used in flight, after an emergency landing, or after ditching, to broadcast a distress signal (SOS) automatically on 500 kc and 8364 kc alternately, or may be used selectively on 500 kc to broadcast distress signals, position, or message by key operation. The key may also be used to operate a signal light connected to the transmitter. The transmitter is fitted with a reel antenna which must be extended by balloon or kite to its full length for maximum range. Two balloons are provided in metal containers. A hydrogen generator in a metal container is used to inflate the balloons.

LIGHTING EQUIPMENT

All lighting circuits operate on dc power except the students' station lights on Ⓓ airplanes, which are powered by 28-volt alternating current through a transformer in the unregulated ac supply system. On Ⓐ and early Ⓑ airplanes, the circuits are protected by non-trip-free circuit breakers. On late Ⓑ and all Ⓒ and Ⓓ airplanes, the circuits are protected by trip-free circuit breakers, except the students' station lights on Ⓓ airplanes which are protected by a fuse located on the bulkhead behind the second student table on the left-hand side. Circuit breakers that protect flight compartment and exterior lights are located on the main circuit breaker panel behind the copilot's seat. Those which protect training compartment lights are located on the auxiliary circuit breaker panel, on the radio circuit breaker panel, and on the master radar station light switch panel on Ⓐ, Ⓑ, and Ⓒ airplanes, or on the master bombardier station light switch panel on Ⓓ airplanes.

EXTERIOR LIGHTS

Position Lights

One white light and one yellow light are located on the aft fuselage tip and red and green lights are located on the left and right wing tips, respectively. On Ⓐ, Ⓑ, and Ⓒ airplanes, two white lights, one each on top and bottom, are centrally located on the fuselage. On Ⓓ airplanes, four white lights, two each on top and bottom, are centrally located on the fuselage. Two circuit breakers protect this circuit. Two switches on the copilot's console control the position lights. The position lights bright-dim switch (figure 4-4) has positions BRIGHT and DIM and controls the intensity of the lights. The position lights steady-flash switch (figure 4-4) has positions STEADY, FLASH, and OFF. On Ⓐ, Ⓑ, and Ⓒ airplanes, a guarded switch mounted in the base of the aft astrodome has OFF and ON positions and provides a means of turning off the upper and lower fuselage white lights. This switch is left in the ON position except when the astrodomes are used for celestial navigation. On Ⓓ airplanes, a two-position toggle switch with ON and OFF positions, is located on the left side of the bombardier's light control panel (12, figure 4-20), to turn off the bottom fuselage lights. This switch is left in the ON position at all times, except when the bombsight is in use at night.

Anticollision Light

A rotating red light is installed on the top of the vertical stabilizer as part of the navigation light system. A circuit breaker on the main circuit breaker panel protects the circuit. An anticollision light on-off switch is provided on the copilot's console.

Note

The rotating anticollision light may be turned off during flight through actual instrument conditions. With the light on during instrument conditions, the pilot could experience vertigo as a result of the rotating reflection of the light against the clouds. In addition, the light would be ineffective as an anticollision light under these conditions since it could not be observed by pilots of other airplanes.

Landing Lights

Two landing lights are mounted flush on the forward, lower surface of the wing, one outboard of each nacelle. Each light is lowered into position by an electrically operated motor, and is turned on automatically when fully extended and turned off automatically as soon as retraction starts. Four circuit breakers protect the landing light circuit: two landing light motor — LH and RH: and two landing light — LH and RH. Two landing light switches (figure 1-8) are mounted on the overhead switch panel. Each switch controls the motor and the light of its corresponding left or right landing light. Switch positions are EXTEND AND ON, OFF, and RETRACT MOTOR.

Taxi Light

The taxi light is mounted in a fixed position on the nose landing gear strut. The taxi light switch (figure 1-8) is mounted on the overhead switch panel next to the landing light switches. It has ON and OFF positions. A taxi light circuit breaker protects the circuit.

Passing Light

The red passing light is mounted flush with the fuselage skin on the nose of the airplane. The passing light switch (figure 4-4) is located on the copilot's console. It has ON and OFF positions. The passing and leading edge light circuit breaker protects the circuit.

Note

The passing light may be turned off during flight through actual instrument conditions. With the light on during instrument conditions, the pilot could experience vertigo as a result of reflection of light against the clouds. In addition, the light would be ineffective as a passing light under these conditions since it could not be observed by pilots of other airplanes.

Wheel Well and Nose Compartment Lights

Lights are provided in the nose and main landing gear well to facilitate servicing the gear and also to afford means of checking the nose gear down-latch and viewing the position of the main landing gear during night landing operations. One light is located in each of the main wheel wells, and two are located in the nose wheel well. The wheel well light circuit breaker protects the circuit. One switch (figure 4-4), located on the copilot's console, controls all wheel well and nose compartment lights. It has ON and OFF positions.

Wing Leading Edge Inspection Lights

Two wing leading edge inspection lights, one for each wing, are mounted flush with the skin on the outboard side of the engine nacelles to provide light for inspecting the wings for icing accumulations. The two lights are controlled by a switch (figure 4-4) located on the copilot's console. It has LEFT, RIGHT, and an unmarked center OFF positions. The passing and leading edge light circuit breaker protects the circuit.

INTERIOR LIGHTS

Instrument Panel Lights

The flight and engine instrument panels are lighted with both red and white illumination. Red and white lights are controlled independently. Two circuit breakers are provided: instrument panel lights — red and white. Four rheostats (8 and 10, figure 1-6), on the pilot's and copilot's console, control the lights.

Overhead Switch Panel Lights

The overhead switch panel and the radio remote control panels (including pilot's and copilot's interphone panels) are edge-lighted. The overhead switch panel light rheostat (figure 1-8) is on the overhead switch panel. It is OFF when fully counterclockwise, and turns clockwise to BRIGHT position. An overhead switch panel light circuit breaker is provided.

Compass Light

This light illuminates the stand-by magnetic compass and is located at the compass. It is protected by the overhead switch panel light circuit breaker. The light is controlled by the magnetic compass light rheostat on the overhead switch panel (figure 1-8).

Console Lights

The pilot's and copilot's consoles are separately illuminated with three lights each (13, figure 1-6), mounted above the consoles. The instrument panel lights — white circuit breaker protects this circuit. The lights are independently controlled by two rheostats (5, figure 1-6). Both rheostats are located directly above their respective consoles and are OFF in the counterclockwise direction and ON in the clockwise direction.

Flight Compartment Utility Spotlights

Two spotlights (14, figure 1-6) are mounted in the flight compartment, one on each side aft of the side windows. Each light has an integral rheostat control. One cockpit spotlight circuit breaker protects the circuit.

Figure 4-23

Flight Compartment Dome Floodlight

The dome floodlight is located in the pilots' dome light switch panel (3, figure 1-5) on the ceiling of the flight compartment. Both red and white illumination are provided by this floodlight. Two circuit breakers, dome lights – red and white, protect the circuit. Two rheostats on the pilots' dome light switch panel are provided for the flight compartment dome floodlight. One is for red and one is for white illumination. A button on the pilots' control wheel will also illuminate the white dome light.

Pedestal Lights

Two lights which spot the pedestal are mounted in the pilots' dome light switch panel (figure 1-5). Both red and white illumination are provided. Two dome lights – red and white circuit breakers protect the circuit. Two rheostats on the pilots' dome light switch panel are provided for the pedestal lights. One rheostat is for red and one is for white illumination.

Pilots' Map Reading Lights

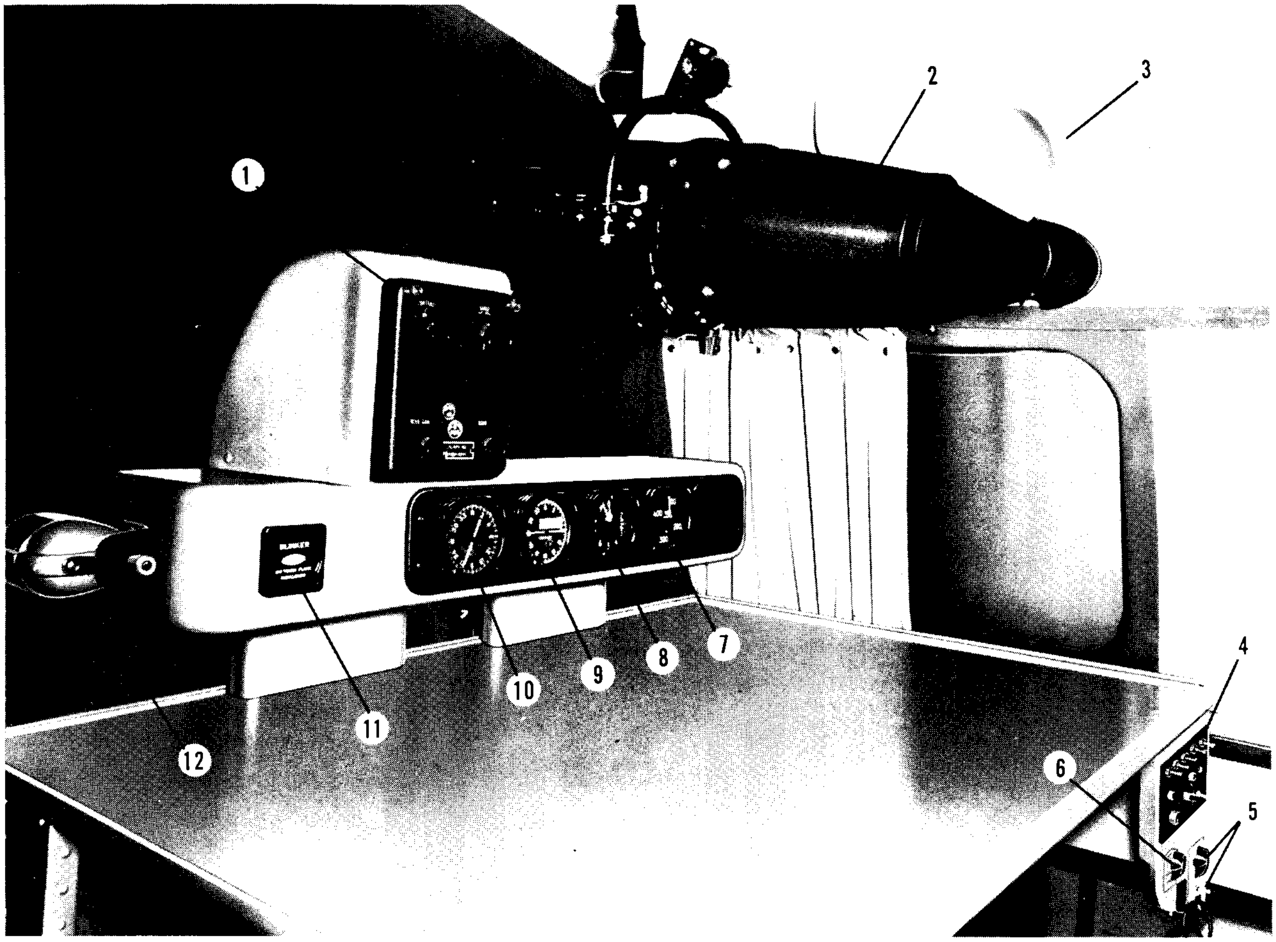
Pilot's and copilot's map reading lights are located in the pilot's dome light switch panel (3, figure 1-5). Only white illumination is provided, but each light has a red filter which can be turned into position by means of an adjacent knob. The lights are protected by the dome lights – white circuit breaker. Separate rheostats on the pilot's dome light switch panel are provided for the pilot's and copilot's map reading lights.

Fuel Control Panel Light

This red light works in conjunction with and is operated simultaneously with, the flight compartment

RADAR TRAINING STATION (TYPICAL)

A, B & C AIRPLANES

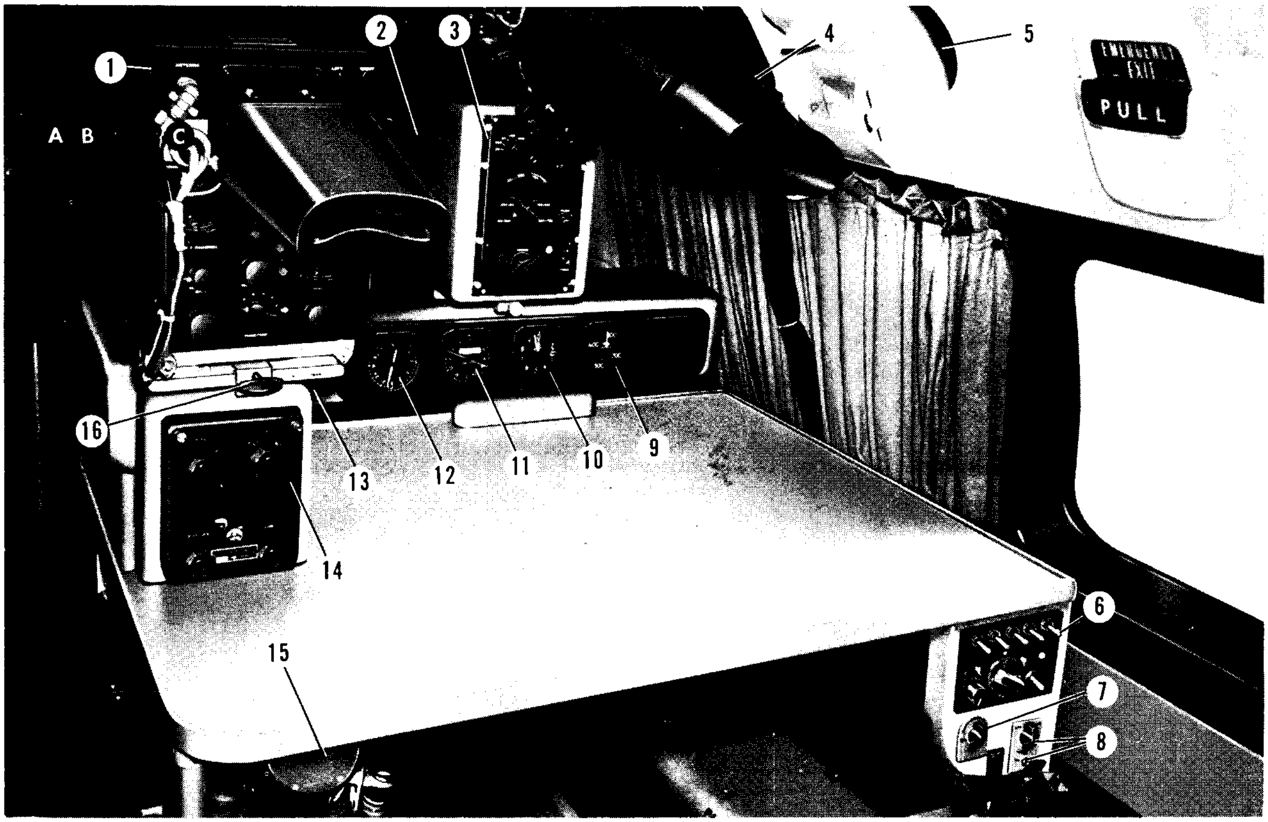


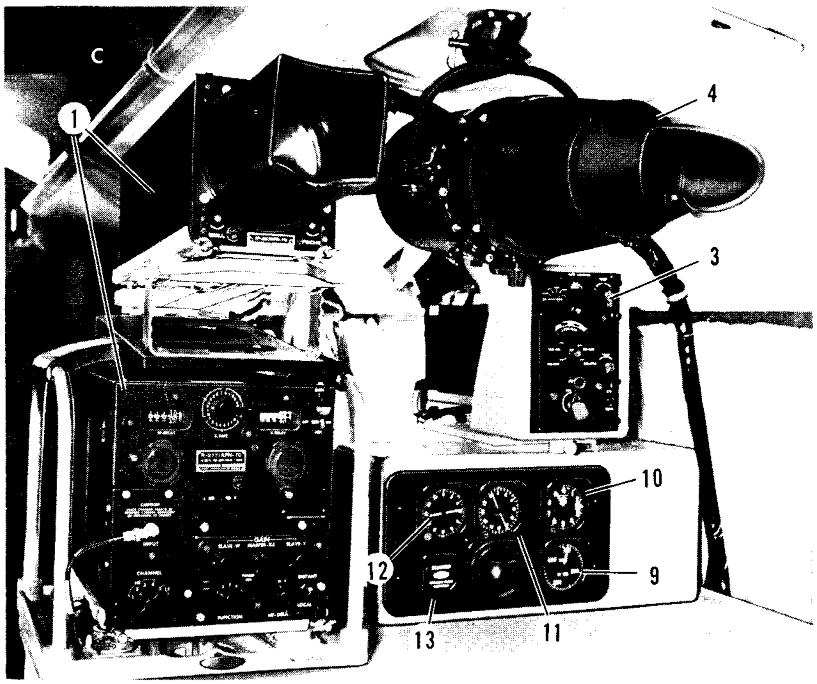
1. Radar Control Panel
2. Auxiliary Radar Scope
3. Free-Air Temperature Gage
4. Interphone Panel
5. Table Lights Switch and Rheostat
6. Interphone and Instrument Panel Lights Rheostat
7. True Airspeed Indicator
8. Altimeter
9. Radio Compass Indicator
10. Slaved Directional Indicator
11. Oxygen Flow Indicator
12. Pencil Sharpener

C-45287

Figure 4-24

COMBINED RADAR AND NAVIGATION TRAINING STATION (TYPICAL) A, B & C AIRPLANES





1. Loran Receiver Indicator
2. Radio Altimeter Panel (Opposite Side of Radio Compass Panel)
3. Radio Compass Panel
4. Auxiliary Radar Scope
5. Free-Air Temperature Gage
6. Interphone Panel
7. Interphone and Radio Compass Panel Lights Rheostat
8. Table Lights Switch and Rheostat
9. True Airspeed Indicator
10. Altimeter
11. Radio Compass Indicator
12. Slaved Gyro Magnetic Compass Indicator
13. Oxygen Flow Indicator
14. Auxiliary Radar Control Panel
15. Oxygen Regulator
16. Turntable Locking Handle

C-45288

Figure 4-25

dome red floodlight. It is protected by the dome lights — red circuit breaker. The rheostat on the pilot's dome light switch panel controls the fuel control panel light.

Hydraulic Reservoir Light

This light is located at the hydraulic reservoir sight gage. Its circuit is protected by the instrument panel lights — white circuit breaker On (A), (B), and (C) airplanes, the switch is mounted on the radio operator's table light control panel (6, figure 4-17). On (D) airplanes, the switch is mounted on the radio rack. The switch has ON and OFF positions.

Entrance Door and Stair Lights

Three lights illuminate entry to the airplane. One is located on the bottom step riser, and two are located on the entrance door so as to shine on the steps. The entry door light circuit breaker protects this circuit. These lights function automatically in relation to the open or closed position of the entrance door. Whenever the door is opened and the stair is down, the lights will be on. They will be out when the stair is folded and the door is closed.

Cabin Dome Lights (A) (B) (C)

Ten dome lights are mounted along the cabin ceiling. The cabin lights circuit breaker protects the circuit. All cabin dome lights except the two in the radar compartment are controlled by three breaker switches (figure 4-17) located above the radio circuit breaker panel. Each has ON and OFF positions. The two radar compartment dome lights are controlled by a single breaker switch located on the table lights control panel at the master radar station. This switch has ON and OFF positions.

Cabin Dome Lights (D)

Thirty dome lights, 20 white and 10 red, are mounted along the cabin ceiling. The cabin lights circuit breakers protect the circuits. The 18 forward dome lights are controlled by two switches located on the dome light switch panel and two switches on the radio rack panel. The aft dome lights are controlled by two switches on the dome light switch panel and two switches on the master bombardier station light control panel. The lights receive power from the main dc bus. When the alarm bell switch is turned on, the cabin dome lights are connected to the circuit and they will illuminate automatically.

Astrodome Lights (B) (C)

A small light is installed in the frame of each astrodome. The astrodome lights circuit breaker protects these lights. An astrodome light rheostat with OFF, DIM and BRIGHT positions, is mounted on the base of each of the astrodomes.

Lavatory Light

This light is mounted on the ceiling in the lavatory compartment. The cabin lights circuit breaker protects this circuit. The switch is mounted adjacent to the light and has ON and OFF positions.

Table Lights

On (A), (B), and (C) airplanes, each radar and navigation station and the radio operator's station is equipped with a wall light for individual station illumination. In addition, the navigation, radio operator's, and master radar stations have adjustable boom-type lights for spot lighting. The lights are protected by four students' lights circuit breakers. A single toggle switch at each table light control panel individually controls each table light. The switches at radar training stations 4, 5, and 6 have only ON and OFF positions, but at all other training stations, on all airplanes, the switches have three positions, FLEX ON — OFF — FIXED ON, for selection of either the wall light or the adjustable boom-type light. A rheostat is provided on each table light control panel for adjusting light intensity. On (D) airplanes a light is mounted on the bombardier's table. The intensity of this light is controlled by a rheostat at the light. This light is protected by a fuse from the 28-volt dc bus.

Interphone Panel Lights

All crew and student interphone panels are edge-lighted. On (A), (B), and (C) airplanes, the lights are protected by the four students' lights circuit breakers. On (D) airplanes, the lights are protected by two fuses. The interphone panel lights at all training stations and at the radio operator's station are individually controlled by rheostats mounted on each table light control panel. The flight mechanic's interphone panel light is controlled by a rheostat which is located on and directly below the interphone panel. The camera operator's interphone panel light is controlled by a rheostat mounted close to the interphone panel on the cabin aft bulkhead. The instructors' interphone panel light rheostats at those stations. On (D) airplanes, the autopilot, AN/APS-23, and the K-3A equipment racks are provided with utility lights. The intensity of each light is controlled by a rheostat which is an integral part of the light assembly. These are protected by a fuse from the main bus.

Students' Radio Compass Control Panel Lights (A) (B) (C)

These panels are edge-lighted. The circuits are protected by the four students' lights circuit breakers. The students' radio compass control panel lights are controlled by the same rheostat as the interphone panel lights at those stations.

Students' Instrument Panel Lights (C)

On late airplanes, individual instruments on the students' instrument panels are illuminated by red lights mounted over each instrument. The lights are dc powered and are controlled by the same rheostat that controls the interphone panel lights at each station.

Trailing Antenna Control Panel Light (A) (B) (C)

The trailing antenna reel control panel is edge-lighted. The circuit is protected by the left hand forward students' light breaker switch. The rheostat controlling the radio operator's interphone panel light is also used for the trailing antenna control panel light.

Radar Rack Utility Light Ⓐ Ⓑ Ⓒ
This focusing light is mounted on the forward, outboard side of the radar rack. The left-hand aft students' lights breaker switch protects this circuit. The aft part of this light is a rheostat which, when turned, controls illumination.

Master Radar Station Ultraviolet Light Ⓐ Ⓑ Ⓒ
This fluorescent, focusing light is mounted on the forward, inboard side of the radar rack. It is attached to a bracket mounted just below the ceiling, which projects the lamp through the radar compartment curtain into the radar compartment. The left-hand aft students' lights breaker switch protects this circuit. The aft part of this light is a rheostat which, when turned, controls illumination.

Bomb Sight Well Light Ⓓ
A bomb sight well light is provided at the master bombardier's station. The light is used for making sight adjustments. The light switch has ON and OFF positions. The circuit is protected by a fuse from the nonessential 28-volt dc bus.

Spare Lamp Bulbs
Stowage for 18 spare lamp bulbs is provided in the copilot's console (15, figure 1-6).

OXYGEN SYSTEM

A gaseous, demand type oxygen system is supplied by two type J-1 oxygen cylinders on Ⓐ airplanes and by one type G-1 oxygen cylinder on Ⓑ, Ⓒ, and Ⓓ airplanes. On Ⓐ and Ⓓ airplanes the cylinders are located in the aft section of the cabin. On Ⓑ and Ⓒ airplanes, the cylinders are located below the cabin floor just forward of the last three student tables.

Note

> On some Ⓑ, Ⓒ, and Ⓓ airplanes, there may be additional, inactive oxygen bottles installed in the aft cabin or below the cabin floor. TCTO 1T-29-601 required the deactivation of cabin regulators and all but one main oxygen system bottle on Ⓑ, Ⓒ, and Ⓓ airplanes. On some airplanes the inactive bottles have been removed; on others they have not.

The oxygen system may be filled at a filler valve accessible through a hinged door (figure 1-42) on the left side of the fuselage aft of the wing trailing edge. The system requires the use of a demand type oxygen mask. On Ⓐ airplanes, the system provides outlets for the pilot, copilot, flight engineer, radio operator, and 14 training stations. On Ⓑ and Ⓒ airplanes, outlets are provided for the pilot, copilot, flight engineer, and one station in the aft cabin. On Ⓓ airplanes, outlets are provided for the pilot, copilot, and flight engineer. On all airplanes, the system is fully charged when the pilot's oxygen pressure gage indicates 400 to 450 psi. For oxygen duration, see figure 4-26.

PRESSURE GAGES
On Ⓐ airplanes, an oxygen pressure gage is installed at each crew, instructor, and student station. On Ⓑ, Ⓒ, and Ⓓ airplanes, an oxygen pressure gage is provided for the pilot and copilot.

REGULATORS
On Ⓐ airplanes, a diluter-demand oxygen regulator is installed at each crew, instructor, student, astrodome, and camera operator station. On Ⓑ and Ⓒ airplanes, a diluter-demand oxygen regulator is installed for the pilot, copilot, and flight engineer and an additional regulator is installed on the cabin rear bulkhead. On Ⓓ airplanes, a diluter-demand regulator is installed for the pilot, copilot, and flight engineer. The pilot's and copilot's regulators (18, figure 1-6) are located under their respective consoles. The flight engineer's regulator is on his oxygen panel. On Ⓐ airplanes, the regulators for the training stations are located under the table tops or adjacent to the station. The astrodome regulators are on panels under the table tops at training stations 6, 8, 10, and 12. Each regulator automatically supplies the required mixture of air and oxygen at all altitudes.

Regulator Diluter Lever
A diluter lever is provided on each regulator. The lever has two positions: NORMAL OXYGEN and 100% OXYGEN. With the lever in the NORMAL OXYGEN position, the regulator automatically supplies the proper mixture of air and oxygen to the mask at all altitudes. With the lever in the 100% OXYGEN position, the regulator supplies 100% oxygen to the mask for emergency use.

Regulator Emergency Knob
A red emergency knob is provided on each regulator, and is safety-wired OFF in the full clockwise position. This knob controls the regulator emergency valve which when opened, provides a continuous stream of 100% oxygen to the mask. The valve is opened by breaking the safety wire and turning the knob counterclockwise as indicated by an arrow marked on the knob. This knob is used only when the regulator is inoperative.

FLOW INDICATORS
Separate oxygen flow indicators are provided for each regulator. The pilot's and copilot's indicators are located on their respective consoles. The flight engineer's indicator is on his oxygen panel. On Ⓐ airplanes, the students' indicators are mounted on their instrument panels; and the radio operator's indicator is mounted on the wall of the cabin, next to the window at that station. The indicators are fitted with an eye-shaped shutter which "winks" with each breath if oxygen is being delivered by the regulator.

PORTABLE OXYGEN UNITS
On Ⓐ airplanes, seven demand-type portable oxygen units are provided. Two units are installed in the flight compartment directly behind the pilot's seat and the other five units are located under the tables at stations No. 5, 6, 10, 14, and 17. On Ⓑ

OXYGEN DURATION CHARTS

A AIRPLANES

GAGE PRESSURE PSI

ALTITUDE-FEET	400 HR	400 MIN	350 HR	350 MIN	300 HR	300 MIN	250 HR	250 MIN	200 HR	200 MIN	150 HR	150 MIN	100 HR	100 MIN	BELOW 100
20,000	2	30	2	12	1	48	1	24	1	6	0	42	0	18	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
	4	12	3	36	3	0	2	24	1	42	1	12	0	36	
15,000	2	0	1	42	1	24	1	6	0	48	0	30	0	12	
	5	6	4	18	3	36	2	54	2	12	1	24	0	42	
10,000	1	48	1	30	1	12	1	0	0	42	0	24	0	12	
	6	48	5	48	4	54	3	54	3	0	2	0	1	0	

CREW AND STUDENTS: 19
BOTTLES: 2 TYPE J-1

B & C AIRPLANES

GAGE PRESSURE PSI

ALTITUDE-FEET	400 HR	400 MIN	350 HR	350 MIN	300 HR	300 MIN	250 HR	250 MIN	200 HR	200 MIN	150 HR	150 MIN	100 HR	100 MIN	BELOW 100
20,000	0	38	0	30	0	26	0	24	0	15	0	11	0	6	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
	1	6	0	59	0	49	0	38	0	29	0	19	0	9	
15,000	0	30	0	24	0	22	0	16	0	11	0	8	0	5	
	1	20	1	10	1	0	0	46	0	36	0	29	0	11	
10,000	0	26	0	20	0	18	0	15	0	9	0	7	0	4	
	1	47	1	35	1	19	1	1	0	47	0	30	0	16	

CREW: 4
BOTTLES: 1 TYPE G-1

D AIRPLANES

GAGE PRESSURE PSI

ALTITUDE-FEET	400 HR	400 MIN	350 HR	350 MIN	300 HR	300 MIN	250 HR	250 MIN	200 HR	200 MIN	150 HR	150 MIN	100 HR	100 MIN	BELOW 100
20,000	0	51	0	40	0	35	0	29	0	20	0	15	0	8	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
	1	28	1	19	1	5	0	51	0	39	0	26	0	12	
15,000	0	40	0	32	0	29	0	22	0	15	0	11	0	7	
	1	47	1	34	1	20	1	2	0	48	0	39	0	15	
10,000	0	34	0	27	0	24	0	20	0	13	0	10	0	5	
	2	23	2	6	1	45	1	21	1	2	0	40	0	21	

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

CREW: 3
BOTTLES: 1 TYPE G-1

C-45289

Figure 4-26

and Ⓒ airplanes, three portable oxygen units are provided. Stowage space is provided in the flight compartment directly behind the pilot's seat, and under the table tops at stations 6, 10, 13, 14, 17, 18. On Ⓓ airplanes, four demand type portable oxygen units are provided. Stowage space is provided in the flight compartment directly behind the pilot's seat, under the table at station 5, and at the master bombardier station. On all airplanes, stowage space is also provided at the extreme end of the cabin in the lavatory. The portable oxygen units should be connected to recharger valves in the airplane while the oxygen system is being recharged.

Note

100% oxygen can be obtained from the portable oxygen unit by placing the hand over the diluter valve. However, this will not increase the rate of flow of oxygen. It will merely restrict air from mixing with the oxygen.

PORTABLE OXYGEN UNIT RECHARGERS

On Ⓐ airplanes, nine portable oxygen unit rechargers are provided as follows: one each at stations No. 5, 6, 8, 11, 12, 15 and 16; and one on the cabin rear bulkhead next to the lavatory. On Ⓑ and Ⓒ airplanes, five portable oxygen unit rechargers are provided as follows: one in the flight compartment; one each at student positions 6, 12, 16; and one at the lavatory portable oxygen unit stowage location. On Ⓓ airplanes, four portable oxygen unit rechargers are provided as follows: one aft of the flight compartment, one each at student positions 5 and 10, and one at the lavatory portable oxygen unit stowage location.

NORMAL OPERATION OF OXYGEN SYSTEM

Set the regulator diluter lever at the NORMAL OXYGEN position. The regulator emergency knob should remain safety-wired in the full clockwise position. When using a portable oxygen unit, recharge the unit before its pressure falls below 50 psi.

Note

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

EMERGENCY OPERATION OF OXYGEN SYSTEM

With the symptoms of the onset of hypoxia or if smoke or fuel fumes should enter the cabin, set the regulator diluter lever to the 100% OXYGEN position. If the oxygen regulator becomes inoperative, open the emergency valve by turning the red emergency knob counterclockwise.

WARNING

When use of the 100% OXYGEN position of the regulator diluter lever or use of the emergency knob becomes necessary, the pilot will be informed of this action. Use of this equipment in this manner rapidly reduces the oxygen supply duration. After the emergency, return the controls to their normal positions and notify the pilot.

AUTOMATIC PILOT

The airplane is equipped with an all-electric, Type E-4 automatic pilot system. The system is powered by 28-volt dc power and 115-volt regulated ac power. Normal control of the system is exercised from the autopilot controller unit located on the pilot's pedestal. Turn control can be transferred to the master radar control station, in the cabin, which is equipped with remote controls for manual or automatic (radar) steering. The remote steering controls are used with bomb scoring function of the radar set for training purposes. Automatic approach equipment is coupled with the autopilot system (refer to AUTOMATIC APPROACH EQUIPMENT, this Section). Release and interlock circuits operate automatically to prevent or stop operation of the system under conditions that are unfavorable. The autopilot system is energized and maintains constant synchronization with changing flight altitudes whenever the airplane's dc and ac systems are operating. The function of the "Pilot On-Off" switch is to control power to the autopilot control circuits and units. The engaging levers provide mechanical connection of the aileron, elevator, and rudder controls with the autopilot system.

AUTOMATIC PILOT CONTROLS

Autopilot Filament Circuit Breaker Switch Ⓓ

A switch-type circuit breaker with FILAMENT and OFF positions is located on the auxiliary circuit breaker panel behind the pilot. When the switch is in the FILAMENT position, dc power from the non-essential bus is supplied to the spare inverter and to the autopilot filaments, if the inverter selector switch is on MAIN. Should the inverter selector switch be placed in the SPARE position, the autopilot, C-1 amplifier, and on some airplanes, the driftmeter and N-1 compass system are automatically disconnected as the spare inverter then supplies ac power for the flight and engine instruments (see figure 1-25).

Power (Pilot) Switch

This on-off switch (22, figure 1-11), when placed in the ON position, applies power to the autopilot control circuits and units. The power switch cannot be moved to the ON position under any of the following conditions:

1. Autopilot circuit breakers are tripped.

2. Regulated ac power supply is less than 90 volts.

3. Power has been supplied for less than two minutes.

4. Either release button (on control wheels) is depressed.

5. Turn knob is not in its detent.

6. Engage and release levers are in ON position.

7. Automatic approach selector switch is not in AUTOMATIC PILOT position.

The power switch will return to the OFF position under the following conditions:

1. Regulated ac power drops to 75 volts.

2. Either release button (on control wheels) is depressed.

3. Autopilot controls are improperly operated.

Note

If the power switch trips to the OFF position for one of the reasons given above, it can not be reset in the ON position if any of the conditions previously listed exists.

Engage and Release Levers

Three levers (figure 4-27), on the quadrant section of the pedestal, are provided for engaging and releasing the aileron, elevator, and rudder control units of the autopilot system. The levers are individually placarded "A," "E," and "R." The positions on the quadrant are ON (aft) and OFF (forward). The levers can be positioned together or individually.

Release Buttons

An autopilot release button (29, figure 1-6) is mounted in the outboard tip of each control wheel. The release buttons are provided so that either pilot can instantly release the autopilot and take over manual control of the airplane, without moving his hands from the control wheel. When either release button is depressed, the primary power circuit to the pedestal controller units is broken and the power switch returns to the OFF position.

Note

Although the release buttons will electrically disengage the autopilot instantly, the manual engage and release levers should be moved to OFF as soon as possible to prevent binding of the elevator trim servo system.

Turn and Trim Knobs

A turn knob (4, figure 1-11), on top of the controller unit, is provided with a detent at its centered position for flight at a constant heading. Rotating the knob to the left or right of its center position results in a coordinated, banked turn in the desired direction. Pitch trim knobs (7 and 24, figure 1-11) are mounted on each side of the controller. Placards on the controller unit, marked "Glide" and "Climb," indicate the direction that the pitch trim knobs should be turned to obtain climb or descent. An aileron trim knob (6, figure 1-11), on the aft face of the controller unit, is normally used to align the trim indicator for wings-level flight after autopilot engagement. Banked turns are usually accomplished with the turn knob.

Altitude Control Switch

The altitude control switch (8, figure 1-11 and figure 4-27) on the aft face of the controller unit, automatically maintains the airplane at the pressure altitude at which it is flying at the moment the switch is turned ON.

CAUTION

The copilot's selector valve, on the flight instrument panel, should not be moved while the altitude control switch is on. Changing the static selector valve setting while the altitude control switch is on will cause the airplane to change attitude very suddenly.

Turn Control Transfer Switch

This switch (figure 4-28), on the bulkhead behind the pilot, has positions PILOT and BOMBARDIER. In the PILOT position, autopilot turn control is limited to the turn knob on the pedestal controller unit. In the BOMBARDIER position, autopilot turn control can be exercised by the remote steering controls on the master radar control station table on Ⓐ, Ⓑ, and Ⓒ airplanes, or on the master bombardier table on Ⓓ airplanes, and an autopilot-to-bombardier indicator light will illuminate at these stations. Autopilot turn control can be returned to the pedestal controller unit by moving the turn control transfer switch to the PILOT position or by moving the turn knob on the pedestal controller unit.

Note

Turn control can be transferred from the pilot to the bombardier only if the following conditions exist: The autopilot is ON, the aileron and rudder engaging levers are in the ON position, both the pilot's and the bombardier's turn control knobs are in detent, and the bombardier's turn control selector switch is in the MANUAL position.

Bombardier's Turn Control Selector Switch

This switch (13, figure 4-21) is located in a cut-out in the top of the master radar operator's table on Ⓐ, Ⓑ, and Ⓒ airplanes, or on the master bombardier's table on Ⓓ airplanes, and has positions AUTOMATIC and MANUAL. When the autopilot-to-bombardier indicator light at these stations is illuminated, the steering function of the autopilot can be controlled through this selector switch. In the AUTOMATIC position, the radar set

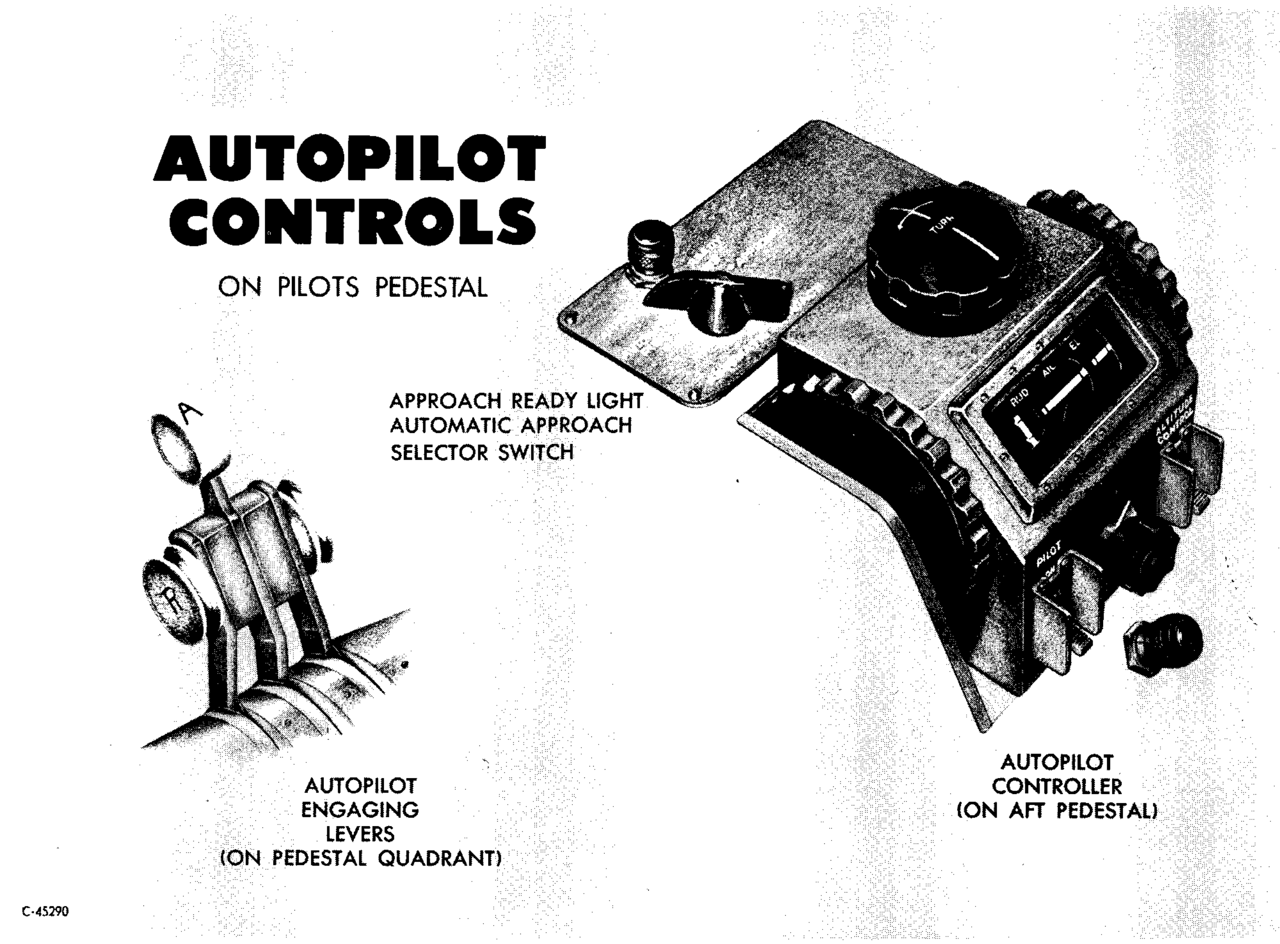


Figure 4-27

automatically steers the airplane on course. In the MANUAL position, the operator controls the autopilot steering by means of the bombardier's turn knob. If the bombardier's turn control selector switch is in AUTOMATIC position, moving the bombardier's turn knob will trip the selector switch to the MANUAL position, where it will remain unless reset to AUTOMATIC. The selector switch can not be moved out of the MANUAL position if the bombardier's turn knob is not in its centered, detent position.

CAUTION

To prevent an abrupt turn, the airplane should be steered to within 5° of the bomb release heading before the turn control selector switch is moved from MANUAL to AUTOMATIC.

Bombardier's Turn Knob

On Ⓐ, Ⓑ, and Ⓒ airplanes, the bombardier's turn knob (13, figure 4-21) is located on the master radar station table. On Ⓓ airplanes, the bombardier's turn knob (21, figure 4-20) is located on the master bombardier station table. The bombardier's turn knob is operated in the same manner as the pilots' turn knob to obtain banked turns while on autopilot control. This knob is effective only when the turn control transfer switch, in the cockpit, is in the BOMBARDIER position.

Compass Slaving Switch

The compass slaving switch (figure 4-28), on the bulkhead behind the pilot's seat, has positions IN and OUT. Normally, the switch is left in the IN position. When placed in the OUT position, the autopilot directional (horizontal) gyro is deslaved from the autopilot compass transmitter in the right wing and is free to precess. The autopilot maintains control of the airplane but is unaffected by the earth's magnetic field. On early airplanes, the slaving switch is inoperative when the autopilot power is OFF, so the directional gyro can not be cut off from the compass transmitter except during autopilot operation. On later airplanes, the slaving switch is operative with the autopilot power switch either ON or OUT. When the compass slaving switch is in OUT, the autopilot compass indicator (8, figure 1-9) may be used as a directional gyro. The compass slaving switch is provided primarily

AUTOPILOT TURN CONTROL TRANSFER SWITCH & COMPASS SLAVING SWITCH

ON BULKHEAD BEHIND PILOT'S SEAT

C-45291

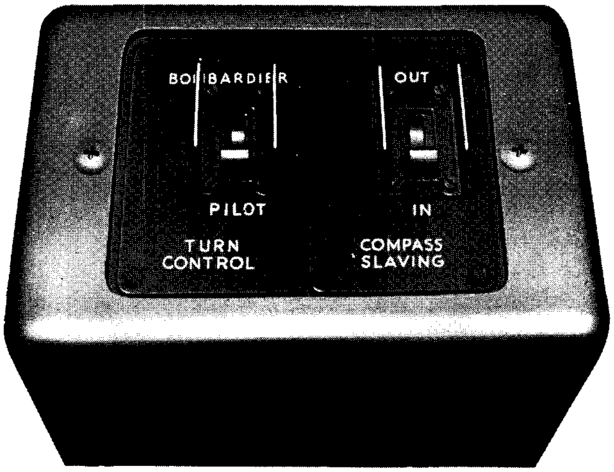


Figure 4-28

to disconnect the autopilot compass transmitter in polar regions, where reliance on the earth's magnetic field for directional guidance is inadvisable. The compass slaving switch is not operative on aircraft modified with the N-1 compass system (TCTO 1T-29-587).

Note

The slaved gyro compass system should not be used in latitudes above 78°N or 69°S, where magnetic inclination exceeds 84°. The system is not dependable in areas bounded by the following points of position: (Northern Hemisphere) 78°N, 70°E; 72°N, 70°E; 72°N, 140°W; 58°N, 90°W; (Southern Hemisphere) 69°S, 115°E; 60°S, 170°E; 69°S, 170°E.

CAUTION

The compass slaving switch must not be cycled more than once in any ten-minute period to prevent possible damage to the gyro as the result of repeated fast erection cycles.

Pilot's V-2 Indicator Selector Switch and Indicator Light B C

A selector switch and indicator light (44, figure 1-6) on the pilot's console permits the pilot to use his slaved heading indicator (8, figure 1-9) with the E-4 (autopilot) slaved gyro magnetic compass system or the J-2 (radar) compass system. The switch has positions ON E-4 and ON J-2. When used with the autopilot system, the pilot's indicator shows magnetic heading as sensed by the compass transmitter (flux valve) in the right wing tip. The compass transmitter for the radar system is located in the left wing tip. The switch is normally used in the ON E-4 position and the indicator is slaved to the autopilot gyro compass transmitter as long as the compass slaving switch is in the IN position. When the switch is in the ON J-2 position, the indicator is slaved to the radar gyro compass transmitter as long as the J-2 compass slaving cut-off switch (12, figure 4-21) at the master radar station is in the SLAVED position. A red indicator light adjacent to the pilot's V-2 selector switch indicates when the radar operator has cut off the radar compass system transmitter.

Note

The E-4 position on the pilot's V-2 indicator selector switch selects N-1 compass heading information to the pilot's slaved heading indicator on those aircraft modified with the N-1 compass system.

AUTOMATIC PILOT INDICATORS

Trim Indicators

A trim indicator unit (5, figure 1-11 and figure 4-27) on the pedestal controller provides visual indication of the airplane trim when the autopilot is on and engaged. The unit consists of three independent voltmeters. The pointer on the "Rud" meter moves horizontally. The pointer on the "Ail" meter rotates about a center pivot. The "El" pointer moves vertically. Before engaging the autopilot, the pointers should be centered, indicating the alignment of the signal system. After engagement, the pointers deviate only when the autopilot is carrying a signal. If a signal is being produced constantly on any axis, the corresponding pointer will show the magnitude of the aerodynamic out-of-trim condition.

Autopilot Off Indicator Light

An amber indicator light (10, figure 1-11), placarded "Autopilot Off," is located on the pedestal below the controller unit. The light operates as a warning when the power supply to the autopilot system is interrupted and the engaging levers are still in the ON position.

Autopilot-to-Bombardier Indicator Light

This green indicator light (9, figure 4-21), on the master radar control station panel on A, B, and C airplanes, or (31, figure 4-20) on the master bombardier station panel on D airplanes, illuminates when the turn control transfer switch (in the cockpit) is moved to the BOMBARDIER position, and goes off when turn control is returned to the controller unit on the pedestal. Illumination of the light indicates that autopilot steering is under control of the bombardier's turn control knob.

NORMAL OPERATION OF AUTOMATIC PILOT

On Entering the Airplane

1. Power switch — OFF.

2. Engaging levers — OFF.
3. Flight controls — Check for freedom of movement.
4. Approach selector switch — AUTOMATIC PILOT.

During Flight

The autopilot can be engaged with complete safety during straight and level flight, normal climb, or normal descent. It should not be engaged when the airplane is turning. If the autopilot is engaged during climb or descent, the airplane will continue to fly in that attitude until the pitch control knobs are moved to change attitude. If a condition unfavorable to operation of the autopilot occurs, or if the controls are improperly operated, automatic release and interlock circuits cut the power supply to the system and the autopilot cannot again be operated until the proper conditions exist.

Engaging Procedure

Engage the autopilot as follows:

1. DC voltmeter and selector switch — Check for 28 volts on BUS position.
2. AC voltmeter and selector switch — Check for 115 volts on INV position.
3. Trim airplane manually for hands-off flight.

CAUTION

If autopilot is turned on without trimming airplane for hands-off flight, unnecessary strains are imposed on the system.

4. Turn control transfer switch — PILOT.
5. Turn knob — Detent.
6. Automatic approach selector switch — AUTOMATIC PILOT.
7. Power switch — ON.
8. Engage levers — ON.
9. Aileron knob and pitch knob — Adjust so that trim indicators are aligned.
10. Settable dial azimuth indicator — Set to course.
11. Altitude control switch — On at desired altitude.

CAUTION

- If altitude control switch is turned ON during climb or descent, airplane will immediately level out and hold altitude at which switch was turned ON. When altitude control switch is turned OFF, airplane will immediately resume flight attitude held when the switch was turned ON.
- Do not move the copilot's static selector valve while altitude control switch is ON or airplane will change attitude very suddently.

Straight and Level Flight

Once the autopilot is turned on and the airplane is on the desired heading and in the desired attitude, the autopilot will maintain that same heading and attitude indefinitely, correcting for deviations. Minor pitch axis attitude changes, resulting from movement of personnel, are automatically corrected by a servo that operates the elevator trim within the range between 15° nose-up and 15° nose-down from neutral setting. On long flights over water or over terrain of known altitude, the most economical fuel consumption will be achieved when the autopilot is operated in the "attitude" (altitude switch OFF) condition, during which the airplane is maintained in a level flight attitude while the altitude varies with thermal conditions. In mountainous regions or in areas where ground altitude variations have not been accurately determined, the "altitude" (altitude switch ON) condition is desirable. The autopilot will be changing airplane pitch constantly to compensate for loss or gain of altitude due to thermal conditions. Under these circumstances, control of the airplane's power setting will have to be exercised to maintain airspeed at the level desired for all attitudes encountered. The "altitude" (altitude switch ON) condition should not be used when icing is encountered. The added weight of ice on the wings causes a reduction in airspeed and a loss of altitude. An attempt by the autopilot to hold altitude if the altitude switch is ON increases up-elevator force, thereby further reducing the airspeed, increasing the tendency of ice to accumulate on the unheated surfaces of the wing and tail, and increasing the danger of a stall. The altitude switch should also be OFF when the airplane is flying through turbulent air.

Maneuvering Flight

Climb and descent are effected by rotating the pitch knobs on the pedestal controller. The change in attitude will be proportional to the amount of pitch knob rotation, and the airplane will remain in the new attitude as long as the pitch knobs are displaced. Coordinated turns are effected by rotating the turn knob on the pedestal controller. The resultant rate of turn will be proportional to the amount of turn knob deflection. The airplane will continue turning as long as the turn knob is displaced. Climbing turns or descending turns can be obtained by coordinated use of the pitch knobs and the turn knob. Aileron trim can be altered by rotating the aileron trim knob on the controller. When the altitude control switch is ON, the pitch trim knobs are ineffectual.

Transferring Turn Control

Transferring turn control from pilot to bombardier:

1. Power switch — ON.
2. Mechanical engaging levers — ON.
3. Pedestal controller turn knob — Detent.
4. Bombardier's turn knob — Detent.
5. Bombardier's turn control selector switch — MANUAL.
6. Turn control transfer switch — BOMBARDIER.

Note

Turn control transfer switch can not be moved to BOMBARDIER position until steps 1 through 5 are accomplished.

Returning turn control to pilot:

1. Turn control transfer switch — PILOT; Or
2. Pedestal controller turn knob — Rotate to angle of bank desired.

Bombardier Operation

Operating turn control from master radar control station:

1. Autopilot-to-bombardier light — ON.
2. Turn knob — Detent.
3. Turn control selector switch — MANUAL or AUTOMATIC.
4. Turn knob — On MANUAL, rotate to angle of bank desired.

Note

Moving turn knob out of detent while selector switch is in AUTOMATIC will cause selector switch to return to and lock in, MANUAL.

Releasing Procedure

There are three ways of turning off the autopilot. For temporary release, move engaging levers to OFF (forward), leaving power switch ON. For permanent release, move engaging levers to OFF and turn power switch OFF. For instantaneous release, press release button in either control wheel; power switch will automatically move to OFF, and engaging levers can be moved to OFF later.

Note

When the release button on the control wheel is used, the engaging levers must be disengaged as soon as possible thereafter to prevent the elevator servo from binding the elevator trim.

AUTOPILOT OPERATING LIMITATIONS

Bank	40°
Climb or descent	10°
Aileron trim	7.5° bank in either direction
Elevator trim (automatic)	15° nose-down 15° nose-up

EMERGENCY OPERATION OF AUTOMATIC PILOT

Engine Failure

If an engine fails while flying on autopilot, the autopilot will hold the airplane substantially to the same course. In such an event, the rudder should be retrimmed manually to zero the rudder meter on the trim indicator unit. By doing this, the pilot will be assured of correct trim when again taking over manual control.

AUTOMATIC APPROACH EQUIPMENT

An automatic approach control unit, powered by direct current, modifies and amplifies signals received from the omnirange (localizer) and glide-slope receivers of the instrument landing system. These signals are then applied to the autopilot to guide the airplane automatically down the intersection of the localizer and glide-slope. The automatic approach equipment is flexible with regard to the geometry of the approach pattern. Altitude, distance from runway, and the angle of interception may be varied to meet specific conditions of weather, terrain and traffic.

AUTOMATIC APPROACH SELECTOR SWITCH

This switch (2, figure 1-11 and figure 4-27) is located on the pilots' pedestal forward and to the left of the autopilot controller unit. The switch has positions AUTOMATIC PILOT, LOCALIZER and APPROACH. The switch is left in the AUTOMATIC PILOT position at all times except during automatic approach. The LOCALIZER position is used in the approach to and alignment with the localizer beam up to the point where the center of the glide-slope beam is intercepted. With the switch in the LOCALIZER position, turns are controlled by the localizer signals. The APPROACH position is used to hold the airplane in the approach glide during the final letdown along the glide-slope. When the switch is in the APPROACH position, the pitch attitude of the airplane is controlled by the glide-slope signals, and turns are controlled by the localizer signals.

WARNING

Glide slope and localizer indications must be monitored and the pilot prepared to assume manual control if the autopilot is not performing a satisfactory approach.

Note

The autopilot system can be operated by either the pedestal controller unit or the automatic approach unit, but can not be operated by both units at once. Moving the automatic approach selector switch out of AUTOMATIC PILOT position while operating the pedestal controller knobs, or moving a pedestal controller knob while the automatic approach selector switch is in LOCALIZER or APPROACH positions, will automatically turn the autopilot off and trip the power switch to OFF position. If the altitude switch is in the ON position, it will move to OFF automatically when the automatic approach selector is turned to APPROACH.

APPROACH READY LIGHT

A green indicator light (1, figure 1-11) is located on the pedestal just forward of the automatic approach selector switch. When the automatic pilot power switch is ON and the VHF-NAV (omni) radio is tuned to a localizer frequency, this light illuminates to indicate that the automatic approach unit is receiving power. It should remain lighted at all times during an automatic approach. If the light goes out during an automatic approach, it is an indication that power to the equipment has been interruped and the power switch has tripped to the OFF position.

NORMAL OPERATION OF AUTOMATIC APPROACH EQUIPMENT

Refer to INSTRUMENT APPROACHES, Section IX.

AUTOMATIC APPROACH EQUIPMENT OPERATING LIMITATIONS

With automatic approach selector switch on LOCALIZER:

Bank	25°

With automatic approach selector switch on APPROACH:

Bank	10°
Climb or descent	5°

EMERGENCY OPERATION OF AUTOMATIC APPROACH EQUIPMENT

There are no provisions for emergency operation of the automatic approach equipment.

NAVIGATION EQUIPMENT

With the exception of driftmeters, astrocompasses, students' true airspeed indicators and portable battery power source for sextants, the navigation equipment in these airplanes is of the electronic type. Refer to COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT, this Section.

DRIFTMETERS

On Ⓐ airplanes, five type B-3 driftmeters are installed in the cabin, one each at training stations No. 5, 13, 14, 16, and 18. On Ⓑ and early Ⓒ airplanes, four type B-3 driftmeters are installed in the cabin, one each at training stations No. 13, 14, 16, and 18. On late Ⓒ airplanes four type B-6A driftmeters are installed. On Ⓓ airplanes, one B-6A driftmeter is installed in the cabin at training station 5. On Ⓐ, Ⓑ, early Ⓒ, and all Ⓓ airplanes, the driftmeters are powered by 115-volt regulated alternating current. On late Ⓒ airplanes, the driftmeters are powered by a driftmeter inverter. The driftmeter inverter is controlled by a switch (7, figure 4-19), located on the control panel at navigation training station 13.

Operation of the Driftmeter Inverter Ⓒ

1. Driftmeter inverter switch — ON.
2. Amber inverter operating light — ON.

Note

- The driftmeter inverter is to be turned ON only during operation of the driftmeters.
- Failure of ac power from the inverter will illuminate the red inverter failure light.

ASTROCOMPASS Ⓐ Ⓑ Ⓒ

Astrocompasses are installed in the hat rack along the right side of the airplane, convenient to the astrodomes that are equipped with astrocompass mounts.

STUDENTS' TRUE AIRSPEED INDICATORS

On Ⓐ, Ⓑ, and Ⓒ airplanes, true airspeed indicators are installed at the 14 student stations. On Ⓓ airplanes, indicated airspeed or true airspeed indicators are installed at student stations 4 and 5. Stations 6 and 7 have true airspeed repeaters from the bomb-navigation system. The true airspeed indicator incorporates a mechanism that compensates for existing conditions of temperature and altitude, and indicates directly the true airspeed of the airplane. On Ⓐ, Ⓑ, and early Ⓒ airplanes, compensation for temperature originates in individual outside air temperature bulbs connected to each instrument. Altitude corrections are made by standard static source mechanisms. On late Ⓒ and all Ⓓ airplanes, indicators are slaved electronically to a master unit which transmits precompensated information so that all stations indicate identical airspeed readings.

PHOTOGRAPHIC EQUIPMENT Ⓐ Ⓑ Ⓒ

Provisions are incorporated at the camera station (9, figure 4-18) for installing a Type K-17 camera and associated equipment for bomb scoring use with the radar set. Refer to RADAR SET AN/APQ-24T-1, this Section for camera operating instructions.

AERIAL CAMERA Ⓓ

On late airplanes, a K-17 aerial camera is mounted in a floor well aft of the master bombardier station. The camera may be operated for single-shot photographs or for series photographs as desired. A stool is provided at the camera for use when loading film or making leveling adjustments. Folding doors are provided in the bottom of the fuselage directly below the camera and are opened to expose the camera for operation. Operating controls are remotely located at the master bombardier station. Electrical power is supplied from the nonessential 28-volt dc bus at the master bombardier station.

Camera Control Intervalometer Ⓓ

A type B-9A camera intervalometer is located at the master bombardier station. This control provides an electrical impulse, at preselected intervals, to the K-17 camera for taking series photographs. The intervalometer control knob has an OFF position and is marked in second graduations from 0 to 60. Non-essential 28-volt dc power is supplied to the unit through the K-17 camera control panel.

Operation of Aerial Camera (D)

To operate the aerial camera equipment:

1. Camera master power switch — ON.
2. Camera door switch — OPEN.
3. Camera door indicator light — ON.
4. Select desired operation (single or series photographs) with shutter operation switch.

Note

If series photographs are desired, set the intervalometer control knob to the desired interval before selecting CYCLE with shutter operation switch.

To turn off aerial camera equipment:

1. Intervalometer control knob — OFF.
2. Camera door switch — CLOSE.
3. Camera door indicator light — OFF.
4. Camera master power switch — OFF.

MISCELLANEOUS EQUIPMENT

WINDSHIELD WIPERS

A hydraulically operated windshield wiper is installed below each main windshield panel. Hydraulic pressure for operation of the wipers is obtained, through a control valve, from the hydraulic power supply system. The valve is operated mechanically by the windshield wiper knob.

Windshield Wiper Knob

The windshield wiper knob (figure 1-6), just below the pilot's side windshield, is used to start, stop, and control the speed of the windshield wipers. The knob is marked ON and OFF with arrows to indicate direction of rotation.

Normal Operation of Windshield Wipers

1. Hydraulic pressure bypass handle — PRESS. (DWN)
2. Windshield wiper knob — ON, as required.

Emergency Operation of Windshield Wipers

There are no emergency provisions for operating the windshield wipers.

TABLES

Tables (figure 4-18) for navigation and radar students and instructors are installed in the cabin. Each table is equipped with an instrument panel and training instruments. Cross-tubes between the legs of each table serve as supports for the navigators' portable platforms.

FLIGHT ENGINEER'S SEAT

The flight engineer's seat (31, figure 1-6) is mounted on rails in a rack below the parachute stowage racks behind the copilot's seat. When the seat is to be used, it is pulled out across the passageway until two pins in the left edge of the seat engage two latches in the radio rack. The seat is stowed by pulling up on a latch wire on the radio rack and pushing the seat into its stowage rack below the parachutes. A safety belt is attached to the seat.

CABIN SEATS

Each station in the cabin is equipped with a fixed upholstered seat that is adjustable in height and that rotates through 360°. A spring-loaded latch locks the seat at 90° intervals of rotation. The latch is released by pulling out on a knob mounted below the right side of the seat. On (D) airplanes, Station 9 is equipped with a fixed, upholstered seat that is adjustable in height and fore-and-aft position but does not rotate. Stations 10 and 11 are equipped with upholstered seats which are adjustable in height, slide fore-and-aft on tracks, and rotate 90° to either side. A jump seat, which folds up against the cabin wall when not in use, is provided at each map checking window on most airplanes. The jump seats are not designed for occupancy during takeoff or landing.

SAFETY BELTS

A safety belt is attached to each seat (except the camera operator's seat on some airplanes).

FOLDING CHAIRS

On late (C) airplanes, two portable folding chairs are provided for the navigator instructor or a student observer and may be moved to all training stations within the airplane. Floor hold-down and safety belt provisions are not provided. The chairs are folded and stowed at the table in the forward cabin.

REAR SERVICE DOOR SAFETY STRAP

A safety strap (figure 3-5) is installed across the rear service doorway. The strap is provided to prevent personnel from falling through the doorway when the door has been jettisoned and to make it necessary to bail out in a head-down position.

SAFETY HARNESS AND ATTACHMENT FITTINGS (B) (C)

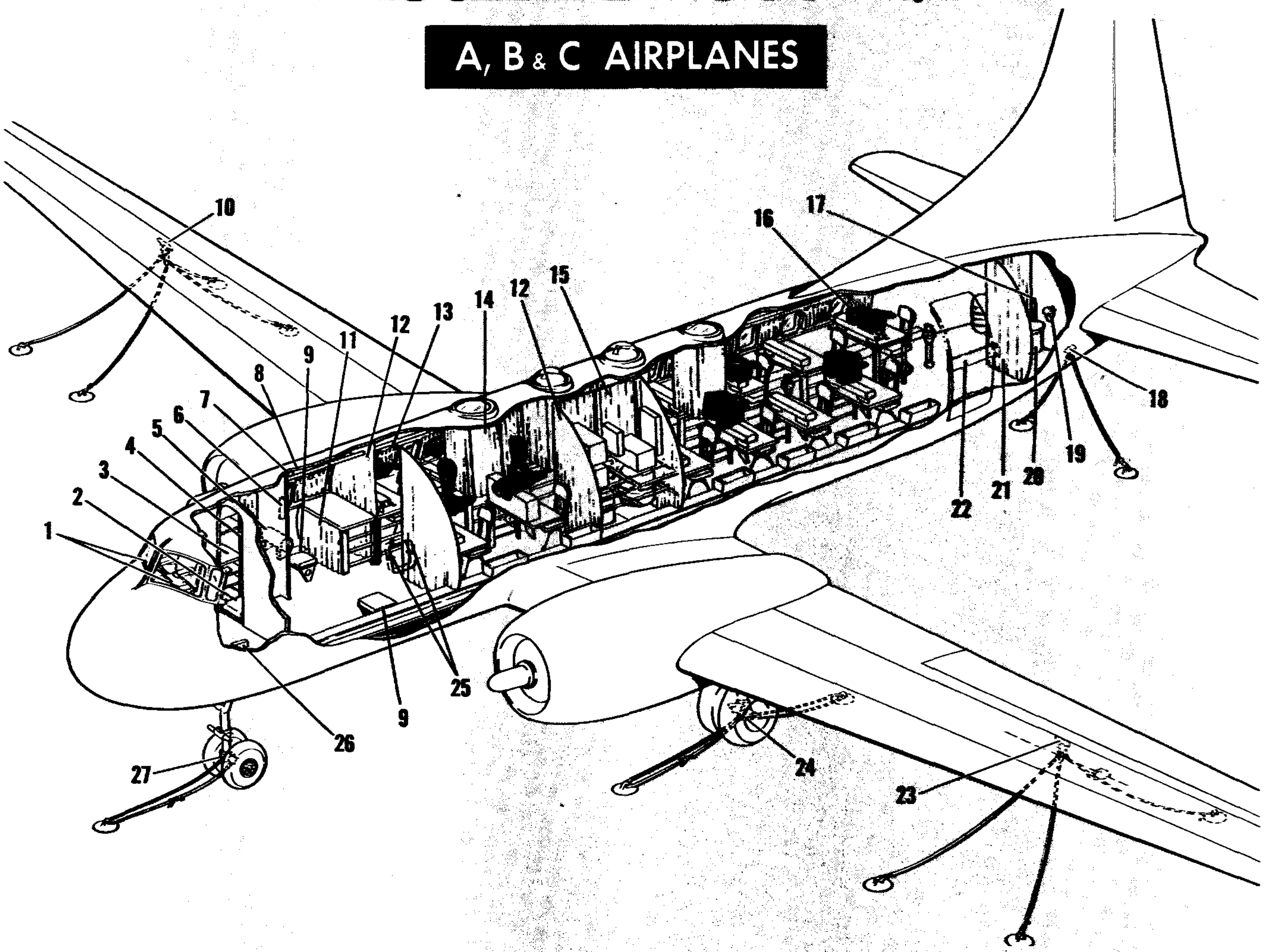
Two safety harnesses are stowed loose in the cabin. Safety harness attachment rings are provided on the platform mounts. During pressurized operation at any altitude above 8000 feet, the harness should be worn and attached to the rings in the mounts when personnel are stationed at the astrodome.

ASTRODOMES AND ASTROCOMPASS MOUNTS (A) (B) (C)

Astrodomes (figure 4-18) are installed on the top center line of the cabin. Two fixed-position wedge plates and an adapter are installed at each astro-

MISCELLANEOUS EQUIPMENT

A, B & C AIRPLANES



1. Windshield Wipers
2. Flight Engineer's Seat
3. Crew Locker
4. Flight Compartment Curtain
5. Drinking Water Tank
6. Drinking Cup Dispenser
7. Driftmeter Cover Stowage
8. Baggage Rack
9. Jump Seats (2)
10. Right Wing Tie-Down Fitting
11. Electrical Equipment Rack Curtains
12. Radar Training Compartment Curtains
13. Cabin Window Curtains
14. Astrodome and Periscopic Sextant Window Curtains
15. Radar Equipment Rack Curtains
16. Pencil Sharpeners
17. Relief Tube
18. Tail Tie-Down Fittings
19. Toilet Paper Dispenser
20. Toilet
21. Lavatory Curtain
22. Rear Service Door Safety Strap
23. Left Wing Tie-Down Fitting
24. Main Landing Gear Mooring
25. Map Checking Windows
26. Data Case
27. Nose Landing Gear Mooring

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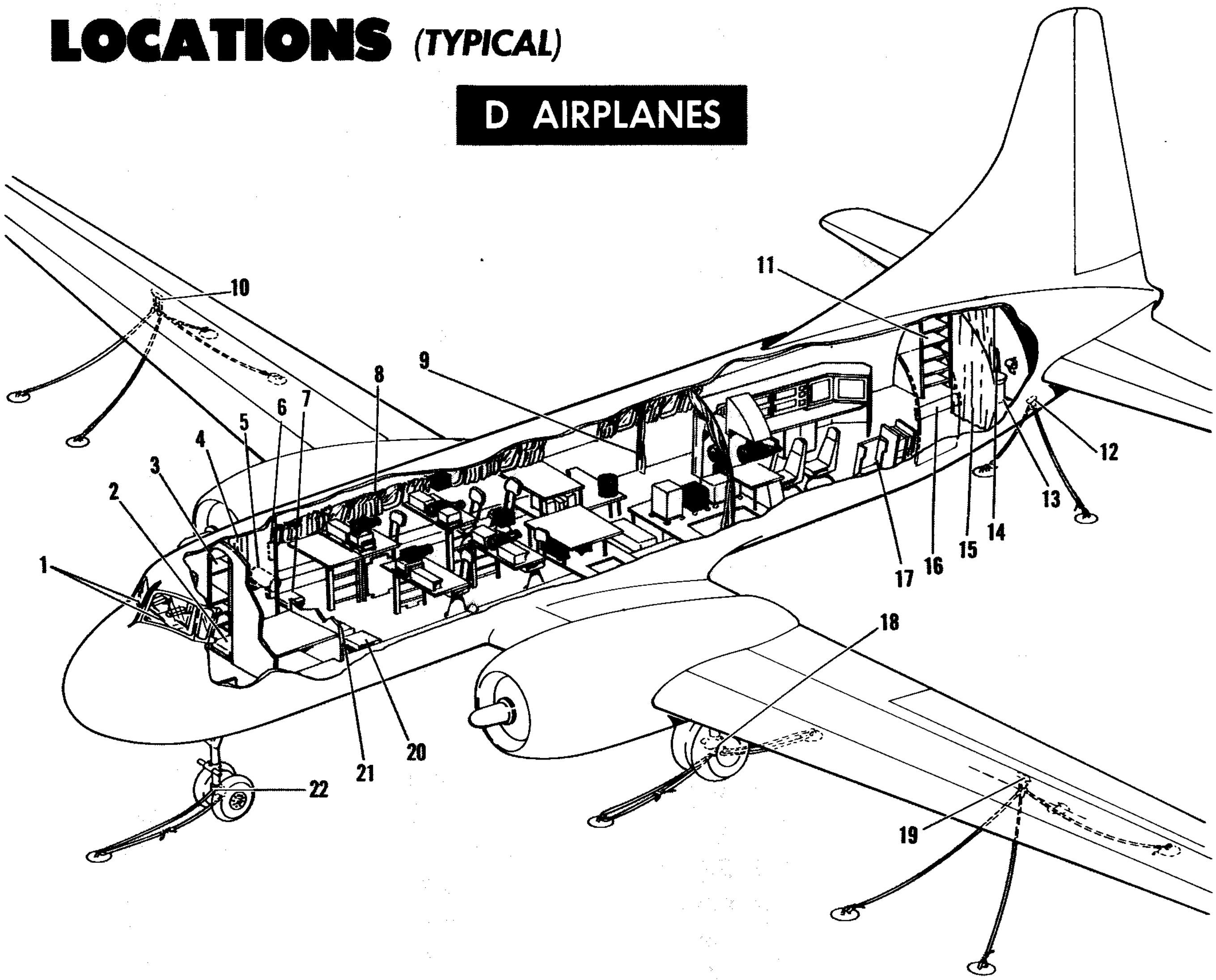
Figure 4-29

LOCATIONS *(TYPICAL)*

D AIRPLANES



1. Windshield Wipers
2. Flight Engineer's Seat
3. Crew Locker
4. Flight Compartment Curtain
5. Drinking Water Tank
6. Drinking Cup Dispenser
7. Jump Seat (RH Side)
8. Cabin Window Curtains
9. Blackout Curtains
10. Right Wing Tie-Down Fitting
11. Student Stowage Rack
12. Tail Tie-Down Fitting
13. Toilet
14. Relief Tube
15. Lavatory Curtain
16. Rear Service Door Safety Strap
17. Map and Chart Stowage
18. Main Landing Gear Mooring
19. Left Wing Tie-Down Fitting
20. Jump Seat (LH Side)
21. Jump Seat (Radio Rack)
22. Nose Landing Gear Mooring

C-45293-2

dome for mounting an astrocompass in four different positions. There are provisions for hanging a sextant from the center of each astrodome. The transparent canopy of each astrodome can be released from the frame so that it falls inward by pulling down on the release handle and removing the rubber seal. See figure 3-5.

PERISCOPIC SEXTANT WINDOWS AND MOUNTS

On Ⓐ and Ⓑ airplanes, periscopic sextant windows (4, figure 4-18) are installed on the top center line of the cabin. A periscopic sextant mount is incorporated in the center of each window. On Ⓒ airplanes, two or four periscopic sextant mounts are installed on the top center line of the cabin. On Ⓓ airplanes, two periscopic sextant mounts are installed on the top center line of the cabin.

NAVIGATORS' PLATFORMS

On Ⓐ, Ⓑ, and Ⓒ airplanes, four navigators' portable platforms for use at the astrodomes and periscopic sextant window, are attached by spring clips to the cross-tubes of four tables. Ⓓ airplanes have two platforms. The platforms are removed from stowed position by pulling them away from the cross-tubes. They are then placed across the aisle, at any one of four levels, so that the ends of the platforms rest on the cross-tubes of facing tables.

MAP CHECKING WINDOWS

Two map checking windows are provided on opposite sides of the cabin at the forward end. Each of these windows is provided with astrocompass mounts.

CURTAINS

On Ⓐ, Ⓑ, and Ⓒ airplanes, curtains are provided between the flight compartment and the cabin; at the autopilot (electrical) equipment rack; forward and aft of the radar training section; at each cabin window; around each astrodome and the periscopic sextant window stations; around the radar equipment rack; and around the lavatory. A blackout panel is provided for the radar compartment astrodome. On Ⓓ airplanes, curtains are provided at the forward side of the electrical rack, around the lavatory, across the cabin forward of the master bombardier station, and at all cabin windows.

DATA CASE, FLIGHT STOWAGE, AND CHECKLIST STOWAGE

A data case (39, figure 1-6) is located to the left of the pilot's seat. The case incorporates an internal holder for checklists.

DRINKING WATER AND CUP DISPENSER

A four-gallon drinking water tank (5, figure 4-29) is mounted on the rear face of the bulkhead aft of the entry. A cup dispenser is located above the water tank.

TOILET AND RELIEF TUBE

A chemical toilet and a relief tube installation (figure 4-29) are located in a curtained enclosure at the aft end of the cabin.

PENCIL SHARPENERS Ⓐ Ⓑ Ⓒ

Two pencil sharpeners are installed on the tables in the cabin, one at the forward end and one at the aft end.

CREW LOCKER AND COAT RACK

A crew locker and coat rack (3, figure 4-29) are located between the copilot's seat and the entrance door.

BAGGAGE RACK

A stowage rack for light baggage is installed along the right side of the cabin above the electrical equipment rack.

PARACHUTE STOWAGE

There are stowage provisions for parachutes at each station in the cabin, either beneath the tables or outboard of the seats. A parachute stowage rack is also provided below the crew locker.

MISCELLANEOUS EQUIPMENT STOWAGE BINS

Stowage bins for miscellaneous equipment are located along the cabin walls outboard of the seats.

PERISCOPIC SEXTANT STOWAGE

On Ⓐ, Ⓑ, and Ⓒ airplanes, stowage straps for a periscopic sextant case are located below the drinking water tank on the rear face of the bulkhead aft of the entrance door. On Ⓓ airplanes, stowage straps are located either behind station 7 or across station 8.

LIFE RAFT STOWAGE

Provisions for tying down three life rafts on Ⓐ, Ⓑ, and Ⓒ airplanes and two life rafts on Ⓓ airplanes (6, figure 3-4) are located on the cabin floor aft of the rear service door.

EMERGENCY RADIO TRANSMITTER STOWAGE

Provisions are made for strapping the AN/CRT-3 emergency radio transmitter (5, figure 3-9) to the cabin wall aft of the rear service door. The straps have quick-release fasteners.

PORTABLE IGNITION ANALYZER

Provisions are made for the installation of a portable ignition analyzer in the crew locker.

OPERATING LIMITATIONS

OPERATING LIMITATIONS
section V

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INTRODUCTION

This airplane possesses certain well-defined limitations which must be observed if safety and efficiency are to be attained. The high performance features compel a rigid adherence to these limitations. This is true of the engines and some of the auxiliary equipment, as well as the airplane itself. It is therefore important that you study this section carefully to familiarize yourself with the limitations as shown herein by illustrations and explanatory text. The knowledge thus gained will result in safe and more proficient operation of the airplane.

INSTRUMENT MARKINGS

Instrument markings shown in figure 5-1 and operating limitations in this section are not repeated elsewhere in this manual. The instrument markings appearing in figure 5-1 are explained in subsequent paragraphs.

EXPLANATION OF MARKINGS

Lower Red Radial

The red radial having the lowest numerical value on an instrument indicates that a dangerous condition would exist if the pointer should drop to or below

INSTRUMENT MARKINGS (TYPICAL)

FUEL GRADE
115/145

Ⓐ Ⓑ

MANIFOLD PRESSURE

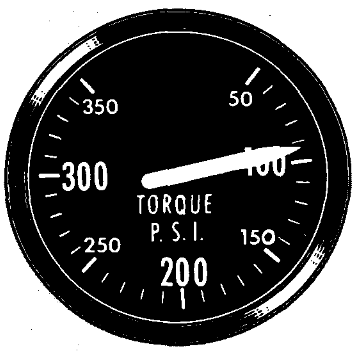
19 to 36 in.	Auto lean permitted
36 to 44 in.	Auto rich required
44 in. (critical altitude)	METO (operation above this pressure limited to 5 minutes at take-off)
53.5 in. S. L.	Maximum (dry)
56.5 in. S. L.	Maximum (wet)

Ⓒ Ⓓ

MANIFOLD PRESSURE

19 to 38 in.	Auto-lean or manual lean permitted
38 to 51.5 in.	Auto-rich or manual adjust
51.5 in. (S. L.)	METO (LOW BLOWER) (operation above this press limited to 5 min. at maximum power, 30 min. at military power.)
63.0 in.	Maximum (dry) S. L.
62.0 in.	Maximum (wet) S. L.

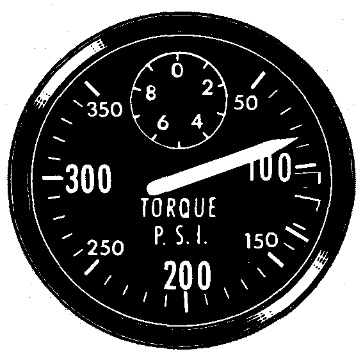
Ⓐ



TORQUEMETER

109 psi	METO (operation above this pressure limited to 5 minutes at take-off)
118 psi	Maximum (dry)
135 psi	Maximum (wet)

Ⓑ



TORQUEMETER

105 psi	METO (operation above this pressure limited to 5 minutes at take-off)
118 psi	Maximum (dry)
135 psi	Maximum (wet)

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Figure 5-1 (Sheet 1 of 7)